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A study of the relative effectiveness of inductive and deductive methods of teaching arithmetic to pupils of the Prentiss Institute, Prentiss, Mississippi

Lelar Christine Watts

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A STUDY OF THE RELATIVE EFFECTIVENESS OF INDUCTIVE AND
DEDUCTIVE METHODS OF TEACHING ARITHMETIC TO PUPILS
OF THE PRENTISS INSTITUTE, PRENTISS, MISSISSIPPI

A THESIS
SUBMITTED TO THE FACULTY OF THE SCHOOL OF EDUCATION, ATLANTA
UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF ARTS

BY
LELAR CHRISTINE WATTS

SCHOOL OF EDUCATION

ATLANTA UNIVERSITY
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L. C. W.
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Rationale.— The difficulties pupils experience in arithmetic may be traced to a variety of causes. Numerous studies have been conducted which reveal certain of the typical errors and difficulties pupils encounter in arithmetic.¹ These studies have led some teachers of arithmetic to attempt to improve their teaching procedures.² Other investigations have shown that inadequate study habits, rather than failure to master subject matter, are often the cause of failure to achieve in arithmetic, and that it is necessary to pay as much attention to the development of effective study habits as to the procedure for presentation of instructional materials.³ Further, it now appears that there is not much transfer of learning from one situation to another - while many things are learned simultaneously, every one of these learnings must be oriented toward the needs, interests, and problems of the learner.⁴ While few


people would doubt the value of developing the social significance of arithmetic, the need for developing arithmetic meanings does not appear to be as readily apparent. This is especially true of developing abilities in reading, reasoning, concept formation, closure, and the meanings of arithmetic.

The phases of mental action involved in building a thought pattern constitute a behavior. Learning demands change in behavior. Behaviors result from an introductory stimulus, a disposition to respond to the stimulus, a response-stimulus, and a consequential end-result. Behaviors produce meanings, or identify relations which constitute meanings. When meanings are comprehended the individual possesses concepts. Arithmetics concept emerge from differentiation, discrimination, and integration - they depend upon experience. Therefore, learning is operative when it is available for continued use-operative learning is the program of experiencing. A mode of thinking is developed whereby the learner is able to deal effectively with quantitative relations, exercise judgment, conceptualize, infer while making adjustments to his quantitative environment. Operative learning must be placed at the learner level and related, by the learner, to himself and, by the teacher, to his developmental program. Hence, learning is facilitated by building larger concepts, whole closures, integration, use and re-appearance, and utilizing the potentialities of intelligence and maturation. Thus, a well organized program of arithmetic education includes experiences of social, sensory-aids, and
arithmetical aspect. These experiences should proceed from the natural direct experience, to the contrived experience, and to the activity experience.¹

Two contrasting methods of teaching arithmetic needs to be re-examined in the light of this rationale. For it now appears desirable that arithmetic be presented as something which is not fixed, final or sacrosanct. Rather, it appears that learners should be encouraged to experiment with different ways of arriving at answers, and gain understanding of the way numbers behave thereby. The inductive approach to study and teaching is an experimental approach. It permits the learner to make discoveries himself, and encourages him to think creatively and scientifically. It assumes that it is far better for the learner to make discoveries for himself and, in the process, prove that he understands the basis of the number system. The deductive approach to study and teaching is quite different. A rule, principle, or generalization is presented, with or without explanation, with this approach, it is the intention that the learner remember the rule, principle, or generalization and apply it when needed in specific computation. On the one hand, the inductive method provides opportunity for the learner to gather data, observe, study, experiment, and discover laws, rules, generalizations, and principles which he, in turn, applies to new data. On the other hand, the

¹Newton Stokes, Teaching the Meanings of Arithmetic. (New York, 1951), Chapters 1-6.
deductive method is based upon the presentation of laws, rules, generalizations, and principles which others have formulated and which the learner now seeks to apply.

**Statement of the Problem.**—The problem involved in this study was to determine the relative effectiveness of the inductive and deductive methods of teaching mathematics to two groups of pupils at the Prentiss Institute, Prentiss, Mississippi.

**Purposes of the Study.**—The major purpose of this study was to test, by utilization of the experimental approach, the following null hypothesis: There is no difference in the relative effectiveness of inductive methods of teaching arithmetic to pupils enrolled at the Prentiss Institute, Prentiss, Mississippi. More specifically, the purposes of this study were:

a. To structure methods of study and teaching which are, by definition, inductive and deductive in nature;

b. To instruct two groups of pupils in one of the methods of study and teaching;

c. To discover the extent of competency attained by the two groups during a nine-week experimental period.

**Definitions of Terms.**—

1. **Inductive method** as used in this study, means:¹

   a. A method of study based on reasoning from particular cases to a general conclusion;

---

b. A method of teaching based on the presentation, to the learner, of a sufficient number of opportunities or specific examples, to enable him to arrive at a definite rule, principle, or fact.

2. **Deductive method** as used in this study means:¹
   a. A method of study in which specific application or conclusions are derived from assumed or established procedures;
   b. A method of teaching that proceeds from rules or generalizations to examples, and subsequently to conclusions or to the application of the generalization.

**Locale of the Study.**—The data for this study was collected at the Prentiss Institute, Prentiss, Mississippi.

**Period of the Study.**—The study was conducted during the second semester of the 1955-1956 school term, and extended over a period of nine weeks.

**Subjects Involved.**—The subjects involved in the study were forty-eight seventh and eighth grade pupils enrolled at the Prentiss Institute, Prentiss, Mississippi.

**Method of Research.**—The experimental method was utilized, employing the technique of parallel grouping, testing, and statistical treatment of the data.

**Value of the Study.**—A study of this nature has value as

¹Ibid., p. 121.
it reflects in the improvement of competency developed by students, instructional procedures utilized by teachers, and administrative provisions structured by supervisors and principals. The findings of this may be of value as they reflect in the continuing program of the school, and in further meeting the needs, serving the interests, and providing satisfying opportunities to students for solution of their problems.

Experimental Design.—

1. The literature was reviewed for the purpose of gaining insight, meaning, implications, and understanding of possible ramifications of the developing philosophy of arithmetic education, developing areas of instructional materials, developing programs of evaluation procedure in arithmetic education, and to identify researches of especial concern which are pertinent to this study.

2. The California Test of Mental Maturity was administered for the purpose of equating the subjects into experimental and control groups.

3. A pre-test was administered for the purpose of establishing the level of competence attained by the subjects prior to the experiment. The Metropolitan Achievement Test, Arithmetics, Form R was used for this purpose.

4. The Control and Experimental Group were taught for a period of nine weeks, forty-five minutes each day, in separate groups, using the inductive method with one group (the experimental group) and the deductive method with the other group (control group).
5. A Post-test was administered for the purpose of ascertaining the level of competence achieved by the two groups at the termination of the experimental period. The Metropolitan Achievement Test, Arithmetic, Form S was used for this purpose.

6. The data were tabulated, organized and statistically treated, using the essential statistical measures of the mean, standard deviation, standard error of the mean, standard error of the difference between means, and Fisher "t".

7. The data were assembled in appropriate tables, and the like, analyzed, and interpreted.

8. Findings, conclusions, implications, and recommendations, were derived from the data.

Review of the Literature

The literature reviewed and presented in this thesis was categorized into the following major headings: (a) the developing philosophy of arithmetic education; (b) the developing purposes of arithmetic education; (c) the developing methodology of arithmetic education; (d) the developing areas of mathematical instruction; (e) evaluation of instruction in arithmetic; and (f) trends in arithmetic education.

Philosophy of Arithmetic Education. -- It is generally agreed that one of the fundamental objectives of the modern elementary school is to develop the whole individual. The realization of this objective necessitates a kind of learning
situation that will foster the total growth of the individual mentally, physically, socially, emotionally, and morally. These areas are usually considered to constitute the broader objectives of the school. Of the relation of these broad objectives to arithmetic Brueckner and Grossnickle\(^1\) say:

The teacher should recognize the possible contributions instruction in arithmetic can make to the social objectives of all education. Many of the experiences pupils have in school that are rich in application of number can be designed as experiences in democratic living. Here the teacher can so conduct the learning program that intelligence forms the basis of action of actual practice in solving problems of daily life, that are of concern to the pupils is a most valuable type of experience in democratic living. In most instances arithmetic makes valuable contributions to these experiences.

The need for consideration of the whole child is stated by Caswell and Foshay\(^2\) as follows:

A teacher cannot teach arithmetic alone, or spelling, or reading. Subject matter cannot be considered a part from the children, and in every experience the whole child is effected. A teacher may ignore attitudes, effects on character, and the like, when teaching arithmetic, but the effects are there nevertheless.

**Developing Purposes of Arithmetic Education.**-- To obtain the sequences of the learning activities the pupil must learn to accommodate his thinking to its requirements. He does not choose the mode of this thinking. The arithmetic dictates it. The pupil is successful in so far as he recognizes and performs the acts of thinking which the arithmetic requires.

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Wheat\textsuperscript{1} gives eight requirements of arithmetic:

(a) Arithmetic requires the pupil to develop ideas of the single groups of each size up to ten, to give each its single name, and to represent each size up to nine by its numeral.

(b) Arithmetic requires the pupil to study the standard group of ten, including the tens, and to learn the special way of writing ten and its relations.

(c) Arithmetic requires the pupil to learn as teens and tens the combinations that exceed ten.

(d) Arithmetic requires the pupil to deal with tens and the powers of the way he deals with ones, that is, with the single groups to nine.

(e) Arithmetic requires the pupil to study the sizes of parts, to represent them according to their uses, and to combine related parts.

(f) Arithmetic requires the pupil to use his ideas of relation amounts as means to familiarize himself with the nature, import, and consequences of the various social, business, and civic situations and transactions that exist and go on around him.

(g) Arithmetic requires the pupil to carry his study of the fraction to the point where he can understand and use it as a way to express the relations between quantities.

(h) Arithmetic requires the pupil to determine amounts in terms of the standards by which, and in respect to which, we measure them.

Wheat continues\textsuperscript{2} . . . "An essential part of a program for developing the pupil's ability to solve problems is recognition of the true purposes of problems in the instructional program."


\textsuperscript{2}Ibid.
The Developing Methodology of Arithmetic Education.---

Theories of arithmetic instruction may generally be characterized under three headings (1) meaning theory, (2) drill theory and (3) incidental-learning theory. Morton\(^1\) says:

Advocators of drill theory of instruction maintain that the facts and process of arithmetic are most easily learned by repetition - that is, by saying or thinking the fact over and over or doing the required process again and again. For example, the theory holds that by thinking or saying a fact (such as \(6 \times 4 = 24\)) a number of times, that fact will be learned. In the same way, it holds that the process of borrowing in subtraction is learned by solving many examples in which the borrowing process occurs.

The incidental-learning theory of instruction states that arithmetic can be most effectively taught if instruction is undertaken only when a child has a need for a fact or a process. To illustrate: A child will not be required to learn multiplication with a two-figure multiplier until some problem in his life, either in school or out of school, calls for the process. Proponents of the theory contend that the need or use that the child has for facts and processes will insure both understanding and retention of the things learned, and for this reason they deny the necessity of planned repetition which is considered so essential in the drill theory.

The meaning theory, then, is characterized by the viewpoint that arithmetic can be learned most easily if children see sense in what they do and if arithmetic is taught as a closely knit system of related ideas, facts and principles. The theory in its present form is so recent and is interpreted in so many different ways that no one description would do justice to the arithmetic procedures based on it.

According to Thiele,\(^2\) "...great reliance would be placed upon the child's discovering for himself effective solutions and upon his seeing relationships." According To Buswell,

\(^1\)R. C. Morton, "The National Council Committee on Arithmetic," Mathematics Teacher, October, 1938.

Brownell, and John,¹ "much use would be made of directing
the child toward the learning of a particular process or fact
through performance of a carefully planned series of steps in-
volving concrete experiences followed by identification of
certain characteristics."

Brownell² emphasizes the relatedness of ideas in arithme-
tic and gives a place to instructional influences as factors
affecting readiness. He states that "a child is ready to
learn a new concept when he has control of all ideas and skills
prerequisite thereto, when his previous experience has brought
him to the stage when he can take on new learning."

McGeoch,³ in discussing a typical process in learning,
states that the first step in learning is a problem situation
and that the problem situation results from a lack of adjust-
ment between an organism's motivating needs, its immediate
environment and its reactive equipment. Gates,⁴ says that the
number of problems of which a child is aware and the serious-
ness with which he responds to them are determined in con-
siderable part by the extent of his information and experience
in given fields.

¹G. T. Buswell, W. A. Brownell, and Lenore John, *Daily Life

²W. A. Brownell, "A Critique of the Committee of Seven's

³J. A. McGeoch, *Psychology of Human Learning* (Chicago,
p. 513.

⁴A. I. Gates, et. al., *Educational Psychology* (New York,
1942), p. 344.
Each of the authors mentioned agrees with one of the three theories of learning although authors may introduce a new name they are relatively the same. Thiele says¹

At one extreme teachers deal with the number experiences which children have in their daily life and attempt to make these experiences as meaningful as possible. At the other extreme, teachers bring to their pupils the content of arithmetic as a series of constituent elements arranged by experts according to logic and relative difficulty of the elements. These elements are to be mastered by pupils in the form in which they are presented by the method of repetition. The content is usually found in a single textbook which children study under the direction of the teacher without any other learning aids. These characteristics identify an instructional method as the "drill" method. Undesirable as this method of instruction may be, it is still the one which prevails in countless classrooms.

There is, however, still a place for the drill method if properly used. Buswell,² gives two distinct concepts which give drill a different position in the teaching of arithmetic. He states

1. Practice should follow, not precede, understanding.
2. Effective drill must emphasize the systematic character of number relations and of the number system.

Developing Areas of Arithmetical Instruction.— Throughout the following discussion, arithmetic is broadly defined to include all mathematical concepts and abilities appropriate to and needed by pupils in the elementary school. Its scope is helpfully outlined in Brownell's list of desirable arithmetic

outcomes:

(1) Computational skill:

Facility and accuracy in operations with whole numbers, common fractions, decimals, and per cents. (This group of outcomes is separated from the second and third groups which follow because it can be isolated for measurement. In this separation much is lost, for computation without understanding when and how to compute is rather empty skill. Actually, computation is important only as it contributes to social ends).

(2) Mathematical understandings:

a. Meaningful conceptions of quantity, of the number system, of whole numbers of common fractions, of decimals, of per cents, of measures, etc.

b. A meaningful vocabulary of the useful technical terms of arithmetic which designate quantitative ideas and the relationships between them.

c. Grasp of important arithmetical generalizations.

d. Understanding of the meanings and mathematical functions of the fundamental operations.

e. Understanding of the meanings of measures and of measurement as a process.

f. Understanding of important arithmetical relationships, such as those which function in reasonably sound estimations and approximations, in accurate checking, and in ingenious and resourceful solutions.

g. Some understanding of the rational principles which govern number relationships and computational procedures.

(3) Sensitiveness to number in social situations and the habit of using numbers effectively in such situations:

a. Vocabulary of selected quantitative terms of common usage (such as Kilowatt hour, miles per hour, decrease and increase, and terms important in insurance, investments, business practice, etc.).

b. Knowledge of selected business practice and other economic applications of number.
c. Ability to use and interpret graphs, simple statistics, and tabular presentations of quantitative data.

d. Awareness of usefulness of quantity and number in dealing with many aspects of life.

e. Tendency to sense the quantitative as part of normal experience, including vicarious experience, as in reading, in observation, and in projected activity and imaginative thinking.

f. Ability to make sound judgments with respect to practical, quantitative problems.

g. Dispositions to extend one's sensitiveness to the quantitative as this occurs socially and to improve and extend one's ability to deal effectively with the quantitative when so encountered or discovered.

Evaluation of Instruction in Arithmetic.—The evaluation of results is as old as the teaching itself. Sometimes the teaching has been more skillfully done than the evaluating and sometimes the opposite is true. In recent years, many pertinent suggestions have been made for improving the technic of evaluation. Unfortunately, it sometimes seems that we are slower in putting into effect the suggestions for improving evaluation than we are the suggestions for improving teaching.  

Wilburn and Wingo  

If the efforts to improve instruction in arithmetic are based upon the assumption that the goals of instruction are

---


the mastery of computational skills and the attaining of a high degree of proficiency in "problem-solving", then there seems to be the necessity for few instruments of evaluation. Various pencil-and-paper tests will usually be appropriate and sufficient to appraise the effectiveness of such an instructional program. When instruction in arithmetic includes goals other than achieving skill in computation and problem-solving, the supervisor and teachers should develop techniques for evaluating the effectiveness of their efforts as they determine the learning activities for improving the teaching program.

In emphasizing the necessity for viewing instruction and evaluation in arithmetic as interdependent, Brownell\(^1\) offers the following comment:

Instruction and evaluation go hand in hand. As teachers develop new insight into learning - its difficulties, its stage or phases of development, the basic understandings required for each advanced step in learning - as teachers acquire these insights, they will employ them in approved evaluation. And as they correct or modify their evaluations and devise procedures which are more comprehensive and more penetrating, they should come upon new data of great significance for better guidance of learning. Viewed thus, instruction and evaluation are inseparable and mutually interdependent.

**Trends in Arithmetic Education.** - The present day concept in arithmetic includes meaningful, and purposeful practice to fix meanings.

According to Clark\(^2\)

Teachers are coming to believe that pupils can and should understand their arithmetic operations. Seldom nowadays do teachers say, "This is the way to do it; get busy and learn it." Instead, they ask, "Can you think of a way to do it? Which of the three ways (if three ways have been suggested) is the easiest to understand? Which


is shortest?" The teacher and the class cooperate in making progressively more mature algorisms, finally arriving at the standard algorism.

In the conventional school the pupils were told the basic facts and were drilled until learned. For example, the pupil's task was to memorize tables, usually a whole table at a time.

Morton\(^1\) relates

The tendency today is to get away from the mere memorizing of tables. Instead, the pupil discovers the basic facts of multiplication and division as learning units. For example, the pupil discovers as phases of one and the same experience that six 5's are 30, that the number of 5's in 30 is 6, and that the number of 6's in 30 is 5. He may arrange objects on a table, and his textbook may show pictures of objects, in five rows, with 6 in a row. Looking at them the other way, he sees 6 rows with 5 in a row. The abstract symbols show five 6's, and also six 5's, which when added, make 30. Then the division questions: How many 6's are there in 30? And how many 5's are there in 30? are easily answered.

Some outstanding characteristics of the present-day concepts of teaching arithmetic as stated by Spitzer\(^2\) are:

1. The present-day teachers of arithmetic are much concerned with the developing understanding of the content of the subject.

2. Instruction in arithmetic recognizes that the subject involves much more than the ability to compute.

3. A conscious effort is made to start instruction at the child's level.

4. Is the attempt to facilitate the use of facts and process and to give the pupil an opportunity to figure things out instead of relying entirely on telling as means of instruction.

---


5. Is the systematic provision for reviews and re-teaching.

Summary

The inductive and deductive approach are two methods whose approach to the learning process involve different concepts of the learning process, although both have their place in a teaching situation. These methods were discussed under the categories of laboratory or meaning theory and the drill theory. The "drill theory" characterizes the deductive approach to teaching and the "laboratory or meaning theory" characterizes the inductive method as used in this study.

From the literature reviewed in this study the following generalized statements may be formulated:

1. The pupil learns better when the situation is meaningful.
2. The teacher should guide the pupil to think creatively, allowing the pupil to make discoveries in the process, prove that he is understanding what he discovers.
3. Drill should follow understanding and should be progressive in character.
Organization and Treatment of Data. -- The present chapter will present, analyze, and interpret the data pertinent to testing the significance of the Null Hypothesis:

There is no difference in the relative effectiveness of inductive and deductive methods of teaching arithmetic to 48 pupils in the seventh and eighth grades of Prentiss Institute, Prentiss, Mississippi.

The requisite data for this research were collected and organized for the purpose of analysis and interpretation under the following captions: (a) the data on the California Mental Maturity Test, (b) Pre-Experimental test scores on skill, (c) Pre-Experimental test scores on reasoning, (d) Post-Experimental test scores on skill, (e) Post-Experimental test scores on reasoning.

The Initial Testing Period was designed for the purpose of equating pupils with respect to general intelligence, previous achievement in arithmetic and level of performance on arithmetic prior to the experiment. The California Short-Form Test R was used for this purpose.

The Final Testing Period was designed for the purpose of securing measures of the final status or change of each pupil with reference to arithmetic achievement.

The scores made during the testing period were obtained from
the two groups identified as Experimental group X and Control group Y. Tests were scored and tabulated for each group. The mean, median, standard deviation, standard error of the mean, the standard error of the difference between two means and the "t" ratio were calculated and utilized as the basis for the interpretation of the data. Appropriate tables and figures illustrative of the data were developed and are found throughout this section.

The "Criterion of Reliability"\(^1\) of statistics involved in the test of significance was established as Fisher's "t" of 2.66 at the one per cent level of confidence with forty-six degrees of freedom, with reference to the data derived from the California Test of Mental Maturity, the Metropolitan Arithmetic Achievement Test R and the Metropolitan Arithmetic Achievement Test Form S.

Results of Performance on the California Test of Mental Maturity

Total Mental Factors of the Control and Experimental Groups.-- This test was administered to sixty pupils in the seventh and eighth grades at Prentiss Institute, Prentiss, Mississippi. Following the tabulation of the scores it was possible to match forty-eight participants based on the criterion given in Table 1.

The data in Table 1 are presented in three parts, namely,

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(1) chronological ages, (2) mental ages and (3) grade-placement. The mental ages and grade-placement were derived from the raw scores equivalent of the California Test of Mental Maturity and will be discussed under this heading. The chronological ages will be discussed later in this study.

### TABLE 1


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<td>10.</td>
<td>117</td>
<td>4.6</td>
<td>145</td>
<td>116</td>
<td>4.7</td>
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<tr>
<td>11.</td>
<td>112</td>
<td>4.4</td>
<td>193</td>
<td>115</td>
<td>3.8</td>
<td>196</td>
</tr>
<tr>
<td>12.</td>
<td>111</td>
<td>4.6</td>
<td>187</td>
<td>112</td>
<td>4.1</td>
<td>165</td>
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<tr>
<td>13.</td>
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<td>200</td>
<td>111</td>
<td>4.5</td>
<td>200</td>
</tr>
<tr>
<td>14.</td>
<td>108</td>
<td>4.3</td>
<td>174</td>
<td>110</td>
<td>3.9</td>
<td>143</td>
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<tr>
<td>15.</td>
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<td>192</td>
<td>109</td>
<td>3.8</td>
<td>172</td>
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<tr>
<td>16.</td>
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<td>3.7</td>
<td>182</td>
<td>106</td>
<td>4.2</td>
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<tr>
<td>17.</td>
<td>105</td>
<td>3.7</td>
<td>172</td>
<td>105</td>
<td>3.5</td>
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</tr>
<tr>
<td>18.</td>
<td>104</td>
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<td>147</td>
<td>103</td>
<td>3.3</td>
<td>187</td>
</tr>
<tr>
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<td>3.2</td>
<td>185</td>
<td>101</td>
<td>3.3</td>
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<td>20.</td>
<td>96</td>
<td>3.6</td>
<td>151</td>
<td>100</td>
<td>3.6</td>
<td>155</td>
</tr>
<tr>
<td>21.</td>
<td>95</td>
<td>3.6</td>
<td>168</td>
<td>98</td>
<td>2.6</td>
<td>149</td>
</tr>
<tr>
<td>22.</td>
<td>94</td>
<td>2.3</td>
<td>126</td>
<td>94</td>
<td>2.9</td>
<td>175</td>
</tr>
<tr>
<td>23.</td>
<td>90</td>
<td>3.0</td>
<td>168</td>
<td>93</td>
<td>2.6</td>
<td>159</td>
</tr>
<tr>
<td>24.</td>
<td>86</td>
<td>2.1</td>
<td>159</td>
<td>85</td>
<td>2.6</td>
<td>136</td>
</tr>
</tbody>
</table>

The above table reveals the data used to divide the subjects into two groups: the Experimental group and the Control group,
equated as nearly as possible with respect to age, sex, general intelligence and grade placement, to the criterion given by the California Test of Mental Maturity - Elementary Grade 4-8, 1950 S-Form.

**Mental Ages of the Experimental and Control Groups.**— The mental ages of the twenty-four pupils in the Experimental group ranged from a low of 86 months to a high of 137 months, with a mean age of 112, a median age of 109.90, with a standard deviation of 12.00, and a standard error of the mean of 2.45.

The mental ages of the twenty-four pupils in the Control group ranged from a low of 86 months to a high of 138 months, with a mean age of 111.49, a median age of 109.50, a standard deviation of 21.10, with a standard error of the mean of 4.39.

Table 1 indicates that no pupils participating in the test had a mental age equal to that of his chronological age.

<p>| TABLE 2 |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| COMPARISON OF THE TOTAL MENTAL AGE FACTORS ON THE CALIFORNIA MENTAL MATURITY TEST FOR THE 48 PUPILS IN THE CONTROL AND EXPERIMENTAL GROUP AT PRENTISS ELEMENTARY SCHOOL |</p>
<table>
<thead>
<tr>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.m</th>
<th>( M_1 - M_2 )</th>
<th>S.E.( M_1 - M_2 )</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>112.00</td>
<td>109.90</td>
<td>12.00</td>
<td>2.45</td>
<td>.51</td>
<td>3.76</td>
</tr>
<tr>
<td>Control group</td>
<td>111.49</td>
<td>109.50</td>
<td>21.10</td>
<td>2.85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparative Data and "t" Ratio Based on Mental Ages.**— Table 2 shows that the mean mental age on total mental factors was 112.00
for the Experimental group and 111.49 for the Control group, a difference of .51 in favor of the Experimental group. The median mental age score on the total mental factors was 109.90, for the Experimental group and 109.50 for the Control; .40 in favor of the Experimental group. The standard deviation for the Experimental group was 12.00, for the Control group it was 14.00, with a difference of 2.00 in favor of the Control group. The standard error of the mean for the Experimental group was 2.45 and 2.85 for the Control group, with a difference of .40 in favor of the Control group. The standard error of the difference between the two means was .51.

The "t" for these data was .13, which was less than the ratio of 2.66 required for significance at the one per cent level of confidence. Since this difference was not statistically significant it was concluded that neither the Experimental group nor the Control group held an advantage with reference to mental age on the total mental factors.

The Intelligence Grade Placement.-- The intelligence grade-placement of the Experimental group ranged from a low of 2.6, to a high of 6.3, with an average grade-placement of 4.6. This test revealed a grade-placement of 2.4 lower that the actual grades of the pupils participating in the test, who were seventh and eighth grade pupils.

The intelligence grade-placement of the Control group ranged from a low of 2.1 to a high of 6.2, with an average grade-placement of 4.2. This test revealed a grade-placement of 2.8 lower than the actual grades of the pupils participating in the test,
who were seventh and eighth grade pupils.

**Results on the California Test of Mental Maturity M. A. Language Factors.**—The data on the level of the Mental Maturity of the forty-eight seventh and eighth grade pupils in the Control and Experimental groups on the Language Factors component are presented in Table 3.

**TABLE 3**

<table>
<thead>
<tr>
<th></th>
<th>M.</th>
<th>Mdn.</th>
<th>Sigma</th>
<th>S.E.</th>
<th>M-M</th>
<th>S.E. M-M</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>103.20</td>
<td>109.5</td>
<td>24.50</td>
<td>5.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Group</td>
<td>112.40</td>
<td>112.3</td>
<td>15.40</td>
<td>3.21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Control Group.**—The data on Language Factors component for the Control group revealed a range of intelligence from a low mental age of 60 to a high mental age of 149 months, with a mean age of 103.20, a median age of 109.20, a standard deviation of 24.50 and a standard error of the mean of 5.11. It is indicated that approximately 46 per cent of the Control group scored above the mean, 33 per cent below the mean and 25 per cent scored within the class intervals of the means.

**Experimental Group.**—The data on Language Factors component for the Experimental group revealed a range of intelligence from a low of 90 to a high of 139 months with a mean age of
112.40, a median age of 112.30, a standard deviation of 15.40 and a standard error of the mean 3.21. It is indicated that approximately 54 per cent of the group scored above the mean, 21 per cent scored below the mean, and 25 per cent scored within the class interval of the mean.

This mental age score yielded a grade-placement of 3.8 for the Control group and 4.4 for the Experimental group, both grade-placements are below the average for the population.

**Comparative Data and "t" Ratio.**— Table 3 shows a mean age on language factors of 103.20 for the Control group and a mean age in language factors for the Experimental group of 112.40, a difference of 9.20 in favor of the Experimental group. The median age for the Control group was 109.50 and for the Experimental group it was 112.30. The standard deviation for the Control group was 24.50 and for the Experimental group 15.40. The standard error of the mean for the Control group was 5.11, and for the Experimental group it was 3.21. The standard error of difference in the two means was 1.52.

The "t" for this data was 1.52 which was not significant since it was less than 2.66 required at the one per cent level of confidence. Therefore, there was not a statistically significant difference in the mental age language factors for the Control and Experimental groups.

**Results on the California Test of Mental Maturity Mental Age Non-Language Factors.**— The data on the level of Mental Maturity of the Non Language factors component of the California Test of Mental Maturity are presented in Table 4.
TABLE V

COMPARISON OF THE MENTAL AGE NON-LANGUAGE FACTORS
ON THE CALIFORNIA TEST OF MENTAL MATURITY FOR THE
FORTY-EIGHT PUPILS IN THE EXPERIMENTAL AND
CONTROL GROUPS OF THE PRENTISS INSTITUTE,
PRENTISS, MISSISSIPPI

<table>
<thead>
<tr>
<th></th>
<th>M.</th>
<th>Mdn.</th>
<th>Sigma</th>
<th>S.E.m</th>
<th>M1-M2</th>
<th>S.E.M1-M2</th>
<th>( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>115.80</td>
<td>114.50</td>
<td>30.03</td>
<td>6.26</td>
<td>5.00</td>
<td>8.56</td>
<td>.63</td>
</tr>
<tr>
<td>Experimental</td>
<td>110.20</td>
<td>109.50</td>
<td>28.10</td>
<td>5.84</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Control Group.— The data on the Non-Language Factors component for the 24 pupils in the Control group revealed a range of Mental Ages from a low of 70 to a high of 159, with a mean age of 110.20, a median age of 109.50, with a standard deviation of 28.10 and a standard error of the mean of 5.84. It is indicated that approximately 58 per cent scored above the mean, 25 per cent below the mean, while 17 per cent scored within the class intervals of the mean, yielding a grade-placement of 4.4, which is below the average for the population.

The Experimental Group.— The data on Non-Language Factors component for the 24 pupils in the Control group revealed a range of Mental Ages from a low of 60 to a high of 169, with a mean age of 115.80, a median age of 114.50, a standard deviation of 30.03 and standard error of the mean, 6.26. It is indicated that 42 per cent of the Experimental group scored above the mean, 50 per cent below and eight per cent within the class intervals of the mean, yielding a grade-placement...
of 4.4, which is below the average population.

Comparative Data and \( t \) Ratio.-- Table 4 shows a mean age on non-language factors of 108.80 for the Experimental group and for the Control group a mean age of 115.80, a difference of 7.00 in favor of the Control group. The median age in non-language factors was 109.50 for the Experimental group and 114.50 for the Control group. The standard deviation for the Experimental group was 28.10 and for the Control group it was 30.03. The standard error of the mean was 5.83 for the Experimental group and 6.26 for the Control group, with a standard error of the difference in the two means of 8.56. The slight differences were in favor of the Control group.

The \( t \) for this data was .63 which was not significant since it was less than 2.66 required at one per cent level of confidence; therefore, there was not statistically significant difference in the mental age factors in non-language factors for the Experimental and Control group.

Spatial Relationship as Measured by the California Test of Mental Maturity.-- The test on Spatial Relationships was divided into two parts, namely Sensing Right and Left and Manipulation of Areas called Spatial Relationships. The possible raw score for this part of the test was 35.

Control Group.-- The data on the Spatial Relationships component of the California Test of Mental Maturity for the Control group indicated a range from a low of 11 to a high of 34, with a mean score of 21.12, a median score of 21.04, a standard deviation of 6.09, and a standard error of the mean
of 1.12. Approximately 42 per cent of the Control group scored above the mean, 42 per cent scored below the mean, while 16 per cent scored within the class intervals of the mean.

**TABLE 5**

**COMPARISON OF THE SPATIAL RELATIONSHIPS ON THE CALIFORNIA TEST OF MENTAL MATURITY FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>Mdn</th>
<th>Sigma</th>
<th>S.E.</th>
<th>M1 - M2</th>
<th>S.E. M1 - M2</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>21.12</td>
<td>21.04</td>
<td>6.09</td>
<td>1.12</td>
<td>1.02</td>
<td>1.83</td>
<td>.56</td>
</tr>
<tr>
<td>Experimental</td>
<td>22.14</td>
<td>22.50</td>
<td>6.75</td>
<td>1.36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Experimental Group.**— The data on the Spatial Relationships component of the California Test of Mental Maturity for the Experimental group indicated a range from a low of 11 to a high of 34, with a mean score of 22.14, a median score of 22.50, a standard deviation of 6.75, and a standard error of the mean of 1.36. Approximately 50 per cent fell above the mean, 34 per cent below the mean, while 16 per cent scored within the class intervals of the mean.

Those who scored high in these tests indicated ability to deal with maps, charts, and graphs as well as global concepts. They are oriented in space relationships. They should be able to give as well as follow directions and they should do well in planning layout design and construction.

A low in these tests may be due to poor perception or memory or both. However, if the unsatisfactory status is due
to lack of opportunity rather than ability, it may be improved through providing adequate opportunities. The writer is of the opinion that the low performance was due to the lack of opportunity.

Comparative Data and "t" Ratio.— Table 5 shows that the mean score for the Control group was 21.12 and for the Experimental group 22.14, a difference of 1.02 in favor of the Experimental group. The median score for the Control group was 21.04 and for the Experimental group, 22.50, a difference of 1.46 in favor of the Experimental group. The standard deviation for the Control group was 6.09 and for the Experimental group, 6.75, a difference of .66 in favor of the Experimental group. The standard error of the mean for the Control group was 1.12 and for the Experimental group, 1.36, a difference of .24, with a standard error of the difference of the two means of 1.83.

The "t" for this data is .56, which was not a significant difference since it was less than the required 2.66 at the one per cent level of confidence. Therefore, there was not statistically significant difference, although there was a slight difference in favor of the Experimental group. The Experimental and Control groups performances represent 63 per cent of all items on Spatial Relationships.

1Elizabeth T. Sullivan, Clark Willis, and Ernest W. Tiegs, Manual, California Test of Mental Maturity. Elementary S-Form (Los Angeles, 1950).
Results on the California Test of Mental Maturity Numerical Reasoning.-- Table 6 presents a comparison of the data obtained by the forty-eight pupils on the "Numerical Reasoning Component of the California Test of Mental Maturity."

**TABLE 6**

A COMPARISON OF NUMERICAL REASONING ON THE CALIFORNIA TEST OF MENTAL MATURITY FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP

<table>
<thead>
<tr>
<th></th>
<th>M.</th>
<th>Mdn.</th>
<th>Sigma</th>
<th>S.E._m</th>
<th>S.E.M._1-M_2</th>
<th>&quot;t&quot;</th>
</tr>
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<tbody>
<tr>
<td>Control Group</td>
<td>7.76</td>
<td>7.50</td>
<td>1.36</td>
<td>.28</td>
<td>.84</td>
<td>.36</td>
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<tr>
<td>Experimental</td>
<td>6.92</td>
<td>6.50</td>
<td>1.11</td>
<td>.23</td>
<td>.36</td>
<td></td>
</tr>
</tbody>
</table>

Control Group.-- The data on the Numerical Reasoning component of the test for the 24 pupils of the Control group showed a range from a low of 2 to a high of 15, with a mean score of 7.76, a median score of 7.50, with a standard deviation of 1.36, and a standard error of the mean, .28. Approximately .46 per cent of the Control group scored above the mean, 20 per cent below the mean, while 34 per cent scored within the class intervals of the mean.

Experimental Group.-- The data on the Numerical Reasoning component of the test for the 24 pupils of the Experimental group showed a range from a low of 5 to a high of 13, with a mean score of 6.92, a median score of 6.50, with a standard deviation of 1.11, and a standard error of the mean .23. Approximately 33 1/3 per cent of the Experimental group scored
above the mean, 33 1/3 per cent scored below the mean, while 33 1/3 per cent scored within the class intervals of the mean. Comparing Data and "t" Ratio.— Table 6 shows that the mean score for the Control group was 7.76 and for the Experimental group 6.92, a difference of .84 in favor of the Control group. The median score for the Control group was 7.50 and for the Experimental group 6.50, with a difference of 1.00 in favor of the Control group. The standard deviation for the Control group was 1.36 and for the Experimental group 1.11, with a difference of .25 in favor of the Control group. The standard error of the mean for the Control group was .28 and for the Experimental group .23, with a difference of .05 in favor of the Control group.

The data indicated that the Control group scored higher than the Experimental group, the larger standard deviation for the Control group showed a wider spread of ability than that of the Experimental group.

The "t" for these data was .23 which was not a significant difference since it was less than the required 2.66 at one percent level of confidence. Therefore, there was not a statistically significant difference between the two groups on numerical reasoning.

Results on the California Test of Mental Maturity Verbal Concepts.— Table 7 presents a comparison of the data obtained by the two groups of seventh and eighth grade pupils on the verbal concepts component of the California Test of Mental Maturity.
TABLE 7

COMPARISON OF THE VERBAL CONCEPTS ON THE CALIFORNIA TEST
OF MENTAL MATURITY FOR THE TWO GROUPS OF THE FORTY-EIGHT
PUPILS OF THE EXPERIMENTAL AND CONTROL GROUPS

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>Mdn.</th>
<th>Sigma</th>
<th>S.E.m</th>
<th>M_1-M_2</th>
<th>S.E.M.</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>10.00</td>
<td>8.33</td>
<td>1.63</td>
<td>.32</td>
<td></td>
<td>.63</td>
<td>.18</td>
</tr>
<tr>
<td>Experimental</td>
<td>10.63</td>
<td>9.20</td>
<td>1.58</td>
<td>.31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Control Group.** -- The data on the Verbal Concepts component for the 24 pupils of the Control group indicated a range from a low of zero to a high of 20, with a mean score of 10.00, a median score of 8.33, a standard deviation of 1.63, and a standard error of the mean .05. Approximately 53 per cent of the Control group scored above the mean, 42 scored below the mean, while 5 per cent scored within the class intervals of the mean.

**Experimental Group.** -- The data on the Verbal Concepts component for the 24 pupils of the Experimental group indicated a range from a low of three to a high of 20 with a mean score of 10.63, a median of 9.20, a standard deviation of 1.58 and a standard error of the mean .044. Approximately 37 per cent of the Experimental group scored above the mean, 42 per cent below the mean and 21 per cent scored within the class intervals of the mean.

**Comparative Data and "t" Ratio of Verbal Concepts.** -- Table 7 shows the mean score for the Control group was 10.00 and for
the Experimental group 10.63, a difference of .63 in favor of the Experimental group. The median score for the Control group was 8.33 and for the Experimental group 9.20, a difference of .87 in favor of the Experimental group. The standard deviation for the Control group was 1.63 and for the Experimental group 1.58, with a wider spread of range of ability for the Control group. The standard error of the mean for the Control group was .32 and for the Experimental group .31, with a standard difference of the mean .04.

The "t" for this data is .18, which was not a significant difference, since it was less than the required 2.66 at one percent level of confidence. Therefore, there was not statistically significant difference between the Experimental and Control groups on Verbal Reasoning.

Results on the California Test of Mental Maturity Logical Reasoning.-- Table 8 presents a comparison of the scores obtained by the two groups of the seventh and eighth grade pupils, the Control and Experimental group on the "Logical Reasoning" component for the California Test of Mental Maturity.

Control Group.-- The data on the Logical Reasoning component of the California Mental Maturity Test for the Control group indicated a range from a low of three to a high of 29, with a mean score of 18.76, a median score of 19.75, a standard deviation of 5.55, and a standard error of the means of 1.12. Approximately 46 per cent of the Control group scored above the mean, 37 per cent scored below the mean, while 17 per cent scored within the class intervals of the mean.
Experimental Group.— The data on Logical Reasoning component for the Experimental group indicated a range from a low of three to a high of 26, with a mean score of 16.99, a median score of 16.54, a standard deviation of 5.82, and a standard error of the mean of 1.66. Approximately 33 1/3 per cent of the Experimental Group scored above the mean, 33 1/3 per cent scored below the mean, while 33 1/3 scored within the class intervals of the mean.

### TABLE 8

**COMPARISON OF LOGICAL REASONING ON THE CALIFORNIA TEST OF MENTAL MATURITY FOR THE EXPERIMENTAL AND CONTROL GROUPS**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>Mdhn</th>
<th>Sigma</th>
<th>S.E.</th>
<th>M1-M2</th>
<th>S.E.M1-M2</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>18.76</td>
<td>19.75</td>
<td>5.55</td>
<td>1.12</td>
<td>1.77</td>
<td>1.66</td>
<td>1.07</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>16.99</td>
<td>16.54</td>
<td>5.82</td>
<td>1.21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparative Data of Logical Reasoning.— The test on Logical Reasoning was divided into two parts namely, Similarities and Inference. The data presented below are of the two parts. The highest possible score for this part of the test was 30. According to the test results, the Control group's performance was 51 per cent of the total score, whereas the Experimental group's was 49 per cent of the total scores. Table 8 indicates a mean score of 18.76 for the Control group and 16.99 for the Experimental group. The median score for the control group was 19.75 and for the Experimental group, 16.54. The standard deviation for the control group was 5.55 and for the Experimental
group, 5.82. The standard error of the mean was 1.12 for the Control group and 1.21 for the Experimental group. The standard error of the difference between the two means was 1.66, with a "t" ratio of 1.07. Therefore, there was no significant difference in the two groups. The slight favor in the Control group was not a statistically significant difference between the two groups on Logical Reasoning.

The Chronological Ages of the Control and Experimental Groups.— Table 9 presents data of the chronological ages of the pupils participating in the experiment.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Median</td>
</tr>
<tr>
<td>Control Group</td>
<td>166.10</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>167.80</td>
</tr>
</tbody>
</table>

The chronological ages of the twenty-four pupils in the Experimental group ranged from a low of 132 months to a high of 200 months, with a mean age in months of 165.10, a median age of 159.50, a standard deviation of 13.20, and a standard error of the mean of 2.75.

The chronological ages of the twenty-four pupils in the Control group ranged from a low of 126 months to a high of 200 months, with a mean age in months of 167.80, a median of 159.50,
a standard deviation of 14.00 and a standard error of the mean of 2.85.

Table 1 indicates that no pupil participating in the test performances had a mental age equal to that of his chronological age. The mean ages for both the Experimental and Control groups are of such nature as to enable one to predict that these pupils will not achieve at a high level.

**Comparative Data and "t" Ratio of the Chronological Ages.**—Table 9 shows the chronological ages of the two groups in terms of months. The mean ages of the Experimental group and Control group were 167.80 and 166.10 respectively, with a difference of 1.70 in favor of the Experimental group. The median age for the Experimental group was 159.50 and for the Control group, 159.10. The standard deviation for the Experimental group was 21.10 and for the Control group, 13.20. The standard error of the mean was 4.39 for the Experimental group and 2.75 for the Control group, with a standard error of the difference between the two means of 5.18.

The "t" for these data was .33 which was not a significant difference since it was less than the required 2.66 at the one per cent level of confidence. Therefore, there was not a statistically significant difference in chronological age between the two groups.

The chronological mean age shows an average of 13 years 9 months for both groups, which is a normal age level for the seventh and eighth grade pupils.
Results of the Performance on the Metropolitan Arithmetic Test for the Experimental and Control Groups.-- The data of the level of arithmetic achievement for the forty-eight pupils in the Control and Experimental groups are presented in figure 1, which presents a comparison of the scores obtained by the two groups in a frequency polygon.

Control Group.-- The data for the Control group indicated that the scores ranged from a low of 0 to a high of 26, with a mean score of 9.61, a median score 10.10, with a standard deviation of 6.33 and the standard error of the mean .35. Approximately 34 per cent of the group scored above the mean, 45 per cent scored below the mean and 21 per cent scored within the class intervals of the mean, yielding a grade placement of 5.9, which is below the average population.

Experimental Group.-- The data for the Experimental group indicated that the scores ranged from a low of 0 to a high of 26, with a mean score of 10.24, a median score of 10.50, with a standard deviation of 6.09 and a standard error of the mean of 1.29. Approximately 42 per cent of the group scored above the mean, 46 per cent scored below the mean and 12 per cent scored within the class intervals of the mean, yielding a grade placement of 6.0, which is below the average population.

Comparative Data of Arithmetic Skill.-- Table 10 shows the mean score on arithmetic skills was 9.61 for the Control group and 10.24 for the Experimental group, with a difference of .53
Frequency Distribution of Scores Made on Metropolitan Advanced Arithmetic Test for the Control and Experimental Group.
in favor of the Experimental group. The median score was 10.10 for the Control group and 10.50 for the Experimental group, a difference of .40 in favor of the Experimental group. The standard deviation for the Control group was 6.33 and for the Experimental group it was 6.09. The standard error of the mean for the Control group was 1.35 and 1.29 for the Experimental group. The difference between the two means was 1.86.

The "t" for this data was .28, which was not a significant difference according to the one per cent level of confidence. Therefore, the difference in the Control group and the Experimental group was not a statistically significant difference between the two groups on the initial arithmetic skills.

**TABLE 10**

**COMPARISON TABLE OF THE INITIAL TEST SCORES ON THE METROPOLITAN ACHIEVEMENT TEST ADVANCED ARITHMETIC FORM R SKILLS**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.m</th>
<th>M₁-M₂</th>
<th>S.E.M₁-M₂</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>10.24</td>
<td>10.50</td>
<td>6.09</td>
<td>1.29</td>
<td>.53</td>
<td>1.86</td>
<td>.28</td>
</tr>
<tr>
<td>Experimental</td>
<td>9.16</td>
<td>10.10</td>
<td>6.33</td>
<td>1.35</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pre-Experimental Test Scores Metropolitan Advanced Arithmetic Form R - Reasoning**

**Results of the Performance on the Metropolitan Arithmetic Test for the Experimental and Control Groups.**— The data on the level of arithmetic achievement reasoning problems of the forty-eight pupils in the Control and Experimental groups are presented in Figure 2, which presents a comparison frequency distribution of the scores obtained by the two groups in a polygon.
Experimental ---
Control ----

No. of Pupils

Scale of Scores

Frequency Polygon of Reason Problems
Metropolitan Advanced Arithmetic Form R
**Control Group.**—The data for the Control group indicated that the scores ranged from a low of 0 to a high of 11, with a mean score of 3.42, a median score of 3.84, with a standard deviation of 3.54 and a standard error of the mean .75. Approximately 21 per cent of the group scored above the mean, 58 per cent scored below the mean, while 21 per cent scored within the class intervals of the mean. The mean score for the reasoning problems indicated a grade-placement of 5.4, which is below the average population.

**Experimental Group.**—The data for the Experimental group indicated that the scores ranged from a low of 0 to a high of 15, with a mean score of 1.75, a median score of 1.50, with a standard deviation of 3.54, and a standard error of the mean of .75. Approximately 50 per cent of the group scored above the mean and 50 per cent scored below the mean. The mean score for the reasoning problems indicated a grade placement of 4.2, which was below the norm of the Metropolitan Arithmetic test which is 11 and 15 respectively.

**TABLE II**

COMPARISON IN ARITHMETIC REASONING PROBLEMS INITIAL TEST ON THE ADVANCED ARITHMETIC FORM R OF THE METROPOLITAN ACHIEVEMENT TEST FOR THE CONTROL AND EXPERIMENTAL GROUP

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.</th>
<th>M₁-M₂</th>
<th>S.E.,M₁-M₂</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3.42</td>
<td>3.82</td>
<td>3.54</td>
<td>.75</td>
<td></td>
<td>.42</td>
<td>.092</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.75</td>
<td>1.50</td>
<td>3.54</td>
<td>.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparative Data and "t" Ratio.-- Table 11 shows that the mean raw score on the Metropolitan Advanced Arithmetic Test Form R, for the Control group on initial reasoning problems was 3.42 and for the Experimental group was 1.75, a difference of 1.67 in favor of the Control group. The median score for the Control group was 3.82 and for the Experimental group 1.50, a difference of 2.32 in favor of the Control group. The standard deviation of the Control group was 3.54 and for the Experimental group 3.54. The standard error of the mean was .75 for the Control group and .75 for the Experimental group. The standard difference between the two means was .37.

The "t" for these data was .092 which was not significant since it was less than the required 2.66 at the one per cent level of confidence. Therefore, the difference in arithmetic reasoning problems was not statistically significant. For the practical purposes of this research the two groups previous arithmetic achievement was equal.

The Program of Instruction and Post-Experimental Scores

The General Characteristics of the Program of Instruction of the Nine Weeks.-- The pupils in both groups were given instruction on planned basis of forty-minute daily periods. An adequate supply of supplementary books and materials were available for the pupils to use. The activities for the group were centered around the following:

1. Used graphs to show facts, such as rainfall, temperature, heights and measurements

2. Measured and drew scales of various things
3. Facts of measurements of perimeter, areas, volume learned by measurements and demonstration
4. Pupils made bills and receipts of actual purchases
5. Reviewed the four fundamental processes
6. Made posters
7. Worked per centages and decimals
8. Used work books

Description of the Methods of Procedure.— During the forty-five minutes of the first period of instruction, the program of work dealt with instructional materials, which had as its objective the promoting of fundamental developments, in the deductive and inductive methods of teaching. The achievement of these approaches were measured after the termination of the nine weeks period.

The Description of Specific Activities of the Group.— The first week the activities were planned more or less with the groups. The initial days were devoted to guiding the pupils into some phases of work which they thought were most essential along with what was required. The following things were suggested by the groups:

1. To continue the use of graphs
2. To use measurements of geometric figures
3. To continue the study of fractions
4. Review the fundamentals
5. To work per centages and decimals

From these suggestions the investigator planned her daily lessons by finding problem situations whereas the outlined
program of work was utilized.

The deductive (Control) group were taught each fact directly and separately with opportunities to discover relationships held to a minimum. The inductive (Experimental) group were guided in the discovery of generalization in their learning and in correcting errors. The rules and principles were not formulated for the pupils, but they showed their discoveries by making statements of their findings and formulating rules as a result of the findings.

The post-experimental test was administered after the termination of nine weeks. The Metropolitan Advanced Arithmetic Test Form S was used for this purpose. The results of the test scores will be discussed and illustrated in this section of the study.

Post-Experimental Test Scores

Results on the Metropolitan Test in Skills Advanced Arithmetic Form S.— The data on the level of arithmetic achievement skills of the forty-eight pupils in the Control and Experimental groups are presented in Figure 3, which presents a comparison of the frequency distribution of the scores obtained by the two groups.

Control Group.— The data for the Control group indicated that the scores ranged from a low 0 to a high of 26, with a mean score of 11.74, a median score of 11.92 with a standard deviation of 6.93 and a standard error of the mean of 1.47. Approximately 29 per cent scored above the mean, 46 per cent scored below the mean and 25 per cent scored within the class
Experimental

Control

No. of Pupils

Scale of Scores

Frequency Distribution of Raw Scores on Metropolitan Advanced Arithmetic Form S for Control and Experimental Groups
intervals of the mean, yielding a grade placement of 6.2 which is below the average grade placement norm of the Metropolitan Advanced Arithmetic Test.

Experimental Group.-- The data for the Experimental group indicated that the scores ranged from a low of 0 to a high of 32, with a mean score of 10.36, a median of 10.75, with a standard deviation of 8.43 and a standard error of the mean 1.79. Approximately 34 per cent of the group scored above the mean, 46 per cent below the mean, and 20 per cent within the class intervals of the mean, yielding a grade placement of 6.1 which is below the average grade placement norm of the Metropolitan Advanced Arithmetic test Form S.

**TABLE 12**

**COMPARISON TABLE ON THE METROPOLITAN ACHIEVEMENT TEST ADVANCED FORM R ARITHMETIC SKILLS FOR THE CONTROL AND EXPERIMENTAL GROUPS FINAL TEST**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.m</th>
<th>M_1-M_2</th>
<th>S.E.M_1-M_2</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>10.36</td>
<td>10.75</td>
<td>8.43</td>
<td>1.79</td>
<td>1.38</td>
<td>1.73</td>
<td>.80</td>
</tr>
<tr>
<td>Experimental</td>
<td>11.74</td>
<td>11.92</td>
<td>6.93</td>
<td>1.47</td>
<td>1.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comparative Data of the Arithmetic Skills.--** Table 12 shows that the mean raw score on the Metropolitan Advanced Arithmetic Test Form S, for the Control group was 11.74 and for the Experimental group 10.36, with a difference of 1.38 in favor of the Control group. The median score for the Control group was 11.91 and for the Experimental group, 10.75, with a difference of 1.17 in favor of the Control group. The
standard deviation for the Control group was 6.93 and 8.43 for the Experimental group. The standard error of the mean for the Control group was 1.47 and 1.79 for the Experimental group, with a standard error of the difference between the two means of 1.73.

The "t" for these data was .80 which was less than the rate of 2.66 required for significances at the one per cent level of confidence. Therefore, the difference in arithmetic skills was not statistically significant.

Post-Experimental Test Scores Reasoning Skill Problems

Results on the Metropolitan Test Reasoning Problems Advanced Arithmetic Form S Final Scores.-- The data on the post-test level of achievement of the forty-eight pupils participating in the experiment are presented in Figure 4, which presents a comparison of the frequency distribution of the scores obtained by the two groups, the Control and Experimental.

Control Group.-- The data for the Control group scores ranged from a low of 0 to a high of 13. The mean raw score was 4.84, a median score of 4.84, with a standard deviation of 3.50 and a standard error of the mean .74. It is indicated that approximately 29 per cent of the group scored above the mean, 46 per cent scored below the mean, while 25 per cent scored within the class intervals of the mean. The mean score yielded a grade-placement of 5.8 which is below the norm of the Metropolitan Advanced Arithmetic Test Form S.
Experimental

Control

Scale of Scores

Frequency Distribution of Raw Scores Made on the Metropolitan Advanced Arithmetic Test by the Control and Experimental Group
Experimental Group. The data for the Experimental group scores ranged from a low of 0 to a high of 17, with a mean raw score of 4.92, a median score of 4.84, with a standard deviation of 3.98 and a standard error of the mean of .85. It is indicated that approximately 29 per cent of the group scored above the mean, 46 per cent scored below the mean, while 25 per cent scored within the class intervals of the mean. The mean score yielded a grade-placement 5.8, which is below the norm of the Metropolitan Advanced Arithmetic test Form S.

TABLE 13

COMPARISON OF ARITHMETIC REASONING PROBLEMS—FINAL TEST
ADVANCED ARITHMETIC FORM S OF THE METROPOLITAN
ACHIEVEMENT TEST FOR THE CONTROL AND
EXPERIMENTAL GROUP

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.M</th>
<th>M1-M2</th>
<th>S.E.M1-M2</th>
<th>&quot;t&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>4.84</td>
<td>4.84</td>
<td>3.50</td>
<td>.74</td>
<td>.08</td>
<td>1.13</td>
<td>.71</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>4.92</td>
<td>4.84</td>
<td>3.98</td>
<td>.85</td>
<td>.18</td>
<td>1.13</td>
<td>.71</td>
</tr>
</tbody>
</table>

Comparative Data of the Arithmetic Reasoning and "t" Ratio.--

Table 13 shows the mean raw score on the Metropolitan Advanced Arithmetic Test Form S, for the Control group 4.84 and for the Experimental 4.92, a difference of .08 in favor of the Experimental group. The median for the Control group was 4.84 and for the Experimental group 4.84. The standard deviation for the Control group was 3.50 and for the Experimental group, 3.98, a difference of .48 in favor of the Experimental group. The standard error of the mean for the Control group was .74 and
for the Experimental group it was .85, with a standard difference in the two means of 1.13.

The "t" for these data was .71 which was not significant since it was less than the required 2.66 at the one per cent level of confidence; therefore, the difference in arithmetic reasoning problems was not statistically significant.

The Correlation Between the Arithmetic Scores and Mental Ages.-- There were two main objectives in the treatment of the data of this research, to wit: (1) to determine the significant difference, if any, in arithmetic achievement between the group of subjects studied, comprised of the forty-eight pupils of the Prentiss Institute Elementary School (2) to determine the degree of correlation, if any, between the scores obtained by the subjects on arithmetic achievement and mental ages.

The correlations which were found to be present are presented in Table 14.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number</th>
<th>Rho</th>
<th>( \sigma_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic scores of the Control and Experimental Groups</td>
<td>24</td>
<td>.84</td>
<td>.054</td>
</tr>
<tr>
<td>Mental ages of the Control group and arithmetic scores</td>
<td>24</td>
<td>.98</td>
<td>.009</td>
</tr>
<tr>
<td>Mental ages of the Experimental group and arithmetic scores</td>
<td>24</td>
<td>.98</td>
<td>.009</td>
</tr>
</tbody>
</table>
The correlation between the Arithmetic Final Scores and Mental Ages.---Table 14 reveals the data on the between scores obtained on the Metropolitan Arithmetic Achievement Test Form S and mental ages obtained by the California Test of Mental Maturity. The were found as follows: the Metropolitan Arithmetic scores for the Control and Experimental group, the \( r \) was .84 and the standard error of the \( r \) was .054. The \( r \) for the Control group, mental ages and arithmetic scores was .98 and the standard error of the \( r \) was .009. The \( r \) for the Experimental group, mental ages and arithmetic scores was .98, and the standard error of the \( r \) was .009.

The correlation between the scores made on the Arithmetic Test for the Control and Experimental groups revealed a very high relationship. The arithmetic scores as obtained by the Metropolitan Advanced Arithmetic Test Form S and the mental ages obtained by the California Test of Mental Maturity indicated a high relationship for the Control and Experimental groups respectively.

There was no statistically significant difference in the two groups in arithmetic achievement and no statistically significant difference in arithmetic scores and mental ages for the Control and Experimental groups.
CHAPTER III

SUMMARY AND CONCLUSIONS

Introductory Statement.— The difficulties pupils experience in arithmetic may be traced to a variety of causes. Numerous studies have been conducted which reveal certain of the typical errors and difficulties pupils encounter in arithmetic. These studies have led some teachers of arithmetic to attempt to improve their teaching procedures. Other investigations have shown that inadequate study habits, rather than failure to master subject matter, are often the cause of failure to achieve in arithmetic, and that it is necessary to pay much attention to the development of effective study habits as to the procedure for presentation of instructional materials. Further, it now appears that there is not much transfer of learning from one situation to another - while many things are learned simultaneously, every one of these learnings must be oriented toward the needs, interests, and the problems of the learner. While few people would doubt the value of developing the social significance of arithmetic, the need for developing arithmetic meanings does not appear to be as readily apparent. This is especially true of developing abilities in reading, reasoning, concept formation, closure, and the meanings of mathematics.

The phase of mental action involved in building a thought pattern constitute a behavior. Learning demands change in
behavior. Behaviors result from an introductory stimulus, a disposition to respond to the stimulus, a response-stimulus, and a consequential end-result. Behaviors produce meanings, or identify relations which constitute meaning. When meanings are comprehended the individual possesses concepts. Arithmetic concepts emerge from differentiation, discrimination, and integration — they are dependent upon experience. Therefore, learning is operative when it is available for continued use — operative learning is the outcome of a program of experiencing. A mode of thinking is developed whereby the learner is able to deal effectively with quantitative relations, exercise judgment, conceptualize, infer while making adjustments to his quantitative environment. Operative learning must be placed at the learners level and related, by the learner, to himself and, by the teacher, to his developmental program. Hence, learning is facilitated by building larger concepts, wholes, closures, integration, use and re-appearance; and utilizing the potentialities of intelligence and maturation. Thus, a well organized program of arithmetic education includes experiences of a social, sensory-aids, and arithmetical aspect. These experiences should proceed from the natural direct experience, to the contrived experience, and to the activity experience.

Two contrasting methods of teaching arithmetic need to be re-examined in the light of this rationale. For now it appears desirable that arithmetic be presented as something which is not fixed, final, or sacrosanct. Rather, it appears that learners should be encouraged to experiment with different ways
of arriving at answers, and gain understanding of the way numbers behave thereby. The inductive approach to study and teaching is an experimental approach. It permits the learner to make discoveries himself, and encourages him to think creatively and scientifically. It assumes that it is far better for the learner to make discoveries for himself and, in the process, prove that he understands the basis of the number system. The deductive approach to study and teaching is quite different. A rule, principle, or generalization is presented, with or without explanation. With this approach, it is the intention that the learner remembers the rule, principle, or generalization and apply it when needed in specific computation. On the one hand the inductive method provides opportunity for the learner to gather data, observe, study, experiment, and discover laws, rules, generalizations, and principles which he, in turn, applies to new data. On the other hand, the deductive method is based upon the presentation of laws, rules, generalizations, and principles which others have formulated and which the learner now seeks to apply.

**Purpose of the Study.**—The major purpose of this study was to test, by utilization of the experimental approach, the following null-hypothesis: There is no difference in the relative effectiveness of inductive and deductive methods of teaching arithmetic to pupils enrolled at the Prentiss Institute, Prentiss, Mississippi. More specifically, the purposes of this study were:

a. To structure methods of study and teaching which are, by
definition, inductive and deductive in nature;
b. To instruct two groups of pupils in one of the methods of study and teaching;
c. To discover the extent of competency attained by the two groups during a nine-week experimental period.

**Locale of the Study.**—The data for this study were collected at the Prentiss Institute, Prentiss, Mississippi.

**Period of Study.**—The study was conducted during the second semester of the 1955-56 school term, and extended over a period of nine weeks.

**Subjects Involved.**—The subjects involved were forty-eight seventh and eighth grade pupils enrolled at the Prentiss Institute, Prentiss, Mississippi.

**Method of Research.**—The experimental method was utilized, employing the technique of parallel grouping, testing, and statistical treatment of the data.

**Value of the Study.**—A study of this nature has value as it reflects in the improvement of competency developed by students, instructional procedures utilized by teachers, and administrative provisions structured by supervisors and principals. The findings of this study may be of value as they reflect in the continuing program of the school, and in further meeting the needs, serving the interests, and providing satisfying opportunities to students for solutions of their problems.

**Experimental design:**

1. The literature was reviewed for the purpose of gaining insight, meaning, implications, and understanding of possible ramifications of the developing philosophy of arithmetic education, developing purposes of arithmetic
education, developing methodology of arithmetic education, developing areas of instructional materials; developing programs of evaluation procedure in arithmetic education, and to identify researches of especial concern which are pertinent to this study.

2. A pre-test was administered for the purpose of establishing the level of competence attained by the subjects prior to the experiment. The Metropolitan Achievement Test, Arithmetic, Form R was used for this purpose.

3. The California Test of Mental Maturity was administered for the purpose of equating the subjects into an experimental and control group.

4. The Control and Experimental groups will be taught for a period of nine weeks, forty-five minutes each day, in separate groups, using the inductive method with one group (the Experimental group) and the deductive method with the other group (the Control group).

5. A Post-test was administered for the purpose of ascertaining the level of competence achieved by the two groups at the termination of the experimental period. The Metropolitan Achievement Test, Arithmetic, Form S was used for this purpose.

6. The data was tabulated, organized, and statistically treated, using essential statistical measures such as the mean, standard deviation, standard error of the mean, standard error of the differences between means, and Fisher's "t".

Summary of Related Literature.-- The literature reviewed which was pertinent to this study involved consideration of the following areas: the developing purposes of arithmetic education; the developing areas of instructional materials; the developing methodology of arithmetic education; and the developing programs of evaluative procedures in arithmetic education. This literature is summarized below.

Brownell identified three major theories of the teaching of arithmetic; the "drill theory," the "incidental learning theory," and the "meaning theory." He asserts that the meaning theory is most consistent with modern educational theory and philosophy, and
with the findings of modern psychology. Brownell defines the meaning theory as a theory which conceives of arithmetic as a closely knit system of understandings, ideas, principles, and processes.

McLellan and Dewey, referring specifically to the philosophy of arithmetic teaching, stressed the importance of teaching for meanings and understanding. Caswell and Foshay, in differentiating between drill and meaning theory, stated that the role of skill training and teaching for meanings are essentially in different directions, "While old fashioned drill neither assumes proficiency in a skill nor fosters interest on the part of the learner, nevertheless recurring opportunities to engage in the activity in which skill is sought is absolutely necessary to attain high-level proficiency. Skill cannot be attained by the laying on of hands or by wishful thinking."

Burton holds that practice (drill) has two essential features: (a) the integrative phase in which perception of the meaning is developed, and (b) the repetitive, a phase in which precision is developed through refining and facilitating understandings. Thiele, in supporting the meanings approach, declared that great reliance should be placed upon the child's discovery for himself of the meanings and relationships between numbers. In further support for himself of the meaning and relationships between numbers and of this meaningful approach to number teaching, Buswell, Brownell, and John state that much use should be made of the procedure through which the child is directed towards learning a particular process or fact through the
performance of a carefully planned sequence or series of steps involving concrete experiences which are followed by the identification of certain characteristics which are common to the relations which exist between numbers.

Morton has stated that "the major trouble with the drill or practice which was provided in the old-fashioned school was that it became before meaning had been developed. Drill should follow, not precede, the development of meanings. Spencer expressed the opinion that "children should be led to make their own investigations and to draw their own inferences. They should be told as little as possible and be permitted to discover as much as possible." Again, Brownell and Hendrickson, in discussing the place of repetitive practice, indicate "The fundamental method of teaching some factual material, most symbols, and arbitrary associations in general, remains, as always, the administration of repetitive practice. This statement holds regardless of the way in which children learn these materials. Wilburn cites a weakness of the drill theory of teaching as involving the fact that the children must depend on the teacher to direct their attention to each new number fact. The experience of receiving each new response directly from the teacher offers the pupils few opportunities to develop any method of thinking which they can use and apply in examining new number ideas. As a result, the pupils have no other resource than memorization of the number facts which the teacher has dictated to them.

Spitzer has identified five outstanding characteristics of the present concept of meanings in teaching arithmetic:
(1) developing understanding of the content of the subject; (2) recognition that the subject involves much more than the ability to compute; (3) starting instruction at the child's level; (4) facilitating the use of facts and processes through giving the pupils an opportunity to figure things out instead of relying entirely on telling as a means of instruction; and (5) the systematic provision of reviews and re-teaching.

**Recapitulation of Findings.**—A summation of the findings derived from the data presented in this study is presented below:

1. The intelligence or mental ability levels of the two groups, the Control and Experimental groups, was markedly below that of the group on which the tests used in this study were standardized, and indicated a marked retardation from the expected mental maturity level. More specifically, the data indicated that:

   a. The Control group had reached a mental maturity level with the "norm" of the grade placement index, as follows:

      1. A grade placement of 4.2 on Total Mental Factor
      2. A grade placement of 3.8 on Language Factors
      3. A grade placement of 4.4 on Non-Language Factors

   b. The Experimental group had reached a mental maturity level with the "norm" of the grade placement index as follows:

      1. A grade placement of 3.8 on Total Mental Factors
      2. A grade placement of 4.4 on Language Factors
      3. A grade placement of 4.4 on Non-Language Factors

2. Both the Control and Experimental groups, had reached a chronological age level which was far above their mental age as follows:

   a. The Mean Chronological age for the Control group was 13 years 4 months, whereas the Mean mental age was 9 years 3 months; a difference of 4 years.

   b. The Mean Chronological age for the Experimental group was 13 years 3 months, whereas their mean mental age was 9 years 3 months, a difference of 4 years.
3. There was no statistically significant difference between the Experimental and Control groups on areas of the mental maturity test either in Spatial Relationships, Numerical Reasoning, Verbal Concepts, or Logical Reasoning. The highest raw scores, however, were made in the area of Spatial Relationships, which represented 63 per cent of all the performances.

4. The obtained grade placement in the area of arithmetic achievement indicated a retardation of from one to two years from the norm of expectancy established for pupils of this age and grade placement. More specifically, it was found that:

a. The Control group tended towards a retardation in arithmetic reasoning, with a grade placement of 5.6, on the initial test.

b. The Experimental group tended towards a retardation in arithmetic reasoning, falling below the Control group, with a grade placement of 4.2 on the initial arithmetic reasoning tests.

c. The Control and Experimental groups attained a grade placement level of 5.9 and 6.0 on the initial test for "Fundamentals of Arithmetic."

d. The Control and Experimental groups attained a grade placement of 5.8 and 5.8 on the final test of arithmetic reasoning.

e. The Control and Experimental groups attained a grade placement of 6.2 and 6.1 on the final test for "Arithmetic Fundamentals."

5. There were no statistically significant differences revealed as to the effectiveness of the "inductive" and "deductive" methods of teaching the Control and Experimental groups.

Conclusions.— The findings of this study appear to warrant the following conclusions:

1. The Control and Experimental groups utilized in this study were at an equal level of mental development prior to the beginning of the experimental study. There was a slight, but statistically insignificant difference in the raw scores and derived I. Q. equivalents of the two groups, in favor of the Experimental group. Hence, it can be said that these groups, insofar as mental maturity is concerned, was a matched group, equated according to mental maturity.
2. There appears to be neither an advantage nor a disadvantage to these groups insofar as chronological age is concerned, since the differences in chronological ages were found to be slight, and statistically insignificant.

3. Achievement in "skills" and "reasoning" occurred at the same level in both groups; there were no statistically significant differences in achievement in either the initial or post-testing periods.

4. The "inductive" and "deductive" methods of teaching arithmetic utilized in this study were equally effective; achievement, or lack of it, in arithmetic did not appear to be a function of teaching method.

Implications.— On the basis of the findings and conclusions identified, the following implications appear pertinent:

1. Apparently, the program for the teaching of arithmetic in the Prentiss Institute for the first six grades has been relatively ineffective, since the seventh and eighth grade pupils are unable to operate at the level of expectancy for these grades.

2. There appears need for the teachers in the Prentiss Institute to consider the development of appropriate arithmetic activities designed for a group of pupils whose chronological ages exceed their mental ages, and whose total mental maturity is somewhat below that expected, when compared with the norms of groups for whom certain tests have been standardized.

3. Conceivably, a progressively expanding testing program at the Prentiss Institute might reveal certain facts or data which would be helpful in providing the base for an optimum teaching-learning situation. The extent to which the levels of achievement and total mental maturity ascertained in this study is an artifact of pupil ignorance of testing procedures cannot be identified in the present study.

4. There appeared to be an inadequate understanding or grasp of meanings in the pupils as to the fundamentals of arithmetic, and the processes involved in reasoning. It may well be that the teachers who work with these pupils have not taught in terms of the development of meanings and of reasoning abilities.

5. There will not emerge statistically significant differences in achievement among these pupils when taught by different methods.
Recommendations.-- The findings of this research appear to warrant the following recommendations:

1. That parents, teachers and principal be informed on the findings pertaining to this study on the level of arithmetic achievement for this study offers objective evidence on this controversial problem as pertains to this group of pupils.

2. That further research in this area be initiated with emphasis on studying the two methods with other standardized tests as the criterion for measurement.

3. That the elementary teachers conduct additional studies on the teaching of arithmetic in a practical and meaningful way.

4. That the testing program initiated in 1955-1956 be continued and the results further utilized.

5. That additional studies be conducted to ascertain the relationship, if any, between achievement in arithmetic and mental abilities of the parent population from which the subjects of this study were drawn.

6. That the program of arithmetic instruction in the Prentiss Institute be scientifically evaluated and/or reorganized so as to operate at the level of mental abilities of its pupil clientele, and in terms of their level of performance.
### TABLE 15

<table>
<thead>
<tr>
<th>Areas</th>
<th>Control Group</th>
<th></th>
<th>Experimental Group</th>
<th></th>
<th>S.E. M₁-M₂ &quot;t&quot;</th>
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<tbody>
<tr>
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<td>Sigma</td>
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<tr>
<td>Non-Language Factors</td>
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<td>10.95</td>
<td>24.50</td>
<td>5.11</td>
<td>112.40</td>
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</tbody>
</table>
### TABLE 16

**SUMMARY OF DATA DERIVED FROM RESULTS ON THE METROPOLITAN ADVANCED ARITHMETIC TEST FORM R AND S**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Sigma</th>
<th>S.E.</th>
<th>Mean</th>
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<th>S.E.M. _1-M_2</th>
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<tbody>
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<td><strong>Skills Form R</strong></td>
<td>9.16</td>
<td>10.10</td>
<td>6.33</td>
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<td><strong>Reasoning From R</strong></td>
<td>3.42</td>
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<td><strong>Skills Form S</strong></td>
<td>11.74</td>
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<td>6.93</td>
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<td>10.75</td>
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<td>4.84</td>
<td>4.84</td>
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<td>.74</td>
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<td>4.84</td>
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<td>.85</td>
<td>1.31</td>
<td>.71</td>
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</table>
BIBLIOGRAPHY

Books


Rogers, Agnes L. *Experimental Test of Mathematical Ability.* New York: Bureau of Publications, Teachers College, Columbia University, 1941.


**Periodicals**


**Articles**


**Theses**


INSTRUCTIONS TO PUPILS:

This is a test of mental maturity. In taking it you will show how well you understand relationships and what you do when you face new problems. No one is expected to do the whole test correctly, but you should answer as many items as you can. Work as fast as you can without making mistakes.

DO NOT WRITE OR MARK ON THIS TEST BOOKLET UNLESS TOLD TO DO SO BY THE EXAMINER.
DIRECTIONS: Mark as you are told the letter, R, for each right hand or foot; mark the letter, L, for each left hand or foot.

<table>
<thead>
<tr>
<th>Samples A and B</th>
<th>Correct Test Booklet Marks</th>
<th>Correct Answer Sheet Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A R L</td>
<td>A B R L</td>
<td></td>
</tr>
<tr>
<td>B R L</td>
<td></td>
<td></td>
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</tbody>
</table>

**TEST 1**

<p>| | | | | |</p>
<table>
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</thead>
<tbody>
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<td>R L</td>
<td>R L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>R L</td>
<td>R L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
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<td>R L</td>
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<tr>
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<td>R L</td>
<td>R L</td>
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<tr>
<td>20</td>
<td>R L</td>
<td>R L</td>
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<td></td>
</tr>
</tbody>
</table>
DIRECTIONS: In each row find the drawing that is a different view of the first drawing. Mark its number as you are told.

TEST 2

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STOP

NOW WAIT FOR FURTHER INSTRUCTIONS

Test 2 Score
(number right)
DIRECTIONS: The first three pictures in each row are alike in some way. Decide how they are alike, and then find the one picture among the four to the right of the dotted line that is most like them and mark its number.

TEST 3

STOP

Test 3 Score (number right)
DIRECTIONS: Read each group of statements below and the conclusions which follow. Then mark as you are told the number of each answer you have decided is correct.

TEST 4

E. If the sun shines it is day.
The sun shines.
Therefore
1 It will not rain
2 It is day
3 The moon may shine tonight —— E

51. All four-footed creatures are animals.
All horses are four-footed.
Therefore
1 Creatures other than horses can walk
2 All horses can walk
3 All horses are animals —— 51

52. Either the sun moves around the earth or the earth moves around the sun.
But the sun does not move around the earth.
Therefore
1 The earth moves around the moon
2 The earth moves around the sun
3 The sun is larger than the earth —— 52

53. Jack runs faster than Harry.
Bert runs faster than Harry.
Which is the slowest of the three?
1 Bert
2 Jack
3 Harry —— 53

54. Jane is taller than Helen.
Helen is taller than Barbara.
Which is the tallest: Jane, Helen, or Barbara?
1 Helen
2 Jane
3 Barbara —— 54

55. All mammals are vertebrates.
The cow is a mammal.
Therefore
1 Some vertebrates live on land
2 Some mammals live in water
3 The cow is a vertebrate —— 55

56. A is either B or C.
A is not C.
Therefore
1 A is not B
2 A is B
3 C is B —— 56

57. Either your cousin is older than you, or the same age, or younger.
But your cousin is not older, nor is he younger.
Therefore
1 Your cousin is younger than you
2 Your cousin is older than you
3 Your cousin is the same age as you —— 57
58. All circles are round figures.
A certain figure is not round.
Therefore
1. It is not a circle
2. It is oval
3. It is either a square or a triangle

59. All metals except mercury are solids.
Gold is a metal.
Therefore
1. Gold is valuable
2. Gold is a solid
3. Metals are usually heavy

60. Some fishes fly.
No birds are fishes.
Therefore
1. All creatures that fly are fishes or birds
2. No fishes resemble birds
3. Creatures other than birds can fly

61. Three boys are up on a ladder.
   Tom is farther up the ladder than Paul.
   Jim is farther up than Tom.
Which boy is in the middle position on the ladder?
1. Tom
2. Paul
3. Jim

62. George Washington was a skillful general.
George Washington was President of the United States.
Therefore
1. Skillful generals make good presidents
2. One President of the United States was a skillful general
3. Good presidents make skillful generals

63. A is situated to the east of B.
B is situated to the east of C.
Therefore
1. C is situated close to A
2. A is situated to the east of C
3. C is nearer to A than to B

64. He is either honest or dishonest.
But he is not dishonest.
Therefore
1. He is desirable for a position
2. He comes from honest people
3. He is honest

65. A is equal to B.
B is equal to C.
Therefore
1. B is larger than C
2. A is equal to C
3. A is equal to B plus C
**TEST 5.**

| TEST 5. | 1. | 2 | 4 | 6 | 8 | 9 | 10 | 12 | 14 | a | b | c | 10 | d | 12 | e | 14 | ___ | F |
|---------|----|---|---|---|---|---|-----|----|----|---|---|---|-----|---|----|---|----|-----|____|
| 56).    | 5  | 10 | 15 | 20 | 22 | 25 | 30  |    |    | a | b | c | 15  | d | 20 | e | 22 | ___ | 66 |
| 57).    | 18 | 15 | 13 | 12 | 9  | 6  | 3   |    |    | a | b | c | 12  | d | 9  | e | 3  | ___ | 67 |
| 58).    | 2  | 5  | 8  | 10 | 11 | 14 | 17  |    |    | a | b | c | 10  | d | 11 | e | 17 | ___ | 68 |
| 59).    | 1  | 2  | 4  | 8  | 14 | 16 | 32  |    |    | a | b | c | 8   | d | 14 | e | 16 | ___ | 69 |
| 60).    | 27 | 9  | 3  | 1  | 0  | ½  |     |    |    | a | b | c | 1   | d | 0  | e | ½ | ___ | 70 |
| 61).    | 3  | 4  | 7  | 8  | 10 | 11 | 12  | 15 |    | a | b | c | 10  | d | 12 | e | 15 | ___ | 71 |
| 62).    | 3  | 9  | 27 | 76 | 81 | 243|     |    |    | a | b | c | 27  | d | 81 | e | 243| ___ | 72 |
| 63).    | 25 | 24 | 22 | 19 | 18 | 16 | 13  | 12 | 9  | 10 | 7 |    | a | b | c | 19 | d | 13 | e | 9  | ___ | 73 |
| 64).    | 1  | 2  | 4  | 7  | 11 | 15 | 16  | 22 | 29 | 37 |   |    | a | b | c | 22 | d | 29 | e | 37 | ___ | 74 |
| 65).    | 12.5 | 11.4 | 10.3 | 9.8 | 9.2 | 8.1 | 7.0 |    |    | a | b | c | 9.2 | d | 8.1 | e | 7.0 | ___ | 75 |

STOP NOW WAIT FOR FURTHER INSTRUCTIONS

**Test 5 Score**

(number right)........................................
DIRECTIONS: Work these problems on a sheet of scratch paper. Mark as you are told the letter of each correct answer.

TEST 6

G. There are 5 birds in a tree and 3 birds on a fence. How many birds are there in both places?

a 2
b 8
c 15
d 7

76. Tom has 5 marbles. Bob has 4 marbles. Bill has 3 marbles. How many marbles do all three boys have?

a 1
b 2
c 12
d 60

77. Tickets to a show cost 10 cents. Jim bought 2 tickets. How much did he pay for them?

a 20¢
b 24¢
c 12¢
d 8¢

78. Ben earns 4 dollars each week helping his father after school. He has earned 16 dollars. How many weeks has he been working?

a 20
b 64
c 4

d 4

79. Seventy girl scouts were divided into 5 groups of equal size. How many girls were there in each group?

a 15
b 14
c 20
d 3

80. How many marbles can you buy for 25 cents at the rate of 3 for 5 cents?

a 15
b 75
c 33
d 40

81. Two boys bought watermelons and sold slices of them at a ball game. They had 50 cents in the cash box to start with. They sold 40 slices of melon at 5 cents a slice. How much should they have in the cash box at the end of the day?

a $2.00
b 80¢
c $3.00
d $2.50

82. Balls which usually sold for 65 cents were sold for a short time for 25 cents less. Frank bought a ball at the lower price and gave the clerk 50 cents. How much change should he get back?

a 25¢
b 20¢
c 10¢
d 5¢
6. At Camp No. 9 it took 10 boy scouts 3 days to set up camp. Camp No. 12, which is the same size, must be set up in one day. How many boys will be needed to do the work?

   a) 3  
   b) 30  
   c) 27  
   d) 13  

7. George lives one-fourth of a mile from school. He goes home at noon for lunch. How far does he walk each day going to and from school?

   a) \( \frac{1}{2} \) mi.  
   b) 1 mi.  
   c) \( \frac{3}{4} \) mi.  
   d) \( \frac{1}{4} \) mi.  

8. A newsboy delivered papers to 30 customers for a month. At the end of the month he collected $15.00. How much did each customer pay?

   a) 50¢  
   b) $2.00  
   c) 5¢  
   d) $5.00  

9. There are 20 girls in the Sunday School class. Each week each girl gives 5 cents to go toward a fund for needy families. How much will all the girls give in 5 weeks?

   a) $1.00  
   b) $25  
   c) $5.00  
   d) $7.50  

10. Richard saw an air rifle advertised for $21.00 at one-third off for cash. How much money will he need to buy it?

    a) $14.00  
    b) $7.00  
    c) $18.00  
    d) $9.00  

11. How much will your mother have to pay for the cleaning of a rug 9 ft. wide and 12 ft. long at the rate of 20 cents a square foot?

    a) $8.40  
    b) $1.08  
    c) $4.20  
    d) $21.60  

12. In a field meet, 20 events were listed for the day. Pupils from your school won 60 per cent of the events. How many events did you lose?

    a) 4  
    b) 3  
    c) 8  
    d) 12  

13. A swimming pool is 60 ft. long and 30 ft. wide. The water in the pool is 4 ft. deep on the average. How long will it take to fill the pool if the water runs in at the rate of 90 cubic feet a minute?

    a) 80 min.  
    b) 5 min.  
    c) 26 min.  
    d) 45 min.  

Test 6 Score
(number right)...........................................
**DIRECTIONS:** Mark as you are told the number of the word that means the same or about the same as the first word.

<table>
<thead>
<tr>
<th>TEST 7</th>
<th></th>
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</thead>
</table>
| H. blossom | 1 tree 2 vine 3 flower 4 garden  
91. journey | 1 state 2 travel 3 end 4 fair  
92. law | 1 rule 2 power 3 able 4 help  
93. always | 1 larger 2 forever 3 know 4 apart  
94. almost | 1 rarely 2 never 3 now 4 nearly  
95. alarm | 1 blame 2 signal 3 address 4 comfort  
96. damage | 1 manage 2 collect 3 injure 4 recover  
97. announce | 1 keep 2 publish 3 reform 4 destroy  
98. improve | 1 make 2 better 3 satisfy 4 admit  
99. difficult | 1 different 2 pleasant 3 hard 4 task  
100. despair | 1 mind 2 time 3 past 4 hopelessness  
101. consent | 1 occur 2 offer 3 oppose 4 agree  
102. portion | 1 collect 2 part 3 make 4 refer  
103. amuse | 1 afford 2 gift 3 game 4 please  
104. lack | 1 use 2 want 3 admit 4 apart  
105. cease | 1 consent 2 concert 3 stop 4 strain  
106. disguise | 1 reveal 2 declare 3 show 4 mask  
107. distinct | 1 success 2 clear 3 interest 4 noticed  
108. sincere | 1 satisfactory 2 genuine 3 hopeful 4 noble  
109. lofty | 1 tone 2 high 3 example 4 tool  
110. extend | 1 refuse 2 remain 3 lengthen 4 revert  
111. condemn | 1 false 2 blame 3 oppose 4 alarm  
112. humble | 1 secure 2 dwelling 3 lowly 4 proud  
113. expert | 1 average 2 master 3 business 4 student  
114. apply | 1 piece 2 use 3 correct 4 mean  |

---

**STOP**

Test 7 Score (number right).................
California Short-Form Test of Mental Maturity

Devised by E. T. Sullivan, W. W. Clark, and E. W. Tegs

See MANUAL for instructions.

**DIAGNOSTIC PROFILE**

<table>
<thead>
<tr>
<th>Mental Age</th>
<th>84</th>
<th>96</th>
<th>108</th>
<th>120</th>
<th>132</th>
<th>144</th>
<th>156</th>
<th>168</th>
<th>180</th>
<th>192</th>
<th>204</th>
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<td>Yr.</td>
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<td>9.0</td>
<td>10.0</td>
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<td>14.0</td>
<td>15.0</td>
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<td>17.0</td>
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</table>

**TOTAL VERBAL CONCEPTS** - 50

**TOTAL MENTAL FACTORS** - 140

**LANGUAGE FACTORS** - 80

[(4+6)+7] - 10

**NON-LANGUAGE FACTORS** - 60

[(1+2)+3]+5 - 20

**CHRONOLOGICAL AGE**

Average Grade Placement Equivalent

**INTELLIGENCE GRADE PLACEMENT**

<table>
<thead>
<tr>
<th>Mental Age</th>
<th>84</th>
<th>96</th>
<th>108</th>
<th>120</th>
<th>132</th>
<th>144</th>
<th>156</th>
<th>168</th>
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<th>204</th>
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<td>14.0</td>
<td>15.0</td>
<td>16.0</td>
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</table>

**SUMMARY OF DATA**

**TOTAL MENTAL FACTORS**

**LANG GRADE FACTORS**

**NON-LANG FACTORS**

For comparison and prediction, use I.Q. percentile norms on page 19 of Manual.

**INTELLIGENCE GRADE PLACEMENT**

* Non-language Tests
# METROPOLITAN ACHIEVEMENT TESTS

## ADVANCED ARITHMETIC TEST: FORM R

**By Richard D. Allen, Ph.D.**  
**Harold H. Bixler, Ph.D.**  
**William L. Connor, M.A.**  
**and Frederick B. Graham, P.D.M.**

<table>
<thead>
<tr>
<th>Test</th>
<th>Standard Score</th>
<th>Grade Equivalent</th>
</tr>
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<tbody>
<tr>
<td>1. Arithmetic Fundamentals</td>
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</tr>
<tr>
<td>2. Arithmetic Problems</td>
<td></td>
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<tr>
<td>Average Arithmetic</td>
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<td></td>
</tr>
</tbody>
</table>

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Copyright 1946 by World Book Company. Copyright in Great Britain. All rights reserved.
TEST 1. ARITHMETIC FUNDAMENTALS

DIRECTIONS. Work each example and write the answer in the box near it. If you have to copy your answer, be sure to copy it correctly. Reduce improper fractions to mixed numbers, and all fractions to lowest terms.

1. Add
   $2499.29
   .82
   737.95
   7.87
   66.44
   
2. Subtract
   771315
   166428
   
3. Multiply
   5627
   94
   
4. 
   7)7947
   
5. 
   32)704
   
6. 
   49)24856
   
7. Add
   $\frac{2}{3}
   $\frac{1}{6}$
   
8. Add
   $\frac{5}{8}
   $\frac{27}{8}$
   
9. $\frac{1}{2} + \frac{2}{5} + \frac{3}{4} =$
   
10. Subtract
    $\frac{1}{2}
    $\frac{1}{8}$
    
11. Subtract
    $\frac{3}{8}
    $\frac{1}{2}$
    
12. Subtract
    $4\frac{1}{4}
    $\frac{2}{3}$
    
[ 2 ] (Go right on to the next page)
3. \( \frac{3}{5} \times \frac{5}{12} = \) 

4. \( 12 \times 2 \frac{3}{4} = \) 

5. \( 6 \frac{1}{4} \times 8 \times 2 \frac{2}{5} = \) 

6. \( 12 \div 2 \frac{3}{4} = \) 

7. \( \frac{2}{3} \div \frac{5}{6} = \) 

8. \( \frac{3}{5} \div 12 = \) 

9. \( 5 \frac{1}{3} + 1 \frac{1}{6} = \) 

10. **Add**

    \[
    \begin{align*}
    &.241 \\
    &8.5006 \\
    &2.35054 \\
    &.745 \\
    &2.6012 \\
    &9.327 \\
    \end{align*}
    \]

11. \( \$78 - \$3.11 = \) 

12. \( \frac{3}{4} + .035 = \) 

13. \( 100 \times .066 = \) 

14. \( .24 \times 52.4 = \) 

15. \( 6.42 = \) 

16. \( .004 \div .0368 = \) 

17. \( 1.26 \div 88.2 = \) 

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(To the next page.)
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>28. 5% of 300 =</td>
<td>15</td>
</tr>
<tr>
<td>29. ( \frac{3}{12} ) =</td>
<td>( % )</td>
</tr>
<tr>
<td>30. 60% of 24 =</td>
<td>14.4</td>
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<tr>
<td>31. 300% of 120 =</td>
<td>360</td>
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<tr>
<td>32. 37 1/2% of 24 =</td>
<td>11.125</td>
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<tr>
<td>33. 16 is what percent of 64?</td>
<td>25%</td>
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<tr>
<td>34. What percent of 24 is 9?</td>
<td>37.5%</td>
</tr>
<tr>
<td>35. ( \frac{1}{8} ) of 1600 =</td>
<td>200</td>
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<tr>
<td>36. 45 is 30% of what?</td>
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**School Subjects Best Liked in One City**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Count</th>
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<tbody>
<tr>
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<tr>
<td>History</td>
<td>400</td>
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<tr>
<td>Art</td>
<td>300</td>
</tr>
<tr>
<td>Music</td>
<td>200</td>
</tr>
<tr>
<td>Science</td>
<td>100</td>
</tr>
</tbody>
</table>

37. About how many pupils liked physical training best? [Answer: 200]

38. 2 yr. 9 mo. = [Answer: 30 months]

39. 3 sq. yd. = [Answer: 27 sq. ft]

40. Add
   - 2 ft. 4 in
   - 3 ft. 8 in
   - 4 ft. 6 in
   - [Answer: 10 ft. 8 in]

41. The ratio of a foot to a yard is [Answer: 1 to 3]

42. The distance on above map from A to B is 1 4/5 in. According to the given scale what is distance in miles? [Answer: 100 miles]
3. Find the average of 4, 8, 12, 16, 20, 24.

4. Principal = $750
Rate = 3%
Time = 3 yr.
Interest =

5. Selling price = $2,500
Rate of commission = 18%
Commission =

6. Principal = $500
Time = 1 yr. 4 mo.
Rate = 6%
Interest =

7-48. Principal = $600
Rate = 4%
Time = 60 da.
Interest
Amount

9. The volume of the above figure is cu. in.

50. The figure above is called a

51. Its area is sq. in.

52. The letters of two parallel lines are

53. How many degrees in angle C?

54. What kind of angle is angle A?

55. $x + 27 = 49$ $x =$

56. $\frac{x}{3} = 5$ $x =$

57. $\sqrt{81} =$

STOP!
1. Rose had a piece of ribbon \(3\frac{3}{8}\) yards long. She had \(1\frac{1}{2}\) yards left after making bows. How many yards did she use for the bows? \(1\) yd.

2. Mr. Lane bought a new flagpole for his front yard. It is \(28\frac{7}{8}\) feet long. If he puts it \(4\frac{1}{2}\) feet into the ground, how many feet of the pole will be above ground? \(2\) ft.

3. Mrs. Doyle bought two chickens for dinner. One chicken weighed \(3\frac{1}{2}\) pounds and the other \(2\frac{3}{4}\) pounds. How many pounds of chicken did she buy in all? \(3\) lb.

4. Emil's father got 20 baskets of berries. He said he would give a fourth of them to his brother and a fourth to a neighbor and keep the rest. How many baskets was he going to keep? \(4\)

5. Ned bought \(\frac{1}{2}\) dozen roses for \$1.68. At that price what did one rose cost him? \(6\) ¢

6. How much material should Louise buy for 6 towels, each of which is to be \(\frac{7}{8}\) yard long? \(6\) yd.

7. If a map is drawn to a scale of 100 miles to \(\frac{1}{4}\) inch, what distance will be represented by a line \(1\frac{1}{2}\) inches long? \(7\) mi.

8. Mr. Nelson bought a table for \$12.75. He paid \$1.50 to have it carted to his shop. He spent \$1.69 to repaint it. He sold it for \$20.00. How much did he gain on it? \(8\)

9. Susan has \(3\frac{3}{8}\) yards of ribbon that she wants to cut into \(\frac{3}{4}\)-yard lengths. How many lengths can she cut? \(9\)

10. My father is paid twice a month. If each check is \$75, how much does he get a year? \(10\) $
1. Nancy had the following marks in her mid-term tests: 92, 68, 84, 74, and 100. What was her average mark? 

2. Our class bought a box of 2 dozen candy bars for 95¢ and sold the bars for 5¢ each. How much did we make on a box? 

3. Sol earns 40¢ an hour. Yesterday he worked from 8:30 to 11:00 and from 2:30 to 3:30. How much did he earn? 

4. Ruth needs 200 ice-cream cones for the church fair. If a quart of ice cream fills 10 cones, how many gallons of ice cream should she order? 

5. The speedometer showed 2014.9 miles when we started on our trip and 2030.8 when we finished. How many miles did we travel? 

6. Mrs. Combs pays $200 down and $10 a week for a 550-dollar piano. How long will it take her to pay for it? 

7. On different days last week, Rose's sister worked 5½ hours, 8 hours, and 6½ hours. If she was paid 48¢ an hour, how much did she receive for her work last week? 

8. What will ice cream for 224 persons cost if you allow 1 quart of ice cream for 8 persons and pay $2.00 a gallon for it? 

9. Bertha has a 6-yard piece of lace. She gave 1¾ yards to her sister for a dress and used 7/8 of a yard on her own dress. How much did she have left? 

10. Polly bought ¾ yard of ribbon at 40¢ a yard and 5/8 yard of silk at $1.68 a yard. How much was the bill? 

11. On Ruth's bar graph 1 inch represents a river 2000 miles long. How long would the bar be for a river 2500 miles long? 

12. At our field day 65% of the 1000 pupils took part. 20% of those who took part won prizes. How many received prizes? 

13. Nan is making 3 doll's dresses of the same size from a 2-yard piece of cloth. What part of a yard will she use for each doll? 

[7] (Go right on to the next page.)
24. Lena's sister earns $32 a week. Every Monday she puts $4 in the bank. What per cent of her money does she save? ......

25. How much would \( \frac{4}{3} \) pounds of salted nuts cost at $1.50 a pound? ............

26. A radio which cost $50 was sold for $60. The overhead on the radio was 30% of the first cost. How much money was lost on the sale? .......

27. Laura painted the kitchen floor, which is 18 feet by 12 feet. How much did the painting cost at 12\( \frac{1}{2} \) a square foot? ............

28. The city tax rate is $2.72 per $100 of assessed value. What does Mr. Smith pay on his house assessed at $9500? .........

29. Mr. Hall borrowed $850 for 90 days at 4%. How much interest did he owe then? .........

30. Our motorboat ran a distance of 19.8 miles in 1.2 hours. Find its rate of speed per hour. ............

31. Find the annual premium on a 20-year life insurance policy if the rate is $47.80 per $1000 and the face of the policy is $6000. .......

32. Mr. Astor shipped 115 barrels of apples to his agent, who sold them at an average price of $4 a barrel. He charged 5% commission. Other expenses came to $24. What were Mr. Astor's net proceeds? .......

33. Mr. Rob borrowed $1600 to start a grocery store. After 15 months he paid the loan, with interest at 5%. What sum did he pay? .........

STOP!
METROPOLITAN ACHIEVEMENT TESTS

ADVANCED ARITHMETIC TEST: FORM R

For Grades 7, 8, and first half of 9

KEY AND DIRECTIONS FOR SCORING

GENERAL DIRECTIONS

Note. The following directions should be read carefully before any scoring is done, and they should be followed implicitly.

1. The keys are provided to make the scoring objective, and at the same time as convenient, quick, and accurate as possible. No answer should be given credit if it is not in the key except as indicated in the detailed instructions below for the separate tests. Be consistent in marking all papers in the case of any variation from the key.
2. Use colored pencils to mark the right and wrong answers.
3. The aim of the test is to find whether or not pupils know the correct answers to the questions, and although specific directions are given to the pupils concerning the method of indicating the answers, any correct indication should be given credit.
4. Each item is allowed 1 point if the answer is correct, zero if the answer is wrong. No part or fractional credits are given.
5. To obtain the score for each test, the number of correct answers is required. Make a short horizontal dash after each item that is correct. For greater accuracy make a cross after each item that is wrong or omitted. To get the number right for any test, count the number of dashes. To check it, add the number of X's and subtract their sum from the number of the last item attempted. At the end of each test there is a space for recording the number right. It is not necessary to mark any item beyond the last one attempted by a pupil in any test. The maximum possible number of right answers on a test is the same as the number of the last item.
6. The answers in the key are spaced the same as the places for the answers on the test pages. In every test the answers appear in one or more columns on each page.
7. Before scoring each test study the specific directions which are given on the following page.
8. All scoring should be checked, as well as the counting of correct answers to obtain the number right for each test. This means that a random sampling of the papers scored by each person should be rescored. If more than just a few careless errors are discovered, all the papers scored by that person should be rescored.
9. The number right for each test should be written on the dotted line at the end of the test. On the key for each test will be found a table which will give the standard score, grade equivalent, and age equivalent corresponding to this score. Raw score, standard score, and grade or age equivalent should be entered in the proper spaces at the bottom of the last page of each test. The grade and age norms are independent of one another. The norm to be used depends upon the way in which the local community is to utilize the test results.

(Directions continued on page 2)
Note. Be sure keys are cut apart on broken line or fold before starting to score any test.

Test 1. Fold the key along each of the heavy black lines. To score the test, open the key and lay the strip for page 2, column 1, along the left side of the test page. Mark each question in this column right or wrong. Fold the strip for page 2, column 1, to the left as you would turn the page of a book so that the key for page 2, column 2 is on top. Score this column in the same way. Continue to fold the key to the left for pages 3, 4, and 5. When page 5 is finished, count the correct responses on all pages of this test and record the number right at the bottom of page 5. From the table on the key, read off the standard score and grade or age equivalent corresponding to this score and enter them at the bottom of the page as well. The maximum possible score is 57. If the correct answer is not written in the box for it but there is no doubt of the example it refers to, the pupil should be given credit. No credit should be given for an improper fraction or a fraction that is not reduced to lowest terms. Credit should be given if a fractional answer is expressed as a decimal or vice versa. Disregard omission of "$","in.," or other denominations in the answer. No credit should be given if a decimal point is omitted. Give the pupil credit if his work shows that he has obtained the correct answer but he has made a mistake in copying the answer.

Test 2. Fold the key along the heavy black lines. With the strip for page 6 on top, score this page by marking each item right or wrong. Turn the key to the left and score page 7. Record number right, standard score, and grade or age equivalent in the same manner as described in Test 1. The maximum possible score is 33. If the correct answer is not written in the box for it but there is no doubt of the problem it refers to, the pupil should be given credit. Credit should be given if a fractional answer is expressed as a decimal or vice versa. Give the pupil credit if his work shows that he has obtained the correct answer but he has made a mistake in copying the answer.

Directions for Completing Table on the Title Page

As soon as the tests have been scored, the standard score and either the grade or age equivalent for each test should be transferred to the table on the title page. This table provides a column for standard scores, another for grade equivalents, and a third column in which age equivalents or other equivalents such as percentiles, local norms, modal age norms, etc., may be entered. Additional norms may be found in supplementary materials. Average Achievement should be found by averaging the grade or age equivalents for the separate tests. The standard scores should not be averaged.

It has been recommended that standard scores be entered on the title page of each booklet. All supplementary norms have been set up in terms of standard score, and it is therefore possible to interpret the test results, through standard scores, in terms of any of the different supplementary norms. For example, percentile rank may be entered on the title page by the use of the table of percentile norms. Furthermore, by having standard scores on the title page it is possible at a later date to study the test results in terms of different norms from those originally used without having to go back to each individual test. Standard scores further have an advantage which raw scores do not, in being comparable from battery to battery in the same subject areas and from form to form. Standard scores are not comparable from test to test within a battery. A further explanation of standard scores will be found in the Manual for Interpreting.
<table>
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<tbody>
<tr>
<td>7. 5/6</td>
<td>14. 33</td>
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<tr>
<td>8. 8(\frac{1}{4})</td>
<td>15. 120</td>
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<tr>
<td>9. 1(\frac{13}{20})</td>
<td>16. 16</td>
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<td>10. 3/8</td>
<td>17. 4/5</td>
</tr>
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<td>11. 3(\frac{3}{8})</td>
<td>18. 1(\frac{1}{20})</td>
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<td>12. 3(\frac{7}{12})</td>
<td>19. 4(\frac{4}{7})</td>
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<td>20. 356.385</td>
<td>21. 74.89</td>
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<td>22. .785</td>
<td>23. 6.6; 6.60; 6.600</td>
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<td>24. 12.576</td>
<td>25. .07</td>
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<td>26. 9.2</td>
<td>27. 70</td>
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<td>28. 15</td>
<td>29. 66(\frac{2}{3})</td>
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<td>30. 14.4; 14.40; 14(\frac{2}{5})</td>
<td>31. 360</td>
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<td>32. 9</td>
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<td>34. 37(\frac{1}{2})</td>
<td>35. 2</td>
</tr>
<tr>
<td>36. 150</td>
<td>37. 380–390</td>
</tr>
<tr>
<td>38. (\frac{3}{4})</td>
<td>39. 27</td>
</tr>
<tr>
<td>40. 10 ft. 6 in.; (10\frac{1}{2}) ft.</td>
<td>41. 1 to 3</td>
</tr>
<tr>
<td>42. 300</td>
<td>43. 300</td>
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Cut along this fold.
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<th>11. 333/3</th>
<th>14. 5</th>
<th>17. 9.72</th>
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Metropolitan: Adv. Arith.: Key-R
# Intermediate and Advanced Arithmetic Tests

## Class Record

Form: \[\text{Grade}\] \[\text{Date}\] \[\text{Teacher}\] \[\text{School}\] \[\text{City}\] \[\text{State}\]

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<tr>
<th>Pupils' Names</th>
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This Class Record is for analyzing the data for a class and should be kept on file by the teacher or the principal for comparison with results at a later date.

In these columns should be recorded the grade or age equivalents of the pupils' scores in terms of the test norms or the local data for the school.

An additional column is provided in order to make it possible to record optional data.
Directions. In this form should be tabulated grade or age equivalents of pupils' scores on the tests rather than the scores themselves. Two scales are given, a Grade Equivalent Scale and an Age Equivalent Scale. The two scales are independent. An identifying mark should be put at the top of whichever scale is being used. For each pupil a tally mark should be made opposite his grade (or age) level under each test and the total. If a pupil's grade equivalent in Test 1 is 5.2, put a tally mark after 5.2 under the column headed "1. Arith. Fund." If his grade equivalent in Test 2 is 6.5, put a tally mark after 6.5 under the column headed "2. Arith. Prob.," and so on. The Average Arithmetic grade (or age) equivalent for any pupil is the average of his grade (or age) equivalents on the two arithmetic tests. For accuracy and ease in doing the work, all the grade (or age) equivalents should be tallied first for Test 1, then for Test 2, etc.

In place of a tally mark, as explained above, for each pupil's grade or age equivalent, an identification number may be used by means of which each pupil's status in the distribution for the class may be determined for each test. The number preceding each pupil's name in the Class Record may be used for this purpose.

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Note. To insure accurate and reliable results, the examiner should read the entire contents of these directions before administering the tests. Details concerning the interpretation of test results and their use in the improvement of instruction are given elsewhere.¹

Content of the Series

The complete batteries. The basic unit in the Metropolitan Achievement Test Series is the complete battery, containing a number of coördinated tests in the major school subjects. There are five such batteries in the series: Primary I Battery for Grade 1, Primary II Battery for Grade 2, the Elementary Battery for Grades 3 and 4 (replacing Primary III Battery of the older edition), Intermediate Battery for Grades 5 to 7.5, and Advanced Battery for Grades 7 and 8 and beginning half of Grade 9.² The separate subject-matter tests comprising these batteries provide reliable measures of individual achievement. The average of the subtest scores on each battery provides a measure of average achievement for the individual pupil. Summaries of individual pupil data for various administrative units (class, school, grade, community, etc.) will reveal the relative status in each of the areas measured or on total achievement.

The division of the Metropolitan Achievement Tests into five separate batteries, each battery covering not more than two full grades, permits a

¹ A Manual for Interpreting is planned for the series and must be ordered separately.
² Besides the five achievement batteries, the Metropolitan Readiness Tests have been issued, to provide a means of determining the readiness of pupils to learn the work of the first grade.

Publisher’s Note. All the authors listed above participated actively in the planning of the new Metropolitan Tests. However, the untimely death of three of these authors (Richard D. Allen, William L. Connor, and Frederick B. Graham) prevented their participation in the program of revision. The Division of Research and Test Service of World Book Company, with the able assistance of Dr. Harold H. Bixler, has carried out to the fullest possible extent the basic plans agreed upon for this project.
larger proportion of the content within each battery to be at grade level and thus adds to the reliability ¹ and validity of the measurement.

The Intermediate and Advanced Complete Batteries contain ten subtests:

Partial batteries and separate subject tests. In addition to the complete batteries as described above, the Intermediate and Advanced Batteries are published in the form of partial batteries which contain the following subtests: 1. Reading; 2. Vocabulary; 3. Arithmetic Fundamentals; 4. Arithmetic Problems; 5. English; 6. Spelling. There are no partial batteries for the Primary or Elementary Tests, since these already are composed chiefly of skill tests.

Since in many instances it is desirable to use an arithmetic test or a reading test independently of any others, the tests in these two subjects are published separately for the Elementary, Intermediate, and Advanced Batteries. In every case the separate Reading Test is made up of the Vocabulary and Reading Tests of the appropriate battery, while the Arithmetic Test is made up of the Arithmetic Fundamentals and Arithmetic Problems Tests from the battery.

**GENERAL DIRECTIONS FOR ADMINISTERING**

_The examiner should be thoroughly familiar with the directions and the battery before giving it._

_The examiner should take the tests himself in order to be thoroughly acquainted with them._

1. Testing, by its very nature, differs from teaching. If the examiner gives more help than the directions allow, the results may be invalidated.

2. Every effort must be made to prevent pupils from helping each other. Otherwise a true picture cannot be obtained of the extent of pupil achievement or of pupil difficulties and the reasons for them. Arranging the situation so that pupils cannot copy from each other is far better than reminding them constantly that they are not to look at each other’s papers.

3. The natural classroom situation should be retained as far as possible.

4. Accurate administering requires implicit following of instructions. The precise wording of directions has been worked out with great care and any marked deviation may invalidate the results. A natural manner and tone of voice should be used. There is no need to read instructions mechanically if the examiner is sufficiently familiar with them.

5. These tests are designed as measures of achievement of pupils—not as tests of following directions. If there is any doubt of the ability of the pupils to follow the directions, the teacher may provide the assistance she considers advisable before the battery is administered.

6. Requests to leave the room, and such emergencies as are presented by pupils who are hard of hearing or who have temporary vision troubles and the like, should be taken care of at the discretion of the examiner, who is in the best position to judge the proper handling of each case.

7. The pupils should be warned that during the test periods no one but the examiner needs to do any talking. During the course of the test

¹ See Table 2, page 6.
the examiner should walk about the room to see that pupils are working on
the right page. The examiner should give a pupil only the help necessary
to get him to indicate the answer in the right place or correct manner, but
should not help the pupil to mark the right answer. The examiner should
also see that on a test that takes two pages or more the pupils do not stop
at the end of any page before the last one of the test. Likewise, pupils
must be cautioned not to go beyond the test being taken. No questions
are to be answered during the course of the test. The pupil may raise
his hand only if his pencil breaks. An extra supply of sharpened pencils
should be on hand in case of need.

8. No one but the examiner should make any preliminary statements
about the tests to the pupils.

9. Provision should be made to insure quiet and an absence of interrup-
tions of any kind. Some examiners post on the door of the room a card
reading “Examination. Keep out.”

10. Accurate timing is an important feature in giving the tests that have
time limits. A stop watch or a watch with a second hand should be used.
The testing program should be so planned that ample time is allowed.
In no case should a test be stopped before the complete time allowance for
it is given. The examiner should not attempt to compress the testing into
too brief a period, thereby giving the impression of hurry and strain.

11. Time limits are provided for both tests. The time limits should be
adhered to strictly. It is advisable for the examiner to make a note of the
time in writing, just as soon as the signal is given to begin a test. Other-
wise the examiner may lose track of the time. The record should be made
in minutes and seconds, since an error of several seconds may seriously affect
the scores of individual pupils.

The time limits for the tests are as follows:

| Test 1. Arithmetic Fundamentals | 40 minutes |
| Test 2. Arithmetic Problems | 40 minutes |

The working time for the two tests is approximately 80 minutes. The
total time, including the passing out of test booklets, giving directions, etc.,
should be about 1½ hours.

Detailed Directions for Administering

When all necessary arrangements have been made and the class is ready,
say to the class: “We are going to have some tests today. They are printed in
booklets which I shall give you. Leave the booklet on your desk. Do not open
it or write anything on it until I tell you to.”

Pass out the booklets, being sure that the front page is face up. When
each pupil has his booklet, hold up a copy, point to the place on the front
page where the word Name is printed, and say: “Find the word Name
here on the front page and write your name after it.” In the same manner
instruct the pupils to fill in the other information called for.

When all the information is filled in, say: “Now put your pencils down and
listen carefully while I tell you what you are to do. (Make sure that all pencils
are down and all pupils are listening attentively.) In this booklet there are
two tests. There are some questions in each test that you will all be expected to answer correctly. There are some questions that only the very best pupils in the class will be able to answer. You are expected to do just the best you can. If you come to a question that you cannot answer, skip it, go on to the next question, and go back later to any questions you skip.

"At the beginning of each test there are directions that tell you what you are to do. I will read these directions with you. "Work steadily but don't hurry, because you will have time to do all you can with each test. Keep your eyes on your own paper. Do not look to see what anyone else is doing. If your pencil breaks, raise your hand and I will give you another. Are there any questions?" (Pause for a moment.)

Note. The same directions may be used for Intermediate and Advanced Arithmetic.

TEST 1. ARITHMETIC FUNDAMENTALS

"Open your booklets to page 2. On this page and the next three pages there are some examples in arithmetic. Look at the directions at the top of the page while I read them to you. Work each example and write the answer in the box near it. If you have to copy your answer, be sure to copy it correctly. Reduce all improper fractions to mixed numbers and all fractions to lowest terms. Do all your work on the test page. If necessary, use the margins. Be sure to put the answer to each example in the box for it. Remember that this test is on four pages and that there are two or more columns on each page. Ready. Go."

Make a note of the time in minutes and seconds. During the course of the test the examiner should walk about the room, making sure that pupils do not stop at the end of page 2, 3, or 4 before the time is up, and that they are putting the answers in the boxes. At the end of exactly 40 minutes, say: "Stop. Turn one page, like this, to 'Test 2. Arithmetic Problems,' on page 6." (Illustrate.)

TEST 2. ARITHMETIC PROBLEMS

"On this page and the next two pages there are some arithmetic problems. Look at the directions at the top of the page while I read them to you. Work each problem and write the answer in the box after the problem. Do your work in the margin at the right of the page. Be sure to copy your answer correctly in the box for it. Remember that this test is on three pages. Ready. Go."

Make a note of the time in minutes and seconds. The examiner should see that pupils put their answers in the boxes, and that they do not stop at the end of page 6 or page 7, before the time is up. At the end of exactly 40 minutes, say: "Stop. Put your pencils down. Close your booklets." Collect all booklets immediately.

DIRECTIONS FOR SCORING

Detailed directions for scoring accompany the keys which contain the correct answers. The directions for scoring should be read carefully and followed implicitly, and the keys should be used for the greatest accuracy and ease in scoring. No matter how well the tests have been administered, the results will have little value if they are inaccurately scored.
Interpretation of Test Scores

Well-established norms are necessary to interpret the achievement of individuals or groups of individuals. Raw scores (the number of items right or in some cases the number right minus the number wrong) have meaning only in comparison with some standard in terms of which they can be evaluated. In the Metropolitan Achievement Tests the raw scores have been translated into a variety of different norms. A table showing the standard score, age equivalent, and grade equivalent corresponding to each raw score will be found on the key for each test. The grade equivalents are based on the median scores of all pupils in a given grade regardless of age. The age equivalents are based on the median scores of all pupils of a given age regardless of grade placement. Other norms, such as percentile and modal age, which are useful for specific purposes, will be available elsewhere in the supplementary materials.

Theoretical grade equivalents higher than and lower than the range of grades covered by these tests are given in the tables. These were obtained by extrapolating; that is, by arbitrarily extending the tables upward and downward in a manner consistent with the trend shown in the grades covered. These extrapolated scores are intended to help in the differentiation of degrees of inferiority and superiority and are not to be interpreted as meaning that a pupil has mastered the work of the grades not covered by this test. This is true particularly at the upper level. For example, where a pupil in the eighth grade gets a score to which a grade equivalent of 11.0 has been assigned, it does not mean that he has mastered the work of the ninth and tenth grades, since these tests do not even touch on the curriculum content of those grades. It simply means that the pupil is about as far above the norm (8.0 if the tests were given in the first month of the eighth year) as another pupil in the same grade having a grade equivalent of 5.0 is below the norm.

Table 1 may be used to find the grade status of a pupil or class at the date of testing, provided the school year runs approximately from September 1 to June 15. If the school year is atypical, the grade norm should be determined by computing the number of tenths of a school year which have elapsed by the time the tests are administered.

<table>
<thead>
<tr>
<th>Grade Placement Corresponding to Testing Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date of Testing</strong></td>
</tr>
<tr>
<td>Grade Placement</td>
</tr>
</tbody>
</table>

**Brief Suggestions for Using Test Results**

While the space limitations of the Directions for Administering will not permit any detailed discussion of the utilization of test results, the following brief suggestions as to how the tests may be used to advantage are given. (Further information will be found in the supplementary material.)
1. To determine the achievement level of each pupil in arithmetic. Thus the strength and weaknesses of individual pupils are revealed and a basis is provided for the individualization of instruction in the classroom.

2. To evaluate class, school, and community achievement in arithmetic at each grade level.

3. To help the teacher in evaluating her teaching methods objectively.

4. To provide an objective and reliable basis for classification and grouping for instructional purposes.

This list of uses is far from exhaustive. It is intended only to be suggestive of some of the things which may be done with the test results. It should be emphasized at this point that standardized achievement tests are an aid to the teacher or administrator, but should be taken into consideration along with other pertinent information such as local curriculum practices, school marks, health records, general level of intelligence, and many other similar factors.

**Reliability**

By the reliability of a test is meant the accuracy of the measures it provides. Many factors, such as the length of the test, validity of the questions, conditions under which the test is administered, etc., affect the test results. It is, therefore, desirable for a test to be so designed that errors are reduced to a minimum. How well this has been realized in a given test is indicated by the coefficient of reliability. Table 2 gives the corrected (Spearman-Brown formula) split-half reliability coefficient for each subtest for Grade 5 and for Grade 7. It also gives the standard error of measurement for each test, together with other information. This standard error, as well as the mean and standard deviation, is given in terms of raw scores. In interpreting the scores of any individual on any test, the size of the standard error should be kept in mind and the deviation of any individual's score from any reference point, such as mean or median of the class or the norm on the test, should be evaluated in terms of the standard error of the test.

**TABLE 2**

**Corrected Split-Half Reliability Coefficients and Related Data for Metropolitan Achievement Tests:**

**Intermediate and Advanced Arithmetic Tests: Form R**

<table>
<thead>
<tr>
<th>Test</th>
<th>Reliability Coefficient</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Stand. Error Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 5 (Intermediate)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arith. Fund.</td>
<td>.914</td>
<td>204.4</td>
<td>20.1</td>
<td>6.0</td>
</tr>
<tr>
<td>Arith. Problems</td>
<td>.879</td>
<td>197.8</td>
<td>18.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Grade 7 (Advanced)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arith. Fund.</td>
<td>.900</td>
<td>249.5</td>
<td>24.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Arith. Problems</td>
<td>.902</td>
<td>223.2</td>
<td>28.0</td>
<td>9.6</td>
</tr>
</tbody>
</table>

1 Based on raw scores. 2 In terms of Comprehensive Standard Scores.
The Metropolitan Achievement Tests have been forms of the Metropolitan Achievement Tests are matter areas are covered by a subtest at the ap test in the Intermediate and Advanced Complete The major change has been the addition of ascience discussed in detail in the Manual for Interpreting, pattern of the first edition of this series has been used very widely for a number of years, and the old content of the tests was to remain in each battery. As now organized, all major subject-matter areas are covered by a subtest at the appropriate battery level.

Selection of content of subtests in each battery. Before beginning preparation of the new forms, careful plans were made with regard to what of the old content of the tests was to remain in each battery and what was to be replaced. Many of the items appearing in the first edition had proved their usefulness by satisfactory performance over a period of years, and were therefore retained. Many new items were prepared for each test in the series, and in the case of the reading tests practically all the items are new. All material, whether new or old, was carefully justified in the light of courses of study, textbooks, and opinions of experts in the field. A comprehensive experimental edition was prepared which consisted of many more items than were to appear in the final tests. More than 50,000 pupils were given one or more batteries of this edition for item-analysis purposes. Items were retained and arranged within the tests on the basis of the per cent of pupils passing the item at successive grade levels, and in the case of Reading and Vocabulary by the use of the biserial correlation of each item with the total test score. Also, in the case of the Reading Test, the Large Readability Index was used to insure that all reading content would be within the appropriate grade range. No item was retained which did not prove its worth.

Integration of the series. Item-analysis data were used not only to retain or reject items but to balance the forms for difficulty after they had been balanced for content. As a final check, a series of carefully controlled experiments based upon thousands of cases was carried out to insure the equivalence of forms and the proper overlapping of each test with the same test in the adjacent battery. Within the limits of the reliability of the subtests in the series, it is possible to go freely from one battery to another or from one test to another in making comparisons, confident that the differences found are real differences in the pupils tested and are not due to variations in the tests themselves.

In order that communities using the Metropolitan Achievement Tests, Forms A to E inclusive, may be able to know how the old norms compare with the new, a carefully controlled experiment was conducted for equating the new series to the old. Appropriate tables giving these comparisons are to be found in the supplementary materials.

Establishment of a variety of norms to be used in interpreting test results. Perhaps the most essential and difficult part of a well-standardized test is the establishment of a variety of norms on the basis of an adequate population. The adequacy of such norms depends upon the size and geographic distribution of the norm population, the freedom from selection or bias in the preparation of the new forms, and the types of analysis applied to the test data derived from the standardization program. While it is recognized that sheer numbers of cases are not important, the testing of a nation-wide sample inevitably involves the problem of testing large numbers. In the case of the Metropolitan Achievement Test standardization, a national program was carried out on a cooperative basis that involved testing in every state in the country. The total number of tests distributed amounted to more than 500,000. The actual norms were based upon a 25 per cent random sample drawn from each classroom tested. The size of the sample used for forms of the number of cases to be compared in order to render to insignificance the sampling errors in this process. Freedom from selection within the norm population was insured by the wide range of communities included from a geographic point of view, by the wide variety of administrative units (large cities, small cities, towns and villages, rural areas, etc.), and by the fact that all pupils in at least three grades in each community were included in the testing.

The basic types of norms provided are the traditional age and grade equivalents. These have been chosen because of their wide use at the present time. Other types of norms which have specific advantages in certain circumstances also are included, but, however, to meet every need that can be anticipated. These norms are given in the supplementary material, which is available on order.

Attention to the mechanics of the test. The kinds and sizes of type used, arrangements of questions, size of page, length of line, and all other mechanical details were determined with the purpose of producing a test that would be pleasing to the pupil, easy for him to read, and simple to administer and score. The test accessories have been worked out as a result of administering the tests to many groups of pupils and in the light of the experiences of test users. The Directions for Administering are complete enough to enable a relatively untrained examiner to administer the test successfully. In the Scoring Keys an effort has been made to arrive at an effective compromise that will insure the validity of measurement within each subtest while providing for simplicity, ease, and objectivity of scoring. Norms are furnished directly on the key for each test in order to facilitate the interpreting of raw scores in terms of the desired equivalents. The Individual Profile Chart, which is found on each test booklet, is designed to furnish a graphic picture of the achievement of an individual pupil.

The Class Record and Class Analysis Chart provides a powerful tool for the utilization of the test results of the class.
PART 1  Description of the Test
Reliability and Validity

PART 2  Uses of Test Results
Diagnostic Profile

PART 3  Directions for
Administration

PART 4  Directions for Scoring
Norms

PART 5  Description of the Test
Reliability and Validity

PART 6  Uses of Test Results
Diagnostic Profile

PART 7  Directions for
Administration

PART 8  Directions for Scoring
Norms
California Short-Form Test of Mental Maturity

The Authors

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The Test

The California Short-Form Test of Mental Maturity (1950 S-Form) is part of a larger parent test called the California Test of Mental Maturity. It is available on five levels: pre-primary, primary, elementary, intermediate, and advanced.

The California Short-Form Test of Mental Maturity has been developed in order to secure as valid a measure of mental maturity as can be secured by a one-period group test.

Selections from the parent test provide sub-tests which measure both language and non-language mental maturity and four of the major factors involved in intelligence or mental capacity, namely: spatial relations, logical reasoning, numerical reasoning, and verbal concepts which are useful in the thinking process.

Because of the wide range of abilities found in most age or grade groups this test provides for measurements several grades or years above and below the particular group being tested.

Although this test is primarily diagnostic and analytical, attention is called to the fact that it yields not one mental age and I.Q. characteristic of the familiar intelligence test, but three mental ages (language, non-language, and total) and three I.Q.'s (language, non-language, and total).

The Diagnostic Profile has been devised in order to show graphically the status of each pupil in language, non-language, and total mental age and intelligence quotients. It also provides spaces for recording the chronological age and the actual grade placement status of each pupil in relation to mental age.

The Diagnostic Profile provides the teacher not only with information relative to norms, but with clues for guiding the activities of pupils who are experiencing learning difficulties. Thus the major purpose of this test is not to obtain mental age or I.Q.'s, but to provide information on the nature and organization of the abilities of a given pupil in order that that information may be used to guide his learning activities.

Pupil answers may be written on the test booklet itself, on a machine-scoring answer sheet, or on a scoreze answer sheet. Scoreze, devised by Ethel M. Clark, is a unique dual answer sheet, one-half of which can be machine-scored; the other half is self-scoring and diagnostic and kept by the teacher or counselor. It has been devised for exclusive use with California Test Bureau tests and inventories.

NOTE: This is the complete Manual for administering the California Short-Form Test of Mental Maturity Elementary (1950 S-Form).
DESCRIPTION OF THE TEST

The California Short-Form Test of Mental Maturity, Elementary (1950 S-Form) will be found useful when time, convenience, or local conditions make it necessary to use a one-period mental test. It will provide as reliable a measurement and more diagnostic information than most group intelligence tests in current use. However, users of the Short-Form are encouraged to examine the manuals and tests of the complete California Test of Mental Maturity.

SPATIAL RELATIONSHIPS

The following two tests are designed to measure the status of certain aspects of thinking which involve orientation in space and the use of spatial relations.

SENSING RIGHT AND LEFT — Test 1

Test 1 consists of 20 pictures of hands and feet in various positions. These 20 items are designed to reveal the individual's ability to orient himself in these situations by discriminating between right and left.

MANIPULATION OF AREAS — Test 2

This test consists of 15 items which measure the pupil's ability to use spatial imagery in manipulating spatial patterns of many different forms and in many different positions.

LOGICAL REASONING

The simpler elements of logical reasoning are involved in most educational as well as other activities. In general, no matter how simple the situation, wherever a problem requiring a decision or a choice of responses presents itself, the simpler aspects of logical reasoning are present.

SIMILARITIES — Test 3

This test consists of a total of 15 picture situations. The first three pictures are alike in some way. The pupil determines the nature of this likeness and then finds another picture among the other four which is similar to the first three.

INFERENCE — Test 4

This test consists of 15 situations in which the pupil is given a major and a minor premise and is required to select the logical outcome or answer from the two premises.

NUMERICAL REASONING

Many factor analysis studies have yielded a more or less independent factor of intelligence variously called number factor, number facility, or numerical reasoning. This ability involves the recognition and use of likenesses and differences, and the making of inferences with special respect to quantitative or number situations and problems.

NUMBER SERIES — Test 5

This test consists of 10 series of numbers which increase or decrease according to a principle which the pupil must discover. Each series contains one number which does not belong. The pupil must find and mark this number.

NUMERICAL QUANTITY — Test 6

This test consists of 15 problems in quantitative reasoning. The pupil is given a numerical situation in each case, together with a question to which he must find the answer.

VERBAL CONCEPTS — Test 7

This test measures much more than mere connections between symbols and the realities for which they stand. Ideas and meanings begin as perceptions which enter consciousness through the senses; if they are remembered, they may function in many relationships, spatial or non-spatial in nature, and they may be enriched and refined through use in logical and numerical situations. They finally emerge as concepts which are useful in thinking.

This test consists of 100 words (the key word and the word which must be selected in each case). Each of these 100 words must be properly identified in order to obtain the correct response. The key words are identified by matching them with the word of the same meaning selected from four words which are listed in each case.
RELIABILITY AND VALIDITY

RELIABILITY

The coefficients of reliability of the California Short-Form Test of Mental Maturity, Elementary, reported below, are based on 1000 pupils in grades 4 to 6. These reliability coefficients have been computed by the split-halves method and corrected by the Spearman-Brown formula. These coefficients and the standard errors of measurement expressed in months of mental age are as follows:

<table>
<thead>
<tr>
<th>Tests</th>
<th>Grades 4-6</th>
<th>Reliability</th>
<th>S.E. Meas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Mental Factors</td>
<td></td>
<td>.952</td>
<td>3.5</td>
</tr>
<tr>
<td>Language Factors</td>
<td></td>
<td>.948</td>
<td>3.7</td>
</tr>
<tr>
<td>Non-language Factors</td>
<td></td>
<td>.910</td>
<td>4.8</td>
</tr>
<tr>
<td>Spatial Relationships</td>
<td></td>
<td>.867</td>
<td>5.8</td>
</tr>
<tr>
<td>Logical Reasoning</td>
<td></td>
<td>.872</td>
<td>5.7</td>
</tr>
<tr>
<td>Numerical Reasoning</td>
<td></td>
<td>.897</td>
<td>5.1</td>
</tr>
<tr>
<td>Verbal Concepts</td>
<td></td>
<td>.934</td>
<td>4.1</td>
</tr>
</tbody>
</table>

No. of cases 1000
S.D. (M.A. in Mo.) 16

The standard errors of measurement of the I.Q.'s, determined from the same data, are as follows:

<table>
<thead>
<tr>
<th>Tests</th>
<th>S.E. Meas. of I.Q.'s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Mental Factors</td>
<td>3.5</td>
</tr>
<tr>
<td>Language Factors</td>
<td>3.7</td>
</tr>
<tr>
<td>Non-language Factors</td>
<td>4.8</td>
</tr>
</tbody>
</table>

No. of Cases 1000
S.D. of I.Q.'s 16

For those who are interested, additional reliability data may be obtained by writing the California Test Bureau.

VALIDITY

Since there are no purely objective criteria for establishing the validity of intelligence or mental maturity tests, the validity of such tests must be estimated in other ways. The original two-period California Test of Mental Maturity, of which the California Short-Form is a one-period edition, was designed to measure, by group methods, most of the types of mental processes which are sampled by the individual Binet. Like the Long-Form, the California Short-Form consists of five series of tests of increasing difficulty. A comprehensive analysis of the Stanford-Binet was made by Dr. Elizabeth T. Sullivan and her results were embodied in a record form entitled, A Psychographic Record Blank.1

From this conceptual framework, individual test items were prepared and subjected to statistical analysis to determine difficulty and correlation with criteria such as the Binet mental ages and the California Test of Mental Maturity total scores. Intercorrelations among the separate tests were computed and the test data were also factor-analyzed by the Thurstone Centroid Method. The total mental factors score has been found by the authors and other investigators to correlate as high or higher with the individual Stanford-Binet than any other one-period mental ability test.

The seven tests constituting the Short-Form are described on the preceding page. The intercorrelations among the main test sections, based on 1000 cases in grades 4 to 6, are as follows:

INTERCORRELATIONS OF TEST SECTIONS

California Short-Form Test of Mental Maturity, Elementary, Short-Form
(1000 Pupils — Grades 4 to 6)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Relationships</td>
<td>31.8</td>
<td>33.3</td>
<td>29.2</td>
<td>25.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Logical Reasoning</td>
<td>26.1</td>
<td>26.9</td>
<td>27.8</td>
<td>24.3</td>
<td>27.6</td>
</tr>
<tr>
<td>Numerical Reasoning</td>
<td>25.5</td>
<td>25.8</td>
<td>26.0</td>
<td>33.2</td>
<td>28.3</td>
</tr>
<tr>
<td>Verbal Concepts</td>
<td>16.6</td>
<td>14.0</td>
<td>17.0</td>
<td>17.5</td>
<td>17.5</td>
</tr>
<tr>
<td>Language Factors</td>
<td>37.6</td>
<td>37.3</td>
<td>47.7</td>
<td>47.9</td>
<td>47.9</td>
</tr>
<tr>
<td>Non-Language Factors</td>
<td>62.4</td>
<td>62.7</td>
<td>52.3</td>
<td>52.1</td>
<td>52.1</td>
</tr>
<tr>
<td>Total Mental Factors</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

1 See the Journal of Delinquency, Vol. X. No. 1, January, 1926.

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Uses of Test Results

Diagnostic Profile

USES OF TEST RESULTS

Some of the ways in which intelligence or mental maturity may be defined are: brightness, mental power, ability to understand relationships, ability to profit from experience. Early students thought that it could be measured on a vertical scale like pupil height.

However, it was soon discovered that pupils with identical mental ages or intelligence quotients did not have the same abilities and did not succeed equally well.

Thorndike and others pointed out that this concept was too simple and among the new dimensions or aspects of intelligence which they suggested were the speed with which an individual works and the difficulty of the tasks which he can perform. These and other contributions led to extensive factor analysis studies which seem to indicate that intelligence consists of a number of relatively independent factors.

In measuring evidences of intelligence, a score is first obtained either from a whole test or from some major part of a test. This score is then expressed in terms of a mental age. Mental age means mental ability equal to that possessed by the average or typical pupil of a given age group. Thus, if a large representative number of pupils who were 12 years, 6 months old chronologically made an average score of 130 on a particular intelligence test, any other pupil who subsequently made a score of 130 on this intelligence test would be said to have a mental age of 12 years, 6 months.

Another measure is also used in designating intelligence; namely, the Intelligence Quotient (I.Q.). The Intelligence Quotient is obtained by dividing the Mental Age by the Actual or Chronological Age. It is therefore a ratio and shows the rate at which a particular pupil is developing mental ability. Thus the pupil who is 8 years old chronologically but has a mental age of 10 years has an I.Q. of 125 and is developing at a rate 25% faster than the average child.

This particular test is standardized so that the average I.Q. of an unselected population at the elementary level is 100. This means that we merely assign this I.Q. to the average of this age group. The Intelligence Quotient may also be used to find the probable mental age of a person, when no new test data are available, by multiplying it by the chronological or actual age at any given time.

I.Q.'s are ordinarily interpreted about as follows:

<table>
<thead>
<tr>
<th>I.Q.</th>
<th>Descriptive Classification</th>
<th>Typical Population Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 &amp; above</td>
<td>Very superior</td>
<td>3%</td>
</tr>
<tr>
<td>115-129</td>
<td>Superior</td>
<td>12%</td>
</tr>
<tr>
<td>100-114</td>
<td>High average</td>
<td>35%</td>
</tr>
<tr>
<td>85-99</td>
<td>Low average</td>
<td>35%</td>
</tr>
<tr>
<td>70-84</td>
<td>Inferior</td>
<td>12%</td>
</tr>
<tr>
<td>Below 70</td>
<td>Very inferior</td>
<td>3%</td>
</tr>
</tbody>
</table>

In general, the higher the score, mental age, or intelligence quotient, the more complex, abstract, and difficult the task or problem which an individual can handle. Mental ability is one of the most significant factors in educational and in occupational adjustment. Frequently, the level of intelligence is the controlling factor in success.

Care must be observed in using the I.Q. before age 16. Mental ages indicate the level of intelligence or ability at a given time. In business, industry, and in school tasks, the mental age requirements are often known. It is thus possible to assign tasks to individuals which are appropriate to their mental ability.

However, two individuals having approximately the same I.Q. may have very different mental ages. A pupil in the second grade with an I.Q. of 125 cannot do as difficult tasks as a pupil in the sixth grade with an I.Q. of 125. The pupil in the 2nd grade may have a mental age of 10 years, whereas the pupil in the 6th grade would probably have a mental age of 15 years. Comparisons between individuals who are both more than 16 years of age chronologically can usually be made with I.Q.'s as well as M.A.'s.

Up until the age of 16 it is advisable to use M.A. in predicting achievement. In other words, what a given pupil up to this age ought to do can be told more accurately from his mental age than his intelligence quotient.

However, measures of capacity or intelligence should never be used alone, but should be considered in relation to other factors. (Continued on page 7.)

The above distributions and percentages apply only to those tests such as the California Test of Mental Maturity and California Capacity Questionnaire which have provided for a normal, rather than skewed, distribution of mental ages and I.Q.'s. They would not apply in the cases of several intelligence tests which have arbitrarily allotted certain scores to higher mental ages without consideration of the normal probability curve, or which do not have a standard deviation of 16 points for a normal distribution of I.Q.'s.
The Diagnostic Profile presents, graphically, significant elements of pupil ability. It summarizes the major factors which are measured by the test. It reduces the mystery which has been associated with the use of mental ages and intelligence quotients. The identification of pupil strengths and weaknesses is greatly facilitated so that they are available to use as the basis for guiding educational activities.

PREPARATION OF THE PROFILE

1. Record the Pupil's Score for each of tests 1 to 7 in the light-colored boxes immediately to the right of the Possible Score in each case.
2. Add the pupil's scores on tests 1 and 2, and write this sum in the box below them.
3. Add the pupil's scores on tests 3 and 4, and write this sum in the box below them.
4. Add the scores on tests 5 and 6, and write this sum in the box below them.
5. To obtain the Total Mental Factors score, add the totals for Spatial Relationships, Logical Reasoning, Numerical Reasoning, and the Verbal Concepts score. Record this sum in the box to the right of Possible Score 140.
6. To obtain the Language Factors score, add the scores on tests 4, 6, and 7, and write this sum in the box to the right of Possible Score 80.
7. To obtain the Non-Language Factors score, add the scores on tests 1, 2, 3, and 5, and write this sum in the box to the right of Possible Score 60.
8. Chronological Age (C.A.) is the actual or life age of the pupil in months. It is essential that this age be correct for the purpose of calculating the I.Q.'s. (In all cases where the pupil is 16 years of age or older, 192 months is used as the divisor in obtaining I.Q.'s. However, each pupil’s correct age is recorded in the box to the right of Chronological Age.) The age should be determined from the pupil’s birth certificate, school records, or some other source, if these are doubtful.

9. Average Grade Placement Equivalent which appears in small type immediately below Chronological Age is indicated by the numbers on the lower side of the Chronological Age scale. For example, if the pupil’s chronological age is 132 months as indicated above the heavy line, a reference to the numbers below the line indicates that those who are 132 months old chronologically have an Average Grade Placement of about 5.7. If it is desired to mark actual grade placements on the profile it can be done on this average Grade Placement Equivalent line, as illustrated on the sample profile above, since otherwise it is used only for inspection.

For more accurate information on chronological age — grade placement relationships, see the Grade Placement and Age Norms which appear in all manuals of the California Achievement Tests. First locate chronological age in one of the columns headed Av. C.A. (mos.) (or Age in Months) and then find the corresponding grade placement in the first column.
USES OF TEST RESULTS (Continued from page 5)

One should not attempt to predict individual achievement from mental test data alone any more than one would attempt to judge an automobile on the basis of a single measure, such as height, weight, length, or horse-power.

LANGUAGE AND NON-LANGUAGE DATA
Tests 1, 2, 3, and 5 are presented with a minimum use of language. Tests 4, 6, and 7 are presented in language form.

The language test data are particularly useful in indicating how well the individual understands relationships expressed in words, such as instructions, conference discussions, statements of logical principles or courses of action, and the like.

The non-language test data indicate how well the individual understands relationships among things or objects when no language or a minimum amount of language is involved, such as physical or mechanical relationships.

Individuals may possess these two kinds of mental ability in very different degrees. It is not unusual for a person to have a language I.Q. of 70 or 80 and to have a non-language I.Q. of 100. Similarly, the reverse is frequently the case.

In general, score differences between the Language and Non-Language sections may be used as follows:

1. To determine if learners need simplified programs (because of lack of ability) or
remedial work (because of failure to realize their potentialities)

2. To predict success in certain industrial arts fields

3. To provide longitudinal (historical) data which may be of clinical significance in cases of mental deterioration

4. Together with factor scores, to determine the types of educational activities which will be most effective in aiding those who are experiencing learning difficulties.

MENTAL FACTORS DATA

The Mental Factor scores provide many clues for helping the pupil who is experiencing learning difficulties. Although factor scores of 25 to 50 points cannot be as reliable as the total Mental Factor score of 140 items, these factor scores are often more useful in guidance than the total score, mental age, or I.Q. obtained from the much larger number of items. For example, two pupils may obtain the same mental age and even the same I.Q. and yet one of them may be very successful in a given kind of work which requires high numerical reasoning ability, whereas the other one fails because he lacks this ability; but he may be good in spatial relationships or logical reasoning. If a pupil is having difficulty and his test shows that he has a very low score in one or two factors, the teacher or counselor has an immediate point of departure for investigating his difficulty.

SPATIAL RELATIONSHIPS

Those who score high in these tests indicate ability to deal with maps, charts, and graphs as well as global concepts. They are oriented in space relationships. They should be able to give as well as to follow directions and they should do well in planning layout design and construction.

A low in these tests may be due to poor perception or memory or both. However, if the unsatisfactory status is due to lack of opportunity rather than ability, it may be improved through providing adequate opportunities.

LOGICAL REASONING

Those who obtain high scores on 3 and low scores on 4 may lack reading or memory ability.

Test 7 should be checked in this connection. When inability to reason logically is due to a remediable cause such as a very unfavorable environment over a period of years, the individual can be aided in improving his reasoning ability. However, where the environment has been favorable and he has had the commonly available opportunities, a low score usually indicates an actual lack of capacity.

Individuals with superior logical reasoning ability should be expected to recognize the nature and implications of problems, to distinguish between evidence and propaganda, to project and test possible solutions, and to reach valid conclusions.

NUMERICAL REASONING

Individuals who score high on this test should do good thinking in arithmetic, the mathematical phases of shop work, the numerical phases of home economics having to do with recipes, problems of everyday life involving expenses, income, bookkeeping, making change and the like.

If individuals who make low scores have not been denied the usual opportunities available to most people, such low scores suggest a deficiency in this factor of intelligence. They frequently lack an appreciation of the significance or value of money; they must frequently be assisted in relating income to prices and expenses; much that is quantitative in their environment escapes them; and they lack definiteness and preciseness in their relations with others.

On the other hand, they may think well in the qualitative and emotional aspects of literature, music, and art, and do well in creative work which requires little or no numerical reasoning.

VERBAL CONCEPTS

Individuals who score high in this test possess the capacity to understand and profit from their experiences. They should do well in reading, literature, and drama. They possess some of the basic abilities involved in understanding others and making others understand them. A low or average score on this test is not proof of lack of ability in the verbal factor; such a score may be due to lack of a favorable environment or training in the skills associated with this ability.
GENERAL INSTRUCTIONS TO THE EXAMINER

This test is primarily analytical and diagnostic but it also yields standardized test data including the customary M. A.'s and I. Q.'s.

TIME LIMITS

This is a power rather than a speed test.* However, the time limits should be observed. They are ample for pupils to reach the practical limits of their abilities, and the test should be completed in one ordinary period. In many instances classes of advanced or bright pupils will complete a test section in less than the specified time. In such instances the examiner should proceed without waiting for the specified time to elapse. Time should not, of course, be counted on any sub-test until pupils actually begin to work.

It should be remembered that the time limits suggested for this test include only actual testing time. In addition to this, the examiner must allow sufficient time for giving directions, making explanations when necessary, and for passing out and collecting the test materials.

CAUTION AGAINST COACHING

It is important that pupils understand clearly the manner in which they are expected to indicate their responses. However, the examiner should remember that he is giving a test, and not directing a learning activity; therefore, the correct response should in no way be indicated for any item except in the practice exercises.

The California Short-Form Test of Mental Maturity is so designed that the same test booklet is used regardless of whether answers are to be marked on the test booklet, on machine-scoring answer sheets, or on the SCOREE answer sheet. However, the directions differ somewhat in the methods of administration. If answers are to be marked on test booklets, use the directions which follow immediately after this paragraph. If answers are to be marked on machine-scoring answer sheets, or on the SCOREE answer sheet, the appropriate directions begin on page 11.

DIRECTIONS FOR ADMINISTRATION

when answers are marked on test booklets

Suggested time allotment:

California Short-Form Test of Mental Maturity (1950 S-Form) 47 minutes (testing time only)

Materials required:

For each pupil:

1 test booklet — California Short-Form Test of Mental Maturity
1 ordinary lead pencil with eraser attached
1 eraser (if not attached to pencil)
1 sheet of scratch paper

In addition, for the examiner:

extra pencils
extra erasers
extra copy of test booklet — for demonstration purposes, if necessary
stop watch, or watch or wall clock with second hand.

SAY: You will notice that at the bottom of the front cover-page of the test booklet which you have just been given, it says: Instructions to Pupils. Read these instructions silently while I read them aloud. The instructions are:

This is a mental maturity test. In taking it you will show how well you understand relationships and what you do when you face new problems. No one is expected to do the whole test correctly, but you should answer as many items as you can. Work as fast as you can without making mistakes. Do not write or mark on this test booklet or on the answer sheet unless told to do so by the examiner. Now turn the test booklet over. Notice in the light space in the upper right-hand corner that there are lines for your name, grade, age, and so on. Write this information on these three lines.

Note the space set off by parentheses in the middle of the third line for identifying data. This space is provided for teachers or examiners who wish pupils to indicate their section, class, home room, etc., in order to facilitate the handling of data and test booklets after tests have been scored.

Give pupils time to record these data. Check to see that information is properly entered.

**SAY:** When you have finished, turn your test booklet back to the front page and wait for further instructions.

When all pupils have finished,

**SAY:** Now open the test booklet to Test 1 and fold it back so that only the test shows.

Demonstrate and be sure that all pupils understand.

**TEST 1**

Suggested time limit, 3 minutes

**SAY:** Since you are to mark your answers on this test booklet, pay no attention to the statement on the cover about not writing on it. Now look at the directions above Test 1 and read them silently while I read them aloud. These directions are: Mark as you are told the letter, R, for each right hand or foot. Mark the letter, L, for each left hand or foot. Look at the pictures of hands and feet. Under each picture is a letter R, meaning right, and a letter L, meaning left. Now look at Samples A and B in the upper left-hand corner. They have not been marked. Now look at the next pair of hands to the right. Under the words, Correct Test Booklet Marks, notice that each has been marked with a circle. Are they correctly marked? Yes, they are. A is a right hand and B is a left. Now go back and mark samples A and B correctly by putting a circle around each right answer.

The examiner should check to be sure that pupils are marking the samples correctly. If pupils ask about the correct answer sheet marks at the upper right-hand corner of the page, tell them to ignore them.

**SAY:** Now do as many as you can from 1 to 20. Ready, begin.

After 3 minutes,

**SAY:** Stop. Now turn the booklet over to Test 2.

**TEST 2**

Suggested time limit, 5 minutes

**SAY:** The directions for Test 2 are: In each row find the drawing that is a different view of the first drawing. Mark its number as you are told. Now look at the first drawing in row C. Look at all the other drawings in row C. The first drawing is among the other drawings in row C but it is in a different position or it is turned over. It is number 3, so a 3 should be written on the answer line to the right. Do it now. This is the way you will mark your answers. Now do as many as you can from 21 to 35. Ready, begin.

After 5 minutes,

**SAY:** Stop. Now turn the page and fold it back to Test 3.

**TEST 3**

Suggested time limit, 5 minutes

**SAY:** The directions for Test 3 are: The first three pictures in each row are alike in some way. Decide how they are alike, and then find the one picture among the four to the right of the dotted line that is most like them and mark its number.

Now look at the pictures in row D. In what way are the first three pictures alike? Yes, they are all pictures of things to wear. Now look along row D to the right and find a picture of something else to wear. Number 2, the sweater, is the right picture because it belongs with the other three things in the row. Therefore, a 2 should be written on the line to the right. Do it now. That is the way you will mark your answers. Now do as many as you can from 36 to 50. Ready, begin.

After 5 minutes,

**SAY:** Stop. Now turn the booklet over to Test 4.

**TEST 4**

Suggested time limit, 8 minutes

**SAY:** The directions for Test 4 are: Read each group of statements below and the conclusions which follow. Then mark as you are told the number of each answer you have decided is correct. When you finish page 5, turn it, fold it back, and continue on page 6. Now look at Sample E. If the sun shines it is day. The sun shines. Therefore, 1 It will not rain 2 It is day 3 The moon may shine tonight. The correct answer is No. 2: It is day.

Therefore, a 2 should be written on the line to the right. Do it now. Do all the others from 51 to 65 in the same way. Ready, begin.

After 8 minutes,

**SAY:** Stop. Now turn the booklet over to Test 5.

**TEST 5**

Suggested time limit, 6 minutes

**SAY:** The directions for Test 5 are: In each row of numbers below, there is one that does not belong. Find the number that should be omitted from each row among the answer numbers on the right and mark its letter as you are told.

Now look at Sample F which contains the numbers 2, 4, 6, 8, 9, 10, 12, 14. You will notice that if one number were taken out, each number would be 2 larger than the one before it. Which number is it? Yes, 9. The numbers should be 2, 4, 6, 8, 10, 12, 14. Notice that the number that does not belong, 9, appears among the answers to the right and that it has a small b in front of it. Therefore, a b should be written on the answer line to the right. Do it now. Do all the others from 66 to 75 in this same way.

After 6 minutes,

**SAY:** Stop. Now turn the page and fold it back to Test 6.

**TEST 6**

Suggested time limit, 10 minutes

**SAY:** The directions for Test 6 are: Work these problems on a sheet of scratch paper. Mark
as you are told the letter of each correct answer. When you have finished page 8, turn your test booklet over, and continue on page 9.

Look at Sample G and read the problem: There are 5 birds in a tree and 3 birds on a fence. How many birds are there in both places? The correct answer is 8 so the letter b should be written on the line to the right. Do it now. Do 76 through 90 in the same way. Ready, begin.

After 10 minutes,
SAY: Stop. Now turn the page and fold it back to Test 7.

TEST 7
Suggested time limit, 10 minutes
SAY: The directions for Test 7 are: Mark as you are told the number of the word which means the same or about the same as the first word. Look at Sample H. The first word is blossom. The word that means about the same is flower. Flower has a small 3 in front of it, so the number 3 should be written on the line to the right. Do it now. Now do the others from 91 to 140 in the same way. Ready, begin.

After 10 minutes,
SAY: Stop. Put your pencil down.

First collect all scratch paper, so that pupils will not carry away test items or other information which may tend to invalidate the test for further use with these pupils. The examiner should check by counting if necessary, to see that all scratch paper distributed has been returned.

Collect the test booklets and any pencils that have been distributed.

DIRECTIONS FOR ADMINISTRATION

when answers are marked on machine-scoring answer sheets or on the C.T.B. SCOREZE answer sheet

Suggested time allotment:
California Short-Form 49 minutes
Test of Mental Maturity (testing time only) (1950 S-Form)

Materials required:
For each pupil:
1 test booklet — California Short-Form Test of Mental Maturity (1950 S-Form)
1 machine-scoring answer sheet No. 1990, or C.T.B. SCOREZE answer sheet No. 100 (identifiable in the lower right-hand corner of page 1).
1 electrographic pencil with attached eraser (an ordinary pencil with attached eraser is adequate if answer sheets are not to be scored with an I.B.M. test-scoring machine).
1 sheet of scratch paper

In addition, for the examiner:
extra pencils
extra erasers
extra copy of test booklet — for demonstration purposes, if necessary
stop watch, or watch or wall clock with second hand.

First check to see that all pupils have pencils, erasers, and scratch paper.

From this point on, certain parts of these directions are printed in this different type face. These parts are to be read to pupils.

SAY: I am about to give you some answer sheets. Do not crease or fold them in any way. To do so might lower your mark if they are scored with an electrical test-scoring machine.

Next distribute the appropriate answer sheets, either (1) the machine-scoring answer sheet for the California Short-Form Test of Mental Maturity No. 1990; or (2) the C.T.B. SCOREZE answer sheet No. 100.

SAY: Look at the part of your answer sheet that has name, date, age, etc., printed on it. Write in the information that is called for. Caution: Press down firmly with your pencil when filling in this information.

Note the space set off by parentheses in the middle of the second line for identifying data. This space is provided for teachers or examiners who wish pupils to indicate their section, class, home room, etc., in order to facilitate handling of data and test booklets after tests have been scored.

The examiner should check to see that pupils have completed the identifying data properly.

Emphasize the next directions to pupils. Illustrate the routine for changing a mark on the blackboard.

SAY: The general directions for recording your answers on this answer sheet are: Mark on this answer sheet under the number or letter of the answer you have decided is correct. Make each mark as long as the pair of dotted lines and move the pencil up and down firmly to make a heavy black line. If you make a mistake or wish to change an answer, do it this way: FIRST MAKE AN X ACROSS THE WRONG ANSWER. THEN MAKE A HEAVY BLACK MARK FOR THE ANSWER THAT YOU THINK IS CORRECT. AFTER YOU HAVE MARKED THE NEW ANSWER, ERASE THE OLD ANSWER AND THE X COMPLETELY. ANY QUESTIONS?

NOTE: If pupils are unfamiliar with machine-scoring answer sheets and need practice, follow the directions below. However, if there is no doubt about their understanding the procedure, omit the directions between the horizontal lines.

SAY: Now find the box which has "For Practice Only" in it. You will do this test to learn how to mark your answers. Notice the first sentence, X. On which side of the road do people
drive? The correct answer is the right side. Now notice the two pairs of dotted lines to the right after the letter X. One has R above it for right and the other has L above it for left. Since R is the correct answer, make a black mark within the pair of dotted lines under the R. Do it now.

Check to see that pupils have filled in the dotted lines correctly. SAY: Now notice the next sentence. How many eyes do people have? Two is correct. What number does the word two have just in front of it? Four is correct. Now look at the pairs of dotted lines with 1, 2, 3, and 4 above them to the right. Since 4 is the correct answer, make a black mark within the pair of dotted lines under Number 4 to the right. Do it now. Are there any questions? Check to see that pupils understand.

SAY: I am now going to give each of you a copy of the test booklet. Do not write or mark on it in any way.

Distribute the California Short-Form Test of Mental Maturity, Elementary, face-up.

SAY: You will notice that at the bottom of the front cover of the test booklet which you have just been given, it says: Instructions to Pupils. Read these instructions silently while I read them aloud. The instructions are: This is a mental maturity test. In taking it you will show how well you understand relationships and what you do when you face new problems. No one is expected to do the whole test correctly but you should answer as many items as you can. Work as fast as you can without making mistakes. Do not write or mark on this test booklet unless told to do so by the examiner. I am telling you not to write or mark on this test booklet. You mark all your answers on the answer sheet.

Now open the test booklet to Test 1 and fold it back so that only the test shows.

Demonstrate. Be sure that pupils have Test 1 and that test booklets and answer sheets are conveniently arranged.

TEST 1
Suggested time limit, 4 minutes
SAY: Read the directions for Test 1 silently while I read them aloud. The directions are: Mark as you are told the letter, R, for each right hand or foot. Mark the letter, L, for each left hand or foot.

Look at the pictures of hands and feet. Under each picture is the letter R meaning right and the letter L meaning left. Now look at Samples A and B in the upper left-hand corner. They have not been marked. On the extreme right under the words, Correct Answer Sheet Marks, notice that a mark has been made under R for Sample A and that a mark has been made under L for Sample B.

Are these samples correctly marked? Yes. They are. A is a right hand and B is a left foot.

Now find Test 1 on your answer sheet and just to the left below it, answer rows A and B. Now mark the correct answers for Samples A and B on your answer sheet. Are there any questions about how to mark your answers?

After questions have been answered,
SAY: Now find answer row 1 on your answer sheet. Do as many as you can from 1 to 20. Ready begin.

After 4 minutes,
SAY: Stop. Now turn the booklet over to Test 2.

TEST 2
Suggested time limit, 6 minutes
SAY: The directions for Test 2 are: In each row find the drawing that is a different view of the first drawing. Mark its number as you are told.

Now look at the first drawing in row C. Look at all the other drawings in row C. The first drawing is among the other drawings in row C but it is in a different position or it is turned over. It is number 3.

Now find Test 2 on your answer sheet. The first answer row below it is C. Since the correct answer for Sample C is 3, make a black mark under the 3 in answer row C. Now do as many as you can from 21 to 35 in the same way. Ready, begin.

After 6 minutes,
SAY: Stop. Now turn the page and fold it back to Test 3.

TEST 3
Suggested time limit, 5 minutes
SAY: The directions for Test 3 are: The first three pictures in each row are alike in some way. Decide how they are alike, and then find the one picture among the four to the right of the dotted line that is most like them and mark its number. Look at the pictures in row D. In what way are the first three pictures alike? Yes, they are all pictures of things to wear. Now look along row D to the right and find the picture of something else to wear. Number 2, the sweater, is the right picture because it belongs with the other three things in the row.

Now find Test 3 in the arrow on your answer sheet and the first answer row opposite it which has the letter D in front of it. Since the correct answer for Sample D is number 2, make a black mark under the 2 in answer row D. Now do as many as you can from 36 to 50 in the same way. Ready begin.

After 5 minutes,
SAY: Stop. Now turn the booklet over to Test 4.

TEST 4
Suggested time limit, 8 minutes
SAY: The directions for Test 4 are: Read each group of statements below and the conclusion.
which follow. Then mark as you are told the
number of each answer you have decided is
correct. When you finish page 5, turn it,
fold it back, and continue on page 6.
Now look at Sample E. If the sun shines it
is day. The sun shines. Therefore, 1 It will
not rain 2 It is day 3 The moon may shine
tonight. The correct answer is: It is day.
Notice that the answer, It is day, has a small
2 in front of it.

Now find Test 4 on your answer sheet and
answer row E just below it. Since number 2
is the correct answer for Sample E, make a
black mark below the 2 in answer row E. Now
do as many as you can from 51 to 65 in the
same way. Ready, begin.

After 8 minutes,
Y: Stop. Now turn the booklet over to Test 5.

ST 5
Suggested time limit, 6 minutes
Y: The directions for Test 5 are: In each row
of numbers below there is one that does not
belong. Find the number that should be
omitted from each row among the answer
numbers on the right, and mark its letter as
you are told.

Now look at Sample F which contains the
numbers 2, 4, 6, 8, 9, 10, 12, 14. You will notice
that if one number were taken out, each num-
ber would be two larger than the one before it.
Which number is it? Yes, 9. The numbers
should be 2, 4, 6, 8, 10, 12, 14. Notice that the
number that does not belong, 9, appears
among the answers to the right and that it
has a small b in front of it.

Now find Test 5 on your answer sheet and
right below it answer row F. Since the correct
answer for Sample F is b, make a black line
under the b in answer row F. Do as many as
you can from 66 to 75 in the same way.
Ready, begin.

After 6 minutes,
Y: Stop. Now turn the page and fold it back
to Test 6.

ST 6
Suggested time limit, 10 minutes
Y: The directions for Test 6 are: Work these
problems on a sheet of scratch paper. Mark
as you are told the letter of each correct
answer. When you have finished page 8, turn
your booklet over and continue on page 9.

Look at Sample G and read the problem:
There are five birds in a tree and three birds
on a fence. How many birds are there in both
places? The correct answer is 8. Notice
that this correct answer, 8, has a small b in
front of it.

Now find Test 6 on your answer sheet and
right below it answer row G. Since the letter,
b, appears in front of the correct answer, 8,
make a black mark under the b in answer row
G. Do as many as you can from 76 to 90
in the same way. Ready, begin.

After 10 minutes,
SAY: Stop. Now turn the page and fold it back
to Test 7.

TEST 7
Suggested time limit, 10 minutes
SAY: The directions for Test 7 are: Mark as you
are told the number of the word that means
the same or about the same as the first word.
Look at Sample H. The first word is
blossom. The word that means about the
same is flower. Flower has a small 3 in front
of it.

Now find Test 7 on your answer sheet and
answer row H just below it. Since the correct
answer, flower, has a small 3 in front of it,
make a black mark under the 3 in answer
row H. Now do as many as you can from
91 to 140 in the same way. Ready, begin.

After 10 minutes,
SAY: Stop. Put your pencil down.

First collect all scratch paper, so that pupils
will not carry away test items or other information
which may tend to invalidate the test for further
use with these pupils. The examiner should
check by counting if necessary, to see that all
scratch paper distributed has been returned.

SAY: Now look at the test booklet. Did you make
any accidental dots or marks in it? If so, erase
them.

After sufficient time has elapsed,
SAY: Now hand in your test booklet.

Count the test booklets to be sure you have
the right number.

SAY: Now inspect your answer sheet. Are all your
marks heavy black lines? If not, go over the
light ones and blacken them well. Have you
made any accidental dots or marks? If so, erase
them. Are any of your erasures untidy?
If you changed any answers, did you erase
the wrong ones and the X's completely? Make
your answer sheet clean and neat.

After sufficient time has elapsed,
SAY: Now hand in your answer sheet.

Count the answer sheets to be sure that you
have the right number.

If you have given out electrographic pencils,
collect and count them next.
DIRECTIONS FOR SCORING

HAND SCORING THE TEST BOOKLETS

The examiner may use the key or mark an unused test booklet with the correct answers as an aid in scoring. It is advisable for the examiner to take the test without reference to the key since this procedure will acquaint him with the diagnostic values of the test. Instructions for scoring are:

1. Each item is considered right or wrong. No partial credits are given for partial answers.
2. Mark each correct item with a C.
3. The score for each section is the number right.
4. Credit any clear method of indicating the correct answer. Consider the intention of the pupil, if it can be determined. If in doubt, consider the answer wrong.
5. If two or more answers are given, count the item wrong, unless the pupil has attempted to erase or cross out the incorrect answer.

HAND SCORING THE ANSWER SHEETS

First examine each answer sheet. If two or more answers are given for any item, erase them and count that item wrong.

The score for each section of a test is obtained by counting the pupil response marks exposed by the round openings in the appropriate hand-scoring stencil superimposed upon the answer sheet. (When ordering, be sure to state whether you want hand-scoring or machine-scoring stencils.)

Record section scores on the special answer sheet in the spaces provided. The Diagnostic Profile is completed as directed on page 6.

MACHINE SCORING THE ANSWER SHEETS

First examine each answer sheet. If two or more answers are given for any item, erase them. Such an item is considered to be wrong.

Directions for setting the machine are printed on the machine-scoring stencil. However, note that most scores need not be written and mental ages need not be looked up in the manual.

The raw scores for Language Factors, Non-Language Factors and Total Mental Factors need only be circled and their corresponding mental ages are given below them in the fourth line. Thus a Language Factor score of 36 yields a Mental Age of 137 months. A Non-Language Factor score of 48 yields a Mental Age of 1 months.

Each entry in the fifth line presents the intelligence grade placement equivalent of the fourth entries directly above it.

This device greatly reduces the scoring time required for ordinary machine-scoring answer sheets.

SCORING THE C. T. B. SCOREZE ANSWER SHEET

The first page may be hand or machine scored like any machine-scoring answer sheet.

The third, or teacher’s page, is self-scoring.

RECORDING THE SCORES FROM THE C.T. SCOREZE ANSWER SHEET

1. First insert a letter opener or other pointed object at the word, open, on the margin of the answer sheet, and unseal the side in the direction indicated by the arrow. (Do not tear the two sheets apart at this perforation at this time.) Remove the carbon sheet.
2. On page 3 count the number of marks which fall within the light circles for each section of the test and enter each score in the place provided at the left by the pupil’s name. Be sure to count as wrong any item for which an X or a smudge appears in a light circle (which shows that the pupil did not intend it to be a choice for the answer).
3. If a profile is desired on the back of the machine-scoring answer sheet (for possible use in principals’ or administrators’ offices as well as on page 4, replace the carbon that it will register on page 2 and fold page 3 back over it. (If only one profile is desired, dispose of the carbon, tear the machine-scoring part of the answer sheet from the other half, and proceed with step 4.)
4. Turn to the Diagnostic Profile on page...
5. Bend the right-hand margin of the sheet over to the left so that the entries just made (as instructed in item 2 above) are visible and align them with the respective entry blanks on the profile.

6. Copy these numbers in the appropriate places on the Diagnostic Profile.

7. Complete the profile.

8. Tear the machine-scoring part of the answer sheet from the other half. (If only one profile is being made, this step has already been completed.)

ORMS

The original standardization of each level of the California Short-Form Test of Mental Maturity as based on 25,000 cases for which control data from other standardized tests were available. Since that time these norms have been checked against over 100,000 additional cases for many of which control data were available. Only a few minor adjustments had to be made as a result of these checks.

In their final form the norms for the California Short-Form Test of Mental Maturity, Elementary, have been based on a controlled (stratified) sampling of over 125,000 cases which instituted a normal distribution of mental ability, chronological age-grade relationships, and other characteristics as follows:

1. The median I.Q. for grades 4 to 8 was 100. The standard deviation of I.Q.'s was 16 points.
2. Seventy per cent of the pupils were making normal progress through the grades; about 20 per cent were retarded one-half year or more; and 10 per cent were accelerated one-half year or more.
3. About 85 per cent of the population was Caucasian and the remainder was Mexican, Negro and other minority groups.

MENTAL AGE AND INTELLIGENCE

GRADE PLACEMENT NOlMS

These norms represent the average (median at scores) of the standardization population described above. In using the mental age norms, the examiner simply locates the particular score which the pupil obtained in Total Mental Factors, Language Factors, or Non-Language Factors in the columns on page 20 of this manual and then notes the corresponding numbers in the Mental Age columns. Age and/or grade norms are possible the interpretation of the pupil's score by relating it to the average (median) mental ability of a large group.

PERCENTILE NORMS

Percentile norms provide a means for making comparisons between pupils in the same age groups. If a pupil obtains a percentile rank of above 75% it indicates that he surpasses 25% and is passed by 75% of the pupils of that group.

In using the tables of percentile norms on pages 1, 18, and 19 for scores of various mental factors, the examiner first locates the table for the pupil's exact chronological age. Thus a pupil with a chronological age between 132 and 143 months has obtained a score of 28 on Spatial Relationships has obtained a percentile rank of 70; a pupil of the same age who has made a score of between 95 and 101 on Total Mental Factors has a percentile rank of 80.

For convenience in interpretation, all scores above 70 are assigned to all those which are located between percentile points 65.0 to 74.9.

PERCENTILE RANKS OF I.Q.'S FOR VARIOUS POPULATIONS

In addition to the percentile norms for the chronological age groups normally found at the elementary level, percentile ranks of I.Q.'s for various populations are also presented on the right-hand side of page 19. Once a pupil's Total Mental Factors I.Q., Language Factors I.Q., and Non-Language Factors I.Q. are known, such a pupil may be compared with any of the populations included in the table, beginning with Normal Population, Ninth Graders, any other group up to College Graduates, by locating his I.Q.'s in the appropriate group and then reading his percentile rank from the percentile scale on the lefthand side of the page. Thus a pupil with a Total Mental Factors, Language Factors, or Non-Language Factors I.Q. of 105 would be at the 60th percentile when compared with 9th graders, at the 40th percentile when compared with college freshmen, and the 5th percentile when compared with college graduates.

DIFFERENCES IN ACHIEVEMENT TO BE EXPECTED OF GROUPS WITH VARYING MEDIAN INTELLIGENCE QUOTIENTS

The average achievement of various schools and classroom groups in fundamental learning skills as measured by the California Achievement Test Series should be evaluated in relation to average intelligence quotients of the groups. For this reason a table on achievement test data in relation to I.Q. medians, based on over 100 school surveys, is presented.

The tabulation on page 16 shows what variation in median achievement may be expected above and below the test norms for class or grade groups possessing various median intelligence quotients.

Median achievement variations from the norms are shown in fractions of a year above (+) and below (-) the test norms for pupils of average ability.

Thus a fifth grade class with a median I.Q. of 105 should be expected to obtain a median score in reading one-half year above norm; a seventh grade class with a median I.Q. of 89 may be expected to fall about three-fourths of a year below norm in arithmetic.
### Differences in Achievement to Be Expected of Groups with Varying Median Intelligence Quotients

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**Note:** The table above summarizes the expected differences in achievement across various IQ percentile ranks for reading, arithmetic, and language skills.
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**PERCENTILE**

**SPATIAL RELATIONSHIPS**

**LOGICAL REASONING**

**NUMERICAL REASONING**

**VERBAL CONCEPTS**

**TOTAL MENTAL FACTORS**

**LANGUAGE FACTORS**

**NON-LANGUAGE FACTORS**

**SPATIAL RELATIONSHIPS**

**LOGICAL REASONING**

**NUMERICAL REASONING**

**VERBAL CONCEPTS**

**TOTAL MENTAL FACTORS**

**LANGUAGE FACTORS**

**NON-LANGUAGE FACTORS**

**SPATIAL RELATIONSHIP**

**LOGICAL REASONING**

**NUMERICAL REASONING**

**VERBAL CONCEPTS**

**TOTAL MENTAL FACTORS**

**LANGUAGE FACTORS**

**NON-LANGUAGE FACTORS**
## California Short-Form Test of Mental Maturity - Elementary - '50 S-Form

### Percentile Norms

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<th>AGE 12-0 to 12-11 (144 to 155 Months)</th>
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*Notes:*
- Age 14-11: 1 year to 11 months
- Age 15-19: 16 years to 19 years
- Normal Population: (N=100,000
- Ninth Grade I.Q.’s: (N=25,000)
- Tenth Grade I.Q.’s: (N=25,000)
- Eleventh Grade I.Q.’s: (N=25,000)
- Twelfth Grade I.Q.’s: (N=25,000)
- Coll. Freshman I.Q.’s: (N=15,000)
- Coll. Sophomore I.Q.’s: (N=1,000)
- Coll. Graduate I.Q.’s: (N=2,000)
## MENTAL AGE AND INTELLIGENCE GRADE PLACEMENT NORMS

### CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

#### ELEMENTARY—'50 S-FORM

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* Intelligence Grade Placements established from median mental ages of respective actual grade placements.

** Indicates college graduate percentile rank.