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# An Analysis of Relationships Among Ratings on Entrance Examinations and Academic Achievement in the College of Engineering, University of New Mexico

Elizabeth B. Thurston

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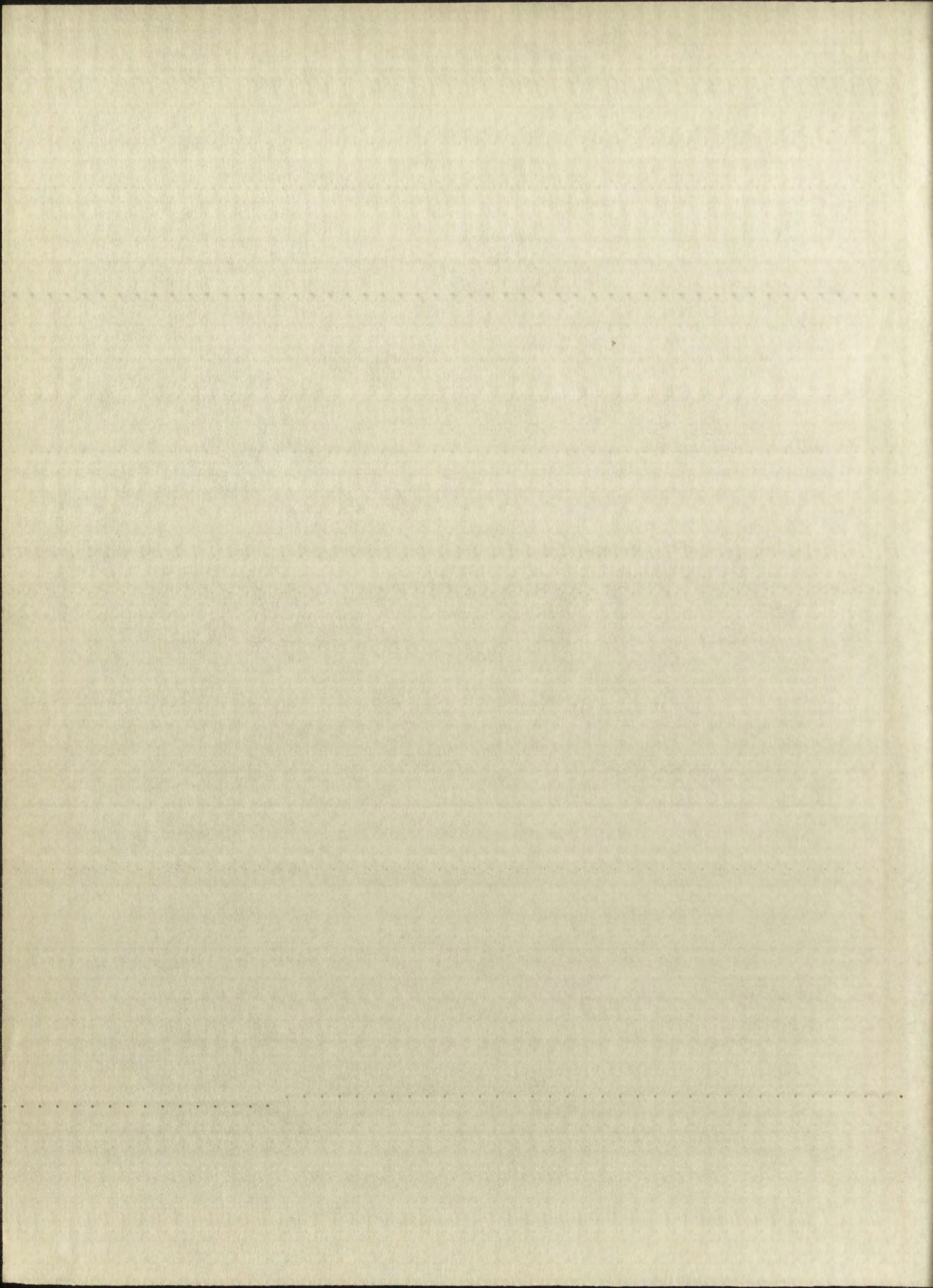
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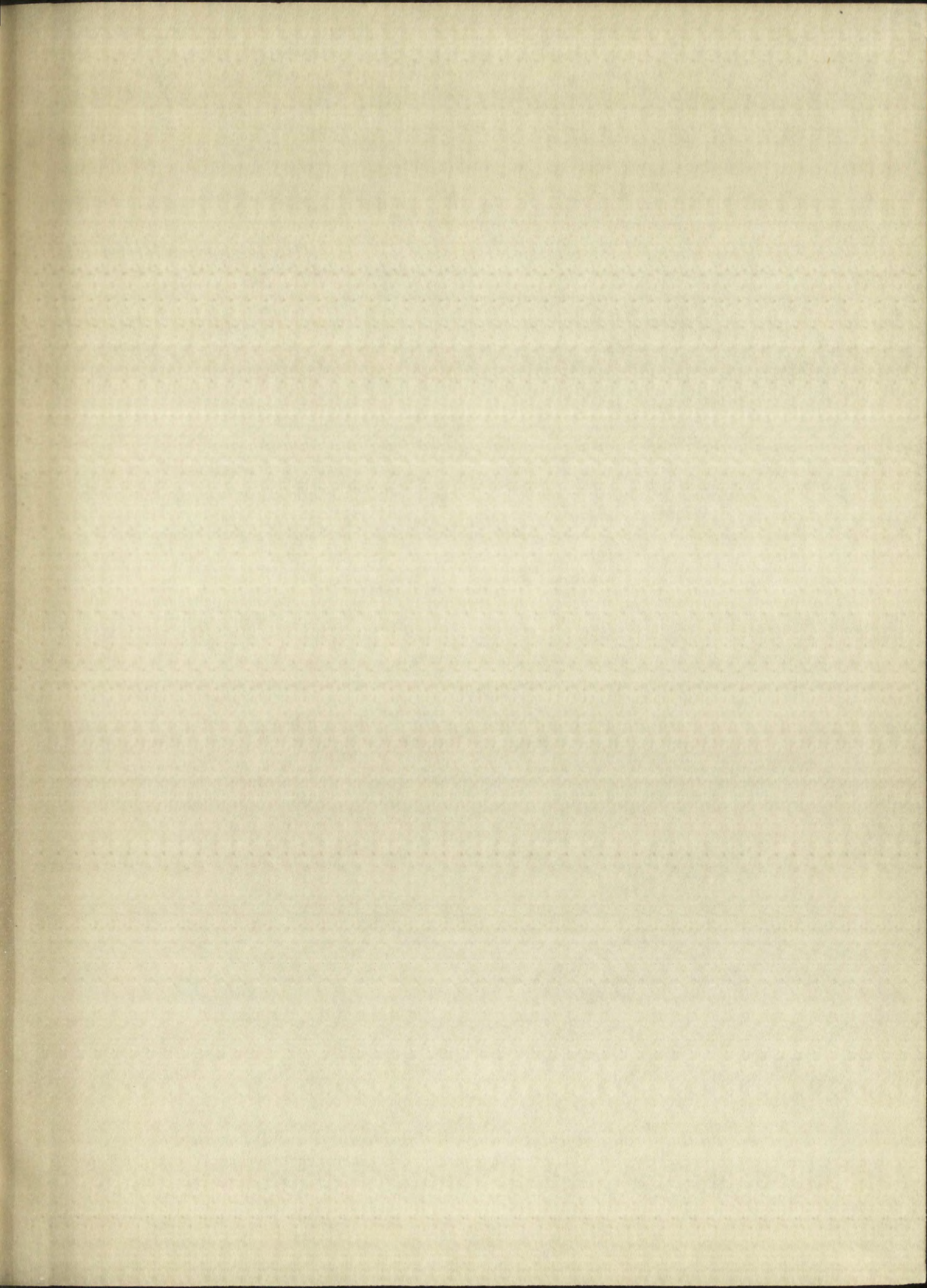




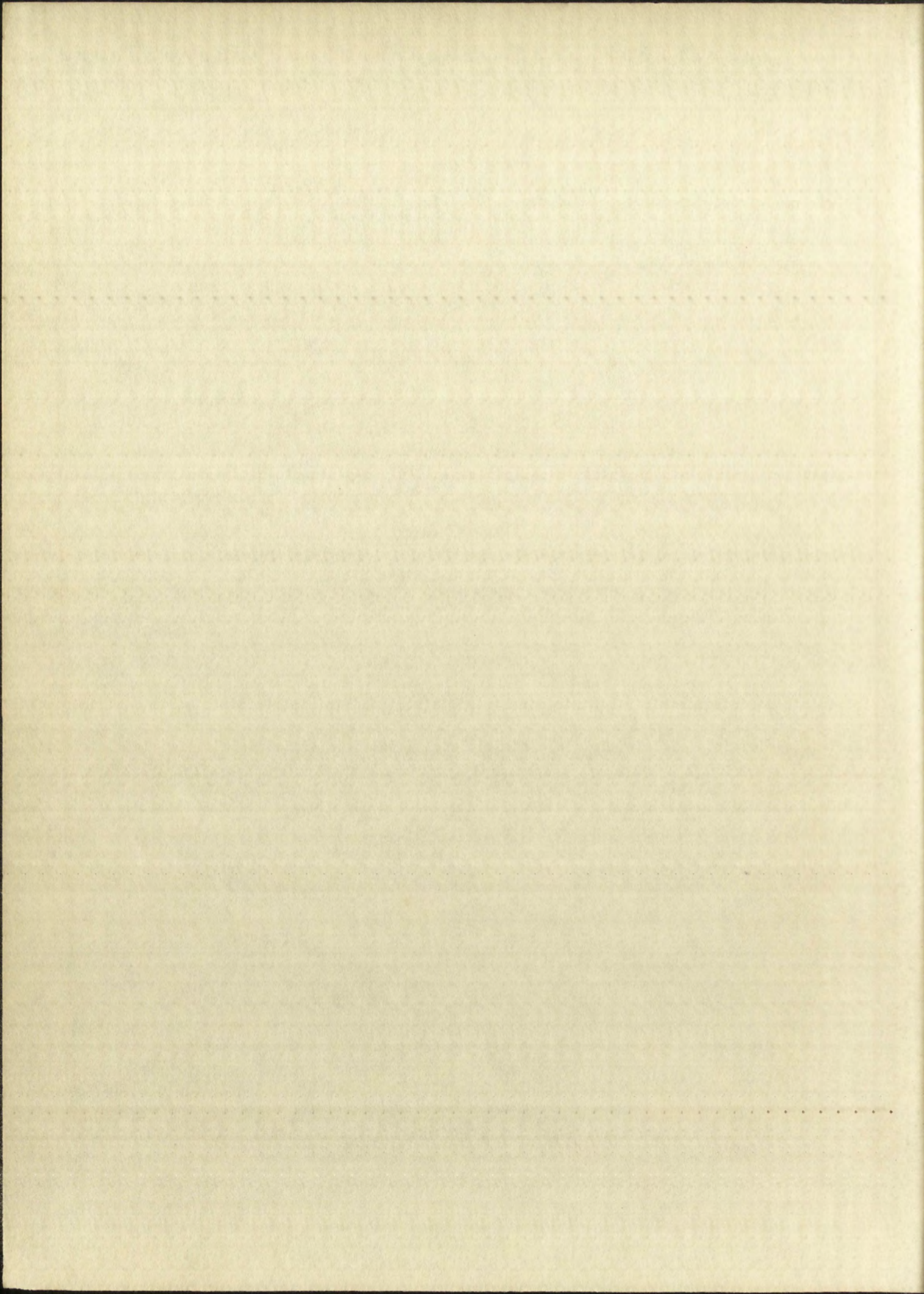








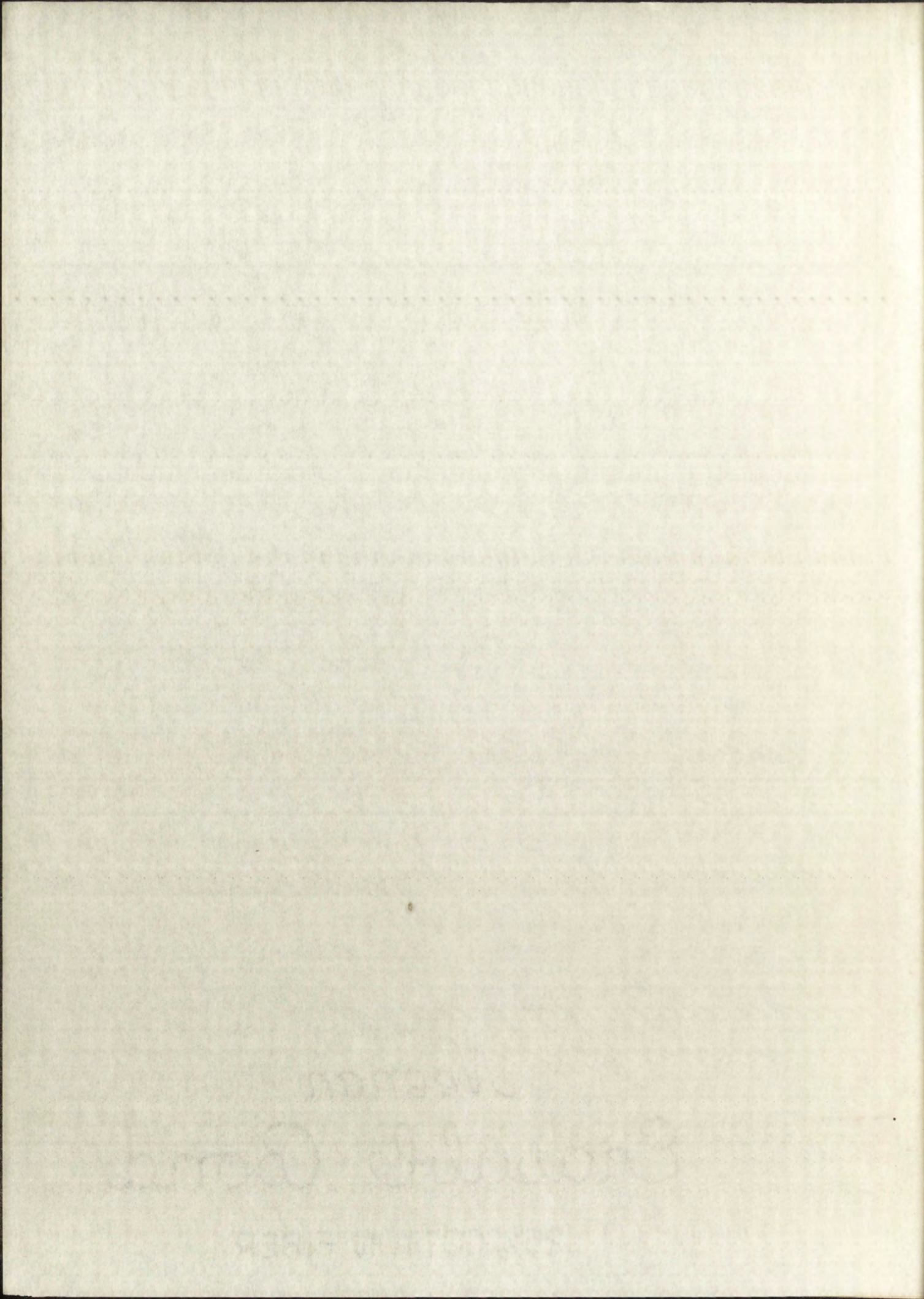






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An Analysis of Relationships  
among Ratings on Entrance Examinations and Academic Achievement  
in the College of Engineering,  
University of New Mexico

By

Elizabeth B. Thurston

A thesis submitted to the Faculty of the Graduate School,  
University of New Mexico, in partial fulfillment of the  
requirements for the Degree,  
Master of Arts in Psychology

The University of New Mexico

1958





AN ANALYSIS OF REFLECTIONS

ANALYSIS OF REFLECTIONS ON THE NATURE OF THE UNIVERSE

IN THE COLLEGE OF THE UNIVERSITY

UNIVERSITY OF TORONTO

ELIZABETH H. GIBSON

A thesis submitted to the Faculty of the Graduate Studies

University of Toronto in partial fulfillment of the requirements for the degree of

Master of Arts in Philosophy

Master of Arts in Philosophy

The University of Toronto

1964



This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

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## Chapter I

### Introduction

Statement of the problem. The purpose of this study is two-fold:

1. to determine relationships between academic success of students in the College of Engineering, University of New Mexico, and their standing in certain entrance examinations; and

2. to recommend cutting scores on the various tests which might be set as standards for admittance to the College of Engineering.

Significance of the problem. Of recent years, there has been considerable publicity concerning the great need in our country for engineers in all specialties, to perform technical services in our nation's industry and defense, and to assist in the industrial development of the backward nations of the world. The high initial rate of pay for graduate engineers, prospects of choice of good jobs and locations, professional prestige, the fascination of technology to many young Americans, and the publicity devoted to attracting young people into engineering all serve to make this field of study attractive to many students entering college.

At the same time, authorities are generally agreed that in the high schools, the standards of education in the basic sciences necessary to the engineer are widely variable and in many schools deplorably low. Thus many students are presenting themselves to the colleges, desiring entrance to a field of study which is in great demand, but bringing greatly varied proficiencies and background training.

It seems apparent that economic waste, to student and college, of admitting students who will fail, is great. The colleges, faced with







the difficulties of increased enrollment and shortages of qualified teaching personnel, will increasingly need to attempt to select only the students with the best possible chances of success. From the student's standpoint, withdrawal from engineering school because of failure entails not only financial loss and poor use of educational time, but also possibly serious psychological effects and social disability.

Many factors affecting success are very difficult or impossible to measure - factors such as drive, self-discipline, emotional equilibrium, and environmental circumstances. But tests have been designed which are believed to measure some of the aptitudes which make for academic success. This paper attempts to determine the extent to which results of these tests may predict success in engineering college. It is recognized that at best, because of the many other factors which may enter into academic success, the tests give only a rough prediction, but they may still be useful insofar as they predict better than chance selection.

Background of study. All students desiring to enter the University of New Mexico College of Engineering are required to take a battery of tests designed to measure their aptitudes and abilities for this course of study. Exception to this requirement is made in the case of students entering with advanced standing from other accredited engineering schools. The testing program is administered through the Counseling and Testing Service of the University. The test results are used by the Counseling and Testing Service, and also by the faculty of the College of Engineering, to assist students in evaluating their abilities and planning a profitable course of study.







The tests. The tests upon which this study is based are:

1. American Council on Education Psychological Examination for College Freshmen. The test has two parts: Linguistic (yielding the L score) and Quantitative (yielding the Q score). "The L-score is indicative of ability to succeed in those fields which require proficiency with language and facility of expression. The Q-score measures ability to deal with the type of material covered in technical curricula. Separate and composite scores are easily obtainable." (29) The composite score is called the T-score.

2. Pre-Engineering Ability Test of the Educational Testing Service. The test has two parts: Part I, Comprehension of Scientific Materials; Part II, General Mathematical Aptitude. The records of the students' scores on this test are in the form of a composite score for the two parts.

3. University of Nebraska Mathematics Placement Test. This is an achievement test, the results of which show the student to be prepared for more or less advanced mathematics in the curriculum of the University of New Mexico.

Approach to the problem. For the purpose of this study, no correlations were drawn between scores on these entrance examinations and grade point averages for university work. The criterion for validity for these tests in this case was not grade point averages, but simply the "succeed-fail" differential. Since a "C" (1 point) average is required for graduation, this is the point at which the "succeed-fail" cut score was set, averages above this point being counted as "success", and averages below being counted as "fail". The College of Engineering is not primarily interested in predicting the relative standing of the students, but in



The results of the test are as follows:

1. The test was conducted on 10 subjects.

2. The test was conducted on 10 subjects.

3. The test was conducted on 10 subjects.

4. The test was conducted on 10 subjects.

5. The test was conducted on 10 subjects.

6. The test was conducted on 10 subjects.

7. The test was conducted on 10 subjects.

8. The test was conducted on 10 subjects.

9. The test was conducted on 10 subjects.

10. The test was conducted on 10 subjects.



differentiating between those who have the ability to succeed in graduating, and those who do not. Therefore the analysis of the data in this study has been restricted to various aspects of measuring ability to succeed by means of these tests. This type of analysis was recommended as early as 1919 by Thurstone, who advised that for purposes of determining critical scores, such as would be useful in determining acceptance or rejection of candidates for specialized training, scattergrams should be used in preference to correlation coefficients. (24) As he said:

"The correlation methods do not place this emphasis on the individual but state the abstract relation between the several variables and this does not bring home to the psychologist his chances of error in advising about an individual student."



differentiating between those who have the ability to learn and those who do not. The former are given the opportunity to learn and the latter are not. This is the basis of the selection process. The selection process is based on the ability to learn and the ability to learn is based on the ability to learn.

Thursdays, who advised that the selection process is based on the ability to learn and the ability to learn is based on the ability to learn. Such as would be stated in the selection process. For specialized training, the selection process is based on the ability to learn and the ability to learn is based on the ability to learn.

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## Chapter II

### Review of the Literature

In 1952, Dr. A. Wellock, Director of Counseling and Testing Services, University of New Mexico, made a study of relationships between entrance test ratings and academic success during the freshman year, of 99 students who entered the College of Engineering of the University in the fall of 1951 and spring of 1952. Dr. Wellock's findings were presented in a paper read before the annual meeting of the Southwest Section of the American Society for Engineering Education at the University of New Mexico on April 3, 1953. The title of this paper was "The Prediction of Academic Success in the College of Engineering of the University of New Mexico". Some of the principal findings of this study are summarized as follows:

1. Pre-Engineering Ability Test. Of students ranking 6, 7, 8, and 9 (top of the scale), 94% made successful records in the freshman year; of students ranking 1, 2, 3, and 4 (low end of the scale), 35% made satisfactory records.
2. Q-score of the ACE Psychological Test. Of students ranking 6, 7, 8, and 9, 72% made successful records; of students ranking 1, 2, 3, and 4, 37% made satisfactory records.
3. L-score of the ACE Psychological Test. Of students ranking 6, 7, 8, and 9, 80% made successful records; of students ranking 1, 2, 3, and 4, 19% made satisfactory records.
4. T-score of the ACE Psychological Test. Of students ranking







6, 7, 8, and 9, 83% made successful records; of students ranking 1, 2, 3, and 4, 24% made satisfactory records.

It should be emphasized that these results apply only to the freshman class, while the present study is applied to students over a period of 5 years.

An excellent review of literature pertaining to the prediction of success in engineering college is to be found in the bulletin, "Selection and Counseling of Students in Engineering: Papers from a Conference on Counseling of Engineering and Science Students Held at the University of Minnesota in November, 1952." (25) Since this review is available, it is here merely summarized. Over the years, there seem to have been three principal types of studies made on the subject of engineering college success:

1. Studies of the patterns of student progress in engineering, including numbers of students entering engineering schools, intelligence levels, rates of drop-outs, rates of graduation, and subsequent career use of training.

2. Studies of correlations between grade-point averages and various methods of measurement and prediction, including a great variety of individual tests, multiple correlations involving various combinations of test instruments, sometimes combined with such other indicators as high school grades.

3. Studies of relations between engineering entrance, progress, and graduation, and other factors than those which are measured by tests of aptitude and ability. These factors include father's occupation, student's personality, interests, social level, etc.

The bulk of the studies pertain to correlations between single tests







or batteries of tests, and grade point averages, usually for the first term of first school year. The correlation coefficients ranged from about .55 to about .70, while multiple correlations, usually including high school grades, tend to yield somewhat higher coefficients. In general, the highest correlations are with grades on tests of mathematical ability, with high school grades, especially with grades in science and mathematics, and with these two combined.

Some studies not cited in the University of Minnesota bulletin are reviewed here.

Bartlett (2) published in 1943 his findings in a study of 534 students tested with the Yale Battery of Tests of Differential Academic Aptitudes. His studies showed the tests of Quantitative Reasoning, Mathematical Aptitude, Spatial Visualization, and Mechanical Aptitude produced significantly higher scores for engineering students than for non-engineering students, and that the reverse was true of tests of Verbal Comprehension and Artificial Language.

Carrillo and Reichart (4) published in 1952 a study of the effect of applying a "caution factor" to the scores on the ACE Psychological Examination. This "caution factor" was the ratio of the number of correct responses to the number of responses attempted. Multiplying Q, L, and T scores by this factor was found to increase the predictive value of the test for grades in the first year of the engineering curriculum.

Crook, in a Ph.D. thesis at the University of Minnesota (28), reported an attempt to measure the value of personality adjustment inventory items in predicting outcomes of college engineering training. He found a significant correlation between adjustment scale and first term grades,







but less for the second term grades, and no significant correlation for third term grades.

Sessions (21) at the University of Idaho made a study of the predictive value of the Pre-Engineering Ability Test in 1955, using first semester grade averages as criteria. He found that the test's correlation with grades, .60, was not significantly higher than that of the Cooperative General Achievement Mathematics Test, .56, and that "profile patterns as well as scattergrams revealed that even though the ACE test (ACE Psychological Test for College Freshmen) correlated lower than other tests with engineering grades, it served as the best test for determining critical scores". This comparison was between the ACE, the Cooperative Mathematics Test, and the Pre-Engineering Ability Test. Sessions also cites Thurstone as having pointed out "that the critical score techniques was more useful for practical prognostic purposes than the multiple correlation method because of the ease of application and because it differentiated better between those who failed or passed, though it did not predict actual grades". He quotes also Jex (27) and Slaymaker (23) as having independently shown evidence that supported Thurstone's observations.

Jones (11), in 1948 found a correlation of .63 between grade point averages and scores on the Cooperative Mathematics Test, and Cooperative Chemistry or Physics Test, when combined for multiple correlation with high school grades. For the tests alone, he found a correlation of .58.

Drake and Thomas (6) found that a combination of the Pre-Engineering Ability Test and either ACE Psychological or the centile rank in high school separated the high and poor achievers very well, 50% of the high achievers ranking in the top fourth on the tests, and 82% of the poor achievers ranking







in the lowest fourth on the tests.

Jones and Case (12) made a validation study of a new aptitude examination for engineering students at UCLA. The test was validated against grade point averages of freshmen and sophomores, and the correlations were found to be not higher than those found with other tests. They stated that it was their conclusion that "prediction of success in Engineering School cannot be improved by further manipulation of aptitude measures. If more of the variance is to be accounted for, it probably will be in terms of interest and personality variables."



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### Chapter III

#### Methods and Materials

The students whose records comprise the data for this study entered the College of Engineering in the fall of 1951, spring and fall of 1952, and spring and fall of 1953. The total number of these students is 400. The time elapsed since the entrance of these students is sufficient for them to have completed the normal four-year course of study. Success or failure has been interpreted partly on the basis of completion of the requirements for graduation. In the case of students who transferred out of the College voluntarily, distinction has been drawn between those who left with satisfactory records (a "C" average or better), and those whose records were below the "C" average required for graduation.

In order to determine the relationships between the students' standings on the tests under consideration, and their academic achievement, the records of the Registrar of the University pertaining to these students were consulted. From these records, the students were grouped as follows:

Group I. Graduates. Students who have either graduated from, or are still enrolled in the College of Engineering. In the case of students still enrolled, a satisfactory grade point average was considered presumptive evidence of eventual graduation. There were no students still enrolled who had less than satisfactory averages. Evidently, by this time, any whose work was less than satisfactory have dropped out in one way or another.

Group II. Successful Transfers. Students who withdrew from the College while still in good standing. There were various reasons for these







withdrawals. Some students left college to serve in the armed forces, and did not return. Some transferred to other institutions, and their ultimate achievement is not a matter of record here. Others no doubt withdrew for financial and personal reasons. Some evidently found a greater affinity for other careers, as evidenced by the fact that they transferred into other colleges of this university--especially the Colleges of Education, Business Administration, and Arts and Sciences.

There is here a problem as to whether these transfers should be considered to have succeeded in engineering, and whether prediction of success for these students on the basis of these tests can be considered evidence of test validity. However, none of the tests under consideration presumes to be a test of personality factors, interests, or attitudes. The fact that these students did succeed in maintaining a satisfactory grade average until the time of transfer or withdrawal would seem to indicate that their academic potential for engineering was adequate, and it was other factors not measurable by these tests which caused their withdrawal from engineering.

Group III. Unsuccessful Transfers. Students who left the College of Engineering with less than a satisfactory grade point average, but still of their own volition.

Group IV. Suspended. Students who were suspended by action of the College of Engineering.

Since the first two groups are similar in having demonstrated ability to perform adequately in the engineering courses undertaken, these two groups have been combined, for some of the analyses, into a single group termed "Successful". Groups III and IV also being similar in having







demonstrated inability to perform adequately in engineering courses, have been combined, for some purposes, into a single group termed "Unsuccessful". Most of the tables give figures for all four groups, and also for the combined groups.

Standings on entrance tests were categorized as follows:

1. The raw scores of the ACE Psychological Examination and the Pre-Engineering Ability Test were converted to nine scaled scores, called stanines. Stanine is the abbreviated term for "standard nine". A stanine is an interval of one half of a standard deviation, except for the extreme stanines 1 and 9. The middle stanine is 5, and contains the scores from  $1/4$  S.D. below the mean through  $1/4$  S.D. above the mean. Stanine 9 contains the scores above  $1-3/4$  S.D. above the mean score, and stanine 1 contains the scores below  $1-3/4$  S.D. below the mean. The scores on the ACE Psychological Examination were scaled according to norms established in this University. The scores of the Pre-Engineering Ability Test were also converted to stanines, but in this case the norms used were national norms as announced by the publisher.

2. The raw scores of the University of Nebraska Mathematics Placement Test were scaled in two groups only, according to whether the student did or did not exceed a cut score of 10, and 40, on the two parts of the test. These scores were not recorded separately, the cut score being a combination of the two partial scores. This criterion established the students' placement in their first mathematics courses at the university.

Except in the case of actual graduates, grade point averages were the criterion of success. On the basis of 1 point for a "C", any student whose grade point average was less than his number of credit hours was



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considered unsatisfactory. In other words, the student must have maintained at least a "C" average in all work, to be considered as successful.

For most analyses of this study, the raw numbers of students falling within various categories and stanines have been converted into percentages. While this method seemed most practicable for the group as a whole, it should be observed that at the high and low ends of the scale, the raw numbers are very low, to the point that the percentage figured becomes very subject to distortion. Therefore the reader is reminded to bear in mind the possible weakness of the percentage expressions at the ends of the scale.

In this study, the term "cut score" refers to a practical use of test results in the selection of students. The cut score is whatever score is set by college administrators as minimum standard for admittance, or for advising students in favor of their attempting a course of study.



considered unnecessary. In fact, the only way to make it

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## Chapter IV

### Presentation and Analysis of the Data

In this chapter data relating to the five test scores (Q score, L score, T score, Pre-Engineering Ability Test score, and Mathematical Placement score) will be presented and analysed. There will also be a presentation of results obtained by combining the three best tests, according to their predictive value, in a battery. The results obtained by grouping the students' scores by stanines, and their academic achievement according to their various success categories are presented in tables and graphs, and discussed.

#### The Q Scores

Tables 1, 2, 3 and 4 and Figure 1 present the data relating to the Q scores.

Table 2 reveals that the division between stanines 3 and 4 is a point above which a student had a better than even chance of success, and below which he had a 2-to-1 chance of failing. Inspection of Figure 1 also shows a definite break in the curve of successes--a very rapid drop in successes below this point. Analysis of the data of Table 3, using the division between stanine 3 and stanine 4 as a point of analysis, reveals the following facts:

1. Of the Graduates, 97% ranked 4 or better.
2. Of the Successful Transfers, 92% ranked 4 or better.
3. Of the Unsuccessful Transfers, 88% ranked 4 or better.
4. Of the Suspended group, 77% ranked 4 or better.
5. Of the entire 400 students, 91-1/2% ranked 4 or better.



In this chapter, the author discusses the various factors that have influenced the development of the world's history.

According to the author, the world's history is a complex process that has been shaped by a variety of factors, including geography, climate, and human activity. The author argues that the world's history is a continuous process that has been shaped by the interactions of these factors over time. The author also discusses the role of the individual in the world's history, and how the actions of individuals can influence the course of history.

Table 1. The World's History: A Summary of the Main Factors.

Table 1

Table 2. The World's History: A Summary of the Main Factors. This table provides a detailed summary of the main factors that have influenced the world's history, including geography, climate, and human activity. The table is organized into three columns, with the first column listing the factor, the second column describing the factor, and the third column providing a summary of the factor's influence on the world's history.

Table 2

1. Of the Geography, the author discusses the role of geography in the world's history, and how the physical features of the world have influenced the course of history.
2. Of the Climate, the author discusses the role of climate in the world's history, and how the weather and climate have influenced the course of history.
3. Of the Human Activity, the author discusses the role of human activity in the world's history, and how the actions of individuals and groups have influenced the course of history.
4. Of the Geography, the author discusses the role of geography in the world's history, and how the physical features of the world have influenced the course of history.
5. Of the Climate, the author discusses the role of climate in the world's history, and how the weather and climate have influenced the course of history.



6. Of the combined Successful group, 96% ranked 4 or better.

7. Of the combined Unsuccessful group, 84% ranked 4 or better.

Thus a cut point below stanine 4 would have admitted 96% of the Successful students, and 84% of the Unsuccessful. It would have eliminated 4% of the Successful and 16% of the Unsuccessful students. While this difference is not so great as admissions officers might wish, for their purpose of selection, it is statistically significant. Using the chi square test for the significance of differences, it is found that the groups separated between stanines 3 and 4 are significantly different at the .01 level of confidence, with respect to success in engineering studies.

A cut point between stanines 4 and 5 would have eliminated 15% of the Successful group, and 30% of the Unsuccessful. Thus we see that a cut point below stanine 4 would have eliminated four times as great a percentage of unsuccessful students as successful, while a cut point below stanine 5 would have eliminated only twice as great a percentage of unsuccessful as successful students. Comparison of raw numbers shows that a cut point below stanine 4 would have eliminated 11 successful and 23 unsuccessful students. With a cut point below stanine 5, 39 successful and 44 unsuccessful students would have been eliminated. Thus at stanine 5 we approach the point of eliminating as many successful as unsuccessful students.

Table 3 also shows what percentage of all the students would have been admitted, by establishing cut points below the respective stanine levels. Thus, if the cut point were below stanine 3, 96% would have been admitted. If the cut point were below stanine 5, 79% would have been admitted.

Table 4 shows what percentage of students admitted according to the respective stanine level cut points would have been successful. Thus, if the



6. Of the combined successful group, the combined level was 70.0.

7. Of the combined unsuccessful group, the combined level was 50.0.

Thus a cut point level of 60.0 was established.

Successful students, and for the first time, it was possible to determine

the level of the successful and the level of the unsuccessful group.

It was not as great as the level of the successful group, but it was

close to the level of the successful group. It was 55.0.

Test for the significance of differences. It is found that the

difference between the level of the successful and the level of the

level of the unsuccessful group is significant.

A cut point level was established at 60.0.

The successful group, and for the first time, it was possible to determine

the level of the successful and the level of the unsuccessful group.

It was not as great as the level of the successful group, but it was

close to the level of the successful group. It was 55.0.

Test for the significance of differences. It is found that the

difference between the level of the successful and the level of the

level of the unsuccessful group is significant.

A cut point level was established at 60.0.

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the level of the successful and the level of the unsuccessful group.

It was not as great as the level of the successful group, but it was

close to the level of the successful group. It was 55.0.

Test for the significance of differences. It is found that the

difference between the level of the successful and the level of the

level of the unsuccessful group is significant.

A cut point level was established at 60.0.



cut point for admittance were below stanine 3, 64% of the students admitted would have been successful. If the cut point were below stanine 5, 67% of the students admitted would have been successful. The data show that of all students actually admitted, 63% were successful, according to our present definition of success in relation to these tests, although only 44% actually graduated.

The distribution of successes and failures by stanines is graphically presented in Figure 1.

With a grouping of all scores at or above stanine 4 as High, and all below as Low, the tetrachoric correlation coefficient ( $r_t$ ) was computed for the relation between High and Low standing on the Q score, and Successful and Unsuccessful groups. The  $r_t$  was .25, which is significant.



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Table 1  
Distribution of Number of Q-Scores on  
ACE Psychological Examination for College Freshmen

Category	Stanines									Sum
	9	8	7	6	5	4	3	2	1	
Graduates	13	26	38	52	21	21	4	1	0	176
Successful Transfers	9	9	24	10	10	7	3	2	1	75
Unsuccessful Transfers	3	12	17	22	17	17	7	3	2	100
Suspended	1	1	6	17	9	4	8	3	0	49
Totals	26	48	85	101	57	49	22	9	3	400
Successful	22	35	62	62	31	28	7	3	1	251
Unsuccessful	4	13	23	39	26	21	15	6	2	149
Totals	26	48	85	101	57	49	22	9	3	400







Table 2

Percentages of Q-Scores for Success Categories on  
ACE Psychological Examination for College Freshmen

[illegible]







Table 3

Percentages of Q Scores on ACE Psychological Examination for College Freshmen  
Falling Above Stanine Level Cut Points  
by Categories of Success

Category	Stanines*								
	9	8	7	6	5	4	3	2	1
Graduates	7	22	44	73	85	97	99	100	100
Successful Transfers	12	24	56	69	83	92	96	99	100
Unsuccessful Transfers	3	15	32	54	71	88	95	98	100
Suspended	2	4	16	51	69	77	93	99	100
Successful	9	23	47	72	85	96	98	99	100
Unsuccessful	3	11	26	50	70	84	94	98	100
Total†	6	18	39	65	79	91	96	98	100

\*The scores falling in the given stanines are included in the percentage.  
That is, the cut point is below the given stanine.

†The total gives the percentage of total applicants that would have  
been admitted if only those in or above the given stanine had been admitted.



# Percentage of Scores in Various Categories

Table 1  
 of Scores in Various Categories

Category	1	2	3	4	5	6	7	8	9	10
Graduates	12	11	10	9	8	7	6	5	4	3
Successful Transferees	12	11	10	9	8	7	6	5	4	3
Unsuccessful Transferees	12	11	10	9	8	7	6	5	4	3
Rejected	12	11	10	9	8	7	6	5	4	3
Successful	12	11	10	9	8	7	6	5	4	3
Unsuccessful	12	11	10	9	8	7	6	5	4	3
Total	12	11	10	9	8	7	6	5	4	3

The scores falling in the first category are shown in Table 1. That is, the first point is below the first standard. The total given the second point is shown in Table 2. The scores falling in only one of the first two categories have been shaded in only those cases where the total score is 10 or more.



Table 4

Percentage of Successful Students to Total Students

Above Each Stanine Level for Q Scores

	Stanines								
	9	8	7	6	5	4	3	2	1
Percentage	85	77	75	69	67	66	64	63	63



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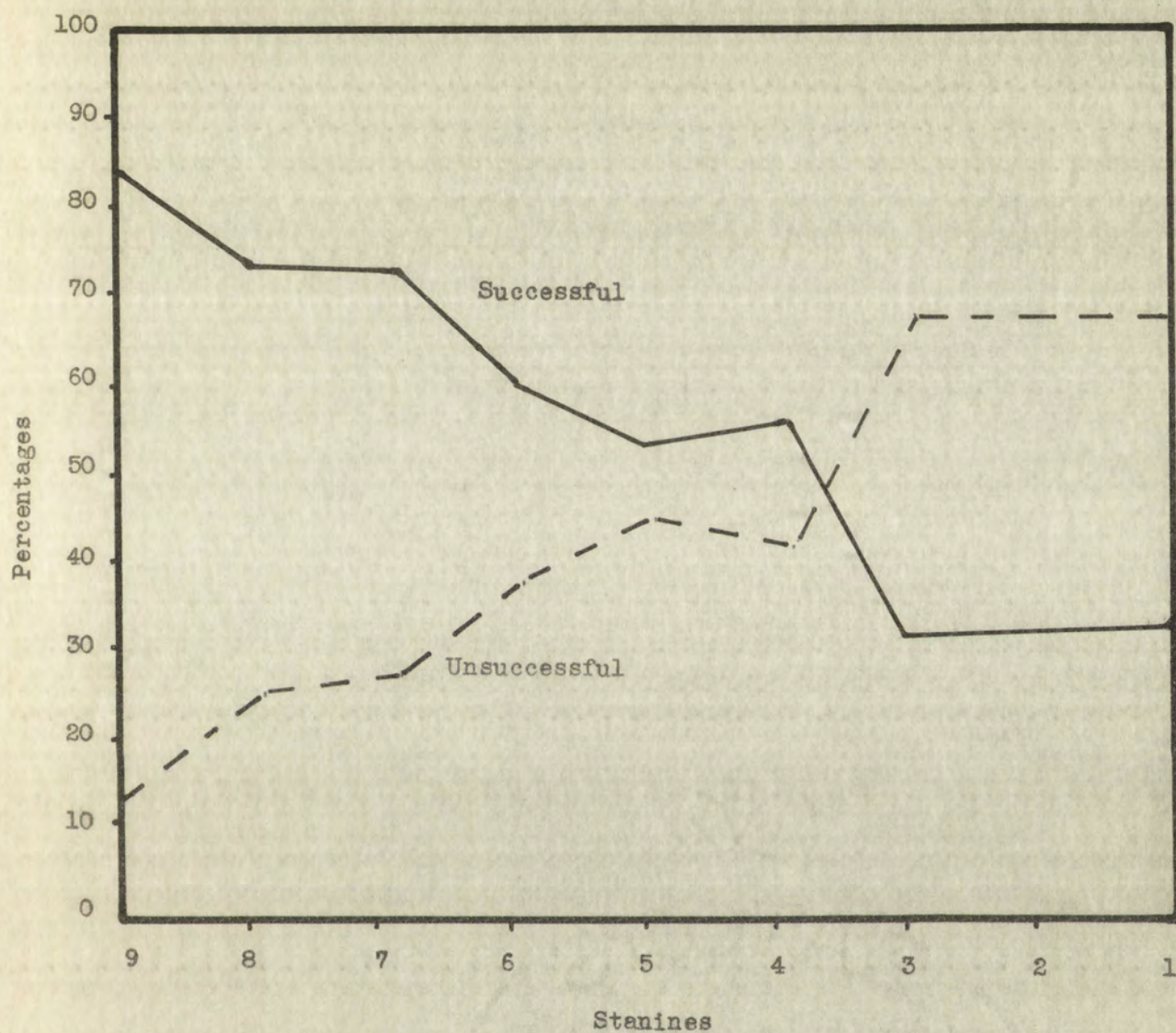


Figure 1. Percentages of Students Who Were Successful and Unsuccessful in Each Stanine of Q Scores on ACE Psychological Examination



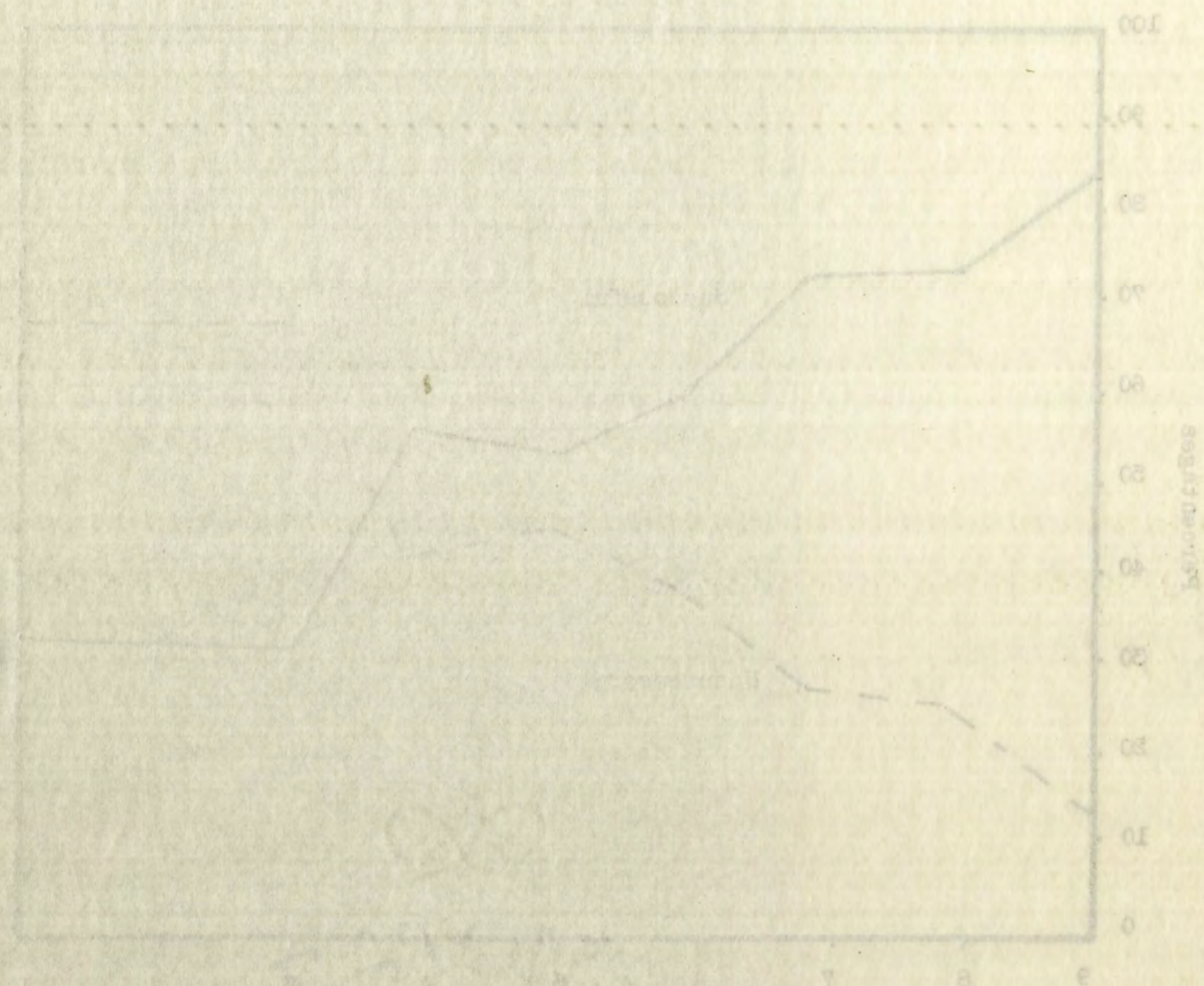


Figure 1. Percentage of two components  
of a mixture of two components  
of a mixture of two components



### The L Score

Tables 5, 6, 7 and 8 and Figure 2 present the data relating to the L score. Figure 2 reveals graphically the lack of any clear-cut relationship between the L score and engineering college success, although in stanines 8, 7, 6, 5 and 4, there is a higher percentage of successful than of unsuccessful students.

Analysis of the data of Table 7, using the division between stanines 3 and 4 as a point of analysis, analogously to the analysis of the Q score data, reveals the following facts:

1. Of the Graduates, 87-1/2% ranked 4 or better.
2. Of the Successful Transfers, 87% ranked 4 or better.
3. Of the Unsuccessful Transfers, 74% ranked 4 or better.
4. Of the Suspended group, 86% ranked 4 or better.
5. Of the total 400 students, 84% ranked 4 or better.
6. Of the combined Successful group, 88% ranked 4 or better.
7. Of the combined Unsuccessful group, 78% ranked 4 or better.

Thus a cut point below stanine 4 would have admitted 87% of the Successful students, and 80% of the Unsuccessful. It is seen that the differentiation here is considerably less than was the case with the Q score. In fact, at some of the high stanine levels, there is here a higher percentage of Suspended students than of Successful. There is also no point of reversal, as there was with the Q scores, of chance of success, except at stanine 1 and, oddly at stanine 9. As has been pointed out, the percentage method of determining relationships is weak at the ends of the scale, because of the low number of scores involved. However, even with



Figure 2, 3, 4 and 5 show the results of the analysis of the data. Figure 2 shows the results of the analysis of the data for the first two points. Figure 3 shows the results of the analysis of the data for the third point. Figure 4 shows the results of the analysis of the data for the fourth point. Figure 5 shows the results of the analysis of the data for the fifth point.

Analysis of the data for the first two points shows that the results are in good agreement with the theoretical predictions. The results for the third point show that the results are in good agreement with the theoretical predictions. The results for the fourth point show that the results are in good agreement with the theoretical predictions. The results for the fifth point show that the results are in good agreement with the theoretical predictions.

1. Of the first two points, the results are in good agreement with the theoretical predictions.
2. Of the third point, the results are in good agreement with the theoretical predictions.
3. Of the fourth point, the results are in good agreement with the theoretical predictions.
4. Of the fifth point, the results are in good agreement with the theoretical predictions.
5. Of the sixth point, the results are in good agreement with the theoretical predictions.
6. Of the seventh point, the results are in good agreement with the theoretical predictions.
7. Of the eighth point, the results are in good agreement with the theoretical predictions.

Thus a comparison of the results of the analysis of the data for the first two points with the theoretical predictions shows that the results are in good agreement. The results for the third point show that the results are in good agreement with the theoretical predictions. The results for the fourth point show that the results are in good agreement with the theoretical predictions. The results for the fifth point show that the results are in good agreement with the theoretical predictions. The results for the sixth point show that the results are in good agreement with the theoretical predictions. The results for the seventh point show that the results are in good agreement with the theoretical predictions. The results for the eighth point show that the results are in good agreement with the theoretical predictions.



this reservation, the distribution of scores is here not such as to make a clear differentiation between Successful and Unsuccessful students. Application of the chi square test of the significance of difference shows that a separation of two groups at a point between stanines 3 and 4 is not significant. It might be recommended to the College of Engineering that the L score be used only for aid in assessing the students' ability to handle the more general or linguistic courses, but not their ability to succeed in engineering courses.

Table 7 also shows, on the basis of the L score, what percentage of students would have been admitted, with cut scores at the respective stanine levels.

Table 8 shows what percentage of students, admitted according to cut points at the various stanine levels, would have succeeded.



this reservation, the 10 per cent of cases in which the  
a clear differentiation between the two groups is observed.  
application of the chi-square test to the data shows that  
... that a separation of two groups is not indicated by the chi-square  
significant. It might be mentioned that the chi-square test  
the I score is used only for a rough estimate of the degree of  
handle the more complex of problems, but the chi-square test  
success in engineering courses.  
Table 7 also shows, on the basis of the I score, that  
of students would have been similar, and the chi-square test  
statistical level.  
Table 8 shows what percentage of students, selected at random,  
out points at the various statistical levels, which are indicated.

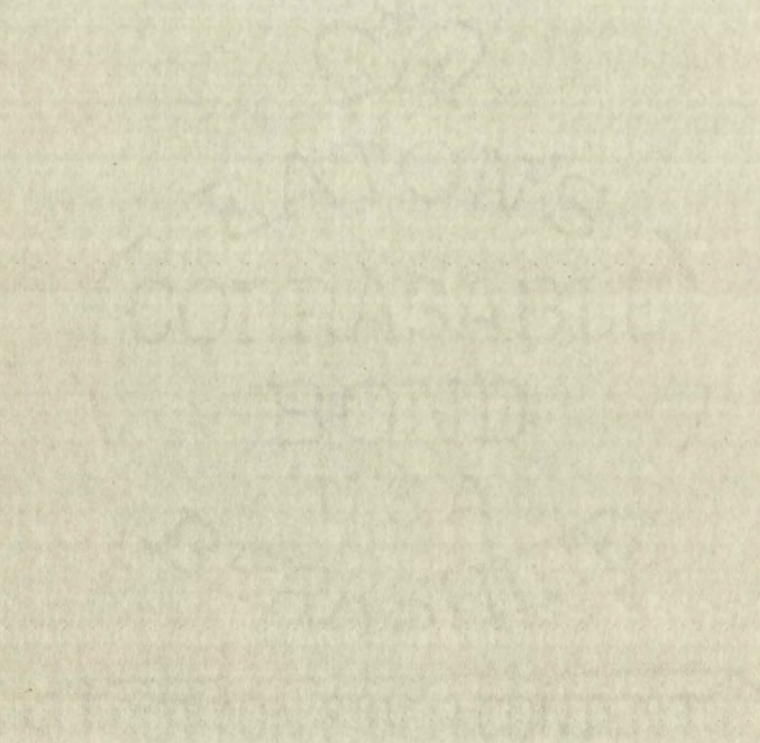




Table 5  
Distribution of Number of L Scores on  
ACE Psychological Examination

Category	Stanines									Sum
	9	8	7	6	5	4	3	2	1	
Graduates	0	8	21	52	36	37	17	5	0	176
Successful Transfers	1	4	6	22	21	11	5	4	1	75
Unsuccessful Transfers	2	2	10	18	18	24	17	8	1	100
Suspended	1	5	3	12	15	6	4	1	2	49
Totals	4	19	40	104	90	78	43	18	4	400
Successful	1	12	27	74	57	48	22	9	1	251
Unsuccessful	3	7	13	30	33	30	21	9	3	149
Totals	4	19	40	104	90	78	43	18	4	400







Table 6

Percentages of L Scores for Success Categories on  
ACE Psychological Examination

[illegible]







Table 7  
 Percentage of L Scores on ACE Psychological Examination  
 Falling Above Various Stanine Level Cut Points  
 by Categories of Success

Categories	Stanines*								
	9	8	7	6	5	4	3	2	1
Graduates	0	4	16	46	66	88	97	99	100
Successful Transfers	1	7	15	44	72	87	93	99	100
Unsuccessful Transfers	2	4	14	32	50	74	91	99	100
Suspended	2	12	18	43	73	86	94	96	100
Successful	1/2	5	16	46	68	88	96	99	100
Unsuccessful	2	7	17	37	59	78	91	97	100
Total <sup>+</sup>	1	6	16	42	64	85	95	99	100

\*The scores falling in the given stanines are included in the percentages. That is, the cut points are below the given stanines.

<sup>+</sup>The total gives the percentage of total applicants that would have been admitted if only those in or above the respective stanines had been admitted.







Table 8

Percentage of Successful Students to Total Students

Above Each Stanine Level for L Scores

	Stanines								
	9	8	7	6	5	4	3	2	1
Percentages	25	56	63	68	68	65	64	63	63



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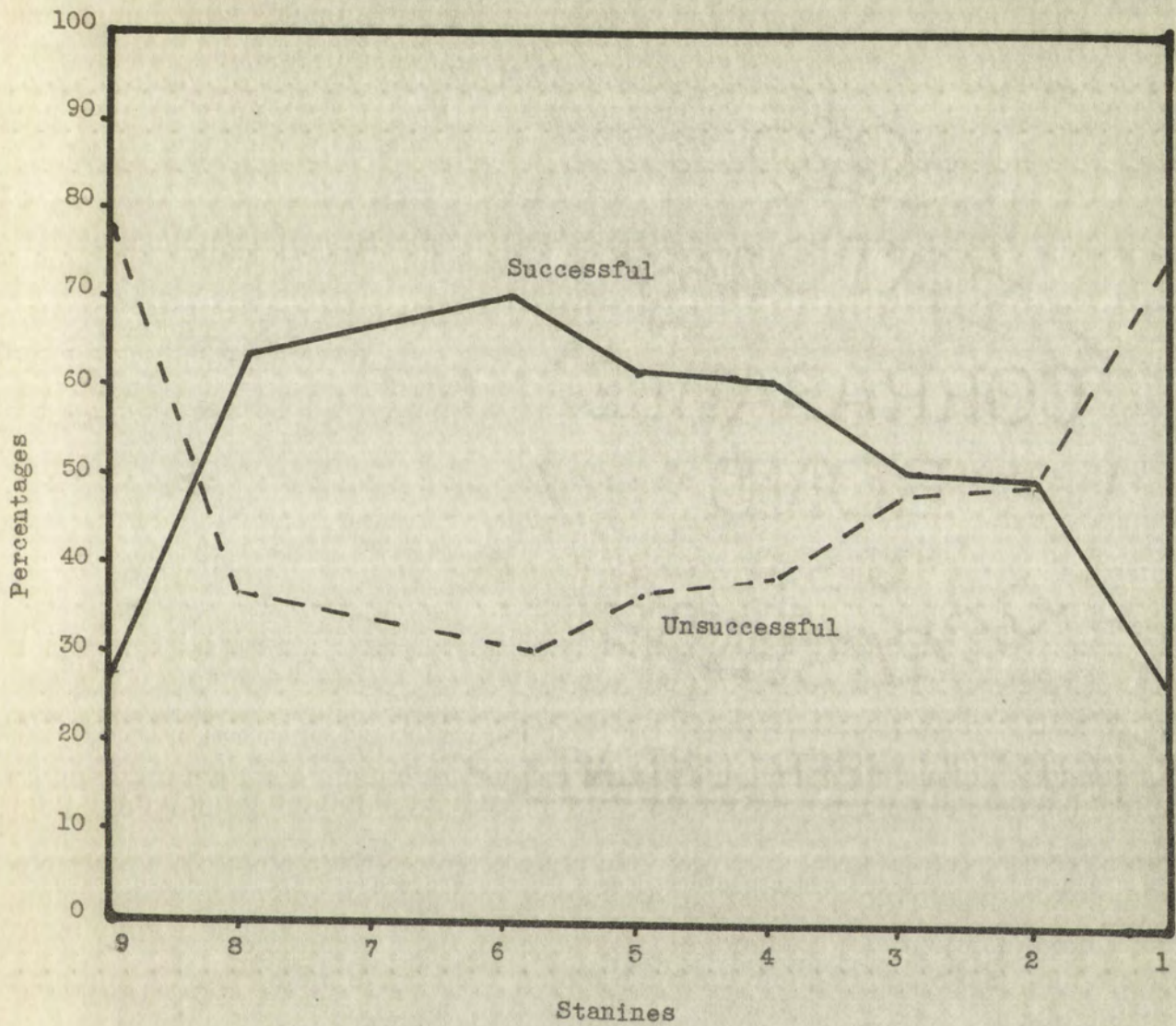


Figure 2. Percentages of Students Who Were Successful and Unsuccessful in Each Stanine of L Scores on ACE Psychological Examination



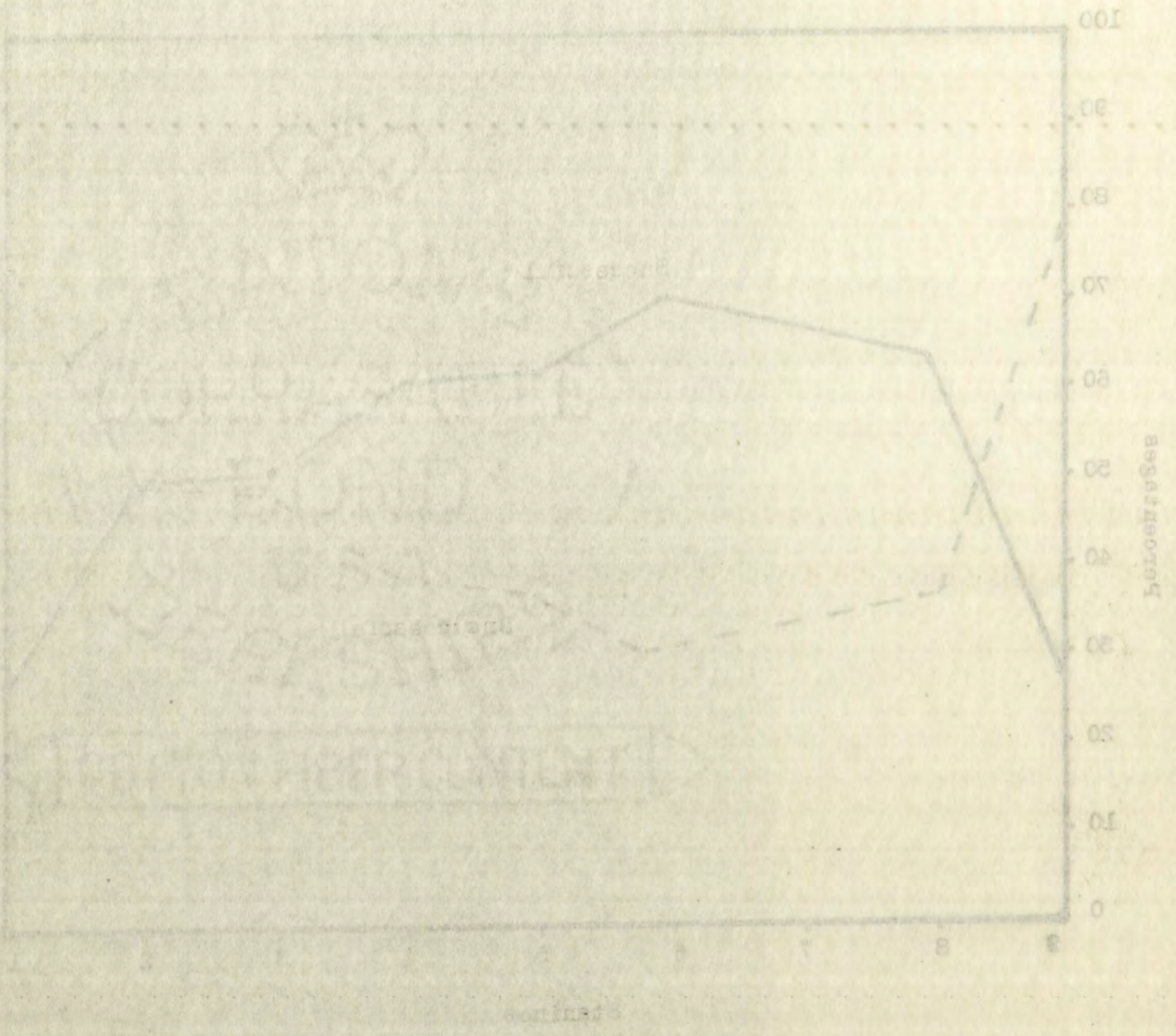


Figure 2. Percentage of vegetation and distance in the distance of 1000 m on the distance of 1000 m.



### The T Score

The T score of the ACE test is a composite score, representing a combination of the L score and Q score. Since there is disparity of predictive value between the L and Q scores, and the T score is a composite of the two, we might expect the latter to prove less valuable than the Q score, but more valuable than the L score. This is indeed the case, as may be seen by examination of Tables 9, 10, 11 and 12, and Figure 3, all pertaining to the T scores. Therefore no analysis will be made of these results, which add nothing of value to this study.



The T score of the test is a measure of the relative position of the score in the distribution of the test.

Consideration of the T score and the standard deviation of the test is necessary to determine the relative value between the T score and the standard deviation.

of the two, we might expect the test to be a measure of the relative value between the T score and the standard deviation.

of scores, but more significant than the T score, which is a measure of the relative value between the T score and the standard deviation.

may be seen by examination of the T score, which is a measure of the relative value between the T score and the standard deviation.

pertaining to the T score. The T score is a measure of the relative value between the T score and the standard deviation.

results, which are a measure of the relative value between the T score and the standard deviation.

results, which are a measure of the relative value between the T score and the standard deviation.



Table 9  
Distribution of Number of T-Scores on  
ACE Psychological Examination

Category	Stanines									Sum
	9	8	7	6	5	4	3	2	1	
Graduates	0	14	31	48	42	28	11	2	0	176
Successful Transfers	3	6	15	16	16	8	8	2	1	75
Unsuccessful Transfers	2	5	9	22	21	22	14	3	2	100
Suspended	0	0	5	9	14	14	2	4	1	49
Totals	5	25	60	95	93	72	35	11	4	400
Successful	3	20	46	64	58	36	19	4	1	251
Unsuccessful	2	5	14	31	35	36	16	7	2	149
Totals	5	25	60	95	93	72	35	11	4	400











# Percentage of Games for Various Games

Age 17-19

Category	1	2	3	4	5	6	7	8	9	10
Unsuccessful	0	10	20	30	40	50	60	70	80	90
Successful	100	90	80	70	60	50	40	30	20	10
Unsuccessful	0	10	20	30	40	50	60	70	80	90
Successful	100	90	80	70	60	50	40	30	20	10
Unsuccessful	0	10	20	30	40	50	60	70	80	90
Successful	100	90	80	70	60	50	40	30	20	10
Unsuccessful	0	10	20	30	40	50	60	70	80	90
Successful	100	90	80	70	60	50	40	30	20	10
Unsuccessful	0	10	20	30	40	50	60	70	80	90
Successful	100	90	80	70	60	50	40	30	20	10



Table 11

Percentages of T Scores on ACE Psychological Examination  
 Falling Above Various Stanine Level Cut Points  
 by Categories of Success

Category	Stanines *								
	9	8	7	6	5	4	3	2	1
Graduates	0	8	26	53	77	93	99	100	100
Successful Transfers	4	12	32	53	75	85	96	99	100
Unsuccessful Transfers	2	7	16	38	59	81	95	98	100
Suspended	0	0	10	29	57	86	90	98	100
Successful	1	9	28	53	77	90	98	100	100
Unsuccessful	1	5	14	35	58	82	93	97	100
Total <sup>†</sup>	1	8	22	46	70	88	96	99	100

\* The scores falling in the given stanines are included in the percentages. That is, the cut point is below the given stanine.

<sup>†</sup> The total gives the percentage of applicants that would have been admitted if only those in or above the respective stanines had been admitted.



# Table II

Percentages of T Scores on ACT by Grade and Sex

Falling Above Various Standard Levels of Achievement

by Grade and Sex

Category	9	8	7	6	5	4	3	2	1
Stagnant	0	0	0	0	0	0	0	0	0
Successful Transfers	4	10	20	30	35	40	45	50	55
Unsuccessful Transfers	2	5	10	15	20	25	30	35	40
Suspended	0	0	0	0	0	0	0	0	0
Successful	1	5	10	15	20	25	30	35	40
Unsuccessful	1	5	10	15	20	25	30	35	40
Total	1	5	10	15	20	25	30	35	40

\* The scores falling in the given categories are included in the next category.

That is, the one point is below the given standard.

The total gives the percentage of applicants that have been

admitted if only those 10 or above the respective standard have been

admitted.



Table 12

Percentage of Successful Students to Total Students

Above Each Stanine Level for T Scores

	Stanines								
	9	8	7	6	5	4	3	2	1
Percentage	60	77	77	72	64	65	64	63	63



Table 12

Percentage of Population Subject to Total Expenditure

Above Each Standard Level for a Decade

Standard

Percentage	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
1	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

STATISTICS  
COMPARABLE  
SECOND  
CENTURY  
AD



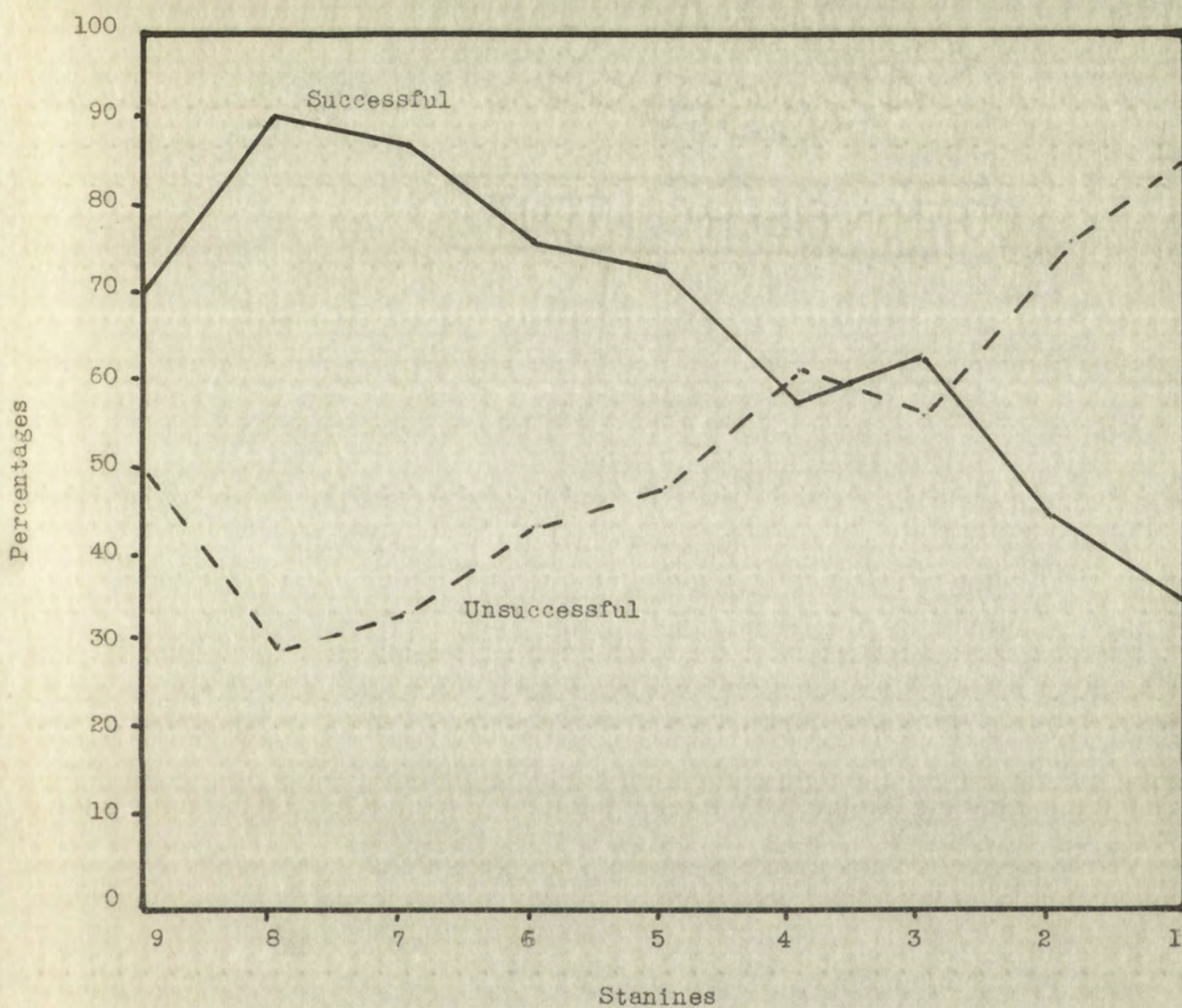
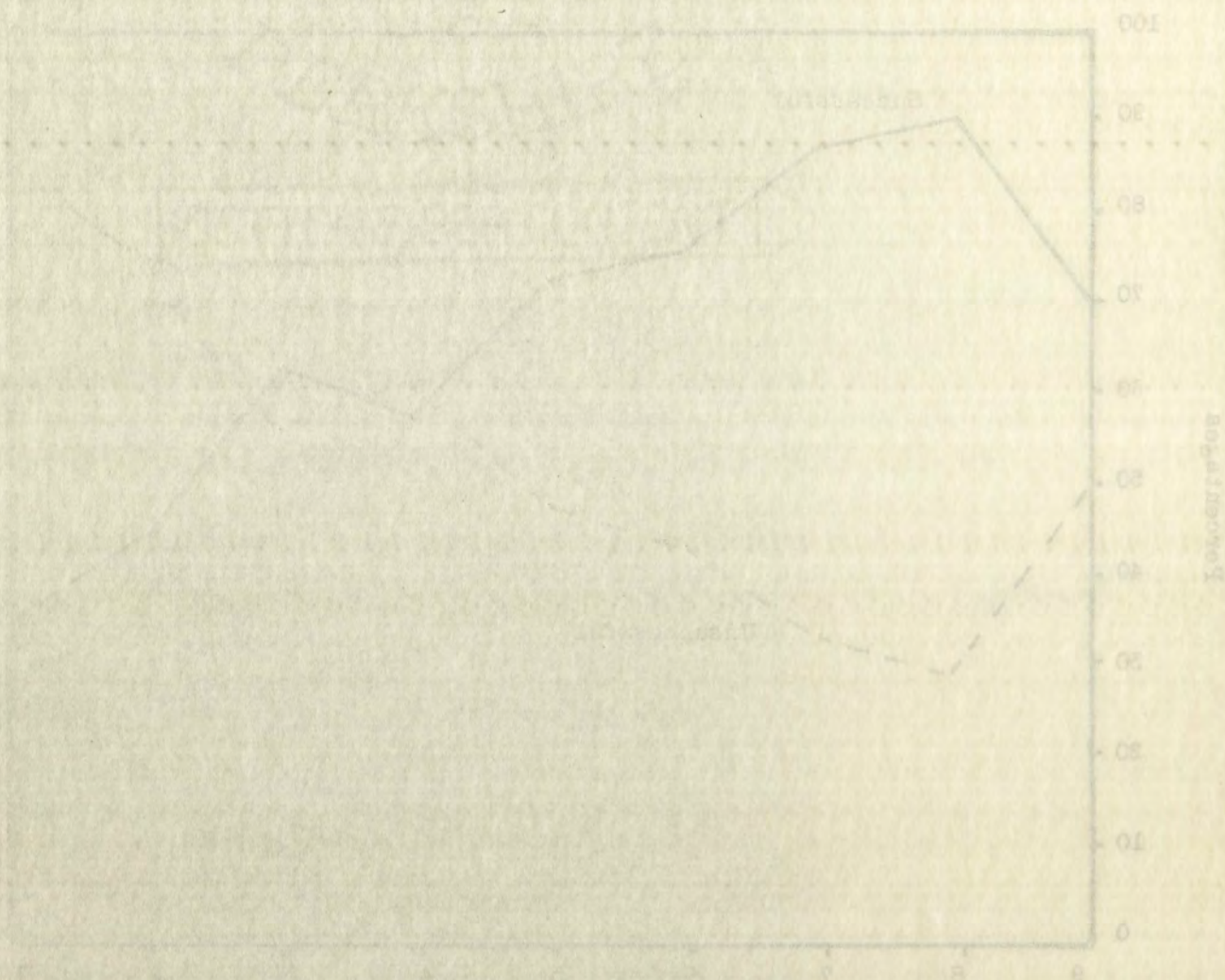


Figure 3. Percentages of Students Who Were Successful and Unsuccessful in Each Stanine of T Scores on ACE Psychological Examination







### Pre-Engineering Ability Score

Tables 13, 14, 15 and 16 and Figure 4 present the data pertaining to the Pre-Engineering Ability Test. Note that the total number of scores is, in this case, 330. For some students who were scored on the ACE, there were no scores on record for this test.

Examination of Table 15 and Figure 4 shows that on this test, as on the Q scores, there is a point, within stanine 4, above which there is a rapidly increasing chance of success, and below which there is a rapidly increasing chance of failure, this latter amounting to 2-to-1 at stanine 3, and 4-to-1 at stanine 2.

Analysis of the data of Table 15, using the division between stanines 3 and 4 as the point of analysis, reveals the following facts:

1. Of the Graduates, 94% ranked 4 or better.
2. Of the Successful Transfers, 91% ranked 4 or better.
3. Of the Unsuccessful Transfers, 65% ranked 4 or better.
4. Of the Suspended group, 60% ranked 4 or better.
5. Of all 330 students, 82% ranked 4 or better.
6. Of the combined Successful group, 92% ranked 4 or better.
7. Of the combined Unsuccessful group, 64% ranked 4 or better.

Thus a cut point below stanine 4 would have admitted 92% of the successful students, and 64% of the unsuccessful. It would have eliminated 8% of the successful, and 36% of the unsuccessful. It is seen that this difference is much larger than was the case for any of the previous three scores. At this point, therefore, this test may be said to be more useful for differentiating between successful and unsuccessful students.



Tables 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

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Application of the chi square test to this data shows that a cut score below stanine 4 separates two groups of students, Successful and Unsuccessful, far beyond the .01 level of significance.

Table 15 also shows what percentage of students would have been admitted, with cut points at respective stanine levels. Thus, if a cut point were below stanine 3, 95% of the students would have been admitted, and if a cut point were below stanine 5, 61% of the students would have been admitted.

Table 16 shows what percentage of students admitted at the various stanine level cut points would have been successful.

Figure 4 presents graphically the distribution of Successful and Unsuccessful students at the various stanine levels. The apparent reversal of trend at stanine 9 must be interpreted in light of the fact that there were only 3 cases at this point, which is not sufficient for accurate percentage representation.

With a grouping of all scores at stanine 4 or above as High, and of all below as Low, the tetrachoric correlation coefficient ( $r_t$ ) was computed for the relation between High and Low standing in the test, and Successful and Unsuccessful groups. The  $r_t$  was .63, which is highly significant.



Application of the chi-square test to the data in Table 1.

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Table 13  
Distribution of Number of Scores on  
Pre-Engineering Ability Test

Category	Stanines									Sum
	9	8	7	6	5	4	3	2	1	
Graduates	1	5	24	41	38	25	10	0	0	144
Successful Transfers	1	2	13	15	19	7	4	3	0	64
Unsuccessful Transfers	0	0	5	9	12	27	20	8	0	81
Suspended	1	0	1	6	7	10	11	5	0	41
Totals	3	7	43	71	76	69	45	16	0	330
Successful	2	7	37	56	57	32	14	3	0	208
Unsuccessful	1	0	6	15	19	37	31	13	0	122
Totals	3	7	43	71	76	69	45	16	0	330







Table 14

Percentages of Scores for Success Categories on  
Pre-Engineering Ability Test

[illegible]







Table 15  
Percentages of Pre-Engineering Ability Test Scores  
Above Various Stanine Level Cut-Points  
by Categories of Success

Category	Stanines *								
	9	8	7	6	5	4	3	2	1
Graduates	1	4	21	50	76	94	100	100	100
Successful Transfers	2	5	26	50	80	91	98	100	100
Unsuccessful Transfers	0	0	6	17	32	65	90	100	100
Suspended	2	2	5	19	36	60	87	100	100
Successful	1	5	22	49	76	92	99	100	100
Unsuccessful	1	1	2	18	33	64	89	100	100
Total †	1	3	16	38	61	82	95	100	100

\* The scores falling in a given stanine are included in the percentages. That is, the cut point is below the given stanine.

† The total gives the percentage of total applicants that would have been admitted if only those in or above the respective stanines had been admitted.







Table 16  
Percentage of Successful Students to Total Students Above  
Stanine Levels for Pre-Engineering Ability Test

	Stanines								
	9	8	7	6	5	4	3	2	1
Percentages	66*	90	87	82	80	71	65	63	63

\*Note that this percentage is a distortion, due to the fact that there were only three cases at this level.



Percentage of successful students

Examinee level in the

Percentage

Note that this percentage is

these were only three cases



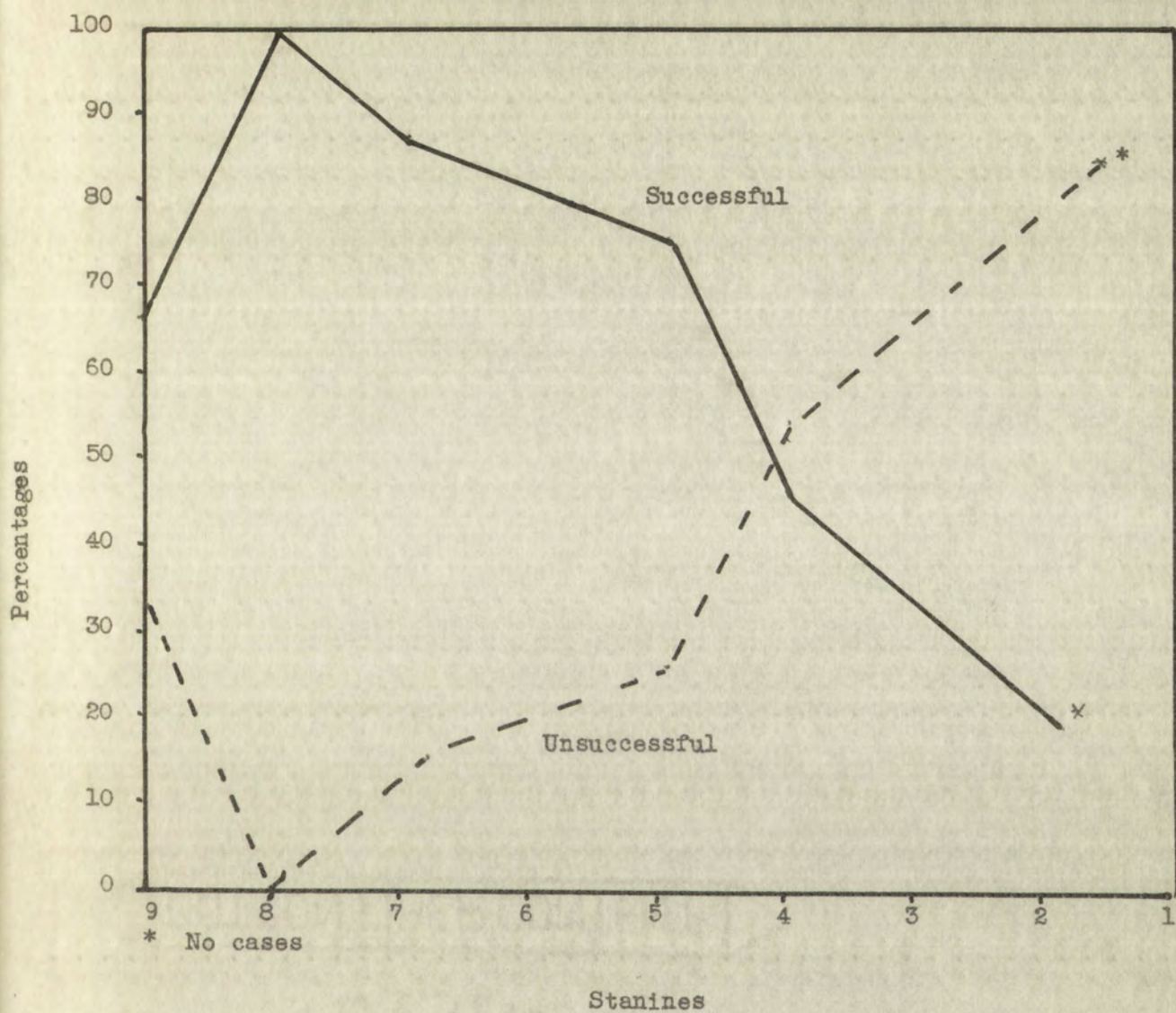
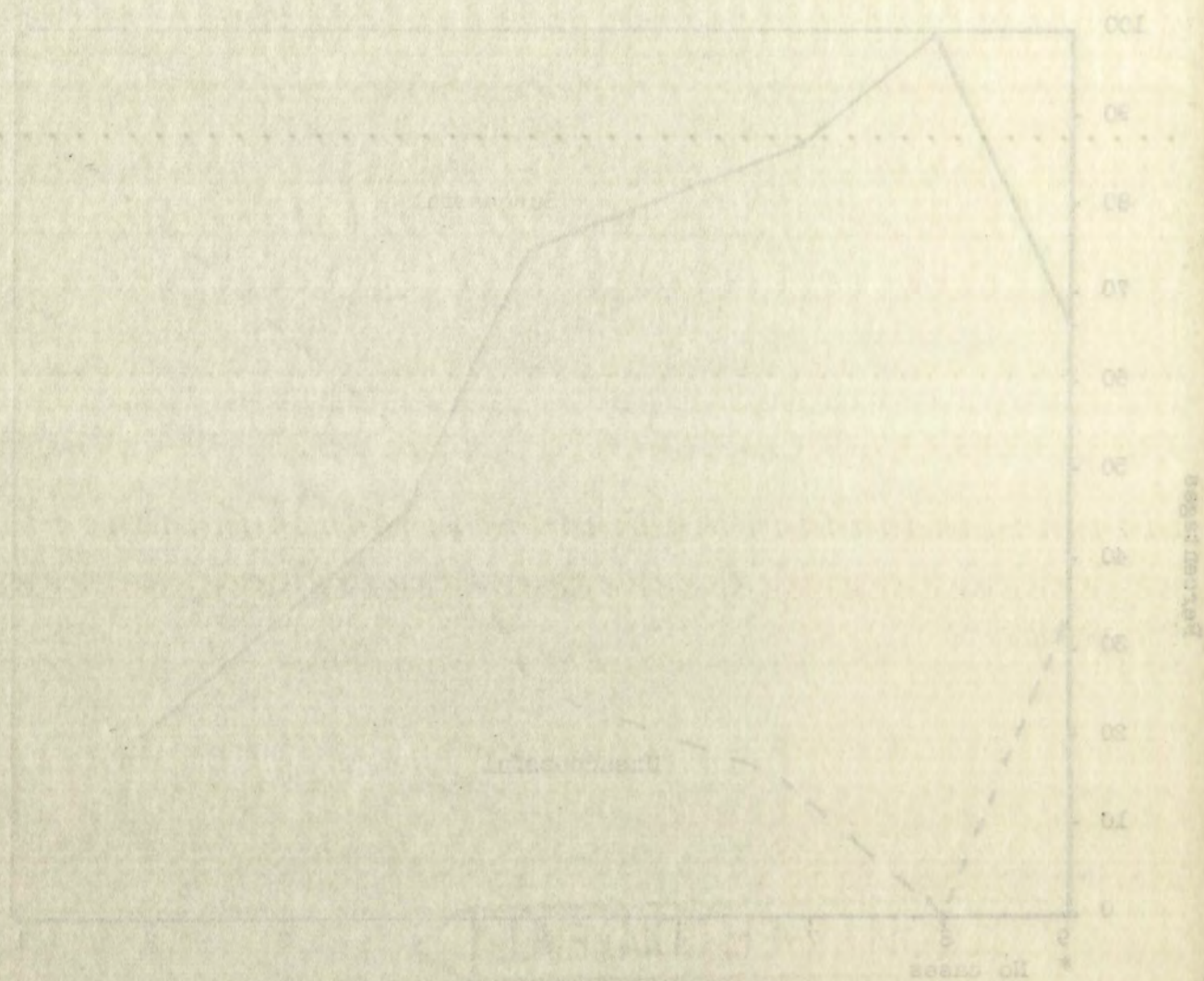


Figure 4. Percentages of Students Who Were Successful and Unsuccessful in Each Stanine of Pre-Engineering Ability Test Scores







## University of Nebraska Mathematics Placement Test

The scores of this test were scaled into only two groups, those which exceeded a cut score which was a combination of the scores on two parts of the test (scores of 10 and 40 respectively), and those which did not exceed this cut score. For the purpose of this study, the first group is here designated "High", and the second "Low".

Tables 17, 18, and 19 present the data pertaining to the grouping of scores and categories of students, according to the results of this test. Note that the number of students for whom this data was available was 374.

Examination of the tables shows a strong positive correlation between mathematics placement level, as established by this test, and chance of success in engineering courses. Application of the chi square test shows that the differentiation of Successful and Unsuccessful students on the basis of High and Low scores on this test is valid at the .01 level of confidence.

Table 18 shows the percentage of each category of students who scored High and Low. Particularly striking is the fact that of the actual Graduates, 92% scored High. Also noteworthy is the fact that the 25% of the entire group who scored Low accounted for 45% of the Unsuccessful records, while the 75% who scored High accounted for 88% of the Successful records.

Table 19 shows that of the Low group, only 31% succeeded, while of the High group, 73% succeeded.

A tetrachoric correlation coefficient ( $r_t$ ) was computed for the relation between High and Low scores and Successful and Unsuccessful groups. A  $r_t$  of .61 was found, which is highly significant statistically.

The fact that this test is an achievement test must enter into the interpretation of these results, since achievement tests reflect more of







specific school opportunity than do aptitude tests. The results here may be interpreted to indicate that the more adequate foundation in mathematics greatly enhances the chances of success in engineering college. They may also mean that those students who have shown interest in and ability for mathematics in high school have demonstrated to a high degree the requisites for success in engineering college. In any case, the results here shown would seem to indicate that success in mathematical training prior to undertaking an engineering course may make the difference between a student's having a greatly preponderant chance of success, or a strong chance of failure.

Inequalities of scientific education among widely scattered school systems, and even at times within the same school system, are admitted facts. It appears possible that among students who present themselves for entrance to engineering college, some may have aptitude, as evidenced by good scores on the Pre-Engineering Ability Test and the Q score on the ACE, but have deficient preparation in mathematics, as reflected by poor scores on the Mathematics Placement Test. Proper attention to improving this preparation, prior to admittance to engineering courses, might result in the avoidance of failure by such students. With 92% of Graduates scoring High on this test, it might seem advisable to make a High score a prerequisite to admittance to engineering courses. However, in the interest of keeping all potentially successful students in engineering, it would also be important to ascertain the reasons for Low placement on this test. For some it might be lack of ability, for others possibly lack of stimulation, low standard of local requirements, or lack of available advanced high school mathematics courses in the home community. For a few, there might have been a late awakening







in the adolescent of interest in engineering, at a time too late for him to complete an adequate preparation in mathematics. Thus some preliminary college mathematics courses might serve to differentiate between students who lack ability for engineering and those whose deficiency is in preparation.

It must be observed, however, that of the Unsuccessful group, a higher percentage scored High on this than scored Low. Therefore a High score on this test is not of itself sufficient indication of probable success. In view of the many factors that may influence a student's performance on this test, it would seem wise that it be used only in conjunction with other tests, in assessing the student's potentiality for success.



in the absence of interest in the subject, it is not possible to neglect an adequate investigation of the subject, and the results of the investigation must be made known to the public.

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It must be observed, however, that the results of the investigation must be made known to the public, and the results of the investigation must be made known to the public. In view of the above, it is not possible to neglect an adequate investigation of the subject, and the results of the investigation must be made known to the public.



Table 17  
 Number of High and Low Scores by Categories on  
 University of Nebraska Mathematics Placement Test

Category	Low	High	Totals
Graduates	14	151	165
Successful Transfers	15	53	68
Unsuccessful Transfers	39	57	96
Suspended	25	20	45
Totals	93	281	374
Successful	29	204	233
Unsuccessful	64	77	141
Totals	93	281	374







Table 18  
Percentage of Low and High Scores by Categories on  
University of Nebraska Mathematics Placement Test

Category	Low	High	Totals
Graduates	8	92	100
Successful Transfers	22	78	100
Unsuccessful Transfers	41	59	100
Suspended	56	44	100
Successful	25	75	100
Unsuccessful	45	55	100
Total Group	25	75	100



CONTENTS

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Table 19  
Percentage of Successful and Unsuccessful Students in  
Scoring Groups  
University of Nebraska Mathematics Placement Test

	Low	High
Successful	31%	73%
Unsuccessful	<u>69%</u>	<u>27%</u>
Totals	100%	100%



University of Minnesota  
 Department of Psychology  
 Percentage of Successful and Unsuccessful  
 Group 1

100	100	Total
75	75	Successful
25	25	Unsuccessful

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### A Suggested Battery

After the foregoing analyses had been made of the scores of the individual tests in relation to academic success, a study was made of the relations between a combination of the scores of the three tests which had proved most valuable, and success in engineering studies. This combination of tests, hereafter called the "Battery", consisted of the ACE Q section, the Pre-Engineering Ability Test, and the University of Nebraska Mathematics Placement Test. Preliminary findings had established that a point between stanines 3 and 4 made valid and practical separation between Successful and Unsuccessful students, on the basis of the Q scores and Pre-Engineering Ability Test. Therefore, for comparison with results of the Mathematics Placement Test and the Battery, all students who ranked in stanine 4 or higher in these scores, were grouped as High, and all students below stanine 4 were grouped as Low. For the Battery, all students who ranked High on all three tests, were grouped as High, and all students who ranked Low on any one or more of the three tests, were grouped as Low.

Data pertaining to the Battery are shown in Tables 20, 21 and 22. From Table 22, it may be seen that the Battery makes a very good differentiation between Successful and Unsuccessful students, the High group including 85% of the Successful and only 40% of the Unsuccessful, while the Low group includes only 15% of the Successful and 60% of the Unsuccessful students. This Battery would be especially valuable for eliminating Unsuccessful students, of whom 60% did not make the High group. However, a requirement of High rank on the Battery would also have eliminated 15% of the Successful students. It may also be noted here, that of the 72 Unsuccessful students







who ranked Low on the Battery, 31, or 43%, ranked High on both aptitude tests, and Low only on the Mathematics Placement Test. As was pointed out in discussion of the Mathematics Placement scores, some special preparation in mathematics might affect their ultimate success considerably. However, it was also found that of the 32 Successful students who ranked Low on the Battery, 16, or 50%, ranked High on the aptitude tests, and Low only on the Mathematics Placement Test. This would seem to indicate that the low mathematics preparation can be overcome by some good students with good aptitude. The difference between these Successful students with Low rank on the Battery, and the Unsuccessful who also were Low, may be to a large extent the factors of drive, determination, and self-discipline which these tests cannot measure.

#### A Comparison of Results

Table 23 summarizes for comparison the percentages of students, Successful and Unsuccessful, who placed High on the individual tests and on the Battery, and the tetrachoric correlation coefficients, for the tests and for the Battery, of Successful and Unsuccessful groups and High and Low test rank. It may be seen that the test results show varying proportions of Successful and Unsuccessful students to have ranked above and below the suggested cut points for the respective tests. It is also shown that some of the test measures discriminate much more clearly than others between the Successful and Unsuccessful groups, with the Battery discriminating far better than any single test.







Table 20

Number of Successful and Unsuccessful Students

Who Ranked High and Low on Battery

Category	Low	High	Total
Successful	32	178	210
Unsuccessful	<u>72</u>	<u>48</u>	<u>120</u>
	104	226	330



# COTTON REPORT

1911

Table 1

Number of Successful and Unsuccessful Cotton

Who Ranked High and Low on Cotton

Category	Low	High	Total
Successful	62	100	162
Unsuccessful	73	48	121
	135	148	283

COTTON  
REPORT  
1911



Table 21

Percentage of Students Low and High on Battery  
Who Were Successful and Unsuccessful

Rank	% Successful	% Unsuccessful	Total
Low	31	69	100
High	79	21	100



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High	Low	Range
100	100	100
100	100	100
100	100	100



Table 22

Percentage of Successful and Unsuccessful Students

Who Ranked High and Low on Battery

	Low	High	Total
Successful	15%	85%	100%
Unsuccessful	60%	40%	100%



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Table 23

## Comparison of Individual Tests and Battery

	Tests			
	ACE-Q	Pre-Eng.	Math. Pl.	Batt.
1. % of Students, Successful and Unsuccessful, in High Group				
Successful	96	92	88	85
Unsuccessful	84	64	55	40
2. % of Students, in High and Low Groups, Who Were Successful				
High	66	71	73	79
Low	34	29	27	21
3. Tetrachoric Correlation Coefficients				
	.25	.63	.61	.69



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## Chapter V

### Discussion and Conclusions

This chapter is concerned with some considerations which should be borne in mind in interpreting and evaluating the preceding material, and with conclusions.

In the review of the literature, it was seen that most of the studies of the predictive value of tests have been concerned with correlations between test scores and grade point averages for the first year, or at most for the first two years. There is therefore an important difference between the present study, in which the four or five year record of the students has been studied, and the previous studies cited. From one standpoint, this might seem to make the present study more definitive, since it allows for the ultimate criterion of success, graduation. However, insofar as this is a study of the validity of tests for prediction, rather than of the careers of the students, the time element may have contributed little to its value. Perhaps students show as well in their first year, as in four or five, the extent to which these tests have measured their abilities for academic success. An interesting and perhaps instructive study would be a comparison of the long-term predictive value of these tests, as indicated in this study, with their short term value for prediction of first year success of the same group of students.

In evaluating these results, it should be borne in mind that the students involved were to some extent a pre-selected group. It seems logical to assume that most of the students who would attempt an engineering course would have had some previous evidence of aptitude or special



Chapter 7

Discussion and Conclusions

This chapter is devoted to a discussion of the results of the study.

be borne in mind in interpreting the results of the study and with conclusions.

In the review of the literature, it was noted that most of the

studies of the problem of the relationship between the two

studies between test scores and the ability to solve problems

at most for the first two years. There is a need for more studies

between the present study, which is the first of its kind in the

students has been studied and the results of the study are

point, this might lead to some of the following conclusions:

allows for the highest correlation of the two variables, the

as this is a study of the relationship between the two

the results of the study, the results of the study are

to its value. Before we can draw any conclusions from the

four or five, the results of the study are as follows:

for students' success in solving problems, the results of the

be a comparison of the results of the study with the results

listed in this study, with the results of the study in the

year success of the students in solving problems.

In evaluating these results, it is noted that the results

students involved were not as high as the results of the

logical to assume that most of the results of the study are

ing course would have had some positive effect on the results



interest in it. Thus, the relationships between test results and academic success should be less clear-cut than would be the case if the students involved were a general college population. The attempt here is to differentiate among an already restricted group of students. In view of this fact, the results obtained with these tests are more significant than might seem apparent.

The choice of tests to be used in the selection of students would seem to be a matter of the primary objective of the College of Engineering. If the primary aim is to admit a very large proportion of potentially successful students, the Q score of the ACE might be used as criterion, with knowledge that this would also involve admitting a large proportion of potentially unsuccessful students. On the other hand, if the primary objective is to weed out a large proportion of the potentially unsuccessful students, the criterion of High rank on the Battery, involving High rank on all three of the best tests, might be chosen, with knowledge that this would also involve eliminating a fair proportion of potentially successful students. Between these two extremes, there are the Pre-Engineering Ability Test and the Mathematics Placement Test, which could be used in conjunction with each other, to assess two aspects of student potential, aptitude, and preparation. Thus we see that each of the four test measures can be successful in its own way, or in conjunction with the others. It is recommended that the College of Engineering study the results obtained with the various measures, to determine which best suit its purposes.



interest in it. Thus, the relation between the two groups of students should be less clear-cut than would be the case if the groups involved were a general college population. In addition, the results obtained in this study are more similar to those obtained in the past, which might seem apparent.

The choice of tests to be used in the selection of students seems to be a matter of the primary importance of the College of Education. If the primary aim is to select a high proportion of potentially successful students, the scores of the students on the tests which knowledges that this would also have a high proportion of potentially unsuccessful students. On the other hand, if the primary objective is to weed out a high proportion of the potentially unsuccessful students, the criterion of high rank on the tests, particularly rank on all three of the tests, might be chosen. This study indicates that this would also involve eliminating a high proportion of potentially successful students. Between these two extremes, there are the various measuring Ability Test and the Mathematics Test, which could be used in conjunction with each other, to select two groups of students of similar mental, aptitude and preparation. Thus we see that each of the four measures can be successfully in its own way, or in conjunction with the others. It is recommended that the College of Education select the tests obtained with the various measures, to determine which tests are the best responses.



### Summary and Recommendations

The findings and recommendations of this study may be summarized as follows:

1. Three of the test scores showed significant relationship with student success in the College of Engineering. These were the scores of the Q section of the ACE Psychological Examination for College Freshmen, the Pre-Engineering Ability Test, and the University of Nebraska Mathematics Placement Test. The relationships for the latter two were highly significant, with tetrachoric correlation coefficients for the relation between High and Low test rank and Successful and Unsuccessful student grouping of .63 and .61 respectively.

2. A cut point which is statistically valid and also practically useful for admissions purposes was found to exist, for the ACE Q scores and the Pre-Engineering Ability Test scores, at a division between stanines 3 and 4 of the stanine scale.

3. Students who ranked above the cut point on these two scores, and also above the Mathematics Placement Test cut point already established by the University for placement in mathematics courses, were found to be widely differentiated, in favor of success, from students who placed below the cut point on any of the three test measures. The use of the three scores as a battery is recommended for the purpose of making the best differentiation between potentially Successful and Unsuccessful students. A requirement of High standing on all three tests would, however, have eliminated 15% of the ultimately Successful students.

4. Special mathematics preparation is recommended, as pre-requisite to admission to engineering courses, for students who rank above the







cut point on the two aptitude tests (the ACE Q test and the Pre-Engineering Ability Test), but below the cut point on the Mathematics Placement Test.

5. It is recommended that a study be made, comparing these results concerning the long-range predictive value of the tests, with results of a similar study of the same student group and the same test scores, on a short-range basis, using success in the first year of engineering college as criterion. This might indicate whether there is any particular value in a long-range study, such as this one, in establishing the validity of the tests concerned.

6. It is recommended that a study similar to this one be made, after a period of a few years, to determine whether the findings of this study can be considered valid on a long term basis, for practical selection of, or advising of students.



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6. It is recommended that a test be given to the subject before the test begins.

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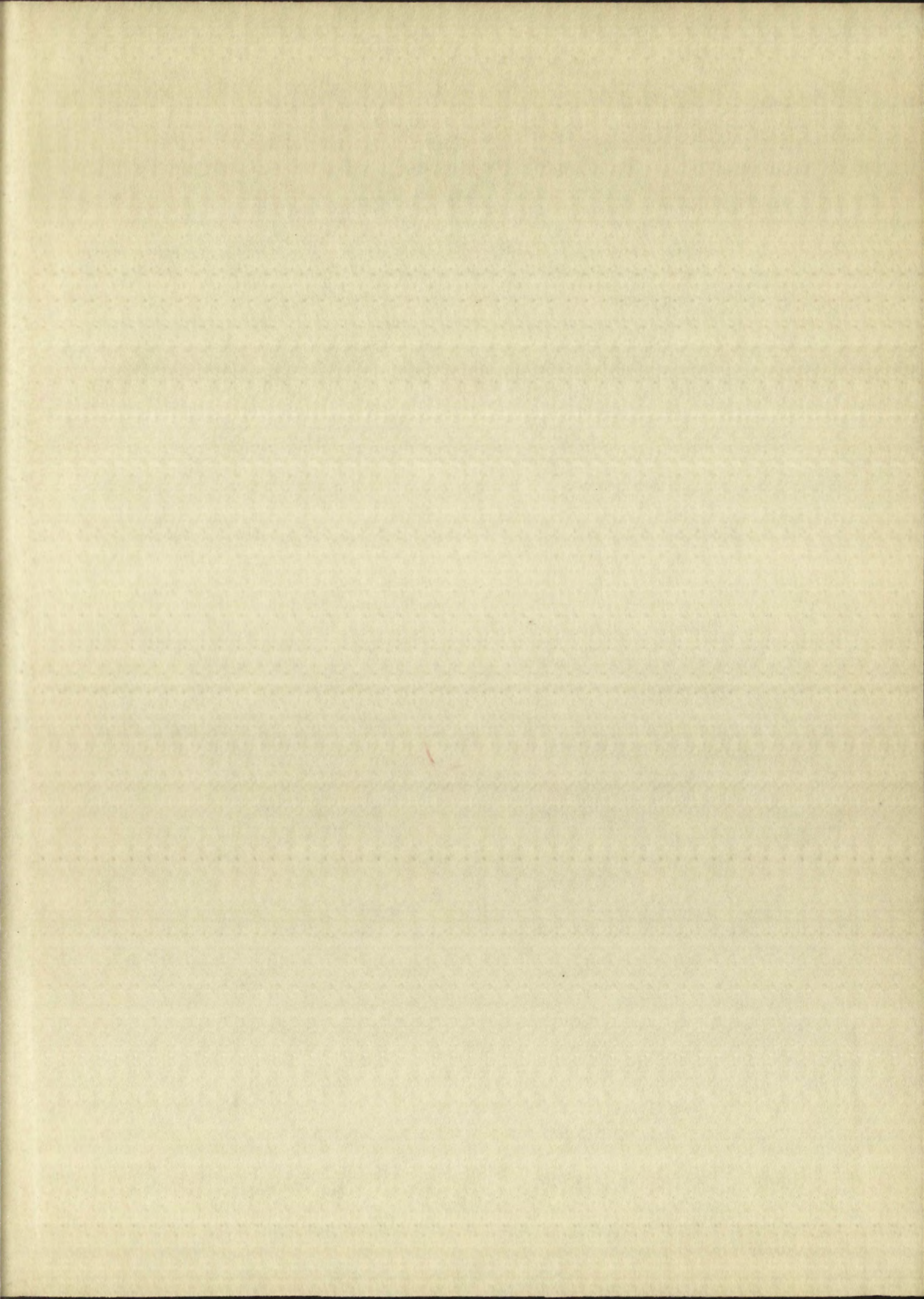
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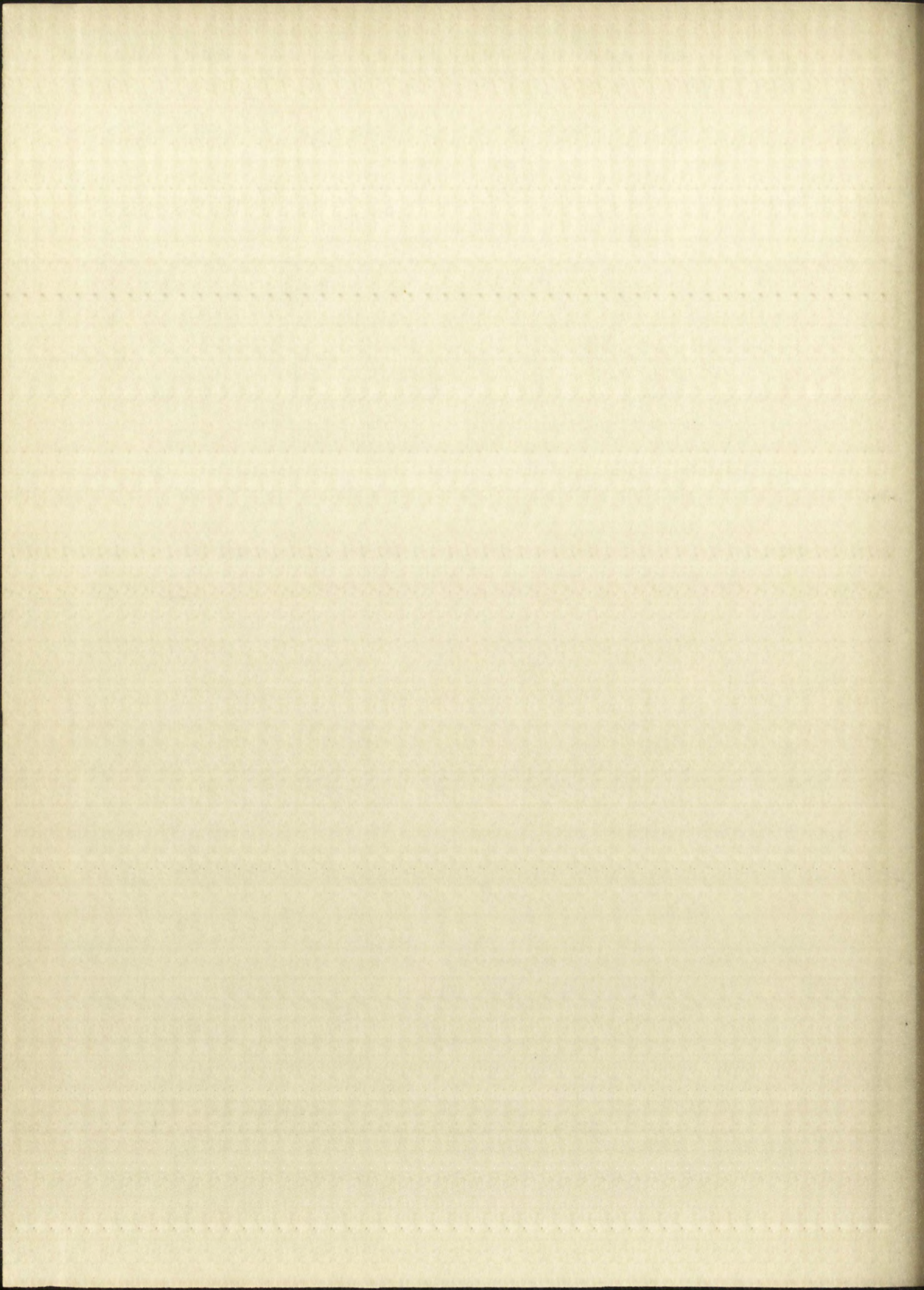
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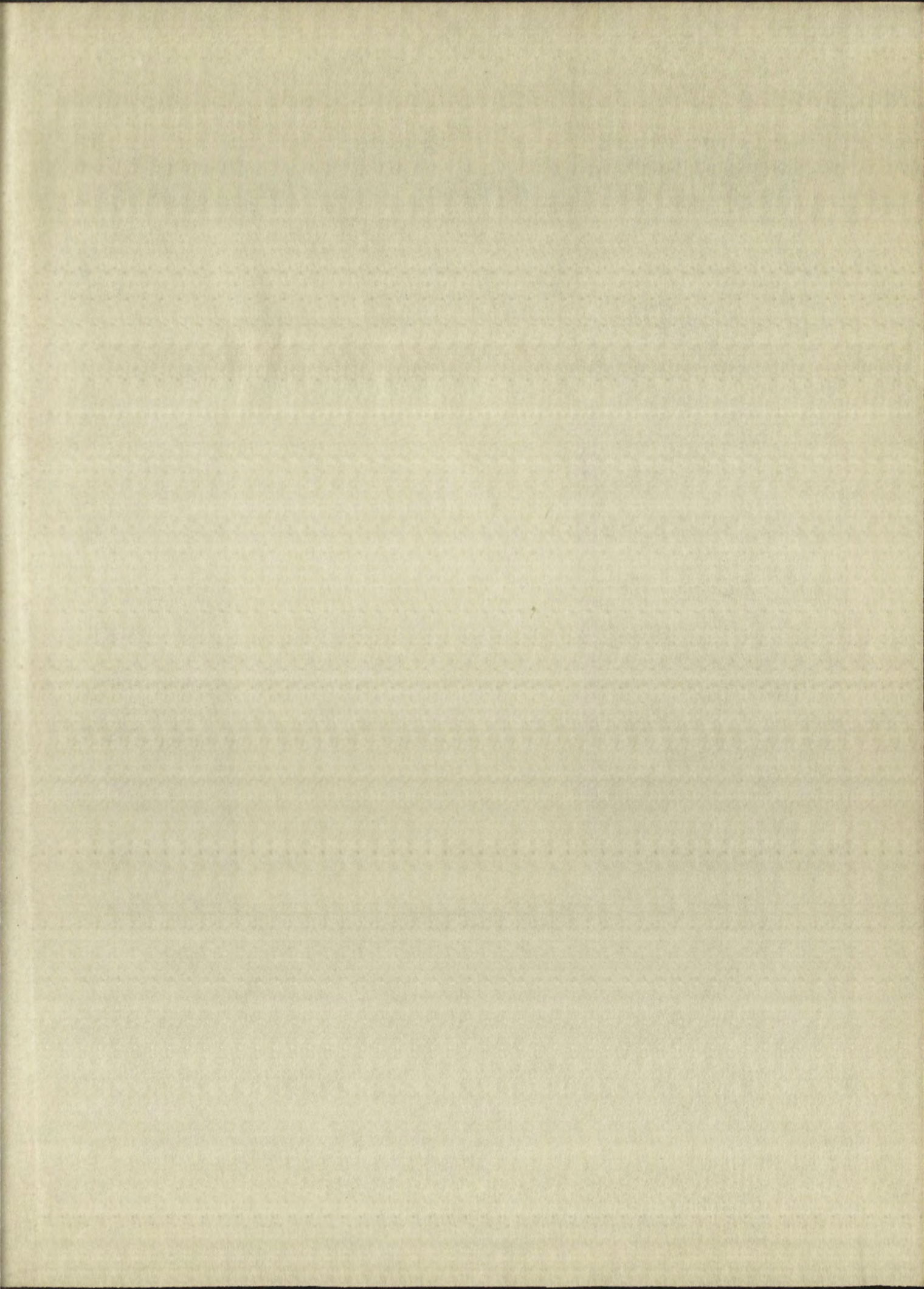














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