A Comparative Study of the Scores made by Three Levels of Eighth Grade Arithmetic Students of Central Junior High School of Kansas City, Kansas.

by

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CHAPTER I

INTRODUCTION

The testing movement in education has led to a large number of changes in the method and the materials of teaching. This is especially true in the larger school systems where it is possible to be somewhat progressive because finances are available to a limited extent. One of the most common practices in the large schools which is a direct result of the testing movement is the orginization of classes into homogeneous groups. The method used at Central Junior High School, Kansas City, Kansas, is as follows:

Each student is given a battery of five standardized tests and from the data obtained he is placed into the group for which he seems fitted. In case of doubt, the teacher's estimate of the child's ability, plus his score on the tests, determines his classification. The tests used are: Stone's Silent Reading Test; Van Wagemen Georgraphy Scale; Buckingham Scale for Problems in Arithmetic; and Otis Self-Administering Test of Mental Ability. These tests are given in the spring to all children who expect to enter Central Junior High School the following fall. They are given at Central Junior High School by an instructor who has had special

training in testing and six years' experience in actual testing and the use of standardized scales. Using the results of these tests, the children are put into one of nine groups which are known as: 2^1 - 2^2 - 2^3 - 2^4 - 2^5 - 2^6 - 3^1 - 3^2 - 3^3. This method of grouping is followed in classifying the members of the seventh and eighth grades. The method used to determine the number that shall be in each group is that of dividing the total number of pupils enrolled to take a particular subject by the number of classes which can be formed for that subject. For example, there are four-hundred-seventeen (417) pupils who must take eighth grade arithmetic and the schedule of classes permits forming only twelve (12) classes. After dividing the number of pupils by the number of classes, about thirty-six (36) pupils are put in each group. Therefore, the thirty-six (36) children making the highest score are placed in the 2^1 group; the next thirty-six (36) are placed in the 2^2 group; and the division is continued until all groups are filled. Ordinarily there is only one class for each group.

It is necessary to state here that there is in the school a group called the accelerate group which is composed of those having especially high I.Q's; and children who have been recommended by the teacher for this group. These pupils are given the opportunity to do the work of the seventh and

eighth grades in one year; and at the end of the year they are promoted to the ninth grade if their work has been satisfactory. If it has not been satisfactory, they are required to take the regular eighth grade work.

Sometime during the last six weeks of the school year, a list of the seventh and eighth grade pupils is submitted to each of four teachers who is expected to check each child he has taught during the year and recommend any changes in grouping which he deems necessary. Unless such a recommendation is made, the pupil remains in the same group the following year. It is customary, however, for a teacher who believes that a child is in the wrong group to suggest to the chairman of the Mental Tests and Measurements Committee that the child be retested. If the schedule of classes permits, a change is made. Most of the changes in grouping should and do take place during the first or second six weeks period of the school year. The year consists of thirty-six (36) weeks which are divided into two semesters. Practically all subjects are full year subjects. Since the number of classes and the number of teachers are limited, a child who fails in the first half of a full year subject must continue with the class until the end of the year. At the end of the year he passes and goes on with the next unit of work or fails and does the entire year's work again. This is undesirable, but under present conditions, a necessary evil.

There have been many statements and some experimentation in attempts to evaluate the effect of homogeneous group-

ing. One measure of the effect of grouping is to be obtained by actual measurement of the relative progress of the various groups in particular subjects. The writer of this thesis is interested especially in the teaching of mathematics and in homogeneous grouping as it relates to the effectiveness of instruction in this subject. He, therefore, attempted to ascertain the gains made by the three groups of eighth grade pupils in arithmetic. These gains will be estimated from the results of standardized arithmetic scales.

CHAPTER II

RELATED STUDIES

S. S. Colvin, formerly professor of experimental psychology at Brown University, carried out an experiment, with the aid of one of his classes, in 1922, somewhat similar to this study. Before the students were permitted to do the actual work of the experiment, Professor Colvin gave them very careful training in the administration of mental and educational tests. The training was given in the spring and the following fall the class was sent to various Rhode Island communities to make the survey. Colvin makes the following statement as to the object of his experiment: "The purpose of the article is to present the significant data bearing on the relationship existing between capacity as indicated by I.Q. and actual achievement as indicated by A.Q."

In grades five to eight inclusive, the National Intelligence Test (a) and the Lippincott-Chapman Test (in reading and arithmetic) were used. In the lower grades, Otis' Primary Intelligence Scale and Haggerty Reading Examination, Sigma I, were used. Individual scores on the intelligence test were converted into M.A. and the individual Intelligence Quotients were found. The scores on school products tests were converted into pedadogical ages and the individual Accomplishment Quotients were found by dividing the pedadogical age by the mental age. Thus

an I.Q. and an A.Q. were found for each pupil.

The data revealed by the various projects in regard to capacity and actual accomplishment were in close agreement with the results given by Murdock who found at Punahou School in Honolulu high negative correlations to exist in a mental and educational survey of four-hundred-fifteen (415) pupils. The r for the I.Q. and the reading A.Q. was -.45; and the r for the I.Q. and the arithmetic A.Q. was -.73. The result of the Brown University study shows a range from just about zero correlation to a very high negative correlation of -.71. In fact, the conclusions were that increases in I.Q. were accompanied by decreases in A.Q. and that on the whole pupils having I.Q.'s above eighty-five were not working up to capacity; and the greater the intelligence of the pupil, the less he actually accomplished. Colvin says that this study is a striking portrayal of the fact that superior children are not working up to their capacity and that less gifted children exceed both normal and superior groups in doing just about what one is justified in expecting of them. A possible explanation of this may be that existing standards of achievement in the Rhode Island communities are better suited to the slow pupils and under such conditions the superior and normal children develop habits that are not conducive to studiousness and industry.

Katherine Murdock[2], Director of Educational Research, Punahou School, Honolulu, Hawaii, in her experiment, which she calls the Accomplishment Quotient-Finding It and Using It,

gives the results of a mental and educational survey which was made during the winter of 1921 in her school. Punahou School is a private school attended by most of the white children in Honolulu. About 10% of the school population is Oriental and 20% is part Hawaiian; but the author states there is no significant difference in intelligence or school attainment in the three races represented in the school.

The National Intelligence Tests, Form A and B; Thorndike-McCall Reading Scale, Form I; and the Woody-McCall Mixed Fundamentals, Form I were used in grades III to VIII. From the results of these tests, Murdock obtained the Intelligence Quotient by dividing the mental age of each child by his chronological age; the Subject Quotient was obtained by dividing the subject age by the chronological age; and the Subject Accomplishment Quotient was obtained by dividing the subject age by the mental age. Murdock wished to use these three quotients for the following reasons: Reclassification of pupils; enlightenment of pupils and teachers; and for further testing of special cases brought to light by this initial group of tests. The results of the study are: Correlations between Intelligence Quotients and Subject Quotients are negative and large in amount; correlation between Intelligence Quotient and Reading Accomplishment Quotient is -.45; between Intelligence Quotient and Arithmetic Accomplishment Quotient is -.73. Murdock believes that the chances are very great that a boy or a girl of unusual mental ability will not achieve in his school

work as much as his mental age warrants. The correlations between Intelligence Quotients and Subject Quotients show that the brighter pupils are achieving more than the others; but they are not working to the limit of their mental capacity. Murdock concludes her work with the following words: "Certainly the results which we have obtained do show loafing by the brighter pupils and emphasizes the necessity for our doing forcing where it is necessary." She also believes that the backward pupil is more likely to be accomplishing all that his mental ability warrants.

These studies are based on the accomplishment quotient technique to which Kelley and others make objections. A number of studies have been made in this field and a few excerpts will be given from two such studies.

The Misleading Accomplishment Quotient, an article by Wilson[3] of Ohio University, contains the following statement: "Certain assumptions that are at least questionable are involved in the use of the accomplishment quotient.- - - - They are, first, that there is a general ability which can be made the sole determinant of school accomplishment; second, as a corallary, that special abilities and qualitative differences in ability do not exist; and third, that this general ability can be completely stated by a simple figure." Wilson's conclusions are: "1. The unreliability of the measures upon which the accomplishment quotient is based alone is sufficient to account for the negative correlation between intelligence quotient and accomplishment quotient.

2. Since intelligence quotient is not the sole determinant of possible achievement its use in finding the accomplishment quotient results in too high an expectation for bright pupils and too low an expectation for dull pupils.

3. Conclusions based on the use of accomplishment quotient are misleading unless they take into account the reliability of the measures, the validity of the measures, and the part played by the factors determining the intelligence quotient in school achievement under conditions of maximum motivation."

Herbert Popenoe[4], Statistician in Los Angeles City Schools, in his study, A Report of Certain Deficiences of the Accomplishment Quotient, states: "In so far as may be judged from the results of the study the administrative use of the accomplishment quotient is open to serious criticism."

Symonds[5], in his book on measurement in secondary education, gives a summary of a number of studies made on homogeneous grouping according to ability or intelligence quotient. He believes that the evidence concerning progress of homogeneous groups up to the present is not at all conclusive.

The first study is by Moyer[6]. In this he compares the achievement of high school students who were grouped into classes according to their standing in intelligence tests with pupils of like ability who were taught in mixed classes. The total number of cases used in each group was about fifteen

and therefore the results are suggestive only. In algebra the segregated superior pupils did no better than the unsegregated; but the Latin segregated superior pupils made better scores than the unsegregated. Moyer concluded: "In order to judge the value of segregation we must compare the achievements of pupils who are in segregated classes corresponding to their ability with similar pupils in mixed classes. When we make the comparison we find that the superior and medium pupils appear to do somewhat better in segregated than in mixed classes. The inferior pupils, however, do not appear to benefit by segregation so far as their scores on the standardized tests are concerned."

Keener[7] made a study in 1924 in the Chicago schools. He explains: "We have no control experiment on homogeneous groups to report, but we shall present conditions and results of actually classifying junior high school pupils into groups which are more or less homogeneous as to ability and needs." The Otis' Classification Test was given to all the pupils and these scores were the sole basis of classification as there was no other data available. Each grade was divided into classes by taking the lowest forty for the low class, the next forty for the next class, and so on. Keener states: "In the beginning, some of the Junior High School principals and teachers were skeptical as to the value of the test results and the grouping, but after nearly two years of trial they almost unanimously consider homogeneous grouping the best means

of caring for individual differences under present conditions. - - - - - - - - - - Homogeneous classification has made it easier to fit the Junior High School to the pupil and until it is possible and feasible to use a superior device, it will answer the need better then heterogeneous grouping."

A study was made by Theisen[8] in the Cleveland schools on the relative progress of VII-B groups sectioned on the basis of ability. The pupils had been given the Illinois intelligence test early in January. The results were utilized by the Junior High School principals in arranging them into VII-B groups of different ability as they entered Junior High School January 31st. At the end of the semester in June, an effort was made to determine the achievements of the different sections in each school. The pupils were tested with the Stone Reasoning test in Arithmetic; the Monroe Reading Test, Form II; and the Charters Language Test. After the results of the tests had been tabulated by classes, the records were arranged according to the class intelligence score. All classes with an intelligence score of eighty-two and up were placed in Group I; between seventy-two and eighty-two in Group II; between sixty-seven and seventy-two in Group III; between sixty-two and sixty-seven in Group IV; between fifty-six and sixty-two in Group V, and below fifty-six in Group VI. The number of classes in the different groups ranged from nine to fifteen. Fourteen schools were tested. Theisen found that the brighter groups made greater progress than the

duller groups. The average class of high intelligence was in no case less than three semesters ahead of the average class in low intelligence. There was, however, considerable difference in the achievement of classes having the same ability. It is his belief then that: "Grouping by intelligence or mental maturity does not eliminate the necessity of good teaching to bring out the best results. Equal or approximately equal intelligence does not mean equal scholarship. Some low intelligence classes did better than others of high intelligence."

In the March issue of the Journal of Educational Research[9] is an editorial on homogeneous or non-homogeneous grouping which states that the purpose of classifying school children is to bring together pupils who are equal or approximately equal in ability in order that common instruction may be given. The writer cites a school system which abandoned homogeneous grouping because the teachers and the administration found its undesirable results far outweighed its advantages. For seven years the seventh, eighth and ninth grades had been classified on the basis of the previous years' average scholastic standing into four groups of varying ability. Few, if any intelligence tests had been given. The plan of homogeneous grouping had been abandoned because it seemed to have two desirable features while its undesirable features were said to be nine in number. The desirable features were: The plan worked fairly well with the middle 50% of the pupils; and the upper quartet covered somewhat larger amounts of subject matter. The undesirable features were: The pupils in the upper quartet de-

pended on versatility and cleverness rather than hard work; this group developed snobbishness and egotism; the pupils in the lowest quartet made little effort; to many, the opportunity of getting into higher groups made no appeal; parents did not understand the scheme and nagged the children who were in the lower groups; teachers favored the stronger and slighted the weaker sections; such classification is undemocratic; since it is impossible to give the same work to all sections, the pupils in the lower sections enter High School handicapped; intelligence tests show high mental ability among some pupils whose scholastic standing is low. These points, however, merely bring out the fundamental fact that the problem of doing effective school work is not solved by classification. There should also be a modification of method, an adjustment of the curricular offerings in terms of the ability of these different groups, and the administration of the whole scheme wisely. Classification is but one means to the end of carrying for individual differences in children and it is of little value if all the other means to this same end are disregarded.

Richard D. Allen[10] considered the problem of classification from another standpoint. It is well worthwhile to note the following quotation from his study on some neglected problems in classifying High School pupils: "A classification of pupils according to intelligence in the junior high schools as well as in senior high schools should be more than a mere admin-

istrative device to increase the efficiency of instruction. It should be a means by which problems can be isolated, studied, and solved---at first tentatively, but as time goes on with greater accuracy and assurance. A guidance program in these schools, which made use of individual psychological and educational measurements for purposes of individual guidance as well as for efficient instruction---such a program will prove an important step toward the solution of many of our most difficult educational problems."

Ferguson[11] of the Univeráity of Wisconsin, obtained data from the schools of West Allis, Wisconsin, while he was Director of Educational Measurements in West Allis. The effect of classification upon pupil promotion was considered. He wanted to find if classification and proper grade placement of pupils reduced the number of failures. The percent of failures was recorded for the period of non-classification and for the period of classification. The standards of promotion were the same for both periods. The experiment was carried out in grades I through IX. The personnel of the teaching staff during the two periods was practically the same. The pupils were classified into three intelligence-quotient groups, denoting dull, normal and bright pupils.Ferguson found that the classification of pupils into homogeneous groups according to ability tends to reduce the failures. Proper grade placement and classification reduced mal-adjustments, mental and educational

over-ageness and under-ageness, and resulted in a better educational product.

Odell of the University of Illinois[12] made a critical study of the measures of achievement relative to capacity. He gives his purpose in making the study in the following words: "The use of measures of achievement relative to capacity has been one of the most enthusiastically recommended and widely employed procedures that have arisen in connection with the standardized test movement. - - - - - - - - - - - - - As is so frequently true, so in this instance, the majority of those who adopted such procedures did so non-critically. - - - - - - - - - - - It has, therefore, appeared worthwhile to devote this bulletin to a critical study of measures of achievement relative to capacity."

Chapter I of the bulletin gives a definition of the measures of achievement and intelligence such as mental age, achievement age, educational age, intelligence quotient, subject quotient, accomplishment quotient, and other similar terms in use among educators. The next chapter contains a historical account of the origin of the measures. Odell's concluding statement in the chapter is: "Present practice may be summarized by saying that the achievement quotient suggested by Monroe, and its synonym, the original accomplishment quotient of Franzen are widely used, the subject quotient, the educational quotient, and the accomplishment ratio somewhat less so, and the others rarely or not at all."

The merits and demerits of the various measures are presented in chapter III. Quotient measures are to be recommended chiefly because their use is already much more common. After a critical consideration of the suggestions of Ferguson, Peters, Otis, Symonds, and Nygaard, Odell finds that Symonds' index of effort is the only one which has much practical merit. The validity of most quotient measures is low because the units of measures used in computing the quotient are not equivalent. Odell's personal investigation and his review of studies of reliability of measures of achievement relative to capacity lead him to conclude that their reliability is entirely unsatisfactory. He says: "Indeed their reliability is so low that it is recommended that they never be employed for the diagnosis, classification, or other treatment of individual pupils except possibly when they are based upon the combined results from several group tests or one individual intelligence test.

These studies and many others which may be found in current literature advocate the practice of homogeneous grouping and call attention to the fact the technique of homogeneous grouping stands in great need of improvement. The work of the educator is to devote his time and efforts to improving the practice. There should be no thought of discarding it when in spite of poor organization it has shown good results.

CHAPTER III

THE PROBLEM AND THE METHOD OF PROCEDURE

The problem is: A comparative study of the scores made by three levels of eighth grade arithmetic students of Central Junior High School, Kansas City, Kansas, in order to determine the speed, accuracy, comprehension, and reasoning of each level in so far as these elements are measured by the Compass Diagnostic Tests in Arithmetic. The problem purports to give the amount of gain of each group and to discover the groups which make the greater gains in the various tests. The study is based on data obtained from four tests given for the purpose of determining the speed, the accuracy, the comprehension, and the reasoning ability of each group. The tests used were tests IV, IX, XVII and XIX of the Compass Diagnostic Tests in Arithmetic. Test IV which deals with the division of whole numbers is a sixty minute test and was used to test the speed of the three groups. It was necessary to divide the period for giving this test into two class sessions. Test IX: Addition, subtraction, and multiplication of decimals is a twenty minute test, given for the purpose of testing the accuracy of the three groups. Test XVII: Problem analysis is a thirty-five minute test and was used to test the comprehension of the groups.

Test XIX: General problem scale, another twenty minute test, was given to test the arithmetic reasoning of the groups.

The tests were given on consecutive days, beginning February the 6th and ending February the 10th; and all groups were tested on the same days with the same tests. The 2^1 group was a second hour class; the 2^4 group was a first hour class, and the 3^3 group was a fourth hour class. The school day begins at 8:30 A.M. and ends at 2:35 P.M. There are five class periods of fifty-five minutes each. The lunch period begins at 11:50 A.M. and ends at 12:30 P.M. Hours four and five follow the lunch period.

The groups were tested twice. The initial testing took place the week of February the 6th and the final testing was the week of May the 16th. An interval of three months existed between the giving of the two tests. It was necessary to use Form A of the Compass Diagnostic Tests in Arithmetic both times because it was the only form published at that time. There was no discussion of the tests at either testing and all of them were graded by the same instructor. Group 2^4 and group 3^3 were under the instruction of one teacher and group 2^1 was under the instruction of another.

TABLE I

The Scores Made By 2^1 Group on Tests IV, IX, XVII and XIX, of Compass Diagnostic Tests.

Pupil	Test IV		Test IX		Test XVII		Test XIX	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
R. A.	379	389	59	69	50-1/3	72	10	9
C. B.	212	215	50	57	60-2/3	67-2/3	11	9
D. B.	365	368	180	184	66-1/3	71-1/3	14	14
R. C.	300	307	122	129	47-2/3	67-1/3	10	14
E. D.	180	196	82	120	53	62	12	11
H. H.	341	350	78	91	52-1/3	69-1/3	14	12
P. H.	319	328	99	118	67-1/3	72	12	14
H. K.	361	364	126	120	58-1/3	70	14	15
D. K.	337	334	138	140	69-2/3	65-2/3	14	12
A.M.	323	339	94	136	63-2/3	72-2/3	15	13
D. N.	374	406	124	157	73	74-1/3	14	14
R. R.	254	261	114	123	68-2/3	72	13	15
P. S.	373	380	113	115	64-1/3	72	14	13
R. T.	326	336	113	102	64	68-1/3	9	14
I. V.	323	343	80	131	64	72	11	13
T. W.	381	401	119	143	52-1/3	67-1/3	10	14
F. W.	296	325	133	144	62-2/3	71-1/3	14	15
D. W.	263	272	121	142	65	67	15	12
T. W.	339	352	123	142	66	71-2/3	14	12
K. Y.	269	265	121	121	68	58-1/3	13	12

TABLE II

The Scores Made by 2^4 Group on Tests IV, IX, XVII and XIX, of Compass Diagnostic Tests

Pupil	Test IV		Test IX		Test XVII		Test XIX	
	Initial	Final	Initial	Final	Inital	Final	Inital	Final
E. A.	195	317	61	51	43	56	8	13
R. A.	347	351	107	130	44-1/3	64-2/3	12	9
E. B.	372	377	146	146	71	69-2/3	11	15
R. B.	322	353	108	110	37-2/3	47-1/3	11	10
M. D.	333	331	93	132	45-2/3	54-2/3	12	13
D. E.	325	319	158	157	57	73-2/3	11	13
E. F.	337	305	125	129	50	55-2/3	13	12
H. G.	359	270	164	161	65	60	13	14
B. G.	252	307	75	97	51	59-2/3	9	7
H. J.	343	354	161	165	65-2/3	66-2/3	15	15
M. K.	304	294	131	130	36-1/3	61-1/3	14	14
E. L.	299	317	148	154	59-2/3	61	11	15
A. M.	342	263	154	163	53-1/3	70-2/3	13	13
W. M.	347	379	108	112	31-2/3	35	8	11
F. M.	301	321	113	118	38-2/3	55-2/3	10	11
A. O.	332	355	104	118	55-2/3	67-1/3	12	12
G. P.	311	335	117	126	56	68	13	15
C. R.	300	313	135	0	46	66-2/3	14	14
M. S.	379	401	143	173	72	74-1/3	13	12
H. S.	273	265	107	119	33-1/3	31-2/3	10	9
L. T.	374	374	163	161	49-2/3	67	14	13
A. W.	289	230	78	96	37-2/3	52	13	8
R. W.	261	239	55	39	50	50	9	9

TABLE III

The Scores Made by 3^3 Group on Tests IV, IX, XVII, and XIX, of Compass Diagnostic Tests

Pupil	Test IV		Test IX		Test XVII		Test XIX	
	Initial	Final	Initial	Final	Initial	Final	Inital	Final
L. B.	337	357	58	101	33	35	7	9
J. C.	264	250	101	122	22-1/3	44	6	7
C. C.	268	317	61	80	39	32	8	6
A. C.	253	270	99	113	51	48-2/3	10	10
L. C.	122	103	59	77	30-1/3	31-2/3	6	8
C. D.	289	280	74	98	32-2/3	27	7	8
J. D.	186	162	35	40	19-2/3	15-1/3	4	4
M. G.	263	254	76	103	40	27-1/3	7	9
E. G.(a)	119	120	22	25	14-1/3	13-2/3	3	4
E. G.(b)	56	53	3	32	12-1/3	14-1/3	1	2
J. H.	169	200	59	60	14-2/3	48-1/3	5	10
B. M.	267	299	88	91	25-1/3	26	12	12
T. P.	201	208	73	100	24-2/3	21-2/3	9	8
C. P.	236	227	21	41-1/3	41-1/3	37	9	12
F. P.	212	179	91	109	29	42	7	9
R. R.(a)	215	262	53	63	27-2/3	47-1/3	7	7
R. R.(b)	244	234	93	69	33-2/3	36-1/3	9	10
L. S.	296	321	103	105	29	32	8	10
M. K.	140	149	25	15	17	12-2/3	4	7
M. E.	203	215	94	57	35	34-2/3	10	10

CHAPTER IV

THE RESULTS

Tables I, II and III give the raw scores made by the three groups on the four tests, the first and second time the tests were given. These tables show that the high score for each group on each giving of the four tests is as follows:

Test IV	Score	
Group	First Time	Second Time
2^1	381	406
2^4	379	401
3^3	337	357

Test IX	Score	
Group	First Time	Second Time
2^1	180	184
2^4	164	173
3^3	103	122

Test XVII	Score	
Group	First Time	Second Time
2^1	73	74-1/3
2^4	72	74-1/3
3^3	51	48-2/3

Test XIX	Score	
Group	First Time	Second Time
2^4	15	15
2^4	15	15
3^3	12	12

From Table IV, the medians for the groups on the four tests each time they were given are as follows:

Test IV	Median	
Group	First Time	Second Time
2^1	330	340
2^4	321-2/3	335
3^3	230	230

Test IX	Median	
Group	First Time	Second Time
2^1	117-1/2	128
2^4	127-1/2	127-1/2
3^3	70	80

Test XVII	Median	
Group	First Time	Second Time
2^1	63	70-1/2
2^4	49	61-1/2
3^3	28-1/3	32-1/2

Test XIX	Median	
Group	First Time	Second Time
2^1	13-1/2	13-2/3
2^4	12-1/2	13-1/10
3^3	7-3/5	9

In the discussion of the test results, the 2^1 group will be designated as the superior group, the 2^4 group as the middle group, and the 3^3 group as the slow group.

The results of test IV: Division of whole numbers, which was given to measure the speed of the groups, show that the superior group made a higher score than the middle group, and the middle group made a higher score than the slow group at the beginning of the experiment. This is as it should be. The second time the test was given the superior group again ranked first, the middle group second, and the slow group last; but the difference in score between the superior group and the middle group is only five points, while the difference between the middle group and the slow group is one hundred five points. The difference between the superior group and the middle group could scarcely be considered an appreciable difference.

The results of test IX: Addition, subtraction and multiplication of decimals, which was given to test the accuracy of the groups, show that the superior and middle groups made exactly the same score the first time the test was given and the

superior group was half a point ahead of the middle group the second time. Therefore, the accuracy of the superior and middle groups is the same; and the accuracy of the slow group is much lower, as shown by a difference of forty-seven and one-half points on the first and second giving of the test. This is not according to expectations, because according to the theory underlying homogeneous grouping, the superior group should rank first; the middle group second; and the slow group, last.

The results of test XVII: Problem analysis, which was given to measure the comprehension of the groups, shows that the superior group ranked first; the middle group, second; and the slow group, last. In each case, there was an appreciable difference in score at both the first and second testing. As was expected, the comprehension of the superior group was much better than the comprehension of the middle group. Furthermore, the middle group surpassed the slow group in comprehension, as it should have done.

The results of test XIX: General problem scale, which was given to measure the arithmetic reasoning of the groups, shows that the superior group ranks first; the middle group second; and the slow group, last. Again, as in Test IV, we find that the difference in score between the superior group and the middle group is very slight and almost negligible at the two testings. The first difference is one point, and the second difference is a little more than half a point. Judging from the results of this test, we

could say that the middle group equals the superior group in arithmetic reasoning; and both of these groups surpass the slow group.

TABLE IV

The Median, the Range, and the Standard Deviation of Groups 2^1, 2^4, and 3^3, on the Four Tests.

Group	Range		Median		Standard Deviation	
	Initial	Final	Initial	Final	Initial	Final
	TEST IV					
2^1	180 to 381 or 201	196 to 406 or 210	330	340	1.15	1.91
2^4	195 to 274 or 179	230 to 401 or 171	321-2/3	335	1.36	1.5
3^3	56 to 337 or 281	53 to 357 or 304	230	230	2.33	2.55
	TEST IX					
2^1	50 to 180 or 130	57 to 187 or 127	117-1/2	128	2.94	2.88
2^4	55 to 164 or 109	0 to 173 or 173	117-1/2	127-1/2	3.23	4.217
3^3	3 to 103 or 100	15 to 122 or 107	70	80	2.89	3.26
	TEST XVII					
2^1	47-2/3 to 73 or 25-1/3	58-1/3 to 74-1/3 or 16	63	70-1/2	1.38	.08
2^4	31-2/3 to 72 or 40-1/3	31-2/3 to 74-1/3 or 42-1/3	49	61-1/2	1.24	1.06
3^3	12 to 51 or 39	12 to 48 or 36	28-1/3	32-1/2	1.41	1.02
	TEST XIX					
2^1	9 to 15 or 6	9 to 15 or 6	13-1/2	13-2/3	1.19	3.71
2^4	8 to 15 or 7	7 to 15 or 8	12-1/2	13-1/10	1.93	2.34
3^3	1 to 12 or 12	2 to 12 or 10	7-3/5	9	2.62	2.54

TABLE V

The Average Score of Each Group on Tests IV, IX, XVII, and XIX, of Compass Diagnostic Tests.

Group	Number of Cases	Average Score Initial	S. D. Initial	Average Score Initial	S. D. Initial
	TEST IV				
2^1	20	309.8	1.15	324.2	1.91
2^4	23	307.3	1.36	323.25	1.5
3^3	20	216.68	2.33	218.75	2.55
	TEST IX				
2^1	20	108.3	2.94	126.03	2.88
2^4	23	117.21	3.23	119.81	4.217
3^3	20	65	2.89	75.	3.26
	TEST XVII				
2^1	20	59.95	1.38	68.3	.08
2^4	23	46.89	1.24	57.21	1.06
3^3	20	26.6	1.41	28.6	1.02
	TEST XIX				
2^1	20	12.95	1.19	13.2	3.71
2^4	23	11.99	1.93	12.5	2.34
3^3	20	7.4	2.62	8.94	2.54

Table V gives the average score, the number of cases, and the standard deviation of each group for the four tests. Using Garrett's formula for the significance of the difference and the data given in Table V, we can determine exactly how reliable are the differences obtained. The formula to be used is: $\frac{D}{\sigma_{diff}}$ where D is the actual difference in the average scores and σ_{diff} is $\sqrt{\sigma_{av_1}^2 + \sigma_{av_2}^2}$ The σ_{av} is equal to $\frac{\sigma_{dis}}{\sqrt{N}}$

For Test IV, the reliability of the difference between the superior group and the middle group for the initial test is:

which means that the chances are 99.9 in 100 that the real difference will be greater than zero.

In the same manner the reliability of the difference between the groups on the other tests is calculated and the results are given in Table VI on the following page.

TABLE VI

A Tabular Form of the Results of the Study Showing the Between Each Group and the Chances of a True Difference Greater than Zero.

Group	Initial	Final	Chances in 100 of a True Difference Greater Than Zero: Initial	Final
TEST IV				
2^1 and 2^4	6.5	1.5	99.9	93
2^4 and 3^3	153.	161.	99.9	99.9
TEST IX				
2^4 and 2^1	9.4		99.9	
2^1 and 2^4		5.71		99.9
2^4 and 3^3	56.9	39.2	99.9	99.9
TEST XVII				
2^1 and 2^4	32.5	50.2	99.9	99.9
2^4 and 3^3	52.	90.2	99.9	99.9
TEST XIX				
2^1 and 2^4	2.03	.725	98.	76.5
2^4 and 3^3	6.8	4.76	99.9	99.9

TABLE VII

The Gains Made by the Three Groups on the Tests.

Group	Test	Gain	Reliability
			Chances in 100
2^1	IV	14.4	99.9
2^4	IV	15.95	99.9
3^3	IV	2.07	99.
2^1	IX	17.73	99.9
2^4	IX	2.6	98.9
3^3	IX	10.	98.9
2^1	XVII	8.35	99.9
2^4	XVII	10.32	99.9
3^3	XVII	2.	99.9
2^1	XIX	.25	61.
2^4	XIX	.51	79.
3^3	XIX	1.54	97.

TABLE VIII

The Rank of the Three Groups on the Tests Based On the Amount of Gain.

Test	First	Second	Third
IV	2^{4}	2^{1}	3^{3}
IX	2^{1}	3^{3}	2^{4}
XVII	2^{4}	2^{1}	3^{3}
XIX	3^{3}	2^{4}	2^{1}

Table VII on page 31 gives the amount of gain and the reliability of that amount in terms of the number of chances in 100 that the gain is a true gain. Table VIII on page 32, gives the rank of each group as to the amount of gain made on the test. From this table we discover that the superior group made the greatest gain on test IX, was second on tests IV and XVII, and made the least gain on test XIX. The middle group made the greatest gain on tests IV and XVII, was second on test XIX, and made the least gain on test IX. The slow group made the greatest gain on test XIX, was second on test IX and made the least gain on tests IV and XVII. It seems, therefore, that the three groups vary only a little in their ability in speed, accuracy, comprehension, and arithmetic reasoning, as shown by the gains made on the tests over a period of twelve weeks. The superior group should have excelled the middle group in all the tests; and the middle group should have excelled the slow group in all the tests. According to the results of this study, however, we find no such difference. It is surprising to note from the data given in Table VIII that the slow group makes a greater gain than the middle group; and that the superior group makes less gain than the slow or middle groups on test XIX. From the same data, it is apparent that on no test do we find the order of gain to be the expected order of superior, middle and slow. The ranking on test IV is middle, superior and slow; on test IX, the ranking is superior, slow and middle; and on test XVII, the ranking is middle, superior and slow.

It is beyond the scope of this study to explain why the superior group did not excel the middle group and the slow groups in the various tests. Nor is it possible to explain why the slow group made greater gains in some of the tests, than either of the others. Perhaps the results would have been very much different if a larger number of cases could have been used in each group.

CHAPTER V

SUMMARY

The purpose of this study was to compare the scores made by the 2^1, 2^4, and 3^3 groups of arithmetic students in speed, accuracy, comprehension and arithmetic reasoning; and also to find the gains made by each group. Instruction is based on the following principle of enrichment; the course of study outlines more work for the 2^4 group than the 3^3 group; and even more work for the 2^1 group than for the 2^4 group. Enrichment includes more and different work. For example, in the teaching of positive and negative numbers the work required for the 3^3 group is the presentation of the idea of positive and negative numbers, but the 2^1 and 2^4 groups must be taught addition of positive and negative numbers; and the 2^1 group must also know subtraction of positive and negative numbers. The entire course of study for the three groups may be found in the appendix.

This experiment indicates that there is a difference in the attainment of the three groups and a rather significant difference which suggests real differences in relative abilities. In spite of the difficulties encountered in carrying out the study, the data in Chapter IV justifies our saying that there is a significant difference between the 2^1 group and the 2^4 group in speed, accuracy, comprehension, and arithmetic reasoning; and the

same figures show an even greater difference between the 2^4 group and the 3^3 group. The differences appear at the beginning of the experiment. The gains, however, are not what would be prognosticated.

The gains made by the three groups on the four tests are given in Table VII and from this data the ranking of the groups is obtained,. For example, on test IV the 2^1 or superior group made a gain of 14.4 points; the 2^4 or middle group made a gain of 15.95 points; and the 3^3 or slow group made a gain of 2.07 points. The ranking, therefore, is as follows: middle group, first; superior group, second; and slow group, third. Table VIII gives the ranking of the groups on all the tests. From these rankings, we can see that there is no uniformity of differences in the gains made by each group that correspond to mental ranks. Theoretically, one would expect the superior group to make the largest gain, and the slow group to make the smallest gain. This is not true from results of this experiment. If all the factors were controlled and the number of cases used were sufficiently large, this might have been true. One is not justified, therefore, in assuming general differences from a study which has only twenty cases in each group. The paucity of cases seems to be the weakness of most of the studies regarding the value of homogeneous grouping.

This study indicates distinct differences in ability of the three groups, but at the same time it shows that the gains made by each group are not what should be expected. In every test, except one, the superior group made a higher average score than the middle group; and in no test did the slow group make a higher average score than the middle group. This, however, was not true in the amount of gains made by the three groups; because on test XIX the slow group made a far greater gain than the superior or the middle group.

One can assume that there is a need for careful and large-scale experimentation in the field to determine ways in which individual differences in ability may be recognized and made to function in the school room. From this and other studies in the field of experimental education, it appears that the practice of homogeneous grouping is one of the devices which has not yet proved its value. That the scheme is not always dependable is shown by the fact that we did not obtain in all cases the results anticipated theoretically by the initial status of the group. The superior group did not make the gains in the tests which is expected of them. It may be because the subject matter is not so organized as to give the individuals of the group an opportunity to display their abilities. The method of teaching is probably not sufficiently differentiated for the distinct groups.

Whatever the reasons may be (judging from the results of this study), we may say that homogeneous grouping has not brought the desired and expected results. There should be theoretically in every case as great a difference between the superior and middle groups as there is between the middle and slow groups. We should find the superior group surpassing the middle group upon every test and the middle group surpassing the slow group in every regard. In addition to that, there should be distinctly appreciable differences which do not appear in this study.

CHAPTER VI

APPENDIX

The following pages show the computations for the data given in table VI on page 30 of chapter IV.

The reliability of the difference between the groups is found by means of Garrett's formula:

$$\frac{D}{\sigma_{diff}}$$

The reliability of the difference between group 2^4 and group 3^3 on the initial giving of test IV is:

$$\frac{90.62}{\sqrt{(.281)^2+(.521)^2}} = 153$$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero. For the final testing the reliability is:

$$\frac{104.5}{\sqrt{(.312)^2+(.57)^2}} = 161$$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero.

In test IX we find that group 2^4 excels group 2^1 in the initial giving og the test and the reliability of that difference is:

$$\frac{8.91}{\sqrt{(.658)^2+(.673)^2}} = 9.4$$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero.

$\frac{D}{\sigma_{diff}}$ for final testing is: $\frac{6.22}{\sqrt{(.644)^2+(.879)^2}} = 5.71$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

The reliability of the difference between group 2^4 and group 3^3 on initial testing of the same test is:

$$\frac{5.21}{\sqrt{(.673)^2+(.646)^2}} = 5.69$$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero.

$\frac{D}{\sigma_{diff}}$ for final testing is:

$$\frac{44.81}{\sqrt{(.879)^2+(.729)^2}} = 39.2$$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

In Test XVII, the reliability of the difference between group 2^1 and group 2^4 in the initial testing is:

$$\frac{13.06}{\sqrt{(.308)^2+(.258)^2}} = 32.5$$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

$\frac{D}{\sigma_{diff}}$ for final testing is: $\frac{11.09}{\sqrt{(.018)^2+(.221)^2}} = 50.2$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

For the same test the reliability of the difference between group 2^4 and group 3^3 on the initial giving is:

$$\frac{20.29}{\sqrt{(.258)^2+(.294)^2}} = 52$$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

D

σ diff for the final testing is:

$$\frac{28.61}{\sqrt{(.221)^2+(.228)^2}} = 90.2$$

which means that the chancesare 99.9 in 100 that the difference will be greater than zero.

For test XIX, we find the reliability of the difference between Group 2^1 and group 2^4 in the initial testing is:

$$\frac{.96}{\sqrt{(.215)^2+(.402)^2}} = 2.08$$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero.

D

σ diff. for final testing is:

$$\frac{.7}{\sqrt{(.834)^2+(.487)^2}} = .725$$

which means that the chancesare 99.9 in 100 that the difference will be greater than zero.

The reliability of the difference in the initial testing of the same test for group 2^4 and 3^3 is:

$$\frac{4.59}{\sqrt{(.402)^2+(.546)^2}} = 6.8$$

which means that the chances are 99.9 in 100 that the difference will be greater than zero.

D

σ diff. for final testing is: $\frac{3.56}{\sqrt{(.487)^2+(.568)^2}} = 4.76$

which means that the chances are 99.9 in 100 that the difference will always be greater than zero.

Table IX, at the end of this chapter, briefly sums up the above facts and shows that if the sampling is a random sampling, the chances in all cases but three are 99.9 in 100 that there will be a true difference greater than zero. Table X gives the tank of each group on the four tests.

Using the data given in Table VIII and the formula $\frac{D}{\sigma \text{ diff}}$ we can find the amount of gain each group made and the reliability of the gain.

On test IV, the 2^1 group made a gain of 14.4 points. The reliability of the gain is:

$$\frac{14.4}{\sqrt{(.257)^2+(.427)^2}} = 28$$

The 2^4 group made a gain of 15.95 points and the reliability is

$$\frac{15.95}{\sqrt{(.283)^2 + (.312)^2}} = 37.8$$

The 3^3 group made a gain of 2.07 points and the reliability is

$$\frac{2.07}{\sqrt{(.521)^2 + (.57)^2}} = 2.6$$

On test IX, the 2^1 group made a gain of 17.73 points. The reliability of the gain is

$$\frac{17.73}{\sqrt{(.457)^2 + (.644)^2}} = 19.3$$

The 2^4 group made a gain of 2.6 points and the reliability is

$$\frac{2.6}{\sqrt{(.673)^2 + (.878)^2}} = 2.35$$

The 3^3 group made a gain of 10 points and the reliability is:

$$\frac{10}{\sqrt{(.646)^2 + (.729)^2}} = 10.2$$

On test XVII, the 2^1 group made a gain of 8.35 points. The reliability of the gain is:

$$\frac{8.35}{\sqrt{(.308)^2 + (.018)^2}} = 27.1$$

The 2^4 group made a gain of 10.32 points and the reliability is

$$\frac{10.32}{\sqrt{(.258)^2 + (.221)^2}} = 30.3$$

The 3^3 group made a gain of 2 points and the reliability is:

$$\frac{2}{\sqrt{(.314)^2 + (.228)^2}} = 5.1$$

On test XIX, the 2^1 group made a gain of .25 points. The reliability of the gain is:

$$\frac{.25}{\sqrt{(.266)^2 + (.829)^2}} = .27$$

The 2^4 group made a gain of .51 points and the reliability is:

$$\frac{.51}{\sqrt{(.402)^2+(.487)^2}} = .8$$

The 3^3 group made a gain of 1.54 points and the reliability is:

$$\frac{1.54}{\sqrt{(.588)^2+(.568)^2}} = 1.89$$

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LIST OF TABLES

Table IX

Eighth Grade

tent	Where taught	Aim	Drill
How to solve problems			
Expressing relations between numbers by 1. Rules 2. Formulas 3. Tables 4. Graphs	xyz xy x	Read tables and graphs Build through all four steps in class Build through all four steps	Fundamental operations 1. Integers 2. Fractions a. Common b. Decimal
Equations	xyz xy x	Solve by intuition Introduce axioms but solve by intuition Solve by axioms	Idea of percent Check results by substitution
		End of first six weeks	
Practical measurements 1. Finding known distances by a. Direct measurements b. Scale drawings c. Right triangles 1. Pythagorean 2. Tangents	xyz xy x xy	Find unknown distances by direct measurements and scale drawings Develop three methods Develop as many methods of finding unknown distances as time permits Teach square root	Commonly used tables of weight and measurements 1. Linear measure a. English b. Metric (1) Contimeter (2) Meter 2. Square measure used in finding areas of a. Squares b. Parallelograms c. Triangles d. Circles 3. Cubic measure used in finding volumes of a. Rectangular solid b. Cylinders 4. Liquid measure 5. Dry measure 6. Avoirdupois weight Square root omit in "Z" group
		End of second six weeks	

tent	Where taught	Aim	Drill
Business principles	xyz	Teach use of checkbooks, checks and stubs	Cancellation 1. Aliquot parts
Commercial	xy	Interpret bank statement	
Bank	x	Teach "clearing house"	Use of a commercial bank
Promissory	xyz	Teach the "securing" of notes	1. Deposit slip
	xyz	Interpret notes	2. Passbook
	xy	Teach buying and selling of notes	3. Checkbook
Thrift		Show how money will accumulate	4. Checks and stubs
1. Savings Accounts		by means of Savings Accounts	5. Statements in xy groups
	xyz	1. Interpret by class working as a group	Simple interest
	xy	2. Interpret by class working as individuals	1. Decimals
			2. Percent
		End of Third Six Weeks	
2. Compound Interest	xyz	Show how money will accumulate from - 1. Compound interest	Decimals
		a. Develop by use of tables as class problems	Common fractions
	xy	b. Develop by use of tables	
	xy	c. Develop by individuals performing all steps	
3. Building & Loan Assn.		2. Building and Loan Assn. Teach uses	
		a. Investments	
		b. Loans	
	xy	Explain organization	
		3. Bonds	
		Teach uses	
		Teach kinds	
	xyz	a. Civics	
		b. Industrial	
	xy	Buy and sell	
4. Stocks		4. Stocks	
	xyz	Teach uses	
		Teach kinds	
		a. Common	
		b. Preferred	
	xy	Buy and sell	
		End of Fourth Six Weeks	
Protection	xyz	Teach purpose, use and need	
1. Insurance	xy	Teach terminology	
a. Property	x	Explain organization and teach	Budget in "X" group only
b. Life		how rates are determined	
2. Taxes	xyz	Teach purpose of Taxation	Decimals
		Civic necessity	
	xyz	Show how the "valuation" for taxable purposes is obtained	
	xy	Show how the tax rates are determined	
	xy	Show different ways of stating rates of taxes	

tent	Where taught	Aim	Drill
Exchange		Teach	
1.Domestic	xyz	Postoffice money orders	
	xyz	Express money orders	
	xyz	Travelers checks	
	xy	Drafts	
2. Foreign	xyz	Teach the names of foreign units of money	
	xy	Teach the appropriate monetary values of foreign units of money	
, Positive nd negative umbers	xyz	Introduce positive and negative numbers	
	xy	Addition	
	x	Teach subtraction	
		End of Sixth Six Weeks	

Table X

Standard Mathematical Service

COMPASS DIAGNOSTIC TESTS IN ARITHMETIC

RUCH—KNIGHT—GREENE—STUDEBAKER

EDITED BY G. W. MYERS

TEST IV: DIVISION OF WHOLE NUMBERS: FORM A

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

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

School..... Date.....

(Name) (City) (State)

SUMMARY OF PUPIL'S SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	PART 6	PART 7	TOTAL
Scores on Parts of Test								
Educational Age Equivalent								
Grade Equivalent of Score								

PART 1—THE VOCABULARY OF DIVISION

Directions: **Four possible answers follow each of the first seven exercises below. Draw a line under the *one* of the four possible answers which makes the sentence true.**

1. An example of division is: $6+3=9$ $18-4=14$ $8\div2=4$ $14\times4=56$
2. In the example, $8\div4=2$, 2 is the: dividend quotient remainder divisor
3. The sign used to indicate division is: $+$ $\div$ $-$ $\times$
4. The example, $9\overline{)810}$, would be solved by: multiplication division subtraction addition
5. In the example, $16\overline{)49}$, the dividend is: 16 3 49 1

$$\begin{array}{r} 3 \\ 16\overline{)49} \\ \underline{48} \\ 1 \end{array}$$

6. The one of the following questions which calls for division is: Twelve is $\frac{1}{6}$ of what number? How many 19's are there in 471? What number is 6 times 18? What number is 8 less than 12?
7. Division is checked by: divisor $\times$ dividend quotient $\times$ divisor $+$ remainder divisor $\times$ quotient $-$ remainder dividend $\times$ quotient $+$ remainder

8-10. Copy the following three examples in form for working. Do not work them, however. Copy directly below the printed examples.

8. $89672\div34$

9. $90063\div607$

10. $1439652\div7308$

Score on Part 1 = Number right =.....
[Total possible score = 10 points]

PART 2—FUNDAMENTALS OF SHORT DIVISION

How many 9's in 72?.....	45 ÷ 5 =	9)81	7 ÷ 7 =
How many 8's in 32?.....	28 ÷ 4 =	6)42	0 ÷ 8 =
How many 6's in 36?.....	18 ÷ 2 =	8)72	63 ÷ 9 =
56 divided by 7 is.....	27 ÷ 3 =	7)63	54 ÷ 6 =
48 divided by 8 is.....	63 ÷ 7 =	6)4476	4)36036

Score on Part 2 = Number right =.....
[Total possible score = 20 points]

PART 3—SHORT DIVISION WITH CARRYING

Directions: **Work the next twelve examples. Write only the answers.**

2)2648	5)1055	3)69690	4)88088
7)448	6)14812	5)855	3)2926
9)6219	4)27608	8)65084	2)10818

Score on Part 3 = Number right =.....
[Total possible score = 12 points]

PART 4—MULTIPLICATION, ADDITION, AND SUBTRACTION USED IN DIVISION IN PARTS 2, 3, 5, 6, AND 7

Multiply (*Do not divide*):

8 × 6 =	7 × 5 =	3 × 8 =	5 × 8 =	3 × 7 =	2 × 7 =	0 × 0 =	7 × 9 =
4 × 9 =	6 × 0 =	7 × 0 =	5 × 4 =	0 × 6 =	3 × 6 =	1 × 6 =	7 × 2 =
7 × 8 =	9 × 6 =	5 × 2 =	0 × 5 =	4 × 6 =	1 × 5 =	7 × 6 =	6 × 6 =
5 × 6 =	9 × 0 =	3 × 4 =	9 × 4 =	0 × 2 =	6 × 8 =	1 × 4 =	7 × 3 =
8 × 0 =	8 × 4 =	1 × 2 =	2 × 9 =	1 × 0 =	5 × 9 =	2 × 8 =	3 × 3 =
9 × 9 =	9 × 8 =	2 × 4 =	8 × 8 =	0 × 7 =	2 × 6 =	6 × 7 =	8 × 7 =
5 × 0 =	9 × 3 =	1 × 9 =	6 × 9 =	0 × 4 =	1 × 7 =	7 × 7 =	8 × 9 =
6 × 4 =	9 × 2 =	2 × 2 =	4 × 2 =	3 × 9 =	0 × 9 =	2 × 0 =	
8 × 5 =	7 × 1 =	6 × 1 =	4 × 7 =	6 × 2 =	4 × 8 =	4 × 5 =	

Add (*Do not multiply*):

56 + 6 =	36 + 7 =	8 + 8 =	36 + 2 =	4 + 8 =	1 + 6 =	1 + 3 =
21 + 1 =	0 + 1 =	24 + 2 =	5 + 7 =	3 + 5 =	10 + 4 =	8 + 3 =
32 + 6 =	14 + 4 =	42 + 1 =	35 + 4 =	4 + 1 =	20 + 3 =	20 + 4 =
6 + 1 =	0 + 4 =	18 + 1 =	64 + 7 =	0 + 9 =	12 + 4 =	0 + 5 =
45 + 3 =	40 + 4 =	32 + 3 =	40 + 7 =			

Go to the next page and finish Part 4.

PART 4—Continued

Subtract (*Do not add*):

44 − 42 =	41 − 36 =	35 − 35 =	22 − 21 =	81 − 81 =	36 − 36 =
10 − 10 =	10 − 8 =	14 − 12 =	8 − 5 =	29 − 27 =	62 − 54 =
27 − 24 =	65 − 64 =	8 − 8 =	44 − 40 =	28 − 28 =	52 − 48 =
5 − 5 =	16 − 15 =	9 − 9 =	0 − 0 =	28 − 24 =	18 − 18 =

2550	1518	412	1207	427	4389	1064	222	3337
−2448	−1480	−412	−1064	−384	−4389	−1064	−222	−2670
6675	282	2513	205	599	1228	89	32	1020
−6230	−240	−2436	−156	−560	−1184	−74	−27	−816
3920	447	21	380	87	320	72	2040	1854	492
−3920	−296	−18	−296	−80	−320	−40	−2040	−1854	−468
195	4450	796	432	86	1436	258	672	248	1692
−192	−4450	−627	−432	−63	−1330	−252	−672	−234	−1254

Score on Part 4 = Number right = ...
[Total possible score = 164 points]

PART 5—ESTIMATING THE FIRST QUOTIENT FIGURE

Directions: **Write only the first correct quotient figure in its proper place. Do not take time to finish the examples. Look at the samples before you begin to work.**

SAMPLES: $8\overline{)896}$ (1) $87\overline{)563}$ (6)

$48\overline{)282}$	$74\overline{)222}$	$9\overline{)32}$	$296\overline{)447}$	$64\overline{)195}$	$408\overline{)1020}$	$9\overline{)2}$
$560\overline{)3920}$	$89\overline{)667}$	$627\overline{)796}$	$40\overline{)7}$	$89\overline{)333}$	$627\overline{)1692}$	$48\overline{)427}$
$40\overline{)72}$	$627\overline{)4389}$	$560\overline{)392}$	$89\overline{)445}$	$296\overline{)380}$	$206\overline{)1854}$	$64\overline{)35}$
$296\overline{)1228}$	$48\overline{)432}$	$296\overline{)1518}$	$206\overline{)412}$	$74\overline{)89}$	$9\overline{)54}$	$40\overline{)320}$
$40\overline{)87}$	$627\overline{)0}$	$74\overline{)15}$	$408\overline{)2550}$	$9\overline{)21}$	$408\overline{)2040}$	$560\overline{)599}$

Score on Part 5 = Number right × 2 = ...
[Total possible score = 70 points]

PART 6—FUNDAMENTALS OF LONG DIVISION; CHECKING

Directions: **Work the eleven examples below. Check numbers 10 and 11 where indicated.**

1. $9\overline{)21242}$

2. $64\overline{)1955}$

3. $74\overline{)22289}$

4. $40\overline{)87207}$

5. $890\overline{)333750}$

6. $206\overline{)1854412}$

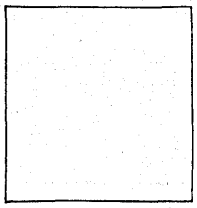
7. $560\overline{)59920}$

8. $408\overline{)255000}$

9. $296\overline{)1228780}$

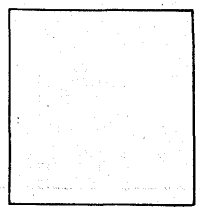
10. $48\overline{)28272}$

Check No. 10 below:



11. $627\overline{)796290}$

Check No. 11 below:



Score on Part 6 = Number right × 10 = ...
[Total possible score = 110 points]

PART 7—FINDING ERRORS IN LONG DIVISION

Directions: **Study the five examples below. Some of the examples have mistakes in them. You are to put a heavy line through the first mistake you find in each example, as shown in the sample.**

SAMPLE:

```
   20
213)4260
  416
  100
```

1.

```
   454
266)120764
  1064
  1436
  1330
   1064
   1044
     20
```

2.

```
   276
78)20528
  156
  592
  546
   468
   468
```

3.

```
    38
84)25872
  252
   672
   672
```

4.

```
   519
406)251314
  2436
   771
   406
  3654
  3654
```

5.

```
   135
63)8642
  63
  234
  199
  352
  315
   37
```

Score on Part 7 = Number right × 5 = ...
[Total possible score = 25 points]

Standard Mathematical Service

COMPASS DIAGNOSTIC TESTS IN ARITHMETIC

RUCH—KNIGHT—GREENE—STUDEBAKER

EDITED BY G. W. MYERS

TEST IX: ADDITION, SUBTRACTION, AND MULTIPLICATION OF DECIMALS: FORM A

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

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

School..... Date.....

(Name) (City) (State)

SUMMARY OF PUPIL'S SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	TOTAL
Scores on Parts of Test						
Educational Age Equivalent						
Grade Equivalent of Score						

PART 1—VOCABULARY AND NOTATION OF DECIMALS

Directions: **Below are ten numbers written in words. Write each of these numbers in decimal form on the line at its right. Study the samples.**

SAMPLES: four-tenths *.4*

fifteen *15*

six-tenths .....

two and three-tenths .....

thirty and seven-tenths .....

eight hundred .....

three-thousandths .....

eight-hundredths .....

twenty-four thousandths .....

three thousand .....

twenty-two hundredths .....

two hundred ninety-six thousandths .....

Directions: **Study the number at the left below and then write on the lines the place value of each of the figures. Notice that the place value of the first figure has already been filled in correctly.**

68247.5391

6 *ten thousands*

8.....

2.....

4.....

7.....

5.....

3.....

9.....

1.....

Turn over the page and finish Part 1.

PART 1—Continued

Directions: **Draw a line under the larger number in each pair below. Study the sample.**

SAMPLE: 247 24.7

87	98	35761	3576.9	5.49	5.5
87	8.9	4000	.0008	2.04	2.40
.92	.909	7	7.7	0.318	.3018
14.00	1.496	34	32.6	1.437	0.437

Directions: **Write on each line below a number which will make each statement true.**

.4 is one-tenth of.....

8 is ten times as large as.....

24 is a hundred times as large as.....

3.5 is.....times as large as .35

84 multiplied by 1000 equals.....

.67 is $\frac{1}{100}$ of.....

36 is one-tenth as large as.....

36 is ten times as large as.....

21 is one-hundredth as large as.....

21 is a hundred times as large as.....

19 is one-thousandth as large as .....

19 is a thousand times as large as.....

Directions: **Write each number below in words. Study the sample.**

SAMPLE: .7 *seven-tenths*

6 .....

60 .....

600 .....

6000 .....

9 .....

.9 .....

.09 .....

.009 .....

5452 .....

4.247 .....

Score on Part 1 = Number right =.....
[Total possible score = 52 points]

PART 2—CHANGING FRACTIONS AND MIXED NUMBERS TO DECIMAL FORM, AND THE REVERSE

Directions: **Change the fractions and mixed numbers below to decimal form. Carry to three decimals if necessary.**

$\frac{1}{2}$ =	$2\frac{1}{5}$ =	$27\frac{2}{3}$ =	$9\frac{4}{5}$ =	$31\frac{214}{1000}$ =
$\frac{1}{4}$ =	$4\frac{1}{3}$ =	$\frac{9}{10}$ =	$2\frac{1}{8}$ =	$85\frac{27}{1000}$ =
$\frac{3}{4}$ =	$6\frac{2}{5}$ =	$\frac{74}{100}$ =	$6\frac{5}{6}$ =	$\frac{973}{100}$ =

Go to the next page and finish Part 2.

PART 2—Continued

Directions: **Change the decimals below to fraction form. Reduce fractions to lowest terms wherever possible.**

$.16\frac{2}{3}=$	19.17 =	13.875 =	5.75 =	$.66\frac{2}{3}=$
3.5 =	2.03 =	.077 =	.09 =	2.375 =
$6.83\frac{1}{3}=$	8.25 =	4.341 =	.6 =	13.625 =

Score on Part 2 = Number right = ...
[Total possible score = 30 points]

PART 3—FUNDAMENTALS OF ADDITION AND SUBTRACTION OF DECIMALS

Add:

1.	2.
4.72	.7254
8.34	.3219
9.68	.4380
4.28	.0473

Copy correctly and add these numbers. Do your work under the proper number in the spaces below.

3. 4.27 + 34.6 + 93.02 + 647.1
4. 34.5 + .09 + 627 + 3.014
5. 244 + 24.4 + 2.44 + .244 + .0244
6. Nine-tenths plus two, plus six and three-tenths, plus eighteen and five-hundredths

3.	4.	5.	6.

Subtract (*Do not add*):

7.	8.	9.
72.443	9.346	.0004
−51.002	−4.132	−.00019

Copy correctly and subtract these numbers. Do your work under the proper number in the spaces below:

10. 36.724 − 36.0724
11. 921.008 − 911.25
12. Find the difference between six and three-hundredths and four and two-tenths.

10.	11.	12.

Score on Part 3 = Number right × 5 = ...
[Total possible score = 60 points]

PART 4—PLACE VALUE AND POINTING IN MULTIPLICATION OF DECIMALS

Multiply:

$46 \times 10 =$	$3.2 \times 100 =$	$7.05 \times 1000 =$	$.97 \times 10 =$
$932 \times 100 =$	$.7 \times 1000 =$	$.84 \times 10 =$	$7510.3 \times 100 =$
$376 \times 1000 =$	$7.6 \times 10 =$	$7.268 \times 100 =$	$95.206 \times 1000 =$
$.046 \times 0 =$	$.04 \times 100 =$	$.9324 \times 1000 =$	

Directions: The figures of the answers to the examples below are already printed in correct order. The decimal points and some zeros needed in locating the decimal point are missing. Put the decimal points in the proper places. Mark very plainly.

$734 \times 75.08 =$	5 5 1 0 8 7 2	$9315.2 \times .004 =$	3 7 2 6 0 8
$488.2 \times 300.4 =$	1 4 6 6 5 5 2 8	$.005 \times .3214 =$	1 6 0 7 0
$93.14 \times 5.182 =$	4 8 2 6 5 1 4 8	$7618.9 \times 2148 =$	1 6 3 6 5 3 9 7 2
$.5320 \times 73.18 =$	3 8 9 3 1 7 6 0	$39.872 \times 7679 =$	3 0 6 1 7 7 0 8 8
$5678 \times .3914 =$	2 2 2 2 3 6 9 2	$.7001 \times 625.2 =$	4 3 7 7 0 2 5 2

Directions: Find the products for each multiplication example below.

654	760.1	.273	450.3	.9182
$\times .89$	$\times 30.5$	$\times .194$	$\times .2653$	$\times .2104$

Score on Part 4 = Number right = ...
[Total possible score = 30 points]

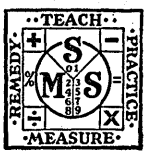
PART 5—FINDING ERRORS IN POINTING ANSWERS

Directions: The figures in the answers below are correct as printed. But there are mistakes in placing the decimal point. Cross out the answers and write the correct answers below.

.721	67.3	4.721	38.214	9219.30	.817003
.038	51.4	6.548	-12.163	-213.14	$-.512914$
.961	7.2	6.001	.026051	900616	304089
.500	81.6	.94			
.2220	21.9	3.614			
	5.3	21824.			
	2347				

72.62	3.256	21007	.983
$\times 2.4$	$\times 4.11$	$\times 40.12$	$\times .041$
29048	3256	42014	983
14524	3256	21007	3932
1742.88	13024	840280	.40303
	1.338216	84280084	

Score on Part 5 = Number right $\times 2$ = ...
[Total possible score = 20 points]



Standard Mathematical Service

COMPASS DIAGNOSTIC TESTS IN ARITHMETIC

RUCH—KNIGHT—GREENE—STUDEBAKER

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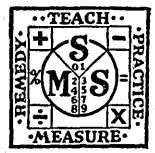

TEST XVII: PROBLEM ANALYSIS: ELEMENTARY: FORM A

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

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

School..... Date.....
(Name) (City) (State)

SUMMARY OF PUPIL'S SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	TOTAL
Scores on Parts of Test						
Educational Age Equivalent						
Grade Equivalent of Score						

Do Not Turn the Page until Told to Do So.

PROBLEMS	PART 1—COMPREHENSION	PART 2—WHAT IS GIVEN
Read each problem below. Then work across the two facing pages to the right, doing all the Parts for one problem before going to the next. Do not go back and work on a Part after you have completed the one following. *Read the Sample below.*	*Put a cross (×) on the line before the **one** statement below which is true for each problem.*	*Put a cross (×) on the line before **every** statement below which tells a fact given in the problem.*
Sample [*Read the problem*] ***My reading book has 124 pages. I have read 72 pages. How many pages do I have left to read?*** →	Sample [*Check (×) true statement*] ___ I have read all my reader. ___ I have read less than half my book. ___ I have the most of my book to read. × I have read a little more than half my book. ___ I should add to get the answer to this problem. →	Sample [*Check (×) what is given*] ___ Number of pages to read × Number pages in book. × Number of pages I have read. ___ Number of stories I have read. ___ Number of pages with pictures on them. →
Remember: **Work across the page to the right.**		
[*Read the problem*] ***Problem 1*** ***Our baseball team played 7 games this summer. We lost 2 and tied none. How many games did we win?*** →	[*Check true statement*] ___ Team won all games played. ___ Team lost all games played. ___ Team won more than it lost. ___ Team lost half of the games played. ___ Team won about half of the games played. →	[*Check what is given*] ___ Number of games played ___ Number of boys on team ___ Number of games tied. ___ Number of games won. ___ Number of games lost. →
[*Read the problem*] ***Problem 2*** ***There are 24 books to be divided equally among 8 children. How many books should each child receive?*** →	[*Check true statement*] ___ There are more children than books. ___ There are exactly twice as many books as children. ___ There are three times as many children as books. ___ There are just as many books as there are children. ___ There are three times as many books as children. →	[*Check what is given*] ___ Number of books per child ___ Number of books. ___ Cost of the books ___ Number of children. ___ Number of children who will not get a book. →

PART 3—WHAT IS CALLED FOR	PART 4—PROBABLE ANSWER	PART 5—CORRECT SOLUTION
Put a cross (×) on the line before the statement below which tells what is called for in the problem.	*Put a cross (×) on the line before the **one** statement below which gives the nearest probable answer to the problem. Do not take time to work the problems.*	*Put a cross (×) on the line before the **one** correct solution given for each problem. Figure in the margin if you want to.*
Sample [*Check (×) what is called for*] __ Number of pages in book. X Number of pages yet to read. __ Number of pages I have read. __ Number of stories I have read. __ Number of pages with pictures. →	**Sample** [*Check (×) probable answer*] __ One book. __ About 124 pages. __ About 72 stories. X About 50 pages. __ About 196 pages. →	**Sample** [*Check (×) correct solution*] __ 124+72=196 __ 124+72=196 196÷ 2= 98 __ 124−62= 62 62+72=134 134÷ 2= 52. __ 124−72=72. X 124−72=52.
Remember: **Work across the page to the right.**		
[*Check what is called for*] __ Number of games lost. __ Number of boys on team. __ Number of games won. __ Number of games where score was tied. __ Number of games played. →	[*Check probable answer*] __ 9 boys. __ 6 schools. __ About 7 boys. __ 9 games. __ About 5 games. →	[*Check correct solution*] __ 7+2=9 __ 7−2=5 __ $7\div3=3\frac{1}{2}$ __ 7×2=14 __ 7×2=14; 14−9=5 **Now Start Problem 2.**
[*Check what is called for*] __ The number of books. __ The number of children. __ Total number of books and children. __ Number of books for each child. __ Number of children not getting a book. →	[*Check probable answer*] __ About 16 books. __ 192 books. __ 32 children. __ About 4 books. __ 3 children. →	[*Check correct solution*] __ 24×8=192 __ 24−8=16 __ 24÷8=3 __ 24− 8=32 32× 3=96 96÷32= 3 __ 24+ 8=32

Turn over the page to Problem 3.

PROBLEMS	PART 1—COMPREHENSION	PART 2—WHAT IS GIVEN	A
[*Read the problem*] ***Problem 3*** ***A farmer had 120 sheep. He sold 14 sheep to one man, 3 to a second man, and 9 to another. How many sheep did he sell altogether?***	[*Check true statement*] ____ More sheep were sold to one man than to the other two men. ____ All sheep were sold to one man. ____ Sold exactly as many sheep to one man as to the other two men. ____ The man sold all the sheep he had. ____ Sold one-third of the sheep to each man.	[*Check what is given*] ____ Cost of the sheep per head ____ Number of sheep sold t second man. ____ Number sold to first man ____ Total amount paid for th sheep. ____ Number sheep sold t third man.	
[*Read the problem*] ***Problem 4*** ***My mother buys 2 quarts of milk each morning. How many quarts does she buy in one week?***	[*Check true statement*] ____ My mother buys milk twice a week. ____ My mother buys only one quart of milk each morning. ____ My mother buys two quarts of milk every other morning. ____ My mother buys two quarts of milk each morning. ____ My mother buys no more than two quarts of milk per week.	[*Check what is given*] ____ Number of weeks. ____ Number of quarts of mil each morning. ____ Number of quarts ever other morning. ____ Number of quarts eac week. ____ Number of mornings with out milk.	
[*Read the problem*] ***Problem 5*** ***I had a dime and a penny. I bought some apples for 8 cents and some candy for 3 cents. How much money did I have left?***	[*Check true statement*] ____ I had more dimes than pennies. ____ I spent as much for candy as for apples. ____ I spent more for apples than for candy. ____ I spent more for candy than for apples. ____ I had more pennies than dimes.	[*Check what is given*] ____ Number of dimes befo spending any. ____ Amount of money spe for apples. ____ Number of pennies I ha ____ Amount of money spe for candy. ____ Total amount spent f both apples and cand	
[*Read the problem*] ***Problem 6*** ***If a boy saves 5 cents a day, how much more will he need to save to make his total savings fifty cents in seven days?***	[*Check true statement*] ____ A boy saves more one day than another. ____ A boy saves five cents in a week. ____ A boy saves exactly fifty cents in a week. ____ After saving for seven days the boy still has less than fifty cents. ____ A boy saves more than a half-dollar in a week.	[*Check what is given*] ____ Amount of money bo saves each day. ____ Amount boy saves in thr days. ____ Number of days he save his money. ____ The amount he spent eac day. ____ The difference between h savings and fifty cent	

PART 3—WHAT IS CALLED FOR	PART 4—PROBABLE ANSWER	PART 5—CORRECT SOLUTION
[*Check what is called for*] _ Amount received for the sheep. _ Number of sheep sold to one man. _ Number of sheep the farmer had altogether. _ Number of men buying sheep. _ Number of sheep sold to the three men.	[*Check probable answer*] ____ 2 sheep. ____ 5 men. ____ About 27 dollars. ____ 5 sheep. ____ About 25 sheep.	[*Check correct solution*] ____ $14-9=5$ ____ $14+9+3=26$ ____ $14\times9=126$ ____ $14+9=13$ ____ $14+9=23$
[*Check what is called for*] _ Amount of milk bought each month. _ Amount of milk bought each morning. _ Amount of milk bought in one week. _ Number of days in a week. _ Number of days without milk.	[*Check probable answer*] ____ About 9 quarts. ____ About 15 quarts. ____ 3.5 quarts. ____ About 14 days. ____ 7 days.	[*Check correct solution*] ____ $2+7=9$ ____ $7\times2=16$ ____ $7-5=2$ ____ $2\times7=14$ ____ $7-2=5$
[*Check what is called for*] _ Amount of money I spent. _ Amount of money I had left. _ Amount of money I had to spend. _ Amount spent for apples. _ Amount spent for candy.	[*Check probable answer*] ____ About 9 cents. ____ 2 apples. ____ 0 cents. ____ 1 cent. ____ 11 apples.	[*Check correct solution*] ____ $10+1=11$, $8+3=11$, $11-11=0$ ____ $10+1=11$, $11-3=8$ ____ $1+1=2$, $2+3=5$ ____ $10+1=11$, $11-8=3$ ____ $10+1+3+8=22$
[*Check what is called for*] _ How much less than fifty cents will he have in one week. _ Amount of money boy saves each day. _ Amount saved in six days. _ Total amount of money boy had. _ Amount saved in one month.	[*Check probable answer*] ____ 15 days. ____ About 7 days. ____ 85 days. ____ About 16 cents. ____ 1 week.	[*Check correct solution*] ____ $6\times5=30$, $50-30=15$ ____ $50+5=55$ ____ $50\div5=10$, $10\times7=70$, $70-50=20$ ____ $50-5=45$ ____ $5\times7=35$, $50-35=15$

PROBLEMS	PART 1—COMPREHENSION	PART 2—WHAT IS GIVEN	PA
[*Read the problem*] ***Problem 7*** ***We drove our auto 4 miles to the railway station and there took a train on which we rode 3 hours at 40 miles per hour. How far did we ride altogether that day?***	[*Check true statement*] ____ We rode on the train all day. ____ We rode only to the station. ____ We rode 40 miles per hour in the auto. ____ We rode only on the train. ____ We rode much farther on the train than in the auto.	[*Check what is given*] ____ Distance from home t station. ____ Distance we rode on trai ____ Speed of train. ____ Time we rode on the trai ____ Speed of auto.	
[*Read the problem*] ***Problem 8*** ***If you found 9 eggs in each of 4 nests, how many dozen eggs did you find?***	[*Check true statement*] ____ More than a dozen eggs were found in each nest. ____ Eggs were found in a dozen nests. ____ All nests contained a dozen eggs. ____ There will be some multiplication in the solution of this problem. ____ Each nest contained only one egg.	[*Check what is given*] ____ Number of eggs in o dozen. ____ Number of eggs in eac nest. ____ Number of nests. ____ Number of dozens of egg found. ____ Number of empty nests.	
[*Read the problem*] ***Problem 9*** ***A boys' baseball club has $3.50 to spend. If they buy a bat for $1.50, how many balls at $1.00 each can they buy with the remainder?***	[*Check true statement*] ____ As many baseballs as bats were bought. ____ The boys purchased two bats and one baseball. ____ The purchase of one bat and two baseballs took all the money. ____ A baseball and a bat cost the same. ____ A baseball for each member of the club was bought.	[*Check what is given*] ____ Number of baseba bought. ____ Number of bats bough ____ Cost of one bat. ____ Amount club had to spen ____ Cost of one ball.	
[*Read the problem*] ***Problem 10*** ***Two boys sold a mink hide for $4.00 and a muskrat hide for $2.00. They each shared alike in the money. How much did each receive?***	[*Check true statement*] ____ One boy received twice as much money as the other. ____ Both boys received the same amount of money. ____ The two hides sold for the same price. ____ One hide sold for three times the price of the other. ____ One boy received only half as much as the other.	[*Check what is given*] ____ Price of mink hide. ____ Amount each received. ____ Price of muskrat hide. ____ Total amount from sa of hides. ____ The money was divide equally between th boys.	

PART 3—WHAT IS CALLED FOR	PART 4—PROBABLE ANSWER	PART 5—CORRECT SOLUTION
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Distance we rode on train alone.	____ 132 miles.	____ { 40 + 4 = 44 44 × 3 = 132
__ Distance from home to station.	____ About 124 hours.	____ { 40 × 3 = 120 120 + 4 = 124
__ Speed of train.	____ About 280 miles.	____ { 40 × 3 = 120 4 × 4 = 16 120 + 16 = 136
__ Total distance we rode.	____ 148 hours.	____ { 40 × 3 = 144 144 + 4 = 148
__ Speed of auto.	____ About 123 miles.	____ { 4 + 3 = 7 40 × 7 = 280
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Total number of eggs.	____ Almost 36 dozen.	____ { 9 × 4 = 39 39 ÷ 13 = 3
__ Number of eggs in each nest.	____ About $3\frac{1}{4}$ dozen.	____ 9 × 4 = 36
__ Number of dozens of eggs altogether.	____ 4 nests.	____ { 12 × 4 = 48 9 + 4 = 13 48 ÷ 13 = 4
__ Number of nests.	____ 3 eggs.	____ { 9 × 4 = 36 36 ÷ 12 = 3
__ Number of nests containing 4 eggs.	____ 1 dozen.	____ { 4 + 9 = 12 12 ÷ 12 = 1
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Total money the ball club had to spend.	____ About 3 balls.	____ { 3.50 + 1.50 = 5.00 5.00 ÷ 1.00 = 5
__ Cost of bat.	____ 2 bats.	____ { 3.50 − 1.00 = 3.00 3.00 ÷ 1.50 = 2
__ Number of bats bought.	____ 6 balls.	____ { 3.50 − 1.50 = 2.00 2.00 ÷ 1.00 = 2
__ Cost of baseball.	____ 5 bats.	____ 3.50 + 1.50 + 1.00 = 6.00
__ Number of baseballs the club can buy.	____ 1 bat.	____ { 1.50 + 1.00 = 2.50 3.50 − 2.50 = 1.00 1.00 ÷ 1.00 = 1
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Price of mink hide.	____ About 3 hides.	____ { 4.00 ÷ 2 = 2.00 2.00 + 2.00 = 4.00
__ Total amount of money from sale of hides.	____ 2 boys.	____ 4.00 + 2.00 = 6.00
__ Amount of money each boy should have received.	____ About $2.96.	____ { 4.00 + 2.00 = 6.00 6.00 ÷ 3 = 2.00
__ Price of muskrat hide.	____ 6 dollars.	____ { 4.00 − 2 = 2.00 2.00 − 2 = 1.50 1.50 + 2.00 = 3.50
__ One boy's share was $\frac{1}{3}$.	____ 1 hide.	____ { 4.00 + 2.00 = 6.00 6.00 ÷ 2 = 3.00

PROBLEMS	PART 1—COMPREHENSION	PART 2—WHAT IS GIVEN	A
[*Read the problem*] ***Problem 11*** ***Fred caught 8 fish, and Jim caught 10. They fried 3 for supper. The rest they sold for 75 cents. What did they get on the average for each fish sold?***	[*Check true statement*] ____ More fish were eaten than were sold. ____ More fish were sold than were fried for supper. ____ Both boys caught the same number. ____ One boy caught twice as many as the other boy. ____ More fish were sold than were caught.	[*Check what is given*] ____ Number of fish caught by each boy. ____ Number of fish cooked for supper. ____ Price per fish. ____ Amount received for all fish sold. ____ Number of fish sold.	
[*Read the problem*] ***Problem 12*** ***I gave a man $2.00 in payment for 2 pounds of meat at 25 cents per pound and a chicken costing $1.05. How much change should I have received?***	[*Check true statement*] ____ Meat and chicken cost more than the amount I gave the man. ____ The meat cost more than the chicken. ____ Chicken and meat together cost less than $2.00. ____ The chicken cost $1.05 per pound. ____ The meat and chicken cost exactly the same.	[*Check what is given*] ____ Amount I gave the man. ____ Number of pounds of mea I bought. ____ Cost of chicken. ____ Exact change to be re ceived. ____ Cost of meat per pound	
[*Read the problem*] ***Problem 13*** ***A man spent $240 for cattle at $60 per head. He bought the same number of horses at $120 a head. How much did he spend altogether for cattle and horses?***	[*Check true statement*] ____ The man bought more cattle than horses. ____ The man paid the same per head for cattle and horses. ____ The man bought more horses than cattle. ____ The man bought 120 horses. ____ The man paid out twice as much for horses as for cattle.	[*Check what is given*] ____ Total amount spent fo horses and cattle. ____ Cost of horses per head. ____ Number of cattle an horses purchased. ____ Cost of cattle per head. ____ Amount spent for cattl	

PART 3—WHAT IS CALLED FOR	PART 4—PROBABLE ANSWER	PART 5—CORRECT SOLUTION
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Number of fish caught. __ Average price received for each fish sold. __ Number of fish cooked for supper. __ Number of fish sold. __ Amount received for all fish sold.	____ 18 fish. ____ About 15 cents. ____ 5 fish. ____ About 4 cents. ____ 4 fish.	____ 10 + 8 = 15 75 ÷ 15 = 5 ____ 10 + 8 = 18 18 − 3 = 15 75 ÷ 15 = 5 ____ 10 + 8 = 18 75 − 3 = 72 72 ÷ 18 = 4 ____ 10 × 8 = 80 80 − 75 = 5 ____ 10 − 8 = 2 2 + 3 = 5 75 ÷ 5 = 15
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Amount of money I gave the man. __ Price of chicken per pound. __ Total cost of meat. __ Price of meat per pound. __ Exact change to be received.	____ $1.45 ____ 45 pounds. ____ 70 cents. ____ About 50 cents. ____ 2 pounds.	____ 25 × 2 = 50 1.05 + 50 = 1.55 2.00 − 1.55 = .45 ____ 1.05 + 25 = 1.30 2.00 − 1.30 = 70 ____ 2.00 + 25 + 1.05 = 3.30 ____ 25 × 2 = 50 1.05 + .50 = .55 2.00 − .55 = 1.45 ____ 25 × 2 = 40 1.05 + 40 = 1.45 2.00 − 1.45 = .55
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
__ Number of cattle purchased. __ Cost of all horses bought. __ Cost of horses and cattle together. __ Number of horses bought. __ Difference in cost of horses and cattle.	____ 8 cattle. ____ About 700 cattle. ____ About $700. ____ About 420 dollars. ____ 4 horses.	____ 240 ÷ 60 = 3 120 × 3 = 350 240 + 350 = 590 ____ 240 + 120 = 360 360 × 4 = 1440 ____ 240 ÷ 60 = 4 4 × 120 = 480 480 + 240 = 720 ____ 120 ÷ 60 = 2 2 × 240 = 480 480 + 240 = 720 ____ 240 ÷ 60 = 4 4 × 120 = 480 480 + 120 + 60 = 660

PROBLEMS	PART 1—COMPREHENSION	PART 2—WHAT IS GIVEN
[*Read the problem*] ***Problem 14*** ***Mother sent me to the store. She gave me 3 dimes. I bought a bottle of milk for 10 cents. Mother told me I might buy candy with half the money that was left and bring her back the change. How much did I have to spend for candy?***	[*Check true statement*] ____ I spent more for the milk than I did for candy. ____ I spent more for candy than I did for milk. ____ I spent all the money I had. ____ Mother told me I could spend the money that was left. ____ I spent as much as I took back to mother.	[*Check what is given*] ____ Amount of money spen for milk. ____ Total sum of money I ha left. ____ Amount spent for candy ____ Number of bottles of mil bought. ____ Number of pieces of mone my mother gave me.
[*Read the problem*] ***Problem 15*** ***A boy worked 3 hours at 20 cents per hour. With what he earned he bought a new book for 40 cents and a tablet for 10 cents. How many pencils at 5 cents each could he buy with the money he had left?***	[*Check true statement*] ____ The boy earned less than his book cost. ____ The boy spent more for pencils than he did for his tablet. ____ The book cost more than the pencils and tablet together. ____ The pencils cost more than his book. ____ The pencils cost more than the tablet.	[*Check what is given*] ____ Cost of book. ____ Amount boy earned p hour. ____ Cost of one pencil. ____ Number of pencils bough ____ Cost of tablet.
	Score = No. right = ... [Total possible score = 15 points]	*Score = No. right ÷ 3 =* ..... [Total possible score = 15 points]

PART 3—WHAT IS CALLED FOR	PART 4—PROBABLE ANSWER	PART 5—CORRECT SOLUTION
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
_ The cost of a bottle of milk. _ The amount of money I had. _ The cost of candy per pound. _ The amount I could spend for candy. _ The amount I took home to mother.	____ 1 pound. ____ 15 cents. ____ About 9 pounds. ____ 20 cents. ____ About 11 cents.	____ 10+10+10=30 30−10=20 ____ 10×3=30 30−10=20 ½ of 20=10 ____ 10+10+10=30 30÷2=15 15−10=5 ____ 10×3=30 30+10=40 40÷4=10 ____ 10×3=30 30+10=40 ½ of 40=20
[*Check what is called for*]	[*Check probable answer*]	[*Check correct solution*]
_ What the boy earned. _ The cost of his book and tablet. _ The number of pencils he could buy. _ Total amount spent by the boy. _ Time he worked to earn his money.	____ 2 cents. ____ About 2 pencils. ____ 4 pencils. ____ 10 hours. ____ About 10 cents.	____ 20+20+20=60 60−40=20 20÷5=4 ____ 20×3=60 60+40+10=1.10 1.10÷5=22 ____ 20×3=50 40+10=50 .50−.50=0 ____ 20×3=60 40+10=50 60−50=10 10÷5=2 ____ 20×3=60 40+10=50 60+40=1.00 1.00÷.50=2
Score=No. right=..... [Total possible score=15 points]	*Score=No. right=*..... [Total possible score=15 points]	*Score=No. right=*..... [Total possible score=15 points]

Standard Mathematical Service

COMPASS DIAGNOSTIC TESTS IN ARITHMETIC
RUCH—KNIGHT—GREENE—STUDEBAKER
EDITED BY G. W. MYERS

TEST XIX: GENERAL PROBLEM SCALE: ELEMENTARY: FORM A

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

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

School..... Date.....
(Name) (City) (State)

Summary of Pupil's Score	
Number of Problems Right	
Educational Age Equivalent	
Grade Equivalent of Score	

Directions: **Work as many of these problems as you can. You may figure on the margins or on scratch paper. Record your answers on the dotted lines. Be sure to name your answers.**

1. Last week I sold 32 Saturday Posts. This week I sold 39. How many more Posts did I sell this week than last week? *Ans.* .....

2. There are 24 girls in our school who want to play basketball. How many teams of six girls each can we organize to allow every girl to play? *Ans.* .....

3. Mother sent me to the store with a dollar to get a box of oatmeal at 15 cents, a cake of soap at 5 cents, and a lemon at 5 cents. How much did I spend for these articles? *Ans.* .....

4. My father is paid $6.00 per day for driving an auto truck. Last month he worked 26 days. How much did he earn last month? *Ans.* .....

5. James had 22 cents at the end of last week and has saved 15 cents more thus far this week. Today he spent 10 cents for a tablet. How much has he left? *Ans.* .....

6. Our grocer had 40 quarts of milk delivered to his store this morning. He sold 2 quarts to each of 9 people before nine o'clock. How much milk did he have left at that time? *Ans.* .....

7. How many peaches are there in four baskets if three of the baskets contain 18 peaches each and the fourth contains 14? *Ans.* .....

8. If four boys have 15 marbles each how many dozen marbles have they altogether? *Ans.* .....

Turn over the page and finish the problems.

9. A girl had \$3.75 in her purse. She bought some silk which cost her \$3.45. How many spools of silk thread at 10 cents per spool could she buy with the money she had left?

Ans. .....

10. I work at a store one hour each morning and one hour each evening. For my work each morning I receive 35 cents and for work each evening I am paid 40 cents. How long will it take me to earn a scout suit costing \$6.00?

Ans. .....

11. Three boys, Robert, Harold, and Ted, worked for Mr. Brown picking apples. Together they picked 24 bushels in a day. Robert picked one-fourth of all the apples and Harold picked four bushels more than Robert. How many bushels did Ted pick? *Ans.* .....

12. Frank worked eight weeks during vacation at \$4.50 per week. Before school opened he bought a suit for \$19.50, a hat for \$2.50, and a pair of shoes for \$3.50. How much was left from his summer earnings? *Ans.* .....

13. Four girls agree to share equally the expense of a party. They buy two gallons of ice cream at \$2.00 per gallon and three cakes at 80 cents each. How much should each pay?

Ans. .....

14. A street car conductor collected on one trip a total of \$3.70 in fares. Eighteen of these were 12 cent fares. The balance were 7 cent fares. How many 7 cent fares were there?

Ans. .....

15. Our school baseball team made \$167.40 on games this year. After purchasing new suits at \$9.50 each and shoes at \$3.85 per pair for each of the nine players, it was decided to spend the balance of the money for the purpose of buying sweaters to be given to the nine regular players on the team. How much could we pay per sweater? *Ans.* .....

Score = Number of problems right = ...
[Total possible score = 15 points]