# REPORT

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## COMMITTEE ON THESIS

THE undersigned, acting as a committee of the Graduate School. have read the accompanying thesis submitted by Florence M. Brawthen for the degree of Master of Arts. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts.

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# An Analytical Study of the Transference of Training

A Thesis

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by

Florence M. Brawthen

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# AN ANALYTICAL STUDY OF THE TRANSFERENCE OF TRAINING.

To begin with, my problem covered an analytical study of the practice effects of normal and backward children. In fact, my research was mainly to ascertain the effect of intelligence as a factor in the transference of training. After making a detailed study of the practice effects of normal children thru experimental tests given in the public schools of Minneapolis, I found that my original problem was too comprehensive an undertaking for my limited time. Hence, this report deals with a study of transfer-effects of normal children only. Part I give a detailed account of what has been discussed, experimented, and accomplished along various lines of research. Part II deals exclusively with my own experimental study of transference of training.

## Part I.

Up to the present time, there has been little, if any, distinction made between the doctrine of "Formal Discipline" and the "transference of training."

Literature on the subject gives a great variety of definitions for Formal Discipline, but for the most part, each interpretation of the theory assumes that transference of training and Formal Discipline are identical. Briefly stated, the doctrine of Formal Discipline maintains that "the mind is a collection of faculties or powers observation, attention, memory reasoning, will and the like, and that any gain in any faculty is a gain for the faculty as a whole."[1] "It is even said that improvement of any one power will improve all the other mental powers: e. g. that learning to attend to Latin forms will make one not only attend, but remember, reason, and observe better than he did before."[2] I am of the opinion that there is a difference between Formal Discipline and transference of training; the former assumes that the faculties can be equally trained in all directions; the latter assumes that training is not equally transferred. Instead, training may either help or hinder the transfer. In other words, there may be positive or negative transfer-effects according to the theory of transference of training. However, I am sure

1. Thorndike, E. L. "Principles of Teaching." N. Y. 1906, Chap. XV P. 236.
2. Thorndike, E. L. "Principles of Teaching." N. Y. 1906, Chap. XV P. 237.

that the two are alike in certain assumptions. For example, both theories assert that improvement of any one mental function will improve others only in so far as they have identical elements common to both.[3.]

In the educational field, no theory has been so strongly supported on the one hand, and so vigorously attacked on the other, as the doctrine of formal discipline often called the doctrine of the transference of mental training. Those who oppose the theory maintain that "the mind is by no means a collection of a few general facilities, observation, memory, reasoning, will and the like, but is the sum total of countless particular capacities, each of which is to some extent independent of the others, and each of which must be educated by itself."[4.] Scores of investigations and discussions have been made concerning the possibility of certain mental functions on others; consequently the supporters of the faculty theory have been gradually losing ground.

The doctrine of formal discipline was first clearly formulated as an educational theory, by Locke

3. Thorndike, E. L. "Principles of Teaching." N. Y 1906, Chap. XV PP. 239-240.
4. Thorndike, E. L. "Principles of Teaching." N. Y Chap. XV P. 240.

in the seventeenth century. Its special purpose was to uphold Latin and the classical studies in general, which were being put aside for many of the new studies in science and modern languages. According to Locke's theory, the thing learned as well as the process of learning was important because of its effect upon the mind and character.[5.] This was of significant importance, when we consider that at the time he formulated his theory, a new conception of education was being advocated in which the process of learning rather than the thing learned was the important element. In other words, the correct process or method of education would result in the development of a special mental power which would be applicable to all subjects. The faculties, especially memory and reason, were to be trained.[6.] Returning to Locke, we find that his theory was very definite. He believed that training did transfer. He pointed this out clearly in the study of Mathematics where he even used the term "transfer" saying that "children having got the way of reasoning which mathematics should develop, they might transfer it to other

5. Pedagogical Seminary, Sept. 1914. "Formal Discipline." Lyon C. K. PP. 348-50.
6. Monroe, P. "Brief Course in the Hist. of Ed." P. 270-1.

parts of knowledge as they have occasion.[6a] Locke's theory also considered that transfer was due to "identical elements" a factor which will be discussed later. On the whole, this doctrine has had a tremendous effect upon education and even today, it has many supporters. This conception of education has controlled the work of the secondary schools and the old universities of England, the gymnasium of Germany, and the colleges and secondary schools of America in the earlier period.[7]

Speaking of education in our own day, we find that the course of study has been revised considerably to meet the practical turn of mind of the times. Many subjects have been added to the curriculum for their practical subjects as manual training, cooking, sewing, and gardening, claim that such subjects are not introduced for their practical value alone; they are simply to achieve more effectively than did the old list of studies the training of the faculties, memory, reasoning, observation etc. Just so, supporters of nature study claim that such a study helps to better observation in respect to "both the number of things observed

6a. Monroe, P., Brief Course in the Hist. of Ed., 1906 p. 271.
7. Monroe, P., Brief Course in the Hist. of Ed., 1906 p. 275.

and the acuteness of the process." In fact, the general attitude of such educators toward nature study is that it does not make much, if any, difference what is observed just so that the mental function of observation is performed.[8]

Taking this view of the theory, one can easily understand why a very large class of people in this country send their sons to military schools which are in no way preparatory to West Point. These people are not planning upon their sons becoming soldiers. In many cases, the very boys who are sent to these schools care little for drill and for soldierly service. Such people usually believe that their boys learn respect, obedience, promptness, attention, courage, patriotism and many other valuable qualities which a military training naturally brings.[9]

We also find that in convents, cloistral schools, and institutions, rigid rules and regulations are enacted. Lights go out at a certain time at night; rising bells ring at a definite time. Everything is carried out on a systematic basis. Most of the teachers

8. Bennett, E. J., "Formal Discipline" 1907, Teacher's College Columbia, N. Y., pp. 7-12.
9. Bennett, C. J., "Formal Discipline," 1907, Columbia Univ., Teacher's College, N. Y., pp. 11-20.

confess that such a systematic training teaches children to do the things they are to do, at the right time, and in the right way. Such ideas are closely connected with the theory of the transfer of general forms of training.[10.]

Aside from the question of the effect of general forms of training, quarrels have arisen among educators as to whether special forms of training "improve the general capacities of the mind." Questions as to the improvement of one's general reasoning powers thru the study of Latin or of Mathematics, the training of the power of observation for all sorts of facts through laboratory work in acience and similar questions have been greatly discussed and analyzed.[11.] Other questions that have been raised are "does learning to be accurate with numbers make one more accurate in keeping his accounts in weighing and measuring, in telling anecdotes or in judging the character of his friends? How har does learning to reason out rather than guess at, or learn by heart a problem in geometry make one more thoughtful and logical in following political arguments or in

10. Bennett, C. J. "Formal Discipline." 1907 Columbia Univ.
11. Thorndike, E. L., Ed. Psychology.-"Influence of Special Forms of Training upon more General Abilities." Chapter VIII.

choosing a religious creed; how far does the habit of obedience to a teacher in school generate the habit of ebedience to parents, laws, and the voice of conscience?"[12.]

It is interesting to find how such questions as these have been both supported and attached. One can partly account for the wide differences of opinion in this subject when analyzing articles pertaining to Formal Discipline. Those who attack such questions as above have very different ideas from those who defend theory.[13.] For these reasons, so few convincing conclusions have been reached.

Formal Discipline, as seen by its foes, has been attacked for two specific reasons. Firstly, they consider that it is a doctrine maintaining that "training is transferable," and have found its basis in the faculty psychology.[14.] Secondly, they also think that the theory is used as a weapon to defend subjects that are not practical or of use in the curriculum.

The first definite rejection of the doctrine of formal discipline was ~~that~~ by Herbart in the first

12. Thorndike, E. L. Principles of Teaching N. Y. 1906 Chap XV. pp. 235-236.
13. Pedagogical Seminary, Sept. 1914. "Formal Discipline," Lyon, C. K., p. 343.
14. Pedagogical Seminary, "Formal Discipline," Lyon, C. K., P. 342.

quarter of the nineteenth century. He believed that ideas do the thinking and that the interplay of thots upon each other is the activity of consciousness. Hence there are no faculties left: in other words, he said that we do not have the mind and ideas but rather just the ideas. This part of his theory was entirely against the theory of Formal Discipline. For example, Herbart said that the important thing for a teacher to know was not how well drilled a child was or how well his faculties could be expected to work, but what experience he had assimilated.[15.]

Herbart's views on the theory raised considerable criticism and discussion. Hugh, in a reply to the Herbartians, said that intellectual training stands on very much the same basis as physical training. A man's physical nature can be trained by doing useful work or the exercise of the gymnasium, which have no value whatever except their effect upon the physical system of the performer. Hugh also asserted that many physical exercises that usually are not classed as mental training, have no less value for the training of the

15. Henderson, Text Book in the Principles of Education, 1910 Chap. X. Question of Formal Discipline, pp. 291-293.

mind that the study of the classics or the sciences. He showed how manual labor, football, and other forms of athletics are just as important in intellectual development as many other subjects of the curriculum as they not only train the muscular system but also the brain cells by which the muscles are controlled.[16.]

The strongest support for the doctrine of formal discipline comes from the psychologists basing their beliefs upon physiology. In the first part of the nineteenth century, Gall and his pupil Spurzheim wrote the "Anatomie et physiologie du systeme nerveux" in which is to be found a system of phrenology which bears on this subject. According to this system, the brain is supposed to contain more than thrity separate and individual organs. These organs are the seat of the most "complex psychic capacities or internal senses such as combativeness, the fear of God, a sense of fact, the impulse of self preservation, the sense of language, etc." It was only an incident to this system that the locality of these internal senses was found on the surface of the brain, and that the external evidence for them ex-

16. Pedagogical Seminary, April 1898, "Formal Ed. from the standpoint of physiological Psychology," Hugh, D. D.

isted in the certain prominences on the skull.[17] The interest in this now bizarre theory lies, as far as this discussion is concerned in the fact that here we find in a most pronounced form, a justification of the theory of transference of mental training. "The first assumption is that the mind is composed of a number of separate faculties, and from this, it readily showed that these can be educated in their entirety and made to serve in the various situations of life equally well for all purposes. The second assumption has looked upon the various activities of the nervous system particularly of the cortex as "highly specialized and definitely localized and has viewed the corresponding psychic functions as something quite discreet and separate." Extremely, for example, this assumption implies that there is not a cortical centre for language, but a distinct area for nouns, or for verbs, not only a cortical centre for vision, but a definite area for color. There seems no limit to the multiplication of centres which can result from such a theory, and it surely serves as a firm foundation for the doctrine that there is no education

17. Colvin, S. S., The Learning Process, 1911. "A Partial Justification of the so-called Dogma of Formal Discipline" Bul. No. 2, School of Ed., Univ. of Ill., p. 211.

in general, and that the best we can do is to train the individual to interpret a certain number of definite sense stimuli and to respond to a limited number of concrete situations in the same old way."[18.]

Thru out the middle of the nineteenth century, the doctrine of Formal Discipline was widely encouraged. Its validity, however, was impaired in the conflict mentioned previously between the classics and mathematics on the one hand, and the natural and social sciences on the other. Spencer and Huxley were great leaders in this conflict in behalf of the sciences. In 1867, there was published in this country a collection of essays, illustrating stages in the evolution of thought from the traditional doctrine of formal discipline to the present doctrine of specific disciplines. According to these essays, the main argument for the disciplinary value of the sciences is based upon both the superior formal and specific discipline, and the knowledge to be derived from them.[19.]

The present opinion on the theory is what most closely concerns us here. In order to show both sides

18. Colvin, S. S., "The Learning Process," 1911, Chap. XIV. p. 212.
19. Heck, W. H., "Mental Discipline and Ed. Values," 1911, p. 30.

of the question, quotations must be given from psychologists and educational writers as to their attitude toward the doctrine of formal discipline. R. N. Roark says, "Since the mind is a unit, and the faculties are simply phases or manifestations of its activity, whatever strengthens one faculty indirectly strengthens all the others. The verbal memory seems to be an exception to this statement, however, for it may be abnormally cultivated without involving to any profitable extent the other faculties. But only things that are rightly perceived and understood can be rightly remembered. Hence, whatever develops the acquisitive and assimilative powers will also strengthen memory; and conversely, rightly strengthening of the memory necessitates the developing and training of the other powers."[20] C. L. Morgan says that it is as a means of training the faculties of perception and generalization that the study of such a language as Latin in comparison with English is so valuable.[21]

According to Ibid, "by means of experiment and observation, all work in science, not only will one's attention be excited, the power of observation; pre-

20. R. N. Roark, "Method in Education." p. 11
21. C. L. Morgan, "Psychology for teachers," p. 186

viously awakened, much strengthened, and the senses exercised and disciplined, but the very important habit of doing homage to the authority of facts rather than to the authority of men be initiated."[22] In Ibid we also find the study of the Latin language does discipline the faculties and secures to a greater degree than that of any other subjects we have discussed, the formation and growth of those mental qualities which are the best preparatives for the business of life whether that business is to consist in making fresh mental acquisitions or in directing the powers thus strengthened and matured to professional or other pursuits."[23] "The most valuable thing in the way of discipline which comes from a study of a foreign language is its influence in improving pupils command of his own. This means improvement in general judgment and discrimination which is evinced by a finer linguistic sense."[24] Another article of interest concerning the theory was given by Wendell on the general value of specific training in voluntary attention. He said that the practical aim of a general education is such a training as shall enable a man to de-

22. Ibid, p. 261
23. Ibid, p. 264
24. Ibid, p. 129

vote his faculties intently to matters which of themselves do not interest him. The power which enables a man to do so is obviously the power of voluntary, as distinguished from spontaneous attention. In other words, whatever interests people commands their spontaneous attention, and accordingly, such power of concentration as is naturally theirs. But if a man is to make anything out of a matter which does not interest him, he must "concentrate his powers on it by a strenuous act of attention controlled by the full power of his will."[25] Just so, children thruout all their years of schooling are compelled, in spite of every human reluctance, to fix their attention on matters which of themselves could never have held the attention for five minutes together. Unknowingly, the faculty will is cultivated.

Many other subjects other than the classics and mathematics could have been made to serve the purpose, and today the practical subjects introduced into the course of study could be made to serve the purpose of affording "increasing and lastingly masculer power of voluntary attention."[26] Professor Angell, in an article

25. Wendell, "The privileged classes," -1908. "Our National Superstition," pp. 171-174.
26. Wendell, "The privileged classes," -1908. "Our National Supersition." p. 174.

which he gave in a meeting at the Michigan Schoolmaster's club, expressed some ideas quite similar to Wendell's. He says that the persistent and voluntarily direct use of attention especially when the subject attended to is lacking in interest, speedily becomes acutely distasteful. From this point of view, it may be well to believe that such studies as the classics and mathematics have a peculiar value in affording the maximum of native interest; consequently a student who learns to tolerate prolonged attending to their intricacies may find almost any undertaking by contrast easy. In this discussion, Angell also raised two important questions which are; first, does the serious pursuit of any study whatever leave the mind better able than before to cope with every other subject, and second, are there specific studies which are valuable in this regard? He states that the connecting of stimulation and response requires conscious guidance and has to be learned. After the act has been repeated a number of times conscious control tends to fall away and leaves in its place a condition closely comparable to a reflex act, in

which an appropriate movement is made in response to a stimulus without the interposition of consciousness.[27] W. C. Ruediger, in a recent volume on the principles of education, discusses formal discipline and believes that training possesses a general vlue. He taught that neatness as an ideal could be transferred to other subjects. He says if we have analyzed the doctrine of formal discipline correctly, it is evident that its extreme advocates and extreme opponents are both wrong. Knowledge and training are not merely specific in their application, but they also have a general value.[28] Heck, in his "Mental Discipline", believes that there is danger in an emphasis of the doctrine of formal discipline, but does not deny the clearly established fact of transfer of training. He also thinks that it would be a great misfortune to convey the belief generally that because the doctrine of formal discipline may be wrong in certain of its theoretical aspects, the practical effect of learning in one field upon learning in another is nil. Heck's chief arguments against formal discipline are bases upon certain theoretical assumptions, not up on experimen-

27. Educational Rev., June 1908 -"The Doctrine of Formal Discipline in the Light of the Principles of General Psychology." Vol. 36 pp. 1-14.
28. W. C. Ruediger, "The Indirect Improvement of Mental Functions thru ideals," Educational Review, Nov. 1908. p. 369.
W. C. Ruediger, "Principles of Education," 1900, pp. 97-9.

tal evidence. He identifies the doctrine of formal discipline with the old faculty psychology. He says that the faculty psychology of our fathers is not basal to a belief in the transfer of mental training.

A second theoretical objection which Heck finds to the doctrine of Formal discipline is that it does not agree with the current theories of the localization of nervous functions. He seems to adopt a theory of absolute localization, although he recognizes the fact that "cortical activity is not limited to these particular states of consciousness, for consciousness at any moment is related to an equilibrium of activity in the cortex as a whole."[29] Heck's hypothesis has no verifiable facts. He cannot prove his point for if we try to overthrow the doctrine of transfer on the grounds of absolute localization of nervous functions, we are doing so on dubious theoretical grounds and are holding to a theory which runs counter to what we know of mental elements and mental organization. Heck also apposes the doctrine of Formal Discipline asserting that habits are specific and that a generalized habit is impossible.

29. W. A. Heck--"Mental Discipline and Educational Values"-2d edition, 1911-pp. 12-62.

There are, however, just as many writers who think that a habit may be general as those who believe that they may be specific, but on the whole almost everyone emphasizes the specific character of mental training.

Some recent writers on the subject believe in the theory of the transference of mental training, basing their proof upon the notion of "indentical elements." Henderson in his "Formal Discipline from the standpoint of analytical and experimental psychology," says that "wherever practice in one exercise leads to improvement in another, certain specific elements in both are identical and call forth identical responses which premote success in both exercises."[30] Bolton in his article on "Gen'l Discipline and Educational Values" also asserts that "whenever a new activity involves an element already learned that part of the process does not need to be again mastered."[31] "Just so almost every study involves elements that have been mastered in other connections, and most of the subjects have a great many similar elements which can be easily woven together.

The strongest support for the theory of the trans-

30. Henderson, C. H., "What is to be educated." pp. 609-610.
31. School Review, Bolton "Gen'l Discipline and Ed. Values." Feb. 1904, Chap. XXVIII pp. 757-o.

ference of mental training has come from experimental data on transfer that have been almost confined to tests given by investigators in special lines of research. As early as 1858, Volkmann found that training the left arm to discriminate touches proved somewhat although not equally the power of the right arm in such discrimination, also on the fineness of space discrimination on the skin by means of the webe compass, and he found that practice with the finger tips of the left hand increased the fineness of discrimination of the finger tips of the right hand but not of the left fore arm.[32.] The experiments of Thorndike and Woodworth as reported in an article in the Psychological review show that training in discriminating words containing e and s, brought a little improvement in the rapidity of discriminating words containing "i" and "t", or misspelled words, or the letter "A" in a list of letters, and accuracy also improved but to a lesser degree. Training in discriminating English verbs brought a scarcely perceptible increase in the ability to discriminate quickly other parts of speech.

32. Volkman- "Ueber den Einfluss der Uebung auf das Erkennen raumlicker Distanzen." - Ber. der Kgl. sachs Ges d. Wiss 1858 x 38. (from the cyclopedia of Ed. Monroe p. 654.)

It seemed to produce a tendency toward omitting to note many instances of the word to be marked. The development thru practice of the power to estimate by the eye the areas of certain rectangles improved considerably the power to estimate the areas of rectangles that were different either in size or shape or both. So too, the power to estimate heavier weights accurately was improved by practice with lighter weights but training in estimating the length of lines did not invariably result in a gain in power to estimate longer or shorter ones. The conclusion reached in these experiments were that most of the subjects showed some improvement when tested after the practice series. Thorndike's general conclusion is that while there is some transfer, it is not due to any mysterious transfer of practice, or to an unanalyzable property of mental functions but rather to a transfer of identical elements from the practice series to the final test series. He also says that this transfer on the whole does not seem to be great and its spread is limited largely to activities that closely resemble one another. Speed likely to be improved far

33. Thorndike, E. L., Psychol. Rev., "Influence of Improvement in one mental function upon the efficiency of other functions," 1901. Vol. VIII.

more than accuracy.[33]

Among the earlier experiments, the transfer of training from one specific set of reactions to another was investigated under the one direction of Scripture in the psychological laboratory at Yale University. The first series of experiments considered the increase of mascular steadiness thru the practice in inserting a needle in a very small hole, and the transfer of this increase to the corresponding muscles of the opposite half of the body. The left hand was tested first, and showed fifty per cent of correct trials. After practice with the right hand for ten days, the left hand showed seventy-six per cent of successes. Scripture says that these results are due primarily to a training of the attention rather than to any carrying over of skill in adjustment. Experiments on the steady increase of muscular power after practice showed a steady increase in the muscular power of the right hand due to practice and also an increase of the power of the right hand due to what might be called "indirect practice."[34]

Later, Judd carried on a series of experiments on

33. Thorndike, E. L. Psychol. Rev. "Influence of Improvement in one mental function upon the efficiency of other functions." 1901. Vol. VIII.
34. Yale studies, Vol. 2, By Scripture, E. W. Smith T. S. & Brown, E. E. p. 114.
Yale studies, Vol. 2, 6, & 7 & Monograph Supplement to the Psych. Review, On the Education of Muscular Control and Power," studies from the Yale Psych.Lab.

the effect of practice without knowledge of results. He had his subject judge the length of certain lines; the right hand and arm were entirely hidden by a large screen, so that the person could not see what his hand did. Nine different lines in succession were shown to the person, on the left side of the screen. When he saw the lines he had to place a pencil held in the unseen right hand in the direction indicated by several lines seen before him. The result was that he placed his pencil more accurately than at first, and errors were lessened considerably. There was clear evidence of a transfer effect. Judd by another interesting class experiment of aiming darts at a target under water, was also able to show a considerable spread of training.[35.] Another important series of experiments on transfer was conducted by Coover and Angell on the general practice effects of special exercises. In one experiment, the training series consisted in the discrimination of sound intensities; the test series consisted of discriminating shades of gray. The results showed a clear transfer of practice effect.

35. Judd, C. Psychological Review IX pp. 27-39.(1902).

In a second test given about the same time, in which the training series consisted in sorting cards and the test series in typewriter reactions, transfer effects were shown, although in a lesser degree than the first test.[36.]

In 1908, Fracker carried on a series of experiments on the transference of training in memory in the psychological laboratory of the State University of Iowa. The practice tests consisted in memorizing the order of four tones. The end tests were eight in number which were as follows: first, memory for poetry; the second test included memory for the order of four shades of gray; third, the memory for the order of nine tones; fourth, the memory for the order of nine shades of gray; fifth, the memory for the order of four tones; sixth, memory for the order of nine geometrical figures; seventh, memory for the order of nine numbers; and eighth, memory for the extent of arm movement. The conclusions reached from this experiment showed that there were clear indications of transfer found, generally more evident where the end test and the practice tests were

36. Coover, J. E. and F. Angell. "Practice effects of Special Exercises." Vol. 18, pp. 328-340. Am. Jour. of Psychology, 1907.

similar; it was noted, however, in some cases that there was very little improvement where a great similarity between the practice and end tests were used. In fact, it seemed to have a negative effect. During his experiments, Fracker recorded the introspections of the observers, and the records show that "mental imagery and properly controlled attention have much to do with this transfer." Fracker reaches the conclusion that a general development of some psychical factor has taken place. A critical examination of the experiment reveals one very important weakness. The very inadequate number of observers gave rise to a series of irregularities in the results: For example - in one test omitting No. 5, whose jump is from 45 to 80% he arrived at respective improvements of 9% and 8% instead of 13% and 8%. Fracker's results are as good as could be expected. In his investigations, however, there is no evidence for the view that there occurred a general development of some psychical factor; it furnishes us with some corroboration of the opposed view that the training had been of a specific kind, most effective where the test matter

resembled it most closely, and ineffective where this resemblance ceased."[37]

Winch also made an investigation of some importance upon memory work. His end test consisted of the learning of selections from a historical reader. The practice tests consisted of the committing of poetry after being tested in their power to memorize. The class consisting of more than one hundred British school children, were divided into two sections of equal ability. One was given practice in committing to memory one hundred lines of poetry; a second test showed that as a result of its practice, the one section showed ten per cent more gain in power than the other section. Conclusions reached by Winch are "that improvement gained by practice, in memorizing one subject of instruction, is transferred to the memory work in other subjects whose nature is certainly diverse from that in which the improvement was gained. He also came to the conclusion that rote memory can be improved."[38] Bergstrom reported in the American Journal of Psychology an experiment in sorting cards which has some interesting results. After

37. Psychological Review-Monographs-1908. Vol. IX No. 38, "University of Iowa, Studies in Psychology No.2 on the Transference of Training in Memory." pp.89-93, Fracker, pp. 56-102. (1907)
38. Winch, W. H. Brit. Jour. of Psychology. "The Transfer of Improvement in Memory of School Children." Vol.II. pp.384-293. 1910 III p. 386.

speed in sorting was gained by practice, the experimenter tried interchanging the position of the piles of the various kinds of cards. Results showed "slower sorting than in the original trial. Continued practice in interchanging the positions, however, resulted in the shifting being quicker from one to the other piles." [39.] Quite similar results were also found by Münsterberg in one of his experiments. He placed two inkwells on his desk, one full, and one empty. Having accustomed himself to the full inkwell in one position, he changed the position of the two inkwells; the result was that his pen was for time continually thrust into the empty well. Münsterberg, in this and similar experiments found "that practice in shifting improved the power to change from one habit to the other." [40.]

Although a number of experiments on memory have been given, there are still several others that are valuable in regard to transfer effects. Professor James found that practice in committing to memory verses of Paradise Lost, did not improve his power to memorize other verses. In his own case; there was a

39. Amer. Jour. of Psychology-Vol.I. Mr. Bergstrom-from Monroe Cyclopedia of Education. p. 644.
40. Gedachtnesstudien Teil L. Betrage Heft 4. 1894. "The Relation of the Interference to the Practice Effect of an Association."

slight loss due possibly to fatigue.[41] With other experimenters, there was no significant gain or loss. Ebert and Neumann practiced committing to memory nonsense syllables, noting the method of learning them that seemed the most economical. They tested the effects upon the power to learn series of other nonsense syllables, words and lines of poetry or prose. "The improvement was proportional to the similarity of the test material with the practice material."[42]

Bair made an interesting experiment on the influence of practice in forming certain associative habits upon the ability in certain different habits. His experiment consisted of six keys of a typewriter labelled with six symbols. Fifty-five letters were shown one by one and the person on seeing a letter, tapped the corresponding key. The time taken to tap out the corresponding key was recorded. Six different symbols were then used with a new series composed of them, and the subject's time record was taken as before. This was continued until twenty different sets of symbols had been used. The results showed steady improvement although

41. James-Psychol. Review--vol. 1 page 667.
42. E. Ebert and E. Neumann-Archiu fur die Gesamte Psychologie-Vol. 4. B IV No. 1904. IV 1-233.

the symbols had been changed each time as for example 62-52; 95 to 85; 65 to 56. The gain was not due to getting used to the machine or the general features of the experiment, for the fourth subject was already used to these and still gained nine-tenths as much as the other three. A second test given by Bair consisted of a daily record for twenty days, by means of a stop watch, of the time required to repeat the alphabet from memory. The experiment was as follows: (1) alphabet repeated between the letters; (2) letter n intercepted between the letters; (3) alphabet backward as fast as possible; (4) n intercepted between the letters backward. At the end of twenty days, the alphabet was repeated three times forward with x between, then r, backward with x and r. Results showed "that improvement in the end tests after twenty day's training with the practice tests put the abilities in the end tests as far ahead as three days of the direct training would have done."[43.]

Experiments were made by Whipple to determine the effect of practice upon the range of visual attention and of visual apprehension. Two sets of experiments

43. Bair, Monograph supplement, No. 19, Psycholog. Review, pp. 25-28; 64-67.

were made. In the first set of experiments, five, six, and seven place series of isolated letters were exposed, for 0.08 seconds with a tachistoscope. The observers were six college students. The second set of experiments consisted of groups of dots, pictures, drawings nonsense syllables and stanzas of poetry which were exposed for three seconds with the tachistoscope; collocations of ten objects were exposed without instrumental aid for six seconds. Three people observed the experiments. The author concludes that the effect of the practice was specific in both sets of experiments.[44.]

At the University of Illinois, investigations were made by H. L. Rietz and Miss Shade to prove that training in one subject might very well be made effective in the other. The investigations concerned the facts of correlation between the efficiency of students in mathematics on the one hand, and the efficiency of students in foreign languages and the natural sciences on the other. Results of these investigations are in brief "That a high correlation exists between efficiency in Mathematics and natural sciences and also between ef-

44. Whipple "Effect of Practice upon the Range of Visual Attention and Visual Apprehension" - Journal of Ed. Psychology, Vol. I, pp. 249-262.

ficiency in Mathematics and foreign languages. Results also show that studies as far apart as Mathematics and a foreign language evidently have many points in common so that training in one subject might very well be made more effective in the other subjects." [45]

In the last few pages of this article, I have cited experiments which have both proven that training can and cannot be transferred. Of course, in the present day, the extreme doctrine of transfer, based upon "faculty" psychology, that training in one direction can be transferred equally well in all, is held as untenable. Nevertheless, as a result of discussions and investigations as to the possibility of certain mental functions on others, the fact of transfer can hardly be doubted. It has, in fact, been proven that there is no one study that can train the mind equally well in all directions. However, it is just as absurd to deny that there is no influence between various mental activities. Thus it is that "the factors involved in transfer, the extent to which transfer can take place under any given series of conditions, and the best methods of securing

45. Rietz, H. S. and Shade, I. "Correlation of Efficiency in Math. and efficiency in other Subjects", Univ. of Ill. Studies Vol. VI-No.10 (1908).

such transfer, will long remain questions for investigations and discussion."

Therefore, my problem is a renewed attempt to throw more light upon the theory of transference of mental training by means of experimental test work. There have been short comings in previous work on the subject which I have tried to benefit by in my experiment. For example Professor Neumann tried to prove that there is a general memory function which can be perfected upon any material involving the use of memory. At the conclusion of his experiment, a considerable and general improvement appeared in the results of the second and the third. He answered his question that there are, no doubt, related memory functions which can be perfected upon any material involving the use of memory. Objections have been raised as to his general mode of procedure; first, the number of observers employed in the experiment very limited, only six in number; second, he attributes the entire cause of the improvement in the tests to the practice in nonsense syllables thus making no allowance for the direct training to be derived from the tests

46. Colvin, "The Learning Process," Chap. XVI, p. 241.

themselves; third, he gives no guarantee that these second and third sets of experiments were of the same difficulty as the first; fourth, there was no basis for comparing the results of the three tests, much irregularity is shown in the conduct of the tests. For instance, B's results are omitted in test 1 because he learned four verses; in text 2, he was re-admitted.. In Winch's tests given to a group of British school children, there have also been found objections. His method of calculation tends to obscure the facts. For comparing the results before and after practice, he takes the average of all the three test results before practice, and compares that average with the one result after practice. The average results of the three tests would not be nearly so high as the one result obtained from the last of these three. The comparison of chief interest to the reader is that between the last of the three tests before practice and the one after practice. The failure to give this obscures the values of the percentages he gives. Other short comings as to methods of procedure, the material used, and many other factors

47. Sleight, W. G. British Journal of Psychology 1911, Vol. IV. "Memory and Formal Training." pp. 386-457.

have been found in the data of work on this subject. I hoped to overcome some of these factors in my experiment. I aimed to keep the two groups tested, uniform as far as possible; I had children of the average age and same grade, but in two different schools. I gave the same tests to both groups (except the series of practice tests.) As I could not give the tests at the same tine, I gave the tests to the one group from February second to the twenty-fifth; in the other group from March second to the twenty-fifth. I began the tests with twenty-four in each group, but several dropped out leaving only twenty-two clear records in each. Under no circumstances, did I allow a child who had dropped out of the tests to be readmitted. I admit that more satisfactory results would have been obtained had I tested a larger group, but on account of lack of material I could not test forty in each group as I had planned. The time given by Dr. Spaulding, Superintendant of Schools for making the experiment was rather too limited for accurate results in all cases, but I tried to make the best of it.

## Part II.

For the purpose of making a further experimental study of the problem of "Transfer of Training," a series of tests were given to two groups of children in the Motley and Marcy schools of Minneapolis, respectively. To the first group mentioned, four tests were given twice before and twice after a three week's training in one specific practice test. Four tests were also given to the other group on two consecutive days; after a period of three weeks without any practice work, the tests were repeated. The improvement or lack of improvement over the first tests by the second gives a measure of the effect of the practice series given to group I. Twenty-four children were tested in each group: on account of sickness, several children dropped out of school during the testing period. Hence, the results of twenty-two children in each group are given in the following charts.

The test work of group I began at 1:15 P. M. on

February second. Firstly, general directions were given, and the four "end" tests consisting of two sorting tests of sticks and pegs, and two cancelation tests of letters and geometrical figures, were described. The stick test was given first. Six boxes, one large, and five small ones, were placed upon each child's desk. The large box contained two hundred sticks of five different lengths, forty of each kind, one, two, three, four, and five inches long respectively, and one eighth of an inch thick. The five small boxes corresponded to the length of the sticks; each stick was to be sorted into its corresponding box. Only one stick at a time was to be sorted. In order that the children might fully understand what they were to do, I sorted the sticks into the boxes for several minutes to show them. After further instructions were given, the test began. Two minute's time for practice in sorting was allowed. Then the test was given again for four minutes. When the test was finished, the boxes, together with the names of the children, were placed upon a table to be counted. The letter cancellation test was next given. Each child

was given a sheet of paper, upon which was printed twenty rows of letters of the alphabet, with fifty six letters in each row. "K's" and "F's" were to be cancelled. The sheets were turned over on each desk before the test began, so directions were given to hold the pencil in the right hand and to turn the sheet over with the left. To show the children how to cancel, the letters K and F were written upon the blackboard. Just one line was drawn through each letter. The letters were erased from the board before starting the test. Three minutes' time was given for the test, and then the papers were collected. A sorting test of one hundred and twenty pegs, twenty-four of each of the following five colors, red, blue, yellow, orange, and green, followed the cancellation test. Five small boxes of uniform size were placed upon each desk. Into these, the pegs were to be sorted, one box for each color. Instructions were given to sort only one peg at the time, but as fast as possible. The given time for the test was three minutes. After two minutes of practice work, the test was repeated. The geometrical

figure test, given last, was very much like the letter cancellation test. A sheet of paper of four hundred geometrical figures of five different kinds, stars, crosses, squares, circles, and triangles, were placed face down upon each desk. The squares and crosses were to be cancelled. Before starting I put the five geometrical figures upon the blackboard, and cancelled the square and the cross. The same directions as in the letter cancellation test were given. After erasing the figures from the blackboard, the test began. Two minutes were allowed. Time for all the tests was recorded by means of a stop watch. As to the grading, the number sorted and cancelled correctly in each test was recorded; mistakes made did not count except as a waste of time in each case.

The same tests were given on the following day. Instructions were repeated as on the day before. The following chart tabulates the individual results in each of the four tests given on the second and third of February.

The first column gives the name of each child in

the group. The other columns of figures are classified as follows:-

(1) Column II - the number of sticks sorted correctly by each individual on February second. The average number sorted by the group was 88; the mean variation of the group was 23.

(2) Column III - represents the number of sticks sorted correctly by each child on February third. The average number of sorted by the group was 115; the mean variation of the group was 23.

(3) Column IV - represents the average of column II and III. The average of the group in column IV was 102 and the mean variation was 23.

(4) Column V - represents the number of pegs sorted correctly by each individual of the group on February second. The average of the group in this column was 73; the mean variation was 15.

(5) Column VI - represents the number of pegs sorted correctly by each individual of the group on February third. The average of the whole group was 90; the mean variation was 16.

(6) Column VII - represents the average of column V and VI. The average of the group in this column was 82 and the mean variation was 16.

(7) Column VIII - represents the number of "K's" and "F's" cancelled by each individual of the group on February second. The average of the group was 51, and the mean variation was 11.

(8) Column IX - represents the number of "K's" and "F's" cancelled by each individual of the group on February third. The average number of "K's" and "F's" cancelled by the group was 78 and the mean variation was 15.

(9) Column X - represents the average of column VIII and IX. The average of the group was 65 and the mean variation was 13.

(10) Column XI - represents the number of geometrical figures cancelled by each individual of the group on February second. The average of the group was 52 and the mean variation was 7.

(11) Column XII - represents the number of geometrical figures cancelled by each individual of the

group on February third. The average of the group was 78, and the mean variation was 15.

(12) Column XIII - represents the average of column XI and XII. The average of the group in this column was 65 and the mean variation was 11.

CHART I.

Results of the Tests - February 2d and February 3d, 1915.

Motley School

Group I.

| I. | Stick Test II. | | III. | IV. | Peg Test V. | | VI. | VII. |
|---|---|---|---|---|---|---|---|---|
| | Feb 2 | | Feb 3 | Av. | Feb 2 | | Feb 3 | Av. |
| Ruth Adams | 62 | | 116 | 89 | 66 | | 88 | 77 |
| John Cullen | 133 | | 137 | 135 | 48 | | 64 | 56 |
| Katherine Dunn | 113 | | 137 | 125 | 92 | | 93 | 93 |
| Ethel Gunderson | 94 | | 99 | 97 | 74 | | 104 | 89 |
| Frances Hickey | 35 | | 60 | 48 | 53 | | 59 | 56 |
| Janet Hildebrant | 105 | | 111 | 108 | 74 | | 79 | 77 |
| Lowell Jones | 84 | | 96 | 90 | 51 | | 58 | 55 |
| Irene Kielman | 173 | | 180 | 176 | 117 | | 118 | 118 |
| Fannie Kabulnikoff | 131 | | 177 | 154 | 93 | | 120 | 107 |
| Lilian Lind | 89 | | 96 | 83 | 54 | | 69 | 62 |
| Frederick Moore | 94 | | 122 | 108 | 83 | | 82 | 83 |
| Bernice McKay | 39 | | 88 | 64 | 57 | | 74 | 66 |
| Millicent Mason | 84 | | 77 | 81 | 62 | | 72 | 67 |
| Margaret Mork | 78 | | 81 | 80 | 77 | | 110 | 94 |
| Ethelyn Quigley | 79 | | 119 | 99 | 65 | | 106 | 76 |
| Florence Schilling | 83 | | 117 | 100 | 49 | | 77 | 63 |
| Virginia Stevens | 66 | | 125 | 98 | 99 | | 92 | 96 |
| Lewellyn Vanfleet | 55 | | 124 | 90 | 73 | | 93 | 83 |
| Carl Schramek | 92 | | 148 | 120 | 111 | | 113 | 112 |
| Mary Bowen | 78 | | 98 | 88 | 65 | | 88 | 77 |
| Arthur Peck | 99 | | 105 | 102 | 70 | | 104 | 87 |
| Bernice Lycher | 119 | | 128 | 124 | 66 | | 118 | 92 |
| Average | 88 | | 115 | 102 | 73 | | 90 | 82 |
| Mean variation | 23 | | 22 | 23 | 15 | | 16 | 16 |

CHART I. (Continued)

Results of the Tests - February 2d and February 3d, 1915.

Motley School

Group I.

| | Letter VIII. | Canc. IX. | Test X. | Geom. XI. | Canc. XII. | Test XIII. |
|---|---|---|---|---|---|---|
| | Feb 2 | Feb 3 | Av. | Feb 2 | Feb 3 | Av. |
| Ruth Adams | 54 | 71 | 63 | 54 | 111 | 83 |
| John Cullen | 30 | 76 | 53 | 57 | 59 | 58 |
| Katherine Dunn | 50 | 119 | 85 | 58 | 65 | 62 |
| Ethel Gunderson | 48 | 107 | 78 | 42 | 83 | 63 |
| Frances Hickey | 58 | 84 | 71 | 51 | 73 | 62 |
| Janet Hildebrant | 67 | 92 | 80 | 64 | 79 | 72 |
| Lowell Jones | 49 | 77 | 63 | 50 | 76 | 63 |
| Irene Kielman | 59 | 120 | 90 | 67 | 113 | 90 |
| Fannie Kabulnikoff | 59 | 94 | 77 | 49 | 85 | 67 |
| Lilian Lind | 34 | 61 | 48 | 34 | 62 | 48 |
| Frederick Moore | 67 | 114 | 91 | 52 | 115 | 84 |
| Bernice McKay | 49 | 80 | 65 | 55 | 73 | 64 |
| Millicent Mason | 40 | 69 | 55 | 42 | 67 | 55 |
| Margaret Mork | 70 | 116 | 93 | 63 | 103 | 83 |
| Ethelyn Quigley | 46 | 60 | 53 | 50 | 82 | 61 |
| Florence Schilling | 30 | 49 | 40 | 36 | 46 | 41 |
| Virginia Stevens | 40 | 76 | 58 | 48 | 63 | 56 |
| Lewellyn Vanfleet | 43 | 80 | 62 | 70 | 72 | 71 |
| Carl Schramek | 45 | 70 | 58 | 46 | 48 | 47 |
| Mary Bowen | 70 | 83 | 77 | 57 | 87 | 72 |
| Arthur Peck | 55 | 67 | 61 | 46 | 66 | 56 |
| Bernice Lycher | 69 | 91 | 80 | 52 | 78 | 65 |
| Average | 51 | 78 | 65 | 52 | 78 | 65 |
| Mean variation | 11 | 15 | 13 | 7 | 15 | 11 |

From the fourth to the twenty-third of February, a series of practice tests of twelve consecutive days was given to group I. The writer gave general instructions as to the sorting tests previously described. Six boxes, one large and five small, were placed upon each desk. The large box contained two hundred words. The same five geometrical figures as were used in the figure cancellation test were pasted upon the wads, forty of each kind. The small boxes of uniform size were each labelled with geometrical figures and numbered as follows: star 1; circle 2; square 3; cross 4; triangle 5. The wads were to be sorted into their corresponding boxes, forty in each. A change in the order of boxes was made every two days. Four minutes of practice work was given. Then the test was repeated for four minutes.

Different tests were finished before the given time. Ending the work as soon as any member of the group finished, the time was consequently shortened in the particular test. To correct the loss of time, I equalized it with the regular time given for the test. For example, if the practice test was finished in three minutes, one

minute's time was taken from the test. To equalize the time, I changed the three and four minutes to seconds; then divided the two hundred and forty seconds by the one hundred eighty seconds. When this was done, the average of each child in the test, was multiplied by the result obtained.

Chart II tabulates the results of the practice tests of Group I. Each of the twelve columns represents the number of wads sorted correctly by each individual of group I. Column XIV gives the average per-cent of improvement between the results of the first days' practice and the last. The average of each days' testing (89, 119, 112, 130, 142, 160, 178, 189, 194, 195, 200 and 197 wads respectively) and the mean variations are tabulated at the bottom of the chart. The averages indicate that the group improved daily except on the third day. The drop in this average was partly due to an overheated condition of the school room. The third day also happened to be Monday and the group as a rule, did slower work at the beginning of the week. This will be shown later. The first change in the order of boxes was

also made. All these factors may have caused a drop in the third days' results. The mean variations for each days' testing was 13, 21, 18, 21, 24, 26, 31, 28, 27, 27, 24, and 22 respectively. The variations increased daily until the maximum of variability was reached by the group on the seventh day. Then the variations gradually decreased. The fact that the variability increased to a certain point and then decreased, proves that some of the children improved more rapidly than others and by the seventh day were able to sort more than two hundred wads in four minutes. For example,

| Group I. | No. sorted 1st day | 7th day |
|---|---|---|
| Irene Kielman | 109 | 218 |
| Fannie Kabulnikoff | 130 | 219 |
| Margaret Mork | 109 | 217 |
| Bernice Kejcher | 103 | 219 |

The averages above show that four children in group I. averaged from 217-219 wads in four minutes on the seventh day.

The averages now to be given, show the marked improvement of three children whose work was below the av-

erage on the first days testing, but on the seventh was over two hundred in two cases.

| Group I. | No. sorted 1st day | 7th day |
|---|---|---|
| Ruth Adams | 68 | 192 |
| Ethelyn Quigley | 62 | 208 |
| Virginia Stevens | 77 | 206 |

The averages now to be given show that children were improving but the number of wads sorted in each case was considerably lower than some of the others of the group.

| Group I. | Av. on 1st day | Av. on 7th day |
|---|---|---|
| John Cullen | 50 | 131 |
| Frances Hickey | 48 | 104 |
| Bernice McKay | 43 | 124 |

Thus, the variability of the group was naturally highest after a week's drill. Some of the children were able to adapt themselves quicker to the test than others, and were able to work faster. Others were improving daily but their rate of improvement was much slower than those who had almost reached their physiological limit at the end of a weeks' drill. The mean variations decreased because some children had reached their limit,

while others were gradually reaching theirs.

CHART II.

Geometrical Wad Test Feb. 4 - 23, 1915

Group I.

| I. | II. | III. | IV. | V. | VI. | VII. | VIII. |
|---|---|---|---|---|---|---|---|
| | Feb4 | Feb5 | Feb8 | Feb9 | Feb10 | Feb11 | Feb15 |
| Adams, Ruth | 68 | 96 | 96 | 115 | 121 | 171 | 192 |
| Cullen, John | 50 | 89 | 93 | 90 | 80 | 113 | 121 |
| Dunn, Katherine | 93 | 119 | 109 | 120 | 147 | 169 | 161 |
| Gunderson, Ethel | 105 | 148 | 143 | 136 | 130 | 169 | 192 |
| Hickey, Frances | 48 | 66 | 54 | 57 | 68 | 91 | 104 |
| Hildebrant, Janet | 105 | 149 | 131 | 141 | 158 | 175 | 201 |
| Jones, Lowell | 87 | 113 | 89 | 114 | 113 | 132 | 141 |
| Kielman, Irene | 109 | 160 | 134 | 167 | | 199 | 218 |
| Kabulnikoff, Fannie | 130 | 175 | 166 | 200 | 190 | 198 | 219 |
| Lind, Lilian | 77 | 95 | 101 | 153 | 140 | 130 | 148 |
| Moore, Frederick | 73 | 120 | 113 | 123 | 135 | 160 | 172 |
| McKay, Bernice | 43 | 92 | 106 | 115 | 120 | 114 | 134 |
| Mason, Millicent | 87 | 123 | 97 | 96 | 146 | 146 | 160 |
| Mork, Margaret | 109 | 110 | 117 | 121 | 180 | 196 | 217 |
| Quigley, Ethelyn | 62 | 135 | 120 | 170 | 168 | 196 | 208 |
| Schilling, Florence | 94 | | 78 | 126 | 118 | 133 | 150 |
| Stevens, Virginia | 77 | 125 | 110 | 128 | 143 | 152 | 206 |
| Vanfleet, Lewellyn | 89 | 127 | 127 | 131 | 197 | 193 | 214 |
| Schramek, Carl | 80 | 111 | 133 | 155 | 157 | 158 | 169 |
| Bowen, Mary | | 106 | 129 | 137 | 175 | 175 | 208 |
| Peck, Arthur | | 137 | 99 | 142 | 152 | 158 | 173 |
| Lejcher, Bernice | 102 | 115 | 119 | 132 | 145 | 197 | 219 |
| Average | 89 | 119 | 112 | 130 | 142 | 160 | 178 |
| Mean variation | 13 | 21 | 18 | 21 | 24 | 26 | 31 |

CHART II. (Continued)

Geometrical Wad Test Feb. 4 - 23, 1915

Group I.

| | IX. Feb16 | X. Feb17 | XI. Feb18 | XII. Feb19 | XIII. Feb24 | XIV. Av Gain bet. I&XIII. |
|---|---|---|---|---|---|---|
| Adams, Ruth | 195 | 201 | 204 | 204 | 204 | 200% |
| Cullen, John | 125 | 142 | 141 | 146 | 147 | 194 |
| Dunn, Katherine | 167 | 174 | 179 | 189 | 186 | 100 |
| Gunderson, Ethel | 201 | 199 | 204 | 201 | 196 | 87 |
| Hickey, Frances | 114 | 119 | 135 | 146 | 144 | 200 |
| Hildebrant, Janet | 197 | 187 | 187 | 199 | 201 | 83 |
| Jones, Lowell | 139 | 138 | 141 | 158 | 164 | 89 |
| Kielman, Irene | 224 | 226 | 226 | 231 | 226 | 107 |
| Kalbulnikoff, Fannie | 215 | 222 | 226 | 228 | 227 | 75 |
| Lind, Lilian | 159 | 163 | 164 | 172 | 168 | 118 |
| Moore, Frederick | 208 | 213 | 202 | 212 | 216 | 196 |
| McKay, Bernice | 142 | 152 | 148 | 159 | 152 | 354 |
| Mason, Millicent | 183 | 200 | 182 | 190 | 185 | 113 |
| Mork, Margaret | 223 | 223 | 227 | 228 | 223 | 105 |
| Quigley, Ethelyn | 215 | 217 | 215 | 222 | 213 | 343 |
| Schilling, Florence | 214 | 220 | 219 | 211 | 210 | 122 |
| Stevens, Virginia | 204 | 212 | 227 | 227 | 216 | 181 |
| Vanfleet, Lewellyn | 214 | 215 | 223 | 219 | 221 | 148 |
| Schramek, Carl | 182 | 177 | 189 | 193 | 186 | 132 |
| Bowen, Mary | 224 | 223 | 218 | 225 | 216 | 104 |
| Peck, Arthur | 196 | 220 | 217 | 219 | 219 | 60 |
| Lejcher, Bernice | 223 | 226 | 227 | 226 | 212 | 178 |
| Average | 189 | 194 | 195 | 200 | 197 | 121 |
| Mean variation | 28 | 27 | 27 | 24 | 22 | |

1945

On account of the unsatisfactory results of the third day's practice work of Group I, the same series of practice tests was given in the Horace Mann School from April sixth to the twenty-first. The results of this third Group, are found in Chart III. The averages in each column represent the number of wads sorted correctly by each individual. The tests were given for twelve days, and in the very same way as in Group II. The average of the whole group for each of the twelve days' practice was 86, 109, 125, 142, 155, 173, 191, 198, 203, 200, 195, and 194 wads respectively. These averages show that the group improved very rapidly in the first six tests; the other averages improved at a much slower rate of improvement until the maximum of 203 was reached. The averages of the last three days of testing were a little below the maximum, (200, 195 and 194 wads respectively.) The mean variation for each test which is given on the bottom row of the chart was 14, 14, 17, 16, 21, 23, 14, 15, 10, 14, 9, and 8. From these variations, the same conclusions as in the variations of the other practice group can be drawn.

The mean variation increased until it reached its maximum on the sixth day. Tabulating some of the individual results on the first and the sixth day, I found:

| Results | 1st day | 6th day |
|---|---|---|
| Ilene Engstrom | 130 | 179 |
| Winifred Fargo | 101 | 199 |
| Sadie Gjertsen | 102 | 196 |
| Harley Lundberg | 105 | 195 |
| Mabel Cochran | 79 | 192 |
| Irene McGarvey | 77 | 196 |
| Elvira Nelson | 78 | 191 |
| Stanley Nelson | 80 | 190 |
| Helen Robinson | 76 | 194 |
| Evelyn Walberg | 80 | 138 |
| Jerry Wunderly | 55 | 109 |
| Henry Waldeland | 49 | 133 |
| Donald Stuart | 43 | 157 |
| Gladys Jacobson | 34 | 131 |
| | Av.86 | Av. 173 |

CHART III.

Geometrical Wad Test - April 6 - 21, 1915

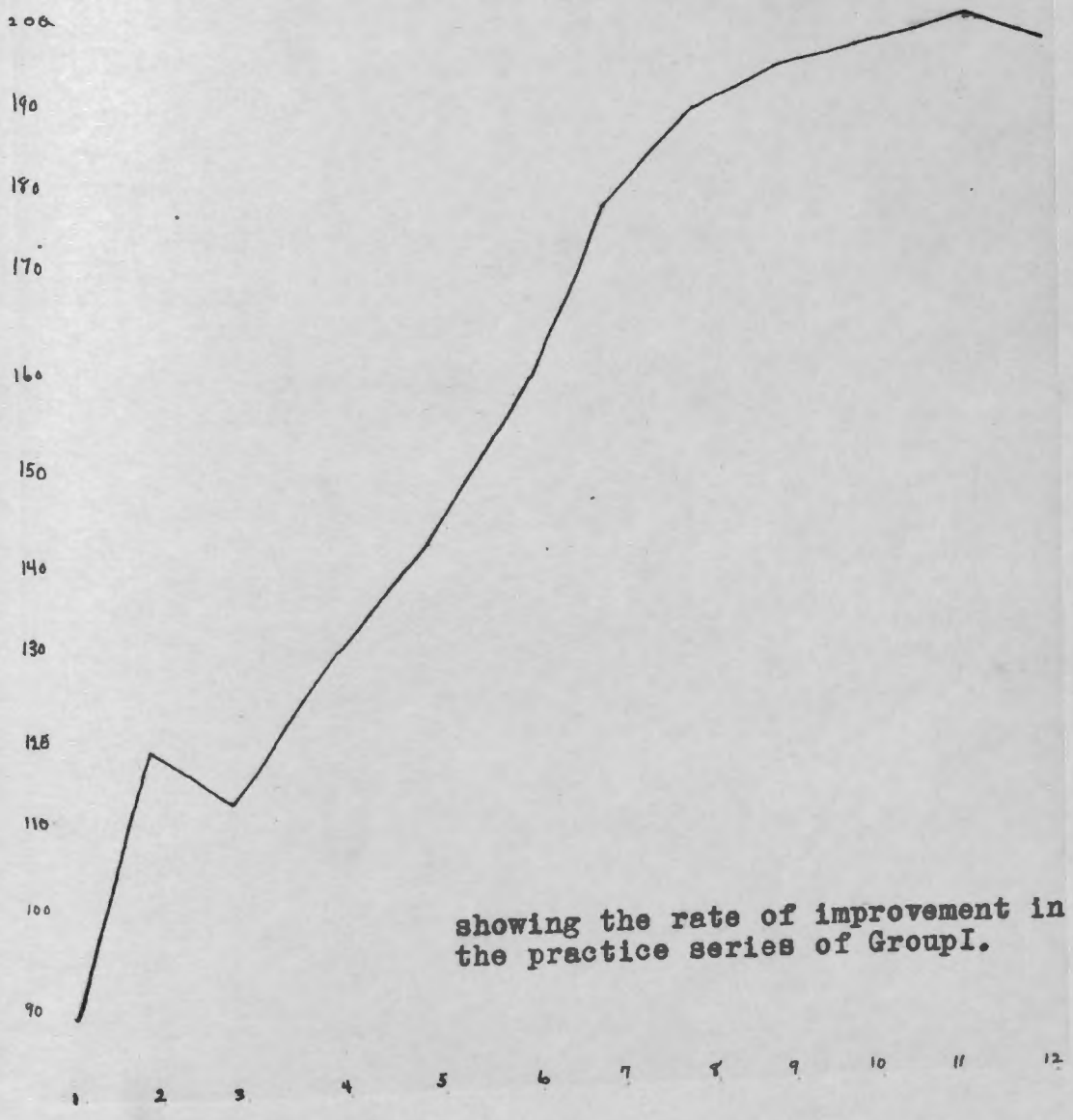
| Name | April - 6 | 7 | 8 | 9 | 12 | 13 |
|---|---|---|---|---|---|---|
| Brawthen, George | 98 | 105 | 138 | 139 | 151 | 192 |
| Bolmgren, Ruth | 98 | 101 | 128 | 145 | 157 | 200 |
| Cochran, Mable | 79 | 109 | 136 | 173 | 185 | 192 |
| Dyste, Evelyn | 97 | 111 | 115 | 158 | 175 | 191 |
| Engstrom, Ilene | 130 | 132 | 149 | 150 | 132 | 179 |
| Fargo, Winifred | 101 | 134 | 150 | 165 | 187 | 199 |
| Gjertsen, Sadie | 102 | 140 | 152 | 159 | 170 | 196 |
| Holt, Elsie | 81 | 139 | 150 | 160 | 171 | 170 |
| Jacobson, Gladys | 54 | 56 | 83 | 108 | 120 | 131 |
| Johnson, Dorothy | 70 | 99 | 117 | 140 | 152 | 171 |
| Lawson, Geneva | 77 | 113 | 119 | 126 | 138 | 158 |
| Lundberg, Harley | 105 | 115 | 118 | 139 | 157 | 195 |
| McGarvey, Grace | 77 | 113 | 130 | 143 | 153 | 196 |
| Nelson, Elvira | 78 | 107 | 140 | 168 | 190 | 191 |
| Nelson, Stanley | 80 | 105 | 109 | 119 | 131 | 190 |
| Robinson, Helen | 76 | 123 | 143 | 171 | 183 | 194 |
| Rogers, Marion | 84 | 126 | 140 | 153 | 185 | 172 |
| Stuart, Donald | 43 | 60 | 95 | 108 | 130 | 158 |
| Victorson, Willard | 76 | 112 | 111 | 128 | 140 | 161 |
| Waldelend, Henry | 49 | 89 | 91 | 122 | 134 | 133 |
| Wunderly, Jerry | 55 | 101 | 123 | 109 | 121 | 109 |
| Walberg, Evelyn | 80 | 113 | 114 | 134 | 146 | 138 |
| Average | 86 | 109 | 125 | 142 | 155 | 173 |
| Mean variation | 14 | 14 | 17 | 16 | 21 | 23 |

CHART III. (Continued)

Geometrical Wad Test, April 5 - 21, 1915

| Name | April-14 | 15 | 16 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|
| Brawthen, George | 191 | 196 | 196 | 198 | 196 | 200 |
| Bolmgren, Ruth | 199 | 203 | 201 | 198 | 204 | 197 |
| Cochran, Mable | 205 | 219 | 210 | 214 | 200 | 201 |
| Dyste, Evelyn | 197 | 205 | 207 | 213 | 201 | 198 |
| Engstrom, Ilene | 205 | 216 | 210 | 223 | 208 | 206 |
| Fargo, Winifred | 206 | 227 | 212 | 224 | 199 | 205 |
| Gjertsen, Sadie | 206 | 216 | 214 | 214 | 200 | 203 |
| Holt, Elsie | 173 | 180 | 213 | 193 | 197 | 191 |
| Jacobson, Gladys | 157 | 163 | 158 | 180 | 155 | 150 |
| Johnson, Dorothy | 196 | 199 | 197 | 204 | 196 | 190 |
| Lawson, Geneva | 192 | 196 | 204 | 198 | 196 | 190 |
| Lundberg, Harley | 193 | 196 | 191 | 195 | 192 | 194 |
| McGarvey, Gracè | 170 | 179 | 209 | 191 | 197 | 191 |
| Nelson, Elvira | 226 | 227 | 224 | 224 | 210 | 200 |
| Nelson, Stanley | 182 | 188 | 212 | 180 | 108 | 200 |
| Robinson, Helen | 212 | 218 | 217 | 222 | 216 | 201 |
| Rogers, Marion | 205 | 207 | 213 | 214 | 200 | 203 |
| Stuart, Donald | 172 | 180 | 186 | 176 | 189 | 180 |
| Victorson, Willard | 173 | 182 | 205 | 185 | 190 | 193 |
| Waldelend, Henry | 165 | 172 | 199 | 174 | 190 | 189 |
| Wunderly, Jerry | 177 | 183 | | 183 | 176 | 190 |
| Walberg, Evelyn | 187 | 195 | 185 | 191 | 180 | 186 |
| Average | 191 | 198 | 203 | 200 | 195 | 194 |
| Mean Variation | 14 | 15 | 10 | 14 | 9 | 8 |

GRAPH I.

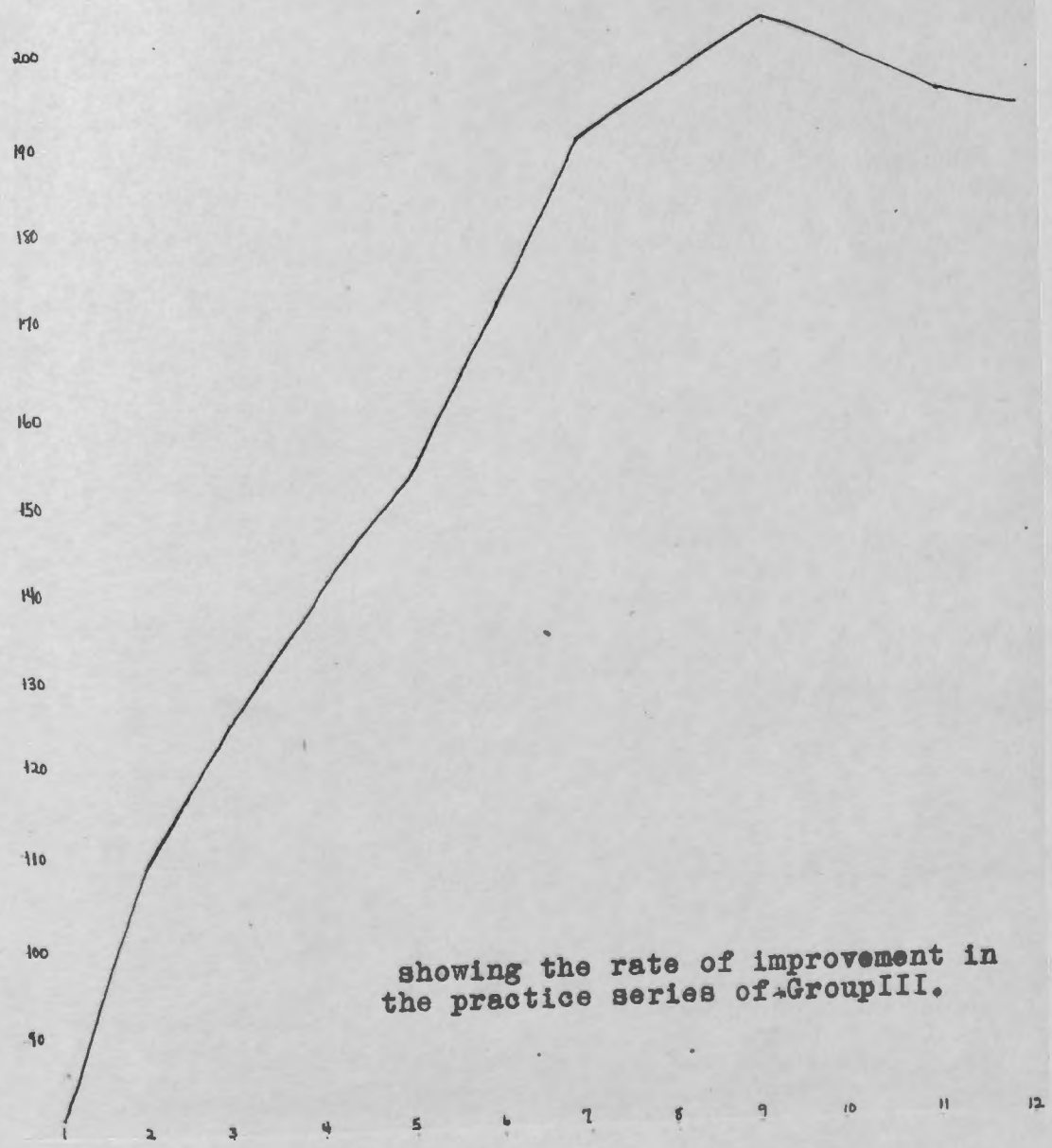



showing the rate of improvement in the practice series of GroupI.

Note:

90-200 (number of wads sorted)
I-I2 (number of days in the practice series)
89, II9, II2, I30, I42, I60, I78, I89, I94, I95, 200, I97-
(i2 points in the practice curve)

GRAPH II:




showing the rate of improvement in the practice series of Group III.

Note:

90-200 (number of wads sorted)
I-I2 (number of days in the practice series)
8I, I09, I25, I42, I55, I73, I9I, I98, 203, 200, 195, I94-(I2points in the practice curve)

Two curves representing the rate of improvement in the practice tests of groups I and III are shown in the two ~~following~~ graphs. In each graph, twelve points are plotted, each one representing the average of wads sorted on each of twelve days. The points in the first practice curve are 89, 119, 112, 130, 142, 160, 178, 189, 194, 195, 200 and 197 respectively. In group III, the points in the practice curve are 81, 109, 125, 142, 155, 173, 191, 198, 203, 200, 195 and 194 respectively. In graph I the first point is higher than the first point in graph II because the first group had had two days of practice preceding the first practice test which group III had not had. The first curve is not as smooth as might be wished. On the third day, there was a drop in the curve due to the overheated condition of the schoolroom. The maximum was apparently reached on the eleventh day in the first practice curve. Had the test work continued for several days longer, this could be made more certain. In the second practice curve, the group reached their maximum on the ninth day for the averages of the last three days showed a gradual de-

crease below the maximum. The average percentage of improvability between the second day's results and the first, between the third day's results and the second, and the like in each group were as follows:

| | | | | | | Group I | Group III |
|---|---|---|---|---|---|---|---|
| Improvement | of | 2d | day's | testing | over 1st | 33% | 34% |
| " | " | 3rd | " | " | " 2nd | -6 | 15 |
| " | " | 4th | " | " | " 3rd | 16 | 14 |
| " | " | 5th | " | " | " 4th | 9 | 9 |
| " | " | 6th | " | " | " 5th | 13 | 11 |
| " | " | 7th | " | " | " 6th | 10 | 10 |
| " | " | 8th | " | " | " 7th | 6 | 4 |
| " | " | 9th | " | " | " 8th | 3 | 4 |
| " | " | 10th | " | " | " 9th | 2 | -2 |
| " | " | 11th | " | " | " 10th | 2 | -3 |
| " | " | 12th | " | " | " 11th | -2 | -1 |

The chart above shows that the rate of improvement of each group decreased with practice; the most improvement was gained between the first two tests.

In order to see whether a recess from practice from Friday until Monday affected the average percent of improvement of each group, I figured out the following:

| Group I. | Average % Improvement | Group III. | Average % Improvement |
|---|---|---|---|
| From Thurs. to Fri. | 33 | From Tues. to Wed. | 34 |
| " Fri. to Mon. | -6 | " Wed. to Thurs. | 15 |
| " Mon. to Tues. | 16 | " Thurs. to Fri. | 14 |
| " Tues. to Wed. | 9 | " Fri. to Mon. | 9 |
| " Wed. to Thurs. | 13 | " Mon. to Tues. | 11 |
| " Thurs. to Mon. | 10 | " Tues. to Wed. | 10 |
| " Mon. to Tues. | 6 | " Wed. to Thurs. | 4 |
| " Tues. to Wed. | 3 | " Thurs. to Fri. | 4 |
| " Wed. to Thurs. | 2 | " Fri. to Mon. | -2 |
| " Thurs. to Fri. | 2 | " Mon. to Tues. | -3 |
| " Fri. to Tues. | -2 | " Tues. to Wed. | -1 |

In group 1, there was a loss of 6 percent on the first Monday's work. On the following Monday, the class improved a little less than on the Friday before. This, however, was natural as the improvability between the tests gradually decreased.

No test work was given on the following Monday but on Tuesday, there was a loss of two percent in comparison with Firday's average. In Group III, the average percent of improvement was 5 less than on the Friday before, the next two days showed a higher percent of improvement, hence the group was slightly affected by the recess from Friday to Monday. The following Monday's percent showed a loss of two percent. The following two days also show-

ed a loss of improvement but this was due in a large measure to the fact that the children were tired of the test. All in all, the children did not work as well on Mondays after a recess of several day's practice. The maximum of sorting in each group was reached on a Friday.

The "end" tests were given again for two consecutive days to Group I on the twenty-fourth and twenty-fifth of February. Instructions were given exactly as in the first set of tests. Great improvement in the sorting tests resulted, the cancellation tests also showed marked improvement. In fact, the effect of the practice tests was surprising. The following chart is similar to chart I; it gives the individual results for each test, the general individual average of the two days testing, the average of each days' testing and the mean variation. The average of the two stick tests was 173; of the peg tests 164; of the letter cancellation test 129, and the geometrical test 105. These averages will be referred to later.

CHART IV.

End Tests After Practice.

Group I.

| | I. Stick Feb24 | II. Stick Feb25 | III. Stick Av. | IV. Peg Feb24 | V. Peg Feb25 | VI. Peg Av. |
|---|---|---|---|---|---|---|
| Ruth Adams | 170 | 183 | 177 | 152 | 171 | 162 |
| John Cullen | 163 | 172 | 168 | 139 | 148 | 144 |
| Katherine Dunn | 174 | 179 | 177 | 171 | 176 | 174 |
| Ethel Gunderson | 176 | 183 | 180 | 159 | 170 | 165 |
| Frances Hickey | 145 | 156 | 151 | 140 | 147 | 144 |
| Janet Hildebrant | 181 | 185 | 183 | 167 | 173 | 170 |
| Lowell Jones | 160 | 162 | 161 | 130 | 140 | 135 |
| Irene Kielman | 194 | 198 | 196 | 176 | 179 | 178 |
| Fannie Kabulnikoff | 187 | 194 | 191 | 174 | 179 | 177 |
| Lilian Lind | 167 | 168 | 168 | 164 | 162 | 163 |
| Frederick Moore | 179 | 181 | 180 | 170 | 174 | 172 |
| Bernice McKay | 139 | 138 | 139 | 143 | 149 | 146 |
| Millicent Mason | 143 | 146 | 145 | 143 | 147 | 145 |
| Margaret Mork | 181 | 192 | 187 | 173 | 179 | 176 |
| Ethelyn Quigley | 166 | 177 | 172 | 164 | 171 | 168 |
| Florence Schilling | 167 | 176 | 172 | 164 | 171 | 168 |
| Virginia Stevens | 171 | 178 | 175 | 176 | 176 | 176 |
| Lewellyn Vanfleet | 154 | 186 | 170 | 165 | 170 | 168 |
| Carl Schramek | 164 | 169 | 167 | 167 | 173 | 170 |
| Mary Bowen | 184 | 188 | 186 | 173 | 177 | 175 |
| Arthur Peck | 178 | 179 | 179 | 164 | 176 | 170 |
| Bernice Lejcher | 167 | 183 | 175 | 171 | 179 | 175 |
| Average | 169 | 176 | 173 | 161 | 168 | 164 |
| Mean variation | 11 | 12 | 12 | 11 | 10 | 11 |

CHART IV. (Continued)

End Tests After Practice.

Group I.

| | VII. Letter Canc. | | VIII. | IX. | X. Geom. Fig. | | XI. | XII. |
|---|---|---|---|---|---|---|---|---|
| | Feb24 | Feb25 | Av. | | Feb24 | Feb25 | Av. | |
| Ruth Adams | 134 | 133 | 138 | | 116 | 130 | 123 | |
| John Cullen | 96 | 109 | 103 | | 73 | 86 | 75 | |
| Katherine Dunn | 140 | 142 | 141 | | 106 | 121 | 114 | |
| Ethel Gunderson | 131 | 134 | 138 | | 121 | 127 | 124 | |
| Frances Hickey | 115 | 128 | 122 | | 86 | 100 | 93 | |
| Janet Hildebrant | 117 | 141 | 129 | | 92 | 100 | 96 | |
| Lowell Jones | 98 | 106 | 102 | | 95 | 104 | 100 | |
| Irene Kielamn | 173 | 183 | 178 | | 136 | 167 | 152 | |
| Fannie Kabulnikoff | 139 | 150 | 145 | | 114 | 139 | 127 | |
| Lilian Lind | 98 | 119 | 109 | | 79 | 92 | 86 | |
| Frederick Moore | 126 | 130 | 128 | | 128 | 123 | 126 | |
| Bernice McKay | 126 | 127 | 127 | | 87 | 107 | 97 | |
| Millicent Mason | 115 | 116 | 116 | | 87 | 95 | 91 | |
| Margaret Mork | 220 | 216 | 218 | | 138 | 166 | 147 | |
| Ethelny Quigley | 107 | 120 | 114 | | 94 | 105 | 100 | |
| Florence Schilling | 100 | 111 | 106 | | 72 | 92 | 82 | |
| Virginia Stevens | 109 | 121 | 115 | | 89 | 102 | 96 | |
| Lewellyn Vanfleet | 126 | 131 | 129 | | 95 | 133 | 114 | |
| Carl Schramek | 89 | 109 | 99 | | 66 | 80 | 73 | |
| Mary Bowen | 159 | 163 | 161 | | 86 | 126 | 106 | |
| Arthur Peck | 95 | 111 | 103 | | 81 | 97 | 89 | |
| Bernice Leicher | 123 | 131 | 127 | | 84 | 103 | 94 | |
| Average | 124 | 134 | 129 | | 96 | 113 | 105 | |
| Mean variation | 21 | 19 | 20 | | 16 | 19 | 18 | |

The four end tests were given to group II on two consecutive days, March second and third. The same instructions were given. The following chart gives the results of the end tests given in the Motley school for each child. The general average of the group for each day's testing, the average of the two days of testing and the mean variation are included in the chart. The average of the two days testing of sorting sticks averaged 99; of the pegs 82; of the letter cancellation test, 70; and the geometrical figure test 65. These results will also be referred to later and discussed.

CHART V.

Results of End Tests.

Group II.

| | I. | II. Stick | III. | IV. | V. Peg. | VI. |
|---|---|---|---|---|---|---|
| | Mar2 | Mar3 | Av. | Mar2 | Mar3 | Av. |
| Hugh Aylmer | 41 | 76 | 59 | 57 | 70 | 64 |
| William Brown | 88 | 104 | 96 | 67 | 88 | 78 |
| Joseph Burke | 107 | 123 | 115 | 73 | 79 | 76 |
| Dorothy Crippen | 128 | 136 | 132 | 75 | 84 | 80 |
| Senta Estergard | 99 | 115 | 107 | 85 | 95 | 90 |
| Evelyn Esterley | 109 | 128 | 119 | 90 | 104 | 97 |
| Willard Farnum | 129 | 123 | 126 | 83 | 105 | 94 |
| Richard Furber | 98 | 112 | 105 | 110 | 113 | 111 |
| Howard Metz | 86 | 110 | 98 | 84 | 99 | 92 |
| Alfred Peppar | 120 | 122 | 121 | 75 | 76 | 76 |
| Paul Palthen | 44 | 83 | 64 | 80 | 81 | 81 |
| Harold Purdy | 104 | 114 | 109 | 81 | 89 | 85 |
| George Roth | 86 | 95 | 91 | 56 | 79 | 68 |
| John Simpson | 97 | 127 | 112 | 63 | 81 | 72 |
| Theodore Tinge | 74 | 83 | 79 | 77 | 99 | 88 |
| ClarenceReamer | 91 | 97 | 94 | 67 | 85 | 76 |
| Margaret Smith | 105 | 111 | 107 | 73 | 96 | 84 |
| Ferdinand Hohenstein | 115 | 123 | 119 | 130 | 132 | 131 |
| Maizie Carroll | 98 | 109 | 104 | 72 | 85 | 79 |
| Sanford Chilson | 59 | 103 | 81 | 66 | 95 | 81 |
| Carol Swanson | 70 | 77 | 74 | 73 | 92 | 83 |
| Hildegarde Zicke | 54 | 82 | 68 | 60 | 71 | 66 |
| Average | 91 | 107 | 99 | 77 | 90 | 82 |
| Mean variation | 20 | 15 | 18 | 11 | 10 | 11 |

CHART V. (Continued)

Results of End Tests.

Group II.

| | VII. | VIII. Letter Canc. | IX. | X. | XI. Geom. Fig. | XII. |
|---|---|---|---|---|---|---|
| | Mar2 | Mar3 | Av. | Mar2 | Mar3 | Av. |
| Hugh Aylmer | 58 | 72 | 65 | 50 | 62 | 56 |
| William Brown | 40 | 60 | 50 | 48 | 67 | 58 |
| Joseph Burke | 50 | 82 | 66 | 59 | 69 | 64 |
| Dorothy Crippen | 61 | 77 | 69 | 48 | 73 | 61 |
| Senta Estergard | 62 | 83 | 73 | 52 | 71 | 62 |
| Evelyn Esterley | 62 | 80 | 71 | 71 | 87 | 79 |
| Willard Farnum | 56 | 70 | 63 | 60 | 71 | 66 |
| Richard Furber | 51 | 80 | 66 | 64 | 79 | 72 |
| Howard Metz | 58 | 78 | 68 | 63 | 64 | 64 |
| Alfred Peppar | 78 | 94 | 86 | 63 | 79 | 71 |
| Paul Palthen | 80 | 86 | 83 | 70 | 84 | 77 |
| Harold Purdy | 45 | 56 | 51 | 43 | 56 | 50 |
| George Roth | 71 | 83 | 77 | 65 | 81 | 73 |
| John Simpson | 57 | 101 | 79 | 51 | 92 | 72 |
| Theodore Tinge | 66 | 75 | 71 | 50 | 79 | 65 |
| Clarence Reamer | 61 | 88 | 75 | 60 | 79 | 70 |
| Margaret Smith | 57 | 72 | 65 | 53 | 64 | 59 |
| Ferdinand Hohenstein | 62 | 90 | 76 | 62 | 74 | 68 |
| Maizie Carroll | 72 | 83 | 78 | 42 | 68 | 55 |
| Sanford Chilson | 51 | 82 | 67 | 62 | 83 | 76 |
| Carol Swanson | 49 | 68 | 59 | 50 | 60 | 55 |
| Hildegarde Zicke | 62 | 85 | 74 | 48 | 60 | 54 |
| Average | 60 | 80 | 70 | 56 | 73 | 65 |
| Mean variation | 8 | 8 | 8 | 8 | 8 | 8 |

Three weeks after the four "end" tests were given to group II.; they were repeated. Chart VI. gives the actual results of the tests given after the three weeks without practice. Just as in the other charts, the individual results in the two day's work, together with an average of these results are given for each of the "end" tests. The average of each day's results together with the mean variation are also at the bottom of the chart. The average number of sticks sorted by the group for the two days of test work were 107; average number of pegs 97; of letters cancelled 101; and the average of geometrical figures cancelled was 84. This chart will also be referred to for further discussion.

CHART VI. Group II.

End tests after 3 weeks intermission.

| | Stick Test. | | | Peg Test. | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Children | Mar.24 | Mar.25 | Av. | Mar24 | Mar25 | Av. |
| Hugh Aylmer | 68 | 100 | 84 | 101 | 106 | 104 |
| William Brown | 111 | 124 | 118 | 109 | 113 | 116 |
| Joseph Burke | 88 | 123 | 106 | 89 | 98 | 94 |
| Dorothy Crippen | 118 | 148 | 133 | 102 | 109 | 106 |
| Senta Estergard | 90 | 119 | 105 | 92 | 106 | 99 |
| Evelyn Esterley | 109 | 150 | 130 | 126 | 125 | 126 |
| Willard Farnum | 94 | 126 | 110 | 82 | 107 | 95 |
| Richard Furber | 92 | 128 | 60 | 105 | 120 | 113 |
| Howard Metz | 88 | 112 | 100 | 77 | 118 | 98 |
| Alfred Peppar | 122 | 145 | 134 | 98 | 120 | 109 |
| Paul Patthen | 83 | 93 | 88 | 89 | 112 | 101 |
| Harold Purdy | 98 | 116 | 107 | 86 | 95 | 91 |
| George Roth | 83 | 117 | 100 | 63 | 75 | 69 |
| John Simpson | 91 | 134 | 113 | 54 | 87 | 71 |
| Theodore Tinge | 93 | 108 | 102 | 97 | 114 | 106 |
| Clarence Roth | 88 | 110 | 99 | 77 | 108 | 93 |
| Margaret Smith | 96 | 117 | 107 | 89 | 115 | 102 |
| Jerdinand Hohenstem | 109 | 136 | 123 | 108 | 115 | 112 |
| Maizie Carroll | 90 | 123 | 112 | 83 | 100 | 92 |
| Snaford Chilson | 102 | 108 | 105 | 58 | 80 | 69 |
| Correl Swanson | 79 | 91 | 85 | 75 | 100 | 88 |
| Hildegarde Zicke | 81 | 90 | 86 | 70 | 87 | 79 |
| Average | 94 | 119 | 107 | 88 | 105 | 97 |
| Mean Variation | 10 | 13 | 12 | 14 | 10 | 12 |

CHART VI. Group II.
(Conoluded.)

End tests after 3 weeks intermission.

| | K & P Tests | | | Geom. | Canc. Test. | |
|---|---|---|---|---|---|---|
| | VII | VIII | IX | X | XI | XII |
| Children | Mar24 | Mar25 | Av | Mar.24 | Mar.25 | Av. |
| Hugh Aylmer | 97 | 110 | 104 | 80 | 90 | 86 |
| William Brown | 77 | 106 | 92 | 68 | 86 | 77 |
| Joseph Burke | 100 | 106 | 103 | 77 | 92 | 85 |
| Dorothy Crippen | 98 | 127 | 103 | 75 | 88 | 82 |
| Senta Estergard | 110 | 124 | 117 | 80 | 92 | 86 |
| Evelyn Esterley | 75 | 131 | 103 | 72 | 97 | 85 |
| Willard Farnum | 86 | 93 | 89 | 83 | 93 | 88 |
| Richard Furber | 93 | 120 | 107 | 94 | 104 | 99 |
| Howard Metz | 97 | 105 | 101 | 80 | 98 | 89 |
| Alfred Peppar | 70 | 94 | 82 | 76 | 75 | 76 |
| Paul Patthen | 123 | 127 | 125 | 87 | 101 | 94 |
| Harold Purdy | 95 | 97 | 96 | 66 | 88 | 78 |
| George Roth | 107 | 110 | 109 | 76 | 85 | 81 |
| John Simpson | 90 | 105 | 98 | 85 | 93 | 89 |
| Theodore Tinge | 93 | 115 | 104 | 76 | 87 | 82 |
| Clarence Roth | 66 | 97 | 82 | 71 | 95 | 83 |
| Margaret Smith | 91 | 109 | 100 | 70 | 91 | 81 |
| Ferdinand Hohenstem | 102 | 115 | 109 | 81 | 94 | 88 |
| Maizie Carroll | 91 | 103 | 97 | 73 | 84 | 79 |
| Sanford Clilson | 96 | 107 | 102 | 76 | 95 | 86 |
| Carrol Swanson | 103 | 107 | 105 | 70 | 78 | 74 |
| Hildegarde Ziche | 80 | 97 | 89 | 75 | 84 | 71 |
| Average | 93 | 109 | 101 | 76 | 91 | 84 |
| Mean Variation | 10 | 9 | 10 | 5 | 5 | 5 |

Summing up the data so far presented of Group I and II in the "end" tests, only the final averages of the first two and the last two days of testing will be given.

| Before Practice. | | | | After Practice. | | | |
|---|---|---|---|---|---|---|---|
| Stick | Peg | K & F | Geom. Figure | Stick | Peg | K & F | Geom. Figure |
| Group I | | | | Group I | | | |
| 102 | 82 | 65 | 65 | 173 | 164 | 129 | 105 |
| Group II | | | | Group II | | | |
| 99 | 82 | 70 | 65 | 106 | 97 | 101 | 84 |

To measure the improvability of Groups I and II between the first and the last set of end tests, the average difference of the two days results before and after the period of intermediate drill, as a percentage was made. For example, in Group I, the average of sticks sorted correctly on the two days before practice was 102. In the same test, after three weeks of practice, 173 sticks were sorted in the two end tests. Therefore, to measure the improvability, I took the difference tetween 173 and 102 which is 71; then I took the percent of $\frac{71}{102}$ which is 70%. Hence Group I improved 70% after three

weeks of practice. In the Peg tests, 82 pegs were sorted before practice. After practice, the average group as a whole sorted 164 pegs. Therefore, the improvement was 100 percent. In the letter cancellation tests the average number of letters cancelled was 65; after practice, the group averaged 139 letters. The average improvement of the group was 92 percent. In the geometrical figure test, the group averaged 65; after practice, 105 figures were cancelled. The average improvement was 62 percent. In group II, the average number of sticks sorted in the first two tests was 99, in the last two tests after the intermission of three weeks, 106 sticks were sorted. The average percent gain was 7. The average number of pegs sorted on the first two days was 82; on the last two days was 97 pegs. The average percent of gain was 18. In the geometrical figure test, the average number of figures cancelled on the first two days was 65; on the last two days, 84 figures were cancelled. The average percent gain was 30.

The results just given show that group I improved 56 percent more than group II. Putting the results into

diagram form, let the stick test be (1); peg test (2); K and F cancellation test by (3); Geometrical cancellation test be (4) and the practice test by (5).

DIAGRAM I

GROUP I

| (1) | (2) | (3) | (4) | Average % gain. |
|---|---|---|---|---|
| 70% | 100% | 92% | 62% | 81% |

GROUP II

| (1) | (2) | (3) | (4) | |
|---|---|---|---|---|
| $\frac{7\%}{63}$ | $\frac{18\%}{82}$ | $\frac{44\%}{48}$ | $\frac{30\%}{32}$ | $\frac{25\%}{56\%}$ |

DIAGRAM II

GROUP I

| 2 days | 12 days | 2 days | |
|---|---|---|---|
| (1) (2) (3) (4) | (51) | (1) (2) (3) (4) | 81% |

GROUP II

| | | |
|---|---|---|
| (1) (2) (3) (4) | (1) (2) (3) (4) | $\frac{25\%}{56\%}$ |

The first diagram gives the percent of improvement made by group I in each test after three week's practice. (Each average represents the day's averages in each test.) The average of these percents is also given. The percent of improvement made by group II in each test is given together with the average percent of all the tests. The average percent of improvability of Group I is 81. Group II improved 25 percent without practice. This improvement is due to the fact that group II had had two day's practice in the four tests before, and the method of procedure was not new to them. The differences of these two percents is 56, which is the percent of improvement in group I due to practice. In studying diagram I, I found that the cancellation tests averaged a much higher percent of improvability than the stick and peg tests without practice, 44 and 30 percent in comparison to 7 and 18 percent in the sorting tests. In the practiced group, the opposite was true. The sorting tests showed the highest percent of improvement, due to practice, 63 percent in the stick test, and

82 percent in the peg test. The cancellation tests showed a small percent of transfer effect, 48 percent in the letter cancellation, and 32 percent in the geometrical cancellation sheet. Therefore, I have concluded that the transfer effect which was very large in the sorting tests and small in the cancellation test, was due to a large extent, to the process of sorting in the practice test.

Diagram II is a repetition of what has already been given in Diagram I. In other words, it shows that group I improved 81% by having test(5); group II improved 25% without having test(5). The results of the first set of end tests in both groups averaged very nearly the same. Therefore if group I had not had (5) it would also have improved about 25%. Due to (5) group I improved 81%, the average improvement of all the tests; hence the difference of 81% and 25% which is 56, was entirely due to a transference effect of the practice tests.

The following charts gives the amount of improvement of each individual in group I in the end tests

before and after practice. In detail, column I represents the average number of sticks sorted on the two days before practice. Column II represents the average number of sticks sorted on the two consecutive days after the practice series. Column III represents the average percent of gain between column I and column II. Ten other columns are given which are labelled similar to columns I, II, and III.

CHART VII.

Group I.

| | Stick Test | | | Peg Test | | |
|---|---|---|---|---|---|---|
| | Before | After | Gain | Before | After | Gain |
| Ruth Adams | 89 | 177 | 99 | 77 | 162 | 110 |
| John Cullen | 125 | 168 | 34 | 48 | 64 | 25 |
| Katherine Dunn | 125 | 177 | 42 | 93 | 174 | 87 |
| Ethel Gunderson | 97 | 180 | 86 | 89 | 165 | 85 |
| Frances Hickey | 48 | 151 | 235 | 56 | 144 | 157 |
| Janet Hildelrant | 108 | 183 | 69 | 77 | 170 | 130 |
| Lowell Jones | 90 | 161 | 79 | 55 | 135 | 145 |
| Irene Kielman | 176 | 196 | 10 | 118 | 178 | 51 |
| Fannie Kabulnikoff | 154 | 191 | 24 | 107 | 177 | 64 |
| Lillian Lind | 83 | 168 | 102 | 62 | 163 | 163 |
| Frederick Moore | 108 | 180 | 67 | 83 | 172 | 107 |
| Bernice McKay | 64 | 139 | 117 | 66 | 146 | 121 |
| Millicent Mason | 81 | 145 | 79 | 67 | 145 | 116 |
| Margaret Mork | 80 | 187 | 134 | 94 | 176 | 87 |
| Ethelyn Quigley | 99 | 173 | 74 | 86 | 168 | 95 |
| Florence Schilling | 100 | 172 | 72 | 63 | 168 | 166 |
| Virginia Stevens | 96 | 175 | 82 | 96 | 176 | 83 |
| Lewellyn Vanfleet | 90 | 170 | 89 | 93 | 168 | 101 |
| Carl Schramek | 120 | 167 | 39 | 112 | 170 | 52 |
| Mary Bowen | 86 | 166 | 111 | 77 | 175 | 127 |
| Arthur Peck | 102 | 179 | 76 | 87 | 170 | 95 |
| Bernice Leicher | 134 | 175 | 41 | 93 | 175 | 90 |
| Average | 103 | 173 | 70 | 82 | 164 | 100 |

CHARTER VII (Concluded)

Am't of improvement with practice.

Group I

| | K & F Test VII | | | Geom. & Fig. Test XIII | | | |
|---|---|---|---|---|---|---|---|
| | VIII | IX | | X | XI | XII | |
| | Be- fore | Af- ter | Gain | Be- fore | Af- ter | Gain | Av. of % Gain |
| Ruth Adams | 63 | 128 | 103 | 83 | 123 | 48 | 90 |
| John Cullen | 53 | 103 | 94 | 58 | 75 | 29 | 46 |
| Ketherine Dunn | 85 | 141 | 66 | 62 | 114 | 84 | 70 |
| Ethel Gunderson | 78 | 128 | 64 | 63 | 124 | 96 | 85 |
| Frances Hickey | 71 | 122 | 72 | 62 | 93 | 50 | 70 |
| Janet Hildebrant | 80 | 129 | 61 | 72 | 96 | 33 | 73 |
| Lowell Jones | 63 | 102 | 62 | 63 | 100 | 55 | 85 |
| Irene Kielman | 90 | 178 | 98 | 90 | 152 | 69 | 57 |
| Jannie Kalbulnikoff | 77 | 145 | 88 | 67 | 127 | 90 | 62 |
| Lilian Lind | 48 | 109 | 127 | 48 | 86 | 79 | 118 |
| Frederick Moore | 91 | 128 | 41 | 84 | 136 | 50 | 66 |
| Bernice McKay | 65 | 127 | 95 | 64 | 97 | 52 | 96 |
| Millicent Mason | 55 | 116 | 111 | 55 | 91 | 65 | 93 |
| Margaret Mork | 93 | 218 | 134 | 83 | 147 | 77 | 108 |
| Ethelyn Quigley | 53 | 114 | 115 | 61 | 100 | 64 | 87 |
| Florence Schilling | 40 | 106 | 165 | 41 | 82 | 50 | 113 |
| Virginia Stevens | 58 | 115 | 98 | 56 | 96 | 71 | 84 |
| Lewellyn Navfleet | 62 | 129 | 108 | 71 | 114 | 61 | 90 |
| Carl Schramek | 58 | 99 | 70 | 47 | 73 | 55 | 52 |
| Mary Bowen | 77 | 161 | 118 | 72 | 106 | 33 | 122 |
| Arthur Peck | 61 | 103 | 69 | 56 | 89 | 59 | 75 |
| Bernice Lejoher | 80 | 137 | 50 | 65 | 94 | 44 | 56 |
| Average | 68 | 129 | 92 | 65 | 105 | 62 | 81 |

The percents of improvement of each individual between the first two and last two sets of end tests given to group II are tabulated on the following chart. Each column is labelled.

CHART VIII. Group II.

Percent of improvement without practice between "end" tests.

| I | Stick Test. II | III | IV | Peg Test. V | VI | VII |
|---|---|---|---|---|---|---|
| | 1st | last | Gain | 1st | last | Gain |
| Children | 2 days | 2 dys | Av. | 2 dys | Av. | Av. |
| Hugh Aylmer | 59 | 84 | 42 | 64 | 104 | 63 |
| William Brown | 96 | 118 | 23 | 78 | 116 | 48 |
| Joseph Burke | 115 | 106 | 8 | 76 | 94 | 24 |
| Dorothy Crippen | 132 | 133 | 1 | 80 | 106 | 33 |
| Senta Estergard | 107 | 105 | 8 | 90 | 99 | 10 |
| Evelyn Esterley | 119 | 130 | 9 | 97 | 126 | 30 |
| Willard Farnum | 126 | 110 | 14 | 94 | 85 | 1 |
| Richard Furker | 105 | 60 | 43 | 111 | 113 | 2 |
| Howard Metz | 98 | 100 | 2 | 92 | 98 | 7 |
| Alfred Peppar | 121 | 134 | 11 | 76 | 109 | 43 |
| Paul Palthen | 64 | 88 | 38 | 81 | 101 | 25 |
| Harold Purdy | 109 | 107 | 2 | 85 | 91 | 7 |
| George Roth | 91 | 100 | 10 | 68 | 60 | 1 |
| John Simpson | 112 | 113 | 1 | 72 | 71 | 1 |
| Theodore Tinge | 70 | 102 | 29 | 88 | 106 | 200 |
| Clarence Reamer | 94 | 99 | 5 | 76 | 93 | 22 |
| Margaret Smith | 107 | 107 | | 84 | 102 | 21 |
| Ferdinand Hohener | 119 | 123 | 3 | 121 | 112 | 7 |
| Maezie Carroll | 104 | 112 | 8 | 79 | 92 | 17 |
| Sanford Chilson | 81 | 105 | 30 | 81 | 69 | 15 |
| Hildegarde Zicke | 68 | 86 | 26 | 66 | 79 | 20 |
| Average | 99 | 106 | 7 | 82 | 97 | 18 |

CHART VIII. Group II.
(Continued.)

Percent of improvement without practice between the "end" tests.

| | Letter Canc. Test. | | | Geom. Canc. Test. | | | |
|---|---|---|---|---|---|---|---|
| | VIII | IX | X | XI | XII | XIII | XIV |
| | 1st 3 days | last 3 dys | Gain | 1st | last | Gain | Av.% |
| Children | Av. | Av. | Av. | Av. | Av. | Av. | Av. |
| Jugh Aylmer | 65 | 104 | 60 | 56 | 86 | 54 | 55 |
| William Brown | 50 | 92 | 84 | 58 | 77 | 33 | 47 |
| Joseph Burke | 66 | 103 | 56 | 64 | 85 | 33 | 26 |
| Dorothy Crippen | 69 | 103 | 50 | 61 | 82 | 35 | 29 |
| Senta Esleryard | 73 | 117 | 60 | 62 | 86 | 39 | 27 |
| Evelyn Esterley | 71 | 103 | 31 | 79 | 85 | 8 | 20 |
| Willard Farnum | 63 | 89 | 41 | 66 | 88 | 33 | 15 |
| Richard Furber | 66 | 107 | 62 | 72 | 99 | 38 | 24 |
| Howard Metz | 68 | 101 | 49 | 64 | 89 | 39 | 25 |
| Alfred Peppar | 86 | 82 | 5 | 71 | 76 | 7 | 14 |
| Paul Palthen | 83 | 125 | 51 | 77 | 94 | 22 | 34 |
| Harold Purdy | 51 | 96 | 88 | 50 | 78 | 56 | 37 |
| George Roth | 77 | 109 | 41 | 73 | 81 | 11 | 16 |
| John Simpson | 79 | 98 | 24 | 72 | 89 | 23 | 12 |
| Theodore Tinge | 71 | 104 | 46 | 65 | 82 | 26 | 31 |
| Clarence Reamer | 75 | 82 | 9 | 70 | 83 | 19 | 14 |
| Margaret Smith | 65 | 100 | 54 | 59 | 81 | 37 | 28 |
| Ferdinand Hohenear | 76 | 109 | 44 | 68 | 88 | 29 | 17 |
| Maezie Carroll | 78 | 97 | 24 | 55 | 79 | 43 | 23 |
| Sanford Chilson | 67 | 102 | 52 | 76 | 86 | 18 | 21 |
| Hildegarde Zicke | 74 | 89 | 23 | 54 | 71 | 32 | 25 |
| Average | 70 | 101 | 44 | 65 | 84 | 30 | 25 |

The data given has proven that an intermediate period of drill between a certain set of tests results in marked improvement in all the final averages of each test. Then the question arises as to how the results of the end tests correlate with the results of the practice tests. By using Pearson's formula, I figured the following correlation:-

Group I.

Correlation of averages between:

| | |
|---|---|
| First 2 Stick tests and first 3 practice tests | 0.64 |
| " " Peg " " " " " " | 0.55 |
| " " K and F " " " " " " | 0.40 |
| " " Geom. figure " " " " " " | 0.27 |

Group I.

Correlation of averages between:

| | |
|---|---|
| First 2 Stick tests and last 3 practice tests | 0.73 |
| " " Peg " " " " " " | 0.81 |
| " " K and F " " " " " " | 0.55 |
| " " Geom. figure " " " " " " | 0.52 |

The results above show that the correlations between the "end" tests and the last three practice tests are higher than the correlations between the "end" tests and the first three practice test. It is evident, then, that correlations between "tests" can be

raised thru transfer effects of practice. I figured out the correlations between each of the end tests given three weeks apart. The results are as follows:

Group I.

Correlation bet. av. before and after practice of:

| | |
|---|---|
| Stick Test | 0.80 |
| Peg Test | 0.79 |
| K and F " | 0.71 |
| Geom. figure | 0.87 |

Group II.

Correlation bet. av. before and after practice of:

| | |
|---|---|
| Stick Test | 0.67 |
| Peg Test | 0.62 |
| K and F " | 0.13 |
| Geom. figure | 0.39 |

The correlation between each of the end tests before and after practice of group 1 above are higher than the correlation between each of the end tests without practice. The high positive correlations between each of the end tests after practice furnishes evidence in favor of the possibility of transfer effects. The correlations between each of the end tests in group 1 are more alike than the correlations between the tests in group II. For example, in the

correlations between the cancellation tests in group II, the results are low (0.13 and 0.30). The correlations between the same tests in group I are high (0.71 and 0.87). This indicates that there were transfer effects from sorting to cancelling, due to practice. Thus, after practice, the correlation between each set of four "end" tests were raised.

Each group tested, included quick, medium, and slow workers. I roughly divided the group into these classes, judging from the results of the 1st three practice tests. Those sorting close to the average number of wads daily, I classed in the medium group; those sorting much less than the average number of wads I considered slow workers; those sorting far more than the average number of wads as quick workers. When the series of practice tests were completed, the question arose as to who showed the highest improvement, the children of quick, medium or slow ability. The majority of the slow group showed the highest average per cents of improvability between the first and the last set of prac-

tice tests. For example: the improvement of three of the slow workers in Group I.

| | |
|---|---|
| John Cullen | 194 % gain |
| Francis Hickey | 200% " |
| Bernice McKay | 254% " |

Two others who started the tests as slow workers but improved rapidly showed the following gain in improvability.

| | |
|---|---|
| Ruth Adams | 200% |
| Ethelyn Quigley | 243% |

The transference effects between the first and second set of end tests were not the highest of the group of the first three children mentioned.

| | | |
|---|---|---|
| John Allen | 21% | total transference effect due to practice. |
| Frances Hickey | 55% | |
| Bernice McKay | 71% | |

The transference effect on the whole, due to practice, was highest in the medium class of children. For example:

| | | | | |
|---|---|---|---|---|
| Lillian Lind | 118% | - 25% | 93% | total transference effect due to practice. |
| Florence Schilling | 113% | - 25% | 88% | |
| Mary Bowen | 122% | - 25% | 87% | |

Some of the fast workers in the first three tests showed the following improvement with practice.

| | | |
|---|---|---|
| Irene Kielman | 57% - 25% | = 32% |
| Fannie Kabulnikoff | 63% - 25% | = 37% |
| Bernice Lejcher | 56% - 25% | = 31% |

(25 percent is the amount of transfer effects gained by Group II without practice and must be subtracted from the gross improvement of Group I.)

The above figures show that the three quickest workers in the practice tests showed the least transference effects in the final tests.

Summing up what has just been discussed, the children of mediocre ability in the practice tests seemed to show the biggest transfer effects between the first and the last set of end tests. However, the evidence given by the data is not sufficient to conclude that either the slow, medium or quick children showed the largest transfer effects due to practice.

Due to individual differences, each group tested naturally showed considerable variability. Following is a chart giving the mean variation of each group in each test:

Group I.

| Before Practice. | | After Practice. | |
|---|---|---|---|
| Test | M. V. | Test | M. V. |
| (1) | 23. | (1) | 12 |
| (2) | 16 | (2) | 11 |
| (3) | 13 | (3) | 20 |
| (4) | 13 | (4) | 18 |

Group II.

| Before Practice. | | After Practice. | |
|---|---|---|---|
| Test | M. V. | Test | M. V. |
| (1) | 18 | (1) | 12 |
| (2) | 11 | (2) | 12 |
| (3) | 8 | (3) | 10 |
| (4) | 8 | (4) | 5 |

Practice Series

| Group I. | | Group II. | |
|---|---|---|---|
| Day | M. V. | Day | M. V. |
| (1) | 13 | (1) | 14 |
| (2) | 20 | (2) | 14 |
| (3) | 21 | (3) | 17 |
| (4) | 24 | (4) | 16 |
| (5) | 26 | (5) | 21 |
| (6) | 31 | (6) | 23 |
| (7) | 28 | (7) | 14 |
| (8) | 27 | (8) | 15 |
| (9) | 27 | (9) | 10 |
| (10) | 27 | (10) | 14 |
| (11) | 24 | (11) | 9 |
| (12) | 22 | (12) | 8 |

The results just given show that the mean variations of group I. in the four end tests are higher be-

fore practice than those of group II being 23, 16, and 11 respectively in group I's tests, and 18, 11, 8, and 8, respectively in group II. After practice, the mean variations were lowered in the sorting tests of group I. In the cancellation tests, they were raised. I am sure they were lowered in the sorting tests because the group as a whole, were trained in the method of sorting after three week's practice. By that time many were almost at the same level of efficiency in the sorting work, and consequently, the variability of the group ~~was~~ decreased. I think the variations were higher in the cancellation tests because some children could not transfer the training received sorting wads to that of cancelling letters or geometrical figures. In the geometrical cancellation test, the increase in variability may have been due to the factor of inhibition. For instance, in the practice tests, five geometrical figured wads were sorted, in the cancellation test, the same five geometrical figures were used but only the square and cross were to be cancelled. Having worked with the five geometrical forms for three weeks, some of the children in cancelling only

two may have been hindered by the other three figures. On the letter cancellation sheet, there was no systematic arrangement of letters; (On one row were seven "K and F's", the next row nine "K's and F's etc.") This was true of the geometrical cancellation test also. Therefore, no systematic arrangement of cancelling could be employed. On observation, I found that those who had developed a definite method of sorting wads, such as putting all the squares first into one box, then picking out all the circles improved the most in the training, and consequently showed the greatest gain in the final tests. In the practice series, the mean variations of group I in the test increased daily reaching the maximum of variability on the seventh day. Then the variability gradually decreased. This change in the mean variation reaching its maximum on the seventh day and then decreasing is due to the following factors: to start with the group showed reasonable variation due to individual differences. Then the variation increased because some children improved faster than others. They naturally reached their physiological limit before

others. The seventh day's results which showed the highest variations and was the first day that the test was completed before the given time. After this day, I noticed that the aim of the group was to see who could finish before time allowed. This factor may have lowered the variations. The very question of individual difference is an important factor in considering variability in general. In group III, the mean variations were lower than in group I. in the practice tests; nevertheless, there is proof shown that variability increased up to the seventh day: after this point, the variability of the group decreased.

As was said before, the greatest transfer effects in the final series, due to practice, were in the sorting tests. To explain this, I can say that the factor of "identical elements" largely accounts for it. The same method of procedure was used in both the stick and peg tests, as in the practice tests. The same movement in sorting geometrical wads into five small boxes in the practice tests was also used in the practice series--I found the improvement was the most in

the peg tests. The children liked to work with the pegs better than with the sticks. From their kindergarten and primary work in general, they were acquainted with the color of pegs. In fact, upon questioning the two groups as to whether they had ever played with colored pegs before, twelve in one group and sixteen in the other said they had, some had used colored sticks and balls. In the stick test, I found that the children in both groups had not discriminated between length of sticks, lines or pieces of paper. Therefore the improvement was lower in the stick tests because the discriminating between the different lengths of sticks was an entirely new task to perform.

Another conclusion which I have reached and has been partly mentioned previously in this report is that children averaging the same in age and of the same grade, have very nearly the same mental ability in test work given them, for example Groups I. and II were children of two different districts averaging eight years and one month in the former and eight years and four months in the latter mentioned. Taking into

account the factor of individual differences found in every group of children, it is very interesting to find that the two groups averaged exactly the same in the "peg and geometrical cancellation" tests, and within several points of each other in the stick and letter cancellation tests: The actual results of each "end" test are:

| | Stick Test | Peg Test | K & F Test | Geom. Cancel. Test |
|---|---|---|---|---|
| Group I | 102 | 82 | 65 | 65 |
| Group II | 99 | 82 | 70 | 65 |

Therefore, the average results in the first set of end tests in Group I and II indicate that children of the same age and average grade have very nearly the same mental ability if tested with the same material.

Summing up the conclusions reached:

1. The transfer effects from the first set of "end" tests to the second, were much greater in the "practiced" group, who had had a three week's period of intermediate drill between the tests, than the transfer effects between the same tests by an "unpracticed"

group. In other words, the "practiced" group after practice, improved 70 percent in the stick test, 100 percent in the peg test, 92 percent in the letter cancellation test, and 62 percent in the geometrical figure test. In the second set of "end" tests, the "unpracticed" group improved 7 percent in the stick test, 18 percent in the peg test, 44 percent in the letter cancellation test, and 30 percent of gain in all the tests in the first group mentioned was 81; in the second, 25. The improvement of the first is due entirely to transfer affects; the second is due entirely to transfer effects. Therefore, the difference of the two averages, 56, is the percent of improvement due to training in the practise tests. Therefore, the results show considerable transfer effects due to practice, in the last set of "end" tests of group 1.

3. From a study of the two practice curves presented in this paper, I have come to the conclusion that in a series of tests, the variability daily increases until the maximum is reached after a week's drill; then it

gradually decreases. To account for this, I found that about one fourth of the class improved very rapidly and by the end of a week's drill surpassed the average of sorting two hundred wads in four minutes; about one fourth of the group improved slowly up to the end of the seventh day. The rest of the group improved at an average rate. Therefore, the variability of each group was at its maximum in the middle of the series of tests. After reaching the maximum, the variability then gradually decreased. Continued practice in the same test raised the majority of the group to very nearly the same level of efficiency in sorting. Hence, the mean variation decreased.

3. After practice, the mean variation of the stick and peg tests were lowered; in the cancellation tests they were increased. I concluded that the group as a whole were so trained in the method of sorting during the practice tests that in the final stick and peg tests, almost each one in the group was able to transfer the same movement used in the practice work.

4. Hence, the variability of the group would natur-

ally be lowered, and as a fact it was. In the cancellation tests, some of the children were not capable of transferring the training they had received in the sorting of wads to cancelling letters and geometrical figures. Other children who improved very much in the stick and peg tests, improved to an equal extent in the cancellation tests. Hence, the mean variation was increased.

5. In figuring out the percent of improvement day by day, from the first to the last practice test in Groups I and III, I have found that the rate of improvement was at its maximum between the first and the second day's results. Having had the work once, the interest of all was, for the most part, at its highest point, and the most improvement was gained on this day. The rate of improvement decreased with practice. The percent after the first several days' test work, improved for the most part by concentration, effort, and renewed interest. The improvement of the group decreased immensely towards the last of the tests because the maximum had been reached by some and therefore, they were not able to im-

prove very much. Others were tired of the test-work.

6. The average percent of improvement from day to day in the practice tests of Groups I and III indicate that there is a loss in practice effects occurring over Sunday. The maximum of wads sorted in each group was on a Friday.

7. From the results of my study of how the various tests correlated with each other, I found that a higher correlation existed between each of the "end" tests after practice than the correlations between the tests of the "unpracticed" group. The correlation between the stick tests of Group I was 0.80; between the peg tests, 0.79; between the letter cancellation tests, 0.71; between the geometrical figure tests, 0.87. The correlations indicate that there has been a transfer of training from the practice series to the last set of end tests.

8. The transfer effects of the final set of stick and peg tests of Group I was higher than in the two cancellation tests on account of the "identical elements" involved in both the practice series and the final test

series. The plan of the sorting tests were alike; the same movement of sorting five different kinds of objects into five different boxes was included in both tests. The same five kinds of geometrical figures were sorted in the practice test as were printed upon the geometrical figure test but the factor of identical elements did not, on the whole, cause a marked transfer effect in the cancellation test. The factor of exhibition may have been the cause of it. All five geometrical figures were sorted in the practice test, only two figures out of five were cancelled. As the test was given, the other three geometrical figures may have hindered some of the children; I think that if five figures had been cancelled instead of two, the transfer effect would have been much larger.

9. The result of the testing of two groups of children in the same grade and age, with similar tests, shows clearly that, although in different schools, children average very nearly the same in mental ability in the initial test work given. In both the peg and the geometrical figures cancellation test, both groups averaged

the same; in the other two tests, there were only several points of difference between them in both groups.

10. In general, I found that increased power of attending, improvement in the technique of learning, and increase in effort, were important factors in the transference of training.

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