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The comparative validity of sense and non-sense material in determining mathematical aptitude

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THE COMPARATIVE VALIDITY OF SENSE AND NON-SENSE MATERIAL IN DETERMINING MATHEMATICAL APTITUDE

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BY

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CONTENTS

TABLES

FIGURES

CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

THE PROBLEM: The general purpose of this study is to investigate the validity of certain types of subject matter in Mathematical Aptitude Tests. In general two types of subject matter are considered: (1) sense material based on ability to learn, and (2) non-sense material based on ability to learn. Emphasis is placed on the consideration of material based on ability to learn because there is some doubt as to whether past experience in a subject has much relation to ability to learn new ideas and principles in the same subject.

WHY THE PROBLEM WAS CHOSEN: Most of the scholastic aptitude tests that are available at present have been found to be weak in their sections on mathematics. The writer is acquainted with three instances where the makers of scholastic aptitude tests received such poor results on the mathematic section of their test that the sections were discarded so as not to affect the validity of the remaining composite score of the test. As mentioned in the problem above, there is some doubt as to whether past experience in mathematics has much relation to ability to learn new kinds of mathematics in school. For example, it is a well known fact that many persons are able to do simple exercises in arithmetic, and yet when they are confronted with some new everyday problem in mathematics, they give up in despair.

It seems reasonable to assume that an arithmetic test based on ability to learn might produce a higher correlation with success in

mathematics than other tests that are based on past experience.

The mathematic sections mentioned on the previous page that were discovered in other general aptitude tests, were constructed to measure one's ability to solve exercises and problems based on sense material alone. In this study there will be an attempt to determine objectively whether sense or non-sense material is the better in testing one's ability to learn mathematics.

METHOD OF PROCEDURE:

A. There are a number of standardized arithmetic tests on the market at present, all of which are based on past experience. The New Stanford Arithmetic, Form V, was selected for this study. A mathematical test designed to measure only ability to learn was constructed in this study. It is highly improbable that any of the pupils tested knew anything about the latter test which was constructed by the writer (appendix). A tabulation of the 7th and 8th grade average arithmetic marks were also made and correlated with the sense material and non-sense material of the Enfield Aptitude Test in Mathematics (title of ability to learn test constructed).

B. Pupils: The two tests were administered to 204 pupils who entered the ninth grade. The six sets of scores obtained were correlated in this study to determine the value and reliability of the Enfield Aptitude Test in Mathematics.

C. ADMINISTRATION OF TESTS: The three tests were administered on three different days in one week by seven teachers who were in charge of the assembly rooms for the entering pupils in the ninth grade. Conditions were made as constant as possible in regard to time, light, location, ventilation, etc.

CHAPTER II

DEVELOPMENT AND CRITICISM OF MENTAL TESTS

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Mental testing got its start about 35 or 40 years ago and has been carried on with improvements up to the present day. Most of the earlier tests were similar to our present day achievement tests. They were single tests which were concerned mostly with motor and sensory processes. Some of the early tests measured memory while others such as those by Binet-Simon and by Ebbinghaus, were devised to measure the higher mental processes.

The modern method of combining scores from groups of tests, given at one time, to obtain a composite score was not in existence during the early experiments in the field of mental testing. In order to administer single tests of the early movement, it was necessary to obtain experienced, expert proctors to administer each test to individuals. Such a limitation prohibited their universal use. Again the early tests were not standardized as there was no valid method by which the test scores could be compared with other measures of achievement. Thus the reliability of the early mental tests was uncertain.

The early interest in mental testing really began in 1895, but it was not until 1905 that a general interest began in mental testing. Since the close of the World War, mental testing has become very popular and is used very extensively in business, school, and colleges to determine ability and capacity for work.

Individual differences are recognized today as vital forces for ones success in life. The first testing for individual differences was done in 1869 by Galton[1] and in 1890 by Cattell[1]. These and other prominent men at the time recognized the existence and importance of individual differences. About the same time that Cattell was doing work in education, the American Psychological Association[1] gave a series of tests to students at different colleges for the purpose of measuring individual differences.

The first comparison of mental tests was made by T. L. Bolton[1] in 1891 when he compared tests on memory with school marks. In 1894 Gilbert[1] compared tests of mental capacities. The results obtained by Gilbert were later confirmed by Seashore[1] in 1899.

In Europe some of the early pioneers of mental testing were A. Oehrn, Ebbinghaus, Krueger, Spearman, Galton, Pearson and Stern. It was in 1895 that Oehrn[1] published a report on a few tests which dealt with perception. The scores of his experiments were correlated by Krueger[1] and Spearman[1] and found to range from .44 to .69 in some cases. This was really the first successful testing that gave fairly high correlations when compared.

Ebbinghaus[1] invented a completion test in 1897 which aimed at measuring intellectual fatigue. His experiments led him to believe that the highest intellectual activities are the combining activities of the mind. His tests proved valuable as a measure of general intellectual capacity but not as a measure of intellectual fatigue.

The results of most of the early testing were found to be negative when compared with other measures. This unreliability of

of tests resulted in a decrease of interest in testing until Binet[1] brought forth his first intelligence test in 1905. He gave a series of tests to measure general intelligence. No other psychologist had previously tried this type of experimenting and so the test received considerable attention. The purpose of the Binet test was to measure the mental capacity in relation to chronological development of the individual. The chief faults with the test were: (1) that it was a single test and required experienced, expert persons to administer to each individual taking the test; and (2) that being a single test it would take considerable time to administer it to a large group.

MODERN ARITHMETIC TESTS

THE ROGER'S TEST OF MATHEMATICAL ABILITY

An analysis of the Roger's Test of Mathematical Ability[2] shows that the test contains three different kinds of mathematics. Two of the three types assume that the candidate has no previous knowledge of the examples or method of solution. The third type of mathematics in the test has to do with solving algebraic exercises, and this part of the test does assume a knowledge of algebra. Therefore two-thirds of the Roger's Test of Mathematical Ability tends to measure ability to learn new types of exercises in mathematics, while one-third of the test tends to measure attainment of algebra learned in the past.

The complete test consists of nine pages which are divided so that four pages are devoted to plane geometry, two pages to algebra, and three pages to interpolation. Of the four pages on

geometry, two contain drawings, facts, etc. to be studied in order to be able to solve the twelve geometry problems on the other two pages. The drawings and facts may be referred to while doing the problems. The two pages of the test that are designed to measure algebra contain eleven and seven exercises respectively. The three pages on interpolation consist of one page of complete directions with sample examples and two pages of twenty exercises each.

THE NEW STANFORD ARITHMETIC TEST, FORM V

The New Stanford Arithmetic Test[3] Form V for grades 2-9 contains forty exercises in arithmetic reasoning and sixty exercises in arithmetic computation. The test is well planned and the exercises are of high quality. It is, however, a test of attainment and does not tend to measure one's ability to learn arithmetic.

THE METROPOLITAN ACHIEVEMENT TEST, FORM A

The advanced arithmetic test of the Metropolitan Achievement Test[4] Form A for grades 4-8 contains eighty exercises in arithmetic fundamentals and fifty-five exercises in arithmetic problems. Sixty-five minutes are allowed pupils in grades 4-6 and ninety-five minutes for grades 7-8. The primary purpose of the test is to measure achievement and so does not measure ability to learn arithmetic.

THE SCHORLING-CLARK-POTTER ARITHMETIC TESTS

The Schorling-Clark-Potter Arithmetic Test[5] Form B revised for grades 5-12 contains ninety exercises and ten problems in arithmetic. The test places a great deal of emphasis on the four

fundamentals of arithmetic and also gives special attention to exercises in fractions, decimals and percentage. Form A revised for grades 5-12 contains the same number of exercises, but the exercises are more difficult than those in Form B. Both tests tend to measure knowledge and retention in arithmetic and not ability to learn.

COMPASS SURVEY TESTS IN ARITHMETIC, FORM A

The Compass Survey Test in Arithmetic[6] Form A for grades 2-4 contains one hundred fifteen exercises in the four fundamentals of arithmetic. The test takes twenty-five minutes to administer. The Form A for grades 4-8 contains forty exercises in the four fundamentals of arithmetic, ten exercises in percentage, and ten exercises in general problems. The test takes thirty-five minutes to administer. Both tests measure past knowledge and retention in arithmetic.

OTIS GROUP INTELLIGENCE SCALE[7], FORM B

The arithmetic section of Form B of this intelligence test devotes two pages to mathematics. One page contains twenty problems in the four fundamentals of arithmetic. The other page has two geometric figures and twenty problems which measure observation and clear thinking about these two figures. The page on fundamentals tends to measure knowledge and retention in arithmetic learned in the past, while the second page might be said to measure ability to observe and make note of the observations.

THE ARMY ALPHA GROUP EXAMINATION

The mathematical section of the Army Alpha Group Examination[8] contains twenty problems on the four fundamentals of arithmetic and twenty exercises on interpolation. The section is purely a test of past experience.

THE TERMAN TEST OF MENTAL ABILITY, FORM A

The Terman Group Test of Mental Ability[9] Form A for grades 7-12 contains a section on arithmetic which has twelve problems in the four fundamentals of arithmetic and a few problems on ratio and on percentage. This test also measures knowledge and retention in arithmetic learned in the past.

THE NATIONAL INTELLIGENCE TEST, FORM 2

The National Intelligence Test[10] Scale B, Form 2 contains thirty-two exercises on the four fundamentals of arithmetic and includes fractions and decimals. The test is well planned, but it also measures only retention of past knowledge of arithmetic.

CONCLUSIONS

All recent developments of mental testing have been merely attempts to predict specific abilities, aptitudes, or capacities. They have tended to measure specific ability rather than to measure general interest, in order to predict future accomplishments. There are available an ever increasing number of aptitude tests which are constructed to forecast abilities in certain subjects with fair success. In order to pass successfully a modern standardized mental test, it is well known that one must rely a great deal on past experience. The recent aptitude test for Nursing is a practical example of an aptitude test as it is concerned mostly with matter that has not been previously learned.

The relatively poor results obtained by tests based on past experience to predict success in life, and the fair success obtained to date by testing of ability to learn, has acted as a stimulus in this study of preparing a test to measure ability to learn arithmetic.

CHAPTER III

PRELIMINARIES TO RESEARCH

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PRELIMINARIES TO RESEARCH

This study was made in the High School of Enfield, Connecticut. This town is situated on the East bank of the Connecticut River, just below Longmeadow, Massachusetts. It has approximately 1[illegible],500 inhabitants, and it is made up of three villages, namely Thompsonville, Hazardville, and Scitico.

Thompsonville, where the Enfield High School is located, is the largest borough in the town. It is a progressive, industrial, residential, and agricultural center in the Connecticut valley. There are five manufacturing firms in Thompsonville which include the Bigelow Sanford Carpet Company and the International Casket Hardware Company. The Carpet Company alone employs 3500 men. The school enrollment at present in Enfield is about 3000 with 300 additional pupils attending the parochial school. The educational appropriation each year is about $[illegible],000.

<u>CONSTRUCTION OF THE ABILITY TO LEARN ARITHMETIC TEST</u>— In this attempt to determine whether sense material or non-sense material is the better to test ones ability to learn mathematics, groups of examples and problems were constructed on mathematics that pupils entering high school were supposed to know nothing about. At the beginning of each page of the test are directions, and in some cases, sample examples, which explain how to do the problems or examples which follow. No outside experience, other than the students acquired ability to listen, to follow directions, to be able to reason, and his willingness to do his best, will help the

pupil in this test. Only one's ability to learn mathematics will help him materially to obtain a high score.

Before attempting to construct an Ability to Learn Arithmetic Test, the writer gave considerable study to the Ability to Learn Tests already made available by Charles P. McDonnell[11] of West Springfield, Massachusetts and by Mr. Harry N. Glick[12] of the Massachusetts State College. The test made by Mr. McDonnell, however, does not contain anything about ability to learn mathematics.

At first a test was made containing two pages of sense material and two pages of non-sense material. Of the two pages of non-sense material, one page contained an idea with examples which were original, while on the other page the idea was original but the figures to substantiate the idea were taken from a text book on general science.[13]

SAMPLES:

(1) In the example below we have a series of numbers. Whenever the figure 5 occurs, multiply the number before it by 8 and add this product to the number following the 5. Write the sum below the 5 in the example. Take all the numbers that are below the several figure 5's, find their sum, and divide it by the difference of the sums of the first six figures and the last six figures in the example.

[illegible]	3	7
39 52 52	4	4
	5	5
39+52+52 = 143	7	6
143/5 = 28 3/5 Answer	9	4
	8	5
	36	31

36 = sum of first six numbers.
31 = sum of last six numbers.
5 = difference of their sums.

(2) <u>Artificial Table of Distances</u>

1000 Miles equals One Spherogram
34 Spherograms equals One Geon
47 Geons equals One Atmo
22 Atmos equals One Orbi

The planet Mercury is said to be 36,000,000 miles from the Sun. How many Atmos is Mercury from the Sun?

The two pages on sense material consisted of a principle taken from a standard test[14], and of examples taken from a ninth grade text on mathematics.[15]

SAMPLES:

(1) In the examples below you are to examine each row of numbers and find out how the numbers are made up. Then on the dotted lines write the two numbers that come next.

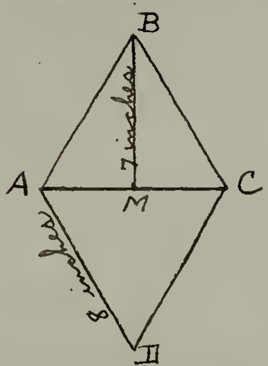
(a) 3 6 9 12 15 ..18.. ..21..

(b) 32 28 24 20 16 ..12.. ..8..

(2) An equilateral triangle is a figure having three (3) connected sides. All three sides are equal and all three angles are equal.

The area of any right triangle is found by taking one-half of the base multiplied by the height of triangle.

If a line is drawn from the top of an equilateral triangle, bisects the base, and is perpendicular to the base, then the equilateral triangle becomes divided into two (2) right triangles.



In this drawing are 2 equilateral triangles ABC and ADC. The line BM divides AC into two equal parts. (bisects it)

The side AD equals 8 inches.
The line BM equals 7 inches.

Find the area of each of the equilateral triangles.

In all four pages the writer attempted to have certain principles and examples that would not be too difficult, nor too easy, and yet examples that any pupil entering the ninth grade would not be familiar with.

This original test of four pages was mimeographed and administered to a ninth grade algebra group of 35 pupils. Each page

was taken separately, and when three pupils of the '[illegible]' group had finished the first page and held up their hands, the time was noted for the page with a stop watch and recorded. Three additional minutes were allowed for the others to finish after the time was recorded. A similar procedure was followed for the other three pages. With this data collected, six additional pages of examples were made. The procedure followed in the making of the first four pages was again followed. Of these six pages, three contained ideas and examples taken from a text on general science[13] and from a text on ninth grade algebra.[15] These six pages were administered separately to another new group of 35 pupils. The procedure for timing each page mentioned above was again followed.

SAMPLES:

(1) A Right Triangle is a plane figure having 3 angles and 3 connected sides. One of the angles is a Right Angle (has 90 degrees).

The Area of a Right Triangle is found by multiplying the Base of the figure by the Height and then dividing the product by two (2).

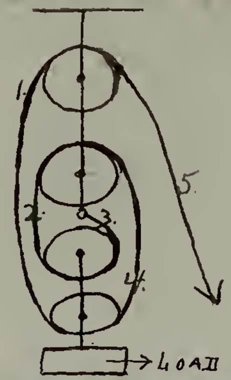
In a Right Triangle if the Base equals 7 inches and the Height equals 10 inches, find the area.

(2) In the example below, you have an algebraic expression. You are to substitute the number value given for each letter and then work out the example as you would in arithmetic.

If a=2, b=3, d=1, c=5

Then $\frac{a+b}{c} - \frac{d}{a} = \frac{2+3}{5} - \frac{1}{2} = \frac{4+6-5}{10} = \frac{5}{10}$ or $\frac{1}{2}$

(3) In dealing with pulleys, if we want to find out whether pulleys are a help to man in doing work, we must find out the Mechanical Advantage (M. A.) of the pulleys. This M. A. maybe different in many pulleys. The Mechanical Advantage of any pulley may be found by counting the supporting strands of rope in the pulley. (The ropes that hold up the load)



Strands of rope 1, 2, 3, and 4 support or hold up the load but number 5 strand does not hold up the load. Therefore the M. A. of this pulley is 4.

A review of the results obtained so far showed that some of the examples were too difficult, and others gave evidence that some pupils were familiar with certain examples from previous experience. The writer then decided to revise most of the pages and try a new test. Since the review of results showed that certain pages of the test had examples that were too difficult for the pupils to do in a reasonable length of time, new and easier examples were introduced that would acquaint the pupils with the new facts and ideas that were to follow. The more difficult problems on the same principle were placed on the following page. The examples that gave evidence in the results of previous knowledge by certain pupils were replaced by new examples. These new examples were constructed from ideas taken from a ninth grade business arithmetic text.[16] (See Appendix)

In revising the test the writer kept in mind the fact that the test must contain examples that all pupils entering the ninth grade could do, examples that only the bright pupils could do, and some examples that none could finish in the allotted time.

No pupil would be able to get a perfect score, and yet all should score on certain pages of the test.

This revised test was administered to two different ninth grade groups of 35 at the same time. All conditions were made comparatively constant. The procedure for recording time mentioned above was used again for each of the ten new pages and recorded when only <u>one</u> of the brighter pupils in each group had finished a page. In order to time these ten new pages, it was necessary to use a double school period. The writer, feeling that 70 minutes was too long a time to expect a pupil entering the ninth grade to concentrate and do his best, decided to divide the test into two parts, namely, Part 'A' and Part 'B'.

Part 'A' contains five pages of examples, three of which test ability to learn sense material and two pages which test ability to learn non-sense material. Part 'B' contains three pages designed to test ability to learn sense material arithmetic and two pages to test ability to learn non-sense material arithmetic examples.

All preliminary work in this study was tried out with pupils who had been in the ninth grade about three months. This was necessary because the test was constructed primarily for pupils entering high school.

The directions for administering the test were made very simple for the person giving the test and for the students to understand. The students are told that the test is not about what they already know, but rather of their ability to learn new kinds of mathematics. They are further told not to get discouraged if they find the

examples difficult because no pupil is expected to get all of the examples correct. Each pupil is told to do his best. (See Appendix)

The directions also instruct the person giving the test to read the directions on each page aloud and slowly, while the pupils read them to themselves.

As Part 'A' and Part 'B' each take 35 minutes to administer, they have to be given on separate days whenever the test is used.

The complete test is made up of twelve pages, each of which begins with directions, and some of which include examples. The first page of the test is designed for tabulating the students name, age, last grammar school attended, and scores for each section. The complete test and directions for administering it will be found in the appendix.

TEST BY SECTIONS:

On the second page of the complete test (appendix) is set forth a principle in non-sense material which is designed to test a pupils power of observation and ability to follow directions. Each example consists of a numerical expression of eighteen figures in a horizontal row. The pupil is told that whenever the figure 5 occurs in the expression, he must multiply the figure preceding it by 8. Then he must divide the sum of these products by the difference between the sum of the first six figures in the expression and the sum of the last six figures in the expression.

Section A, Part 2a of the complete test (appendix) presents definitions, a sample problem, and some examples concerning

measurement and wall papering of rooms. The sample problem explains in detail the procedure to follow.

SAMPLE: Find the number of double rolls of wall paper needed to paper a room 14 ft. long, 12 ft. wide, and 8 ft. high, allowing for 2 windows 3½ ft. wide and 2 doors 3 ft. 3 in. wide.

METHOD: Total perimeter 14' + 14' + 12'6" + 12'6" = 53'
Total width of openings 2 X 3½ = 7'
2 X 3¾ = 7½' = 14½'
Net perimeter 53' minus 14½' = 38½'
Required strips of paper 38½ - 1½ = 25⅔ or 26
Number of strips in a double roll 48' - 8½ = 5
Number of rolls needed 26 - 5 = 5¹/₅ or 6 for ans.

Section A, Part 2b of the complete test (appendix) has to deal with the measurement, laying, and cost of room carpets. An explanation and a sample problem also begins this page. There are three additional examples in wall papering included in this page.

SAMPLE: Find the number of yards of Brussel carpet needed to cover a room 16' X 15'.

METHOD: 15 - 2¼ = 6²/₃ or 7 strips needed.
$\frac{7 \times 16}{3}$ = 37¹/₃ or 38 yards needed is the answer.

Section A, Part 3 of the complete test (appendix) is concerned with artificial examples in simple algebra. In the directions at the head of the page are found the meaning and value of the various letters used in the examples. Section A, Part 3 assumes a fair degree of understanding and ability to follow directions. There are examples on this page.

SAMPLE: When the letter 'a' follows a number it means that the number is to be multiplied by itself. Thus 5a equals 25.
When the letter 'b' follows a number it means that the number is worth only one-half of its value. Thus 6b is equal to 3.

SAMPLES CONTINUED

When the letter 'x' follows a number it reduces the value of the number by two.
Thus 9x is equal to 7.
When the letter 'y' follows a number it increases the number by one-half of itself.
Thus 5y is equal to $7\frac{1}{2}$.
When two letters follow a number as 'ab' or 'xy', one letter at a time should be worked; that is, follow the rule above for 'a' first, then with the answer that you obtain follow the rule for the second letter 'b'.
Thus 8ab equals 64 divided by 2 or 32.

Section A, Part 4 of the complete test (appendix) presents problems in which the relationship of a series of numbers in a horizontal row is to be determined and then the series completed.

Two sample examples are given with nine others to be solved.

SAMPLES: (a) 3 6 9 12 15 ..18.. ..21..

(b) 32 28 24 20 16 ..12.. ..8..

Section B, Part I of the complete test (appendix) deals with a table of artificial distances. There are eleven problems which start off with easy ones and lead up to the more difficult ones. Each problem requires the pupil to change one unit of artificial distance into another unit. Pupils are allowed to refer to the table at the head of the page.

SAMPLES: <u>TABLE OF DISTANCES</u>

1000 Miles equals one Sherogram.
34 Spherograms equals one Geon.
47 Geons equals one Atmo.
22 Atmos equals one Orbi.

EXAMPLES: (a) 6000 Miles equals how many Spherograms?
(b) 235 Geons equals how many Atmos?
(c) 3.117 Atmos equals how many Miles?

CHAPTER IV

COLLECTION OF DATA

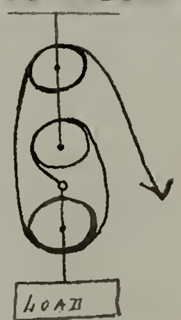
Section B, Part 2a of the complete test (appendix) has to do with finding the Mechanical Advantage of five different pulleys. The procedure for finding the Mechanical Advantage of any pulley is stated at the beginning of the page along with a sample problem which is worked out in detail. The sample problem is also explained on page 13 of this chapter.

Section B, Part 2b of the complete test (appendix) contains three examples on the working of pulleys. One of the examples deals with the amount of a load that can be raised, another concerns the amount of rope pulled in raising a load with pulleys, and the third example has to do with the distance that a load will leave the ground using pulleys. The problems assume a knowledge of how to find the Mechanical Advantage from Section B, Part 2a.

FACTS AND SAMPLE ON PULLEYS:

1. The downward pull on the end of the rope is equal to the weight divided by the M. A.
2. The weight raised is equal to the downward pull multiplied by the M. A.
3. The height that a load can be raised off of the ground is equal to the amount of rope pulled divided by the M. A.
4. The amount of rope pulled is equal to the height that the load is raised multiplied by the M. A.

DRAWING 'B'

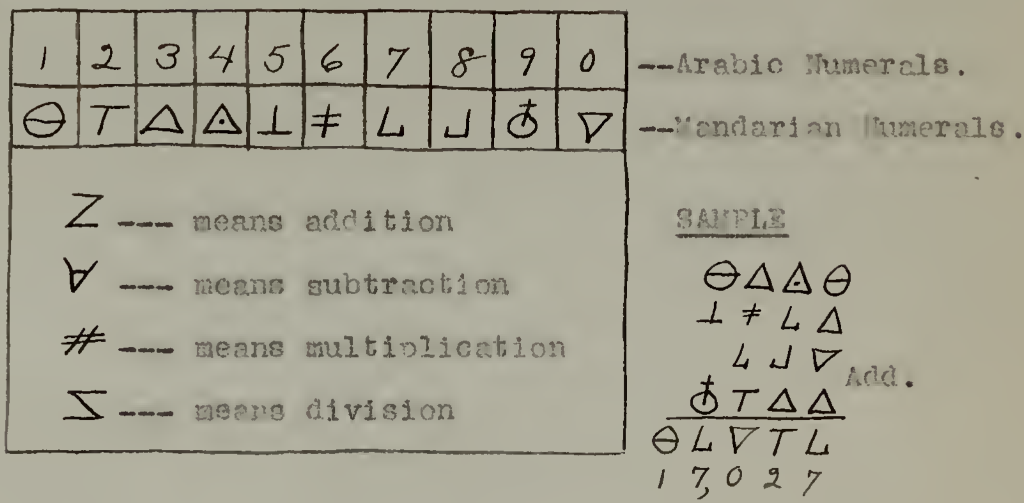


Find the M. A. in drawing 'B'. Refering to the above facts about pulleys, if the load in drawing 'B' is 935 pounds what downward pull will be needed on the end of the rope to raise this weight off of the ground?

Section B, Part 3 of the complete test (appendix) presents a table of artificial numbers called the Mandarian System of numerals. The Arabic System is also mentioned in the table. Below the

table are examples in addition, subtraction, multiplication, and division using the Mandarian System. The pupils are supposed to refer frequently to the table for interpretation of the Mandarian signs and symbols.

CHART:



Section B, Part 4 of the complete test (appendix) consists of examples of algebraic expressions and equations. A sample example is present at the beginning of the page. The values of the letters used in the eight examples on the page are also given.

SAMPLE: If a=2, b=3, c=5, and d=1

$$\text{Then } \frac{a+b}{c} - \frac{d}{a} = \frac{2+3}{5} - \frac{1}{2} = \frac{4+6-5}{10} = \frac{5}{10} \text{ or } \frac{1}{2}$$

CHAPTER I[illegible]

COLLECTION OF DATA

Administration of the Ability to Learn Mathematics Test.

After a few more alterations and corrections the Ability to Learn Mathematics Test for pupils entering high school was ready for a real trial. Permission was obtained from the Principal of the Enfield High School in Thompsonville, Connecticut to administer the test to the new freshmen class. On Monday of the third week after school opened in September 1934, Part A of the Ability to Learn Mathematics Test was administered to 223 freshmen of the Enfield High School. The following Tuesday, Part B of the same test was given but only 215 freshmen were present to take the second part. One week later the New Stanford Arithmetic Test was given but only 204 who had taken both parts of the Ability to Learn Test were present.

The Ability to Learn Mathematics Test was administered in seven different classrooms in the same building. In all seven examining classrooms the test began at 1:15 and ended at 1:50. The students were told that the results would not count in their daily marks, but that each was expected to do his best in order to enable the principal and the teachers to determine which students needed extra help in mathematics.

The seven proctors were given the tests and direction sheets a day in advance to familiarize themselves with the procedure to be followed. An attempt was made to have the working conditions

in all seven examining rooms as ideal and as constant as possible. As far as could be determined, no attempts at cheating were detected by the proctors in charge.

Some of the pupils appeared to be nervous, but on the whole, most of them tried to do their best. A few were fascinated or amused by the non-sense examples and even asked the proctors to discuss in class certain examples after class. Even though certain parts of the test were very easy, there were a few pupils who sat through the entire period without trying. These pupils more than likely had some ability, but because they wanted to leave school or because they never did learn how to study, did very little on the three tests given.

Scoring the Ability to Learn Mathematics Test--- The scoring of both parts of this test was a very tedious task. The scoring was different for each page. One to two credits were given for the easy examples and as high as 10 or 15 credits were given for the more difficult problems and examples. The five pages of each section were corrected separately by the writer without any outside assistance.

The New Stanford Arithmetic Test:-- One week after the Ability to Learn Mathematics Test was administered, the New Stanford Test was given to the same 204 students. An attempt was made to make the working conditions as ideal and constant as possible in all seven examining rooms. The test was given in seven different classrooms on one day beginning at 1:15 P. M. and lasting fifty minutes. The students were told that the results would not count in their daily mark, but that each was expected to do his best in order to

enable the principal and the teachers to determine which students need extra help in arithmetic.

According to the observations of the seven proctors, the majority of the students did their best to cooperate and tried to do all of the examples. No attempts to cheat were detected. There were, however, a few students in each room who did little or nothing in the test. An investigation showed that in most cases these pupils were over-age boys of undeveloped intelligence or were pupils who disliked school and wanted to leave.

The directions accompanying the test were followed verbatim using the exact time allotments and other regulations. The complete test with directions may be found in the appendix.

The special features of the test and the procedure are outlined as follows in the "Guide for Interpreting" published by the World Book Company of New York:

"1. <u>Arithmetic Reasoning</u>-- The guiding principles in the selection of the problems in this part of the test were that the problems should be worth while, that they should require real interpretative ability and not be made difficult through mere computation, and that they should be so clearly stated that the test would measure ability to think in quantitative terms; i.e. arithmetic ability rather than chiefly a language function or verbal intelligence.

"The problems in the revised test are arranged in so far as possible to go from problems involving but a single arithmetic operation and a single discrimination of method by the pupil to those that involve several successive steps in their solution.

EXAMPLES:

1. Charles has 6 brown rabbits and 5 white ones. How many rabbits has he?

2. Jim has 20 cents to spend for marbles. He is going to buy 2 at 3 cents each and spend the remainder for 2-cent marbles. How many will he get altogether?

3. What is the cost of insuring a building valued at $24,000 if it is insured for 80 per cent of its value at the rate of 15 cents per $100 of insurance?

"2. Arithmetic Computation — The selection of examples for this part of the test was based chiefly upon analysis of the leading textbooks and tests for the purpose of discovering all the possible types of examples. The results of these analyses were arranges in the form of an outline showing the major types of examples in each operation, together with all the sub-types. Examples were devised representing as many of these types as, in the opinion of four judges, were considered important. These examples were tried out in representive schools, and the final selection of 300 items (60 for each of the five forms) was made on this basis.

"This part of the test ranges in every form of the battery from simple primary combinations through successive degrees of complexity to the type of mathematics usually taught in the ninth grade.

"3. Preliminary Work in Construction of Test.— The items of each part were arranged in order of difficulty as determined by data from several hundred children in schools located in New York, North Carolina, Iowa, and California. The pupils were

selected from such a wide range of territory in order that the final arrangement of items might not be too greatly influenced by the particular content of the curriculum in any one school system. Of course there is no such thing as an order of arrangement that will be equally satisfactory for all schools and for every pupil. However, the wide variety of educational exposure used in the try-out of this test insures a much better order of its items than that found in a number of current tests which have been arranged on the basis of data from a single school or from a single community or state.

"The method of procedure in determining the relative difficulty of items was as follows: the test was given, as stated above, to typical schools in representative sections of the country. Every item was treated separately. Several hundred pupils' scores on each item were arranged by classes and the per cent of correct answers computed. The second and third grades were grouped together, likewise the fourth and fifth. All other grades were kept separate. The size of the percentage correct and the consistency of its growth from the lower to the upper grades were the determining factors in the retention or rejection of an item and in determining where it belonged in the test.

"It was not feasible to make the difference in difficulty between successive items exactly constant throughout the test. This is not necessary in the type of test under consideration.[17]

"Form V which was used in this study contains forty questions in Arithmetic Reasoning and forty examples in Arithmetic Computation. Complete data collected in this study is presented in Table I."

School Marks: A week after the Aptitude Test and the New Stanford Test were given to the 204 freshmen at the Enfield High School, the writer visited the two elementary schools which the pupils in this study attented before entering the high school. Here permission was obtained to use the schools' permanent office cards, each of which contained the pupils' school marks in every subject in every grade from the first to the eighth inclusive. As the school year in Enfield, Connecticut is divided into five marking periods, there were found to be five marks on each card for 7th grade arithmetic and five for the 8th grade arithmetic. The 7th grade scholastic classification in arithmetic was determined by taking an average of the five arithmetic marks for that grade. The same was done to obtain an eighth grade classification in arithmetic. The marks on the cards were in letters A, B, C, etc. If a pupil had two 'B' marks and three 'C' marks, he was rated 'C Plus' for his average.

TABLE I

The following table shows the arrangement of pupils according to the Ability to Learn Arithmetic Test Scores, the highest first and then in descending order. The first column contains the age of the pupil; the second column contains the score obtained in the Sense Material of the Ability to Learn Test; the third column contains the score obtained in the Non-Sense Material of the Ability to Learn Test; the fourth column contains the total score obtained in the Ability to Learn Arithmetic Test; the fifth column contains the score obtained in the New Stanford Arithmetic Test; the sixth column contains the Average mark obtained in the Seventh Grade in Arithmetic; the last column contains the Average mark obtained in the Eighth Grade in Arithmetic.

No. of Pupil	Age of Pupil	Score on Sense Material	Score on Non-Sense Material	Total Score in Ability to Learn Arith.	Standard Stanford Arith. Score.	Seventh Grade Average Mark	Eighth Grade Average Mark
1	13 yrs	82	55.5	137.5	101	80	83
2	14 "	88	48.5	136.5	113.5	90	83
3	13* "	86	50	136	100	93	95
4	14 "	77	56.5	133.5	101.5	99	95
5	14 "	77	56.5	133.5	106	82	85
6	13 "	80	51.5	131.5	105	85	85
7	13 "	82	49.5	131.5	10[illegible]	79	84
8	14 "	74	55.5	129.5	107	90	80
9	13 "	87	41.5	128.5	104.5	80	90
10	13 "	73	54.5	127.5	119	90	80
11	13 "	73	54.5	127.5	73	80	80
12	13 "	80	46.5	126.5	11[illegible]	90	89
13	14 "	75	50.5	125.5	117	90	90
14	14 "	76	48	124	99	83	90
15	13 "	86.5	36.5	123	103.5	90	80
16	13 "	72	50.5	122.5	10[illegible]	85	70
17	14 "	88	33.5	121.5	106.5	90	92
18	13 "	72	48.5	120.5	99	78	78
19	15 "	77	43.5	120.5	110.5	85	80
20	14 "	79	41.5	120.5	10[illegible]	80	79
21	13 "	74	45.5	119.5	103.5	85	6[illegible]
22	14 "	65	54.5	119.5	107	89	90
23	13 "	81	39.5	119.5	102	85	80
24	15 "	67	52.5	119.5	105	80	80
25	14 "	69	49.5	118.5	103.5	90	90
26	14 "	75	40.5	115.5	110	84	90
27	14 "	72	43.5	115.5	96	92	95
28	14 "	76	39	115	105.5	85	[illegible]
29	14 "	60	53.5	113.5	109	80	75
30	13 "	77	34.5	111.5	95	70	78
31	13 "	62	49.5	111.5	104	80	80
32	13 "	70	39.5	109.5	102.5	83	85

TABLE I CON'T

No. of Pupil	Age of Pupil	Score on Sense Material	Score on Non-Sense Material	Total Score in Ability to Learn Arith.	Standard Stanford Arith. Score	Seventh Grade Average Mark	Eighth Grade Average Mark
33	13 yrs.	78	31.5	109.5	115	80	80
34	13 "	77	31.5	108.5	109.5	80	80
35	13 "	80	28.5	108.5	72	72	74
36	14 "	88	19.5	107.5	119	85	79
37	12 "	83	24	107	116	76	85
38	13 "	84	22.5	106.5	110.5	76	75
39	13 "	59	46.5	105.5	90	70	65
40	13 "	62	42.5	104.5	88.5	80	65
41	14 "	64	40.5	104.5	93	90	80
42	13 "	65	36.5	101.5	108	84	85
43	14 "	53	[illegible]	101.5	92	75	50
44	15 "	69	32	101	72	74	70
45	13 "	66	35	101	110.5	80	85
46	14 "	59	41.5	100.5	102	85	80
47	14 "	72	27.5	99.5	85.5	78	78
48	14 "	66	33.5	99.5	91.5	75	75
49	14 "	64	35.5	99.5	90	70	78
50	14 "	76	23.5	99.5	109	80	77
51	17 "	70	28.5	98.5	95	77	77
52	14 "	70	27.5	97.5	100	78	70
53	13 "	64	33.5	97.5	104	80	80
54	14 "	63	34.5	97.5	114	80	85
55	15 "	68	28.5	96.5	97	72	72
56	15 "	69	17	96	[illegible]	70	75
57	13 "	77	19	96	113	80	80
58	14 "	60	35.5	95.5	81.5	70	71
59	12 "	73	22.5	95.5	115	75	70
60	13 "	74	20.5	94.5	95	91	93
61	14 "	60	34.5	94.5	91	79	78
62	13 "	62	31.5	93.5	86	80	68
63	14 "	67	25.5	92.5	71	65	74
64	14 "	75	16.5	91.5	104.5	80	78
65	11 "	60	31.5	91.5	108	80	70
66	14 "	50	41	91	99	72	72
67	14 "	53	36.5	89.5	102	90	73
68	13 "	64	25.5	89.5	77	70	70
69	14 "	45	44	89	103	80	80
70	14 "	65	23.5	88.5	96	70	83
71	13 "	57	31.5	88.5	88.5	78	73
72	13 "	59	28	87	104	77	74
73	14 "	73	13.5	86.5	93.5	73	70
74	14 "	61	25.5	86.5	100	75	69
75	14 "	63	23.5	86.5	103	73	75
76	16 "	62	24.5	86.5	93	70	79
77	13 "	62	23.5	85.5	98.5	83	70
78	16 "	50	35.5	85.5	93.5	63	61

TABLE I CONT.

No. of Pupil	Age of Pupil	Score on Sense Material	Score on Non-Sense Material	Total Score in Ability to Learn Arith.	Standard Stanford Arith. Score	Seventh Grade Average Mark	Eighth Grade Average Mark
79	13 yrs.	62	23.5	85.5	111.5	74	72
80	13 "	65	19.5	84.5	91.5	66	80
81	15 "	57	27	84	94.5	70	75
82	13 "	56	27.5	83.5	86	77	72
83	13 "	67	16.5	83.5	78	83	77
84	14 "	58	25.5	83.5	96	71	71
85	15 "	62	20.5	82.5	90	79	75
86	13 "	62	20	82	75	50	68
87	13 "	67	14.5	81.5	90	71	80
88	13 "	67	14.5	81.5	97	76	78
89	13 "	61	20.5	81.5	103	60	68
90	13 "	66	15	81	99	65	[illegible]
91	13 "	57	23.5	80.5	[illegible]	92	85
92	12 "	56	24.5	80.5	[illegible]	70	78
93	15 "	46	34.5	80.5	99	73	70
94	14 "	73	7	80	90	60	79
95	13 "	75	4.5	79.5	85	75	70
96	13 "	61	18.5	79.5	[illegible]	75	74
97	14 "	45	34.5	79.5	105	73	83
98	14 "	57	22.5	79.5	96	55	80
99	14 "	43	36	79	115	[illegible]	80
100	13 "	55	23.5	78.5	105	83	72
101	14 "	61	17.5	78.5	93	80	[illegible]
102	13 "	39	39.5	78.5	73	70	70
103	13 "	76	2	78	95	75	75
104	13 "	46	31.5	77.5	73	73	75
105	15 "	55	22.5	77.5	112	73	72
106	14 "	42	35.5	77.5	97	73	85
107	13 "	60	17.5	77.5	100	75	70
108	13 "	57	20.5	77.5	117	68	78
109	14 "	43	33.5	76.5	97	69	80
110	13 "	57	19.5	76.5	110.5	79	75
111	15 "	43	33.5	76.5	120	80	73
112	13 "	43	33.5	76.5	96	72	75
113	13 "	59	16.5	75.5	88	70	73
114	15 "	49	26.5	75.5	84	80	73
115	15 "	53	22.5	75.5	83	80	75
116	13 "	58	17	75	105	72	69
117	14 "	65	10	75	100	83	80
118	15 "	43	31.5	74.5	88	70	65
119	14 "	44	30.5	74.5	117.5	80	65
120	15 "	55	19	74	88	75	70

TABLE I CON'T

No. of Pupil	Age of Pupil		Score on Sense Material	Score on Non-Sense Material	Total Score in Ability to Learn Arith.	Standard Stanford Arith. Score	Seventh Grade Average Mark	Eighth Grade Average Mark
121	14	"	61	12.5	73.5	101.5	85	75
122	13	"	56	17.5	73.5	104	80	70
123	13	"	62	10.5	72.5	54	87	75
124	14	"	56	16.5	72.5	94	60	73
125	13	"	40	32	72	99	80	70
126	13	"	60	11	71	102.5	78	65
127	13	"	65	6	71	77	65	71
128	14	"	41	29.5	70.5	92	70	60
129	14	"	57	[illegible]	70.5	95	85	[illegible]
130	13	"	62	8.5	70.5	76	70	60
131	14	"	36	34	70	93	80	82
132	14	"	52	17.5	69.5	107	63	75
133	13	"	48	21.5	69.5	84	73	53
134	15	"	61	8	69	88	63	60
135	14	"	53	15	68	97.5	80	65
136	14	"	57	11	68	96	76	59
137	15	"	52.5	15.5	[illegible]	104	75	70
138	14	"	[illegible]	11	66	94	70	71
139	13	"	44	[illegible]	66	84	71	79
140	13	"	53	13	66	104	71	82
141	14	"	51	14.5	65.5	94	70	69
142	13	"	32	32.5	64.5	91.5	80	67
143	13	"	41	23.5	64.5	93	72	79
144	15	"	49	14.5	63.5	95	80	60
145	14	"	53	10.5	63.5	91	69	65
146	15	"	36	27.5	63.5	89	70	78
147	14	"	42	21	63	86.5	67	70
148	14	"	32	30.5	62.5	79.5	83	[illegible]
149	14	"	35	26.5	62.5	95	65	68
150	14	"	47	14.5	61.5	89.5	78	7[illegible]
151	14	"	58	3.5	61.5	97	70	75
152	13	"	35	26.5	61.5	86	70	50
153	14	"	39	21.5	60.5	96	65	60
154	13	"	49	11	60	102.5	79	78
155	15	"	40	19.5	59.5	99.5	79	73
156	13	"	50	9	59	107	75	70
157	14	"	59	0	59	99	65	75
158	15	"	40	19	59	99	65	75
159	14	"	48	10.5	58.5	80	79	75
160	13	"	26	32.5	58.5	97	75	73
161	14	"	41	17.5	58.5	102	80	73
162	14	"	48	10	58	76	81	80

TABLE I CONT'D

No of Pupil	Age of Pupil	Score on Sense Material	Score on Non-Sense Material	Total Score in Ability to Learn Arith.	Standard Stanford Arith. Score	Seventh Grade Average Mark	Eighth Grade Average Mark
163	15 yrs	51	7	58.	84	60	61
164	15 "	42	15.5	57.5	83	70	60
165	13 "	47	10	57	85	60	70
166	13 "	38	19	57	113	73	79
167	14 "	43	13.5	56.5	90	70	75
168	15 "	25	31.5	56.5	88.5	70	65
169	14 "	46	10	56	82.5	70	70
170	15 "	38	17.5	55.5	97.5	60	78
171	13 "	39	15.5	54.5	87	78	65
172	14 "	52	2	54	102	80	77
173	14 "	36	17.5	53.5	90.5	75	70
174	14 "	30	22.5	52.5	100	70	78
175	15 "	51	1.5	52.5	96	80	85
176	15 "	50	1	51	84.5	73	77
177	13 "	34	16.5	50.5	94.5	70	70
178	14.5 "	25	25	50	105	70	77
179	14 "	36	13.5	49.5	74	69	60
180	14 "	43	6.5	49.5	92	70	72
181	14 "	39	9.5	48.5	88	71	79
182	14 "	40	8.0	48	87	72	70
183	15 "	47	1.0	48	92.5	95	70
184	16 "	22	25.5	47.5	105	70	80
185	15 "	34	13.5	47.5	89	78	78
186	14 "	47	.5	47.5	97.5	70	70
187	15 "	39	8.	47	89	72	68
188	14 "	46	.5	46.5	90	94	90
189	13 "	46	0.	46	56	75	70
190	13 "	45	0.	45	75	70	80
191	15 "	23	22	45	85	60	60
192	16 "	31	17.5	[illegible]	115	60	80
193	13 "	43	1	44	85.5	91	85
194	15 "	23	20	43	72.5	82	70
195	15 "	40	3	43	97.5	70	75
196	15 "	40	3	43	92.5	70	80
197	13 "	31	11	42	110.5	85	69
198	13 "	21	19	40	92	70	80
199	14 "	36	4	40	90	80	75
200	15 "	32	3.5	35.5	80.5	79	70
201	14 "	34	1	35	105.5	68	60
202	15 "	25	2	27	75	70	70
203	14 "	22	1	23	95	58	70
204	14 "	19	3	22	78	70	65

CHAPTER V

STATISTICAL INTERPRETATION

In this chapter various statistical methods will be applied to the data collected. First, an explanation of these methods will be given and then an interpretation of them.

Statistical methods tend to analyze, summarize, and interpret data and thus render it more easily understood. They also increase the validity and accuracy of the interpretation of the data.

In the pages following the explanation of these methods, tables and graphs will be used in applying the statistical methods to the collected data.

A. GRAPHICAL METHOD: The graphical method of expressing frequency distribution which is used in this study is a very common and useful method because it presents the data more clearly and effectively. Many persons understand graphs but have much trouble in reading tables intelligently. The writer has made use of the broken-line graph, better known as the frequency polygon, to express and compare the distributions of the ability to learn scores, the Stanford Arithmetic scores, language material scores of the ability to learn test, non-language material scores of the ability to learn test, seventh grade average arithmetic marks, and the eighth grade average arithmetic marks.

The horizontal axis in each graph represents the scale along which the intervals of the frequency distributions are plotted. The vertical axis in each graph represents the number of pupils. The lines in each graph do not adhere perfectly to the normal frequency curve, probably because of the small number of cases.

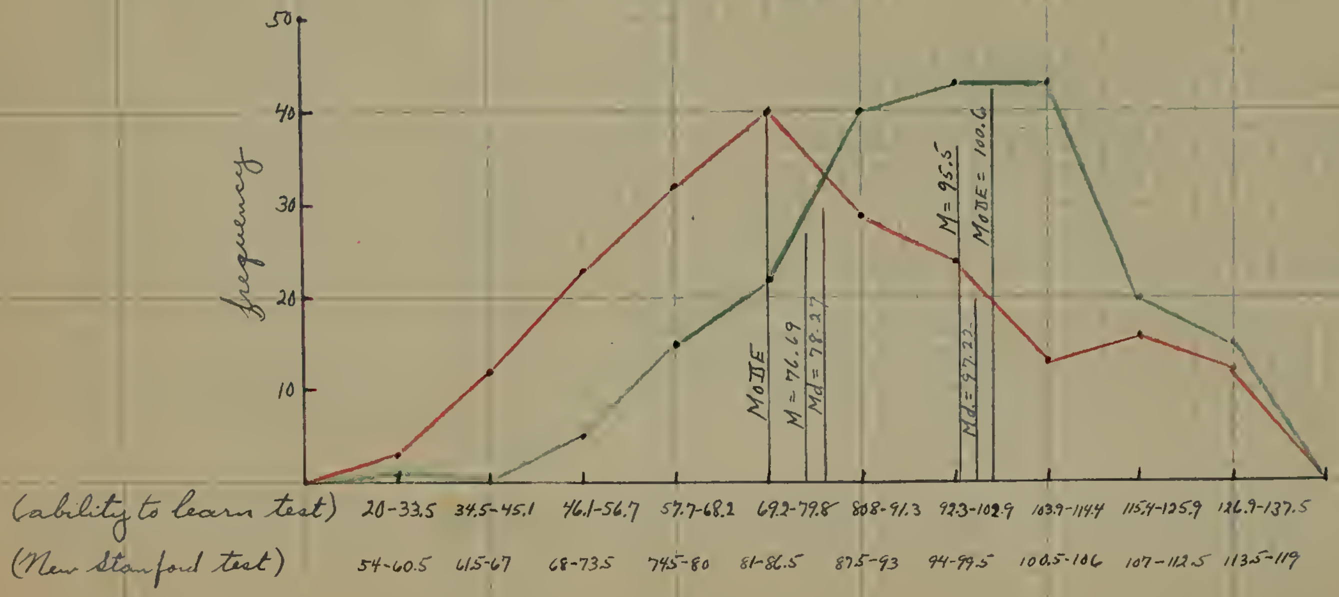
There is, however, a certain rise in the center of the curve in each graph which shows that the greater number of the 104 cases have a narrower range in score. If the number had been increased to [illegible] or [illegible], the curve would have become smoother and more like the normal frequency curve.

Figure I shows the distribution of the ability to learn arithmetic scores and the New Stanford arithmetic test scores of 104 pupils of the entering freshmen class. Although the curve representing the New Stanford scores has two modes and reaches a peak three points higher than the curve representing the ability to learn curve, the latter appears to resemble more closely the normal frequency curve. The curve representing the ability to learn arithmetic scores is positively skewed while the curve representing the New Stanford scores is negatively skewed.

Figure II shows the frequency distribution curves of the average arithmetic marks of the school seventh and eighth grade for 104 cases. The curve representing the seventh grade has a peak of (36) which is five points higher than the peak in the curve representing the eighth grade (31). Each curve has two high points, the seventh grade curve at 30 and 36 and the eighth grade at 28 and 31. Each curve is very similar to the normal frequency curve. The curve representing the seventh grade marks is positively skewed while the eighth grade curve is negatively skewed.

Figure III shows the frequency distribution curves of the sense material and the non-sense material of the ability to learn

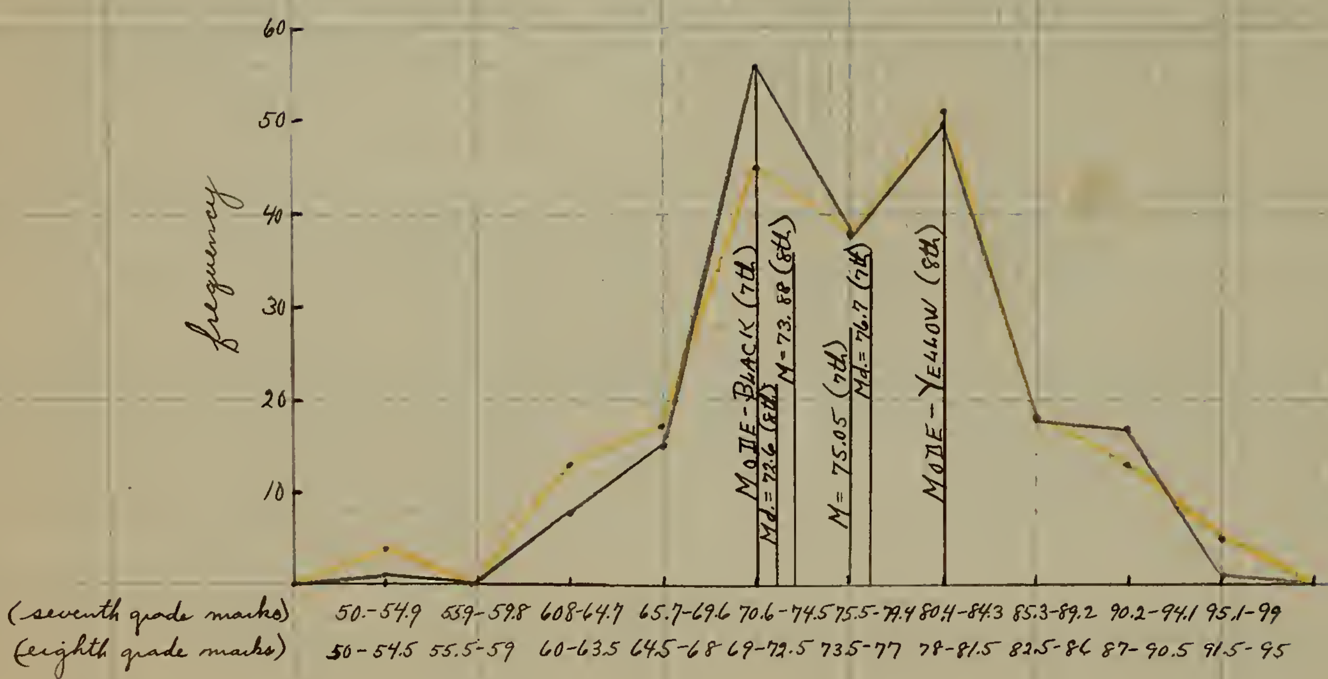
Figure I



Red Line---- ability to learn arithmetic test scores.

Green Line---- New Stanford arithmetic test scores.

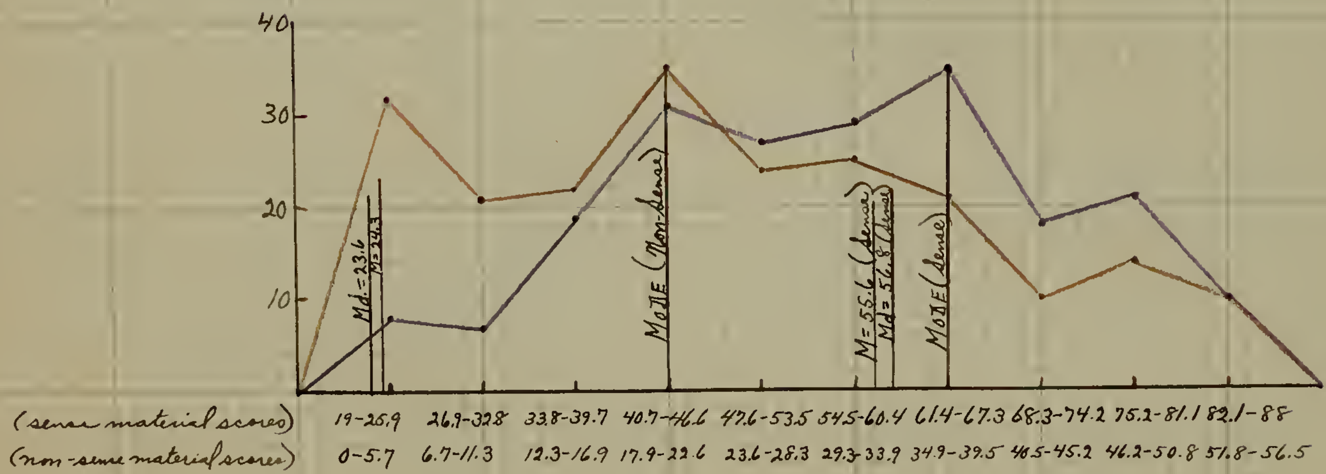
Figure II



Black Line---- average arithmetic marks of the seventh grade.

Yellow Line---- average arithmetic marks of the eighth grade.

Figure III



Purple Line---- sense material scores of the ability to learn test.

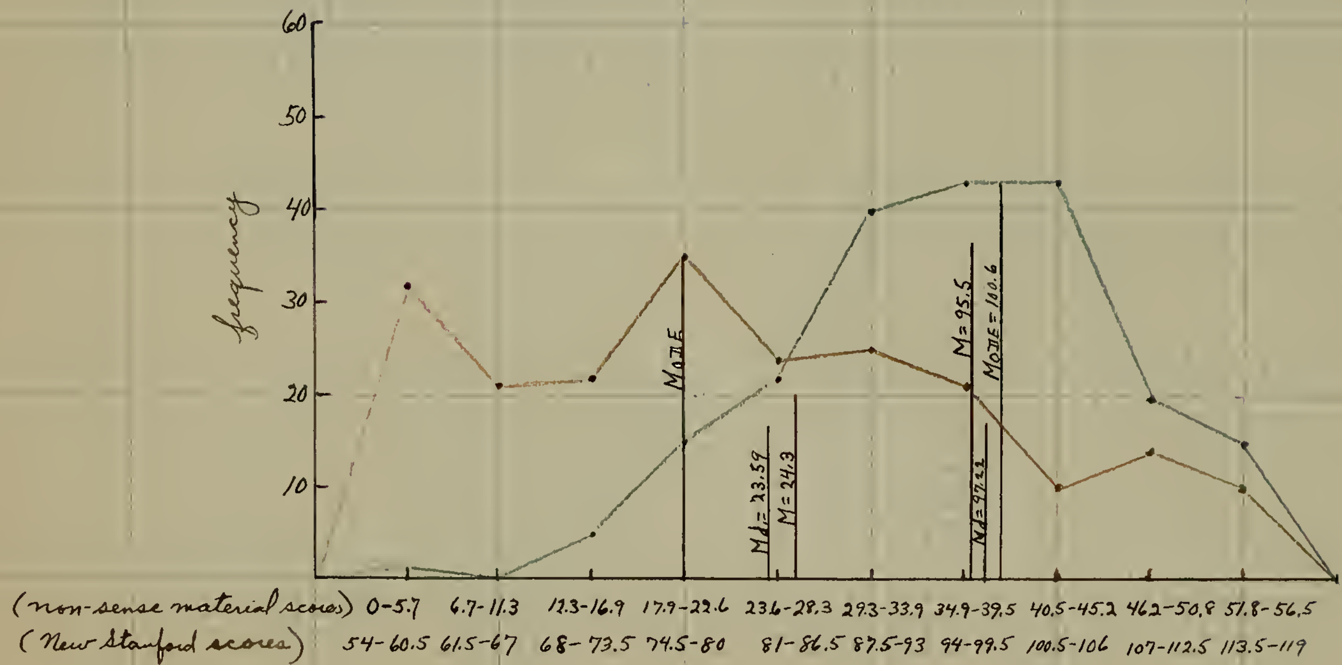
Brown Line---- non-sense material scores of the ability to learn test.

arithmetic test. These curves represent 104 cases. Each curve reaches a high peak of 25 intervals. Each curve has two high points, the sense material curve at 21 and 25 and the non-sense material curve at [illegible] and 15. The curve representing the sense material is negatively skewed and the curve representing the non-sense material is positively skewed. Each curve is similar to the normal frequency curve.

Figure IV shows the frequency distribution curves of the non-sense material scores of the ability to learn arithmetic test and the New Stanford arithmetic test scores of the 104 cases. Each curve has two high points, the non-sense material curve at [illegible] and 25 and the New Stanford curve at 43. The peak of the New Stanford curve (43) is eight points higher than the highest peak of the non-sense material (25). The curve representing the non-sense material is positively skewed and the curve representing the New Stanford scores is negatively skewed. Neither curve resembles the normal frequency curve very well.

Figure V shows the frequency distribution curves of the ability to learn arithmetic scores and that of the school seventh grade marks of 104 cases. The curve representing the school seventh grade average arithmetic marks has two high points at [illegible] and 50. The curve representing the ability to learn arithmetic test reaches a peak of 40 which is 10 points lower than the highest peak in the curve representing the seventh grade marks. The ability to learn arithmetic test curve is positively skewed and the seventh grade curve is negatively skewed. The ability to learn arithmetic curve appears to resemble the normal frequency curve more closely than the school marks.

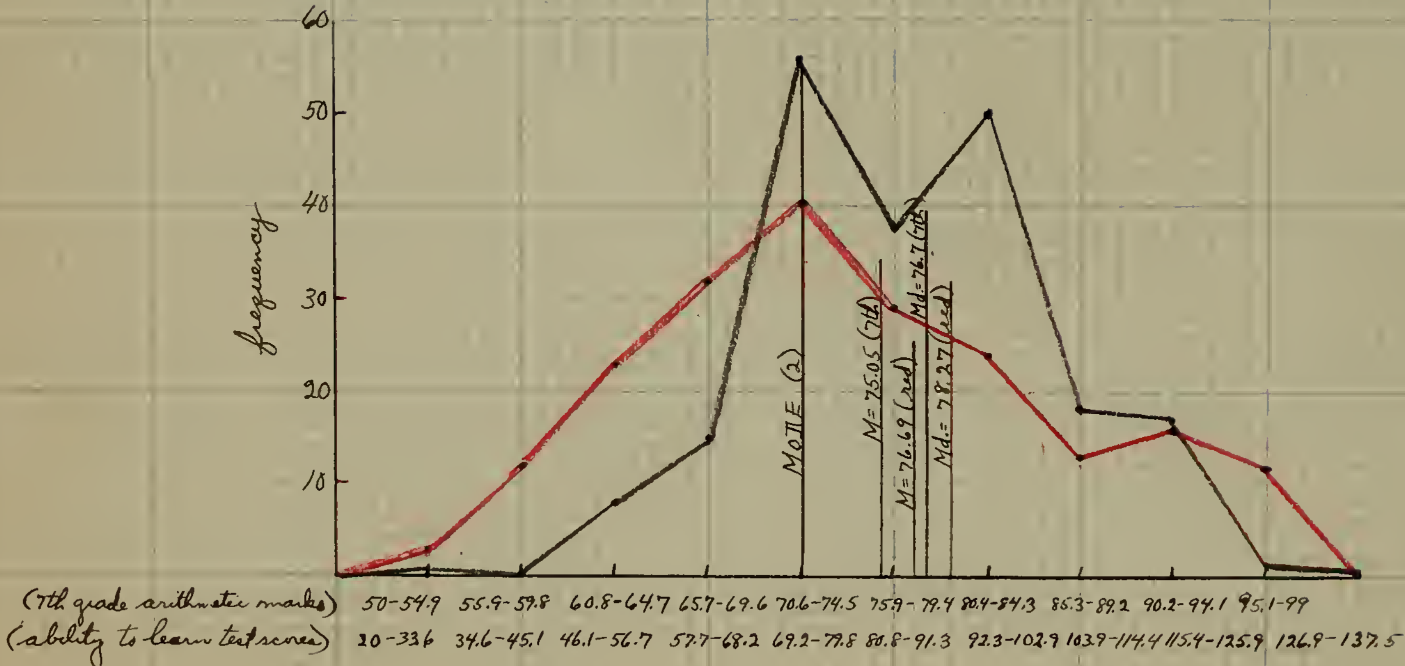
Figure IV



Brown Line---- non-sense material scores of the ability to learn test.

Green Line---- New Stanford arithmetic scores.

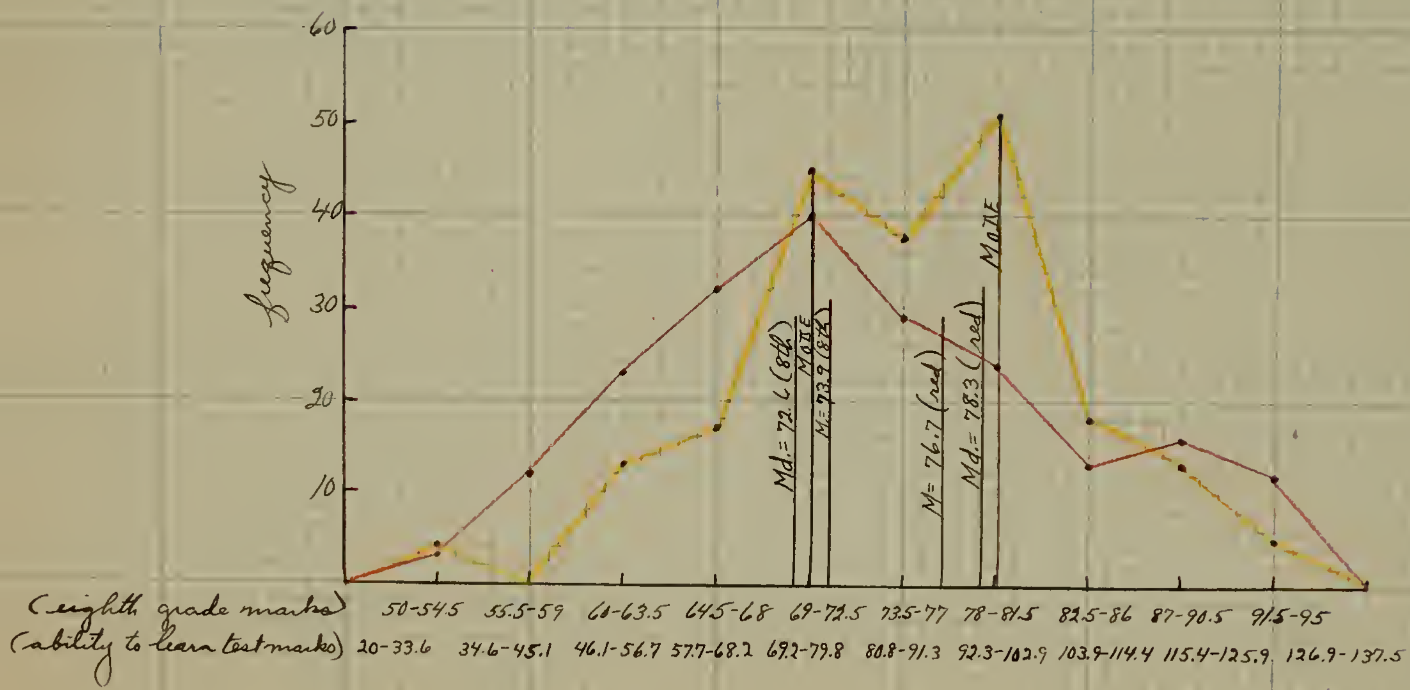
Figure V



Black Line---- average arithmetic marks--Seventh Grade.

Red Line---- ability to learn arithmetic scores.

Figure VI



Yellow Line---- average arithmetic marks--Eighth Grade.

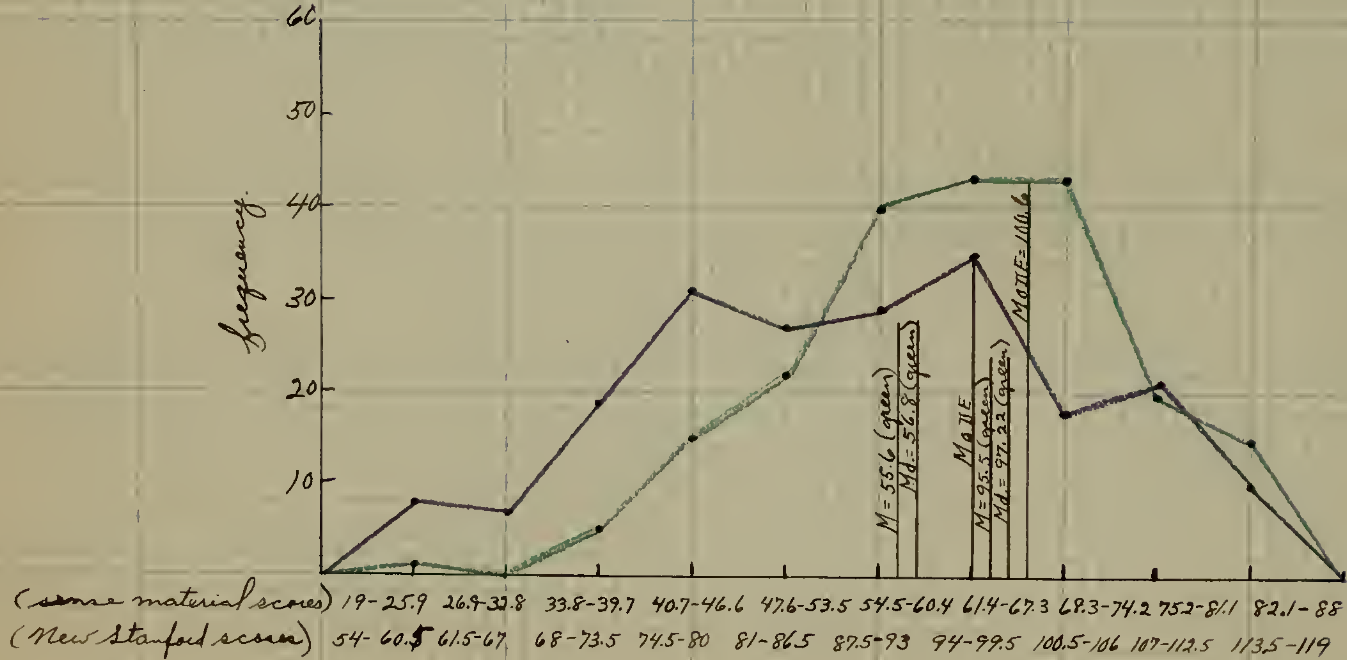
Red Line---- ability to learn arithmetic scores.

Figure VI shows the frequency distribution curves of the ability to learn arithmetic test scores and the eighth grade average arithmetic marks of 204 cases. The curve representing the school eighth grade average arithmetic marks has two high points at 45 and 51. The ability to learn arithmetic test scores reaches a peak of 40 which is eleven points lower than the highest peak in the curve representing the eighth grade average arithmetic marks. It does, however, resemble the normal frequency curve more closely than the school marks. The ability to learn curve is positively skewed and the eighth grade curve is negatively skewed.

Figure VII shows the frequency distribution curves of the sense material scores of the ability to learn arithmetic test and of the New Stanford arithmetic scores of 204 cases. The curve representing the New Stanford arithmetic scores rises more steadily and reaches a higher level than the other. Each curve has two high points, the New Stanford at 43 and the sense material at 32 and 35. The New Stanford curve more closely resembles the normal frequency curve in the center while the curve representing the sense material scores more closely resembles it at the ends.

Figures VIII and IX show the frequency distribution curves of the sense material scores of the ability to learn arithmetic test with that of the seventh and eighth grade average arithmetic marks of 204 cases. Each of the three curves has two high points. The curve representing the sense material scores reaches two high points at 31 and 35. The curve representing the seventh grade

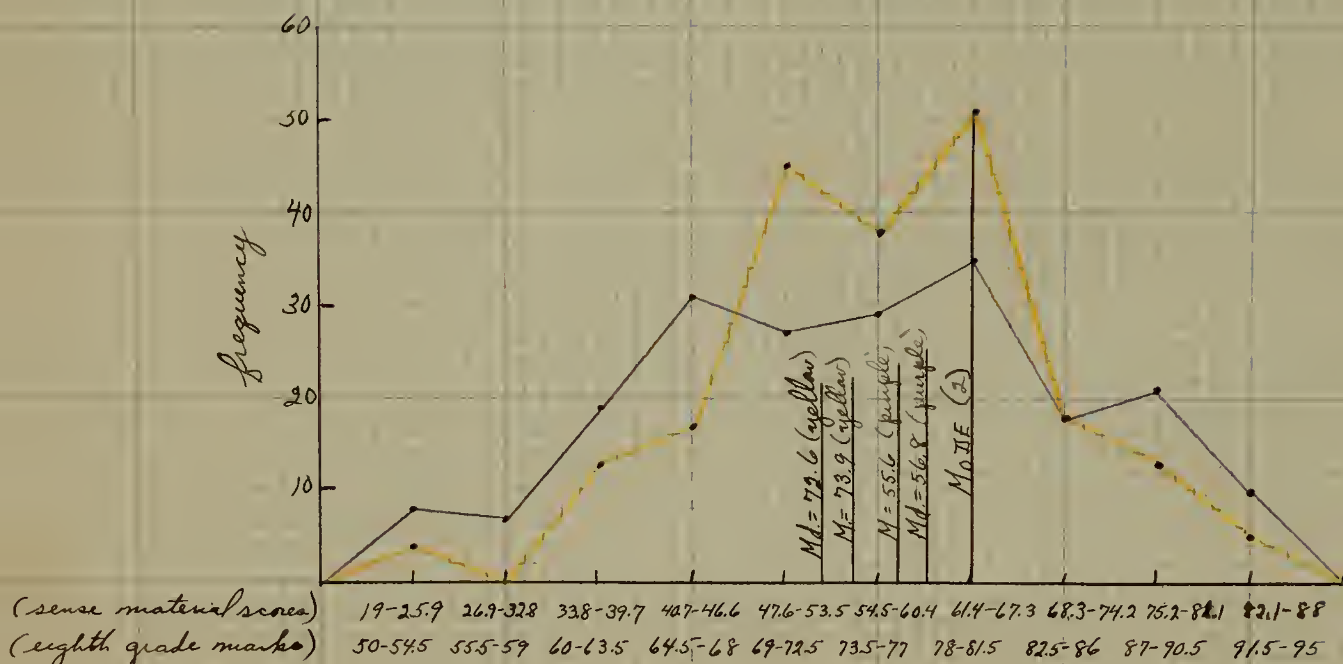
Figure VII



Purple Line---- sense material scores of the ability to learn arithmetic test,

Green Line---- New Stanford arithmetic scores.

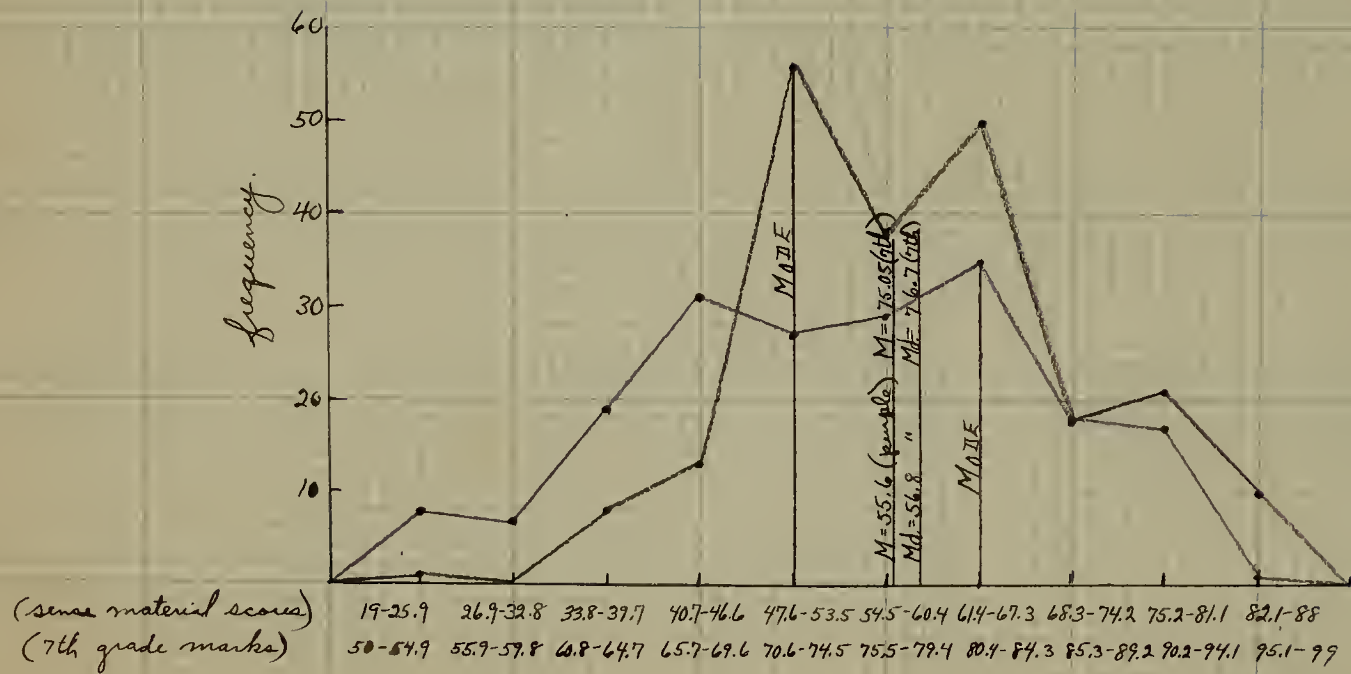
Figure VIII



Purple Line---- sense material scores of the ability to learn arithmetic test.

Yellow Line---- average arithmetic marks--Eighth Grade.

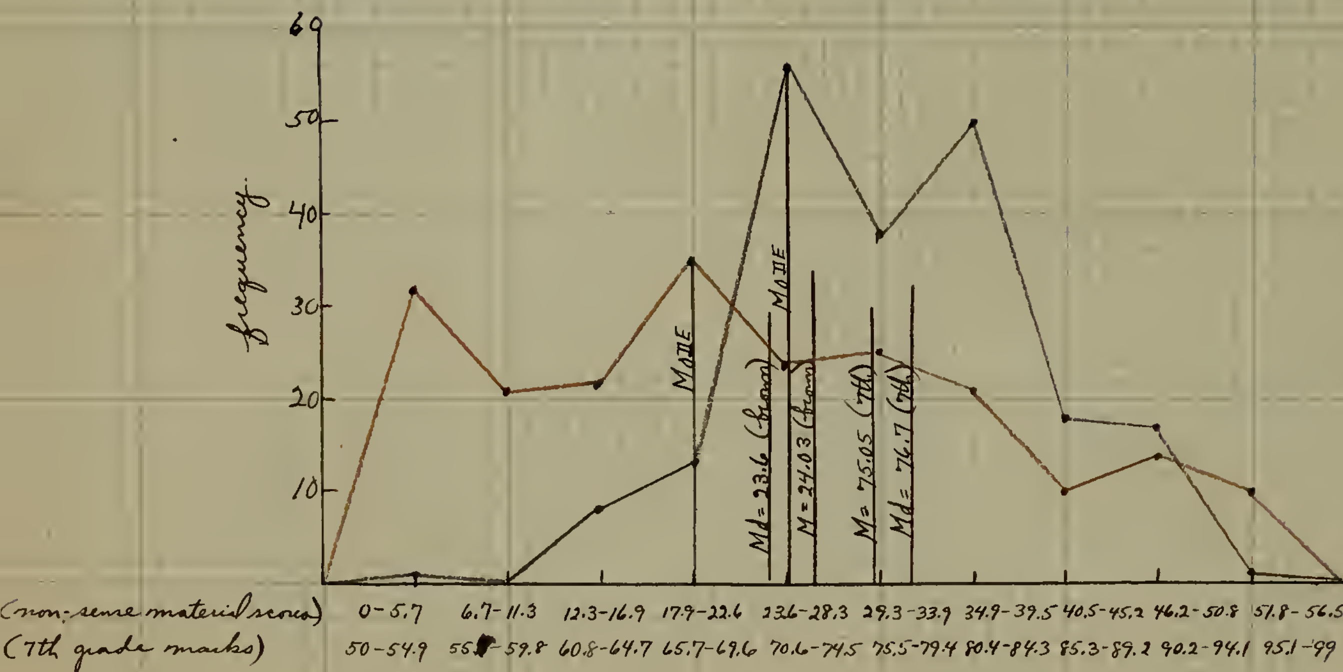
Figure IX



Purple Line---- sense material scores of the ability to learn arithmetic test.

Black Line---- average arithmetic marks-- Seventh Grade.

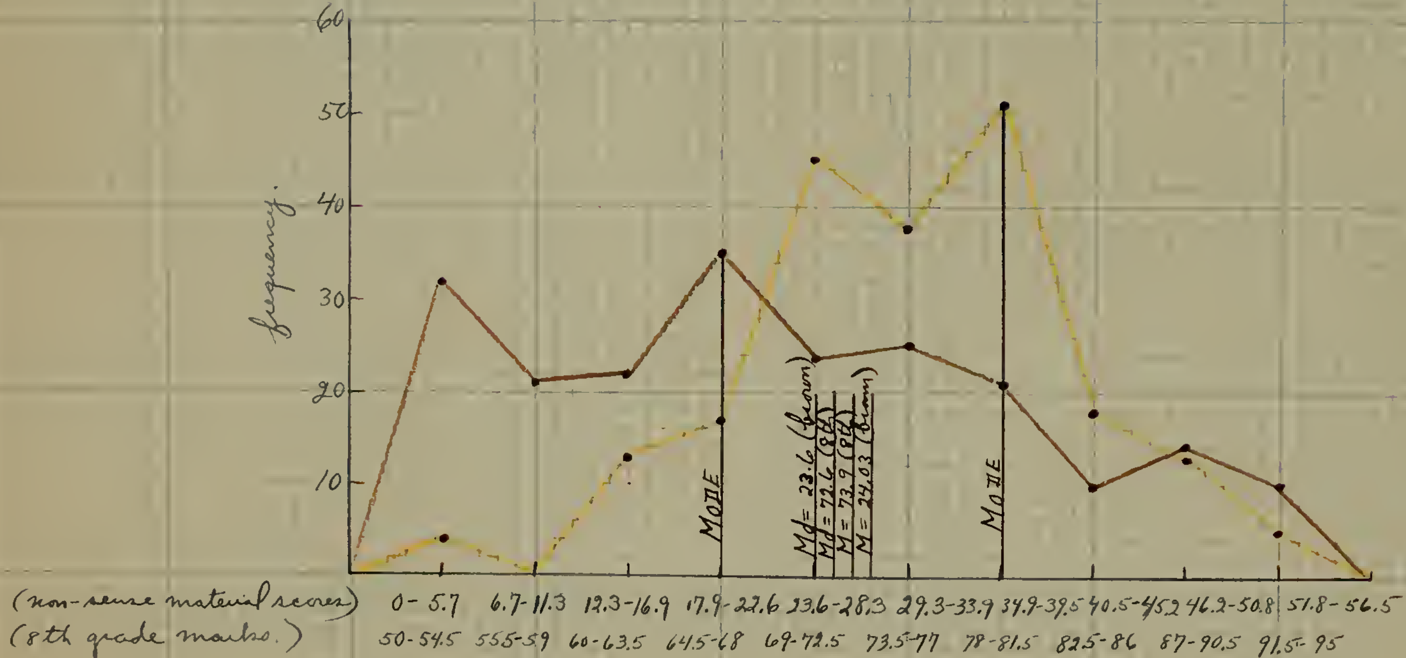
Figure X



Brown Line---- non-sense material scores of the ability to learn arithmetic test.

Black Line---- average arithmetic marks--Seventh Grade.

Figure XI



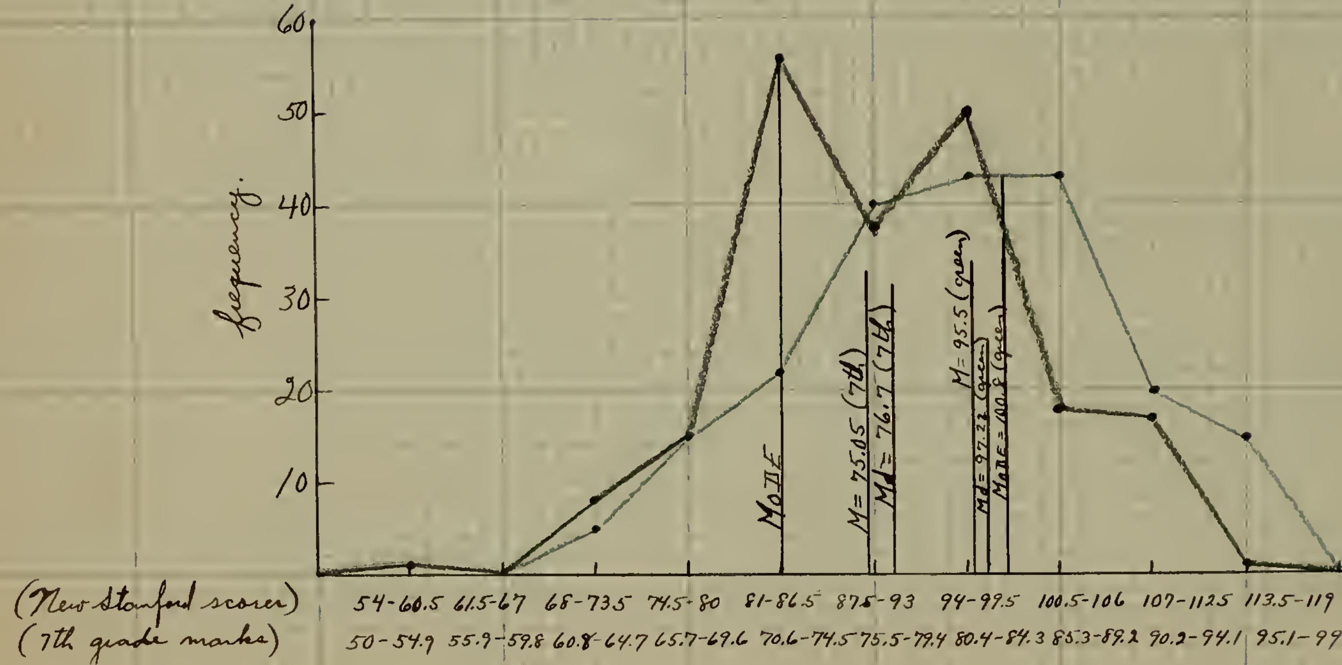
Brown Line----non-sense material scores of the ability to learn arithmetic test.

Yellow Line---- average arithmetic scores--Eighth Grade.

average arithmetic marks reaches two high points at 50 and 56. The curve representing the eighth grade average arithmetic marks reaches two high points at 45 and 51. The eighth grade curve has a peak which is 19 points higher than the highest peak of the sense material curve. The seventh grade curve has a peak which is 21 points higher than the highest peak on the sense material curve. In appearance, however, the curve representing the sense material scores in each graph more closely follows the normal frequency curve than the curve representing the school marks. The sense material and the eighth grade curves are negatively skewed and the seventh grade curve is positively skewed.

Figures [illegible] and [illegible] show the frequency distribution curves of the non-sense material scores of the ability to learn arithmetic test with that of the seventh and eighth grade average arithmetic marks of 104 cases. Each of the three curves has two high points. The curve representing the non-sense material scores reaches two high points at [illegible] and [illegible]. The curve representing the seventh grade average arithmetic marks reaches two high points at 50 and 56. The curve representing the eighth grade average arithmetic marks reaches two high points at 45 and 51. The seventh grade curve has a peak which is twenty-one points higher than the highest peak on the non-sense material curve. The eighth grade curve has a peak which is sixteen points higher than the highest peak on the non-sense material curve. The non-sense material and the seventh grade curves are positively skewed while the eighth grade curve is negatively skewed. All three curves show very little resemblance to the normal frequency curve.

Figure XII



Green Line---- New Stanford arithmetic marks.

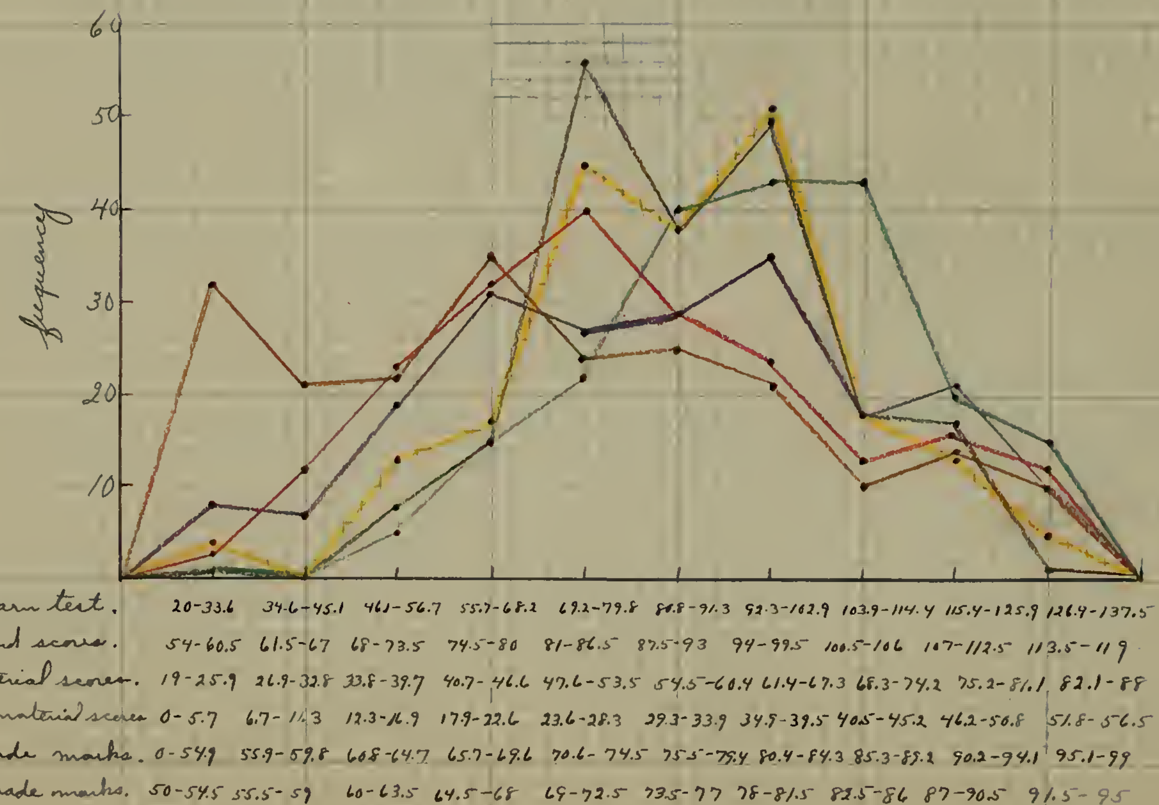
Black Line---- average arithmetic marks--Seventh Grade.

Figure XIII

Yellow Line---- average arithmetic marks-- Eighth Grade.

Green Line---- New Stanford arithmetic scores.

Figure XIV



frequency
60
50
40
30
20
10
RED - - ability to learn test. 20-33.6 34.6-45.1 46.1-56.7 55.7-68.2 69.2-79.8 80.8-91.3 92.3-102.9 103.9-114.4 115.4-125.9 126.9-137.5
GREEN - New Stanford scores. 54-60.5 61.5-67 68-73.5 74.5-80 81-86.5 87.5-93 94-99.5 100.5-106 107-112.5 113.5-119
PURPLE - sense material scores. 19-25.9 26.9-32.8 33.8-39.7 40.7-46.6 47.6-53.5 54.5-60.4 61.4-67.3 68.3-74.2 75.2-81.1 82.1-88
BROWN - non-sense material scores 0-5.7 6.7-11.3 12.3-16.9 17.9-22.6 23.6-28.3 29.3-33.9 34.9-39.5 40.5-45.2 46.2-50.8 51.8-56.5
BLACK - seventh grade marks. 0-54.9 55.9-59.8 60.8-64.7 65.7-69.6 70.6-74.5 75.5-79.4 80.4-84.3 85.3-89.2 90.2-94.1 95.1-99
YELLOW - eighth grade marks. 50-54.5 55.5-59 60-63.5 64.5-68 69-72.5 73.5-77 78-81.5 82.5-86 87-90.5 91.5-95

Figure XII shows the frequency distribution curves of the school seventh grade average arithmetic marks and the scores obtained on the New Stanford arithmetic test. Each curve has two high points, the New Stanford curve at [illegible] (both same) and the seventh grade curve at [illegible] and [illegible]. The highest peak of the seventh grade curve ([illegible]) is thirteen points higher than the peak of the New Stanford curve ([illegible]). The New Stanford test curve appears to resemble more closely the normal frequency curve than the seventh grade curve. The New Stanford curve is negatively skewed and the seventh grade curve is positively skewed.

Figure XIII shows the frequency distribution curves of the school eighth grade marks and the scores obtained on the New Stanford arithmetic test. Each curve has two high points, the New Stanford at [illegible] (both same) and the eighth grade curve at [illegible] and [illegible]. The highest peak of the eighth grade curve ([illegible]) is eight points higher than the peak of the New Stanford curve ([illegible]). Both curves are negatively skewed. The New Stanford test curve appears to resemble more closely the normal frequency than the eighth grade curve.

Figure XIV shows the frequency distribution curves of all six sets of measures used in this study. The curve representing the seventh grade marks reaches a peak higher than any of the other curves. The curves representing the ability to learn test scores and the New Stanford test scores appear to resemble more closely the normal frequency curve than any of the other curves. The peak in each curve is different although some are within a few points of each other.

Summary of Graphical Method

Figure I- These curves appear to indicate that there is little to choose between the reliability of the ability to learn test and the New Stanford test. The mode, median, and the mean of each curve are grouped together rather closely. Each curve follows the normal frequency curve as well as could be expected for such a small representative sample.

Figure III presents the seventh and eighth grade curves in which the mode, median, and the mean in each curve are grouped together rather closely. These two curves also follow the normal frequency curve as well as could be expected for such a small representative sample.

Figure IV presents the non-sense material and New Stanford curves in which the mode, median and mean in each curve are grouped together rather closely. Neither curve resemble the normal frequency curve very closely. There is little to choose between the reliability of the two curves.

Figure VII-- This figure shows the frequency distribution curve of the sense material and New Stanford scores and would seem to indicate that one curve is just as reliable as the other. The mode, median, and the mean of each curve are grouped together rather closely. The New Stanford curve follows the normal frequency curve very closely in the center. The sense material curve follows the normal curve very closely at the ends.

Median[29] The median is the point on the scale on each side of which one-half of the measures fall. It is obtained by counting in from either end of the distribution until exactly one-half of the cases have been taken and determining the point which has been reached to accomplish this. The term median is also in

Correlation[20]-- Correlation means a relation or correspondence between two sets of measures. For example, one may wish to find the relationship between a pupil's marks in arithmetic and science or between the height and weights of pupils. This relationship is called correlation, a term derived from co-relation. Correlation then is a study of two or more facts or measures concerning a group of individuals. The degree of correlation, however, does not furnish proof that either of the two facts affect each other, nor whether both are affected by some other variable.

Coefficient of Correlation[21] -- In the general use of the term, the coefficient of correlation is a numerical index which compares and summarizes the extent to which the corresponding measures in two series depart from their respective averages. The method used in this study to determine the coefficients of correlation is the product-moment method by Karl Pearson, the English statistician, and is abbreviated by 'r'. The product-moment coefficient is such an expression dealing with straight line relationship only. It ranges in value from plus one (+1) through zero to minus one (-1).

Plus one (+1) means perfect, direct relationship and minus one (-1) means perfect, inverse relationship. A zero coefficient means no relationship. For example, if a person who gets first place in one test also gets first in the other, and if another person who gets second in the one, gets second in the other and so on through to the last in one who also gets last in the other, such would be an example of perfect, positive correlation. Similarly, if the first in one test is last on the other, and if the second on the one is next to last on the other, and so on through to the last on the one who gets first place on the other

such would be a case of perfect ne

TABLE II

Calculation of the median of a frequency distribution. The measures are the scores obtained in the Ability to Learn Arithmetic Test.

Scores	f
136 - 140	3
131 - 135	6
126 - 130	5
121 - 125	5
116 - 120	6
111 - 115	6
106 - 110	7
101 - 105	7
96 - 100	12
91 - 95	9
86 - 90	10
81 - 85	14
76 - 80	22
71 - 75	15
66 - 70	13
61 - 65	12
56 - 60	17
51 - 55	7
46 - 50	1[illegible]
41 - 45	[illegible]
36 - 40	2
31 - 35	2
26 - 30	1
20 - 25	2
	N = 204

$$Mdn. = l + \frac{\frac{N}{2} - F}{f}\, i$$

$$= 76 + \frac{102 - 92}{22}\, 5$$

$$= 76 + \frac{10}{22}\, 5$$

$$= 76 + \frac{50}{22}$$

$$= \frac{17[illegible]}{22}$$

$$Mdn. = 78.27$$

Reference — (13)

TABLE III

Calculation of the median of a frequency distribution.
The measures are the scores obtained in the
New Standard Stanford Arithmetic Test.

Scores	f
116 - 120	7
111 - 115	10
106 - 110	20
101 - 105	34
96 - 100	41
91 - 95	25
86 - 90	28
81 - 85	17
76 - 80	14
71 - 75	7
66 - 70	0
61 - 65	0
56 - 60	0
50 - 55	1
	N = 204

$$Md. = l + \frac{\frac{1}{2}N - S}{f}\, i$$

$$= 96 + \frac{\frac{1}{2}\,204 - 92}{41}\, 5$$

$$= 96 + \frac{102 - 92}{41}\, 5$$

$$= 96 + \frac{10}{41}\, 5$$

$$= 96 + \frac{50}{41}$$

$$= \frac{3986}{41}$$

$$Md. = 97.219$$

Reference -- (15)

TABLE IV

Calculation of the median of a frequency distribution. The measures are the scores obtained in the Sense Material part of the Ability to Learn Arithmetic Test.

Scores	-f-
84 - 88	7
79 - 83	8
74 - 78	18
69 - 73	14
64 - 68	19
59 - 63	28
54 - 58	18
49 - 53	19
44 - 48	19
39 - 43	25
34 - 38	12
29 - 33	8
24 - 28	4
19 - 23	5
	N = 204

$$Md. = l + \frac{\frac{1}{2}N - c}{f} i$$

$$= 53.5 + \frac{\frac{1}{2}204 - 92}{18} 5$$

$$= 53.5 + \frac{102 - 92}{18} 5$$

$$= 53.5 + \frac{10}{18} 5$$

$$= 53.5 + \frac{50}{18}$$

$$= \frac{1013}{18}$$

$$Md. = 56.3$$

TABLE V

Calculation of the median of a frequency distribution.
The measures are the scores obtained in the
Non-Sense part of the Ability to
Learn Arithmetic Test.

Scores	f
54 - 59	7
48 - 53	13
42 - 47	8
36 - 41	14
30 - 35	33
25 - 29	19
19 - 24	34
13 - 18	32
7 - 12	21
0 - 6	23
	N = 204

$$Md. = l + \frac{\frac{1}{2} N - c}{f} i$$

$$= 19 + \frac{\frac{1}{2} 204 - 76}{34} 6$$

$$= 19 + \frac{102 - 76}{34} 6$$

$$= 19 + \frac{26}{34} 6$$

$$= 19 + \frac{156}{34}$$

$$= \frac{802}{34}$$

$$Md. = 23.588$$

TABLE VI.

Calculation of the median of a frequency distribution. The measures are the Seventh Grade Marks obtained by the 204 pupils being studied.

Scores	f
86 - 90	24
81 - 85	23
76 - 80	64
71 - 75	32
66 - 70	47
61 - 65	8
56 - 60	5
51 - 55	1
	N = 204

$$Md. = l + \frac{\frac{1}{2}N - F}{f} i$$

$$= 76 + \frac{\frac{1}{2}204 - 93}{64} 5$$

$$= 76 + \frac{102 - 93}{64} 5$$

$$= 76 + \frac{9}{64} 5$$

$$= 76 + \frac{45}{64}$$

$$= \frac{4909}{64}$$

$$Md. = 76.703$$

Reference -- (1[illegible])

TABLE XII

Calculation of the median of a frequency distribution. The measures are the Eighth Grade Marks obtained by the 204 pupils being studied.

Scores	f
91 - 95	5
86 - 90	13
81 - 85	18
76 - 80	56
71 - 75	43
66 - 70	43
61 - 65	11
56 - 60	11
50 - 55	4
	N = 204

$$Md. = l + \frac{\frac{1}{2}N - F}{f} i$$

$$= 71 + \frac{\frac{1}{2}204 - 69}{43} 5$$

$$= 71 + \frac{102 - 69}{43} 5$$

$$= 71 + \frac{33}{43} 5$$

$$= 71 + \frac{165}{43}$$

$$= \frac{3218}{43}$$

Md. = 7[illegible].5[illegible]1

Reference -- (1[illegible])

ative correlation. W. C. Trow[22] says that an example of zero or no correlation at all would be between intelligence and the number of letters in people's names.

Professor H. S. Rugg[23] claims that for educational purposes, a correlation that is less than .15 or .20 is "Negligible", one ranging from .15 or .20 to .35 or .40 is "Present but low"; it is "markedly present" if it exists from .35 or .40 to .50 or .60. If the index is from .60 or .70 up, the correlation is "high".

W. C. Trow[24] says that a correlation from .05 to .20 is very low; from .20 to .40 is low; from .40 to .60 is substantial; from .60 to .80 is high and from .80 to .95 is very high.

F. W. Harper[25] quotes King as saying that if the coefficient of correlation index is more than six times the size of its probable error, there is a practical certainty of the existence of correlation. Also that if the probable error is very small, a correlation above .50 indicates decided correlation.

The formula for finding the coefficient of corrèlation by the product-moment method is $r = \frac{\frac{\Sigma xy}{N} - c_x\ c_y}{\sigma x \quad \sigma y}$

Probable Error-- This is a measure of reliability. It usually accompanies the coefficient of correlation such as $r = .52 \pm .03$. This means that the chances are even that the true coefficient of correlation would or would not be between .49 and .55 (Ref. 26) C. W. Odell[27] says that any measure of central tendency, variability, relationship, or the like characteristics, has a certain amount of unreliability when it is considered as representative of all cases of the sort with which it deals. In other words, one can never

Figure XV

Coefficient of Correlation between the ability to learn arithmetic scores and the New Stanford arithmetic test scores.

	10	20	30	40	50	60	70	80	90	100	110	120	130	T	dy	fdy	fd²y	Σx	Σxy
120																			
110				1	1		5	1	3	5	1	4	1	22	2	44	88	47	94
100			1	2	5	4	9	6	5	4	8	6	6	56	1	56	56	102	102
90		1		8	9	9	12	15	7	3	2	2		68	0	+100	0	0	0
80			1	8	8	9	6	3	4	1				40	-1	-40	40	-39	39
70		2		2	1	1	4	3	1	2		1		17	-2	-34	68	-3	6
60															-3	0	0	0	0
50							1							1	-4	-4	4	0	0
40														204		-78 / +22	256		241
30																			
20																			
T		3	2	21	24	23	37	28	20	15	11	13	7 = 204						
dx		-5	-4	-3	-2	-1	0	1	2	3	4	5	6						
fdx		-15	-8	-63	-48	-23	-157	28	40	45	44	65	42 = 107						
fd²x		75	32	189	96	23	0	28	80	135	176	325	252 = 1411						

$Cx = \frac{107}{204} = .5247$ $\quad c^2x = .2751$ $\quad cx\,Cy = .0565$

$cy = \frac{22}{204} = .1078$ $\quad c^2y = .0116$

$\sigma^2 x = 6.9166 - .2751 = 6.6415$

$\sigma x = 2.577$

$S^2x = \frac{1411}{204} = 6.9166$

$\sigma^2 y = 1.2509 - .0116 = 1.2392$

$\sigma y = 1.113$

$S^2y = \frac{256}{204} = 1.2509$

$$r = \frac{\frac{\Sigma xy}{N} - cx\,cy}{\sigma x \;\; \sigma y}$$

$$= \frac{\frac{241}{204} - .0565}{2.577 \times 1.113}$$

$$= \frac{1.0758}{2.8682}$$

$r = .38 \pm .04$

$$P.E. = .6745 \frac{1 - r^2}{\sqrt{N}}$$

$$= .6745 \frac{1 - (.38)^2}{\sqrt{204}}$$

$$= .6745 \frac{1 - .1444}{14.28}$$

$$= .6745 \frac{.8556}{14.28}$$

$$= .6745 \times .0599$$

$P.E. = .04$

TABLE VIII

This table shows a comparison of correlations. Six sets of measures were correlated with one another

Non-Sense Material of the Ability Test vs. School Seventh Grade Marks.	.37 ± .06
Sense Material of the Ability Test vs. School Eighth Grade Marks.	.28 ± .04
Non-Sense Material of the Ability Test vs. School Eighth Grade Marks.	[illegible] ± .04
Ability to Learn Arithmetic Test vs. School Eighth Grade Marks.	.42 ± .04
Ability to Learn Arithmetic Test vs. School Seventh Grade Marks.	.44 ± .04
Ability to Learn Arithmetic Test vs. New Stanford Standard Arithmetic Test.	.35 ± .04
School Eighth Grade Marks vs. School Seventh Grade Marks.	.56 ± .03
School Eighth Grade Marks vs. New Stanford Standard Arithmetic Test.	.38 ± .04
School Seventh Grade Marks vs. New Stanford Standard Arithmetic Test	.43 ± .04
Sense Material of the Ability Test vs. Non-Sense Material of the Ability Test.	.43 ± .04
Sense Material of the Ability Test vs. New Standford Standard Arithmetic Test.	.30 ± .04
Non-Sense Material of the Ability Test vs. New Stanford Standard Arithmetic Test.	.33 ± .04
Sense Material of the Ability Test vs. School Seventh Grade Tests.	.36 ± .04

Reference-- (19)

be sure that the sample upon which the measure is based is truly
rand
random or representative.

W. C. Trow[24] says the more cases studied, the more representative and dependable the correlation is. The probable error of a coefficient of correlation is used to express the extent of this dependability. If the coefficient is less than three times the probable error, it is not dependable.

In determining the coefficients of correlation in this study, only a sample of all possible cases available was used. For this reason the probable error accompanies each correlation to clarify the probable magnitude of the true coefficients.

Since T. H. Harper quotes King as saying that the coefficient of correlation should be six times the probable error to be reliable and W. C. Trow claims it should be at least three times the probable error and C. W. Odell claims that it should be three to five times the probable error, the writer believes that a conservative ratio would be four. If the coefficient of correlation is found to be four times the probable error, it has a fair degree of reliability.

The formula for finding the probable error is P. E. = .6745 $\frac{1-r^2}{\sqrt{N}}$

Non-Sense Material of the Ability to Learn Arithmetic Test and the Seventh and Eighth Grade Marks. The correlation, obtained by the Pearsonian method, between the Non-Sense Material scores and the Seventh Grade marks is .37 ± .06. Since the index is above .30, it may be said that there exists a relationship between the two variables. Since the index is six times its probable error (.06), the correlation can be said to be reliable. That is, the

chances are even that the true correlation lies between .11 and .61. There is little doubt about the existence of positive relationship between these two sets of measures.

The correlation obtained between the Non-Sense Material scores and the Eighth Grade marks is $.32 \pm .04$. This correlation is also above .30 and so gives evidence of the existence of a relationship between the two variables. As the index is eight times its probable error, the index of relationship between the variables is said to be reliable. The true coefficient must lie between .16 and .48.

Summary -- Although the coefficient of correlation is smaller between the Non-Sense Material scores and the Eighth Grade marks than between Non-Sense Material scores and the Seventh Grade marks, the probable error is also smaller, and so it is reasonable to say that one is as reliable as the other.

Sense Material of the Ability to Learn Arithmetic Test and the Seventh and Eighth Grade Marks. The correlation obtained between the Sense Material scores and the Seventh Grade marks is $.36 \pm .04$, while the correlation index between the Sense Material scores and the Eighth Grade marks is $.29 \pm .04$. The first is above .30 and is nine times its probable error while the latter index is a little less than .30 and seven times its probable error. From this data the writer concludes that both indices are reliable and both give evidence that there exists a relationship between each series of measures. The first correlation is somewhat more reliable than the second, however, because its index is larger than the second index and its probable error is the same.

<u>Non-Sense and Sense Material of the Ability to Learn Arithmetic Test and the New Stanford Arithmetic Test Scores</u>. The correlation obtained by the Pearsonian method between the Non-Sense Material scores and the Stanford scores is .33±.04. As this index is above .30 and is eight times its probable error, there is evidence that there exists a relationship between the two sets of scores and also that the index has a fair degree of reliability. Since the probable error is .04, this means that the true coefficient of correlation must lie between .17 and .49.

The correlation index found between the Sense Material scores and the Stanford Test scores is .30±.04. As this index is at least .30, it is safe to say that there is a certain degree of relationship between the two measures. Since the correlation index is seven times the size of its probable error, it can be said to be reliable. The true correlation lies between .14 and .46.

<u>Summary</u> -- This second coefficient of correlation is a few points lower than the first coefficient of correlation, but the size of the probable error is the same. From this data it is reasonable to conclude that the first coefficient of correlation is more reliable than the second and presents a higher degree of relationship between the first set of measures than between the second set.

<u>Ability to Learn Arithmetic Scores and the New Stanford Arithmetic Scores</u>. The coefficient of correlation found between these two sets of measures is .39±.04. Since the index is above .30 there is evidence of the existence of a relationship between

the two series. As the index is almost ten times its probable error, it is quite reliable. The true correlation index must lie between .23 and .55.

__Ability to Learn Arithmetic Scores and the Seventh Grade Marks__. The correlation index obtained between these two sets of measures is .44±.04. This index is eleven times its probable error and so there is no doubt about the existence of a relationship between the two series nor about the reliability of the index.

__Ability to Learn Arithmetic Scores and the Eighth Grade Marks.__ The coefficient of correlation found by the Pearsonian method between these two sets of measures is .42±.04. As this index is above .30 it can be safely said that there is a relationship between the measures. The true correlation index must lie between .25 and .65. Since the coefficient of correlation is over ten times the size of its probable error, it can be claimed to be reliable.

__Summary__ — The coefficient of correlation between the scores of the Ability to Learn Arithmetic Test and previously obtained knowledge mentioned above, seems to indicate that there is a relationship between the two. Although the correlations are not exceedingly high, they are significant enough to show the presence of a relationship. The low probable error with each correlation also tends to prove that each index is fairly reliable.

__Partial Correlation__[20] Partial Correlation is sometimes preferred to determine whether the size of the coefficient of correlation found between two variables is due to the fact that one of the variables includes the other or that both variables are affected by outside factors or variables.

TABLE [illegible]

Partial Correlation of the First Order Involving Three Variables.

[illegible].—— Stanford Standard Arithmetic Test.
A.—— Ability to Learn Arithmetic Test.
[illegible].—— Eighth Grade Marks.
[illegible].—— Seventh Grade Marks.

$r_{[illegible]}$ = .2755

$r_{[illegible]}$ = .2476

$r_{[illegible]}$ = .2567

$r_{[illegible]}$ = .3192

$r_{[illegible]}$ = .1860

$r_{[illegible]}$ = .2764

$r_{[illegible]}$ = .3124

$r_{[illegible]}$ = .2831

$r_{[illegible]}$ = .2774

$r_{[illegible]}$ = .2724

$r_{[illegible]}$ = .4746

$r_{[illegible]}$ = .4764

$$r_{[illegible]} = \frac{[illegible]}{(1 - [illegible]^2)(1 - [illegible]^2)}$$

$$= \frac{[illegible]}{(1 - .[illegible]^2)(1 - .[illegible]^2)}$$

$$= \frac{[illegible]}{(.[illegible])(.[illegible])}$$

$$= \frac{[illegible]}{.3617}$$

$r_{[illegible]}$ = .3192

Reference -- ([illegible])

TABLE [illegible]

Partial Correlation of the Second Order involving four variables.

[illegible]. ———————— Standard Stanford Arithmetic Test.
[illegible]. ———————— Ability to Learn Arithmetic Test.
[illegible]. ———————— School Eighth Grade Marks.
[illegible]. ———————— School Seventh Grade Marks.

$r_{[illegible]}$ ——— .21[illegible]0

$r_{[illegible]}$ ——— .1362

$r_{[illegible]}$ ——— .2251

$r_{[illegible]}$ ——— .1969

$r_{[illegible]}$ ——— .2108

$r_{[illegible]}$ ——— .[illegible]135

$r_{[illegible]} = \dfrac{[illegible]}{(1 - ([illegible])^2)(1 - ([illegible])^2)}$

$= \dfrac{.2[illegible]31 - .2746 \times .27[illegible]}{(1 - .2746^2)(1 - .27[illegible]^2)}$

$= \dfrac{.2[illegible]31 - .07[illegible]}{(.92[illegible])(.925[illegible])}$

$= \dfrac{.2[illegible]3}{.9251}$

$r_{[illegible]} = .2251$

Reference — (2[illegible])

The size of the coefficient of correlation does not in any way indicate the nature of the relationship of the variables, while the partial correlation does. The limits of partial correlation may range in value from minus one (-1) through zero to plus one (+1).

Theoretically there is no limit to the number of variables that can be treated by partial correlation. The effect of the formula is to eliminate the influence of all variables except two (2) and to determine the remaining correlation between these two.

<u>Partial Correlation of the First Order</u>. The partial correlation of the first order obtained between the New Stanford Arithmetic scores with the Eighth Grade marks "partially out" is .1[illegible]6. This index is very low but it does indicate some existence and the true nature of the relationship between the two sets of measures.

Table [illegible] on page 66 shows the partial correlation between the Ability to Learn Arithmetic scores [illegible] the Eighth Grade marks with the New Stanford Arithmetic scored "partially out" to be .31[illegible]; between the Ability to Learn Arithmetic scores and the Seventh Grade marks with the New Stanford Arithmetic scores "partially out" to be .[illegible]274.

These partial correlations of the First Order are the only important ones determined in this study that are above .[illegible]0. The others range from .1[illegible] to .2[illegible].

<u>Summary</u> — It seems reasonable to assume from this data that the size of the index found by the coefficient of correlation method between any two series of measures in this study is not

effected to any degree by the variables including each other and if so, only slightly.

Partial Correlation of the Second Order. Table X on page 67 shows the partial correlation of the second order involving four variables. The different pairs of variables are correlated with the other pair "partially out".

In this study the indices calculated are found to be very low, ranging from .1362 to .4133 with the important ones being .18 and .19.

This data would seem to indicate that the size of the coefficients of correlation found in this study is effected only slightly by one variable including the other or by both variables being effected by outside factors or variables.

Multiple Correlation.[21] Multiple correlation is the correlation between one variable and two or more other variables. That is to say, it is the correlation between the first variable and the combined effect of all the others. It gives a little higher correlation.

Table XI on page 70 presents eleven multiple correlations involving three variables. These correlations are between five sets of variables used in this study. This work shows the correlation of one variable with the combined effect of two other variables. The various indices in this table range from .5[illegible] to .7195. They are fairly high but this was expected as stated above.

The multiple correlation between the Ability to Learn Arithmetic scores and the combined effect of the New Stanford Arithmetic scores and the Eighth Grade marks is .5775; when the combined effect of the Stanford scores and the Seventh Grade marks is used,

TABLE XI

Multiple Correlation of the Zero Order Involving three variables.

[illegible]. ------ Multiple Correlation.
[illegible]. ------ Standard Arithmetic Test.
[illegible]. ------ Ability to Learn Arithmetic Test.
[illegible]. ------ School Eighth Grade Arithmetic Marks.
[illegible]. ------ School Seventh Grade Arithmetic Marks.

[illegible] = .[illegible]

[illegible] = .5735

[illegible] = .71[illegible]

[illegible] = .5[illegible]7[illegible]

[illegible] = .5[illegible]

[illegible] = .6[illegible]5

[illegible] = .[illegible]15

[illegible] = .5[illegible]

[illegible] = .7106

[illegible] = .5[illegible]

[illegible] = .7132

[illegible] = .[illegible]

Reference -- (21)

the multiple correlation is .5[illegible]94; when the combined effect of the Seventh and Eighth Grade marks is used, the multiple correlation is .5898.

Summary -- Since these three indices are similar and the sizes are fairly high, it is reasonable to conclude that the combined effect of the different pairs of variables on the size of the coefficient of correlation regarding the Ability to Learn Arithmetic scores, is the same.

Coefficient of Correspondence by Quartiles.[33] This is a measure of the relationship between the scores in two series and is defined as the per cent of individuals who have the same relative position within the group in one series of measures as they have in the other. Of the three methods explained by O. [illegible]. Odell for obtaining the coefficient of correspondence, the coefficient of correspondence according to quartiles is the one used in this study. This method is very easy to follow and renders reliable results. The following is the procedure to follow: record one point for every pupil whose scores, in the two tests being compared, are in the same quartile; then add the column of points obtained and divide the sum by the number of cases in one series.

Table VII on page 7[illegible] shows that there is a 71.37% correspondence between the scores in the Non-Sense Material of the Ability to Learn Test and the New Stanford scores and a correspondence of 38.[illegible]% between the scores on the Sense Material of the Ability to Learn Test and the New Stanford Arithmetic scores.

In this table there is also a [illegible]% correspondence between

TABLE III

In this table is presented the Coefficient of Correspondence by Quartiles that were calculated between the six sets of measures used in this study.

Ability to Learn Arithmetic vs. Stanford Arithmetic Test	38.24% Correspondence
Ability to Learn Test vs. School Eighth Grade marks.	39.71% Correspondence
Ability to Learn Test vs. Seventh Grade School marks.	37.75% Correspondence
School Seventh Grade marks vs. School Eighth Grade marks.	50.95% Correspondence
Sense Material of the Ability to Learn Test vs. New Stanford Arithmetic Test.	38.84% Correspondence
Non-Sense Material of the Ability to Learn Test vs. New Stanford Test.	31.37% Correspondence
Sense Material of the Ability to Learn Test vs. School Seventh Grade Marks.	33.73% Correspondence
Non-Sense Material of the Ability to Learn Test vs. School Eighth Grade marks.	38.24% Correspondence
Sense Material of the Ability to Learn Test vs. School Eighth Grade marks.	38.24% Correspondence
Non-Sense Material of the Ability to Learn Test vs. Seventh Grade marks.	35.75% Correspondence

Reference -- (31)

the scores on the Sense Material of the Ability to Learn Arithmetic Test and the Seventh Grade marks while there is a 35.73% correspondence between the scores of the Non-Sense Material of the Ability to Learn Test and the Seventh Grade Marks.

Summary -- From the data collected in table VII, there seems to be a lack of uniformity for which the writer is without explanation. The scores of the Sense Material give a higher per cent of correspondence than the Non-Sense Material when correlated with the New Stanford Arithmetic Scores, and yet the scores of the Non-Sense Material give a higher per cent of correspondence than the Sense Material when correlated with the Seventh Grade marks. The per cent of correspondence for both the Sense and Non-Sense is the same when they are correlated with the Eighth Grade marks.

When the Total Ability to Learn Arithmetic scores are correlated with the New Stanford Arithmetic scores, with the Seventh Grade Arithmetic marks, and with the Eighth Grade marks, the per cent of correspondence by quartiles is different in each.

TABLE VIII

This table shows the range of quartiles used in the Ability to Learn Arithmetic scores, the New Stanford Arithmetic scores, the Sense Material of the Ability to Learn Test, the Non-Sense Material of the Ability to Learn Test, the School Seventh Grade marks, and the School Eighth Grade marks.

<u>Ability to Learn Arithmetic scores.</u>

First Quartile (20 - 60.7)
Second " (60.8 - 76.3) $Q_1 = 60.7$
Third " (76.4 - 96)
Quartile Deviation 17.65 $Q_3 = 96$

<u>Stanford Arithmetic Test.</u>

First Quartile (50 - 88.1)
Second " (88.2 - 97.3) $Q_1 = 88.1$
Third " (97.3 - 103.9)
Quartile Deviation 7.9 $Q_3 = 103.9$

<u>Sense Material of the Ability to Learn Test.</u>

First Quartile (19 - 43.4)
Second " (43.5 - 56.8) $Q_1 = 43.4$
Third " (56.9 - 67.9)
Quartile Deviation 12.25 $Q_3 = 67.9$

<u>Non-Sense Material of the Ability to Learn Test.</u>

First Quartile (0 - 14.3)
Second " (14.4 - 23.6) $Q_1 = 14.3$
Third " (23.7 - 34.4)
Quartile Deviation 10.05 $Q_3 = 34.4$

<u>School Seventh Grade Marks.</u>

First Quartile (50 - 69.9)
Second " (70 - 76.7) $Q_1 = 69.9$
Third " (76.8 - 80.7)
Quartile Deviation 5.4 $Q_3 = 80.7$

<u>School Eighth Grade Marks.</u>

First Quartile (50 - 68.9)
Second " (69 - 72.6) $Q_1 = 68.9$
Third " (72.7 - 79.7)
Quartile Deviation 5.4 $Q_3 = 79.7$

Reference — (34)

CHAPTER VI

INTERPRETATION OF RESULTS

Graphical Results: The frequency distribution curves of the Stanford scores and the ability to learn arithmetic scores, Figure I, follow the normal distribution curve as nearly as could be expected when only a small sample of 204 pupils is used. If the number had been 500, the curves would have been smoother. The curve representing the ability to learn arithmetic scores does not rise as regularly as the curve representing the New Stanford scores, but it follows more closely the normal frequency curve. Figure I would seem to indicate that the ability to learn arithmetic test is just as reliable as the New Stanford arithmetic test.

In Figure III the distribution curves for the sense material scores and the non-sense material scores of the ability to learn test are shown. The curve for the non-sense material rises quite rapidly to a frequency point of 21. It descends suddenly to a point twelve intervals below and then rises again to a point which is eight intervals below its highest frequency point. This point is found at 25. It then rises to its highest frequency point 29. From there on it descends ten points but again rises nine points. Finally it descends regularly to the end. The curve for the sense material behaves similar to the other curve in its rise and descent. It has two high middle points on its scale which are only five (5) intervals apart in the vertical axis and are located at 45 and 65 on the horizontal axis.

There is little to choose between the two curves. With the omission of the extra middle points, each could be said to follow the normal frequency curve as well as could be expected due to the relatively small number of cases used. Considering these curves by themselves, it would be reasonable to conclude here that sense material is no more reliable than the non-sense material. Again a coefficient of correlation of 40 ± .04 was found between these two variables.

In Figure IV and VII the frequency distribution curve for the New Stanford scores is shown with the curve for the sense material and non-sense material scores. Although the curve representing the New Stanford scores rises more evenly and from 11-14 points higher than either of the other two, it is noticeable that the sense material curve follows the New Stanford curve more regularly than the curve representing the non-sense material. There is little to choose between the steady rise and fall of either curves in figure VII. The main difference is that the sense material curve does not reach the peak, with either of its high points, that the New Stanford curve does. The curves in figure IV give no substantial evidence that the Stanford scores are more reliable than the non-sense material scores. The New Stanford scores range from 50-130 with the highest middle point occuring between 99-105. The sense material scores range from 19-88 with the two high peaks occuring at 45 and 65. The non-sense scores range from 0-59 with the two peaks occuring at 20 and 35.

In Figures VIII and XI the frequency distribution curve of the

eighth grade marks are shown with the sense and non-sense material scores. The curve representing the eighth grade marks rises more regularly than any of the others. If the number of eighth grade marks had been 500 or more, the curve would have had a distinct resemblance to the normal frequency curve. It rises twenty-seven points higher than the non-sense material curve and twenty-eight points higher than the sense material curve. Although the sense material curve does not reach the height that the eighth grade curve does, it is more evenly spread out and covers a larger range of scores. This is also true in figure XI. If the sense and non-sense curves each had only one high point instead of two, all three curves would be similar except for height. Thus there is an indication that both the sense and non-sense material scores are just as reliable as the eighth grade marks.

In Figures IX and X the frequency distribution curves of the seventh grade marks and the sense and non-sense material scores are shown. There is little to choose between the rise and fall of all three curves. None rises very steadily. All have two (2) high points instead of one. The curve representing the sense material scores, however, seems to be more evenly spread out. The unevenness of all three curves might be attributed to the small sample used. There seems to be no explanation as to the cause of the extra middle points in the curves. In these two figures, the sense and non-sense material curves appear to follow more closely the normal frequency curve and so it may be said they are more reliable than the seventh grade marks.

In Figure II the frequency distribution curve of the seventh

and eighth grade marks are shown. Although both curves are very similar, the seventh grade curve has the more regular and steady rise. The peak of the eighth grade curve is eight points higher than that of the seventh grade curve but the mode, median, and mean of the latter are more closely grouped together than those of the eighth grade curve. According to Figure II, if there is any real difference in the reliability of the two sets of school marks, the difference is in favor of the seventh grade.

The frequency distribution curves of the ability to learn scores and the school marks are shown in Figures V and VI. Here the curves are very different. The ability to learn test scores rise slowly to a peak of 52 intervals and extends over an exceptionally large range of scores while the seventh grade curve rises irregularly to a central point of 64 intervals. Although the ability to learn curve does not perfectly follow the normal frequency curve, it does follow it more regularly than the curve of the seventh grade marks. Of these two curves there is an indication of more reliability for the ability to learn arithmetic scores. The eighth grade curve rises regularly and quite steadily to a mid-point of 80 on the scale with a fifty-six frequency. The peak of the eighth grade curve is 24 points higher than that of the ability to learn curve but the mode, median, and mean of the latter are more closely grouped together than those of the eighth grade curve.

Figures XII and XIII show the frequency distribution curves of the New Stanford scores and the school marks. The curves of the New Stanford scores and the eighth grade marks each rise

fairly steadily and regularly while the seventh grade curve is a little irregular. Both the eighth grade and the New Stanford curves follow the normal frequency curve very well for the limited number of cases used. It is reasonable to conclude from Figures XII and XIII that there is no real difference in the reliability of the eighth grade marks and the Stanford scores. The seventh grade marks, for some unaccountable reason, are not quite as reliable as the New Stanford scores according to Figure XII.

Figure XIV presents a composite graph of all curves discussed in this chapter and no new evidence is presented.

<u>Coefficient of Correlation Results</u>

ability to learn test	vs.	seventh grade marks	.44 ± .04
ability to learn test	vs.	eighth grade marks	.42 ± .04
New Stanford test	vs.	seventh grade marks	.43 ± .04
New Stanford test	vs.	eighth grade marks	.38 ± .04
New Stanford test	vs.	ability to learn test	.39 ± .04
seventh grade marks	vs.	eighth grade marks	.5[illegible] ± .04

The coefficient of correlation between the seventh and eighth grade marks is eighteen times its probable error and so indicates a very high degree of reliability. The above coefficient of correlation between the ability to learn test and the seventh grade marks is .01 higher than the coefficient of correlation between the New Stanford test and the seventh grade marks. The coefficient of correlation between the ability to learn test and the eighth grade marks is .04 higher than the coefficient of correlation between the New Stanford test and the eighth grade marks. The correlation index between the ability to learn and the New Stanford arithmetic test shows a fair amount of relationship.

Sense Material	Scores	vs.	New Stanford Test	.30±.04
Non-Sense	"	vs.	"	.37±.04
Sense	"	vs.	Eighth Grade Marks	.28±.04
Non-Sense	"	vs.	"	.32±.04
Sense	"	vs.	Seventh Grade Marks	.36±.04
Non-Sense	"	vs.	"	.37±.06
" "	"	vs.	Sense Material Scores	.40±.04

The above coefficient of correlation between the Sense and Non-Sense Material of the Ability to Learn Arithmetic Test shows reasonable relationship between both parts of the Aptitude Test.

It is also indicated in the above coefficients of correlation that the Non-Sense Material is more reliable than the Sense Material of the Ability to Learn Arithmetic Test.

Holvey[10] in his unpublished thesis at the Massachusetts State College in 1932 found the following:

First Term Marks vs. Math. Scores in his Aptitude Test	.35±.04
Second " " vs. " " " " " "	.31±.04
Individual Math. Scores of Ap. Test vs. Av. College Marks	.26±.04

These figures found by Holvey indicate that there is a relationship between Ability to Learn Mathematics and other valid measures. The coefficients of correlation found in this study between the Ability to Learn Scores and the Seventh and Eighth Grade Marks shown on page 79 are slightly higher than the above figures found by Holvey.

It is interesting to note here, however, that the mathematics section of Holvey's test was based on sense material alone. The correlations found in this study between the Sense Material and the Seventh and Eighth Grade average yearly marks are .36±.04 and .28±.04, respectively. These correlations are similar to Holvey's. It is evident that the Non-Sense Material is what raises the correlation indices to .44±.04 and .42±.04 mentioned on page 79.

Partial Correlation Results: (First Order)

$r_{AE \cdot S} = .3192$
$r_{SE \cdot A} = .2555$

$r_{AB \cdot S} = .3274$
$r_{SB \cdot A} = .3124$

$r_{EB \cdot A} = .4704$
$r_{EB \cdot S} = .4746$

In the above tabulation 'A' represents the Ability to Learn Test; 'S' represents the New Stanford Test; 'E' represents the Eighth Grade marks: 'B' represents the Seventh Grade marks.

These partial correlations of the first order indicate (1) that the Seventh and Eighth Grade marks are of equal value in validity and (2) that the Ability to Learn Test scores are more reliable than the New Stanford Test scores.

Partial Correlation Results: (Second Order)

$r_{EB \cdot SA} = .4133$
$r_{AE \cdot SB} = .1969$
$r_{SE \cdot AB} = .1362$

$r_{AB \cdot SE} = .2108$
$r_{SB \cdot EA} = .2251$

The figures above show that the partial correlation of the second order between the Ability to Learn Test scores and the Eighth Grade marks is .0607 higher than the partial correlation of the second order between the New Stanford Test scores and the Eighth Grade marks. The partial correlation between the Ability to Learn Test scores and the Seventh Grade marks is .0143 lower than that between the New Stanford Test scores and the Seventh Grade marks.

The writer can find no cause for this inconsistency, but the coefficients, if averaged, would indicate that the Ability to Learn

Test scores are slightly more reliable than the New Stanford Test scores.

Multiple Correlation Results: (Zero Order)

$R_{a \cdot sb} = .5894$
$R_{s \cdot ab} = .5815$

$R_{a \cdot se} = .5735$
$R_{s \cdot ae} = .5445$

This data shows that the multiphe correlation of the zero order of the Ability to Learn Arithmetic scores with the combined effect of the New Stanford Test scores and the Seventh Grade marks is .0079 higher than the multiple correlation of the New Stanford Test scores with the combined effect of the Ability to Learn Test scores and the Seventh Grade marks.

It also shows that the multiple correlation of the Ability to Learn Test scores with the combined effect of the New Stanford Test scores and the Eighth Grade marks is .0290 higher than the multiple correlation of the New Stanford Test scores with the combined effect of the Ability to Learn Test scores and the Eighth Grade marks.

Coefficient of Correspondence by Quartiles Results:

Sense Material	vs.	New Stanford Test	38.84%	correspondence
Non-Sense "	vs.	" " "	31.37%	correspondence
Sense Material	vs.	Seventh Grade Marks	33.33%	correspondence
Non-Sense "	vs.	" " "	35.78%	correspondence
Sense Material	vs.	Eighth Grade Marks	38.24%	correspondence
Non-Sense Material	vs.	" " "	38.24%	correspondence
Seventh Grade Marks	vs.	Eighth Grade Marks	50.98%.	"

These figures would seem to indicate that the Sense and Non-Sense Material of the Ability to Learn Test give about the same per cent of correspondence according to quartiles when compared with reliable measures.

CHAPTER VII

SUMMARIES AND CONCLUSIONS

It has been found that mental testing from its early beginning up to the present day has passed through many developing stages from the single, unstandardized test of sensory and motor processes to the modern group test (Otis Intelligence), which is still based on past experience.

In this study an attempt was made to construct an aptitude test that would measure, with a fair degree of reliability, the ability of a child entering high school to learn new kinds of mathematics. The Enfield High School Mathematical Test, the name given to the test, was administered to 204 pupils who had enrolled in high school for the first time. The scores obtained on the entire test and on parts of the test (sense and non-sense material) were correlated with scores obtained with the New Stanford Arithmetic Test which was given to the same group of pupils. Correlations and graphs were also made between the above named scores and school eighth and seventh grade marks in arithmetic.

Frequency polygons are presented in chapter V which show the frequency distribution curves of the following: New Stanford arithmetic scores with the ability to learn arithmetic scores, seventh grade marks with eighth grade marks, sense material scores of the ability to learn test with the non-sense material scores, New Stanford arithmetic scores with the non-sense material scores, ability to learn arithmetic scores with the seventh grade marks, ability to learn arithmetic scores with the eighth grade marks, New Stanford arithmetic test scores with the sense material scores,

seventh grade marks with sense material scores; eighth grade marks with sense material scores; seventh grade marks with non-sense material scores; eighth grade marks with non-sense material scores; New Stanford arithmetic scores with seventh grade marks; New Stanford scores with eighth grade marks. All six measures were studied.

Coefficients of correlation were determined between the six measures mentioned above. In table VIII on page 61 these coefficients of correlation are presented.

Partial correlations of the first order involving three variables were found for school marks, New Stanford scores, and for the ability to learn arithmetic scores. Partial correlations of the second order were found for the same measures. Multiple correlations of the zero order were also found for the same measures.

The same combinations were placed in quartiles and the per cent of correspondence by quartiles was determined.

Tables were made showing the frequency distribution and medians of the following: the ability to learn arithmetic scores, New Stanford scores, sense material scores, non-sense material scores, seventh grade marks, and eighth grade marks. Comparison tables were made which present: thirteen coefficients of correlation, partial correlation of the first order, partial correlation of the second order, multiple correlation of the zero order, coefficients of correspondence by quartiles, and the order of the range of quartiles.

There are many standardized arithmetic tests on the market today which are used extensively by schools and colleges. The New Stanford Arithmetic Test is one of them. The Ability to learn

Arithmetic Test, when correlated with the Eighth Grade Marks gives an index which is .04 higher than the index obtained when the Stanford Test is correlated with the same Eighth Grade Marks. When the Ability to Learn Arithmetic Test is correlated with the Seventh Grade Marks, an index is obtained which is .01 higher than when the New Stanford Test is correlated with the same marks.

Partial Correlations and Multiple Correlations both give further evidence of a higher relationship between the Ability to Learn Arithmetic and School Marks than between the New Stanford Test and the School Marks.

The correlations in this study are much higher than those obtained by Holmay[32] when he correlated the mathematics section of the Army Alpha Test with the term marks of freshmen at Massachusetts State College in 1932.

CONCLUSIONS

The data presented in chapter six on "Interpretation of Results" would seem to indicate that the problem considered in this study has been investigated with certain definite results.

The correlation indices obtained in this study are of such magnitude as to give assurance that the average student entering high school does have ability to learn new kinds of mathematics. The correlation indices also give evidence that Non-Sense material would be better than Sense material in measuring ones ability to learn new kinds of mathematics.

Although the frequency polygons do not give any definite solution to the problem, the curves that represent the Sense

and Non-Sense material scores of the Ability to Learn Arithmetic. Test do indicate that these scores follow the normal distribution curve as well as could be expected when a limited number of cases were used. They also indicate quite clearly that the scores obtained in the Sense and Non-Sense material of the Ability to Learn Arithmetic Test are just as reliable as the New Stanford Arithmetic scores and the school arithmetic marks.

The various correlations presented in chapter five give conclusive evidence thet: (a) the Ability to Learn Arithmetic Test is <u>more</u> reliable than the New Stanford Arithmetic Test as a measure of one's ability to learn new kinds of mathematics; (b) the Ability to Learn Arithmetic Test is <u>more</u> reliable than the mathematic sections of the Holway Test as a measure of one's ability to learn new kinds of mathematics; (c) the Ability to Learn Arithmetic Test scores are just as reliable as the school Seventh and Eighth Grade marks in arithmetic; (d) the Sense Material sections of the Ability to Learn Arithmetic Test are just as reliable as the mathematic sections of the Holway Test as a measure of one's ability to learn new kinds of mathematics; (e) the Non-Sense sections of the Ability to Learn Arithmetic Test are <u>more</u> reliable than the Sense Material sections of the Ability to Learn Arithmetic Test as a measure of one's ability to learn new kinds of mathematics; (f) many pupils entering high school do have ability to learn new kinds of mathematics.

It is the earnest hope of this writer that the statistical data and results found in this study will be of some value to others who might carry on an investigation in the fiels of general aptitude testing.

APPENDIX

Directions for Administering the Enfield High School Aptitude Test in Mathematics.

(a) This is not a test of what you have learned. In fact before you begin the test you are not supposed to know the answers or how to do any of the examples in the test. It is intended to be a test of your ability to learn certain kinds of mathematics, some of which you will meet in high school. In every part of the test you will be given an opportunity to study and to learn how to do the examples. Some of the examples you may find difficult to do but do not feel discouraged because no one is supposed to make a perfect score. Just do the best that you can in the time allowed.

(TESTS ARE PASSED OUT TO THE PUPILS)

(b) Do not open the test until you are told to. Write your name, age, and grammar school attended on the lines indicated. During the test you are not to turn over pages until you are told to do so.

(c) Now look at the directions of Section A, Part 1 on page 2 while I read them over with you. (Teacher reads directions aloud). You will be allowed eight minutes. Begin.

(d) Now turn to the directions of Section A, Part 2a on page 3 while I read them over with you. (Teacher reads directions aloud). You will be allowed seven minutes. Begin.

(e) Now turn to the directions of Section A, Part 2b on page 4 while I read them over with you. (Teacher reads directions aloud). You will be allowed seven minutes. Begin.

(Directions Con't on Next Page)

(f) Now turn to the directions of Section A, Part 3 on page 5 while I read them over with you. (Teacher reads directions aloud). You will be allowed eight minutes. Begin.

(g) Now turn to the directions of Section A, Part 4 on page 6 while I read them over with you. (Teacher reads directions aloud). You will be allowed six minutes. Begin. COLLECT ALL TEST PAPERS. TIME--35 minutes.

SECOND PART OF THE TEST
SECTION 'B'

(a) In this part of the test the same rules will be in force as for part 'A'. You are not to turn over any pages until you are told to do so.

(TESTS ARE PASSED OUT TO THE PUPILS)

(b) Now turn to the directions of Section B, Part 1 on page 8 while I read them over with you. (Teacher reads directions aloud). You will be allowed nine minutes. Begin.

(c) Now turn to the directions of Section B, Part 2a on page 9 while I read them over with you. (Teacher reads directions aloud). You will be allowed three minutes. Begin.

(d) Now turn to the directions of Section B, Part 2b on page 10 while I read them over with you. (Teacher reads directions aloud). You will be allowed six minutes. Begin.

(e) Now turn to the directions of Section B, Part 3 on page 11 while I read them over with you. (Teacher reads directions aloud). You will be allowed eight minutes. Begin.

(f) Now turn to the directions of Section B, Part 4 on page 12 while I read them over with you. (Teacher reads directions aloud). You will be allowed nine minutes. Begin.

Time--35 minutes. END OF TEST. COLLECT ALL TEST PAPERS.

For Freshmen Entering Senior High School

Prepared By J. Frank Hassett

Name ....
(Print Name)

Age ....

Grammar School Last Attended ....
(Print)

Sense Material	Score
Section A, Part 2a	
Section A, Part 2b	
Section A, Part 4	
Section B, Part 2a	
Section B, Part 4	
Non-Sense Material	
Section A, Part 1	
Section A, Part 3	
Section B, Part 1	
Section B, Part 3	
	Gross Score.....

FIRST PART OF THE TEST

SECTION 'A'

SECTION 'A'
Part I

Directions:

(a) In the examples below we have a series of numbers. Whenever the figure 5 occurs, multiply the number before it by 8 and add this product to the number following the 5. Write the sum below the 5 in the example.

(b) Take all the numbers that you have written below the several figure 5's, find their sum and divide it by the difference of the sum of the first six figures and the last six figures in the example.

(c) SAMPLE:

3457986546[illegible]
39 52 52

39 + 52 + 52= 143

$\frac{143}{5}$ = 28 3/5 Answer.

1	7
6	4
5	5
7	6
9	4
8	5
36	31

36 = sum of first six numbers.
31 = sum of last six numbers.
5 = difference of their sums.

(d) REFER TO THE DIRECTIONS IN DOING THE EXAMPLES BELOW.

EXAMPLES:

(1) 325867453091585457 Answer. . . . .

(2) 75598675001258 5157 Answer. . . . .

(3) 354768532754585190 Answer. . . . .

(4) 6532545965591085257 Answer. . . . .

(5) 4625475696369570152 Answer. . . . .

(6) 95695423567525801 Answer. . . . .

(7) 896574526451075963 Answer. . . . .

(8) 1253456758995125345 Answer. . . . .

(9) 985765435215985765 Answer. . . . .

(10) 675985125345675985 Answer. . . . .

STOP HERE FOR DIRECTIONS.

Section 'A'
Part 2a

DEFINITIONS:

(a) Room Measurements are expressed with the Length first, then the Width, then the Height. Ten feet is usually written 10' and 6 inches is written 6". So the measurements of a room 22½ft long, 19ft wide and 9½ft high would be written as follows 22'6" x 19' x 9'6".

(b) Facts about Wall Paper. It is made in single rolls of 24' and double rolls of 48' long. All rolls are 1½' wide and must be bought in full rolls.

(c) Net Perimeter of a Room is the total perimeter of a room less the total width of openings in room. (windows and doors)

(d) Number of Strips of Wall Paper Needed to Paper a Room is found by dividing the Net Perimeter by 18 inches or 1½ ft.

(e) Number of Strips on One Roll of Wall Paper is found by dividing the length of the roll by the height of the room.

(f) Number of Rolls Needed to Paper a Room is found by dividing the number of strips needed by the number of Strips in a roll.

EXAMPLE: Find the number of double rolls of wall paper needed to paper a room 14' long, 12'6" wide, and 8'6" high, allowing for 2 windows 3½' wide and 2 doors 3'9" wide.

Method:

Total Perimeter 14' + 14' + 12'6" = 53'
Total Width of Openings 2x3½' = 7') 14½'
2x3¾' = 7½')
Net Perimeter 53' minus 14½' = 38½'
Required Strips of Paper 38½ divided by 1½ = 25 2/3 or 26
Number of Strips in a Double Roll 48' ÷ 8½ = 5
Number of Rolls Needed 26 ÷ 5 = 5 1/5 or 6. Answer.

EXAMPLES:

(1) If Wall Paper cost $1.45 a double roll, what will it cost to paper a room 20' x 1[illegible]' x 10'6"? Allow for 2 windows 4' wide and 1 door 3'6" wide. Answer. . . . .

(2) If Wall Paper cost 95¢ a double roll, what will it cost to paper a room 1[illegible]'6" x 1[illegible]' x [illegible]'6"? Allow for 3 windows 4' wide and 2 doors 4'6" wide. Answer. . . . .

(3) If Wall Paper cost $1.65 a double roll, what will it cost to paper a room 22'6" x 16' x [illegible]'6"? Allow for 2 windows 3'6" wide and 2 doors 4' wide. Answer. . . . .

(4) If Wall Paper cost $1.45 a double roll, what will it cost to paper a room 10' x 10' x [illegible]'6"? Allow for 2 windows 4' wide and 2 doors 4' wide. Answer. . . . .

Section 'A'
Part 2b

DIRECTIONS:

(a) Carpet is sold by the Linear yard and is usually made in strips of ¾yd or 2¼ft wide. It may be bought in any length.

(b) Number of Strips of Carpet Needed to Cover a Room is found by dividing the width of the room by ¾yd or 2¼ft.

(c) Number of Yards of Carpet Needed is found by multiplying the number of yards in one strip (length of the room) by the number of strips needed.

(d) If necessary in doing the examples below, you may refer back to the directions on page 3.

SAMPLE: Find the number of yards of Brussel carpet needed to cover a room 16' X 15' (16ft long and 15ft wide).
$15 \div 2\frac{1}{4} = 6\frac{2}{3}$ or 7 strips needed.
$\frac{7 \times 16}{3} = 37\frac{1}{3}$ or 38 yards needed. Answer.

EXAMPLES:

(1) Find the cost for a carpet to fit a room 15' X 9'6" at $2.70 a yard for the carpet. Answer. . . . . . .

(2) Find the cost for a carpet to fit a room 12' X 12' at $1.90 a yard for the carpet. Answer. . . . . . .

(3) If Wall Paper cost $1.20 a single roll, what will it cost to paper a room 12'3" X 9' X 8'6"? Allow for 3 windows 3'3" wide and 2 doors 3'6". Answer. . . . . . .

(4) Find the cost for a carpet to fit a room 15' X 9'6" at $7.80 a yard for the carpet. Answer. . . . . . .

(5) If Wall Paper cost $1.80 a double roll, what will it cost to paper a room 14' X 10' X 9'? Allow for 6 windows 3' wide and 2 doors 4' wide. Answer. . . . . . .

(6) Find the cost for a carpet to fit a room 15' X 12' at $3.00 a yard for the carpet. Answer. . . . . . .

(7) If Wall Paper cost $1.48 a single roll, what will it cost to paper a room 10' X 10' X 8'6"? Allow for 2 windows 4' wide and 3 doors 4' wide. Answer. . . . . . .

(8) Find the cost for a carpet to fit a room 9' X 12' at $1.48 a yard for the carpet. Answer. . . . . . .

(9) Find the cost for a carpet to fit a room 13' X 12' at $[illegible].25 a yard for the carpet.

Stop here

Section 'A'
Part 3

DIRECTIONS:

In the examples below are found the following letters 'a', 'b', 'x', and 'y'. Each of these letters have a definite meaning in the examples and so if you will read and carefully follow the facts below, the examples will not be difficult.

FACTS ABOUT a, b, x, and y.

1. When the letter 'a' follows a number it means that the number is to be multiplied by itself. Example, 5a equals 25.
2. When the letter 'b' follows a number it means that the number is worth only one-half of it's value. Example, 6b equals 3.
3. When the letter 'x' follows a number it means that the value of the number is reduced by two. Example, 9x is equals to 7.
4. When the letter 'y' follows a number it increases the number by one-half of itself. Example, 5y is equal to 7½.
5. When two letters follow a number as 'ab' or 'xy', you are to work out one letter at a time; that is, follow the rule about 'a' first, then with the answer that you obtain, follow the rule for the second letter 'b'.

Sample: 8a equals 8 times 8 or 64

also
8ab equals 64 divided by 2 or 32 for an answer.

EXAMPLES:

1. $\frac{12a+10ab-14x}{48xy}$ = ... Answer.

2. (20ab−36xy+16ab) ÷ (7a−24b+6xy)

. . . . Answer

3. $\frac{4a+14b-12x+12y}{2y+8xy+5a-6ab}$ = ... Answer.

4. 6ay−9bx−4ax−8xy = ... Answer.

5. $\frac{4by-2ax}{2a} - \frac{6ax-8xy}{[illegible]b}$ = ... Answer.

STOP HERE FOR DIRECTIONS.

Section [illegible]
[illegible]

[illegible]:

(1) [illegible] bers and find out how the numbers are made u[illegible]. Then [illegible] [illegible] next.

(2) [illegible]: (a) [illegible] ....

(b) [illegible] ....

[illegible]

(a) [illegible] 11 10 [illegible] 7 ....

(b) [illegible] 10 [illegible] ....

(c) [illegible] ....

(d) [illegible] 16 [illegible] 10 11 ....

(e) [illegible] 27 [illegible] ....

(f) [illegible] ....

(g) [illegible] ....

(h) 4 [illegible] 7 [illegible] 11 ....

(i) 2 [illegible] ....

[illegible]

[illegible] CONTINUED

Second Part of the Test

Section III

Name. . . . .
(Print name)

Score

Section III, Part [illegible] . . . .

Section III, Part [illegible] . . . .

Section III, Part [illegible] . . . .

Section III, Part [illegible] . . . .

Section III, Part [illegible] . . . .

Section 10:
Part I

DIRECTIONS:

(a) On this page we have a table of artificial distances instead of the earth's distances. In working out the problems, you are to refer to the table frequently and carry out decimals two (2) places.

(b) TABLE OF DISTANCES:

1000 Miles equals one Spheregrade.
[illegible] Spheregrades equals one Ucon,
[illegible] Ucons equals one Atmo,
[illegible] Atmos equals one Orbi.

PROBLEMS:

(1) Six Orbi equals how many Atmos? Answer. . . . .

(2) Ten Atmos equals how many Ucons? Answer. . . . .

(3) Four Ucons equals how many Spheregrades? Answer. . . . .

(4) Six Spheregrades equals how many Miles? Answer. . . . .

(5) 6000 Miles equals how many Spheregrades? Answer. . . . .

(6) [illegible] Ucons equals how many Atmos? Answer. . . . .

(7) 100 Spheregrades equals how many Ucons? Answer. . . . .

(8) 150 Atmos equals how many Orbi? Answer. . . . .

(9) If Planet Mercury is [illegible] miles from the Sun, how many Ucons is Mercury from the Sun? Answer. . . . .

(10) If Planet Earth is [illegible] Atmos from the Sun, how many miles is it from the Sun? Answer. . . . .

(11) If Planet Neptune is [illegible] Orbis from the Sun, is it nearer to the Sun than the Earth or farther away? How much in miles? Answer. . . . .

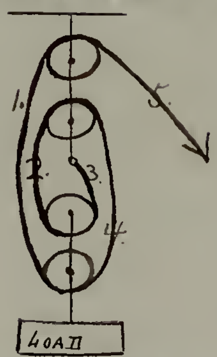
STOP HERE FOR INSTRUCTIONS

Section 'B'
Part I

(a) In dealing with pulleys, if we want to find out whether pulleys are a help to man in doing work, we must find out the mechanical advantage (M.A.) of pulleys. This M.A. may be different in many pulleys.

(b) The mechanical advantage (M.A.) of any pulley system can be found by counting the supporting strands of rope in the pulleys. (The ropes that hold up the load.)

(c) Example:

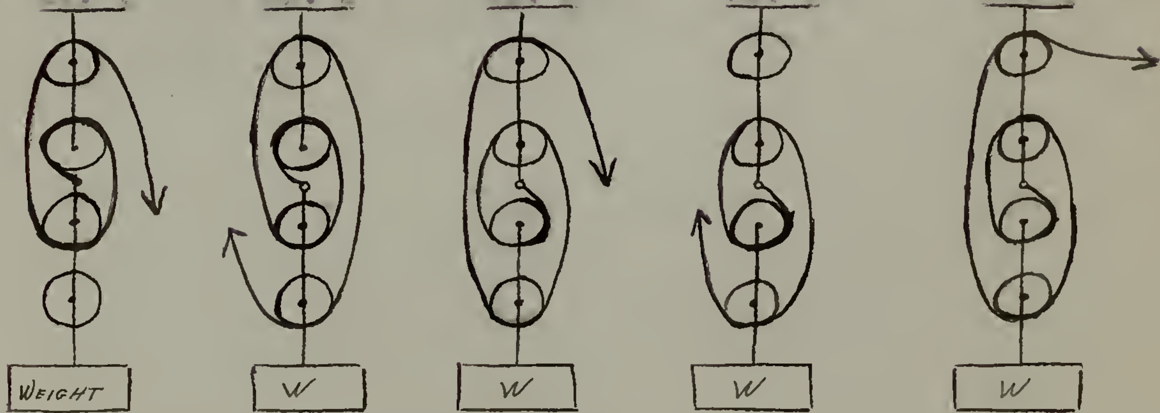


Strands of rope 1, 2, 3, and 4 support or hold up the load but number 5 strand does not. Therefore the M.A. is 4 for this pulley.

(d) In the examples below the weight to be lifted is the same for all pulleys.

Now try to find the M.A. for each pulley.

Ex. 1 Ex. 2 Ex. 3 Ex. 4 Ex. 5



....

(Simply write answers on the dotted lines.)

Turn page for directions.

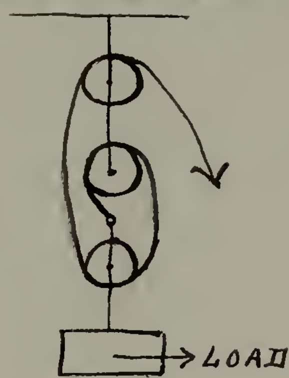
Section 'B'
Part [illegible]

DIRECTIONS:

(a) Now that you understand about the Mechanical Advantage of pulleys and how it is found, you are to read and refer to the following facts about pulleys and then do the examples below.

(b) FACTS ABOUT PULLEYS:

1. The Downward Pull on the end of the rope is equal to the Weight divided by the M. A.
2. The Weight is equal to the Downward Pull multiplied by the M. A.
3. The Height that a Weight is raised off the ground is equal to the Amount of Rope Pulled divided by the M. A.
4. The Amount of Rope Pulled is equal to the Height that the Weight is raised multiplied by the M. A.



DRAWING 'B'

(c) EXAMPLES:

1. Find the M.A. in drawing 'B' above.
Refering back to the facts about pulleys, if the load in drawing 'B' is 3[illegible]0 pounds what Downward Pull will be needed on the end of the rope to raise this weight off the ground?

Answer. . . . .

2. Refering to the facts about pulleys again, how much would the Weight in drawing 'B' weigh, if the necessary Downward Pull on the end of the rope was 350 pounds?

Answer. . . . .

3. In example 2, when the Weight was 1[illegible] feet off the ground, how much rope had been pulled? Refer to the facts about pulleys.

Answer. . . . .

TURN OVER FOR DIRECTIONS.

Section '[illegible]'
Part 3

DIRECTIONS:

On this page we have a comparison between the Mandarian Numerals and the Arabic Numerals that we use in our schools. You are to look this chart below over for a moment and then turn to the problems below. You may and SHOULD refer to the chart frequently in doing the examples.

You are to have two (2) answers for each problem; one in Arabic Numerals and one in Mandarian Numerals.

CHART:

1	2	3	4	5	6	7	8	9	0	- Arabic Numerals
Θ	T	Δ	◬	⊥	≠	L	J	♁	∇	- Mandarian Numerals

Z -- means Addition
∀ -- means Subtraction
-- means Multiplication
Σ -- means Division

PROBLEMS:

1. Add
   Θ Δ ◬ Θ
   ⊥ ≠ L Δ
   L J ∇
   ♁ T Δ Δ
   Answer
   Answer

2. Subt.
   ♁ ∇ Θ Θ ∇
   J L ≠ ⊥ T
   Answer
   Answer

3. Div.
   ≠ ∇) ♁ J ≠ ◬   Answer ____
   Answer ____

4. Mult.
   T ⊥ ≠ L J
   ◬ ⊥
   Answer
   Ans.

5. T Z ◬ # J ∀ ♁ # ⊥ =   Answers

6. Δ ◬ T # ⊥ ∇ =

7. ⊥ J ◬ Σ J =

8. ⊥ ≠ Δ # T Δ =

[illegible] Page 12. [illegible]

Section 'B'
Part [illegible]

DIRECTIONS:

In the examples below you have algebraic expressions and equations. In each example you are to SUBSTITUTE the number value given for each letter and then work out the example as you would in Arithmetic.

SAMPLE:

If a=2, b=3, c=5, d=1

Then $\frac{a+b}{c} - \frac{d}{a} =$

$\frac{2+3}{5} - \frac{1}{2} = \frac{10-5}{10} = \frac{5}{10}$ or $\frac{1}{2}$ for an answer.

EXAMPLES: If a=2, b=3, c=5, and d=1
Solve the following (first five) examples with these values.

(1) 5a equals what? .Answer.

(2) 2a−d equals what? . . . . .Answer.

(3) $\frac{a+b+c}{d}$ = equals what? . . . . .Answer.

(4) $\frac{2a+c}{3d}$ equals what? . . . . .Answer.

(5) $\frac{2c}{a} - \frac{4b}{3d}$ equals what? . . . . .Answer.

(6) If y=4, then solve

$\frac{4}{y+2} + \frac{y}{y-2} - \frac{1}{y-4} = \frac{y^2-3}{1+y^2}$ [illegible] Answer. . . . . .

(7) If x equals 7, then solve

$\frac{x+2}{x-2} + \frac{7}{x^2-4} =$ [illegible] Answer. . . . . .

(8) If c=1, x=2, y=1 Solve

$\frac{c^2-1}{x-y} + \frac{3x-3y}{c^2+bc+3} =$ [illegible] Answer. . . . . .

END OF TEST

STOP WHEN TOLD TO.

[illegible] ARITHMETIC TEST

The Test Procedure

(To be followed verbatim)

"This is a test to show how much you have learned. I will give each of you a test book. Do not [illegible] it or open it until I tell you to." (Do [illegible]) After all are provided with tests, books and pencils: "Now fill the blanks at the top of the first page, here. (Hold up test book and point to the blanks.) Do it as quickly as you can, but write plainly. On the first line where it says Name, write your name. (Pause) After the word Grade, write the number of the grade you are in. (Pause) After Boy or Girl, write the word that tells which you are. (Pause) On the next line, where it says Age, tell how old you will be [illegible]. (Pause) On the next line write the name of this school. (Give the name) At the end of the same line write the date." (Give the date. Give to the younger children the necessary assistance.)

After the blanks have been filled: "Now, listen carefully and do just what I tell you to do. Do not begin until I say Go. The very second I say Stop, you must stop and hold your pencils up. After we have begun, you must not ask questions. If you break your pencil, hold up your hand and I will give you another. Do your best and do not pay any attention to what anyone else is doing. Now turn the page over to Test 1. It says Test 1 at the top of the page."

Test 1. Arithmetic Reasoning

"Read the directions at the top of the page: Find the answers as quickly as you can. Write the answers on the dotted

lines. Use the margins of the paper to figure on. (Pause slightly) The test has two pages. As soon as you have finished the first page, go right on to the next. Ready--Go." (See that pupils do not stop at the end of the first page.)

Allow [illegible] minutes; then say: "Stop. Turn to Test 5 on the next page. Be sure to turn just one leaf." (Pause and make sure that all the pupils have found the place.)

Test 5. Arithmetic Computation

"Read the directions at the top of the page: Get the answers to these examples as quickly as you can without making mistakes. Look carefully at each example to see what you are to do. (Pause slightly) You may use the margins of the page to figure on if you need to. There are three pages of this test. As soon as you have finished the first page, go right on to the next. Ready--Go." (See that pupils do not stop at the end of the first or second page).

Allow [illegible] minutes; then say: "Stop. Close your books." Collect all books immediately.

New Stanford Arithmetic Test

By Truman L. Kelley, Giles M. Ruch, and Lewis M. Terman

TEST: FORM V

FOR GRADES 2–9

Name . . . . Grade . . . . Boy or girl . . . .

Age . . . . When is your next birthday? . . . . How old will you be then? . . . .

Name of school . . . . Date . . . .

Score	Arith. Age	School[1] Grade	Score	Arith. Age	School[1] Grade	Score	Arith. Age	School[1] Grade	Score	Arith. Age	School[1] Grade	Score	Arith. Age	School[1] Grade
120	19–2		100	15–8	9.7	80	12–6	6.7	60	10–8	4.7	40	9–3	3.4
119	18–11		99	15–6	9.5	79	12–4	6.6	59	10–7	4.6	39	9–2	3.4
118	18–8		98	15–4	9.3	78	12–3	6.4	58	10–6	4.6	38	9–1	3.3
117	18–5		97	15–2	9.2	77	12–2	6.3	57	10–6	4.5	37	9–0	3.3
116	18–2		96	15–0	9.0	76	12–0	6.2	56	10–5	4.4	36	8–11	3.2
115	17–11		95	14–10	8.9	75	11–11	6.1	55	10–4	4.4	35	8–10	3.2
114	17–8		94	14–8	8.7	74	11–10	6.0	54	10–3	4.3	34	8–9	3.1
113	17–6		93	14–6[2]	8.5	73	11–9	5.9	53	10–2	4.3	33	8–8	3.1
112	17–4		92	14–4	8.4	72	11–8	5.8	52	10–1	4.2	32	8–7	3.1
111	17–2		91	14–1	8.2	71	11–7	5.7	51	10–0	4.1	31	8–6	3.0
110	17–0		90	13–11	8.1	70	11–6	5.7	50	9–11	4.1	30	8–5	3.0
109	16–10		89	13–9	7.9	69	11–5	5.6	49	9–11	4.0	29	8–4	2.9
108	16–8		88	13–7	7.8	68	11–4	5.5	48	9–10	4.0	28	8–3	2.9
107	16–6		87	13–5	7.6	67	11–3	5.4	47	9–9	3.9	27	8–2	2.8
106	16–5		86	13–3	7.5	66	11–2	5.3	46	9–8	3.9	26	8–1	2.8
105	16–3		85	13–1	7.4	65	11–1	5.2	45	9–7	3.8	25	8–0	2.8
104	16–2		84	12–11	7.2	64	11–0	5.1	44	9–6	3.7	24	7–11	2.7
103	16–0		83	12–10	7.1	63	10–11	5.0	43	9–5	3.6	23	7–10	2.7
102	15–11	10.0	82	12–8	7.0	62	10–10	4.9	42	9–4	3.6	22	7–8	2.6
101	15–9	9.8	81	12–7	6.8	61	10–9	4.8	41	9–3	3.5	21	7–6	2.6
												20	7–5	2.6

[1] Grade defined as in the table in the Directions for Administering.
[2] Arithmetic ages above this point are extrapolated values.

To the Examiner. *Do not administer this test without first reading carefully the Directions for Administering.*

Test	Score	Arith. Age	School Grade
Arith. Reas.			
Arith. Comp.			
Total (Average) Arith.[1]			

[1] The Total Arithmetic Score is the *average* of the scores on the two tests.

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NSAT: V–13

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DIRECTIONS: Find all the answers as quickly as you can. Write the answers on the dotted lines. Use the margins to figure on.

1 Charles has 6 brown rabbits and 5 white ones. How many rabbits has he?
Answer............

2 At a school picnic 9 boys and 15 girls went swimming. How many went swimming?
Answer............

3 Jim has 3 marbles, John has 8, and Bill has 9. If they put them all together, how many will there be?
Answer............

4 A hen had 9 chicks but 3 of them died. How many were left?
Answer............

5 Alice gathered 18 roses and took a dozen of them to a friend. How many did she keep?
Answer............

6 What is the cost of 3 boxes of dates at 21 cents a box?
Answer............

7 A freight train had 16 cars. Seven of them were box cars. The others were flat cars. How many flat cars were there?
Answer............

8 There were 100 people at a school play in the afternoon and 150 in the evening. How many people went to the two performances?
Answer............

9 Three boys together gathered 21 bushels of walnuts. If they shared them equally, how many bushels did each boy get?
Answer............

10 Bob bought a dozen handkerchiefs at the rate of 3 for $1. How much did he pay for them?
Answer............

11 Mr. Jones bought a new car for $975. The dealer allowed him $325 for his old car. How much did he have to pay in addition to the allowance for the old car?
Answer............

Go right on to the next column.

12 Sarah sleeps ten hours every night. If she goes to sleep at nine o'clock, when does she wake up?
Answer............

13 A man paid the street-car fare for himself and two friends. If the fare is 7 cents, how much change should he receive from a half dollar?
Answer............

14 How many pounds of popcorn will be needed to plant a 30-acre field if 6 lb. are needed for one acre?
Answer............

15 Jack had no marbles so he bought as many 3-cent marbles as he could get for 15 cents and then Tom gave him 2 more. How many did Jack have then?
Answer............

16 Mrs. Fox started a savings account by depositing $85. The next month she deposited $75. A few days later she drew out $40. What was her balance in the bank?
Answer............

17 A class gave a candy sale and made $23 with which they wish to buy a picture. The picture costs $30 and the 20 pupils in the class decide to share the rest of the cost equally. How much will it cost each?
Answer............

18 In each 21 pounds of milk there is a pound of milk sugar. How many pounds of milk sugar are there in 1806 lb. of milk?
Answer............

19 A camping party took 12½ lb. of bacon for a 5-day trip. How much did that allow for each day?
Answer............

20 Jim has 20 cents to spend for marbles. He is going to buy 2 at 3 cents each and spend the remainder for 2-cent marbles. How many will he get altogether?
Answer............

Go right on to the next page.

No. Rt.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Score	3	12	21	29	34	39	44	48	53	58	61	64	67	70	74	77	80	83	85	88	91

No. Rt.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Score	94	96	98	100	102	104	105	107	109	110	112	114	115	117	119	120	122	123	125	127

21 When oranges are 2 for 5 cents, how many can I buy for 60 cents?
Answer............

22 Milk sells at 12 cents a quart. At this rate, how much will 12 gallons cost?
Answer............

23 When $1.50 will buy 5 lb. of mixed nuts, how much will $2.40 buy at the same rate?
Answer............

24 Tom has just 4 weeks of vacation and wishes to spend it in a city which it takes two days to reach by train. How many days can he spend in the city?
Answer............

25 Frank gets 30 cents for every $1.50 magazine subscription that he sells. What per cent is his commission?
Answer............

26 A recipe for lobster salad read, "with two cups of lobster meat use ¼ cup of chopped celery." How much chopped celery should be added to 5 cups of lobster meat?
Answer............

27 A box of 12 dozen oranges cost a dealer $4.80. He sold them at 50 cents a dozen. How much gross profit did he make on each dozen oranges?
Answer............

28 A dealer profits 6 cents on a half-dozen buttons. How many dozen must he sell to make $12?
Answer............

29 Jack pays 3 cents for a paper and sells it for 5 cents. What per cent of the selling price is his profit?
Answer............

30 A man dug 60 bu. of potatoes from .3 of an acre of ground. At this rate, how many bushels should he get from 4 acres?
Answer............

31 A boy bought 300 oranges at $2.75 per hundred and sold all of them at the rate of 3 for 10 cents. How much did he make if we ignore the cost of doing business?
Answer............

Go right on to the next column.

32 A boy made a motor-boat trip in 3½ hours when traveling at the average rate of 6 miles an hour. If he had increased his rate by one mile an hour, how long would it have taken him?
Answer............

33 Mrs. Jackson bought 10 shares of Golden Oil at par ($50). No dividends were paid, and at the end of two years she sold for $23 a share. Not counting brokerage charges and interest, how much had she lost?
Answer............

34 A tennis court is 36 feet wide and 78 feet long. How many yards is it around the court?
Answer............

35 A recipe calls for 5 lb. of white flour to 3 lb. of graham flour. How much white flour must be used to make 16 lb. of such a mixture?
Answer............

36 What does one dollar compounded annually at 10 per cent amount to in 2 years?
Answer............

37 A man loaned a friend $300. In a year and 8 months the money was returned with $30 interest. What rate of interest was paid?
Answer............

38 A ladder is standing against a wall in such a way that the base is 12 ft. from the wall and the top of the ladder is 16 ft. from the ground. How long is the ladder?
Answer............

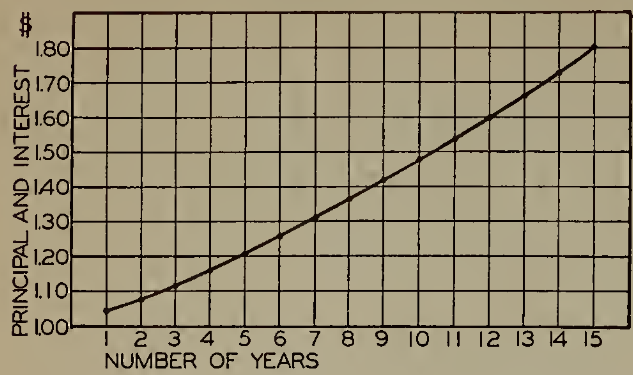
39 What is the cost of insuring a building valued at $24,000 if it is insured for 80 per cent of its value at the rate of 15 cents per $100 of insurance?
Answer............

40 A boy made $1.60 by buying apples at 6 for 8 cents and selling them 3 for 8 cents. How many did he sell?
Answer............

End of Test 1. Look over your work.

(49)

The graph below shows, year by year, the amount of $1.00 invested at 4% interest compounded annually.



What is a dollar worth at the end of the 12th year?

Answer =

(50)

Find the average of

7.53
9.47
8.63
9.02
11.10

(51)

2) 3 yd. 2 ft. 4 in.

(52)

Multiply

6794
4008

(53)

Multiply

-6
$+4$

(54)

$(4)^3 =$

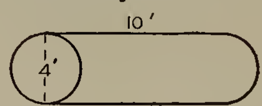
(55)

Add

$7x^2$
$-4x^2$

(56)

Find the volume of this cylinder.



Volume =

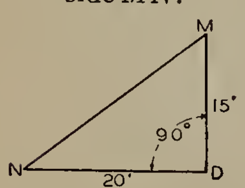
(57)

Principal = $150
Rate = 7 %
Time 1 yr. 6 mo.
Find amount due at maturity.

Answer =

(58)

Find the length of side *MN*.



MN =

(59)

Write this expression in the simplest form:

$-30y + (-6y)$

Answer =

(60)

If $V = \frac{\pi r^2 h}{3}$,

write the formula for h.

$h =$

End of Test 2. Look over your work.

Number right	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Score	3	7	13	19	25	28	31	34	36	37	39	42	44	47	50	53	56	58	60	61	62	64	65	67	68	70	71	73	74	76	78

Number right	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Score	80	83	86	88	90	92	93	95	96	98	101	104	107	109	110	111	112	113	113	114	114	115	115	116	116	117	118	120	122	124

DIRECTIONS: Get the answers to these examples as quickly as you can without making mistakes. Look carefully at each example to see what you are to do.

Begin here.

(1) Add
6
1

(2) Add
5
0

(3) Add
7
4
3
5

(4) Subtract
8
3

(5) Add
17
5

(6) Subtract
12
5

(7) Subtract
16
4

(8) $2 \times 5 =$

(9) Add
37
41
26
55

(10) Subtract
15
9

(11) Subtract
765
327

(12) 2) 8

(13) Add
26890
58475
43261

(14) Multiply
253
6

(15) $0 \times 4 =$

(16) $10 \div 2 =$

(17) 8) 59 ____ and ____ remainder

(18) Add
24
$12\frac{4}{5}$

(19) Subtract
53212
34563

(20) 9) 58

(21) 2) 15.8

(22) $\frac{1}{3}$ of $156 =$

(23) Multiply
4789
76

(24) Subtract
$62\frac{1}{3}$
$37\frac{1}{6}$

(25) $\frac{9}{10} \times \frac{2}{3} =$

Go right on to the next page.

(26)

$\frac{7}{8} \times \frac{5}{7} =$

(27)
Add
$\frac{4}{5}$
$\frac{1}{3}$

(28)
Subtract
$42\frac{5}{6}$
$28\frac{1}{6}$

(29)
Add
$38\frac{2}{5}$
$27\frac{7}{10}$

(30)
Subtract
$\frac{3}{4}$
$\frac{2}{5}$

(31)
Add
$36\frac{1}{2}$
$32\frac{3}{10}$

(32)

$\frac{2}{3} \div \frac{2}{3} =$

(33)

$\frac{4}{7} \div \frac{4}{9} =$

(34)
Subtract
$66\frac{1}{8}$
$58\frac{3}{8}$

(35)

$29\overline{)46545}$

(36)

$\frac{5}{6} \times \frac{10}{11} =$

(37)

$58.25 - 2.9 =$

(38)
Multiply
65.84
5.06

(39)

$25\overline{)11}$

(40)

$\frac{11}{12} + \frac{5}{6} + \frac{3}{4} =$

(41)
Add
$\frac{1}{6}$
$\frac{9}{10}$

(42)

$\frac{9}{10} \times \frac{4}{15} =$

(43)
Subtract
$205\frac{1}{5}$
$85\frac{3}{8}$

(44)
Subtract
$212\frac{3}{10}$
$39\frac{5}{6}$

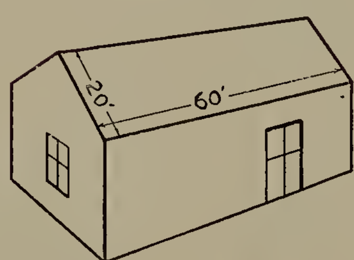
(45)

$6.\overline{)362.4}$

(46)
50 is what per cent of 200?

Answer =

(47)
Find the total roof surface of this building.



Answer =

(48)
Add
$22\frac{3}{10}$
$27\frac{5}{6}$

Turn the page and go right on.

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Approved by

H. N. Glick

G. H. Lindsey

Date May 18, 1936

DATE DUE
