AN ANALYSIS OF STUDIES ON FORMAL DISCIPLINE

by

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INTRODUCTION

CHAPTER I

> The whole art of teaching is only the art of awakening the natural curiosity of young minds for the purpose of satisfying it afterwards.
>
> -Anatole France

The human mind is not a reservoir that may be emptied and filled at will. Students are not preparing their minds for a future sowing of seed, but are sowing and cultivating that seed day by day. Those seeds falling upon a fertile area of the brain may sprout and find nurture, and the resulting growth is oftentimes productive of good fruits throughout the life of the individual in whose mind it has lived.

This suggests the thought that education should be applicable to life situations. Isolated facts are of little value until such times as they become integral parts of some newly created experiences.

In this connection, several questions suggest themselves. (1) To what extent does organized education lend itself to the transfer of training under varying conditions? (2) What are the conditions under which this transfer is effected? (3) Are some subjects richer in transfer value than are others? (4) To what extent is the

method of instruction a factor in this transfer? (5) What scientific evidence has been gathered in recent years that will throw light on these questions?

The purpose of this study is fourfold: (1) to trace the history and meaning of formal discipline and transfer of training up to the present time; (2) to make an analysis of all available studies in the field since 1927; (3) to determine the conditions and the extent of transfer of training in a classroom experiment in mathematics; and (4) to sum up the present trends in the field of transfer of training as they are applicable to the teaching program.

The usefulness of the material has constantly been kept in mind. Facts and data not pertinent to the subject at hand have been avoided. Statistical data have been considered of only moderate importance, with major emphasis being placed on those facts and results which might be considered of pedagogical importance. In other words, what may educators do to increase the possibility of the useful application of the knowledge they impart?

The ideal of education in the present age is a scheme of study, which, while it represents the present state of knowledge, and affords a varied cultivation and harmonious discipline, shall at the same time prepare for the responsible work of life. Experience teaches that a

knowledge of power is essential to prevent the waste of power. Educators face the problem of framing a curriculum which will conform not only to a logical order of subjects, but also to the natural order of the development of the human mind.

This thought is emphasized by Reudiger (59:373). "It is not Latin as Latin and physics as physics that we want, but Latin and physics as the techniques and illuminations of an efficient, meaningful, and satisfying human life."

Nature effects economy of power through repetition of actions in varying situations. Plants, animals, and so-called inert matter move in constantly recurring cycles as they progress through time and varying environments. The same natural laws become an integral part of different natural phenomenon. So it is with the mind of man. The power of his intellect is a function of a versatile application of knowledge. Isolated facts should become parts in generalized experience and knowledge; and, as such, capable of being transferred to and utilized in new response organizations.

FORMAL DISCIPLINE IN HISTORY

THEORY AND PRACTICE

CHAPTER II

The principle of formal discipline simply stated is, "That mental power, however gained, is applicable to any department of human activity (5:632)." This is somewhat clarified by Youmans' (77:12-13) statement: "By mental discipline in education is meant that systematic and protracted exercise of the mental powers which is suited to raise them to their highest degree of capability." The whole problem centers around the fact that an individual's proficiency in any specific response organization may be altered by training and improvement in another response organization. This alteration may be of two types. If training in the original response inhibits or retards the speed, accuracy, or completeness of the response made in a second situation, negative transfer is said to have taken place. If training in the original response aids in the speed, accuracy, or completeness of the response made to a second situation, positive transfer is said to have taken place.

Formal discipline is referred to as formal culture, formal training, spread of training, and transfer of training. Earlier formal discipline was sometimes held

to result in transfer of training; but in the educational psychology texts of the present day, formal discipline is referred to as transfer of training. Some writers suggest a slight difference of meaning in the various terms, but in general their meaning is the same as that given for formal discipline above. The terms are used somewhat interchangably in this study, and it is to be noted that their meanings are the same as indicated at this point.

The doctrine of formal discipline is used in support of disciplinary education. The assumption is that if students master the basic studies, they will acquire a mental power which they may apply to any kind of practical or professional life.

The theory of formal discipline is not new. It dates back, at least to the time of Plato, as one may observe from the dialogue set down in the Seventh Book of The Republic. Socrates is represented as conversing with Glaucon on the practical values of certain studies (56:222-224), as follows:

"And you have further observed that those who have a natural talent for calculation are generally sharp at every other kind of knowledge; and even the dull, if they have had arithmetical training, although they may have derived no other advantage from it, always become much sharper than they would otherwise have been."

Glaucon quite readily agreed with him, whereupon Socrates enlarged his theory to include geometry.

"The inhabitants of your fair city should by all means learn geometry. Moreover the science has indirect effects which are not small.....There are the military advantages of which you spoke.....and we know, of course, that the man who has studied geometry will be wholly and entirely superior to the man who has not, with respect to the better apprehension of all subjects."

The "indirect effects" advanced by Socrates are still the question under consideration by educators today with respect to the type or types and the amounts of transfer.

Sir Francis Bacon was also aware of the disciplinary value of education (4:155). "Nay, there is no stond or impediment in the wit, but may be wrought out by fit studies; like as diseases of the body may have appropriate exercises.....So if a man's wit be wandering, let him study mathematics; for in demonstrations, if his wit be called away never so little, he must begin again. If his wit be not apt to distinguish or find differences, let him study the schoolmen, for they are splitters of hairs."

Bacon suggests the possibility that training is general rather than specific, holding that observation in one field will quicken the wit in another field.

Locke (40:198) has also recorded his theory of formal

discipline. "I have mentioned mathematics as a way to settle in the mind a habit of reasoning closely and in train; not that I think that all men should be deep mathematicians, but that having got the way of reasoning which that study brings the mind to, might be able to transfer it to other parts of knowledge, as they shall have occasion."

Locke postulated a general training, not confined to the subject in which it was given. His statement, ".....as they shall have occasion..." suggests the thesis that consciousness of opportunity is an important condition conducive to transfer.

An account by James (35:663-668) gives the results of an early experimental study conducted to ascertain whether or not training in memorizing one kind of material increases the ability to memorize material of a somewhat different nature.

James memorized, in the course of eight days, 158 lines of Victor Hugo's "Satyr"; a task which required 131.8 minutes. Then, for thirty-eight days, he spent twenty minutes per day in memorizing passages from Milton's "Paradise Lost." Following this training period, he again memorized 158 lines of the "Satyr", finding that this time it required 151.5 minutes. The practice period in one type of memory work had not aided but apparently had hindered in the ability to memorize material of a different

nature.

Similar experiments were subsequently carried out by four of James' students, three of whom were slightly more efficient and one of whom was slightly less efficient in memorizing material somewhat different from that on which they had practiced. These results are of historical interest, as they provided the needed stimulus for further scientific investigation.

Woodworth and Thorndike (73:384-395, 553-564) conducted a series of experiments at the turn of the century investigating the transfer of abilities in measuring areas of geometrical figures. They reported varying amounts of transfer.

During the second decade of the present century, there arose some difference of opinion as to the possible theoretical explanation of the transfer of training. This conflict of thought centered around three theories of transfer; the faculty theory, the theory of identical elements, and the theory of generalization.

There was the already existing "faculty theory" of mental ability, which called for a choice of similar abilities that invoke the same faculties or exercise of the same neural responses in like combination and incidence. The mind, according to this theory, was generally strengthened by specific training of a single faculty of the

mind, in much the same manner that specific exercise of the muscles of the arm prepares the arm for varied muscular activities.

The "faculty of memory", the "faculty of reason", and the "faculty of will" serve as examples to show how early psychologists divided the mental processes. Baldwin (5:369) stated, "But we find in many of the earlier psychologists a tendency to treat faculties as if they were causes, or real conditions, of the states or processes in which they are manifested, and to speak of them as positive agencies interacting with each other. The persistence in voluntary decision is said to be due to extraordinary strength of will, or to will-power, or to the faculty of will."

By reason of careful scrutiny of the underlying principles of this theory and experimental investigation carried on in connection with it, it has come to be considered of little importance. The "faculty of memory", for example, may be shown to be not a single faculty, but a series of complex mental abilities related to many other mental abilities. Thus, it would be difficult to hold that one faculty of the mind is developed for general use by specific training in certain particular performances.

Locke (5:369), in criticizing the term "freedom of the will" pointed out this weakness in the faculty theory.

"We may as properly say that the singing faculty sings, and the dancing faculty dances, as that the will chooses, or that understanding conceives; or, as is usual, the will directs the understanding, or the understanding obeys, or disobeys, the will; it being altogether as proper and intelligible to say that the power of speaking directs the power of singing, or that the power of singing directs the power of speaking."

In discussing the conduct of understanding, Locke (40:181) further enlarged his hypothesis. "The last resort that a man has recourse to, in the conduct of himself, is his understanding: for though we distinguish the faculties of the mind, and give the supreme command to the will, as to an agent, yet the truth is, the man, who is the agent, determines himself to this or that voluntary action, upon some precedent knowledge, or appearance of knowledge, in the understanding. No man ever sets himself about anything but upon some view or other, which serves for him a reason for what he does: and whatsoever faculties he employs, the understanding, with such light as it has, well or ill informed, constantly leads; and by that light, true or false, all his operative powers are directed."

Thorndike (65:358-359) suggested a modification of this theory; that of "identical elements". He presents his theory in the following manner: "The answer which I will try

to defend is that a change in one function alters any other only in so far as the two functions have as factors indentical elements. The change in the second function is in amount that due to the change in the elements common to it and the first. The change is simply the necessary result upon the second function of the alteration of those of its factors which were elements of the first function, and so were affected by its training."

This theory would not have met with as much opposition as it has if Thorndike (65:359) had not defined identical elements as he did. "By identical elements are meant mental processes which have the same cell action in the brain as their physical correlate."

The theory of identical elements has been questioned many times. A review of the literature showed that opposition was based on (1) mobility to explain how transfer takes place, (2) failure to square with reliable experimental investigation, and (3) incompatibility with the ideal of democratic education.

Orata (51:175-176) emphasized these weaknesses in Thorndike's theory. "We have assumed that there are two types of behavior or reaction to two kinds of environment. One is automatic, reflex, or mechanical habit in response to an unchanging environment, and the other is intelligent behavior in a meaningful and highly modifiable situation. In the problem of transfer we are

concerned only with the second type of behavior (intelligent) and the second kind of environment (meaningful)..... There is no better way to insure transfer than to give the child an opportunity to apply his knowledge to the reinterpretation and reorganization of his daily experience."

Still another theory, that of "generalization", was developed by Judd (37:416-424). "There is no inherent reason in the psychology of the human mind, or in the psychology of any subject of instruction, for supposing that experience can not be generalized. On the other hand, there is no reason to assume that experience of one type will infallibly carry over into any other sphere, whatsoever. The generalizing of experience is a qualitatively new fact whenever it appears.

"Given experience A and B, the transfer effect from A to B is just as much a new psychological process where it occurs as were A and B when they first appeared in experience. To think of A and B as related because they exist, is to fail to understand the theory of generalization. Everywhere in human experience there are large possibilities of generalizing experience, and everywhere in school there is the danger that experience will be narrowly specialized."

The generalization of ideas and the extension of subject matter to its greatest possible use are of great

importance in education.

Judd (37:414) has expressed himself quite strongly in opposition to the "identical elements" theory. "When one studies the psychology of generalization he becomes aware of the uselessness of some of the formulas which have been proposed by those who hold that transfer of training takes place in cases where there are identical elements present. The identical element is usually contributed by the generalizing mind. On the other hand, there may be identical elements potentially present in various situations, but wholly unobserved by the untrained or lethargic mind. In fact, the discovery of the identical element in a situation is, in some cases, the whole problem of the training.

"In the same fashion we may show that the principles of intellectual economy which Thorndike frequently includes in his statement of identical modes of procedure, namely, the principle that one can learn to avoid distractions of all sorts, or that he can refuse to give up a piece of work, even when it is uncomfortable, represent generalized identities of procedure which are not always realized. In all these cases we must distinguish sharply between the possibility of identical modes of procedure and the actual achievement of this identity. Such an achievement depends upon the exercise of trained intelligence. The existence

of possible identical modes of procedure does not invariably lead to their realization in fact."

The actual reasons for the transfer of training have not, as yet, been fully explained. Judd and Thorndike presented their theories. Other psychologists have taken one side or the other or have taken an intermediate stand. One may find a variety of opinions existing at the present time. Aside from the fact that Judd and Thorndike disagreed as to theory of transfer, they are in agreement on a more significant item.

Judd states (37:404), "Special emphasis may furthermore be laid on the fact that there is no one who denies that some kind of transfer takes place. The real questions at issue are what is the degree of transfer, and what is its method?"

Similarily, Thorndike makes the statement (65:358): "No one can doubt that all of the ordinary forms of home and school training have some influence upon mental traits, in addition to the specific changes which they make in the particular function, the improvement of which is their main object. On the other hand, no careful observer would assert that the influence on other mental traits is comparable in amount to that upon the direct object of training. The real question is not 'Does improvement in one function alter others', but 'To what extent and why

does it'?"

The theory of faculties, which assumed transfer to be well-nigh complete, received its death blow from the experimental work of Thorndike and Woodworth during the first few years of the present century (73:247-261, 384-395, 553-564). If a faculty had possessed all of the traits it was thought to possess, improvement in function would have been as great in one field as it would in another. This experimental work gave a negative answer. Transfer did not even approach one hundred percent. The theory of faculties fell by the wayside.

Thorndike prepared his theory of identical elements. This was tied to the reflex arc or the stimulus-response-bond concept and held transfer to be an automatic process. Thus limited, it was little more than the faculty theory divided into smaller units. Its limited explanation of transfer has led to conflict among psychologists. This explanation of Thorndikes's theory is supported by Orata (51: 175).

Judd presented his theory of generalization, in which awareness of the possibility of transfer was the keynote. It still interpreted transfer as automatic after the stage had been set. Its weakness lies in the fact that it points to environment as the dominating factor of motivation. This interpretation of Judd's theory is supported by

Bayles (7:425-430).

Orata states (52:252-256), "The problem..... is the ability, not so much to generalize and apply, as to deal with changing ideals and standards, which means the ability and willingness to change the generalizations made previously.....This ability to deal with changing principles or generalizations, Judd's theory does not provide for, much less does Thorndike's theory of identical elements.... Transfer exists without a doubt, but it is not an automatic process."

Mursell (47:104-105) states, "This identity must exist in the learner's mind. Essential recognition, perception, and reaction to identities in various situations is not a passive affair that can be counted on to occur." Similarity and relationship must be sensed, but these are not necessarily based upon any particular level of consciousness.

Marked changes have occurred in school curricula since education first became one of the primary goals of our democracy. These changes, in part, have resulted from new ideas as to the disciplinary values of various subject matters or have sought to abolish the value of formal discipline altogether.

Prior to about 1915, educators had asserted that Latin and Greek provided an indispensible mental training or

discipline. Classical studies were supposedly mental gymnastics of the very best kind. Training in these, they claimed, would prepare the mind to meet the varying conditions of life. As has already been pointed out, mathematics had long been considered a desirable mental gymnastic.

In the latter half of the ninteenth century, these ideas faded very rapidly. Youmans (77:8), writing in 1867, stated, "It thus appears that to secure the disciplinary uses of grammatical study, not even a foreign language is needed, much less a dead one."

John Tyndall (77:85) said, "I ask you whether this land of 'old and just renown' has not a right to expect from her institutions a culture which shall embrace something more than declension and conjugation? They can place physical science upon its proper basis.....and raise the national mind to the contemplation of it as the last development of that increasing purpose which runs through the ages, and widens the thoughts of men."

A similar stand was taken by Huxley (77:144), "But of all this your old stereotyped system of education takes no note. Physical science, its methods, its problems, and its difficulties will meet the poorest boy at every turn, and yet we educate him in such a manner that he shall enter the world as ignorant of the existence of the facts and

methods of science as the day he was born. The modern world is full of artillery, and we turn out our children to battle in it, equipped with the shield and the sword of the ancient gladiator."

Herbert Spencer denounced the limited opportunity for transfer of training from classroom experience to everyday life (77:303-304). "There is no connection between the ability to parse a sentence, and a clear understanding of the causes that determine the rate of wages. The multiplication table affords no aid in seeing through the fallacy that destruction of property is good for trade. Long practice may have produced good penmanship without having given the least power to understand the paradox that machinery eventually increases the number of persons employed in the trades into which it is introduced.....Why do we expect fitness for citizenship to be produced by a discipline which has no relation to the duties of a citizen?"

The interest of the mind in things of twenty centuries ago will not usually equal the interest in the things of the present. Certainly a mere shell of a fact will not bear the same relation to the mind as a living fact. Nothing will arouse the mind more quickly than the realities with which it is required to deal. The mind will usually develop to a greater extent functioning directly with objects and relationships in its physical environment

than it will operating through artificial exercises designed to prepare it for contact with that environment, especially if these are followed half-heartedly or blindly.

Even in the present day, there are those who emphasize the small amount of transfer that takes place. "Millions for factoring but not one cent for compound interest" is the stand taken by Hedrick (29:249). Teachers, he says, carry factoring to an absurd length, but fail to show the relationship of arithmetical progression and compound interest. In this, he may or may not be correct.

It may be that we believe in the theory of identical elements, or it may be that we believe in the theory of generalization. In either case, it would be wise to formulate some generalizations to furnish a working basis for an understanding of transfer of training as it is presented in this study.

All school subjects have some things, if not many, in common. A natural result is the search for things learned in one subject which are being applied in another subject. These facts, in the writer's opinion, should be considered because there exists in education an excessive tendency to isolate learning processes and, thereby, to curtail the generalization of knowledge.

Much may be learned in any subject, and yet transfer will not take place to another field. Pupils may learn

rules of conduct in the social studies; they may learn scientific principles; and yet, if there exists no understanding of these principles and facts in the pupils' minds and no urge to apply them, working knowledge is nonexistent and transfer is impossible.

The largely motor ability of oral or written repetition is no guarantee of the application of principles or of specific knowledge. However, what one knows is likely to influence his judgment and conduct. There is some difference of opinion as to the direction that this influence should take, but it is generally agreed that it should make for a more satisfying life. What exists as knowledge or method can be transferred. Coover's thesis lends support to this hypothesis (16:242), in stating that; "This increase of power is deemed necessary for the aquisition of such mental habits and knowledge as, under the conditions of our civilization, constitute a reasonable preparation for complete living."

With this presentation of some of the working principles of the transfer of training, the writer will proceed to an analysis of some of the more recent investigations in this field.

AN ANALYSIS OF RECENT STUDIES MADE ON FORMAL DISCIPLINE OR TRANSFER OF TRAINING

CHAPTER III

Recent surveys of psychological literature indicate a period of increased activity in experimental investigation in the field of transfer of training. A marked revival of interest has manifested itself since 1927. The methods of investigation have also undergone some change. Orata (52:265-289) has summed up the trends of experimental investigation in this field by the following data.

	Number of Investigations	
Kind of Investigation	1890-1927	1927-1935
Classroom	23	45
Laboratory	56	51

An examination of these figures shows nearly a nine-fold increase in the number of classroom investigations as compared with a four-fold increase in the number of more strictly, and generally more artificial, laboratory investigations. These figures indicate a present trend to regard transfer of training as an educational and technological problem, rather than a narrowly scientific or strictly psychological problem.

The analysis of studies reported in this unit has been limited to experimental work completed in transfer

of training. The scope of the investigation is such as to include only those experiments involving human subjects. No experiments reported prior to 1927 have been reported. Brownell (11) reviewed the more important investigations reported prior to this date. No experiments in the field of bi-lateral transfer or cross-education have been reviewed.

An examination of available publications revealed forty-five experimental investigations of such a nature as to fall within the scope of this study. It seemed advisable to classify these investigations with respect to the subject fields in which they were conducted. Such a classification divides them as follows: one investigation on the transfer value of school subjects in general, one study in athletics, nine in language, eight in mathematics, four in science, three in spelling, three in social science, four in character, and twelve studies of a somewhat miscellaneous nature.

Seven factors have been kept in mind in examining these reports: (1) adequacy of the published report, (2) the definition of population, (3) adequacy of the sampling of subjects, (4) adequacy of the experimental program, (5) appropriateness of the training period, (6) adequacy of control, and (7) soundness of conclusions.

This writer sought answers to questions regarding

the status of transfer of training. In this paper, the principal emphasis has not been placed on experimental procedure and statistical information, but rather upon the pedagogical implications suggested by the experimental results.

No investigation examined by this writer has attempted to give a complete synthesis of the field of transfer of training, even from any one act of learning. A summation of transfer studies made in the different fields, however, may aid in an interpretation of the present status of the whole question of the value of transfer of training.

Transfer Value of School Subjects in General

The first investigation considered will be that of Brolyer, Thorndike, and Woodyard (10:377-404), who attempted to solve the problem of the relative amount of transfer value accruing from the pursuit of one subject for a period of one year. Over a period of three years, 1924-1927, the authors administered tests of mental alertness, general mental ability, arithmetical problems, absurdities, analogies, and spatial relations to over 13,000 students from several large high schools.

It was difficult to find students enrolled in courses containing three similar subjects and one dis-similar

subject, or subject of a somewhat different nature. For this reason the authors grouped several similar subjects under a single head. By such an arrangement these writers believed it was possible to compare the influence of the study of a certain group of subjects for a period of one year by the administration of a testing program at the close of the year.

Several subjects stood out clearly with regard to transfer value. The natural sciences, business arithmetic, and bookkeeping were always high in mental discipline as measured by the testing program at the close of the year. Dramatic art and domestic science consistently exhibited a smaller amount of transfer value.

The authors indicate that the superior gains they found associated with the study of certain subjects for a period of one year are not to be regarded as consisting entirely of general improvement in thinking with all sorts of data. Neither can it be entirely accounted for by an enrollment of superior students in these courses. The authors believed that the subjects indicated were richer in transfer value than were other subjects. The extent to which this was actually true was not examined by other methods of attack.

The number of subjects involved and the care exercised in the procedures employed seem to justify the conclusions

of the authors. It would seem, then, from these results that the subjects indicated tend to provide superior discipline in deductive reasoning. Induction having laid the foundation for the correct approach to the general principles, an understanding of these principles was then utilized in the interpretation of material of a somewhat different nature.

The conclusions set forth as a result of this experiment are in disagreement with the results of Downing (21:162), who tested over 2500 pupils from the eighth to the twelfth grade in the elements and safeguards of scientific thinking, and found no evidence to the effect that high school pupils acquire skill in scientific thinking as a necessary by-product of the study of scientific subject matter. Sinclair and Tolman (63:370), who administered various social and moral tests to 208 students in the California Institute of Technology and Occidental College, found no evidence for the transfer of logical thought procedures from fields of specific scientific training to fields involving social judgment.

The Effect of Athletics on Character

Three separate, but similar, experiments were conducted to discover, if possible, the relationship between athletics and the development of certain traits of

character.

Hackenberg (28:264-267) conducted an experiment to ascertain whether or not organized athletics, as conducted in the Dubois, Pennsylvania, School System, really contributed anything to the development of certain traits of character. The study covered the whole year of sports, including football, basketball, and track.

The student body was divided into three groups. Group I actively participated in the school's athletic program. Group II exhibited a keen interest in the sports program, but did not actively participate in it. Group III showed little or no interest in the school's athletic program. Forty pupils were selected from each of these groups.

By an extensive initial- and end-test program designed to measure various character traits, including honesty, obedience, citizenship, adaptation to society, and ability to make wise use of leisure time, Hackenberg found that there was a very slight advantage in favor of the athletic group in comparison with the non-athletic groups, but the difference was so small that the superiority indicated was of little significance. Moreover, his tests and ratings of character traits were not as good as they might have been.

Yeich (28:267-268) matched twenty athletes with twenty non-athletes on the basis of intelligence, grade, and sex.

Teachers' ratings were obtained for each individual with respect to (1) fellowship, (2) followership, (3) obedience, and (4) honesty. The athletic group was favored by the teachers in the first, second, and fourth traits measured; while the non-athletic group was favored in the third trait mentioned.

The differences in the scores were very slight, and no conclusions were drawn by the author. The experiment failed to present any results indicative of a clear group difference.

Weisenfluh (28:268) conducted a similar experiment with fourteen athletes paired with a like number of non-athletes. The procedure of teacher rating was the same as indicated in Yeich's experiment. The results showed that the non-athletes exceeded the athletes in fellowship, followership, and obedience, while the athletic group had a slightly higher rating with regard to honesty.

This trio of experiments indicates a mere possibility of athletics developing desirable traits of character. The results forcibly point out the fact that the contribution of athletics in this respect is much smaller than many have held it to be.

It is this writer's opinion that the success or failure of the school's athletic program in the development of desirable character traits is dependent to a large

extent upon the attitude of the coach and the community. This attitude differs in different localities, and would be likely to influence the results of experiments similar to the ones carried out by Hackenberg, Yeich, and Weisenfluh.

The experiment conducted by Hackenberg was well executed, and the resulting lack of difference between the athletic and the non-athletic groups is significant. In the experiments conducted by Yeich and Weisenfluh, there existed the possibility of variation of teacher ratings that might nullify any apparently significant results obtained.

Transfer Studies in the Field of Language

Cooper (15:826-833) conducted an experiment to test the hypothesis that functional grammar taught at the college level, and deliberately taught for transfer, will carry over into the composition skills.

Thirty-two students were given the Iowa Placement Examination to determine their relative abilities in English and were then divided into two sections of approximately equal ability. Each student was paired with another student in the opposite section on the basis of equality with respect to Iowa scores. By this arrangement, a comparison of progress for the period of one year was made

possible.

The teaching program for the "A Group" called for three times as much practice in grammar as in writing, while in "Group B" three times as much practice in writing as in grammar was employed.

The teacher rated three themes of each student at the beginning of the year and three themes at the close of the year. Hudelson's English Composition Scale was used in each case. The students were given a second test at the close of the year on another form of the Iowa Examination, and the teacher again rated several of each student's themes. It was then possible to make a comparison of progress with regard to ability in English as measured in composition as brought out by the application of the Hudelson Scale.

The progress of "Group B" in general knowledge of English was slightly greater than that of "Group A", as measured by the Iowa Examination; while "Group B" exhibited slightly superior progress with respect to improvement in composition. In this connection the author pointed out that at the present time there is no known device for measuring the more subtle values of composition, such as imagination and emotional appeal. These values vary with the individuality of the reader.

Although the experimental results were not conclusive,

two things of importance stood out. In the first place, both groups showed improvement in composition and in the knowledge of the mechanics of English. In the second place, the increased amounts of grammar and drill did not retard the progress in English composition, but rather accelerated it.

The greater amount of improvement in "Group B", as measured by the Iowa Examination, suggests that the rudiments of grammar, if properly presented, may be transferred to the field of English composition. It would seem that it is possible to teach for transfer.

The fact that both methods of teaching produced definite progress suggests that either method might be used to motivate the individual student to better composition. Probably the increased interest of the teacher and pupils in the experiment was a factor worthy of consideration.

The effect of general and specific factors in the transfer of training within verbal tests was the theme of a study undertaken by Gordon (26:1-41). The testing program, which included the Thorndike-McCall Reading Test, and tests in sentence completion, disarranged sentences, vocabulary, and analogies, was administered to the fifth and sixth grade pupils of the Lexington, Kentucky, schools. An end-test program for comparative measures was administered after an interval of eight weeks.

From a tabulation of scores the author drew several conclusions. (1) The less able individuals profit most, both from the practice of taking the original tests and from the special training in analogies. (2) Close relationship between two abilities does not guarantee that training in one ability will transfer to another ability. (3) Training is useful in transfer insofaras the individual can see ways to apply this training to other situations. (4) Test scores may be influenced by non-intellectual functions, such as the method of approach to the problem.

Of the conclusions suggested by this author, the last three are supported by the work of numerous experimenters. Some doubt exists about Gordon's first conclusion. Johnson (36), Jacobson (33), Werner (69), Bedell (8), and Roberts (58) have all reported data indicating the opposite to be true. In general, intelligence is positively correlated with transfer. Whipple (71:200-209) suggested that the more important agencies of transfer function in the higher planes of intelligence.

The transfer of training from Latin to English vocabulary, English grammar, and English spelling was the subject of an experiment reported by Douglas and Kittelson (20:26-33). These authors selected eighty-seven students from six mid-western schools, and grouped them in

trios on the basis of intelligence and their having had no Latin, beginning Latin, or more than two years of Latin. By means of quite thorough initial- and end-test programs, the authors concluded that:

(1) Pupils who have had two years of Latin are likely to do better in English spelling, vocabulary, and grammar tests than equated students who have had no experience with the language.

(2) Pupils who have had more than two years of Latin score materially higher than those who have had no Latin, and slightly higher than those students who have had two years of Latin.

(3) The differences noted were not great enough to be statistically reliable in respect to words of Latin origin.

(4) The differences were so small that the author was in doubt as to whether or not Latin, as it is taught in the present-day secondary school, lends itself effectively to the development of abilities in English vocabulary, spelling and grammar.

These conservative conclusions are in agreement with those from other available experiments. Werner (69) found the same results with respect to modern foreign languages. Woody (74) found non-language students making superior vocabulary gains.

A study of the transfer of training from experience

in one or more foreign languages to the ability to get meaning from an unfamiliar language was the text of an investigation reported by Johnson, Hinderman, and Ryan (36:579-584). 204 students from the University of Wisconsin High School formed the experimental and the control groups. The curriculum of the school offered opportunity for the study of Latin, French, and German, but not Spanish. After an elimination, including all of those students who indicated a varying knowledge of Spanish, the arrangement offered a suitable set-up for the proposed experiment.

An excerpt from a Spanish newspaper was used as reading material, and objective methods were used to score the student's comprehension. The conclusions from the experiment were:

There are four factors that influence a student's ability to get meaning from an unfamiliar language as a result of contact with other languages. Listed in the order of their importance, as indicated by the experiment, they are: (1) the extent of the student's foreign language experience measured in semesters, (2) the number of semesters that the student has been in school, (3) the mental ability exhibited by the student, and (4) the student's chronological age.

The ability to get meaning from an unfamiliar langu-

age as a result of experience with other languages increased very rapidly for the first year of foreign language experience, but was negatively accelerated thereafter.

It was pointed out that it made little difference in the amount of transfer whether or not the student had all of his experience in a single language or had divided his time among several languages.

More language transfer was made in vocabulary than in interpretative ability. The girls exhibited superior vocabulary gains when compared with the gains made by the boys, while the boys slightly exceeded the girls in the gains made in transfers of an interpretative nature.

No conclusions of pedagogical significance were advanced by the authors. From the fact that languages themselves contain words of other languages, it is possible that contact with those words of varying origin would lead one to recognize similar words in an unfamiliar language to a slightly greater degree than would otherwise be possible. This fact is suggested by the predominance of vocabulary gain over comprehension.

In an attempt to show how incidental teaching of character traits through the study of Latin was related to social attitudes in her school, Meek (44:241-243) selected forty pupils who had studied the same subjects under the same teachers, with the exception of Latin in which twenty of the pupils were enrolled. This

arrangement made possible an experimental and a control group, with pairings made on the basis of intelligence, chronological age, sex, and the composite grades of the eight elementary years.

To test the effect of Latin upon the development of desirable attitudes toward social situations, the Hill Test of Civic Attitudes was administered. The means difference of the two groups was .8, with a standard error of .37, and the mathematical probability of 62 to 1 that the difference favored the Latin group.

To test the effect of the study of Latin upon attitudes toward war, Thurstone's Attitude Toward War Scale was used. The scoring ranged from 0, or extremely militaristic, to plus 11, or extremely pacificistic. The mean score of the control group was 6.30, and that of the Latin group was 6.77, indicating a slightly greater degree of pacificism on the part of the Latin students. The means difference was .47, with a standard error of .20, and a mathematical probability of 105 to 1 that the true difference above zero favored the Latin group.

To test the effect of Latin training upon international attitudes, the Neumann-Kulp-Davidson Test of International Attitudes was used. A high score indicates conservatism, while a low score indicates liberalism. The mean for the control group was 3.89, and that of the Latin

group was 3.59, indicating a slight tendency toward greater liberalism on the part of the Latin group. The means difference was .30, with a standard error of .094, and the mathematical probability of 1200 to 1 that the true difference favored the Latin group. The reliabilities and validities of the scales employed in this experiment were not available.

The results from the first two tests indicated that the incidental teaching of character traits through the study of Latin had had a positive effect, while the results of the third test showed a lower mean score but a larger probability on the part of the Latin pupils. The author (44:243) states: "All three of our measures consistently suggest the possibility of developing character traits by stressing them in connection with the study of Latin.

It is entirely possible that continued teacher-pupil contact might have influenced the results obtained. The small number of subjects involved would not lend great reliability to the conclusions. It would be possible under such experimental conditions that the students would mirror the teacher's point of view, rather than express their own.

The question arises as to just what is meant by incidental instruction. It is entirely possible that the incidental instruction in this situation had become

something of a primary aim on the part of the teacher.

Longstreet (41), Kniss (38), and Eichler (23) have presented a great deal of evidence to the effect that incidental instruction along these lines does not alter student attitudes very greatly.

The complete report of Nihard's work (50:23-31) was not available; however his experimental work on the formative value of Latin and Greek was the basis of several conclusions worthy of note. This author suggests that mental development, as indicated by the group intelligence test, is little affected by the kind of educational activity involved. Emphasis was placed on the fact that the disciplinary value of school subjects depends upon the method of study, and this method should be such as to insure the largest amount of transfer possible. The teacher should teach for transfer.

There is some difference of opinion about Nihard's conclusions. Brolyer (10:404) points out that some subjects are richer in transfer value than others. Shendarkar (62:41) strongly suggests that transfer is proportional to the similarity of material rather than to the method of instruction employed.

On the other hand, Allen (1:258), Beito (9:89), Cluley (14:42), Gates (25:80), Archer (2:131), Salisbury (61:254), and Woodrow (72:172) all indicate the method

of instruction as the important condition of transfer.

In an experiment on the transfer of "transfer thinking" Smith, Mead, and Peters (64:380-384) attempted to discover what effect four months of training in Latin translation would have on the general nature and level of reasoning ability. 161 pupils who had had four months work in Latin, and had made some progress in it, were paired on the basis of intelligence test scores with 161 non-Latin pupils. Fifty-three approximate pairings were also made. The groups were given reasoning tests in arithmetic, history, and sociology at the beginning and at the end of the term. In the case of the Latin pupils, the reasoning tests were administered before and after contact with the language.

A summary of the study by the authors points out that: (1) More Latin pupils made gains proportionally during the four months than did the non-Latin pupils. (2) Non-Latin pupils gained more in reasoning, on the average, than did the Latin pupils. (3) Improvement in Latin may be accompanied by no improvement in reasoning ability, and vice versa.

The conclusions advanced by the authors are in agreement with current theories of transfer. It is to be noticed that in this experiment, as in others reported, emphasis has been placed on the fact that teaching for transfer is necessary if a large amount of transfer is to

be obtained. The conditions of transfer reported in this experiment agree particularly well with Coover's position (16:234-242).

Werner (69:99-145) tested some 14,500 high school and college students in an effort to determine the influence of the study of modern foreign languages on the development of desirable abilities in English. The subjects were given standardized tests in reading (rate and comprehension), punctuation, sentence structure, language, and grammar. Approximately half of the students were used as a non-foreign language control group.

As a result of a careful examination of the scores made by such a large number of students, the author set forth the following conclusions:

(1) It is doubtful whether or not the study of modern foreign language always aids in the development of desirable abilities in English.

(2) In general, the study of modern foreign language aids in the development of desirable abilities in English, with respect to reading and grammar.

(3) The study of modern foreign language interferes with the ability to punctuate correctly and to discover faulty sentence structure in the English language.

(4) It is doubtful whether or not the study of modern foreign language aids in the development of desirable abilities in English language and vocabulary.

(5) The lower the intelligence exhibited by the student, the greater is the chance of interference in the attempt to develop desirable abilities in English. The higher the mental ability of the subject, the greater is the possibility of correlation.

(6) If modern foreign language students are expected to develop desirable abilities in English, their mental abilities should be somewhat above the average of those of their schoolmates.

The results of this experiment are worthy of study, not only from the standpoint of the number of subjects involved, but also because of the carefullness of control and the methods of procedure employed. The implications emphasizing the importance of intelligence as a factor of transfer are of particular importance.

The influence of the teaching of first year French on the acquisition of English vocabulary has been reported by Woody (74:149-184). Two forms of the Hootkin's English Vocabulary Tests were administered to over 4000 high school pupils at the beginning and at the close of the school year. The tests, as constructed, contained words of both French and non-French derivation. The pupils were divided into three equated groups: non-language, beginning Latin, and beginning French pupils.

A tabulation of the vocabulary gains made as the result

of the year's study placed these three groups in the following order with respect to their relative gains in English vocabulary: (1) non-language students, (2) beginning Latin students, (3) beginning French students. No reason was advanced by the author for the fact that both the non-language pupils and the beginning Latin pupils made greater vocabulary gains in words of French derivation than did the beginning French students. He attributed the results obtained partially to a faulty classroom presentation of the subject.

These results are supported by Werner (69), who found little evidence to the effect that studies in modern foreign language aid in the development of English vocabulary.

Transfer Studies in Mathematics

In an experiment conducted to attempt to discover the comparative effectiveness of the teaching of plane geometry by the individual and the recitation methods of instruction in actual subject-matter achievement, Allen (1:254-258) attempted to answer the question, "What is the effect of differences in teaching method upon ability and traits of character in a given academic subject?"

Two groups, each numbering seventy-five students, were obtained in which intellectual ability was approxi-

mately equal. One group was taught by the recitation method, while the other was given individualized instruction. Various tests were used in securing initial and final data. The authors drew the following conclusions:

The individual method is distinctly superior to the recitation method, as indicated by a measurement of academic progress. Slight personality changes also took place, as indicated by an extensive testing program. It was found that in the case of the group to which individualized instruction was given there was a development indicating (1) more emotional stability, (2) less introversion, (3) less dominance, (4) more self-sufficiency, (5) less deception, (6) less prejudice, and (7) less mathematical interest.

In the personality measurements, the experimental differences were very slight, and their only significance lay in the fact that in all but one case the differences favored the individualized instruction group. The experimental ratios were smaller for incidental learning than they were for actual subject-matter achievement. This experiment, as seen by the author, does little more than suggest to educators the possibility of the value of the individualized method, and an accompanying change, though slight, in favor of the development of more desirable personality traits.

The amount of improvement in a directly trained ability is, probably, almost never accompanied by an equal amount of improvement in other abilities. In general, the improvement varies according to the similarity existing between those other abilities and the one specifically trained.

Beito and Brueckner (9:569-589) have reported an experiment on the measurement of transfer from the learning of number combinations to the response to reverse forms. Ninety-seven children were selected from three 2B classes, and were divided into three groups to make possible three different methods of presenting the material.

The experiment extended over a period of three weeks, with material being presented by the methods outlined below: (1) teacher's own method plus the use of drill cards; (2) the use of flash cards and number games; and (3) the use of drill cards exclusively.

Four conclusions were drawn by these authors. (1) When pupils are taught only the direct form of an addition combination, such as 7 plus 4, as nearly as can be, the reverse form, 4 plus 7, is learned concomitantly, at least as completely as the direct form. (2) The bond produced in learning the direct form of an addition combination carries over almost completely to the reverse

form. (3) The amount of carry-over is little affected by the method of presentation. (4) Of the three methods employed, disregarding the question of transfer, the use of drill cards plus the teacher's own methods of instruction proved to be the most efficient way to present the material, as measured by academic progress.

An extensive study by Overman (53) emphasizes the fact that each arithmetical step should be taught separately, as transfer is seldom complete. This fact does not lend support to the first two conclusions set forth by Beito and Brueckner, although the length of the steps which are to be learned and transferred is a qualifying condition of the whole situation. As indicated in the report of Nihard's work, there is a difference of opinion as to whether or not the method of instruction is a functioning agency in transfer.

An experiment reported by Cluley (14:34-42) deals with the relative amounts of transfer resulting from three methods of study. Three groups, each composed of ninety-five pupils, were selected from the sixth and seventh grades from four cities in southern Wisconsin. The subject-matter used dealt with rectangles and triangles. General information, recognition of form, and computation of areas were the three phases of material that were covered. Three different methods were used in presenting the material.

"Method A" constituted a formal presentation of the material. The formula for finding the area of each figure was given, and the pupils were instructed to use the formulas in the computation of areas. Verbal problems dealing with abstract situations were used as practice material.

In "Method B", an objective presentation of the material was used. As an example, the area was shown to be the sum of squares formed within the figure when lines were drawn across its face one linear unit apart. The problems used as practice material were verbal, but employed figures in their natural setting in the child's environment.

In "Method C", "Method B" was enlarged by an addition of practice work including (1) recognition of rectangles and triangles in larger figures, and (2) computation of the areas of the figures indicated. The examples used were non-verbal, but referred to common figures and spaces in the child's environment.

The results showed "Method B" to be superior to "Methods A and C", as the greatest amount of transfer took place in this group. None of the methods was particularly valuable in aiding in the solution of problems through oral or visual presentation. The time consumed by the experiment was too short for the observation of the

correct practice effects. The author pointed out that the problem of transfer is, in part, the problem of classroom instruction.

Jablonower (32:808-818), lacking any experimental evidence aside from general classroom experience, has outlined the opportunities for transfer in the study of mathematics. It was the hope of the author that mathematics might serve as the necessary mental discipline to strengthen sincerity and truthfulness in man's general nature. The mathematics teacher should digress from the theorem at hand to point out its application in everyday life, according to this author.

Assuming from the beginning that (1) training tends to be specific, (2) discriminating transfer must be practiced, and (3) transfer is often practiced indiscriminately; Jablonower listed four definite methods by which general truths may be presented in the study of mathematics. These methods are as follows:

(1) In the case of 'epithets', there is ample opportunity to point out human faults and limitations. Such terms as 'nature abhors a vacuum', 'imaginary', 'infinity', and 'transcendental' show that there are many things that man cannot understand, let alone explain.

(2) In the use of quadratic equations, it may be pointed out that an effective cause is not necessarily an

exclusive cause. Responses may be varied for a given stimulus and still be correct.

(3) The theory of functions will open the way for a presentation of the complexity of related elements. The changing of the value of one variable is accompanied by a change in the values of all related items.

(4) Postulates may be broadened in scope to indicate what people should do with their hidden faults and prejudices in achieving an understanding of their fellowmen.

Longstreet (41) has pointed out that if student attitudes are to be altered, the alteration must become a primary aim of the teaching program. Kniss (38) and Eichler (23) have indicated that incidental instruction along these lines is relatively ineffective in altering student attitudes. Such experimental results do not lend support to Jablonower's hypothesis.

Lehman (39:77-82) conducted a simple experiment in the classroom on the transfer of training with respect to the knowledge of algebra as utilized in the solving of simple mathematical problems by algebraic methods. The conclusions advanced by this author are:

(1) The pupil's knowledge may fail to function when confronted with relatively simple and obviously mathematical situations.

(2) Pupils are more often than not totally unaware of

the possibility of transfer.

(3) Application of knowledge is one kind of transfer.

(4) The existence of identical elements is in itself no guarantee of transfer.

(5) Transfer may or may not occur.

McKinney (42:854-864) conducted an experiment, the purpose of which was to ascertain the qualitative and quantitative elements of transfer. Transfer in 104 cases was measured by a comparison of the initial response with the response made to altered forms of geometric figures. Several relationships were brought out by the study.

(1) The percent of transfer decreased as the alteration of the geometrical figure increased, providing the locus of alteration remained constant. The amount of transfer was not directly proportional to the degree of alteration, but was represented by a varying percentage thereof. Transfer was not proportional to the amount of identical material present.

(2) The amount of transfer present was a function of the locus of alteration.

(3) The locus of alteration became a more important factor in transfer as the quantity of reduction was increased.

(4) Symmetrical stimuli yielded a greater amount of transfer than did asymmetrical stimuli, by a ratio of three to one.

(5) Symmetry was a more significant factor in transfer than was size.

The author (42:364) states, "These results are interpreted as contradictory to a strictly identical elements theory, and in agreement with a theory advocating meaning as the condition of similarity between the original and the transfer situation". This conclusion is supported by Mursell (47:104) who holds that such identities must exist in the learner's mind.

The effect of instruction in three types of two-place and three-place additions and subtractions for fifty-two second grade classes has been reported by Overman (53:183-190) in a second experiment. In addition to the problem as stated, the author attempted to determine whether or not the amount of transfer was a function of the method of teaching.

The pupils were divided into four equated groups, each of which was instructed by a different method. These methods, as reported by the author, were: (1) "Drill was given without generalization." (2)"Generalization was employed." (3) Rationalization was encouraged." (4) "Both generalization and rationalization were utilized." Useful amounts of transfer were reported, the greatest amount occurring in the group in which generalization had been stressed. Three conclusions of pedagogical interest were

advanced by the author. These are:

(1) The results indicate, that while transfer from one type of example to a related type may occur in large amounts and may even be complete in some individual cases, it is seldom complete for the group as a whole. Instruction and practice in the fundamentals of arithmetic must be based on a full analysis of the fundamental processes. As transfer is seldom complete, all of the steps should be taught.

(2) Although transfer from one type of example to related types is possibly never complete, it does occur in amounts which cannot be ignored.

(3) The effectiveness of a given method of instruction in securing the immediate end sought is not the sole test of its worth. The methods of teaching the fundamentals of arithmetic should be those which will secure the maximum amount of transfer to related types as well as to the specific types taught. In addition to the teaching of any type of example, the teacher should aid the pupil in using the problem as a basis for generalization.

Transfer is, in part, a function of the method of instruction. The largest amount of transfer will take place when the similarity of material is appreciated by the generalizing mind.

Shendarkar (62:27-41) has reported an experimental

investigation in "teaching to solve problems" in arithmetic and the light that it throws on the doctrine of formal training. From an experiment employing six training methods for dealing with arithmetical material, and by employing several tests of varying degrees of similarity to the training material used, it was concluded by this author that transfer is proportional to the degree of similarity between the training material and tests used rather than related to the method of instruction employed.

As has been pointed out in the review of Nihard's (50) work, there exists some difference of opinion about the relative value of the method of instruction as an agency of transfer. Shendarkar's conclusions are not in agreement with the trends of recent investigation. Similarity of material is no guarantee of transfer.

Transfer Studies in Science

Bedell (8:158-162) has reported an investigation dealing with the relationship between the ability to recall and the ability to infer in specific learning situations. "In general, psychologists identify the so-called lower mental processes with automatism, habit, and custom; while the so-called higher mental processes are identified with reason and thinking.....The principles and generalizations of science must, therefor, occupy considerable

space in the program of general education, the aim of which is life-enrichment.....The major generalizations and associated scientific attitudes are seen as of such importance, that an understanding of them is made the objective of scientific teaching (48:43-44)."

With these facts in mind, Bedell constructed two tests, one to measure the ability to recall, and the other to measure the ability to infer. In the test designed to measure recall, the pupils were given an opportunity to recall thirty general scientific principles set forth in the average ninth grade general science course. The inference test presented five pertinent science situations, with an opportunity given for the pupils to infer the same thirty principles that were associated with the recall test.

The testing program was administered to 324 pupils in several Missouri junior high schools. Several conclusions were reached. (1) The boys were better in inference than were the girls. No sex variation was noted in the scores on the recall test. (2) The ability to infer is more difficult than the ability to recall. (3) The lowest one-fourth in mental ability, as indicated by the scores made in various intelligence tests, are, for all practical purposes, unable to make inferences of the type generally required in the general science course. (4) The

ability to infer is related to the ability to recall which in turn is related to the ability to score correctly on the Terman Intelligence Examination as 1 is to 3 is to 2. The most important result reported by Bedell is the functioning of intelligence as a qualifying factor in transfer.

"Science (21:87-89) is both organized knowledge and method, and the latter is more important than the former in the life of the average man, for he is bound to encounter many problems which will be successfully solved only as he is skillful in accurate scientific or reflective thinking, while needed knowledge can be obtained from books as occasion demands." The ordinary science course is organized around subject-matter material, and desired mental attitudes are left to chance as by-products.

In this respect, Downing (21:87-89) tested 2500 pupils from the eighth to the twelfth grades in the elements and the safeguards of scientific thinking. In the tabulation of scores, no evidence was found to the effect that high school pupils acquire skill in scientific thinking as a necessary by-product of the study of scientific subject-matter as it is presented in the average high school science course.

This situation Downing holds to be undesirable. He believes that method is more important than knowledge in

everyday life. Emphasis should not be placed on the development of the 'encyclopedic mind'. The paramount need of man is to be able to make use of the facts that he has at his command.

The fact that the author (21) found no evidence to support the belief that development of scientific thinking parallels the study of scientific subject-matter is in agreement with the work of numerous experimenters. Some writers, however, will oppose his interpretation of the conclusions which he drew.

The 'consciousness of method' as a means of the transfer of training was the purpose of an investigation conducted by Meredith (45:37-45). "The wide-spread interest formerly shown in the problem of 'Transfer of Training' has waned somewhat in recent years. Yet a great deal more evidence is necessary before the question may be regarded as closed, even in its theoretical aspects; and it cannot be regarded as solved in its practical (i.e., educational) aspect until the solution so far obtained has had its due influence on pedagogical practice (45:37-38)."

By means of initial and final tests in defining ordinary words, the transfer effects due to training in science definitions were sought by Meredith. Three groups were equated with respect to mental ability. Different

instructional procedures were employed with each group. The "A Group" simply took the initial and final tests in defining ordinary words, and were not given instruction in defining scientific terms. The "B Group" received instructions through laboratory demonstrations and discussions producing definitions in the fields of magnetism and electricity. "Group C" was instructed in the same manner as was "Group B" except that the essentials of a good definition were constantly stressed.

In this experiment, involving sixty boys of thirteen and fourteen years of age, "Group C" showed a larger gain in the ability to define ordinary words. The author states (45:43), "We are accordingly justified in affirming that 'Group C' benefited in its training in defining scientific terms, and carried this training over, or 'transferred' it to the definition of ordinary terms." Here again there is evidence to the effect that teachers should teach for transfer. Methods of instruction should be so designed as to provide the maximum opportunity for transfer.

Sinclair and Tolman (63:362-370) conducted an interesting experiment on the effect of scientific training upon the logical qualities of thought and of prejudice. An answer was sought to the question of the relative standing of pupils who have been trained more or less

intensively in science and mathematics to be more logical, more reasonable, and less affected by presuppositions when considering common social, economic, political, and religious problems than are pupils of approximately equal educational experience trained more generally in the liberal arts. Fifty-three freshmen and fifty-three seniors from Occidental College and forty-nine freshmen and fifty-three seniors from the California Institute of Technology formed the two groups for the comparative investigation.

The Goodwin Watson Tests were used as the basis of measurement. These include annoying stimulus words, a degree of truth test, a situations-possible inference test, a moral judgment test, a relative strength of argument test, and a generalization test (tendency to ascribe to the group as a whole faults exhibited by a minority).

The students from the California Institute of Technology were found to have fewer prejudices as measured by these tests. The means difference between the freshman groups was 5.86, while the means difference between the senior groups was only 1.27. The means of the freshman and the senior groups at the C. I. T. remained practically the same, while at Occidental College a noticeable change occurred as indicated by the means difference between the freshman and the senior groups.

The authors reached these conclusions (63:370): "We have found here no evidence for the transfer of logicality and reasonable habits of thought from fields of specific scientific training to fields involving questions of economic, social, and ethical judgments, as they are presented in the Goodwin Watson Tests. This study shows that there is a correlation between the choice of a scientific vocation and the ability to draw correct inferences. This is, however, no indication that this correlation is to be ascribed to the scientific training itself, and we think it not unreasonable that the pursuit of science should attract a group on the whole superior in this respect."

The conclusions drawn are in agreement with other experimental data, indicating that the study of scientific subject-matter is not in itself any guarantee of an accompanying development in scientific thinking.

Transfer Studies in Spelling

In experimental work done with over a thousand school children in thirty school systems in Iowa and Minnesota, Archer (2:122-31) found that there was a definite amount of transfer of knowledge from certain word-endings to words not studied. This was true for both easy and difficult words. The amount of transfer was not affected by

sex; and scores on the Haggerty Intelligence Examination, Delta I, were not a factor in the transfer.

Transfer was evidenced in proportion to the similarity of the material used. The suggestion advanced by the author is that pupils are going to generalize, regardless of the situation; and in the attempt to guide this generalization wisely lies the possibility of a saving of pupil-time and an increase in the efficiency of teaching.

Another report of Archer's (3:1-63) work presented by the University of Iowa Department of Education gives experimental data and conclusions from a study in transfer of training in spelling involving approximately 3500 seventh and eighth grade pupils. Archer had in mind the determination of the effect of the study of words upon certain derived forms and, in addition, the effect of the derived forms on the base words.

Most children learn to spell only four or five thousand words, and yet many children are able to spell many more than this number. As a consequence, the author concluded that either transfer takes place or there exists some other way of learning to spell these additional words.

Both positive and negative transfer were found by Archer for words of varying degrees of difficulty. The unit of transfer was sometimes as small as one syllable, with the accented syllable apparently the most important

item of transfer. No significant difference existed between the boys and the girls; and intelligence, as scored, was not a factor in the transfer.

Archer concluded that, in all probability, the closer the similarity of the kinds of material, the greater the amount of positive transfer. A point must necessarily be reached, however, where the element in common becomes so small that transfer takes place only occasionally and, then, to only a limited extent.

It is probable that as words become more dissimilar, positive transfer becomes less. The possibility also arises that negative transfer may be increasing at the same time, and probably reaches its maximum influence when the greatest conflict in the principles of construction is reached, or when the words have many similar sounds, but are spelled in different manners.

It may be noticed that Archer found that intelligence, as measured by present-day tests, was not a factor in transfer. This is in disagreement with a great deal of the other material set forth in the present study. It may be a factor of the subject-matter used, since spelling is more of a drill subject than a thought subject.

Gates (25:1-80) conducted an experimental investigation involving over 3700 pupils from the second to the eighth grades. Two control groups of 1071 and 823 pupils

studied spelling for a period of one term. Generalization in these groups was not a part of the teaching program. Two experimental groups of 1089 and 823 pupils studied spelling for a period of one term. Generalization in these groups was a part of the teaching program.

From carefully planned initial- and end-tests in spelling, a final test in generalization, and a test of range and power in spelling, Gates derived the following conclusions:

(1) In a test of 100 miscellaneous words, comprising approximately one-third of those studied during the term, the generalization group excelled by an amount so small as to be of no practical significance. The time spent in word grouping, calling attention to rules, and stressing the basis of generalizations, as measured by a comprehensive test at the end of the term, did not result in a better mastery of daily assignments than did the practice of devoting all of the available time to a study of the words themselves.

(2) In several spelling tests containing words governed by the rules and generalizations under consideration, the advantage of generalization experience was negligible. Pupils learn words by one method just as well as by the other.

(3) Tests calling for statements of spelling rules

favored the generalization group, but only small significance can be attached to this fact.

(4) In a test of 'range and power' designed to carry the pupil beyond his training to spell words correctly, the generalization group showed a larger, a more reliable, and a practically more significant superiority over the other group. While the generalization pupils did not improve in the mastery of daily assignments, they were better able to apply their knowledge of spelling to unfamiliar words. In other words, the generalization students had increased their ability to spell new words.

The results of this study lend support to Archer's (2, 3) conclusions. The ability of pupils to spell unfamiliar words results from a transfer of principles and facts learned in the spelling of familiar words. While Archer holds that this transfer takes place as the result of a similarity of material in itself, Gates suggests that this identity of material is supplied by the process of generalization. Gates did not investigate the relationship between the degree of intelligence and the amount of transfer.

Transfer Studies in Social Science

Two similar experiments conducted for the purpose of determining the possibility of influencing high school

pupils to become more internationally minded by means of incidental teaching in economic geography have been reported by Campbell (13) and Stover (13) in two experiments reported jointly.

In the work reported by Campbell (13:244-246), eighty pupils in the Connellsville, Pennsylvania, High School were divided into experimental and control groups and matched on the basis of intelligence. The 'unit mastery' technique was used, with the basis of subject-matter being the various economic regions of the earth. Pupil activities were directed by a series of appropriate lesson plans.

Both groups followed closely the lesson plans, but at the close of each unit, in the case of the experimental group, incidental instruction and discussion were held in an effort to effect an increase in international-mindedness. This instruction was designed to increase respect for Germans, to increase opposition toward war, and to increase preference for the Chinese.

The scores of the Thurstone Attitude Scales, Forms A and B, indicated the experimental group to have been influenced toward an increased respect for the Germans and an increased opposition toward war, while scores on the Neumann-Kulp-Davidson Test slightly favored the control group with respect to an increased preference for the Chinese. The reliability and validity of the scales used

in the tests were not reported.

Stover (13:246-248) conducted an experiment very similar to that of Campbell, with the additional aim of determining the effectiveness of certain visual aids. Eighy-six students were paired on the basis of scores made on the Bogardus Racial Distance Scale. With the control group, the regular course of study was followed; while with the experimental group, visual aids were introduced in an effort to broaden the pupils' views in international human relationships. A final testing program indicated that increased gains were made by the experimental group.

In summing up the two experiments, the authors (13) pointed out that: (1) The consistency with which the findings favored the same group amply confirmed the thesis that international and interracial attitudes may be altered by instruction governed by the objective, insofaras the methods of testing were valid. (2) Visual aids seemed to add appreciably to the effectiveness of education directed toward international and interracial liberalism.

If the results of these investigations are to be interpreted as in agreement with existing data, the so-called 'incidental teaching' would necessarily have to be considered as a primary aim of the teaching program.

Eichler and Merrill (23:233-236) conducted an investigation in an attempt to answer the questions: (1) Can

social leadership be improved by systematic training? (2) Since social leadership is conditioned by the employment of certain techniques, can at least a partial mastery of these techniques be developed in the pupils through instruction?

In one part of the experiment, seventy-two members of a sophomore class were given a mimeographed sheet containing a list of names of their fellow classmates and were asked to rate each of these class members for social leadership. In another part of the experiment, forty-four freshmen and seniors were asked to rate their fellow classmen for social leadership. In both groups, pairings were made on the basis of final leadership ratings obtained for each student.

With both experimental groups, instruction was given in the techniques of social leadership. In the first part of the experiment, six fifty-four-minute lectures on the qualities of leadership were given over a period of six weeks. In the second part of the experiment, eleven thirty-minute conferences were held over a period of seven months. Various qualities of leadership technique were stressed. The reliability coefficients of ratings were reported to be .935 in the first part and .964 in the second part. The actual methods of end-measurement were not reported.

In a tabulation of gains and difference-gains in

the second part of the study, it was found that there was a slight difference in favor of the experimental group, with a computed mathematical probability of two and two-tenths to one that the true difference above zero favored this group. The results of the first part of the experiment were not reported separately, but were used as supporting evidence in the general conclusions set forth by the authors. These were:

(1) From the statistical point of view, the results were far from conclusive.

(2) The gains made were all in the same direction, and this fact strengthened the reliability of measurement.

(3) Due to the complexity of the traits of social leadership, the results were all that might have been anticipated.

(4) It seemed possible to measure reliably leadership qualities by means of student ratings.

(5) It is probable that leadership qualities can be measurably improved through direct instruction.

Longstreet (41:202-208) conducted an experiment in four high schools of Volusia County, Florida, in order to examine the existing theory that high school instruction in subject-matter alters pupil attitudes. Thurstone's Attitude Scales, Numbers 2, 11, 12, and 34 were used in the course of the testing program. Records

of 250 pupils were reported and a final summary made in which about 40,000 responses were represented.

In schools A, B, and C, the teachers were not aware of the purpose of the administration of the testing program. Lonstreet taught the history classes in the fourth school and, in this case, the method of teaching was quite important. In the three school groups which were unaware of the purpose of the study, the teaching of history and civics material did not appreciably alter pupil attitudes. In the author's own classes, the attitude toward war was changed to a slight extent as a result of statements made by the teacher concerning his experience in the World War. Out of sixty hours of instruction, two and one-half hours were devoted to this type of information.

The conclusion of the author was that the pursuit of social studies, as they are offered in the present-day secondary school, will not alter pupil attitudes unless that alteration becomes a primary aim of the teaching program.

Transfer Studies in Character Education

The purpose of an experiment by Cressman (17:250-253) was to determine whether or not character, or at least moral knowledge, could be improved by presenting to junior

high school pupils life situations upon which they were called to pass judgment. An attempt was also made to measure the difference in gains when the situations were presented in workbook form and when they were presented orally for class discussion. These gains in turn were to be compared with the gains made by a group of pupils to whom no moral instruction was given.

Three groups of forty-seven pupils each were selected for the experiment. These groups were arranged in sets of three pupils each who had been matched with respect to moral knowledge as indicated by an initial testing program. Seventeen life situations were presented, one each week, for a period of one term.

The results obtained by Cressman from a final testing program were not conclusive. The indications were that instruction on moral problems contributes somewhat to the clarification of the moral concepts of the junior high school pupils. The workbook method seemed slightly superior to the oral method, especially in the transfer of materials different from those used in the training period.

For the purpose of studying the effect of incidental instruction as applied to character education, three similar experiments were carried on by Kniss (38), Robb (38), and Glatfelter (38). All three experiments were reported in one paper.

Kniss (38:259-263) attempted to determine the extent to which character could be taught incidentally in connection with a course in tenth-grade history. Eighteen matched pairs were available on the basis of the Sims Score Card for Socio-Economic Status and the Otis Self-Administering Test of Mental Ability. Character education in the case of the experimental group was incidental, and led directly from the study of tenth-grade history. Baker's Test on "Telling What I Do", and a test designed by the author, were used in the initial and the final measurements. In each case, the results favored the control group. It was concluded by the author that incidental instruction in the experiment as conducted made no measurable change in the experimental group, or made a slight negative change.

Robb (38:260-262) made a study of the importance of incidental instruction on character values at the junior high school level. Experimental and control groups were set up on the basis of the Sims Score Card and the Otis Intelligence Test. With the control groups, the work in each subject proceeded according to the regular course of study; while with the experimental groups discussions about character were encouraged as a part of the program of incidental instruction. The results favored slightly the control groups in the seventh and the ninth grades, while the experimental groups were more influenced

in the eighth grade.

The results, as indicated by the author, did not show any benefits to be derived from the inclusion of incidental instruction in character education in the course of study in the junior high school.

Glatfelter (38:262-263) gave an incomplete report of the effect of incidental character education included in the course of study offered some 500 pupils in a New York junior high school. There was an equal division of amount of change in the scores of the experimental and the control groups. The results seemed to parallel those of Robb and of Kniss.

The authors concluded (38:263), "From this trio of experiments it seems clear that incidental instruction in morals is ineffectual in improving moral judgment and furthering moral conduct."

This definite conclusion reached by the authors is in general agreement with data furnished by other investigators, indicating that incidental instruction is not likely to alter pupil attitudes.

Milsom (46:249) investigated the effect of systematic teaching of ideals of courtesy in the junior high school. Fifty-six pairings were made on the basis of scholastic work, with the experimental group being given special instruction over a period of three months in the principles

and techniques of courtesy. Relative progress was measured by initial and final pupil ratings.

The results pointed out that for all three junior high school grades, the experimental group improved more than the control group by a slight margin. This fact merely suggests the possibility for such a program in effecting added courtesy in the junior high school. The differences reported were so small that it is doubtful whether or not such a program would be very valuable in achieving its desired objective.

Robb and Faust (57:237-240) have reported two similar experiments dealing with the possibility of improving ethical discrimination and moral conduct by systematic instruction on ethical problems in the senior high school.

In Robb's (57:237-239) work, fifty-two high school seniors were paired on the basis of results of the Otis Group Intelligence Examination and the Sims Score Card. The experiment was carried on in connection with a class in "Problems in Democracy". In the control group, the regular course of study was followed. In the experimental group, the work was supplemented for a period of eight weeks with direct instruction on ethical problems and encouragement, at all times, of class discussion on problems related to the field of character education.

Both groups were given initial and final tests in

moral knowledge and ethical discrimination. Kohs' Ethical Discrimination Test was used. Initial and final teacher ratings in which the Character Education Inquiry Conduct Record Sheet was used as an aid were obtained for each individual.

The results from the Kohs Test showed a mean difference of 4.77, with a standard error of 3.17, and a mathematical probability of 14 to 1 that the true difference favored the experimental group. The teacher ratings showed a mean difference of 5.17, with a standard error of 1.93, and a mathematical probability of 332 to 1 that the difference favored the experimental group. The pupil ratings showed a means difference of .03, with a standard error of .173, and the mathematical probability of 1.35 to 1 that the difference favored the experimental group.

In work reported by Faust (57:239-240), sixty ninth-grade pupils were divided into an experimental and a control group, being equated on the basis of intelligence, chronological age, school grade, and type of subjects taken. The experimental group had home-room programs one hour per week for a period of eighteen weeks, in which various attributes of character were stressed. The control group had a similar home-room program, except that character education was not stressed in any way.

Both groups were tested at the beginning and at the close of the term on (1) character attribute tests, (2) character attributes self-rating plan, and (3) character reaction tests. In addition, both groups scored themselves at the close of the experiment on the O'Reilly Character Analysis Chart.

The outcome of this experiment was inconclusive, as witnessed by the author's statement (57:240): "Or it may be that the outcome of this experiment should be interpreted as a draw, indicating no advantage from the discussion of problems of conduct."

Robb and Faust were very conservative in the conclusions drawn (57:240). "While not entirely conclusive, these experiments suggest the possibility of slight acceleration of ethical development, as measured by verbal tests, and functioning conduct, as measured by rating scales, as a result of systematic discussion of problems in the field of human conduct."

Those transfer studies dealing with the alteration of student attitudes and various aspects of character development have led in late years to a gradually increasing general conservatism. This fact is pointed out by several authorities in these fields.

Whipple (71:209) states, "It is particularly in this field of moral education that there has prevailed a

general and uncritical acceptance of the dogma of formal discipline. While it is probably true that through the agency of higher level relations there may occur an important development of certain 'quasi moral' attitudinal traits, there has been no clear experimental demonstration of this transfer and it remains precisely in this field of moral education that we know least about the possibilities or limitations of transfer."

Orata (52:282) indicates a limitation of the amount of transfer occuring in these fields. "It remains to add that the kind of training that will transfer to the social situation is not obtained, except rarely, by even the most effective study of formal subjects."

The developments made in these fields are difficult to measure, as indicated by the report of the Character Education Inquiry (76:404). "There is no reason for expecting tests of persons to yield the constant results found in physical measures. Exactly the same situation can never recur, and can never be presented to two different persons. We deal in human life with a series of events having common elements but always distinguished by unique features and having thus unique totalities. The attempt to measure one trait after another, eventually to be summed up into a character, is doomed for two reasons. One is the very simple fact that before we can

get to the last traits in the series, the individual will have changed in some of the earlier aspects measured. We can not measure fast enough. Even our measuring does something to change the person we would measure. Moreover, if we could bid the sun and all events in time to stand still for our measuring, we would still have the impossible task of combining a series of rigid abstractions into an integrated whole, the parts of which interact, supplement, and compensate.

"Even our careful test methods for character education will be found relative to a particular group and time. With another group, another teacher, in a changed community, relative effectiveness is apt to change. We deal, even in measurements and research, with evanescent approximations."

Miscellaneous Transfer Studies

Barlow (6:122-128) of the University of Utah made a study of the transfer effect on one kind of material from training in reasoning with material of an utterly different sort. Seventy-eight pupils from the seventh and eighth grades and fifty-seven adults made up the experimental and the control groups. An initial test of the entire groups was made using fifteen of Aesop's Fables, with instructions to write the moral of each fable. The experimental groups throughout the year were given twelve

carefully planned lessons treating simple analysis, abstraction, and generalization. The control groups had no instruction in the experiment, but took the initial and the final tests. All of the subjects were retested after a period of one year.

The pupil experimental group made a gain of 64.03% over the pupil control group which had made an improvement of only .09%. The adult experimental group made a gain of 23.7% over the adult control group which had made a gain of 7.3%.

Barlow (6:128) states, "Several factors lend support to the theory that general transfer takes place in the form of the learning curve.....Although transfer effects as found in studies of record have not appeared to take place in the form of the learning function, if our theory theory is correct, they may be shown to take place in this way with small measuring units."

Several other implications were pointed out by this author (6) in a summary of the study. They are:

(1) "If later experiments are completed which bring out the fact that transfer conforms to the learning curve, it will not necessarily create opposition to the present theories of transfer."

(2) "Transfer resulting from similarity between test material and the training material is to be accounted for by the increasing complexity of the learning activities."

(3) "Transfer, from the viewpoint of generalization, may be thought of as integrated activities in which the way of doing the interpolated performances is applied to the performance of the end test."

(4) "The organization theory, meaning that transfer takes place in the degree to which activities learned during practice become organized components of the end test responses, implies learning to be a unitary experience which grows more complex with practice."

DeWeerdt (18:438-440) conducted an experiment designed to determine the transfer effects of practice in related functions upon a group intelligence test. A group of forty-five children were given an initial test, the Illinois Examination, Form I, and were then trained on a practice program before the administration of the final examination.

The group practiced a total of 260 minutes over an eleven day period on sbustitution, multiplication, reading, cancellation, and synonym-antonym tests. The Illinois Examination resembled this series in that it contained a synonym-antonym test, and a test of substitution which reversed the direction of response with respect to the practice test employed.

A control group, individually matched with the practice group on a basis of intelligence test scores, took

only the initial and final examinations at the same times as the experimental group. A comparison of the initial and final scores of these two groups showed marked effects from the practice.

After eliminating the scores on the analogies test, the author contended that specific practice fails to transfer in any marked degree to the group intelligence test. It was pointed out, however, that in evaluating intelligence test results, one must take into consideration not only any previous experience with the test itself, but also experience with practice elements of similar identity with respect to those of the test. It is necessary to consider specific practice effects.

"An equivalent group experiment with college freshmen to determine the amount of transfer depending upon the readiness to act as built up by suggestion given at the time of performance" has been reported by Dorsey and Hopkins (19:410-417). The work was divided into three sub-experiments, which were as follows: (1) transfer of method of study to the study of a particular material, (2) transfer of knowledge (Latin) to an allied field (English) containing both new and old material, and (3) transfer of skill in manipulation of ideas from an old to a new situation.

The experimental groups, which were given instructions

to use the old in the performance of the new, showed clear superiority over the control groups, which were left to perform the tasks as they saw fit. The general implications of the study are summarized as follows: (1) Paired subjects having the same ability, as measured; the same previous training; and taking the same test, differ in the amount of transfer when the suggestion is varied. (2) Attitude causes subjects to vary in amount of transfer exhibited, not only in respect to the individuals with whom they have been paired, but also in respect to the group to which they belong. (3) Attitude affects transfer in varying amounts for the same individuals under varying conditions.

Gundlach and Herington (37:199-206) have reported a study of the relative and absolute value of transfer discrimination. The work of the authors has not been adequately reported in publications available, but the conclusions of the authors "in the light of Gestalt Psychology" are of interest.

The relative transfer of discrimination does not involve either significant transposition of structures or indications of related judgments or concepts. The results may show that the subject being examined has simply failed to detect the subtle change introduced by the experimenter. This may continue to be true until the

subject recognizes that the second set of values is different from the first set. The authors suggest that the stimulus values from the study of related responses should be selected in terms of the threshold in order that the subject being tested may recognize them from one presentation to another.

Jacobson (33:1-85) has reported two experiments with work-type reading exercises in the ninth grade. The unsatisfactory results obtained in the first experiment were given as the reason for the undertaking of the second experiment.

The object of the first experiment was to find the effect of sixty lessons of work-type reading exercises given in English on the reading comprehension scores of ninth grade pupils and on their knowledge of general science. 122 pupils were divided into an experimental and a control group, being equated on the basis of mental ability, reading ability, and knowledge of general science. The progress of the sixty-one pupils in the control group was compared with the progress made by the experimental group. This group completed during the course of the term a series of sixty work-type reading exercises.

It was impossible from the data obtained to state whether or not reading exercises had influenced the poor

or the good initial reader more. The reading instruction that was given had no effect on the grade-point average of the pupils, or on achievement in general science. On account of the inconclusive data obtained in this first experiment, the author designed sixty work-type reading exercises covering several units of the general science course offered, and observed the effect of the administration of this series on an experimental group. He compared these results with the progress made by a control group to whom this series was not given. 276 pupils were equated in the same manner as in the first experiment; and were divided, 177 in the experimental group and 99 in the control group. The series of the sixty work-type reading exercises was administered throughout the course of an eighteen week's term.

The results of the experiment were as follows: (1) There was a gain in reading ability, with respect to comprehension, exhibited by the experimental group. (2) The experimental group made greater progress in general science, as indicated by tests in achievement. (3) A higher grade-point average was achieved by the experimental group, the extent of which exceeded the mathematical probability of error. (4) Neither the poor nor the good initial reader was influenced more greatly than the other by this procedure.

Newkirk and Gundlach (49:291-294), not satisfied with an experiment conducted by Poffenberger in 1915, carried on an investigation in the transfer of training in connection with the cancellation of numbers and letters. The authors intimated that the former experiment had not been designed to obtain the results reported.

250 subjects were given exercises in the cancellation of letters and numbers. It was found upon tabulation of the scores that practice in cancelling the number "6" had led to an increase in the ability to cancel the letter "d". There was no appreciable amount of transfer in the cancellation of the number "2", a situation analogous to that existing in Poffenberger's experiment. The reason for this result was explained by these authors in terms of interference. They stated (49:293), "In summary we find that, concordant with Poffenberger's results, but contrary to his conclusions, practice in the cancellation of one item increases the speed of the cancellation of certain other items."

Marginaenu (43:1-166)of the University of Cluj, Rumania, has reported a series of experiments involving 480 students. Eight experimental groups of thirty students each were matched with eight control groups also containing thirty students each. Complete information was not available on the procedures employed, but each group

was given a series of tasks to perform, three of which were specific, and five of which were general in nature. Transfer was found to be about two-thirds positive and one-third negative.

This study has been included, even in the absence of complete information, on account of the definiteness of the conclusions set forth by the author. These conclusions are: (1) There is no transfer from specific function to specific function. (2) There is no transfer from specific function to general function. (3) There is a small and an irregular amount of transfer from general function to specific function. (4) There is a definite amount of transfer from general function to general function. (5) There is a significant relationship between the amount of transfer and the generality of the situations functioning in that transfer.

Roberts (58:1-94) of the University of Iowa Department of Child Welfare has reported an experimental investigation in regard to the ability of pre-school children to solve different situations according to the same plan. Twenty-one pre-school children from the Iowa Pre-School Laboratories and 19 children from the Iowa Soldiers' Orphans' Home were presented with situations of color, form, and size. The range of intelligence quotients for the laboratory children was 106 to 150, while the

range of the orphan children was 80 to 106.

This author drew four conclusions from his study. (1) Learning ability, as studied in this experiment, was more closely related to mental age than to chronological age. (2) The application of the solution was not as much a function of mental age as was the learning of the situation, as shown by the fact that there were no significant differences between the mental age groups in any situation after the first. (3) For these particular children, the ability to apply the solution was not dependent upon the number of trials required for the learning of the solution. (4) Mere perception on the part of the child of the similarity between the stimulus and the desired response, was not sufficient to bring about the solution of the situation to be learned.

In order to test the current belief that intelligence and positive transfer are correlated, Ryan (60:492-500) devised an experiment in digit manipulation. He administered it to 100 high school girls. The Kuhlman-Anderson Examination was given to each subject to provide an index of mental ability. By employing alternate periods of digit practice, it was found that those with the highest scores in the Kuhlman-Anderson Test exhibited the greatest amount of negative transfer.

It was pointed out that in some situations it is

possible that negative transfer is more closely related to higher intelligence than is positive transfer. From the logical point of view, positive transfer, intelligence, and learning should be closely related. A possible explanation of the results set forth from this study might be found in the fact that the more intelligent pupils are the better retainers, and that their proficiency in retentiveness causes an interference of previously learned materials with the learning of somewhat similar material at a later date.

Salisbury (61:241-254), in an experiment designed to examine the "consciousness of method" theory, carried on a study of the transfer effects of training in logical organization.

The experiment was conducted on the "equivalent group" method in which 474 pupils from the seventh, ninth, and twelfth grades were grouped with respect to intelligence, mental age, and scores on the Haggerty Reading Examination. The training was accomplished by the presentation of thirty carefully planned lessons in logical organization of material. The time consumed in the administration of the lessons varied.

An examination of the results led the author to conclude that: (1) Training in the conscious use of outlining, when taught through the practice of general material,

will transfer to specific study situations, and will tend to improve mastery of subject-matter content, general thinking and reasoning, and reading comprehension, with a slight reduction in rate. This fact was particularly noticeable in the ninth and the twelfth grades. (2) Practice in logical organization had no effect on intelligence test scores. (3) Skill in outlining, as a study habit, is a highly successful aid in the learning process. (4) Improvement in thinking, as exemplified in reading comprehension and comprehension of units of subject-matter material, can be achieved in the public school under normal conditions by giving the pupils directed practice in outlining and in summarizing.

Vaughn (67:688-689), in observing the success of many poorly educated carpenters in squaring up the foundation of a house, conducted an experiment to determine, in part, the relative practicability of present-day education. He placed the problem before 113 college undergraduates, and found that only 38.4% of the men and 14.7% of the women could produce a right angle.

The author indicated that these results tended to reveal how little transfer there is from the classroom to daily living unless, as in some instances, theory and practice have been combined in the learning process.

Woodrow (72:159-172), of the University of Minnesota,

has conducted an experiment on the effect of the type of training upon transference. The hope of the author was to point out that the amount of transfer that takes place is not of as much importance as the amount of transfer that might take place.

Three groups were selected from among the university sophomores. A control group numbering 160, a practice group numbering thirty-four, and a training group numbering forty-two made a total of 236 subjects used in the course of the experiment which covered a five week's program of memorizing poetry, prose, facts, Turkish-English vocabulary, historical data, and memory span for constants repeated at varying intervals. Initial- and end-tests were given to all of the subjects.

The control group was simply given the initial- and the end-tests. The members of the practice group were instructed to train themselves in memorizing the practice material in any manner that they wished. The training group used the same time and material as did the practice group, but with a definite budget of time set up. Seventy-six minutes were devoted to memorizing poetry, seventy-six minutes were spent in listening to a presentation of the technique of memorizing, and twenty-five minutes were used in memorizing nonsense syllables. Following a comparison of initial and final results, Woodrow drew several

conclusions.

(1) Both the control group and the practice group exhibited a very slight improvement, as indicated by the performance made on the end test. (2) On several occasions, negative transfer was found in the case of the practice group. (3) The training group, on the other hand, improved over the practice group to the amount of 31%, plus or minus 5% computed error. It would seem from this evidence that methods of study are the important factors on which transfer depends.

A CLASSROOM EXPERIMENT IN THE TRANSFER OF TRAINING

CHAPTER IV

Experiments in the transfer of training are sometimes objected to because of the excessive classroom time which they require. Investigations requiring less time are objected to sometimes because of the inconclusive results yielded. The following experiment has been designed to utilize the students' previous training and to indicate the tendency of students to apply knowledge which they already possess when presented with a situation that gives opportunity for that application. This study is an enlargement of an investigation suggested by Lehman (39) of Ohio University.

Preparation and Procedure

Two mimeographed sheets, one containing Problems 1, 2, 3, and 4; and the other containing Problems 5, 6, 7, and 8 were prepared for use in this experiment. These sheets are reproduced in Exhibits I and II on Pages 90 and 93.

The test was administered to sixty-six college students in the Oregon State College, and ninety-eight pupils in the Albany, Oregon, High School. The total

number of subjects tested during the course of the experiment was 164.

The college students represented two different groups. A freshman algebra class provided twenty-three subjects and a class in educational psychology furnished forty-three subjects. The latter class was made up of students from several college divisions. Very few of these had had any mathematics beyond their high school courses. Response charts for these classes are given in Tables I and II on Pages 102 and 103.

The high school pupils were members of seven classes. Of this number, five were algebra classes, one was an English class, and one was a geometry class. Two of the high school algebra classes, one of twenty and one of sixteen pupils, were used in a secondary experiment designed to determine the effect of suggestion on the amount of transfer. These two classes were approximately equal in mental ability, as judged by their teacher. The responses made by the high school pupils are given in Tables III, IV, and V on Pages 104, 105 and 106.

The percent of subjects in each group using the algebraic response is presented in graphic form in Tables VI and VII on Pages 107 and 108. The percent of subjects in each group solving the problems correctly is presented in graphic form in Tables VIII and IX on Pages 109 and 110.

EXHIBIT I

A CLASSROOM EXPERIMENT IN MATHEMATICS

Instructions-

Below you will find four simple mathematical exercises. Work each example to the best of your ability, and show all of your work in each case.

1. $\frac{22 \times 12 + 5 \times 12 - 20 \times 12}{7 \times 12} =$

2. $\frac{20 \times 11 + 12 \times 11 - 30 \times 11}{11} =$

3. $16\ (14 \times 15) + 14\ (14 \times 15) - 29\ (14 \times 15) =$

4. $27^2 - 2 \times 27 \times 23 + 23^2$

Discussion of the Problem

Problems 1, 2, 3, and 4 (shown in Exhibit I, page 90) are simple mathematical exercises. They were so designed that they might be solved easily by the use of algebraic methods, providing the pupils discovered the possibility of using these short-cut methods.

In Problem 1, the number "12" was a common term in both the numerator and the denominator. Two general methods of procedure may be used to solve the problem. In the first place the pupil may perform each operation indicated. If he does this, he may be said to have employed the "longhand method". This interpretation of the term is employed throughout this report. On the other hand the pupil may apply the algebraic knowledge that he possesses in the solving of the problem. If he does this, he may be said to have employed the "algebraic method". Subsequent references to this term employ the same meaning as used at this point. In the place of multiplying out each operation indicated, the pupils may factor out the number "12", the result being 7 over 7 or 1. The advantage of this method is seen in the fact that no multiplication is necessary, the time consumed in the solution of the problem is lessened, and the possibility of error is decreased.

Similarly in Problem 2, the pupil may perform each operation indicated, or he may factor out the number "11", and the answer becomes 32 minus 30, or 2.

In Problem 3, the common term is (14×15). Here again the pupil may work out each operation indicated in longhand; or he may factor out the term (14×15). This leaves 30 minus 29 times this term, (14×15) or 210.

Problem 4 is of a more difficult nature. As in the case of the first three problems, the pupil may perform each indicated operation. This procedure, however, takes quite a little time and space. If the pupil's knowledge of algebra is put into use, the solution to the problem is relatively simple. The mathematical statement suggests the algebraic statement of $a^2 - 2ab + b^2$. This is the same as $(a - b) \times (a - b)$ or $(a - b)^2$. If "27" is substituted for "a" and "23" is substituted for "b", the problem resolves itself into $(27 - 23)^2$ or $(4)^2$ or 16.

Problems 5, 6, 7, and 8 (shown in Exhibit II, Page 93) were designed to determine whether or not the pupils possessed the necessary algebraic knowledge required for a simple solution of Problems 1, 2, 3, and 4. If the pupils were able to solve the last four problems by algebraic methods, what percent of them were able to utilize this knowledge in the solving of the first four problems? An answer to this question was sought in the experiment.

EXHIBIT II

THE EXPERIMENT CONTINUED

Instructions-

Four more problems are listed on this page. Each problem may be solved quite easily by algebraic methods. Be careful to put down each step that you use in solving the problem.

5. $\frac{22x + 5x - 20x}{7x} =$

6. $\frac{20x + 12x - 30x}{x} =$

7. $16x + 14x - 29x =$

8. $a^2 - 2ab + b^2$

   (when $a = 27$ and $b = 23$)

Problems 5, 6, 7, and 8 are algebraic statements of the mathematical equations presented in Problems 1, 2, 3, and 4. In Problem 5, "x" was substituted for the number "12" in Problem 1, and the answer becomes 7x over 7x, or 1. In Problem 6, "x" was substituted for the number "11" in Problem 2, and the answer becomes 2x over x, or 2. In Problem 7, "x" was substituted for the term (14 $\times$ 15), and the answer becomes 30x minus 29x, or "x".

In Problem 8 the algebraic statement of $a^2 - 2ab + b^2$ is given with instructions to substitute the number "27" for "a" and the number "23" for "b". This gives the same statement that was presented in Problem 4. The algebraic statement of the equation should suggest the term $(a - b)^2$ more readily than the statement of the problem as presented in Problem 4. This fact is borne out by the results obtained.

It was evident to over 95% of all of the people tested that Problems 5, 6, and 7 could be solved quite readily by inspection. Only to a very small percentage was it evident that these problems were similar to Problems 1, 2, and 3 on the first sheet, "x" having been substituted for "12" in the first problem, for "11" in the second problem, and for (14 $\times$ 15) in the third problem. The same situation existed in the case of Problems 4 and 8, but to a lesser extent, the problem in

factoring in these problems apparently becoming a more difficult task.

It is evident to the observer that if students know how to solve a simple algebraic equation, there should exist some tendency to transfer that knowledge to the solving of a simple mathematical statement of the same equation. A tabulation of the responses made revealed that this tendency, as measured, was decidedly weak.

In the college freshman algebra class, 4% of the students used the algebraic method in the solving of the first problem, 4% the second problem, 13% the third problem, and 0% the fourth problem. This is to be contrasted with 100% algebraic responses for Problems 5, 6, and 7; and 26% for Problem 8.

In the educational psychology class, a similar situation existed. Responses made by the forty-three students showed that 7% used the algebraic method in solving Problem 1, 9% Problem 2, 12% Problem 3, and 1% Problem 4. This is contrasted with 100% algebraic responses for Problems 5, 6, and 7; with 9% for Problem 8.

It is quite evident that a small amount of transfer had taken place among the college students. They were generally unaware of the possibility of application or transfer in this situation. The amounts of transfer found in the two classes were approximately equal. The

mathematics class exhibited a slight superiority in ability to work the problems correctly over the educational psychology class.

It may be noticed that none of the college students used the longhand method in Problems 5, 6, and 7, but that in Problem 8 many of them reverted back to this method. This situation is accounted for by the fact that after substituting "27" for "a" and "23" for "b" the pupils proceeded to solve the problem in the same manner in which they had solved Problem 4.

The responses made by the high school pupils in the algebra class in which suggestion was used are not included in the responses of high school students, as given in Table III, Page 104, but are presented separately in Table V on Page 106. Of the seventy-eight high school pupils included in Table III, 18% used the algebraic method in solving Problem 1, 19% Problem 2, 31% Problem 3, and 1% Problem 4. 100%, 97%, 99%, and 28% used the algebraic method in solving Problems 5, 6, 7, and 8, respectively. In the case of the high school pupils, the amount of transfer was very limited. They made a greater amount of transfer than did either of the college classes. The abilities of the high school pupils and the students of the college algebra class to work the last four problems correctly were approximately equal. Both

slightly exceeded the ability of the psychology class in solving these problems correctly. The high school pupils exhibited a distinct superiority in the ability to answer the first four problems correctly. This situation suggests that ability to give the correct response is a function of the amount of transfer.

In reviewing the recent experimental investigations in the field of transfer of training, this writer noticed that there are several non-intellectual factors which may function in transfer. The attitudes of the students, their motivation, the methods of instruction, and suggestion have all been reported to influence the amount of transfer.

A secondary experiment within this experiment was carried on in an attempt to determine the effect of suggestion on the amount of transfer. Two high school algebra classes were available for this purpose. A class of twenty and a class of sixteen pupils were approximately equal in mental ability, as judged by their teacher.

In the class of twenty pupils, the following initial instruction was added before they started to solve the problems on the first sheet: "You will find in these four problems an opportunity for application of your knowledge of algebra. If you use this opportunity, your work will be greatly simplified." No instruction beyond that

printed on the second sheet was given to this group when they began to solve the problems on that sheet. The class of sixteen pupils was given no instruction beyond that printed on the two mimeographed sheets. Responses for these two classes are given in Tables IV and V on Pages 105 and 106.

Of the twenty pupils to whom suggestion was given, 40% used the algebraic method in solving Problem 1, 45% Problem 2, 50% Problem 3, and 20% Problem 4. In contrast with this, of the sixteen pupils to whom no suggestion was given, none used the algebraic method in solving Problems 1, 2, and 4; and only 3% used this method in solving Problem 3.

Only a very slight amount of difference existed in the type of responses made by the two classes in Problems 5, 6, 7, and 8. This situation suggests that both groups had approximately the same ability to solve the first four problems by algebraic methods. The higher percentage of pupils using the algebraic method on the first four problems in the class in which suggestion was used compared with the low percentage of pupils using the algebraic method in the class in which no suggestion was used emphasizes the power of suggestion, in this case a form of instruction, as a function of the amount of transfer. Transfer, in some cases, is definitely affected

by positive suggestion given at the time of performance.

It may be noticed that the percentage of pupils using the algebraic method in the first four problems in the experimental class in which no suggestion was used is lower than the percentage of general high school pupils using the algebraic method on these same problems. This fact may be accounted for by the presence of more advanced students in some of the other classes tested.

The ability to answer the first four problems correctly was greater in the group in which suggestion was used than it was in any other group tested. The amount of transfer was also greatest in this group. This fact lends reliability to the hypothesis already advanced, that the ability to make the correct response is a function of the amount of transfer. Lehman (39:77-82) administered a similar test to 108 college students at Ohio University, and found the following percentages of students using algebraic methods in the solving of eight problems of the same type and arranged in the same manner as the problems used in this writer's experiment.

Problem	1	2	3	4	5	6	7	8
Percent	4%	4%	3%	0%	96%	96%	96%	9%

The responses made by the college students in the present study are closely parallel to those reported by

Lehman, while the responses made by the high school pupils are consistently larger than the percentages reported in the Ohio study. The small percentage of subjects using the algebraic method in solving Problems 4 and 8 in the writer's study, as well as the study reported by Lehman, suggests that the procedures called for in these two problems are more difficult than are the procedures called for in the other problems, and that these procedures represented longer mental steps than most of the pupils and students were able to take.

Conclusions from this Experiment

This experiment has not been extensive enough to enable the writer to record any finely definite measurements, but it has furnished data that suggest some rather definite conclusions. These are, as follows:

(1) Application of knowledge is one type of transfer.

(2) The existence of identical elements is of itself no guarantee of transfer.

(3) Transfer may or it may not occur.

(4) The results of this study fail to validate the assertion that mathematics as it had been taught to these groups has intrinsic values for the general improvement of reasoning power.

(5) Students are quite often unaware of the possibility

of applying their knowledge.

(6) The student's algebraic knowledge may fail to function when he is confronted with a simple and obviously mathematical situation.

(7) Students should be taught that algebra is a form of generalized arithmetic.

(8) The power of suggestion built up at the time of test performance is a conditioning factor in transfer.

TABLE I

RESPONSE CHART

College Freshman Algebra Class No. of Subjects, 23

No. of Responses Made

	Problem No. 1	2	3	4	5	6	7	8
LONGHAND METHOD	22 96%	21 91%	19 83%	21 91%				17 74%
Answer Correct	6 27%	8 38%	9 47%	7 33%				5 29%
Answer Incorrect	16 73%	13 62%	10 53%	14 67%				12 71%
ALGEBRAIC METHOD	1 4%	1 4%	3 13%	0	23 100%	23 100%	23 100%	6 26%
Answer Correct	1 100%	1 100%	3 100%	0	22 96%	23 100%	22 96%	3 50%
Answer Incorrect					1 4%	0	1 4%	3 50%
No Response Made		1 4%	1 4%	2 9%				
Total Ans. Correct	7 30%	9 39%	12 52%	7 30%	22 96%	23 100%	22 96%	8 35%

TABLE II

RESPONSE CHART

Educational Psychology Class No. of Subjects, 43

No. of Responses Made

	Problem No. 1	2	3	4	5	6	7	8
LONGHAND METHOD	40 93%	39 91%	38 88%	38 88%				38 88%
Answer Correct	14 35%	15 38%	18 47%	5 13%				10 26%
Answer Incorrect	26 65%	24 62%	20 53%	33 87%				28 74%
ALGEBRAIC METHOD	3 7%	4 9%	5 12%	1 2%	43 100%	43 100%	43 100%	4 9%
Answer Correct	2 67%	4 100%	4 80%	1 100%	31 72%	34 79%	35 81%	4 100%
Answer Incorrect	1 33%	0	1 20%	0	12 28%	9 21%	8 19%	0
No Response Made				4 9%				1 2%
Total Ans. Correct	16 37%	19 44%	22 51%	6 14%	31 72%	34 79%	35 81%	14 33%

TABLE III

RESPONSE CHART

High School Pupils — No. of Subjects, 78

No. of Responses Made

Problem No.

	1	2	3	4	5	6	7	8
LONGHAND METHOD	64 82%	61 78%	47 60%	61 78%				51 65%
Answer Correct	29 45%	32 52%	29 62%	15 25%				13 25%
Answer Incorrect	35 55%	29 48%	18 38%	46 75%				38 75%
ALGEBRAIC METHOD	14 18%	15 19%	24 31%	1 1%	78 100%	76 97%	77 99%	22 28%
Answer Correct	13 93%	12 80%	19 79%	1 100%	65 83%	61 80%	71 92%	18 82%
Answer Incorrect	1 7%	3 20%	5 21%	0	13 17%	15 20%	6 8%	4 18%
No Response Made		2 3%	7 9%	16 21%		2 3%	1 1%	5 7%
Total Ans. Correct	42 54%	44 56%	48 62%	16 20%	65 83%	61 78%	71 91%	31 40%

TABLE IV

RESPONSE CHART

High School Algebra Class — No. of Subjects, 16

No Suggestion Used — No. of Responses Made

	Problem No. 1	2	3	4	5	6	7	8
LONGHAND METHOD	16 100%	16 100%	11 69%	14 88%				10 63%
Answer Correct	6 37%	9 56%	7 63%	2 14%				3 30%
Answer Incorrect	10 63%	7 44%	4 37%	12 86%				7 70%
ALGEBRAIC METHOD	0	0	3 19%	0	16 100%	16 100%	16 100%	6 37%
Answer Correct			2 67%		14 88%	13 81%	14 88%	3 50%
Answer Incorrect			1 33%		2 12%	3 19%	2 12%	3 50%
No Response Made			2 12%	2 12%				
Total Ans. Correct	6 38%	9 56%	9 56%	2 12%	14 88%	13 81%	14 88%	6 38%

TABLE V

RESPONSE CHART

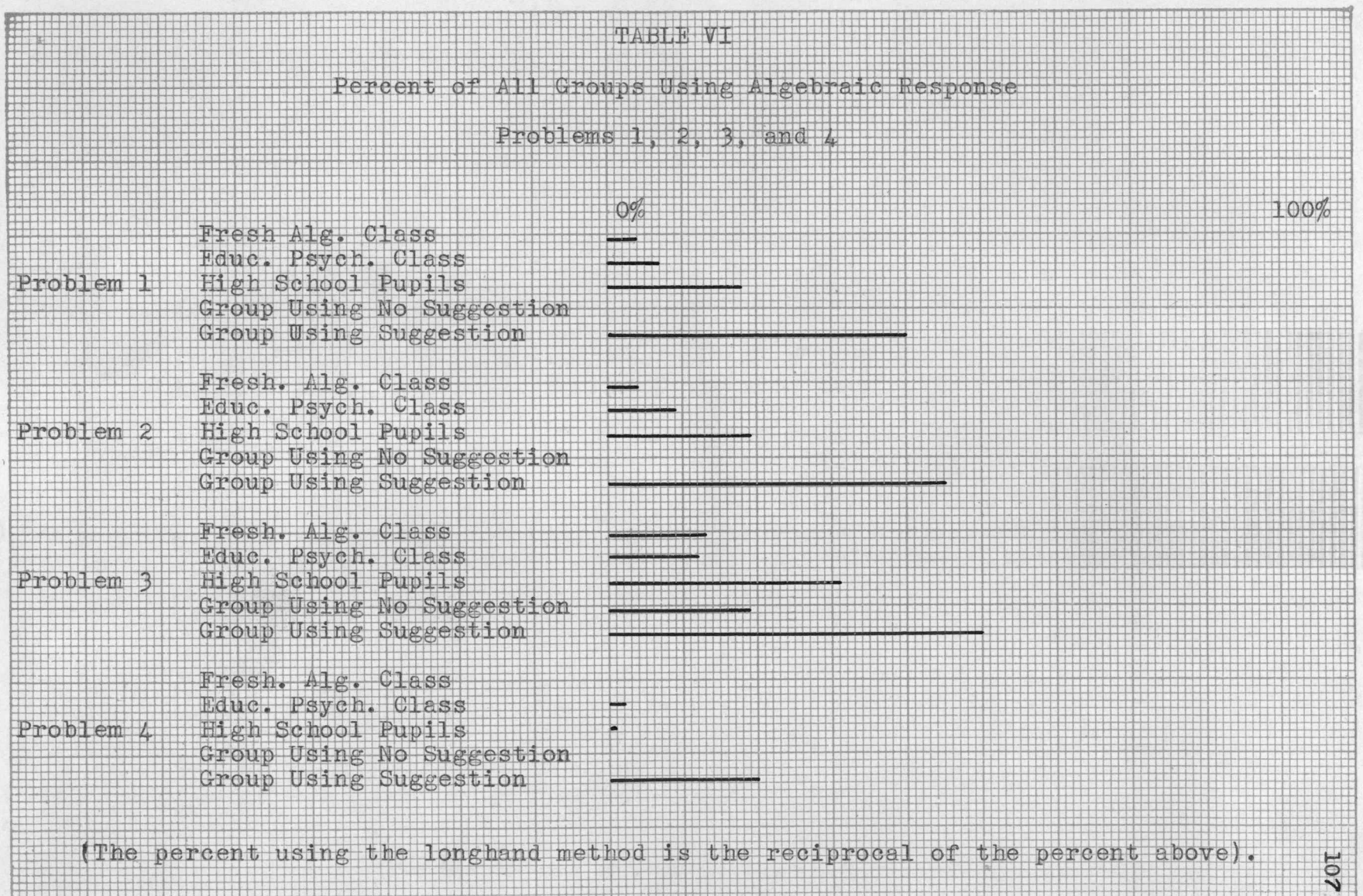
High School Algebra Class No. of Subjects, 20

Suggestion Used	No. of Responses Made							
	Problem No.							
	1	2	3	4	5	6	7	8
LONGHAND METHOD	12 60%	11 55%	10 50%	16 80%				8 40%
Answer Correct	5 42%	6 55%	7 70%	5 31%				3 38%
Answer Incorrect	7 58%	5 45%	3 30%	11 69%				5 62%
ALGEBRAIC METHOD	8 40%	9 45%	10 50%	2 20%	19 95%	18 90%	19 95%	9 45%
Answer Correct	6 75%	7 78%	10 100%	1 50%	16 84%	17 94%	18 95%	5 55%
Answer Incorrect	2 25%	2 22%		1 50%	3 16%	1 6%	1 5%	4 45%
No Response Made				2 10%	1 5%	2 10%	1 5%	3 15%
Total Ans. Correct	11 55%	13 65%	17 85%	6 30%	16 80%	17 85%	18 90%	8 40%

TABLE VI

Percent of All Groups Using Algebraic Response

Problems 1, 2, 3, and 4

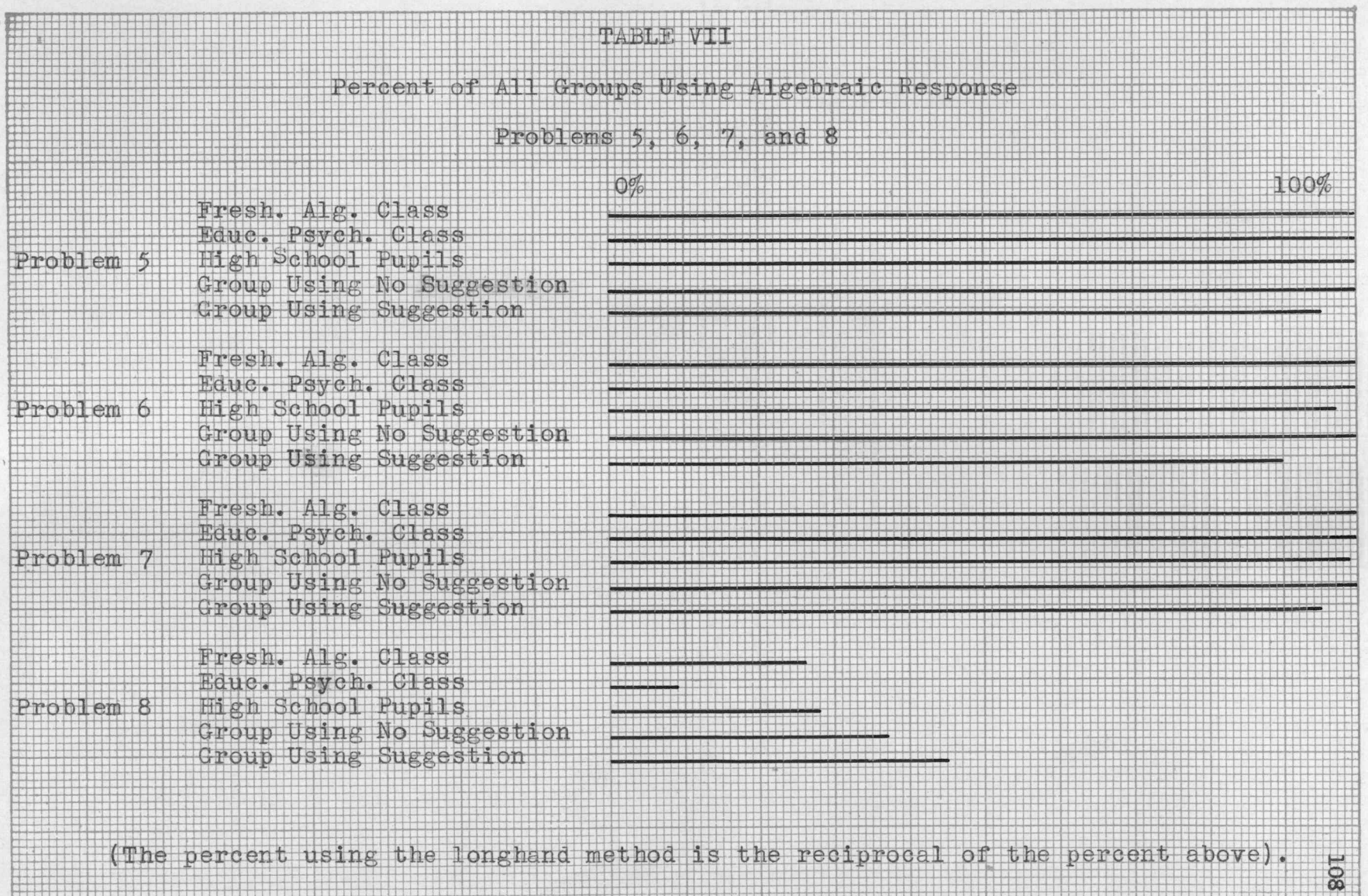


(The percent using the longhand method is the reciprocal of the percent above).

TABLE VII

Percent of All Groups Using Algebraic Response

Problems 5, 6, 7, and 8



(The percent using the longhand method is the reciprocal of the percent above).

TABLE VIII

Percent of All Groups Solving the Problems Correctly

Problems 1, 2, 3, and 4

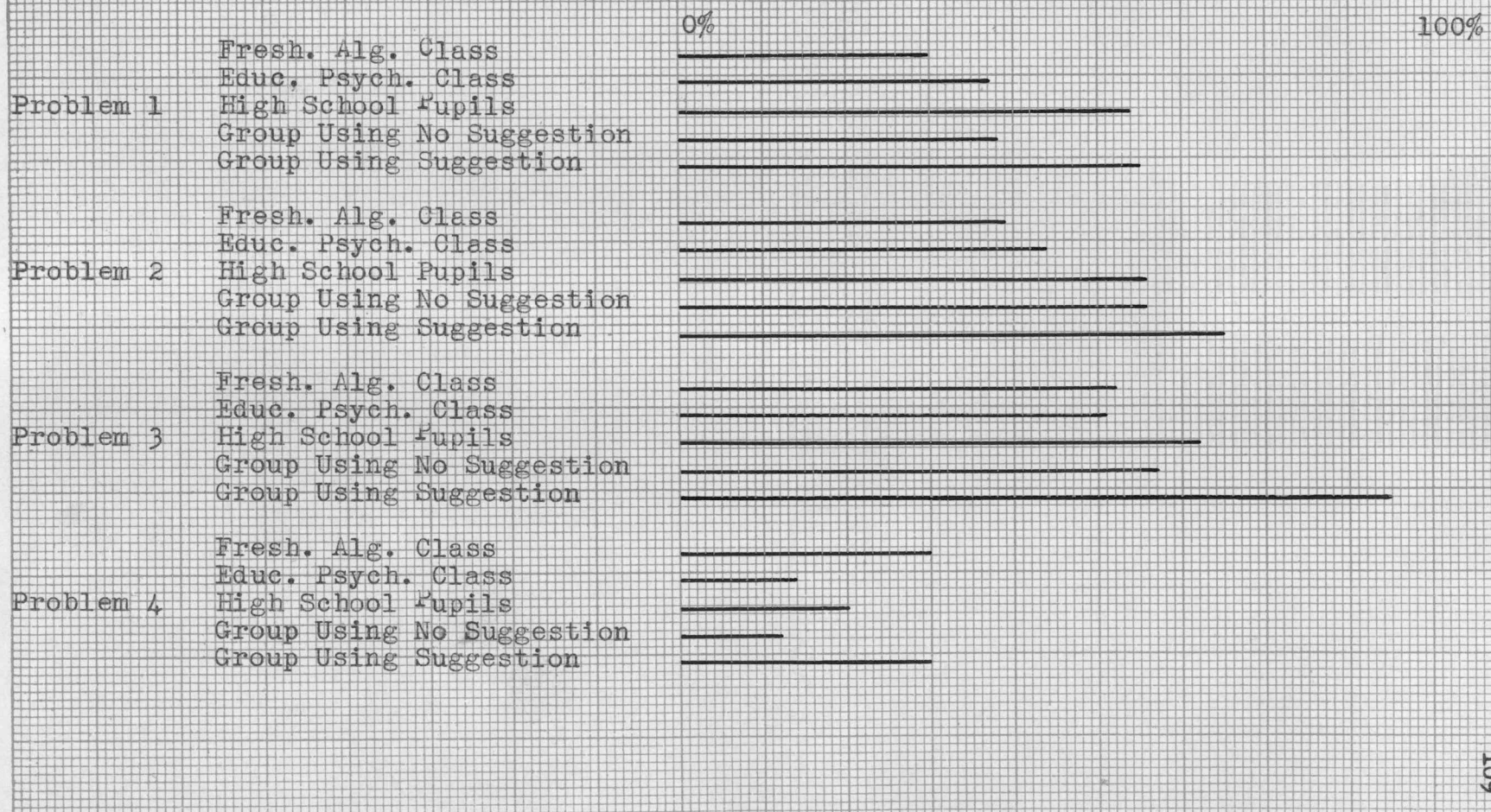
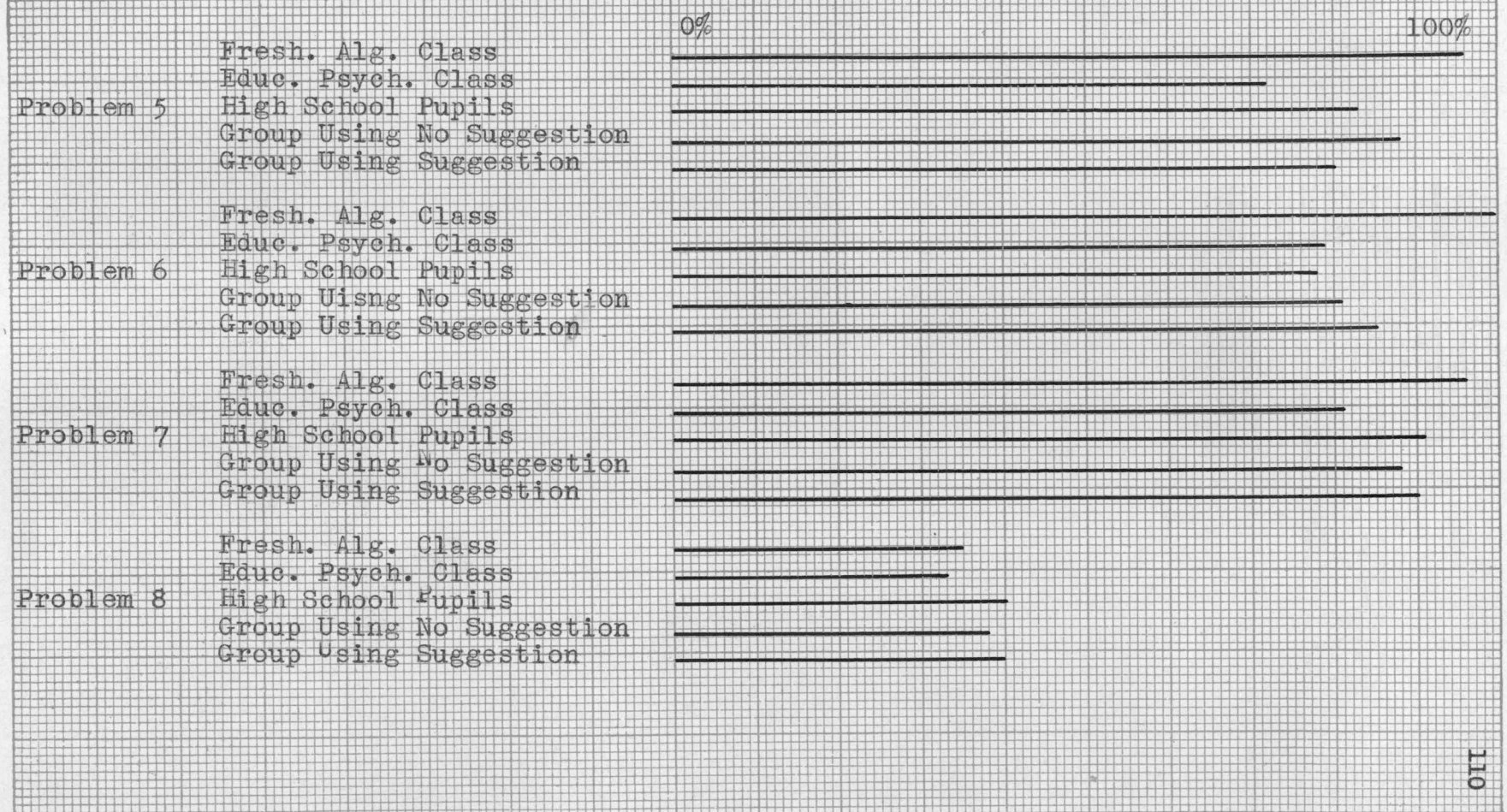


TABLE IX

Percent of All Groups Solving the Problems Correctly

Problems 5, 6, 7, and 8



SUMMARY AND GENERAL CONCLUSIONS

CHAPTER V

Major emphasis in this study has been placed on those experimental results related to the transfer of training that may be considered of pedagogical importance. This writer has stressed classroom procedures which have seemed desirable as necessary factors in increasing the useful application of acquired knowledge. An examination has been made of (1) the extent to which organized education lends itself to the transfer of training under varying conditions, (2) the conditions under which transfer of training operates, (3) the relative transfer values of various subjects, and (4) the importance of methods of instruction as factors in the transfer of training. Recent experimental investigations in the field of transfer of training have been examined in a search for those facts and results that may aid in a current interpretation of these questions.

The problem of transfer of training has received increased emphasis in the last decade. Experimental investigations conducted during this period have indicated a definite trend toward regarding transfer of training as an educational and technological problem rather than a narrowly scientific or strictly psycho-

logical problem.

Interpreted in the light of the knowledge generally accepted as necessary for reliable inference, many of the experimental investigations examined were limited in scope and method to the extent that they provided weak bases for reliable conclusions.

Varying amounts of positive and negative transfer were reported. Very few experimenters reported no transfer of either type. In several of the investigations reviewed in which a definite amount of transfer was reported, the claims advanced for that transfer were inadequate. In some, the differences found between trained and untrained subjects or groups were so slight that they were of little or no importance.

In a preponderant number of investigations reviewed, however, there has been reported a measurable, though limited, amount of transfer. In general, the more similar the influencing and influenced activities, the more certain the transfer of training and the greater its amount. Usually, the amount of training transferred to a second situation may be expressed as a minor fraction of the amount of change produced by the original training.

An examination of the views of recent investigators in the field of transfer of training points out the fact that there is no more unanimous agreement about the

causes of transfer than there is about the amounts of transfer. Apparently, the presence of identical elements facilitates transfer, but is no guarantee of its occurence. The ability of the students to re-interpret and generalize knowledge in a highly modifiable situation is an important factor in transfer, but the presence of this ability does not insure that it will operate and, thus, bring about transfer. Attitude, method of instruction, the degree to which the training is carried out, the ideals and the emotions or enthusiasms of the pupils, the amount and direction of suggestion, the intelligence of the subjects, and their maturity have all been reported as qualifying factors of transfer.

There is not perfect agreement about the conditions under which transfer operates, but the investigations reviewed point out that (1) previous practice in making a response to a stimulus is likely to result in a marked amount of positive transfer to a new period of practice, even though the two situations are not altogether identical; (2) learning to make a new response to a new situation is likely to result in a slight amount of positive transfer; (3) learning to make a new response to an old situation is likely to result in a slight amount of negative transfer, which may change to positive transfer following a short period of operation;

(4) calling attention to similarities between two or more of the stimulus-response terms is likely to increase positive transfer and decrease negative transfer; and (5) integrating the initial learning is likely to increase positive transfer.

From the evidence examined in this study, it seems certain that in most situations the teacher may very reasonably expect the brighter pupils to surpass the duller pupils in the amount of transfer gained from specific training. In proportion as the pupils intelligence is lower must the teacher bring attention to the relationships to be educed and the subsequent use of these relationships in the interpretation of the pupil's environment. Even with the aid of skillful instruction on the part of the teacher, the spread of training will be decidedly less among the dull than among the bright.

Evidence gathered points to the fact that transfer of training should be found at its maximum in pupils whose mental activities are still in the formative stage. While it is true that adults possess higher intrinsic capacities to apply specific knowledge in varying situations, these capacities are less evident simply because the majority of relations which they desire to make have already been educed, conceptualized, and applied under the stress of the adult's daily experience and routine. On

the other hand, it is reasonable to suppose, although there is no experimental evidence available at present, that more mature people who have been and are working in fields which are not routine but which require thinking and the making of new associations and modifications will be more proficient than less mature people of equal ability but less background knowledge and practice. Transfer of training resembles, at least, or is dependent upon the extent and accuracy of association as a mental process.

Those investigations carried out in the transfer of training in the social and moral environments have pointed out that transfer is here decidedly limited; and is dependent to a large extent upon the method of instruction, the aims of the teaching program, and the attitudes of pupils, teachers, and communities.

The question of whether or not some school subjects are richer in transfer values than are others has not been definitely answered in the experimental investigations examined. The natural sciences, bookkeeping, and business arithmetic have been reported to have superior transfer values. It seems, however, from the results of most of the investigations, that the extent to which the subject-matter is applied in the interpretation of existing environments is a more important factor in trans-

fer than are the intrinsic transfer values which may be presumed to lie in the subject-matters themselves.

There is a definite trend toward emphasizing the value of the quality and the type of the instruction as the important conditions in bringing about transfer. Isolated facts which have become a part of the pupils' knowledge are not a guarantee of transfer. The facts must become a part of newly created experience and generalized knowledge in order to insure transfer. The method of teaching should take pains to see that these facts are so presented to the pupils that the pupils are able to see the relationships between these facts, and are subsequently able and willing to utilize these relationships in the handling of other sets of facts in which similar relationships pertain. Such methods of intructions will enhance the amount of transfer to a marked extent.

Application and generalization of subject-matter seem to cause transfer if the application really becomes a part of the student's apperception. Transfer is assured to a greater degree if emphasized directly and consciously by illustration, principle, and application of this principle to existent situations. Transfer can be taught, but it is best brought about by the learners themselves. Training for transfer is not only a type of

education, but a method and an ideal.

John Tyndall (77:60) stated, "I do not think that it is the mission of this age, or of any other particular age, to lay down a system of education that shall hold good for all ages. The basis of human nature is, perhaps, permanent, but not so the forms under which the spirit of humanity manifests itself. It is sometimes peaceful, sometimes warlike, sometimes religious, sometimes skeptical; and history is simply a record of its mutations."

The achievements of past and present educators should not be condemned as in error or as inadequate, but should be commended as the necessary transition products leading to added achievements and interpretations that will be more applicable to the changing situations of the future.

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