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### A Study of the Methods and Conditions of Mathematics Teaching in New Mexico High Schools

Betty Ruth Moseley

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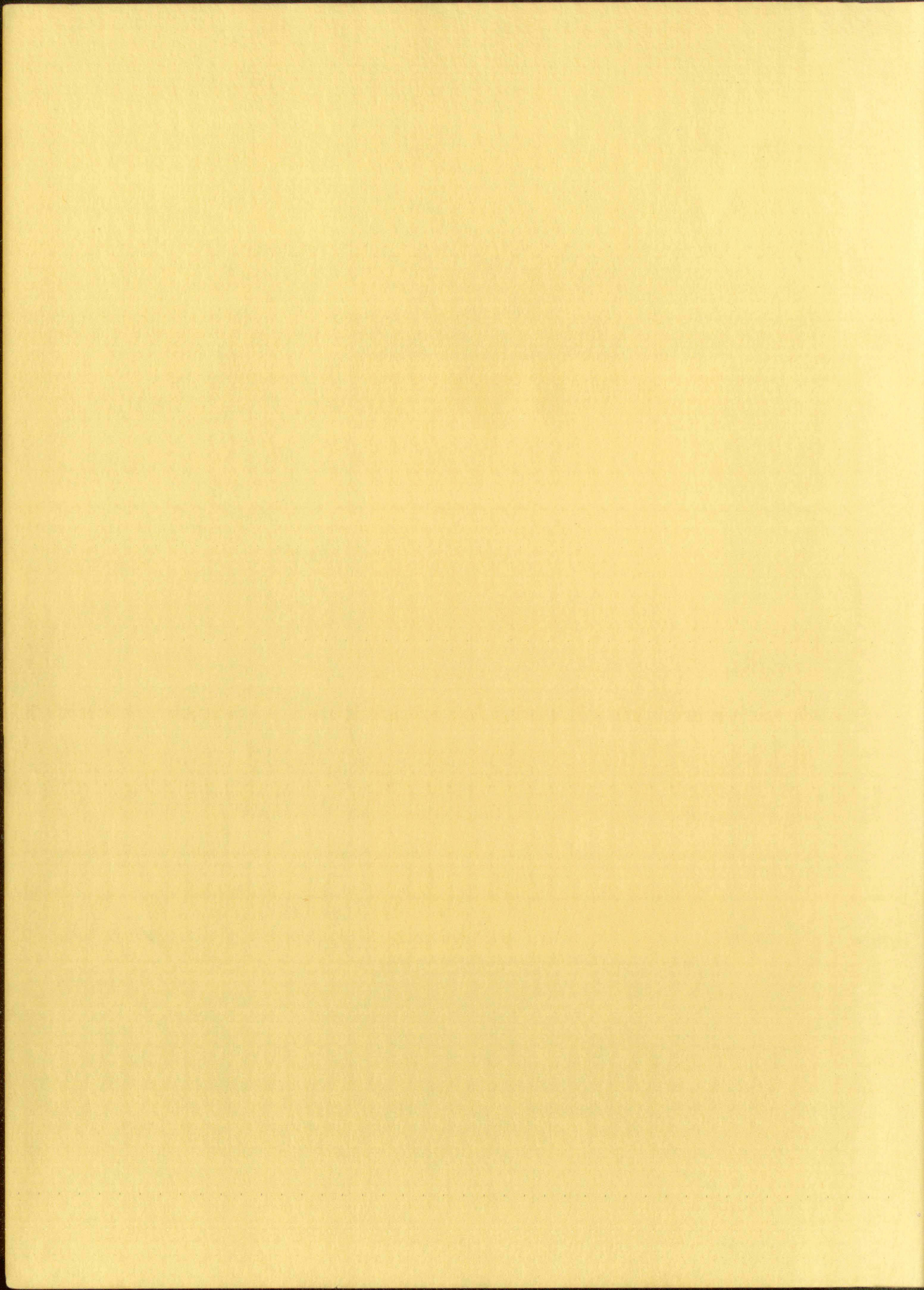
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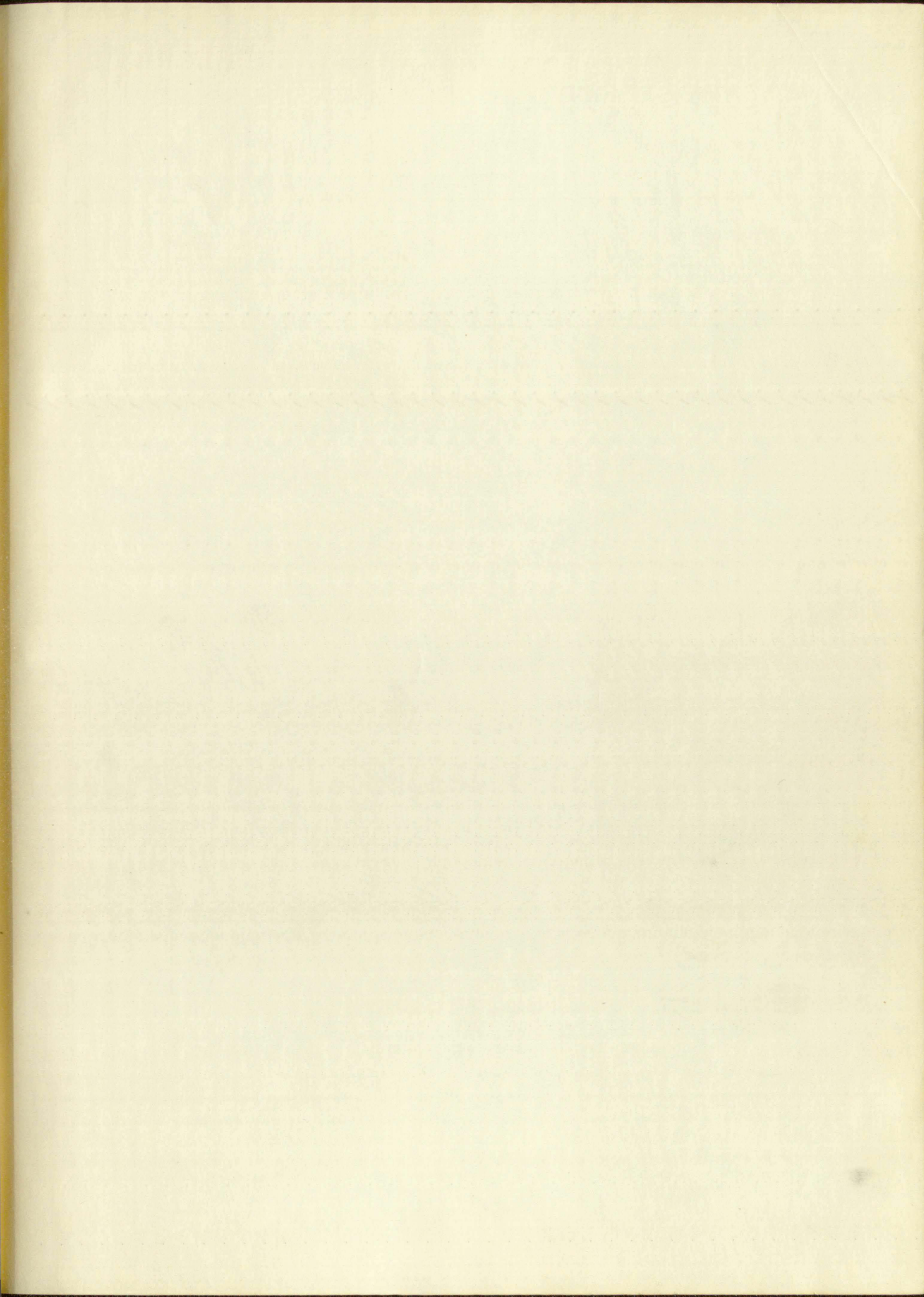
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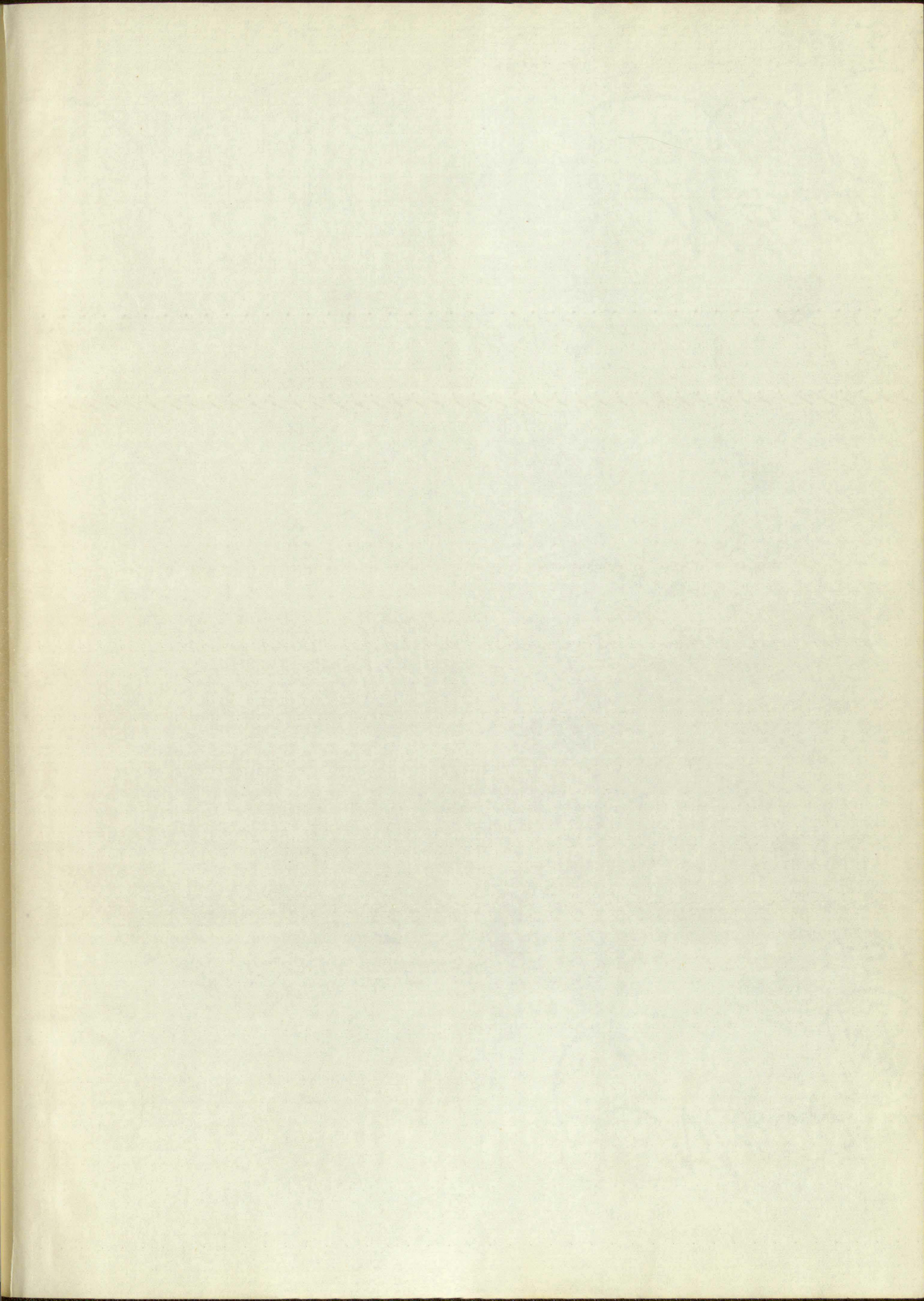




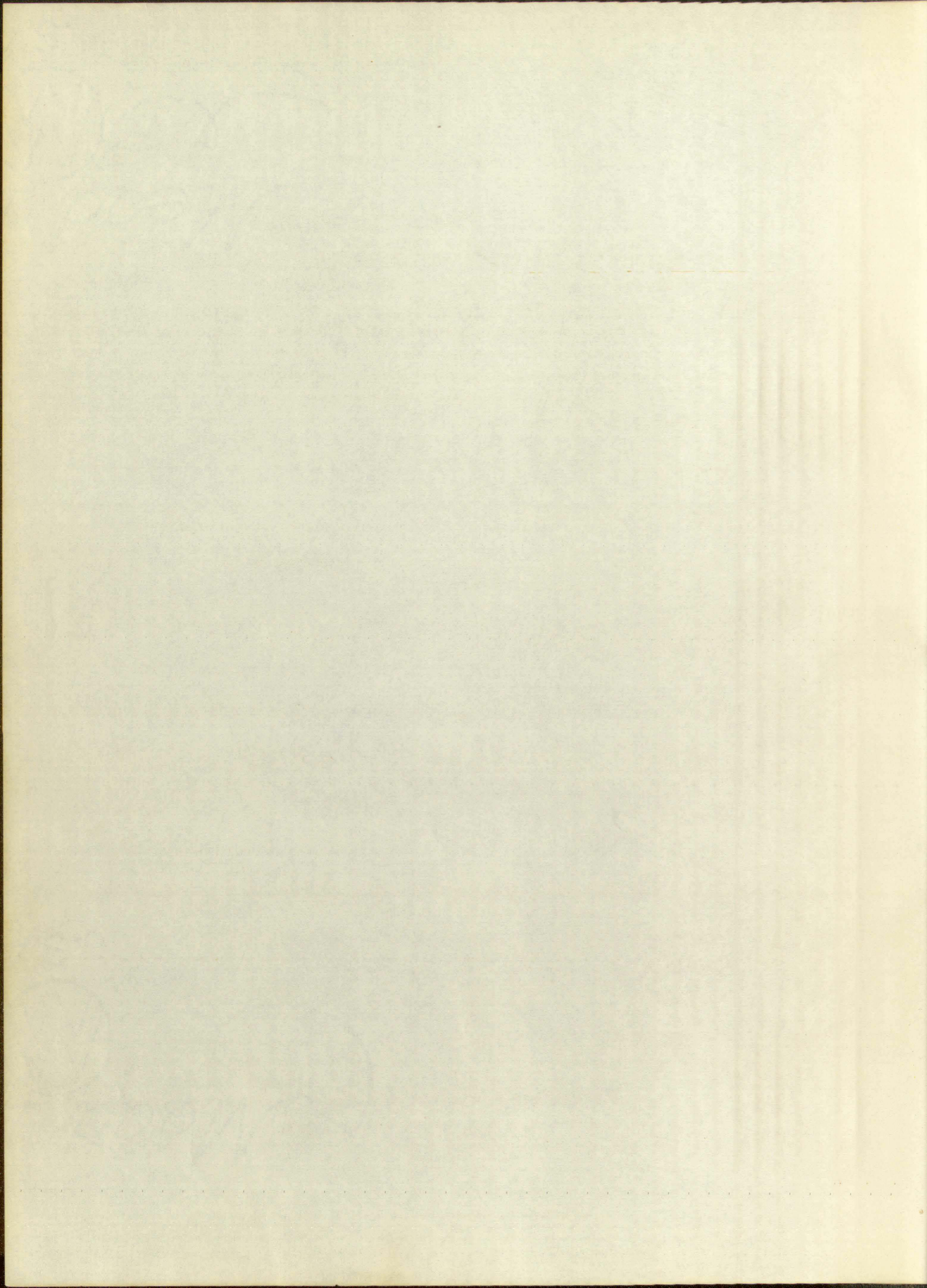














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A STUDY OF THE METHODS AND CONDITIONS  
OF MATHEMATICS TEACHING IN NEW MEXICO HIGH SCHOOLS

By  
Betty Ruth Moseley

A Thesis  
Presented in Partial Fulfillment of the  
Requirements for the Degree of  
Master of Arts in Education

University of New Mexico

1952



STUDY OF THE BONDING AND CRYSTALLINITY

OF POLYMERIZATION OF VINYL MONOMERS

# EFFICIENCY ERASE BOND FRAGMENT



BY

PAUL H. HARRIS

Abstract

Presented in a series of papers at the  
Symposium on the Chemistry of  
Polymers, New York, N. Y., 1954.

Published by the American Chemical Society



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

MASTER OF ARTS

*E. Castetter*  
DEAN

5-31-52  
DATE

A STUDY OF THE METHODS AND CONDITIONS  
OF MATHEMATICS TEACHING IN NEW MEXICO HIGH SCHOOLS

By

Betty Ruth Moseley

Thesis committee

*Nelson N. Innis*  
CHAIRMAN

*B. M. Crawford*

*Kathleen McCann*



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

MASTER OF ARTS

DATE

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## CHAPTER I

### THE PROBLEM AND METHODS OF PROCEDURE

The complexity of modern society demands increasingly more of the individual in every aspect of life. Modern science and technology have advanced with great strides since the turn of the century; these not only create the need for more and more scientists, engineers, and technologists, but demand of them greater skill and broader knowledge. Those individuals who do not enter scientific fields find that they must possess an increasingly greater degree of functional competence in mathematics in order to perform the ordinary computation and reasoning demanded by everyday life.

No man can have a basic knowledge of modern scientific civilization without some understanding of the simplest, easiest, and most enjoyable language in the world--the language of mathematics.<sup>1</sup>

There has been a growing feeling in recent years that students graduating from the secondary schools are not functionally competent in mathematics, a subject that plays a vital part in the daily life of the graduate in any occupation or training which he enters. The question often arises as to just how the secondary schools are attempting to teach their students to use mathematics to solve problems

---

<sup>1</sup> Denning Miller, Popular Mathematics (New York: William H. Wise and Company, Inc., 1942), p. xi.



THE FUTURE OF EDUCATION

The complexity of modern society demands increasingly more of the individual in every aspect of life. But in science and technology have advanced with great strides since the turn of the century; these advances have created the need for more and more scientific, engineering, and technical-ogists, but demand of these greater skill and broader knowledge. These individuals who do not enter research fields find that they must possess an increasingly broader degree of functional competence in order to perform the ordinary occupational and reasoning demanded by everyday life.

No man can have a basic knowledge of modern scientific civilization without some understanding of the principles of science, and our educational system in the United States is largely of antiquity. There has been a growing feeling in recent years that students graduating from the secondary schools are not functionally competent in mathematics, a subject that plays a vital part in the daily life of the citizen in any modern nation. The question of the relation of the secondary schools to the needs of the citizen is a subject that has been discussed for many years. The question of the relation of the secondary schools to the needs of the citizen is a subject that has been discussed for many years. The question of the relation of the secondary schools to the needs of the citizen is a subject that has been discussed for many years.

I am writing this book for the purpose of presenting a plan for the reorganization of the secondary schools to meet the needs of the citizen. I am writing this book for the purpose of presenting a plan for the reorganization of the secondary schools to meet the needs of the citizen. I am writing this book for the purpose of presenting a plan for the reorganization of the secondary schools to meet the needs of the citizen.



now and problems they will meet later in actual life. This study is concerned with analysis of the conditions of mathematics teaching in New Mexico high schools and the functional competence of the graduates in mathematics.

## I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to investigate and present an analysis of the conditions and methods of mathematics teaching in New Mexico high schools as revealed through a questionnaire study; (2) to obtain an objective measure of the functional competence of New Mexico students in mathematics by administering the Davis Test of Functional Competence in Mathematics to a representative number of high school seniors in the state and comparing their levels of achievement with national norms; (3) to evaluate the present conditions and analyze the effectiveness of the present methods in teaching the students in terms of their functional competence in mathematics as shown by the results of the test and the questionnaire; and (4) to give a composite picture of the status of mathematics in New Mexico high schools.

Importance of the study. World War II, industry, and society as a whole have shown the definite need for mathematics in life and the lack of functional competence



now and proposed the study to be done in Mexico. This study is concerned with a study of the conditions of mathematics teaching in the public high schools and the mathematical competence of the students in mathematics.

Statement of the problem. It was the purpose of this study (1) to investigate and present an analysis of the conditions and methods of mathematics teaching in the Mexico high schools as revealed through a questionnaire study; (2) to obtain an objective picture of the mathematical competence of high school students in mathematics in Mexico; (3) to determine the present conditions and the status and compare the results of mathematics in Mexico with the national norms; (4) to estimate the present conditions and analyze the effectiveness of the present conditions in teaching mathematics in terms of their functional competence; (5) to give a picture of the results of the study and the status of mathematics in the Mexico high schools.

Importance of the study. Mathematics is a basic science and society as a whole have shown the interest and need for mathematics in the past and the high school mathematics



on the part of most of the population. As early as 1941, the military had established the fact that mathematical deficiencies were prevalent. Admiral Nimitz wrote:

A carefully prepared selective examination was given to 4200 entering freshmen at twenty-seven of the leading universities and colleges of the United States. Sixty-eight per cent of the men taking this examination were unable to pass the arithmetical reasoning test. Sixty-two per cent failed the whole test, which included also arithmetical combinations, vocabulary, and spatial relations. The majority of failures were not merely borderline, but far below a passing grade. Of the 4200 entering freshmen who wished to enter the Naval Reserve Officers' Training Corps, only ten per cent had already taken elementary trigonometry in the high schools from which they had graduated. Only twenty-three per cent of the 4200 had taken more than one and a half years of mathematics in high school.

The experience which the Navy has had in attempting to teach navigation in the Naval Reserve Officers' Training Corps Units and in the Naval Reserve Midshipmen Training Program (V-7) indicates that seventy-five per cent of the failures in the study of navigation must be attributed to the lack of adequate knowledge of mathematics. Since mathematics is also necessary in fire control and in many other vital branches of the naval officer's profession, it can readily be understood that a candidate for training for a commission in the Naval Reserve cannot be regarded as good material unless he has sufficient mathematics.

The Navy depends for its efficiency upon trained men. The men are trained at schools conducted for this purpose and the admission of men to these schools is based upon the meeting of certain carefully established requirements. However, in order to enroll the necessary number of men in the training schools, it was found necessary at one of the training stations to lower the standards of fifty per cent of the admissions. This necessity is attributed to a deficiency in the early education of the men involved. The requirements had to be lowered in the field of arithmetical attainment. Relative to the results obtained in the General Classification Test, the lowest category of achievement was in arithmetic.







A study has been made of the grades received in the examination of candidates for enlistment in the Navy, classified geographically according to the location of the recruiting station through which the candidates applied for enlistment. It is to be noted that the proficiency in arithmetic in the eastern part of the country was strikingly greater than that of the middle west and west. The lowest average mark east of the Mississippi was equal to the highest average mark west of the Mississippi. The three highest average attainments in arithmetic were achieved by the recruiting stations in Troy, Brooklyn, and Buffalo--all in New York State.<sup>2</sup>

Since the preceding letter was written in 1941, an increasing number of studies, surveys, and discussions show that the situation is not improving. One example of college interest in the subject is a panel discussion which took place at the meeting of the Southwestern Section of the Mathematics Association of America held at the University of New Mexico in March, 1951. Earl Walden, of New Mexico College of Arts and Mechanical Arts, was the moderator. It was evident from this discussion that there is a lack of mathematical competency in the high school graduates who enter college.

Two topics were discussed: What should be the entrance requirements in mathematics? and What can the colleges do to improve high school mathematics? It was pointed out that by general cooperation colleges that have no entrance requirements in mathematics can and should insist on two years of mathematics for entrance, provided that the selection be made from a broad base of mathematical subjects. The date for such

---

<sup>2</sup> Admiral C. W. Nimitz, A Letter reprinted in Mathematics Teacher, 35:255-56, October, 1942.



A study has been made of the grades received in the examination of candidates for admission to the University of California, and the results are as follows: The percentage of successful candidates for admission to the University of California is 10.1. The percentage of successful candidates for admission to the University of California is 10.1. The percentage of successful candidates for admission to the University of California is 10.1.

Since the preceding letter was written in 1911, an

increasing number of studies, surveys, and discussions show that the situation is not improving. One example of college interest in the subject is a panel discussion which took place at the meeting of the Southwestern Association of the Mathematical Association of America held at the University of New Mexico in 1921. Panel members, at New Mexico College of Arts and Mechanical Arts, and the University of New Mexico. It was evident from this discussion that there is a lack of mathematical competency in the high school graduates who enter college.

Two topics were discussed: What should be the entrance requirements for admission to college? and What can be done to improve high school mathematics? It was pointed out that the high school mathematics curriculum should be revised to include more of the material which is necessary for entrance to college. The date for such



change should be set sufficiently in advance to enable high schools to establish "two or three track" systems for their students.

Colleges can help high school mathematics programs by intensive training of prospective mathematics teachers in mathematics as well as education, deliberately stressing the relationship of advanced mathematics to the work of the secondary school, and by encouraging the most competent to teach. It was also argued that colleges provide intellectual stimulation for the gifted by visiting lecturers, awarding prizes, medals and scholarships, by sponsoring tournaments, clubs, and school publications. All students, however, should be provided with the guidance pamphlets recently issued by the M.A.A. and the N.C.T.M.

The panel of this discussion was appointed as a committee to meet with a similar committee of secondary school teachers to work on common problems and make recommendations to the Section at the 1952 meeting.<sup>3</sup>

In 1944 the National Council of Teachers of Mathematics created a Commission on Post-War Plans. This Commission stated that "the school should guarantee functional competence in mathematics to all who can possibly achieve it."<sup>4</sup> Of course, the question as to what constituted functional competence in mathematics then arose. In 1947 the Commission published a check-list of twenty-nine "musts" of mathematics. Later, David John Davis, in his doctoral dissertation, designed his test which would show

---

<sup>3</sup> R. L. Westhafer, secretary, Minutes of the March Meeting of the Southwestern Section of The Mathematical Association of America, Inc., The American Mathematical Monthly, 58:519-22, August-September, 1951.

<sup>4</sup> Second Report of the Commission on Post-War Plans, Mathematics Teacher, 38:196, May, 1945.



changes would be made sufficiently in advance to enable high schools to arrange for their students.

Colleges can help high school mathematics programs by intensive training of prospective mathematics teachers in mathematics as well as education. Teachers are also training the mathematics of advanced mathematics to the point of the secondary school, and by encouraging the work of the secondary school. It was also agreed that colleges provide mathematical education for the gifted by visiting teachers, awarding prizes, medals, and scholarships, by sponsoring tournaments, etc., and school publications. All students, however, should be provided with the guidance pamphlets recently issued by the U.S.A. and the N.S.T.M.

The panel of this discussion was appointed as a committee to meet with a similar committee of secondary school teachers to work on common problems and make recommendations to the section at the 1952 meeting.

In 1944 the National Council of Teachers of Mathematics

created a Commission on Post-War Plans. This Commission stated that "the school should guarantee national competence in mathematics to all who can possibly achieve it." Of course, the question as to what constitutes national competence in mathematics is open. In 1947 the Commission published a check-list of twenty-nine "marks" of mathematical literacy. David John Taylor, in his doctoral dissertation, assigned his test which would show the following results:

J. E. Weather, secretary, Minutes of the 1947 Meeting of the Post-War Section of the Mathematical Association of America, Inc., The American Mathematical Monthly, 58:219-22, August-September, 1951.

4 Second Report of the Commission on Post-War Plans, Mathematical Section, 1947, May, 1947.



how well the schools were teaching mathematical literacy, as defined in terms of these fundamentals.

The Davis test, which was published in 1951, has not been used in New Mexico. This study takes advantage of the recent publication of such a test which determines the levels of mathematical competence which young people exercise in their daily lives. By making a study of the conditions and methods of teaching mathematics and following this survey with actual test results, a picture of the status of mathematics in New Mexico is presented.

Delimitations of the study. ✓ The part of this study dealing with the conditions and methods of teaching mathematics included only the public high schools. All public high schools which did not include the twelfth grade were excluded. For the portion of the study concerning the tests, only five representative high schools were selected from those public high schools. No schools for the handicapped or for special groups were included.

## II. DEFINITIONS OF TERMS USED

Functional competence in mathematics. In this study, functional competence in mathematics shall be defined in terms of the twenty-nine essential points that the schools should teach as given by the Commission on Post-War Plans



how well the students were doing in mathematics as defined in terms of these standards.

The Davis test, which was published in 1925, has not been used in New Mexico. This study takes advantage of the recent publication of such a test which determines the levels of mathematical competence which young people exercise in their daily lives. By making a study of the conditions and methods of teaching mathematics and following this survey with actual tests results, a picture of the status of mathematics in New Mexico is presented.

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dealing with the conditions and methods of teaching mathematics included only the public high schools. All private high schools which did not include the twelfth grade were excluded. For the portion of the study concerning the tests, only five representative high schools were selected from those public high schools. No schools for the handicapped or for special groups were included.

II. DEFINITION OF TERMS USED

Functional competence in mathematics. In this study functional competence in mathematics shall be defined in terms of the twenty-nine essential points that the schools should teach as given by the Commission on Post-Sec. Plans



of the National Council of Teachers of Mathematics and as measured by the Davis Test of Functional Competence in Mathematics. The report of the Commission, including these twenty-nine points, is indicated later in this chapter.

### III. SOURCES OF THE DATA

The basis for comparing the level of mathematical competence of New Mexico students to that of other students throughout the nation was the Davis Test of Functional Competence in Mathematics by David J. Davis, published by the World Book Company.

Data concerning methods of teaching used in New Mexico and conditions of the mathematics curriculum in the state were obtained from a 22-item questionnaire sent to mathematics teachers in the 105 public high schools in the state.

The reports on the Commission on Post-War Plans of the National Council of Teachers of Mathematics were used in the study to give the basis for the Davis Test and for functional competence in mathematics as defined in this study. Opinions of various authorities in this field and results of several studies were used in constructing the check-list prepared for this study.



of the National Council of Teachers of Mathematics and as  
measured by the Davis Test of Functional Competence in  
Mathematics. The reports of the Commission, including  
these twenty-nine points, is indicated later in this  
chapter.

### III. PURPOSES OF THE STUDY

The basis for comparing the level of mathematical  
competence of New Mexico students to that of other students  
throughout the nation was the Davis Test of Functional  
Competence in Mathematics by David J. Davis, published by  
the World Book Company.

Data concerning methods of teaching used in New  
Mexico and conditions of the mathematics curriculum in this  
state were obtained from a 25-item questionnaire sent to  
mathematics teachers in the 100 public high schools in the  
state.

The reports on the Commission on Post-Secondary  
Education of the National Council of Teachers of Mathematics were used  
in the study to give the basis for the Davis Test and for  
functional competence in mathematics as defined in this  
study. Opinions of various authorities in this field and  
results of several studies were used in corroborating the  
check-list prepared for this study.



#### IV. METHODS OF PROCEDURE

A 22-item questionnaire was prepared and sent to mathematics teachers in each of the 105 public high schools in the state. The details of preparation of the questionnaire are related in Chapter II. Sixty-seven per cent of the schools returned the check-lists, but this figure represents an even higher per cent of the total number of mathematics teachers, since more than one teacher from some schools answered it. An exact per cent of teachers who responded was not determined because the precise number of mathematics teachers in the state could not be obtained. A sufficient number of questionnaires was sent to each school to insure each mathematics teacher's receiving one. A total of ninety teachers responded, thereby giving a survey of 211 mathematics classes in the state.

The questionnaire was a survey of the status and methods of mathematics teaching in the state. A copy of the questionnaire is given in Appendix A.

To obtain objective data for measuring the effectiveness of the present methods and conditions, the Davis Test of Functional Competence in Mathematics was administered to graduating classes in five high schools, A, B, C, D, and E, in New Mexico. These representative high schools were chosen by a stratified random sampling. For effectiveness,



IV. RESULTS OF RESEARCH

A 25-item questionnaire was prepared and sent to mathematics teachers in each of the 104 public high schools in the state. The results of the questionnaire are listed in Table II. Sixty-seven per cent of the schools returned the questionnaire, but this figure represents an even higher per cent of the total number of mathematics teachers, since more than one teacher from some schools answered it. An exact per cent of teachers who responded was not determined because the precise number of mathematics teachers in the state could not be obtained. A sufficient number of questionnaires was sent to each school to insure each mathematics teacher's receiving one. A total of ninety teachers responded, giving a return of 211 replies. Replies came from the state.

The questionnaire was a survey of the status and methods of mathematics teaching in the state. A copy of the questionnaire is given in Appendix A.

To obtain objective data on teaching and effectiveness of the present methods and conditions, the results of functional observation in mathematics was administered to graduating classes in five high schools A, B, C, D, and E in New Mexico. These representative high schools were chosen by a carefully random sampling. For objectiveness,



a stratification based upon a known population characteristic was selected, which was presumed from available knowledge to be associated with the criterion variable (mathematical competence). The most feasible base for stratification was school enrollment. The enrollments of the 105 rural and municipal public high schools in New Mexico were divided into three groups. In the groups, twelve high schools had enrollments of more than 500 pupils; twenty-one had between 200 and 500 pupils; and seventy-two schools had less than 200 pupils.

Since only 10.4 per cent of all the high schools had enrollments of more than 500, it was decided that one school from that group would be representative. The group with enrollments ranging from 200 to 500 constituted only twenty per cent of the total; therefore, it was deemed necessary to have only one school tested from that group. The remaining 69.4 per cent of the public high schools had enrollments of less than 200. From this enrollment group, two schools were used in the testing program.

Of New Mexico's public high schools, 89.6 per cent had enrollments of less than 500 pupils. To be certain that the three schools tested were representative of this smaller enrollment group which includes a large percentage of all high schools, another school was included to verify test results.



a stratification based upon a known population characteristic was selected, which was based upon available knowledge to be associated with the criterion variable (mathematical competence). The most feasible base for stratification was school enrollment. The enrollment of the 107 rural and municipal public high schools in New Mexico were divided into three groups. In the groups, twelve high schools had enrollments of more than 500 pupils; twenty-one had between 200 and 500 pupils; and seventy-two schools had less than 200 pupils.

Since only 10.1 per cent of all the high schools had enrollments of more than 500, it was decided that one school from that group would be representative. The group with enrollments ranging from 200 to 500 constituted only twenty per cent of the total; therefore, it was deemed necessary to have only one school tested from that group. The remaining 69.1 per cent of the public high schools had enrollments of less than 200. From this enrollment group, two schools were used in the testing program.

Of New Mexico's public high schools, 69.6 per cent had enrollments of less than 200 pupils. To be certain that the three schools tested were representative of this smaller enrollment group which includes a large percentage of all high schools, another school was included to verify test results.



In selection of the sample, such additional substrata as geographic location of the schools, municipal or rural characteristics, and accreditation by North-Central Association were used. Schools from various sections of the state were chosen. Four of the schools were municipal; one was rural. Two of the schools had long-time accreditation by North-Central Association; two were not accredited; and one was accredited only recently.

Results of the test were analyzed with respect to the size of the school, the number of years of mathematics courses the student had taken, and the sex of the students. New Mexico seniors were compared in mathematical competence with other seniors in the nation. Results of the tests and the survey afforded material for a comparative study of present methods, status, and accomplishments in the field of secondary mathematics in New Mexico and offered implications for improvement of mathematics teaching.

## V. REVIEW OF THE RELATED LITERATURE

The genesis of this study was in the creation of the Commission on Post-War Plans in 1944 by the National Council of Teachers of Mathematics to plan mathematics programs for high schools in the post-war period. In 1945 this Commission made a second report in which thirty-four suggestions were presented. These were tentative theses from the collective



In selection of the schools, the following criteria were used: (1) the schools, municipal or rural characteristics, and accreditation by the Central Association were used. Schools from various sections of the state were chosen. Four of the schools were multi-plant ones and one was rural. Two of the schools had been re-accredited by the Central Association; two were not accredited; and one was accredited only recently. Results of the first year are reported with respect to the size of the school, the number of years of attendance courses the students had taken and the sex of the students. New Mexico students were compared to students of comparable with other sections in the nation. Results of the first year the survey afforded material for a comparative study of present methods, classes, and accomplishments in the field of secondary mathematics in New Mexico and other parts of the nation for improvement of mathematics teaching.

#### V. REVIEW OF THE SECOND YEAR

The results of this study are in the question of the Commission on Post-war Plans in 1945 of the National Council of Teachers of Mathematics to plan a national program for high schools in the post-war period. In 1945 this Commission made a second report in which thirty-four suggestions were presented. These were tentative ideas for a national collective



experience and thinking of the entire Commission and from pedagogical literature and investigation. Some of these theses had long been advocated by educational leaders. The first of these was: "Thesis I--The school should guarantee functional competence in mathematics to all who can possibly achieve it."<sup>5</sup> This thesis is of vital concern to all teachers from Grade I through the junior college.

Then the Commission came to grips with this thesis and outlined the common mathematical fundamentals--the essentials of functional competence in mathematics. In their final report, written to the high school students, the Commission showed the importance of mathematics for personal use and for various occupations. A "Check-List" of twenty-nine objectives for the mathematics student was prescribed.<sup>6</sup> These objectives were called the "29 'Musts' of Mathematics" which should be understood "to fit Mr. Average Citizen culturally and vocationally to his modern, scientifically charged environment."<sup>7</sup>

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<sup>5</sup> Second Report of the Commission, loc. cit.

<sup>6</sup> Guidance Report of the Commission on Post-War Plans, Mathematics Teacher, 40:315-39, November, 1947.

<sup>7</sup> Teaching Trends, Pamphlet 39R published by Scott, Foresman and Company.



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- 5 Second Report of the Commission, Jan. 1917.
  - 6 Outline Report of the Commission on Post-War Plans,  
Mathematics Teacher, 40:315-32, November, 1917.
  - 7 Teaching Trends, February 1917 published by Scott,  
Powers and Gurnea.



### The Check List<sup>8</sup>

1. Computation. Can you add, subtract, multiply, and divide effectively with whole numbers, common fractions, and decimals?
2. Percents. Can you use percents understandingly and accurately?
3. Ratio. Do you have a clear understanding of ratio?
4. Estimating. Before you perform a computation, do you estimate the result for the purpose of checking your answer?
5. Rounding numbers. Do you know the meaning of significant figures? Can you round numbers properly?
6. Tables. Can you find correct values in tables; e.g., interest and income tax?
7. Graphs. Can you read ordinary graphs: bar, line, and circle graphs? the graph of a formula?
8. Statistics. Do you know the main guides that one should follow in collecting and interpreting data; can you use averages (mean, median, mode); can you draw and interpret a graph?
9. The nature of a measurement. Do you know the meaning of a measurement, of a standard unit, of the largest permissible error, of tolerance, and of the statement that "a measurement is an approximation"?
10. Use of measuring devices. Can you use certain measuring devices, such as an ordinary ruler, other rulers (graduated to thirty-seconds, to tenths of an inch, and to millimeters), protractor, graph paper, tape, caliper micrometer, and thermometer?
11. Square root. Can you find the square root of a number by table, or by division?
12. Angles. Can you estimate, read, and construct an angle?
13. Geometric concepts. Do you have an understanding of point, line, angle, parallel lines, perpendicular lines, triangle (right, scalene, isosceles, and equilateral), parallelogram (including square and rectangle), trapezoid, circle, regular polygon, prism, cylinder, cone, and sphere?
14. The 3-4-5 relation. Can you use the Pythagorean relationship in a right triangle?
15. Constructions. Can you with ruler and compasses construct a circle, a square, and a rectangle, transfer a line segment and an angle, bisect a

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<sup>8</sup> Guidance Report of the Commission, op. cit., pp. 320-25.



The Interview

1. Conceptualization. Can you add, subtract, multiply, and divide effectively with whole numbers, common fractions, and decimals?
2. Perception. Can you use geometric instruments and accurately?
3. Ratio. Do you have a clear understanding of ratios?
4. Measurement. Before you work on a comparison, do you estimate the result for the purpose of checking your answer?
5. Counting numbers. Do you know the meaning of different figures? Can you round numbers properly?
6. Tables. Can you find correct values in tables?
7. Graphs. Can you read ordinary graphs: bar, line, and circle graphs? the graph of a formula?
8. Statistics. Do you know the mean, median, mode, and standard deviation in collection and interesting data? Can you use averages (mean, median, mode); can you draw and interpret a graph?
9. The nature of a measurement. Do you know the meaning of a measurement, of a standard unit, of the largest permissible error, of tolerance, and of the statement that "a measurement is an approximation?"
10. Use of measuring devices. Can you use certain measuring devices, such as an ordinary ruler, other rulers (graduated to thirty-seconds, to tenths of an inch, and to millimeters), protractor, graph paper, tape, calliper, microscope, and thermometer?
11. Square root. Can you find the square root of a number by table, or by division?
12. Angles. Can you estimate, read, and construct an angle?
13. Geometric concepts. Do you have an understanding of point, line, angle, parallel lines, perpendicular lines, triangle (right, scalene, isosceles), and quadrilateral (rectangle, rhombus, square, parallelogram) (including square and rectangle), trapezoid, circle, regular polygon, prism, cylinder, cone, and sphere?
14. The 3-4-5 relation. Can you use the Pythagorean relationship in a right triangle?
15. Constructions. Can you with ruler and compasses construct a circle, a square, and a rectangle, bisect a line segment and an angle, draw a



- line segment and an angle, copy a triangle, divide a line segment into more than two equal parts, draw a tangent to a circle, and draw a geometric figure to scale?
16. Drawings. Can you read and interpret reasonably well, maps, floor plans, mechanical drawings, and blueprints? Can you find the distance between two points on a map?
  17. Vectors. Do you understand the meaning of a vector, and can you find the resultant of two forces?
  18. Metric system. Do you know how to use the most important metric units (meter, centimeter, millimeter, kilometer, gram, kilogram)?
  19. Conversion. In measuring length, area, volume, weight, time, temperature, angle, and speed, can you shift from one commonly used standard unit to another widely used standard unit; e.g., do you know the relation between yard and foot, inch and centimeter, etc.?
  20. Algebraic symbolism. Can you use letters to represent numbers; i.e., do you understand the symbolism of algebra--do you know the meaning of exponent and coefficient?
  21. Formulas. Do you know the meaning of a formula--can you, for example, write an arithmetic rule as a formula, and can you substitute given values in order to find the value for a required unknown?
  22. Signed numbers. Do you understand signed numbers and can you use them?
  23. Using the axioms. Do you understand what you are doing when you use the axioms to change the form of a formula, or when you find the value of an unknown in a simple equation?
  24. Practical formulas. Do you know from memory certain widely used formulas relating to areas, volumes, and interest, and to distance, rate, and time?
  25. Similar triangles and proportion. Do you understand the meaning of similar triangles, and do you know how to use the fact that in similar triangles the ratios of corresponding sides are equal? Can you manage a proportion?
  26. Trigonometry. Do you know the meaning of tangent, sine, cosine? Can you develop their meanings by means of scale drawings?
  27. First steps in business arithmetic. Are you mathematically conditioned for satisfactory adjustment to a first job in business, e.g., have you a start in understanding the keeping of a simple account, making change, and the arithmetic that illustrates



line segment and an angle, copy a triangle. 16.  
a line segment, a ray, or a line, draw a geometric figure  
to model? 17.  
Drawing. Can you read and interpret reasonably  
well, maps, floor plans, mechanical drawings, and  
diagrams? 18.  
points on a number line  
Vectors. Do you understand the meaning of a vector,  
and can you find the resultant of two vectors?  
19.  
Metric system. Do you know how to use the most  
important metric units (meter, kilogram, liter,  
meter, liter, gram, etc.)?  
Conversion. In measuring length, area, volume,  
weight, time, temperature, angle, and speed, can  
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Algebraic symbols. Can you use letters to represent  
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Formulas. Do you know the meaning of a formula--  
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22.  
Signed numbers. Do you understand signed numbers  
and can you use them?  
23.  
Using the scales. Do you understand what you are  
doing when you use the scales to change the form  
of a formula, or when you find the value of an  
unknown in a simple equation?  
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Practical formulas. Do you know from memory certain  
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25.  
Similar figures and proportion. Do you understand  
the meaning of similar triangles, and do you know  
how to use the fact that in similar triangles the  
ratios of corresponding sides are equal? Can you  
make a proportion?  
26.  
Translations. Do you know the meaning of congruent,  
similar, equal? Can you develop their meanings by  
means of real examples?  
27.  
Using graphs in business arithmetic. Are you familiar  
with the different types of graphs commonly used  
to a great extent in business, e.g., bar graphs  
in representing the keeping of a ship's account,  
making charts, and the arithmetic that illustrates



- the most common problems of communications and everyday affairs?
28. Stretching the dollar. Do you have the basis for dealing intelligently with the main problems of the consumer; e.g., the cost of borrowing money, insurance to secure adequate protection against the numerous hazards of life, the wise management of money, and buying with a given income so as to get good values as regards both quantity and quality?
  29. Proceeding from hypothesis to conclusion. Can you analyze a statement in a newspaper and determine what is assumed, and whether the suggested conclusions really follow from the given facts or assumptions?

The Commission by no means underestimated the difficulty of teaching these twenty-nine separate phases of mathematics.

The task of insuring mathematical literacy to all people is enormously difficult--one that has not been done in any community throughout all history. It will take time, energy, and money. But it is a challenge that mathematics teachers should accept.<sup>9</sup>

For his doctoral dissertation at the University of Michigan in 1950, David John Davis wrote "A Comparative Study of Achievement Levels of Twelfth Grade Pupils on a Test Designed to Measure Functional Competence in Mathematics." The criteria for the test were based on the fundamentals of mathematics listed by the Commission on Post-War Plans. Davis compared criteria in this report with those in reports of other groups set up to study the place of mathematics in the secondary school curriculum and found general agreement.

The major assumptions of Davis' study, which also

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<sup>9</sup> Second Report of the Commission, loc. cit.



the most common problem of communication and  
everyday thinking?  
Summarizing the data, you have the basis for  
selecting material with the main problem of  
the content, and the cost of learning money,  
insurance to secure accurate presentation  
the question of life, the who management  
of money, and dealing with a river, river and  
get good values as regards cost, quality and quantity.  
Proceeding from hypothesis to conclusion, can you  
analyze a statement in which the main problem is  
is assumed, and which shows a logical conclusion  
readily follow from the given facts or assumptions?

28.  
29.

The Commission by its report underlined the difficulty

of teaching these twenty-nine separate phases of mathematics.

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The major assumptions of Davis' study, which also



are present in this study, were: (1) that the "essentials of the Check List" constitute real essentials for functional competence in mathematics, and (2) that a paper and pencil test, employing these criteria, is a valid means of measuring functional competence.

After construction of the test, Davis administered it to various groups of twelfth grade students in Michigan. The test was later standardized on a basis of national norms by the World Book Company. The author then compared the scores of boys with those of girls, the scores of pupils with one kind of mathematical background with groups of another background, and made several other comparisons. He recommended further use of the test, taking into consideration teaching methods that have been used in the mathematics courses the students have taken.

Schunert made a study to determine the status of mathematics instruction in Minnesota's public secondary schools, in a doctoral dissertation entitled "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School." One hundred schools were selected according to size and administrative organization, and later subsamples of classes were chosen in these schools. The study was conducted during the school years, 1947-49. Identical mathematics achievement tests constructed by the investigator were administered at the



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beginning and end of the year. The Otis Quick-Scoring Mental Ability Test was also given. Questionnaires concerning pupil age, sex, education plans, and social background were completed by the pupils being studied. Another questionnaire concerning teacher experience, training, and instructional practices was completed by the teachers involved in the study. The achievement of pupils taught by teachers who indicated a regular use of certain practices was compared to that of pupils whose teachers seldom used these practices.

Schunert observed several major results. With respect to the factors associated with the teacher, he found that classes taught by graduates of private colleges and state universities achieved more (on a basis of test evaluation) than did classes taught by graduates of teachers' colleges.

The teaching factors found to be important were used as criteria in preparing the questionnaire and are quoted in Chapter II. The factors which were determined as not significant in algebra achievement were sex of the students, rural or urban elementary school background, and type of secondary school attended. Some of the factors which were not significant in geometry were college or terminal plans of the pupil, class size, type of college the teacher attended, and the use of pupil-leadership. Other findings of this study are related in Chapter II.

The implications Schunert<sup>10</sup> drew from his study were



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of this study are related in Chapter II.

The implications of this study are discussed in Chapter III.



as follows: (1) If all Minnesota secondary school pupils are to have opportunities for mathematics instruction equal to those recommended by educational authorities, it will be necessary to improve present conditions with respect to (a) training of some teachers, (b) instructional techniques employed, (c) educational and psychological principles observed. (2) If all teachers are to have opportunity to teach under conditions equal to those recommended by educational authorities, it will be necessary to improve present status with respect to (a) number and kinds of preparations required per day, (b) size of pupil-day load, and (c) availability of materials of instruction. The optimum class size should be between twenty and thirty. Less mathematics learning took place in schools having less than 100 pupils and more than 500 pupils than in those with enrollments between 100 and 500 pupils.

Recommendations from Schunert's study are: (1) Educational research should be more directly available to those who establish educational policies and those who execute the policies. (2) Subsidies should be granted by the government or private institutions so that experienced

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<sup>10</sup> Jim Schunert, Summary of his Doctor's dissertation (The University of Minnesota, 1950), "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School," Journal of Experimental Education, 19:236-37, March, 1951.



Journal of Experimental Education 19:230-37, 1930, 1931  
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 (The University of Minnesota, 1930). "The Association of  
 10 Jim Bennett, Summary of his Career in Education

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 as follows: (1) If all Minnesota secondary schools pupils



teachers, professional investigators, and competent graduate students may be encouraged to do research of a causal-comparative and experimental nature, the results of which might put mathematics instruction on a scientific basis and assure continued improvement.<sup>11</sup>

These studies comprise the significant related literature to be found for use in this study. Several textbooks in the field of the teaching of secondary mathematics were used in the preparation of the questionnaire. Opinions of these authors and leaders, who are recognized as authorities in this field of mathematics, were used in selecting criteria for the check-list, and quotations from, and summaries of, these writings are included later in the study.

## VI. ORGANIZATION OF THE REMAINDER OF THE STUDY

✓ Details of the preparation of the questionnaire, the criteria used in making it, and the items which were included are presented in Chapter II. Methods used in testing are explained also, with some description of the types of schools in which the seniors were tested.

Chapter III is concerned with the results of the questionnaires and the tests. Comparisons are made between

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<sup>11</sup> Ibid., pp. 237-38.



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what was actually being done in the mathematics field and what was recommended by the leaders in the field. New Mexico seniors are compared in functional competence in mathematics with national norms. The size of their school, their mathematical background, and their sex are used as bases for comparisons.

Chapter IV is a summary of the findings and comparisons made from data gathered by the questionnaire and the test. A composite picture of the status of mathematics is shown in this chapter, and several recommendations are presented.



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## CHAPTER II

### PREPARATION OF THE QUESTIONNAIRE AND ADMINISTRATION OF THE TEST

The questionnaire was carefully prepared from all the gathered criteria. The most essential topics related to this study were included. The test of functional competence was administered to a representative number of high school seniors. Details of these procedures are presented in this chapter.

#### I. PREPARATION OF THE QUESTIONNAIRE

Form of the questionnaire. The over-all picture of the methods and conditions of mathematics teaching in New Mexico was obtained from a questionnaire sent to high school mathematics teachers in the state. The questionnaire was prepared for this study from criteria set up from general knowledge of mathematics teaching, from opinions of several authorities in this field, and from the results of various studies. A group of these opinions and ideas was gathered, and from these a selection of twenty-two principal items was made with sub-topics under some items. In order to gain a true picture of the mathematics teaching actually being done in the state, an attempt was made to include methods and procedures which are generally considered to be both good and bad.



## PREPARATION OF THE QUESTIONNAIRE AND

## ADMINISTRATION OF THE TEST

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## 1. PREPARATION OF THE QUESTIONNAIRE

Form of the questionnaire. The overall design of the methods and conditions of mathematics teaching in Mexico was obtained from a questionnaire sent to high school mathematics teachers in the state. The questionnaire was prepared for this study from extensive consultation with general knowledge of mathematics teaching. Their opinions and several authorities in this field, and from the results of various studies. A group of these opinions and ideas was gathered, and from these a selection of twenty-five original items was made with one copy of each item. In order to gain a wide picture of the mathematics teaching actually being done in the state, an attempt was made to include methods and procedures which are generally considered to be both good and bad.



The questionnaire was made in the form of a check-list on which teachers could indicate their answers with only a mark. Each item on the check-sheet had several choices for responding.

Items and criteria for the questionnaire. The first items were of general information concerning the titles and sizes of mathematics classes and the school enrollment. In his study which has been previously reviewed, Schunert found that the optimum class size is between twenty and thirty. He also discovered that less mathematics learning took place in schools with enrollments of less than 100 and more than 500 pupils than in schools with enrollments between 100 and 500 pupils.<sup>12</sup>

Since the trend in mathematics teaching today is to use meaningful life situations in order to give students a clearer understanding of mathematics and a feeling of its value, this topic was the content of the second item.

A very important means of stimulating interest in mathematics is through pointing out its applications to fields of work through which people gain their livelihood. . . . By pointing out these applications, teachers can perform valuable service in the way of guidance to the students and at the same time stimulate their interest in mathematics itself.<sup>13</sup>

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<sup>12</sup> Ibid., p. 237.

<sup>13</sup> Charles H. Butler and F. Lynwood Wren, The Teaching of Secondary Mathematics (New York: McGraw-Hill Book Company, Inc., 1941), p. 114.



The question also was asked in the form of a check list on which teachers could indicate their answers with only a mark. Each item of the check-sheet had several choices for responding.

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Schunert<sup>14</sup> found from his study that algebra classes in which regular use of life applications was made exceeded those in which these applications were seldom used. However, the use of life situations did not seem to affect achievement in geometry classes to any appreciable degree.

Breslich,<sup>15</sup> whose textbook concerning methods of teaching mathematics was written some twenty years ago but whose articles in this field are still appearing, says that after the new material has been developed adequately, then it is time for assimilative study, which the teacher directs. The mathematics class itself, with the teacher present to help and guide, provides the best conditions for the organizing and learning of mathematics by the pupil.<sup>16</sup> "Few pupils of high school age know how to study effectively. . . During the regular period, many hints concerning study can be given and should be given whether a supervised hour is provided or

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<sup>14</sup> Schunert, op. cit., p. 233.

<sup>15</sup> Ernest R. Breslich, The Technique of Teaching Secondary-School Mathematics (Chicago: The University of Chicago Press, 1930), p. 13.

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<sup>14</sup> Schunert, op. cit., p. 233.

<sup>15</sup> Ernest H. Breslich, The Technique of Teaching Secondary-School Mathematics (Chicago: The University of Chicago Press, 1910), p. 13.

<sup>16</sup> Butler and Wren, op. cit., p. 142.



not."<sup>17</sup> The supervised study period is the best place to give individual help.

Directed study does not reduce teaching to an entirely individual basis, but it does attempt to combine the main advantages of individual instruction for those students who need it with the economy of time and other advantages generally recognized as accruing to group instruction.<sup>18</sup>

To carry on effective supervised study, the teacher must be adept, quick to spot errors and show students how to correct them, in close contact with students, careful not to give too much help nor to neglect the brighter pupils.<sup>19</sup>

Therefore, from these opinions, it seemed that the question in this category which would and could be answered most truthfully and easily by teachers was, "How often is supervised study given during the class period?" Schunert's study<sup>20</sup> revealed that algebra classes in which supervised study was given between twenty and thirty minutes per day exceeded those classes in which more or less than this amount of supervised study was given. However, it was found better to have more than thirty minutes of supervised study than to have less than twenty minutes in both algebra

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<sup>17</sup> Jasper O. Hassler and Rolland R. Smith, The Teaching of Secondary Mathematics (New York: The Macmillan Company, 1930), p. 192.

<sup>18</sup> Butler and Wren, op. cit., p. 142.

<sup>19</sup> Ibid., pp. 165-66.

<sup>20</sup> Schunert, op. cit., p. 233.



not. The supervisor should be in the first place to

give individual help.

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exceeded those classes in which more or less than this amount of supervised study was given. However, it was

found better to have more than thirty minutes of supervised study than to have less than twenty minutes in both algebra

and geometry classes.

17 Jessor, G. *Teacher and Student*. New York: The Macmillan Company, 1930. p. 192.

18 Butler and Wren, *op. cit.*, p. 142.

19 *Id.*, pp. 142-44.

20 Schumaker, *op. cit.*, p. 237.



and geometry classes.

The developmental and assimilative phases of instruction represent essentially the stages during which actual learning of new material takes place. Any subject matter, however, is likely to be forgotten no matter how well it has been initially mastered, unless it is maintained by repeated application and practice. This is particularly true of mathematical skills and relationships. Skills need to be perfected and maintained through systematic drill, and concepts and relationships must be reviewed and applied at frequently recurring intervals. The instructional effort which is directed toward these ends may well be called teaching for permanence. . . Its avenues are drill, review, and application.<sup>21</sup>

The next five items on the questionnaire dealt with drill and review work.

There has been much controversy in recent years as to the place of drill in mathematics. A lack of understanding as to the entire nature and outcomes of drill has been given as a reason for this controversy.

The reaction against the excessive and indiscriminate use of drill, which came along with the reorganization movement and with the increased emphasis upon concepts and meanings, has caused some educators to go to the other extreme and to inveigh against all drill as being futile and valueless. . . This old pedagogy undoubtedly laid too much emphasis upon memorization and mechanical learning, to the consequent neglect of meanings.<sup>22</sup>

The assumption was that memorization implies understanding. On the other hand, the "new pedagogy" says that only meanings have value and excludes drill from the instruction.

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<sup>21</sup> Butler and Wren, op. cit., p. 149.

<sup>22</sup> Ibid., pp. 149-50.



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<sup>21</sup> Butler and Wren, op. cit., p. 119.

<sup>22</sup> Ibid., pp. 119-20.



A more enlightened view should be between these two extremes.

Drill must be recognized as an essential means of attaining some of the desired outcomes, just as a strong emphasis upon concepts must be regarded as essential. Many of the operations of mathematics need to be performed not only correctly but with reasonable facility and speed if they are to be very useful. Some of them need to be actually automatized. The acquisition of facility in such operations can be secured only through systematic and repeated practice, i.e., through drill.<sup>23</sup>

Understanding must come before drill, of course.

Breslich<sup>24</sup> states that accuracy is far more important than speed and that drill should have accuracy as its first aim.

Effective drill must be well motivated. "Contests between selected teams, improvement charts, and games involving the materials to be mastered are typical of the numerous devices which have been developed for motivating drill work in mathematics."<sup>25</sup>

In doing drill work, students should be able to work at differing rates and levels, according to their abilities. Drill periods should be short; preferable lengths are not more than twenty minutes, and generally only about ten minutes. The drill time "should be distributed in relatively small amounts at recurring intervals which should become

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<sup>23</sup> Ibid., p. 150.

<sup>24</sup> Breslich, op. cit., p. 20.

<sup>25</sup> Butler and Wren, op. cit., p. 151.



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Drill must be regarded as an essential means of training some of the desired attitudes. Just as a strong emphasis upon concepts must be regarded as essential, many of the operations of mathematics need to be performed not only correctly but with responsible facility and speed. It may be to be very useful, some of them need to be actually automatized. The acquisition of facility in such operations can be secured only through systematic and repeated practice, i.e., through drill.

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Brereton<sup>24</sup> states that economy is far more important than

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In doing drill work, students should be able to work

at differing rates and levels, according to their abilities.

Drill periods should be short; preferably less than one hour.

more than twenty minutes, and generally only a few minutes.

The drill time "should be distributed in such a way that small amounts of repeating material will be secured."

BRITISH

23 Ibid., p. 150.

24 Brereton, op. cit., p. 20.

25 Butler and Wood, op. cit., p. 151.



more widely spaced as time goes on."<sup>26</sup> Drill should be specific and correct. A definite stimulus is added when the student can know immediately whether or not his responses are correct.

"Pupils in general do not know how to review."<sup>27</sup>

The seventh item on the check-sheet was included to discover the extent to which New Mexico students were taught to conduct their own study and review in mathematics. Review and drill are sometimes mistakenly identified as being the same thing because they both stress repetition and fixation. However, review has another important function, that of organization of details into a coherent whole.<sup>28</sup>

Review work may be incidental as it is integrated with the course work, but there is a need for special systematic review. Reviews "should always contain a new element or give a new view of the old. They should be given during the course when and where need for them arises."<sup>29</sup>

On the whole, most teachers do a better job of conducting drill work than they do of conducting review work. . . This is probably due in part to their failure to recognize the main function of review as different from that of drill. Students need to be taught how to review material just as they need to be taught how to

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<sup>26</sup> Butler and Wren, loc. cit.

<sup>27</sup> Breslich, op. cit., p. 23.

<sup>28</sup> Butler and Wren, op. cit., pp. 153-54.

<sup>29</sup> Breslich, op. cit., p. 22.



more widely based on class work. A similar addition is added when specific and correct. A similar addition is added when the student can know intelligently whether or not his responses are correct.

"Principles in general do not have to review. The seventh item on the chart - it was intended to discover the extent to which review students were taught to conduct their own study and review in the classroom. Review and drill are sometimes mistakenly identified as review and are a thing because they both stress repetition and fixation. However, review has another important function, that of organization of details into a coherent whole."

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26 Butler and Wren, op. cit.

27 Butler, op. cit., p. 23.

28 Butler and Wren, op. cit., pp. 127-28.

29 Butler, op. cit., p. 23.



study. They cannot review effectively without definite instructions. . . . The task of helping students plan their review work is a responsibility which every teacher should take seriously.<sup>30</sup>

From the study made by Schunert,<sup>31</sup> it was found that algebra classes in which review was conducted more than once each month exceeded those in which reviewing was done no more than once each six weeks; however, the frequency of reviews did not affect geometry classes so much.

To some pupils a review assignment means little else than that there is nothing to do for the next day. On the other hand, if pupils are taught to form the habit of setting aside a few minutes every day for reviewing and organizing all they are expected to know about the unit, they will become thoroughly familiar with all the important facts and processes of the whole unit, and when it is completed there will be no need for a formal review at the end.<sup>32</sup>

Questions as to the type and frequency of tests followed the review categories. Hassler and Smith<sup>33</sup> recommend a daily written test of from two to fifteen minutes in length. Usually this should be given at the beginning of the period. Schunert's study showed that geometry classes tested more than once a week achieved more than classes tested less than once a week, but the optimum use of tests in algebra classes was not determined. However, the study

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<sup>30</sup> Butler and Wren, op. cit., p. 155.

<sup>31</sup> Schunert, op. cit., p. 233.

<sup>32</sup> Breslich, op. cit., p. 23.

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30 Butler and Schumm, op. cit., p. 155.

31 Schumm, op. cit., p. 155.

32 Butler, op. cit., p. 155.

33 Butler and Schumm, op. cit., p. 155.



implied that instruction would be improved in all classes if tests were used more frequently than they usually were.<sup>34</sup>

Teacher-made tests have several advantages over standard or extramural tests: they are flexible and adaptable to local situations and to repeated evaluations; they include only what the course has emphasized; and they are inexpensive and always available.<sup>35</sup> Essay-type (or problem type) tests have an advantage over new-type (short answer) tests if the pupils' ability to organize and reason is important in solving the problems. On the other hand, the new-type tests can cover a wider range of sampling and are usually more objective and more reliable. A disadvantage to the new-type tests is that really good ones require considerable time, care, and experience to construct.<sup>36</sup> Written tests are more efficient than oral tests and should be used whenever possible.<sup>37</sup>

The next several items dealt with the assignment. The first of these was to determine how often homework was given. Several authorities in the field of mathematics agreed that it was far better to give complete preparation previous to the assignment rather than always giving home-

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<sup>34</sup> Schunert, op. cit., p. 233.

<sup>35</sup> Butler and Wren, op. cit., p. 179.

<sup>36</sup> Ibid., pp. 179-80.

<sup>37</sup> Hassler and Smith, op. cit., p. 142.



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<sup>36</sup> Ibid., pp. 179-80.

<sup>37</sup> Hessler and Smith, op. cit., p. 112.



work. Objective evidence that the pupil understands the material should be obtained prior to making any assignment.

The second of these items in the assignment category was concerned with how the assignment was made.

The practice of making the assignments in mathematics at the beginning or at the end of the class period is questionable, even when the teacher gives suggestions as to the way the work is done. Definite connections must be established between class work and the work to be done at home. When the teacher does this in school, objections to home work will cease.<sup>38</sup>

If a teacher uses only the recitation method, he has little time for preparation for the assignment.

To him the assignment is simply a matter of writing it on the board or dictating it hurriedly at the end of the hour, sometimes after the closing bell has rung. The next day he hears the assignment and his task is done. This can hardly be called teaching.<sup>39</sup>

Certain common types of homework are objectionable. Some teachers assign work just to cover the ground. The pupils do not understand the work, but the conscientious pupil works extremely hard and finally completes the assignment. However, the easy-going student soon gives up trying and copies the work or does not get it at all. Pupils must first be taught effective methods of study, and then they will not only do the assignment but find voluntary homework.<sup>40</sup>

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<sup>38</sup> Breslich, op. cit., p. 18.

<sup>39</sup> Hassler and Smith, op. cit., p. 180.

<sup>40</sup> Breslich, op. cit., pp. 19-20.







The question then arose as to how long it should take the pupil to complete the assignment. Schunert's study<sup>41</sup> showed that the amount of algebra and geometry assigned homework was not significant. Statements from authorities are in agreement that a large portion of the assignment should be finished during the supervised study period.

The educational world now is keenly aware of the problem of individual differences. This problem can be solved to a large extent by differentiated assignments. Algebra classes in which differentiated assignments were used regularly showed definite superiority over those in which this procedure was seldom used.<sup>42</sup> The use of this procedure places an added burden on the teacher, but "it has much to commend it from the standpoint of instructional effectiveness."<sup>43</sup> This plan can be used in schools which are too small to have ability grouping. Several methods of differentiated assignments can be used: the contract plan, special projects and reports, and honors courses.<sup>44</sup>

Another topic which was deemed important in the study was the percentage of failures each year. Algebra classes taught by teachers who usually failed no more than

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<sup>41</sup> Schunert, op. cit., p. 233.

<sup>42</sup> Ibid., p. 232

<sup>43</sup> Butler and Wren, op. cit., p. 163.

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- 11 Schenck, op. cit., p. 233.
  - 12 Ibid., p. 232.
  - 13 Butler and Brown, op. cit., p. 103.
  - 14 Ibid., pp. 103-05.



two per cent of the students each year achieved more than those taught by teachers who failed at least ten per cent.<sup>45</sup>

One of the most vital parts of the questionnaire was to discover the practices or methods most used in mathematics teaching in the state. The lecture method was included as the first choice.

It has little place in the teaching of high school mathematics. . . . When a teacher gives voluntary information upon a part of a lesson that can be learned as well by the pupil through his own initiative under proper guidance and encouragement, he is using the lecture method and by so doing is reducing the pupil's chance for independent thinking.

The main excuse given for lecturing often is that more can be accomplished; however, this impression of accomplishment may be false, and the pupils' attention may be wandering.

The second method selected for use in the questionnaire was socialized discussion by pupils and teacher. This method bears close relationship to the heuristic (individual) method and the genetic (class) method, in which the pupil, or pupils, are led, by questions, to discover mathematical truths for themselves. The heuristic method is an ideal procedure for individual teaching or for very small classes, but it is not easy to use in large classes. The genetic method aims to retain the spirit of the procedure by direct-

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<sup>45</sup> Schunert, op. cit., p. 233.

<sup>46</sup> Hassler and Smith, op. cit., p. 140.



two per cent of the students of the school were...  
those taught by...  
One of the...  
to discover the...  
teaching in the...  
the first...  
It has been...  
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# EXPERIENCE

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ing questions to all the class. The socialized discussion procedure is difficult to administer because the teacher must constantly adapt the work to the mental abilities of the pupils and because it cannot become stereotyped.<sup>47</sup>

The advantages, . . . where it is successfully employed, are manifest. It makes the student an active participant in the learning process and provides a spur to quicken his interest since it places him in the role of at least a quasi investigator rather than a mere passive recipient of information.<sup>48</sup>

According to Hassler and Smith, projects with units of work tend to give a logical order to mathematics.<sup>49</sup> They believe a pupil will wish to work mathematics problems if he understands them. This procedure of projects with units of work was included in the questionnaire.

Following projects and units, the method of demonstration and use of laboratory materials was added. Hassler and Smith<sup>50</sup> say that, to be worth-while, laboratory work must make clear to pupils the practical use of mathematics and suggest mathematical reasoning.

The common practice of recitation by pupils was put in as the next method. This method too often results in

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<sup>47</sup> Breslich, op. cit., p. 33.

<sup>48</sup> Butler and Wren, op. cit., p. 136.

<sup>49</sup> Hassler and Smith, op. cit., p. 149.

<sup>50</sup> Ibid., p. 151.







mere "lesson hearing," which Colvin calls "the lowest and most inefficient aspect of teaching," in his book, An Introduction to High School Teaching.<sup>51</sup> "The object is to find out what the pupil has learned (memorized). No teaching is done. No thought is stimulated."<sup>52</sup> Breslich claims that it is merely a device to give marks in most cases.<sup>53</sup> The pupil is often interrupted for criticisms, and he fails to get a chance to express his understandings.

The recitation method should be used occasionally. The best time is usually after the unit of work is completed when the teacher needs to get direct oral responses revealing the student's foundation for another topic.

The daily-test procedure is recommended by Hassler and Smith. They say a short test should be given every day or nearly every day--usually at the beginning of the period. "It may sample the home lesson, cover exercises similar to those of the assignment, or take up original work, as the case demands."<sup>54</sup> Some benefits of this method are that it starts the class promptly, makes comparisons of students possible, gives incentive to pupils to study and

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<sup>51</sup> Ibid., p. 148.

<sup>52</sup> Ibid., p. 149.

<sup>53</sup> Breslich, op. cit., p. 25.

<sup>54</sup> Hassler and Smith, op. cit., p. 153.







to listen to explanations in class, puts the teacher before the class in the true light--that of the master of his subject imparting it to those who desire to learn. The daily-test procedure shows the pupils that the purpose of homework is to help themselves, provides basis for individual help, and economizes on time in the total teaching period.<sup>55</sup>

In recent years much supplementary material, especially in the form of workbooks, has appeared. "Generally speaking, . . . workbooks which are properly designed and which are used in appropriate situations and in appropriate ways embody certain features which may make them valuable aids in instruction."<sup>56</sup> The workbook should be selected wisely. Workbooks save time which is in general wasted when students have to copy problems from the textbook before solving them. The objections to workbooks are that often they are superficially prepared by the authors, that they are so objective that students merely fill in blanks and do no organizing, and that they involve additional expense. They definitely should be coordinated with textbooks.<sup>57</sup> Schunert's study showed no better achievement for geometry classes which used workbooks and supplementary materials than those which did

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<sup>55</sup> Ibid., pp. 154-55.

<sup>56</sup> Butler and Wren, op. cit., p. 87.

<sup>57</sup> Ibid., pp. 87-95.



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showed no better advantage for the student than the  
workbooks and supplementary material in the textbook.<sup>27</sup>

<sup>25</sup> Ibid., pp. 12-13.  
<sup>26</sup> Butler and Wood, op. cit., pp. 12-13.  
<sup>27</sup> Ibid., pp. 12-13.



not use them.<sup>58</sup>

It was necessary to determine the length of class periods, and then the question as to how much time each teacher had for individual help was asked. As is already shown by previous criteria, the ideal expressed by the authorities is to have adequate time in class for individual help.

The questionnaire was concluded with several items concerning the teacher: his teaching-load, his college preparation, and his experience. Poor teaching done by unprepared and nonenthusiastic teachers have served as bases for criticisms of the short-comings of the subject of mathematics in the past few years. These kinds of teachers often leave the impression that mathematics is only a tool subject without any order. "Undefined standards of preparation and varied patterns of certification have contributed very materially to the general chaotic condition that exists."<sup>59</sup>

It is strange. . . to find a prevalent misconception that, if anyone has had as much as one course in mathematics beyond what he teaches, he is a satisfactory teacher. Until this diseased state of mind is healed we shall continue to have indifferent teaching of mathematics. Every teacher of mathematics who expects to continue as such should feel obligated to make further (and then further) acquaintance with his subject.<sup>60</sup>

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<sup>58</sup> Schunert, op. cit., p. 231.

<sup>59</sup> Butler and Wren, op. cit., p. 199.

<sup>60</sup> Hassler and Smith, op. cit., p. 18.







The teacher of mathematics should be a guide "who knows what is inside, far beyond the point to which he expects to lead his class."<sup>61</sup>

No general agreement seems to be in evidence as to what constitutes adequate preparation for the teaching of secondary mathematics. This conclusion was established by H. T. Karnes in his doctoral dissertation, "The Professional Preparation of Teachers of Secondary Mathematics," in 1940.<sup>62</sup>

As long as this situation exists, the employment of mathematics teachers, the assignment of mathematics classes, and even the inclusion of mathematics in the educational program, will remain on a rather unstable professional basis.<sup>63</sup>

Of course, there is a general feeling that mathematics teachers should have significant knowledge and background of the subject matter and have also an effective technique, but the exact amount of training that comprises this combination is rather vague. The Joint Commission of the Mathematical Association of America, Inc., did something about this situation in their proposal of the following as a desirable minimum for teacher preparation:

1. In mathematics:
  - a. Courses including complete treatments of college algebra, analytic geometry (including a little solid analytics), and six semester-hours of calculus.

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<sup>61</sup> Hassler and Smith, loc. cit.

<sup>62</sup> Butler and Wren, op. cit., p. 199.

<sup>63</sup> Loc. cit.



The teacher of mathematics should be able to lead his class inside, for example, to a discussion of the subject.

No general statement can be made as to what constitutes ability in mathematics. Secondary mathematics.

H. F. Kerner in 1914: "The Preparation of Teachers of Mathematics."

As long as this is the case, the mathematics teacher should be able to lead his class inside, for example, to a discussion of the subject. Educational progress is the result of professional work.

Of course, there is a general feeling that teachers should have a certain amount of the subject matter which they are to teach.

but the exact amount of this knowledge is rather vague. The Association of American Teachers of Mathematics in 1914 proposed a minimum for teaching mathematics.

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I. In mathematics:  
a. Geometry: Euclidean geometry, including the properties of triangles, circles, and solids; and the construction of figures.  
b. Algebra: Algebra, including the properties of numbers, and the solution of equations.  
c. Calculus: Calculus, including the properties of functions, and the solution of problems.

61. Hasler and Smith, 1914.  
62. Butler and Smith, 1914.  
63. Lee, etc.



- b. A course that examines somewhat critically Euclidean geometry, and gives brief introductions to projective geometry and non-Euclidean geometry, using synthetic methods (three semester-hours).
- c. Advanced algebra, including work in theory of equations, mathematics of finance, and statistics (six semester-hours). This course should give some careful attention to the basic laws of algebra, to the nature of irrational and complex numbers, and operations with them. It should be throughout somewhat critical and not purely manipulative.
- d. Either directed reading or a formal course in the history of mathematics and its concepts.
- 2. In related fields (the related subject is not regarded here as a teaching subject):  
An introductory course in physics, astronomy or chemistry that makes some use of mathematics.
- 3. In professional preparation:
  - a. A course in methods (two or three semester-hours). This work should be given by a person who has had a good mathematical education and also experience in high school teaching.
  - b. A course in secondary education (three semester-hours). Some consideration of educational philosophy and of the history of education can be given in this course.
  - c. A course in psychology, with emphasis on its educational bearing and on the problem of learning (three semester-hours).
  - d. A course in educational tests and measurements that employs some statistical material (two semester-hours).
  - e. Practice teaching. It is not usually possible for a student to have practice teaching in two fields. If mathematics is his major he should have practice teaching in that subject.<sup>64</sup>

For those teachers who will teach only mathematics

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<sup>64</sup> Joint Commission of the Mathematical Association of America, Inc., and the National Council of Teachers of Mathematics, "The Place of Mathematics in Secondary Education," Fifteenth Yearbook of the National Council of Teachers of Mathematics (New York: Bureau of Publication, Teachers College, Columbia University, 1940), pp. 201-02.



A course in advanced mathematics, including  
calculus, differential equations, and  
linear algebra, is required for students  
pursuing a degree in engineering or  
science.

Advanced mathematics, including  
calculus, differential equations, and  
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and who will give advanced courses in secondary mathematics, the Joint Commission recommended the following additional courses:

1. Advanced calculus and differential equations or mechanics (six semester-hours).
2. Additional work in geometry, such as projective geometry, descriptive geometry, etc.. (three semester-hours).
3. Additional work in algebra, including some modern algebra (three semester-hours).
4. At least one more of the three sciences of physics, chemistry, and astronomy.<sup>65</sup>

Further factors in teacher preparation and training<sup>✓</sup> were obtained from the Schunert study,<sup>66</sup> which revealed that the achievement of classes taught by teachers who had more than eight years of experience exceeded that of those taught by teachers with less experience. No significant difference in achievement was found between the classes taught by teachers with less than two years experience and the classes of teachers having two to eight years. The scores on the tests constructed for Schunert's study did not show direct association with the college mathematics training of the teachers who helped in the study; however, the study brought out definite implications that the mathematical preparation of teachers was important in a long-range mathematics program and in giving students the necessary

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<sup>65</sup> Ibid., pp. 202-03.

<sup>66</sup> Schunert, op. cit., p. 228.



and who will give advice to the Joint Commission on the courses:

1. Advanced course in mathematics
2. Additional mathematics
3. Additional mathematics
4. Additional mathematics

Further details of the courses were obtained from the Joint Commission on the achievement of the students in the last eight years of the course. The results of the examination in the last eight years of the course are as follows:

the results of the examination in the last eight years of the course are as follows:

the results of the examination in the last eight years of the course are as follows:



background for more advanced mathematics and for competence in dealing with the problems they meet in everyday life. Teachers must have an adequate background to fully appreciate mathematics as a perfect system and to impart this appreciation to pupils.

A final question, "Do you feel that you have time to do the teaching job you would like to do?" was included in the check-sheet to give teachers an opportunity to express their personal feelings and to review the general status of mathematics, as seen by the teachers themselves. The teachers were free to give any answer they desired.

Final draft of the questionnaire. After the completion of the check-list, several mathematics teachers were asked to read and criticize it. A few minor changes were made before mimeographing the final form and sending the questionnaires to the New Mexico high school mathematics teachers.

It must be assumed, of course, in this questionnaire study, as in any such subjective survey, that teachers' responses were accurate. Care was taken to urge truthful responses by emphasizing in a covering letter that this element was essential to useful findings. Elimination of names from questionnaires in an attempt to encourage reliable responses was an additional measure taken.



background for each of the teachers in the study.

In dealing with the teachers, the following questions were asked:

Teachers were asked to indicate their level of agreement with the following statements:

Mathematics is a central subject in the curriculum.

It is important to provide mathematics education to pupils.

A final question was asked: "In the past five years, have you:

in the teaching of mathematics been involved in any of the following activities?

The check-boxes for each of the activities were as follows:

their personal feelings and to express their views on the subject.

of mathematics, as well as the teachers' attitudes towards it.

Teachers were asked to indicate their level of agreement with the following statements:

Final draft of the questionnaire (to be used for the study)

pletion of the questionnaire. The questionnaire was distributed to the teachers.

were asked to read and complete the questionnaire. The questionnaire was distributed to the teachers.

were made before the questionnaire was distributed to the teachers.

the questionnaire for the study. The questionnaire was distributed to the teachers.

teachers.

It must be noted that the questionnaire was distributed to the teachers.

study, so in any case the questionnaire was distributed to the teachers.

responses were collected. The questionnaire was distributed to the teachers.

responses by returning the questionnaire. The questionnaire was distributed to the teachers.

element was essential to the study. The questionnaire was distributed to the teachers.

names from the questionnaire. The questionnaire was distributed to the teachers.

responses was an additional measure. The questionnaire was distributed to the teachers.



Another step taken to make the survey somewhat objective was the inclusion of blank spaces under most of the items after the choices were listed. Teachers were asked to add comments about any of their personal methods, conditions, or ideas that were pertinent to the category. It was felt that any teachers who had special procedures or problems would take time to jot these down, thereby, giving a more accurate picture of the actual status of the subject.

Whenever possible, obvious or directed responses were excluded from the questionnaire. It was felt that the presence of items for which the choices were indicative of obviously good or bad methods would prejudice teachers.

## II. ADMINISTRATION OF THE TEST

Description of the test. The Davis Test of Functional Competence in Mathematics, by David J. Davis, is one of the Evaluation and Adjustment Series published by World Book Company. Form Am of the test was used in this study.

The test is comprised of eighty items in the following areas:

- |          |            |   |
|----------|------------|---|
| Part I.  | Section A. | Consumer Problems<br>(Questions 1-24)           |
|          | Section B. | Graphs and Tables<br>(Questions 25-33)          |
| Part II. | Section A. | Symbolism, Equations, etc.<br>(Questions 34-57) |
|          | Section B. | Ratio, Tolerance, etc.<br>(Questions 58-80)     |







The time required for administering the test is two 40-minute periods. The test gives objective evidence as to the relative mastery of these various topics by the students.

Description of the schools and senior classes tested.

Procedures of the sampling were related in Chapter I. Information about the chosen schools will be given in this chapter.

School A, with an enrollment of more than 500 pupils, was the largest school tested in this study. There were 110 students in the senior class in this school. School A was a municipal school, accredited by North-Central Association.

School B was in the 200 to 500 enrollment group, with thirty-seven seniors. This school was also a municipal school, accredited by North-Central Association.

The third and fourth schools selected were schools with enrollments of less than 200. School C, which was not accredited by North-Central Association, was a rural school; School D was a municipal school and had accreditation. There were fifteen seniors in each of these schools.

School E, with an enrollment of approximately 200, was included as a check on the representative characteristics of Schools B, C, and D. This municipal school was not accredited by the North-Central Association of Secondary Schools and Colleges. There were thirty-five pupils in the senior class in School E.



The time required for obtaining the same is but a few  
minute periods. The same is also applicable to the  
the relative history of these various bodies of water.

Description of the school and its location  
Procedures of the **EFFICIENCY**  
The school is located in the center of the city  
School A, which is the largest of the group.

**REASONS FOR**  
was the largest school in the city. It had  
110 students in the school. The school was  
was a municipal school, controlled by the  
city.

School B was the second largest of the group.  
thirty-seven students. The school was  
school, accredited by the State Board of  
The school and the school building were in  
with enrollment of about 100. The school was  
accredited by the State Board of Education.

School C was a small school, with an enrollment of  
were fifteen students in each of the two  
School D, with an enrollment of about 100.  
was included as a school in the group.

of Schools B, C, and D. The school was  
accredited by the State Board of Education.  
Schools and Colleges. There were three schools in the  
the senior class in School E.



Description of the testing. The tests were administered to the seniors in the schools according to directions. The tests were given as close to the end of the school year as possible, so that the measurement would in fact reveal the functional competence of the graduates of the selected secondary schools.



Description of the tests.

ferred to the center of the subject's body. The tests were given as far as possible, so that the subject would be as comfortable as possible. The functional components of the tests were as follows:

secondary schools.

HE  
ER  
R



## CHAPTER III

### THE QUESTIONNAIRE AND TEST RESULTS

The questionnaire responses were tabulated and studied. Comparisons were made with the criteria from which the questionnaire was prepared. The tests were scored and statistically compared with national norms. The results were further compared with respect to the size of the school and the mathematical background and sex of the students.

#### I. THE QUESTIONNAIRE RESULTS

Character of the responses. It was necessary to determine whether techniques and conditions of mathematics teaching in the responding schools were significantly different from the schools from which no responses were obtained. Since replies were received from teachers in schools of all enrollment groups and of all the usual mathematics courses offered in the high school curriculum, it was assumed that results would have been very much the same had these additional schools responded. Another factor which helped determine that the ninety teachers who responded were typical of the teachers who did not respond was the summation of several questionnaire replies received after the tabulation of those used in this study.







Comparisons of results and criteria. Findings for each item on the questionnaire will be discussed, followed by comparative conclusions.

A general picture of the mathematics curriculum was gained from the cross-section of the schools from which replies were received. The basic subjects of general, first-year algebra, and plane geometry are offered each year in a majority of the schools reporting. In some small schools plane geometry is sometimes alternated with other courses. General mathematics is called socialized mathematics for ninth and tenth grades in some schools. Since this course is taught in the junior high schools, it is not offered in the largest senior high schools.

Relatively few of the schools offer a full mathematics program beyond the three foundation courses. Algebra II is offered in only approximately one-fifth of the schools. In several of these it is taught in alternation with plane geometry or trigonometry. Only one teacher indicated that he taught a class in Algebra III; this was in a school of more than 500 pupils.

Twelve of the schools offer solid geometry; thirteen offer trigonometry. One semester of each is given in most of these schools, which are all in the medium or large enrollment groups. Four of the larger schools include business mathematics in the curriculum; one school offers



Comparison of results and conclusions

each item on the questionnaire will be discussed.

by comparative conclusions.

A general picture of the educational system is

gained from the first section of the questionnaire.

Results were received. The data collected

first-year algebra, and geometry, and

year in a majority of the schools.

schools plane geometry is now being introduced

courses. General mathematics is being introduced

matter for algebra and geometry in some schools.

this course is taught in the junior high schools.

offered in the largest number of schools.

Relatively few of the schools offer a first-year

program beyond the first year of high school.

offered in only approximately one-third of the schools.

several of these is in the form of a separate

geometry or trigonometry. It is one of the

is taught a class in algebra. This was in

more than 500 schools.

Twelve of the schools offer a first-year

offer trigonometry. The majority of these

of these schools, which are in the junior high

enrollment program. Most of the larger schools

business mathematics in the first year and



pre-flight mathematics.

These findings indicate that very few schools offer their students a variety of mathematics courses from which to choose.

Studies previously reviewed indicated that the optimum class size is between twenty and thirty pupils. Responses to the questionnaire constituted a cross-section of each size high school in the state, but in some groups and subjects an insufficient number of schools reported to give an accurate sample of the enrollment; therefore, these averages were omitted in Table I.

In no case was the average of the total enrollments reported for each subject more than thirty. The average enrollment of the mathematics classes was 13.7 in schools with less than 100 pupils. This is far less than the number established in Schunert's study as optimal for easy and effective teaching.

In the 100-199 enrollment group, the average enrollment in mathematics classes was 19.2 pupils. General mathematics classes had an average enrollment of 27.4 pupils, the largest for any mathematics subject in this group of schools.

In schools with 200 to 499 pupils, the mean enrollment in mathematics classes was 20.9 pupils, which is within the optimum enrollment. General mathematics classes in this







TABLE I

## AVERAGE CLASS ENROLLMENTS

Course	School Enrollments				
	Less than 100	100-199	200-499	500-1000	More than 1000
General Mathematics	16.8	27.4	31.8	27.6	----
Algebra I	16.8	21.1	27.4	24.2	----
Algebra II	8.7	11.3	12.0	24.0	24.0
Algebra III	----	----	----	----	----
Plane Geometry	12.6	16.8	24.2	27.5	28.6
Solid Geometry	----	5.0	15.0	15.3	20.0
Trigonometry	----	----	12.6	15.0	15.8
Business Mathematics	----	----	23.0	27.0	----
Pre-Flight	----	----	----	----	----
Averages	13.7	19.2	20.9	22.9	22.1



# TABLE I ANALYSIS OF THE SAMPLES

ANALYSIS OF THE SAMPLES				
Sample No.	Weight, g.	Volume, ml.	Conc., g./ml.	Conc., %
1	0.15	10.0	0.015	1.5
2	0.15	10.0	0.015	1.5
3	0.15	10.0	0.015	1.5
4	0.15	10.0	0.015	1.5
5	0.15	10.0	0.015	1.5
6	0.15	10.0	0.015	1.5
7	0.15	10.0	0.015	1.5
8	0.15	10.0	0.015	1.5
9	0.15	10.0	0.015	1.5
10	0.15	10.0	0.015	1.5
11	0.15	10.0	0.015	1.5
12	0.15	10.0	0.015	1.5
13	0.15	10.0	0.015	1.5
14	0.15	10.0	0.015	1.5
15	0.15	10.0	0.015	1.5
16	0.15	10.0	0.015	1.5
17	0.15	10.0	0.015	1.5
18	0.15	10.0	0.015	1.5
19	0.15	10.0	0.015	1.5
20	0.15	10.0	0.015	1.5
21	0.15	10.0	0.015	1.5
22	0.15	10.0	0.015	1.5
23	0.15	10.0	0.015	1.5
24	0.15	10.0	0.015	1.5
25	0.15	10.0	0.015	1.5
26	0.15	10.0	0.015	1.5
27	0.15	10.0	0.015	1.5
28	0.15	10.0	0.015	1.5
29	0.15	10.0	0.015	1.5
30	0.15	10.0	0.015	1.5
31	0.15	10.0	0.015	1.5
32	0.15	10.0	0.015	1.5
33	0.15	10.0	0.015	1.5
34	0.15	10.0	0.015	1.5
35	0.15	10.0	0.015	1.5
36	0.15	10.0	0.015	1.5
37	0.15	10.0	0.015	1.5
38	0.15	10.0	0.015	1.5
39	0.15	10.0	0.015	1.5
40	0.15	10.0	0.015	1.5
41	0.15	10.0	0.015	1.5
42	0.15	10.0	0.015	1.5
43	0.15	10.0	0.015	1.5
44	0.15	10.0	0.015	1.5
45	0.15	10.0	0.015	1.5
46	0.15	10.0	0.015	1.5
47	0.15	10.0	0.015	1.5
48	0.15	10.0	0.015	1.5
49	0.15	10.0	0.015	1.5
50	0.15	10.0	0.015	1.5
51	0.15	10.0	0.015	1.5
52	0.15	10.0	0.015	1.5
53	0.15	10.0	0.015	1.5
54	0.15	10.0	0.015	1.5
55	0.15	10.0	0.015	1.5
56	0.15	10.0	0.015	1.5
57	0.15	10.0	0.015	1.5
58	0.15	10.0	0.015	1.5
59	0.15	10.0	0.015	1.5
60	0.15	10.0	0.015	1.5
61	0.15	10.0	0.015	1.5
62	0.15	10.0	0.015	1.5
63	0.15	10.0	0.015	1.5
64	0.15	10.0	0.015	1.5
65	0.15	10.0	0.015	1.5
66	0.15	10.0	0.015	1.5
67	0.15	10.0	0.015	1.5
68	0.15	10.0	0.015	1.5
69	0.15	10.0	0.015	1.5
70	0.15	10.0	0.015	1.5
71	0.15	10.0	0.015	1.5
72	0.15	10.0	0.015	1.5
73	0.15	10.0	0.015	1.5
74	0.15	10.0	0.015	1.5
75	0.15	10.0	0.015	1.5
76	0.15	10.0	0.015	1.5
77	0.15	10.0	0.015	1.5
78	0.15	10.0	0.015	1.5
79	0.15	10.0	0.015	1.5
80	0.15	10.0	0.015	1.5
81	0.15	10.0	0.015	1.5
82	0.15	10.0	0.015	1.5
83	0.15	10.0	0.015	1.5
84	0.15	10.0	0.015	1.5
85	0.15	10.0	0.015	1.5
86	0.15	10.0	0.015	1.5
87	0.15	10.0	0.015	1.5
88	0.15	10.0	0.015	1.5
89	0.15	10.0	0.015	1.5
90	0.15	10.0	0.015	1.5
91	0.15	10.0	0.015	1.5
92	0.15	10.0	0.015	1.5
93	0.15	10.0	0.015	1.5
94	0.15	10.0	0.015	1.5
95	0.15	10.0	0.015	1.5
96	0.15	10.0	0.015	1.5
97	0.15	10.0	0.015	1.5
98	0.15	10.0	0.015	1.5
99	0.15	10.0	0.015	1.5
100	0.15	10.0	0.015	1.5



group, however, averaged 31.8 pupils, which is slightly above the optimum. One teacher reported an enrollment of forty, and two teachers reported enrollments of thirty-two in their general mathematics classes. Algebra classes in this enrollment group were also rather large, the average being 27.4 pupils.

The 500-1000-pupil schools and schools with more than 1000 pupils had larger average enrollments in each subject than did small schools. A few teachers of plane geometry reported classes as large as forty-five pupils. The average enrollment in schools of 500 to 1000 pupils was 22.9; the average was 22.1 in schools of more than 1000 pupils. Further information about class enrollments is given in Table I.

General mathematics, the subject which is taken by a majority of pupils because it fulfills the requirement of one year's credit in mathematics, had the largest average enrollments in all groups of schools. Nine general mathematics teachers reported classes larger than thirty pupils; one of these had an enrollment of forty. Several plane geometry teachers reported enrollments between thirty-eight and forty-five. The more advanced subjects generally had fewer students enrolled than the basic subjects of general mathematics, Algebra I, and plane geometry.

Thirty of the teachers reported that they had one or more classes with enrollments of more than thirty pupils.







Even though the average in all except one case was within or less than the optimum size, there was a significant number of mathematics classes in the state with enrollments which are entirely too large for optimum teaching. Several teachers remarked that students, regardless of preparation, background, and ability, were placed in their classes as long as there was seating capacity for them. The average enrollment was lowered somewhat by some of the schools in which very few students choose mathematics as electives.

From studying the responses given by teachers, one can conclude that there is an important number of schools in the state, especially the average-sized schools, which have classes above the optimum enrollment. In this type of learning situation, the teachers are unable to teach with greatest effectiveness.

Use of formulas applicable in science, industry, and business was reported for more classes than any other idea suggested in the category concerning life applications or situations. Five per cent of the responses showed no use of life applications of any kind. Practical applications were made in a majority of the geometry classes. Sixty-nine per cent of the plane geometry teachers used scale drawings; 37.7 per cent reported the use of problems dealing with air navigation. Other ideas suggested by the teachers themselves included use of problems arising from agriculture



Even though the average... less than the... of mathematics... are entirely too large... teachers remarked... background, and ability... long as there was... enrollment was... which very few... From studying... can conclude that... in the field, especially... have classes above... of learning situation... with greatest efficiency... Use of formulas... business was reported... suggested in the... situations. Five... of life applications... were made... nine per cent... drawing... with all... themselves included...



and home economics, surveying, astronomy, measurement and area, and construction.

General and business mathematics teachers made regular use of life applications. In twenty-five per cent of the general mathematics classes graphs showing students' expenditures of time and money were used; in 35.7 per cent of the classes the students prepared family budgets; 57.1 per cent used problems involving the increase in the cost of living, present prices, and family needs. Several teachers also reported the use of graphs picturing school data. Others used practical applications of mathematics in finance and business, savings and investment, bargain sales, buying and selling, and transportation.

Infrequent use of life applications was indicated in algebra classes. This fact is in contrast to Schunert's finding that students in algebra definitely profited from such applications. A few teachers used algebra problems connected with farming and homemaking. No other important applications were indicated other than the usual textbook problems.

As revealed from several studies and opinions, daily supervised study is considered to be a vital part of mathematics instruction. About seventy-five per cent of all the classes from which reports were received had a supervised study period each day. Several teachers mentioned that they



and home economics, art, music, and physical education, and  
and construction.

General and technical mathematics for business

regular use of this application. The results of the study

of the general mathematics classes at the University of

expenditures of time and money were not significant. The results of the study

of the classes was that the students who had taken the course

per cent used problems involving the application of mathematics

of living, present affairs, and family needs. The results of the study

also reported the use of groups planning and doing the work.

used practical applications of mathematics in business and

business, savings and investments, and insurance, buying and

selling, and transportation.

Interpretation of this application was made in the

algebra classes. This fact is in contrast to the results

finding that students in algebra classes had had more

such applications. A few students used algebra problems

connected with farming and home-making. The other students

applications were included under the word "other"

problems.

As revealed from several studies and opinions, only

supervised study is considered to be a valid type of mathematics

its instruction. The results of the study

classes from which reports were received had a significant

study period each day. Several teachers reported that they



spent twenty to thirty minutes for this period. This practice is in accord with the recommendations of Schunert's study. Three teachers replied that they had time for a forty-five minute directed study period.

No teachers neglected supervised study altogether. However, responses to later items in the questionnaire showed that a majority of teachers do not have time for sufficient individual help or time to do the job they would like to do. It may be concluded, therefore, that although supervised study was conducted with some degree of frequency, study periods were not long enough to allow teachers to direct the study of each pupil in the right direction everyday. An itemized account of the responses is given in Table II.

The modern point of view is one which shows the necessity of meaningful drill and practice after understanding has been developed. Only 38.4 per cent of the teachers responding to this item indicated that they found it necessary to have daily practice work. In 23.6 per cent of the classes, practice work was used about three times a week. Approximately seventeen per cent of the classes had drill once a week. However, 21.1 per cent of the teachers used drill only occasionally. This could not be considered the systematic, regular, and frequent drill considered essential in attaining some of the desired outcomes of mathematics.



agent twenty to thirty minutes per day. This was  
close to in accord with the recommendations of the  
study. Three teachers reported that they had done  
forty-five minutes of work per day.  
No teachers reported supervising study.  
However, responses to the question  
showed that a majority of teachers in various  
sufficient individual help in the job. They  
like to do. It may be concluded, therefore, that  
supervised study was conducted with some degree of frequency.  
Study periods were not long enough to allow teachers to  
direct the study of each pupil in the class every  
day. An ideal amount of the work was 15 minutes.

Table II.

The modern point of view is that study  
necessity of meaningful drill and practice of new material  
ing has been developed. This has led to the  
responding to this idea is that study is necessary  
to have daily practice with new material.  
practice work has been done in the past.  
nearly everyone has seen the value of the  
week. However, the practice of drill is  
only occasionally. This could not be considered as  
also, regular, and frequent drill is essential to  
attaining some of the desired results.



TABLE II  
FREQUENCY OF SUPERVISED STUDY

Course	Daily	About twice a week	Once a week	Occasion- ally	Never
General Mathematics	17	7	2	3	0
Algebra I	48	7	3	2	0
Algebra II	22	5	0	0	0
Algebra III	1	0	0	0	0
Plane Geometry	47	9	4	4	0
Solid Geometry	8	2	1	1	0
Trigonometry	11	2	0	0	0
Business Mathematics	3	2	0	0	0
Pre-Flight	1	0	0	0	0
Totals	158	33	10	10	0







On no response was there indication that drill was distributed at recurring intervals which became more widely spaced as time went on.

To be effective, drill must be well motivated. Ideas which were especially recommended by the leaders were contests and mathematical games. The responses showed that the teachers used a variety of methods, but in only fifteen to eighteen per cent of the classes were mathematical games or contests ever used as motivation in drill. In almost eighty per cent of the classes use was made of the blackboard and of written work. Oral exercises were given for drill work part of the time in about sixty-five per cent of the classes; the same percentage of classes had some individual help in practice work.

A few other procedures mentioned by individual teachers were quizzes, the use of flash cards, verbal explanation of particular problems without reaching definite answers, and reports on community problems, but in no instance was any of these mentioned by more than one teacher. Table III and Table IV list specific data on the practice and drill work category.

The conclusion drawn from this category is that practice work generally constituted variations of written and oral exercises, blackboard work, and some individual help, but there is little indication that this drill had



On no response was there indicated. The results were  
attributed at recurring intervals with some minor  
spaced as time went on.

To be effective, drill must be well planned, in-  
which were especially recommended by the teachers who  
tests and mathematical games. The teachers showed that the  
teachers used a variety of methods, but in only fifteen  
eighteen per cent of the classes were mathematical  
or contents even used as motivation for drill. In eleven  
eighty per cent of the classes was not made in the  
board and of written work. Oral exercises were given  
drill work part of the time in about thirty-five per cent  
of the classes; the average percentage of a lesson was about  
individual help in written work.

A few other procedures mentioned by the teachers  
teachers were drilled, the use of flash cards, verbal  
explanation of mathematical problems of drill requiring  
answers, and requests for complete problems. In the  
was any of these mentioned by more than the teachers  
III and Table IV also reported that the teachers  
drill work category.

The concluding remarks from this category is that  
practice work general in content and varying in  
and oral exercises, flashcards, and some individual  
help, but there is little indication that drill is



TABLE III  
FREQUENCY OF PRACTICE AND DRILL WORK

Course	Daily	Three times a week	Once a week	Occasion- ally	Never
General Mathematics	8	10	7	5	0
Algebra I	20	20	9	8	0
Algebra II	11	7	2	5	0
Algebra III	0	1	0	0	0
Plane Geometry	23	15	9	11	0
Solid Geometry	6	0	2	4	0
Trigonometry	5	0	2	6	0
Business Mathematics	0	2	1	1	0
Pre-Flight	0	1	0	0	0
Totals	73	46	32	40	0



# OFFICE

## EXERCISES

Course					Credits				
General					Mathematics				
General	1	2	3	4	1	2	3	4	5
Algebra I	1	2	3	4	1	2	3	4	5
Algebra II	1	2	3	4	1	2	3	4	5
Algebra III	1	2	3	4	1	2	3	4	5
Plane Geometry	1	2	3	4	1	2	3	4	5
Solid Geometry	1	2	3	4	1	2	3	4	5
Trigonometry	1	2	3	4	1	2	3	4	5
Business	1	2	3	4	1	2	3	4	5
Mathematics	1	2	3	4	1	2	3	4	5
Pre-Flight	1	2	3	4	1	2	3	4	5
Total	1	2	3	4	1	2	3	4	5



TABLE IV  
PROCEDURES OF PRACTICE WORK

Course	Mathe- matical Games	Blackboard	Indi- vidual Help	Written Work	Oral Exercises	Contests
General Mathematics	6	23	17	21	17	5
Algebra I	12	49	42	45	39	15
Algebra II	5	23	17	17	20	5
Algebra III	0	1	1	1	0	0
Plane Geometry	7	48	37	37	41	9
Solid Geometry	1	7	7	7	7	2
Trigonometry	2	9	7	7	8	2
Business Mathematics	0	2	1	4	2	0
Pre-flight	0	1	0	1	0	0
Totals	33	163	129	159	134	38



SECRET

Category	1950	1951	1952	1953	1954	1955
Light	0	1	1	1	1	1
Medium	0	3	1	1	1	1
Dark	3	1	1	1	1	1
Very Dark	1	1	1	1	1	1
Black	1	1	1	1	1	1
White	1	1	1	1	1	1
Grey	1	1	1	1	1	1
Blue	1	1	1	1	1	1
Green	1	1	1	1	1	1
Yellow	1	1	1	1	1	1
Pink	1	1	1	1	1	1
Orange	1	1	1	1	1	1
Brown	1	1	1	1	1	1
Purple	1	1	1	1	1	1
Black & White	1	1	1	1	1	1
Color	1	1	1	1	1	1
Monochrome	1	1	1	1	1	1
Grayscale	1	1	1	1	1	1
High Contrast	1	1	1	1	1	1
Low Contrast	1	1	1	1	1	1
High Resolution	1	1	1	1	1	1
Low Resolution	1	1	1	1	1	1
High Bit Depth	1	1	1	1	1	1
Low Bit Depth	1	1	1	1	1	1
High Frame Rate	1	1	1	1	1	1
Low Frame Rate	1	1	1	1	1	1
High Bit Rate	1	1	1	1	1	1
Low Bit Rate	1	1	1	1	1	1
High Data Rate	1	1	1	1	1	1
Low Data Rate	1	1	1	1	1	1
High Storage	1	1	1	1	1	1
Low Storage	1	1	1	1	1	1
High Transfer	1	1	1	1	1	1
Low Transfer	1	1	1	1	1	1
High Compression	1	1	1	1	1	1
Low Compression	1	1	1	1	1	1
High Security	1	1	1	1	1	1
Low Security	1	1	1	1	1	1
High Reliability	1	1	1	1	1	1
Low Reliability	1	1	1	1	1	1
High Accuracy	1	1	1	1	1	1
Low Accuracy	1	1	1	1	1	1
High Precision	1	1	1	1	1	1
Low Precision	1	1	1	1	1	1
High Consistency	1	1	1	1	1	1
Low Consistency	1	1	1	1	1	1
High Integrity	1	1	1	1	1	1
Low Integrity	1	1	1	1	1	1
High Availability	1	1	1	1	1	1
Low Availability	1	1	1	1	1	1
High Scalability	1	1	1	1	1	1
Low Scalability	1	1	1	1	1	1
High Flexibility	1	1	1	1	1	1
Low Flexibility	1	1	1	1	1	1
High Portability	1	1	1	1	1	1
Low Portability	1	1	1	1	1	1
High Interoperability	1	1	1	1	1	1
Low Interoperability	1	1	1	1	1	1
High Compatibility	1	1	1	1	1	1
Low Compatibility	1	1	1	1	1	1
High Compatibility	1	1	1	1	1	1
Low Compatibility	1	1	1	1	1	1

Category	1950	1951	1952	1953	1954	1955
Light	0	1	1	1	1	1
Medium	0	3	1	1	1	1
Dark	3	1	1	1	1	1
Very Dark	1	1	1	1	1	1
Black	1	1	1	1	1	1
White	1	1	1	1	1	1
Grey	1	1	1	1	1	1
Blue	1	1	1	1	1	1
Green	1	1	1	1	1	1
Yellow	1	1	1	1	1	1
Pink	1	1	1	1	1	1
Orange	1	1	1	1	1	1
Brown	1	1	1	1	1	1
Purple	1	1	1	1	1	1
Black & White	1	1	1	1	1	1
Color	1	1	1	1	1	1
Monochrome	1	1	1	1	1	1
Grayscale	1	1	1	1	1	1
High Contrast	1	1	1	1	1	1
Low Contrast	1	1	1	1	1	1
High Resolution	1	1	1	1	1	1
Low Resolution	1	1	1	1	1	1
High Bit Depth	1	1	1	1	1	1
Low Bit Depth	1	1	1	1	1	1
High Frame Rate	1	1	1	1	1	1
Low Frame Rate	1	1	1	1	1	1
High Bit Rate	1	1	1	1	1	1
Low Bit Rate	1	1	1	1	1	1
High Data Rate	1	1	1	1	1	1
Low Data Rate	1	1	1	1	1	1
High Storage	1	1	1	1	1	1
Low Storage	1	1	1	1	1	1
High Transfer	1	1	1	1	1	1
Low Transfer	1	1	1	1	1	1
High Compression	1	1	1	1	1	1
Low Compression	1	1	1	1	1	1
High Security	1	1	1	1	1	1
Low Security	1	1	1	1	1	1
High Reliability	1	1	1	1	1	1
Low Reliability	1	1	1	1	1	1
High Availability	1	1	1	1	1	1
Low Availability	1	1	1	1	1	1
High Scalability	1	1	1	1	1	1
Low Scalability	1	1	1	1	1	1
High Flexibility	1	1	1	1	1	1
Low Flexibility	1	1	1	1	1	1
High Portability	1	1	1	1	1	1
Low Portability	1	1	1	1	1	1
High Interoperability	1	1	1	1	1	1
Low Interoperability	1	1	1	1	1	1
High Compatibility	1	1	1	1	1	1
Low Compatibility	1	1	1	1	1	1

ENCLOSURE OF DOCUMENTS

TABLE 1A



motivation or that it stimulated pupils to learn.

The cited studies have shown that students must be taught to review and to study. Responses to the question concerning the extent to which students are taught how to do independent study and review showed that many teachers devoted time to this topic only before major tests. Some teachers reported that some time was used for this topic before each major test, and then it was occasionally discussed between tests. A systematic unit on study and review was used at the first of the year in only eighteen per cent of the classes. Approximately twenty-five per cent of the teachers discussed review and study habits only occasionally or else they spent no time at all on the topic. These responses are shown in Table V.

In half of the classes for which a report was made, reviews were conducted before each major test, which in most cases were the six-weeks' tests. A few of these classes had short reviews more frequently. Twenty per cent of the classes reviewed daily. Fifty-five per cent of the classes had reviews at the end of each topic; most of them also had short reviews more frequently. Breslich and other authorities state that pupils should be taught the habit of doing some systematic reviewing each day, and then no formal review would be needed at the end of each unit. Further information concerning the frequency of reviews is in Table VI.



motivation of these is attributed mainly to the fact that the cited studies have shown that students are taught to review and to study. The purpose of the present study is to determine the extent to which students are taught to do independent study and review and to what extent they devote time to this study and review before each major test, and how this time is spent. The results of the study are presented in Table I. A systematic review of the literature on the subject of the classroom review and study habits of students was conducted at the first of the year in only a few cases of the classroom. Approximately twenty-five students in the teachers' classroom review and study habits were interviewed. They or else they spent no time at all on the review. Their responses are shown in Table I.

In half of the classroom reviewed a review was made. Reviews were conducted before each major test. In all most cases were the review made. In the review of the had short reviews were frequently. In the review of the classroom reviewed fairly. In the review of the had reviews at the end of each topic. In the review of the short reviews were frequently. In the review of the this state that pupils should be taught to review and study some systematic reviewing each day, and when to review review would be needed at the end of each unit. This information concerning the frequency of review is in Table II.



TABLE V  
EXTENT TO WHICH STUDENTS ARE TAUGHT  
TO CONDUCT THEIR OWN STUDY AND REVIEW

Course	Week or more on this topic at first of yr.	Before each major test	Review mate- rials given: Often Occas. Never	Occasion- ally discussed	No time spent on topic
General Mathematics	4	17	7	13	7
Algebra I	11	28	16	14	30
Algebra II	5	10	12	7	8
Algebra III	1	0	0	1	0
Plane Geometry	9	34	17	14	33
Solid Geometry	2	5	2	3	7
Trigonometry	2	6	3	4	6
Business Mathematics	1	1	1	1	3
Totals	35	101	56	53	100
				49	3



# Y. 12345

THESE ARE THE NAMES OF THE  
 PERSONS WHO WERE PRESENT AT

THE MEETING OF THE  
 BOARD OF DIRECTORS OF THE  
 COMPANY ON THE 15TH DAY OF  
 JANUARY, 1900.

NAME	RESIDENCE	DATE OF BIRTH	DATE OF DEATH	DATE OF INTERMENT
JOHN A. BROWN	123 Main St., New York	1850	1900	1900
MARY A. BROWN	123 Main St., New York	1855	1900	1900
JOHN B. BROWN	123 Main St., New York	1860	1900	1900
MARY B. BROWN	123 Main St., New York	1865	1900	1900
JOHN C. BROWN	123 Main St., New York	1870	1900	1900
MARY C. BROWN	123 Main St., New York	1875	1900	1900
JOHN D. BROWN	123 Main St., New York	1880	1900	1900
MARY D. BROWN	123 Main St., New York	1885	1900	1900
JOHN E. BROWN	123 Main St., New York	1890	1900	1900
MARY E. BROWN	123 Main St., New York	1895	1900	1900



TABLE VI

## FREQUENCY OF REVIEWS

Course	Daily	Several times a week	Weekly	Monthly	Before each major test	At end of each topic
General Mathematics	4	7	3	0	15	13
Algebra I	11	13	9	2	30	27
Algebra II	6	7	1	0	14	12
Algebra III	0	1	0	0	0	0
Plane Geometry	10	14	5	2	30	37
Solid Geometry	4	1	2	0	7	8
Trigonometry	4	2	1	0	8	9
Business Mathematics	0	1	1	0	1	4
Pre-Flight	1	0	0	0	1	1
Totals	40	46	22	4	106	111







Methods of reviewing, shown in Table VII, are perhaps more important than frequency of reviews. Nearly all teachers reported use of written practice problems similar to those on the test. Some teachers required that students hand them in; others did not. Sixty-five per cent of the responses showed that teachers gave individual help. A large portion of these responses were modified by the statement that individual help was given whenever there was enough time for it.

Oral reviews were used in about sixty per cent of the classes, usually being interspersed with written problems and board work. Approximately fifty per cent of the classes made regular use of the blackboard in reviewing. Several teachers mentioned that they used the review exercises in the textbook.

A close relationship between drill and review procedures as used by New Mexico mathematics teachers can be seen in the responses. Only thirty-five per cent of the classes had any group work in reviewing, and only ten per cent were given any teacher-prepared review materials. These two items were the only two choices included which might "contain a new element or give a new view of the old."<sup>67</sup> No teacher mentioned any procedure used individually to

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<sup>67</sup> Breslich, op. cit., p. 22.



Methods of reviewing, shown in the following, perhaps more important than frequency of review. All teachers reported use of written review, similar to those on the test. Some teachers reported that students had their own review sheets. Some of the responses showed that students gave individual help. A large portion of these responses were related to the statement that individual help was given whenever it was enough time for it. Oral review was used in about half of the classes, usually being interspersed with written review and board work. Approximately half of the teachers made regular use of an outline, some in revision. Teachers mentioned that they used the review material in the textbook. A close relationship between oral and written reviews as used by New Mexico teachers was seen in the responses. Some teachers reported that their classes had any group work in reviewing, and only one cent were given any teacher-constructed review material. These two items were the only two measures combined which contained a new element or gave a new twist to the review. No teacher mentioned any procedure for individual help.



TABLE VII

## METHODS OF REVIEWING

Course	Written prob- lems, similar to test, handed in	Orally	Group work	Practice problems, not handed in	Board work	Review materials to pupils	Indi- vidual help
General Mathematics	20	17	10	10	17	3	17
Algebra I	35	34	20	25	32	6	38
Algebra II	15	15	9	11	14	1	15
Algebra III	1	1	0	0	0	0	0
Plane Geometry	36	39	17	21	30	7	39
Solid Geometry	8	7	3	3	5	2	11
Trigonometry	6	7	7	4	4	1	9
Business Mathematics	3	3	1	2	0	0	2
Pre-Flight	1	1	0	0	0	0	0
Totals	125	124	67	76	102	20	131



Category	Item	Value	Unit	Notes
General	1. General	100	Yr	100
	2. General	100	Yr	100
	3. General	100	Yr	100
	4. General	100	Yr	100
	5. General	100	Yr	100
Special	1. Special	100	Yr	100
	2. Special	100	Yr	100
	3. Special	100	Yr	100
	4. Special	100	Yr	100
	5. Special	100	Yr	100
Other	1. Other	100	Yr	100
	2. Other	100	Yr	100
	3. Other	100	Yr	100
	4. Other	100	Yr	100
	5. Other	100	Yr	100

ORIGINAL TO BE KEPT

IV SIGN



interest pupils and stimulate them to review voluntarily.

On the whole, there seems to be little differentiation between drill and review in the present classes. Review, although generally conducted more than once each six-weeks, does not seem to be done systematically day-by-day in most schools. Pupils should be given more definite instructions concerning methods of study and review.

Schunert's study revealed that mathematics classes, especially geometry, achieved more if tested more than once a week. Fourteen classes were tested daily and six more were tested more than once a week. This number comprises approximately ten per cent of all the classes. Smith and Hassler highly recommend a short daily written test, but only seven per cent of the classes are given this type test.

Forty per cent of the classes are given short quizzes weekly and longer tests at the end of the grading period or when a topic is finished. Several teachers used three- and six-weeks' examinations and a comprehensive semester examination. Table VIII gives a tabulation of the results of this item.

Most of the teachers prepared their own tests, using a variety of types. The new-type tests were used exclusively by a very small number of teachers. Standard tests were used at the end of the semester by a few teachers. Quizzes from the book were used in some classes along with teacher-



interest pupils and stimulate them to review voluntarily.

On the whole, there seems to be little difference between drill and review in the present situation. Review, although generally considered more than once each six-weeks, does not seem to be done systematically day-by-day in most schools. Table VIII gives more definite information concerning methods of study and review.

Schumann's study revealed that mathematics classes, especially geometry, reviewed more than any other class. Fourteen classes were tested daily and six times a week. Fourteen more were tested once a week. This number comprises approximately two per cent of all the classes. Latin and History highly recommended a short daily written test, but only seven per cent of the classes are given this type test. Forty per cent of the classes are given short quizzes weekly and longer tests at the end of the grading period or when a topic is finished. Several teachers used three- and six-weeks' examinations and a comprehensive examination. Table VIII gives a tabulation of the results of this item.

Most of the teachers prepared their own tests, using a variety of types. The new-type tests were used exclusively by a very small number of teachers. Standard tests were used at the end of the semester by a few teachers. Chicago uses the book were used in some classes along with teacher-



TABLE VIII  
FREQUENCY OF TESTS

Course	Daily	Weekly	Once during grading period	End of topic	Never
General Mathematics	2	12	6	15	0
Algebra I	4	26	12	33	0
Algebra II	1	11	4	17	0
Algebra III	0	1	0	0	0
Plane Geometry	6	24	9	39	0
Solid Geometry	1	3	3	7	0
Trigonometry	0	2	2	10	0
Business Mathematics	0	2	0	3	0
Pre-Flight	0	1	0	1	0
Totals	14	84	36	125	0



TABLE III  
PRELIMINARY ON TESTS

Course	Daily	Weekly	Lessons during trading period	Lessons before
General Mathematics	2	12	6	12
Algebra I	4	20	12	22
Algebra II	1	11	4	17
Algebra III	0	1	0	0
Plane Geometry	6	24	9	29
Solid Geometry	1	3	3	7
Trigonometry	0	2	2	10
Business Mathematics	0	2	0	1
Pre-Flight	0	1	0	1
Totals	14	85	38	127



prepared tests at the end of the grading period.

In no case did a teacher use oral tests altogether. A few teachers used only tests which were assigned by page and number in the book.

Mixed word and drill-type computation examples were the most popular of the teacher-prepared and book tests; however, a small per cent of the teachers used only drill-type exercises. Table IX contains a tabulation of the results of the test types.

The general picture of testing showed that in the mathematics classes studied, tests are not given as often as recommended, but that the types of tests which are given compare favorably with opinions of authorities in this field. Most teachers vary the type of tests given within each class. The teachers' ability to construct tests, especially the new-type tests, was not determined.

Teachers' opinions concerning frequency of homework assignments ranged from daily to never, as shown by Table X. About 70.2 per cent of the classes were assigned work daily; many teachers stated that most of this work was finished in the supervised study period. Several teachers stated that they definitely felt that there should be daily outside work. Ten per cent of the classes were assigned homework only occasionally or not at all.

The aspect of how the assignment was made also brought



prepared tests at the end of the grading period.  
In no case did a teacher use oral tests.  
A few teachers used only tests which were selected by page  
and number in the book.  
Mixed word and drill-type composition exercises were  
the most popular of the exercises used and the most  
however, a small part of the tests were of the  
type exercises. The II category of composition of the results  
of the test types.  
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a week or not at all.  
The aspect of how the test program was made also was



TABLE IX

## TYPES OF TESTS

Course	Teacher- prepared, written	New- type	Word problems	Typical drill-type computation	Mixed word and drill	Oral
General Mathematics	22	6	6	8	16	4
Algebra I	49	13	20	17	29	5
Algebra II	24	9	7	9	13	3
Algebra III	1	0	1	0	1	0
Plane Geometry	54	17	19	17	32	7
Solid Geometry	13	4	3	3	7	0
Trigonometry	12	3	3	3	7	0
Business Mathematics	4	1	4	0	3	1
Pre-Flight	1	1	1	0	0	0
Totals	180	54	64	57	108	20



SCIENCE  
CASE RECORD  
CONTENTS

Case	Author	Year	Journal	Volume	Page	Notes
1	Smith	1901	Annals	10	1-10	General
2	Johnson	1902	Annals	11	1-10	General
3	Williams	1903	Annals	12	1-10	General
4	Brown	1904	Annals	13	1-10	General
5	Miller	1905	Annals	14	1-10	General
6	Davis	1906	Annals	15	1-10	General
7	Wilson	1907	Annals	16	1-10	General
8	Moore	1908	Annals	17	1-10	General
9	White	1909	Annals	18	1-10	General
10	Black	1910	Annals	19	1-10	General
11	Green	1911	Annals	20	1-10	General
12	Adams	1912	Annals	21	1-10	General
13	Nelson	1913	Annals	22	1-10	General
14	Kimberly	1914	Annals	23	1-10	General
15	Clark	1915	Annals	24	1-10	General
16	Wright	1916	Annals	25	1-10	General
17	Scott	1917	Annals	26	1-10	General
18	Green	1918	Annals	27	1-10	General
19	Adams	1919	Annals	28	1-10	General
20	Nelson	1920	Annals	29	1-10	General

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TABLE X  
FREQUENCY OF HOMEWORK

Course	Daily	About three times per week	Once a week	Occasion- ally	Never
General Mathematics	18	6	0	3	2
Algebra I	38	13	1	5	3
Algebra II	18	7	1	1	0
Algebra III	1	0	0	0	0
Plane Geometry	43	13	2	5	1
Solid Geometry	10	1	0	1	0
Trigonometry	10	2	0	1	0
Business Mathematics	2	2	0	0	0
Pre-Flight	1	0	0	0	0
Totals	141	44	4	16	6



# UNIVERSITY OF MONTANA

## COURSE CATALOG

Course	Daily Study Time per week	Academic Study Time per week	Once a Week	Occasional	Never
General Mathematics	18	6	0	3	2
Algebra I	18	12	1	3	1
Algebra II	18	7	1	1	0
Algebra III	1	0	0	0	0
Plane Geometry	12	13	2	2	1
Solid Geometry	10	1	0	1	0
Trigonometry	10	2	0	1	0
Business Mathematics	2	2	0	0	0
Pre-Calculus	1	0	0	0	0
<b>Totals</b>	<b>71</b>	<b>34</b>	<b>1</b>	<b>10</b>	<b>0</b>



a variety of opinions. These are tabulated in Table XI. At least part of the time assignments were made orally in about three-fourths of the classes. Many teachers used the written and oral methods interchangeably.

Responses showed that in about thirty per cent of the classes teachers spent most of the period explaining the new work, thereby giving the students adequate preparation for their homework assignment. In about twenty additional classes teachers spent part of the period, usually about fifteen or twenty minutes, explaining the new assignment. Others reported that when needed some time was devoted to this phase.

Thirty per cent of the classes were given assignments at the first of the period, which means that an assignment was made before any explanation was given. Even though explanation may have been made later, teachers have no assurance that all new material can be explained during the period or that pupils will understand the lesson fully. Approximately 37.5 per cent of the classes were assigned homework after the recitation period. It can validly be assumed that in most of these classes very little time was spent explaining the new assignment. To be added to these two percentages, is another eight per cent in which classes teachers spent little time on the new work, as stated by their responses.



a variety of opinions. These are tabulated in Table VI.

At least part of the time available was made available for about three-fourths of the classes. Many teachers have the written and oral methods intermingled.

Responses showed that in about half the cases of the classes teachers spent most of the period explaining the new work, thereby giving the students adequate preparation for their homework assignment. In about twenty additional classes teachers spent part of the period, usually about fifteen or twenty minutes, explaining the new assignment. Others reported that when needed some time was devoted to this phase.

Thirty per cent of the classes gave given assignments at the first of the period, which means that an assignment was made before any explanation was given. Even though explanation may have been made later, teachers have no assurance that all new material can be explained during the period or that pupils will understand the lesson fully.

Approximately 37.5 per cent of the classes were assigned homework after the recitation period. It can hardly be assumed that in most of these classes very little time was spent explaining the new assignment. To be added to these two percentages is another eight per cent in which classes teachers spent little time on the new work, as stated by their responses.



TABLE XI

## PROCEDURES OF MAKING ASSIGNMENTS

Course	Written on board	Given orally	Given at first of period	Given at end of period	Made after recitation	Most of period explaining new work	Very little time on new work
General Mathematics	14	16	8	7	10	9	2
Algebra I	20	40	16	22	23	18	4
Algebra II	8	22	9	9	10	6	2
Algebra III	1	0	1	0	0	0	0
Plane Geometry	21	40	17	17	22	16	3
Solid Geometry	4	8	4	2	5	5	1
Trigonometry	3	10	6	2	4	7	1
Business Mathematics	2	2	1	2	2	0	1
Pre-flight	0	1	0	0	0	0	1
Totals	73	147	62	61	76	61	15







It can be concluded that at least sixty-five per cent of the classes did not receive adequate preparation before assignments were made. Because of the personal prejudice factor, it was necessary to determine the results in this manner rather than to ask specifically whether or not preparation was made previous to giving an assignment.

The majority of teachers felt that it should take thirty to forty-five minutes to complete the daily assignment, as pictured in Table XII. In addition to the figures given in the table, a few other teachers replied that the amount of homework varies. Most of these teachers stated that thirty to forty-five minutes was the usual length of the assignment, but that sometimes as much as an hour was given. One teacher reported that freshmen were given assignments of fifteen to twenty minutes in length, sophomores had thirty to forty-five minutes, and advanced classes had sixty minutes or more. A number of classes completed most of their assignments in the supervised study period, which is the procedure recommended by several writers. There seems to be fairly general agreement among teachers in the state concerning the amount of time students should spend on mathematics' assignments; however, the amount of assigned homework was not found to be a significant factor from Schunert's study.

In 25.2 per cent of the classes no differentiated assignments at all were given. In about half of the classes



Y  
BOND

It can be seen from the above that the amount of the classes did not receive adequate preparation before assignments were made. However, it was found that prejudice factor, it was necessary to take into account in this manner rather than to be restricted to not preparation was made reference to the following:

The majority of teachers felt that the amount of thirty to forty-five minutes in English was not as pictured in Table XII. In addition to the English classes in the table, a few other classes reported that they were of homework variety. Most of these teachers reported that to forty-five minutes was the most suitable time, but that sometimes as much as an hour was given. The teachers reported that treatment was given at least a half hour to twenty minutes in length, approximately half hour to five minutes, and advanced classes half hour to one hour. A number of classes reported that they were in the supervised study period, which is the period in which by several writers. There seems to be a fairly wide agreement among teachers in the table concerning the amount of time students should spend on homework, approximately half hour to the amount of half hour to one hour.

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TABLE XII  
LENGTH OF ASSIGNMENT

Course	15-20 minutes	30-45 minutes	An hour or more
General Mathematics	6	20	2
Algebra I	14	43	1
Algebra II	5	19	3
Algebra III	0	1	0
Plane Geometry	14	41	5
Solid Geometry	2	7	4
Trigonometry	1	10	3
Business Mathematics	1	3	0
Pre-Flight	0	1	0
Totals	43	145	18



# TABLE III

## REPORT OF ASSIGNMENT

Course	15-30 minutes	30-45 minutes	45-60 minutes
General Mathematics	6	20	2
Algebra I	11	43	1
Algebra II	5	19	3
Algebra III	6	1	
Plane Geometry	11	11	1
Solid Geometry	3	7	4
Trigonometry	1	10	3
Business Mathematics	1	3	
Pre-flight	5	1	0
Totals	45	115	15

ESTABLISHED BOND

RECEIVED



teachers give the faster and poorer students extra work, but only 15.7 per cent of all the classes are given teacher-prepared materials for differentiated assignments. The extra work given brighter pupils was usually more difficult and/or more advanced, which actually gave these students an opportunity to develop their mathematical ability.

Only twenty-four classes were grouped according to ability. Several teachers mentioned that their schools were too small for ability grouping. Since such a small number of classes were grouped, the need for differentiated assignments within the class was evident.

About one-eighth of all the classes used problems arising from life situations for differentiated assignments, about one-fourth received extra credit for research, and in about one-tenth of the classes faster pupils were allowed to work ahead in the book. One teacher supplemented the latter choice with the statement that this was true when assignments were made at one time for the entire six-weeks period.

Four teachers used the contract plan, or a similar procedure. Students, working under these plans, were allowed to work to their maximum or work for a particular grade by choosing and doing a certain number of projects during the year. Tabulation of the differentiated assignments item is made in Table XIII.



Teachers give the teacher and parent a copy of the report but only 15.7 per cent of all the classes are given teachers prepared materials for differentiated assignments. The work given brighter pupils are usually more difficult and/or more advanced, which requires more time and effort on the part of the pupil to develop their self-motivation and ability. Only twenty-five percent of the classes are given assignments of ability. Several teachers mentioned that their schools were too small for ability grouping. There were a small number of classes were grouped, the need for differentiated assignments within the class was evident. About one-third of all the classes had problems arising from the assignment for differentiated assignments about one-fourth received extra assignments, and in about one-tenth of the classes, better pupils were allowed to work ahead in the book. One teacher emphasized the latter choice with the statement that this was true when assignments were made at one time for the entire six-week period. Four teachers used the contract plan, or a similar procedure. Students, working under these plans, were allowed to work to their maximum or goal for a particular grade by choosing and doing a certain number of projects during the year. Tabulation of the differentiated assignments from is made in Table III.



TABLE XIII

## DIFFERENTIATED ASSIGNMENTS

Course	Better stu- dents given extra work			This extra work:			Poorer stu- dents given extra work		
	Often	Some	Never	More difficult	More advanced	Same type but more	Often	Some	Never
General Mathematics	10	7	12	8	7	2	6	7	16
Algebra I	18	17	25	17	12	6	13	21	26
Algebra II	4	10	13	6	6	2	3	7	17
Algebra III	1	0	0	1	0	0	1	0	0
Plane Geometry	17	20	27	19	14	4	9	21	34
Solid Geometry	3	4	5	4	3	0	4	2	6
Trigonometry	2	5	6	3	4	0	2	2	9
Business Mathematics	1	1	2	1	1	0	0	2	2
Totals	56	64	90	59	47	14	38	62	110







TABLE XIII (continued)  
DIFFERENTIATED ASSIGNMENTS

Course	Arise from life situations	Ability grouping	Extra credit for research	Past pupils work ahead in book	Teacher- prepared materials	Not Given
General Mathematics	4	1	6	3	6	6
Algebra I	8	7	13	5	9	14
Algebra II	3	3	7	4	3	9
Algebra III	1	0	1	0	1	0
Plane Geometry	7	7	15	6	9	15
Solid Geometry	1	2	2	1	0	3
Trigonometry	1	2	3	2	2	4
Business Mathematics	1	0	1	0	1	2
Totals	26	24	48	21	33	53



Station	OS	JS	QJ	IS	ES	ES
Station 1	I	0	I	0	I	S
Station 2	I	S	C	S	S	I
Station 3	I	S	S	I	0	C
Station 4	I	I	IS	0	C	IS
Station 5	I	0	I	0	I	0
Station 6	C	C	I	I	C	I
Station 7	0	I	IS	2	C	IS
Station 8	I	I	0	C	0	0

Station	Station	Station	Station	Station	Station	Station
Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Station 8	Station 9	Station 10	Station 11	Station 12	Station 13	Station 14
Station 15	Station 16	Station 17	Station 18	Station 19	Station 20	Station 21
Station 22	Station 23	Station 24	Station 25	Station 26	Station 27	Station 28
Station 29	Station 30	Station 31	Station 32	Station 33	Station 34	Station 35
Station 36	Station 37	Station 38	Station 39	Station 40	Station 41	Station 42
Station 43	Station 44	Station 45	Station 46	Station 47	Station 48	Station 49
Station 50	Station 51	Station 52	Station 53	Station 54	Station 55	Station 56
Station 57	Station 58	Station 59	Station 60	Station 61	Station 62	Station 63
Station 64	Station 65	Station 66	Station 67	Station 68	Station 69	Station 70
Station 71	Station 72	Station 73	Station 74	Station 75	Station 76	Station 77
Station 78	Station 79	Station 80	Station 81	Station 82	Station 83	Station 84
Station 85	Station 86	Station 87	Station 88	Station 89	Station 90	Station 91
Station 92	Station 93	Station 94	Station 95	Station 96	Station 97	Station 98
Station 99	Station 100	Station 101	Station 102	Station 103	Station 104	Station 105

STATIONED VARIOUSLY

TABLE XII (continued)



From the results of this survey and Schunert's study one can conclude that instruction would be improved in New Mexico mathematics classes if differentiated assignments were used more regularly by all teachers. Many of the poorer students are receiving no additional help; brighter students are given very little opportunity to further their interest and ability in mathematics. This situation reduces the teaching to the level of the average student. Very few teachers are taking time to prepare materials and to teach effectively by using differentiated assignments that fit individual needs in the class.

Forty per cent of the teachers in the state anticipated a percentage of failures from year to year. These per cents range from one per cent through fifteen per cent. One teacher stated that he had had only one failure in six years, while others stated that the per cent was highly variable. Many teachers reported that the number of failures depended on the care and effectiveness of counseling before registration. Fifty per cent of those who expect a certain rate of failures anticipate ten per cent or more. This percentage is twenty per cent of the total responses. One-third of this group anticipate less than five per cent of their classes to fail.

Several teachers stated that this was their first year to teach; therefore, they had no basis for answering the question and did not respond to this item. Many classes



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anticipated ten per cent or more. This percentage is twenty

per cent of the total respondents. One-third of the total

anticipated less than five per cent of their classes to fail.

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were too small to have a set percentage.

As previously related, Schunert showed in his study that teachers, especially in algebra classes, who usually failed no more than two per cent of the students each year had classes which achieved more than those taught by teachers who failed at least ten per cent. A significant number of mathematics teachers in the state have an annual failure rate of much more than two per cent.

The following question in this category for those who anticipated a percentage of failures revealed that seventy-five per cent of the classes this year were expected to meet the annual failure rate. No more students than usual were expected to be failed. In sixteen per cent of the classes less students will fail than usual. These data give evidence that the classes being taught this year are about average classes; consequently, methods used in teaching this year should coincide with those usually employed.

The lecture method "has little place in the teaching of high school mathematics;"<sup>68</sup> however, as shown from the results in Table XIV, this method is used regularly in over thirty-seven per cent of the classes in the state. This is not to say that the lecture is the only method used in some

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<sup>68</sup>Hassler and Smith, op. cit., p. 140



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<sup>68</sup> Hessler and Kuttel, op. cit., p. 110.



TABLE XIV

## TEACHING PRACTICES USED

Course	Lecture method	Socialized discussion	Projects with units of work	Demonstration and laboratory materials	Recitation method	Daily test method	Individual book teaching
General Mathematics	9	16	6	7	9	2	2
Algebra I	24	28	4	13	32	4	3
Algebra II	9	15	4	7	7	1	1
Algebra III	1	0	0	0	0	0	0
Plane Geometry	23	31	9	29	34	6	10
Solid Geometry	5	7	1	6	6	1	0
Trigonometry	5	8	1	5	6	0	1
Business Mathematics	2	2	0	1	1	0	0
Totals	78	107	25	68	95	14	17







of these classes, but it occupies an important position in about three-eighths of all mathematics classes.

Socialized discussion, the method most recommended, was used in fifty-one per cent of the classes. This method was employed along with other procedures in all these classes in which it was used.

The use of projects with each unit of work was seldom used by the teachers surveyed. Demonstrations and laboratory materials were used most commonly in plane geometry classes. Only 32.4 per cent of the classes were ever taught by this method, which, if carried out correctly, shows the applications of mathematics more clearly than the other methods.

The recitation method, which so often deteriorates, was practiced in 45.2 per cent of the classes. Although supplemented by other methods in most classes, this method was too common in the school studied. Many experts have called deteriorated recitation the lowest form of teaching.

The daily test method, so highly recommended by Hassler and Smith and others, was very seldom used. Mention was formerly made of this item.

Individual teaching was used whenever possible by approximately one-third of the teachers. The classes, with the exception of about three or four, were too large to afford time to do much individual teaching.



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The recitation method, which is often neglected,  
was practiced in 42.5 per cent of the classes. Although  
supplemented by other methods in most classes, this method  
was too common in the school studied. Many experts have  
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A workbook was used in only seventeen of the 211 classes reporting. According to Butler and Wren, a wise selection of workbooks and supplementary materials would improve instruction.

In conclusion, it can be said that the lecture and recitation methods are too commonly used in the mathematics classes surveyed. Projects and laboratory materials should be included more often, after careful study by the teacher in an effort to employ only those which are of value. Daily tests in more classes would improve the learning of the subject as well as teaching students the importance of study and attentiveness in class.

The length of the classes ranged from forty to sixty minutes. Two per cent of the classes were 40 minutes long; twenty-eight per cent were 45 minutes; ten per cent were 50 to 54 minutes; forty per cent were 55 to 59 minutes in length; and twenty per cent were an hour long. Of the teachers responding, 44.4 per cent felt that their periods allowed adequate time for individual help; 55.6 per cent said they had insufficient time to give individual help.

The teaching load of the teachers surveyed averaged 6.28 hours per day. Some teachers spent only two hours teaching mathematics, while others spent as many as six hours in mathematics classes. During part of the day forty-seven per cent of the teachers taught classes besides



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mathematics, meaning that several preparations had to be made daily. The range in the number of hours spent teaching other classes was from three-fourths of an hour to more than four hours.

A large number of the teachers, 57.9 per cent, had to care for study halls. Some teachers spent as much as two hours in study halls daily. The responsibility of extra-curricular activities included 62.6 per cent of the teachers. Some teachers spent only an hour or so on these activities each day; on the other hand, some teachers spent five hours daily outside of class with extra activities.

In seven cases the mathematics teacher reporting was either superintendent, principal, supervisor, or coach. In only one instance did these individuals feel that they had time to do the teaching job they would like to do. Many teachers stated that any time for individual help had to be taken from their personal time after school hours.

A significant number of teachers are in the classroom or closely associated with school activities eight or nine hours each day. Teachers also have many papers to grade and lessons to plan outside of school. They cannot be expected to do their maximum teaching when their teaching load is too heavy.

All teachers reporting had at least a bachelor's degree. Those having only bachelor's degrees included



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A large number of the teachers, 51.9 per cent, had to care for study halls. Some teachers spent as much as two hours in study halls daily. The responsibility of extra-curricular activities amounted to 22.0 per cent of the teachers. Some teachers spent only an hour or so on these activities each day; on the other hand, some teachers spent five hours daily outside of class with extra activities.

In seven cases the mathematics teacher reported was either superintendent, principal, supervisor, or coach. In only one instance did these individuals feel that they had time to do the teaching job they would like to do. Many teachers stated that any time for individual help had to be taken from their personal time after school hours.

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All teachers reporting had at least a bachelor's degree. Those having only bachelor's degrees included



forty-seven per cent of the total reporting. Those with master's degrees constituted forty-five per cent of the teachers, and those to whom master's degrees will soon be granted made up eight per cent. Besides the Bachelor of Arts, Bachelor of Science, Master of Arts, and Master of Science degrees, some teachers had degrees in business administration, physical education, and engineering.

The number of college semester-hours in mathematics ranged from a total of six hours to sixty-six hours. Thirteen per cent of the teachers had only fifteen hours or less in mathematics training. Twenty-nine per cent had less than the twenty-four hours recommended as a mere minimum by the Joint Commission. While some were ill-prepared in the field of mathematics, others were well-prepared, and about twenty-three per cent of the teachers had the forty hours recommended by the Joint Commission for teachers who teach advanced secondary mathematics.

The range in semester-hours in education courses was from nine to eighty-five hours. The average was 37.4 semester-hours of education, which is well above the fifteen hours the Joint Commission recommended as a minimum.

The results in this category of responses show that a significant number of teachers are not prepared to give students the background material in mathematics that should be taught, because they, themselves, are without sufficient



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background in mathematics. On the other hand, this cannot be said of all the teachers in the state. There are teachers in the state who are doing little to improve their mathematics teaching. One indication of this fact is that some teachers have taught for more than twelve years and have yet only ten semester-hours of work in college mathematics.

A majority of the teachers in the state have taught for twelve or more years. The percentages for the number of years taught are given in Table XV. About fifty-nine per cent of the teachers in the state had more than eight years of experience, as compared with thirty per cent who had less than two years. Schunert's study revealed that teachers with more than eight years of experience were more effective than those with less than two years of experience. Generally speaking, the teachers seem to have sufficient experience for a high level of teaching.

The response to the final item of the questionnaire indicated an inferior position for mathematics in New Mexico schools. The status of mathematics in the curriculum seems to be one which is overshadowed by other subjects, activities, and poor conditions. In answer to the question, "Do you have time to do the teaching job you would like to do?" 65.3 per cent of the teachers replied emphatically, "No!" Several others said they felt they would have the



background in mathematics. In other words, this cannot be said of all the teachers in the state. There are teachers in the state who are doing little to improve their mathematics teaching. The questionnaire data also show that some teachers have taught less than twelve years and have yet only one year of work in college mathematics. A majority of the teachers in the state have taught for twelve or more years. The percentages for the number of years taught are given in Table A. About fifty-nine per cent of the teachers in the state had more than eight years of experience, as compared with thirty per cent who had less than two years. Teachers' ratings revealed that teachers with more than eight years of experience were more effective than those with less than two years of experience. Generally speaking, the teachers seem to have sufficient experience for a high level of teaching. The responses to the final item of the questionnaire indicated an inferior quality of mathematics in the Mexico schools. The status of mathematics in the curriculum seems to be one which is overshadowed by other subjects, activities, and poor conditions. In answer to the question "Do you have time to do the teaching you would like to do?" 67.3 per cent of the teachers replied negatively. "No!" Several others said they felt they could save the



TABLE XV  
TEACHING EXPERIENCE

Number of years	Number of teachers	Per cent of total reporting
First year	9	10
1-3	20	22.2
4-6	8	8.8
7-11	10	11.1
12 or more	43	47.9
	90 teachers	100.0 per cent



EFFICIENT  
ERASE  
RAG COVER

TEACHING THE STUDENT

Number of years	Number of months	Number of days
First year	12	365
1-3	36	1095
4-6	72	2190
7-11	108	3285
12 or more	144	4380
Total		11040



time were their students prepared for the mathematics courses in which they were enrolled. Those who answered that they had time to do their job efficiently constituted 29.3 per cent of the total number of teachers responding. In comparing these answers with previous items, it was found that nearly all the teachers who answered in the affirmative spent only five hours a day doing school work or they interpreted the question as pertaining only to the length of the class period, and in answer to this, felt that fifty-five or sixty minute periods were long enough for high school students.

There were many comments in answer to this item. Many felt that the day should be rescheduled, the curriculum readjusted, or the requirements in previous mathematics training of students made more rigorous. Some teachers did not have the aids and materials they needed for effective teaching; others were rushed with a heavy load of extra-curricular activities. The following was a common statement: "No real teacher ever does have enough time, considering the fast-moving schedule and present conditions."

This concluded the comparative study of theory and practice in the field of mathematics teaching in New Mexico. A summary of the findings are included in Chapter IV.

## II. THE TEST RESULTS

Nature of the comparisons. The results of the tests



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In comparing these answers with those found that nearly all the teachers who were employed in the field of education spent only 7.1 per cent of their time or they interpreted the material in the length of the class period. In general, the length of the class period was about fifty-five or sixty minutes. The school students.

There were many comments in answer to this question. Many felt that the day should be devoted to the teaching of the material in the classroom. The training of students was more important. Some felt that not have the class and laboratory work should be done. Teaching should be done with a heavy load of material. Curriculum activities. The following was a common statement.

"No real teacher ever does have enough time to do the fast-moving schedule and present a variety of material. This demands the cooperative of the student in practice in the field of education. Teaching is not a theory. A summary of the findings are included in Table 1."

TABLE 1  
Summary of the findings. The data is presented in the following table.



given in this study were compared first with national norms. After the general picture as to how New Mexico seniors stand in functional competence on a national level was found, these results were further studied to determine what factors contributed to the over-all status of mathematics in the state. Further bases for comparison of test results were the size of the school, mathematical background of pupils, and the sex of pupils

Results of the test as compared with national norms.

The mean standard score of School A was 117, which placed the school in the 45th-percentile. The standard scores ranged from 90 through 156, with a median score of 117.

School B had a mean standard score of 98, which gave the school a percentile rank of nine. The scores ranged from 83 through 115. The median of the scores was 98.75.

The median for School C was 92.5; the average (mean) standard score was 97.36. The class ranked in the 8th-percentile. The standard scores ranged from 85 through 119.

The mean standard score for School D was 101.07; the median was 105. The class was in the 13th-percentile when compared with national norms. The range of scores was from 81 through 121.

School E, which was used as a check to determine whether or not the number of schools chosen from the lower enrollment group was representative of the entire group,



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SECRET  
NO  
SE BOND  
CONTENT

of pupils

Results of the tests are compared with national norms. The mean standard score of School A was 117, which placed the school in the 15th percentile. The standard score ranged from 90 through 114, with a median score of 114. School B had a mean standard score of 90, which placed the school a percentile rank of first. The scores ranged from 63 through 115. The median for School C was 92.3, the 10th percentile. The standard score was 91.5. The class rank in the 10th percentile. The standard score was 90.75, the 10th percentile. The mean standard score for School D was 111. The median was 101. The class was in the 15th percentile when compared with national norms. The range of scores was from 81 through 121.

School E, which was last in a class of 10 schools, whether or not the impact of school change from the last enrollment group was representative of the entire group.



showed results very similar to the other schools in this group. The median was 98.5; the mean standard score was 98.46, placing the school between the 9th- and 10th-percentile. Therefore, it was concluded that the schools tested were representative of schools in the state. The scores in School E ranged from 79 through 131.

As can be seen clearly, no school tested compared at all favorably with the national scores. The average of the mean standard scores for the schools was 102.31, placing New Mexico schools, on the whole, in the 15th-percentile.

The relatively low status of mathematics in New Mexico was clearly described from the subjective evidence obtained from the questionnaire survey and the objective evidence obtained from the test study. Functional competence in mathematics is not being taught well. The previous chapter brought out the evidence that poor methods and conditions are common in the state. Further comparisons were made to determine other factors which were presumed to have a bearing on the status of the subject.

Size of the schools, as a basis for comparison. A basis for comparison between the schools themselves was the enrollment. School A, the largest school tested, having an enrollment of more than 500, ranked highest among those tested. This school was in the 45th-percentile, which, even



showed results very similar to the other schools in this group. The median was 98.5. The mean standard error was 98.46, placing the school among the 9th and 10th percentile. Therefore, it was concluded that the school is tested above representative of schools in the state. The scores in School E ranged from 95 through 101. An analysis of the school tested compared at all favorably with the national scores. The average of the mean standard error for the schools was 100.11, placing New Mexico schools, on the whole, in the 15th percentile. The relatively low status of mathematics in New Mexico was clearly suggested from the subjective evidence obtained from the questionnaire survey and the objective evidence obtained from the test study. Functional competence in mathematics is not being taught well. The questionnaires brought out the evidence that poor methods and materials are common in the state. Further comparisons were made to determine other factors which were presumed to have a bearing on the status of the subject.

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Basis for comparison between the schools themselves was the enrollment. School A, the largest school tested, having an enrollment of more than 500, ranked highest among those tested. This school was in the 15th percentile, while, given



though the highest of the New Mexico schools in this study, was below even the middle rank of the nation.

School B, in the 200 to 500 enrollment group, fell far below School A, being in the 9th-percentile. School C, a rural school which was not accredited and with an enrollment of less than 200, ranked about equally with School B. However, School D, of the same enrollment group as School C, ranked slightly higher than the 9th-percentile, its rank being the 13th-percentile. School E, having an enrollment of approximately 200, was also close to the ranks of the other small schools, the 9th- to 10th-percentile.

It was concluded that students from the larger schools, especially those with enrollments greater than 500 pupils, received better instruction in functional competence than those students from smaller schools. This conclusion substantiates a similar one reached by Schunert. There was no significant difference between the scores of students from schools with enrollments of 200 to 500 and those from schools with enrollments of less than 200 pupils.

Mathematical background of pupils, as a basis for comparison. A factor presumed to be significant in the whole picture of functional competence was the amount of instruction that pupils had obtained in mathematics in the high schools.



though the highest of the various schools in this district  
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School B, in the 200 to 300 enrollment range, fell  
far below School A, being in the 100-200 enrollment  
a rural school which had not been established with an enroll-  
ment of less than 200, ranked about equally with School C.  
However, School D, of the 300 to 400 enrollment range, ranked  
slightly higher than School A, being in the 100-200 enrollment  
range. The 180-200 enrollment range, School E, ranking in the  
of approximately 200, was also close to the level of the  
other small schools, the 100 to 200 enrollment range.  
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Mathematical background of pupils at a single school  
A factor presumed to be significant in the  
whole picture of functional competence was the mathematical  
background that pupils had obtained in the schools in the  
high schools.



Seniors from School A had taken an average of 1.9 years of mathematics. Every senior had had at least one year of mathematics in high school. The greatest number of pupils had studied algebra. A few seniors had taken business mathematics and shop mathematics, solid geometry, and trigonometry. The amount of instruction received by students in the selected schools is shown in detail in Table XVI, in its relation to student achievement. The table reveals definitely that the more mathematics instruction a student receives the better is his score on the Davis Test. The second year of mathematics was responsible, in part at least, for an improvement of 14.9 points in the average scores. Each additional year of mathematics showed a further gain in score. To a certain degree, of course, the ability and interest factors enter the picture since students with ability and interest in mathematics most often continue in the subject. It is clear that although one can only speculate about causal effects of interest and ability, student scores on the Davis Test are directly related to the amount of mathematics instruction the students have received.

School A, having the advantage of the larger enrollment, was able to offer a mathematics curriculum including nine mathematics or related courses; the smaller schools offered only the three basic subjects of general mathematics, first year algebra, and plane geometry. Occasionally business



Seniors from School A had taken an average of 1.5 years of mathematics. Every senior had had at least one year of mathematics in high school. The average number of pupils had studied algebra. A few seniors had taken trigonometry and some mathematics. The amount of instruction in the selected schools is shown in detail in Table X. The Davis Test is a student achievement test. The Davis Test definitely tests the way mathematics instruction is given. It reveals the better in his score on the Davis Test. The second year of mathematics was responsible in part at least for an improvement of 11.9 points in the average score. Each additional year of mathematics showed a further gain in score. To a certain degree, of course, the ability and interest factors enter the picture since ability and interest in mathematics were other variables in the study. It is clear that although one can only speculate about causal effects of interest and ability, which scores on the Davis Test are directly related to the amount of mathematics instruction the students have received. School A, having the advantage of the larger school, was able to offer a mathematics curriculum consisting also mathematics or related courses; the smaller schools offered only the three basic subjects of algebra, trigonometry, and plane geometry. Occasionally seniors



mathematics or second year algebra were offered. This factor may account in part for the higher achievement of pupils in the larger schools.

School B showed that seniors had taken an average of 1.6 years of mathematics; each student had taken at least one year; no student had more than three years. Nearly every student had taken general mathematics. Table XVI shows the relationship of experience in instruction and scores on the test for each of the schools. Students in School B who had taken two years of mathematics did not improve their test scores, but those who had taken three years of mathematics showed some improvement.

School C offered only the three basic mathematics courses, and the seniors had taken an average of 1.8 years of mathematics. Plane geometry had been studied by more pupils than any other subject. No students who were tested in School C had taken more than two years of mathematics. Those who had two years showed an improvement in the test scores of about four points over those who had taken only one year.

In School D seniors had taken an average of 1.8 years of mathematics. There was definite improvement with each additional year of mathematics instruction. Those who had taken three years showed an improvement of almost twenty points in test scores.



machines of a kind, for which the  
factor was a record in the  
pupils in the larger schools.

School 2 showed that progress was made in the

1.6 years of instruction, with the

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in School 2 who had taken two years of instruction

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School 3 showed only that three

courses, and the results had

of instruction, and the

pupils than any other school.

In School 4 had taken more than

those who had two years showed

scores of about four points

one year.

In School 5 pupils had taken

years of instruction. There

each additional year of instruction

who had taken three years showed

twenty points in test scores.



TABLE XVI

RELATIONSHIP OF TEST SCORES  
AND MATHEMATICAL BACKGROUND

School	Average scores for the following no. of courses:			
	1 year	2-2½ years	3-3½ years	4 years
A	107.0	120.9	123.9	134.8
B	97.4	96.5	100.7	--
C	95.0	98.9	--	--
D	94.0	100.0	119.7	--
E	93.9	101.4	118.7	--



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TABLE VII

RELATIONSHIP OF TEST SCORES  
AND NATURAL TEST PERFORMANCE

AVERAGE SCORES FOR THE FOLLOWING				
1 year 2-3 years 3-5 years 5 years				
A	107.0	100.3	101.4	101.1
B	97.1	98.7	100.1	100.1
C	97.0	97.9	100.1	100.1
D	97.0	100.0	101.1	101.1
E	97.9	101.4	101.4	101.4



One and one-half years of mathematics was the average of the seniors in School E. General mathematics was the most popular subject. Each additional year of mathematics added a considerable number of points to the average test score, as shown in Table XVI.

In conclusion, the mathematical background of the students is very important in determining their degree of functional competence. In all except one instance an additional year of mathematics significantly improved the scores. The schools with less than 500 pupils enrolled did not offer a sufficient number of mathematics courses from which the students could choose those courses which interested them.

Sex of the students, as a basis for comparison.

Whether or not the sex of the students was a significant factor in mathematical competence was determined by comparing the standard scores of the boys with those of the girls. In School A, boys made an average score of 121.55; the girls made an average score of 117.73. Of the four students ranking higher than the 90th-centile, three were boys. One boy in this school ranked in the 99th-centile.

In school B, boys ranked 1.6 points higher than girls. The average standard score of the boys was 99.3, and that of the girls was 97.7. The highest score, 115, was made by one







boy and one girl.

Scores of boys were significantly higher than those of girls in School C. The boys made an average score of 101.7 as compared with the girls' average score of 92.5. The highest percentile rank, 50, was attained by a boy.

School D showed reversed results, with the girls scoring slightly higher than the boys. The girls' score was 101.7 while that of the boys was 100.6. Most of the boys in this school had taken only one year of mathematics.

In School E, the boys made an average score of 99.5; the girls made 98.4. The highest score, 126, was made by a boy.

It can be concluded that boys generally made slightly higher scores on the functional competence tests than did girls. The average score in all the schools tested was 104.5 for the boys and 101.6 for the girls, an average of 2.9 points more for the boys.

Completion of comparisons. The preceding comparisons constituted the comparative procedures used in studying the test results. A summary of the findings is found in the final chapter of the study.



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## CHAPTER IV

### SUMMARY AND CONCLUSIONS

#### I. SUMMARY

This study dealt with the methods and conditions of mathematics teaching in the high schools of the state of New Mexico, and the effectiveness of these teaching procedures as measured by a test in functional competence in mathematics.

Chapter II of the study presented the procedures and criteria used in preparing the questionnaire sent to the mathematics teachers in the state. This chapter also gave a description of the Davis Test and the testing procedures used in the objective part of the study.

Chapter III included a comparative study of the results of the questionnaire and the tests. The following findings are considered significant with regard to the questionnaire survey.

1. A majority of the schools offer only the three basic mathematics courses--general mathematics, first year algebra, and plane geometry.
2. A significant number of mathematics classes are above the optimum size; however, the over-all average is within the optimum size of twenty to thirty pupils.
3. Life applications are used by a majority of geometry, general and business mathematics teachers, but few



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2. A significant number of mathematics classes are above the optimum size; however, the over-all average is within the optimum size of twenty to thirty pupils.
3. The applications are used by a majority of teachers, but few general and business mathematics teachers, but few



are used in algebra classes.

4. About seventy-five per cent of the classes have a supervised study period daily, but in some cases this is not of adequate length.
5. A variety of types of practice and drill work is used frequently, but there is little indication that this work is well motivated.
6. There is a close relationship between drill and review; very little time is spent teaching students how to conduct their own study and review.
7. Tests are not given as often as recommended, but the general nature of the tests compares favorably with the types recommended.
8. The majority of teachers give thirty to forty-five minute assignments daily. In sixty-five per cent of the classes there is evidence that sufficient preparation is not given before making the assignment.
9. No differentiated assignments are given in one-fourth of the classes. Only fifteen per cent of the classes are given teacher-prepared materials for differentiated assignments. Very few classes are grouped according to ability, giving evidence of the need for differentiated assignments.
10. Twenty per cent of the teachers anticipate an annual failure rate of at least ten per cent; a large number



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6. No differentiated assignments are given in one-fourth of the classes, only fifteen per cent of the classes are given teacher-prepared materials for differentiated assignments. Very few classes are grouped according to ability, giving evidence of the need for differentiated assignments.
7. Twenty per cent of the teachers anticipate an average failure rate of at least ten per cent; a large number



of teachers usually assign failing marks to more than two per cent of their pupils. In seventy-five per cent of the present classes, the teachers anticipate that about as many pupils will fail as usually do. Therefore, this year may be considered a normal one so far as pupil achievement is concerned.

11. The lecture and recitation methods are commonly used. Projects and laboratory materials are not often used, and the daily test method is used in less than ten per cent of the classes.
12. The majority of classes are fifty-five or sixty minutes in length. Over half the teachers do not have time for sufficient individual help.
13. The teaching load averages 6.28 hours per day; a majority of the teachers care for study halls and/or have extra-curricular responsibilities. Forty-seven per cent of the mathematics teachers teach other subjects.
14. Forty-seven per cent of the teachers reporting have bachelor's degrees; forty-five per cent have master's degrees; eight per cent will soon receive master's degrees. A significant number of mathematics teachers in the state are not adequately prepared in the field of mathematics; however, all the teachers have preparation in the field of education that compares favorably



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14. Forty-seven per cent of the teachers reported have a bachelor's degree; forty-five per cent have master's degrees; eight per cent will soon receive master's degrees. A significant number of mathematics teachers in the state are not adequately prepared in the field of mathematics; however, all the teachers have preparation in the field of education that compares favorably



with criteria established by the Commission.

15. About fifty-nine per cent of the teachers have more than eight years of experience. About thirty per cent have less than two years of experience.
16. About sixty-five per cent of the teachers feel that they definitely do not have time to do the teaching job they would like to do. Of the 29.3 per cent who answered that they do have the time to do the job well, the majority misinterpreted the question as pertaining only to the length of the class period. A significant number reported that students are not adequately prepared for high school mathematics courses.

The following findings are considered significant with regard to the test results.

1. The average rank of the representative seniors in New Mexico high schools on the Davis Test of Functional Competence in Mathematics was in the fifteenth-percentile.
2. Pupils from schools with enrollments of more than five hundred are more functionally competent in mathematics than pupils from schools with less than five hundred students.
3. The mathematical background of pupils is important in determining their degree of functional competence



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16. About thirty-five per cent of the teachers feel that they collectively do not have time to do the teaching job and would like to do it full time. For some who answered that they do have the time to do the job well, the majority maintain that the question as pertaining only to the length of the class period. A significant number reported that students are not adequately prepared for high school mathematics courses.

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in mathematics. An improvement in the scores is shown for each additional year of mathematics taken. The smaller schools have few curriculum offerings.

4. The boys made an average of 2.9 points above the girls on the test.

## II. CONCLUSIONS

The conclusions to be drawn from this study are as follows.

1. New Mexico seniors are far below the national level of functional competence in mathematics.
2. The composite picture of high school mathematics in the state gives evidence of the low status of this subject.
3. With respect to the administrative factors, the number of mathematics courses offered in most high schools is insufficient, and the teaching load is too heavy in some schools. The larger schools have better mathematical programs.
4. With respect to the teaching practices, many inferior methods are being used, especially in regard to drill, review, life applications, differentiated assignments, presentation of subject matter, and individual guidance.



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4. With respect to the teaching practices, many inferior methods are being used, especially in regard to drill, review, rote repetition, differentiated assignments, presentation of subject matter, and individual guidance.



5. With respect to the teacher factors, a significant number of teachers are inadequately prepared in the field of mathematics. A majority of the teachers meet the recommendations in the field of education and teaching experience.

### III. RECOMMENDATIONS

The final recommendations of this study are indication for the improvement of the status and teaching of mathematics in New Mexico high schools.

1. The mathematics curriculum should be expanded, especially in schools with enrollments of less than five hundred pupils.
2. The teaching load should be reduced for teachers in a majority of the schools.
3. Certain teaching procedures, specifically with reference to motivating drill, conducting review, and preparing for the assignment, should be improved.
4. Differentiated assignments and life applications should be used more regularly by many teachers. Teacher-prepared materials which fit the needs of the individual class should be used.
5. In many cases the lecture and recitation methods of teaching mathematics should be replaced by projects, laboratory materials, and socialized discussion.



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6. Mathematics standards should be raised in every class, both elementary and secondary, to insure adequate preparation of pupils for advanced classes.
7. Pupils with mathematical ability should be encouraged to continue in this field.
8. A large number of mathematics teachers should have more mathematical training. Refresher courses should be taken by some teachers to give them a new view of their subject and more background for teaching.
9. One of the principal aims of mathematics teachers should be to teach students to become functionally competent in the subject, and the classes should be conducted with this objective in view.



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BIBLIOGRAPHY



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1111

122

133



## A. BOOKS

Breslich, Ernest R., The Technique of Teaching Secondary-School Mathematics. Chicago: The University of Chicago Press, 1930. 239 pp.

Butler, Charles H., and P. Lynwood Wren, The Teaching of Secondary Mathematics. New York: McGraw-Hill Book Company, Inc., 1941. 514 pp.

Hassler, Jasper O., and Rolland R. Smith, The Teaching of Secondary Mathematics. New York: The Macmillan Company, 1930. 405 pp.

Miller, Denning, Popular Mathematics. New York: William H. Wise and Company, Inc., 1942. 616 pp.

## B. PERIODICAL ARTICLES

Admiral C. W. Nimitz, A Letter reprinted in The Mathematics Teacher, 35:255-56, October, 1942.

Commission on Post-War Plans, National Council of Teachers of Mathematics: First Report, The Mathematics Teacher, 37:226-32, May, 1944.

Commission on Post-War Plans, National Council of Teachers of Mathematics: Second Report, The Mathematics Teacher, 38:195-221, May, 1945.

Commission on Post-War Plans, National Council of Teachers of Mathematics: Guidance Report, The Mathematics Teacher, 40:315-39, November, 1947.

Schunert, Jim, "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School," (A summary of an unpublished Doctor's dissertation of the same title, University of Minnesota, 1950), Journal of Experimental Education, 19:219-38, March, 1951.

Scott, Foresman and Company, Teaching Trends, Pamphlet 39R, 1951.



Brooklyn, August 11, 1911. The following is a list of the  
Schools mentioned in the report of the  
Board, 1911, p. 27.

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Schools mentioned in the report of the  
Board, 1911, p. 27.

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## C. PUBLICATIONS OF LEARNED ORGANIZATIONS

Joint Commission of the Mathematical Association of America, Inc., and the National Council of Teachers of Mathematics: The Place of Mathematics in Secondary Education, Fifteenth Yearbook of the National Council of Teachers of Mathematics. New York: Bureau of Publications, Teachers College, Columbia University, 1940. 253 pp.

March Meeting of the Southwestern Section of The Mathematical Association of America, Inc., The American Mathematical Monthly, Volume 58, August-September, 1951. Pp. 519-522.

## D. UNPUBLISHED MATERIALS

Davis, David John, "A Comparative Study of Achievement Levels of Twelfth Grade Pupils on a Test Designed to Measure Functional Competence in Mathematics." Unpublished Doctor's dissertation, The University of Michigan, Ann Arbor, 1950. 207 pp.

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3. RECOMMENDATIONS OF THE COMMITTEE

Joint Committee of the National Association of  
States, Inc., and the National Council of Teachers  
of Mathematics. The Place of Mathematics in Science  
and Education. Publication of the National  
Academy of Sciences, Washington, D.C., 1930.  
1930. 225 pp.

Joint Committee of the National Association of  
States, Inc., and the National Council of Teachers  
of Mathematics. Publication of the National  
Academy of Sciences, Washington, D.C., 1930.  
1930. 225 pp.

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Joint Committee of the National Association of  
States, Inc., and the National Council of Teachers  
of Mathematics. Publication of the National  
Academy of Sciences, Washington, D.C., 1930.  
1930. 225 pp.

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APPENDIX

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## APPENDIX A

2017 North La Veta Drive  
Albuquerque, New Mexico  
March 25, 1952

Dear Fellow Math Teacher:

Teachers, parents, educators, employers, and students themselves--nearly all of us in New Mexico--talk about how mathematics should be taught, but few of us ever have time to find out what methods are really best, what kind of teaching is being done, and what, if any, improvements should be made to make the "finished products" of our schools equal in functional competence in mathematics to the graduates in other states. In fulfilling my requirements for a Master's degree in Education at the University of New Mexico, I am making an investigation of these phases of mathematics teaching.

Having decided, with the help of my advisers, that a study of this kind was worthwhile, I immediately found that it could not be validated without some direct information from teachers of mathematics in our state. Therefore, I am calling on you to help me with my study, and I will appreciate your contribution a great deal.

I would like to write you personally, but I find it impossible to secure the name and address of each mathematics teacher in the state. Consequently, I am taking this means of sending you my questionnaire and asking your cooperation in answering it and returning it to me in the enclosed envelope at your earliest convenience.

All that is needed in most cases in answering the questions is a check-mark. Anything you care to add will be of value to me. Sometimes you will want to put more than one check-mark under a question. I am sure you realize that I am trying to get a clear picture of the teaching of mathematics and that the study will be worthless unless the questions are answered accurately. Neither your name nor the name of your school will be used in any way. I am not asking you to sign the questionnaire.

I greatly appreciate your help and thank you for the time you spend filling out the questionnaire.

Very sincerely,

*Betty Ruth Moseley*  
(Mrs.) Betty Ruth Moseley



2017 letter to Mrs. Moore  
 Alhambra, Cal. 91801  
 March 22, 1962

Dear Fellow Math Teacher:

Teachers, parents, educators, employers, and ourselves--nearly all of us in our nation--believe that mathematics should be taught, but few of us ever have tried to find out what methods are really best, what kind of teaching is being done, and what, if any, improvements can be made to make the "standard procedure" of our schools more functional, more effective in preparation for the practical aspects of life. In fulfilling my responsibilities for a study in Education at the University of New Mexico, I am making an investigation of these phases of mathematics teaching.

Having decided, with the help of my advisor, that a study of this kind was worthwhile, I immediately found that it could not be validated without some kind of cooperation from teachers of mathematics in our state. Therefore, I am calling on you to help me with my study, and I will appreciate your contribution a great deal.

I would like to write you personally, but it is impossible to secure the name and address of each mathematics teacher in the state. Consequently, I am taking this chance of sending you my questionnaire and asking your cooperation in answering it and returning it to me in the enclosed envelope at your earliest convenience.

All that is needed to meet these instructions is a check-mark. Checking your name to and still be of value to me. Sometimes you will want to put more than one check-mark under a question. I am sure you realize that I am trying to get a clear picture of the teaching of mathematics and that the study will be worthwhile unless the questions are answered accurately. Without your name and name of your school will be used in any way. I am not asking you to sign the questionnaire.

I greatly appreciate your help and thank you for the time you spend filling out the questionnaire.

Very sincerely,

*Betty Ruth Moore*  
 (Mrs.) Betty Ruth Moore



## APPENDIX B

Titles and enrollments of mathematics courses you teach:

(a) \_\_\_\_\_ (c) \_\_\_\_\_  
(b) \_\_\_\_\_ (d) \_\_\_\_\_

School enrollment: Less than 100 \_\_\_\_\_ 100-199 \_\_\_\_\_  
200-499 \_\_\_\_\_ 500-1000 \_\_\_\_\_ More than 1000 \_\_\_\_\_

Check any of the following ideas which are similar to those used in your classes in practical application problems:

Air navigation \_\_\_\_\_ Scale drawings \_\_\_\_\_ Making graphs  
of how each student spends his time or money \_\_\_\_\_  
Formulas applicable in industry, science, etc. \_\_\_\_\_  
Keeping family budgets \_\_\_\_\_ Problems involving increase  
in cost of living, present prices, and family needs \_\_\_\_\_  
Carpentry \_\_\_\_\_ Others \_\_\_\_\_

How often is supervised study during the class period given?

Daily \_\_\_\_\_ About twice a week \_\_\_\_\_ Once a week \_\_\_\_\_  
Occasionally \_\_\_\_\_ Never \_\_\_\_\_

How often is it necessary to have practice and drill work?

Daily \_\_\_\_\_ Three times a week \_\_\_\_\_ Once a week \_\_\_\_\_  
Occasionally \_\_\_\_\_ Never \_\_\_\_\_

How is this practice work carried out?

Use of mathematical games \_\_\_\_\_ Blackboard \_\_\_\_\_ Indi-  
vidual help \_\_\_\_\_ Written work \_\_\_\_\_ Oral exercises \_\_\_\_\_  
Use of contests \_\_\_\_\_ Others \_\_\_\_\_

What is the extent to which you teach students how to conduct their own study and review?

A week or more devoted to this topic towards the first of  
year \_\_\_\_\_ Some time given to this topic before each  
major test \_\_\_\_\_ Occasionally discussed \_\_\_\_\_ Review  
sheets or materials given often \_\_\_\_\_; occasionally \_\_\_\_\_; never \_\_\_\_\_  
No time spent on this topic \_\_\_\_\_

How often are reviews conducted?

Daily \_\_\_\_\_ Several times a week \_\_\_\_\_ Weekly \_\_\_\_\_  
Monthly \_\_\_\_\_ Before each major test \_\_\_\_\_ At the end  
of each topic \_\_\_\_\_



# APPENDIX B

Times and enrollment of mathematics courses you teach:

(a) \_\_\_\_\_  
(b) \_\_\_\_\_

School enrollment: less than 100 \_\_\_\_\_  
100-199 \_\_\_\_\_  
200-299 \_\_\_\_\_  
300-399 \_\_\_\_\_  
400-499 \_\_\_\_\_  
500-599 \_\_\_\_\_  
600-699 \_\_\_\_\_  
700-799 \_\_\_\_\_  
800-899 \_\_\_\_\_  
900-999 \_\_\_\_\_  
1000-1099 \_\_\_\_\_  
1100-1199 \_\_\_\_\_  
1200-1299 \_\_\_\_\_  
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1900-1999 \_\_\_\_\_  
2000-2099 \_\_\_\_\_  
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2900-2999 \_\_\_\_\_  
3000-3099 \_\_\_\_\_  
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6900-6999 \_\_\_\_\_  
7000-7099 \_\_\_\_\_  
7100-7199 \_\_\_\_\_  
7200-7299 \_\_\_\_\_  
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9600-9699 \_\_\_\_\_  
9700-9799 \_\_\_\_\_  
9800-9899 \_\_\_\_\_  
9900-9999 \_\_\_\_\_

Check any of the following items which are typical of your  
used in your classes in mathematical applications problems:  
Air navigation \_\_\_\_\_  
Auto mechanics \_\_\_\_\_  
At least one student spends his time on \_\_\_\_\_  
Formulas applicable in industry, science, art, \_\_\_\_\_  
Keeping family budgets \_\_\_\_\_  
In cost of living, present prices, and family needs \_\_\_\_\_  
Carpentry \_\_\_\_\_  
Others \_\_\_\_\_

How often is supervised study during the class period given?  
Daily \_\_\_\_\_  
About twice a week \_\_\_\_\_  
Once a week \_\_\_\_\_  
Occasionally \_\_\_\_\_  
Never \_\_\_\_\_

How often is it necessary to have practice and drill work?  
Daily \_\_\_\_\_  
Three times a week \_\_\_\_\_  
Once a week \_\_\_\_\_  
Occasionally \_\_\_\_\_  
Never \_\_\_\_\_

How is this practice work carried out?  
Use of mathematical games \_\_\_\_\_  
Use of mathematical papers \_\_\_\_\_  
Individual work \_\_\_\_\_  
Written work \_\_\_\_\_  
Use of computers \_\_\_\_\_  
Others \_\_\_\_\_

What is the extent to which you assess students how to conduct  
their own study and review?  
A week or more devoted to this topic towards the end of  
year \_\_\_\_\_  
Some time given to this topic before year  
major test \_\_\_\_\_  
Occasionally discussed \_\_\_\_\_  
Never \_\_\_\_\_  
Students or materials given of \_\_\_\_\_  
No time spent on this topic \_\_\_\_\_

How often are reviews conducted?  
Daily \_\_\_\_\_  
Several times a week \_\_\_\_\_  
Monthly \_\_\_\_\_  
Before each major test \_\_\_\_\_  
of each topic \_\_\_\_\_



## APPENDIX B (continued)

How are reviews conducted?

Written problems and exercises similar to those on test assigned to be handed in previous to test \_\_\_\_\_ Group work \_\_\_\_\_ Use of practice problems which are not handed in \_\_\_\_\_ Students work at board \_\_\_\_\_ Individual help \_\_\_\_\_ Review sheets given to each pupil \_\_\_\_\_ Orally \_\_\_\_\_ Others \_\_\_\_\_

How often are tests given?

Daily \_\_\_\_\_ Weekly \_\_\_\_\_ Once during the grading period \_\_\_\_\_  
At the end of each topic \_\_\_\_\_ Never \_\_\_\_\_

What type tests are usually given?

Teacher-prepared written tests \_\_\_\_\_ New-type (short answer) \_\_\_\_\_ Word problems \_\_\_\_\_ Typical drill-type computation exercises \_\_\_\_\_ Mixed word and drill-type computation examples \_\_\_\_\_ Oral \_\_\_\_\_ Others \_\_\_\_\_

How often is homework given?

Daily \_\_\_\_\_ Weekly \_\_\_\_\_ Once during the grading period \_\_\_\_\_  
At the end of each topic \_\_\_\_\_ Never \_\_\_\_\_

How is the assignment usually made?

Written on the board \_\_\_\_\_ Given orally \_\_\_\_\_ Given at the first of the period \_\_\_\_\_ Given at the end of the period \_\_\_\_\_ Made after the recitation \_\_\_\_\_ Most of the period spent explaining the new assignment \_\_\_\_\_ Very little time spent on the new work \_\_\_\_\_

How long should it take the average pupil to complete the daily assignment?

15-25 minutes \_\_\_\_\_ 30-45 minutes \_\_\_\_\_ An hour or more \_\_\_\_\_

If differentiated assignments are given, check any of the following situations which are similar to those in your classes:

Better students given extra work often \_\_\_\_\_; occasionally \_\_\_\_\_; never \_\_\_\_\_  
This extra work is more advanced \_\_\_\_\_; more difficult \_\_\_\_\_; the same type as all the class has but more of it \_\_\_\_\_  
Poorer students given extra work for practice often \_\_\_\_\_; some \_\_\_\_\_; never \_\_\_\_\_



How are reviews conducted?

Written problems are assigned to students to solve. The student is given a certain amount of time to solve the problem. The student is then given a certain amount of time to discuss the problem with the teacher. The student is then given a certain amount of time to write up the solution. The student is then given a certain amount of time to present the solution to the class.

How often are tests given?

Tests are given weekly. The tests are given at the end of each week. The tests are given at the end of each week. The tests are given at the end of each week. The tests are given at the end of each week.

What type tests are usually given?

Tests are given in the form of multiple choice, true/false, and short answer. The tests are given in the form of multiple choice, true/false, and short answer. The tests are given in the form of multiple choice, true/false, and short answer. The tests are given in the form of multiple choice, true/false, and short answer.

How often is homework given?

Homework is given weekly. The homework is given at the end of each week. The homework is given at the end of each week. The homework is given at the end of each week. The homework is given at the end of each week.

How is the assignment usually made?

The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher. The assignment is made by the teacher.

How long should it take to complete the assignment?

The assignment should take about 15-20 minutes to complete. The assignment should take about 15-20 minutes to complete. The assignment should take about 15-20 minutes to complete. The assignment should take about 15-20 minutes to complete. The assignment should take about 15-20 minutes to complete.

If differentiated assignments are given, how are they given?

Differentiated assignments are given by the teacher. Differentiated assignments are given by the teacher. Differentiated assignments are given by the teacher. Differentiated assignments are given by the teacher. Differentiated assignments are given by the teacher.

Best of luck to all students. This is a very important test. The test is given at the end of the semester. The test is given at the end of the semester. The test is given at the end of the semester. The test is given at the end of the semester.

WILLIAMS



## APPENDIX B (continued)

Problems used for extra work arise from life situations \_\_\_\_\_

Class is grouped according to ability \_\_\_\_\_

Extra credit is given for research work \_\_\_\_\_

Faster pupils are allowed to work ahead in the book \_\_\_\_\_

Teacher-prepared materials for differentiated assignments used \_\_\_\_\_

Others \_\_\_\_\_

Do you anticipate from year to year any percentage of failures?

Yes \_\_\_\_\_ No \_\_\_\_\_ If so, approximately what per cent? \_\_\_\_\_

In your estimation how will the failures in these classes compare with the usual per cent expected?

More will fail \_\_\_\_\_ Fewer will fail \_\_\_\_\_ About as usual \_\_\_\_\_

What practice(s) is (are) most used in this class? (Please use a, b, c, d, corresponding to Question I on the first page, instead of check-mark).

Lecture method \_\_\_\_\_ Socialized discussion of material by both teacher and pupils \_\_\_\_\_ Use of various projects with each unit of work \_\_\_\_\_ Demonstration and use of laboratory materials \_\_\_\_\_ Recitation by pupils \_\_\_\_\_ Daily test procedure \_\_\_\_\_ Individual teaching \_\_\_\_\_ Workbook \_\_\_\_\_ Others \_\_\_\_\_

How long is each class period? \_\_\_\_\_ minutes

How much time is there for individual help?

Adequate \_\_\_\_\_ Some, but insufficient \_\_\_\_\_ None \_\_\_\_\_

Approximate number of hours you spend doing school work daily:

\_\_\_\_\_ hours teaching mathematics; \_\_\_\_\_ hours teaching other subjects; \_\_\_\_\_ hours in study halls; \_\_\_\_\_ hours in extra-curricular work.

What is your most advanced degree? \_\_\_\_\_

Approximately how many hours of college work have you taken in the field of mathematics? \_\_\_\_\_ of education? \_\_\_\_\_

Teaching experience: First year \_\_\_\_\_ 1-3 years \_\_\_\_\_  
4-6 years \_\_\_\_\_ 7-11 years \_\_\_\_\_ 12 or more years \_\_\_\_\_

Do you feel that you have the time to do the teaching job you would like to do?

\_\_\_\_\_



CONFIDENTIAL  
E Z E R V A S E

INTERVIEW QUESTIONS

1. What is your present position?  
2. How long have you been in this position?  
3. What are your major responsibilities?  
4. How do you feel about your work?  
5. What are your career goals?

6. Do you have any suggestions for improving the organization?  
7. How do you feel about the future of the organization?  
8. What are your strengths and weaknesses?  
9. How do you handle stress?  
10. What are your hobbies and interests?

11. What is your educational background?  
12. How did you choose your field of study?  
13. What are your academic achievements?  
14. How do you feel about your education?  
15. What are your career aspirations?

16. How long have you been in the organization?  
17. How much time do you spend on your job?  
18. How do you feel about your job?

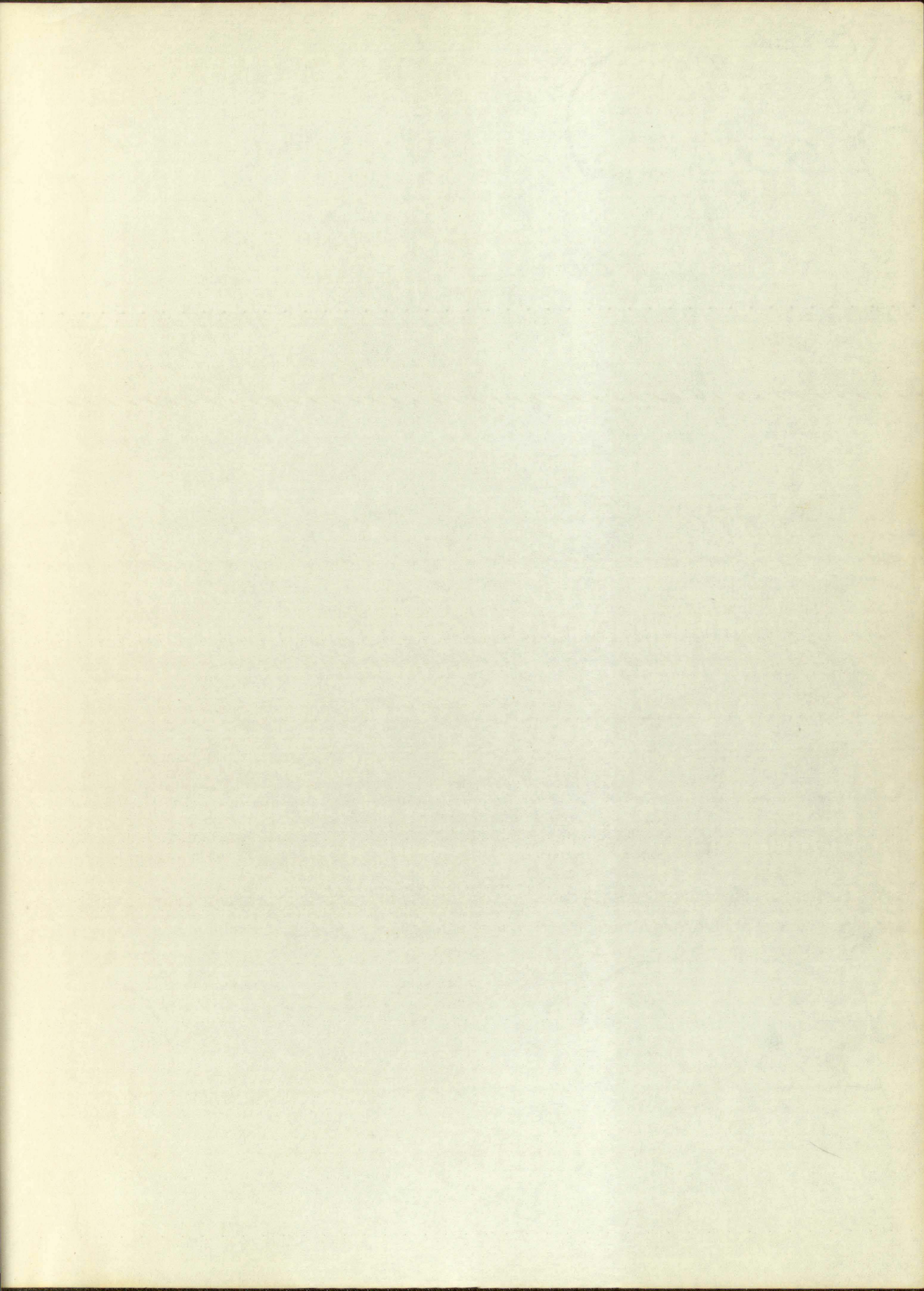
19. Approximate number of hours per week you work?  
20. How do you feel about your work?  
21. How do you feel about your job?

22. What is your most difficult task?  
23. How do you feel about your work?  
24. How do you feel about your job?

25. Teaching experience? Yes/No  
26. How long have you been teaching?

27. Do you feel that you are well suited to the position?  
28. How do you feel about your job?

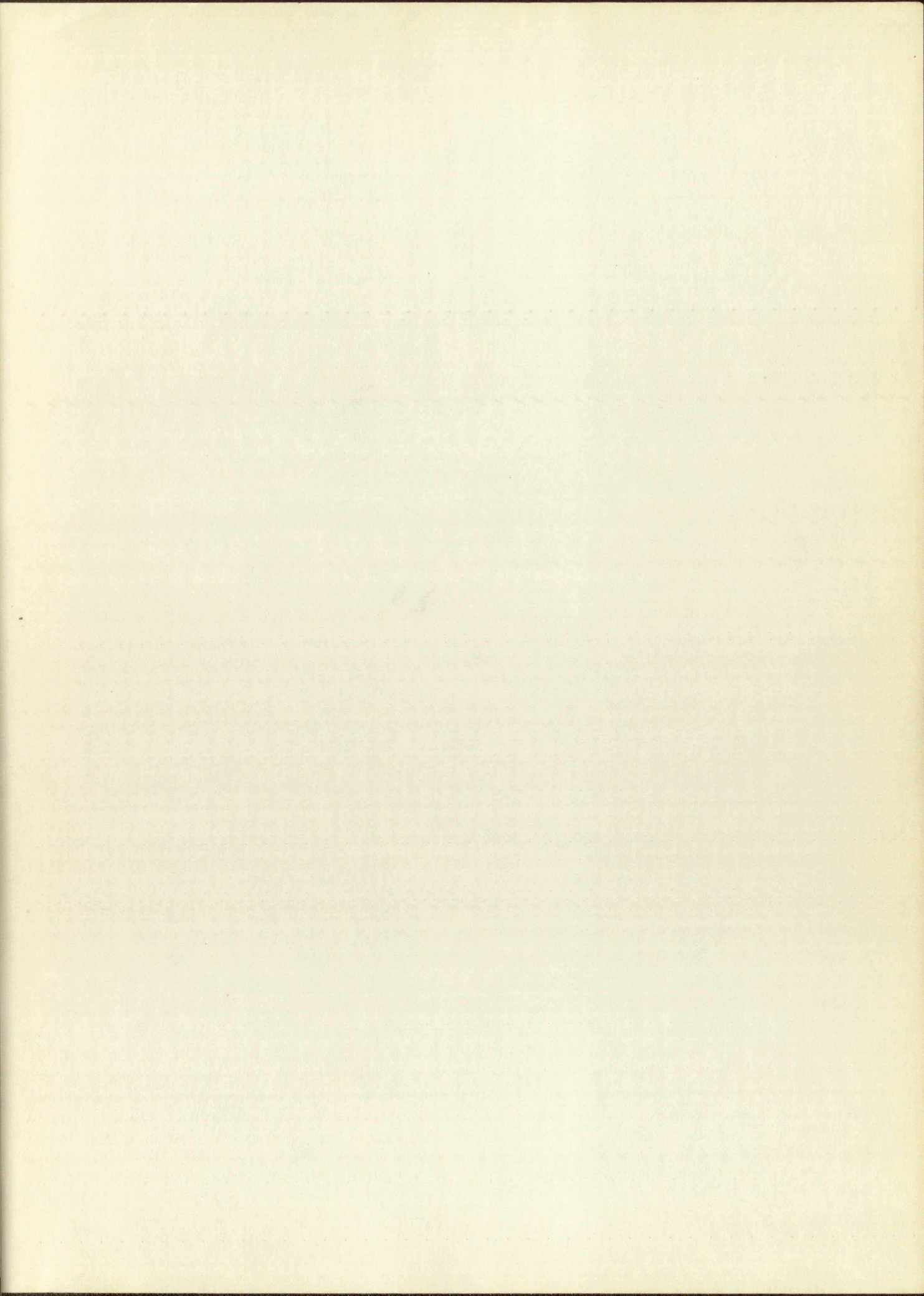




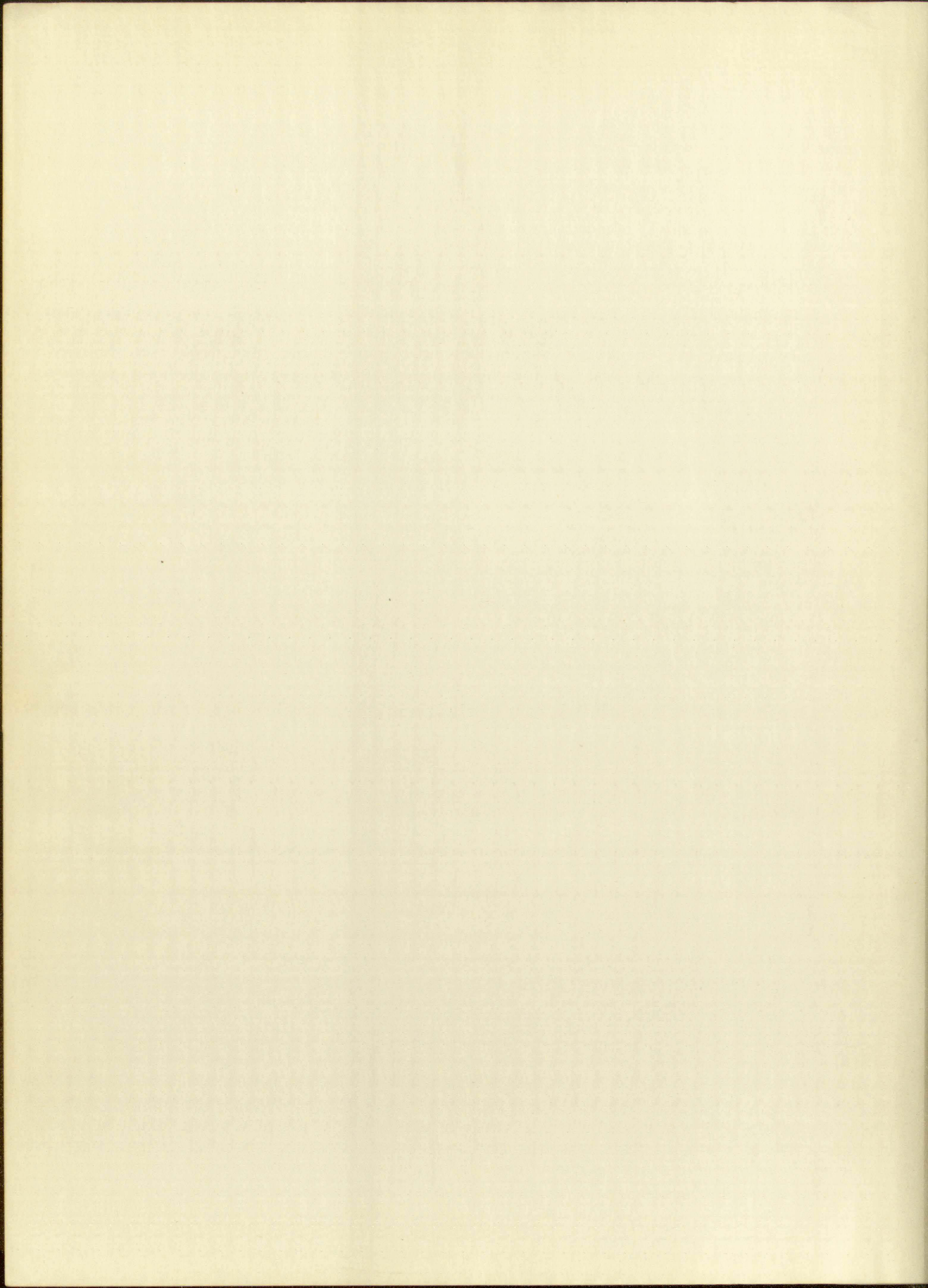




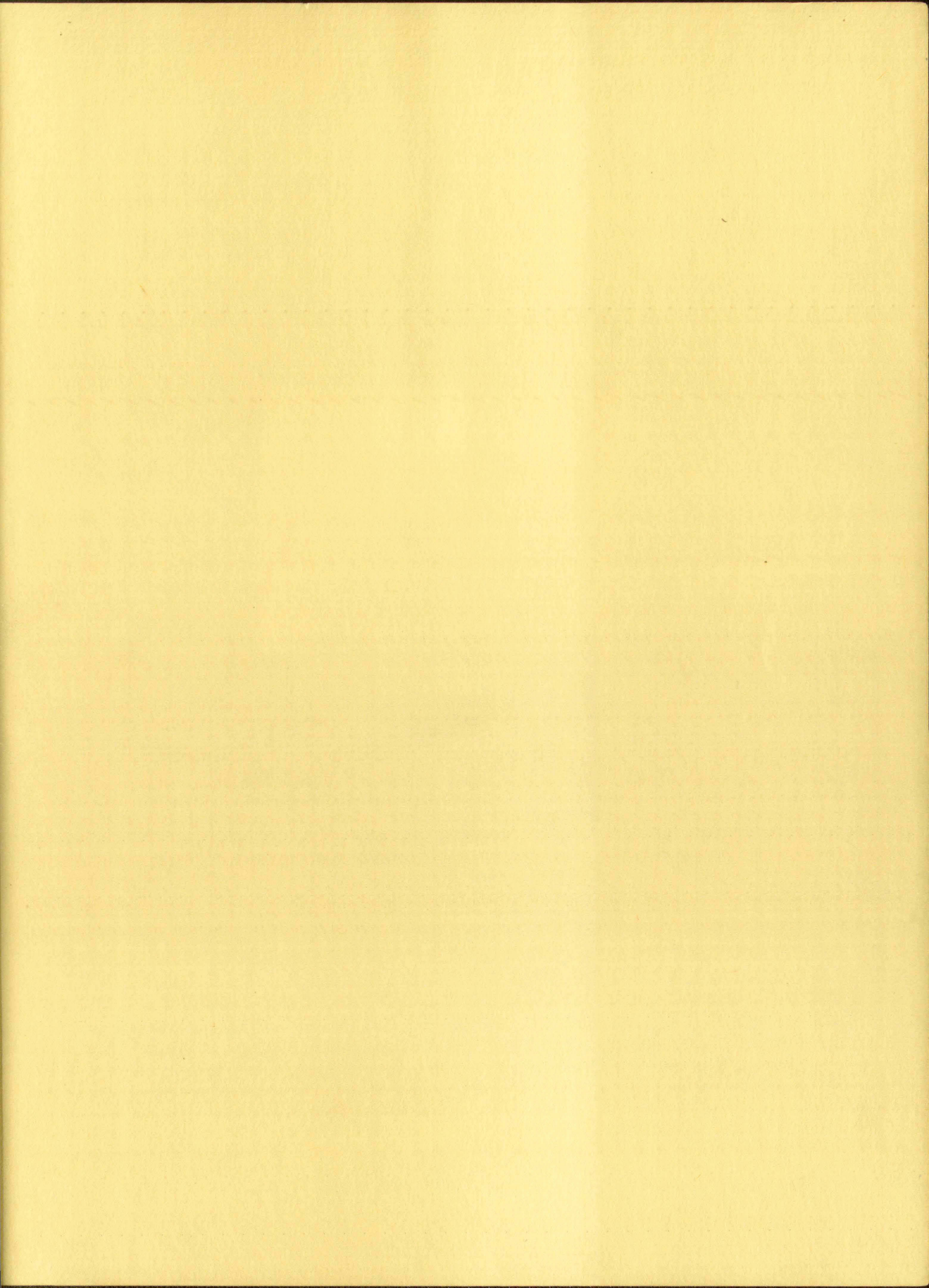














# IMPORTANT!

Special care should be taken to prevent loss or damage of this volume. If lost or damaged, it must be paid for at the current rate of typing.

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AUG 9 1954		JUL 3 RECD
APR 25 1955		JUL 3 1958
MAY 13 1955		JUL 3 RECD
JUN 2 1956		JUL 30 1958
JUN 4 RECD		JUL 25 RECD
AUG 8 RECD		DEC 22 1958
NOV 5 1958		DEC 15 RECD
NOV 26 1956		NOV 18 1959
DEC 12 1956		NOV 18 RECD
FEB 18 1957		DEC 14 1960
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