An evaluation of the effect of illustrations on comprehension in the fifth and sixth grades

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SCHOOL OF EDUCATION

AN EVALUATION OF THE EFFECT
OF ILLUSTRATIONS ON COMPREHENSION
IN THE FIFTH AND SIXTH GRADES

Submitted by
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INTRODUCTION

The following study is an effort to discover to what extent illustrations affect the reader's comprehension of written matter.

In recent years there has been a growing concern as to the effectiveness of the illustrations in children's books. Previous to this period of concern, it was an accepted supposition that a book containing illustrations was more meaningful to children than a book that lacked illustrations. Education has entered an era of finding out by experimentation, and is gradually emerging from an era of supposition into one of research. Considerable research has been carried on in the field of illustrations, particularly in regard to the types of illustrations that children prefer. The results of these studies have been and will continue to be most helpful to both illustrators and publishers.

Until it is known what types of illustrations are preferred by most children, it is not possible to determine effectively to what degree the illustrations influence the comprehension of the written material that they accompany. It is logical to reason that children will give more attention to the illustrations in their books if they are illustrations which appeal to them and hold their interest than if they do not attract their attention nor appeal to their interests. It necessarily follows that illustrations that hold the interest of children will have a greater effect upon their comprehension than those
which do not. It is highly important then, that the first consideration in illustrating be to discover what children prefer. After that is determined, it will be possible to study the effect of illustrations upon comprehension. Therefore, the purpose of this study is to determine the effect of illustrations in factual material on the reader's comprehension at the fifth and sixth grade levels.
CHAPTER I

SUMMARY OF PREVIOUS RESEARCH

Most of the research carried on to determine children's preferences in illustrations has been concerned especially with pre-school age picture books and primary readers. Less has been discovered concerning the preferences of children at the intermediate grade level.

Jean Ayer\(^1\) working with youngsters at the nursery school and primary grade level found that children preferred:

1. Large pictures and those that add to his understanding of the book.
2. Characters and inanimate objects that look as he thinks they should look.
3. In the nursery school and first grade, factual pictures of familiar every-day things.
4. In the second and third grade, elves, fairies and other fanciful creatures.
5. Realistic type of illustration to the stylized or decorative.
6. Large easily distinguishable objects with the important figures centered.
7. In black and white drawings those with some shading to outline drawings.
8. Especially pictures that show action and suggest a story.
9. Pictures of animals.
10. Humorous pictures. (The child's idea of humor is often different from the adult's.)
11. Many colors to only two or three.

---
\(^1\) Jean Ayer, "Format and Reading Appreciation," Elementary English Review, 17:213-17, October, 1940.
Another study concerned with what children prefer in illustrations was carried on by Bamberger\(^1\) at Johns Hopkins University. She discovered that children prefer:

1. Illustrations in which the colors are bright, highly saturated and fairly intense.
2. Action and humor.
3. Illustrations that suggest stories.
4. Few details.
5. Full page pictures to pictorial insertions.
6. Median size four and one-half inches long by four inches wide.
7. Blue, red and yellow—especially blue.

With reference to the importance of using pictures which appeal to children one writer has said, "... if they (pictures) do not attract the child they will not influence him, unless it be negatively."\(^2\) The same writer\(^3\) reports that children indicate the following likes and dislikes in illustrations.

1. Prefer color.
2. Like a broad simple treatment either in color or in black and white.
3. Those above two years old like detail.
4. Poster style appeals.
5. Do not care for decorative illustrations.
6. Want action. Like to see things go.
7. The picture must tell a story and one that child can appreciate.

---


\(^3\) Ibid., Chapter IX, 140-153.
Mr. Field concludes his study with the warning that it is better to have no pictures at all than to have wrong ones.¹

Freeman and Freeman² in their study of the preferences of nursery children found that the pictures that these youngsters preferred contained:

1. Story-telling qualities.
2. Familiar subject matter.
3. Somewhat crude and elementary coloring.

These writers feel that only by an individual method of testing can true picture preferences be obtained.³ Again making reference to the prevalent practice of letting adults choose illustrations for children's books, Freeman and Freeman say, "... Many picture books seem to have been constructed for the amusement of over imaginative and sentimental adults rather than for children."⁴

¹ Ibid., p. 150.
³ Ibid., p. 37.
⁴ Ibid., p. 59.
Gardner and Ramsey\(^1\) discovered many of the same preferences in their study. They found that the youngest children like:

1. Story-telling pictures of other children at work and play.
2. Phases of human life that lie within the range of their experience.
3. Above all domestic animals--either at work or play.
4. Pictures trying to depict humor by showing the discomfort of persons or animals may arouse laughter but suggest negative virtues.

Making a study of 821 children in grades one, three, and five for the purpose of discovering whether children preferred colored illustrations or black and white and whether they preferred a conventionalized style or a presentation or the subject as it really is (realistic), Mellinger\(^2\) found that:

1. Children have decided preferences.
2. Prefer color to black and white.
3. Prefer realistic to conventionalized style.

Miller\(^3\) also discovered that children have decided preferences among them:

1. Preference for photographs increased in higher grades.
2. Boys registered more preferences for photographs than girls.

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2 Bonnie E. Mellinger, \emph{Children's Interests In Pictures} (Teachers College Contributions to Education, No. 516. New York: Teachers College, Columbia University, 1932).

3. Preference for photograph increased as mental age increased.
4. Red was preferred to blue.
5. Lower intelligence quotients chose red and blue more often than higher intelligence quotients.

Such information as this study gives, enables publishers to know more about the type of illustrations they can expect children in special classes to enjoy.

Findings similar to those reported by the writers mentioned are spoken of by Newton\(^1\) in his study of the trends in book illustrations. He found that pictures have an almost purely objective interest for the child. He found also that:

1. Story-telling quality of pictures appeals to children.
2. Trend is toward simplification.
3. Strong vivid colors are liked.
4. Vivacity and humor are enjoyed.
5. Picture must be understandable to all.
6. Aesthetic qualities of line, color and form are a matter of education and development.

McKissock\(^2\) also interested in noting the tendencies in the illustrating of children's books, making a random selection from three hundred books on the children's list at the Carnegie Library of Pittsburgh, studied the types of illustrations contained and compared the various processes of reproducing employed.


She discovered that although children have been found to not prefer the conventionalized type of illustration¹ most of the illustrators of these books used the conventionalized type of illustration.

It is interesting to note what one of the most famous illustrators of children's books has to say concerning illustrations. Often illustrators are criticized by persons not of the profession for producing pictures that appeal to them and to other adults without striving primarily to produce that type of picture which the children who will be their audience will enjoy most. It is, therefore, refreshing to hear what Maud Petersham² has to say concerning her work and that of her husband, both of whom are noted illustrators of children's books. Speaking for her husband and herself, she has said:

In some ways we do not much care whether grown-ups like our pictures or not; but we do care whether children like them. The highest compliment we can have is to hold some child's happy interest and attention with one of our pictures.³

The studies investigated above would seem to indicate that there is a decided trend toward making the illustrations in children's books the type of illustrations that appeal to most children and are enjoyed most by children. This trend should

¹ Ayer, op. cit.
³ Ibid., p. 85.
increase the usefulness of illustrations, make them more meaningful, and, as a result, written material should be so enhanced that comprehension of the material read will be increased. This is a problem about which relatively little has actually been made known by experimentation.

Relatively few studies have been concerned with the problem undertaken in this study, that of determining the effect that illustrations have on the comprehension of material read. Since the trend in education is toward teaching for understanding and since illustrations occupy such a large amount of the space in the books in all schools, it seems pertinent to discover whether or not this space and the great expense involved on the part of publishers are warranted. Understandings must be taught through knowledge of facts and it would seem logical that facts could be made more meaningful by the use of illustrations. This again, however, is an adult opinion.

It is not only children who are prone to get incorrect or insufficient understandings from the printed page. Military authorities have used visual aids in training programs in all branches of the armed services.¹ There, as in the schools, the stress is toward teaching for understanding. Military authorities responsible for the training of men in the armed forces subscribe to Halbert's theory: "Seeing in a major degree is understanding."²

² Ibid., p. 43.
Those studies that have undertaken to discover whether or not illustrations aid comprehension have been carried out almost entirely in the primary grades, especially in grade one. The written matter in primary grade readers is usually within the experience of the child. It does not, therefore, require pictures to clarify the meaning for most of the children. At this age level, however, the motivation and enjoyment provided by pictures is no doubt extremely valuable and necessary.

Miller\(^1\) carried on a study with primary grade children which showed that children who read without pictures understood what they read as well as did children who read the same material with the aid of pictures. The writer indicated that this did not measure interest, enjoyment, or appreciation in the artistic sense.

In a previous study,\(^2\) the same writer believes the five following reasons may be responsible for the failure of pictures to contribute more to the understanding of the text.

1. Children do not read pictures accurately.
2. Verbalism may exist in picture reading as well as in printed material.
3. Children may get only general impressions if they have had no training in reading pictures.
4. Some children get erroneous meanings from pictures because of limited experiences.
5. Pictures are not always focused on the parts of the reading matter most difficult to understand.


In conclusion he says:

It is possible that in the matter of illustration we have used adult standards in judging what we call the interests of children without distinguishing between the appeal of brightly colored pictures and the appeal of well-written story material that has intrinsic worth.\(^1\)

It is interesting to note that previous to either of these studies, Miller\(^2\) in an unpublished study in 1935 asked one hundred teachers if they thought children could learn to read by means of a book without illustrations and the answer was invariably "No." His later study\(^3\) disproved this supposition which once again brings to the fore the possibility of a wide variance in what adults (even teachers) suppose to be true of children and what children themselves indicate.

There are some writers who thoroughly disapprove of illustrating books for children. Their main criticism is the impossibility of coordinating the mental imagery of the three persons involved, the person who writes the story, the person who does the illustrations, and the child. One of the persons particularly opposed to illustrating children's books is Peppino Mangravite. She has said that young children see the world in one dimensional plane because of their lack of experience with

\(^1\) Ibid., p. 263.


things. To substantiate her disapproval, the writer has said, "It is because of my belief in the true creative vision of children that I disapprove of illustrated children's books."2

Denault3 was also concerned with the effect of illustrations on mental imagery and made a study of sixty-four children in grade four. Four stories were presented in rotation—two illustrated and two not illustrated. She discovered that the differences in mental imagery between the illustrated and unillustrated stories were not statistically significant nor were the differences in the amount of retention.

Halbert4 made an experimental study of children's understanding by evaluating three elementary school readers, prepared for rural school children in terms of the effectiveness of illustrations and general adaptability to the children's experience. She discovered that children get more relevant ideas from a story with pictures than from a story alone or pictures alone, contrary to the findings of Miller.5 Halbert drew the

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2 Ibid., p. 124.
5 Miller, "Reading With and Without Pictures," op. cit.
conclusion that to the extent that memory for ideas is a measure of comprehension pictures contribute to the comprehension of reading materials.

In an attempt to determine what one hundred children in grade three saw in six pictures without the suggestion or stimulation provided by any definite direction or guidance, Miller\textsuperscript{1} carried on another study. He discovered that:

1. Children reported seeing relatively few items possible.
2. The items of a picture are seen in isolation rather than in parts of a whole.
3. The most important items in a picture often escape the notice of the children.
4. Children with higher intelligence quotients tend to identify more items in pictures than do children with lower intelligence quotients.
5. In grade three chronological age is not important for identification of items in pictures.
6. There are no significant sex differences in ability to identify items in pictures.

Mr. Miller added that if pictures are to be an aid to the understanding of printed material, teachers will need to direct the child's attention to the important items in the picture and develop an interpretation of these items.

Because this study is specifically concerned with comprehension, the following statements by Gray\textsuperscript{2} in regard to


comprehension in general are pertinent:

In the act of reading one cannot always rely on the meanings which he has previously attached to specific words. This is due to the fact that they are often used by the writer in a new or different sense. As a result, the reader must search for the specific meanings implied by the words read. Often the reader must make use of glossaries, dictionaries, encyclopedias, textbooks, and even periodicals, radio broadcasts, pictures, or direct contact with reality in an effort to discover appropriate meanings.

According to Gray, then, if pictures are to serve the purpose for which they are intended they should clarify the meaning of the written matter. This study hopes to discover to what degree that is true. Zisman\(^1\) who is concerned with improving illustrative material in textbooks says, "Illustrations should be the means of making more concrete whatever may be difficult or elusive in comprehension because of abstraction or vagueness."

Textbook illustrations should be meaningful enough to enrich and supplement the written material. This, of course, implies the selection of appropriate illustrations that have direct connection with the subject matter.\(^3\) In geography it is vitally important that new understandings be developed and that concepts are enriched in geography textbooks. Pictures account


\(^{2}\) Ibid., p. 219.

from twenty to twenty-five per cent of the content of a
geography textbook.\textsuperscript{1} Reporting on an experiment conducted in
seven different classes in grades six through eight using 294
children, Goodykoontz\textsuperscript{2} found that most illustrations in geogra-
phy books have little or no relation to the organization of the
textual material. The results of this study caused the writer
to conclude that although pictures undoubtedly provide vicarious
experience which adds to the understanding of the textual mate-
rial, further evidence is necessary in order to help authors
and publishers in the selection and arrangement of pictures and
to aid teachers in educating children to use pictures effec-
tively.\textsuperscript{3}

Since geography is a subject in which many new under-
standings must be developed and in which many words with new
meanings are introduced, pictures "constitute the basic labora-
tory material" in teaching this subject.\textsuperscript{4} Hunter\textsuperscript{5} has noted
that some reading books, especially geography and history books,

\begin{itemize}
  \item Irving R. Melbo and Ivan R. Waterman, "Pictures In Our
  Geography Textbooks," \textit{Elementary School Journal}, 36:362-76,
  January, 1936.
  \item Bess Goodykoontz, "Relation of Pictures to Reading Com-
  \item Ibid.
  \item E. P. Parker, "Pictures As Laboratory Material in Geog-
  \item Maude W. Hunter, "Reading To Understand," \textit{Instructor},
  53:23, April, 1944.
\end{itemize}
have, on a single page, a dozen words that are meaningless to the child.\(^1\) She adds, "It isn't that the words themselves are too difficult but rather that the child is unfamiliar with their meaning."\(^2\)

It may be that geography material can be made more meaningful by an increased use of pictures and a reduction of written matter. The trend seems to be toward this. Williams\(^3\) has suggested that eventually the trend may be to have illustrations the core of the book and written material an amplification of the illustrations in contrast to the present practice of using illustrations to amplify and supplement the written matter. The Building America series is an example of this trend already in practice. Dalgliesh\(^4\) feels that this is an important step toward increasing the usefulness of informational books. She believes that in many cases, the text could be reduced fifty per cent to the improvement of the book. Concerning this matter she has written, "I don't believe we have as yet scratched the surface of the possibilities of the informational book that is full of pictures with only a little text."\(^5\)

\(^1\) Ibid., p. 23.
\(^2\) Loc. cit.
\(^3\) P. T. Williams, "Textbooks Need Better Pictures," Nation's School, 33:50 June, 1944.
\(^5\) Ibid., p. 66.
There is so much concern as to the effectiveness of illustrations and so little actual information on the subject that this particular study has been set up for the express purpose of trying to determine to what extent, if any, illustrations affect the comprehension of factual material read by fifth and sixth grade pupils.
CHAPTER II

PLAN OF THE EXPERIMENT

No one seems to question the role that illustrations play in adding interest and enjoyment to reading. The question is concerned with the extent to which illustrations affect understanding of the written material. Publishers spend large sums of money each year illustrating textbooks; it is important for them to know whether or not illustrations are serving the purpose for which they are intended, that of enhancing the story and making it more meaningful. It is the purpose of this study to determine to what extent illustrations do affect the understanding of material read.

In setting up this experiment, it was necessary:

1. To decide upon the best way to secure the desired information.
2. To decide the population to be used.
3. To secure the cooperation of a school where the experiment could be carried out.

Since social studies material involves the development of many new understandings and requires the learning of many new facts which can be easily illustrated, it was decided that the four stories used should be concerned with some phase of social studies material. Many intermediate grade social studies books were investigated in a search for suitable stories. The writer finally chose the following stories. A story about the Panama Canal was selected from Our Country by Heebe, Hanna, McClure published by Laidlaw and Company. The second story included in
each booklet was entitled "The Weatherman and His Work." This story was taken from the Unit Study Book No. 551, *Weather*, by A. Eleanor Thomas. The third story, about the Sequoia trees of California, was taken from *Stories In Trees* written by Mary I. Curtis and published by Lyons and Carnahan. This story is called "A Giant Forest." The fourth and last story was an original story by the writer. It was given the title "Sailing." Each story was concerned with a different area in the social studies field and an attempt was made to select topics which would be of interest to the children as well as unfamiliar to them.

These four stories were united in booklet form. In this form the booklets could be easily distributed to children without loose pages being lost. Two forms of the booklet were prepared, Form A and Form B. Each of the four stories was presented in two forms, one with illustrations, the other without illustrations. The same stories were used in both booklets.¹

A plan of rotation was arranged in order to equate the stories for difficulty. The stories were incorporated in two booklets called Form A and Form B of the experiment. In Form A, the first story, "The Panama Canal," and the third story, "A Giant Forest," were illustrated while the second story, "The Weatherman and His Work," and the fourth story, "Sailing," were

¹ Copy of Form A and Form B of the experiment may be found in the Appendix.
not illustrated. In Form B the first story, "The Panama Canal," and the third story, "A Giant Forest," were not illustrated while the second story, "The Weatherman and His Work," and the fourth story, "Sailing," were illustrated.

The illustrations were black and white line drawings done by the writer. An endeavor was made to illustrate those portions of the story which contained statements or concepts which might not otherwise be made perfectly clear in the text. For example, in the story, "Sailing," is found the following statement: "The edge of the sail which is attached to the mast is known as the luff while the leech is the outside edge of the sail." In order to make this statement more meaningful, a diagram of a sail was drawn with the two parts, luff and leech, indicated.

Directly following each story in the booklet was a comprehension check. Multiple choice, matching, completion and diagram methods of checking comprehension were used.

An example of the multiple choice checks used follows:

The United States realized the great value of a canal across the Isthmus of Panama when:

1. Balboa crossed the Isthmus and discovered the Pacific Ocean.
2. Theodore Roosevelt paid the French company forty million dollars.

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1 See Appendix: Form A "Sailing" p. 2, Form B "Sailing" p. 2.
2 See Appendix: Form A or Form B of the experiment. Comprehension check following story "The Panama Canal."
3. The Spanish began to talk about digging a canal.
4. In the Spanish War one of our battleships had to go around South America.
5. Panama became an independent republic.

Matching questions found in "The Weatherman and His Work" are:

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Barometer</td>
<td>( ) measures speed and direction of wind</td>
</tr>
<tr>
<td>2. Hygrometer</td>
<td>( ) tells force and speed of wind</td>
</tr>
<tr>
<td>3. Thermometer</td>
<td>( ) tells which way the wind is blowing</td>
</tr>
<tr>
<td>4. Anemometer</td>
<td>( ) tells the pressure or weight of air</td>
</tr>
<tr>
<td>5. Barograph</td>
<td>( ) tells how much moisture is in the air</td>
</tr>
<tr>
<td>6. Balloons</td>
<td>( ) the height of the clouds</td>
</tr>
<tr>
<td>7. Special gauges</td>
<td>( ) traces a record of changes in weather</td>
</tr>
<tr>
<td>8. Weather vane</td>
<td>( ) tells temperature of the air</td>
</tr>
<tr>
<td>9. Ceiling limits</td>
<td>( ) show how much snow or rain has fallen</td>
</tr>
</tbody>
</table>

A sample of the completion type question found in the story "A Giant Forest" is:

The largest of these trees is called the ______ tree.

For the story "Sailing" a diagram type of comprehension check was used. A diagram of a sailboat was made with parts numbered. Below were listed the names of the various parts with

---

1 See Appendix: Form A and Form B of the experiment. Comprehension check following story "The Weatherman and His Work."

2 See Appendix: Form A and Form B of the experiment. Comprehension check following story "A Giant Forest."
the position on the diagram to be indicated by numbers.¹

Most of the studies concerned with this particular problem have been carried out in the primary grades. Therefore, it was decided to gather information from children at a higher grade level. Pupils in grades five and six in a nearby school system were used. There were two fifth grades and two sixth grades in the same school building. All of the pupils in these four rooms who were present at school were included in the experiment. Not any were excluded because of reading difficulty or for any other reason. It was a heterogeneous group and not a selected population.

The experiment required three days. The first day the booklets were distributed to the pupils in alternation, one child receiving Form A of the booklet, the next child Form B etc. in this manner until each child had a booklet. Instructions were given to fill in the information requested on the front page. It was explained that the booklets contained four stories each having questions after it. The first two stories were to be read the first day and the questions following them were to be answered. At no time during the experiment was attention directed to the illustrations. No time limit was set. As soon as the booklets were distributed and the instructions given, the examiner proceeded to another classroom and continued in the same

¹ See Appendix: Form A and Form B of the experiment. Comprehension check following story "Sailing."
manner. Booklets were collected by the teacher and kept in the room until the examiner returned on the following day.

On the second day of the experiment, before the booklets were distributed, a retention check was given on the two stories read the previous day. The same comprehension checks which were included in the booklet were used for the retention check. Following this the booklets were distributed and instructions given to read the third and fourth stories answering the questions at the end of each. On the third, and last day of the experiment, retention checks were given on the third and fourth stories which had been read the previous day. This concluded the work with the pupils.

Booklets were distributed to 113 pupils on the first day of the experiment. Due to absences on the second and third days of the experiment, and due to inability to secure intelligence quotients on several pupils, the total number of pupils used in analyzing the data was 103.

All booklets and retention checks were given and scored by the writer.
CHAPTER III

ANALYSIS OF DATA

The data were analyzed to study the effect of illustrations on comprehension in factual material in the fifth and sixth grades on:

1. The comprehension and retention scores of the total population.

2. The comprehension and retention scores according to intelligence level.
A. COMPARISON OF SCORES ON TOTAL POPULATION
1. Original comprehension scores
2. Retention scores

B. COMPARISON OF MATERIAL ACCORDING TO INTELLIGENCE LEVELS
1. Comprehension Superior Group
2. Retention Superior Group
3. Comprehension Average Group
4. Retention Average Group

TABLE I shows the comparison of Story I illustrated and non-illustrated.

TABLE I
Comparison of Scores on Story I

<table>
<thead>
<tr>
<th>Material</th>
<th>'Number'</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
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<td>Illus.</td>
<td>52</td>
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<td>2.97</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>51</td>
<td>7.46</td>
<td>2.16</td>
<td>.41</td>
<td>.81</td>
<td>.51</td>
<td>1.60</td>
</tr>
</tbody>
</table>

The mean score of the illustrated stories was 8.00 compared to 7.46 for the non-illustrated stories. The critical ratio of 1.6 showed the difference not to be statistically significant. Chances are 94 in 100 that this is a true difference in favor of the illustrated.
TABLE II shows the comparison of Story II illustrated and non-illustrated.

**TABLE II**

Comparison of Scores on Story II

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>51</td>
<td>13.76</td>
<td>5.26</td>
<td>.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>52</td>
<td>14.23</td>
<td>5.70</td>
<td>.80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated was 13.76 as compared to 14.23 for the non-illustrated. The critical ratio of .58 indicated no significant difference. The chances are 73 in 100 that this is a true difference in favor of the non-illustrated.

TABLE III shows the comparison of Story III illustrated and non-illustrated.

**TABLE III**

Comparison of Scores on Story III

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>52</td>
<td>8.90</td>
<td>2.58</td>
<td>.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>51</td>
<td>8.38</td>
<td>2.87</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The mean score of the illustrated in Story III was 8.9 compared to 8.88 for the non-illustrated. The critical ratio of .04 is not significant. The chances are 71 in 100 that this is a true difference in favor of the illustrated.

TABLE IV shows the comparison of Story IV illustrated and non-illustrated.

**TABLE IV**

Comparison of Scores on Story IV

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff. S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>51</td>
<td>7.68</td>
<td>3.32</td>
<td>.46</td>
<td>1.13</td>
<td>.57</td>
</tr>
<tr>
<td>Non-Illus</td>
<td>52</td>
<td>6.55</td>
<td>2.52</td>
<td>.35</td>
<td>1.00</td>
<td>.57</td>
</tr>
</tbody>
</table>

The mean score of the illustrated was 7.68 compared to 6.55 with the non-illustrated. A critical ratio of 1.98 showed no significant difference. Chances are 98 in 100 that this is a true difference in favor of the illustrated.
2. Comparison of Retention Scores

TABLE V shows the comparison of retention in Story I illustrated and non-illustrated.

**TABLE V**

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>52</td>
<td>6.09</td>
<td>2.35</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>51</td>
<td>7.81</td>
<td>1.97</td>
<td>.27</td>
<td>1.72</td>
<td>.42</td>
<td>4.09</td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 6.09 compared to 7.81 for the non-illustrated. The critical ratio of 4.09 shows this difference to be statistically significant. The difference is in favor of the non-illustrated.

TABLE VI shows the comparison of retention in Story II illustrated and non-illustrated.
### TABLE VI

Comparison of Retention Scores Story II

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>51</td>
<td>13.87</td>
<td>1.82</td>
<td>.25</td>
<td>.06</td>
<td>.36</td>
<td>.16</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>52</td>
<td>13.93</td>
<td>1.98</td>
<td>.27</td>
<td>.08</td>
<td>.51</td>
<td>.15</td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 13.87 compared to 13.93 for the non-illustrated. A critical ratio of .16 shows no significant difference.

### TABLE VII

Comparison of Retention Scores Story III

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>52</td>
<td>9.12</td>
<td>2.36</td>
<td>.33</td>
<td>.08</td>
<td>.51</td>
<td>.15</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>51</td>
<td>9.04</td>
<td>2.62</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 9.12 compared to 9.04 for the non-illustrated. A critical ratio of .15 shows no significant difference.
TABLE VIII shows the comparison of retention in Story IV illustrated and non-illustrated.

TABLE VIII
Comparison of Retention Scores Story IV

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>51</td>
<td>7.42</td>
<td>3.43</td>
<td>.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>52</td>
<td>6.26</td>
<td>3.90</td>
<td>.55</td>
<td>1.16</td>
<td>.74</td>
<td>1.56</td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 7.42 compared to 6.26 for the non-illustrated. The critical ratio of 1.56 shows the difference not to be statistically significant. There are 94 chances in 100 that this is a true difference in favor of the illustrated story.

B. COMPARISON OF MATERIAL ACCORDING TO INTELLIGENCE LEVELS

The population was divided according to intelligence levels into two groups. Children with Intelligence Quotients above 110 were considered in the superior group. The range was from 110 to 132. Those with Intelligence Quotients from 90 to 110 were considered in the average group. Those with Intelligence Quotients below 90 were not considered. There were only five of these. One child was eliminated who had an Intelligence Quotient of 156. All Intelligence Quotients were obtained from
records available at the school where the experiment was carried out.

1. Comprehension Superior Group

TABLE IX shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story I.

TABLE IX

Comparison of Scores Story I Superior Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>22</td>
<td>8.00</td>
<td>2.59</td>
<td>.55</td>
<td>.05</td>
<td>.65</td>
<td>.08</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>21</td>
<td>8.05</td>
<td>1.73</td>
<td>.37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 8.00 compared to 8.05 for the non-illustrated. The critical ratio of .08 shows the difference not to be statistically significant. There are 54 chances in 100 that this is a true difference in favor of the non-illustrated.
TABLE X shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story II.

TABLE X

Comparison of Scores Story II Superior Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical</th>
<th>M.</th>
<th>M. Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>21</td>
<td>15.86</td>
<td>4.47</td>
<td>.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>22</td>
<td>15.87</td>
<td>5.65</td>
<td>1.20</td>
<td>.01</td>
<td>1.54</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 15.86 compared to 15.87 of the non-illustrated. The critical ratio of .01 shows the difference not to be statistically significant.

TABLE XI shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story III.

TABLE XI

Comparison of Scores Story III Superior Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical</th>
<th>M.</th>
<th>M. Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>22</td>
<td>9.04</td>
<td>1.11</td>
<td>.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>21</td>
<td>10.19</td>
<td>.73</td>
<td>.15</td>
<td>1.15</td>
<td>.27</td>
<td>4.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The mean score of the illustrated Story III is 9.04 compared to 10.19 for the non-illustrated. The critical ratio of 4.25 shows a statistically significant difference in favor of the non-illustrated.

TABLE XII shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story IV.

TABLE XII

Comparison of Scores Story IV Superior Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>21</td>
<td>9.14</td>
<td>3.26</td>
<td>.71</td>
<td>2.73</td>
<td>1.22</td>
<td>2.23</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>22</td>
<td>6.41</td>
<td>4.70</td>
<td>1.00</td>
<td>2.23</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 9.14 compared to 6.41 of the non-illustrated. The critical ratio of 2.23 shows that the difference is not statistically significant. There are 98.6 chances in 100 that this is a true difference in favor of the illustrated.
2. Retention Superior Group

TABLE XIII shows the comparison of retention scores of Story I illustrated and non-illustrated at the superior intelligence level.

**TABLE XIII**

Comparison of Retention Scores Story I Superior Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff. S.E.</th>
<th>Critical N. M. Diff. Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>22</td>
<td>8.09</td>
<td>2.54</td>
<td>.54</td>
<td>.29</td>
<td>.66 .43</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>21</td>
<td>8.38</td>
<td>1.79</td>
<td>.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 8.09 compared to 8.38 of the non-illustrated. The critical ratio of .43 shows the difference not to be statistically significant. Chances are 67 in 100 that this is a true difference in favor of the non-illustrated.

TABLE XIV shows the comparison of retention scores of Story II illustrated and non-illustrated at the superior level.
**TABLE XIV**

Comparison of Retention Scores Story II Superior Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical M.</th>
<th>M.</th>
<th>Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>21</td>
<td>17.095</td>
<td>3.57</td>
<td>.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>22</td>
<td>14.82</td>
<td>5.99</td>
<td>1.28</td>
<td>2.28</td>
<td>1.49</td>
<td>1.53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 17.095 compared to 14.82 for the non-illustrated. The critical ratio of 1.53 shows the difference not to be statistically significant. Chances are 93 in 100 that this is a true difference in favor of the illustrated.

**TABLE XV**

Comparison of Retention Scores Story III Superior Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical M.</th>
<th>M.</th>
<th>Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>22</td>
<td>9.04</td>
<td>2.53</td>
<td>.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>21</td>
<td>9.86</td>
<td>2.14</td>
<td>.46</td>
<td>.82</td>
<td>.70</td>
<td>1.17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 9.04 compared to 9.86 for the non-illustrated. The critical ratio of 1.17 shows the
difference not to be statistically significant. The chances are 87 in 100 that this is a true difference in favor of the non-illustrated.

TABLE XVI shows the comparison of retention scores of Story IV illustrated and non-illustrated at the superior level.

**TABLE XVI**

Comparison of Retention Scores Story IV Superior Level

| Material, Number, Mean, S.D., S.E., Diff., S.E. Critical M. M. Diff. Ratio |  |
|---|---|---|---|---|---|---|---|---|---|
| Illus. | 21 | 8.95 | 3.35 | .73 |  |
| Non-Illus. | 22 | 6.82 | 4.61 | .98 | 2.13 | 1.23 | 1.73 |  |

The mean score of the illustrated is 8.95 compared to 6.82 for the non-illustrated. The critical ratio of 1.73 shows the difference not to be statistically significant. Chances are 96 in 100 that this is a true difference in favor of the illustrated.
3. Comprehension Average Group

TABLE XVII shows the comparison of scores of Story I illustrated and non-illustrated, average intelligence level.

**TABLE XVII**

Comparison of Scores Story I Average Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>26</td>
<td>7.77</td>
<td>2.24</td>
<td>.44</td>
<td></td>
<td>.55</td>
<td>.64</td>
</tr>
<tr>
<td>Non-Illus</td>
<td>27</td>
<td>7.22</td>
<td>2.45</td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 7.77 compared to 7.22 of the non-illustrated. The critical ratio of .86 shows the difference not to be statistically significant. Chances are 80 in 100 that this is a true difference in favor of the illustrated.

TABLE XVIII shows the comparison of scores of Story II illustrated and non-illustrated at the average intelligence level.
TABLE XVIII

Comparison of Scores Story II Average Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff. S.E.</th>
<th>Critical Diff. Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>27</td>
<td>12.87</td>
<td>5.13</td>
<td>.99</td>
<td>.92</td>
<td>1.44</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>26</td>
<td>13.79</td>
<td>5.37</td>
<td>1.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 12.87 compared to 13.79 for the non-illustrated. The critical ratio of .64 shows the difference not to be statistically significant. The chances are 74 in 100 that this is a true difference in favor of the non-illustrated.

TABLE XIX shows the comparison of scores of Story III illustrated and non-illustrated at the average intelligence level.

TABLE XIX

Comparison of Scores Story III Average Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff. S.E.</th>
<th>Critical Diff. Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>26</td>
<td>8.84</td>
<td>2.53</td>
<td>.49</td>
<td>.10</td>
<td>.79</td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>27</td>
<td>8.74</td>
<td>3.25</td>
<td>.62</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 8.84 compared to 8.74 for the non-illustrated. The critical ratio of .13 shows no significant difference. Chances are 56 in 100 that this is
a true difference in favor of the illustrated.

TABLE XX shows the comparison of scores of Story IV illustrated and non-illustrated at the average intelligence level.

TABLE XX

Comparison of Scores Story IV Average Intelligence Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical M.</th>
<th>M.</th>
<th>Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>27</td>
<td>7.00</td>
<td>3.02</td>
<td>.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus</td>
<td>26</td>
<td>6.88</td>
<td>3.15</td>
<td>.62</td>
<td>.12</td>
<td>.85</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 7.00 compared to 6.88 for the non-illustrated. The critical ratio of .14 shows no significant difference. Chances are 56 in 100 that this is a true difference in favor of the illustrated.

4. Retention Average Group

TABLE XXI shows the comparison of scores of Story I illustrated and non-illustrated at the average intelligence level.
### TABLE XXI

Comparison of Retention Scores Story I Average Level

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>26</td>
<td>7.85</td>
<td>1.93</td>
<td>.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus</td>
<td>27</td>
<td>7.52</td>
<td>1.33</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 7.85 compared to 7.52 for the non-illustrated. The critical ratio of .73 shows the difference not to be statistically significant. Chances are 77 in 100 that this is a true difference in favor of the illustrated.

### TABLE XXII

Comparison of Retention Scores Story II Average Level

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>27</td>
<td>9.59</td>
<td>4.71</td>
<td>.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Illus</td>
<td>26</td>
<td>12.24</td>
<td>5.34</td>
<td>1.04</td>
<td>2.65</td>
<td>1.38</td>
<td>1.92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 9.59 compared to 12.24 for the non-illustrated. The critical ratio of 1.92 shows
that the difference is not statistically significant. Chances are 97 in 100 that this is a true difference in favor of the non-illustrated.

TABLE XXIII shows the comparison of retention scores of Story III illustrated and non-illustrated at the average intelligence level.

TABLE XXIII

Comparison of Retention Scores Story III Average Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical M. Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>26</td>
<td>9.11</td>
<td>2.22</td>
<td>.44</td>
<td>.26</td>
<td>.74</td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>27</td>
<td>8.85</td>
<td>3.13</td>
<td>.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 9.11 compared to 8.85 for the non-illustrated. The critical ratio of .37 shows no significant difference. The chances are 64 in 100 that this is a true difference in favor of the illustrated.
TABLE XXIV shows the comparison of retention scores of Story IV illustrated and non-illustrated at the average level.

**TABLE XXIV**

Comparison of Retention Scores Story IV Average Level

<table>
<thead>
<tr>
<th>Material</th>
<th>Number</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>Diff.</th>
<th>S.E.</th>
<th>Critical M.</th>
<th>M. Diff.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illus.</td>
<td>27</td>
<td>6.96</td>
<td>3.55</td>
<td>.68</td>
<td>1.01</td>
<td>.96</td>
<td>.93</td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>Non-Illus.</td>
<td>26</td>
<td>6.00</td>
<td>3.21</td>
<td>.63</td>
<td></td>
<td>.96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean score of the illustrated is 6.96 compared to 6.00 for the non-illustrated. The critical ratio of 1.01 shows the difference not to be statistically significant. Chances are 84 in 100 that this is a true difference in favor of the illustrated.
CHAPTER IV
SUMMARY AND CONCLUSIONS

The purpose of this study was to determine to what extent illustrations affect the reader's comprehension of factual material in the fifth and sixth grades.

To carry out the experiment, four stories were incorporated into booklet form. Two forms of the experiment were constructed. In one form (Form A) the first and the third stories were illustrated and the second and fourth stories were not illustrated. In the other form of the experiment (Form B) the first and the third stories were not illustrated and the second and the fourth stories were illustrated. The same stories were included in both forms of the experiment.

The stories were presented to a heterogeneous population in two fifth grades and in two sixth grades in the same school building. The experiment was carried out on the total population of 103 pupils.

In carrying out this experiment several limitations were in evidence. The type of illustrations used was felt by the investigator to be a definite limitation of this experiment. Being non-professional pen and ink line drawings, they did not meet the standards found by experimentation to be preferred by children. It is doubtful, therefore, that interest was created or attention sustained by the type of illustration used. It is also felt by the writer that the illustrations were not meaningful in all instances.
It is possible that an excess of factual details were included in the comprehension checks. This too may be considered a limitation of this experiment.

CONCLUSIONS

A. Comparison of comprehension scores of total population.
   1. The illustrations seemed to have little effect on the comprehension scores. In three out of the four stories, the differences noted were in favor of the illustrated material. In one story the difference was in favor of the non-illustrated material. None of the differences was statistically significant.
   2. The results of the retention scores were not consistent. Stories one and two were in favor of the non-illustrated material and three and four were in favor of the illustrated. The difference in Story I was statistically significant.

B. Comparison of comprehension scores by Intelligence Levels.
   1. The children with Superior Intelligence had higher scores on the non-illustrated material in three out of the four stories. In one case, Story III, the difference was significant.
2. In two stories, the retention is better in illustrated material and in two stories the non-illustrated scores were higher. None of the scores was significant.

3. The children with average Intelligence Quotients had slightly higher scores in the illustrated material than in the non-illustrated material in three of the four stories. None of the differences was significant.

4. The retention scores for the average group were slightly higher in the illustrated material in three of the four stories. None of the differences was significant.
CHAPTER V

SUGGESTIONS FOR FURTHER RESEARCH

1. Repeat this experiment using professional illustrations which meet the qualifications discovered by research to be preferred by children.


3. Repeat this experiment directing attention of the pupils specifically to the illustrations.

4. Repeat this experiment on a larger population.

5. Repeat this experiment using different stories.

6. Check retention over a longer period of time.
FORM A

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>
You have learned how Columbus sailed westward across the Atlantic Ocean in search of a short route to the Spice Islands of the East. Columbus died without knowing that he had discovered two large continents and that these continents barred his short route to the East. The great discoverer sailed along the Isthmus of Panama looking for a passageway. Other explorers kept up the search for two hundred years before they learned that the New World blocked their westward route all the way from a frozen ocean in the north to another frozen ocean in the south. You have read how Balboa crossed the Isthmus of Panama and discovered the Pacific Ocean and heard stories of vast wealth in the lands farther south.

This wealth was soon discovered. Then there was a great deal of travel across the isthmus to get the gold and silver of Peru and ship it to Spain. Only thirty years after the discovery of America, the Spanish began to talk about digging a canal across the isthmus to connect the two oceans. They talked about it for three hundred years and by that time they had lost most of their New World empire.

Nothing was done until about sixty years ago, when a French company made an attempt to dig the canal. The work was badly managed and there was much sickness among the workers. In a few years the company could raise no more money and the work stopped.

The United States had been deeply interested in a canal across the isthmus for many years. A canal would shorten immensely the sailing distance between our east and west coasts. The value of a canal was clearly shown in the war with Spain when one of our battleships had to steam all the way around South America to go from the Pacific Ocean to the Atlantic.

Theodore Roosevelt was President of the United States when the work was started. Our government paid the French company forty million dollars for their rights and for the work they had done. This payment did not give the United States all the rights it needed. At this time Panama was one of the states of the Republic of Colombia in South America.

Panama feared that the canal would be dug in another location. She had fought fifty-three revolutions in fifty-three years and she decided it was a good time to have another. This time she was protected by the United States and so Colombia could do nothing.

Panama became an independent republic. Two weeks later she sold the Canal Zone to the United States for ten million dollars. The United States also promised to pay Panama $250,000 each year. The Canal Zone is a strip of land ten miles wide reaching from ocean to ocean.

Before the United States could start the real work on the canal, the Canal Zone had to be cleaned up and made free from yellow fever and malaria. This work was in charge
of William C. Gorgas who had learned in Cuba how to control hot climate diseases.

The streets of the cities were paved. Sewers were dug and a supply of pure water was piped into the cities. The Canal Zone was one of the worst yellow fever regions in the world. We had learned in Cuba that yellow fever is spread by a certain kind of mosquito. To fight this insect the government of the Canal Zone screened all the houses, drained the swamps, and sprayed oil on the pools of water where mosquitoes laid their eggs. All this was a heavy task but it made the Canal Zone the most healthful place in the hot regions of the world. After trying several other engineers, the government placed the work of digging the canal in charge of George W. Goethals of the United States Army.

The Atlantic end of the Canal Zone has more than twelve feet of rain a year. This amount of rain makes the streams full and swift. They tumble down the hills and rush on to the ocean. The American engineers built an immense dam across one of the rivers and in this way made a large body of water which is now a huge lake. This lake makes up twenty-three miles of the canal but it is eighty-five feet above the level of the oceans. Boats are lifted up to the level of the lake by means of three large locks near each end of the canal. The canal has been called a "bridge of water."
Digging the Culebra Cut was the hardest job of all. Here it was necessary to dig through nine miles of almost solid rock. This great ditch is three hundred seventy-five feet deep and three hundred feet wide at the bottom. At the top the cut is more than a half a mile wide.

The Panama Canal was a machine age undertaking. Large steam shovels loaded the rock and earth into railroad cars. The long trains were pulled away by locomotives and the rock and dirt taken off by machinery. The great work was finished in the year when the First World War began. It was now clearer than ever before that the United States was becoming a world power with world-wide interests to protect.

The Panama Canal is now one of the busiest trade routes in the world. In peace times it is used on equal terms by the ships of all nations. The canal has shortened the sailing distance between our eastern and our western coasts by ten thousand miles. It has brought the seaports of western South America seven thousand miles nearer to our eastern seaports than they were before. In time of war we can move our fighting ships from one ocean to the other in a few days.
The Panama Canal

Circle the number in front of the correct answer.

1. There was much travel across the Isthmus of Panama
   1. to discover the Pacific Ocean.
   2. to find a short route to the East.
   3. to get the gold and silver of Peru.
   4. to find a place for a canal.
   5. to help fight in a revolution.

2. The United States realized the great value of a canal across the Isthmus of Panama when:
   1. Balbóa crossed the isthmus and discovered the Pacific Ocean.
   2. Theodore Roosevelt paid the French company forty million dollars.
   3. the Spanish began to talk about digging a canal.
   4. in the Spanish War one of our battleships had to go around South America.
   5. Panama became an independent republic.

3. The methods used in the construction of the Panama Canal proved that:
   1. the work was finished when the First World War began.
   2. it was a machine age undertaking.
   3. the United States was becoming a world power.
   4. The Culebra Cut was the hardest job of all.
   5. it was necessary to dig through solid rock.

If the statement is true put (T) in parenthesis before it; if it is false put (F) before it.

( ) The Canal Zone is a strip of land twelve miles wide.

( ) The Canal Zone was one of the worst yellow fever regions in the world.

( ) The Canal Zone today is one of the most unhealthful places in the hot regions of the world.

( ) More than twelve feet of rain falls every year at the Atlantic end of the Canal Zone.

( ) The lake formed by the dam is twenty-three miles above the level of the oceans.

( ) In peace times the Panama Canal is used by ships of all nations.

( ) The Canal has made the distance between the Atlantic and Pacific coasts 7000 miles shorter.
Circle the correct answer:

1. Boats are lifted up to the level of the lake by means of ______ large locks.
   ten  three  two  twelve  twenty

2. ________ miles of solid rock were dug through in digging the culebra Cut.
   twenty-three  three hundred  nine  three

3. The great ditch is ________ feet deep.
   500  30  750  375  85
For hundreds of years men have watched the sky and wondered about tomorrow's weather. But the men of long ago knew little about the great ocean of air which is all around us. They had no way to tell what the weather would be. They had no way to send news of the weather quickly from place to place.

When Columbus discovered America, no way had been invented to find out how cold or how hot the weather was. The first thermometer was not invented until about one hundred years later. In 1593, Galileo of Italy made a crude instrument to mark the temperature. In 1643, Torricelli, his assistant and secretary, invented the barometer, or weather-glass, which marks the coming of fair or stormy weather.

Many great men have been interested in the weather. Benjamin Franklin looked up at the sky just as you and I do and wondered if those dark clouds meant rain. In fact, he did more than wonder about those clouds. Franklin studied the winds and the weather. Thomas Jefferson was interested in the weather, too. He actually owned a barometer, and in those days there were only two in all the Colonies.

Real weather forecasting in our country did not begin until the year 1870. By that time, the American Colonies had become the United States of America. The early pioneers had crossed the continent in their covered wagons and settled the West. Trains puffed and snorted over the plains and through the mountains. Telegraph wires linked the Pacific Coast and the Atlantic Coast. News could now be carried quickly from place to place.

*Reprinted from Weather by A. Eleonor Thomas, Unit Study Book, No. 551.*
Congress gave the Secretary of War the duty of setting up weather stations and sending out weather reports. He was to collect news of the weather from all parts of our country and from this news forecast the weather. Twenty years later, in 1890, the United States Weather Bureau was set up as part of the Department of Agriculture in Washington, D.C.

Uncle Sam is now in touch with hundreds of weather stations. Most of these are in the United States, but there are also some in Canada, Alaska, Hawaii, Mexico, the Canal Zone, the West Indies, Europe and Asia.

Every morning and every evening at eight o'clock, weathermen at observing stations study the clouds and look at their instruments. The barometers tell them the pressure or weight of the air. The thermometers tell them the temperature of the air. The anemometer tells them the force and speed or velocity of the wind, and the weather vane tells them which way the wind is blowing. The hygrometer tells them how much moisture is in the air. Special gauges show how much snow or rain has fallen. Sunshine recorders, barographs, and thermographs trace a record of the changes in the weather. Every morning, too, these weathermen study the height of the clouds, or the ceiling limits, and figure out the dew points.

At the same time, pilots at 26 airports in all parts of our country hop into their planes and take off. These pilots are going up to study the weather from high in the sky. The weather instruments in the cockpit of each plane will tell them the air pressure, temperature and humidity at different heights.

At about 60 weather stations, men fill small balloons with hydrogen and send them into the upper air. These weather balloons help measure the speed and direction of the wind and the height of the ceiling. The balloons are sent up at least four
times within every 24 hours and oftener if the weather is very stormy or a bit unusual.

News of the weather is sent from the weather stations to the big United States Weather Bureau in Washington, D.C. The telegraph wires buzz and hum. The radio clicks busily. Weather stations in Alaska, Canada, Hawaii, the West Indies, the Canal Zone and Mexico are sending in reports.

The pilots of airplanes and the captains of ships at sea flash their weather reports to Washington. More weather news comes from other countries across the Atlantic and across the Pacific, from the Azores, Iceland, Greenland and the Faroe Islands.

From all these reports, weather maps are made and studied by weather experts in Washington, D.C., Chicago, New Orleans, Denver and San Francisco. They learn about coming frosts, cold waves, blizzards, hot spells, hurricanes, storms, floods, and the weather in general. Then the weather experts prepare their forecasts.

Within two hours after the weather reports have been flashed from faraway corners of the world, the forecasts are being sent out by telegraph to nearly two thousand stations in different parts of our country. From there, the forecasts are spread still further by telegraph, telephone, radio, newspapers, and even by mail.
The Weatherman and His Work

Match the two columns below by putting before each statement in Column 2, the number of the statement in Column 1 with which it belongs.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Galileo</td>
<td>( ) Had no instruments to measure weather.</td>
</tr>
<tr>
<td>2. Thomas Jefferson</td>
<td>( ) Invented the barometer</td>
</tr>
<tr>
<td>3. 1643</td>
<td>( ) Studied clouds and winds</td>
</tr>
<tr>
<td>4. 1870</td>
<td>( ) U.S. Weather Bureau was set up</td>
</tr>
<tr>
<td>5. Torricelli</td>
<td>( ) Owned a barometer</td>
</tr>
<tr>
<td>6. 1492</td>
<td>( ) Invented the thermometer</td>
</tr>
<tr>
<td>7. Benjamin Franklin</td>
<td>( ) Weather forecasting began</td>
</tr>
<tr>
<td>8. 1593</td>
<td>( ) Instrument invented to mark temperature</td>
</tr>
<tr>
<td>9. 1890</td>
<td>( ) Weather-glass was invented</td>
</tr>
<tr>
<td>10. Columbus</td>
<td>( ) No inventions to tell weather</td>
</tr>
</tbody>
</table>

Circle the number before the statements that are true.

By the time that real weather forecasting began in our country:

1. Trains had crossed over the plains and through the mountains.
2. News could be carried quickly from place to place.
3. The U.S. Weather Bureau was set up in Washington, D.C.
4. The American Colonies had become the U.S. of America.
5. Pilots studied the air high in the sky.
6. The Weather Bureau was under the Department of Agriculture.
7. Pioneers had settled the West.
8. Weather stations were set up.
9. Telegraph wires linked the Pacific Coast and the Atlantic Coast.
10. The Secretary of War had charge of sending out weather reports.
Katch the two columns below by putting before each statement in Column 2, the number of the statement in Column 1 with which it belongs.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Barometer</td>
<td>( ) measures speed and direction of wind</td>
</tr>
<tr>
<td>2. Hygrometer</td>
<td>( ) tells force and speed of wind</td>
</tr>
<tr>
<td>3. Thermometer</td>
<td>( ) tells which way the wind is blowing</td>
</tr>
<tr>
<td>4. Anemometer</td>
<td>( ) tells the pressure or weight of air</td>
</tr>
<tr>
<td>5. Barograph</td>
<td>( ) tells how much moisture is in the air</td>
</tr>
<tr>
<td>6. Balloons</td>
<td>( ) the height of the clouds</td>
</tr>
<tr>
<td>7. Special gauges</td>
<td>( ) traces a record of changes in weather</td>
</tr>
<tr>
<td>8. Weather vane</td>
<td>( ) tells temperature of the air</td>
</tr>
<tr>
<td>9. Ceiling limits</td>
<td>( ) show how much snow or rain has fallen</td>
</tr>
</tbody>
</table>

Fill in the blanks to make the sentence true.

Weather news is sent to Washington from ____________, ____________

and ____________.

From all these reports ____________ ______ are made and studied by weather experts. Then the experts prepare their ____________.
A giant forest, with trees as large as any Gulliver ever saw in his travels among the giant people, is growing right here in our own country. Gulliver's giants have disappeared, but the giant trees of California are still living. Some of them are thousands of years old, but they are so sound and strong that they look as if they would live for thousands of years to come.

We usually call these giant trees the Big Trees of California, but if a botanist were speaking of one of them he would call it by its name, Sequoia. The Big Trees were named in honor of the famous Cherokee Indian Chief, Sequoia, who was the wisest man of his tribe and a very great man among the Indians, because he invented an alphabet for the language of his people so that they could learn to read and write, instead of making signs and pictures as they had always done before.

The largest of these trees is called the General Sherman tree. It is about 230 feet high; it is 102 feet around the base of the trunk, and the bark is almost two feet thick. No other tree in the world is so tall and at the same time so large around the trunk.

# Reprinted from Stories In Trees by Mary I. Curtis, Lyons & Carnahan
If you could put the tallest oak tree that you know on top of the tallest walnut tree that you have ever seen, the two together would not reach up to the top of the General Sherman Tree. Lofty pine trees, which grow very tall indeed, look like little saplings beside these forest giants. If the General Sherman Tree were cut off smoothly, fifty horses could easily stand upon its stump.

One of the Big Trees has a tunnel cut right through the trunk. The tunnel is so big that a coach and four horses can pass through it easily.

Not far from this tree is a house which is nothing but the hollow log of a fallen Sequoia tree, with doors and windows cut where they are needed.

Sequoias are not only the largest trees in the world, they are the oldest too. Some of these trees that are standing today were old trees before Columbus ever discovered this land in which they live. Perhaps the General Sherman Tree was beginning to grow when Moses was a baby. At any rate, men who know how to judge the age of trees tell us that some of the Big Trees must be more than five thousand yeard old. We can hardly believe that anything that lived in those long ago days can be still living today, but you can count more than four thousand rings
on the stumps of several of the Sequoias which have been cut down - one ring for every year that the tree has lived.

In Europe, there are one or two very old trees, nobody knows just how old they are, that are pointed to with tremendous pride by the inhabitants of the countries where they grow. One old lime tree in the city of Nuremberg, in Germany, is quite famous. But the poor tree is almost dead. Its trunk is crumbling with decay, and it has to be held up with props and pillars to keep from falling down. You would never think of comparing this poor cripple with any of the mighty trunks of our Sequoias, which are as sound and sturdy today as they were thousands of years ago.

The Big Trees keep their youth much longer than any other trees we know. At a time when most trees are beginning to die of old age, a Sequoia is still in its first youth. It cannot be called properly grown up before it is fifteen hundred years old, and it is not old until it has lived three thousand years or more. Even then it has a long life before it, and keeps on growing and adding to its size every year it lives.

The roots of the Big Trees stretch out under the ground for two hundred feet or more around each tree, and sometimes these roots send up shoots which grow into young Sequoias clustering around the base of the old tree. These young Sequoias are like children growing in a family around the parent tree.
No blight ever seems to fall upon these wonderful trees. Full of eager, vigorous life, they stand high above all the other trees of the forest looking out over the world - the first of all the trees to see the early light of morning, and the last to bid the sun good night.

There are no other trees like the Sequoias anywhere else in the world. Men who study trees say that in ages long ago, before the beginnings of our earliest history, these forest giants may have grown in other lands. But the United States of America is now the only country where the Big Trees grow. There are about six hundred Sequoias lifting their lofty heads high above the pine trees of central California. The General Sherman Tree is the largest of them all - it is the largest and oldest living thing in the whole world.
A Giant Forest

Finish these sentences by filling in the blanks.

1. The giant trees in the story grow in the state of ______________.
2. They were named in honor of the famous _______ Chief ________.
3. The largest of these trees is called the _______ ________ tree.
4. Some of these trees were old before ____________ came to America.
5. There is a very old lime tree in the country of _____________.
6. The _______ of the Big Trees stretch out around each tree under the ground.
7. People are grown up when they reach twenty-one; Sequoias are not grown up until they are ________ years old.
8. No other tree is so _______ and at the same time so large around the trunk.

Circle the correct statement.

1. The General Sherman Tree is _______ feet high.
   4000  50  280  5000  102
2. If the General Sherman Tree were cut off ______ horses could stand on its stump:
   102  4  280  50  2000
3. Some Sequoias are thought to be more than _______ years old.
   5000  280  500  3500  1500
4. Perhaps the General Sherman Tree was beginning to grow when _______ was a baby.
   Columbus  General Sherman  Sequoia  Moses  California
5. A Sequoia is not grown up until it is ________ years old.
   3000  1500  5000  50  280
Even before a person can step into a sailboat for a sailing lesson, he must have a dry-land sailing lesson. This is so that he will know what he is doing, what it is possible for the boat to do and so that he will know the safety rules of sailing.

To learn to sail a boat, you first need to know the parts of a sailboat and the parts of the sail as well as the way in which the sail is handled. Small sailboats, such as are most popular with young people in small harbors, usually have only one sail or else one large sail and one smaller sail.

The forward part of a boat is called the bow while the back part of a boat is known as the stern. The main part of a boat, not including the mast and sails, is the hull. The top part of the hull is the deck. Each of these parts has various sections each having a special name, but it is not important for us to learn those in this simple lesson.

There are two main types of sailboats as far as the shape of the bottom of the boats is concerned. Most boats have a keel which extends along the center of the bottom and helps to keep the boat properly balanced. Some small light-weight boats have a centerboard instead of a keel. A center-board serves the same purpose as a keel and is nothing more than a wide board, fixed so that it can be pulled up when the boat is in shallow water.

We have spoken about the main part of the boat (the hull) and about the part of the boat that is underwater (keel or center-board). Now let us learn something of the rest of the boat. The part that we will be most concerned with is the sail. The sail is made of canvas or some other fabric. It is attached to a long wooden pole called the mast which rises from the deck. The mast is near the
center of the boat, but usually toward the bow. To keep the lower part of the sail in place, it is attached to another shorter wooden pole called the boom. So the sail is held fast by two poles, the mast and the boom.

The top part of the sail is its head and the bottom edge is quite naturally called the foot of the sail. The edge of the sail which is attached to the mast is known as the luff while the leach is the outside edge of the sail. These are the four principal parts of the sail. If a boat has more than one sail, the largest and most important is named the mainsail probably because it is the main or principal sail on the boat. The smaller sail on a boat of this kind is known as the jib.

All boats have many ropes, ropes to raise and lower the sails, ropes to control the sails when you are sailing and ropes for many other purposes. However, we do not call them ropes on board ship. Once we step off a dock and into a boat, we must learn to speak a new language, the language of the sea. And just as we call it a deck on a boat and a floor in a home, so we call ropes lines on a boat. These lines all have different names according to their uses on the boat. The lines that are used to let out or take in the sail are called sheets. For example, the line that controls the mainsail is the mainsheet. Can you imagine what name is given to the line that controls the jib? It is called the jibsheet.

We will learn the name of only one other important thing on the boat in this first dry-land sailing lesson. It is the part of the boat which serves the same purpose as the steering wheel on your car. In sailing, the boat is steered by the tiller. The tiller looks like a stick of polished wood and is attached to the stern.

Now let us see how well you have learned your first lesson about boats and sailing.
Look at the diagram of the boat in which the parts are numbered. Beside each word in the list below, write the number of the part.

( ) bow    ( ) keel    ( ) tiller    ( ) boom
( ) hull   ( ) stern   ( ) head     ( ) foot
( ) luff   ( ) mainsail ( ) deck
( ) mast   ( ) leach    ( ) jib
FORM B

NAME:
GRADE:
SCHOOL:
DATE OF BIRTH:
DATE TODAY:

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The Panama Canal #

You have learned how Columbus sailed westward across the Atlantic Ocean in search of a short route to the Spice Islands of the East. Columbus died without knowing that he had discovered two large continents and that these continents barred his short route to the East. The great discoverer sailed along the Isthmus of Panama looking for a passage way. Other explorers kept up the search for two hundred years before they learned that the New World blocked their westward route all the way from a frozen ocean in the north to another frozen ocean in the south. You have read how Balboa crossed the Isthmus of Panama and discovered the Pacific Ocean and heard stories of vast wealth in the lands farther south.

This wealth was soon discovered. Then there was a great deal of travel across the isthmus to get the gold and silver of Peru and ship it to Spain. Only thirty years after the discovery of America, Spanish began to talk about digging a canal across the isthmus to connect the two oceans. They talked about it for three hundred years and by that time they had lost most of their New World empire.

Nothing was done until about sixty years ago, when a French company made an attempt to dig the canal. The work was badly managed and there was much sickness among the workers. In a few years the company could raise no more money and the work stopped.

The United States had been deeply interested in a canal across the Isthmus for many years. A canal would shorten immensely the sailing distance between our east and west coasts. The value of a canal was clearly shown in the war with Spain when one of our battleships had to steam all the way around South America to go from the Pacific Ocean to the Atlantic.

# Reprinted from Our Country by Beebe, Hanna, McClure, Laidlaw.
Theodore Roosevelt was President of the United States when the work was started. Our government paid the French company forty million dollars for their rights and for the work they had done. This payment did not give the United States all the rights it needed. At this time Panama was one of the states of the Republic of Colombia in South America.

Panama feared that the canal would be dug in another location. She had fought fifty-three revolutions in fifty-three years and she decided it was a good time to have another. This time she was protected by the United States and so Colombia could do nothing.

Panama became an independent republic. Two weeks later she sold the Canal Zone to the United States for ten million dollars. The United States also promised to pay Panama $250,000 each year. The Canal Zone is a strip of land ten miles wide reaching from ocean to ocean.

Before the United States could start the real work on the canal, the Canal Zone had to be cleaned up and made free from yellow fever and malaria. This work was in charge of William C. Gorgas who had learned in Cuba how to control hot climate diseases. The streets of the cities were paved. Sewers were dug and a supply of pure water was piped into the cities. The Canal Zone was one of the worst yellow fever regions of the world. We had learned in Cuba that yellow fever is spread by a certain kind of mosquito. To fight this insect the government of the Canal Zone screened all the houses, drained the swamps, and sprayed oil on the pools of water where mosquitoes laid their eggs. All this was a heavy task but it made the Canal Zone the most healthful place in the hot regions of the world.

After trying several other engineers, the government placed the work of digging the canal in charge of George W. Goethals of the United States Army.

The Atlantic end of the Canal Zone has more than twelve feet of rain a year. This amount of rain makes the streams full and swift.
They tumble down the hills and rush on to the ocean. The American engineers built an immense dam across one of the rivers and in this way made a large body of water which is now a huge lake. This lake makes up twenty-three miles of the canal but it is eighty-five feet above the level of the oceans. Boats are lifted up to the level of the lake by means of three large locks near each end of the canal. The canal has been called a "bridge of water."

Digging the Culebra Cut was the hardest job of all. Here it was necessary to dig through nine miles of almost solid rock. This great ditch is 375 feet deep and 300 feet wide at the bottom. At the top the cut is more than half a mile wide.

The Panama Canal was a machine age undertaking. Large steam shovels loaded the rock and earth into railroad cars. The long trains were pulled away by locomotives and the rock and dirt taken off by machinery. The great work was finished in the year when the First World War began. It was now clearer than ever before that the United States was becoming a world power with world-wide interests to protect.

The Panama Canal is now one of the busiest trade routes in the world. In peace times it is used on equal terms by the ships of all nations. The canal has shortened the sailing distance between our eastern and western coasts by ten thousand miles. It has brought the seaports of western South America seven thousand miles nearer to our eastern seaports than they were before. In time of war we can move our fighting ships from one ocean to the other in a few days.
The Panama Canal

Circle the number in front of the correct answer.

1. There was much travel across the Isthmus of Panama
   1. to discover the Pacific Ocean.
   2. to find a short route to the East.
   3. to get the gold and silver of Peru.
   4. to find a place for a canal.
   5. to help fight in a revolution.

2. The United States realized the great value of a canal across the Isthmus of Panama when:
   1. Balboa crossed the isthmus and discovered the Pacific Ocean.
   2. Theodore Roosevelt paid the French company forty million dollars.
   3. the Spanish began to talk about digging a canal.
   4. in the Spanish War one of our battleships had to go around South America.
   5. Panama became an independent republic.

3. The methods used in the construction of the Panama Canal proved that:
   1. the work was finished when the First World War began.
   2. it was a machine age undertaking.
   3. the United States was becoming a world power.
   4. The Culebra Cut was the hardest job of all.
   5. it was necessary to dig through solid rock.

If the statement is true put (T) in parenthesis before it; if it is false put (F) before it.

( ) The Canal Zone is a strip of land twelve miles wide.

( ) The Canal Zone was one of the worst yellow fever regions in the world.

( ) The Canal Zone today is one of the most unhealthful places in the hot regions of the world.

( ) More than twelve feet of rain falls every year at the Atlantic end of the Canal Zone.

( ) The lake formed by the dam is twenty-three miles above the level of the oceans.

( ) In peace times the Panama Canal is used by ships of all nations.

( ) The Canal has made the distance between the Atlantic and Pacific coasts 7000 miles shorter.
Circle the correct answer:

1. Boats are lifted up to the level of the lake by means of ______ large locks.
   ten   three   two   twelve   twenty

2. _______ miles of solid rock were dug through in digging the culebra cut.
   twenty-three  three hundred  nine  three

3. The great ditch is ________ feet deep.
   300   30   750   375   85
For hundreds of years men have watched the sky and wondered about tomorrow's weather. But the men of long ago knew little about the great ocean of air which is all around us. They had no way to tell what the weather would be. They had no way to send news of the weather quickly from place to place.

When Columbus discovered America, no way had been invented to find out how cold or how hot the weather was. The first thermometer was not invented until about one hundred years later. In 1593, Galileo of Italy made a crude instrument to mark the temperature. In 1643, Torricelli, his assistant and secretary, invented the barometer, or weather-glass, which marks the coming of fair or stormy weather.

![Temperature and Weather Chart]

Many great men have been interested in the weather. Benjamin Franklin looked up at the sky just as you and I do and wondered if those dark clouds meant rain. In fact, he did more than wonder about those clouds. Franklin studied the winds and the weather. Thomas Jefferson was interested in the weather, too. He actually owned a barometer, and in those days there were only two in all the Colonies.

# Reprinted from Weather by A. Eleanor Thomas, Unit Study Book No. 551.
Real weather forecasting in our country did not begin until the year 1870. By that time, the American Colonies had become the United States of America. The early pioneers had crossed the continent in their covered wagons and settled the West. Trains puffed and snorted over the plains and through the mountains. Telegraph wires linked the Pacific Coast and the Atlantic Coast. News could now be carried quickly from place to place.

Congress gave the Secretary of War the duty of setting up weather stations and sending out weather reports. He was to collect news of the weather from all parts of our country and from this news, forecast the weather. Twenty years later, in 1890, the United States Weather Bureau was set up as part of the Department of Agriculture in Washington, D.C.

Every morning and every evening at eight o’clock, weathermen at observing stations study the clouds and look at their instruments. The barometers tell them the pressure or weight of the air. The thermometers tell them the tempera-
ture of the air. The anemometer tells them the force and speed or velocity of the wind, and the weather vane tells them which way the wind is blowing. The hygrometer tells them how much moisture is in the air. Special gauges show how much snow or rain has fallen. Sunshine recorders, barographs and thermographs trace a record of the changes in the weather. Every morning, too, these weathermen study the height of the clouds, or the ceiling limits, and figure out the dew points. At the same time, pilots at 26 airports in all parts of our country hop into their planes and take off. These pilots are going up to study the weather from high in the sky. The weather instruments in the cockpit of each plane will tell them the air pressure, temperature and humidity at different heights.

At about 60 weather stations, men fill small balloons with hydrogen and send them into the upper air. These weather balloons help measure the speed and direction of the wind and the height of the ceiling. The balloons are sent up at least four times within every 24 hours and oftener if the weather is very stormy or a bit unusual.

News of the weather is sent from the weather stations to the big United States Weather Bureau in Washington, D.C. The telegraph wires buzz and hum, The radio clicks busily. Weather stations in Alaska, Canada, Hawaii, the West Indies, the Canal Zone, and Mexico are sending in reports.

The pilots of airplanes and the captains of ships at sea flash their weather reports to Washington. More weather news comes from other countries across the Atlantic and across the Pacific, from the Azores, Iceland, Greenland and the Faroe Islands.
Weather Reports from Planes and Ships

From all these reports, weather maps are made and studied by weather experts in Washington, D.C., Chicago, New Orleans, Denver and San Francisco. They learn about coming frosts, cold waves, blizzards, hot spells, hurricanes, storms, floods and the weather in general. Then the weather experts prepare their forecasts.

Within two hours after the weather reports have been flashed from faraway corners of the world, the forecasts are being sent out by telegraph to nearly two thousand stations in different parts of our country. From there, the forecasts are spread still further by telegraph, telephone, radio, newspapers and even by mail.
The Weatherman and His Work

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Circle the number before the statements that are true.

By the time that real weather forecasting began in our country:

1. Trains had crossed over the plains and through the mountains.
2. News could be carried quickly from place to place.
3. The U.S. Weather Bureau was set up in Washington, D.C.
4. The American Colonies had become the U.S. of America.
5. Pilots studied the air high in the sky.
6. The Weather Bureau was under the Department of Agriculture.
7. Pioneers had settled the West.
8. Weather stations were set up.
9. Telegraph wires linked the Pacific Coast and the Atlantic Coast.
10. The Secretary of War had charge of sending out weather reports.
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Fill in the blanks to make the sentence true.

Weather news is sent to Washington from _________, _______.

and _________.

From all these reports _________ _______ are made and studied by weather experts. Then the experts prepare their _________.

A giant forest, with trees as large as any Gulliver ever saw in his travels among the giant people, is growing right here in our own country. Gulliver's giants have disappeared, but the giant trees of California are still living. Some of them are thousands of years old, but they are so sound and strong that they look as if they would live for thousands of years to come.

We usually call these giant trees the Big Trees of California, but if a botanist were speaking of one of them he would call it by its name, Sequoia. The Big Trees were named in honor of the famous Cherokee Indian Chief, Sequoia, who was the wisest man of his tribe and a very great man among the Indians, because he invented an alphabet for the language of his people so that they could learn to read and write, instead of making signs and pictures as they had always done before.

The largest of these giant trees is called the General Sherman tree. It is about 280 feet high; it is 102 feet around the base of the trunk, and the bark is almost two feet thick. No other tree in the world is so tall and at the same time so large around the trunk. If you could put the tallest oak tree that you know on top of the tallest walnut tree that you have ever seen, the two together would not reach up to the top of the General Sherman Tree. Lofty pine trees, which grow very tall indeed, look like little saplings beside these forest giants. If the General Sherman Tree were cut off smoothly, fifty horses could easily stand upon its stump.

One of the Big Trees has a tunnel cut right through the trunk. The tunnel is so big that a coach and four horses can pass through it easily. Not far from this tree is a house which is nothing but the hollow log of a fallen Sequoia tree, with doors and windows cut where they are needed.
Sequoias are not only the largest trees in the world, they are
the oldest too. Some of these trees that are standing today were
old trees before Columbus ever discovered this land in which they
live. Perhaps the General Sherman Tree was beginning to grow when
Moses was a baby. At any rate, men who know how to judge the age
of trees tell us that some of the Big Trees must be more than five
thousand years old. We can hardly believe that anything that lived
in those long ago days can be still living today, but you can count
more than four thousand rings on the stumps of several of the Sequoias
which have been cut down - one ring for every year that the tree has
lived.

In Europe, there are one or two very old trees, nobody knows just
how old they are, that are pointed to with tremendous pride by the
inhabitants of the countries where they grow. One old lime tree in
the city of Nuremberg, in Germany, is quite famous. But the poor
tree is almost dead. Its trunk is crumbling with decay, and it has
to be held up with props and pillars to keep from falling down. You
would never think of comparing this poor cripple with any of the
mighty trunks of our Sequoias, which are as sound and sturdy today
as they were thousands of years ago.

The Big Trees keep their youth much longer than any other trees
we know. At a time when most trees are beginning to die of old age,
a Sequoia is still in its first youth. It cannot be called properly
grown up before it is fifteen hundred years old, and it is not old
until it has lived three thousand years or more. Even then it has
a long life before it, and keeps on growing and adding to its size
every year it lives.

The roots of the Big Trees stretch out under the ground for
two hundred feet or more around each tree, and sometimes these roots
send up shoots which grow into young Sequoias clustering around the base of the old tree. These young Sequoias are like children growing in a family around the parent tree.

No blight ever seems to fall upon these wonderful trees. Full of eager, vigorous life, they stand high above all the other trees of the forest looking out over the world - the first of all the trees to see the early light of morning, and the last to bid the sun good night.

There are no other trees like the Sequoias anywhere else in the world. Men who study trees say that in ages long ago, before the beginnings of our earliest history, these forest giants may have grown in other lands. But the United States of America is now the only country where the Big Trees grow. There are about six hundred Sequoias lifting their lofty heads high above the pine trees of central California. The General Sherman Tree is the largest of them all - it is the largest and oldest living thing in the whole world.
A Giant Forest

Finish these sentences by filling in the blanks.

1. The giant trees in the story grow in the state of ____________.
2. They were named in honor of the famous _______ Chief _________.
3. The largest of these trees is called the _______ _________ tree.
4. Some of these trees were old before __________ came to America.
5. There is a very old lime tree in the country of _____________.
6. The _________ of the Big Trees stretch out around each tree under the ground.
7. People are grown up when they reach twenty-one; Sequoias are not grown up until they are _________ years old.
8. No other tree is so _________ and at the same time so large around the trunk.

Circle the correct statement.

1. The General Sherman Tree is ______ feet high.
   4000  50   280  5000   102

2. If the General Sherman Tree were cut off ______ horses could stand on its stump;
   102   4   280   50   2000

3. Some Sequoias are thought to be more than ______ years old.
   5000  280   500   3500   1500

4. Perhaps the General Sherman Tree was beginning to grow when _______ was a baby.

   Columbus   General Sherman   Sequoia   Moses   California

5. A Sequoia is not grown up until it is _______ years old.
   3000  1500  5000    .50   280
Sailing

Even before a person can step into a sailboat for a sailing lesson, he must have a dry-land sailing lesson. This is so that he will know what he is doing, what it is possible for the boat to do and so that he will know the safety rules of sailing.

To learn to sail a boat, you first need to know the parts of a sailboat and the parts of the sail as well as the way in which the sail is handled. Small sailboats, such as are most popular with young people in small harbors, usually have only one sail or else one large sail and one smaller sail.

The forward part of a boat is called the bow while the back part of a boat is known as the stern. The main part of a boat, not including the mast and sails, is the hull. The top part of the hull is the deck. Each of these parts has various sections each having a special name, but it is not important for us to learn those in this simple lesson.

There are two main types of sailboats as far as the shape of the bottom of the boats is concerned. Most boats have a keel which extends along the center of the bottom and helps to keep the boat properly balanced. Some small light-weight boats have a center-board instead of a keel. A center-board serves the same purpose as a keel and is
nothing more than a wide board, fixed so that it can be pulled up when the boat is in shallow water.

We have spoken about the main part of the boat (the hull) and about the part of the boat that is underwater (keel or center-board). Now let us learn something of the rest of the boat. The part that we will be most concerned with is the sail. The sail is made of canvas or some other fabric. It is attached to a long wooden pole called the mast which rises from the deck. The mast is near the center of the boat, but usually toward the bow. To keep the lower part of the sail in place, it is attached to another shorter wooden pole called the boom. So the sail is held fast by two poles, the mast and the boom.

The top part of the sail is its head and the bottom edge is quite naturally called the foot of the sail. The edge of the sail which is attached to the mast is known as the luff while the leech is the outside edge of the sail. These are the four principal parts of the sail. If a boat has more than one sail, the largest and most important is named the mainsail probably because it is the main or principal sail on the boat. The smaller sail on a boat of this kind is known as the jib.
All boats have many ropes, ropes to raise and lower the sails, ropes to control the sails when you are sailing and ropes for many other purposes. However, we do not call them ropes on board ship. Once we step off a dock and into a boat, we must learn to speak a new language, the language of the sea. And just as we call it a deck on a boat and a floor in a home, so we call ropes lines on a boat. These lines all have different names according to their uses on the boat. The lines that are used to let out or take in the sail are called sheets. For example, the line that controls the mainsail is the mainsheet. Can you imagine what name is given to the line that controls the jib? It is called the jib-sheet. We will learn the name of only one other important thing on the boat in this first dry-land sailing lesson. It is the part of the boat which serves the same purpose as the steering wheel on your car. In sailing, the boat is steered by the tiller. The tiller looks like a stick of polished wood and is attached to the stern.

Now let us see how well you have learned your first lesson about boats and sailing.
Look at the diagram of the boat in which the parts are numbered.

Beside each word in the list below, write the number of the part.

( ) bow    ( ) keel    ( ) tiller    ( ) boom
( ) hull   ( ) stern   ( ) head     ( ) foot
( ) luff  ( ) mainsail ( ) deck
( ) mast   ( ) leach   ( ) jib
The Panama Canal

Circle the number in front of the correct answer.

1. There was much travel across the Isthmus of Panama
   1. to discover the Pacific Ocean.
   2. to find a short route to the East.
   3. to get the gold and silver of Peru.
   4. to find a place for a canal.
   5. to help fight in a revolution.

2. The United States realized the great value of a canal across the Isthmus of Panama when:
   1. Balbóa crossed the isthmus and discovered the Pacific Ocean.
   2. Theodore Roosevelt paid the French company forty million dollars.
   3. the Spanish began to talk about digging a canal.
   4. in the Spanish War one of our battleships had to go around South America.
   5. Panama became an independent republic.

3. The methods used in the construction of the Panama Canal proved that:
   1. the work was finished when the First World War began.
   2. it was a machine age undertaking.
   3. the United States was becoming a world power.
   4. The Culebra Cut was the hardest job of all.
   5. it was necessary to dig through solid rock.

If the statement is true put (T) in parentheses before it; if it is false put (F) before it.

( ) The Canal Zone is a strip of land twelve miles wide.
( ) The Canal Zone was one of the worst yellow fever regions in the world.
( ) The Canal Zone today is one of the most unhealthful places in the hot regions of the world.
( ) More than twelve feet of rain falls every year at the Atlantic end of the Canal Zone.
( ) The lake formed by the dam is twenty-three miles above the level of the oceans.
( ) In peace times the Panama Canal is used by ships of all nations.
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Circle the correct answer:

1. Boats are lifted up to the level of the lake by means of ______
   large locks.
   ten   three   two   twelve   twenty

2. ______ miles of solid rock were dug through in digging the
   culebra Cut.
   twenty-three   three hundred   nine   three

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   350   30   750   375   85
The Weatherman and His Work

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</tr>
<tr>
<td>9. Ceiling limits</td>
<td>( ) show how much snow or rain has fallen</td>
</tr>
</tbody>
</table>

Fill in the blanks to make the sentence true.

Weather news is sent to Washington from ____________, ____________, and ____________.

From all these reports ____________ ______ are made and studied by weather experts. Then the experts prepare their ____________.
A Giant Forest

Finish these sentences by filling in the blanks.

1. The giant trees in the story grow in the state of _____________.
2. They were named in honor of the famous _______ Chief _________.
3. The largest of these trees is called the _______ ________ tree.
4. Some of these trees were old before ___________ came to America.
5. There is a very old lime tree in the country of _____________.
6. The ________ of the Big Trees stretch out around each tree under the ground.
7. People are grown up when they reach twenty-one; Sequoias are not grown up until they are ________ years old.
8. No other tree is so ________ and at the same time so large around the trunk.

Circle the correct statement.

1. The General Sherman Tree is _______ feet high.
   4000  50  280  5000  102
2. If the General Sherman Tree were cut off _______ horses could stand on its stump:
   102  4  280  50  2000
3. Some Sequoias are thought to be more than ________ years old.
   5000  280  500  3500  1500
4. Perhaps the General Sherman Tree was beginning to grow when ________ was a baby.
   Columbus  General Sherman  Sequoia  Moses  California
5. A Sequoia is not grown up until it is ________ years old.
   3000  1500  5000  50  280
Look at the diagram of the boat in which the parts are numbered.

Beside each word in the list below, write the number of the part.

( ) bow     ( ) keel     ( ) tiller     ( ) boom
( ) hull    ( ) stern    ( ) head      ( ) foot
( ) luff    ( ) mainsail ( ) deck      ( )
( ) mast    ( ) leech     ( ) jib
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