A CASE STUDY OF DIAGNOSTIC AND REMEDIAL TEACHING IN JUNIOR HIGH SCHOOL ARITHMETIC

By

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CHAPTER I

INTRODUCTION

A. The Problem

For a period of fifteen or more years it has been an accepted theory that the best teaching results can be obtained by applying scientific diagnosis followed by special remedial measures. Considerable experimental work has been done in the field. In most of the cases reported, there have been hospital rooms and a trained corps of workers to carry on the investigation. In arithmetic, most of the remedial work reported has been done in the primary and intermediate grades. Granting that it would be most economical of teacher and pupil time to have the fundamentals of arithmetic mastered in these grades, the fact remains that many reach junior high school with arithmetical skills very inadequately developed. This makes a need for diagnostic and remedial work at this level. The writer felt this need and desired to try a plan of diagnostic and remedial work which any teacher might use in the regular room in a school not equipped with special facilities or technically trained workers.
B. Review of the Literature

In a summary of arithmetic research made by Guy M. Wilson in 1925, mention is made of a book by Dr. W. J. Osburn, "Corrective Arithmetic," which contained practically all that was then known concerning remedial work. The most complete study which Dr. Osburn reported was conducted in Wisconsin in 1920-21, under his personal direction. This was the basis for diagnostic and remedial work, which dates from about that time.

In 1927, H. J. Otto reported a study made of Grade IV pupils in Buffalo Lake, Minnesota. Nine pupils were found poor in arithmetic and were made subjects of special study. Diagnostic and remedial measures were applied in remedial rooms, with the following results:

1. The pupils showed increase in rate and accuracy during the remedial work and an increase in these skills after the remedial work was discontinued.

2. Increased skill and accuracy helped the pupils to progress with the rest of the class.

E. A. Neal and Inez Foster reported an experiment with remedial work in common fractions, conducted in Grade V.

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They reported that children taught by this plan made greater progress than children in the control groups.

May Lazar reported a very careful study which she made in Grade VI. She used a single group of forty-three pupils. Her work consisted of an intelligence test, an achievement test, a diagnostic test, individual observation and oral examination, and remedial work during ten minutes of the daily arithmetic period. She stated that at the end of five months, the initial arithmetic tests were given again, showing achievement "statistically significant".

W. S. Guiler reported a study made by Ora Hanna in Grade VII. He made a preliminary survey and found ten pupils below the grade standard. The diagnostic study was made by re-checking the original papers. Individual analysis was made by the Buswell-John Diagnostic Test. Since the outstanding error of the group was number combinations, the Wisconsin Inventory Tests in Arithmetic were used to discover the particular combinations giving difficulty. After suitable remedial work was done, a re-test was made with survey scale at the end of twelve weeks.

Another study which probably is more closely related to the

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present one is "Improvement of Instruction in Arithmetic,"7 by F. P. O'Brien, a report of a diagnostic and remedial experiment with children in the two upper elementary grades. The title was included in a bibliography of arithmetic studies, but the writer was unable to obtain a copy of it, or any additional information concerning it.

A similar study, about which the writer was also unable to obtain further information is "Diagnosis and Remedial Teaching in Seventh Grade Mathematics,"8 by F. G. Lankford.

All of the investigations reported tend to show the positive value of the diagnostic and remedial procedure in arithmetic. Most of the studies, however, have been made in the elementary grades, in a special room, under the direction of trained workers.

The present study was made of the same general type of procedure, used by the classroom teacher in Grades VII and VIII, in the regular schoolroom situation, without any special facilities or technically trained workers.


The Materials Used and Groups Studied

The Terman Group Test of Mental Ability, Form A was used to determine the mental age of the pupils studied. At the beginning of the study the Compass Survey Test, Form A, was used to measure the arithmetic achievement. Throughout the year at various intervals, the twenty Compass Diagnostic Tests, Form A were given. There was no standardized remedial material used. The drill material was chosen from various arithmetic drill books, and some from texts of appropriate difficulty. At the end of the study, the Compass Survey Test, Form B, was given to measure the achievement. A comparison of the scores on Tests A and B showed the improvement made, and from this the value of the procedure was judged.

The study was made in Room Four of the Roseville School in Parke County, Indiana, in the school year 1935-1936. There were thirteen pupils in Grade VII and the same number in Grade VIII. Of these, two were not present during the entire study. One member of Grade VIII withdrew at the close of the first semester, and one of the pupils in Grade VII entered early in the second semester. The remaining twenty-four were present throughout the entire study, and it is from the data with respect to their progress that the conclusions were made.
CHAPTER II

TECHNIQUE AND RESULTS

A. Procedure

School had been in session two weeks when the intelligence test was given, and three weeks when Compass Survey Test A was given. These tests were scored and the results tabulated. The survey tests were returned to the pupils with the errors and achievement level marked. The instructor explained that the test results would be used to help them make as great an improvement in their work as possible. She encouraged them to notice closely their own errors and in so far as it was possible to make the necessary corrections.

Each class devoted one hour a day regularly to arithmetic. This time was divided equally between study and recitation. Both groups were put into one section for taking the tests and for some of the remedial and drill work. The diagnostic tests were given at an average interval of two weeks, and required an average of three-fourths of the scheduled arithmetic time for the day. During about four months of the time an additional drill period of fifteen minutes was given in the afternoon once or twice a week to the group as a whole. The number of these extra periods depended upon the amount of time available from other activities, and upon the immediate need as evidenced by the work of a particular period.

All of the diagnostic tests were returned to the pupils after they had been marked. The tests were marked to show both
the errors and the achievement level of the individual on each part of the test. When the test showed satisfactory achievement it was returned to the pupil with no other comment than that he should take note of his errors and make the necessary corrections before returning the paper. When a paper showed a decided weakness the instructor kept it until there was time during the study period to point out the difficulties to the individual and help him get started on the task of correcting his work. When, as was sometimes the case, the difficulty was too great for the pupil to be able to work profitably with the material of the test, the instructor pointed out the lack of achievement and proceeded to teach the process with material suited to his achievement level.

When the results of Diagnostic Test IX were tabulated the instructor observed that the entire group was weak in the fundamentals of decimals. She placed both classes into one section for a period of two days and devoted the entire arithmetic time to re-teaching decimals. She introduced the subject as she would have to a class meeting decimals for the first time. In showing their relations to common fractions she gave the class the tables of fractional and decimal equivalents, which they memorized as part of their preparation. They also drilled on the place names and the reading of decimals.

Before teaching any of the work in division of decimals the instructor gave and scored Diagnostic Test X. This revealed the need for class instruction in this process also. The instructor developed the rules for multiplication and division by ten and its multiples by moving the point to the right or left. Since
several pupils had difficulty in placing the decimal in the quotient correctly, this process was taught and class drill conducted using material in which the quotient figures were given and the decimal omitted. After this work was re-taught in the class period, problems of the same type were used in the extra drill periods.

Diagnostic Test XI revealed such a general weakness in denominate numbers that the instructor kept the test and postponed further work in that topic until she was ready to teach mensuration as outlined in the regular course. At that time she again put both classes into one group and began by having them learn the common tables of measure. When these were fairly well mastered she taught the processes of changing units and later of addition and subtraction of denominate numbers. Before re-teaching the processes of multiplication and division she gave Diagnostic Test XII. This showed an improvement in knowledge of tables, and the work done in changing units carried over to some degree, making the work in multiplication fairly satisfactory. Only a very few could do anything in division of decimals and this process was later taught in the regular class period.

Since the initial achievement of the group was so low in denominate numbers, it seemed to the instructor that they probably had done very little work in mensuration and that giving Diagnostic Test XIII would not be profitable. She left both classes in one section and taught them the work in mensuration outlined for Grade VII. She then put them into their regular groups and continued in Grade VIII with the work in mensuration outlined for the class.
This was the last topic studied in the class. When it was completed and Diagnostic Test XIII given there was no time remaining in which to do any remedial work.

Survey Test B was given a week before the close of the eight month school year. These tests were scored and marked to show errors and achievement level as in the case of Test A. They were returned to the pupils with the usual instructions and in addition the instructor made a chart showing the initial achievement, the present achievement, and the number of years growth for each pupil.

The scores on the survey tests were transferred to the grade equivalents according to Table 7 in the Manual of Directions for Compass Survey Tests in Arithmetic. The highest score given is 40 which is equivalent to grade 8.9. For the scores above 40 the writer extrapolated values, using one score point equivalent to .2 of a grade.

The scores on the parts of the survey tests were transferred to grade equivalents according to Table 5 in the same manual. The highest norm given in any instance is for the grade 8.9. By studying the rate of increase between the grade norms in the table, the writer arrived at the grade equivalent of 11.9 for a perfect score in Parts One to Four, for score 5.0 in Part Five, and for score 9.0 in Part Six.

The lowest norms in Table 5 are for grade 4.9; the grade levels less than 4.9 shown on the graphs were determined by the same method of extrapolation.

Only one mental test was given; the mental age at the time of Survey Test B was estimated by adding to the original mental
age, the product of seven months and the I Q.

B. Results

The following results were shown by the study:

1. The greatest achievement reached was grade 11.5, by Pupil II.

2. The greatest gain was 3.5 years, made by Pupil XVI, whose I Q was only 88.

3. The smallest gain was nothing, made by Pupil XVIII, whose I Q was 68.

4. The average gain for Grade VII was 1.85 years, and for Grade VIII, 1.54.

5. The average gain for the entire group was 1.7.

6. Since the normal gain for a school year would be 1.0 year, the additional .7 year of the average gain can fairly be attributed to the diagnostic and remedial procedure.

7. The average gain for those whose I Q was above the median in each group, was 1.86, and for those below the median it was 1.5.

8. In the group whose I Q's were above the class medians there were three whose achievements were below the class medians.

9. The average gain for those whose initial achievement was above the class median was 1.83, and for those whose initial achievement was below the class median, the gain was 1.55 years.

10. Of the twenty-four pupils, all but five reached an achievement level above that of their mental age.

The gains for each pupil can be seen in Table I and compared with I Q and achievement.
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*Not enrolled when these tests were given
*Score too low to have a grade equivalent assigned
CHAPTER III

CASE STUDIES

Pupil I

Bertha comes from a farm home of few advantages. She is small for her years and gives the appearance of being undernourished. She has a good singing voice and has taken part in one or more amateur programs. She was absent from school a week or more because of illness, and seemed to have a low vitality for a long period after she returned. Her work was always neatly done and she seemed to have an interest in making satisfactory achievement.

When school opened Bertha was thirteen years ten months old and had a mental age of twelve years one month. Survey Test A showed a general arithmetic achievement of grade seven, equivalent to her mental age. In subtraction she had only a fourth grade standing, and division was the only topic in which she was up to her grade norm.

Diagnostic Tests I, II, III, and IV showed no real weakness in dealing with whole numbers. She made the zero error in multiplication combinations, and made some errors in estimating the first quotient figure in division. She also made some errors in carrying through the complete processes of column addition, multiplication and division. She corrected these errors and took part in class drills in the four processes with whole numbers.

Test V showed difficulty in finding the common denominator and in reducing fractions to lowest terms. The instructor
explained these processes to her and gave her fifth grade drill material for practice. On Test VI, although she was able to perform the various steps in subtraction of fractions, she could not carry through the total process. Again the instructor gave her fifth grade drill material after she understood the method of solution.

Test IX showed errors in reading and writing decimals and in appreciating place values. She also made many errors in changing fractions to decimals and the reverse. She seemed however, to need no special work other than that given to the whole group.

Test XI showed an almost total lack of knowledge of tables of measure. The instructor assigned these to the whole group for memorization and re-taught the processes of changing units and addition and subtraction of compound denominate numbers. After this, on Test XII, Bertha showed a decided weakness in the knowledge of the tables, but was able to carry through the process of multiplication. She, as was a large number of the group, was completely ignorant of the process of division of compound denominate numbers. The instructor taught this to the whole group, and gave Bertha help with her preparation. The rules for area and volume covered by Test XIII were taught while Bertha was ill and there was no time after she returned to let her make it up. Therefore, it shows many weaknesses which have not been corrected.

Test XIV showed a lack of knowledge of the fractional
values of per cents and also errors in writing per cents as decimals and the reverse. The instructor gave her the fractional value tables for memorization and drill in writing per cents as decimals. She was unable to read the percentage problem, classify it into the proper type and decide upon the correct solution. In the many percentage problems of the regular course the instructor helped her to state them in type form.

Test XV showed a great weakness in the vocabulary of interest and business forms. She was unable to fill the business forms correctly, made many errors in computing interest and discount, and knew almost nothing of the use of an interest table. Such material was almost wholly foreign to her. The instructor demonstrated the correct forms, but did nothing else toward improving the situation. Test XVI showed a lack of knowledge of general arithmetic vocabulary. These terms were used for spelling drill. She was also unable to state many of the rules of arithmetic.

Tests XVII and XVIII showed her greatest weakness in general problem solving to be in reading the problem understandingly, and in deciding upon and carrying through the correct solution. The problems in the regular course were the ones she used for study. The instructor asked her to analyze each one before attempting the solution.

Survey Test B showed no improvement in division and a loss in percentage. The greatest growth was in multiplication, which
FIGURE 1

SCORES OF PUPIL I

* Grade Levels from Total Scores
  Scores for Test B
  Scores for Test A

Norms for Grade 8.9
14 14 7 7 7 7 7 6.5 3 1 6 7 40.0 8.5*

Norms for Grade 7.9
13 13 7 3 7 4 7 4 6.4 2.4 5 4 35.5 7.0*
was equivalent to about 3.0 years, and in other topics the improvement was 2.0 years or more. Her total arithmetic achievement was of grade 8.5, which was still below her grade norm, but was above the level of her mental age. This was a growth of 1.5 years, which in view of her mental age, low vitality, and absence from school may be considered satisfactory.

Pupil II

At the beginning of her eighth year in school, Mary was twelve years eight months old. She is one of a family of three, an older brother and a younger sister. Her home is a typical country home; seemingly, it is a pleasant home for the parents are very jovial. Her parents are interested in the children's work and permit Mary to be in the school band. She has a slight impediment in her speech and perhaps on this account, seems a little timid.

Mary seemed interested in her school work and made a good scholastic record. However, she seldom volunteered in class recitation, which was probably due to the speech difficulty. According to the intelligence test her mental age was thirteen years nine months. Survey Test A showed an arithmetic achievement of grade 9.5, practically a year above the level of her mental age. The only point of weakness was in division, which was about a year below her grade norm.

Diagnostic Test IV showed a few errors in estimating the first quotient figure in division. She failed to detect a remainder larger than the divisor and made an error in
multiplication. She corrected the errors and did the class drill work as a remedial measure. Test IX revealed weaknesses in reading decimals and giving their place values. The preliminary work in decimals given to the entire class seemed to remove the difficulty. Test X showed a difficulty in locating the decimal in division. The instructor explained the process and assigned problems for drill.

Tests XI, XII and XIII showed weaknesses common to the group; namely, lack of knowledge of tables, difficulty in changing units, inability to divide denominate numbers, failure to apply the rules properly in finding volumes and inability to state rules as formulae. These difficulties were all handled as class problems.

Test XIV showed a difficulty in properly interpreting the percentage problem and classifying it according to type. This topic was stressed in the regular work of the class. Test XV showed a lack of understanding of the vocabulary of interest and business problems, and the inability to fill the business forms correctly. The errors were pointed out and corrected, but no additional work done. Tests XVII and XVIII showed her chief difficulty in problem solving to be error in judgment of correct method and inability to estimate the answer. Many written problems were given as regular class work.

Survey Test B showed a growth of 2.0 years, or a grade level of 11.5, the highest in the group, almost 3.0 years
Norms for Grade 8.9 14 14 7.7 7.7 7.7 7.9 6.5 6.1 6.7 40.0
Norms for Grade 7.9 13 13 7.3 7.4 7.4 6.4 2.4 5.4 35.5

* Grade Levels from Total Scores

Scores for Test B
Scores for Test A

FIGURE 2

SCORES OF PUPIL II
above the level of her mental age, and more than 3.0 years above that of her chronological age. Her greatest improvement was in division, which was equivalent to about 5.0 years. No improvement was shown in addition or subtraction.

Pupil III

Edith is the oldest of a family of three and has one brother and one sister. Her home life is perhaps not entirely satisfactory, for her parents seem not to be altogether congenial. They have all the comforts of an average farm home and the father has perhaps more than the average financial success. The parents show an interest in the children's welfare and give them every possible advantage. Edith belongs to the school band and takes part in all the school activities.

At the opening of school she was thirteen years five months old and the intelligence test showed her mental age to be fourteen years. Survey Test A showed her arithmetic achievement to be grade 9.7, more than a year above the level of her mental age. The only topic in which she was below her grade norm was percentage.

Diagnostic Test IV showed difficulty in division problems having zeros in the quotient. The errors on the test were corrected and a few problems involving similar difficulties were assigned for drill. Test IX showed that she had the characteristic class weakness in reading decimals and appreciating their relative values. This difficulty was corrected by class work. Test XI showed an error in changing
FIGURE 3

SCORES OF PUPIL III

* Grade Levels from Total Scores
Scores for Test B
Scores for Test A
the form of a compound denominate number preparatory to subtraction. A brief explanation, correcting the error and some class drill removed the difficulty. Test XII showed a lack of knowledge of the tables of measure, and of the process of division of compound denominate numbers. This was taken up with the entire class. Test XIII showed inability to apply the rules for finding areas and volumes, and to express rules as formulae. This was handled as a class problem.

Test XIV showed inability to write per cents as decimals and decimals as per cents. The instructor helped her correct her paper and gave her some drill in these processes.

Survey Test B showed a growth of .8 year, which was an achievement of grade 10.5, about 1.5 years above the level of her chronological age and practically 1.0 year above that of her mental age. Her greatest improvement was in subtraction and next was in percentage, which still remains slightly below her class norm. No change was shown in addition, multiplication or division. The improvement of only .8 year seems unsatisfactory.

Pupil IV

John is an only son in an average country home. He has always been a well behaved boy, but recently has developed some unsatisfactory traits and occasionally an inclination to be rude. This change may be due to environment, but more likely it is a reaction to a too-close home supervision.
He has never been permitted to participate in the activities of a normal boy because the mother was afraid he might get hurt. This year she consented to his being on the basketball team, and the association with the other boys seemed to be a decided advantage. John is quite interested in nature and has a room of his own where he keeps the various collections he has made.

At the beginning of the year he was thirteen years two months old and had a mental age of thirteen years four months. The Survey Test A showed his arithmetic achievement to be grade eight, which is normal for his age. In addition, percentage and general problems he was decidedly low, but in subtraction, multiplication and division he was above his grade norm.

Diagnostic Test I showed difficulty in column addition which was probably due to lack of concentration or attention span. John took part in class drill in addition and the instructor recommended extra practice. Test III showed the zero error in multiplication combinations. His attention was called to the error and drill given involving the combinations. Test IV showed the same error, a weakness in short division and in estimating the first quotient figure. He was also deficient in ability to carry through the process of long division, and made the error of omitting the zero from the quotient. The instructor tried to make him conscious of these errors by having him correct the test and then gave him extra practice material in addition to the class drill.
Test V showed that in changing fractions to larger denominators John neglected to multiply by the numerator. He also was unable to find the least common denominator. The instructor pointed out his errors and showed him how to correct them. She gave him practice material of fifth grade level. Test VII contained a few errors in cancellation, which were pointed out and corrected.

Test IX showed a few errors in reading and writing decimals, which were corrected by class drill. His greatest weakness was in changing fractions to decimals and decimals to fractions. The instructor pointed out his difficulty and had him correct the errors. She also assigned the tables of fractional equivalents for decimals to be memorized.

Test X showed that John was unable to divide decimals by ten or its multiples by moving the decimal. He had difficulty also in correctly locating the decimal in the quotient when dividing a whole number by a decimal. For practice he solved problems in locating the decimal when the quotient figures were given.

Test XI showed lack of knowledge of the tables of measure. His errors in addition of compound denominate numbers were due to this fact, but his inability to subtract was due to an incorrect method of changing the minuend.

Test XII contained errors in multiplication due to incorrectly changing quantities in the product to larger units. He was completely ignorant of the process of division of denominate numbers. Test XIII showed errors in the application
of the rules for finding areas and volumes and a total inability to state rules by formulae. The whole subject of measures was re-taught to the entire group and John was given special help with subtraction and division.

Test XIV showed errors in writing per cents as fractions and the reverse, and in giving fractional and percentage equivalents. He also had difficulty in reading percentage problems, classifying them into the correct type, and deciding upon the proper solution. This was stressed in the regular work of the class. The pupils stated the type and method of solution before continuing with the work.

Test XV showed errors in interest and discount due, it seemed, to carelessness. It also showed a total inability to solve interest problems by the use of the table. The only remedial work he did was to correct the work of the test.

Tests XVII and XVIII showed his greatest weakness in general problems to be in deciding upon the correct solution and correctly carrying it through. The regular outline for the class gave sufficient material for drill in problem solving.

Survey Test B showed a marked improvement in addition and general problems, and a satisfactory gain in multiplication and division. He made no growth in subtraction or percentage. His total arithmetic achievement was grade 9.5 which was above the level of both his chronological and mental ages and represented a gain of 1.5 years.
Norms for Grade 8.9

Grade 7.9

Norms for

* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 4

SCORES OF PUPIL IV
Pupil V

Marcella is an only child reared as the daughter of her maternal grandmother. She is clever and attractive, but somewhat spoiled, as one would expect of an only child among several adults. She is popular among her companions and participates in all the school activities. Her interest in her work was not especially great and she often gave the impression of playing for the attention of others rather than concentrating her efforts on constructive work. She was absent from school about three weeks near the end of the year, due to a severe illness. She had little opportunity to do the work she missed from lack of time and a physical condition which was still not good.

At the opening of school she was twelve years six months old and had a mental age of thirteen years nine months. Survey Test A showed her total arithmetic achievement to be grade 8.9, above the levels of both her chronological and mental ages. Subtraction was the only topic in which she was below her grade norm; her greatest achievement was in division.

Diagnostic Tests I and II showed very few errors. Test III showed an unusual situation; in giving the basic multiplication facts, Marcella missed the zero combinations, but made a perfect score on the part containing the complete multiplication process which included many examples with zeros. No individual work was done on these topics other than
correcting the errors on the test. Test IV showed errors in the zero combinations stated 0x7, but correct responses for those stated 7x0. She also missed those division problems which had zero as the final figure of the quotient. The instructor pointed out her errors and gave her some division problems for drill.

Tests V, VI, VII and VIII indicated no difficulties in fractions. She had missed fraction examples in the subtraction part of the Survey Test A, but in light of Test VI these seemed to be careless errors, or she had recognized and corrected her difficulty in the interval between the tests.

Test IX showed a failure to understand place values of decimals and also the inability to change decimals to fractions and the reverse. Since Marcella’s case was similar to many others in the class, the remedial work given to the whole group was all that she required.

Test XI showed the inability to change denominate numbers to different units. She did not understand the plan of changing the minuend in subtraction of compound denominate numbers. Test XII showed a poor knowledge of the tables of measure, total ignorance of the process of division of compound denominate numbers and an unusual error in multiplication.

After changing the smaller unit to the larger one, Marcella wrote in her answer the number which she should have added to the larger unit. The instructor pointed out her errors, had her correct them, and watched her work while she was re-teaching denominate numbers to the whole group. Test XIII
Scores for Test B
Scores for Test A

FIGURE 5

SCORES OF PUPIL V
showed many errors in finding areas and volumes. This was the work which Marcella missed and there was no time to do any remedial work.

Test XIV showed that Marcella did not remember all the tables of fractional values for per cents and made some mistakes in writing decimals as per cents. She was also unable to classify problems into the proper type or select the correct method of solution. She memorized the tables and drilled the other points of percentage throughout the regular course. The instructor had her state the type to which a problem belonged and the method of solution before attempting the written solution.

Test XV showed mistakes in filling out check stubs and some difficulty in understanding the terms used in interest and business. No remedial work was done other than the correction of the errors on the test.

Survey Test B showed an achievement of grade 10.5. She made an improvement of about 3.0 years in multiplication and general problems, but no gain in either subtraction or percentage, both of which remained below her grade norm. Her total improvement was equivalent to 1.6 years.

Pupil VI

Richard is next to the youngest in a large family. Both he and his younger brother are of very low mental ability. The older children are normal, and have finished high school making very good scholastic records. Richard had
been retained in the primary grades until he became overgrown for his class and it seemed evident that he would never be able to do regular school work. Since the school had no facilities for providing for the underprivileged, he had merely been passed along until he was with the group in grade eight.

Richard was very sensitive of his limitations. The instructor spent much time trying to teach him to read and spell and did meet with some success. When working with primary material he would keep his book hidden behind a history or whatever book the rest of the class were using. The instructor suggested that he work in the office or an unused room, but he objected, apparently not wishing to be noticeably different from the others. He always listened to the class discussions and occasionally was able to add some bit of information which he had gathered.

At the opening of school he was fifteen years three months old and had a mental age of nine years one month. Survey Test A showed an arithmetic achievement of grade 4.1 which was equivalent to his mental age. The scores on the separate topics were too low to be interpreted by the tables and seem to have no significance.

The instructor gave Richard the diagnostic tests, telling him to leave out anything he did not understand. From the results she could determine, not his particular points of weakness, but rather the few things he knew and could do.
This was not altogether reliable for he was clever in seeing his neighbor's work. This is not unusual in one who had so long been faced with things he was unable to do.

Diagnostic Tests I, II, III and IV are the only ones of any significance. Test I showed that he knew most of the addition combinations, or was quick at counting. It was probably a combination of both. He obtained the correct sums for about half of the shorter column additions. He knew a few of the subtraction combinations, but was unable to subtract when the borrowing situation was involved. He did not understand the meaning of the times sign, and added instead of multiplying. He did that part of Test IV which was addition and subtraction, but did none of the division.

Judging by his mental age, the instructor decided to start Richard in workbook four. He did the addition examples without much difficulty. Before he started subtraction, she gave him subtraction flash cards with the answers on the back. She explained the additive method of subtraction and had him do many examples of this type. He had to do most of his work independently.

The multiplication examples in workbook four were not suitable to Richard, for they presupposed the knowledge of part of the tables and he did not know any. He changed to workbook three and started on the multiplication tables. He worked as far as the sixes and was able to multiply a three figure number by a single digit.
Norms for Grade 8.9 14
-7.7 _7.7 _7.7 _7.9 _6.5 _3.1 _6.7 _40.0

Norms for Grade 7.9 13
-7.3 _7.4 _7.4 _6.4 _2.4 _5.4 _35.5

* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 6

SCORES OF PUPIL VI
He did some work in division. He had difficulty in understanding the relation between multiplication and division and was never very sure how many times a number was contained when there was a remainder.

Survey Test B showed a growth of .1 year, or an achievement of grade 4.2. In subtraction and division he showed a growth of a year or more, but in other topics the score remained the same or was even lower. To measure Richard's achievement accurately, a scale of lower level needed to be used.

Pupil VII

Dorothy is one of a family of several children, all of whom are of low mental ability. The father has ill health and the family is decidedly underprivileged. Dorothy is small for her age and shows signs of being undernourished. She is nervous and cries easily if she suspects that anyone is in any way calling attention to her shortcomings. She has the added disadvantage of a speech defect.

Since the school lacked facilities for properly treating cases of Dorothy's type, she has been retained for a while and then passed along until at sixteen years of age she was entering the eighth grade. She was unable to do any of the work with the class. The instructor provided her with reading material within her grasp and workbooks of lower grades. She listened to the class discussions and during study periods busied herself with the materials provided her.
### FIGURE 7

**SCORES OF PUPIL VII**

<table>
<thead>
<tr>
<th>Grade Levels from Total Scores</th>
<th>Not Enrolled for Test B</th>
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</thead>
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<tr>
<td><strong>Scores for Test A</strong></td>
<td></td>
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<table>
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<td>7.4</td>
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<td>6.4</td>
<td>2.4</td>
<td>5.4</td>
<td>36.5</td>
<td></td>
</tr>
</tbody>
</table>

* Grade Levels from Total Scores

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The mental test showed her mental age to be ten years ten months. Using this as a basis for judgment, the instructor started her in fifth grade workbooks. Survey Test A, given later, showed an arithmetic achievement of grade 4.2, with greatest achievement in addition.

Diagnostic Test I showed remarkably few errors in addition of whole numbers. Test II showed a few errors in basic facts, but no knowledge of the subtraction process involving borrowing. Tests III and IV showed that she knew practically none of the multiplication facts. Nothing significant could be obtained from the results of the other tests, except that occasionally when an example was solved, Dorothy was able to follow the process in a few of the easiest cases. This was noticeable in the processes with fractions.

Dorothy worked on addition and the instructor helped her with the borrowing method of subtraction, for that was the way she seemed to have been originally taught. She left school at the end of the end of the first semester and went to work for a married sister.

Pupil VIII

Carl is the older of two brothers. Until two years ago the father had been a miner; the family has lived in different mining towns and Carl has changed schools frequently. At present they are living on a farm and Carl helps with the work. He is older than the other boys in his class and aside from
his interest in athletics, he has little in common with them. He is permitted the use of the family car, and seems to have more spending money and more freedom than many boys his age.

His most condemning characteristic is his quick temper, but usually after losing control he sees his mistake and is willing to make amends. He missed about two weeks of school because he was needed at home during his father's illness. This showed a lack of interest, for the situation clearly could have been met in some other way.

At the beginning of school Carl was sixteen years two months old and had a mental age of twelve years one month. The fact that he is so many years retarded may be due in part to his having changed schools frequently, but his low ability seems to be an important factor. Survey Test A showed his arithmetic achievement to be grade seven, which is about equivalent to the level of his mental age. His scores were especially low in addition, division and percentage, and above his grade norm in subtraction, multiplication and general problems.

Diagnostic Tests I, II and III showed a few errors in combinations, which were corrected; but the tests indicated that his difficulties were not in the handling of whole numbers. Test IV showed a zero difficulty and trouble in estimating the first quotient figure. The instructor gave him special help with this work and assigned him problems in long division for drill.
Test V showed lack of ability to change fractions to larger denominators. This point was easily explained and a little practice removed the difficulty. Test IX revealed that he, too, had the class weakness in decimals; namely, inability to read and write decimals, or to understand relative place value. Since this was re-taught to the whole class, individual work was not necessary. Test X showed the inability to divide decimals by ten or its multiples by moving the decimal. He also had some trouble in locating the decimal in the quotient of many division problems. This point was drilled with the entire class.

Test XI showed a lack of knowledge of the tables of measure, and difficulty in addition and subtraction of compound denominate numbers due to errors in changing units. Test XII showed the same difficulty with tables and trouble in changing units. It also showed complete lack of knowledge of the process of division of compound denominate numbers. Test XIII showed inability to apply the rules for areas and volumes, especially in curved figures. He was also unable to state rules as formulae. The only individual work Carl received in this topic was in connection with the preparation of the daily assignments, as this work was re-taught to the entire group.

Test XIV showed weakness in every phase of percentage. He was unable to change per cents to decimals and the reverse. He was given special help and drill in this work. He had
difficulty in understanding a problem, classifying it in the proper type and choosing the correct solution. The instructor gave him much help in the preparation of his daily assignments in percentage, but did not assign him any special work.

Test XVI showed a weakness in properly filling business forms, but time did not permit any work on this point except merely correcting the errors on the test. Test XVI showed a deficiency in arithmetic vocabulary, especially in spelling. Carl used this list for spelling study and drill and made some progress, but not as much as could be desired. He seemed to have a real spelling weakness.

Tests XVII and XVIII showed the greatest weakness of his general problem solving to be in determining the question to be answered. The instructor frequently had Carl state what was given and the question asked in the many written problems of the regular course.

Survey Test B showed improvement in all topics except percentage, and a total growth equivalent to 2.3 years. His achievement was grade 9.3 which, although below the level of his chronological age, is more than a year and half above the level of his mental age. His improvement in addition was equivalent to 4.5, in subtraction to 2.5 years, in multiplication almost 3.0 years, in division 1.5 years and in general problems about a half year.
FIGURE 8

SCORES OF PUPIL VIII

* Grade Levels from Total Scores

--- Scores for Test B

--- Scores for Test A
Pupil IX

At the beginning of the school year, Frank was fourteen years one month old. He is one of a family of five, three older sisters and one younger brother. His home is an average country home, and he has had the experiences of a normal country boy. He is one year retarded in school due to an illness during his first school year.

In school Frank is a good pupil. He has a natural interest in his work and has a good scholarship record. He has a pleasing personality and is popular with his classmates. He is interested in athletics and plays basketball with real skill.

According to the intelligence test his mental age was thirteen years four months. On Survey Test A, his arithmetic achievement was grade 9.1, which was practically equivalent to the level of his chronological age and somewhat above that of his mental age. In division and percentage he ranked below his grade norm.

The diagnostic tests failed to reveal very many weaknesses. Test VI showed some inaccuracy in subtraction of fractions. He corrected the errors on the test. Test XII showed a real lack of knowledge of the process of division of compound denominate numbers. He was also inaccurate in changing quantities from one unit to another. Since these topics were re-taught to the entire class, Frank required no
FIGURE 9

SCORES OF PUPIL IX

* Grade Levels from Total Scores

Scores for Test B

Scores for Test A
individual work. The same was true in the statement of rules by formulae as shown by Test XIII. According to Test XIV his difficulty in percentage was due to the failure to recognize the type of problem. Much of the regular work of the class dealt with percentage and at every opportunity the instructor had him classify the problems into the different types. Frank never at any time seemed to need individual attention, but was able to prepare his work satisfactorily.

According to Survey Test B, Frank's greatest improvement was in division. He made a decided improvement in percentage, but was still a little below the grade norm. His scores in addition and subtraction remained the same. According to his total score his achievement was grade 10.7, a growth of 1.6 years.

Pupil X

Harold was thirteen years five months old at the beginning of his eighth year in school. He is the second in a family of four boys. His father is an invalid and has been unable for several years to bear his share of the family responsibility. They live on a fruit farm owned by the maternal grandparents; the mother is much over-burdened, although the boys show a fine spirit of helpfulness and doubtless do all they can to lighten the load. The maternal grandfather is a minister and all members of the family show strong
religious tendencies.

Harold seemed to have little in common with his classmates. He lives at a remote edge of the school district at too great a distance to take part in the school activities or programs at night. There was no antagonism between him and the other boys, but he seemed to have few associates, and the boys with whom he was thrown seemed to be of the less desirable group.

On the intelligence test Harold had a mental age of fifteen years three months. On Survey Test A, his arithmetic achievement was grade 9.3, which is almost a year below the level of his mental age. In percentage he was about a year below his grade norm.

Diagnostic Tests IX and X showed that he had the same weakness in decimals which were common to the group; namely, reading and writing decimals and multiplying and dividing by ten and its multiples by moving the decimal. Tests XI, XII and XIII showed that he did not know his tables of measure very well, he did not change quantities from one unit to another accurately, nor was he able to state rules by formulae. In percentage, according to Test XIV, his difficulty was in proper interpretation and accurate solution of examples of greater difficulty. This phase of the work was covered by regular work in the material outlined in the course of study. No individual remedial work was done, except what Harold did through his own interest. He always inspected his
FIGURE 10
SCORES OF PUPIL X

* Grade Levels from Total Scores

Scores for Test B
Scores for Test A

Norms for Grade 8.9 14
Norms for Grade 7.9 13

Chronological Age Mental Age Addition Subtraction Multiplication Division Percentage General Total

11.3*

9.3*
corrected tests and was interested in the class drills. He was very careful in the preparation of his daily work.

Survey Test B showed an arithmetic achievement of grade 11.3, an improvement of two years, and a standing somewhat above the level of his mental age. The addition score remained the same and multiplication showed a loss; the other parts showed gains and percentage a very decided gain of about 5.0 years.

Pupil XI

Lowell is one of a large family of very limited finances. He missed several days of school because of the icy roads and missed perhaps more than necessary because of the abnormal fear which the parents had toward the danger. He missed several other days due to illness. He is a very quiet boy and very attentive to his work.

At the opening of school he was fourteen years three months old and his mental age was thirteen years one month. According to Survey Test A his arithmetic achievement was grade 7.3, or about a half year below his grade level and his mental age. He was below his grade norm in every topic except subtraction, and decidedly low in general problems.

Diagnostic Test I showed a weakness in column addition, perhaps due to inability to concentrate. Test III showed a difficulty in problems involving the zero. Test IV showed a few errors in first quotient figures and in problems containing
zero in the quotient. In each of these cases the errors were corrected and class drill work done.

Test V showed several errors in changing fractions to equivalent forms and also failure to reduce fractions to lowest terms. The instructor helped Lowell correct these errors and gave him similar problems for drill.

Test IX showed the characteristic class weakness in reading and writing decimals and recognizing the comparative values. This was corrected by class instruction. He was also unable to change decimals to fractions and the reverse. He was given individual help in these processes. His inaccuracy in addition and subtraction seemed not to involve the decimal, but to be only inaccuracy in figures. Test X showed inability to divide decimals by ten or its multiples by merely moving the decimal. This required much drill, much of which was conducted in class. The test also showed a decided weakness in carrying through accurately the process of long division.

Test XI showed a decided lack of knowledge of tables of measure and inability to change from one unit to another. Test XII showed a total lack of knowledge of the process of division of compound denominate numbers. This work was re-taught to the whole class. Test XIV showed a failure to interpret percentage problems correctly and classify them into the proper type. The regular work furnished ample opportunity for drill in this type of problem. Test XV revealed a very
Scores for Test B
Scores for Test A

FIGURE 11

SCORES OF PUPIL XI
noticeable difficulty with the vocabulary of interest and business forms. The correct forms were demonstrated and Lowell corrected his errors in computation. Test XVI showed weakness in arithmetic vocabulary, which he studied as spelling drill.

Tests XVII and XVIII indicated a weakness in determining what is called for in a written problem. The instructor had him state the question in several problems before he attempted the solution, and insisted that the first step in written problems be to analyze them.

Survey Test B showed an achievement of grade 9.5, only a little below the level of his chronological age, and above that of his mental age. His total improvement was equivalent to 2.2 years; his greatest gain was in addition and was equivalent to about 4.0 years. In multiplication and in general problems his gain was about 3.0 years. His gain in percentage was satisfactory, but he was still a little below his grade norm. His gain in division was very slight, and his achievement was still decidedly below his grade norm. In subtraction his achievement was about a half year lower than in the beginning.

Pupil XII

At the beginning of this school year James was fourteen and a half years old. He is the only child in the home of his half-sister and brother-in-law. Although, by the child's
statement, the brother-in-law was very strict in his dealings with him, the sister was probably more lenient. He lacked the characteristics of a well disciplined child.

James was unusually fond of sports and kept well posted on events of local and national interest in this field. He was a member of an eighth grade basket-ball team and played with skill. His particular interest in the academic subjects lay in the social studies. He enjoyed reading if permitted to browse through material of his own choice; however, he seemed to resent being held to a definite assignment and he especially disliked arithmetic.

On the mental test his age was fourteen years, but on that section which related to arithmetic he ranked decidedly low. On Survey Test A, the results of which are shown in Figure 12, his grade level was only 5.3, although he was in Grade VIII. He seemed to feel that his deficiency in arithmetic accomplishment would be no great handicap to him and therefore displayed little desire to remedy the situation. This attitude seemed to be well established, and may have been emphasized by a previous teacher whose especial interest was social studies, and who, by the boy's statement, had said that his failure in arithmetic would not keep him back as long as he accomplished his other work. This may have been a wholesome attitude in this case, since his mental test revealed a decided weakness in this respect; nevertheless, it was not conducive to very great effort on his part and at no time did
he show any real interest in his arithmetic.

According to the results of Survey Test A, his addition ability was of fifth grade level. Diagnostic Test I failed to reveal any particular weakness in addition of whole numbers except in Part One, which is explained by the misunderstanding of the plus sign, which he interpreted as multiplication. Test V, IX and XI showed the weakness to be in handling fractions, decimals and denominate numbers.

His subtraction ability was on the fifth grade level. Test II revealed a weakness in combination facts and also the borrowing situation. For remedial work he was given the diagnostic test from which he made a copy of the combinations and filled in correct answers for memorization. The instructor also gave him special help with problems involving the borrowing situation, and furnished him drill material of this type.

Test III revealed that James along with a high percentage of the group made the zero error in multiplication, saying 0x4=4. This was corrected for the whole group. No individual work was given in multiplication, for the trouble seemed to be in failure to concentrate and carry through an example to the correct conclusion. At various times class drills were given in multiplication.

Division was James' greatest weakness. Test IV showed errors in a few multiplication facts, which the instructor gave him for memorization. It also showed the weakness in subtraction, which he had not yet overcome. The greatest
weakness, however, seemed to be, as in multiplication, failure to carry through the process, rather than in any one phase. He took part in the class drills, and also solved a number of examples of lesser difficulty.

Fractions presented a real difficulty. Tests V, VI, VII, and VIII showed an accomplishment lower than his general arithmetic level of the fifth grade. A very little explanation and drill corrected his error in changing denominators, for he was merely forgetting to multiply by the numerator. He was unable to reduce fractions to lowest terms. He failed to notice common factors for the terms. Examples of fourth and fifth grade levels were used for corrective and drill material. He was altogether unfamiliar with the process of changing the form of the minuend when the fraction of the subtrahend was larger. The instructor taught him this process, using material of fifth grade level. His specific difficulty in multiplication was cancellation. This was very closely related to his difficulty in reducing fractions; and was removed, or at least reduced, by the drill work done. In division, he knew that he should invert the divisor, but when the process involved both the changing to an improper fraction and inverting, he would omit the second part. He also failed in the process of inverting a whole number. The instructor gave him individual instruction in this work also, and gave him examples of fifth grade level.
Tests IX and X showed an almost total lack of conception of decimals. The instructor did not give James much individual work in decimals, but gave him special attention during the time the entire group spent in review of reading and writing decimals, and in giving place names. In common with many of the group, he did not understand, or use with facility, the process of moving the decimal to the right or left when multiplying or dividing by 10 or by a multiple of 10. Since there was difficulty in arousing James' interest, the instructor gave him only the drill which she used for the entire group.

James' difficulty with percentage is not hard to understand in the light of his arithmetic achievement and the arithmetic phase of his mental test. Diagnostic Test XIV showed a weakness in every phase of the subject. The instructor gave him the tables of fractional equivalents for memorization, and gave him special help in the preparation of regular class work, much of which dealt with percentage. However, the topic seemed almost beyond his stage of development, and he faced such difficulties with the four fundamentals, that the instructor did not emphasize it very strongly.

James' chief difficulty with the vocabulary of arithmetic was a spelling difficulty and this was probably due to a general spelling weakness, as was shown in all his written work.

Test XV showed a lack of understanding of the vocabulary of interest and business problems. He was unable to properly fill out checks and bills. He knew nothing of the use
of an interest table. Along with the group he studied the correct solution for the examples of the test and the instructor explained the use of the interest table. It seemed unadvisable for him to do any further work.

In addition to the work given the whole group, James needed special help in subtraction of denominate numbers. He was unable to change the form of the minuend correctly. He solved many problems of this type and at the time seemed to master them; however, there is some doubt about the permanency of the accomplishment. In addition of denominate numbers he was able to change the form of the answer to larger units, but the process failed to carry over into multiplication. A little help corrected this difficulty. More than a little help was necessary in division, and although he solved many examples he never became very accurate or efficient.

The instructor gave James considerable individual help in the preparation of his work in finding areas and volumes. He never really learned the rules and was always uncertain about applying them. The work was made as concrete as possible.

Survey Test B showed no improvement in subtraction or percentage. The improvement in problem solving shown in Part Six was equivalent to 5.0 years, and the improvement in addition, multiplication and division was equivalent to a year or more. The total improvement was equivalent to 1.1 years, which was much less than desired; however, in view of
* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 12

SCORES OF PUPIL XII
his evident lack of interest, and his low innate ability in this subject, and in comparison with his standing of 5.4 grade level in the fall after eight years in school, for he was retarded one year, it is perhaps a satisfactory achievement.

Pupil XIII

In September Charles was thirteen years four months old. He is the oldest of four children, and the only boy. His father is a member of the American Legion, and belongs to one of the oldest families in the community. Their home has been the family home for three or more generations; however, the family had met financial difficulties and expect to lose the home. The children were withdrawn from school at the close of the first semester and plans were being made to move from the community. After an absence of two weeks, a change of plans seems to have come about and the children were returned to school. Charles was absent about two weeks on other occasion, once because of his own illness and again because of the serious illness of his father. Home conditions were probably unpleasant because of the illness and the financial trouble.

Charles' primary teacher related how, when he first entered school, he had to be taught in minutest detail how to associate with other children and how to respond to instructions. By his actions at that time he would have been classed as
decidedly subnormal. He responded to instruction and this year in grade eight seemed to have the characteristics of an average boy; however, he was lacking in traits of personal neatness and sociability. It may be that he really did not enjoy the company of other children, or that he merely preferred to read.

On the intelligence test, Charles' mental age was fifteen years three months. On Survey Test A his arithmetic achievement was grade 9.5, somewhat below the level of his mental age. Very few errors were revealed by the diagnostic tests, even in IV, VIII, X and XII, the division tests, in which topic he made his lowest rating; or in Tests XVII to XX which deal with general problems. Test III showed the zero error in multiplication, and Test VII showed the failure to cancel in a few instances in multiplication of fractions.

The only remedial work done was to make Charles aware of his errors by returning his corrected tests and letting him take part in the class work and drills. He displayed a real interest in his work and may have done more drill than was assigned. He always held first place in the ciphering contests and had held this reputation from previous years.

According to Survey Test B, his achievement was grade 11.3, or a little above the level of his mental age. The improvement in his total score was 1.8 years; his greatest improvement was in division, about three years, and in general problems, about 2.0 years. He showed no gain in subtraction.
Grade Levels from Total Scores

Norms for Grade 8.9

Norms for Grade 7.9

FIGURE 13

SCORES OF PUPIL XIII
Pupil XIV

Vera is the youngest child in an underprivileged home. She is of an unhappy disposition and easily offended by her associates. She is a retiring type of child and seems not to fit into the group of her classmates. She was eager to please and desired to succeed. She is a year retarded and somewhat overgrown. During the school year she was ill with the mumps and was absent on other occasions for shorter durations of time.

At the beginning of her seventh grade she was thirteen years four months old and had a mental age of twelve years one month. Her arithmetic achievement, according to Survey Test A, was grade 6.9, with addition and subtraction above her grade norms and the other topics somewhat low.

Diagnostic Tests I, II, III and IV showed very few errors in combinations. In column addition she seemed to lack a sufficient attention span and failed to carry through the process correctly. She made a few errors in the zero combinations in multiplication and was very inaccurate in estimating the first quotient figure in division. The instructor gave her the test papers for correction and she did drill work with the class.

Tests V, VI, VII and VIII revealed few errors in fractions. Test V showed that in finding the least common denominator, she sometimes found a correct denominator, but not the least one. She also failed to reduce fractions to lowest terms in some instances. On Tests I, III and VII she was very inaccurate
in detecting errors in incorrect solutions given. She corrected the errors on her papers as they were returned to her, and she solved a few problems of the various processes in the class drills.

Test IX showed that Vera was lacking in the foundations of decimals. She was unable to give place values or to appreciate relative sizes of decimals. She improved in this work as it was re-taught to the class. Test X showed inability to correctly locate the decimal in the quotient when a decimal appeared in the divisor. She was also unable to carry through the process of long division, and on this test she failed to detect the errors in the quotients given. For remedial work, the instructor gave her problems in division of decimals, and also many exercises in locating the decimal in the quotient when the figures were already given.

Test XI showed a knowledge of denominate numbers greater than the class average; however, she was slow and rather uncertain about her work and profited by the work in this topic which it was necessary to give the class. Test XIII showed that she was unable to divide compound denominate numbers and was inaccurate in the use of some of the tables. She learned this as it was taught to the group. Test XIII showed that she had forgotten to divide by two in finding the area of a triangle and was unable to do any work with circles. This test was given too late in the term to accomplish any effective remedial measures.
Test XIV showed that Vera was wholly unable to choose the correct process for the solution of a percentage problem. She made a few errors in writing fractions and decimals as per cents and per cents as decimals. She corrected these errors and the instructor emphasized the classification of percentage problems into types, each with its method of solution.

Test XV showed very meager knowledge of business forms and interest problems. She had an average understanding of the vocabulary, but was unable to fill out check stubs and account sheets. Her greatest difficulty with interest problems seemed to be in the use of the decimal. She corrected her own work in the interest problems and observed the correct solutions for the problems using business forms.

Tests XVII and XVIII showed her greatest difficulty in general problems to be in the choice of the correct solution. Remedial work in this was carried on throughout the year by analyzing the many written problems in the regular course.

Survey Test B showed an achievement of grade 8.7, above her grade level and her chronological and mental ages. She made an improvement of 2.5 years in everything except percentage, which remained the same, and subtraction in which her score was almost 3.0 years lower. In these two topics she remained below her grade norms, in spite of her total improvement of 1.8 years.
FIGURE 14

SCORES OF PUPIL XIV

* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

Chronological Age
Mental Age
Addition
Subtraction
Multiplication
Division
Percentage
General
Total

Norms for Grade 7.9
13 13 7.3 7.4 7.4 6.4 2.4 3.4 35.5

Norms for Grade 6.9
12 12 6.7 6.6 6.2 4.9 2.1 4.0 30.0

8.7* 8.9*
Pupil XV

Hal is the younger of two brothers in an average country home. He is small for his age, but is very active and especially interested in sports. He is a well-adjusted child and seems to have understanding parents who have provided a wholesome home environment. He probably received too little rest, for he was out almost every night for practice in the school band or in basketball. He also took part in all the school programs.

By changing schools from South Bend to our school in the latter part of the school year during his fourth grade, it was necessary either that he be placed in 3A, or in 4A, after having had only a small part of 4B. The latter course was taken with the result that he really omitted much of grade four. He had done the work satisfactorily, but was considered somewhat weak in arithmetic.

When he entered grade seven he was eleven years nine months old and had a mental age of fourteen years two months. Survey Test A showed his arithmetic achievement to be grade seven; but in division, percentage and general problems he was decidedly below his grade norms. His arithmetic achievement was below the level of his mental age.

Diagnostic Tests I, II, III and IV showed almost perfect work. The few errors that he made in division did not indicate any characteristic weakness. Tests V, VI, VII and VIII showed no difficulties in fractions. On Survey Test A
he had missed all the problems in division of fractions; but
there was an interval of three months between the two tests,
and apparently he had removed the difficulty during the time.

Test IX showed that he did not distinguish between
hundred and hundredths and the other corresponding place
names. He did not know the table of decimal and fractional
values and was inaccurate in changing to the fractional form.
Test X showed that he did not understand how to divide by ten
and its multiples by moving the decimal point. The work in
decimals given to the class was sufficient to remove his
difficulties.

Test XI revealed a marked deficiency in handling de-
nominate numbers. He had an insufficient knowledge of the
tables and their use in changing units. This prevented
accuracy in each of the four processes with compound denom-
inate numbers. Test XII showed a decided weakness in divi-
sion. Hal accomplished this work also as it was re-taught
to the entire group. Test XIII showed that he did not know
how to work with triangles and circles; but there was no
time for further work, so this remains yet to be corrected.

Test XIV showed the difficulty in percentage to be the
inability to classify problems according to the type and to
choose the correct solution. Throughout the year in the
regular work of the class he dealt with the percentage pro-
blems. He practiced identifying the problem with the type
and selecting the corresponding solution.
Norms for Grade 7.9
Norms for Grade 6.9

* Grade Levels from Total Scores

Scores for Test B
Scores for Test A

FIGURE 15

SCORES OF PUPIL XV
Test XV contained errors in filling out check stubs. He was also unable to use the interest table. He noted his errors and did some drill in the use of the table. The remaining tests showed no weakness in general problems. On Survey Test A there was a noticeable weakness in this topic, but Hal had evidently improved during the interval between the tests. The class had much practice in written problems and Hal was independent about his work, requiring little direct supervision.

Survey Test B showed the remarkable improvement of 3.3 years, and an achievement of grade 10.3, which was above the level of his mental age. His improvement was satisfactory in all topics, but it was greatest in those in which he was low on Test A. His marked improvement was probably due to his real interest in his work. He saw from the diagnostic tests what he had failed to get in making the adjustment necessary in changing schools.

Pupil XVI

Harry is the youngest of a large family. His parents seem to have firmer control over their children than many do and it seems to have a wholesome effect. Harry is a well-behaved boy; his attitude toward his teachers is commendable and he is a favorite among his classmates.

Harry is a year retarded in school, being thirteen years
nine months old when he entered the seventh grade. His mental age was only twelve years one month; he is rather small for his age. According to Survey Test A his arithmetic achievement was only grade 6.6. He reached his grade norm in multiplication and division, but was low in everything else and was decidedly low in addition and percentage.

Diagnostic Test I and II showed no weakness; Test III showed errors in problems containing zeros. He corrected these errors and solved additional examples for drill.

Test V contained a few errors in finding the least common denominator and some in the total process of addition of fractions, but none which showed any characteristic weakness. On Test VI he missed those problems in which it was necessary to change denominators and also increase the fraction of the minuend. He was able to solve problems involving either one of these difficulties, but not both. The instructor helped him correct the errors on his test and gave him additional examples for drill.

Test IX showed inability to give the proper place names in decimals and in appreciating their relative values. He was also inaccurate in changing fractions to decimals. On Test X he was unable to divide by ten or its multiples by merely moving the decimal. The work presented to the entire class was sufficient to correct these weaknesses.

Test XI indicated lack of knowledge of the tables of measure and their use in changing units. In spite of this
he was surprisingly accurate in addition and subtraction of
compound denominate numbers, but he seemed slow in addition.
He learned the tables with the class and solved problems in
addition and subtraction for drill. Test XII showed a total
lack of knowledge of the process of division of denominate
numbers; this, too, he learned as it was re-taught to the
class.

Test XIII showed that Harry had failed to learn the
vocabulary of mensuration, and was unable to apply the rules
of finding area and volume. Much of this had been taught
during the school year and no time was left to do any reme-
dial work.

Test XIV indicated difficulty in classifying a percent-
age problem into the proper type and choosing the correct
solution. This type of problem was studied repeatedly during
the year and he was trained to classify each and decide upon
the method of solution before starting his work.

Test XV contained many errors in interest problems, most
of which were caused by careless reading and therefore finding
the wrong thing. Many times his work included the correct
answer, but he gave a different number as the answer to the
question.

Tests XVII and XVIII showed that poor comprehension and
inability to estimate an answer were his greatest difficulties
in general problems. He had worked on problem analysis through-
out the year, but little direct remedial work was done following
Grade Levels from Total Scores
Scores for Test B
Scores for Test A

FIGURE 16
SCORES OF PUPIL XVI
these tests.

According to Survey Test B Harry made remarkable improvement in every topic except percentage, in which he still remained decidedly below his grade norm. His total gain was equivalent to 3.5 years, and his achievement was grade 10.1. This is above the level of his chronological age.

Pupil XVII

Grace is the oldest in a family of several children. The home is very undesirable, both in its material surrounding and moral atmosphere. On view of her heritage and environment, Grace has succeeded very well. She seems undernourished and many times gave the impression of receiving insufficient rest.

When Grace entered the seventh grade she was twelve years seven months old and had a mental age of thirteen years. Survey Test A showed her arithmetic achievement to be grade 8.9, with a high standing in addition, subtraction and multiplication; the remaining topics were at about her grade norm.

Diagnostic Test I to IV contained only one significant type of error. In the multiplications she gave the correct response when the zero combination was stated as $3 \times 0$, but gave it incorrectly when it was stated in the reverse form. She also made errors in the division problems containing zero in the quotient. The errors were pointed out and she corrected the division problems.
Tests V to VIII showed a good understanding of fractions. She made a few errors due perhaps to haste or carelessness, and in two instances misinterpreted the instructions, none of which indicated the need for any remedial work other than caution.

Tests IX and X showed some real difficulties in decimals. She was unable to give the place names or to understand the relative value of decimal numbers. She also made many errors in changing decimals to fractions and the reverse. She was not able to place the decimal in the quotient when a whole number was divided by a decimal, nor to divide by ten or its multiples. She corrected these weaknesses as the work was re-taught to the class.

Tests XI and XII indicated a fair knowledge of the tables of measure, but inability to use them in changing units. She had no knowledge of the process of division of compound denominate numbers, but she learned it as it was re-taught to the class. Test XIII indicated an almost total ignorance of the rules for areas of triangles and circles and her ability to any work in mensuration was very small, but there was no time to do any further work in it.

Test XIV did not show any particular weakness in percentage, although it was very evident on the survey tests. She made some errors in choice of correct solutions for type problems. Much practice was done in percentage throughout the year.

Test XV showed a very definite weakness in the vocabulary of interest and business forms. She was unable to fill out
* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 17

SCORES PF PUPIL XVII
account sheets and check stubs and was very careless in her reading and computation of interest problems. She corrected her work for the interest problems and continued with many examples of the same kind in her regular work. In the other cases the correct forms were pointed out, but no additional work done. Test XVIII indicated a low comprehension of general problems, but the other tests on problem solving indicated a very satisfactory accomplishment.

Survey Test B showed an achievement or grade 9.9, a growth of exactly 1.0 year. In addition and multiplication she made no change and her score was lower in subtraction and percentage, making division and general problems her only points of improvement. This seems, at first, very unsatisfactory; but perhaps it is acceptable when all facts are considered. The addition score was perfect, multiplication within one point or perfect, and the difference in subtraction was only one point. This leaves percentage as the one really unsatisfactory topic.

Pupil XVIII

Raymond is a brother to Pupil VI. His I Q and mental age are somewhat higher than his brother's but he is still wholly incapable of doing the regular work of grade seven to which he was assigned. He seemed less conscious of his limitations, but caused far greater discipline problems than his brother. He and his brother worked together in reading and spelling,
but he showed less interest and made less progress. He listened to the regular lessons of his class and frequently experienced apparent satisfaction in relating points of review in history or geography in which he, many times, was surprisingly accurate. He also enjoyed telling an experience or story which he had heard.

He was fourteen years three months old when school opened and had a mental age of nine years nine months. Survey Test A showed practically no arithmetic achievement, with a total of only two points.

The instructor used the same procedure with him as with his brother, and had already made the same error of starting him in arithmetic workbook four before starting the testing program. He drilled himself in subtraction combinations with flash cards and the instructor showed him the subtraction process using the additive method. He seemed able to execute the process at the time, and did many problems for drill; however he was not able to retain the ability for any duration of time. His primary teacher related a similar experience regarding his work in reading. After two repetitions he seemed able to read; but when he returned after the summer vacation he had lost all of his reading ability. The instructor changed him to workbook three and attempted to teach him a few multiplication tables, but with the same result; what he seemed to learn he did not retain.

He took the diagnostic tests and was given the same instructions as his brother; namely, that many of the points he
Scores for Test B

Scores for Test A

FIGURE 18

SCORES OF PUPIL XVIII
could not answer and that he should attempt only those parts that he knew how to do. The results were not helpful, for the tests were not adapted to his ability and moreover, he was clever at seeing his neighbor's work and his score was not always an accurate measure of his arithmetic ability. Test I showed that when the combinations were written in the form 5+2, he subtracted the smaller from the larger, but when written under one another he usually gave the correct sum. He did his work in both addition and subtraction combinations so slowly that he probably obtained most of the answers by counting.

A comparison of the scores on Survey Tests A and B is not very enlightening, except in the conclusion that it does not show any progress.

Pupil XIX

Beulah is the older of two daughters in an average country home. She seems to have a satisfactory home life and good surroundings. In spite of these wholesome conditions she seemed to lack the proper interest in school work. This may have been due in part to much absence, most of which was caused by illness and some by bad roads and weather. Her physical development seemed ahead of her years, and she was interested in boy friends and dates. This, no doubt, had a decided influence on her interest in school.

Beulah was twelve years six months old when she entered the seventh grade and had a mental age of thirteen years eight
months. Her arithmetic achievement as shown by Survey Test A, was grade 6.6, which was not only below her grade norm, but also below the level of her chronological and mental ages. In addition and percentage she was decidedly low and had a satisfactory score in only subtraction and multiplication.

Diagnostic Tests I to IV indicated an inability to discover an error in a given solution and also many errors in the borrowing situation in subtraction. She made a few errors in the fundamental combinations and several errors in carrying in addition. In short division most of her errors were due to lack of knowledge of tables. She made errors in estimating the first quotient figure in long division and had very little skill in carrying through the long division process. The instructor returned these tests with the errors marked; she pointed out her difficulty in subtraction and gave her additional examples to solve. Beulah made a list of the combinations which she needed to learn and memorized them. After she had drilled on the tables the instructor helped her with the process of long division. She was able to do accurately only the very simplest examples, and did many of fifth grade level. She took part in class drill in everything except division, in which she had not developed sufficient skill to work with the group.

Test V indicated one striking type of error. In finding the least common denominator, when it was not very obvious, she gave a common factor when there was one and for the others
she gave the larger denominator. She corrected these errors when the proper method was explained; and on Test VI made no mistakes of that kind. However, she did not understand how to change the form of the minuend when it was necessary to increase the fraction. After this was explained she practiced on material of fifth grade level. On Test VII she was unable to solve the more difficult problems, but she apparently understood the process for she did the easier examples. As on some previous tests she was unable to detect the errors in given solutions. She drilled with the class in multiplication of fractions, and on Test VIII she made very few errors.

Tests IX and X showed the lack of knowledge of place names of decimals and of their relative values. She was also unable to change fractions to decimals. The errors which she made in the four processes with decimals were, in most instances, not errors in locating the decimal, but in the use of numbers; she had some difficulty in locating the decimal in division. Much of her difficulty was removed by the class work; but she continued to drill in division, since it was a distinct weakness with her.

Test XI showed that she had a very poor knowledge of the tables of measure and their use in changing units. She was unable to change a sum to the correct form, or to make the necessary changes in the minuend. Test X showed a similar difficulty in changing the product. She had no knowledge of the process of division of compound denominate numbers. She memorized the tables and worked with the class as they studied
the four processes with denominate numbers.

Test XIII showed that of the work in mensuration which she had done previously she did not remember the rules concerning triangles and circles. There was no time in which to correct these difficulties.

Test XIV revealed errors in Beulah's work different from most of the others. She did not know the tables for fractional and percentage values and had no ability for comparing areas in percentages, but she made a standard score in choosing the correct solution for percentage problems in type form. She made many errors in the solution of both easy and difficult percentage problems. The instructor gave her the tables of fractional and percentage values for memorization and continued to stress the classification of problems according to type before attempting the solution.

Test XV showed inability to fill check stubs and account sheets and errors in the use of the interest table. She observed the correct forms for those she missed and drilled in the use of the interest table.

Survey Test B showed an achievement of grade 8.2, which is below the level of her mental age. She made an average gain in addition and percentage, remained the same in subtraction and lost in multiplication. In all these she remained below her grade norms. The gains in division and general problems were unusually great, making a total gain of 1.6 years.
Grade Levels from Total Scores

Scores for Test B
Scores for Test A

FIGURE 19

SCORES OF PUPIL XIX
Pupil XX

Alice is the younger of two daughters in an average country home. She seemed to have low vitality and near the end of school she missed about a week of school due to an illness, after which she did not seem to regain her normal strength. She was a well adjusted child and congenial with her companions. She belonged to the school band and took part in the various school activities.

Alice was twelve years two months old when she entered the seventh grade and had a mental age of fifteen years one month. Survey Test A showed her arithmetic achievement to be grade eight. In subtraction and percentage she was below her grade norm, while addition and multiplication were her highest points of achievement.

Diagnostic Tests I to IV showed very little difficulty in the use of whole numbers. She made a few errors in carrying in addition and some in the borrowing situation in subtraction. She made some addition errors in the multiplication process and seemed rather slow in detecting errors in given solutions. Tests V to VIII showed no characteristic types of errors in fractions on Survey Test A. She corrected her errors on all of these tests and took part in the various class drills.

Tests IX and X revealed some difficulties in decimals. She was not able to give the place names and she failed to appreciate their comparative values. Her errors in the fundamental processes with decimals were due largely to errors
in numbers rather than decimals. She was, however, unable to divide by a number composed of one in the tenth, hundredth or thousandth place and locate the decimal correctly. This was part of the work re-taught to the class.

Test XI indicated that she knew her tables fairly well, but was unable to use them in changing units. This caused inaccuracies in addition and subtraction of compound denominate numbers. The class work in tables of measures and changing units was sufficient to remove this difficulty. Test X showed that she did not know all of the tables yet, but was able to use the more common ones in changing units and was reasonably skillful in multiplication. She did not know how to divide compound denominate numbers, but she learned this as it was re-taught to the class. Test XIII showed that she did not know any of the rules for areas and volumes except for rectangles and rectangular solids. She had to leave this undone because of lack of time.

According to Test XIV her work in percentage exceeded her grade norm. This test was given four months after Survey Test A, on which her percentage score was low. During this time much attention had been given to percentage.

Tests XVII and XVIII indicated a good understanding of general problems, with the greatest weakness in estimating the answer and choosing the correct solution; however, on Test XX she did unsatisfactory work. The cause was not evident. She continued to analyze the problems and to check
FIGURE 20

SCORES OF PUPIL XX
her computation.

Survey Test B showed very satisfactory results in her work. Her achievement was grade 11.1, a total improvement of 3.1 years, and a satisfactory growth in all topics. The greatest improvement was in subtraction, which she raised from a score below her grade norm to a perfect score.

Pupil XXI

William is next to the youngest in a large family of boys. The children seem to have the reputation of being mischief makers in the neighborhood and William has the attitude that he receives the blame for whatever is done. His interest in school is not very great and he seems to expend very little effort on his work; he really is a discipline problem.

He is one year retarded, being thirteen years nine months old at the beginning of the seventh grade. His mental age was twelve years eleven months. Survey Test A showed his arithmetic achievement to be grade eight; however, in addition, percentage and general problems he was below his grade norms.

Diagnostic Tests I and II contained very few errors. The only ones of any significance were in the borrowing situation in subtraction. The few errors on Test III were due to mistakes in tables, adding incorrectly, or forgetting the carry figure and probably the latter. Test IV contained various types of errors; namely, estimating quotient figures incorrectly, subtraction, multiplication and omitting zero from the
quotient. William corrected all the errors on these tests and took part in class drills in the four fundamentals.

Although Tests V to VIII contained a few errors, they indicated no specific difficulty with fractions. He corrected each test as it was returned to him. Test IX indicated some difficulty in decimals. In giving place names he disregarded the decimal and assigned names from right to left as in whole numbers. He was also unable to multiply by ten or its multiples by merely shifting the decimal. Test X indicated very poor skill in division of decimals. The errors were due mainly to figures rather than the decimal. He made some errors in locating the decimal in dividing by ten and its multiples and by decimals composed of one and zeros. He corrected most of these difficulties from the introductory work in decimals which was repeated with the class.

Test XI showed some trouble in reducing and borrowing in denominate numbers, and due to this, some inaccuracies in addition and subtraction. Test XII showed the continuance of some of these difficulties after the work was re-taught to the class; but it also showed that William was one of the few in the class who could divide compound denominate numbers. Test XIII showed no knowledge of the rules for areas and volume except for rectangles and rectangular solids, but there was no time for any remedial work.

Test XIV showed almost no ability in choosing the correct solution for percentage problems stated in the type form or in solving those of greater difficulty. The instructor had
Norms for Grade 7.9
13 3 7 7 4 7 4 6 4 2 4 5 4 33.5

Norms for Grade 6.9
12 6 7 6 6 6 2 4 9 2 1 4 0 30.0

* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 21

SCORES OF PUPIL XXI
William state the percentage problems in the regular work in type form and choose the method of solution before beginning actual computation.

Test XVIII indicated a real weakness in the choice of the correct solution for general problems. As in the case of percentage the regular work furnished much drill. The instructor insisted on the analysis of the problem and decision as to the method of solution before the actual computation was begun.

Survey Test B showed an arithmetic achievement of grade 9.5, an improvement of 1.5 years. His improvement in general problems was more than 4.0 years; in addition, 3.0 years and in division, 1.0 year. His scores in percentage, subtraction and multiplication remained the same; the first was below his grade norm, but the others were decidedly above.

Pupil XXII

Tony is the younger of two brothers in a family from southeastern Europe. The parents do not speak English and unlike most foreign people have made their home in the country. Tony has never done good school work, but he and his brother have both shown strong artistic tendencies. Tony seems shy and seldom takes part in school programs, but is always willing to help in making posters or doing anything which brings his art into use.

He was retarded in school, being thirteen years seven
months old when he entered the seventh grade. His mental age was only eleven years six months. According to Survey Test A his arithmetic achievement was only grade 5.6, and in addition and division he was far below this average.

Diagnostic Tests I and II showed only a few errors in combinations; however, his addition score was low for he misinterpreted the plus sign and gave products for the combinations stated in that form. On Test III he missed all the zero combinations and many examples of the total multiplication process. He corrected all these errors and solved additional examples for practice. Test IV revealed more real difficulties. He was very weak in the vocabulary of division and missed many examples of short division and in estimating the first quotient figure. He was accurate in the multiplication combinations, indicating that the errors were due to poor judgment when the division was not exact. He accomplished very little in the section containing the whole process of long division. The instructor pointed out his errors and had him correct some of them. He then worked on easier examples of division.

Tests V to VIII showed many difficulties in fractions. He was unable to change fractions to larger denominators, made many errors in choosing the least common denominator, and was inaccurate in reducing fractions. After he corrected Test V he was able to do these parts of Test VI correctly. He was unable to make the necessary change in the minuend when
the fraction was too small and made many errors in both addition and subtraction. He made many errors in cancellation and was very weak in the multiplication process. In division he sometimes forgot to invert the divisor, and was still having difficulty with cancellation. While the remainder of the class was drilling on these processes the instructor explained them to Tony and helped him get started. He solved many problems of fifth grade level.

Tests IX and X indicated the need for intensive work in decimals. He was unable to give the place names of decimals and did not understand their comparative values. He made errors in changing fractions to decimals and the reverse. He was unable to divide decimals by ten and its multiples or by a decimal composed of a one and zeros. Most of his errors in the four fundamentals were due to the figures rather than the decimal in the quotient if there was one in the divisor. The work in decimals which the class did helped Tony get started and he continued practicing in division.

Tests XI and XII indicated a fair accomplishment in denominate numbers. He made some errors in tables and was so slow in reducing denominate numbers that he had no time to solve those involving borrowing. He understood the process however, for he was fairly accurate in the subtraction problems. He was unable to do the multiplication and division processes, but learned them as they were re-taught to the class. Test XIII showed no knowledge of the rules for areas
and volumes except for rectangles and rectangular solids, but there was no time for further work of this kind.

Test XIV failed to show his particular weakness in percentage. He made many errors in changing per cents to fractions and decimals to per cents. These he corrected when the test was returned. He also made errors in choosing the correct solution for problems stated in type form, and solving both easier and harder percentage problems. The instructor explained the different types of percentage problems and the methods of solution. The pupils identified the problems with the type before starting the calculation. The work on this topic was continued at intervals throughout the year.

Test XV showed a good knowledge of the vocabulary of interest and business problems but no ability in filling the forms correctly. He was fairly accurate in all of the interest problems except in the use of the interest table. The instructor gave drill in the use of the table, but did nothing with the business problems other than demonstrate the correct forms.

Tests XVII and XVIII indicated weakness in determining what was given and the question asked in a general problem, and also in estimating the probable answer and choosing the correct solution. The class received much practice in analyzing problems, for there were many in their regular work.

Survey Test B showed satisfactory improvement in everything except percentage, in which his score remained the same.
Norms for Grade 7.9:

- Chronological Age: 13
- Mental Age: 13
- Addition: 7.3
- Subtraction: 7.4
- Multiplication: 6.4
- Division: 2.4
- Percentage: 5.4
- General: 35.5
- Total: 7.8

Norms for Grade 6.9:

- Chronological Age: 12
- Mental Age: 12
- Addition: 6.7
- Subtraction: 6.6
- Multiplication: 6.2
- Division: 4.9
- Percentage: 2.1
- General: 4.0
- Total: 30.0

* Grade Levels from Total Scores

---
Scores for Test B
Scores for Test A

FIGURE 22
SCORES OF PUPIL XXII
Although he made an improvement of more than two years in 
addition and division, he was still below his grade norms in 
both. He made his greatest improvement in subtraction, and 
he was well above his grade norm in this, as well as in multi-
plication and general problems. His total achievement was 
grade 7.8, which although slightly below his grade level, 
was well above that of his mental age and represented a growth 
of 2.2 years.

Pupil XXIII

Perry is the younger of two brothers in an average farm 
home. The parents seem to provide a wholesome home environ-
ment; the boys are well adjusted and are very congenial with 
their classmates. They belong to the school band and partici-
pate in all the activities of the school.

He was twelve years one month old when he entered the 
seventh grade and had a mental age of thirteen years ten 
months. Survey Test A showed an arithmetic achievement of 
grade 8.5, about equal to the level of his mental age. The 
multiplication and percentage scores were below his grade norm.

Diagnostic Tests I and II showed no difficulties. On 
Test III he gave the wrong answers for the zero combinations 
stated in the form 0x2, but the correct answer when the same 
combinations were stated in the reverse order. He made errors, 
by crowding the figures in the partial products and adding them 
incorrectly. He corrected these and other careless mistakes 
and also a few which he made on Test IV.
Test V showed some trouble in reducing fractions to lowest terms and a few errors in choosing the least common denominator. After correcting Test V, he made similar errors on Test VI, which he also corrected. Test VII showed various inaccuracies in the multiplication of fractions, none of which indicated any characteristic difficulties. He corrected these errors and did very careful work on Test VIII.

Test IX showed a good foundation in decimals, but he failed to distinguish between the place names of whole numbers and decimals by adding the th ending to the latter. Calling his attention to these and a few other errors was all he really needed. Test X contained several errors in locating the decimal in quotients when the divisor was a decimal. Problems in locating the decimal when the quotient figures were given were used for drill.

Tests XI and XII showed a satisfactory knowledge of denominate numbers. He was one of the few who understood the process of division of compound denominate numbers. The work in this topic which was re-taught to the class furnished review and drill for Perry.

Test XIII indicated that he knew the rules for areas and volumes only in the cases of rectangles and rectangular solids, but no time was left for additional work after the test was given.

Test XIV indicated inability to choose the correct solution for a percentage problem stated in the type form and some errors in solving ordinary percentage problems. The instructor
* Grade Levels from Total Scores

Scores for Test B

Scores for Test A

FIGURE 23

SCORES OF PUPIL XXIII
helped him classify according to type the percentage problems which were a part of the regular course, and to choose the correct solution before starting the calculation.

Survey Test B showed an achievement of grade 9.9, a little above his mental age and an improvement of 1.4 years. He made about 4.0 years growth in multiplication and percentage. His scores in addition and subtraction dropped a little, but were well above his grade norms.

Pupil XXIV

Ellen is a sister to Pupil Thirteen, the oldest of the three girls. Unlike her brother she is neat in appearance. She missed school at the beginning of the second semester when the family was considering moving and some on other occasions because of colds, for she was subject to attacks of croup. She was erratic in her work, on some days doing very poor and on others, quite well. It took her unusually long to become adjusted at the beginning of the year and her work during the second semester was much better than during the first.

She was eleven years ten months old when she entered the seventh grade and had a mental age of twelve years one month. According to Survey Test A her arithmetic achievement was grade 6.4 and she reached her grade norms only in general problems.

Diagnostic Tests I and II contained only a few errors. In addition she made two errors in her carry figure, she failed to complete one subtraction problem, and made two errors in borrowing. On Test III she missed the zero combinations and
made errors in the complete process by carrying the wrong figure. She missed two long division problems in which she omitted a final zero from the quotient, besides a few others. She corrected all of these tests as her errors were pointed out.

Tests V, VI and VII contained a few errors in changing fractions to equivalent forms, reducing to lowest terms and cancellation. She was able to correct these tests without any help. Test VIII contained two striking types of errors. In changing the division to the multiplication form she treated those divisors which were proper fractions as though they had been composed of the number one and the fraction. In the total process she inverted both the dividend and divisor, except in those cases in which the dividend was a whole number. The instructor pointed out the errors and explained the correct process, after which Ellen corrected the test and solved other examples for practice.

On Test IX she omitted most of the examples in comparison of decimals, and changing fractions to decimals and the reverse. She made very few errors in the work which she attempted. Test X indicated that she could do nothing in division of decimals except locate the decimal when the divisor was a whole number. Most of this work she learned as it was re-taught to the class, but the instructor gave her special help and extra practice material in division.

On Test XI she made very few errors in the addition and
subtraction processes, but she was less accurate in giving the facts from the tables of measure and too slow to complete the work. She was also so slow in reducing denominate numbers to larger units that she had no time to change the minuend as necessary in preparation for subtraction. She showed that she understood the process, however, in the subtraction examples. Test XII contained some errors in tables and some in multiplication due to failure to change to larger units. She knew nothing of the process of division of compound denominate numbers. This she learned as it was re-taught to the class.

Test XIII showed no knowledge of rules for areas and volume except for rectangles and rectangular solids, but no further work was done in the topic.

On Test XIV she made several errors in changing fractions to per cents, per cents to decimals and the reverse processes. She also was inaccurate in choosing the correct solution for problems in type form and in solving ordinary percentage problems. Much work in percentage was done throughout the year and the instructor taught the three type forms and the methods of solution. The pupils classified the problems according to type, and decided upon the method of solution, before beginning the computation.

Test XV showed almost no knowledge of the vocabulary used in business or of business forms. It contained many errors in interest calculation and showed almost no knowledge of the use of the interest table. She corrected her work in interest
* Grade Levels from Total Scores

Scores for Test B
Scores for Test A

FIGURE 24

SCORES OF PUPIL XXIV
and the instructor demonstrated the correct business forms and
gave drill in the use of the interest table.

Tests XVII and XVIII indicated weakness in comprehen-
sion of general problems and in analyzing them for the state-
ments of what is given. The class solved many general pro-
blems and practiced analyzing them by stating what was given
and the question asked before attempting the solution.

According to Survey Test B her achievement was grade 8.7,
an improvement of 2.3 years. She made perfect addition and
multiplication scores and her score in general problems was
above her grade norm. Her score in percentage was lower, and
although she made a year or more growth in subtraction and
division, these scores were still below her grade norms.

Pupil XXV

Hazel is the younger of two sisters in an average country
home. The girls have the advantage of congenial parents and
wholesome environment. The father is a prosperous farmer and
the mother, a successful home maker who was trained for busi-
ness. Hazel is very heavy, a trait which she seemingly ac-
quired from her father. She has a pleasing personality and
has many friends of whom she is very considerate. She is
especially thoughtful of those having fewer opportunities than
herself. She belongs to the school band and takes part in all
the school activities. She is a poor reader and consequently
has much difficulty in all her work. She had an apparent inter-
est in her work, and in an effort to improve her standing did
much homework under her mother's supervision. She was troubled with diseased tonsils and was absent from school on several occasions because of gland trouble and throat infection.

She was twelve years two months old when she entered the seventh grade and had a mental age of eleven years ten months. According to Survey Test A her arithmetic achievement was grade 5.8, about a year below the level of her mental age. Her lowest achievement was in addition.

Diagnostic Test I failed to reveal her addition difficulty. She missed three fundamental combinations which the instructor pointed out, and she made a few errors in column addition. She corrected these and did further drill of similar material. On Test II she made only three errors, two of which were fundamental combinations and the other, a borrowing difficulty. Test III contained only two errors in multiplication combinations which she gave correctly in the first part. This would indicate lack of attention or short attention span. Test IV contained many errors. In many instances she became confused and gave the wrong response by giving the sum instead of the product, or the quotient when she should have subtracted. She was very inaccurate in estimating the first quotient figure and had little skill in the complete process of long division. The instructor helped her with many examples of easy long division problems and gave her others for practice.

Test V to VIII indicated the need for much remedial work in fractions. She made many errors in finding the least common
denominator, in changing to larger denominators and in reducing to lowest terms. The instructor helped her with these processes and gave her practice material. Afterwards she gave her practice material in addition and later in subtraction of fractions. Drill for greater speed and accuracy in multiplication and division of fractions was all she needed in those processes.

Test IX showed that Hazel needed the introductory work in decimals. She was unable to give the place names in decimals and had no understanding of their relative values. She was unable to change fractions to decimals or the reverse. She made errors in the processes using decimals due both to number calculation and position of the decimal. She worked with the class as this material was being re-taught and solved several examples for extra drill. Test X revealed inability to divide by ten or its multiples, and also to locate the decimal when a whole number is divided by a decimal. She worked with the class in oral drill with problems in dividing by ten and its multiples and in locating the decimal in quotients already given. She also practiced in the whole process of division of decimals.

Tests XI and XII showed a lack of knowledge of the tables of measure and little ability in changing quantities from one unit to another or in any of the four processes using compound denominate numbers. She began with the class memorizing the tables. Later she worked at changing quantities both to smaller
and larger units. She studied successively each of the four processes using denominate numbers. The instructor supervised her work closely and gave her additional material for drill at home.

Test XIII revealed a very great weakness in finding areas and volumes. She apparently interpreted the term area to mean perimeter, which she found in many instances. She attempted no problems in volumes, except for rectangular solids, and none dealing with circles. There was no time for remedial work.

Test XIV showed many difficulties in decimals. She did not know the tables of fractional values for per cents and made errors in writing per cents as decimals and the reverse. She was unable to choose the correct solution for percentage problems stated in type forms and was very inaccurate in the solution of all percentage problems. The instructor gave her the tables of fractional values for per cents to be memorized and gave her drill in changing per cents and the reverse. Much time was spent in identifying percentage problems with the type forms and performing the correct solutions. This formed a large part of the regular work of the class.

Test XV indicated very little knowledge of business forms. She knew almost none of the vocabulary and was unable to fill in check stubs, receive a bill or make an account sheet. She attempted only three interest problems and in two of these she made careless errors. The instructor demonstrated the correct form for the business problems and continued the work
Norms for Grade 7.9
13 13 7.3 7.4 7.4 6.4 2.4 5.4 35.5

Norms for Grade 6.9
12 12 6.7 6.6 6.2 4.9 2.1 4.0 30.0

* Grade Levels from Total Scores
--- Scores for Test B
---- Scores for Test A

FIGURE 25
SCORES OF PUPIL XXV
or the regular course in interest.

Test XVI revealed the need for drill on arithmetic vocabulary, both in meaning the spelling. She did this work with the group.

Tests XVII to XX indicated weaknesses in general problems. Her greatest difficulty seemed to be in choosing the correct method of solution. The instructor had her analyze the written problems, stating the given facts, the question and the steps in the solution before beginning the calculation. Many written problems were solved as part of the regular work.

Survey Test B showed very little improvement, for her achievement was only grade 6.3. She made no gain in subtraction, percentage or general problems, and made a lower score in division. Her improvement in addition and multiplication was a little more than 1.0 year and her total gain was only .5 of a year. She was more than 1.0 year below her grade norms in all topics and about 1.0 year below her mental age in her total achievement.

Pupil XXVI

Ralph is the older of two brothers in a farm home of restricted advantages. He is large for his age and on slight acquaintance gives the impression of being older. He was not a member of the group when the mental test was given, but the indications are that his mental age would be less than his chronological age.
When he entered the class in January he was twelve years of age. The first test he took was Diagnostic Test XIV which revealed a decided weakness in percentage. He made many errors in changing fractions to per cents and omitted all the examples of changing decimals to per cents. This evidently was due to lack of time. He omitted many of the examples of changing per cents to decimals. He was unable to compare areas in per cents; he could not choose the correct solution for percentage problems stated in the type forms or solve ordinary percentage problems. The instructor gave him the tables for fractional values for percentages to be memorized and explained the relation of per cents and decimals. The class studied the three types of percentage problems and the correct solution for each. The instructor supervised the daily preparation of his work and helped him classify the percentage problems according to type before attempting the solution.

Test XV showed almost no knowledge of business forms and interest. There was little time for intensive work on these topics, but he watched the demonstration of the correct business forms and continued with the regular course which included interest. He received some drill in the use of the interest tables and instruction in the different methods of interest computation.

Test XVI showed lack of knowledge of the vocabulary of arithmetic, particularly a spelling deficiency. He used the words as a special spelling list which he studied and drilled
for several days.

Although Ralph missed Test XI, which was given just before he entered the class, he took the work in tables of measure and their use. He also did the work in addition and subtraction of compound denominate numbers. Test XII showed the need for additional work in tables of measures. He was very inaccurate in multiplication and knew nothing of the process of division of compound denominate numbers. Both of these topics were re-taught to the group.

Test XIII showed many errors in the vocabulary of measurement and no knowledge of areas and volumes, except for rectangles and rectangular solids. In some of the problems for which he knew the correct method of solution he made errors in computation. There was no time following this test for any remedial work other than pointing out the errors.

Test XVIII indicated poor comprehension in general problems and also difficulty in determining what was called for and in estimating the probable answer. The instructor helped him analyze the problems of the regular course before attempting their solution, but Test XX showed a continued weakness with this kind of problem.

There is nothing with which to make a comparison of the scores on Survey Test B to show improvement made, but a comparison with grade norms shows their unsatisfactory level. His arithmetic achievement was grade 5.7. He was below his grade norms in every topic and decidedly low in multiplication and division.
FIGURE 26

SCORING OF PUPIL XXVI

* Grade Levels from Total Scores
Scored for Test B
Not enrolled for Survey Test A or Mental Test

SCORES OF PUPIL XXVI
CHAPTER IV

SUMMARY AND CONCLUSIONS

This study relative to the value of diagnostic and remedial procedure in junior high school arithmetic, conducted in the regular room by the room teacher, confirms the current opinion that the procedure is a valuable one. There was no perceivable value derived from it by the two pupils whose I Q's were less than 70, but with the data of these cases included there was an average improvement of 1.7 years. Grade VII made the greater gain, with an average growth of 1.85 years. Since the normal expectancy of the work of a school year is a growth of one year, the average gains greater than this amount may fairly be attributed to the diagnostic and remedial procedure.

A comparison of the improvement made by those of higher I Q with those of lower I Q shows that of the first group to be greater. Three cases above the class medians of I Q's were below the class medians of achievement. A comparison of average improvement made by those of higher initial achievement with those of lower initial achievement shows the same general result; the improvement was greater for those having greater initial achievement. This seems to indicate that the procedure has value, not only for the pupil having noticeable difficulty, but for all pupils.

On the basis of this study the writer feels that the following conclusions are justifiable:
1. Diagnostic and remedial procedure should be used in the teaching of arithmetic in the junior high school as well as in the intermediate grades.

2. Diagnostic and remedial procedure should be used in the teaching of arithmetic to pupils whose achievement is satisfactory as well as to those whose achievement is not satisfactory.

3. Diagnostic and remedial procedure should be used in the teaching of arithmetic in all schools since the success of the plan does not depend upon the use of a hospital room, or the supervision of technically trained workers.
BIBLIOGRAPHY


APPENDIX

A. DATES ON WHICH TESTS WERE GIVEN AND TIME REQUIRED

<table>
<thead>
<tr>
<th>Date</th>
<th>Test Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 10</td>
<td>Terman Group Test of Mental Ability</td>
<td>35 min.</td>
</tr>
<tr>
<td>Sept. 18</td>
<td>Compass Survey Test, Form A</td>
<td>65 min.</td>
</tr>
<tr>
<td>Sept. 23</td>
<td>Test I Addition of Whole Numbers</td>
<td>30 min.</td>
</tr>
<tr>
<td>Oct. 1</td>
<td>Test II Subtraction of Whole Numbers</td>
<td>25 min.</td>
</tr>
<tr>
<td>Oct. 8</td>
<td>Test III Multiplication of Whole Numbers</td>
<td>40 min.</td>
</tr>
<tr>
<td>Oct. 22</td>
<td>Test IV Division of Whole Numbers</td>
<td>65 min.</td>
</tr>
<tr>
<td>Nov. 13</td>
<td>Test V Addition of Fractions and Mixed Numbers</td>
<td>55 min.</td>
</tr>
<tr>
<td>Nov. 21</td>
<td>Test VI Subtraction of Fractions and Mixed Numbers</td>
<td>45 min.</td>
</tr>
<tr>
<td>Nov. 27</td>
<td>Test VII Multiplication of Fractions and Mixed Numbers</td>
<td>35 min.</td>
</tr>
<tr>
<td>Dec. 5</td>
<td>Test VIII Division of Fractions and Mixed Numbers</td>
<td>45 min.</td>
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<td>Dec. 13</td>
<td>Test IX Addition, Subtraction and Multiplication of Decimals</td>
<td>50 min.</td>
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<tr>
<td>Jan. 3</td>
<td>Test X Division of Decimals</td>
<td>45 min.</td>
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<tr>
<td>Jan. 16</td>
<td>Test XI Addition and Subtraction of Denominate Numbers</td>
<td>30 min.</td>
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<tr>
<td>Jan. 22</td>
<td>Test XIV Basic Facts of Percentage</td>
<td>45 min.</td>
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<tr>
<td>Feb. 12</td>
<td>Test XVI Definitions, Rules and Vocabulary of Arithmetic</td>
<td>30 min.</td>
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<tr>
<td>Feb. 20</td>
<td>Test XVII Problem Analysis, Elementary</td>
<td>40 min.</td>
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<tr>
<td>Feb. 26</td>
<td>Test XV Interest and Business Forms</td>
<td>50 min.</td>
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<tr>
<td>Mar. 3</td>
<td>Test XII Multiplication and Division of Denominate Numbers</td>
<td>35 min.</td>
</tr>
<tr>
<td>Mar. 9</td>
<td>Test XIX General Problem Scale, Elementary</td>
<td>25 min.</td>
</tr>
</tbody>
</table>
DATES ON WHICH TESTS WERE GIVEN AND TIME REQUIRED (Cont'd)

Mar. 13 Test XVIII Problem Analysis, Advanced 40 min.
Mar. 25 Test XX General Problem Scale: Advanced 25 min.
Apr. 16 Test XIII Mensuration 60 min.
Apr. 20 Compass Survey Test, Form B 65 min.

The time given includes actual working time and also time for filling information blanks and for giving instructions.
All the diagnostic tests used were Compass Tests.