A SURVEY OF THE TEACHING OF MATHEMATICS IN THE HIGH SCHOOLS OF KANSAS

by

JOHN MCANERNEY BROWNE

A. B., St. Mary's College, 1923

A THESIS

submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1933

TABLE OF CONTENTS

INTRODUCTION

The purpose of this survey of "The Teaching of Mathematics in the High Schools of Kansas" is to determine what the mathematics departments in these high schools are accomplishing.

Arithmetic is one of the essentials with which one should be equipped when leaving high school. A high school graduate should possess some skill in the fundamental operations of arithmetic.

The study divides itself into three parts. The first part deals with the preparation, experience, methods, and attitudes of the mathematics teachers. The second part shows the arithmetic ability of students on entering high school. The third part shows with what mathematical ability pupils leave high school.

METHOD

The basis for the report on the mathematics teacher, his training, experience, methods, and attitudes was a questionnaire sent to some four hundred teachers in the mathematics departments of high schools of various sizes, located in different sections of the state. This question-

naire was sent out during the school year 1931-1932. Replies were received from 270 teachers in 213 schools. These were representative of schools ranging in size from the smallest to the largest, both as to enrollment and as to the number of teachers employed.

To gain some knowledge of the arithmetical ability of pupils entering high school, arrangements were made with sixteen high school superintendents or principals to have administered to the freshmen classes in their respective schools "The New Stanford Arithmetic Test" by Kelley, Ruch, and Terman. The test was given to a total of 724 freshmen in the early part of the first semester of the 1931-1932 school year.

To find what mathematical ability pupils have on leaving high school, fifteen of the sixteen schools which gave the arithmetic tests also gave tests in Algebra I and II and in Plane Geometry to the senior classes. These were administered the latter part of the second semester of the school year, 1931-1932. "The Algebra Test" by Ethel Rumney of K. S. T. C., Emporia, Kansas, and "The Plane Geometry Test" by Garman and Philips of K. S. T. C., Emporia, Kansas, were the same tests used in "The Every Pupil Scholarship Contest" for the state in the 1930-1931 school year.

Copies of questionnaire and tests follow:

1. How long have you been teaching?_____years.

2. How many years have you taught in high school including the present year?_____years.

3. How many years have you taught mathematics in high school including the present year?_____years.

4. What branches of mathematics have you taught in high school? (Underline) Algebra I, Algebra II, AlgebraIII, Plane Geometry, Solid Geometry, Trigonometry, Commercial Arithmetic, Business Arithmetic, (any other subjects in mathematics.) _____.

5. What branches of mathematics are you now teaching in high School? (Underline) AlgebraI, Algebra II, Algebra III, Plane Geometry, Solid Geometry, Trigonometry, Commercial Arithmetic, Business Arithmetic, (any others)_____.

6. What subjects other than mathematics are you teaching for the present year?_____.

7. What branches of mathematics are now being offered in your high school? (Underline) Algebra I, Algebra II, Algebra III, Plane Geometry, Solid Geometry, Trigonometry, Commercial Arithmetic, Business Arithmetic, (any others)_____.

8. Number enrolled in the high school._____

9. Number enrolled in Algebra I._____

10. Number enrolled in Algebra II._____

11. Number enrolled in Algebra III._____

12. Number enrolled in Plane Geometry._____

13. Number enrolled in Solid Geometry._____

14. Number enrolled in Trigonometry._____

15. Number enrolled in Commercial Arithmetic._____

16. Number enrolled in Business Arithmetic._____

17. Number enrolled in any other mathematics._____

18. Is mathematics required for graduation from your high school?____

19. If so, how much?_____.

20. Do you find students deficient in mathematics when coming from the elementary school?_____.

21. If so, what are the dificiencies?_____
_____.

22. Do you think mathematics should be required in high School?_____

23. If so, why?_____
_____.

24. If not, why not?_____
_____

25. Do you think students are as interested in mathematics as they are in other subjects in high school?_____

26. What per cent, approximately, of the problems in the text book do you require your students to solve?_____

27. Do you stress difficult problems or the more simple, practical ones?_____.

28. Do you use work books to accompany the mathematics text books?
_____.

29. In what branches of mathematics? (Underline) Algebra I, Algebra II, Algebra III, Plane Geometry, Solid Geometry, Trigonometry, Commercial Arithmetic, Business Arithmetic, (any others) _____
_____.

30. Do you think the work books practical?_____.

31. Reasons for answer to question # 30._____
_____
_____

32. What preparation have you had in mathematics? (Underline) High School Algebra I, II, III, Plane Geometry, Solid Geometry, Trigonometry, Business Arithmetic, Commercial Arithmetic, (any others in high school) _____, College Algebra (3 hours or 5 hours), Analytic Geometry, Calculus I, Calculus II, Methods in Mathematics, (Other courses you have had in mathematics
_____.

33. Have you had special or adequate training for teaching high school mathematics?_____.

34. Were you employed as a teacher of mathematics or was the subject assigned you to fill up your program?_____
_____.

New Stanford Arithmetic Test

By TRUMAN L. KELLEY, GILES M. RUCH, and LEWIS M. TERMAN

TEST: FORM V

FOR GRADES 2–9

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

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

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

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

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

TO THE EXAMINER. *Do not administer this test without first reading carefully the Directions for Administering.*

TEST	SCORE	ARITH. AGE	SCHOOL GRADE
Arith. Reas.			
Arith. Comp.			
Total (Average) Arith.[1]			

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

Published by World Book Company, Yonkers-on-Hudson, New York, and Chicago, Illinois

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

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

Go right on to the next column.

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

Go right on to the next page.

No. Rt.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Score	3	12	21	29	34	39	44	48	53	58	61	64	67	70	74	77	80	83	85	88	91	94	96	98	100	102	104	105	107	109	110	112	114	115	117	119	120	122	123	125	127

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

Go right on to the next column.

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

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

Answer.....

End of Test 1. Look over your work.

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

Begin here.

(1) Add
6
1

(2) Add
5
0

(3) Add
7
4
3
5

(4) Subtract
8
3

(5) Add
17
5

(6) Subtract
12
5

(7) Subtract
16
4

(8)
$2 \times 5 =$

(9) Add
37
41
26
55

(10) Subtract
15
9

(11) Subtract
765
327

(12)
$2\overline{)8}$

(13) Add
26890
58475
43261

(14) Multiply
253
6

(15)
$0 \times 4 =$

(16)
$10 \div 2 =$

(17)
$8\overline{)59}$ and remainder

(18) Add
24
12⅘

(19) Subtract
53212
34563

(20)
$9\overline{)58}$

(21)
$2\overline{)15.8}$

(22)
⅓ of .156 =

(23) Multiply
4789
76

(24) Subtract
62⅓
37⅙

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

Go right on to the next page.

(26)

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

(27)

Add

$\frac{4}{5}$

$\frac{1}{3}$

(28)

Subtract

$42\frac{5}{6}$

$28\frac{1}{6}$

(29)

Add

$38\frac{2}{5}$

$27\frac{7}{10}$

(30)

Subtract

$\frac{3}{4}$

$\frac{2}{5}$

(31)

Add

$36\frac{1}{2}$

$32\frac{3}{10}$

(32)

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

(33)

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

(34)

Subtract

$66\frac{1}{8}$

$58\frac{3}{8}$

(35)

$29\overline{)46545}$

(36)

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

(37)

$58.25 - 2.9 =$

(38)

Multiply

65.84

5.06

(39)

$25\overline{)11}$

(40)

$11\frac{1}{12} + \frac{5}{6} + \frac{3}{4} =$

(41)

Add

$\frac{1}{6}$

$\frac{9}{10}$

(42)

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

(43)

Subtract

$205\frac{1}{5}$

$85\frac{3}{8}$

(44)

Subtract

$212\frac{3}{10}$

$39\frac{5}{6}$

(45)

$.6\overline{)3624}$

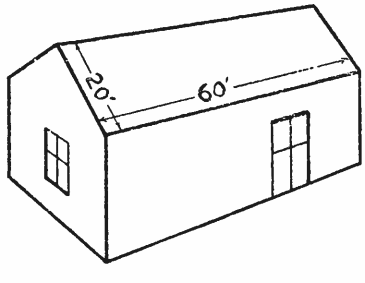
(46)

50 is what per cent of 200?

Answer =

(47)

Find the total roof surface of this building.



Answer =

(48)

Add

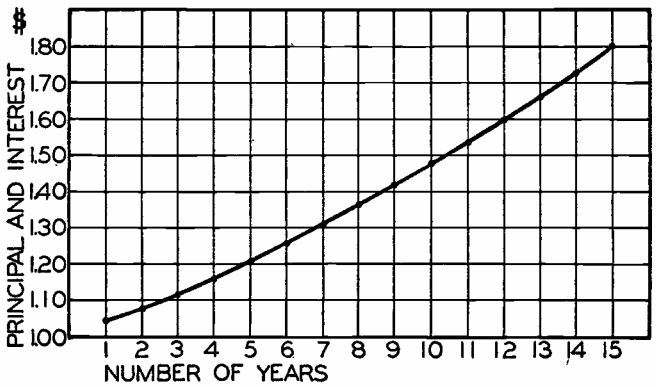
$22\frac{3}{10}$

$27\frac{5}{6}$

Turn the page and go right on.

(49)

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



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

Answer =

(50)

Find the average of

7.53
9.47
8.63
9.02
11.10

(51)

2) 3 yd. 2 ft. 4 in.

(52)

Multiply
6794
4008

(53)

Multiply
−6
+4

(54)

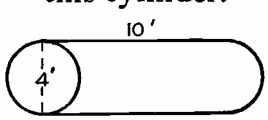
$(4)^3 =$

(55)

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

(56)

Find the volume of this cylinder.



Volume =

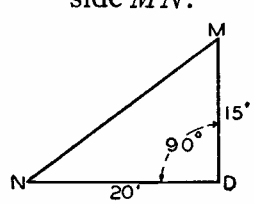
(57)

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

Answer =

(58)

Find the length of side MN.



$MN =$

(59)

Write this expression in the simplest form:

$-30y + (-6y)$

Answer =

(60)

If $V = \frac{\pi r^2 h}{3}$,
write the formula for h.

$h =$

End of Test 2. Look over your work.

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

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

Directions: Answer the easiest parts first. Go back and work on the others. You will have exactly 40 minutes.

I:IP

EVERY PUPIL SCHOLARSHIP CONTEST

Bureau of Educational Measurements
Kansas State Teachers College, Emporia

FIRST YEAR ALGEBRA

By Ethel Rumney, K. S. T. C., Emporia, Kansas.

Possible points **78**

Number wrong and omitted .....

FINAL SCORE .....

Pupil ..... Age ..... Grade .....

School ..... Town ..... State ..... Date .....

PART I.

DIRECTIONS: Perform the computations indicated in the following problems. Wherever there is a group of stars an important word or answer has been omitted. Write the important word or answer on the blank line in front of the statement.

1. ..... $\frac{1}{12} + \frac{1}{24} =$ ****
2. ..... $-1 - 7+6 - 4 =$ ****
3. ..... $4a - (-3a) - 6a =$ ****
4. ..... $\frac{4x}{9} = \frac{****}{27}$
5. ..... $6a+3b+5c - 2b+4c - 2a+7a - 6c+b =$ ****
6. ..... $3a^2(6ab - 7a^2) =$ ****
7. ..... $(7x^2 - 2xy+5y^2) - (4x^2 - 2xy - 5y^2) =$ ****
8. ..... $a^2 \cdot a^3 =$ ****
9. ..... If $c+15 = 7$, then $c =$ ****
10. ..... $1 - \frac{1}{c} = \frac{****}{c}$
11. ..... If $2a + 5 = 11$, then $a =$ ****
12. ..... In d dollars there are **** quarters.
13. ..... If $-2x = 10.8$, then $x =$ ****
14. ..... $\frac{1}{a} + \frac{1}{b} =$ ****
15. ..... If a boy is y years old now, he was **** years old three years ago.
16. ..... $(2a)^3 (3a^2)^2 =$ ****
17. ..... $(a^2 + 10a + 21) \div (a+3) =$ ****
18. ..... If one pencil costs c cents, 8 pencils cost **** cents.
19. ..... If $kx+mx=s$, then $x=$ ****
20. ..... $(2a - 3)(a+12) =$ ****
21. ..... $(3x - 4)^2 =$ ****
22. ..... If $\frac{c}{3} = 0.81$, then $c =$ ****
23. ..... If $7y+15 = 3y + 27$, then $y =$ ****
24. ..... $\frac{9\,ac^2+12a^2+15a^3}{3a} =$ ****
25. ..... $\frac{x^2y}{x^4y^2} \cdot \frac{x^3y^4}{y^2} =$ ****
26. ..... An algebraic expression consisting of two terms is a ****
27. ..... $(4ab - 8a^2b^2) \div 4ab =$ ****
28. ..... If a train travels m miles per hour, it will require **** hours to travel 275 miles.
29. ..... $\frac{x}{x+9} + \frac{x}{x-8} =$ ****
30. ..... $(\frac{1}{2})^4 =$ ****
31. ..... In 50 pounds of a mixture of two kinds of grass seed, there are x pounds of one kind. There are **** pounds of the other kind.
32. ..... Reduce to lowest terms $\frac{4a + 2b}{2a + b} =$ ****
33. ..... A man is k years old. In **** years he will be 50 years old.
34. ..... $\frac{x}{x^2+xy} - \frac{1}{x} + \frac{1}{x+y} =$ ****
35. ..... $\frac{7c^2}{7c^2} =$ ****
36. ..... If $\frac{2}{3}y - 1 = 21$, then $y =$ ****
37. ..... $\frac{a^2}{b^2} \div \frac{a^2}{b^2} =$ ****
38. ..... If $2a+17 = 8a+41$, then $a =$ ****
39. ..... Reduce to lowest terms: $\frac{2x+10}{10x} =$ ****
40. ..... Given the formula $s = 4\pi r^2$. If r is multiplied by 3, then s is multiplied by ****
41. ..... $(6c^2+c - 35) \div (3c - 7) =$ ****
42. ..... $\frac{a}{6} + \frac{a}{3} + \frac{a}{4} =$ ****

43. ..... If $\frac{3x}{5} = \frac{3x}{7} + 6$, then x = ****

44. ..... Reduce to lowest terms:
$$\frac{9c^2 - 16b^2}{9c^2 + 24bc + 16b^2} = ****$$

45. ..... $(a^3+b^3) \div (a+b) = ****$

46. ..... If $a = \pi rs$, then s = ****

47. ..... Given $x+y = 6$. If $x = -1$, then $y = ****$

48. ..... If $n = 6$ and $d = 3$ in the formula $p = \frac{nd^2}{2.5}$ then p = ****

49. ..... $\frac{a^2-7a+12}{a^2+a-20} \div \frac{a^2+a-12}{a^2+12a+35} = ****$

50. x= ..... and x= ..... If $x^2 - 11x + 30 = 0$, then x = **** and x = ****

51. ..... The **** of one quantity to another of the same kind, expressed in the same units, is the quotient obtained by dividing the first quantity by the second.

52. ..... In making a bar graph, a bar 1 cm. long is to represent 25,000 head of cattle. A bar which represents 85,000 head of cattle will be **** cm. long.

PART II.

Resolve to prime factors:

1. ..... $m^2 - s^2 = ****$

2. ..... $5a^2 - 20b^2 = ****$

3. ..... $a^2 - 6a + 9 = ****$

4. ..... $25a^2 + 20ab + 4b^2 = ****$

5. ..... $a^3 + 4a^2 + 11a = ****$

6. ..... $4x^3 - 11x^2y - 3xy^2 = ****$

7. ..... $x^2 - 0.4xy + 0.04y^2 = ****$

8. ..... $7c^3 + 7cd^2 = ****$

PART III.

1. Of two candidates for an office, the winner received a majority of 11 votes. If 297 votes were cast, how many did the winning candidate receive?

.....votes.

2. What number must be subtracted from both terms of the fraction 17/23 to obtain a fraction whose value is 2/3?

.....

3. Mrs. Black paid $75 for a rug 9 ft. x 12 ft. If the price varies according to size, how much must she pay for a rug 12 ft. x 15 ft?

$.....

4. A real estate dealer has reason to believe that Mr. Smith will pay $4,500 for a piece of property owned by Mr. Jones. How much can the dealer afford to pay Mr. Jones for the property in order to make a commission of 5% on his investment? (Give the result to the nearest dollar.)

$.....

5. A picnic party started out from a certain town at the rate of 25 miles per hour. Half an hour later, another party started out over the same route at the rate of 30 miles an hour. How long had the first party been on the way when the second party overtook them?

..... hours.

6. Mrs. Brown paid $1.79 for 3 cans of beans and 5 cans of corn, and her neighbor, Mrs. Smith, paid $2.08 for 6 cans of beans and 4 cans of corn of the same size and grade. Find the price per can of each.

$..... Corn

$..... Beans

Directions: Answer the easiest parts first. Go back and work on the others. You will have exactly 40 minutes.

I:IP

EVERY PUPIL SCHOLARSHIP CONTEST

Bureau of Educational Measurements
Kansas State Teachers College, Emporia

PLANE GEOMETRY

By Helen R. Garman and A. W. Philips
K. S. T. C., Emporia.

Possible Points **113**

Number wrong and omitted .....

FINAL SCORE .....

Pupil ..... Age ..... Grade .....

School ..... Town ..... State ..... Date .....

PART I.

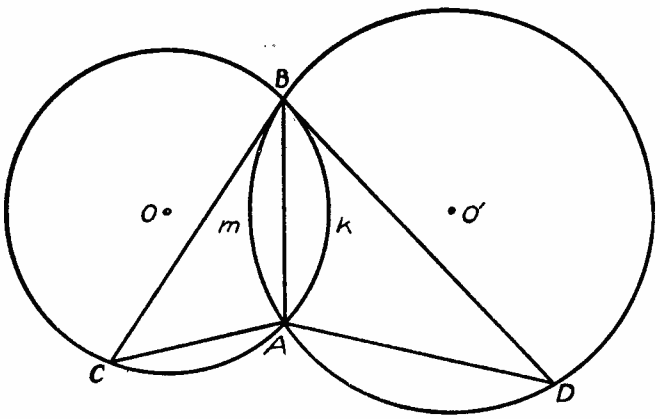
DIRECTIONS: A word (or words) has been omitted from each of the following statements where the ***** are placed. Write the appropriate word (or words) on the line at the right of the statement.

1. The **** of a circle is greater than any other chord. 1. .....
2. A straight line which intersects a circle in two points is called a **** of a circle. 2. .....
3. The length of a circle is called its ****. 3. .....
4. The **** of a polygon is the sum of the lengths of its sides. 4. .....
5. Two circles can intersect each other in not more than **** point(s). 5. .....
6. In a circle the chord of an arc of 60° is **** than twice the chord of an arc of 30°. 6. .....
7. If two intersecting diameters divide a circle into four equal arcs, the diameters are **** to each other. 7. .....
8. Write the proportion $\frac{a}{b} = \frac{c}{d}$ by **inversion.** 8. .....
9. Write the proportion $\frac{a}{b} = \frac{c}{d}$ by **alternation.** 9. .....
10. The mean proportional between 8 and 2 is **** 10. .....
11. If $ab = cx$, write a proportion of which x is the fourth term. 11. .....
12. In the proportion $\frac{a}{x} = \frac{x}{b}$, x is called the **** 12. .....
13. If a line divides two sides of a triangle proportionally, it is **** to the third side. 13. .....
14. If one acute angle of a right triangle is 30°, the side opposite is exactly **** the hypotenuse. 14. .....
15. The **** of two similar polygons have the same ratio as any two corresponding sides. 15. .....
16. Two isosceles triangles are **** if a base angle of one equals a base angle of the other. 16. .....
17. Any two corresponding medians of similar triangles have the **** as any two corresponding sides. 17. .....
18. The mid-point of the hypotenuse of a right triangle is **** from the three vertices. 18. .....
19. Two rectangles whose dimensions are 4 by 8 and 5 by 10 are **** 19. .....
20. If the radii of two circles are 8 and 16, the area of the large circle is **** times the area of the small circle. 20. .....
21. The area of a triangle whose base is **b** and altitude **a**, may be expressed by the formula A = ****. 21. .....
22. The area of a trapezoid having altitude **a** and bases **b** and **b′** may be expressed by the formula A = ****. 22. .....
23. The segments cut off on two transversals by a series of parallels are **** 23. .....
24. Parallelograms with equal bases have the same ratio as their **** 24. .....
25. Parallel lines intercept **** arcs on a circle. 25. .....

PART II.

DIRECTIONS: First study the figure, the facts which are given, and the statement to be proved and think through the proof. Write the missing statements on the lines left for them. Find the correct reason for each statement in the list of "reasons" on this page and write its number in the parenthesis following the statement. Supply the reasons for the printed statements as well as for those you write in.

PROBLEM: Two intersecting circles have the common chord AB. Lines BC and BD are so drawn that each is a chord of one circle and tangent to the other at B. Chords CA and AD are drawn. Show that AB is a mean proportional between CA and AD.



GIVEN: AB a common chord to intersecting circles; BC is a chord of circle O and is tangent to circle O′ at B; BD is a chord of circle O′ and tangent to circle O at B; also chords CA and AD.

To Prove: $\frac{CA}{AB} = \frac{AB}{AD}$

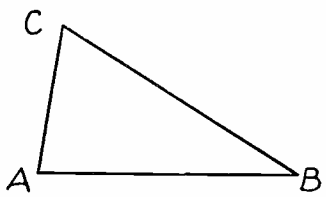
PROOF:	**REASONS**
1. ∠CBA is measured by ½ arc AmB	1. ( )
2.	2. ( )
3. ∴ ∠CBA=∠D	3. ( )
4.	4. ( )
5. ∠C is measured by ½ arc BkA	5. ( )
6. ∴	6. ( )
7. ∴	7. ( )
8. ∴	8. ( )

REASONS

1. An inscribed angle is measured by one-half of its intercepted arc.
2. Two triangles are similar if they are mutually equiangular.
3. Angles which are measured by one-half of the same arc are equal.
4. Two triangles are similar if corresponding sides are in proportion.
5. An angle formed by two chords intersecting within a circle is measured by one-half the sum of the arcs intercepted by it and its vertical angle.
6. An angle formed by a tangent and a chord drawn to the point of tangency is measured by one-half of its intercepted arc.
7. Two triangles are similar if two angles of one are equal, respectively, to two angles of the other.
8. An angle inscribed in a semi-circle is a right angle.
9. Corresponding sides of similar triangles are proportional.
10. The altitude drawn to the hypotenuse of a right triangle is the mean proportional between the segments of the hypotenuse.

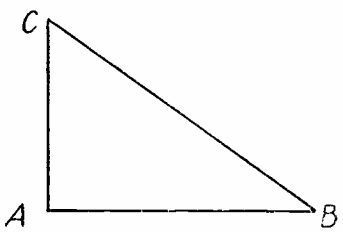
PART III.

1. In triangle ABC, sides AB and AC are 9 and 5, respectively. The third side, BC, lies between what limits?



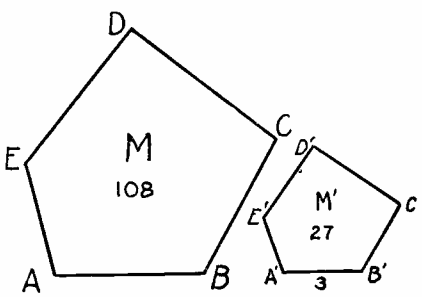
Between ..... and .....

2. In right triangle ABC, side AC is 12. AB and BC have the ratio 4:5. Find BC.



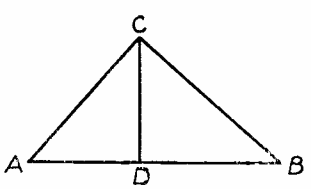
BC = ...

3. The polygons M and M′ are similar. Their areas are 108 and 27, respectively. Side A′B′ is 3. Find side AB.



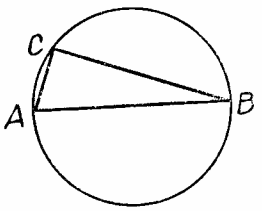
AB = ...

4. In this figure, ∠ACB is a rt. ∠; CD⊥AB; AB=18; AD=8. Find BC.



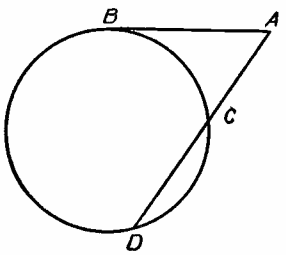
BC = ...

5. In this figure, the diameter AB is 37. The side AC is 12. What is the length of BC?



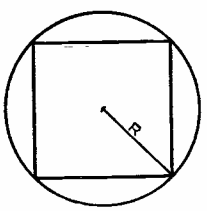
BC = ...

6. In this figure, the tangent AB is 18 and the segment AC of the secant AD is 12. Find CD.



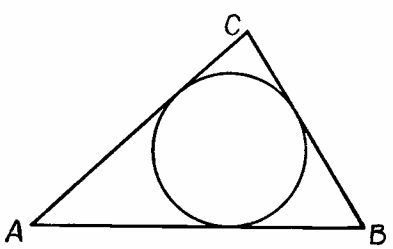
CD = ...

7. In this figure, the radius of the circle is 4. Find the area of the inscribed square.



Area = ...

8. Triangle ABC has a perimeter of 64. The diameter of the inscribed circle is 12. Find the area of the triangle.

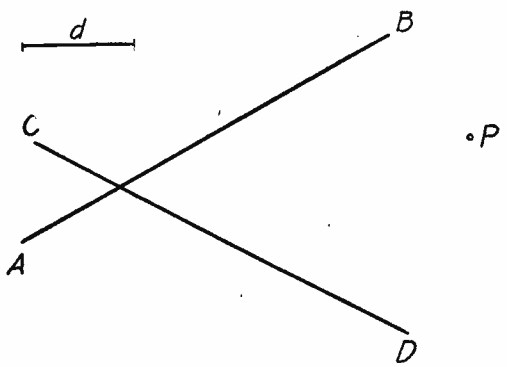


Area = ...

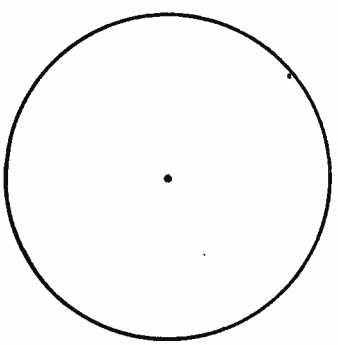
PART IV.

DIRECTIONS: In these exercises you are to make certain formal constructions. Compass and straight edge alone are to be used. All necessary construction lines are to appear in the completed figure.

1. Locate all points which are at a distance **d** from the point P and equidistant from the two intersecting lines AB and CD.



2. Inscribe a square in this circle.



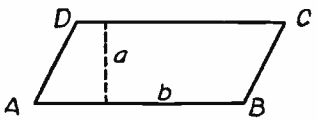
3. Construct a line segment **x** which will be the fourth proportional to line segments **a**, **b**, and **c** as given below.

a

b

c

4. Construct a parallelogram having twice the area of the given parallelogram ABCD.

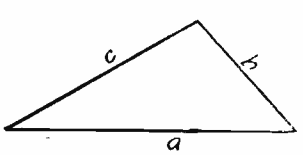


5. Construct a mean proportional **x** between the line segments **a** and **b**.

a **b**

6. Using line **p** as the perimeter, construct a triangle similar to a triangle whose sides are **a**, **b**, and **c**, below.

p



THE SURVEY

Part I

Questionnaire

With the purpose in mind, as stated in the introduction, the following question, "How long have you been teaching?" was submitted to some four hundred teachers in the mathematics departments of high schools throughout the state. Of the 270 teachers who replied, 180 had taught ten years or less. Of this number, 45 had had five or six years of teaching experience. The number of those having more than six years of experience declines quite rapidly. This has been shown by means of a graphical representation of Question No. 1.

The results found from the summarization of the answers to Question No. 2, "How many years have you taught in high school, including the present year?" are also shown graphically. The outstanding fact revealed here is that a large per cent of our high school teachers of mathematics have had very little experience. In studying over the matter at hand, one notes that in a very large per cent of the cases the teachers having the least preparation as well as those with little experience are employed in the smaller schools.

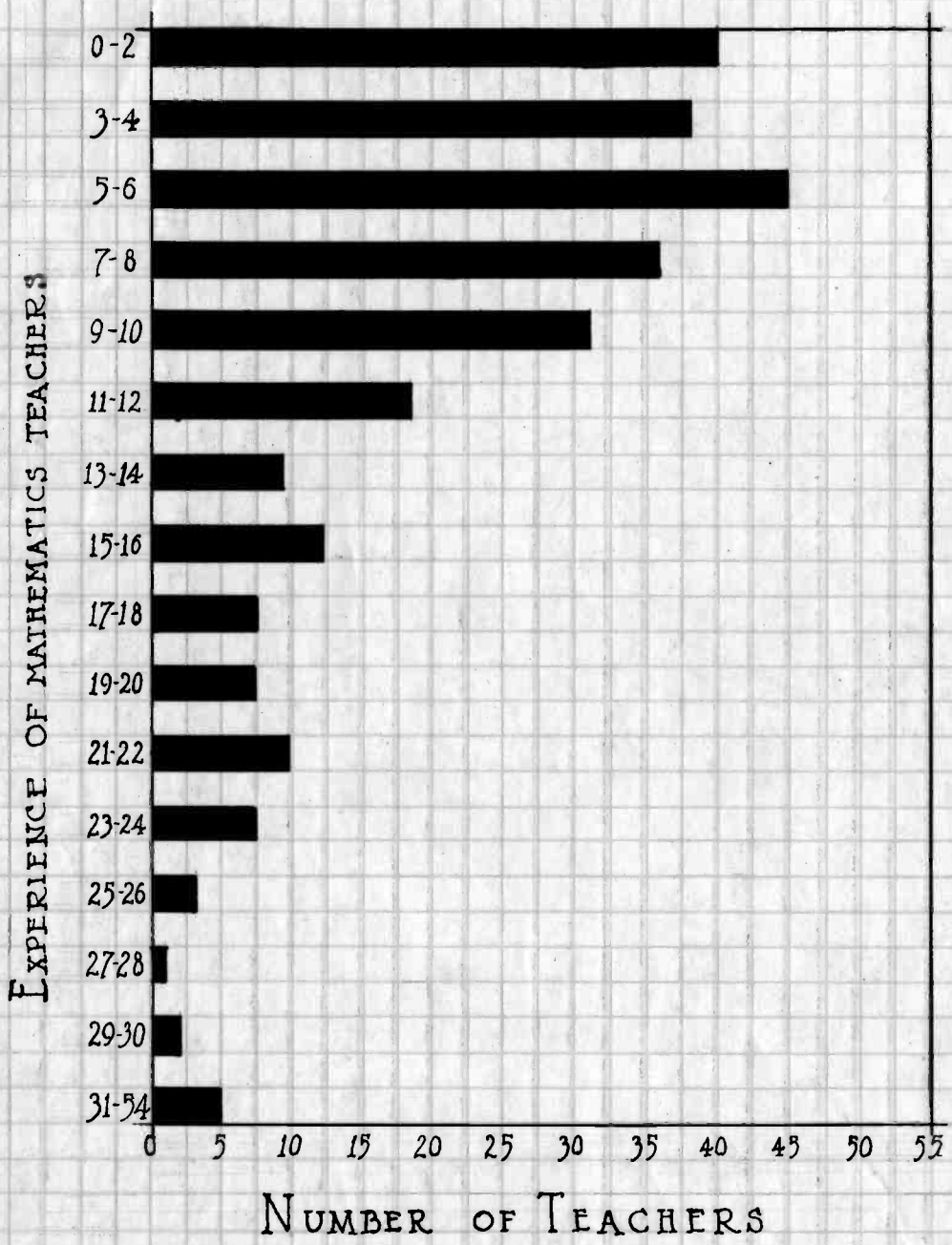


Figure 1. Graphical Representation of Returns from Question Number 1.

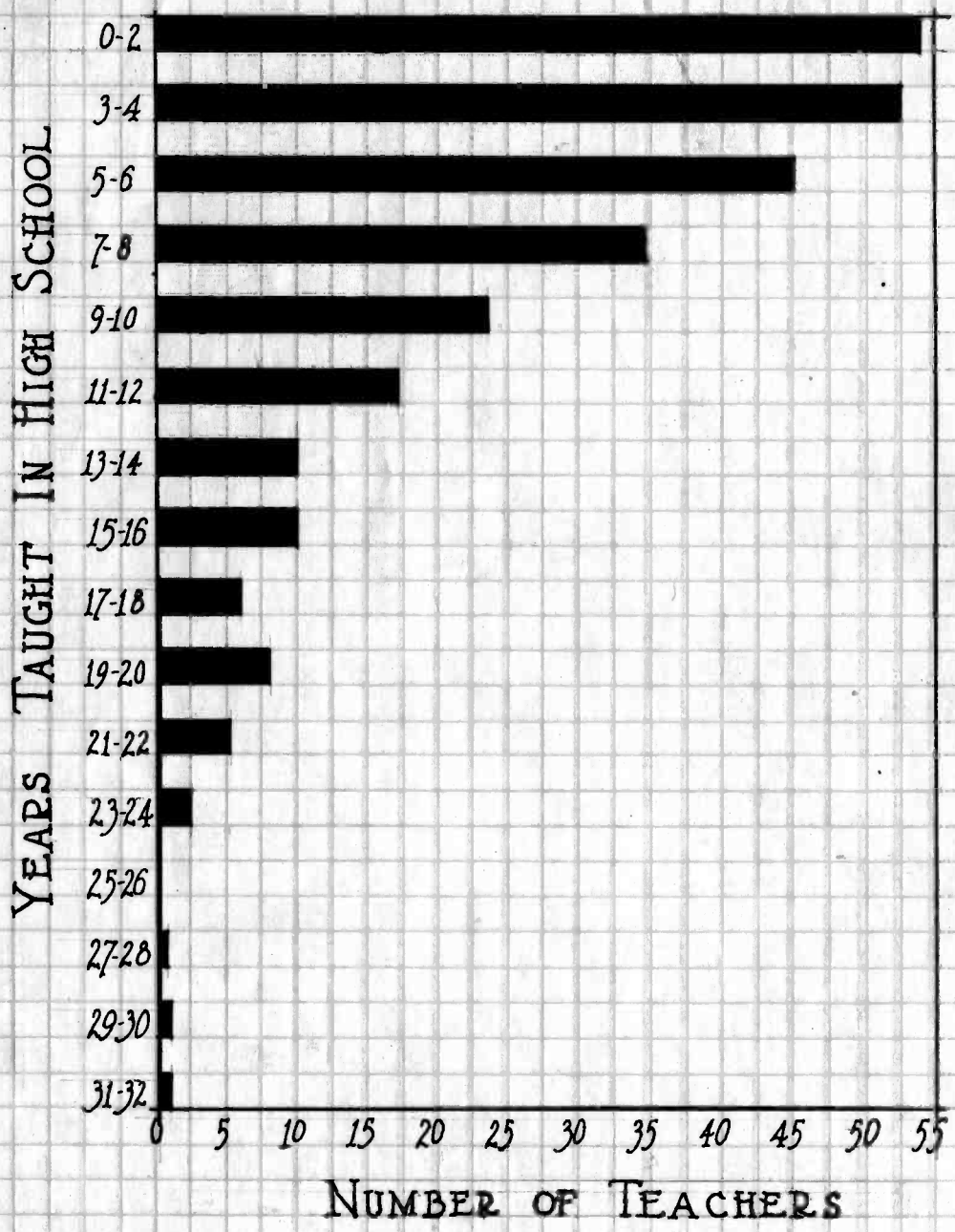


Figure 2. Graphical Representation of Returns from Question Number 2.

Table I. Comparing, in per cent, Question No. 1 with Question No. 2

Per cent of teachers having had grade school teaching experience	Years taught in the grades
11.4	1
9.2	2
4.4	3
2.5	4
1.8	5
3.0	6
2.2	7
1.8	8
.7	9
1.1	10
1.1	11
.7	13
.3	14
.3	15
.7	20
.3	41

The above table shows that 41.5% of the teachers have had from one to forty-one years of grade school experience. This leaves 58.5% having had no grade school experience.

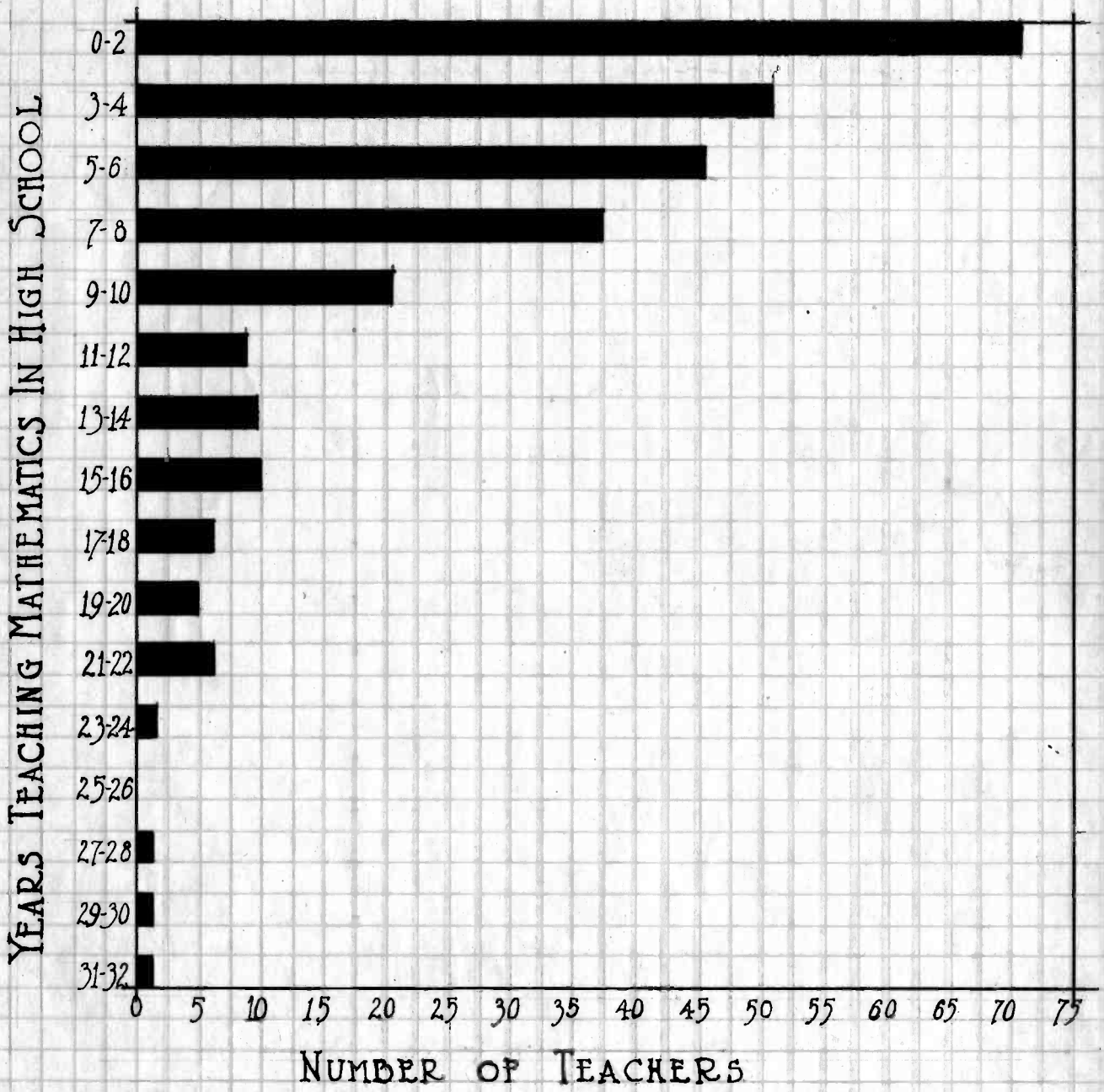


Figure 3. Graphical Representation of Returns from Question Number 3.

The graphical representation for Question No. 3 shows the findings to the following question, "How many years have you taught mathematics in high school, including the present year?" The majority of the mathematics teachers have had less than six years of experience in the mathematics department. The largest number is found in the group having had one and two years of experience in that department.

Of the 270 teachers replying to the question, "What branches of mathematics have you taught in high school?" about twenty per cent had taught only Algebra I, Algebra II, and Plane Geometry. The following are the most frequent combinations found:

Algebra I and II; Plane Geometry 55

Algebra I and II; Plane Geometry; Commercial Arithmetic 42

Algebra I, II, and III; Plane Geometry; Solid Geometry 28

Algebra I, II, and III; Plane Geometry; Solid Geometry; Commercial Arithmetic 28

Algebra I, II, and III; Plane Geometry; Solid Geometry; Trigonometry; Commercial Arithmetic. 20

The remaining 97 replies were from those who had taught but one branch of mathematics or various combinations of those listed above.

The answers to Question 5, "What branches of mathematics are you now teaching in high school?" might be summarized as follows:

Algebra I and II; Plane Geometry 84

Algebra I and II 26

Plane Geometry 24

Algebra I and II; Plane Geometry; Commercial Arithmetic 24

Commercial Arithmetic 15

Algebra I and II; Commercial Arithmetic. . . . 11

Algebra I and II; Plane Geometry; Solid Geometry 11

The remaining 55 replies to this question were from those who were teaching from two to four classes in mathematics. Trigonometry was offered in the course of twelve of the schools reporting.

The survey of the teaching program of the mathematics teachers in these schools also discloses the fact that only 29.8% teach nothing outside the department. With few exceptions these are found to be teachers with special training. Of the remaining number, 26.7% teach mathematics and two other subjects; 12.8%, three other subjects; 4%, four other subjects.

It is interesting to note that of the 26.7% of the teachers who teach mathematics and one other subject, the latter found most frequently was physics with second place given to manual training or typing. Third place was given to either English or General Science. Of the 26.7% teaching mathematics and two other subjects, the combina-

tions most frequently found were physics and manual training or physics and general science. In the combination of mathematics with three or four other subjects, the combinations are so varied that it would be impossible to give first or second place to any one group.

The response to the question, "What branches of mathematics are now being offered in your high school?" shows that 26% offer only Algebra I, Algebra II, and Plane Geometry, while 31% offer Algebra I, Algebra II, Plane Geometry, and Commercial Arithmetic. This leaves a remaining 42% offering various combinations of Algebra I and II, Plane Geometry, and Commercial Arithmetic with the addition of one or more of the following: Algebra III; Solid Geometry; Trigonometry. It might also be stated here that it is usually in the larger school systems having instructors highly specialized in this field that Algebra III, Solid Geometry, and Trigonometry are offered.

Table II. The accompanying diagram gives the enrollment of the high schools with the per cent of schools having the same.

Number enrolled	Schools in per cent
1- 100	66.2
100- 200	16.2
200- 300	7.2
300- 400	4.8
400- 500	.4
500- 600	1.4
600- 700	.4
700- 800	.4
800- 900	.9
900-1000	.4
1000-1100	--
1100-1200	--
1200-1300	.4
1300-1400	--
1400-1500	--
1500-1600	--
1600-1700	--
1700-1800	.4
1800-1900	--
1900-2000	.9
Total	100.0

Number enrolled in the different branches of mathematics

Table III. The accompanying diagram shows the range of enrollment of high school students in the different branches of mathematics

Enrollment	Algebra I and II	Algebra III	Plane Geometry	Solid Geometry	Trigonometry	Commercial Arithmetic	Business Arithmetic
Smallest Class	6	3	3	1	6	1	1
Largest Class	306	113	315	93	32	66	218
Enrollment most frequently found	17	10	10	7	8	17	8

Number enrolled in other mathematics

Thirteen of the 213 schools reported that they offered one or more courses in mathematics other than Algebra I, Algebra II, Algebra III, Plane Geometry, Solid Geometry, Trigonometry, and Commercial or Business Arithmetic.

"Is mathematics required for graduation from your high school?" "If so, how much?" A total of 139 schools reported that some mathematics was required for graduation.

Of this number, approximately 31% had a requirement of one unit, while 67% had a requirement of two units. The majority of those requiring one unit specified Algebra I and Algebra II. The majority of those requiring two units specified Algebra I and II, and Plane Geometry.

Seventy-one schools that reported required no mathematics for graduation from high school. In three instances where the answer to Question No. 18 was, "No," Question No. 19 was answered, "We recommend Algebra I and II, and Plane Geometry." Another four required either one year of mathematics or one year of science.

A total of 263 teachers replied to the question, "Do you find students deficient in mathematics when coming from the elementary schools?" "If so, what are the deficiencies?" Of these, 89.7% found them to be deficient while 10.3% were satisfied that the pupils' grade school preparation was adequate and thorough enough for their life's needs. Summarizing the answers to the above question, we find:

1. That 50% of the pupils in high schools lack a fair degree of speed and accuracy in the fundamental operations.
2. That many of these same pupils have difficulties with fractions and decimals, with percentage, and with the less used operations of finding the roots or powers of numbers.

3. That the pupils are unable to reason out stated problems.
4. That pupils coming from the rural schools meet with more difficulties than do the children who have a graded school experience.
5. That the ill-prepared, unprofessional grade teacher is sometimes responsible for the inadequate training in mathematics of many pupils on their entry into high school.

With the purpose of ascertaining the attitude of these high school teachers toward the study of mathematics in high school, the writer also submitted these questions, "Do you think mathematics should be required in high school?" "If so, why? If not, why not?" Eight failed to answer these questions. Of the 262 who replied 219 believed a course in mathematics essential for high school students, 37 made a negative reply, and six said, "Not for all."

The important aims that the teaching of mathematics should serve are (1) practical, (2) disciplinary, (3) cultural. The three classes mentioned are not mutually exclusive but the convenience of discussion rather than logical necessity often assigns a given aim to one or the other of these classes. However, any truly disciplinary aim is practical, and in a broad sense, the same is true of cultural aims. For convenience, the replies of

those favorable to a course in mathematics for the high schools might be grouped under one or the other of these classes in this way:

1. Practical aims:
   a. Mathematics teaches order, precision, and arrangement of facts.
   b. It is the foundation for future scientific study. It is the language of the sciences - one of the keys to our civilization.
   c. High school is a place for discovering abilities; hence, the mathematical ability of pupils must be tried.
   d. An understanding of the language of algebra is necessary, and the ability to use this language intelligently and readily in the expression of such simple, quantitative relations as occur in every-day life and in the normal reading of the educated person is most important.
   e. Gives a progressive increase in the students' understanding of the nature of the fundamental operations and the power to apply them in new situations.
   f. To train, organize, and develop the mind to solve situations that present themselves. The grades do not give enough training to enable

pupils to solve these ordinary problems.

g. Mathematics teaches the use of definite symbols instead of vague ideas in solving every-day problems.

h. It furthers the ability to understand and interpret correctly, graphic representations of various kinds. The individual citizen often comes in contact with situations of a mathematical or statistical nature. The greater the individual fund of knowledge, the greater is the likelihood he will be able to handle the exact situations presented.

i. Teaches pupils to select values and to discard what is useless.

2. Disciplinary aims:

a. Trains in reasoning and exactness.

b. Is the source for the acquisition of those ideas where quantitative thinking is done.

c. Gives training in accurate thinking, quick judgment, and instant decision.

d. It aids in the development of reasoning power, and in the ability to follow specific directions.

e. Aids pupils to concentrate.

f. Develops an analyzing ability not acquired in other subjects.

g. Creates a desire to understand a situation.

h. Gives training in thoroughness and clearness, and a distaste for vagueness and incompleteness.

3. Cultural aims:

a. Ideas of perfection as to logical structure, precision of thought and of statement, and discrimination between the true and the false.

b. An appreciation of the beauty in the geometrical forms of nature and of art.

The replies coming from those who do not favor the teaching of mathematics with other subjects in the high school curriculum seemed less potent. These might be summarized into one group as follows:

a. Some pupils are not capable of getting mathematics. It is not necessary for all.

b. Algebra and geometry are very difficult for some. Either gives little the average pupil will use.

c. Some pupils are deficient in native ability. To require mathematics from all would mean many repeaters. One year of arithmetic might be beneficial.

d. High school should start a pupil's specialization. Very few in some schools will have as much use for algebra and geometry as for other courses offered.

e. Beyond the fundamentals which should be imparted in eight years, one should choose the things he will do well because he wishes to do them.

f. Special fields have their own style of mathematics.

g. Graduates of rural elementary schools do not know how to use or interpret mathematics. Mathematics becomes a bore to such.

Comparing the reaction to each of the three questions last stated, it is found that most teachers are very much in favor of a course in mathematics for high school pupils. Those giving a negative reply were found, in most cases, to be teachers with no special training in the subject, assigned to this department to fill his or her program. Many of these same teachers believe that all subjects should be elective for the high school pupils. The well-prepared and really professional man believed it unwise to allow free election of studies during these years. During this period, interests are likely to be transient, and guidance is imperative. Preparation for life should be broad so that later when the individual has discovered himself he may select his vocation wisely. Studies of fundamental importance should be required of all, with possible rare exceptions. Mathematics should be one of these required subjects.

To the question, "Do you think students are as

interested in mathematics as they are in other subjects in high school?" the replies showed the following results:

Yes	No	Some	More	Boys are more interested	Depends on instructor	Yes, if elective	Don't know
68.7%	20.6%	6.4%	1.5%	.8%	.8%	.8%	.4%

A marked difference in the requirements of teachers was disclosed when the replies to the question, "What per cent, approximately, of the problems in the text book do you require your pupils to solve?" were listed. Two teachers stated they required pupils to solve 35% of the problems in the text book, while twenty-three teachers had the pupils solve 100% of the problems. Approximately 50% of the teachers required the solution of 75% or more of the problems.

Question No. 27, "Do you stress the difficult problems or the more simple, practical ones?" was answered by a total of 259 teachers. Of this number, 179 required the pupils to solve only the simple practical problems, five spent more time with the difficult ones, and seventy-five stressed both the difficult problems and the simple, practical ones.

Reports also show that 166 teachers use work-books in mathematics, that 104 do not use them, and that thirty have at some time used them. Work-books in Algebra I, Algebra II,

or Plane Geometry were used in 91% of the cases. The other nine per cent used them in Algebra III, Solid Geometry, or Commercial Arithmetic.

Wanting to know some of the arguments for and against the use of work-books, the following questions were inserted: "Do you think the work-books practical? If so, why? If not, why not?" It was interesting to learn that 57.4% of the teachers were using or had used them with favorable comment, 14% were opposed to their use, 14% believed they might be practical with some classes under certain working conditions, and the remaining 14.6% failed to answer, had not used them, or found them impractical for one reason or another. Some of the favorable comments read:

a. Provide new material and consequently interesting review.
b. Provide a means to gain accuracy, speed, and a measurement of knowledge in the subject.
c. Aid in diagnosing specific weaknesses.
d. Bring to the pupil something more than text-book form.
e. Algebra requires more drill than the text offers.
f. Takes the work up in closely related units.
g. Offer a diversion from regular class routine.
h. Enable a pupil to see readily his own progress.

i. Keep the course concentrated, pupils like them, they save paper, they encourage neatness, and give practice in filling-in forms.

j. Cover many variations of problems in a short amount of time - a time saver for a crowded schedule.

k. The work-book proves a good tool in the hands of a competent teacher, but a poor tool for a lazy, incompetent one.

l. Give adequate review material in a form easy to use.

m. Repetition is the one law of learning. Work-books provide several times the amount of review in the same length of time as do many other sources of review.

n. Most pupils take pride in keeping their work-books, and the accomplishment graph with most work-books is very interesting.

o. Relieve the pupil of some of the tedious routine of copying figures.

p. Most interested pupils want extra work.

q. The more contacts the better. We learn to do by doing.

r. Help to discover weaknesses, strength, and principles that must be re-taught.

s. To pupils they seem more as a contest or game, and thus create interest.

t. Provide additional material with perhaps a new slant on the work.

u. Word problems are usually stated differently from those in the text, and require thought to interpret them in terms of the knowledge gained from the text.

v. Give the opportunity to use a large number of exercises from the simple to the difficult on certain different topics.

Again others say:

a. Take up too much time. The teacher's time is better spent observing what pupils do and their methods of doing, with some work at the blackboard.

b. Impractical, unless the teacher makes his own work-books. The problems can be made by the teacher to fill class needs and situations.

c. Too much like busy work.

d. Do not take care of individual differences.

e. Give no chance for self-expression.

f. Teachers should be able to adapt the text-book to individual needs without a special stimulation.

g. Rapid thinkers have little use for the work-books, as they are too simple for them.

h. There is a tendency to consider them the maximum rather than the minimum knowledge. Some teachers tend to act as a checker of books rather than

inspiring original work and individual ways of gain through an understanding of the subject.

Since the teaching of mathematics involves two distinct tasks, and since the first of these is that of teaching the fundamental operations, we conclude that work-books, properly employed, may be used in a beneficial way. The fundamental operations may be called the "machinery of arithmetic." When a pupil has once acquired this machinery, his work with it is afterward largely mechanical, and for life purposes it is very desirable that it should be so. One should be able to add, subtract, multiply, or divide with the greatest ease and accuracy. If nothing further was gained from these work-books, we might get such practice in other ways. However, there are some thought problems, there is a desire to compete with one's self, with the individuals in a class, and with the class as a whole. Competition is always good. Neatness is encouraged. Too often it is neglected.

Work-books serve as a check on the teacher. Some of us are unwilling to have our character of work and our standard of requirements exposed to our class or classes. The teacher, as well as the pupil, gets from his work that which he puts into it. Work-books might be employed very beneficially. That is the problem of the teacher, but in all events must he consider the essential needs of his

class or classes.

Taking note of the findings from the question, "What preparation have you had in mathematics?" we conclude that 247 teachers had adequate or special training for the teaching of mathematics in high school, while twenty-three had little or no training beyond a course in Algebra I and II, and Plane Geometry. Of the former number 133 had special training. Many of these had a major or minor in mathematics.

On the basis of the returns received to the question, "Were you employed as a teacher of mathematics or was the subject assigned you to fill up your program?" approximately 75% of the teachers were hired to teach mathematics while 25% were assigned to this department to fill up his program. From these observations it is assumed that it is a common practice to assign a class in mathematics to a teacher who has had little or no training in the subject and whose interests are elsewhere because in the construction of the time table he happens to have a vacant period at that time.

Part II

The Arithmetical Ability of Ninth Grade Beginners

The purpose of giving the arithmetic test to the high school freshmen was to determine the arithmetic abilities of these pupils when entering high school. Table IV shows

the results found for each school, both as to the boys and the girls, as well as for the whole class in each school. I have also shown in this table the results obtained by throwing the schools to-gether. As a matter of convenience I have designated each school by letter, such as A, B, etc.

By means of this table we can compare the results found in the different schools of various sizes. We can also compare each school with the results of the total group.

Considering that the average age of pupils entering high school is fifteen years, we can see from a comparison of Table IV with the table prepared by the authors of "The New Stanford Arithmetic Test" and found on the first page thereof, that approximately 50% of the freshmen have an arithmetic age of fifteen years or more, that 25% have an arithmetic age of fourteen years, and that the remaining 25% have an arithmetic age below fourteen years.

Table V shows the correlation sheet in which the correlation is found between the reasoning and the computation abilities for the boys. Table VI shows a similar correlation for the girls.

The correlation coefficient for the boys' group is found to be almost identical with that of the girls. Both the boys and the girls are better in computation than in reasoning.

Table IV. Distribution for the Entire High School Freshman Group on the Arithmetic Test

Freshman Scores	High School								
	A			B			C		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
120-4	--	--	--	--	--	--	--	--	--
115-9	10	3	13	1	1	2	1	--	1
110-4	18	19	37	2	6	8	3	3	6
105-9	18	19	37	4	9	13	2	1	3
100-4	15	11	26	5	6	11	3	--	3
95-9	19	16	35	7	1	8	--	1	1
90-4	7	12	19	6	3	9	2	4	6
85-9	8	6	14	2	5	7	1	2	3
80-4	8	7	15	--	3	3	2	--	2
75-9	1	2	3	4	2	6	2	--	2
70-4	--	--	--	1	--	1	--	--	--
65-9	2	--	2	1	1	2	--	--	--
60-4	--	--	--	--	--	--	--	1	1
55-9	--	2	2	--	--	--	--	--	--
50-4	--	--	--	--	--	--	1	--	1
45-9	--	--	--	--	--	--	--	--	--
40-4	--	--	--	--	--	--	--	--	--
Totals	106	97	203	33	37	70	17	12	29
Medians	102.67	101.59	102.21	96.79	102.92	99.38	100.83	93.75	94.58

Read: In the arithmetic test a score of 85 to 89 was made by 8 boys and 6 girls; total, 14, in School A.

Table IV. Continued

Freshman Scores	High School								
	D			E			F		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
120-4	--	1	1	--	--	--	--	--	--
115-9	1	--	1	--	2	2	--	--	--
110-4	--	1	1	--	2	2	--	--	--
105-9	1	1	2	--	--	--	1	1	2
100-4	--	1	1	1	1	2	1	--	1
95-9	--	--	--	2	2	4	1	--	1
90-4	--	1	1	1	--	1	--	1	1
85-9	--	2	2	1	--	1	1	--	1
80-4	--	--	--	1	--	1	--	--	--
75-9	--	--	--	--	--	--	--	--	--
70-4	--	--	--	--	--	--	--	--	--
65-9	--	--	--	--	--	--	--	--	--
60-4	--	--	--	--	--	--	--	2	2
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--
45-9	--	--	--	--	--	--	--	--	--
40-4	--	--	--	--	--	--	--	--	--
Totals	2	7	9	6	7	13	4	4	8
Medians	112.5	102.5	106.25	95	111.25	99.38	100	77.5	95

Table IV. Continued

Freshman Scores	High School								
	G			H			I		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
120-4	--	--	--	--	--	--	1	--	1
115-9	--	--	--	3	--	3	3	4	7
110-4	--	1	1	--	5	5	7	6	13
105-9	--	1	1	2	2	4	9	6	15
100-4	1	--	1	1	3	4	5	16	21
95-9	2	1	3	3	1	4	5	9	14
90-4	--	3	3	1	1	2	6	5	11
85-9	1	--	1	2	5	7	11	5	16
80-4	--	--	--	1	2	3	7	5	12
75-9	--	1	1	1	2	3	6	2	8
70-4	--	--	--	1	--	1	1	--	1
65-9	--	1	1	--	--	--	1	1	2
60-4	--	--	--	1	--	1	--	--	--
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--
45-9	--	--	--	--	--	--	--	--	--
40-4	--	--	--	--	--	--	--	--	--
Totals	4	8	12	16	21	37	62	59	121
Medians	97.5	93.33	95	96.67	97.5	96.88	94.17	100.78	98.75

Table IV. Continued

Freshman Scores	High School								
	J			K			L		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
120-4	1	--	1	--	--	--	--	--	--
115-9	3	--	3	--	--	--	--	--	--
110-4	5	9	14	2	--	2	--	--	--
105-9	3	9	12	1	3	4	--	--	--
100-4	11	5	16	3	6	9	--	1	1
95-9	3	4	7	1	2	3	--	1	1
90-4	0	6	6	3	1	4	2	--	2
85-9	2	--	2	3	--	3	1	1	2
80-4	1	--	1	2	--	2	2	--	2
75-9	--	--	--	1	2	3	1	1	2
70-4	--	--	--	--	--	--	--	--	--
65-9	1	--	1	--	1	1	--	--	--
60-4	--	--	--	--	--	--	--	--	--
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--
45-9	--	--	--	--	--	--	--	--	--
40-4	--	--	--	--	--	--	--	--	--
Totals	30	33	63	16	15	31	6	4	10
Medians	103.64	105.83	104.53	93.33	101.25	99.17	85	90	87.5

Table IV. Continued

Freshman Scores	High School								
	M			N			O		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
120-4	--	--	--	--	--	--	--	--	--
115-9	--	1	1	2	--	2	--	--	--
110-4	1	2	3	1	3	4	1	--	1
105-9	1	4	5	2	4	6	1	2	3
100-4	2	3	5	3	1	4	1	--	1
95-9	2	--	2	5	1	6	1	--	1
90-4	1	1	2	--	--	--	1	--	1
85-9	2	--	2	2	--	2	--	1	1
80-4	--	1	1	1	--	1	--	1	1
75-9	--	1	1	--	1	1	--	--	--
70-4	--	1	1	--	--	--	--	1	1
65-9	--	--	--	--	--	--	--	--	--
60-4	--	--	--	--	--	--	1	--	1
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--
45-9	--	--	--	--	--	--	--	--	--
40-4	--	--	--	--	--	--	--	--	--
Totals	9	14	23	16	10	26	6	5	11
Medians	98.75	105	102.5	100	107.5	103.75	100	87.5	97.5

Table IV. Continued

Freshman Scores	High School P			TOTALS		
	Boys	Girls	Total	Boys	Girls	Totals
120-4	--	--	--	2	1	3
115-9	1	2	3	25	13	38
110-4	3	4	7	43	61	104
105-9	1	2	3	46	64	110
100-4	4	1	5	56	55	111
95-9	2	7	9	53	46	99
90-4	2	8	10	32	46	78
85-9	7	4	11	44	31	75
80-4	2	2	4	27	21	48
75-9	1	1	2	17	15	32
70-4	1	3	4	4	5	9
65-9	--	--	--	5	4	9
60-4	--	--	--	2	3	5
55-9	--	--	--	--	2	2
50-4	--	--	--	1	--	1
45-9	--	--	--	--	--	--
40-4	--	--	--	--	--	--
Totals	24	34	58	357	367	724
Medians	92.5	94.38	94	99.38	100.95	100.18

The norm accompanying the arithmetic test shows that a score of 100 indicates an arithmetic age of 15 years 8 months and a school grade of 9.7.

Table V. Correlation for the Boys

Correlation ..... Reasoning (x) ..... and ..... Computation (y)

	Y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	F_y	F_yY	F_yY^2	$\Sigma'F_{xy}X$	$Y\Sigma'F_{xy}X$	$(\Sigma'F_{xy}X)^2$	$\frac{(\Sigma F_{xy}X)^2}{F_y}$
	" X =	50-4	55-9	60-4	65-9	70-4	75-9	80-4	85-9	90-4	95-9	100-4	105-9	110-4	115-9	120-4	125-9												
20																													
19																													
18																													
17	120-4														1	1							2	34	578	29	493		
16	115-9									1		1	2	4	7	4	1						20	320	5120	270	4320		
15	110-4								1	7	3	13	18	19	13	1							75	1125	16875	904	13410		
14	105-9								1	1		4	6	4	3								19	266	3724	227	3178		
13	100-4							1	2	3	3	12	8	2	2								33	429	5577	362	4706		
12	95-9						1	1	4	8	7	9	9	5	2								46	552	6624	487	5844		
11	90-4						2	3	5	7	8	14	6	6	2								53	583	6413	548	6028		
10	85-9							2	5	3	2	5	5										22	220	2200	216	2160		
9	80-4					1	2	2	5	3	5		2	1									21	189	1701	185	1665		
8	75-9							1	4	7	7	5	1										25	200	1600	239	1912		
7	70-4	1		2				2	4	7	2	4											22	154	1078	180	1260		
6	65-9							4	2	5													11	66	396	89	534		
5	60-4		1		1			1	1	1													5	25	125	30	150		
4	55-9					1																	1	4	16	5	20		
3	50-4							1															1	3	9	7	21		
2	45-9																												
1	40-4			1																			1	1	1	3	3		
	Fx	1	1	3	1	2	5	18	34	53	37	67	57	41	30	6	1						357	4171	52037	3781	45704		
	FxX	1	2	9	4	10	30	126	272	477	370	737	684	533	420	90	16						3781		ΣF_yY^2	$\Sigma FxyX$	$\Sigma FxyXY$		$\Sigma(\Sigma FxyX)^2$ / Fy
	F_xX^2	1	4	27	16	50	180	882	2176	4293	3700	8107	8208	6929	5880	1350	256						42059	ΣFyX^2						
	$X\Sigma'F_{xy}X$																							$\Sigma FxyXY$						
	$(\Sigma'F_{xy}X)^2$																							$\Sigma(\Sigma'FxyY)^2$ / Fx						
	$\frac{(\Sigma F_{xy}Y)^2}{F_y}$																												

Av. $x = \frac{3781}{357} = 10.591\ (97.96)$

Av. $y = \frac{4171}{357} = 11.683\ (93.42)$

Coefficient of correlation (r) $= \frac{45704 - 10.59 \times 4171}{\sqrt{42059 - 10.59 \times 3781}\ \sqrt{52037 - 11.68 \times 4171}} = .5934 \pm .0233$

Table VI. Correlation for the Girls

Correlation — Reasoning (x) — and — Computation (y)

	Y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	F_y	F_yY	F_yY^2	$\Sigma'F_{xy}X$	$Y\Sigma'F_{xy}X$	$(\Sigma'F_{xy}X)^2$	$\frac{(\Sigma F_{xy}X)^2}{F_y}$
	" X =	50-4	55-9	60-4	65-9	70-4	75-9	80-4	85-9	90-4	95-9	100-4	105-9	110-4	115-9	120-4	125-9												
20																													
19																													
18																													
17	120-4																												
16	115-9											1	9	7	7		1						25	400	6400	324	5184		
15	110-4					1	1	1	5	5	14	26	27	20	11	2							113	1695	25425	1297	19455		
14	105-9							2	2	6	3	7	5	1	1								27	378	5292	278	3892		
13	100-4		1			1		3	2	1	9	13	8	1	2								41	533	6929	423	5499		
12	95-9					2		1	2	8	7	7	7	3									37	444	5328	375	4500		
11	90-4				1	2	1	2	4	8	9	3	3										33	363	3993	297	3267		
10	85-9					1	1		5	6	4	1	1										19	190	1900	168	1680		
9	80-4					3		1	3	4	1	5	2	1									20	180	1620	184	1656		
8	75-9				1	1	1	2	6	2	2	4	1										20	160	1280	171	1368		
7	70-4			2	1	2		5	3	2	5		1	2									23	161	1127	185	1295		
6	65-9	2			1	1		1	1														6	36	216	26	156		
5	60-4			1																			1	5	25	3	15		
4	55-9																												
3	50-4																												
2	45-9					2																	2	4	8	10	20		
1	40-4																												
	Fx	2	1	3	4	16	4	18	33	42	54	67	64	35	21	2	1						367	4549	59543	3741	47987		
	FxX	2	2	9	16	80	24	126	264	378	540	737	768	455	294	30	16						3741		ΣFyY^2	$\Sigma FxyX$	$\Sigma FxyXY$		$\Sigma\frac{(\Sigma FxyX)^2}{Fy}$
	F_xX^2	2	4	27	64	400	144	882	2112	3402	5400	8107	9216	5915	4116	450	256						40497	ΣFyX^2					
	$X\Sigma'F_{xy}Y$																							$\Sigma FxyXY$					
	$(\Sigma'F_{xy}Y)^2$																							$\Sigma\frac{(\Sigma'FxyY)^2}{Fx}$					
	$(\Sigma F_{xy}Y)^2$																												

Av. $x = \frac{3741}{367} = 10.193\ (95.97)$

Av. $y = \frac{4549}{367} = 12.395\ (96.98)$

Coefficient of correlation $(r) = \frac{47987 - 10.19 \times 4549}{\sqrt{40497 - 10.19 \times 3741}\ \sqrt{59543 - 12.39 \times 4549}} = .5924 \pm .0230$

Part III

Algebra I and II and Plane Geometry Tests

Algebra

The purpose of giving the algebra and the geometry tests to the seniors of the selected high schools was to determine the mathematical abilities of high school graduates. Fifteen of the sixteen schools which gave the arithmetic tests gave these tests in algebra and geometry. The Algebra Test is made on the freshman level. It was administered to the freshmen over the state in the second semester of the 1930-1931 school year scholarship contest, conducted by the Kansas State Teachers' College, Emporia, Kansas. The median of the scores when given state-wide was thirty-one. The median score on the same test when given to the seniors in the fifteen schools in the 1931-1932 school year was twenty-one and forty-one hundredths.

Schools A, B, I, J, and L offered one and one-half years of algebra. In School A, 64 seniors had had one and one-half years of algebra; in School B, 14; in School I, 9; in School J, 15; and in School L, 9. School A had a median of 26.47; School B, 15.71; School I, 15.96; School J, 23.44; and School L, 32.5. In three of the five schools in which some of the pupils have had one and one-half years of algebra, we find a median above the group median, which

was 21.41. School L had the highest median, but all of the pupils in that school had had one and one-half years of algebra.

In the ten remaining schools, we find School C with a median of 19.5; School D, 18.75; School E, 16.88; School F, 13.75; School G, 12.5; School H, 22.5; School K, 15.5, School M, 19.58; School N, 21.88; and School A, 31.25.

School O, in the latter group, has a median almost as high as L in the former group. This might be due to the fact that School O has a small class, and therefore the teacher can give his pupils more individual attention.

Three-tenths of the schools offering but one year of algebra have a median above the median of the group, while six-tenths of those offering one and one-half years have a median above the group median. In figuring the median of all the pupils having had one and one-half years of algebra, we find it to be 40.92.

Table VII. Distribution for the Entire High School Senior Group on the Algebra Test

Scores	High School								
	A			B			C		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
65-9	1	--	1	--	--	--	--	--	--
60-4	1	3	4	--	--	--	--	--	--
55-9	5	1	6	1	--	1	--	--	--
50-4	5	2	7	2	1	3	--	1	1
45-9	4	4	8	2	--	2	--	--	--
40-4	9	1	10	3	--	3	--	1	1
35-9	6	3	9	--	1	1	--	--	--
30-4	13	2	15	2	1	3	1	1	2
25-9	5	12	17	1	--	1	--	--	--
20-4	9	16	25	1	1	2	1	1	2
15-9	6	14	20	3	4	7	2	3	5
10-4	8	6	14	2	8	10	2	--	2
5-9	2	3	5	2	9	11	--	--	--
0-4	--	3	3	--	--	--	--	--	--
Totals	74	70	144	19	25	44	6	7	13
Medians	32.69	22.81	26.47	31.25	12.18	15.71	17.5	22.5	19.5

Read: In the algebra test, in School A, a score of 40-44 was received by 9 boys and 1 girl; total, 10.

Table VII. Continued

Scores	High School								
	D			E			F		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
65-9	--	--	--	--	--	--	--	--	--
60-4	--	--	--	--	--	--	--	--	--
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--
45-9	--	--	--	--	1	1	--	--	--
40-4	--	--	--	--	--	--	--	--	--
35-9	--	--	--	--	--	--	--	--	--
30-4	--	--	--	--	--	--	--	--	--
25-9	--	--	--	--	--	--	--	--	--
20-4	1	--	1	--	1	1	1	--	1
15-9	1	1	2	3	1	4	1	--	1
10-4	--	--	--	2	--	2	2	--	2
5-9	--	--	--	1	--	1	1	--	1
0-4	--	--	--	--	--	--	--	--	--
Totals	2	1	3	6	3	9	5	--	5
Medians	20	17.5	18.75	15	22.5	16.88	13.75	--	13.75

Table VII. Continued

Scores	High School								
	G			H			I		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
65-9	--	--	--	--	--	--	--	--	--
60-4	--	--	--	--	--	--	1	--	1
55-9	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	1	1	--	--	--
45-9	--	--	--	--	--	--	1	--	1
40-4	--	--	--	--	--	--	1	1	2
35-9	--	--	--	1	--	1	1	1	2
30-4	--	--	--	1	0-	1	3	1	4
25-9	1	1	2	3	3	6	3	2	5
20-4	--	1	1	2	--	2	5	7	12
15-9	--	--	--	1	3	4	9	4	13
10-4	--	3	3	1	3	4	6	15	21
5-9	1	2	3	1	--	1	4	6	10
0-4	--	--	--	--	--	--	--	4	4
Totals	2	7	9	10	10	20	34	41	75
Medians	17.5	12.5	12.5	25	18.33	22.5	18.89	13.5	15.96

Table VII. Continued

Scores	High School								
	J			K			L		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
65-9	1	--	1	--	--	--	--	--	--
60-4	3	1	4	--	--	--	--	--	--
55-9	--	1	1	--	--	--	--	1	1
50-4	1	1	2	--	--	--	--	--	--
45-9	--	1	1	--	1	1	--	--	--
40-4	2	2	4	--	--	--	--	1	1
35-9	2	--	2	--	--	--	--	2	2
30-4	--	1	1	--	3	3	1	--	1
25-9	2	5	7	--	4	4	1	1	2
20-4	4	4	8	--	3	3	--	--	--
15-9	1	5	6	3	2	5	1	1	2
10-4	2	6	8	5	6	11	--	--	--
5-9	1	3	4	2	2	4	--	--	--
0-4	--	2	2	--	--	--	--	--	--
Totals	19	32	51	10	21	31	3	6	9
Medians	28.75	20	23.44	13	20.83	15.5	27.5	37.5	32.5

Table VII. Continued

Scores	High School									TOTALS		
	M			N			O					
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
65-9	--	--	--	--	--	--	--	--	--	2	--	2
60-4	--	--	--	--	--	--	--	--	--	5	4	9
55-9	--	--	--	--	--	--	--	--	--	6	3	9
50-4	--	--	--	--	--	--	--	--	--	8	6	14
45-9	--	--	--	--	--	--	--	--	--	7	7	14
40-4	--	1	1	--	--	--	--	--	--	15	7	22
35-9	--	--	--	1	1	2	2	--	2	13	8	21
30-4	--	--	--	2	--	2	4	2	6	27	11	38
25-9	1	3	4	1	2	3	2	2	4	20	35	55
20-4	2	1	3	5	3	8	--	--	--	31	38	69
15-9	2	4	6	1	3	4	--	--	--	34	45	79
10-4	2	1	3	2	1	3	--	--	--	34	49	83
5-9	--	--	--	1	1	2	1	--	1	17	2 6	43
0-4	--	--	--	--	--	--	--	--	--	0	9	9
Totals	7	10	17	13	11	24	9	4	13	219	248	467
Medians	18.75	20	19.58	22.5	20.83	21.88	31.88	30	31.25	23.95	19.44	21.41

Geometry

The Plane Geometry test was made on the sophomore level. It was administered to the sophomore classes over the state in the second semester of the 1930-1931 school year in the scholarship contest conducted by the Kansas State Teachers' College, Emporia, Kansas. The median score when given state-wide to the sophomores was 34. The median score on the same test when given to the seniors in the 15 schools in the second semester of the 1931-1932 school year was 22.29.

Schools A, B, I, and J offered both Plane Geometry and Solid Geometry. In School A, 37 pupils had had both Plane and Solid Geometry; in School B, 15; in School I, 8; and in School J, 6.

School A had a median score of 26.54; School B, 23.5; School I, 16.36; and School J, 22.5. Three-fourths of the schools offering Solid Geometry in addition to Plane Geometry had a median above the group median.

In the remaining 11 schools we find the following medians: C, 14.5; D, 13.75; E, 18.75; F, 23.75; G, 18.13; H, 25.5; K, 23.75; L, 16.88; M, 23.33; N, 19.58; O, 22.5. Five-elevenths, or not quite one-half, of the schools offering only Plane Geometry had a median score above the group median.

In none of the 15 schools do we find a median score as high as the median score, 34, when the test was given to the sophomores in the state-wide contest.

The median score of the group of seniors from the 15 schools who had had both Plane and Solid Geometry was 41.56.

Table VIII. Distribution for the Entire High School Senior Group on the Plane Geometry Test

Score	High School											
	A			B			C			D		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
85-9	--	--	--	--	--	--	--	--	--	--	--	--
80-4	2	--	2	--	--	--	--	--	--	--	--	--
75-9	--	1	1	--	--	--	--	--	--	--	--	--
70-4	2	--	2	--	--	--	--	--	--	--	--	--
65-9	3	--	3	--	--	--	--	--	--	--	--	--
60-4	2	2	4	--	--	--	--	--	--	--	--	--
55-9	1	--	1	--	--	--	--	1	1	--	--	--
50-4	6	--	6	1	--	1	--	--	--	--	--	--
45-9	3	1	4	3	1	4	--	--	--	--	--	--
40-4	4	6	10	2	--	2	--	--	--	--	--	--
35-9	8	4	12	1	--	1	1	2	3	--	--	--
30-4	5	9	14	2	2	4	--	--	--	--	--	--
25-9	3	10	13	1	2	3	1	--	1	--	--	--
20-4	8	12	20	3	2	5	--	--	--	1	--	1
15-9	11	10	21	--	3	3	--	1	1	--	--	--
10-4	7	11	18	2	4	6	3	2	5	1	1	2
5-9	3	2	5	--	4	4	1	1	2	--	--	--
0-4	--	--	--	--	--	--	--	--	--	--	--	--
Totals	68	68	136	15	18	33	6	7	13	2	1	3
Medians	32	24.58	26.54	33.75	16.67	23.5	13.33	17.5	14.5	17.5	12.5	13.75

Read: In the geometry test, in School A, a score of 35-39 was made by 8 boys and 4 girls; total, 12.

Table VIII. Continued

Score	High School											
	E			F			G			H		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
85-9	--	--	--	--	--	--	--	--	--	--	--	--
80-4	--	--	--	--	--	--	--	--	--	--	--	--
75-9	--	--	--	--	--	--	--	--	--	--	--	--
70-4	--	--	--	--	--	--	--	--	--	--	--	--
65-9	--	--	--	--	--	--	--	--	--	--	--	---
60-4	--	--	--	--	--	--	--	--	--	--	--	--
55-9	--	--	--	--	--	--	--	--	--	--	--	--
50-4	--	--	--	--	--	--	--	--	--	--	--	--
45-9	--	1	1	--	--	--	--	--	--	--	--	--
40-4	--	--	--	1	--	1	--	--	--	--	--	--
35-9	--	--	--	--	--	--	--	--	--	--	--	--
30-4	--	1	1	1	--	1	--	--	--	--	--	--
25-9	1	--	1	--	--	--	--	2	2	6	4	10
20-4	1	--	1	2	--	2	--	1	1	2	1	3
15-9	--	2	2	1	--	1	1	3	4	2	2	4
10-4	2	--	2	--	--	--	--	1	1	--	1	1
5-9	1	--	1	--	--	--	1	--	1	--	--	--
0-4	--	--	--	--	--	--	--	--	--	--	--	--
Totals	5	4	9	5	--	5	2	7	9	10	8	18
Medians	13.75	25	18.75	23.75	--	23.75	12.5	19.17	18.13	25.83	25	25.5

Table VIII. Continued

Score	High School											
	I			J			K			L		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
85-9	--	--	--	--	--	--	--	--	--	--	--	--
80-4	--	--	--	--	--	--	--	--	--	--	--	--
75-9	--	--	--	--	--	--	--	--	--	--	--	--
70-4	--	--	--	1	--	1	--	--	--	--	--	--
65-9	--	--	--	2	1	3	--	--	--	--	--	--
60-4	--	--	--	--	1	1	--	--	--	--	--	--
55-9	1	--	1	2	--	2	--	--	--	--	--	--
50-4	--	1	1	--	1	1	--	--	--	--	--	--
45-9	1	--	1	1	--	1	--	--	--	--	--	--
40-4	--	3	3	2	--	2	--	1	1	--	--	--
35-9	1	1	2	--	--	--	--	--	--	--	--	--
30-4	2	4	6	1	1	2	--	3	3	--	--	--
25-9	4	1	5	1	8	9	3	2	5	--	1	1
20-4	1	3	4	3	4	7	1	3	4	1	--	1
15-9	7	4	11	3	8	11	--	4	4	2	2	4
10-4	9	6	15	1	3	4	--	2	2	--	2	2
5-9	4	5	9	2	3	5	1	--	1	--	1	1
0-4	1	3	4	--	2	2	--	--	--	--	--	--
Totals	31	31	62	19	32	51	5	15	20	3	6	9
Medians	16.07	16.88	16.36	27.5	20	22.5	25.83	22.5	23.75	18.75	15	16.88

Table VIII. Continued

Score	High School									TOTALS		
	M			N			O					
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
85-9	--	--	--	--	--	--	--	--	--	--	--	--
80-4	--	--	--	--	--	--	--	--	--	2	--	2
75-9	--	--	--	--	--	--	--	--	--	--	1	1
70-4	--	--	--	--	--	--	--	--	--	3	--	3
65-9	--	--	--	--	--	--	--	--	--	5	1	6
60-4	--	--	--	--	--	--	--	--	--	2	3	5
55-9	--	--	--	--	--	--	--	--	--	4	1	5
50-4	--	--	--	--	--	--	1	--	1	8	2	10
45-9	--	--	--	--	--	--	--	--	--	8	3	11
40-4	1	--	1	--	--	--	--	--	--	10	10	20
35-9	--	1	1	--	--	--	--	1	1	11	9	20
30-4	--	3	3	--	--	--	--	2	2	11	25	36
25-9	1	1	2	1	1	2	1	--	1	23	32	55
20-4	3	--	3	5	1	6	1	1	2	32	28	60
15-9	2	1	3	3	3	6	1	--	1	33	43	76
10-4	--	2	2	1	1	2	2	--	2	28	36	64
5-9	--	1	1	1	--	1	1	--	1	15	17	32
0-4	--	--	--	--	--	--	1	--	1	2	5	7
Totals	7	9	16	11	6	17	8	4	12	197	216	413
Medians	22.5	27.5	23.33	20.5	18.33	19.58	15	32.5	22.5	23.2	21.25	22.29

IMPORTANT STATEMENTS AND CONCLUSIONS

Part I

The Questionnaire

The results show:

1. That the better prepared mathematics teachers and those having the most experience are employed in the larger school systems.
2. That 58.5% of the high school mathematics teachers have had no grade school experience.
3. That in the schools requiring some mathematics for the high school graduates, either Algebra I and II, or Algebra I and II and Plane Geometry were the required branches. No reference was made to arithmetic.
4. That in many schools, the teacher of mathematics is not employed as such, but rather assigned to this department to fill up his or her program.
5. That 60% of the mathematics teachers use work-books.
6. That approximately 70% of the teachers require pupils to solve only the simple, practical problems.
7. That 89.7% of the high school teachers of mathematics say that they find the pupils deficient in mathematics when they enter high school.

Part II

Arithmetic

To one scoring the arithmetic tests, it would seem that the grade school teachers are not getting results in arithmetic. However, when the scores on the arithmetic tests were converted into the corresponding arithmetic ages, the results showed that 75% of the freshmen who took the test had an arithmetic age of 14 or more years.

The scores were changed to the arithmetic ages by using the table on page one of the arithmetic test. The tests and tables are very reliable as they were made by sampling a large number of children over a very large area.

Part III

Algebra and Plane Geometry

In comparing the findings when administering the freshman Algebra test and the sophomore Plane Geometry test to the senior classes, we as teachers are inclined to ask ourselves several questions, "Are the students retaining a sufficient amount of algebra and geometry? Are the high schools which require one or two units of mathematics justified in making this apply to Algebra I and II and

Plane Geometry? If they do require Algebra I and II and Plane Geometry, should they not also require Algebra III and Solid Geometry?"

When scoring these tests one is prone to believe that students do not retain a sufficient amount of algebra and geometry. It was discovered that the medians in the Algebra and the Plane Geometry tests when given to the seniors were much lower than were the medians of the same tests when administered to the freshmen in the state-wide scholarship contest. It does not seem that all students should be required to take Algebra I and II, or Algebra I and II and Plane Geometry. However, this study leads one to believe that if a student does take Algebra I and II, he should be required to take Algebra III. In Algebra III, he will learn again the parts forgotten and thus will retain them for a longer period of time. It seems too, and for the same reason that if a student has a course in Plane Geometry, he should be required to take a course in Solid Geometry.

The above recommendations are made especially for those students who do not intend to go to college. Those going on to college will not be deprived of higher algebra and Solid Geometry.

ACKNOWLEDGMENTS

I wish to express my appreciation to those who have assisted me in making this survey; to the late Dr. W. H. Andrews, who aided me in choosing this field in which to work; to Dr. V. L. Strickland for his advice and counsel in the working up of the results; to the superintendents, principals, and mathematics instructors of the schools participating; and to my wife for her assistance in checking and tabulating.

LITERATURE CITED

Book, William F.
The Intelligence of High School Seniors. New York. Macmillan, 371 p. 1928.

Holzinger, Karl J.
Statistical Methods for Students in Education. New York. Ginn, 372 p. 1928.

Inglis, Alexander.
Principles of Secondary Education. Chicago. Houghton Mifflin, p. 481-505. 1918.

Judd, Charles Hubard.
Cleveland Education Survey. Philadelphia. Fell, 290 p. 1916.

Rugg, Harold O.
Statistical Methods Applied to Education. Chicago. Houghton Mifflin, 410 p. 1917.

Schultze, Arthur.
The Teaching of Mathematics in Secondary Schools. New York. Macmillan, 370 p. 1916.

Strickland, V. L.
Relative Levels of Intelligence in College and High School. Kansas State College Bulletin. p. 114. Nov. 1926.

Smith, David Eugene and Reeve, William David.
The Teaching of Junior High School Mathematics. Chicago. Ginn, 411 p. 1927.

Trabue, Marion Rex.
Measuring Results in Education. Chicago. American Book Co. 492 p. 1924.

Van Wagenen, M. J.
Educational Diagnosis and the Measurement of School Achievement. New York. Macmillan, 276 p. 1926.

Virginia Education Commission.
Virginia Public Schools. A Survey of a Southern State Public School System. New York. World Book Co. 235 p. 1921.

Williams, J. Harold.
Graphic Methods in Education. Chicago. Houghton Mifflin, 319 p. 1924.

Young, John Wesley.
The Reorganization of Mathematics in Secondary Education. Mathematical Association of America, 652 p. 1923.