

1935

**The construction of the Athol High School scholastic aptitude test
and a study of its comparative validity in predicting success
among school children**

Claude B. Germany
University of Massachusetts Amherst

Follow this and additional works at: <https://scholarworks.umass.edu/theses>

Germany, Claude B., "The construction of the Athol High School scholastic aptitude test and a study of its comparative validity in predicting success among school children" (1935). *Masters Theses 1911 - February 2014*. 1551.
<https://doi.org/10.7275/6871094>

This thesis is brought to you for free and open access by ScholarWorks@UMass Amherst. It has been accepted for inclusion in Masters Theses 1911 - February 2014 by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

UMASS/AMHERST



312066013577532

THE CONSTRUCTION OF THE ATHOL HIGH SCHOOL
SCHOLASTIC APTITUDE TEST AND A STUDY OF
ITS COMPARATIVE VALIDITY IN PREDICTING
SUCCESS AMONG SCHOOL CHILDREN

GERMANY - 1935

LD
3234
M268
1935
G373

MASSACHUSETTS
STATE COLLEGE



DATE DUE			

UNIV. OF MASSACHUSETTS/AMHERST
LIBRARY

LD
3234
M268
1935
G373

THE CONSTRUCTION OF THE ATHOL HIGH SCHOOL SCHOLASTIC
APTITUDE TEST AND A STUDY OF ITS COMPARATIVE
VALIDITY IN PREDICTING SUCCESS
AMONG SCHOOL CHILDREN

BY

CLAUDE B. GERMANY

LIBRARY
JUN 12 1935
25- 248
2249.1.12.1935

THESIS SUBMITTED FOR DEGREE OF MASTER OF SCIENCE
MASSACHUSETTS STATE COLLEGE, AMHERST

JUNE, 1935

ACKNOWLEDGMENT

The writer wishes to express appreciation to Dr. Harry N. Glick for his helpful supervision in the development of this study.

TABLE OF CONTENTS

	Page
I. Introduction	
A. The Problem	1
B. History of Testing	2
1. The Nature of Standard Tests	4
a. The Reading Quotient	6
b. The Educational Quotient	6
c. The Achievement Quotient	6
d. Mental Age (Binet)	9
e. The Intelligence Quotient	10
f. Group Tests	10
C. Recent development of "Mental Ability" Tests	
II. Analysis of Tests Used in This Study	14
A. Otis Group Intelligence Scale, Advanced Examination: Form A	14
B. The Athol High School Scholastic Aptitude Test	16
1. Science	17
2. History	19
3. Language	20
4. Geography	20

TABLE OF CONTENTS

(Continued)

	Page
5. English	21
6. Mathematics	22
III. A Criticism of Intelligence Tests	24
A. The Otis Group Intelligence Scale	26
B. The Terman Group Test of Mental Ability	29
C. The Athol High School Scholastic Aptitude Test	32
IV. Collection of Data	34
A. Otis Group Intelligence Scale	34
B. Athol High School Scholastic Aptitude Test	34
C. School Marks	53
V. Statistical Analysis	61
A. The Scatter Graph Method and the Coefficient of Correlation Method	63
B. Frequency Polygon Method	153
VI. Summary and Conclusions	161
A. The Scatter Graph and the Coefficient of Correlation	163
B. The Frequency Polygon	165
VII. Bibliography	167
VIII. Appendix	

I INTRODUCTION

INTRODUCTION

The problem of this thesis has to do with the origin, construction, and comparative validity of the Athol High School Scholastic Aptitude Test. The Otis Group Intelligence Scale has been used as a means of comparison with the Athol High School Scholastic Aptitude Test.

It is commonly conceded by psychologists and educators everywhere that the intelligence test and the achievement test fail to measure certain mental attributes essential to success in school work. Harl R. Douglass² says that probably the most valuable use of tests is for predicting the ability of pupils to succeed in their various school subjects.

(Reference to numbers throughout this study will be found in references in Chapter VII). "Much more attention", he says, "is being paid today to educational and vocational guidance than formerly, because of the recognition of the importance of guiding school pupils into subjects and vocations suited to their individual needs, abilities, and interests." He continues to inform us that "not many tests have as yet been devised which may be used for this purpose, and the widespread use of tests for this purpose waits upon the development of further tests."

The Athol High School Scholastic Aptitude Test is an instrument planned for the purpose of testing school pupils along the line of their ability to succeed in school subjects.

It is a test of one's ability to learn and not a test of what one has already learned. It is composed of material with which the pupil is altogether unfamiliar. This new material is contained in a study syllabus, and is given to the pupil to study for a specified period of time. Subsequently he is tested upon what he has just learned. The achievement test and the intelligence test, such as the Otis Group Intelligence Scale, are based primarily upon past experience. They test general, and not specific ability. They, therefore, fail to measure the traits we would like to have measured, and in the main measure only knowledge. This thesis is an attempt to determine whether a test based upon ability to learn has a closer relationship with school marks than the Otis Group Intelligence Scale or similar tests.

A brief review of the beginnings in educational measurements might serve as a background for a better understanding of this study. The real beginning of standardized testing will probably never be known to us, but records place some of the early developments as early as 1864.⁶ Sample performances of various degrees of excellence were recorded in the form of "scale books" by an English schoolmaster. A similar plan was devised and adopted by a number of superintendents of schools in Norfolk County, Massachusetts in 1875. This work was confined to the field of arithmetic

and met with very little success.

In 1894 Dr. J. M. Rice⁶ stirred up quite a bit of discussion and antagonism when he attempted to judge the excellence of various methods of teaching spelling by the use of a uniform spelling test. Psychologists and educators everywhere took the position that "he was trying to measure things in human nature to which no objective yard stick could be applied."

Within a short time a few far-sighted psychologists realized the merit of this objective method of measuring school work, and proceeded to develop plans for the exact quantitative measurement of handwriting. The credit for pioneer work along this line goes to Professor E. L. Thorndike of Columbia University. Working upon the theory that differences in quality in handwriting are equally noted by competent judges, he obtained samples of handwriting which differed from each other by known amounts of quality, and arranged them in the order of merit to form a scale. The handwriting of pupils could then be graded by comparing them and matching their samples as closely as possible with the specimens on the scale. Thorndike's Handwriting Scale appeared in 1909.

While Thorndike was developing his handwriting test, one of his students by the name of C. W. Stone conceived the idea of an arithmetic test to be used in testing the mathematical ability of school children. Two tests were

developed, one on fundamentals and the other on reasoning or problems which he gave in the sixth grade. While giving his tests, a co-worker of Stone's decided to administer them to all the grades from the third through the high school. He felt so greatly encouraged by the results from giving these tests that he proceeded to develop and perfect them. The result was the splendid series of Curtis Arithmetic Tests that were so widely known and used throughout the country. In 1911-12 these tests were used in a survey of the schools of the city of New York.

Testing by means of these standardized tests became the hobby of every school in every city, town, and hamlet, and hundreds of tests for various subjects soon appeared.

L. P. Ayres developed a handwriting scale based on legibility. An index of legibility was calculated from the average rate of reading of samples of pupils' handwriting which had been secured under controlled conditions. Ayer also at this time, 1912-15, developed scales for measuring ability to spell.

In 1913 B. R. Buckingham formed a test in spelling which was made up of words arranged in the order of their difficulty. This measuring device began with words which practically all pupils could spell, and increased in difficulty until comparatively few pupils could spell the words correctly.

Perhaps at this point it would be advisable to describe

somewhat briefly the nature of standard tests.

The characteristics of a good standard test are many. A test must measure the achievement or ability which it is supposed to measure. A test in Algebra, for example, must be so constructed that the pupils having the best mathematical ability will receive the highest scores.

A test must be objective, that is, each question must be so constructed as to admit of only one definitely correct answer. Examinations drawn up by teachers are likely to be of such a nature as to allow the corrector's own judgment to enter into the marking. In this event, the test will be subjective.

A test must possess a high degree of validity, that is, it must always give the same or nearly the same results.

It must be interesting to the pupils. An interesting test appeals to all the pupils taking it, and consequently all are likely to put forth their best efforts.

A good test must provide reliable standards or norms by means of which comparisons can be made. In this connection, when it is desired to know just where a pupil stands in a given test, one needs only to compare his score with the norm for the test. If his grade is much above this norm, then his score is high. If, on the other hand, his grade is below the norm, then his score is low.

A number of quotients have been evolved for the purpose of grading or classifying pupils according to their ability

or achievement in school subjects. An example of reading
7
quotients obtained by giving the Thorndike-McCall Reading
Scale to several pupils is as follows:

Pupil	Chron. Age	Score	Reading Age	Reading Quotient
A	120 mos.	26	82 mos.	62
B	134	40	121	90
C	124	41	124	100
D	130	60	178	145

A subject quotient of 100 indicates that the pupil
has normal or average ability in that subject. Quotients
above or below 100 indicate superior or inferior ability.

The educational quotient offers another means of
grading or classifying pupils. To determine the educational
quotient, a composite of the scores of several tests given
at nearly the same time is formed and a single numerical
result is obtained which will express each child's perform-
ance. These scores are then compared with previously de-
termined standards to form the educational age. The edu-
cational quotient is then found by dividing the educational
age by the chronological age, and multiplying by 100.

The achievement quotient is important in that, unlike
the other above mentioned quotients, it takes into consider-
ation the native intelligence or inborn ability of the child
who is tested. The mental ability of a child is a very potent
factor in determining what and how fast he learns. The
mental age of the pupil is determined by the use of intelli-
gence tests. The achievement quotient can then be determined

by dividing the child's subject age by his mental age and multiplying by 100.

Suppose that a pupil is ten years old and has a reading age of ten years. His achievement quotient is 100. Suppose another pupil has a mental age of eleven years and a reading age of ten years. His achievement quotient will be 90.9. Obviously this pupil is not doing the grade of work of which he is capable.

The achievement quotient is declared by such experts as McCall⁹ and others as being our most useful educational measuring device. By virtue of the fact that it takes into consideration both ability and performance, it has a high degree of efficiency and probably is the most exact measuring device we have.

Many forms of accomplishment or achievement tests have been developed which may be used in estimating what the pupil has derived from study in his school subjects. They are sometimes called "subject" tests. They measure only what one has learned. The Kansas Silent Reading Test, the Holmes Pennmanship Test, the Peet-Dearborn Arithmetic Test, the Hand-schin Modern Language Tests, the Sones-Harry High School Achievement Test, the New Standard Achievement Test are examples of tests of this sort. These tests have a very important place in educational measurements.

All of the aforementioned tests referred to have to do

with the measuring of what the pupil has already learned or accomplished. They do not measure native ability or intelligence. The intelligence test has been devised for the purpose of measuring native equipment. Pioneer work along this line goes back to Francis Galton. He attacked the problem with the thesis in mind that "acuity of the senses" was the determining factor in intelligence. However, it was soon discovered that, while this was a strong contributing factor, it was not the dominant factor, and this type of testing was abandoned.

Another method of attack, in devising means of intelligence testing, was along the line of "motor acuity". In this connection all sorts of devices for timing responses to stimulations were invented. Motor skill was the keyword in intelligence measurement. But it was soon discovered that many men of marked intellectual ability were not so skillful along motor lines, whereas others of low mentality were skillful.

Faculty psychology came in with its bid at mental testing with the theory that "faculties of the mind" were the determiners of intelligence. Consequently, there were developed tests of memory, of reason, of judgment, and so on. It was found, however, that a man might have a good memory for some things and a poor one for others. So also for reasoning, and the other faculties, therefore, this line of attack fell down.

A French doctor, Binet, and his colleague Simon, did much to solve the problem of intelligence testing. They worked on the principle that, since no single test had been satisfactory, a series or battery of tests could be given, and the average of these could be used to represent mental ability. They also perfected plans for determining the "mental age" of the pupil. This was accomplished by the establishment of certain norms, or degrees of development or performance which the average child should accomplish and comparing those tested with these norms. If a boy of eleven could accomplish and pass only the test which the average nine year old child could do, then he has a mental age of nine. If, on the other hand, a pupil of nine years of age could pass the test which the average eleven year old pupil could pass, then he has a mental age of eleven, and is a superior child.

The test, as Binet left it, was brought to this country and translated. It was found to be faulty in some respects, and was revised for use in this country by Professor Lewis M. Terman of Stanford University. Revisions were also made by Goddard and Kuhlmann.

The nature of the test may be seen from the following example:

YEAR XVI (Average Adult)

1. Vocabulary test, defines 65 words.
2. Interpretation of fables (4 of 5).
3. Differences between abstract words (3 of 4).
Laziness-idleness: evolution-revolution: poverty-misery;
character-reputation.

4. Enclosed boxes puzzle (3 of 4).
 5. Repeats 6 digits backwards (1 of 3), 471952; 583294; 752638.
 6. Code: writes "Come quickly" in six minutes with not more than two errors.
- Alt. Repeats 28 syllables (1 of 2).
- a. Walter likes very much to go on visits to his grandmother, because she always tells him many funny stories.
 - b. Yesterday I saw a pretty little dog in the street. It had curly brown hair, short legs, and a long tail.
- Alt. Comprehension of physical relations (2 of 3).
- a. Path of cannon ball.
 - b. Weight of fish in water.
 - c. Hitting distant mark.

This is an individual and not a group test. It is given by allowing the pupil to begin with that part of the test which corresponds to his chronological age, and working down until he reaches a test where no failures are made. He then works up until he reaches a test where complete failure results. His mental age is found by adding to the "basal year" the standard number of months for each test passed. Pupils were classified according to their mental age. A much more accurate means of classifying pupils was devised. It is known as the "intelligence quotient", and is found by dividing the mental age of the child by the chronological age. That is, if a ten year old child is tested and found to have a mental age of twelve years, then his intelligence quotient would be $12 \div 10 = 1.2 \times 100 = 120$. Such a pupil is superior in his intellectual capacity.

It takes from one hour to one hour and a half to give a Stanford Examination, and the process of testing many pupils is, hence, seen to be a long and expensive proposition. When the United States entered the World War it became desirable to examine and classify the army recruits according

to their mental as well as their physical ability. Naturally, this would call for a test such as could be given to a large group of soldiers at one sitting. Dr. Arthur S. Otis had already begun a plan for testing large groups, and his work was accepted as a basis for a test. An examination was worked up by the American Psychological Association which consisted of ten tests, each test being made up of from twelve to forty items. The men tested had to do no writing but only had to indicate their answer to the questions by placing a check after the questions, by underling a word, or by supplying a missing number. This test was known as the Army Alpha Test.

It was soon discovered that the Army Alpha Test failed to measure the intelligence of those persons having linguistic difficulties. A person might be intelligent enough, but his knowledge of the English language was so deficient as to cause him to make a poor showing on the test. For such men a test based upon performance, and known as the Beta Test was perfected.

After these tests had been in use for a short while, others of a similar form and structure appeared. Among these are the Terman Group Test of Mental Ability, and the Otis Group Intelligence Scale. These tests have been accurately standardized, and are used extensively. They are used to measure general mental ability.

More recent developments in testing have been directed toward predicting one's ability to learn, or to succeed in future school subjects. The importance of guiding pupils into subjects and fields of endeavor suited to their ability and interests is widely felt among educators and psychologists everywhere.

Dr. H. H. Glick¹⁰ and Mr. Charles P. McDonnell in 1932 developed a test known as the West Springfield High School Scholastic Aptitude Test which is based upon ability to learn. It has a study syllabus and a test syllabus, and is composed of five sections. Section I offers study and tests in Science, Section II study and tests in History, Section III tests in Language, Section IV study and tests in Geography, and Section V study and tests in Reading Comprehension.

Mr. McDonnell administered this test, along with the Terman Test of Mental Ability, to one hundred and fifty pupils of the ninth grade and the same number of the tenth grade of the West Springfield High School. He determined coefficients of correlation between the Scholastic Aptitude Test scores and (1) the Terman Test scores, (2) the school marks and (3) the teachers' estimated marks. The correlation between the Terman Test and the Scholastic Aptitude Test scores was relatively high in both grades, being .67. In the ninth grade the coefficient of correlation between the Terman Test scores and the school marks was .46. The coefficient of

correlation between the Scholastic Aptitude scores and the school marks was .60, which is fourteen points higher than that between the Terman Test scores and the school marks.

In the tenth grade the coefficient of correlation between the Terman Test scores and the school marks was .463, and between the Scholastic Aptitude Test scores and the school marks it was .467.

The coefficient of correlation between the Scholastic Aptitude Test scores and the teachers' estimated marks in the ninth grade was rather high, namely .58. The correlation between the Terman Test scores and the teachers' estimated marks in the ninth grade was .54. In the tenth grade the figures for the same results were .38 and .44 respectively.

From this study made by Mr. McDonnell, and from the study of the results obtained from the Athol High School Scholastic Aptitude Test, it seems plausible to assume that the Ability to Learn Test is more valid than the Intelligence or the Achievement Test for predicting success in school work, and for directing pupils along vocational lines suited to their individual needs and interests.

The first two tests are based on the assumption that the data are normally distributed. The third test is based on the assumption that the data are normally distributed and that the variance is known. The fourth test is based on the assumption that the data are normally distributed and that the variance is unknown. The fifth test is based on the assumption that the data are normally distributed and that the variance is unknown and that the sample size is small.

Table 1 shows the results of the tests for the data in Figure 1.

The first two tests are based on the assumption that the data are normally distributed.

The third test is based on the assumption that the data are normally distributed and that the variance is known.

II ANALYSIS OF TESTS USED

The first two tests are based on the assumption that the data are normally distributed.

The third test is based on the assumption that the data are normally distributed and that the variance is known.

The fourth test is based on the assumption that the data are normally distributed and that the variance is unknown.

The fifth test is based on the assumption that the data are normally distributed and that the variance is unknown and that the sample size is small.

The results of the tests for the data in Figure 1 are shown in Table 1. The first two tests are based on the assumption that the data are normally distributed. The third test is based on the assumption that the data are normally distributed and that the variance is known. The fourth test is based on the assumption that the data are normally distributed and that the variance is unknown. The fifth test is based on the assumption that the data are normally distributed and that the variance is unknown and that the sample size is small.

The first two tests are based on the assumption that the data are normally distributed.

The third test is based on the assumption that the data are normally distributed and that the variance is known.

The fourth test is based on the assumption that the data are normally distributed and that the variance is unknown.

The fifth test is based on the assumption that the data are normally distributed and that the variance is unknown and that the sample size is small.

The results of the tests for the data in Figure 1 are shown in Table 1. The first two tests are based on the assumption that the data are normally distributed. The third test is based on the assumption that the data are normally distributed and that the variance is known. The fourth test is based on the assumption that the data are normally distributed and that the variance is unknown. The fifth test is based on the assumption that the data are normally distributed and that the variance is unknown and that the sample size is small.

ANALYSIS OF TESTS USED

The Otis Group Intelligence Scale, Advanced Examination: Form A,¹ covers ten fields, with a total number of 230 items. The first test is a test in following directions and contains 20 problems. The letters of the alphabet are listed at the top of the page, and this sample problem follows:

"Write the fifth letter of the alphabet.....(E)"

The other problems are similar to the above.

The second test is designed to determine one's ability to select opposites. It contains 25 problems, with these samples at the top of the sheet:

"(up.....(short, down, small, low, young)

(hot.....(warm, ice, dark, cold, fire)"

This test is in multiple choice form.

Test three contains twenty-five problems, and is a test in rearranging of disarranged sentences, the pupils being asked to state whether the rearranged sentence is true or false. The samples are:

"(men money for work.....(true false)

(uphill rivers flow all.....(true false)

(ocean waves the has.....(true false)"

There are 20 problems in Test 4 which includes a list of twenty-four proverbs, the pupil being asked to find the

statement that explains it and put the number of that statement in the parenthesis before the proverb.

The mathematics test is in two parts; one arithmetic test, number 5, and the other a geometry test, number 6. The arithmetic test contains twenty problems such as may be found in any book on that subject, for example:

"If a boy had 10 cents and earned 5 cents, how much money did he have then?.....()" "

The geometry test contains two figures; one composed of a rectangle imposed upon the lower half of a circle, with the numbers 1, 2, and 3 placed within these at different places. The second figure is made up of a rectangle, a circle, and a triangle, all superimposed upon each other with thirteen numbers placed about. Each problem asks a question that is answered by a number. The sample problem refers to figure 1 and is as follows:

"What number is in the circle but not in the rectangle?"
.....(1)

There are twenty problems.

Test 7 is a test to determine a pupil's ability to select analogies. The samples are as follows:

"(finger: hand--toe:(?).....foot, knee, arm, shoe, nail
(clothes: man--fur(?).....coat, animal, hair, skin, cloth
(tall: short---fat(?).....man, wide, thin, boy, heavy"

This is a multiple choice test and there are twenty-five problems.

Test 8 is a test in selecting similarities.

"(hat, collar, glove.....hand, cane, head, shoe, house
(rose, daisy, violet.....bush, red, plant, bed, pansy
(desk, bed, chair.....book, table, floor, pencil, coat"

This is a multiple choice test having twenty problems altogether.

In test 9 a narrative on, "The Reward of Kindness" is given with certain words omitted. These words are supplied along with a number of other words, making a multiple choice problem out of it. There are twenty-five problems in this part.

Test 10 contains thirty problems, each in form of a true-false test. It is a test of memory. A story is read to the class and questions are asked, some of which pertain to the story and others of which do not. The pupil is expected to answer the question in the light of the story read.

Samples: "(Was the story about a king?....(yes, no didn't say)
(Was the king's daughter 16
(years old?.....(yes, no didn't say)
(Was she ugly?.....(yes no didn't say)"

The Athol High School Scholastic Aptitude Test, the study of this thesis, was constructed in 1934 by Claude B. Germany under the supervision of Dr. Harry N. Glick. It consists of subject matter which is entirely new to the pupils who are to be tested. The test is divided into two parts; Form A and Form B. For each form there is a study syllabus and an examination syllabus.

Form A includes tests in the fields of science, history, and language, while Form B offers tests in geography, literature, and mathematics.

The pupils are allowed to study the new material of Form A for a specified period of time, then these sheets are collected and the examinations passed out. On the following day Form B is presented in the same manner. In these tests there is no direct opportunity for past experience to play a part in aiding the pupil and, consequently, he is being tested along the lines of his capacity to learn, his brilliance, and his aptitude to succeed in the junior or senior high school.

Science. The science test is divided into two parts; A and B. On the study sheet appears a drawing of a flower with the different parts labeled. The biological significance of each part is stated. The flower is drawn and labeled in such a way as to bring out both its structural and functional values. Above the drawing is a paragraph which explains more in detail how each part of the flower is constructed and the part each plays in reproduction. On the second sheet is an enlarged pistil which tells more fully just how seeds are formed. The pupil is allowed five minutes to study this test.

The examination (Section 1, Part A) contains a drawing of the flower with the parts numbered. The names are found

at the right of the drawing and the student is required to place the correct number in the parenthesis before the name. Below the drawing and on the next page of the test sheet, is a list of facts deducible from information gathered from the study sheet with multiple choice endings. The pupil is required to place a check after the statement which best completes each sentence. For example, in the sentence

"The main purpose of the flower is (to beautify nature
(to produce seed*

a check has been placed after the phrase "to produce seed" because it best completes the sentence. There are nine of these sentences. Five minutes are allowed for this test.

The study syllabus (Section I, Part B) contains definitions and explanations of certain scientific principles and laws such as "when heated any form of matter, such as an iron ball, will expand, that is, grow larger." The pupil is allowed five minutes to study this page.

The test (Section I, Part B) contains diagrams, each of which demonstrates one of the principles explained in the study syllabus. For example, the fifth diagram, which includes "ball-and-ring combination" explains the principle of expansion.

The pupil is expected to identify the process represented by each set of diagrams by placing a check in the proper spaces at the beginning of the test. Diagram number 5 is an example of expansion so the pupil is to place a check in column five opposite the word "expansion." Five

minutes are allowed for this test.

This part of the science test is expected to accomplish the same thing that experiments would accomplish. It is the nearest thing to an experiment which could be improvised and may be substituted for a series of experiments. Of course, it is impossible to perform experiments as a part of an intelligence test, but I felt that if the pupils were allowed to study the laws and principles printed in the study syllabus this knowledge could be used in actually solving the problems presented.

When an instructor of science performs an experiment the pupil's analysis and conclusions are based upon information previously learned. He is using knowledge to solve the problem in hand. The test is a test of his analytical and synthetic ability; his ability to take a problem and think it through to some logical conclusion.

History. The study syllabus, Section II, contains two paragraphs, and is a biographical and historical description of the life and character, and main events in the life of Rousseau. The pupil is allowed two minutes to study this sheet.

On the test sheet of Section II are seventeen multiple choice sentences based upon the study of the life of Rousseau. The pupil is to place a check after the word that best completes the statement. For example, in the sentence

Rousseau was born at (London
Geneva*
Paris

a check has been placed after Geneva because that is the correct ending for that sentence. The pupils are allowed two minutes to take this test.

Language and Grammar. There is no study sheet for this part of the test. In the test syllabus, Section III, may be found an artificial vocabulary and five artificial rules of a language built up by the authors. On the opposite page are some English sentences, and beneath each is its translation into the artificial language. Some of these translations are correct and some are incorrect. The pupil is to draw a line through every word that is incorrectly translated. He may consult the vocabulary and rules freely while taking the test. Twelve minutes are allowed for this test.

This is the end of the first part of the Athol High School Scholastic Aptitude Test. It constitutes all of Form A, and is the first day's test. Form B should be given on another day, preferably the following day.

Geography. This is the first test of Form B and is the fourth of the series. The study sheet is a map of no known country. It was improvised and drawn by the author, and therefore contains no facts known to the pupil. Ten states, two islands, three bays, one strait, an ocean, three rivers,

three mountain ranges, a desert, three cities, an oil field, a cattle belt, and a cave are located on the map. Five minutes are allowed to study this page.

The test, Section IV, Part A, contains the same map with the names omitted and numbers substituted for them. On the opposite page are the names of the states, cities, rivers, industries, etc. with parentheses before them. The pupil is to put the numbers before the names which the numbers represent. A number "1" is placed before the "caves of Luray" because the caves are located where the "1" is to be found on the map. The pupils are allowed six minutes to take this test.

In the study syllabus, Section IV - Part B, is a list of twenty geographical facts. These facts have been selected so as to eliminate the possibility of the pupil having previously gained knowledge of them. Three minutes are allowed to study this page.

On the test, (Section IV - Part B) is a list of the same twenty facts with the important words left out. Below is a list of the words which have been omitted. The pupil is required to place the number of the statement in the parentheses which precede the word needed to complete the sentence. Six minutes are allowed for this test.

English. Section V of the study syllabus is divided into two parts; A and B, both of which are on one sheet. Part A contains a paragraph taken from English Literature by

William J. Long. Part B is a short poem taken from Shakespeare. Three minutes are allowed to study this part.

The test (Section V - Part A) contains the same paragraph with certain important words left out and numbers substituted for them. Below the paragraph is a list of the words that have been omitted. The pupil is required to place the numbers in the parentheses preceding the word which belongs in the space of corresponding numbers.

Part B of this section consists of a number of statements some of which are true and some false when considered in the light of the poem studied in the study syllabus. The pupil is required to place a check in the proper columns opposite each statement, indicating whether true or false.

Mathematics. There is no study sheet for this part of the Athol High School Scholastic Aptitude Test. In the study syllabus, (Section VI - Part A) are fifteen syllogisms. It is felt that in solving these syllogisms the pupil is demonstrating a similar type of reasoning as that used in solving mathematical problems. Consequently, a test in syllogisms is used as a test of mathematical ability. In each syllogism the pupil is asked to study statements a and b and to mark statement c in each as true or false using a plus sign in the parenthesis if true, and a minus sign if the statement is false. The pupils are allowed five minutes to take this part of the test.

Part B allows ten minutes, and consists of two examples in addition, two in multiplication, one of these being of decimal quantities, two examples in addition of mixed numbers, and two examples in percentage. (For a complete copy of this test see appendix page.)

III A CRITICISM OF INTELLIGENCE TESTS

A CRITICISM OF INTELLIGENCE TESTS

It is more desirable to know one's ability to learn than it is to know the facts one has acquired because of the inconsistency of the environment. Intelligence and achievement tests are primarily tests of experience. They are not tests of one's ability to learn, but of what one has already learned. The prime function of our educational institutions is to help pupils to grow in mental power. Intelligence cannot be defined solely in terms of experience. Our definition must include all the other mental traits such as the ability to take a problem and analyze it into all of its component parts, for purposes of a clear understanding, the ability to reason, the power of quick perception, etc. Otis,¹ in defining intelligence, says that "mental ability is that growing ability in a child which enables him year by year to think more abstractly and solve more difficult problems. Brightness is that fixed quality of mind which determines the rate at which a child's thinking power shall grow. It is differences in brightness that cause children of the same age to differ in mental ability and that enables some individuals to reach ultimately a higher level of intellectual power than others."

The intelligence and the achievement tests for the most part fail to measure intelligence, and in a large measure fail to determine some of the essential requisites for

success in school work. Many teachers and psychologists have had pupils who, in spite of a low score on such tests, have done remarkably well in their school work. On the other hand, there have been those who, while receiving high scores on the tests, have done poorly in their school work.

This study has included a careful analysis of many intelligence and achievement tests such as the Otis Group Intelligence Scale, the Terman Group Test of Mental Ability,⁵ the Sones-Harry High School Achievement Test,¹¹ and the Cooperative Test Service series of tests. The intelligence tests are largely nothing more than achievement tests. They measure what one has learned, and do not necessarily measure one's native mental power. They measure to a great extent the effects of environment instead.

The achievement test, according to W. S. Monroe,³ has as its general function the measurement of what one has learned, whereas the intelligence test is used to measure the pupil's general capacity to do work. Edward A. Lincoln,⁸ in discussing intelligence tests, says that "they are used for the measurement of native intelligence, brain power, or inborn ability of the individual. Because they test innate mental ability, they are so constructed that formal education has little or no effect on the scores which the children make."

It is the belief now among many educators that the intelligence test does not accurately measure innate mental ability, and that formal education does effect the scores by a large amount. It is the contention of the writer of this thesis that the intelligence test is a test of experience.

Most of the content of these tests is material with which pupils everywhere are familiar. In solving the problems contained in them, it is pre-supposed that the pupils have knowledge of the way in which the problems should be organized and solved. If the pupil has not encountered the same problems at some time in his life, either in school or out of school, he will be unable to solve them.

Consider the Otis Group Intelligence Scale, and the Terman Group Test of Mental Ability. Test 2 of the Otis Test is a test of one's ability to select "opposites".

A sample from the test follows:

"Up.....(short, down, small, low, young)
Hot.....(warm, ice, dark, cold, fire)"

These opposites have been hooked together at some time in the child's past experience. In rhymes such as "all that goes up, is bound to come down", and in the ordinary experiences about the home, the ideas have been associated. It requires a small amount of reasoning or native mental power to solve such problems as these. The "all-or-none" principle operates, and either the pupil knows the answer,

or he does not know it, and consequently his answer will be right or wrong, and native power has played no part in obtaining the answer.

A proverbial point of criticism of the intelligence test is the great emphasis placed upon English. In this respect, pupils of foreign parentage or those of poor English preparation, though possessing a marked degree of intelligence, find themselves handicapped in working out the problems. Test 3 of the Otis Group Intelligence Scale, and Test 8 of the Terman Test is a test of one's ability to reconstruct disarranged sentences, and to determine whether true or false. A sample taken from the Terman Test may be considered:

"Hear are with to ears-----true false
Eat gunpowder to good is-----true false"

The re-arrangement of the sentences involves an exercise of one's ability to do what he has already been taught to do in his study of grammar and reading. In determining whether the statements are true or false, one has only to appeal to past experience. Either he knows, or he does not know whether "gunpowder is good to eat", or whether the "ears are to hear with". Knowledge of such facts does not constitute the whole index to intelligence. Throughout all of these tests, the same thing is tested, namely experience.

Test 5 of both the Otis Group Intelligence Scale and the Terman Test is an arithmetic test. Let us consider a sample from the Otis Group Intelligence Scale:

- "1. If a boy had 10 cents and earned 5 cents, how much money did he have then?
2. At 4 cents each, how much will 12 pencils cost?
8. If $2\frac{1}{2}$ yards of cloth cost 20 cents, what will 10 yards cost?"

The knowledge used in solving these problems is empirical. Similar problems may be found in any book of arithmetic. The pupils have already been taught how to solve them. Consequently, the test is not a test of intelligence where innate ability is concerned.

Tests 7 and 8 of the Otis Group Intelligence Scale are tests in selecting analogies and similarities among words and figures. The samples are:

"finger: hand--toe: (?)--foot, knee, arm, shoe, nail
clothes: man--fur: (?)--coat, animal, hair, skin, cloth
hat; collar, glove: (?)--hand, cane, head, shoe, house
rose; daisy, violet: (?)--bush, red, plant, bed, pansy."

These associations have their inception in childhood and all through early life. They have been formed and ingrained into the experiences of the individual. The possession of the associations is no gauge to one's intelligence. The surprise would be, so far as most of the analogies and similarities are concerned, that the child did not have the ideas already hooked together in his mind. Intelligence enters in only when we are ~~face~~ face to face with a new situation, a new problem, something of an original nature to be studied and worked.

The narrative completion story found in Test 9 of the Otis Group Intelligence Scale, is one commonly known to a large number of children. The multiple choice of words suggested adds little to the complexity of the problem, for the pupil need not go very far with his task of completing the story before he recognizes the story as being one he has heard before.

The Terman Group Test of Mental Ability is largely a test of experience. For the most part, problems in the test are problems which call into use facts previously acquired by the pupil.

In Test 1 (Information) a number of "fact" questions are asked. Some of them may be considered here.

- "1. Coffee is a kind of--bark, berry, leaf, root.
2. Sirloin is a cut of--beef, mutton, lamb, veal.
6. Napoleon was finally defeated at--Leipzig, Paris,
Verdun, Waterloo.
11. Confucius founded the religion of--Persians, Ital-
ians, Chinese, Indians."

It is not the contention of the writer of this thesis that acquiring and retaining information is detrimental to the individual. Certainly, it is of advantage to anyone to have at his command all the facts possible for him to retain. But in many cases individuals holding much information at their command are often judged to be very intelligent on this basis alone. We know now that this is a false idea, and that other factors of the mind must be

considered as well. A test of this sort, testing mostly facts alone, cannot be looked upon as having much validity where so many other traits are concerned.

From Test 2, (Best Answer) we have the samples:

- "1. Spokes of a wheel are often made of hickory because
 1. Hickory is tough.
 2. It cuts easily.
 3. It takes paint nicely.
5. If the earth were nearer the sun
 1. The stars would disappear.
 2. Our months would be longer.
 3. The earth would be warmer.
8. A steel battleship floats because
 1. The engines hold it up.
 2. It has much air space inside.
 3. It contains some wood."

From Test 3, (Word Meaning) we may take the following samples:

fall-drop.....	<u>same</u> --opposite
north--south.....	same-- <u>opposite</u>

From Test 4, (Logical Selection) we have the samples:

1. A horse always has:
harness, hoofs, shoes, stable, tail.
2. A circle always has
altitude, circumference, latitude, longitude,
radius.
5. An object always has
smell, size, taste, value, weight.
9. A ship always has
engine, guns, keel, rudder, sails.

Examples from Test 6, (Sentence Meaning) are as follows:

- | | | |
|---|-----|----|
| 2. Is an alloy a kind of musical instrument? | Yes | No |
| 3. Is scurvy a kind of medicine? | Yes | No |
| 7. Is the mimeograph something used by stenographers? | Yes | No |
| 9. Are proteids essential to health? | Yes | No |
| 13. Are sheep carnivorous? | Yes | No |

Examples of Analogies taken from Test 7 are:

1. Coat is to wear as bread is to
eat, starve, water, cook.
2. Week is to month as month is to
year, hour, minute, century.
6. Cat is to tiger as dog is to
wolf, bark, bite, snap.

Examples of problems in Classification of words are as follows:

1. Frank, James, John, Sarah, William
5. Hop, run, skip, stand, walk.
13. Digestion, hearing, sight, smell, tough.

After a careful analysis of the above examples, it seems logical to conclude that, for the most part, the Terman Test is a test of experience, and not a test of one's ability to learn. The intelligence test is primarily an achievement test.

In a similar manner, one might take an analysis of other intelligence tests, and he invariably will arrive

at the same conclusions. These tests are largely based upon previous knowledge, and cannot possess much potency for intelligence testing. They cannot be used with accuracy in predicting the success of school children in their academic subjects.

The Athol High School Scholastic Aptitude Test was developed with the hope that it would meet with the demands of those who desire greater accuracy in measuring intelligence of children, and in predicting the probability of success one might expect of pupils entering the junior or senior high school courses. The test is composed of both artificial and real material, but altogether new material for the pupils to be tested. Before rendering the test, the pupils are advised that they are not expected to know what they are to be tested on, since the test is not a test of what they already know, but of their ability to learn. Consequently, the test is not a test of experience, but a test largely of innate ability. Pupils like to take the Athol Test because they feel that it is a challenge to their intellectual power. They are relieved of any fear of facing unfamiliar problems. The test has a study syllabus, and a test syllabus. The pupils are allowed to study the new material for specified periods of time and are then tested on what they have learned.

In the sixth section, the mathematics part of the test, may be found syllogisms. These syllogisms offer a new and unfamiliar type of material for testing. It is believed that the type of reasoning used in solving these syllogisms is the same as used in solving mathematical problems. Hence, the pupil is being tested along the lines of his ability to succeed in mathematics.

An artificial map, containing fictitious countries, cities, rivers, a cave, mountains, etc. forms a part of the test. The map is symmetrical and well organized. It is made to appeal to the interests of the child. An artificial language was developed to be used in estimating ability in grammar. Throughout the entire test may be found diagrams, pictures, and figures, all of which offer a new means of testing pupils.

COLLECTION OF DATA

The Otis Group Intelligence Scale, Form A, was given to 180 pupils of the ninth grade of the junior high school of Athol, Massachusetts on October 4, 1934. The results of this test are given in Table I. The purpose of giving the test was to offer material which could be used as a means of comparing the merits of the Athol High School Scholastic Aptitude Test, and also to aid the teachers in classifying pupils and to assist in the solving of certain problems which might arise in connection with vocational guidance. The test was rendered by the class room teachers under the supervision of the writer, and were later scored by each teacher and checked by the supervisor, and the grades arranged in the order of their "total score", the highest score being placed first in the test.

The Athol High School Scholastic Aptitude Test was given to the same pupils on October 26 and 27, 1934. The test is composed of two parts, Form A which was administered on the 26th, and Form B which was given on the 27th. The pupils taking this test were advised that the results would in no way influence their school marks, and that they should look upon it as a mental track meet in which each should like to make a good showing. They were further advised not to feel discouraged if they found some of the material difficult to

TABLE I

Scores by Rank of 163 Pupils Taking
the Otis Group Intelligence
Scale

No. of Pupil	Score in each of 10 tests (Adv. Exam.)										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
1	16	20	16	20	17	4	18	19	22	21	183	105	126
2	16	17	12	16	12	13	14	16	19	21	156	94	121
3	14	14	14	7	12	9	12	11	20	20	133	98	112
4	13	18	15	13	16	18	17	18	12	20	150	88	121
5	13	19	18	20	9	11	14	12	16	23	155	94	121
6	13	19	25	16	14	8	16	16	17	22	166	94	124
7	15	17	12	13	14	12	15	16	21	24	159	111	116
8	13	21	19	16	12	13	18	16	6	20	154	93	121
9	15	17	12	5	19	13	19	16	12	17	145	113	111
10	14	14	5	8	11	11	12	15	9	23	122	101	107
11	14	17	15	13	11	6	15	16	12	22	141	95	116
12	15	16	14	7	13	10	14	17	22	20	148	98	117
13	13	13	19	1	10	7	11	10	3	23	106	123	94
14	15	15	14	12	12	16	13	16	20	23	156	98	120
15	11	14	19	5	8	5	13	15	21	25	136	101	112
16	15	17	12	16	13	10	15	15	19	21	153	90	121
17	13	17	17	9	13	9	16	15	20	22	151	110	114
18	15	15	16	13	12	6	8	10	20	21	136	107	110
19	10	11	13	4	11	11	12	10	13	16	111	99	104
20	11	15	12	9	11	13	16	15	23	18	143	97	116

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
21	13	13	13	10	10	11	12	16	22	23	143	99	115
22	12	19	16	11	14	8	14	9	13	21	137	95	114
23	11	11	10	9	14	10	14	11	18	19	127	99	110
24	13	13	12	9	13	8	7	13	0	25	113	102	104
25	14	16	25	5	8	8	14	15	23	17	145	95	117
26	11	16	17	8	9	6	16	17	21	24	145	95	117
27	12	19	18	15	13	6	13	16	22	23	157	95	121
28	12	9	11	7	11	7	13	11	19	21	121	90	111
29	13	9	11	3	13	6	11	11	10	20	107	88	107
30	14	15	17	13	12	12	13	16	23	23	159	103	119
31	10	6	13	5	9	6	14	11	13	22	109	102	103
32	13	19	25	13	9	9	14	12	25	23	162	102	121
33	14	15	17	6	12	6	10	11	21	23	135	99	112
34	11	14	15	5	9	6	8	10	12	18	117	90	109
35	13	13	12	13	11	8	15	13	6	13	117	114	101
36	13	14	12	8	14	13	13	13	17	23	140	100	114
37	14	18	13	18	9	12	17	9	25	22	157	108	117
38	13	21	18	13	12	10	15	15	26	20	162	103	120
39	13	15	12	10	14	8	13	10	5	20	120	90	110
40	11	12	20	4	13	6	14	17	11	16	124	101	108
41	13	15	13	12	15	8	15	17	18	16	142	100	114
42	12	15	14	8	14	11	8	14	22	19	137	102	112
43	14	14	15	7	11	6	11	11	15	19	123	103	107
44	14	15	14	11	11	11	16	17	19	21	149	105	115

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
45	10	7	8	6	11	8	15	10	9	17	101	95	57
46	14	11	11	5	12	12	12	14	20	23	134	101	111
47	9	13	23	7	12	9	12	12	19	21	137	90	116
48	11	11	14	11	16	10	18	15	24	18	148	107	114
49	9	11	3	1	9	10	10	13	15	15	96	110	95
50	14	12	25	5	7	6	8	9	19	19	124	105	107
51	12	13	7	12	9	10	10	11	16	21	121	90	111
52	11	12	6	4	12	7	14	11	19	16	112	98	105
53	12	12	4	10	10	6	15	13	23	21	130	110	107
54	12	9	15	6	10	9	10	14	10	21	116	102	105
55	11	4	10	3	13	9	12	12	21	23	118	102	106
56	15	18	16	17	17	9	15	15	25	25	172	100	124
57	11	12	11	7	12	7	13	12	16	19	120	91	110
58	9	11	16	13	10	8	11	11	7	23	119	110	107
59	15	19	25	11	10	8	20	15	22	26	171	105	122
60	12	11	13	6	11	8	13	10	19	17	120	95	109
61	13	10	10	7	10	7	16	8	6	20	107	94	105
62	13	10	8	10	13	10	10	11	13	18	116	95	107
63	12	9	25	8	13	9	14	16	8	17	131	120	104
64	7	5	15	1	7	8	15	12	3	15	88	110	89
65	12	12	14	5	8	4	11	10	19	17	112	104	103
66	10	12	11	7	12	5	19	14	19	26	135	98	113
67	13	13	12	5	13	7	11	17	8	19	118	118	100

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
68	11	10	15	2	10	7	13	11	14	19	112	96	106
69	9	12	21	8	12	8	8	12	12	24	126	107	107
70	8	5	12	6	9	6	10	8	14	19	97	128	89
71	13	13	15	6	9	8	14	15	21	21	135	102	111
72	14	13	14	8	13	14	14	19	14	24	147	114	111
73	11	16	21	5	10	9	16	19	21	21	149	113	112
74	10	12	13	4	12	8	13	14	8	21	115	99	106
75	10	11	10	8	12	9	8	9	17	19	113	106	103
76	14	11	14	7	11	8	9	13	18	16	121	105	106
78	14	9	8	7	13	8	14	11	17	20	121	95	109
79	10	9	6	1	9	7	11	7	8	21	99	105	98
80	12	12	19	7	14	6	11	13	12	18	124	110	105
81	14	13	7	13	14	7	8	11	8	19	114	107	103
82	12	16	12	10	7	9	15	12	8	17	118	92	109
83	11	10	13	6	12	7	12	11	14	22	118	105	105
84	10	12	11	10	14	6	11	12	22	18	126	95	111
85	13	15	13	10	12	9	19	12	24	22	149	100	117
86	12	13	18	3	15	10	14	15	15	20	135	111	108
87	13	14	18	6	13	8	13	8	25	21	141	101	111
88	10	12	14	3	10	7	14	15	19	23	127	96	111
89	13	9	18	10	14	7	14	10	19	21	135	106	110
90	13	11	14	12	13	7	13	12	10	16	121	101	107
91	11	13	18	5	13	10	13	17	15	18	134	100	112

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
92	14	11	14	8	14	9	14	13	20	19	136	94	114
93	13	13	12	8	12	8	13	15	9	21	124	89	112
94	8	9	13	3	8	5	9	11	16	22	104	99	101
95	12	12	16	4	10	6	11	12	14	21	118	111	103
96	11	11	12	5	10	4	10	12	0	16	91	100	97
97	10	9	9	6	8	8	11	13	3	18	95	117	92
98	13	13	12	8	12	8	13	15	9	21	124	89	112
99	9	8	6	2	13	6	11	13	11	18	97	106	97
100	8	10	8	2	13	4	13	11	0	17	86	102	94
101	13	16	14	6	12	10	17	17	1	18	124	115	103
102	11	6	21	5	10	4	5	11	8	17	98	107	97
103	10	3	4	1	13	8	8	8	4	10	69	102	89
104	12	9	13	1	10	6	11	14	7	20	108	101	103
105	11	15	16	9	10	10	13	9	19	16	128	95	111
107	10	8	9	6	11	6	5	13	8	14	90	123	89
108	9	10	13	1	8	5	7	9	4	16	82	103	93
109	10	16	25	8	10	11	14	14	20	20	148	110	113
110	9	15	24	6	13	4	8	14	10	20	133	101	111
111	12	10	14	3	8	8	13	12	10	20	110	100	104
112	10	10	14	5	9	8	11	12	10	25	114	89	109
114	11	13	15	6	11	9	13	14	0	21	113	106	103
115	14	15	23	1	13	9	1	7	12	13	108	116	97
116	11	15	14	7	10	7	10	14	18	19	125	106	107

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
117	13	14	13	7	10	6	10	9	23	25	130	106	108
118	11	12	17	1	8	7	7	9	7	19	98	97	100
119	9	12	8	6	5	5	6	10	12	19	92	96	98
120	10	13	9	4	11	9	9	10	11	14	100	93	103
121	9	13	15	5	6	5	12	10	14	15	104	107	99
122	10	5	14	5	8	6	8	9	13	22	100	93	103
123	12	8	15	4	10	6	9	11	12	18	95	97	99
124	9	12	9	2	6	8	7	15	15	20	103	111	97
125	11	15	16	6	13	7	22	11	12	16	129	102	109
126	10	3	14	4	9	13	12	9	8	14	96	110	95
127	9	6	7	0	5	7	9	15	7	14	79	111	89
128	12	11	11	6	10	8	8	13	9	19	107	108	99
129	10	9	1	4	10	9	12	12	17	14	98	110	96
130	10	7	13	0	6	7	11	13	10	15	92	102	96
131	11	12	21	1	11	7	14	9	7	19	112	93	107
132	11	11	13	4	13	12	12	11	8	24	119	105	105
133	12	10	14	6	6	7	13	10	14	17	109	102	103
134	12	11	12	7	11	7	10	10	12	15	107	90	106
135	13	11	5	2	10	8	10	11	11	15	96	107	96
136	10	7	19	10	10	6	8	11	11	20	112	103	103
137	10	10	12	2	6	4	11	8	4	18	85	91	98
138	10	13	15	6	8	8	9	7	9	17	102	113	96
139	8	3	9	2	8	2	11	12	0	12	67	105	87

No. of Pupil	Score in each of 10 tests										Total Score	Norm	IQ
	1	2	3	4	5	6	7	8	9	10			
140	12	13	14	6	10	5	12	9	12	10	112	100	105
141	11	13	8	6	12	7	15	6	11	14	103	100	101
142	13	10	11	11	9	8	14	9	11	16	112	104	103
143	10	7	13	3	7	7	9	13	12	19	100	105	98
144	8	11	5	0	6	5	7	10	8	19	79	94	95
145	10	8	16	11	11	8	10	9	19	21	123	121	101
146	12	9	10	4	13	8	15	7	11	14	103	95	103
147	10	9	8	6	7	4	8	11	0	12	75	125	83
148	9	7	2	4	5	4	6	10	8	12	67	102	88
149	10	11	16	9	8	6	10	13	20	17	120	93	107
150	9	14	24	9	13	12	16	3	16	19	145	106	113
151	8	8	8	6	6	5	8	8	13	13	83	119	88
152	10	11	5	4	7	2	6	11	10	17	83	105	92
153	14	14	20	6	15	12	12	17	13	12	135	115	107
154	10	13	12	2	7	3	8	9	14	18	96	109	95
155	11	14	17	3	9	11	12	14	12	13	116	101	105
156	9	15	24	6	13	4	8	14	10	20	133	101	111
157	12	14	15	7	10	7	13	10	21	20	129	106	108
158	2	4	6	2	8	5	10	10	12	14	73	109	88
159	10	10	5	0	10	7	11	12	8	13	86	107	93
160	12	8	13	2	9	5	9	9	14	16	97	110	95
161	6	1	9	0	6	4	7	4	2	22	61	104	85
162	10	11	12	2	11	4	12	12	12	17	103	86	106
163	9	11	1	5	3	1	0	3	8	17	58	100	86

learn, as no one was expected to obtain a perfect score, and that the test was not a test of what they knew but of their ability to learn. They were spurred on to make their best efforts and to obtain a high standing in the rating of the scores.

On the first day of this examination, the study syllabus of Form A was passed out and the pupils were warned not to look at them until permission was given. After being told that the test was in part a test of their ability to follow directions and that the instructions would be given only once, they were asked to open the syllabus to Section I - Part A. The time, five minutes, was allotted to them for the study of this part. At the end of five minutes they were requested to stop and turn to Part B. After studying this the allotted time, five minutes, they were told to stop and turn to Section II and to study that for two minutes. At the end of this time the booklets were collected.

The test - Form A - was then passed out and the pupils were asked to examine the cover carefully to make sure that they had the correct syllabus and to fill in the blank spaces reserved for their name and age. They were then told to turn to Section I - Part A, while directions were being read. They were allowed five minutes on this first part of the Science test. At the close of five minutes, Part B of this test was taken and the other Sections on History and Language, five

minutes being allowed for Part B, two minutes for the History test, and twelve minutes for the Language test.

On the next day, October 27, the second part of the Athol test - Form B, was administered by the teachers of the junior high school and the writer. The study syllabus was passed out and the pupils were given five minutes to study Section IV - Part A, three minutes to study Part B, and three minutes to study Section V. There is no study sheet for Section VI, the mathematics test. The study booklets were then collected, and the tests passed out. After filling in their name and age, the pupils were allowed to begin the test. Six minutes were allowed for the test Section IV - Part A, six minutes for Part B, five minutes for Section V - Parts A and B, five minutes for Section VI - Part A, and ten minutes for Part B.

At the end of this time the booklets were collected. The scores for each Section of the tests were placed in spaces on the cover reserved for that purpose and their totals were placed below. A point was allowed for each correct answer throughout the test, with the exception of the artificial language test and Part B of the Science test. In the artificial language test a point was allowed for every correction made on the examination, one point being deducted if a correctly translated word was crossed off.

In Part B of the science test the score was doubled. It was deemed necessary to do this so as to allow sufficient credit for this difficult work in the total test score.

A perfect score for each Section is as follows:

Section I - 25 points, Section II - 16 points, Section III - 17 points, Section IV - Part A, 28 points, Section IV - Part B, 31 points, Section V - Parts A and B, 23 points, Section VI - Part A, 14 points, and Section VI - Part B, 10 points, giving a total perfect score for Form A of 58 points, for Form B 106 points, and a grand total of 164 points. The results of this test are shown in Table II.

A record of the school marks was obtained from the office cards of all the 180 pupils who took the two tests. All the pupils in the ninth grade are taking academic subjects which include Algebra, Latin, English, History, Civics, Business Arithmetic, Business Training, General Science, and French. The marks were averaged and arranged according to their highest score. Complete tabulation of marks are shown in Table III.

A record of marks on the two tests and of school subject averages were therefore had in complete form for all pupils included in this experiment.

TABLE II

The Scores by Rank of 163 Pupils Taking the Athol High School Scholastic Aptitude Test and the Otis Group Intelligence Scale and their School Averages

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
1	23	16	13	51	22	21	52	94	146	183	90
2	16	15	15	54	22	18	46	94	140	156	86
3	25	14	16	48	17	16	55	81	136	133	82
4	23	15	12	46	21	19	50	86	136	150	92
5	17	16	16	43	22	15	49	80	129	155	84
6	24	16	17	40	20	13	57	73	130	166	86
7	19	15	16	39	21	16	50	76	126	159	78
8	20	13	16	47	18	12	49	77	126	154	80
9	22	13	11	49	14	16	46	79	125	145	63
10	24	12	15	42	16	15	51	73	124	122	86
11	14	13	15	48	21	13	41	82	123	141	74
12	13	15	13	44	19	18	41	81	122	148	82
13	18	10	15	47	17	15	43	79	122	106	68
14	22	11	15	38	19	17	48	74	122	156	74
15	19	13	7	51	18	13	39	82	121	136	73
16	20	15	11	38	21	16	46	75	121	153	85
17	20	14	8	42	21	15	42	78	120	151	70
18	12	15	11	46	19	17	38	82	120	136	81
19	15	14	13	45	18	14	42	77	119	111	74
20	17	14	15	44	12	17	46	73	119	143	68

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
21	17	13	15	39	21	12	45	72	117	143	80
22	22	12	12	32	20	16	46	68	114	137	81
23	23	14	11	37	12	17	48	66	114	127	90
24	16	15	13	36	20	13	44	69	113	113	67
25	16	14	15	37	16	15	45	68	113	145	68
26	14	14	15	43	22	5	43	70	113	145	62
27	14	15	12	42	16	13	41	71	112	157	72
28	22	12	12	40	21	5	46	66	112	121	65
29	21	15	14	35	10	17	50	62	112	107	77
30	23	9	13	35	15	16	45	66	111	159	90
31	21	11	16	35	10	17	48	62	110	109	79
32	20	13	0	44	17	16	33	77	110	162	62
33	18	15	6	44	11	15	39	70	109	135	83
34	10	10	10	40	20	19	30	79	109	117	76
35	25	16	6	35	17	11	42	63	105	117	63
36	16	13	7	41	19	12	36	72	108	140	67
37	15	13	14	37	21	8	42	66	108	157	71
38	15	9	9	41	19	14	33	74	107	162	84
39	16	16	8	36	19	11	40	66	106	120	82
40	10	12	14	48	18	10	36	70	106	124	63
41	17	8	13	47	12	9	38	68	106	142	79
42	10	12	10	37	20	17	32	74	106	137	71
43	18	15	7	37	14	14	40	65	105	123	73
44	14	14	16	33	16	12	44	61	105	149	75

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
45	12	15	7	37	18	16	34	71	105	101	77
46	17	10	9	40	11	18	36	69	105	134	75
47	14	14	10	36	16	14	38	66	104	137	82
48	11	15	15	34	15	14	41	63	104	148	82
49	21	10	7	40	16	9	38	65	103	96	79
50	17	14	10	38	14	9	41	61	102	124	65
51	16	16	15	25	16	13	47	54	101	121	79
52	10	14	0	46	12	19	24	77	101	112	82
53	20	14	3	41	11	11	37	63	100	130	74
54	16	14	8	30	15	16	38	61	99	116	79
55	20	15	6	30	15	13	41	58	99	118	70
56	14	16	7	35	14	12	37	61	98	172	76
57	20	14	10	28	9	16	44	53	97	120	84
58	10	11	12	35	13	16	33	64	97	119	75
59	16	10	9	36	12	13	35	61	96	171	73
60	19	15	9	33	11	8	43	52	95	120	69
61	13	10	5	27	17	21	28	65	93	107	63
62	7	15	9	40	12	12	31	64	95	116	78
63	12	10	6	37	14	15	28	66	94	131	78
64	8	14	9	34	20	9	31	63	94	88	66
65	9	11	16	37	12	8	36	58	94	112	75
66	20	13	9	29	7	15	42	51	93	135	63
67	23	8	10	30	7	15	41	52	93	118	71

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
68	11	13	9	21	9	20	33	60	93	112	70
69	13	13	4	26	18	19	30	63	93	126	76
70	19	12	3	30	13	15	34	58	92	97	78
71	15	13	8	25	17	14	36	56	92	135	73
72	20	8	17	28	3	15	45	46	91	147	76
73	19	15	12	27	16	12	36	55	91	149	94
74	13	14	9	27	18	10	36	55	91		70
75	13	13	11	33	9	12	37	54	91	115	80
76	13	14	11	27	9	16	38	52	90	113	81
77	7	11	9	39	12	13	27	63	90	121	70
78	22	6	13	27	11	10	41	48	89	121	61
79	12	12	9	26	17	13	33	56	89	99	63
80	12	9	10	34	9	15	31	58	89	124	77
81	15	15	8	33	8	10	38	51	89	114	62
82	20	13	10	23	14	18	33	55	88	118	79
83	8	12	11	36	7	14	31	57	88	118	74
84	13	12	7	23	18	14	32	55	87	126	60
85	14	12	8	32	12	8	34	52	86	149	72
86	15	11	5	31	7	17	31	55	86	135	64
87	15	13	9	26	10	13	37	49	86	141	70
88	18	12	3	35	8	9	33	52	85	127	78
89	19	10	10	26	7	13	39	46	85	135	85

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
90	14	12	8	37	9	5	34	51	85	121	71
91	11	8	4	33	9	19	23	61	84	134	72
92	14	12	10	28	8	11	36	47	83	136	85
93	17	14	3	20	17	12	34	49	83	124	66
94	16	12	8	28	15	3	36	46	82	104	76
95	8	7	13	15	23	15	28	53	81	118	63
96	7	11	11	29	11	12	29	52	81	91	60
97	14	12	4	31	2	18	30	51	81	95	71
98	10	15	1	32	13	10	26	55	81	126	75
99	12	10	5	30	7	17	27	54	81	97	72
100	13	16	7	22	7	16	36	45	81	86	62
101	21	13	3	23	7	13	37	43	80	124	73
102	17	12	9	21	11	9	38	41	79	98	52
103	8	10	3	32	11	11	26	53	79	69	67
104	13	11	10	22	8	15	34	45	79	108	64
105	8	12	15	18	8	18	35	44	79		65
106	15	15	3	28	6	12	33	46	79	128	71
107	16	12	6	18	12	14	34	44	78	90	67
108	8	11	3	33	15	7	22	55	77	82	64
109	16	12	3	27	6	13	31	46	77	148	69
110	9	13	10	32	10	6	29	48	77	133	69
111	7	13	12	20	11	14	32	45	77	110	63
112	21	8	0	21	11	15	29	47	76	114	74

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
113	15	13	4	19	9	16	32	44	76		64
114	16	13	8	17	8	14	37	39	76	113	75
115	7	8	9	25	17	10	24	52	76	108	60
116	8	10	13	27	6	11	31	44	75	125	77
117	10	13	6	26	7	13	29	46	75	130	69
118	11	11	7	27	5	14	29	46	75	98	61
119	13	9	12	19	8	17	34	41	75	92	71
120	12	11	12	16	9	14	35	39	74	100	68
121	11	10	7	18	14	14	28	46	74	104	62
122	10	11	11	22	9	10	32	41	73	100	71
123	12	8	12	15	14	12	32	41	73	95	70
124	14	11	7	19	7	14	32	40	72	103	59
125	13	12	3	26	4	13	28	43	71	129	78
126	13	10	6	22	7	13	29	42	71	96	70
127	11	11	6	27	2	13	28	42	70	79	68
128	14	12	2	23	7	12	28	42	70	107	68
129	10	13	5	24	5	13	28	42	70	98	54
130	9	13	9	22	8	9	31	39	70	92	62
131	13	10	4	18	11	12	27	41	68	112	69
132	12	9	0	29	3	15	21	47	68	119	62
133	9	8	15	16	8	12	32	36	68	109	60
134	11	14	10	17	6	10	35	33	68	107	75

No. of Pupil	Sections						Parts		Total Score Apt. Test	Total Score Otis Test	School Marks
	I	II	III	IV	V	VI	A	B			
135	9	11	10	13	8	16	30	37	67	96	63
136	16	13	8	16	3	10	37	29	66	112	62
137	12	11	0	25	4	13	23	42	65	85	55
138	15	10	10	24	9	7	35	30	65	102	57
139	8	14	1	18	10	13	23	41	64	67	68
140	10	9	3	22	12	8	22	42	64	112	70
141	10	7	11	19	3	14	28	36	64	103	51
142	3	8	8	27	6	12	19	45	64	112	64
143	7	4	16	15	7	13	27	37	64	100	66
144	11	12	4	13	13	10	27	36	63	79	56
145	6	5	14	22	3	12	25	37	62	123	60
146	11	11	11	15	7	7	33	29	62	105	64
147	12	5	2	18	7	8	19	43	62	75	62
148	13	5	10	15	7	12	28	34	62	67	59
149	10	14	6	14	12	6	30	32	62	120	54
150	21	14	3	13	4	6	38	23	61	145	68
151	8	14	9	15	7	7	31	29	60	83	61
152	6	11	7	17	6	12	24	35	59	83	62
153	8	5	16	27	8	8	16	43	59	135	65
154	7	11	2	18	9	11	20	38	58	96	65
155	8	11	0	23	7	9	19	39	58	116	68
156	19	10	0	7	6	16	29	29	58	133	63

TABLE III

The Ranking Scores of 163 Pupils in their
Various Academic Subjects and their
School Averages

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.
1	83		93			95	93	86	85	90
2	82				90	90	90	72	90	86
3	78				84	90	90	62	90	82
4	90				92	95	93	91	90	92
5	92	91	79	85			91			84
6	92	85	80	82			92			86
7	82		80			85	76	64	80	78
8	85	78	82	75			80			80
9	50				60	70	74	70	70	63
10	84				92	90	93	72	85	86
11	83	85	73	65		66				74
12	81				80	80	80	84	88	82
13	60				65	76	65		75	68
14	70				55	85	84	62	89	74
15	75				75	75	77	66	80	73
16	78				90	85	84	82	90	85
17	68				75	75	81	41	80	70
18	84	88	80	66			85			81
19	63				66	75	80	77	80	74
20	70	60	78	65			65			68
21	89	75	80	73			81			80

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.	
22	65					85	87	90	71	85	81
23	85					90	85	92	83	90	88
24	68	60	71	66				71			67
25	75	60	67	60				80			68
26	68	50	78	50				65			62
27	75	60	67	60				80			68
28	68	50	78	50				65			62
29	81	68	74	60				78			72
30	53					60	65	70	60	80	65
31	60					81	90	81	72	80	77
32	78					92	90	93	83	90	90
33	76					83	55	94	78	90	79
34	70					53	70	49		70	62
35	75					85	75	90	94	90	83
36	65					76	68	74	77	95	76
37	72	60	73	60				61			65
38	77	68	69	64				55			67
39	83	70	67	60				73			71
40	88	88	83	80				92			84
41	88	85	85	81				70			
42	70	60	67	60				60			
43	83	85	84	69				72			79
44	60					63	68	73	73	89	71

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.
45	78	64	73	69			81			73
46	75	83	75	64			77			75
47	60				82	87	84	72	78	77
48	75				71	75	75	66	90	75
49	78				86	80	90	79	80	82
50	83	80	98	72			76			82
51	61				82	85	92	78		75
52	70	50	85	55			65			65
53	80				83	80	85	64	80	79
54	69				84	90	82	84	85	82
55	65				62	85	80	72	80	74
56	75				78	80	88	74	80	79
57	65				72	80	70	55	78	70
58	82	68	72	80			75			76
59	63				87	90	87	88	85	84
60	83				78	78	74	55	80	75
61	67		75			80	75	58	80	73
62	60				66	80	65	61	80	69
63	60				50	63	66	48	85	62
64	82	78	82	77			69			78
65	63				84	95	80	65	80	78
66	60				53	55	70	89	70	66
67	67				65	75	87	70	87	75
68	51		60			70	72	57	70	63

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.	
69	60					65	80	78	62	80	71
70	66					60	66	75	75	80	70
71	74					70	80	76	75	80	76
72	80		80			80	68			85	78
73	74					65	75	77	67	80	73
74	65		97			75	77	69		75	76
75	95					93	90	95	98	90	94
76	78					68	70	77	56	70	70
77	80	85	85	73				76			80
78	75					80	85	83	83	78	81
79	68		64			70	80	62		80	71
80	60					44	75	65		60	61
81	60					60	55	65	58	79	63
82	73					72	75	87	66	90	77
83	60	40	60	64				85			62
84	82					84	80	80	75	75	79
85	65					80	68	85	78	70	74
86	63	55	63	57				55			60
87	78	80	80	55				65			72
88	68					60	65	73	48	70	64
89	63					75	75	76	60	70	70
90	70					75	80	80	85	80	78
91	88					85	90	92	71	85	85
92	60					76	78	76	61	75	71

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.	
93	65					74	80	77	67	70	72
94	63					90	85	91	91	90	85
95	55					61	78	65	59	78	66
96	64					65	80	70	80	78	76
97	70	60	63	60				63			63
98	68	50	65	54				62			60
99	55					69	70	75	82	80	71
100	70					72	75	80	75	75	75
101	60					62	75	78	73	85	72
102	50					60	65	63	56	80	62
103	50					65	85	65		75	73
104	47					50	60	53	37	64	52
105	60					65	75	68	65	70	67
106	55					66	80	60	49	75	64
107	54					70	62	61	65	78	65
108	65					84	75	77	47	75	71
109	65					70	75	77	67	60	57
110	55					51	69	60	67	80	64
111	75					70	70	84	45	70	69
112	75					75	60	81	64	70	69
113	55					60	70	60	51	79	63
114	67					72	80	76	68	80	74
115	65					67	80	67	47	60	64

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.
116	65		70			90	76	69	80	75
117	50				60	63	61	55	70	60
118	85	35	70	80			64			77
119	68				69	70	80	59	70	69
120	65				47	50	67	58	80	61
121	65		70			80	73	56	80	71
122	68				70	70	65	67	70	68
123	60				45	60	65	61	80	62
124	70	70	75	60			78			71
125	60				69	75	78	58	80	70
126	53				62	50	60	59	80	59
127	68				78	80	82	73	80	78
128	60				76	78	71	60	75	70
129	60				56	62	67	83	80	68
130	70				67	60	60	69	80	68
131	60		55			55	46	43	65	54
132	55				55	62	72	59	70	62
133	65				56	70	74	77	70	69
134	55				60	75	65	47	70	62
135	70	65	60	52			50			60
136	60				75	84	82	76	75	75
137	65				36	70	60	60	85	63

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tre.	Bus. Ar.	Music	School Aver.
138	62				60	65	65	50	70	62
139	65				42	60	57	38	65	55
140	41				42	75	71	54	60	57
141	60				68	60	55	73	90	68
142	65				70	68	66	61	89	70
143	60	40	60	44			50			51
144	75	70	60	51			63			64
145	56				66	75	73	58	70	66
146	49				50	60	50	58	70	56
147	70	60	60	48			50			60
148	73	50	74	62			61			64
149	60				65	70	60	58	60	62
150	60				52	65	60	52	65	59
151	60		50			50	55	51	60	54
152	60				66	75	78	59	70	68
153	60				52	65	56	53	80	61
154	60				63	70	67	45	65	62
155	53				53	70	76	60	80	65
156	65				60	65	65	54	80	65
157	63				60	70	76	66	70	68
158			40			70	78	65	65	63
159	63				60	65	71	56	60	63

No. of Pupil	Eng.	Latin	Algebra	Anc. Hist.	Civics	Sci.	Bus. Tra.	Bus. Ar.	Music	School Aver.
160	55			55	70	76	87	70	69	
161	53			58	75	74	59	75	66	
162	54			40	50	36	47	64	48	
163	55			62	55	53		64	58	

V STATISTICAL ANALYSIS

STATISTICAL ANALYSIS

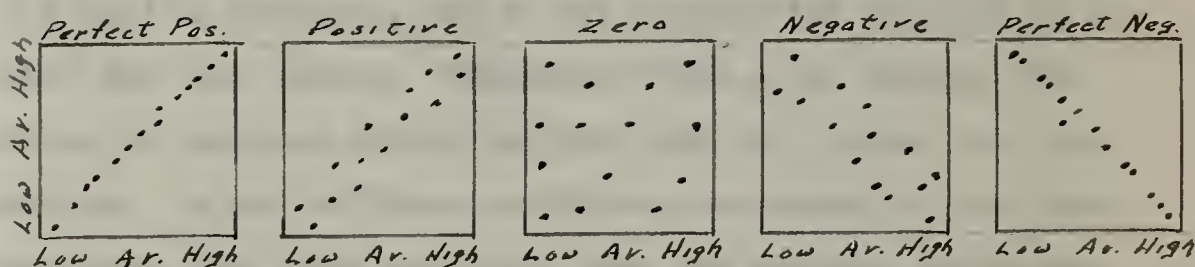
"Every scientific problem," says Thurstone,¹² "is a search for the relationship between variables. Every scientific problem can be stated most clearly if it is thought of as a search for the nature of the relationship between two definitely stated variables. A scientific problem cannot be so clearly stated in any way as when it is thought of as a function by which one variable is shown to be dependent upon or related to some other variable. The core of the problem is always found to be in the nature of the inter-dependence of the two or more variables. When that inter-dependence has been clearly stated and verified, the scientific problem has been solved.

"A physicist who is investigating the velocity of sound through different substances is describing them. He is listing a quantitative measure of this attribute for each substance. The more truly scientific aspect of his problem appears when he becomes curious about the relationship between the velocity of sound through the substance and its other known attributes, such as density, boiling point, electrical conductivity, or shape. He may then discover that some of these characteristics have no relationship to velocity with which the substance conducts sound, while other characteristics do have such a relationship. It is the discovery of such inter-relations that we have the basis for prediction and control

which constitute the practical applications of science."

In this study the problem is to determine the relationship between the tests involved, and the relative degree of validity of the Otis Group Intelligence Scale and the Athol Scholastic Aptitude Test for determining the grade of work on the part of school children in their various academic subjects. The methods used are (1) scatter diagram, (2) coefficient of correlation, (Pearson method) and (3) frequency polygon graph.

The scatter diagram is a graphical method of showing the relation between two variables. It enables one to judge by inspection the degree of relationship between the quantities. Below are five diagrams, taken from Thurstone, which show how the various relationships are shown.



In Part 1 is a diagram which shows a perfect positive relation between the two sets of variables. It might be used to represent the relation between two variables such as the volume and weight of pieces of steel. The points on the graph fall on the diagonal from lower left to upper right and indicate that as the values along one of the scales increase, the values on the other likewise increase. This would indicate a perfect positive correspondence or correlation between the two variables.

In Part II is a diagram with paired observations for a relation that is positive but imperfect. In general, although not in every particular case, the tendency is for the y-values to increase as the x-values increase. Graphed variables which fall out like this have a "marked" degree of correspondence or correlation.

In Part III is a scatter diagram which shows entire absence of relationship between two variables. The points do not fall along the diagonal, and as the x-values change there is not a corresponding change in the values of y. There is, therefore, no correspondence between the two variables and the correlation would be zero.

In Part IV is a diagram for a relation which is imperfect and negative. As the values of x increase, the values of y tend to decrease, but do not necessarily decrease by exactly the same amount. Thurstone gives as an example the number of problems solved per hour and the average time per problem. As one of these variables, the number of problems, increases, the other variable, time per problem, decreases. The relationship is negative, but imperfect.

In Part V is a scatter diagram of a perfect negative relationship between two variables. As one of the variables changes, the other changes in the opposite direction, and by the same amount.

Since the correlation coefficients have been figured out

on the same sheets with the scatter graphs, I shall discuss these figures also along with the graphs and show how each of these two methods bear out the contention which I have made in this thesis, namely, that the Athol High School Scholastic Aptitude Test scores are more closely related to the marks of the school children than are those of the Otis Group Intelligence Scale. This fact holds true in every detail and is evidence of the validity of the Athol Test for determining the success of school children in their various academic subjects.

The correlation coefficient is a number which indicates the degree of relationship between two variables. It is another way of showing the same thing that the scatter diagram shows. The number varies from 1 to -1. When the relationship is perfect and positive, the correlation is 1. When the relationship is perfect but inverse, the coefficient is -1. When there is no relationship between the two variables, the coefficient is zero.

If the relation between two variables is perfect, that is, the coefficient is 1, the points on the scatter graph fall directly upon the diagonal across the page from lower left to upper right. If the relation is close, that is, the coefficient about .7 or .8, the points on the scatter graph hover close to and about the same diagonal. If the relation is small but noticeable, and the coefficient is about .3, the points scatter

more from the diagonal. If there is no relationship and the coefficient is zero, the points distribute equally all over the graph, and do not cluster about the diagonal. If the relationship is opposite, and the coefficient is negative, the points cluster about a diagonal across the sheet which falls from upper left to lower right, and indicates that as the units along the x-axis increase in value, the units along the y-axis decrease in value.

It is obvious, therefore, that the correlation coefficient is a numerical and more objective way of describing the scatter graph. The graph, however, gives more information than can be obtained from the coefficient.

In this study the formula used to obtain the correlation coefficient is the Pearsonian Product-Moment formula¹³ which is as follows:

$$r = \frac{\frac{\sum xy}{N} - Cx Cy}{\sigma_x \sigma_y}$$

where x represents the deviations of the x values from the mean of x, and y represents the deviations of the y values from the mean of y, means "the sum of", N represents the number of cases, Cx the correction on the x axis, Cy the correction on the y axis. σ_x represents the standard deviations of x and σ_y the standard deviations of y.

A correlation coefficient of 1, representing a perfect relationship between two variables, may be illustrated by the following example.

If ten pupils taking two examinations find that their scores fall so that the one receiving the highest score in one test also obtains the highest score in the other, and the one receiving the next highest score in the one also receives the next highest in the other, and this relationship continues throughout the two tests, then the relationship is perfect and the coefficient is 1.

An inverse relationship where the correlation coefficient is -1 may be represented by a quotation from Garrett:¹⁴ "If, in a group of twenty-five boys, the boy standing highest in Latin ranks lowest in shop work, the boy standing second in Latin stands next to the bottom in shop work as he is from the top in Latin, the correspondence is perfect, but the relationship is inverse, and r equals -1.00 ."

A correlation coefficient¹⁵ of .80 to .90 is said to be very high, one of .60 to .70 is said to be high, one from .40 to .60 is said to be marked, one from .20 to .40 is low, and one from zero to .20 is said to have no significant degree of relationship.

In statistical measurements, the reliability of the correlation coefficient is impaired by the probability of an error. If the sample from which the data is taken were one thousand ninth grade children and we desired to determine their average height, then the figure obtained would be very reliable because one thousand is a large number. If the sampling were one hundred children instead of one thousand,

the figure obtained for the average would be less reliable because the cases are fewer. If we reduce the number of cases then the reliability of the figure is impaired. The size of the correlation coefficient also governs the reliability of the figure. If the number is a large one, for example .80 or .90, the comparison between the two variables is almost perfect and the possibility of an error is minimized greatly. But if the coefficient is a small number as .20 to .40 chance relationships enter in and the probability of an error is greatly increased.

The formula for the probable error¹³ of the correlation coefficient is:

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

Table IV shows the distribution of points on the scatter graph and the correlation between the Athol Scholastic Test scores and the Otis Group Intelligence Scale scores as given to 163 pupils in the ninth grade of the Athol schools. The scores for the Athol Scholastic Aptitude Test are distributed along the horizontal or x-axis and range in ten point divisions from 40 to 149. The Otis Group Intelligence Scale scores are distributed along the vertical or y-axis in ten point divisions and range from 50 to 180.

TABLE IV

Correlation between Scholastic Aptitude
Test Scores and Otis Group Intelligence
Scale of 163 Pupils

Athol Aptitude Test Scores - x

	40- 49	50- 59	60- 69	70- 79	80- 89	90- 99	100- 109	110- 119	120- 129	130- 139	140- 149	r	d	fd	fd ²	Σxy
180- 189											/	1	7	7	49	35
170- 179					//							2	6	16	72	0
160- 169						/	/		/			3	5	15	75	35
150- 159						/	//	///	/	/		12	4	48	192	128
140- 149		/	/	//	//	////	////	///				17	3	51	153	42
130- 139	/		//	////	///	///	/	//	/			19	2	38	76	10
120- 129	/	//	///	///	///	///	//	/				26	1	26	26	-12
110- 119	/	///	///	///	///	///	//					28		201		
100- 109	/	/	///	///	/	/	/	//	/			21	-1	-21	21	33
90- 99		//	/	///	///	/	/					19	-2	-38	76	60
80- 89		//	//	/	/	/						6	-3	-18	54	51
70- 79	/	//	/									4	-4	-16	64	48
60- 69	/	//	/									4	-5	-20	100	60
50- 59	/											1	-6	-6	36	30
f	2	10	21	29	24	23	21	14	13	3	2	163	-119	994	529	
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	137	48	50	831				

Otis Group Scores - y

U. S. GOVERNMENT PRINTING OFFICE

TABLE IV (Cont.)

$$C_x = \frac{110-195}{163} = -.621$$

$$C_x^2 = .2714$$

$$C_y = \frac{201-119}{163} = .503$$

$$C_y^2 = .253$$

$$C_x C_y = -.2621$$

$$o_x = \frac{\sqrt{851}}{163} \cdot .2714 = 2.197$$

$$o_y = \frac{\sqrt{994}}{163} \cdot .253 = 2.417$$

$$r = \frac{520 - (-.2621)}{163} = .663$$

$$2.197 \times 2.417$$

$$P.E. = \frac{.6745 (1-.663^2)}{\sqrt{163}} = .0296$$

An inspection of this graph shows that the points fall in a fairly solid block along the diagonal from lower left to upper right. There is, therefore, a close positive inter-relation between these two sets of variables. The Otis test scores increase in value, and the Athol Test scores likewise increase in value, and largely by the same amount.

The coefficient of correlation, also, is high ($.66 \pm .02$) which argues for a close relation. The Otis test has been given to thousands of school children and has, therefore, been standardized and validated to a large extent. The closeness of the correlation between it and the Athol Test argues for the validity of the Athol Test. On further investigation we find that there is a closer correlation between the Athol Test and the school marks than there is between the Otis test and the school marks. This argues still further for the validity and dependability of the Athol Test as a means for prophesying the ability of the school pupil to make a success in his scholastic work.

A study of Table V which shows the relationship between the Athol Test and the school marks shows that the points on the scatter graph hover close to the diagonal with very few cases scattered far away from it. This indicates a high degree of relationship between the two variables, that is, as

TABLE V

Correlation between Scholastic
Aptitude Test Scores and School
Marks of 163 Pupils

Athol Aptitude Test Scores - x

	40- 49	50- 59	60- 69	70- 79	80- 89	90- 99	100- 109	110- 119	120- 129	130- 139	140- 149	f	d	fd	fd ²	Σxy
94- 91						/				/	/	3	5	15	75	45
90- 87								//				2	4	8	32	16
86- 83					//	/	//		///	/	/	10	3	30	90	54
82- 79					/	///	///	///	///	/		18	2	36	72	50
78- 75			/	///	///	///	///	/	/			22	1	22	22	-4
74- 71				///	///	///	///	//	///			23		111		
70- 67		//	///	///	/	///	/	///	//			28	-1	-28	28	28
66- 63	//	///	///	///	///	//	///	/	/			27	-2	-54	108	96
62- 59		/	///	///	///	/		//				21	-3	-63	189	108
58- 55		/	///									4	-4	-16	64	52
54- 51			//	//								4	-5	-20	100	50
50- 47		/										1	-6	-6	36	24
f	2	10	21	29	24	23	21	14	13	3	2	163	-187	816		519
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	117	48	50	831				

School Marks - y

U OF MASS/AMHERST LIBRARY

TABLE V (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$C_x^2 = .2714$$

$$C_y = \frac{111-187}{163} = -.466$$

$$C_y^2 = .2171$$

$$C_x C_y = .2428$$

$$\sigma_x = \sqrt{\frac{881-}{163} .2714} = 2.197$$

$$\sigma_y = \sqrt{\frac{816-}{163} .2171} = 2.188$$

$$r = \frac{519 - (+.2428)}{163} = .612$$

$$2.197 \times 2.188$$

$$P.E. = \frac{.6745 (1-.612^2)}{\sqrt{163}} = .033$$

the values of the Athol Test scores increase, the values of the school marks likewise increase. An examination of the correlation figures for these variables shows a relation of $(.61 \pm .033)$ which is 5 points higher than the figure which represents the relation between the Otis Test scores and the school marks $(.56 \pm .036)$. The scatter graph (Table VI) which shows the relation between the Otis Test scores and the school marks shows a wider scatter of points away from the central tendency, the diagonal. The points do not hover as closely about the diagonal as do those of Table IV. The coefficient of correlation is $(.56 \pm .036)$. From these two comparisons, the scatter graphs and the coefficients, it would seem that the Athol Test is about 9 per cent more accurate in determining the probability of success among school children than is the Otis Test.

The scatter diagrams and their accompanying correlation figures in Tables VII to XII inclusive, show the relation between the Scholastic Aptitude Test total scores and the various sections of the test. In most of these graphs it is seen that the points fall closely along the diagonal, indicating a close relation between the parts of the test and the total scores. The fact that in most of these diagrams the points hover in some cases very close to the diagonal, and in others markedly close, indicates that the test is fairly uniform in difficulty

TABLE VI

Correlation Between Otis Group Intelligence Scale Scores and School Marks of 160 Pupils

Otis Group Test Scores - x

	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	f	d	fd	fd ²	xy
94-91									/	/							25	10	35
90-87								/		/				/			34	12	48
86-83								//	///		///	//					103	30	90
82-79				/	/	///	//	///	///	/							182	36	72
78-75				/	///	///	///	/	//	/			/				221	22	20
74-71				///	/	///	///	///	//	///		/					23	110	
70-67		//	//		///	///	///	//	//	///	/						27-1	-27	27
66-63	/			///	///	///	///	///	///	/							25-2	-50	100
62-59		/	/	///	///	///	///	///		/		/					21-3	-63	189
58-55		/	/	/		/											4-4	-16	64
54-51				//	/		/										4-5	-20	100
50-47				/													1-6	-6	36
f	1	4	4	7	17	20	27	26	20	17	11	3	2	1	160	-182	798	394	
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5	6	7					
fd	-6	20	-16	-21	-34	-20	-117	26	40	51	44	15	12	7	195				
fd ²	36	100	64	63	68	20		26	80	153	176	75	72	49	982				

TABLE VI (Cont.)

$$C_x = \frac{195-117}{160} = .4875$$

$$C_x^2 = .2376$$

$$C_y = \frac{110-182}{160} = -.4500$$

$$C_y^2 = .2025$$

$$C_x C_y = -.2194$$

$$\sigma_x = \sqrt{\frac{982-.2376}{160}} = 2.3103$$

$$\sigma_y = \sqrt{\frac{798-.2025}{160}} = 2.1875$$

$$r = \frac{394 - (-.2194)}{160} = .56$$

$$2.3103 \times 2.1875$$

$$P.E. = \frac{.6745 (1-.566^2)}{\sqrt{160}} = .036$$

TABLE VII

Correlation Between Scholastic Aptitude
Total Test Scores and Section I of
Athol Test

Scholastic Aptitude - x

	40- 49	50- 59	60- 69	70- 79	80- 89	90- 99	100- 109	110- 119	120- 129	130- 139	140- 149	f	d	fd	fd ²	Σxy
25- 24							/		/	//		4	6	24	144	72
23- 22					/	/		////	//	/	/	10	5	50	250	130
21- 20			/	/	//	////	//	///	///			16	4	64	256	40
19- 18		/			//	///	//		///			11	3	33	99	15
17- 16			/	////	//	//	///	////	/		/	21	2	42	84	18
15- 14			/	////	///	//	////	///	/			22	1	22	22	-5
13- 12		/	///	///	///	///	/		//			26		235		
11- 10		/	///	///	//	//	///					22	-1	-22	22	31
9- 8	/	///	////	///	//	//						19	-2	-38	76	88
7- 6		//	//	//		//						8	-3	-24	72	54
5- 4	/											1	-4	-4	16	15
3- 2		/	/									2	-5	-10	50	35
1- 0		/										1	-6	-6	36	24
f	2	10	21	29	24	24	21	14	13	3	2	163		-104	1127	517
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	117	48	50	831				

Aptitude Section I - y

$$C_x = \frac{110-195}{163} = -.521$$

$$\sigma_x = \sqrt{\frac{831}{163} - .2714} = 2.197$$

$$C_x^2 = .2714$$

$$\sigma_y = \sqrt{\frac{1127}{163} - .5505} = 2.629$$

$$C_y = \frac{235-104}{163} = .742$$

$$r = \frac{\frac{517}{163} - (-.3965)}{2.197 \times 2.629} = .62$$

$$C_y^2 = .5505$$

$$C_x C_y = -.3965$$

$$P.E. = \frac{.6745(1-.62^2)}{\sqrt{163}} = .032$$

TABLE VIII

Correlation Between Scholastic Aptitude
Test Scores and Section II of Athol Test.

Scholastic Aptitude Marks - x

	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	f	d	fd	fd ²	Σxy
16					/	/	///		/	/	/	8	5	40	200	70
15				/	//	////	////	///	////	/	/	20	4	80	320	108
14		/	///		/	///	///	///	/	/		24	3	72	216	6
13		/	/	///	///	///	//	//	///			25	2	50	100	-12
12			/	///	///	/	//	//	/			22	1	22	22	-9
11		///	///	///	//	///		/	/			21		264		
10	/	//	//	///	//	///	///		/			18	-1	-18	18	23
9	/		//	/	/		/	/				7	-2	-14	28	22
8			//	///	/	//	/					9	-3	-27	81	36
7			/		/							2	-4	-8	32	16
6					/							1	-5	-5	25	5
5		/	///									4	-6	-24	64	78
4		/	/									2	-7	-14	98	49
f	2	10	21	29	24	24	21	14	13	3	2	163		-110	1204	392
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	117	48	50	831				

Aptitude Section II - y

U OF MASS/AMHERST LIBRARY

TABLE VII (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$\sigma_x = \sqrt{\frac{831-.2714}{163}} = 2.197$$

$$C_x^2 = .2714$$

$$\sigma_y = \sqrt{\frac{1204-.8911}{163}} = 2.5486$$

$$C_y = \frac{264-110}{163} = .944$$

$$r = \frac{\frac{392 - (-.4918)}{163}}{2.197 \times 2.5486} = .518$$

$$C_y^2 = .8911$$

$$C_x C_y = -.4918$$

$$P.E. = \frac{.6745 (1-.518^2)}{\sqrt{163}} = .038$$

TABLE IX

Correlation Between Scholastic Aptitude
Test Scores and Section III of Athol Test.

Scholastic Aptitude Scores - x

	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	f	d	fd	fd ²	Σxy
17-16	/	/				//	/	/	///	//		11	4	44	176	52
15-14			//	/			///	///	///		/	17	3	51	153	69
13-12				///	//	/	/	///	/	/	/	18	2	36	72	26
11-10	//	///	///	///	///	///	///	/	///			28	1	28	28	-22
9-8			///	///	///	///	///		/			28		159		
7-6	/	/	///	//	///	///	///		/			21	-1	-21	21	14
5-4	/	//	//	///	///	//						11	-2	-22	44	36
3-2	//	///	///	///	///	//	/					16	-3	-48	144	87
1-0	//	///	///	/	//		/	/				13	-4	-52	208	128
f	2	10	21	29	24	24	21	14	13	3	2	163		143	846	390
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24	1	21	56	117	48	50	831				

Aptitude Section III - y

U OF MASS/AMHERST LIBRARY

TABLE IX (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$\sigma_x = \sqrt{\frac{831 - .2714}{163}} = 2.197$$

$$C_x^2 = .2714$$

$$\sigma_y = \sqrt{\frac{846 - .0096}{163}} = 2.2979$$

$$C_y = \frac{159-143}{163} = .0981$$

$$r = \frac{390 - (-.0511)}{2.197 \times 2.2979} = .486$$

$$C_y^2 = .0096$$

$$P.E. = \frac{.6745 (1 - .486^2)}{\sqrt{163}} = .04$$

$$C_x C_y = -.0511$$

TABLE X

Correlation Between Scholastic Aptitude
Total Test Scores and Section IV of the
Athol Test

Scholastic Aptitude Scores - x

	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	f	d	fd	fd ²	Σxy
54-50								/		//		3	4	12	48	52
49-45						//	/	///	//			10	3	30	90	31
44-40					/	///	///	////	/			19	2	38	76	68
39-35				///	///	///	///	///				27	1	27	27	28
34-30			///	///	///	///	//	/				22		107		
29-25	/	///	///	///	///	///	/					29	-1	-29	29	35
24-20	/	///	///	///	///							18	-2	-36	72	72
19-15	////	///	///	/								25	-3	-75	225	204
14-10	/	//	///									7	-4	-28	112	100
9-5	/	//										3	-5	-15	75	65
f	2	10	21	29	24	24	21	14	13	3	2	163	-183	754	705	
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	117	48	50	831				

Aptitude - Section IV - y

Table X (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$\sigma_x = \frac{\sqrt{831 - .2714}}{163} = 2.197$$

$$C_x^2 = .2714$$

$$\sigma_y = \frac{\sqrt{754 - .2171}}{163} = 2.099$$

$$C_y = \frac{107-183}{163} = -.466$$

$$r = \frac{705 - (.2427)}{163} = .886$$

$$C_y^2 = .2171$$

$$2.197 \times 2.099$$

$$C_x C_y = .2427$$

$$P.E. = \frac{.6745(1-.886^2)}{\sqrt{163}} = .011$$

TABLE XI

Correlation Between Scholastic Aptitude
Total Test Scores and Section V of Athol
Test

Scholastic Aptitude Scores - x

	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	f	d	fd	fd ²	Σxy
23-22					/			/	/		//	5	5	25	125	70
21-20						/	///	////	////	//		14	4	56	224	116
19-18					/	//	///	/	///			14	3	42	126	63
17-16				/	//	///	///	///	//	/		17	2	34	68	34
15-14				///	//	///	///	/	/			14	1	14	14	0
13-12		/	///	/	//	///	//	//				17		171		
11-10		/	//	///	///	/	///	//				17	-1	-17	17	16
9-8	/	//	///	///	///	///						24	-2	-48	96	88
7-6		///	///	///	///	//						26	-3	-78	234	171
5-4	/	/	//	///								7	-4	-28	112	84
3-2			///	/	/	/						7	-5	-35	175	75
1-0		/										1	-6	-6	36	24
f	2	10	21	29	24	24	21	14	13	3	2	163	-212	1227		741
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	110	189	116	24		21	56	117	48	50	831				

Aptitude - Section V - y

TABLE XI (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$C_x^2 = .2714$$

$$C_y = \frac{171-212}{163} = -.2515$$

$$C_y^2 = .0632$$

$$C_x C_y = .1310$$

$$\sigma_x = \sqrt{\frac{831-}{163} .2714} = 2.197$$

$$\sigma_y = \sqrt{\frac{1227-}{163} .0632} = 2.743$$

$$r = \frac{\frac{741}{163} - .1310}{2.197 \times 2.743} = .732$$

$$P.E. = \frac{.6745 (1 - (.732)^2)}{\sqrt{163}} = .024$$

TABLE XII

Correlation Between Scholastic Aptitude
Total Test Scores and Section VI of the
Athol Test

Scholastic Aptitude Scores - x

	40-	50-	60-	70-	80-	90-	100-	110-	120-	130-	140	f	d	fd	fd ²	Σxy
	49	59	69	79	89	99	109	119	129	139	149					
21-						//					/					
20-												3	5	15	75	25
19-				/	///	/	///		/	/	/	11	4	44	176	40
18-		/	/	//	///	///	//	///	///	/		26	3	78	234	63
17-			//	///	///	///	///	//	///			32	2	64	128	-14
16-	/	///	///	///	///	///	///	///	///	/		44	1	44	44	-37
15-		///	///	///	///	/	///					19		245		
14-		///	//	//	//	///	///					16	-1	-16	16	20
13-	/		///	//								8	-2	-16	32	48
12-					/			//				3	-3	-9	27	-9
11-					/							1	-4	-4	16	4
10-																
9-		///	//	//	//	///	///									
8-			///	//												
7-	/		///	//												
6-					/			//								
5-																
4-					/											
3-																
2-																
f	2	10	21	29	24	24	21	14	13	3	2	163				
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-10	-40	-63	-58	-24	-195	21	28	39	12	10	110				
fd ²	50	160	189	116	24		21	56	117	48	50	831				
														-45	748	140

TABLE XII (Cont.)

$$C_x = \frac{110-195}{163} = -.521$$

$$\sigma_x = \sqrt{\frac{831-.2714}{163}} = 2.743$$

$$C_x^2 = .2714$$

$$\sigma_y = \sqrt{\frac{748-1.508}{163}} = 1.755$$

$$C_y = \frac{245-45}{163} = 1.228$$

$$r = \frac{140 - (-.6403)}{2.743 \times 1.755} = .311$$

$$C_y^2 = 1.508$$

$$P.E. = \frac{.6745 (1-.31^2)}{12.767} = .047$$

$$C_x C_y = -.6403$$

U U P T A O O I A M H E C O I L I U I A M H

and in testing quality throughout. The only point of noticeable weakness is in Section VI, the mathematics test. Here the points scatter somewhat widely from the diagonal, and do not follow it closely enough, that is, not so closely as in other parts of the test. However, the relationship though low is significant. The correlation figures, too, are high and in one case very high. High correlations argue for the validity and uniformity of the test. Since the test as a whole has a high correlation with the school marks, $(.612 \pm .033)$ the close correspondence of the parts as indicated by the scatter diagrams and the correlation figures with the total test scores, would imply a close relationship of these sections with the various school marks of the pupils. This we find to be true as an examination of the next set of diagrams will reveal.

Table XIII is a scatter diagram which shows the relation between the two variables, the school marks in science and the marks in science (Section I) of the Athol Scholastic Aptitude Test, as given to one hundred and twenty-seven pupils of the ninth grade. The correlation figure for this relation is $(.56 \pm .04)$ which represents a marked degree of relationship. The points on the graph hover close to the diagonal, with only a few cases lying outside this column. This means that as the marks of the Aptitude Test science section increase in value,

TABLE XIII

Correlation Between Science Section of
Athol Aptitude Test (Sect. I) and school
marks in Science

Science Marks - x

Section I Scores - Y

	50- 53	54- 57	58- 61	62- 65	66- 69	70- 73	74- 77	78- 81	82- 85	86- 89	90-94- 93 97	f	d	fd	fd ²	Z _{xy}	
25- 24											//		2	6	12	72	60
23- 22					/	/	/	/	//	/	/	//	10	5	50	250	145
21- 20		/				//	///	///	////		//		15	4	60	240	124
19- 18						/	///	///	/		//		10	3	30	90	66
17- 16			/	/		/	//	///			//		12	2	24	48	34
15- 14	/		/	/		/	///	///	/				13	1	13	13	4
13- 12		/	/	///		////	///	///	/	/		/	23		189		
11- 10	//	/	//	//	////	/	/	//	/		/		17	-1	-17	17	15
9- 8	/	/	//	///	//	///	//		/				15	-2	-30	60	36
7- 6				///		///	/						7	-3	-21	63	15
5- 4			/										1	-4	-4	16	12
3- 2						/							1	-5	-5	25	0
1- 0		/											1	-6	-6	36	20
f	4	5	8	13	7	18	23	23	11	2	10	3	127		-83	930	531
d	-5	-4	-3	-2	1		1	2	3	4	5	6					
fd	-20	-20	-18	-26	-7	-91	23	46	33	8	50	18	178				
fd ²	100	80	72	52	7		23	92	99	32	250	48	855				

Section I Scores - y

11 OF 11 PAGES

TABLE XII (Cont.)

$$C_x = \frac{178-91}{127} = .685$$

$$\sigma_x = \sqrt{\frac{855- .4591}{127}} = 2.5046$$

$$C_x^2 = .4591$$

$$\sigma_y = \sqrt{\frac{930}{127} - .6957} = 2.5743$$

$$C_y = \frac{189-83}{127} = .8346$$

$$r = \frac{531}{127} - .5717 = .56$$

$$C_y^2 = .6957$$

$$2.5046 \times 2.5743$$

$$C_x C_y = .5717$$

$$P.E. = \frac{.6745 (1-.56)^2}{11.27} = .041$$

the school marks in the same subject likewise increase in value. By use of this section of the test it is possible to determine the ability of fifty-six or possibly sixty out of every hundred pupils in a science class at the beginning of the year before they have entered upon a study of that subject. This represents a high degree of efficiency in testing devices. A great deal of time and care was taken in developing this part of the test.

Table XIV is a graphical representation of the relation between the two variables, the school marks in history and the history scores (Section II) of the Aptitude Test, as given to thirty-seven school children. Although given to a fairly small group of pupils, the correlation turned out to be quite marked, being $(.466 \pm .086)$. This relationship indicates a high degree of dependability on the part of the test, and is much higher than is the correlation between the Otis Test, Part 10, and a composite of the school marks in history and civics, which is .22.

Section III of the Athol Test is an artificial language test, and has been compared with a composite of the school marks in Latin and English, the only two languages taught in the ninth grade. A study of the scatter diagram in Table XV, and of the correlation figure $(.38 \pm .04)$ will reveal a very close relation between the two sets of variables. The points on the scatter graph fall close to the diagonal.

TABLE XIV

Correlation Between History Section
of Athol Scholastic Aptitude Test
(Sect.II) and school marks in Ancient
History

Ancient History Marks - x

	44- 47	48- 51	52- 55	56- 59	60- 63	64- 67	68-72- 71 75 79	76-80- 79 83	84- 87	f	d	fd	fd ²	Σxy
16				/				///	/	5	5	25	125	80
15				/	///	/	/	/		7	4	28	112	20
14			/	/	/	//				5	3	15	45	-24
13				/	/	//	///			6	2	12	24	10
12			/	/	/					3	1	3	3	-6
11			/		//					3		83		
10								/		1	-1	-1	1	-4
9								/		1	-2	-2	4	-8
8		/	/				/			3	-3	-9	27	18
7	/			/						2	-4	-8	32	24
6										0	-5	0	0	
5		/								1	-6	-6	36	24
												-26	409	134
f	1	3	4	1	8	7	2	4	1	5	1	37		
d	-5	-4	-3	-2	-1		1	2	3	4	5			
fd	-5	-12	-12	-2	-8	-39	2	8	3	20	5	38		
fd ²	25	48	36	4	8		2	32	9	80	25	269		

Aptitude - Section II - y

U OF MICHIGAN LIBRARY

TABLE XIV(Cont.)

$$C_x = \frac{38-39}{37} = -.027$$

$$\sigma_x = \sqrt{\frac{269 - .0729}{37}} = 2.6827$$

$$C_x^2 = .0729$$

$$\sigma_y = \sqrt{\frac{409 - 2.3731}{37}} = 2.9293$$

$$C_y = \frac{83-26}{37} = 1.5405$$

$$r = \frac{\frac{134}{37} - (-.0416)}{2.68 \times 2.93} = .466$$

$$C_y^2 = 2.3731$$

$$P.E. = \frac{.6745 (1 - .466^2)}{\sqrt{37}} = .086$$

$$C_x C_y = -.0416$$

There are a few misplacements, that is, points which fall away from the diagonal, but the large majority of the points lie close to the diagonal. The correlation .38 also indicates a possible marked degree of relationship. It is felt that with further use of this test, that a closer relationship than this might be obtained, and that this part of the test might finally prove to have a marked degree of reliability. The comparison here covered two hundred paired observations.

A study of the scatter graph on Table XVI, and of the correlation figure shows a marked degree of relationship between the school marks in history and civics and Section IV of the Aptitude Test scores. Test IV is a geography test, and reference to Table X shows that it was proven to have a very high correlation with the total test scores ($.886 \pm .011$). The correlation of Test IV with the history and civics marks is $.444 \pm .04$ which is a marked relationship. A study of the points on the scatter graph reveals the fact that they form a compact column close to the diagonal. No points are located far away from the diagonal, and most of them hover close to it. The paired associations here covered one hundred and fifty cases, and the results are entirely satisfactory.

The main part of the geography test consists of an artificial map which the pupil is to study. The material in the study is varied, covering not only countries, cities, and their location, but industries and the economics of the country as well. The drawing is made to look attractive, and consequently

holds the interest and attention of the pupil. It is the contention of the authors of the Athol Test that a test, if it is to have much validity, must be illustrative in nature, that is, it must contain diagrams and pictures, and the material to be tested must be put forth in many forms and must have appeal.

Table XVII contains a scatter graph and a correlation figure which shows the relation between section V scores of the Athol Test, which is a test in reading comprehension, and the English marks of the school children. The graph shows a marked degree of relationship. The points fall very close to the diagonal, and indicate that as the scores in comprehensive reading increase in value, the marks in the English subject likewise increase in value. The dependability here is high. The correlation is $(.453 \pm .042)$ which indicates a close relationship.

Section VI of the Athol Test has been correlated with the school marks in algebra and in business arithmetic, and the results are to be found on Table XVIII. The scatter graph shows that there is a low, although noticeable relation between the two sets of variables. The points fall too near the horizontal, and do not follow the diagonal closely enough. The correlation is $(.27 \pm .048)$ and is certainly more than four times the probable error, which is the standard set by Jordan¹⁷ in order that the coefficient may be accepted as reliable. No particular significance can be attached to these

TABLE XV

Correlation Between the Language
Section of Athol Test (Sect. III)
and school marks in Language

Composite of Latin and English Marks - x

	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	f	d	fd	fd ²	Σxy
	44	49	54	59	64	69	74	79	84	89	94					
17-16			/	/		//		///	//	//	///	15	4	60	240	128
15-14			//		///	//	///	//	///	//		27	3	81	243	93
13-12			/	/	///	///	//	/	///	//	//	25	2	50	100	60
11-10	//		///	//	///	///	///	///	///	///		36	1	36	36	14
9-8	/	/	//	/	///	///	//	///	//	///		35		227		
7-6			//	/	///	///	/	///	/			26	-1	-26	26	6
5-4		/	/	/	///	///	/					11	-2	-22	44	22
3-2		/		///	//	///	//	/	/			15	-3	-45	135	15
1-0	/		//	/	///	/	/					10	-4	-40	160	64
f	4	3	15	11	47	36	20	22	23	14	5	200		-133	984	402
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-20	-12	-45	-22	-47	-146	20	44	69	56	25	214				
fd ²	100	48	135	44	47		20	88	207	224	125	1038				

Aptitude - Section III - Y

U OF MICHIGAN LIBRARY

$$C_x = \frac{214-146}{200} = .34$$

$$C_x^2 = .1156$$

$$C_y = \frac{227-133}{200} = .47$$

$$C_y^2 = .2209$$

$$C_x C_y = .1598$$

$$\sigma_x = \sqrt{\frac{1038}{200} - .1156} = 2.246$$

$$\sigma_y = \sqrt{\frac{994}{200} - .2209} = 2.168$$

$$r = \frac{402}{200} - .1598 = .38$$

$$P.E. = \frac{.6745 (1-.38^2)}{\sqrt{200}} = .04$$

TABLE XVI

Correlation Between History Section of
Athol Scholastic Aptitude Test (Sect. IV)
and School Marks in History and Civics

Composite of History and Civics Marks - x

	40- 44	45- 49	50- 54	55- 59	60- 64	65- 69	70- 74	75- 79	80- 84	85- 89	90- 94	f	d	fd	fd ²	Σxy
54- 50							/			/		2	4	8	32	28
49- 45				/	///		/	//		/		10	3	30	90	36
44- 40		//		////	//	/	///	////	//	/		19	2	38	76	44
39- 35			//	////	///	/	///	///	/	///		24	1	24	24	39
34- 30		//		///	///	///	//		///			23		100		
29- 25	//	/	////	/	//	////	//	//	////	/	//	25	-1	-25	25	-2
24- 20	/	/	/	//	///	///	//	/	/			17	-2	-34	68	28
19- 15	/	/	////	//	///	///	//	/				22	-3	-66	198	81
14- 10		/	/	/	//	/						6	-4	-24	96	44
9- 5	/			/								2	-5	-10	50	30
f	5	4	14	8	28	30	14	14	18	7	8	150		-159	659	328
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-25	-16	-42	-16	-28	-127	14	28	54	28	40	164				
fd ²	125	64	126	32	28		14	56	162	112	200	919				

Aptitude - Section II - y

TABLE XVI (Cont.)

$$C_x = \frac{164-127}{150} = .247$$

$$C_x^2 = .061$$

$$C_y = \frac{100-159}{150} = -.393$$

$$C_y^2 = .154$$

$$C_x C_y = -.0957$$

$$\sigma_x = \sqrt{\frac{919}{150} - .061} = 2.46$$

$$\sigma_y = \sqrt{\frac{659}{150} - .154} = 2.09$$

$$r = \frac{\frac{328}{150} - (-.0957)}{2.46 \times 2.09} = .444$$

$$P.E. = \frac{.6745 (1-.44^2)}{\sqrt{150}} = .04$$

TABLE XVII

Correlation Between Reading Comprehension
Section of Athol Aptitude Test (Sect.V) and
School Marks in English

English Marks - x

	40- 44	45- 49	50- 54	55- 59	60- 64	65- 69	70- 74	75- 79	80- 84	85- 89	90- 95	f	d	fd	fd ²	Σxy
23- 22						/	/		//		/	5	5	25	125	60
21- 20			/		//	///		/	///	/	//	14	4	56	224	80
19- 18					//	/	///	///	//	///		15	3	45	135	78
17- 16			/	/	///		///	///	//		/	17	2	34	68	30
15- 14			/	/	///	/	/	///	///			14	1	14	14	7
13- 12		/	/		/	///	//	/	///	/		16		174		
11- 10		/		//	///	///		///				17	-1	-17	17	6
9- 8	/		//	//	///	///	///	/	/			24	-2	-48	96	22
7- 6			///	///	///	///	//	//		//		26	-3	-78	234	39
5- 4			//		///	//						7	-4	-28	112	36
3- 2		/		//	//	/	/					7	-5	-35	175	45
1- 0			/									1	-6	-6	36	18
f	1	3	13	11	38	31	18	20	17	7	4	163	-212	1236		421
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-5	-12	-39	-22	-38	116	18	40	51	28	20	157				
fd ²	25	48	117	44	38		18	80	153	112	100	735				

Aptitude - Section V - y

$$C_x = \frac{157-116}{163} = .251$$

$$C_x^2 = .063$$

$$C_y = \frac{174-212}{163} = -.233$$

$$C_y^2 = .054$$

$$C_x C_y = -.058$$

$$\sigma_x = \sqrt{\frac{735}{163} - .063} = 2.109$$

$$\sigma_y = \sqrt{\frac{1236}{163} - .054} = 2.765$$

$$r = \frac{\frac{421}{163} - (-.068)}{2.109 \times 2.765} = .453$$

$$P.E. = \frac{.6745 (1-.453^2)}{12.767} = .042$$

TABLE XVIII

	40-	45-	50-	55-	60-	65-	70-	75-	80-	85-	90-	95-	f	d	fd	fd ²	Σxy
	44	49	54	59	64	69	74	79	84	89	94	100					
21-						/		/				/					
20													3	4	12	48	32
19-						///	/	///	///		/						
18													11	3	33	99	63
17-	/	//		//	///		///	//	///	/							
16							///		/				26	2	52	104	30
15-		//	/	//	///	///	///	///	///		/	/					
14						///							33	1	33	33	10
13-	/	///	/	///	///	///	///	///	///	//		/					
12													43		130		
11-			//	///	/	//	///	///		/	/						
10													17	-1	-17	17	-3
9-	/	/		//	///	//	/	/	//	///							
8													16	-2	-32	64	-10
7-	/		///	/	/	/	/										
6													8	-3	-24	72	48
5-					//			/									
4													3	-4	-12	48	0
3-									/								
2													1	-5	-5	25	-15
f	4	8	7	19	23	23	25	19	20	7	3	3	161		-90	510	155
d	-5	-4	-3	-2	-1		1	2	3	4	5	6					
fd	-20	-32	-21	-38	-23	-134	25	38	60	23	15	18	184				
fd ²	100	128	63	76	23		25	76	180	112	75	108	966				

TABLE XVIII (Cont.)

$$C_x = \frac{184-134}{161} = .31$$

$$\sigma_x = \sqrt{\frac{966}{161} - .096} = 2.43$$

$$C_x^2 = .096$$

$$\sigma_y = \sqrt{\frac{510}{161} - .061} = 1.76$$

$$C_y = \frac{130-90}{161} = .248$$

$$r = \frac{\frac{155}{161} - .0768}{2.43 \times 1.76} = .27$$

$$C_y^2 = .061$$

$$C_x C_y = .0768$$

$$P.E. = .048$$

U. S. GOVERNMENT PRINTING OFFICE

correlations, however. The test can be used with a fair probability of success in determining success in the school subjects of mathematics and business arithmetic, but it is felt that it might be improved upon by eliminating a part of it. Possibly it might be advisable to eliminate the last sheet of the test, and retain only the syllogisms.

All other parts of the test are seen to have a close relationship to the school marks. The correlations of the various parts with their corresponding school subjects, with the exception of the mathematics test, are all of a marked degree. This would indicate that the Athol Scholastic Aptitude Test is very reliable for predicting school success.

I have drawn some scatter diagrams and figured some correlations showing the relationship between various parts of the Otis Test and the corresponding school subjects. Of course, the Otis Test does not test in specific abilities, but only in general ability, but parts of the test may be classified as tests of definite scholastic subjects. Part 5, for example, is an arithmetic test and may be used to test general mathematical ability. This has been correlated with a composite of algebra and business arithmetic, and the results may be found on Table XIX. A study of this diagram shows that there is a close relationship. The points fall mostly in the lower left-hand quadrant, which means that both school marks and Part 5 test scores are low, but are closely related. Whereas some

TABLE XIX

Correlation Between School Marks in
Mathematics and Section V of Otis
Group Intelligence Scale Scores

Composite of Algebra and Business Arithmetic Marks - x

	40- 44	45- 49	50- 54	55- 59	60- 64	65- 69	70- 74	75- 79	80- 84	85- 89	90- 94	95- 99	f	d	fd	fd ²	Σxy
19							/						1	7	7	49	0
18													0	6	0	0	0
17							/					/	2	5	10	50	25
16						/					/		2	4	8	32	12
15			/		/					/			3	3	9	27	-9
14				/	//	//	/	//	///				11	2	22	44	-2
13	/	//	//	///	/	/	/// /	/	/// //	/			25	1	25	25	-18
12				//	/// ///	///	///	///	//	//		/	22		81		
11	/	//		///		//	///	///	/	/	/		19	-1	-19	19	18
10	/	//	/	///	/// ///	///	//	/	///	/			25	-2	-50	100	76
9				/	///		//	/// ///	//	/			15	-3	-45	135	-3
8	//	//	/	/	/	///	/						13	-4	-52	208	124
7		/		/	//	/			/			/	7	-5	-35	175	30
6			/	/	//	/	/	//					8	-6	-48	288	60
5				/			/	/					3	-7	-21	147	14
f	5	9	6	19	23	19	24	18	20	7	3	3	156		-270	1299	327
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-30	-45	-24	-57	-46	-19	-221	18	40	21	12	15	106				
fd ²	180	225	216	171	92	19		18	80	63	48	75	1187				

Aptitude - Section E - Y

11 12 13 14 15 16 17 18 19

TABLE XIX (Cont.)

$$C_x = \frac{221-106}{156} = .737$$

$$\sigma_x = \sqrt{\frac{1187}{156} - .543} = 2.63$$

$$C_x^2 = .543$$

$$\sigma_y = \sqrt{\frac{1299}{156} - 1.466} = 2.62$$

$$C_y = \frac{81-270}{156} = -1.211$$

$$r = \frac{\frac{327}{156} - (-.892)}{2.68 \times 2.62} = .425$$

$$C_y^2 = 1.466$$

$$C_x C_y = -.892$$

$$P.E. = \frac{.6745 (1-.43^2)}{12.49} = .044$$

of the points scatter widely from the diagonal, most of them hover rather closely to it. The correlation figure ($.425 \pm .044$) also is marked. This part of the test is quite reliable as means of determining the probability of success among school children in the field of mathematics. It is, however, the only part that correlates so closely with the school marks.

Part 9 of the Otis Test has been compared with the English marks of one hundred and sixty pupils taking that subject. The results may be found on Table XX. A careful analysis of this scatter graph reveals the fact that the points seem to scatter widely, and appear to fall more in a vertical column rather than along the diagonal. The points are so widely distributed as to cause the variables to have practically no significant degree of relationship. The correlation is ($.21 \pm .042$) which indicates a low degree of relationship with a possibility of a "no relationship".

Part 10 has been compared with a composite of the history and civics marks of one hundred and fifty pupils taking these subjects, and the results may be found on Table XXI. An inspection of this graph shows that the points fall in a horizontal column across the upper half of the diagram. They do not follow the diagonal, but scatter widely over the sheet. The correlation, ($.22 \pm .052$) also, is low and of little significance. It is seen, therefore, that when parts of the Otis Test are correlated with school marks, that the relationship almost always turns out to be very low. This means that

TABLE XX

Correlation Between School Marks in
English and Part IX of the Otis Intelligence Scale Scores

English Marks - x

	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-95	f	d	fd	fd ²	Σxy
25-24						/	/	///				7	6	42	252	66
23-22			//		/		//	//	////	/		12	5	60	300	75
21-20					///	////	///	////	//			16	4	64	256	56
19-18				//	////	////	/	/	////	//		18	3	54	162	45
17-16					////	//		//			//	10	2	20	40	20
15-14				//	///	///	//	/	//	/		14	1	14	14	7
13-12	/		///	/	///	///	/		/		/	23			254	
11-10		/		//	///	////	///	//	/	/		17	-1	-17	17	-3
9-8			////	//	///	///	//	//	/		/	20	-2	-40	80	14
7-6		/			/	//		/	/	//		8	-3	-24	72	-24
5-4			/			//			/			4	-4	-16	64	0
3-2			/		/		/		/			4	-5	-20	100	0
1-0					//	///	//					7	-6	-42	252	0
f	1	2	11	9	36	34	18	20	18	7	4	160		-159	1609	256
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-5	-8	-33	-18	-36	100	18	40	54	28	20	160				
fd ²	25	32	99	36	36		18	80	162	112	100	700				

Otis - Part 9 Scores - Y

UNIVERSITY OF MICHIGAN LIBRARY

$$C_x = \frac{160-100}{160} = .375$$

$$C_x^2 = .141$$

$$C_y = \frac{254-159}{160} = .594$$

$$C_y^2 = .303$$

$$C_x C_y = .2227$$

$$\sigma_x = \sqrt{\frac{700}{160} - .141} = 2.058$$

$$\sigma_y = \sqrt{\frac{1609}{160} - .303} = 3.123$$

$$r = \frac{\frac{256}{160} - .2227}{2.058 \times 3.123} = .214$$

$$P.E. = \frac{.6745 (1-.214^2)}{12.767} = .042$$

TABLE XXI

Correlation Between School Marks in
History and Civics and Part 10 of the
Otis Intelligence Scale Scores

Composite of History and Civics Marks - x

Otis - Part 10 - Y

	40- 44	45- 49	50- 54	55- 59	60- 64	65- 69	70- 74	75- 79	80- 84	85- 89	90- 94	f	d	fd	fd ²	Σxy
26- 25			/		/	/		///		/		7	4	28	112	24
24- 23			/	//	///	//		/	//	/	//	16	3	48	144	30
22- 21			//	//	////	////	///	//	///	/	///	31	2	62	124	76
20- 19	//		////	/	///	///	///	////	///		///	34	1	34	34	4
18- 17	///	/	//	/	///	///	///	/	//	/		28		172		
16- 15			/	//	//	///	/	//	///	/		18	-1	-18	18	-9
14- 13		/	///	/	/	//	/	/		/		11	-2	-22	44	-5
12- 11	/	/	/		/							4	-3	-12	36	39
10- 9						/						1	-4	-4	16	0
f	6	3	15	9	31	25	15	14	18	6	8	150		-56	528	159
d	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-30	-12	-45	-18	-31	-136	15	28	54	24	40	161				
fd ²	150	8	135	36	31		15	56	162	96	200	929				

TABLE XXI (Cont.)

$$C_x = \frac{161-136}{150} = .166$$

$$C_x^2 = .0275$$

$$C_y = \frac{172-56}{150} = .773$$

$$C_y^2 = .5975$$

$$C_x C_y = .1283$$

$$\sigma_x = \sqrt{\frac{929}{150} - .0275} = 2.433$$

$$\sigma_y = \sqrt{\frac{523}{150} - .5975} = 1.709$$

$$r = \frac{\frac{159}{150} - .1283}{2.433 \times 1.709} = .22$$

$$P.E. = \frac{.6745 (1-.22^2)}{12.248} = .052$$

the Otis Test does not measure what it really is supposed to measure, and that it is rather unreliable as a means of determining the relative degree of success on the part of school children in their various subjects. The Otis Test does not measure native equipment, intelligence. It is only a measure of knowledge or experience.

Table XXII shows the results of a comparison of Section VI, the mathematics section of the Athol Test, and the corresponding part 5 of the Otis Test. The relationship is also very low, and the coefficient is $(.26 \pm .07)$. The two parts are not related.

Section V, the English part of the Athol Test, has been compared with part 9 of the Otis Test, which may be found on Table XXIII, and the relationship is low. The coefficient is $(.29 \pm .04)$. The two are slightly related.

Section II, the history part of the Athol Test, has been correlated with the corresponding part of the Otis Test, part 10, which may be found on Table XXIV. The correlation is $(.19 \pm .05)$ and there is no relationship. This means that the two parts differ widely in their testing quality.

On the whole, therefore, parts of the Athol Test are slightly related with corresponding parts of the Otis Test. Hence, they do not measure similar traits. One test measures one thing, the other something else. I feel that since there is a closer relationship in every part between the Athol Test and school marks, that the Athol Test measures mental ability

TABLE XXII

Correlation Between Math. Scores (Sect. VI)
of Athol Aptitude Test and Part 5 of the
Otis Intelligence Scale

Section VI Marks - x

	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	f	d	fd	fd ²	Σxy
	3	5	7	9	11	13	15	17	19	21					
19								/			1	8	8	64	16
18											0	7	0	0	0
17						/				/	2	6	12	72	24
16							/		/		2	5	10	50	20
15				//				/			3	4	12	48	-8
14					///	///	//	///			11	3	33	99	15
13		/	///		////	///	///	///	//		26	2	52	104	8
12				/	/	////	///	///	///		22	1	22	22	27
11		/		/	//	///	///	//			19		149		
10				///	///	///	///	//		//	26	-1	-26	26	-6
9		/		///		///	///	//	/		16	-2	-32	64	2
8	/		///	/	/	///	///		/		13	-3	-39	117	33
7				///	/	//			/		7	-4	-28	112	16
6			/	/	//	//	//				8	-5	-40	200	25
5						//		/			3	-6	-18	108	-12
4											0	-7	0	0	0
3			/								1	-8	-8	64	24
f	1	3	8	16	18	44	33	23	10	3	160		-191	1150	184
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-5	-12	-24	-32	-18	-91	33	46	30	12	121				
fd ²	25	48	72	64	18		33	92	90	48	490				

Otis - Part 5 - Scores - y

TABLE XXII (Cont.)

$$C_x = \frac{121-91}{160} = .187$$

$$C_x^2 = .035$$

$$C_y = \frac{149-191}{160} = -2.262$$

$$C_y^2 = .068$$

$$C_x C_y = -.049$$

$$\sigma_x = \sqrt{\frac{490}{160} - .035} = 1.75$$

$$\sigma_y = \sqrt{\frac{1150}{160} - .068} = 2.68$$

$$r = \frac{\frac{184}{160} - (-.049)}{1.75 \times 2.68} = .26$$

$$P.E. = \frac{.6745 (1-.26^2)}{12.649} = .073$$

TABLE XXIII

Correlation Between Section V Scores of
Athol Aptitude Test and Part 9 of Otis
Intelligence Scale

Section V Marks - x

	0-	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	22-					
	1	3	5	7	9	11	13	15	17	19	21	23	f	d	fd	fd ²	Σxy
25-						/	/	//	/	/	/						
24-													7	6	42	252	60
23-				/		/	//	/	//	//	//	/	12	5	60	300	100
22-			/	/	/	//	/	/	///	///	//	/	16	4	64	256	72
21-		/		///	//	/	///	/	//		//	/	18	3	54	162	-3
20-			//		//	/		/	/	/	/	/	10	2	20	40	4
19-	/			///	///		//	//	/			/	14	1	14	14	-13
18-			//	///	///	/	//	//	/	///	///		24		254		
17-				///	///	///		/		/			17	-1	17	17	33
16-		/	/	///	///	/	///	//	///	/			21	-2	-42	84	42
15-		/	/		/	/			//	/			7	-3	-21	63	15
14-			/			/				/			3	-4	-12	48	8
13-		/				/			/		/		4	-5	-20	100	0
12-				///	/	//					/		7	-6	-42	252	54
11-																	
10-																	
9-																	
8-																	
7-																	
6-																	
5-																	
4-																	
3-																	
2-																	
1-																	
0																	
f	1	7	7	25	23	17	17	13	17	14	14	5	160	-154	1588	372	
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-6	-35	-28	-75	-46	-17	207	13	34	42	56	25	170				
fd ²	26	175	112	275	92	17		13	68	126	214	125	1203				

Otis - Part 9 Scores - y

$$C_x = \frac{170-207}{160} = -.231$$

$$\sigma_x = \sqrt{\frac{1203}{160} - .0533} = 2.732$$

$$C_x^2 = .0533$$

$$\sigma_y = \sqrt{\frac{1588}{160} - .390} = 3.038$$

$$C_y = \frac{254-154}{160} = .625$$

$$r = \frac{\frac{372}{160} - (-.1443)}{2.732 \times 3.038} = .292$$

$$C_y^2 = .390$$

$$C_x C_y = -.1443$$

$$P.E. = \frac{.6745 (1-.29^2)}{\sqrt{160}} = .048$$

TABLE XXIV

Correlation Between Section II
(History) Scores of Athol Attitude
Test and Part 10 of Otis Intelli-
gence Scale

Section II Scores - x

Otis - Part 10 Scores - y

	4	5	6	7	8	9	10	11	12	13	14	15	16	f	d	fd	fd ²	Σxy
26							/			/				2	8	16	128	24
25				/						//		/	/	5	7	35	245	105
24				/	/				/	/	/			5	6	30	180	54
23					/	//	//	//	///		///	/		14	5	70	350	175
22								//	///	//	//		/	10	4	40	160	112
21	/		/			/		///	////	///	///	//		22	3	66	198	101
20		/			/	//	///	/	///	/	///	/		18	2	36	72	80
19	/			/	//	//	/	///	/	///	//			20	1	20	20	34
18				//	/	//	//	//	/	/	//			13		313		
17				/	/	///	//	/	//	//	//	/		15	-1	-15	15	-31
16	/			//			///	///		//	/			12	-2	-24	48	-24
15							//	/	/	//				6	-3	-18	54	-36
14			/			/	///	/	/					8	-4	-32	128	-24
13				/		/	/			/		/		5	-5	-25	125	-45
12	///									/				4	-6	-24	144	66
11														0	-7	0	0	0
10						/								1	-9	-9	81	0
f	2	4	1	2	9	7	18	21	21	24	23	20	8	160	-146	1931	591	
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5	6					
fd	-12	-20	-4	-6	-18	-7	-67	21	42	72	92	100	48	375				
fd ²	72	100	16	18	36	7		21	84	216	368	500	288	1726				

TABLE XXIV (Cont.)

$$C_x = \frac{375-67}{160} = 1.925$$

$$\sigma_x = \sqrt{\frac{1726}{160} - 3.705} = 2.66$$

$$C_x^2 = 3.705$$

$$\sigma_y = \sqrt{\frac{1931}{160} - 1.037} = 3.31$$

$$C_y = \frac{313-146}{160} = 1.043$$

$$r = \frac{\frac{591}{160} - 2.00}{2.66 \times 3.31} = .19$$

$$C_y^2 = 1.037$$

$$C_x C_y = 2.00$$

$$P.E. = .05$$

and native equipment. The Otis Test does not measure the most potent mental traits.

According to C. L. Hull¹⁶, in so far as tests correlate with each other, they are testing the same functions. When this correlation approaches 1.00, the two tests become identical, so that if both tests are given, it is equivalent to giving the same test twice. The measuring of the same function in this way by giving the same test twice, is a waste of time and energy. The scatter graphs and correlations in Tables XXV to XXXIV show that the inter-correlations between the various parts of the Athol Test are, with but three exceptions, low or of no significance. These comparisons cover fifteen sets of paired variables, and the results are entirely satisfactory. It may be that chance elements entered into the work to cause even these three marked correlations. The rather close relations were between Science and Geography ($.45 \pm .042$), between History and Geography ($.41 \pm .044$), between Comprehensive Reading and Geography ($.61 \pm .033$). One would expect to get a fair degree of correlation between these subjects because of the many elements in each that are identical. Geography is a branch of Natural Science, hence the close relation between these two subjects. History and Geography have much in common. Six of these correlations fall below .20, six between .21 and .40, two between .41 and .45, and one .61.

Summary of Scatter Graph and Correlation Analysis.

1. The scatter graph and the corresponding correlation

TABLE XXV

Section Scores - X

	4	5	6	7	8	9	10	11	12	13	14	15	16	f	d	fd	fd ²	Σxy
25-									/		/		//					
24-														4	6	24	144	84
23-			/		/	/		/	//	/	/	/	/	10	5	50	250	30
22-					//		/	/		///	///	///		16	4	64	256	108
21-							///		//	/		///		11	3	33	99	63
20-					/		//		///	///	///	//	///	21	2	42	84	90
19-						/	/	//	///	///	///	///	/	22	1	22	22	41
18-														26		-235		
17-					/		//		///	///	///	//	///	22	-1	-22	22	-17
16-														18	-2	-38	76	18
15-														9	-3	-24	72	30
14-							/							1	-4	-4	16	4
13-					/			/						2	-5	-10	50	15
12-														1	-6	-6	36	-18
11-											/							
10-				/	/	/	//	///	///	///	///	//						
9-	/	/		/	/	/	//	///	//	//	///							
8-	/	/			/			///		/		/						
7-							/											
6-																		
5-																		
4-																		
3-					/			/										
2-																		
1-											/							
0																		
f	2	4	1	2	9	7	18	21	22	25	24	20	8				-104	448
d	-7	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-14	-24	-5	-8	-27	-14	-18	-110	22	50	72	80	40	264				
fd ²	98	64	25	32	81	28	18		22	100	216	320	200	1204				

TABLE XXV (Cont.)

$$C_x = \frac{264-110}{163} = .944$$

$$\sigma_x = \sqrt{\frac{1204}{163} - .8911} = 2.5486$$

$$C_x^2 = .8911$$

$$\sigma_y = \sqrt{\frac{1127}{163} - .6464} = 2.503$$

$$C_y = \frac{235-104}{163} = .804$$

$$r = \frac{\frac{448}{163} - .7589}{2.5486 \times 2.503} = .311$$

$$C_y^2 = .6464$$

$$C_x C_y = .7589$$

$$P.E. = .048$$

TABLE XXVI

	0- 1	2- 3	4- 5	6- 7	8- 9	10- 11	12- 13	14- 15	16- 17	f	d	fd	fd ²	Σxy
25- 24			/				/	//		4	6	24	144	60
23- 22						///	///	/		10	5	50	250	90
21- 20	///	///		//	//	//		/	///	16	4	64	256	-24
19- 18	/	///		///	/	/		/	/	11	3	33	99	-18
17- 16		//		//	///	/	//	///	/	21	2	42	84	32
15- 14		//	///	//	///	///	//	///	/	22	1	22	22	6
13- 12	//	//	///	///	//	///	///			26		235		
11- 10	///	/	///	///	/	///	/	//		22	-1	-22	22	12
9- 8	///	/			///	///	//	//	//	18	-2	-36	72	-14
7- 6		/		/	///	/	/	/	/	9	-3	-27	81	-18
5- 4	/									1	-4	-4	16	16
3- 2					/	/				2	-5	-10	50	5
1- 0		/								1	-6	-6	36	18
f	13	16	11	21	28	28	18	17	11	163		-105	1132	177
d	-4	-3	-2	-1		1	2	3	4					
fd	52	48	22	21	143	28	36	51	44	159				
fd ²	208	144	44	21		28	72	153	176	346				

Section I Reverses - X

TABLE XXVI (Cont.)

$$C_x = \frac{159-143}{163} = .0981$$

$$\sigma_x = \sqrt{\frac{846}{163} - .0096} = 2.2979$$

$$C_x^2 = .0096$$

$$\sigma_y = \sqrt{\frac{1132}{163} - .6360} = 2.5113$$

$$C_y = \frac{235-105}{163} = .7975$$

$$r = \frac{\frac{177}{163} - .0782}{2.2979 \times 2.5113} = .178$$

$$C_y^2 = .6360$$

$$C_x C_y = .0782$$

$$P.E. = .051$$

TABLE XXVII

Correlation Between Sections I
and IV of Athol Aptitude Test

Section IV Marks - x

	5- 9	10- 14	15- 19	20- 24	25- 29	30- 34	35- 39	40- 44	45- 49	50- 54	f	d	fd	fd ²	Σxy
25- 24							/	//	/		4	6	24	144	48
23- 22					/	//	///	/	//	/	10	5	50	250	70
21- 20		/		///	///	/	///	///	/		16	4	64	256	4
19- 18	/				//	//	///	/	/	/	11	3	33	99	5
17- 16			///	//	///	/	///	///	/	/	21	2	42	84	10
15- 14			//	//	///	///	///	///	//		22	1	22	22	2
13- 12			/// //	///	/// ///	///	//	/	/		26		235		
11- 10		//	///	///	///	///	//	//	/		22	-1	-22	22	23
9- 8	//	/	///	//	//	///	//				18	-2	-36	72	66
7- 6			///	//	//		/	/			9	-3	-27	81	36
5- 4		/									1	-4	-4	16	16
3- 2		/			/						2	-5	-10	50	26
1- 0		/									1	-6	-6	-36	24
f	3	7	25	18	19	22	27	19	10	3	163		-105	1132	330
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-15	-28	-75	-36	-29	-183	27	38	30	12	107				
fd ²	75	112	225	72	29		27	76	90	48	754				

Section I Scores - y

$$C_x = \frac{107-183}{163} = -.466$$

$$C_x^2 = .2171$$

$$C_y = \frac{235-105}{163} = .7975$$

$$C_y^2 = .6360$$

$$C_x C_y = -.3716$$

$$\sigma_x = \sqrt{\frac{754}{163} - .2171} = 2.099$$

$$\sigma_y = \sqrt{\frac{1132}{163} - .6360} = 2.5113$$

$$r = \frac{\frac{330}{163} - (-.3716)}{2.099 \times 2.5113} = .454$$

$$P.E. = \frac{.6745(1-.454^2)}{12.767} = .042$$

TABLE XXVIII

Correlation Between Sections I
and V of Athol Aptitude Test

Section V Scores - x

	0-	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	22-	f	d	fd	fd ²	Σxy
	1	3	5	7	9	11	13	15	17	19	21	23					
25-									///		/						
24-													4	6	24	144	60
23-				/		/	/	//		/	///	/	10	5	50	250	90
22-																	
21-		/	/	//	/	///		//	//	/	//		16	4	64	256	-16
20-																	
19-				//	/	//	/	/	//	/	/		11	3	33	99	6
18-																	
17-		/		/	/	//	///	///	///	//	//	//	21	2	42	84	42
16-																	
15-		/		///	///	/	/	/	///	//	//	/	22	1	22	22	0
14-																	
13-	/	/	//	///	///	/		//	//	///			26				
12-																	
11-		//	///	///	///		///	//		/	//		22	-1	-22	22	24
10-																	
9-				///	///	///	//	/			/	/	18	-2	-36	72	34
8-																	
7-		/		//	/	//	//		/				9	-3	27	81	39
6-																	
5-			/										1	-4	-4	16	16
4-																	
3-				//									2	-5	-10	50	24
2-																	
1-						/							1	-6	-6	36	6
0																	
f	1	7	7	26	24	17	17	14	17	14	14	5	163		-105	1132	325
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-6	-35	-28	-78	-48	-17	-212	14	34	42	56	25	171				
fd ²	36	175	112	234	96	17		14	68	126	224	125	1227				

$$C_x = \frac{171-212}{163} = -.2515$$

$$C_x^2 = .0632$$

$$C_y = \frac{235-105}{163} = .7975$$

$$C_y^2 = .6360$$

$$C_x C_y = -.2006$$

$$\sigma_x = \sqrt{\frac{1227}{163} - .0632} = 2.743$$

$$\sigma_y = \sqrt{\frac{1132}{163} - .6360} = 2.5113$$

$$r = \frac{\frac{325}{163} - (-.2006)}{2.743 \times 2.5113} = .318$$

$$P.E. = \frac{.6745(1-.318^2)}{12.767} = .046$$

TABLE XXIX

Correlation Between Sections I
and VI of Athol Aptitude Test

Section VI Scores - x

	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	f	d	fd	fd ²	Σxy
	3	5	7	9	11	13	15	17	19	21					
25- 24					/	/	/	/			4	6	24	144	36
23- 22		/			/		/	///	/	/	10	5	50	250	115
21- 20			/	/	/	///	////	///	/		16	4	64	256	108
19- 18				//		///	////	//			11	3	33	99	45
17- 16	/			///	//	///	////	//	//		21	2	42	84	44
15- 14		//	/	//	//	///	///	//	/		22	1	22	22	17
13- 12				/	/	///	///	///	//	/	26		236		
11- 10			//	/	///	///	////	//	///	/	22	-1	-22	22	-19
9- 8			///	///	//	//	//	/	/		18	-2	-36	72	2
7- 6					//	///	/				9	-3	-27	81	-24
5- 4						/					1	-4	-4	16	-4
3- 2						//					2	-5	-10	50	-10
1- 0					/						1	-6	-6	36	0
f	1	3	8	16	19	44	32	26	11	3	163		-105	1132	310
d	-4	-3	-2	-1		1	2	3	4	5					
fd	-4	-9	-16	-16	-45	44	64	78	44	15	245				
fd ²	16	27	32	16		44	128	234	176	75	748				

Section I Scores - y

$$C_x = \frac{245-45}{163} = 1.228$$

$$\sigma_x = \sqrt{\frac{748}{163} - 1.508} = 1.755$$

$$C_x^2 = 1.508$$

$$\sigma_y = \sqrt{\frac{1132}{163} - .6360} = 2.5113$$

$$C_y = \frac{235-105}{163} = .7975$$

$$r = \frac{\frac{310}{163} - .9793}{1.755 \times 2.5113} = .209$$

$$C_y^2 = .6360$$

$$P.E. = \frac{.6745(1-.209^2)}{12.767} = .05$$

$$C_x C_y = .9793$$

TABLE XXX

Correlation Between Sections
II and III of Athol Aptitude Test

Section III Scores - x

Section II Scores - y

	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	f	d	fd	fd ²	Σxy
16				///	/		/	/	//	8	5	40	200	50
15	/	/		////	///	//	///	///	/	20	4	80	320	36
14	//	///		/	///	///	/	///	//	24	3	72	216	12
13	//	/	///	///	///	///	/	///	/	25	2	50	100	-2
12		///	//	//	///	///	//	///		22	1	22	22	-5
11	//	//	/	///	/	///	//	/	//	21		264		
10	//		///	///	///	///	/	/		18	-1	-18	18	12
9	//	/			/	/	//			7	-2	-14	28	12
8	/		/		//	/	//	/	/	9	-3	-27	81	-18
7						/	/			2	-4	-8	32	-12
6							/			1	-5	-5	25	-10
5		/				/		/	/	4	-6	-24	144	-30
4						/		/		2	-7	-14	98	-35
f	12	15	11	21	28	29	19	17	11	163		-110	1284	10
d	-4	-3	-2	-1		1	2	3	4					
fd	-48	-45	-22	-21	-13	629	38	51	44	162				
fd ²	192	135	44	21		29	76	153	176	826				

TABLE XXX

$$C_x = \frac{162-136}{163} = .16$$

$$C_x^2 = .0256$$

$$C_y = \frac{264-110}{163} = .94$$

$$C_y^2 = .8836$$

$$C_x C_y = .015$$

$$\sigma_x = \sqrt{\frac{826}{163} - .0256} = 2.24$$

$$\sigma_y = \sqrt{\frac{1284}{163} - .8836} = 2.64$$

$$r = \frac{\frac{10}{163} - .015}{2.24 \times 2.64} = .013$$

$$P.E. = .05$$

TABLE XXXI

Correlation Between Sections IV
and II of Athol Aptitude Test

Section IV Scores - x

	5- 9	10- 14	15- 19	20- 24	25- 29	30- 34	35- 39	40- 44	45- 49	50- 54	f	d	fd	fd ²	Σxy
16				/	/		///	//		/	8	5	40	200	40
15					//	///	///	///	//	/	20	4	80	320	88
14		///	///	/	///	///	///	///	///		24	3	72	216	-15
13			///	///	///	///	//	//	///	/	26	2	52	104	-18
12		/	//	///	///	///	///	///			21	1	21	21	-10
11		//	///	///	///	//	///				21		265		
10	/	/	///	//	///	//	//	///	/		18	-1	-18	18	14
9	/		/	/	/	/	/	/			7	-2	-14	28	16
8			//	/	///	//			/		9	-3	-27	81	24
7			//								2	-4	-8	32	24
6					/						1	-5	-5	25	5
5			//	/	/						4	-6	-24	144	54
4	/		/								2	-7	-14	98	56
f	3	7	25	18	29	22	27	19	10	3	163		-110	1287	278
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-15	-28	-75	-54	-29	-201	27	38	30	12	107				
fd ²	75	112	225	72	29		27	76	90	48	754				

Section II Scores - y

$$C_x = \frac{107-201}{163} = -.576$$

$$\sigma_x = \sqrt{\frac{754}{163} - .352} = 2.07$$

$$C_x^2 = .332$$

$$\sigma_y = \sqrt{\frac{1287}{163} - .903} = 2.64$$

$$C_y = \frac{265-110}{163} = .95$$

$$r = \frac{\frac{278}{163} - (-.547)}{2.07 \times 2.64} = .41$$

$$C_y^2 = .903$$

$$C_x C_y = -.547$$

$$P.E. = .044$$

TABLE XXXII

Correlation Between Sections
II and V of Athol Aptitude Test

Section V Marks - x

	0- 1	2- 3	4- 5	6- 7	8- 9	10- 11	12- 13	14- 15	16- 17	18- 19	20- 21	22- 23	f	d	fd	fd ²	Σxy
16				/				/	//	/	/	//	8	5	40	200	95
15				/	/	///	//	///	//	///	///	//	20	4	80	320	120
14			/	//	//	//	///	///	///	//	//	/	24	3	72	216	48
13		/	//	///	///	///		//	//	///	///		25	2	50	100	-10
12		/	/	///	///	/	///	/	//	//	///		22	1	22	22	-4
11		/	//	///	///	//	///	/		/			21		264		
10	/		/	///	/	///	/	//	///		/		18	-1	-18	18	18
9		/			///		/	/		/			7	-2	-14	28	14
8		/		//	//	/	/	/	/				9	-3	-27	81	39
7		/										/	2	-4	-8	32	0
6						/							1	-5	-5	25	5
5		/		//	/								4	-6	-24	144	78
4			/	/			/						2	-7	-14	98	21
f	1	7	7	26	24	16	17	15	17	14	13	6	163		-110	1284	424
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-6	-35	-28	-78	-48	-16	-211	15	34	42	52	30	173				
fd ²	36	175	112	234	96	16		15	68	126	208	150	1236				

Section II Scores - y

$$C_x = \frac{173-211}{163} = -.233$$

$$\sigma_x = \sqrt{\frac{1236}{163} - .054} = 2.74$$

$$C_x^2 = .054$$

$$\sigma_y = \sqrt{\frac{1284}{163} - .884} = 2.64$$

$$C_y = \frac{264-110}{163} = .94$$

$$r = \frac{\frac{424}{163} - (-.219)}{2.74 \times 2.64} = .39$$

$$C_y^2 = .884$$

$$C_x C_y = -.219$$

$$P.E. = \frac{.6745(1-.39^2)}{\sqrt{163}} = .045$$

TABLE XXXIII

Correlations Between Sections
II and VI of Athol Aptitude Test

Section VI Scores - x

Section II Scores - y

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	f	d	fd	fd ²	Σxy
16					//	///	/	/		/	8	5	40	200	65
15				/	/	///	///	///	///		20	4	80	320	168
14		/	///	//	///	///	///	///			24	3	72	216	54
13			/	//	//	///	///	///	//	/	25	2	50	100	72
12	/	//		///	///	///	///	//	/		21	1	21	21	11
11			//	//	//	///	///	///			22		263		
10			/	/	//	///	///	//	//	/	18	-1	-18	8	-28
9			/	/			///	/	/		7	-2	-14	28	-20
8				/	/	///	///		/		9	-3	-27	81	-36
7							//				2	-4	-8	32	-16
6					/						1	-5	-5	25	0
5				//		//					4	-6	-24	144	0
4				/		/					2	-7	-14	98	0
f	1	3	8	16	19	44	33	25	11	3	163		-110	1283	270
d	-4	-3	-2	-1		1	2	3	4	5					
fd	-4	-9	-16	-16	45	44	66	75	44	15	244				
fd ²	16	27	32	16		44	132	225	176	75	743				

$$C_x = \frac{244-45}{163} = 1.22$$

$$C_x^2 = 1.49$$

$$C_y = \frac{263-110}{163} = .94$$

$$C_y^2 = .884$$

$$C_x C_y = 1.147$$

$$\sigma_x = \sqrt{\frac{743}{163} - 1.49} = 1.75$$

$$\sigma_y = \sqrt{\frac{1283}{163} - .884} = 2.64$$

$$r = \frac{\frac{270}{163} - 1.147}{1.75 \times 2.64} = .11$$

$$P.E. = .052$$

TABLE XXXIV

Correlation Between Sections
III and IV of Athol Aptitude
Test

	5- 9	10- 14	15- 19	20- 24	25- 29	30- 34	35- 39	40- 44	45- 49	50- 54	f	d	fd	fd ²	Σxy
17- 16			/		//	/	///	//	//		11	4	44	176	32
15- 14			//	/	/	/	///	///	//	/	17	3	51	153	42
13- 12			///	/	///	/	///	///	///	/	19	2	38	76	10
11- 10	/	//	///	///	///	///	///	/	//		29	1	29	29	-24
9- 8			///	//	///	///	///	///			28	162			
7- 6		/	///	///	///	/	///	///		/	21	-1	-21	21	10
5- 4		/	///	/	//	///					11	-2	-22	44	34
3- 2		//	//	///	///	//	/	/			15	-3	-45	135	66
1- 0	//	/	//	//	//	/		/	/		12	-4	-48	192	84
f	3	7	25	18	29	22	27	19	10	3	163		-136	826	254
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-15	-28	-75	-36	-29	-183	27	38	30	12	107				
fd ²	75	112	225	72	29		27	76	90	48	754				

Section III Scores - y

TABLE XXXIV (Cont.)

$$C_x = \frac{107-183}{163} = -.454$$

$$\sigma_x = \sqrt{\frac{754}{163} - .206} = 2.1$$

$$C_x^2 = .206$$

$$\sigma_y = \sqrt{\frac{826}{163} - .0256} = 2.24$$

$$C_y = \frac{162-136}{163} = .16$$

$$C_y^2 = .0256$$

$$r = \frac{\frac{254}{163} - (-.0726)}{2.1 \times 2.24} = .34$$

$$C_x C_y = -.0726$$

$$P.E. = .04$$

TABLE XXXV

Correlation Between Sections
III and V of the Athol Aptitude
Test

Section III Scores - x	Section V Scores - x												f	d	fd	fd ²	Σxy
	0-	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	22-					
	1	3	5	7	9	11	13	15	17	19	21	23					
17-		/		/	/	/	/		//	/	//	/					
16-		/		/	/	/	/		//	/	//	/	11	4	44	176	36
15-		/			//	/	/	/	////	//	///	//	17	3	51	153	81
14-				/	//	//	//	//	//	//	///	//	19	2	38	76	58
13-				/	//	//	//	//	//	/	/	///	29	1	29	29	-26
12-		/		///	///	//	//	///	/	/	///		29	1	29	29	-26
11-		/		///	///	///	///	//	///	///	//		29		162		
10-		/		///	///	///	///	//	///	///	//		29		162		
9-		/		///	///	///	///	//	///	///	//		29		162		
8-		/		///	///	///	///	//	///	///	//		29		162		
7-		/	/	///		/	//	///	//	///			20	-1	-20	20	7
6-		/	/	///		/	//	///	//	///			20	-1	-20	20	7
5-	/	/	/	//	//	/	/		/	/			11	-2	-22	44	42
4-	/	/	/	//	//	/	/		/	/			11	-2	-22	44	42
3-			//	///	/	//	//	/	/				15	-3	-45	135	81
2-			//	///	/	//	//	/	/				15	-3	-45	135	81
1-		/	///	//	/	//	//		/				12	-4	-48	192	100
0-		/	///	//	/	//	//		/				12	-4	-48	192	100
f	1	7	7	27	23	17	17	14	17	14	14	5	163		-138	325	379
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-6	-35	-28	-51	-46	-17	-183	14	34	42	56	25	171				
fd ²	36	175	112	243	92	17		14	68	126	224	125	1232				

TABLE XXXV (Cont.)

$$C_x = \frac{171-183}{163} = -.073$$

$$\sigma_x = \sqrt{\frac{1232}{163} - .005} = 2.74$$

$$C_x^2 = .005$$

$$\sigma_y = \sqrt{\frac{825}{163} - .027} = 2.24$$

$$C_y = \frac{162-136}{163} = .165$$

$$r = \frac{\frac{379}{163} - (-.012)}{2.74 \times 2.24} = .38$$

$$C_y^2 = .027$$

$$C_x C_y = -.012$$

$$P.E. = .045$$

TABLE XXXVI

Correlation Between Sections
III and VI of Athol Aptitude
Test

Section VI Scores - x

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	f	d	fd	fd ²	Zxy
17-16				//		////	//	///			11	4	44	156	16
15-14		/		/	/	///	////	///	//		17	3	51	153	27
13-12		/		/	//	////	////	////	//	/	19	2	38	76	28
11-10			///	//	///	////	///	///	//		28	1	28	28	4
9-8	/	/	/	///	///	///	///	/	/	/	29		161		
7-6			/	/	/	///	///	//			21	-1	-21	21	-6
5-4					/	///		///	///	/	11	-2	-22	44	-36
3-2			//	///	///	///	/				15	-3	-15	135	42
1-0			/	/	//	///	//	//	/		12	-4	-48	192	-8
f	1	3	8	16	19	44	32	26	11	3	163		-106	805	67
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-5	-12	-24	-32	-19	-92	32	52	33	12	129				
fd ²	25	48	72	64	19		32	104	99	48	511				

Section III Scores - y

$$C_x = \frac{129-92}{163} = .227$$

$$C_x^2 = .0515$$

$$C_y = \frac{161-106}{163} = .338$$

$$C_y^2 = .1142$$

$$C_x C_y = .0767$$

$$\sigma_x = \sqrt{\frac{511}{163} - .0515} = 1.75$$

$$\sigma_y = \sqrt{\frac{805}{163} - .1142} = 2.19$$

$$r = \frac{\frac{67}{163} - .0767}{1.75 \times 2.19} = .09$$

$$P.E. = .05$$

TABLE XXXVII

Correlation Between Sections
IV and V of Athol Aptitude Test

Section V Scores - x

	0- 2- 4- 6- 8- 10- 12- 14- 16- 18- 20- 22- 1 3 5 7 9 11 13 15 17 19 21 23												f	d	fd	fd ²	Σxy
54-																	
50									/		//		3	5	15	75	65
49-							//	/	//	///	//		10	4	40	160	88
45																	
44-						///	//		///	///	///	//	19	3	57	171	129
40																	
39-				/	//	//	///	///	///	///	///		27	2	54	108	70
35																	
34-	/		///	///	///	///	///	/			//		22	1	22	22	-13
30																	
29-	///	///	///	///	///			/	///	//			29		138		
25																	
24-	/	/	///	///	///	/	/	/	/				18	-1	-18	18	29
20																	
19-	/	//	/	///	///	//	/	//				/	25	-2	-50	100	116
15																	
14-			//	/	/	/	//										
10													7	-3	-21	63	42
9-				/	/		/										
5													3	-4	-12	48	20
f	1	7	7	26	24	17	17	14	17	14	14	5	163		-101	765	546
d	-6	-5	-4	-3	-2	-1		1	2	3	4	5					
fd	-6	-35	-28	-78	-48	-17	-212	14	34	42	56	25	171				
fd ²	36	175	112	234	96	17		14	68	126	204	125	1207				

$$C_x = \frac{171-212}{163} = -.251$$

$$C_x^2 = .063$$

$$C_y = \frac{188-101}{163} = .534$$

$$C_y^2 = .285$$

$$C_x C_y = -.134$$

$$\sigma_x = \sqrt{\frac{1207}{163} - .063} = 2.7$$

$$\sigma_y = \sqrt{\frac{765}{163} - .285} = 2.09$$

$$r = \frac{\frac{546}{163} - (-.134)}{27 \times 2.09} = .61$$

$$P.E. = .033$$

TABLE XXXVIII

Correlation Between Sections
IV and VI of Athol Aptitude Test

Section VI Scores - x

	2-	4-	6-	8-	10-	12-	14-	16-	18-	20-	r	d	rd	rd ²	Σxy
	3	5	7	9	11	13	15	17	19	21					
54-						/			/	/					
50											3	5	15	75	35
49-				/		//	//	///	//						
45				/		//	//	///	//		10	4	40	160	48
44-		//		/	//	///	///	///	///						
40				/	//	///	///	///	///		19	3	57	171	18
39-		/		///	//	///	///	///	///						
35				///	//	///	///	///	///		27	2	54	108	22
34-			//	///	///	///	///	///	///	/					
30			//	///	///	///	///	///	///	/	22	1	22	22	7
29-	/			/	///	///	///	///	///	/					
25				/	///	///	///	///	///	/	29		188		
24-			/	///	/	///	///	/	/						
20			/	///	/	///	///	/	/		18	-1	-18	18	3
19-			//	/	///	///	///	//	/						
15			//	/	///	///	///	//	/		25	-2	-50	100	-4
14-			//		//	//		/							
10			//		//	//		/			7	-3	-21	63	18
9-			/	/				/							
5			/	/				/			3	-4	-12	48	12
r	1	3	8	17	18	44	32	26	11	3	163		-101	765	159
d	-5	-4	-3	-2	-1		1	2	3	4					
rd	-5	-12	-24	-34	-18	-93	32	52	33	12	129				
rd ²	25	48	72	68	18		32	104	99	48	514				

Section IV Scores - y

$$C_x = \frac{129-93}{163} = .220$$

$$\sigma_x = \sqrt{\frac{514}{163} - .0484} = 1.76$$

$$C_x^2 = .0484$$

$$\sigma_y = \sqrt{\frac{765}{163} - .285} = 2.09$$

$$C_y = \frac{188-171}{163} = .534$$

$$r = \frac{\frac{159}{163} - .1174}{1.76 \times 2.09} = .23$$

$$C_y^2 = .285$$

$$C_x C_y = .1174$$

$$P.E. = \frac{.6745 (1-.23^2)}{12.767} = .05$$

TABLE XXXIX

Correlation Between Sections
I and VI of Athol Aptitude Test

Section VI Scores - x

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	f	d	fd	fd ²	Σxy
23-22		/					//		/	/	5	5	25	125	25
21-20		/		//		///	/	///	//		14	4	56	224	28
19-18					///	///	///	///	//		14	3	42	126	36
17-16				/	//	///	///	//		/	16	2	32	64	18
15-14	/		/	/		///	///	///	/		15	1	15	15	3
13-12			/	///	//	///	//	///	/		17		170		
11-10			/	//	///	///	///	//	/		17	-1	-17	17	1
9-8		/	//	///	///	//	///	///	//	/	24	-2	-48	96	-8
7-6			//	//	//	///	///	///			26	-3	-78	234	0
5-4			/		/	///	/				7	-4	-28	112	12
3-2					/	//	///		/		7	-5	-35	175	-25
1-0						/					1	-6	-6	36	0
f	1	3	8	16	19	44	32	26	11	3	163		-212	1224	90
d	-5	-4	-3	-2	-1		1	2	3	4					
fd	-5	-12	-24	-32	-19	-92	32	52	33	12	129				
fd ²	25	48	72	64	19		32	104	99	48	511				

Section I Scores - y

$$C_x = \frac{129-92}{163} = .227$$

$$\sigma_x = \sqrt{\frac{511 - .0515}{163}} = 1.75$$

$$C_x^2 = .0515$$

$$\sigma_y = \sqrt{\frac{1224 - .0666}{163}} = 2.73$$

$$C_y = \frac{170-212}{163} = -.253$$

$$r = \frac{\frac{90}{163} - (-.0585)}{1.75 \times 2.73} = .128$$

$$C_y^2 = .0666$$

$$C_x C_y = -.0585$$

$$P.E. = \frac{.6745(1-.128^2)}{12.767} = .052$$

figure (.66) show that the relation between the Otis Group Intelligence Scale and the Athol Scholastic Aptitude Test is high.

2. The correlation between the Athol High School Scholastic Aptitude Test and the school marks ($.61 \pm .033$) is five points higher than the relation between the Otis Intelligence Scale scores and the school marks ($.56 \pm .036$). This indicates that the Athol Test is over nine percent more valid than the Otis Test for predicting success in school subjects.

3. The correlation between the total test scores and the various sections of the Athol Test are fairly uniform and high. The uniformity indicates that the Test is well organized and of equal difficulty throughout. They are as follows:

Aptitude Test vs. Science Section	$.618 \pm .033$
Aptitude Test vs. History Section	$.518 \pm .038$
Aptitude Test vs. Artificial Language	$.486 \pm .04$
Aptitude Test vs. Geography Section	$.886 \pm .011$
Aptitude Test vs. Reading Comprehension	$.732 \pm .024$
Aptitude Test vs. Mathematics Section	$.311 \pm .047$

The average correlation between the total Aptitude Test scores and the parts is .59, which is high.

4. The correlations between the sections of the Athol Aptitude Test and their corresponding school marks are in four cases marked, and in two cases low. This means that the sections of the Athol Test are reliable in testing school ability. The figures are, with but one exception, higher than the correlations of the Otis Test scores with the school marks.

The coefficients are given below:

Science Section of Aptitude Test and Marks in Science	.56 \pm .041
History Section of Aptitude Test and Marks in History	.47 \pm .086
Artif. Lang. Sect. of Aptitude Test and a Composite of Marks in Latin and Eng.	.38 \pm .04
Geography Section of Aptitude Test and a Composite of Marks in Hist. and Civics	.44 \pm .04
Reading Comprehension Sect. of Aptitude Test and Marks in English	.45 \pm .04
Math. Section of Aptitude Test and a Com- posite of Marks in Algebra and Business Arithmetic	.27 \pm .048

Part 5 of the Otis Test and a Composite of the marks in Algebra and Bus. Arith.	.42 \pm .044
--	----------------

Part 9 of the Otis Test and the Marks in English	.21 \pm .042
---	----------------

Part 10 of the Otis Test and a Composite of the Marks in History and Civics	.22 \pm .052
--	----------------

It may be seen here that Part 5 of the Otis Test is the only one of the three samples selected that produces any marked degree of relationship with the school marks. Of course, the Otis Test is not designed to test specific abilities, but only tests general ability.

5. Parts of the Otis Group Intelligence Scale have a very low correlation with corresponding sections of the Athol Aptitude Test. The figures are:

Part 5 (Mathematics) of Otis Test vs. Section VI of Aptitude Test	.26 \pm .073
--	----------------

Part 9 (English) of Otis Test vs. Section V of Aptitude Test	.29 \pm .048
---	----------------

Part 10 (History) of Otis Test vs.
Section II of Aptitude Test

.19 \pm .05

6. The intercorrelations of the six parts of the Athol Aptitude Test are low. Consequently, there is less overlapping and less measuring of the same traits by the tests.

C. L. Hull¹⁶ states that, in choosing tests to make up a battery, the correlation between each part should be as low as possible.

The correlations are as follows:

Science Section vs. History Section	.31 \pm .048
Science Section vs. Artificial Language Sect.	.17 \pm .051
Science Section vs. Geography Section	.45 \pm .042
Science Section vs. Reading Comprehension	.31 \pm .046
Science Section vs. Mathematics Section	.20 \pm .05
History Section vs. Artificial Language Sect.	.01 \pm .05
History Section vs. Geography Section	.41 \pm .044
History Section vs. Reading Comprehension	.39 \pm .045
History Section vs. Mathematics Section	.11 \pm .052
Artificial Language Section vs. Geog. Sect.	.34 \pm .046
Artificial Language Section vs. Reading Comprehension Section	.38 \pm .045
Artificial Language Section vs. Mathematics Section	.09 \pm .05
Geography Section vs. Reading Comprehension	.61 \pm .033
Geography Section vs. Mathematics Section	.23 \pm .05
Reading Comprehension Section vs. Mathematics Section	.12 \pm .052

The frequency polygon graph is used in this thesis as another means of comparing the data obtained.

When dealing with a large collection of data, such as the many scores obtained from these tests, the first statistical task is to arrange it in some definite order. This was done for each set of scores which had been obtained. Let us assume that some one inquires after the score of a certain pupil, and desires to know whether the score was high or low. We cannot answer that question unless we know how many of the pupils scored above his grade, and how many scored below. If all the other pupils scored below his grade, his grade is high, but if the other pupils scored above his grade, his grade is low.

So it is obvious that is is not enough to give the test and score the papers; we must also classify the grades so that we may know how many pupils scored in the sixties, how many in the seventies, and so on. Such a table is called a frequency table. A variable is any quantity which changes in numerical value, such as ages, weight, or scores made by various pupils on a given test. The range is the difference between the maximum and minimum values of the variations in the test scores, and the class interval is one of the equal parts into which a scale is divided in tabulation of scores. The class frequency is the number of cases in a class interval. We can extract in-

formation from a frequency table much more easily than from a heterogenous list of scores, but the frequency table is made much more understandable when put in graphical forms.

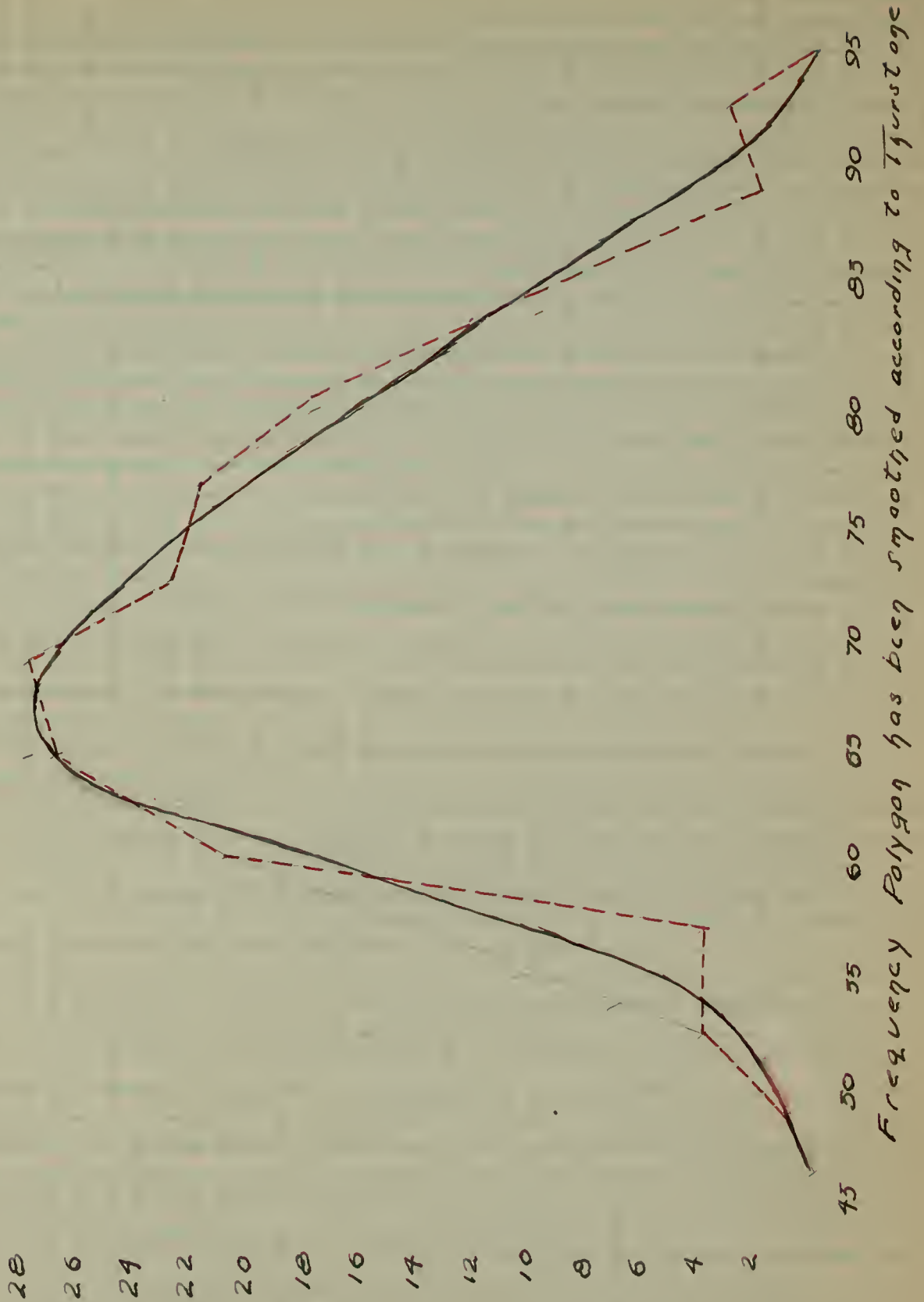
In plotting a frequency polygon, it is customary to arrange the scale with the class intervals horizontally, and usually at the lower part of the sheet. The scale for the frequencies is at the left of the sheet. At every class interval we locate a point vertically above that interval at a place which corresponds to the frequency in the data for that interval. After the point for each interval has been located, the points are then connected by straight lines.

The polygons obtained for the work of this thesis do not exactly coincide with the probability curve, but since we are only trying to make comparisons, this fact does not invalidate the results. The probability curve is a bell-shaped curve of almost perfect symmetry with the greatest concentration in the center, and the scores tapering off equally on both sides of the center. A polygon, plotted with a limited number of cases, is often somewhat irregular. The smoothness of the polygon increases with the number of cases, and becomes more like the probability curve. Any unselected group, according to Rugg, if large enough, say 500 at least, should produce a normal curve unless there is a weakness at some point. The graphs here have been "smoothed" after Thurstone's¹² method. This shows what they would look like with a larger number of cases. If a point on a frequency

polygon is above or below the points on either side, we may infer that its frequency is by some chance effect too low. In smoothing the polygon, we are trying to ascertain the shape which it would take if it represented conditions freed from minor accidental fluctuations. To correct a frequency fluctuation, we connect the two adjacent frequencies by a straight line. The mid-point of the section of that vertical passing through the dislocated frequency is accepted as the correction for the point. A smooth curve is then drawn through all the corrected points to obtain the real frequency polygon.

Figure 1 shows the graphical representation of the distribution of the school marks of 163 ninth grade pupils of the Athol Junior High School. The points with the small circles about them, and the connecting lines represent the results really obtained. The frequency polygon has been smoothed to form the frequency curve. This curve approximates the normal distribution curve fairly well. The scores are concentrated closely about the central tendency, and taper off gradually from the center on each side toward the two extremes. There is, however, a slight degree of positive "skewness", which indicates a piling of the scores on the left side of the scale. The score of greatest frequency is that between 65 and 70, and since 65 is the passing grade for these pupils, the piling-up and the resulting "skewness" may be somewhat attributable to that fact. But taken far and wide, the writer feels that this graph is a true representation of the ability of the pupils in

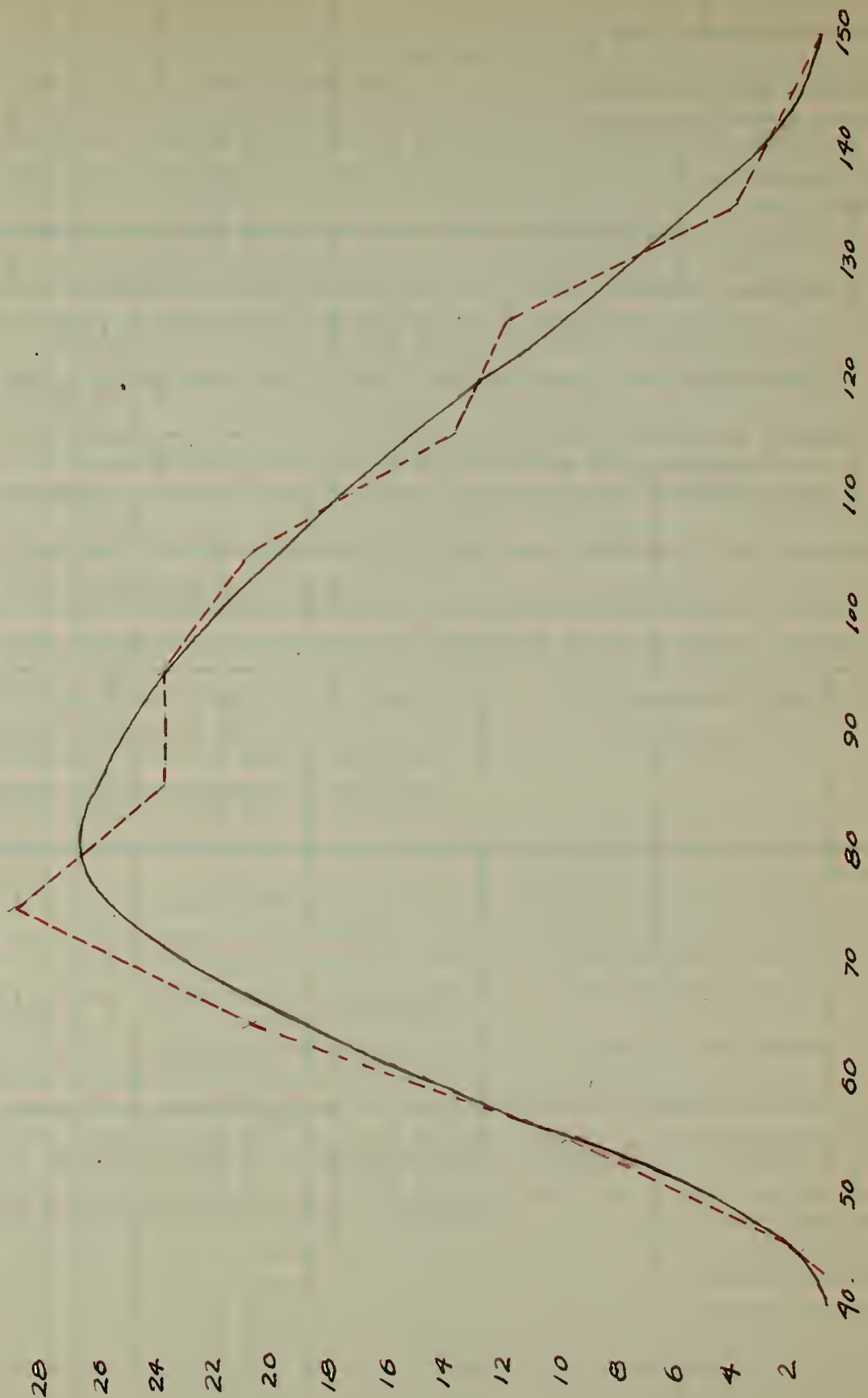
Figure 1
Distribution of School Marks



their combined courses. We have a large number of pupils of foreign-born parentage, where little encouragement is given to them to make a success of their school career. Many of them are poorly fed, poorly cared for, and consequently poorly prepared to make high marks in their subjects. The mentality is comparatively low, hence the piling up of scores about the low point of 65. An examination of Fig. 2, which represents the results of the Athol Test, will show a similar curve. This means that the Athol Test, and not the Otis Test made correct prophesies concerning the nature of the mental capacity of the school children to succeed in their school work.

Fig. 2 is a graph representing the distribution of the scores of 163 pupils taking the Athol High School Scholastic Aptitude Test. The straight lines represent the original polygon, and the curved line is the smoothed polygon. This curve, also approximates the normal distribution curve quite well. The scores are concentrated about the central tendency, and taper off gradually by approximately the same amounts on each side toward the two extremes 40 and 150. The score of greatest frequency is 80, a comparatively low score for this range. The graph possesses positive "skewness", which indicates a piling up of the scores on the left side of the scale. This "skewness" is approximately the same as shown on Fig. 1; the distribution of the school marks of the same pupils. The two curves are almost identical, which proves that there is a close positive relationship between the two sets of scores. This argues strongly for the validity of the Athol Test as a measure of pre-determining the degree of success for school children in academic subjects.

Figure 2
Distribution of Scholastic Aptitude Test Scores

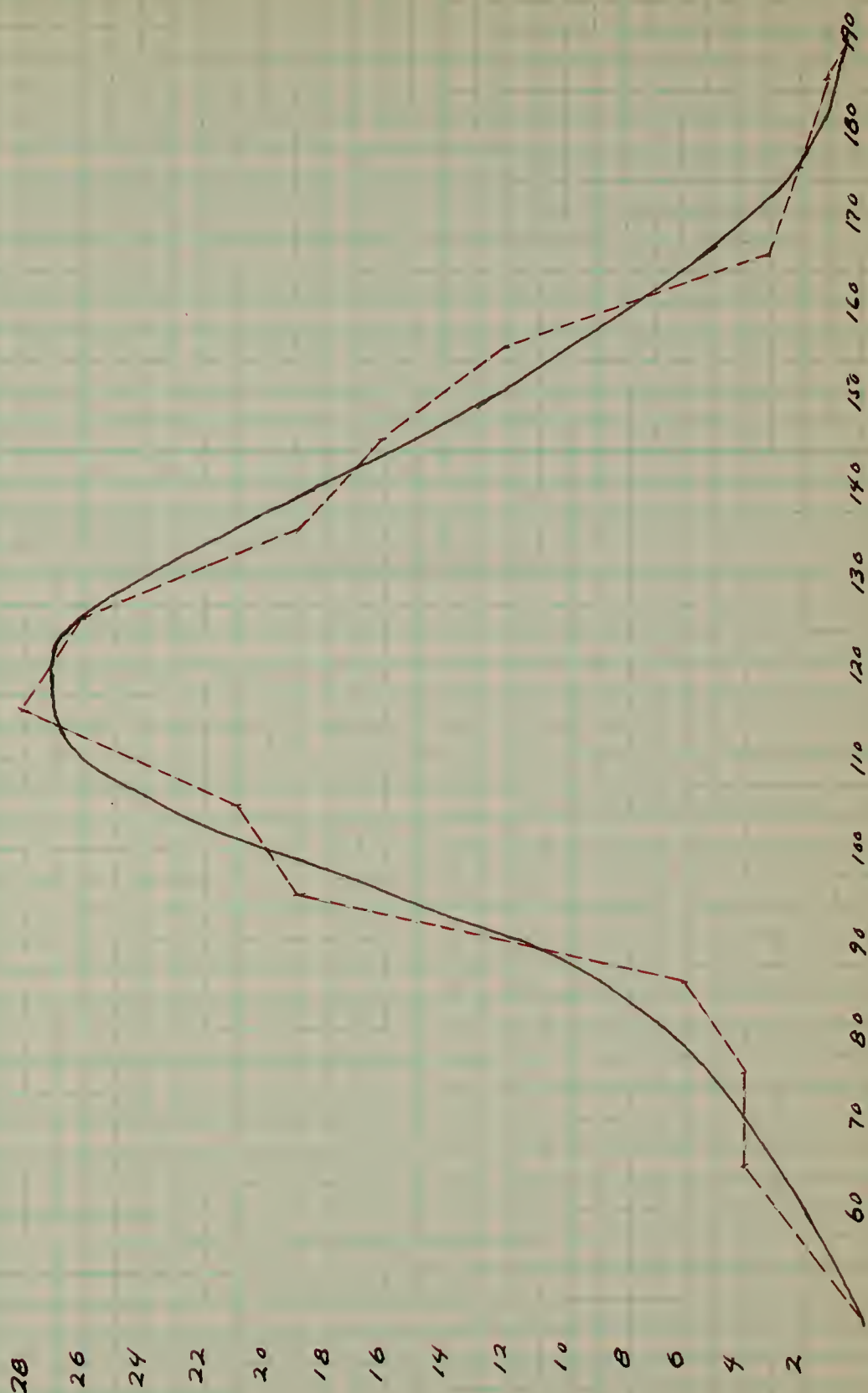


Frequency Polygon has been smoothed according to Thurstone

Fig. 3 shows the distribution of the scores of 160 pupils taking the Otis Group Intelligence Scale. The polygon has been smoothed, and the resulting curve is just about as perfect a probability curve as one could expect to obtain with such a limited number of cases. However, this perfection in the curve does not argue for the validity of the scores, but merely means that it conforms to the law of probability. Since the curve in Fig. 1 closely resembles the normal probability curve, and since this curve more nearly resembles it, the Otis Test is then fairly reliable as a means of determining the success of school children. The scores are concentrated about 120, and this is about the midpoint of the scale. The extremes in the scale are 55 and 190. There is no perceptible "skewness" and the scores taper off by the same amounts on each side of the central tendency.

The conclusion from this graphical consideration is that since the curve representing the distribution of the Athol Scholastic Aptitude Test scores more closely approximates or resembles the curve which represents the distribution of the school marks in academic subjects than does the curve which represents the distribution of the Otis Intelligence Scale scores, the Athol Test is more reliable than the Otis Test for determining success in school subjects.

Figure 3
Distribution of Otis Test Scores



Frequency Polygon has been smoothed according to Thurstone

VI. SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

It has been the purpose of this thesis to explain the origin, construction, and validity of the Athol High School Scholastic Aptitude Test. Most of the intelligence and achievement tests now in use, in the main, fail to measure ability to succeed in school subjects, and fall short in measuring intelligence. It was, therefore, deemed urgent to develop a test composed of some "nonsense" material such as artificial maps, an artificial language, and other meaningful material, but material with which the pupils had no previous knowledge. The Athol High School Scholastic Aptitude Test, based upon these principles, was developed in 1934.

In early September, a preliminary examination was given at Orange, Massachusetts, for the purpose of revision and correction of the test. The Athol High School Scholastic Aptitude Test and the Otis Group Intelligence Scale were then given to 163 pupils in the ninth grade of the Athol Junior High School, for the purpose of comparison. This study includes three sets of marks--(1) the scores received on the Otis Group Intelligence Scale, (2) the scores received on the Athol High School Scholastic Aptitude Test, which was given to the same pupils and (3) the school marks received in academic subjects studied during the first half-year.

The following statistical methods were used in comparing the data obtained--(1) scatter diagrams, (2) coefficient of correlation and (3) the frequency polygon graph.

Scatter graphs and coefficients of correlation were determined for the following: (1) Scholastic Aptitude Test scores and Otis Group Intelligence Scale scores; (2) Scholastic Aptitude Test scores and school marks; (3) Otis Group Intelligence Scale scores and school marks; (4) Scholastic Aptitude Test scores and (a) Science Section of Aptitude Test, (b) History Section of Aptitude Test, (c) Artificial Language Section of Aptitude Test, (d) Geography Section of Aptitude Test, (e) Reading Comprehension Section of Aptitude Test, (f) Mathematics Section of Aptitude Test; (5) Science Section of Aptitude Test and school marks in Science; (6) History Section of Aptitude Test and school marks in History; (7) Artificial Language Section of Aptitude Test and school marks in language; (8) Geography Section of Aptitude Test and a composite of school marks in History and Civics; (9) English Section of Aptitude Test and school marks in English; (10) Mathematics Section of Aptitude Test and a composite of school marks in Algebra and Business Arithmetic; (11) Mathematics Part 5 of Otis Group Intelligence Scale and composite of school marks in Algebra and Business Arithmetic; (12) English Part 9 of Otis Group Intelligence Scale and school marks in English; (13) History Part 10 of Otis Group Intelligence Scale and composite of school marks in History and Civics; (14) Mathematics Part 5 of Otis Group In-

telligence Scale and Mathematics Section of Aptitude Test; (15) English Part 9 of Otis Group Intelligence Scale and English Section of Aptitude Test; (16) History Part 10 of Otis Group Intelligence Scale and History Section of Aptitude Test; (17) inter-correlations of the six parts of the Aptitude Test.

Frequency polygon graphs were drawn which show the distributions of (1) school marks, (2) Aptitude Test scores, and (3) the Otis Group Intelligence Scale Scores.

There are also to be found tables which show (1) the ranking scores of 163 pupils in their various academic subjects and their school averages; (2) the ranking scores of 163 pupils taking the Athol High School Scholastic Aptitude Test, the Otis Group Intelligence Scale, and their school marks; (3) the scores by rank of 163 pupils taking the Otis Group Intelligence Scale.

The scatter graphs and their accompanying correlation coefficients reveal many points of merit about the Athol Aptitude Test. A study of Tables IV - VI shows that there is a "high" correlation between the Athol Aptitude Test scores and the Otis Intelligence Scale scores (.66). The correlation between the Athol Aptitude Test scores and the school marks is also "high", namely .61. This is five points higher than the correlation between the Otis Intelligence Scale scores and the school marks (.56).

An examination of the graphs and correlation figures found in Tables VII - XII shows that sections of the Athol Aptitude Test correlate closely with the test total scores. This indicates that with one exception, (the mathematics section) the test is of uniform difficulty throughout, and is well organized. The mathematics section can be made more valid by omitting the last page.

An examination of Tables XIII - XVIII shows that sections of the Athol Aptitude Test correlate closely with the school marks in each subject. The correlations, with one exception, show a "marked" degree of relationship. These correlations are all higher than the corresponding relationships between the Otis Group Intelligence Scale, and the school marks, excepting the mathematics section.

The Athol Scholastic Aptitude Test does not correlate closely in part with the corresponding parts of the Otis Group Intelligence Scale, as may be seen by studying Tables XXII - XXIV.

Tables XXV - XXXIX show the intercorrelation between the six parts of the Athol Scholastic Aptitude Test. These correlation figures are "low", as they should be. In two of the fourteen comparisons the relationship is above "low", that is, it is "marked", as between Science and Geography (.41) which are both closely related subjects, and between Reading Comprehension and Geography (.61). These results

do not impair the test. According to C. L. Hull¹⁶, the more closely tests correlate, the more probable it is that they are testing the same functions. The more closely the variables approach a perfect positive correlation, the more identical the tests become, so that when both are given it is equivalent to giving the same test twice. Consequently, the giving of two tests so identical would be a waste of time and effort.

This study of the results obtained from the scatter graphs and the correlation coefficients indicate that the Athol High School Scholastic Aptitude Test is more valid for predicting school success than the Otis Group Intelligence Scale.

The frequency curve in Figure 1 shows that the distribution of the 163 school mark averages approximates the normal distribution curve fairly well. The scores are concentrated closely about the central tendency, and taper off gradually on either side toward the two extremes. There is a slight degree of positive "skewness".

The curve in Figure 2 shows the distribution of the scores of the 163 pupils taking the Athol High School Scholastic Aptitude Test. The curve is "skewed" positively like the preceding curve. The identity of these two curves is marked, which indicates a very close relationship between the two variables.

The curve in Figure 3 shows the distribution of the scores of 160 pupils taking the Otis Group Intelligence Scale. The

curve is symmetrical. However, this symmetry does not in this case necessarily argue for the soundness of the test. Its validity here is dependent upon the closeness of its resemblance to the curve in Figure 1.

The results obtained from a study of the probability curves indicate that the Athol High Scholastic Aptitude Test is more potent for determining school success than the Otis Group Intelligence Scale.

VII BIBLIOGRAPHY

BIBLIOGRAPHY

1. Otis, Arthur S., Otis Group Intelligence Scale, Advanced Examination: Form A, World Book Company.
2. Douglass, Harl R., Modern Methods in High School Teaching, Houghton Mifflin Company, 1926, p. 400.
3. Monroe, Walter Scott, An Introduction to the Theory of Educational Measurements, Houghton Mifflin Co. 1923, Chapter I.
4. Otis, Arthur S., Otis Group Intelligence Scale, Manual of Directions for Advanced Examination, p. 9.
5. Terman, Lewis M., Terman Group Test of Mental Ability, Examination: Form, World Book Company.
6. Lincoln, Edward A., Beginnings in Educational Measurement, J. B. Lippincott Company, Chapter II.
7. Lincoln, Edward A., Beginnings in Educational Measurement, J. B. Lippincott Company, p. 21.
8. Lincoln, Edward A., Beginnings in Educational Measurement, J. B. Lippincott Company, 1924, pp. 58-59.
9. McCall, W.M., How to Measure in Education, MacMillan, p. 21.
10. McDonnell, Charles P., A Comparative Study of Certain Types of Subject Matter in Scholastic Aptitude Tests (Thesis for M.S., Graduate School, Massachusetts State College 1932).
11. Sones, W.W.D., and Harry, David P., Sones-Harry High School Achievement Test: Form A., World Book Company.
12. Thurstone, L.L., The Fundamentals of Statistics, The McMillan Company, 1925.
13. Garrett, Henry E., Statistics in Psychology and Education, Longmans, Green and Company, pp. 167-170.
14. Garrett, Henry E., Statistics in Psychology and Education, Longmans, Green and Company.
15. Rugg, Harold, A Primer of Graphics and Statistics, Houghton Mifflin Company, 1925, p. 97.

16. Hull, Clark L., Aptitude Testing, World Book Company, 1928, Chapter VIII.
17. Jordan, A.M., Educational Psychology, Henry Holt and Company, 1928, Chapter IX.

VIII APPENDIX

Directions for Athol High School Scholastic Aptitude Test.

Form A.

This test is in the nature of an experiment. It will not affect your school standing or your school marks at all. You will probably do better if you regard this test as a mental track meet in which you would like to make a good showing. It is not a test of what you already know, in fact, you are not supposed to know any of the content. It is a test of your ability to learn certain facts which you will meet in high school. You will be asked to study some material and later you will be tested on what you have actually learned. Don't be discouraged if you find some of the material difficult to learn, for no one is expected to receive a perfect score. Do the best you can in the time given.

The first booklet to be passed out is for you to study. Do not open it until you are told to do so. After it is studied it will be collected.

(Study booklet is passed out.)

Now look at Section I, Part A, while I read the directions.

(Read directions)

You will be allowed five minutes to study Part A, which includes the first two pages. Begin.

(At the end of five minutes, say "Stop")

Now turn to Part B while I read the directions.

(Read directions)

You will be given five minutes to study this part which includes only the one page. Begin.

(At the end of five minutes say "Stop")

Now turn to Section II while I read the directions.

(Read directions)

You will be given two minutes to study this part, which includes only one page. Begin.

(At the end of two minutes say "Stop")

If you get through before the time is up, you may turn back and study any of the other sheets.

Now close the booklet and pass it forward.

(Study booklets are collected and tests are given out)

(Be sure that the test syllabus is Form A.

Write your name and age on the lines indicated.

Now turn to Section I, Part A, while I read the directions.

(Read directions)

You will be allowed five minutes to take this test, which includes the first two pages. Begin.

(At the end of five minutes say "Stop")

Now turn to Part B while I read the directions.

(Read directions)

You will be allowed five minutes to take this test.

Begin.

(At the end of five minutes say "Stop")

Now turn to Section II while I read the directions.

(Read directions)

You will be allowed two minutes to take this test,
which includes only the one page. Begin.

(At the end of two minutes say "Stop")

Now turn to Section III while I read the directions.

(Read directions)

You will be allowed twelve minutes to take this test,
which includes two pages. Begin.

(At the end of twelve minutes say "Stop")

Test booklets are collected.

Directions for Athol High School Scholastic
Aptitude Test. Form B.

The first booklet to be passed out is for you to study.
Do not open it until you are told to do so. After it is
studied it will be collected.

(Study booklet is passed out.)

Now look at Section IV, Part A, while I read the directions.

(Read directions)

You will be allowed five minutes to study this page. Begin.

(At the end of five minutes say "Stop")

Now turn to Part B while I read the directions.

(Read directions.)

You will be allowed three minutes to study this page. Begin.

At the end of three minutes say "Stop")

Now turn to Section V while I read the directions.

(Read directions)

You will be allowed three minutes to study this page, which
includes Part A and Part B. Begin.

(At the end of three minutes say "Stop")

Now close the booklet and pass it forward.

(Study booklets are collected and tests are given out)

Write your name and age on the lines indicated.

Now turn to Section IV, Part A, while I read the directions.

(Read directions)

You will be allowed six minutes to take this test. Begin.

(At the end of six minutes say "Stop")

Now turn to Part B while I read the directions.

(Read directions)

You will be allowed six minutes to take this test. Begin.

(At the end of six minutes say "Stop")

Now turn to Section V, Part A and Part B, while I read the directions. (Read directions)

You will be allowed five minutes to take this test which includes the page. Begin.

(At the end of five minutes say "Stop")

Now turn to Section VI, Part A, while I read the directions.

(Read directions)

(You will be allowed five minutes to take this test. Begin.

(At the end of five minutes say "Stop")

(Now turn to Part B while I read the directions.

(Read directions)

You will be allowed ten minutes to take this test. Begin.

(At the end of ten minutes say "Stop")

Test booklets are collected.

ATHOL HIGH SCHOOL SCHOLASTIC
APTITUDE TEST

FOR SENIOR HIGH FRESHMEN
(Study Syllabus)

FORM A

Prepared by H. N. Glick and Claude B. Germany

Name
(Last name) (Given names or initials)
Age.....

Section I .....	.....
Section II.....	.....
Section III.....	.....
Score.....	.....

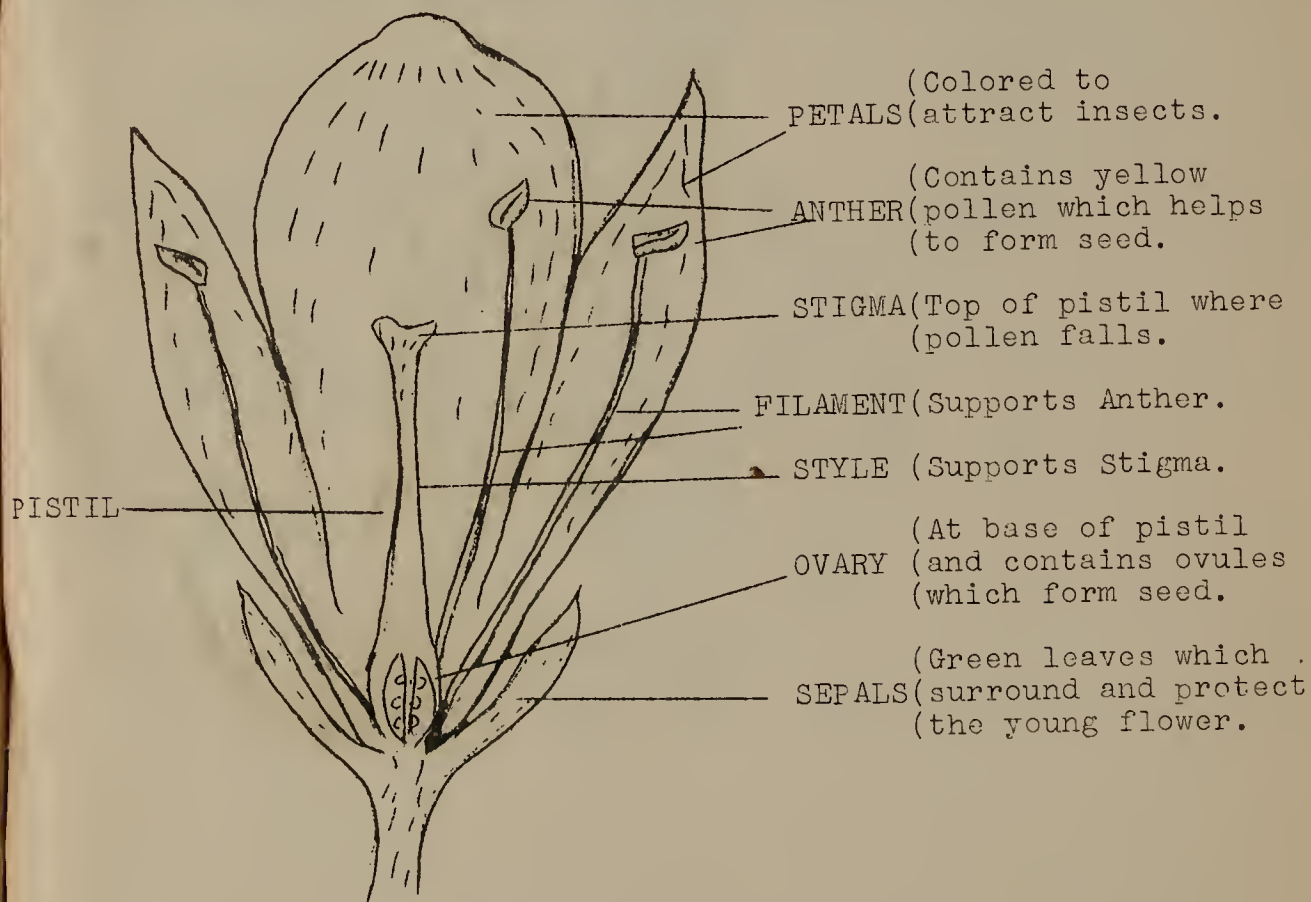
SECTION 1

PART A

Directions:

Study the following paragraph and drawings. You will be asked questions about them. You will not be asked to reproduce the drawing.

The essential reason for the existence of the flower is the production and growing of seed which make new plants. There are two kinds of cells necessary in the formation of seed, sperm cells and egg cells. Sperm cells are contained in pollen grains which rest on the anther of the flower. Egg cells are contained in the ovary at the lower part of the pistil. Sperm cells unite with egg cells and the new cells develop into seed. This uniting of a sperm cell with an egg cell is called fertilization. The pollen grain, containing the sperm cell, must be carried from the anther where it grows to the stigma of the pistil. This is called pollination. Pollen may fall on the stigma, or it may be carried there by insects.

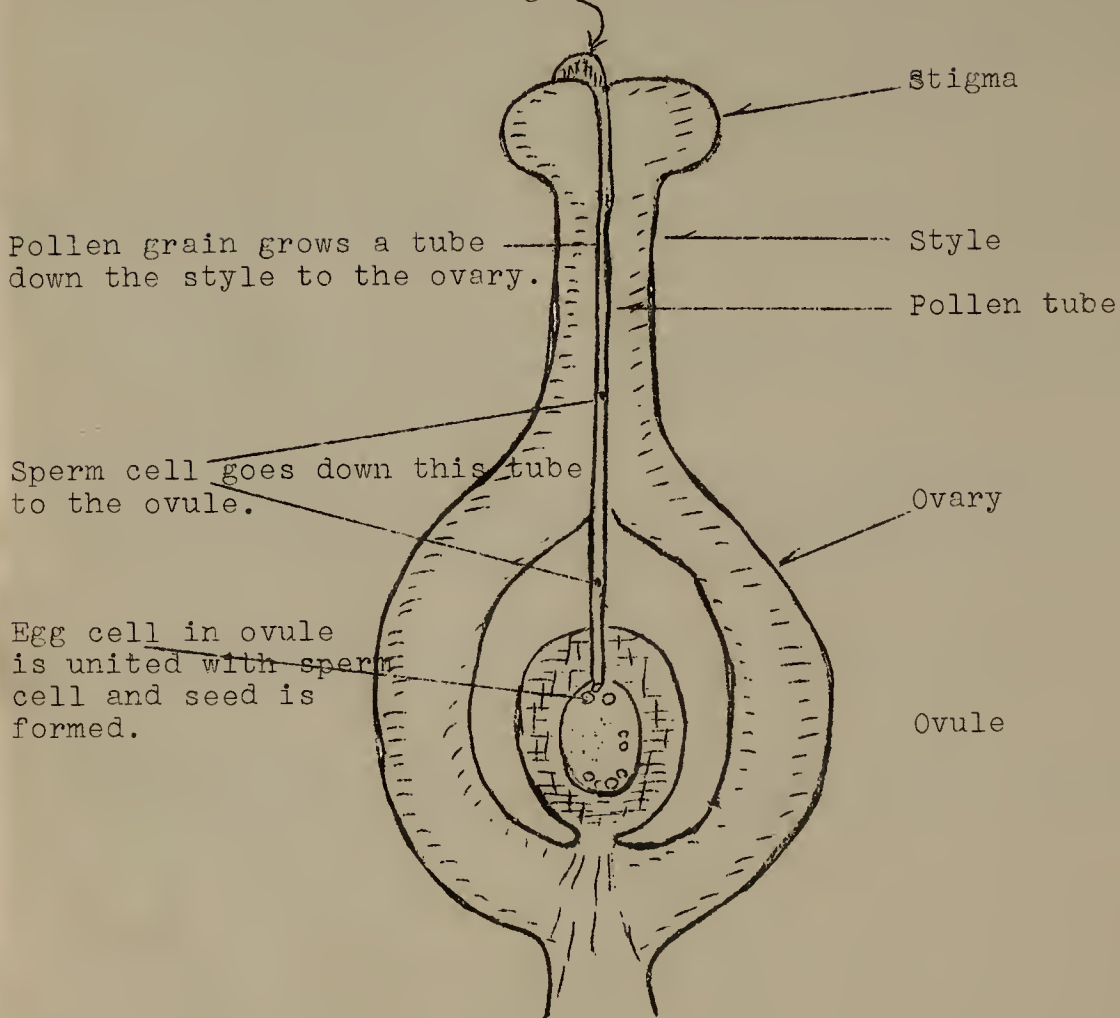


SECTION I

Part A (Cont'd)

AN ENLARGED PISTIL

Pollen grain on stigma



SECTION I
part B

Directions: You are to study the facts below. You are to be tested on them later.

1. The air about you contains a large amount of invisible water-vapor. If this air becomes suddenly chilled, the vapor condenses into water (rain). This process of invisible vapor changing into water is called condensation.
2. Cold air is heavier than warm air, and gravity pulls the heavier object with the greatest force. When air in a certain section becomes suddenly warmed, the ~~seeler~~ colder air on the outside, being heavier, is pulled down and in, and forces the warm air to rise, producing what is known as a convection current (wind).
3. Water is often purified by allowing it to stand in containers for a long while. While remaining undisturbed, gravity pulls the heavier objects to the bottom of the container. The process is called sedimentation.
4. Capillary force is the force whereby any liquid can be made to rise up into the body of a porous substance, as when ink is lifted from the surface of a paper by a blotter.
5. Balloons float up into the air because of the fact that the air is heavier, volume for volume, than the gas-filled balloon. So the heavier air forces the lighter balloon to rise. This uplifting force of air, or liquids, on anything immersed in it, is called buoyancy.
6. When heated, any form of matter, such as an iron ball, will grow larger, that is, expand.
7. Heat travels along metals from particle to particle, so that when heat is applied to one spot of a frying pan, it is conducted to the other parts of the pan.

SECTION II

study carefully the paragraph below. You will be asked questions on it later.

Rousseau, one of the most interesting as well as influential personalities in history, was born at Geneva, Switzerland, in 1712. His mother died while he was still quite young, and his father's influence increased the naturally sentimental temperament of the boy. He was very carelessly educated in childhood, later was apprenticed to an engraver, and at sixteen became a tramp. His wanderings during the period of vagrancy that followed gave him an ardent love of nature, and an intense sympathy with the oppressed, poverty-stricken peasants. He was finally married, but his children he turned over to a foundling home, losing all connection with them. From this account it will be seen that he was entirely irresponsible in character. But he was a brilliant writer in three separate fields, fiction, political theory, and education. It is, of course, his educational writings with which we are concerned in this reading.

The French Revolution broke out in 1789, soon after the close of our own Revolutionary War. Rousseau published his great educational work, "The Emile" in 1762, thirteen years before the battle of Lexington and twenty-seven years before the storming of the Bastille. It was one of the causal factors in the great revolutionary upheavals of that time. Rousseau's aim was to reform the abuses of the time. French society was very unnaturally, and therefore very unjustly, organized. Practically all the land was owned by a very small percentage of the population, ie by the church and a few noblemen. The nobles, the clergy, and the king with his courtiers maintained an expensive, wasteful government, and lived in the most extravagant and senseless luxury. They were supported by the rent of the land, and by rich incomes from government positions, the duties of which were usually merely nominal. The masses of the common people, on the other hand, paid both the rent and the taxes. Hence they were poverty stricken and ground down almost beyond imagination.

ATHOL HIGH SCHOOL SCHOLASTIC

APTITUDE TEST

FOR SENIOR HIGH FRESHMEN

(Test Syllabus)

FORM A

Prepared by H. N. Glick and Claude B. Germany

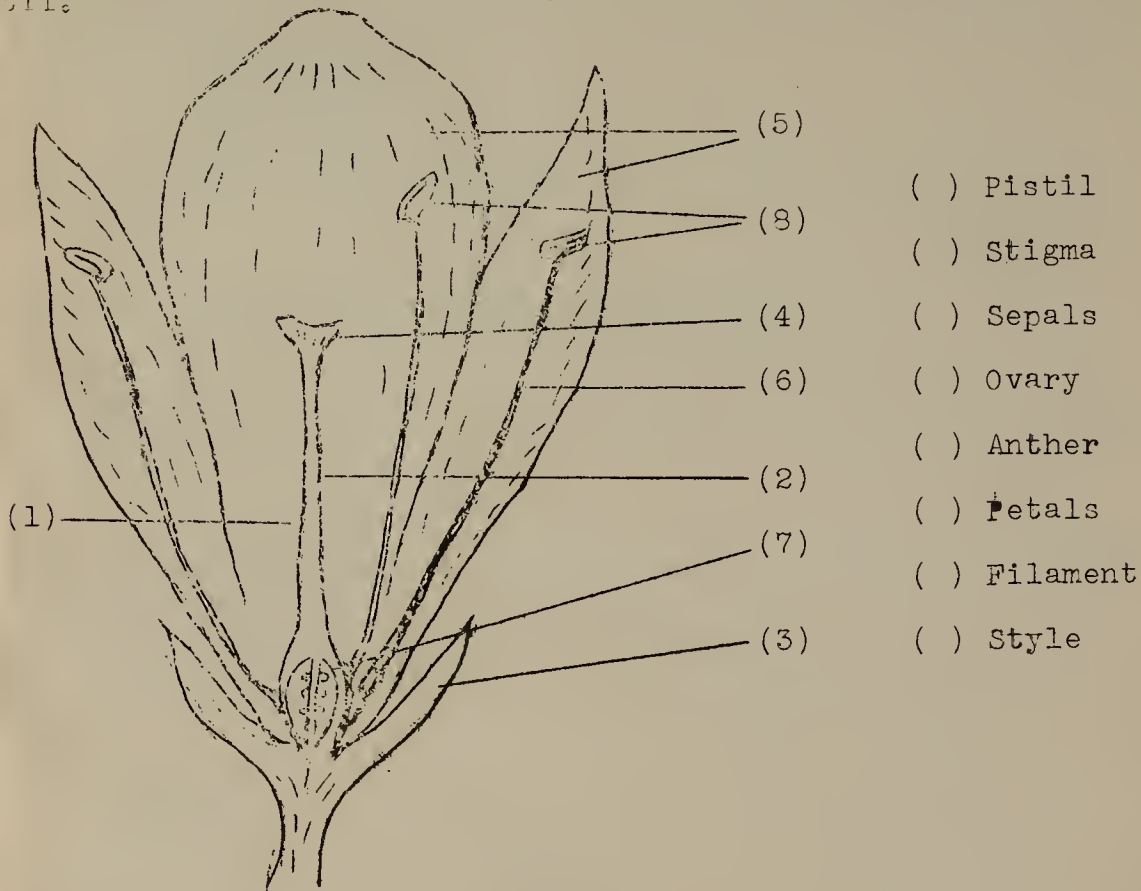
Name.....
(Last name) (Given names or initials)

Age.....

Section I.....	.....
Section II.....	.....
Section III.....	.....
Score.....	.....

SECTION I
Part A

Directions:- This is the drawing you studied. The parts are numbered and the names are at the right. You are to copy the number of each part in the parenthesis before the name of that part. Example: Number 1 is the Pistil, so put a 1 in the parenthesis before pistil.



Here are some statements pertaining to the study of the flower which you did during the study period. You are to place a check after the expression which you think best completes the statement.

Example: In the first statement a check is placed after the expression "to produce seed."

1. The main purpose of the flower is (to beautify the earth
(to produce seed ☒
(stigma
2. The pollen grain grows on the (anther (attracting
3. The colors of the petals are for the purpose of (insects.)
(adorning the world.)
4. Seeds are formed in the (anther
(ovary
(stigma

SECTION I

Part A (Continued)

5. The process whereby pollen is carried from the anther to the stigma is called (fertilization
(pollination
(filtration
6. The sperm cell unites with the egg cell to form (leaves
(anthers
(seed
7. The above process is called (Pollination
(fertilization
8. The pollen grain after being carried from the anther to the stigma, begins to grow a (tube
(plant
9. Sepals, which are at first green leaves, are for the purpose of (beautifying nature
(protecting the young plant

SECTION I

Part B

Directions:- In part B of the study sheet you had to study certain facts pertaining to scientific principles. Below are some pictures or diagrams which illustrate each fact studied. You are to identify the process represented by the pictures by placing a check in the spaces just below. Example: The first diagram illustrated the law of capillary force. That is, the oil flows up the wick by means of the force of capillarity. So a check is placed in column 1 opposite Capillary force.

	1	2	3	4	5	6	7	8	9
Expansion									
Evaporation									
Condensation									
Sedimentation									
Heat conduction									
Capillary Force	✓								
Convection Current									
Refraction of light									
Transparency									

Diagram number 1.

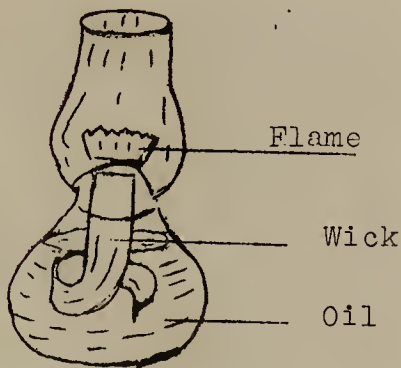


Diagram number 2.

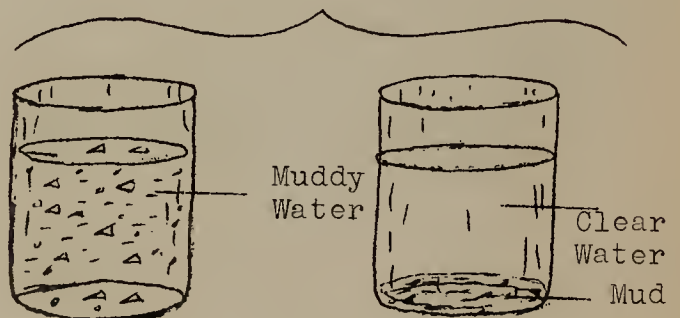


Diagram number 3

Light rays before entering Lens. Light rays leaving Lens.

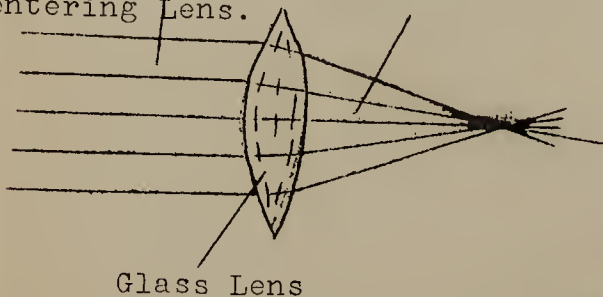
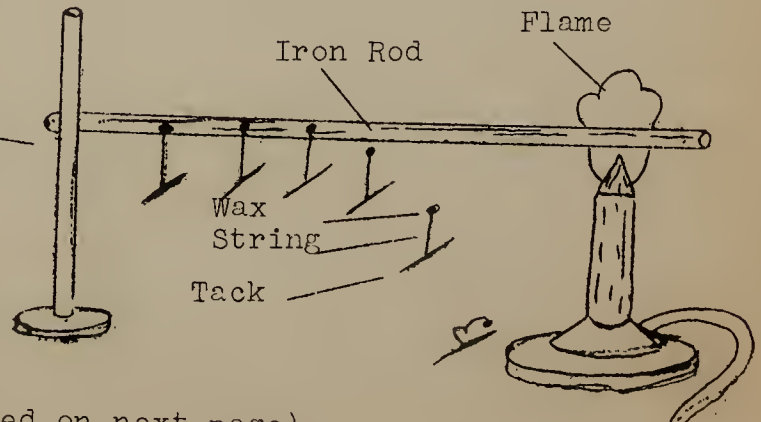


Diagram number 4



(Continued on next page)

Diagram number 5.

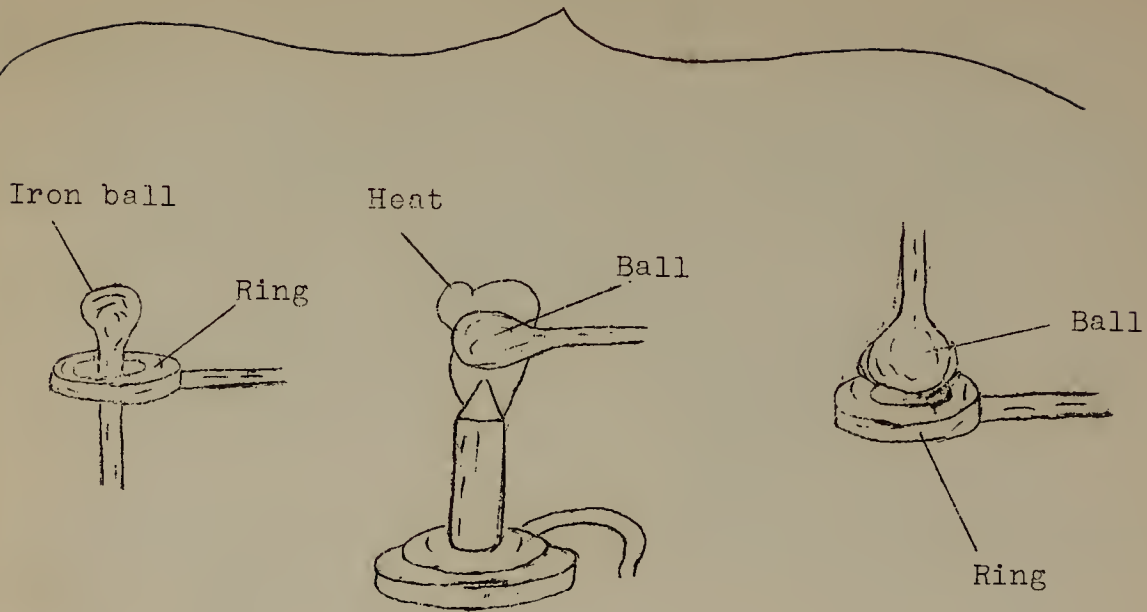


Diagram number 6.

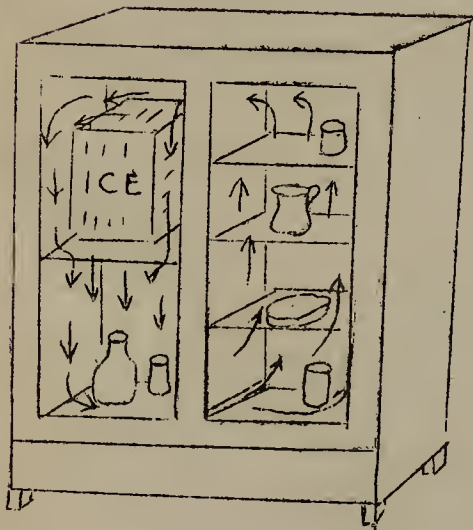


Diagram number 7.



SECTION II

Directions:

Below are some statements taken from the paragraph you studied in Section II. You are to place a check after the expression which you think best completes the statement. Example: In the first statement, a check is placed after the word Geneva.

1. Rousseau was born at

London	
Geneva	✓
Paris	
2. His mother died when he was

middle aged.	
quite young.	
an old man.	
3. He was

well	
poorly	

 educated in childhood.
4. Rousseau became a tramp when he was

12	
20	
16	

 years old.
5. This period of vagrant wanderings gave him an ardent love for nature, and a

hatred	
sympathy	
dislike	

 for the oppressed peasants.
6. Rousseau

kept	
abandoned	

 his children.
7. He was a

poor	
fair	
brilliant	

 literary writer.
8. One of his famous books, "The Emile," was published in

1782	
1770	
1762	
9. "The Emile" was written

before	
after	

 the battle of Lexington.
10. Rousseau was a

reformer	
conservative	
11.

Few	
Many	
None	

 of the people of France owned land at that time.
12. Government funds were

carefully	
wastefully	

 handled.
13. French society was

justly	
unjustly	

 organized.
14. The

nobility	
common people	

 paid the taxes.
15. Rousseau was an

influential	
uninfluential	

 historical figure.
16. He would have made a

good	
poor	

 novelist.
17. In the reading

England	
France	
America	
Spain	

 was mentioned.

SECTION III

Directions: On this sheet you will find a vocabulary, some rules and some sample sentences of an artificial language. On the opposite sheet are some English sentences and just beneath each English sentence is its translation into the artificial language. Some of these translations are correct and some are incorrect. You are to study the language on this sheet and draw a line through every word which is incorrectly translated on the opposite sheet. Do not try to memorize the vocabulary and forms on this sheet, but you may consult them freely while checking the translation. If you mark through correctly translated words, it will count against you.

Vocabulary

I--og
see--set
the--mas
cat--moh
dog--nac
and--ed
run--yar
away--ay
that--mat
bad--goo
take--lig
book--gark
boy--raa
hard--rad
lesson--sonne
he--ti
she--tu
study--lam
difficult--cuf
at--ne
to--te
is--tes
school--toch
chase--sach
away--waw
from--fic
apple--sim
leave--veal
house--seoh
for--rox
give--sig
girl--lir
are--rou

Rules

1. Opposites are formed by adding "xy."
Example: hard--rad
soft-- radxy
2. Past time is indicated by placing "a" before the verb.
Example: take--lig
took--alig
3. The objective case is formed by placing "ge" before the noun or pronoun.
Example: I--og (nominative case)
Me--geog (objective case)
4. The possessive case is formed by placing "gi" before the noun or pronoun.
Example: My or mine--giog
5. Plurals of nouns and pronouns are formed by adding "z"
Example: book--gark (singular)
books--garkz (plural)

I--og (singular)
We--ogz (plural)

SECTION III (Continued)

1. I take the book.
Og lig mat gark.
2. The boy saw me.
Mas raa aset og.
3. The lesson was difficult.
Og gark tes cuf.
4. He studies the lessons.
Ti lam mas sonnez.
5. She studied at school.
Ru alam ne toch.
6. The dog chased the cat.
Mas nac sach mas moh.
7. The boy ran away from school.
Mas raa yar waw fic lam.
8. That book is mine.
Mat gark tes giog.
9. The girl's dog chased him.
Mas gilir nac asach geti.
10. He took the good apples, and left the bad apples.
Ti alig mas goo simz , ed veal mas gooxy simz.
11. The boy ran to the house for his books.
Mas nac ayar te mas seoh rox giti garkz.
12. Take my book and give her book to me.
lig giog gark ed sig gitu gark te geog.
13. The dog ran to the girl.
Mas nac ayar te mas lir.
14. Her lessons are difficult, and mine are easy.
Gitu sonne rou cuf , ed og rou cufxy.
15. That book is difficult for the school.
Mat gark tes cuf rox mas tocz.

ATHOL HIGH SCHOOL SCHOLASTIC

APTITUDE TEST

FOR SENIOR HIGH FRESHMEN

(Study Syllabus)

FORM B

Prepared by H. N. Glick and Claude B. Germany

Name.....
(Last name) (Given names or initials)

Age.....

Section IV.....	
Section V.....	
Section VI.....	
Score.....	

SECTION IV Part A

Directions: You are to study this map carefully. You are to be asked questions about it. You will not be asked to draw the map.



SECTION IV

Part B

Directions: You are to study the statements below. You will be questioned about them later.

1. The United States is the greatest copper-producing country in the world.
2. The Mocking Bird is a common bird of the southern United States.
3. To build up English shipping, agriculture, and manufactures, was the object of English legislation during the colonial period.
4. In the number of tons of freight handled in foreign trade, New Orleans ranks second in the United States.
5. An inlet from the Gulf of Mexico is called a bayou. There are many of these in Louisiana.
6. Los Angeles is one of the chief educational centers in this country.
7. The main conditions of the industrial growth of any country consists of the character of the people and the natural resources,
8. Spanish is the language of most of the South American countries.
9. Turpentine is obtained by tapping the pine tree.
10. The island of Ceylon is pear-shaped, and is 272 miles long.
11. In Sparta weakness was the greatest crime, and was often punished with death.
12. Through stubborn rock, the Nile cut its way and enters Egypt on the south, carrying in its waters rich mud from the Abyssinian highlands.
13. The eggplant was among the first vegetables used by man.
14. The speech of the Eskimo is rather like Chinese and is difficult to learn.
15. The River Clyde has had an important part in making Glasgow a great manufacturing center.
16. India used cotton cloth in 1500 B. C.
17. The most important product of Chile has been the mineral called nitrate.
18. The Houston-Galveston port district ranks fifth among United States ports in foreign trade.
19. Farming has never been important in Newfoundland.
20. The crop which brings the most money to South America is coffee.

SECTION V

Directions; Study carefully the selections given below. You will be asked questions about them later. You will not be expected to memorize the selections.

Part A

The most characteristic feature of the age of Elizabeth was the comparative religious tolerance, which was due largely to the queen's influence. Upon her accession Elizabeth found the whole kingdom divided against itself: the North was largely Catholic, while the southern counties were as strongly Protestant. Elizabeth favored both religious parties, and Catholics and Protestants acted together. The mind of man, freed from religious fears, turned with great creative impulse to other forms of activity. It is partly from this freedom of the mind that the age of Elizabeth received its great literary stimulus.

(English Literature. Long.)

Part B

I saw a smith stand with his hammer, thus,
The whilst his iron did on the anvil cool,
With open mouth swallowing a tailor's news:
Who, with his shears and measure in his hand,
Standing on slippers, which his nimble haste
Had falsely thrust upon contrary feet,
Told of a many thousand warlike French
That were embattled and ranked in Kent.

(Shakespeare.)

ATHOL HIGH SCHOOL SCHOLASTIC

APTITUDE TEST

FOR SENIOR HIGH FRESHMEN

(Test Syllabus)

FORM B

Prepared by H. N. Glick and Claude B. Germany

Name.....
(Last name) (Given names or initials)

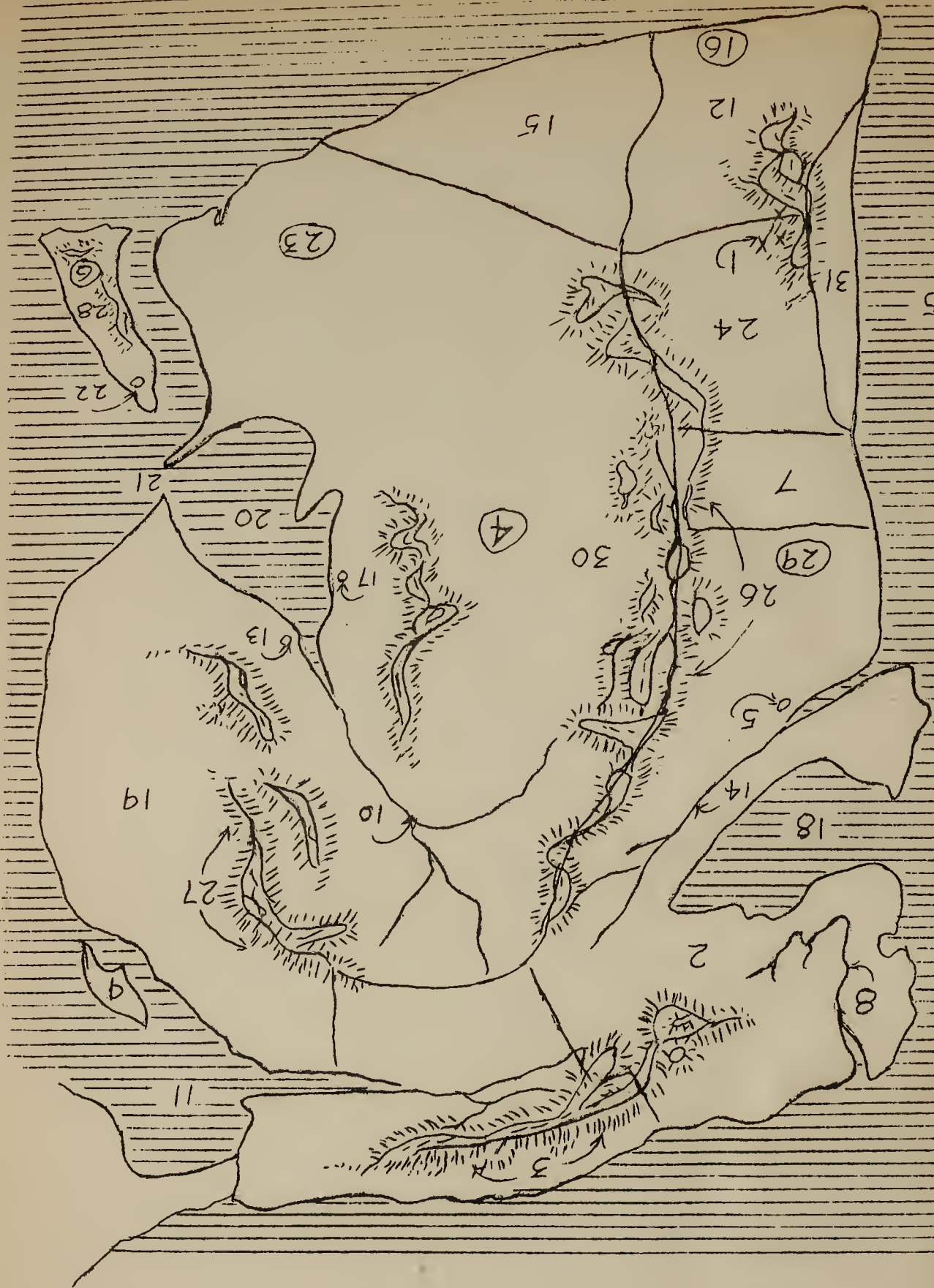
Age.....

S ection IV .....	.....
Section V .....	.....
Section VI.....	.....
Score.....	.....

SECTION IV

Part A

Directions: This is the map you studied. See preceding page.



SECTION IV
Part A

Directions: On the next page is the map you studied with the names left out. The names are given below. You are to place the numbers that are on the map before the names they represent.

Example: The section of the map where you see the number 1 is Caves of Luray, so you place a 1 in the parenthesis before the name Caves of Luray.

- | | |
|-----------------------|----------------------|
| (1) Caves of Luray | () Plata Bay |
| () Luson | () Pigs |
| () West Sidney | () State of Libya |
| () East Sidney | () Bounty Mountains |
| () Desert of Balak | () Adland Ocean |
| () Oil Fields | () Freshet Bay |
| () Denton | () Crescent Island |
| () Strait of Spears | () Hamilton |
| () Boguechitto River | () Bay of Pearls |
| () Pitfall | () Mermon |
| () Albia | () Amstead |
| () Mammoth Mountains | () Island of Duke |
| () Cattle Belt | () Colon |
| () Tall grass plains | () Bristol |
| () Alta River | () Paul Mountains |
| () Shiloh | |

SECTION IV

Part B

Directions: Below are the statements you studied with the answers omitted. You are to copy the number of the statement in the parenthesis after the word that best completes the statement. Example: The word that best completes the first statement is United States, so a 1 is placed in the parenthesis after the word United States.

1. The _____ is the greatest copper-producing country in the world.
2. The _____ is a common bird of the southern United States.
3. To build up English _____, _____, and _____, was the object of all English legislation during the colonial period.
4. In the number of tons of freight handled in foreign trade, _____ ranks _____ in the United States.
5. An inlet from the Gulf of Mexico is called a _____. There are many of these in _____.
6. _____ is one of the chief _____ centers in this country.
7. The main conditions of the industrial growth of any country consists of the _____ of the _____ and the _____.
8. _____ is the language of most of the South American countries.
9. _____ is obtained by tapping the pine tree.
10. The _____ of _____ is pear-shaped, and is 272 miles long.
11. In _____ weakness was the greatest crime, and was often punished with death.
12. Through stubborn rock, the _____ cut its way and enters _____ on the south, carrying in its brown waters rich mud from the _____ highlands.
13. The _____ was among the first vegetables used by man.
14. The speech of the _____ is rather like Chinese and is difficult to learn.
15. The _____ has had an important part in making Glaskow a great manufacturing center.
16. _____ used cotton cloth in 1500 B. C.
17. The most important product of Chile has been the mineral called _____.
18. The _____ port district ranks _____ among United States ports in foreign trade.
19. _____ has never been important in Newfoundland.
20. The crop which brings the most money to South America is _____.

United States.....(1)	Character.....()	Coffee.....()
Eggplant.....()	Houston-Galveston()	Shipping.....()
Island.....()	Nile.....()	Los Angeles.....()
Educational.....()	People.....()	Bayou.....()
Egypt.....()	Turpentine.....()	Sparta.....()
River Clyde.....()	Mississippi.....()	Ceylon.....()
Spanish.....()	Farming.....()	Indian.....()
Eskimo.....()	Mocking Bird.....()	Manufactures....()
Fifth.....()	Second.....()	New Orleans.....()
China.....()	Agriculture.....()	Ceylon.....()
Nitrate.....()	Natural resources()	Abyssinian.....()
Sulphur.....()	India.....()	Louisiana.....()

SECTION V

Part A

Directions: Part A. Below is the substance of the first selection you read with some numbered blanks indicating that some of the words are left out. The words left out are listed below. You are to copy the number of each blank in the parentheses after the word which belongs in the blank.

The most characteristic feature of the Age of (1) was the comparative (2) tolerance, which was due largely to the (3) influence. Upon (4) accession Elizabeth found the whole kingdom (5) against (6); the (7) was largely (8), while the (9) countries were as strongly (10). Elizabeth favored (11) religious parties and Catholic and Protestant acted together. The (12) of man, freed from religious fears, turned with great (13) (14) to other forms of activity. It is partly from this freedom of the mind that the Age of Elizabeth received its great (15) stimulus.

(English Literature. Long)

Shakespeare.†.....()	literary.....()
expansion.....()	religious.....()
impulse.....()	political.....()
her.....()	queen's.....()
Elizabeth.....()	Catholic.....()
king's.....()	Southern.....()
divided.....()	both.....()
itself.....()	neither.....()
North.....()	creative.....()
Protestant.....()	heart.....()
mind.....()	

PART B

Directions:-Answer the following questions according to the poem which you read. If a statement is true, check (✓) true. If it is false, check false. The samples are checked correctly.

	true	false
Samples; 1. The smith was standing with a hammer in his hand.	✓	
2. The tailor told news of warlike Spaniards.		✓
1. The smith stood with his mouth open.		
2. The tailor was swallowing the smith's news.		
3. The tailor held a pair of shears in his hand.		
4. The plot of this poem was laid in the tailor's shop.		
5. The tailor in his haste had put his shoes on wrong.		
6. The smith emptied and refilled his pipe.		
7. The smith stood listening while the iron cooled on the anvil.		
8. Warlike French were embattled in Kent		

Section VI (Continued)
Part A

Directions: In the work which follows, you are to accept the statements which follow (a) and (b) as true. If from these two statements you feel justified in drawing the conclusion listed after (c), you are to insert a plus sign in the parentheses at the left-hand margin of the page. If the statement following (c) is unjustifiable as a conclusion to (a) and (b), you are to insert a minus (-) sign in the parentheses.

Sample: 1. (a) John is younger than Tom.
 (b) Frank is older than Tom.
 () (c) John is younger than Frank.

A plus (+) sign has been inserted in the parentheses because (c) is a justifiable conclusion to draw from statements (a) and (b).

2. (a) M is equal to N
 (b) N is equal to O
 () (c) Therefore, M is equal to O
3. (a) All human beings are thinking beings.
 (b) Man is a human being.
 () (c) Man is a thinking being.
4. (a) All metals are elements.
 (b) Oxygen is an element.
 () (c) Oxygen is a metal.
5. (a) Mercury is heavier than water.
 (b) Lead is heavier than water.
 () (c) Mercury is heavier than lead.
6. (a) All insects are arthropods.
 (b) All bees are insects.
 () (c) All bees are arthropods.
7. (a) The receiver of stolen property should be punished.
 (b) You have been punished.
 () (c) You have received stolen property.
8. (a) Theft is crime.
 (b) Theft was encouraged by the laws of Sparta.
 () (c) The laws of Sparta encouraged crime.
9. (a) All letters which are stamped will be delivered.
 (b) This letter was delivered.
 () (c) This letter was stamped.
10. (a) John is younger than Charles.
 (b) Mary is younger than John.
 Joe is younger than Mary
 () (c) Joe is younger than any of the persons mentioned.

SECTION VI (Continued)

PART A

11. (a) The distance from C to D is less than the distance from A to B.
(b) The distance from B to C is less than the distance from C to D. The distance from D to E is less than the distance from C to D.
() (c) The distance from B to C is less than the distance from D to E.
12. (a) Wholesome food is nutritious and cleanly made.
(b) Doughnuts are wholesome food.
() (c) Doughnuts are nutritious.
13. (a) All Malays are cruel, because all savages are cruel.
(b) All the original inhabitants of Singapore are Malays, because all the natives of the part of Asia are.
() (c) All natives of Singapore are cruel.
14. (a) All gentlemen are polite.
(b) All successful gamblers are polite.
() (c) All successful gamblers are gentlemen.
15. (a) A is older than B.
(b) C is older than D; C is older than A; E is older than C.
() (c) E is older than A, B, C, or D.

2. Add
Form .

Add the following columns of figures:

(1)	2,732	(2)	2,476.98
	8,419		5,732.21
	623		413.26
	8,076		132.71
	12,931		3,276.93
	6,075		1,189.56
	11		458.47
	1,170		<u>9,351.63</u>
	<u>97,000</u>		

Multiply in the following examples:

(3)	971.82	(4)	32114
	<u>2.08</u>		<u>425</u>

Divide in the following examples:

(5)	45 $\overline{) 40.00}$	(6)	.033 $\overline{) 83.7}$
-----	-------------------------	-----	--------------------------

Add the following mixed numbers:

(7)	$4\frac{5}{12}$	(8)	$1\frac{3}{10}$
	$5\frac{1}{3}$		$3\frac{1}{2}$
	$9\frac{3}{8}$		$2\frac{3}{4}$
	$7\frac{5}{6}$		$4\frac{1}{5}$
	<u> </u>		<u> </u>

Compute to the nearest cent: (9) 13% of \$50.25

(10) 22 $\frac{1}{2}$ % of \$150.25

Approved by

F. N. Glick

Naugh

H. D. Bontelle

Date June 5, 1935

