A STUDY OF SOME FACTORS RELATED TO SUCCESS IN MATHEMATICS AND COURSE OFFERINGS

by

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CHAPTER I

INTRODUCTION

Increased emphasis on mathematics as mathematics, and upon mathematics as tool subject for use in other fields, demands that the schools investigate their mathematics programs. In former years, Park County High School students were required to complete one year of mathematics to qualify for graduation, but beginning with the class of 1960 all will be required to submit two credits of mathematics for graduation by a ruling of the State Board of Education[1]. It recommended that these two credits be earned in algebra and geometry. This recommendation parallels the requirements of a great many colleges for entrance into selected schools within the college.[2]

At the present time, courses in general mathematics (consumer type), algebra, plane geometry, advanced algebra, trigonometry and solid geometry are offered in Park County High School. In order to meet the minimum requirement of the State Board of Education, it would be necessary then for everyone in high school to complete the algebra course. The advisability of bringing all students to an acceptable proficiency in algebra while participating in classes with students preparing for college creates problems which are difficult for teachers. There appeared to be three general solutions; homogeneous grouping according to mathematical apptitude, application of dual methods of instruction and learning requirements, or ignoring the proglem completely. Each of these solutions creates new problems.

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[1]State Department of Public Instruction, March 11, 1957, The Bulletin, D.P.I., 1-57M, 2pp.

[2]National Association of Secondary School Principals, The Bulletin, May, 1954, p. 36.

Homogeneous grouping pre-supposes that there is a reliable and ready means of differentiating among different ability groups of students.

Homogeneous grouping would also infer that some students are being prepared for college entrance while others will graduate not so equipped. This also poses problems in that not many of the students are able to state what they are going to do after high school, and of those who seem to have a plan, many find themselves unable to pursue it previous to or after graduation.

The Problem

The recent emphasis on mathematics for the sake of mathematics, and upon mathematics as a tool subject, the ruling of the State Board of Education, and the needs at local levels called for clarification of procedures in mathematics courses. More clearly stated the problem was to determine the answers to three questions. What mathematics courses should be offered? How should our courses be organized as to sequence and context? What measures of ability or aptitude might be used? It was felt that, before inaugurating any changes, it would be well to look critically at the local offering and practices elsewhere.

Materials available on the class for the study consisted of the records of 162 students who entered as freshmen the fall of 1953. They were given the California Algebra Aptitude Test[3] on September 29, 1953, and intelligence quotients from the Henmon Nelson Test of Mental Ability[4] were

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[3] California Algebra Aptitude Test, Copyright 1950, Education Test Bureau, Minneapolis, Minnesota.

[4] Henmon Nelson Tests of Mental Ability, Form A, the high school level, The Psychological Corporation, New York 17, New York.

also available. Scores on the Stanford Arithmetic Achievement Test[5] were supplied by the Lincoln School in Livingston.

Procedure

To facilitate this study the students were divided into groups based upon the amount of mathematics they had taken. Five groups were thus formed; a group which took only general mathematics, those who took general mathematics and algebra, those who took only algebra, another which took algebra and geometry and a group that took elective mathematics, including any one or all of the subjects beyond plane geometry, such as advanced algebra, trigonometry and solid geometry.

An attempt was made to select significant relationships and thirteen graphs, scattergrams, and frequency distributions were worked out. The following areas were investigated:

Intelligence of 162 students

Grade point averages for total high school career of 117 graduates

Mathematics grades of 149 of the students

Raw scores on the California Algebra Aptitude Test for 162 students

Apptitude Index for 162 students

Relationship of algebra grade and Stanford Achievement Score in arithmetic for 62 students

Relationship of California Algebra Aptitude Test scores and intelligence quotients for 162 students

Relationship of intelligence quotient and Aptitude Index for 162 students

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[5] Stanford Achievement Tests, Form G, Copyright 1940, World Book Co., Yonkers-on Hudson, New York.

Aptitude Index and Algebra Grades for 149 students

Algebra Grades and intelligence quotients for 149 students

Number of students who took each mathematics course

Number of students taking specified mathematics courses during their high school career

Percentage of students who took varying amounts of mathematics attending college during the year of 1957-1958

Sources of the Data

The data for this study were compiled from the permanent records of Park County High School and consisted of the following material:

Grade point averages for all graduates

Intelligence quotients as determined by the Henmon Nelson Quick Scoring Tests of Mental Ability[6]

The California Algebra Aptitude Test score[7], the score obtained by counting the correct answers from among 92 possible on the California Algebra Aptitude Test

The Algebra Aptitude Index, a composite score including the California Algebra Aptitude Test score and the intelligence quotient

The grades in all mathematics courses taken in high school

The Stanford Achievement Test score[8] taken from the students eighth grade examination

To assist in the reading of the study definition of certain terms follows.

Definition of Terms

Intelligence Quotient refers to the intelligence as determined by the Henmon Nelson Test of Mental Ability.

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[6]The Psychological Corporation, op. cit.

[7]Educational Test Bureau, op. cit.

[8]World Book Co., op. cit.

Grade Point Average is the term used to indicate the average grades a student achieved in high school over his entire subject field or in the area specified. It is based upon values: A = 3; B = 2; C = 1; D = 0; and F = -1.

Grade Index is the term used when a set of revised values for grades was formulated for purposes of graphing. These values were: A = 8; B+ = 7; B = 6; C+ = 5; C = 4; D+ = 3; D = 2; F+ = 1; F = 0. The plus marks indicate a semester of one grade followed or preceded by a semester of the next higher grade.

California Algebra Aptitude Test refers to a test designed to be given to pre-high school students for the purpose of homogeneous grouping on an ability basis.

California Algebra Aptitude Test Score is the number of problems correct (or raw score) on the California Algebra Aptitude Test. The highest possible score is 92.

Aptitude Index is a composite figure derived by adding the intelligence quotient to the California Algebra Aptitude Test Score. A California Algebra Aptitude Test score of 62 and an intelligence quotient of 120 would yield an aptitude index of 182.

Background of the Group

The class of 1957 was selected for the study of mathematics achievement because data were available, and the class had finished high school. The group was composed of 162 students who were in school on September 23, 1953, the date of the administering of the test. Of this group 117 graduated with a class of 133 students on May 29, 1957. Fifteen students transferred to other schools sometime previous to graduation and left only

partial records. Figures for this segment were included in the overall averages and omitted when dealing with smaller groups. Thirty of the students were classed as dropouts because they did not continue their education. The 117 who graduated left complete records and it was from this group that most of the statistics were derived. The other groups were used where significant.

There were some pressures working on the group which influenced their selection of mathematics courses. That degree of influence was not measurable.

Recommendations as to whether the student should enroll in general mathematics (generally known among the students as "dumbell math") was made by a counselor after studying the results of the arithmetic portion of the Stanford Achievement Tests[9], which had been administered in April of 1953. Students were free to choose algebra over the recommendation of the counselor if they so desired. It was the practice to recommend general mathematics to the student if his grade placement was one year or more below standardized norms for the class.

Another pressure was undoubtedly parental in nature. Some parents recommended one program and others another program.

All students were told that to enter any of the technical schools of the colleges they would have to present credits in algebra and geometry or be prepared to take these courses in college, possibly for no credit. It was further recommended that for those planned to enter the technical schools it would be wise to take all of the mathematics offered in high school.

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[9] World Book Co., op cit.

Livingston is a community of about ten thousand people in south-central Montana. The main sources of livelihood are the Northern Pacific Railroad with its attendant offices and shops, the lumbering industry, the farming and ranching activities, and the attendant service businesses of the community. About four-fifths of the students live in the city. If there is any one group predominant it would be the children of employees of the railroad. This group does not present any homogeneity dur to the wide variation of skills required in such an enterprise. The qualifications would range from the lowest ranks of unskilled labor to high skilled technicians, and from white collar clerking to highly paid administrative positions. Any variations from a normal population due to this factor would probably be insignificant.

Justification for the Study

The study was a necessity if the school was to be able to react intelligently to the current emphasis of these times in increased interest in, and demand for, an imporved mathematics and science program. Schools are being bombarded from all sides by writers, professional and otherwise, with warnings, dire predictions and recommended courses of procedure. They should determine their position and proceed accordingly. It would be well to determine what is now being done before taking off upon any new suggestion. This analysis has been undertaken with that purpose in mind. It was hoped to use the results of this study in the guidance program.

The first step in this study, a review of literature, is presented in Chapter 2.

CHAPTER II

REVIEW OF LITERATURE

The study sought answers to three problems. What mathematics courses should be offered? How should the courses be organized as to sequence and content? How effective are intelligence tests and the California Algebra Aptitude Tests as predictors in achieving homogeneous grouping as to mathematical ability?

Bruns and Frazier[1], in an attempt to determine what courses should be taught in high school, surveyed 37 large cities in the United States. The usual sequence prevailed in 29 of the school studied. It was a four-year sequence of algebra, geometry, advanced algebra, trigonometry and solid geometry in the order named. This sequence made no allowance for any more advanced mathematics in high school.

Many schools worked out interesting variations to allow the gifted to use their time to better advantage. In some areas, selected students enrolled in algebra in grade nine; geometry and advanced algebra in grade ten; trigonometry and solid geometry in the eleventh grade. This arrangement left the twelfth grade open for a variety of offerings, some of these being; mathematical analysis, college algebra, differential and integral calculus, and analytical geometry. In two cases the final semester in high school was reserved for consumer mathematics for all students.

An interesting sidelight on the relative effectiveness of algebra and general mathematics in attaining the recommended 29 mathematical competencies was reported by Beckman in an experiment conducted by him.

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[1]Bruns, Richard F., and Frazier, Alexander, Range and Sequence of High School Mathematics, The Mathematics Teacher, December, 1954, pp. 552-555.

This experiment showed that general mathematics students made greater gains than algebra students in attaining the 29 competencies listed by the commission. He made the following statement:

> The relatively poor gains in both groups may point to a curriculum in mathematics which is poorly planned and developed, or teaching of mathematics is poorly done, or the competencies suggested by the commission have not been accepted as valid objectives by those planning the curriculum[2].

He concluded that one should persist until all students acquire the minimum essentials, then offer opportunity for further mathematics training.

Price[3] listed the impressions about high school mathematics teachers revealed in popular writings as being, a stupid ineffective lot, the youth as being a generation going to the dogs, the poor college teacher as being forced out of his ivory tower and plunged headlong into the world of reality, and that the enemy is rapidly surpassing in trained manpower, largely because the high school graduates are going to college knowing little or no mathematics. Furthermore the impression has been created that it is all the high school teachers' fault.

A plea is made for high school and college cooperation in determining what should be taught and where. It was suggested that every mathematics teacher should teach all of the mathematics subjects in high school, that the mathematics maturity of the upper group of high school students is

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[2]Beckman, Milton W., Report of Competencies by National Council of Teachers of Mathematics Commission on Post War Plans, Journal of Educational Research, March, 1954, pp. 506-511.

[3]Price, H. Vernon, State University of Iowa, as reported in The Mathematics Teacher, January, 1957, p. 73.

sufficient to cope with calculus, and that such mathematics as is sound for college is sound for non-college, that the present interest in mathematics and the demand for mathematicians is evidence not of failure but of success.

His personal criticisms are that the mathematics offering is antiquated 50 years, and fails to capture the imagination of high school students; that the algebra has failed to grow beyond the techniques of simplifying expressions and solving equations; that the geometry consists of one proof after another with no motivation, and that trigonometry consists of solving triangles and graphing instead of analytical trigonometry.

Price further recommended that mathematics be connected to everyday life, that the material be kept to the ability of the student, that basic concepts be taught, and that wherever possible courses should be correlated so as to start college mathematics at a higher level. He then outlines a course of mathematics for high school students.

Treacy[4] in a study of relationship of certain reading skills to the ability to solve verbal problems found a positive correlation. He further designated specific skills, vocabulary, use of quantitative terms, computational ability and general intelligence as all positively related, and that systematic training in a definite attack procedure results in high scores on problem tests.

Rosilda[5] reported a correlation of .42 between intelligence scores ad determined by the California Test of Mental Maturity and algebra

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[4]Treacy, John P., Relationship of Reading Skills to the Ability to Solve Arithmetic Problems, Reviewed in Journal of Educational Research, October, 1944, 11 pp.

[5]Rosilda, Sister M., St. Mary's Convent, West Point, Iowa, in a thesis, Is Intelligence Quotient an Index to Algebra Ability? Reviewed in journal of Educational Research, January, 1951, pp. 371-393.

achievement as measured by the Cooperative Elementary Algebra Test. This correlation is not judged by Rosilda to be sufficiently high to apply as a lone measure in counseling individuals.

Significant in the findings was the fact that 10% of the students having intelligence quotients above 120 made scores below the fiftieth percentile norm, and that 32.4% of the students having intelligence quotients below 90 made scores above the fiftieth percentile norm. She called for a further and more accurate predictor of algebra ability than the lone use of intelligence quotients.

If scholastic failure is a contributing factor to the problem of dropouts, then the mathematics courses as constituted in Park County High School are contributing to the frustration which induces students to drop from school.

In relation to dropouts Gagermeier came to the conclusions that:

1. The trouble causing the dropouts could be placed in the high school.
2. Achievement is linked to dropouts, the higher the grade average the lower the percentage of dropouts.
3. Dropouts are more prevalent among low intelligence groups than among the above average groups.
4. Since the dropouts occurred after entering high school, a major portion of the work of a preventive nature should be carried out in the high school.[6]

There is reason to question his first conclusion, many students coming from a compulsory attendance situation in the grade schools on a

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[6]Gagermeier, Louis John, an unpublished thesis, "AStudy of the Relationship Between Dropouts, Achievement and Intelligence" from the eighth grade through one half of the ninth grade in School District #1 Missoula, Montana, 1952, Library, Montana State University.

social promotion basis, attend only long enough to convince their parents that they tried.

From the study of literature, it seemed evident that not enough mathematics courses were offered to high school pupils to challenge the better students and that some provision should be made for them. Combining courses, omitting unnecessary material, and teaching basic concepts are suggested.

Colleges and high schools have not worked together in determining content and placement of subject matter to avoid needless duplication of material and to build a logical sequence of learning experiences.

Several measures of mathematical ability were reported. Reading ability, various tests of algebra aptitude, general intelligence, and teachers estimates all are factors to be considered.

In Chapter III data on the students grouped according to mathematics courses taken is presented.

CHAPTER III

SUCCESS OF SUBJECT PREPARATION GROUPS IN RELATION TO TEST RECORDS AND ARITHMETIC ACHIEVEMENT AS PREDICTIVE FACTORS

The 162 students of the class of 1957 were divided into five groups on the basis of what mathematics they had taken. These are referred to as subject preparation groups and fall into five categories:

Those who took only general mathematics

Those who took only general mathematics and algebra

Those who took only algebra

Those who took only algebra and geometry

Those who took elective mathematics beyond algebra and geometry

Certain test results commonly used in predicting success were available. The relationship of these as predictive factors in the success of different subject pattern groups is presented in the following sections.

Group Which Took Only General Mathematics

Of the 162 students in the study, 11 of them took only general mathematics while in high school. Five of this group graduated. Their overall scholastic averages were: .25; .48; 1.428; .416 and .38. A equals three; B equals two; C equals one; D equals 0 and F equals minus one. Three of the group failed to pass the course the first time they enrolled and gained the necessary credit at a later date. Six of them dropped out of high school, and none of the group attempted to go to college. Statistics on this group are presented in Table 1.

TABLE 1. INTELLIGENCE QUOTIENTS, APTITUDE SCORES AND APTITUDE INDEX SCORES OF ELEVEN STUDENTS WHO TOOK ONLY GENERAL MATHEMATICS

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotients--Henmon Nelson Tests of Mental Ability	113	65	90
C. A. A. T.--Raw scores on California Algebra Aptitude Test	50	10	25
Aptitude Index--Sum of intelligence quotient and raw score on California Algebra Aptitude Test	144	75	115

Group Which Took Only General Mathematics and Algebra

Fourteen students who completed the general mathematics course apparently believing they were prepared to enter the algebra class, were enrolled in algebra. Eleven of the group failed to get any credit in algebra and the best grade earned by any of them was a D+.

Individual scores for this group based upon the three criteria, intelligence quotient, C. A. A. T. score, and aptitude index, as shown in Table 2, reveal that while the lowest scores occur in the group which took only general mathematics occasional higher scores appear there also. This indicated that other factors were at work within the group. The averages for intelligence quotient, C. A. A. T. scores and aptitude index increase progressively thru the five groups. In the group of 14 which took only general mathematics and algebra, six of them dropped out of school, six graduated, one transferred to another school and one went to college, but failed scholastically and dropped after one quarter.

TABLE 2. INTELLIGENCE QUOTIENTS, APTITUDE SCORES AND APTITUDE INDEX SCORES OF 14 STUDENTS WHO TOOK ONLY GENERAL MATHEMATICS AND ALGEBRA

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotients	112	82	96
C. A. A. T.	72	6	39
Aptitude Index	175	88	125

Group Which Took Only Algebra

Forty-three members of the class enrolled in algebra during their freshman year and did not take any more mathematics in high school. Thirteen of the group dropped from school for a variety of reasons and failed to finish high school. Thirty of the group graduated and one went to a business college. Average intelligence quotients, C. A. A. T. scores and aptitude indices continue to climb when compared with the other groups, being respectively according to groups in Tables 1, 2 and 3: 93,96 and 102; 25,39 and 43; and 115, 125 and 145 for the three groups discussed. Table 3 presents statistical data on this group; the high, low and average scores of those students who took only algebra.

TABLE 3. INTELLIGENCE QUOTIENTS, APTITUDE SCORES AND APTITUDE INDEX SCORES OF 43 STUDENTS WHO TOOK ONLY ALGEBRA

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotients	120	85	102
C. A. A. T.	70	18	43
Aptitude Index	183	106	145

Group Which Took Only Algebra and Geometry

Algebra and geometry were recommended by the guidance department as the minimum mathematics required for college entrance. Thirty-six students took this mathematics program. Only four failures were recorded in this group, one in algebra and three in geometry. Three "A'S" were recorded in algebra and two "A's" in geometry earned by the same students who received the "A's" in algebra. One of these students dropped from school, 35 of them graduated from high school and 21 of them went to college. Statistics for the group indicate higher levels of ability and performance than in the previous three groups as shown in Table 4.

TABLE 4. INTELLIGENCE QUOTIENTS, APTITUDE SCORES AND APTITUDE INDEX SCORES OF 36 STUDENTS WHO TOOK ONLY ALGEBRA AND GEOMETRY

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotient	126	87	105
C. A. A. T.	77	17	48
Aptitude Index	199	116	153

Group Which Took Elective Mathematics

Students who expected to enter any of the technical schools in college were advised to take additional mathematics courses. Thirty-seven students took advanced algebra (full year), 14 of these went on to a course in trigonometry, and ten of these completed solid geometry. One failure was experienced by this group in the trigonometry class. One student, I. Q. 126, in this group had taken general mathematics but took only algebra and geometry. All of the group graduated from high school and 36 of them went to college. This was a rather select group, with an average intelligence quotient of 112, a C. A. A. T. average of 60 and aptitude index average of 174. Table 5 indicates the scores of this group.

TABLE 5. INTELLIGENCE QUOTIENTS, APTITUDE SCORES AND APTITUDE INDEX SCORES OF 37 STUDENTS WHO TOOK ELECTIVE MATHEMATICS

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotient	133	94	112
C. A. A. T.	80	36	60
Aptitude Index	212	135	174

A study of the five groups indicated some observable trends. Intelligence averages increase progressively through the groups being 90, 96, 102, 105 and 112 respectively for groups one to five. C. A. A. T. average scores climb from 25, 39, 43, 48 to 60 and the aptitude index averages mounted from a low of 115, 125, 145, 153, to 174. College attendance among the groups varied from zero, as shown in Table 1, to 36 of 37 students shown in Table 5.

Dropouts were confined almost entirely to groups one, two, and three, These groups accounted for 25 of the 26 dropouts.

One conclusion drawn was that success in mathematics seemed to be indicative of success in other subject areas. This suggested that a study of success of students in other areas might be a worthwhile project for further study.

Available statistical information[1] on the group was used to make a series of graphs. It was believed that significant relationships could be derived from them. The first five tables presented data on the subject preparation groups and established some basic facts in regard to the comparative ability and performance of the subject preparation groups. In this section of Chapter III, 13 graphs are presented. The purpose of the first five graphs was to determine whether or not the class would conform to a normal distribution curve when scores on intelligence, grade point averages, mathematics grades, the California Algebra Aptitude Test and aptitude index were charted. It was believed that basic relationships would be shown. Graph number six, seven, eight, nine and ten showed relationship of various factors and numbers 11, 12, and 13 presented material dealing with the number of students pursuing various courses.

Intelligence of 160 Students

The graph, Figure 1, shows the range and distribution of the intelligence quotients of 160 of the subjects. These quotients were derived from the Henmon Nelson Test, Form A. This is a standardized test and has been used in Park County High School for approximately 15 years. It is probable that raw scores would give a better picture of true ability but

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[1]Appendix, pp. 56-60, of this study.

these were not available. The curve is not a normal distribution curve. This could be due to a combination of many factors some of which are: (1) this is a select group (eighth grade graduates), (2) the scores represent only the results of a single test, (3) the possibility of error in any one of the operations, (4) insufficient number of samples, and (5) reliability of the test.

The curve approaches the normal closely enough to show that the class was normal enough in intelligence for general conclusions.

Grade Point Averages for Total High School Career of 117 Graduates

The belief that relationships existed among the various factors led to the construction of Figure 2 which showed grade point averages of 115 graduates among the 162 students who took the C. A. M. T. in their freshman year. The averages were figured on all subjects taken in high school on a basis of A = 3 points, B = 2 points, C = 1 point, D = 0 points, F = -1 points. This system has prevailed in Park County High School since 1952. The minus value assigned to F may account for the large number of students in the lower reaches of the graph. A more normal distribution might have obtained by eliminating the minus one feature for F and assigning a value above 0 for a grade of D.

Mathematics Grades of 149 of the Students

The graph in Figure 3, shows the distribution of mathematics grades for the group. For this purpose values were assigned: A = 8, B+ = 7, B = 6, C+ = 5, C = 4, D+ = 3, D = 2, F+ = 1, F = 0. A plus grade indicates a semester of work in the next highest grade category.

Some of these students had only general mathematics and others took all of the courses offered: algebra, planegeometry, advanced algebra,

trigonometry and solid geometry. If there was anything significant in this chart it showed that, in comparison with the preceding chart the mathematics grades are lower than the general subject averages.

Figure 3 indicated a heavy concentration of the students grades in the portions of the graph, 13.42% of the students received a grade of F+ (one-half credit or less); 21.47% received a grade between F+ and D; 16.78% were graded between D and D+; 17.45% received grades between D+ and C; 14.76% received grades between C+ and B; 11.41 received grades between B and B+; 4.03% received grades between B+ and A and 7.38% received a grade of A.

That mathematics teachers tended to give low grades might have been a valid conclusion when one considers Figure 1, which indicated that the group rated slightly above normal in intelligence. Figure 2 indicates a grade range also skewed to the left. This pointed to low grading habits by the school faculty as a whole.

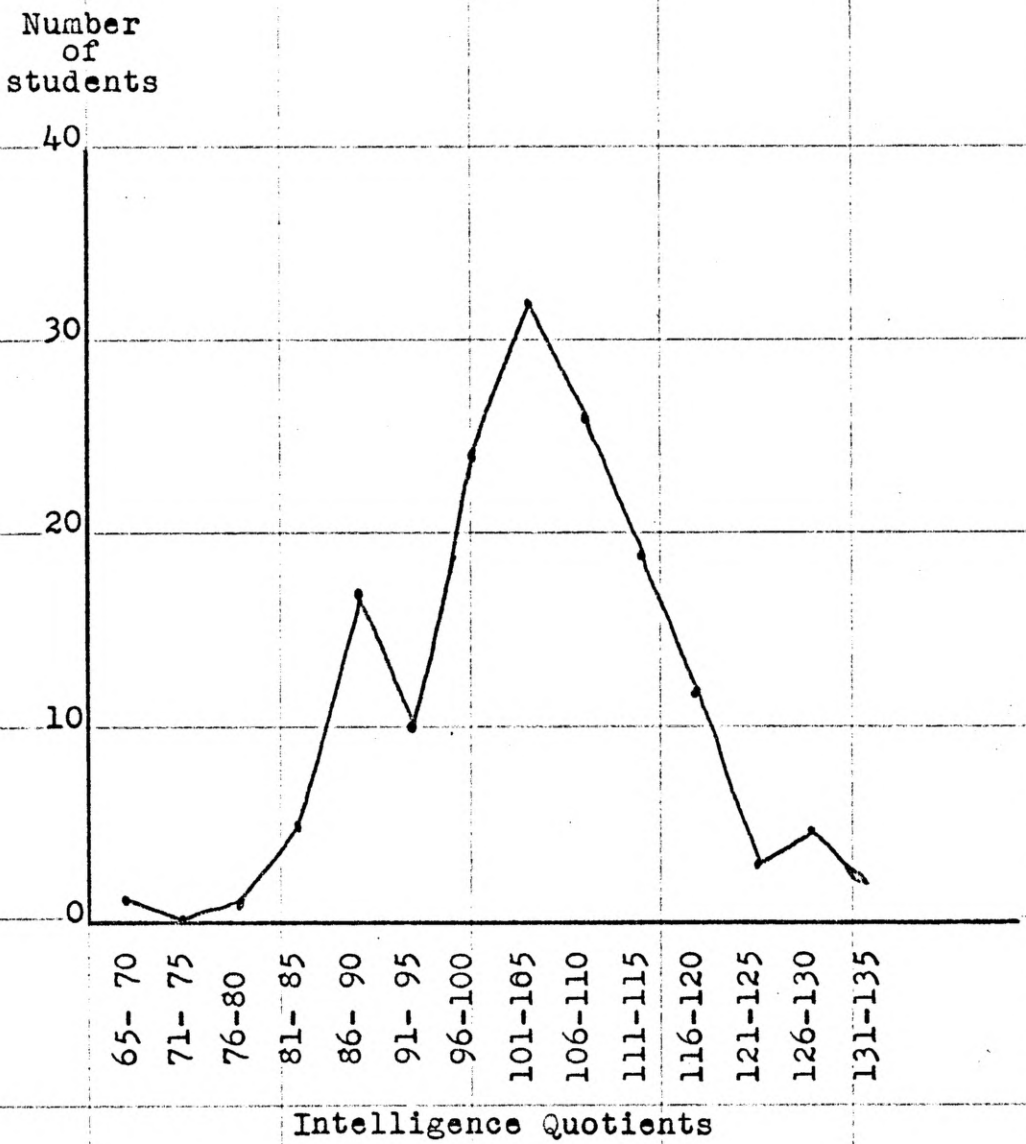


FIGURE 1. INTELLIGENCE QUOTIENTS OF 162 STUDENTS

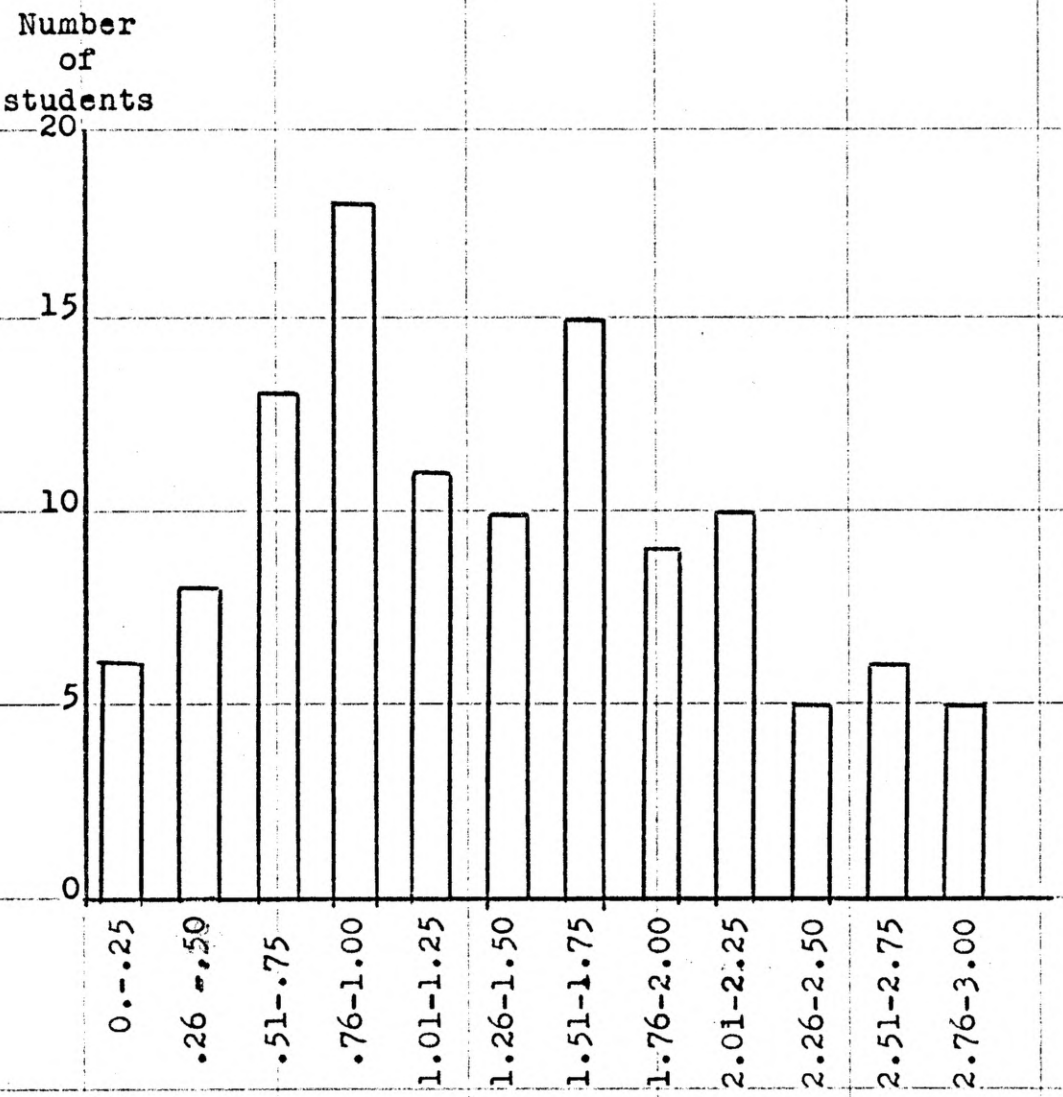


FIGURE 2. GRADE POINT AVERAGES FOR TOTAL HIGH CAREER OF 117 GRADUATES

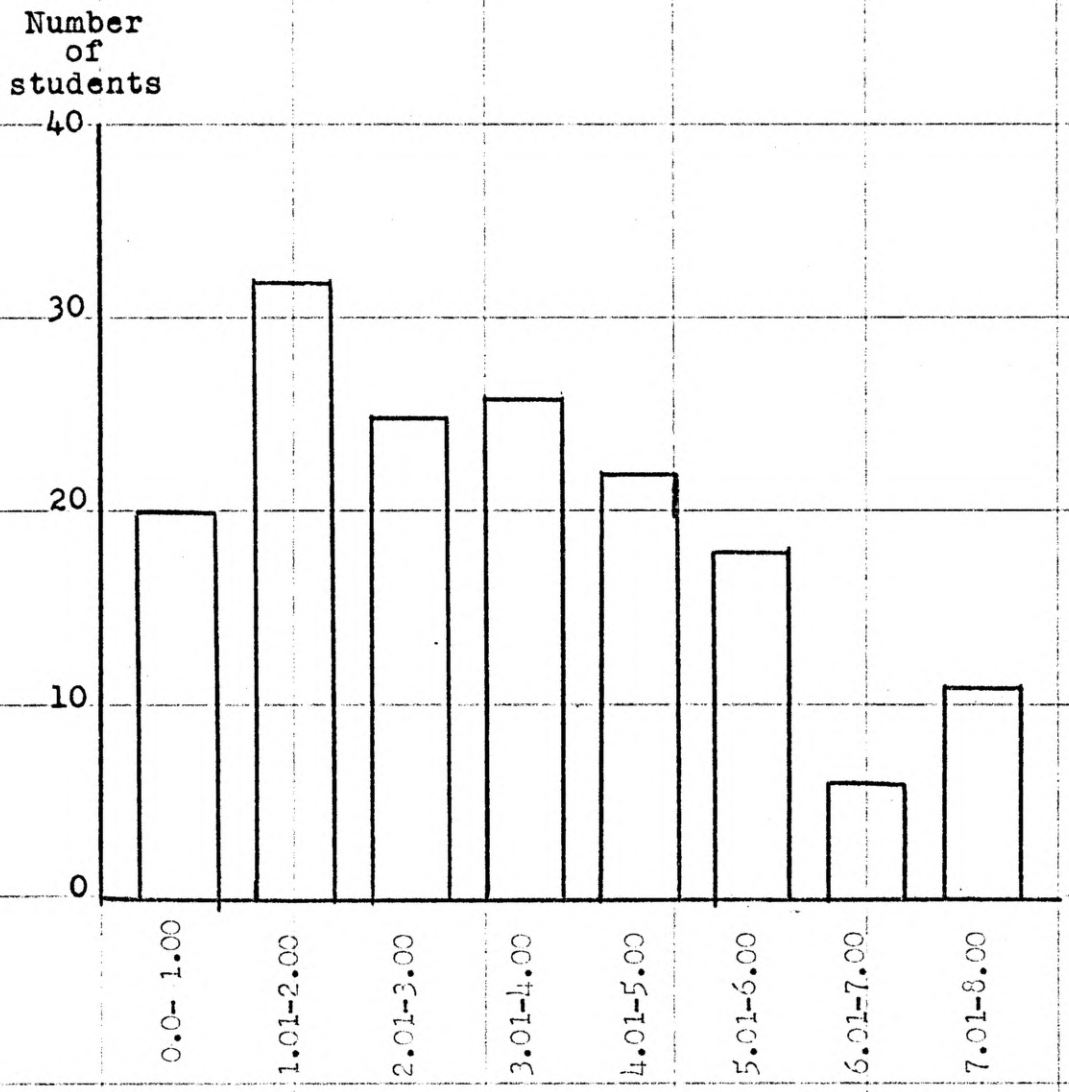


FIGURE 3. MATHEMATICS GRADES OF 149 STUDENTS

Raw Scores on the California Algebra Aptitude Test for 162 Students

The graph in Figure 4 shows the scores on the California Algebra Aptitude Test[2]. This test is composed of three sections: one of problems for solution, a second section of formulas, and the last section is composed of number series. It is given a correlation coefficient[3] of .77 when used alone to forecast algebra ability. The highest possible score is 92. The highest score achieved by any of the 162 students was 89, and the lowest score was six. The scores were grouped by ranges of ten for purposes of constructing the graph.

Figure 4 indicates that the students tended to gather in the high score portions of the test. This is in direct contrast to the grouping when teachers' grades were graphed, and is in agreement with the results obtained in Figure 1, Intelligence of 160 Students.

Aptitude Index for 162 Students

Figure 5 shows the total number of students and the distribution of their scores using the aptitude index. The aptitude index is a composite score combining the total C. A. A. T. score and the intelligence quotient of the student. It is given a coefficient of correlation[4] of .82, by the makers of the test, in relationship to algebra achievement.

The distribution of the scores compared quite closely with Figure 1 (intelligence), and with Figure 4 (C. A. A. T. score) both interpreted as measures of ability, but contrasted with Figures 2 and 3 which indicated performance as measured by teachers.

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[2]Educational Test Bureau, op. cit.

[3]Coefficient of Reliability

[4]Coefficient of Reliability

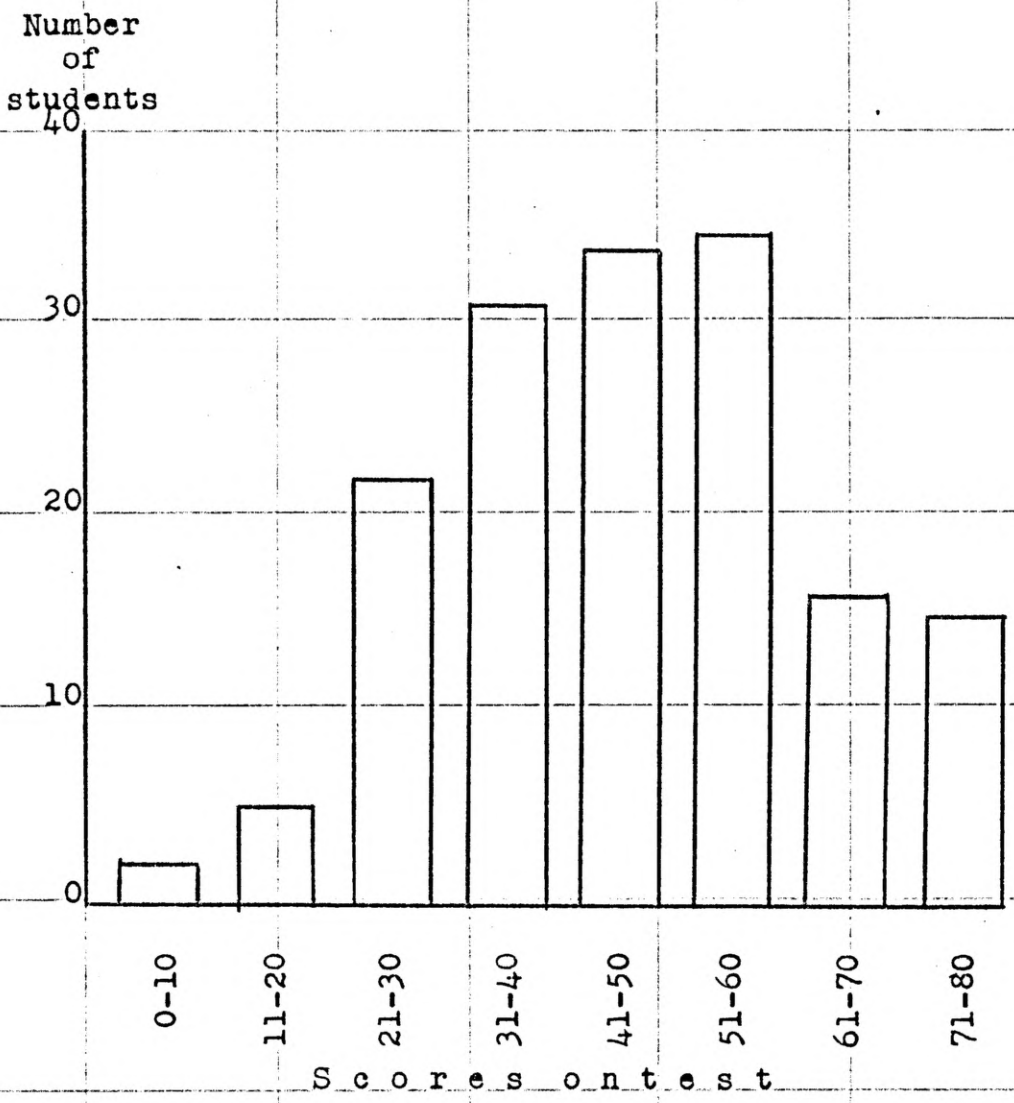


FIGURE 4. RAW SCORES ON THE CALIFORNIA ALGEBRA APTITUDE TEST FOR 162 STUDENTS

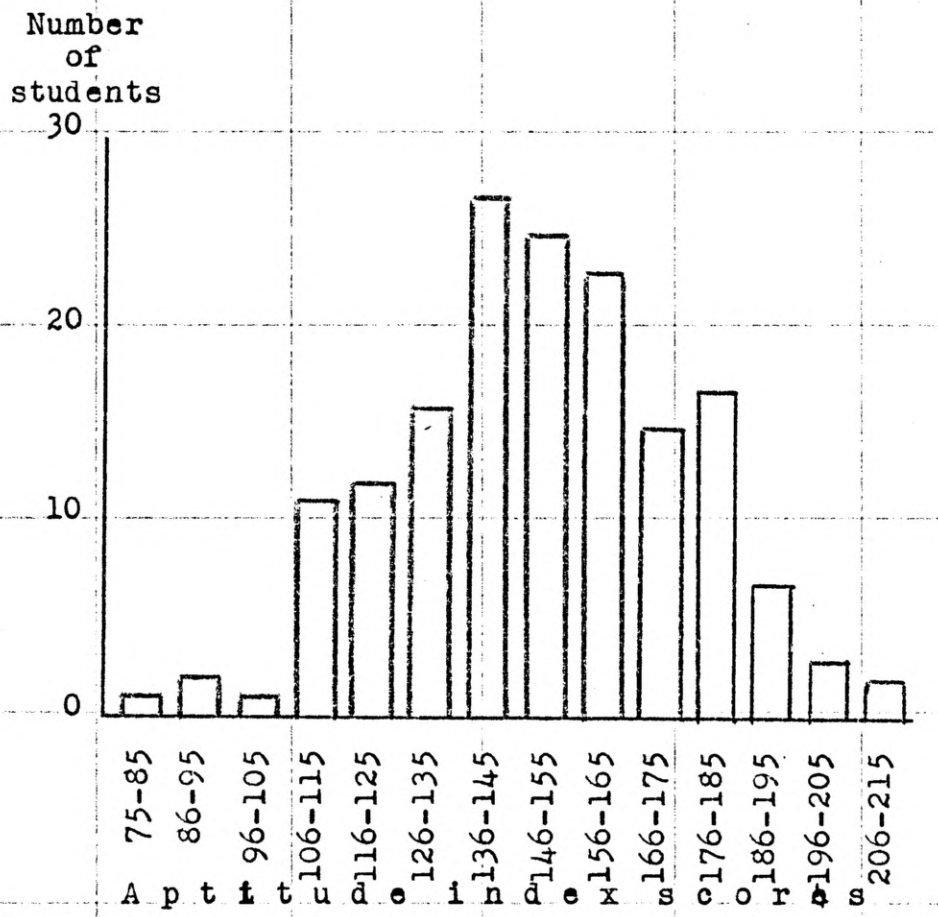


FIGURE 5. APTITUDE INDEX FOR 162 STUDENTS

Algebra Grade and Stanford Achievement Score
In Arithmetic for Sixty Two Pupils

Figures 6, 7, 8, 9 and 10 show relationships of the measures used in the study. The Scattergram was selected as the means of showing these relationships.

Figure 6 is a scattergram distribution showing the relationship between raw scores on the Stanford Arithmetic Achievement Test[5] and grades actually received in algebra by a group of students. The Stanford Test was administered in April of 1953 to all of the Lincoln School students. The algebra grade has been adjusted as explained in "grade index" page five.

Ideally these markers would be in a straight line with r = 1.0. The spread indicates a relatively low degree of correlation.

Relationship of California Algebra Aptitude Test Scores
And Intelligence Quotients for 162 Students

The graph in Figure 7 was used to indicate the relationship of scores on the California Algebra Aptitude Test and the intelligence quotient. The ideal scattergram would place all of the dots on a line from the lower left to upper right. The indication, from the graph, is a general pattern of correlation. Without figuring the correlation coefficient it is possible to say that the correlation tends to be a fairly strong positive one. In general those people with high intelligence quotients received high scores on the California Algebra Aptitude Test. Some exceptions are noted. Those students in the A area were above average, 103.5 in intelligence, and below average, 47 on the California Algebra Aptitude Test Score. In the B area are those below average in intelligence but above average in achievement.

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[5] World Book Company, op. cit.

The top California Algebra Aptitude Test score of 80 was not recorded by the most intelligent (Henmon Nelson Test) student nor did the least intelligent, by the Henmon Nelson Test, get the lowest score on the California Algebra Aptitude Test.

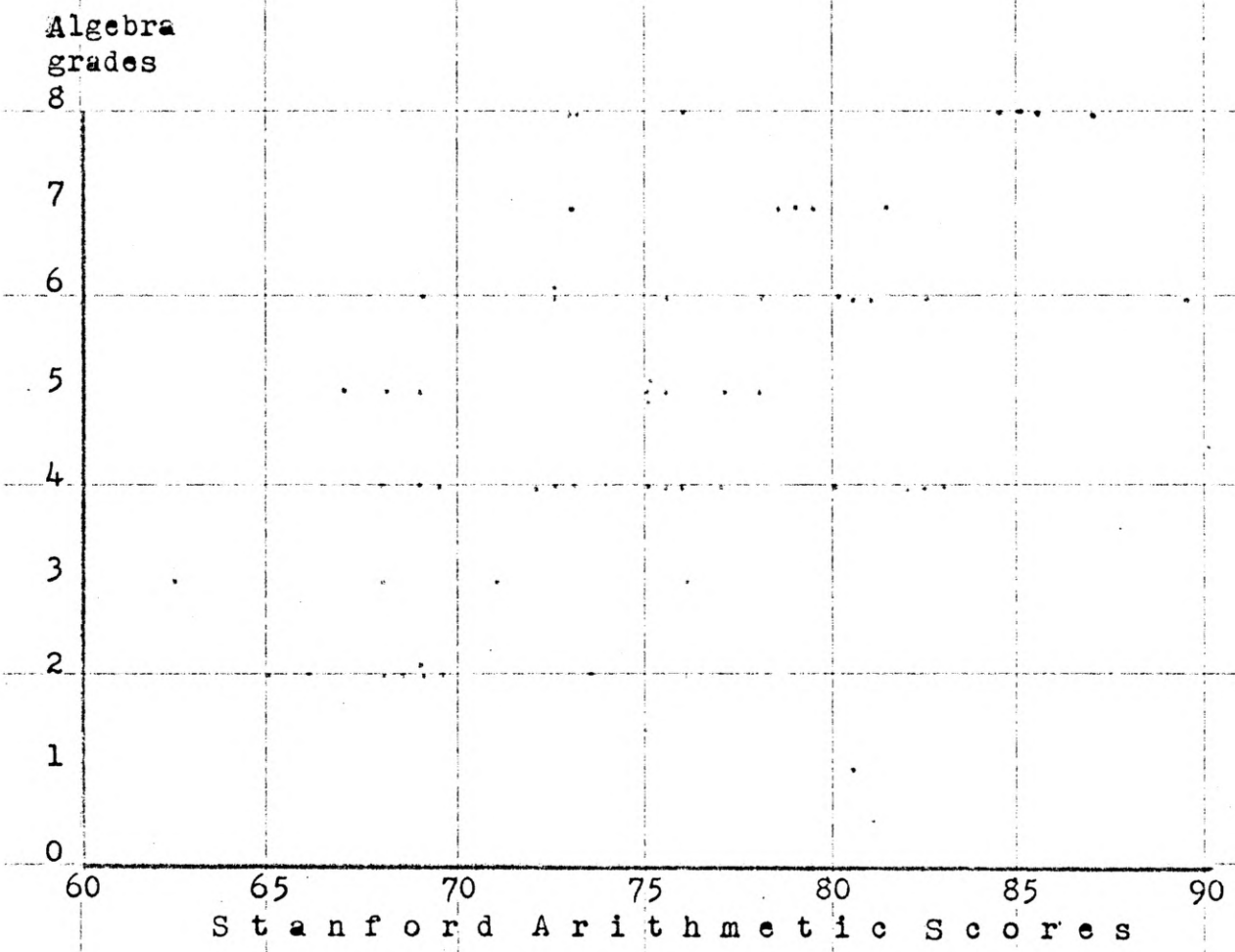


FIGURE 6. RELATIONSHIP OF ALGEBRA GRADE AND STANFORD ACHIEVEMENT SCORE IN ARITHMETIC FOR 62 STUDENTS

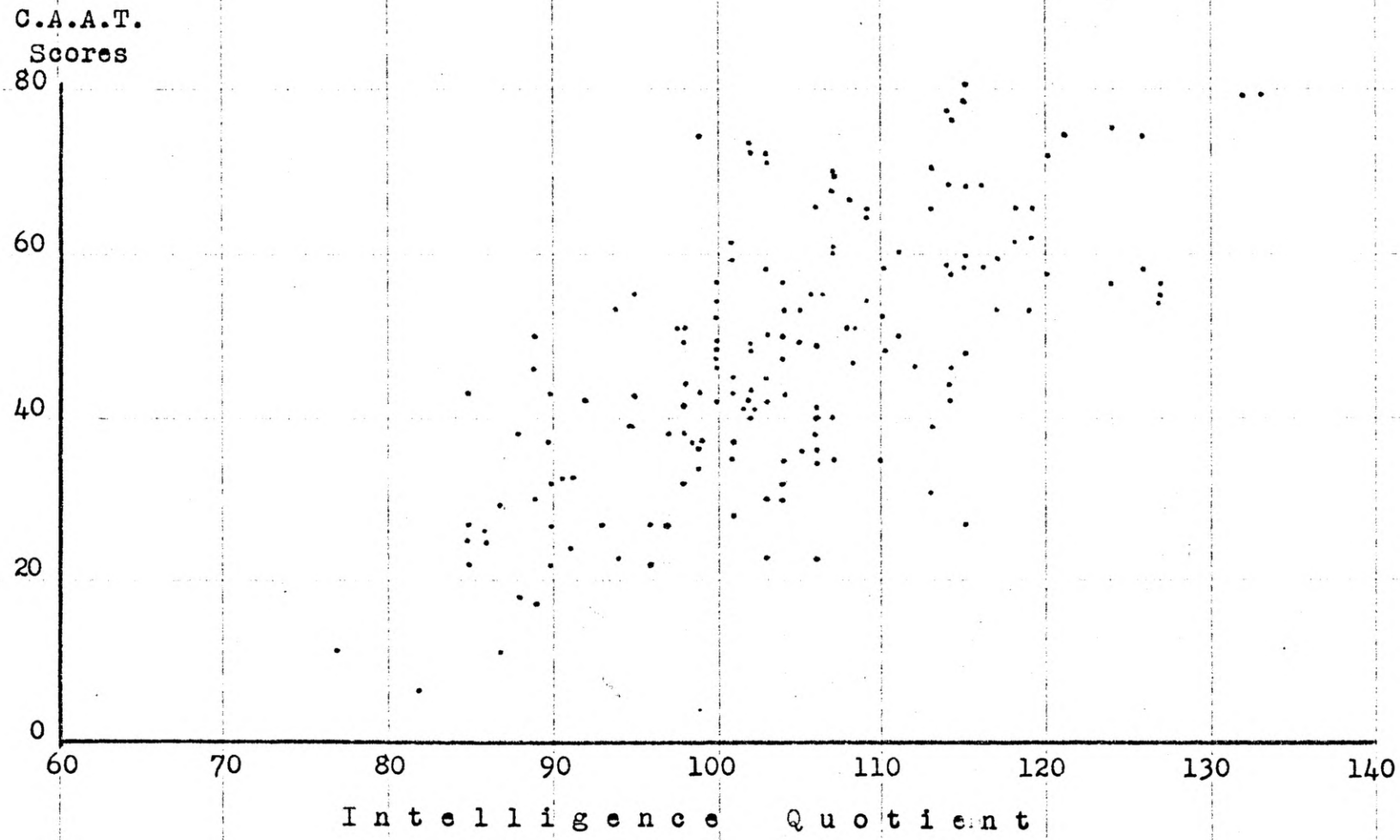


FIGURE 7. RELATIONSHIP OF CALIFORNIA ALGEBRA APTITUDE TEST SCORES AND INTELLIGENCE QUOTIENTS FOR 162 STUDENTS

Relationship of Intelligence Quotients
And Aptitude Index for 162 Students

Figure 8 is a scattergram showing the distribution of students when the intelligence quotient is plotted against the aptitude index. As expected, these came closer to perfect correlation than the others due to the fact that aptitude index is a composite score, one part being the intelligence quotient and the other part the California Algebra Aptitude Test score.

Aptitude Index and Algebra Grade of 149 Students

Figure 9, is a scattergram comparing the actual algebra grade received by 149 students to the aptitude index. The correlation run on these figures gave a coefficient of .85 (r = .85). This is a higher degree of correlation than that found by Sister M. Rasilda[6].

The 19 students who failed algebra constitute a group which should be investigated further.

Algebra Grades and Intelligence Quotients
For 149 Students

A correlation of .83 was computed for the relationship of algebra index and intelligence quotient of the same 149 cases as used in Figure 9 on page 34. Figure 10 indicates this relationship.

The difference in degree of correlation .83 and .85 favoring algebra index and aptitude index is so minor as to make questionable the advisability of going to the expense of administering the California Algebra Aptitude Test.

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[6]Rosilda, Sister M., op. cit., pp. 371-393.

Figures 6, 7, 8, 9 and 10 indicated a positive relationship between the various factors studied as possible predictors of success in mathematics in high school. Of the possible predictors, the aptitude index (composite of intelligence quotient and California Algebra Aptitude Test score) appeared the best. Using the Ayres Method formula a coefficient of correlation of .85 was determined.

Only two of these measures of ability were available at the time the freshman class chose its courses in the fall of 1953. These were the intelligence quotients and the scores on the Stanford Arithmetic Achievement Test. It appeared likely that the use of the California Algebra Aptitude Test scores coupled with intelligence quotients would have resulted in fewer failures, less frustration and possibly fewer dropouts.

The three remaining graphs, Figures 11, 12, and 13, show the number of students who took each mathematics course, the number who took specified mathematics programs, and the percentage that took each program and entered college.

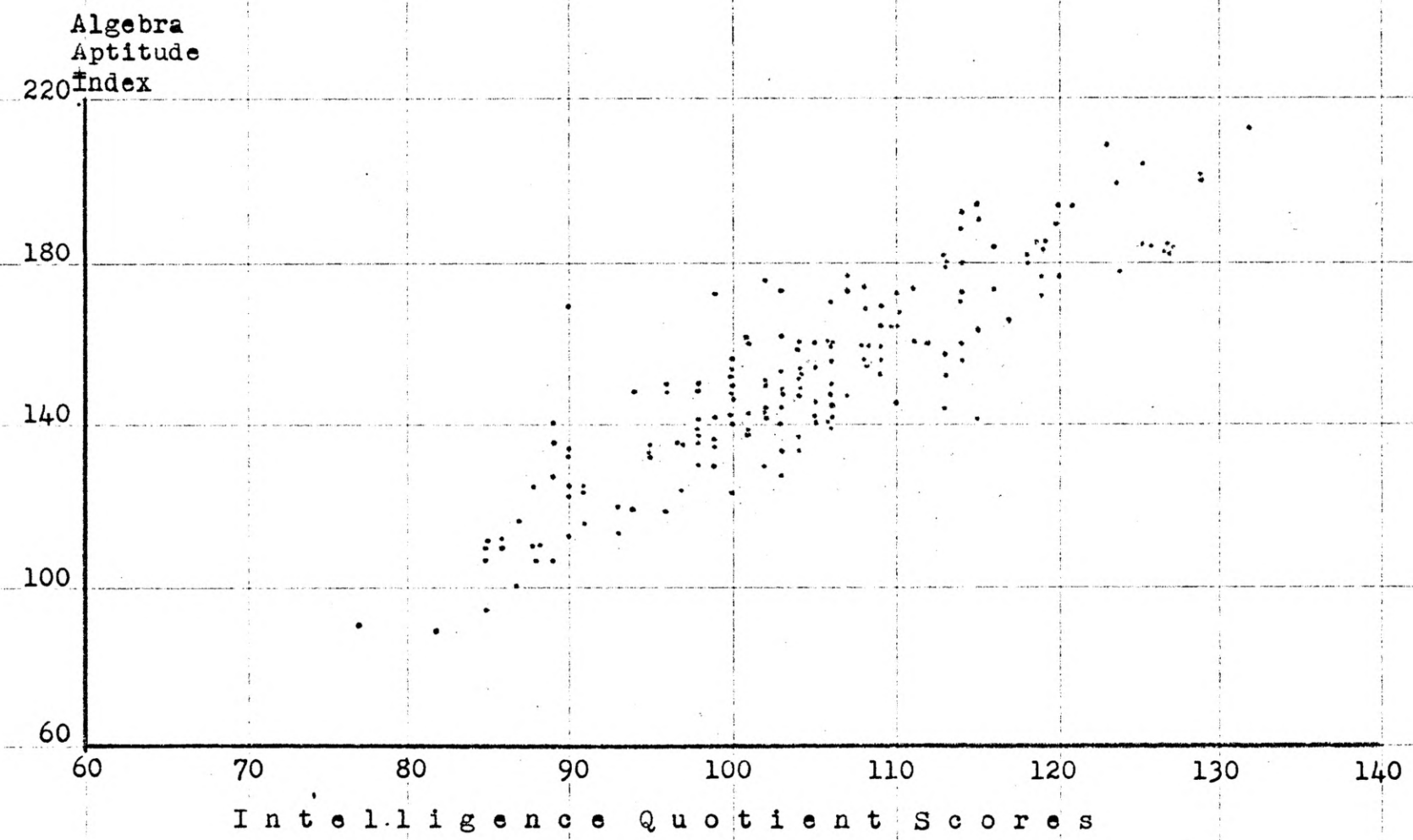


FIGURE 8. RELATIONSHIP OF CALIFORNIA ALGEBRA APTITUDE INDEX AND INTELLIGENCE QUOTIENTS FOR 162 STUDENTS.

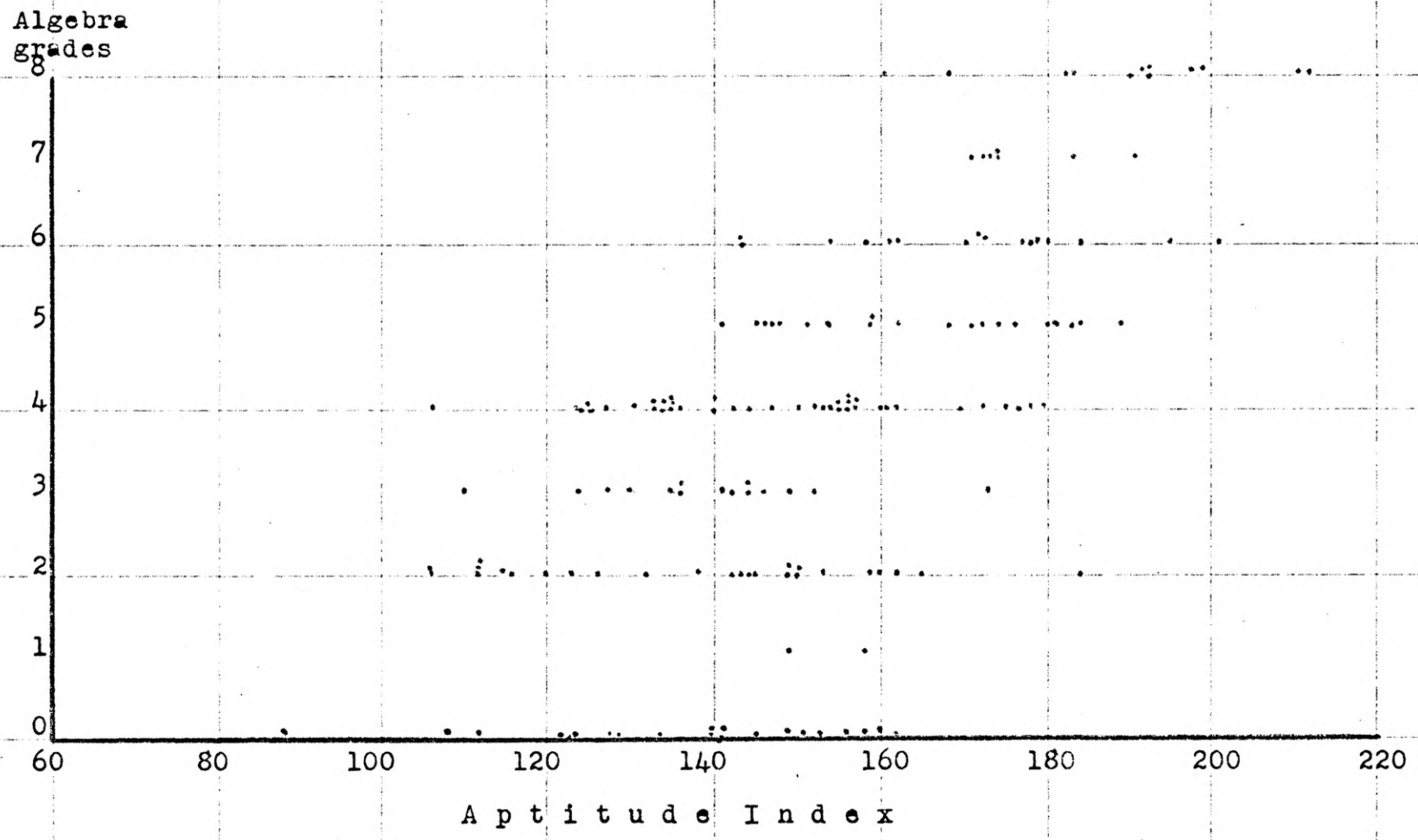


FIGURE 9. APTITUDE INDEX AND ALGEBRA GRADES FOR 149 STUDENTS

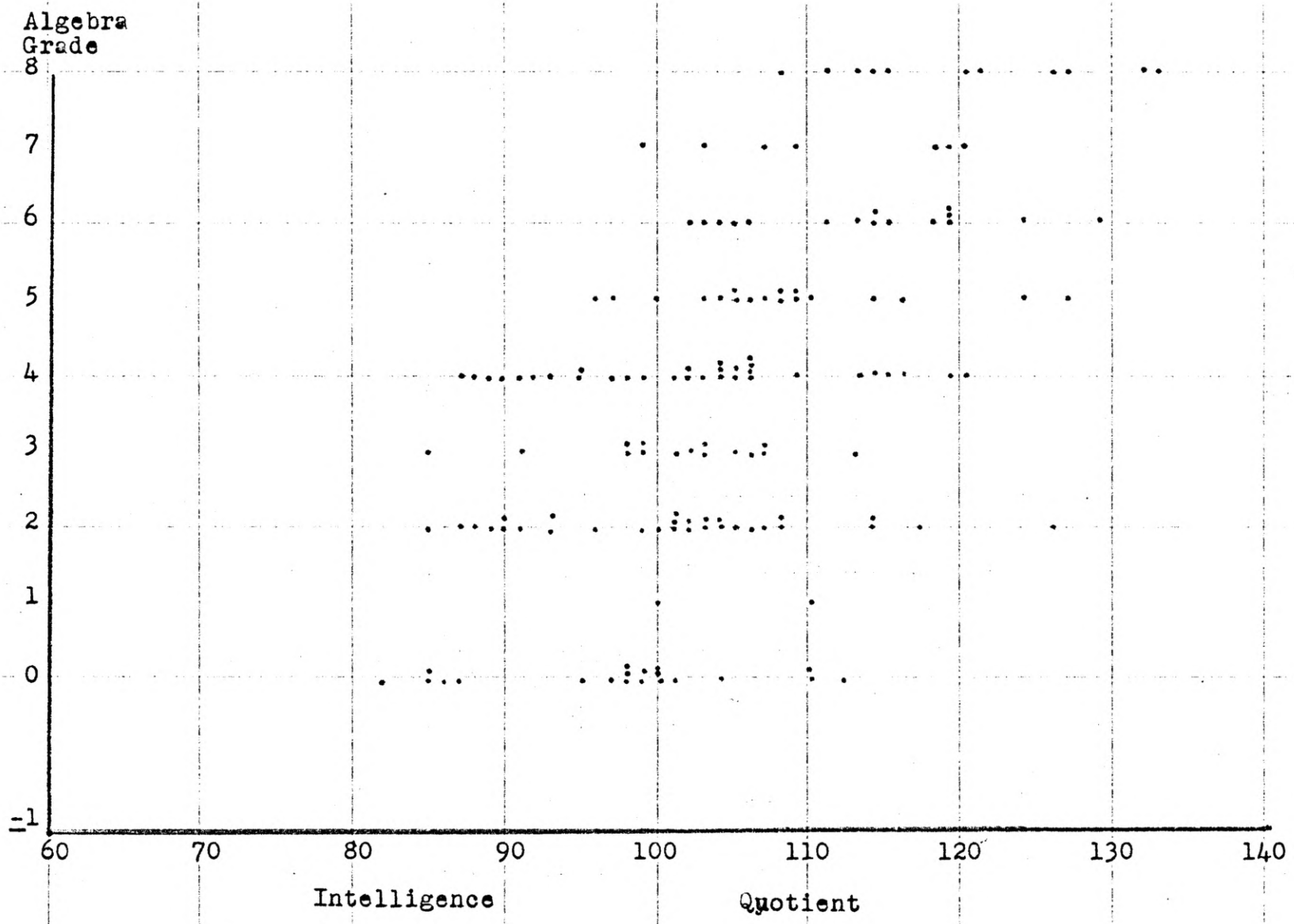


FIGURE 10. ALGEBRA GRADE AND INTELLIGENCE QUOTIENTS FOR 149 STUDENTS

Number of Students Who Took Each Mathematics Course

The graph in Figure 11 indicates the number of students who took each of the mathematics courses offered in Park County High School. Each course is considered independent of all of the others, and at a time when graduation requirements called for completion of one mathematics course. Significant is the fact that fifty-eight students took no high school mathematics beyond algebra.

Number of Students Who Took Specified Mathematics Courses During Their High School Career

The graph in Figure 12 shows the number of students who chose the various mathematics programs offered by the high school. They were divided into seven groups on the basis of the amount of mathematics they took.

Percentage of Students Who Took Varying Amounts Of Mathematics Attending College During the Year of 1957-1958

The graph in Figure 13 shows the percentage of students who attended college divided into groups as to the number of high school mathematics courses they took in high school.

Figures 11, 12, and 13 show the number of students who took each mathematics course, the number taking specified mathematics programs, and the percentage of each group who attended college in 1957-1958, respectively.

When it is remembered that these students completed high school during a time when one credit in mathematics was required for graduation, and that algebra was the recommended course, it became apparent why algebra was the most popular mathematics course. Only 91 chose to attempt geometry, which was advised for college entrance, and still fewer students, (31), entered mathematics courses on a purely elective basis. This indicated that 19% of

the class were interested in mathematics for the sake of mathematics, or for college entrance requirements into special technical fields .

It may be concluded that the holding power of the mathematics program is quite limited.

Figure 12 indicates the number of students who took each mathematics program. The rapid drop in numbers, once the requirements are ment, was once more apparent. Only 31 students advanced beyond algebra and geometry.

That students took mathematics for the purpose of meeting college entrance requirements would be a logical conclusion based upon a study of Figure 13. One hundred percent of those who took 4 or 5 mathematics courses attended college; 9[illegible]% of those who took three years of mathematics; 44% of those who took two years of mathematics; and none of those with one year attempted to go to college. It is concluded that the prospect of college attendance was a powerful incentive to enrollment in mathematics classes.

Thirty students of the total 162 dropped from high school. A Brief study of this group is presented in Chapter IV.

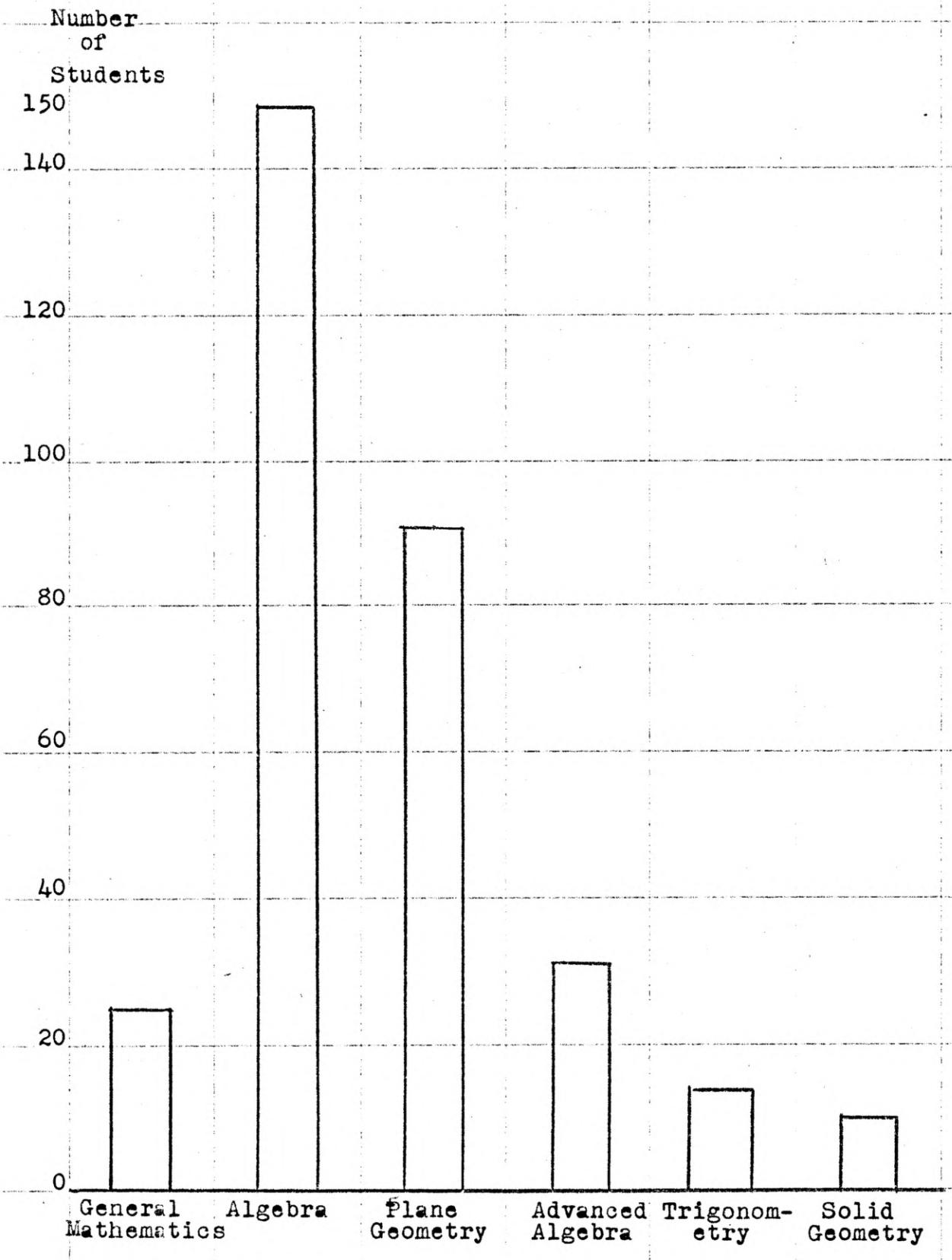


FIGURE 11. NUMBER OF STUDENTS WHO TOOK EACH MATHEMATICS COURSE

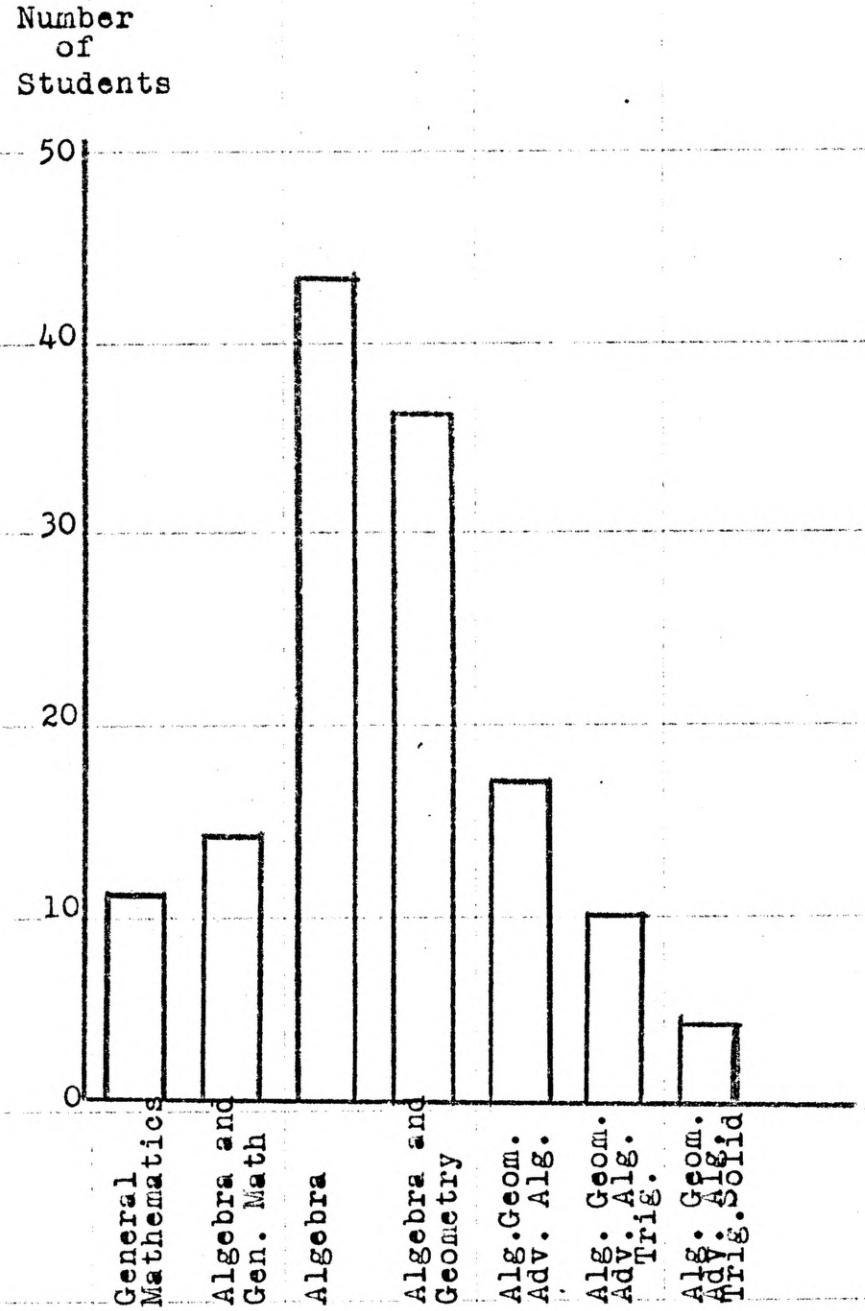


FIGURE 12. NUMBER OF STUDENTS TAKING SPECIFIED MATHEMATICS COURSES IN HIGH SCHOOL

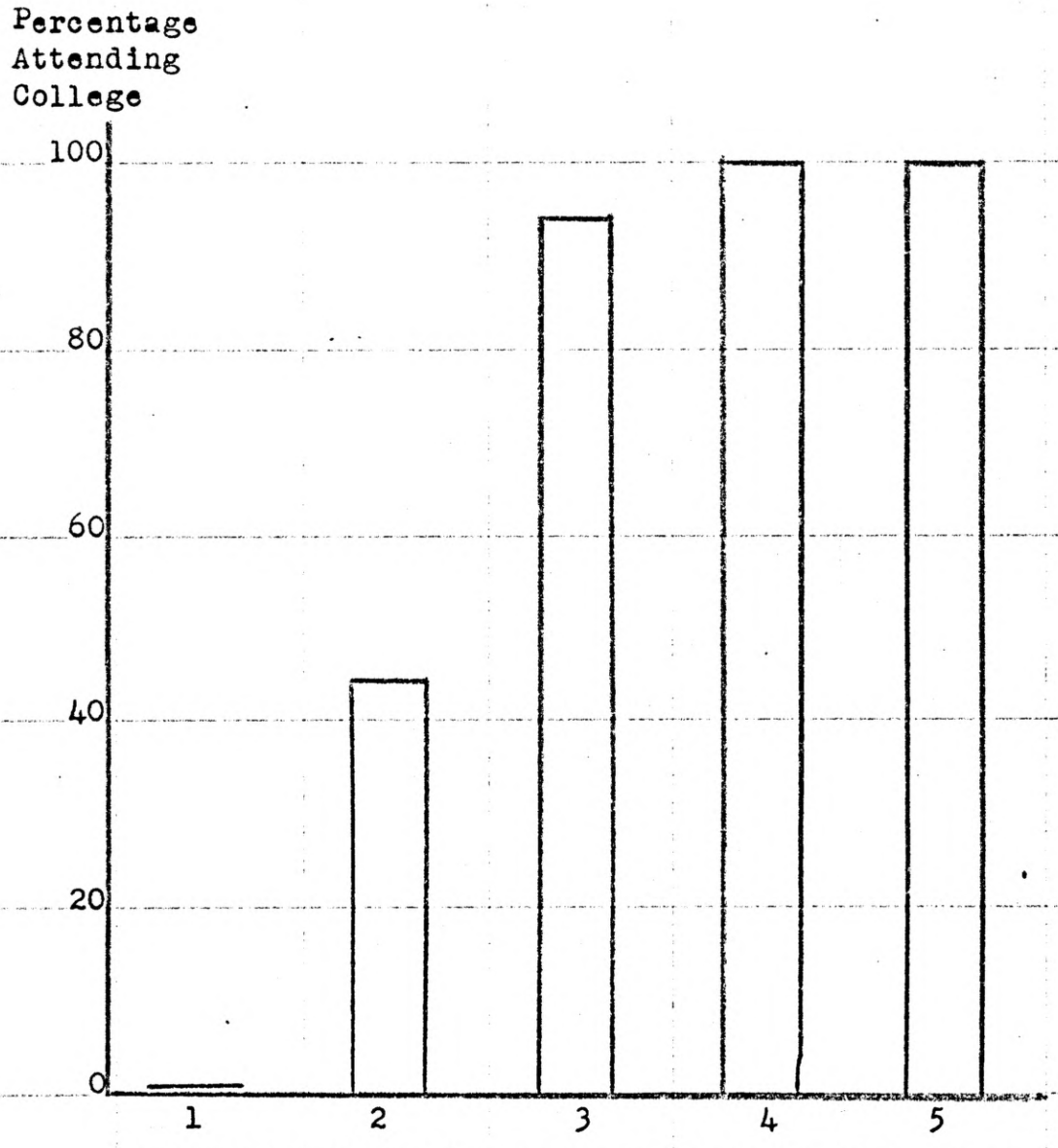


FIGURE 13. PERCENTAGE OF STUDENTS WHO TOOK VARYING AMOUNTS OF MATHEMATICS ATTENDING COLLEGE

CHAPTER IV

DROPOUTS IN RELATION TO MATHEMATICS COURSES TAKEN

Of the original 162 students who took the California Algebra Aptitude Test, 30 dropped out of school before graduation. Among the 30 dropouts were eighteen of the total of 25 who took general mathematics. In other words, 72% of the general mathematics students failed to finish high school.

The highest intelligence quotient registered for this group was 110, the lowest 65 for an average of 94. The highest score on the California Algebra Aptitude Test was 56 out of a possible 92 and the lowest score was six. Averages were 94 and 34 respectively.

A study of the reasons for dropouts reveals the following: six of them left because of marriage, another six left because of home conditions, and the remaining 18 were academic failures. Table 6 indicates characteristics of credits earned by the 18 dropouts who were academic failures.

TABLE 6. CHARACTERISTICS OF CREDITS EARNED BY 18 STUDENTS WHO DROPPED FROM SCHOOL

Characteristics	Credits Earned
Total credits normally earned by 18 students in one year	76½
Credits earned by dropout group	36½
Greatest number by one student	3½
Smallest number by one student	0
Average credits for the group	2+

The question arises as to the reason for the high percentage of dropouts. In an attempt to find an answer intelligence was considered. Eliminating the six who were married, there were 24 students left who dropped from school. They ranged from 65 to 127 in intelligence quotients from the highest to the lowest. Table 7 shows the intelligence of the 24 students who dropped from school.

TABLE 7. INTELLIGENCE QUOTIENTS OF 24 STUDENTS WHO DROPPED FROM SCHOOL

127*	101**	98**	90
120*	100**	98**	85**
110**	100**	97*	85*
107	100**	97**	82**
104**	100	94	77**
102*	98**	90	65**

(*) dropped because of home conditions
(**) failing in mathematics when dropped

Those marked (*) were classed as dropouts because of home conditions. None of these was doing failing work in any mathematics class at the time of dropping. Those marked (**) were failing in mathematics when they dropped.

This group ranged in intelligence from 65 to 110. In light of the general acceptance of normal intelligence from 90 to 110, all but four of the 13 cases of failure occur in this category. A brief study of the group that successfully completed high school reveals a range of 48 points in intelligence, from 85 to 133. Nine students with intelligence quotients below 90 completed high school. Two of these successfully attended college. Failures in high school mathematics tend to be concentrated in the first year's work. It was an avoided subject after that.

Table 8 shows the test scores on the 32 students who failed mathematics courses.

TABLE 8. TEST SCORES OF 32 STUDENTS WHO FAILED MATHEMATICS COURSES

Type of Test	Scores		
	High	Low	Avg.
Intelligence quotient	115	65	97.8
C A. A. T.	56	6	35.8
Aptitude Index	162	75	133.6

Table 9 shows the distribution of the failures according to mathematics courses.

TABLE 9. DISTRIBUTION OF FAILURES BY MATHEMATICS COURSES

Mathematics Course	Number of Failures	Number taking Course
General Mathematics	6	25
Algebra	22	149
Geometry	3	91
Advanced Algebra	0	31
Trigonometry	1	14
Solid Geometry	0	10

In all except the general mathematics courses, and one algebra failure, the failure marked the end, in high school, of the students' mathematics career. In general mathematics they were required to repeat the course.

Dropouts and failures continue to be a vexing problem to school administrators. In the group concerned here there were three contributing factors: pregnancy and marriage, home conditions, and scholastic failure. In many cases it was true that the dropout might have been the result of an intermingling of the above factors. The pregnancy cases were more prevalent in broken homes and working-mother situations, as four of the six were in this category. Home conditions might be: broken homes, inadequate finances, large families or waywardness on the part of the child. Academic failure, other than the cases of extremely low intelligence also reflected conditions in the home not conducive to scholastic success.

In Chapter V a summary of the study, with recommendations for improving the mathematics program is presented.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The pressing national need is to encourage enough students to continue studies in mathematics so as to fill important positions in research and technology, as well as to raise the mathematical intelligence of the general public. To accomplish these jobs it is essential that the holding power of the mathematics courses be improved at all levels.

The study revealed that 54 of the students dropped mathematics from their course as soon as they had met the minimum requirements for graduation. Another 36 dropped it as soon as they had satisfied college entrance requirements and only thirty one took mathematics as an elective.[1]

In a nationwide survey[2], conducted in 1952-53, one-third of all the tenth grade pupils were enrolled in geometry. In Park County High School the figure was in excess of one-half[3]. For advanced algebra the figures showed one-fourth nationwide and less than one-fifth locally. One-tenth of the twelfth grade pupils chose to study mathematics nationally and one-twelfth of the local seniors chose mathematics as an elective. This indicates a rapid decrease in interest once the basic requirements have been met.

The subjects offered in Park County High School are those common thruout the nation[4]. The variations offer the interesting possibilities.

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[1]See graph number 12 on page 44 of this study.

[2]Association for Supervision and Curriculum Development, National Education Association, 1956 Yearbook, What Shall the High Schools Teach?

[3]See graph number 11 on page 42 of this study.

[4]See page 12, paragraph one of this study.

The following summary statements represent the findings:

1. Students who took only general mathematics averaged lower in all measures used than those who took more mathematics. They did not attempt to go to college.

2. Table 2 and accompanying text indicated that general mathematics did not prepare the students for algebra.

3. A very high percentage, 30%, of those who chose only one year of mathematics dropped from school before graduation.

4. Most students who took algebra and geometry planned to go to college (text and Table 4).

5. That failure in mathematics courses was [illegible] experienced by very few students who chose the elective mathematics subjects was revealed by Table 5.

6. Figure 1 indicated that the group studied was normal in intelligence.

7. Grades received by the graduating members of the class tended to be grouped at the lower end of the grading scale.

8. Students tended to earn lower mathematics grades than would be expected from the results of the intelligence test.

9. The raw scores on the California Algebra Aptitude Test indicate that the class of 1957 was a superior group as does the graph Figure 5 which shows the aptitude index for the class.

10. Figure 6 indicated a low degree of correlation between Stanford Arithmetic score and algebra grade.

11. The pattern resulting when California Algebra Aptitude Test scores was plotted against intelligence quotients revealed a fairly strong positive correlation.

12. The use of the algebra aptitude index would be justified by Figure 9. Ayres Method correlation gave a coefficient of correlation between index and algebra grade of .85.

13. Intelligence was shown to be a good indicator of algebra ability by Figure 10. The coefficient of correlation between intelligence and algebra grades was .82.

14. Approximately one-third of all students, 58 of 162, dropped mathematics courses as soon as possible.

15. Algebra was the most popular mathematics course.

16. The number of students who chose mathematics decreased rapidly once minimum college entrance requirements were met.

17. Most of the students who met college entrance mathematics requirements went to college as shown by Figure 13.

18. The number of subject failures among dropouts exceeded the rate experienced by the non-dropouts as indicated by Table 6.

19. Intelligence was not the only factor concerned in the problem of dropouts.

The specific findings indicated the conclusions which follow.

Conclusions

From an analysis of the statistics on the 162 students in the study the following conclusions concerning course offerings, their organization and content, and predictive measures have been drawn.

1. General mathematics did not prepare students for algebra as evidenced by the fact that 11 of 14 who attempted this sequence failed algebra.

2. Mathematics courses were not adjusted to the students needs. A large number of students in the lower areas of the grade scale indicated the

possible sacrifice of thoroughness of teaching for the slow group in an attempt to keep from boring the brilliant.

3. Homogeneous grouping according to ability and achievement should be effected in mathematics classes. The results of the Stanford Arithmetic Achievement Test revealed a spread in grade placement of five years among members of the class at the time they were freshmen. Effective teaching of a group wherein such a spread exists poses problems which teachers might not be able to solve.

4. That few mathematics students sensed a feeling of continuity in the subject was made evident by the great number of students who terminated their mathematics education as soon as possible.

5. Intelligence was a factor in predicting success in mathematics. The more intelligent got better grades and a correlation of .83 was figured on the relationship.

6. The California Algebra Aptitude Test provides a means of increasing the reliability of intelligence as a factor in predicting mathematics success. The coefficient of correlation was .85 between aptitude index and algebra grades.

7. Academic failure in mathematics as a contributing factor to the dropout problem was indicated by the high percentage of mathematics failures recorded by the dropouts.

From the general conclusions listed above and the specific conclusions at the end of the chapters, recommended procedure were made.

Recommendations

What mathematics then should be offered in Park County High School? It is recommended that all of the present courses be kept, that the gifted

students be allowed to double up on basic mathematics courses and that additional courses be added.[5] The consumer mathematics in grade twelve looked especially worthy of special consideration for all students.

Further investigation, and recommendations from the mathematics department are needed to determine what should be done. The study showed that we have a problem, that it is receiving nationwide research, and that it is capable of solution.

How should the courses be organized as to sequence and content? Apparently the problem has many facets and should be thoroughly studied by the faculty.

Mac Lane[6], states that algebra and geometry, as covered in schools, consists exclusively of ideas already well known two hundred years ago, many of them two thousand years ago, and that no matter how much better these particular ideas are taught to more and more pupils, their presentation leaves school mathematics in a far more antiquated state than any other part of the school curriculum. Pupils would conclude that there is no such thing as a new mathematical idea. This need not be so. He points to the isolation of the secondary schools from new mathematical concepts and calls for the teachers to exchange ideas with the mathematicians.

Mayor, recommends a course of study adapted to a two track program and calling for homogeneous grouping.

Grade 9

Mathematics 9g--a continuation of the general mathematics of grades seven and eight

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[5]See page twelve, paragraph 2 of this study.

[6]Mac Lane, Saunders, The Impact of Modern Mathematics, Bulletin of the National Association of Secondary School Principals, May, 1954, pp.66-70.

Mathematics 9s--a first year of algebra with emphasis on relations to arithmetic and applications in geometry.

Grade 10=

Mathematics 1[illegible]g=-a continuation of general mathematics of grades seven, eight and nine.

Mathematics 1[illegible]s--plane geometry with topics from solid geometry and trigonometry.

Grade 11

Mathematics 11--intermediate algebra and trigonometry.

Grade 12

Mathematics 12--elementary mathematical analysis, including topics traditionally in college algebra, trigonometry and analytic geometry; and an introduction to calculus.

Mathematics 12c--consumer mathematics, one semester.[7]

The preceding recommendations are in accord, much of the way, with the courses being worked on at the University of Illinois as reported by Miss Brush[8].

If it is proper to double-track the present mathematics program, some measures of ability upon which to base the selection of students is needed.. The graph in Figure 7, page 31, showed a relationship between intelligence and algebra ability as measured by the California Algebra Aptitude Test, and graph number 9 shows the relationship between aptitude index and algebra grade. A correlation of .85 was determined for this relationship. This indicates a means of selection. Other criteria that should be studied carefully in making ability group assignments are pointed out by Potter.

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[7]Mayor, John R., A Suggested Course of Study in Mathematics, The Bulletin of the National Association of Secondary School Principals, May, 1954, pp. 83-87.

[8]Brush, Berneice, Former faculty member Park County High School, Participant in University of Illinois Mathematics Study Program.

1. The intelligence quotient.
2. The drive for work possessed by the pupil.
3. Teacher judgment of his skill and information in mathematics as shown by his marks and cumulative record.
4. Scores on standard tests in both arithmetic and reading.
5. The physical health of the pupil.
6. His nervous balance or stability.
7. The type of course demanded by the pupil often dictated by his current vocational plans.
8. The wishes of his parents.
9. The educational background of the family.
10. The economic status of the parents, which often determines wheter or not the pupil will need to prepare for college.[9]

Characteristics of the gifted pupil need be known to teachers so that they may identify these pupils informally before testing. Fehr gave ten traits of the gifted as follows:

1. An extraordinary memory--Gifted pupils have a mental storage capacity that is amazing, and it is relational rather than rote memory. They recall facts and concepts learned years ago and practiced very littly in the interim. The gifted child seems never to forget.
2. High level abstract thinking--Brilliant students make generalizations quickly and accurately.
3. Application of knowledge--Creative students see mathematics in their environment and they are facile in the application and manipulation of mathematical concepts.
4. Intellectual curiosity--A talented student is speculative and answers his doubts by a logical procedure.

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[9]Potter, Mary A., Mathematics for the Lower Fifty Per Cent, The Bulletin of the National Association of Secondary School Principals, May, 1954, pp. 96-103.

5. Persistent goal-directed behavior--Able children have the capacity for long and deep concentration on their problems. They do not give up, nor do they muddle through to a solution. They refine and polish their solutions until they are examples of concise thinking. This stick-to-itness is a rare trait and is readily recognized in those pupils who finally solve the most difficult exercises.

6. Intuition--The talented pupil has insight and the ability to penetrate, coming up with solutions in a manner that is frequently incomprehensible to teachers. How the pupil achieves this we do not know--perhaps through experience and outside reading and thinking, yet when it occurs, we should recognize it as a powerful predictor of future success.

7. Facility of expression--Ability in mathematics is almost always accompanied by high vocabulary and fluency of communication. Teachers can recognize this in class explanations and reports on assigned problems.

8. Hobby interest--The gifted pupil, at a given time, usually has a special interest on which he reads and works, and which he constantly relates to everything that goes on in class. Such interest must be recognized and encouraged. Examples are seen in the twenty-nine winners in the field of mathematics in the Search for Science Talent.

9. Virtuosity--The creative pupil gives every problem a new and more significant turn. He adds a more complex, more abstract connotation to a problem. If you cut a cone by a plane, you get a conic sections. The creative pupil says, "What do you get is you cut the cone by a parabolic cylinder, or more generally by any conical cylinder?" And the pupil who asked this question is an outstanding mathematician today.

10. Advanced mathematical knowledge--The mathematically gifted pupils have read and studied by themselves, and in class present solutions using far more mathematics than has been taught. Teachers must not deny the use of this advanced knowledge, but rather insist that it be used accurately and with correct understanding.[1]

Teachers should be on the alert for students possessing these characteristics.

The administrator must be able to adapt and adjust the school program to allow for variations in programming for these pupils.

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[1] Fehr, Howard F., Mathematics for the Gifted, The Bulletin of the National Association of Secondary School Principals, May, 1954, pp. 103-110.

Fehr suggests a number of problems as follows:

1. What is the best syllabus for study by these pupils?
2. What changes in administration and classroom procedures are necessary, feasible, and acceptable to provide maximum opportunity for the intellectually gifted?
3. What textbooks, library reference books, and other materials for study must be made available to both teachers and pupils?
4. How do colleges and examining boards co-operate with the high school in testing, giving advanced credit, and preventing repetition of work accomplished in the high school?[11]

There are several tests of mathematics aptitude which can be aplied. In the present program Park County High School used the general intelligence test, the scores on the Stanford Achievement Test in arithmetic, the California Algebra Aptitude Tests, and teacher appraisal to determine placement in general mathematics or algebra. Exchange between the groups is made possible and allowed but the student once placed, is almost on his own. Interest in mathematics drops rapidly once the minimum requirements are met . Motivation seems lacking for all except the eminently successful.

Such tests as the mathematics portion of the Differential Aptitude Tests; and the tests of the American Council on Education, Mathematics division, should be administered and evaluated as predictors of success in the local situation. The Kuder Preference Test can be administered on a group basis and aptitude testing used as a follow-up in those areas where interest is expressed.

What can be done to interest students in mathematics and keep them there long enough to allow them to develop their potential without encroaching

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[11]Fehr, Howard F., ibid., pp. 103-110.

upon the time needed for their proper development in other fields? Revision of the content of the courses seems a first step. Recognition of the gifted is called for, reorganization of programming to allow for individual differences and a definite motivating procedure is needed.

Teachers must be brought up-to-date on reorganization, content, and method. The pure mathematicians must come from their laboratories and assume a position of leadership among the teachers, and the teachers must welcome the assistance.

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APPENDIX

DATA FOR THE STUDY

Student Number	Graduate, Transfer, or Drop	Grade Point Average	Intelligence Quotient	California Algebra Aptitude Score	Appitude Index	Mathematics Courses: General Mathematics	Algebra	Geometry	Advanced Algebra	Trigonometry	Solid Geometry	Number of Courses Taken	Grade Points Mathematics Only	Stanford Arithmetic Scores
1	G	.536	101	35	136		D					1	2	69
2	G	2.12	99	74	173		B	B+	B	B	A	5	5.5	69
3	T		112	46	158	D+	F					2	1.5	
4	T		89	30	119	C								
5	G	.85	99	36	135		D+	C	D			3	3	68
6	G	2.33	114	57	171		B	C	B			3	5.3	81
7	G	1.89	113	65	178		B	C+	C			3	5	78
8	G	2.63	102	42	144		B	B	C			3	5.3	72.5
9	G	2.44	103	71	174		B+	B				2	6.5	80.5
10	G	.92	103	45	148		C+	D+				2	4	69
11	G	.25	104	32	136	D+						1	3	69
12	G	1.03	96	55	151		C+	C	D			3	3.3	75.5
13	G	.48	89	50	139	D+						1	3	66
14	G	1.82	111	60	171		B	C+				2	5.5	73
15	D		90	27	117	D						1	2	
16	D		87	11	98	F						1	0	
17	D		104	42	146		C+					1	5	
18	D		77	11	88	F						1	0	
19	T		85	25	110		D+					1	2	
20	T		114	42	156		C					1	4	
21	G	.83	91	33	124		C	D				2	3	67
22	G	1.36	109	54	163		C+	C	C			3	4.3	77
23	G	1.10	97	38	135		C					1	4	75.5
24	T		100	42	142		F					1	0	
25	G	1.54	100	54	154		C+					1	5	75
26	D		85	22	107	C	F					2	2	
27	G	1.55	109	37	156		C	D+	C			3	3.2	68
28	D		98	32	130		F					1	0	
29	G	1.821	115	48	163		C	C				2	4	73
30	D		110	58	168		C+							
31	G	1.68	119	53	172		B					1	7	79.5
32	G	2.03	105	40	145	B+	C+					2	6	
33	G		114	77	191	B	A	C+				3	6.7	
34	D		106	35	141		D+					1	3	
35	G	.67	114	46	160		D	F+				2	1.5	
36	G	.82	105	35	140		C					1	4	
37	G	1.43	86	25	111	B						1	6	63
38	G	.75	108	66	174		C+	C+	D			3	4	78
39	G	1.01	101	59	160		C					1	4	

DATA FOR THE STUDY (Continued)

Student Number	Graduate, Transfer, or Drop	Grade Point Average	Intelligence Quotient	California Algebra Aptitude Score	Aptitude Index	Mathematics Courses: General Mathematics	Algebra	Geometry	Advanced Algebra	Trigonometry	Solid Geometry	Number of Courses Taken	Grade Points Mathematics Only	Stanford Arithmetic Scores
40	G	2.60	105	49	154		C	B				2	5	82
41	G	.42	113	31	144	D						1	2	
42	G	.37	87	29	116		D	D				2	2	
43	D		100	52	152		D					1	2	
44	D		85	27	112		D					1	2	
45	G	2.71	107	69	176		C+	B+	B	A		4	6.5	69
46	G	.38	99	34	133	D						1	2	69.5
47	G	2.71	121	73	194		A	B+				2	7.5	87
48	D		65	10	75	F						1	0	
49	G	.75	98	51	149		D+	D				2	2.5	71.5
50	G	1.00	106	46	152		C	B+				2	2	80
51	G	1.88	106	49	155		C	B				2	5	83
52	G	.43	108	47	155		D	F				1	1	68.5
53	G	2.57	119	61	180		C	B				2	5	82.5
54	G	1.96	119	61	180		B	B+	C+	B	B	5	6	
55	G	2.28	129	72	201		B	B	C	C		4	5	
56	G	2.78	120	71	191		B+	B+	A	A	A	5	7.6	79
57	G	2.34	113	44	157		C	C				2	4	
58	D		101	61	162		D					1	2	
59	D		102	48	150		C					1	4	
60	G	3.00	111	50	161		A	A				2	8	73
61	G	1.96	105	53	158		B	C+	B	B	B	5	5.8	78.5
62	G	2.77	115	78	193		A	B+	B+			3	7.3	85.5
63	G	.88	114	64	178		C	C	C	C	B	5	4.4	77
64	G	.68	91	33	124	D+	D+					2	2.5	
65	G	2.07	107	66	173		B+	B	B	C		5	4.6	78.5
67	G	1.57	127	54	181		C+	C	C			3	4.3	
68	G	.68	116	58	174		C	D				2	3	
70	D		98	44	142	D+	F					2	1.5	
71	D		94	23	117	D						1	2	
72	G	1.61	99	43	142		D					1	2	68
73	G	2.138	118	61	179		B					1	6	80
74	G	.74	106	40	146		D+					1	3	
75	G	1.03	109	64	173		C+	C	C	C	B	5	4.6	75.5
76	T		106	36	142		D+					1	3	
77	G	.78	103	23	126		D	D				2	2	69.5
78	T		106	53	159		C+	C				2	4.5	
79	D		97	49	146		C+					1	5	

DATA FOR THE STUDY (Continued)

Student Number	Graduate, Transfer, or Drop	Grade Point Average	Intelligence Quotient	California Algebra Aptitude Score	Aptitude Index	Mathematics Courses: General Mathematics	Algebra	Geometry	Advanced Algebra	Trigonometry	Solid Geometry	Number of Courses Taken	Grade Points Mathematics Only	Stanford Arithmetic Scores
80	G	1.54	113	39	152		D+					1	3	76
81	G	2.07	118	65	183		B+	C+				2	6	
82	D		90	22	112	D						1	2	
83	D		100	47	147		F					1	0	
84	G	2.57	108	60	168		A	B	C+			3	6.3	73
85	G	1.00	106	38	144		C	C	D+	C		4	3.8	72
86	G	2.72	126	73	199		A	A				2	8	
87	G	.89	90	22	112		D					1	2	69
88	G	.47	90	32	122		F	D				2	1	59
89	T		119	65	184		B					1	6	
90	G	.92	90	37	127		D	D				1	3	62.5
91	D		100	49	149		F+					1	0.5	
92	G	1.37	95	39	134		C	C				2	4	63
93	T		116	68	184		C+					1	5	
94	D		114	77	191		C+	C+				2	5	
95	G	1.46	103	50	153		C	C+				2	4.5	68
96	G	2.11	124	56	180		C+	C+	C			3	4.6	
97	G	2.11	109	65	174		B+					1	7	81.5
98	T		103	35	138		D					1	2	
99	G	2.36	113	70	183		A					1	8	76
100	G	1.71	89	17	106		C	C+				2	4.5	
101	G	.93	106	65	171		C	D+				2	3.5	76
102	D		104	56	160	F+	F					2	0.5	
103	T		108	51	159		D	C				2	3	
104	G		106	37	143	D	D					2	2	
105	D		98	51	149	D	F					2	1	
106	G	.96	88	18	106		D					1	2	66
107	G	1.86	108	51	159		C+	B				2	5.5	
108	G	.59	102	49	151		D					1	1	73.5
109	G	1.59	106	55	161		C					1	4	75
110	G	2.93	132	79	211		A	A	A	A		4	8	84.5
111	D		97	27	124	C	F					2	2	
112	G	.61	93	19	112	C	D					2	3	65
113	G	1.00	102	40	142		C	C				2	4	
114	G	2.79	133	79	212		A	A	A	A	A	5	8	85.5
115	G	1.39	89	46	135		C					1	4	
116	G		100	40	140	D+	F					2	1	
117	G		95	39	134	C	F					2	2	
118	G	.89	92	42	134		C	D				2	3	72.5
119	G	.71	104	30	134		D					1	2	55.5

DATA FOR THE STUDY (Continued)

Student Number	Graduate, Transfer, or Drop	Grade Point Average	Intelligence Quotient	California Algebra Appitude Score	Appitude Index	Mathematics Courses: General Mathematics	Algebra	Geometry	Advanced Algebra	Trigonometry	Solid Geometry	Number of Courses Taken	Grade Points Mathematics Only	Stanford Arithmetic Scores
120	G	1.07	94	53	147		C	D+	C			3	3.6	68.5
121	T		106	55	161		B					1	6	
122	G	1.50	115	80	195		B	C	C			3	4.7	89.5
123	G	1.21	127	56	183		C+	D+	C			3	4	
124	G	1.61	104	43	147		C	C				2	4	
125	G	.11	101	28	129		F					1	0	58
126	T		100	56	156		F					1	0	
127	G	1.11	95	43	138		C	C		F		3	3.7	68
128	G	1.21	101	43	144		D	D+				2	2.5	76
129	G	1.00	104	53	157		C					1	4	72
130	D		127	55	182		A					1	8	
131	D		110	52	162		F+					1	0	
132	G	.77	110	48	158		F+					1	0.5	80.5
133	G	2.24	114	58	172		B	B	C			3	5.3	82.5
134	T		93	27	120		D					1	2	
135	T		103	30	133		C	C				2	4	
136	G	.02	110	35	145		F					1	0	
137	G	.36	102	45	147		D	D				2	2	
138	D		100	22	122		F					1	0	
139	G	1.04	102	42	144		D+					1	3	64.5
140	G	.46	96	27	123		D					1	2	60.5
141	G	.43	102	28	130	D+						1	3	62.5
142	G	1.21	90	43	133		C					1	4	65
143	G	1.39	87	38	125		C	D				2	3	68
144	G	1.39	98	38	136		C	C+				2	4.5	
145	G	2.86	120	74	194		A	A	A	A	A	5	8	75.5
146	G	.57	117	48	165	C	D					2	3	
147	G	1.04	99	37	136		D+					1	3	71
148	G	1.57	105	36	141		C+	C				2	4.5	73.5
149	G		86	26	112	C	F					2	2	
150	G	2.11	104	50	154		B	C+				2	5.5	
151	G	1.96	103	59	162		B	B	C	C	B	5	5.2	74.5
152	G		85	43	128	C+	F					2	2	
153	D		82	6	88	F	F					2	0	
154	G	1.64	98	41	139		C					1	4	73
155	G	.59	115	27	142	F+						1	1	
156	G	.70	102	73	175	D+	D+					2	3	85
157	G	.00	126	58	184	D+	D	D				3	2.3	
158	G	1.00	91	24	115		D	D	C			3	3	61.5
159	G	1.21	103	41	144		D+					1	3	

DATA FOR THE STUDY (Continued)

Student Number	Graduate, Transfer, or Drop	Grade Point Average	Intelligence Quotient	California Algebra Aptitude Score	Aptitude Index	General Mathematics	Mathematics Courses: Algebra	Geometry	Advanced Algebra	Trigonometry	Solid Geometry	Number of Courses Taken	Grade Points Mathematics Only	Stanford Arithmetic Scores
160	D		107	40	147		D					1	2	
161	G	2.67	124	75	199		A	A	B+	A	A	5	7.8	86.5
162	G	1.39	104	47	151		D					1	2	72.5
163	T		119	58	177		B					1	6	
164	D		120	57	177		C					1	4	