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# Effects of Equal Periods of Massed Exposure versus Distributed Exposure to Systematic Exercises on the Physical Fitness of Fifth and Sixth Grade Boys

Michael L. Nolan

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EFFECTS OF EQUAL PERIODS OF MASSED EXPOSURE  
VERSUS DISTRIBUTED EXPOSURE TO SYSTEMATIC EXERCISES ON  
THE PHYSICAL FITNESS OF FIFTH AND SIXTH GRADE BOYS

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A Thesis  
Presented to  
the Graduate Faculty  
Central Washington State College

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Education

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by  
Michael L. Nolan

August 1969

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## TABLE OF CONTENTS

| CHAPTER   | PAGE |
|---|------|
| I. THE PROBLEM AND DEFINITIONS OF TERMS USED . . . .                  | 1    |
| The Problem . . . . .   | 2    |
| Statement of the problem . . . . .                                    | 2    |
| Importance of the study . . . . .                                     | 3    |
| Limitations of the study . . . . .                                    | 4    |
| Definitions of Terms Used . . . . .                                   | 5    |
| Block group . . . . .   | 5    |
| Ten minute group . . . . .  | 5    |
| Diastole . . . . .  | 5    |
| Obliquity angle . . . . .   | 5    |
| Physical fitness . . . . .  | 6    |
| Rest to work ratio . . . . .  | 6    |
| Systolic pulse wave amplitude . . . . .                               | 6    |
| T <sub>1</sub> . . . . .  | 6    |
| T <sub>2</sub> . . . . .  | 6    |
| Overview of the Remainder of this Thesis . . . .                      | 7    |
| II. REVIEW OF THE LITERATURE . . . . .                                | 8    |
| Opinions of Leaders and Experts . . . . .                             | 8    |
| Selected Studies Related to Physical Fitness<br>of Children . . . . . | 10   |
| Tests Selected for this Study . . . . .                               | 13   |
| Physical Fitness Index . . . . .                                      | 14   |

| CHAPTER  | PAGE |
|--|------|
| Hall's Quotient Drop-off Index . . . . .                         | 14   |
| Johnson Fundamental Skills Tests for boys<br>and Girls . . . . . | 15   |
| Heartometer Test . . . . .                                       | 16   |
| III. PROCEDURES OF INVESTIGATION . . . . .                       | 20   |
| Hypothesis to be Tested . . . . .                                | 20   |
| Research Hypothesis . . . . .                                    | 20   |
| Subjects . . . . .   | 20   |
| Plan of the Investigation . . . . .                              | 20   |
| Tests and Test Batteries . . . . .                               | 21   |
| Physical Fitness Index . . . . .                                 | 21   |
| Two hundred yard run . . . . .                                   | 22   |
| Six hundred yard run . . . . .                                   | 22   |
| Hall's Quotient Drop-off Index . . . . .                         | 22   |
| Johnson's Fundamental Skills Tests . . . . .                     | 23   |
| Heartometer . . . . .  | 23   |
| Organization of the Experiment . . . . .                         | 24   |
| Classification index . . . . .                                   | 24   |
| Organization of testing . . . . .                                | 24   |
| Selection of the level of significance . . . . .                 | 25   |
| Statistical analysis . . . . .                                   | 25   |
| IV. RESULTS OF THE STUDY . . . . .                               | 27   |
| Statement of the Problem . . . . .                               | 27   |
| Subjects . . . . .   | 27   |

| CHAPTER   | PAGE |
|---|------|
| Similarities and differences in the<br>physical fitness program . . . . . | 27   |
| Tests utilized . . . . .  | 28   |
| Physical Fitness Index . . . . .  | 28   |
| Hall's Quotient Drop-off Index . . . . .                                  | 28   |
| Johnson Fundamental Skills Tests for<br>Boys and Girls . . . . .          | 28   |
| Heartometer Test . . . . .  | 28   |
| Findings of the Study . . . . .   | 29   |
| Equating the subjects . . . . .   | 29   |
| Analysis of the data . . . . .  | 30   |
| Kruskal-Wallis one-way analysis of variance<br>by ranks (H) . . . . .     | 39   |
| Summary . . . . .   | 56   |
| V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS . . . . .                     | 57   |
| Conclusions . . . . .   | 58   |
| Recommendations . . . . .   | 63   |
| BIBLIOGRAPHY . . . . .  | 64   |
| APPENDIX A . . . . .  | 68   |



## LIST OF TABLES

| TABLE  | PAGE |
|--|------|
| I. Significance of Difference Between Uncorrelated Means of the Ten Minute Group and the Block group, Classification Index I . . . . . | 30   |
| II. Significance of Differences Between Physical Performance Test Means: September and May . . . . .                                   | 33   |
| III. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Physical Fitness Index: Inter-Group Comparisons . . . . .                   | 41   |
| IV. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Hall's Quotient Drop-off Index: Inter-Group Comparisons . . . . .            | 42   |
| V. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Johnson's Throw-and-Catch Test: Inter-Group Comparisons . . . . .             | 45   |
| VI. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Johnson's Kicking Test: Inter-Group Comparisons . . . . .                    | 46   |
| VII. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Johnson's Jump-and-Reach Test: Inter-Group Comparisons . . . . .            | 47   |
| VIII. Kruskal-Wallis One-Way Analysis of Variance by Ranks: Johnson's Zigzag Run Test: Inter-Group Comparisons . . . . .               | 48   |

| TABLE   | PAGE |
|---|------|
| IX. Kruskal-Wallis One-Way Analysis of Variance<br>by Ranks: Heartometer: Area Under the Curve:<br>Inter-Group Comparisons . . . . .          | 51   |
| X. Kruskal-Wallis One-Way Analysis of Variance<br>by Ranks: Heartometer: Area Divided by Sur-<br>face Area: Inter-Group Comparisons . . . . . | 52   |
| XI. Kruskal-Wallis One-Way Analysis of Variance<br>by Ranks: Heartometer: Systolic Pulse Wave<br>Amplitude: Inter-Group Comparisons . . . . . | 53   |
| XII. Kruskal-Wallis One-Way Analysis of Variance<br>by Ranks: Heartometer: Rest to Work Ratio:<br>Inter-Group Comparisons . . . . .           | 54   |
| XIII. Kruskal-Wallis One-Way Analysis of Variance<br>by Ranks: Heartometer: Angle of Obliquity:<br>Inter-Group Comparisons . . . . .          | 55   |

LIST OF FIGURES

| FIGURE                          | PAGE |
|---------------------------------|------|
| 1. Obliquity Angle . . . . .    | 6    |
| 2. Rest to Work Ratio . . . . . | 18   |

## CHAPTER I

### THE PROBLEM AND DEFINITIONS OF TERMS USED

Physical fitness has come to increased public attention in the last few years due to comments made about Americans as being "flabby" and the rising rate of heart attacks. Today's mass media inform the American people on ways to become fit and how to live a healthier life. The President's Councils on Physical Fitness have made reports, created tests, and urged the youth of America to become members of the President's All American Team. Adults are urged to keep fit and to keep their families fit by participating in the family sport of jogging.

People who participate in these fitness programs soon reap the benefits and encourage others to join and become physically fit. By becoming fit these people enjoy themselves more in both work and play. They meet new people, do new things, and are more mentally alert. Once they see the above benefits they continue their fitness programs with added vigor. All in all the physically fit person not only feels better but looks better to those around him. Because of the above mentioned benefits, people want their children to realize the attributes of being fit throughout life. People who educate the youth of America are asked whether these children are physically

fit to a minimum degree. Some educators claim the present physical education programs of their schools meet the requirements for fitness, others conversely claim that their physical education programs are inadequate. Most claims, however, are based on limited studies done in the field of physical fitness as related to physical education.

## I. THE PROBLEM

### Statement of the Problem

It was the intent of this study to investigate the effect of varied proportions of physical exercise equated in type and duration, on two equated groups of fifth and sixth grade boys. The phrase "varied proportions" had the following specific meaning: During 1967-1968, two fifth and three sixth grade classes of boys participated in physical education daily. The time allotment was ten minutes daily or one thousand minutes over the entire year. During the 1968-1969 school year, three fifth and two sixth grade classes of boys participated in daily physical education. The physical exercise aspect of their program also equalled one thousand minutes over the entire school year but was allocated in five segments of time amounting to twenty minutes per day for ten school days in each segment. Thus, the total time spent on exercise during the year for the groups composing the study was equal. The variable factor

was the manner in which the total time spent on physical exercise was allocated.

### Importance of the Study

The importance of this study lay in determining which of two physical fitness programs would provide youngsters with the best development in physical fitness and fundamental motor skills. The physical fitness programs were the same except in technique of administration. One program presented ten minutes of physical fitness exercises each physical education period throughout the school year. The second program was administered in five segments. Each segment consisted of ten consecutive physical education periods in length. This study followed a modification of recommendations of the President's Council on Youth Fitness with one slight variation. According to the President's Council on Youth Fitness:

It is recommended that all students spend at least 15 minutes per day in participating in sustained conditioning exercises and developmental activities designed to build vigor, strength, flexibility, endurance, and balance (18).

Instead of the recommended fifteen minutes per day of physical fitness exercises there were only ten minutes of exercises. The physical education period was twenty minutes long. The total time was divided in half. Ten minutes were used as already stated and ten minutes of non-fitness type

activities completed the period.

The Washington state law stipulated that teachers provide twenty minutes of physical education exercises each school day, as follows:

In 1919, specific requirements for elementary schools were established by the following statute: "L. '19 p. 205, sec. 1. Physical education for common schools. After the first day of September, 1919, with periods averaging at least 20 minutes in each school day, every pupil attending the first eight grades of the public schools of the State of Washington shall have physical education. Individual pupils or students may be excused on account of physical disability or religious belief (2:7).

Therefore, the physical education program for the ten minute group will consist of fifty per cent physical fitness exercises and fifty per cent physical education activities. The block group's physical education program will concentrate the same amount of physical fitness exercises into five block periods spaced over a school year.

### Limitations of the Study

This study was limited in the following ways:

1. The subjects consisted of 149 fifth and sixth grade male students.
2. The number of boys was determined by the assignment to each class.
3. The study was confined to Lincoln Elementary School in Vancouver, Washington.

## II. DEFINITIONS OF TERMS USED

### Block Group

This term refers to the 1968-1969 group of students assigned to the two week periods of concentrated physical fitness exercises during physical education class.

### Ten Minute Group

This term refers to the 1967-1968 group of students that received ten minutes of physical fitness exercises each physical education period.

### Diastole

The time during which the heart fills its ventricles during each single cycle (7:235).

### Obliquity Angle

The angle created by the systolic stroke in each pulse wave of the heart. This angle (ABO) is measured from the maximum systolic point of the graph. One line is drawn from this point to the center of the graph. The other line is drawn almost tangentially to the upward systolic stroke line, going through point A (7:244). See Figure 1, page 6.



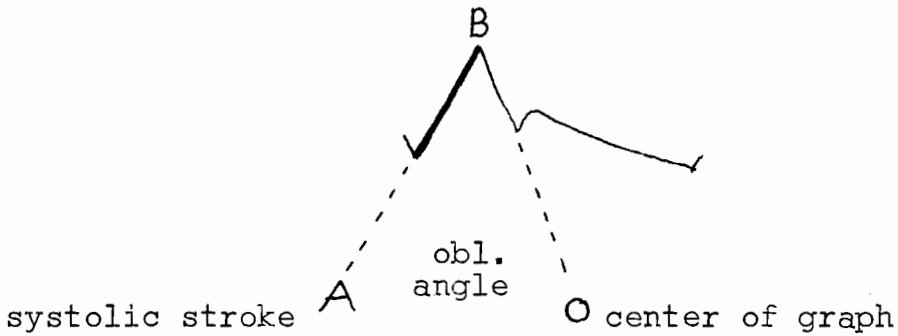


FIGURE 1

## OBLIQUITY ANGLE

Physical Fitness

This may be defined as:

. . . the development and maintenance of a sound physique and of soundly functioning organs, to the end that the individual realizes his capacity for physical activity, unhampered by physical drains or by a body lacking in physical strengths and vitality (4:16).

Rest to Work Ratio

This ratio compares the time the heart rests to the time the heart works per single cycle (7:249-250).

Systolic Pulse Wave Amplitude

This amplitude indicates the magnitude of the heart muscle due to the contraction of the ventricles (7:236).

T<sub>1</sub>

Initial test given in September: pre-test.

T<sub>2</sub>

Identical test to T<sub>1</sub> but given in May: post-test.

## OVERVIEW OF THE REMAINDER OF THIS THESIS

1. Chapter II related the historical background of physical fitness from Socrates to the late President Kennedy's Council on Youth Fitness. Also, it described the test batteries selected for this study.

2. Chapter III contained the procedure of investigation, the Classification Index, the physical fitness tests, and the fundamental skill tests used in this study.

3. Chapter IV analyzed the data obtained by this study.

4. Chapter V contained the summary, conclusions, and recommendations of this study.

## CHAPTER II

### REVIEW OF THE LITERATURE

#### I. OPINIONS OF LEADERS AND EXPERTS

Great men throughout history have been concerned with the physical fitness of their people. Fraley, Johnson, and Massey have quoted several noted educational leaders' views on physical fitness. Three of them are stated below:

Socrates (420 B.C.)

Our children from their earliest years must take part in all the more lawful forms of play, for if they are not surrounded with such an atmosphere they can never grow up to be well conducted and virtuous citizens (12:4).

Comenius (1650)

Intellectual progress is conditioned at every step by body vigor. To attain the best results, physical exercise must accompany and condition mental training (12:6).

Horace Mann (1845)

One of the most important items in a nation's wealth consists in the healthfulness and vigor enjoyed by its people (12:8).

In support of the above:

John F. Kennedy (1961)

We must take immediate steps to insure that every American child be given the opportunity to make and keep himself physically fit, fit to learn, fit to understand, to grow in grace and stature, to fully live (18:1).

From the quotations above one can assume that physical fitness, throughout world history has been on the minds of its great men.

In the United States more and more attention has been given to physical fitness following the Korean War and the publicity regarding the unfitness of American children as compared to European children. The latter was based upon the Kraus-Weber Test, which was published in the Journal of the American Association for Health, Physical Education, and Recreation (21:17-19) in December of 1953. Acting upon the results of this article, a friend of Dr. Kraus brought the conclusions to the attention of President Eisenhower. The president later called the first President's Conference of Fitness of American Youth in June of 1956 (22:25-33).

The late President Kennedy re-emphasized the need for keeping physically fit. His Council helped to improve existing programs and to develop new physical education programs with an emphasis on physical fitness (19:15-17).

The American Medical Association's Committee on Exercise and Physical Fitness stated that:

Regular exercise can be beneficial in controlling obesity, delaying degenerative disease, rehabilitating the ill or injured, and shortening recuperative periods. It is also unique in developing and maintaining physical fitness and in improving cardiovascular and respiratory efficiency (1:6+).

Even after an adequate state of physical fitness has been achieved it cannot be forgotten. One will have to do a certain amount of physical fitness exercises to maintain one's physical fitness (28:78).

## II. SELECTED STUDIES RELATED TO PHYSICAL FITNESS OF CHILDREN

Fox and Atwood in 1955 administered the Kraus-Weber Minimum Fitness Test to 575 children in grades one through six, in Iowa City, Iowa. The results of the data showed 66.1 per cent of the children failed due to lack of flexibility and 34.8 per cent failed because of weakness in one or more of the remaining tests (11:20-25).

The results of another study also showed the United States to be physically inferior. The fitness test of the American Association for Health, Physical Education and Recreation was administered to a group of children from England, Japan, Denmark and the United States. American boys and girls exceed the means of only the Japanese and on only one test--the sit up. On all other tests the American boys and girls performed below the children from the other countries (20:1).

Huttinger found that horizontal ladder exercises performed for ten minutes per day, five days a week, for a three-month period significantly increased the upper body strength of third graders (16:159-162).

Pattillo provided statistical results at the .01 level of significance that an exercise program designed for the large muscle groups was superior to a pupils' free

choice program and a partial exercise program. He had three groups each of which worked on one of the above programs. Each group was represented at the fourth, fifth, and sixth grade levels and he used the Washington State Elementary Physical Fitness Test as a measure of physical fitness. The experiment lasted nine weeks during which time all groups made improvement but the greatest and most significant was made by the experimental group (23:37-41).

Fabricius' study on the "Effects of Added Calisthenics on the Physical Fitness of Fourth Grade Boys and Girls" proved well beyond the .01 level of confidence that an added three minutes and nine seconds of calisthenics per physical education period resulted in better physically fit youngsters. The Oregon Motor Fitness Test was used as a measure of physical fitness (10:135-140).

Taddonio's study on the "Effects of Daily Fifteen Minute Periods of Calisthenics upon the Physical Fitness of Fifth Grade Boys and Girls" indicated a negative result, as follows:

Examination of postexperimental data for both the boys groups and the girls groups indicated that 15 min. daily periods of calisthenics in the intensity cited had little or no effect upon the physical fitness of 5th grade boys and girls as measured by the AAHPER Youth Fitness Test (27:278).

In recent times many people keep fit by jogging. According to David, jogging keeps you physically fit because your entire cardiovascular system is active. David

recommends jogging thirty minutes three or four times a week to keep fit (8:46-47+).

Cooper's Aerobics (with oxygen) exercise program emphasizes the ability to do prolonged work without fatigue. The latter is referred to as endurance fitness as it has to do with the body's overall health--the health of the heart, the lungs, the entire cardiovascular system and the other organs, as well as the muscles. The key to the whole program is oxygen. By doing a certain amount of exercise weekly an individual can maintain his physical fitness (6:80).

Duncan said, "Physical fitness means total body fitness." This implies that not only your body is fit but, also your mind is aware of the relationship of physical fitness to social and mental well-being, the knowledge of which to build and maintain personal fitness (9:19-20).

Physical fitness and physical education go hand in hand. This is brought out in the first "General Outcome of the Washington State Physical Education Guide, 1961; viz., "To develop and maintain maximum physical fitness for living" (2:7). The other general outcomes are:

- To develop useful skills.
- To develop social-emotional stability and mental alertness.
- To enjoy wholesome physical recreation (2:7).

Many physical education professionals believe that without

an adequate level of physical fitness none of the above outcomes can be fully accomplished.

### III. TESTS SELECTED FOR THIS STUDY

As stated earlier in Clarke's definition of physical fitness one can conclude physical fitness is a fairly broad concept involving the elements of strength, cardiovascular respiratory endurance, and muscular endurance. The writer has chosen the following physical fitness tests to evaluate the programs of this study because they measure the above elements of physical fitness. The tests are described below.

#### Physical Fitness Index

In 1925 Dr. Frederick Rand Rogers standardized a battery of tests to measure athletic performance and muscular strength (25:183). Through these tests Rogers established the Strength Index (SI) and the Physical Fitness Index (PFI).

The Strength Index is the gross score obtained from six strength tests plus lung capacity. The Physical Fitness Index is a score derived from comparing an achieved Strength Index with a norm of basic physical fitness elements (25:183-184).

Due to time required for administration, cost of test equipment, and the necessity for well-trained testers, Clarke and Carter of the University of Oregon undertook several simplifications of the test battery. The elementary



school simplification resulted in a multiple correlation of .977 with the full seven item Strength Index. The SI is the test and the PFI is the quotient resulting from the achieved SI being divided by a norm for SI which in turn is based upon sex, weight, and age. The equation for the PFI is:

$$\text{PFI} = \frac{\text{achieved SI}}{\text{normal SI}} \times 100$$

The Strength Index relates to the Physical Fitness Index as follows:

Regression equations for each of the multiple correlations were computed. By use of the appropriate equation, the physical educator is able to estimate approximately the SI each boy or girl would have achieved had he or she taken the full test. Thus, the regular SI norms may be used to estimate Physical Fitness Indices (4:166-167).

The equation for upper elementary school boys is:

$$\text{SI} = 1.05 (\text{leg lift}) + 1.35 (\text{back lift}) + 10.92 (\text{push-ups}) + 133$$

In the PFI a score of 100 is average. If the score is above or below 100 the person is considered superior or inferior in physical fitness. Factors that lower the PFI affect physical fitness and once these factors are corrected a person's PFI presumably should increase.

#### Hall's Quotient Drop-off Index

Hall's Index has been used as an endurance index because it shows a person's ability to maintain his short

run speed over a longer course (15:41). Hall's "Q" Index is based upon the 200 yard run and the 600 yard run. Runs longer than 600 yards had discouraged high participation by 4-H members; therefore, the 200-600 yard combination was established (15:43). During the Illinois 4-H Club field days in the years 1945-48, 95.2% of 7596 boys and girls taking part participated in the endurance test runs (15:38). Hall established the minimum index scores by using American and world championship records for the 200 yard run and the 600 yard run. By using championship records for the short and long run Hall established a time ratio constant that could be related to a distance ratio constant. The distance ratio constant for the 200 and 600 yard runs would always be three ( $600 \div 200$ ), but the time ratio constant would have to be updated as the championship records changed through the years. Hall's ideal "Q" Index is 1.29 established in 1951. It is possible for a person to better his index by not going "all out" on the shorter run. Emphasis must be placed on the runner doing his best on the 200 yard run. The "Q" Index is a valuable score to test the endurance of an individual.

#### Johnson's Fundamental Skills Tests for Boys and Girls

These tests consist of five basic physical education skills for grades one to six. The skills are throwing,

catching, kicking, jumping, and running. Johnson adapted tests for these five skills so that each proved to be an objective indicator of the child's ability to perform the tested skill. The final battery of tests consisted of a throw-and-catch test, a jump-and-reach test, a kicking test, and a zigzag run test (17:95). The reliability of the tests was determined by the test-retest technique. Approximately 50 boys and 50 girls each from grades one through six were tested twice during a four day period. The correlations met the requirements of a P of .01. To determine the validity of the test the classroom teachers ranked their students on a 1 (very poor) to 5 (superior) point scale. The results of the ranking were correlated with the skill test scores. The correlations for the fifth and sixth grade levels were significant at a P of .05 except in jump-and-reach. Some variations occurred in the primary grades (17:95-96). The Johnson Fundamental Skills Tests objectively measure the achievement of boys and girls in grades one through six in the five selected motor areas (17:101).

#### Heartometer Test

The heartometer test is administered in much the same manner as is the systolic blood pressure. Fifteen different measurements can be analyzed from one's heartograph. The writer selected five different measurements.

They were area under the curve, area under the curve divided by surface area, systolic pulse wave amplitude, rest to work ratio, and the angle of obliquity. These measurements were chosen because Irving, a heartometer expert, recommended them due to his experience with this age group.

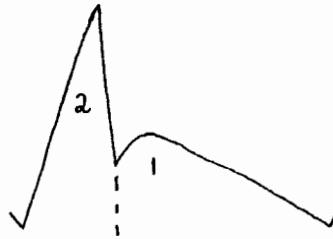
The area under the curve reflects somewhat the volume of blood pumped per stroke of the heart. A poorly conditioned cardiovascular system delivers a small volume of blood at rest and also under stress of exertion, and a well-conditioned cardiovascular system delivers a more adequate volume of blood (7:235-236). The measurement was done with an integrating polar planimeter. The writer then converted this measurement from square inches to square centimeters.

The area under the curve divided by the surface area measurement is computed in two steps as follows: (1) the subject's height and weight are converted to surface area by means of a nomograph; (2) area under the curve (in square centimeters) is then divided by surface area (in square meters). This measurement makes possible the direct comparison of pulse waves of individuals of different physical size.

The systolic pulse wave amplitude measurement indicates the magnitude of cardiac contraction (myocardial action) due to contraction of the ventricles. Above average

amplitude indicates a strongly acting cardiovascular system up to the limit of the normal range. Below average amplitude suggests a heart with a relatively weak stroke during systole (7:236).

The rest to work ratio compares the time of ventricle relaxation (time of diastole<sup>1</sup>) to the time of ventricle contraction (time of systole<sup>2</sup>). See Figure 2 (7:235).



time of complete cycle

FIGURE 2

REST TO WORK RATIO

The rest to work ratio is an index of the efficiency of the heart. For example, a strong efficient cardiovascular system has a high ratio of four to one. That is, the four relates to the time devoted to rest and refilling of the ventricles (diastole) and the one refers to the time devoted to contractile work (systole). A person with a poor ratio is an individual reflecting a poor state of physical condition probably with a low minute volume capacity (7:249). The measurement is accomplished with vernier calipers.

The angle of obliquity was measured by protractor from the maximum systolic point of the graph. One ray (side of the angle) goes from the latter point to the middle of the graph. The other ray is superimposed upon the upward systolic stroke. The significance of this angle is that a slow acting heart produces a greater obliquity angle because more time is taken for the upward systolic stroke to reach its maximum point (7:244).

Appendix A contains an explanation of the use of the planimeter, vernier calipers, and protractor used for the heartometer measurements.

Cureton achieved a validity coefficient of .809 using the heartometer to predict endurance running on the Cureton Weighted Endurance Running Pulse Rate Condition Test. Cureton used standard scores from eight heartometer items, as follows: (1) Area, (2) Systolic Amplitude, (3) Dicrotic Notch Amplitude, (4) Fatigue Ratio, (5) Angle of Obliquity, (6) Pulse Rate, (7) Time of a Single Cycle, and (8) Rest to Work Ratio (7:250).

## CHAPTER III

### PROCEDURES OF INVESTIGATION

In this chapter will be found the research hypothesis to be tested, a description of the subjects, as well as a description of the tests used, and the statistical procedures followed.

#### I. HYPOTHESIS TO BE TESTED

##### Research Hypothesis

There will be significant differences between the two groups in both physical fitness and motor skills abilities.

##### Subjects

The subjects were from the Lincoln Elementary School student body, located in Vancouver, Washington. The subjects were the fifth and sixth grade boys from the school years 1967-68 and 1968-69. The Ten Minute group was represented by the 75 boys who participated in 1967-68. The Block group was represented by the 74 boys who participated in 1968-69. There were 149 boys altogether. The school is located in a middle socio-economic class area.

#### II. PLAN OF THE INVESTIGATION

A physical education program was developed containing

planned elements of physical fitness and motor skills activities. The time exposure was equal for each of the two groups who participated but was varied as to proportions over the school year. Each of the two groups was tested at the beginning and again at the end of the school year on selected tests of physical fitness and fundamental motor skills. The participants were fifth and sixth grade boys who were studied over a period of two school years.

The 1967-1968 group received ten minutes each day; whereas, the 1968-1969 group received five separate blocks of physical fitness exercises five times throughout the school year. The blocks were spaced approximately five weeks apart. The first block was at the end of September, the second in the middle of November, the third in the middle of January, the fourth at the beginning of March, and the fifth at the end of April. Except for the physical fitness aspect both groups were taught the same games, dances, and self-testing exercises throughout the school year.

### III. TESTS AND TEST BATTERIES

#### Physical Fitness Index

Two of the physical fitness tests that make up the PFI are the back lift and leg lift. These tests are measured on an instrument called a dynamometer. "The back and leg dynamometer is an instrument used in measuring the



strength of both back and leg muscles" (4:187). The dynamometer when properly calibrated can measure up to 2,500 pounds. The chain utilized with the dynamometer should be 24 inches in length and its handle should be from 20 to 22 inches long (4:187). The procedure of measurement and the instrument are illustrated in Application of Measurement to Health and Physical Education, 3rd edition (4:189). The physical fitness tests mentioned are described in detail in Appendix A.

#### Two Hundred Yard Run

The boys ran 200 yards at their top speed. Their runs were timed to the nearest one-tenth second.

#### Six Hundred Yard Run

The boys ran 600 yards at their fastest possible speed. Their runs were timed to the nearest one-tenth second.

#### Hall's Quotient Drop-off Index

The 200 yard run and 600 yard run test results were combined into a Quotient Drop-off Index. The equation is:

$$Q = \text{time ratio} \left( \frac{\text{long run}}{\text{short run}} \right) + \text{distance ratio} \left( \frac{\text{long run}}{\text{short run}} \right)$$

The two running tests measure speed (the elapsed time of the runner in the 200 yard run) and ability of the

runner to maintain his short run speed (elapsed time of the runner in the 600 yard run). The physical fitness of the runner was evaluated by the Quotient Drop-off Index. For example, if a person ran the 200 yard run in 22 seconds, he should theoretically be able to run the 600 yard run in 66 seconds. Although the latter is physically impossible, the extent to which the person can maintain his maximal speed is a measure of his physical fitness. The physical fitness of a runner is evaluated by the change in his "Q" Index, with a decreased index denoting increased physical fitness (15:42).

### Johnson's Fundamental Skills Tests

These tests measure the following fundamental skills of elementary school children: throwing, catching, kicking, jumping, and running. Johnson selected these skills as being typical of the activities continuously engaged in by elementary school children. See Appendix A for a description of and the administration procedures for the Johnson tests.

### Heartometer

The heartometer is an instrument that displays a graphic record of cardiovascular action. The record is referred to as a heartograph. Cureton explains it as follows:

The heartograph is a graphical record made by an almost frictionless pen which is activated by the pulsations of the brachial artery transmitted by means of a standard pressure cuff and enclosed air column of the sphygmomanometer type. The air pressure operates a delicate bellows to which is attached the leverage system activating the writing pen (7:232).

#### IV. ORGANIZATION OF THE EXPERIMENT

##### Classification Index

Before the physical fitness programs started each participant was measured in height to the last full inch, weighed to the last full pound, and had his age computed to the nearest half year. The age, height, and weight were then combined in the following formula:  $CI\ 1 = 20\ Age + 6\ Ht. + Wt.$  A table facilitated the computation.

##### Organization of Testing

Following the age-height-weight classification the physical fitness and fundamental skills pre-test were administered in the order previously described. The heartometer pre-test was given in November to a random sample of 27 subjects. Randomization was accomplished in the following manner: Each student's name was written on a piece of tag board. The cards were put in a box. The school librarian blindly drew out one card and read the name to the writer. The card was then put back into the box. Between drawings the box was vigorously shaken. The above

procedure continued until the sample number was obtained. The test was given later than the other tests because the writer had to secure both medical and administrative permission to administer the cardiac function test to the subjects.

### Selection of the Level of Significance

For this study alpha was set at the .05 level of confidence.

### Statistical Analysis

The data were analyzed by means of a  $\underline{t}$  test for the significance of differences between means of uncorrelated groups for small samples. The formulas are:

$$t = \frac{M_1 - M_2}{SE \text{ diff}_M} \quad (14:191)$$

$$SE \text{ diff}_M = \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2} \quad (14:214)$$

The writer's objectivity in determining the heartograph measurements was determined by his ability as compared to Dr. Irving, who is highly qualified in making the measurements. Dr. Irving has made measurements on over 10,000 heartographs during his years of experience working with the heartometer. He has interested non-active businessmen into

physical fitness programs by showing how others have improved their physical condition by following such a program. The results are shown by way of improved heartographs. The correlations between the writer and Dr. Irving in making these measurements were as follows:

1. Area under the curve .9963.
2. Area under the curve divided by surface area .9845.
3. Systolic pulse wave amplitude .9928.
4. Rest to work ratio .9719.
5. Angle of obliquity .9995.

The equation used for the above correlations was:

$$r = \frac{N \sum XY - \sum X \sum Y}{\sqrt{[N \sum X^2 - (\sum X)^2] [N \sum Y^2 - (\sum Y)^2]}}$$

(14:143)

## CHAPTER IV

### RESULTS OF THE STUDY

#### I. STATEMENT OF THE PROBLEM

It is the intent of this study to investigate the effect of varied proportions of physical exercise equated in type and duration, on two equated groups of fifth and sixth grade boys. The reader is referred to Chapter I for a more definitive explanation of the purpose of this study.

#### Subjects

The subjects were from Lincoln Elementary School student body. There were a total of 149 fifth and sixth grade boys participating. The 1967-68 or Ten Minute group consisted of 75 boys who came from two fifth grade rooms (30 boys) and three sixth grade rooms (45 boys). The 1968-69 or Block group consisted of 74 boys who came from three fifth grade rooms (42 boys) and two sixth grade rooms (32 boys).

#### Similarities and Differences in the Physical Exercise Program

The exercise program was the same for both the Ten Minute and the Block group except in the technique in which it was administered. The Ten Minute group received ten minutes of physical fitness exercises each physical education period; whereas, the Block group received its physical

fitness exercises five times throughout the school year for ten consecutive physical education periods each time. Each physical education exercise period lasted for twenty minutes.

### Tests Utilized

Physical Fitness Index. The Oregon simplification of the PFI was used as a strength test. The PFI used consisted of the following three tests: back lift, leg lift, and dips. The back and leg lifts were evaluated on the dynamometer. The dips were evaluated on the parallel bars by counting the number accomplished.

Hall's Quotient Drop-off Index. Hall's Index evaluated the functional cardiovascular respiratory endurance of the subjects. The "Q" Index involved the 200 and 600 yard runs. The "Q" Index is computed by way of a time ratio (long run divided by short run) and a distance ratio (long run divided by short run).

Johnson Fundamental Skills Test for Boys and Girls. The Johnson test evaluated five basic motor skills of fifth and sixth graders. The skills were throwing, catching, kicking, jumping, and running.

Heartometer test. The heartometer test produces a

pulse wave graph of the heartbeat. Parts of the pulse wave were measured by the writer. The parts measured were area under the curve, area under the curve divided by surface area, systolic pulse wave amplitude, rest to work ratio, and the angle of obliquity.

## II. FINDINGS OF THE STUDY

### Equating the Subjects

Before the physical fitness programs started each subject was given a CI 1 number (20 Age + 6 Ht. + Wt.). The writer equated the subjects by way of a  $t$  test based on the CI 1 numbers. The September CI 1 numbers for the two groups were compared by use of the  $t$  test for the significance of difference between uncorrelated means. Table I shows the  $t$  for the means of the Ten Minute and Block groups was .334. The  $t$  was not significant. The means were 650 and 648 respectively. Therefore, the two groups can be considered statistically equal.



TABLE I

SIGNIFICANCE OF DIFFERENCE BETWEEN UNCORRELATED MEANS  
OF THE TEN MINUTE GROUP AND THE BLOCK GROUP  
CLASSIFICATION INDEX I

| Ten Min.<br>Group Mean | Block<br>Group Mean | diff | SE <sub>diff</sub> | df  | <u>t</u> * |
|------------------------|---------------------|------|--------------------|-----|------------|
| 650                    | 648                 | 2    | 5.98               | 147 | .334       |

\*In order to be significant at the .05 l/c the t must be 1.96 for a two-tailed statistical test.

Analysis of the Data Based on t Ratios Computed for Significance of Difference Between Means

As the subjects had been equated at the outset by means of a combination of age, height, and weight it was felt that t tests computed for the significance of differences between uncorrelated means would adequately portray the influence of the difference in time allocation in the two programs. However, because of suspicions that equality between groups based on CI 1 might mask functional performance differences between the groups, it was decided to compute t ratios in September between groups as well as in May at the conclusion of the school year.

Physical Fitness Index. Table II shows the Ten Minute group's mean to be 107.8 in September. The Block group's mean was 102.1. The difference between means was

5.6. The  $\underline{t}$  of 1.26 was not significant at the .05 level. The May mean for the Ten Minute group was 114.5 and the Block group's mean was 101.2. The difference between means was 13.3. The  $\underline{t}$  of 3.25 was significant at the .001 level. The Ten Minute group was statistically superior in strength in May but had more than a five point advantage over the Block group the previous September.

Hall's Quotient Drop-off Index. The Ten Minute group had a mean of 1.41 in September and the Block group's mean for the same month was 1.38. The difference was .03 between the means. The  $\underline{t}$  of 1.07 was not significant at the .05 level. In May the Ten Minute group's mean was 1.35 and the Block group's mean was 1.33. The difference between the means was .02. The  $\underline{t}$  of .13 was not significant at the .05 level. The Ten Minute group made a slight overall improvement in "Q" Index, .06 as compared to .05. Therefore, even though the Block group had a lower "Q" Index both in September and May, the Ten Minute group showed more improvement over the same period. That is, their mean functional cardiovascular respiratory ability improved slightly more than did the Block group.

Johnson Fundamental Skills Tests for Boys and Girls.

1. Kicking test. The Ten Minute and Block groups' means were 36.1 and 42.5 respectively. The difference was 6.4. The  $t$  of 1.93 was not significant. In May the Ten Minute group's mean was 54.0 and the Block group's mean was 48.9. The difference was 5.1 between the means. A  $t$  of 1.50 was not significant at the .05 level. The  $t$  ratios for this test were near the significance level. A closer look at the means shows that during the two programs the Ten Minute group made the greater improvement, 17.9 points as compared to 6.4 points by the Block group. Although the  $t$ 's were not significant it could be assumed that the Ten Minute group made the greater foot-eye coordination improvement.

2. Throw-and-catch test. A mean of 33.2 was computed for the Ten Minute group for September. The Block group's September mean was 23.1. The difference was 10.1 between the means. The  $t$  of 4.21 was significant at the .001 level. The Ten Minute group was statistically superior over the Block group in September. In May the Ten Minute group's mean was 40.2 and the Block group's mean was 37.3. The difference was 2.9. The  $t$  of .90 was not significant at the .05 level. The Ten Minute group was statistically superior in September but by May the Block group had

TABLE II

SIGNIFICANCE OF DIFFERENCES BETWEEN PHYSICAL  
PERFORMANCE TEST MEANS: SEPTEMBER AND MAY

| Test battery | Test item      | Ten min. group Sept. | Ten min. group May | Block group Sept. | Block group May | diff | SE <sub>diff</sub> | df  | <u>t</u> * |
|--------------|----------------|----------------------|--------------------|-------------------|-----------------|------|--------------------|-----|------------|
| PFI          |                | 107.8                |                    | 102.1             |                 | 5.6  | 4.45               | 147 | 1.26       |
| PFI          |                |                      | 114.5              |                   | 101.2           | 13.3 | 4.09               | 147 | 3.25       |
| Q            |                | 1.41                 |                    | 1.38              |                 | .03  | .028               | 147 | 1.07       |
| Q            |                |                      | 1.35               |                   | 1.33            | .02  | .226               | 147 | .13        |
| Johnson test | Kicking        | 36.1                 |                    | 42.5              |                 | 6.4  | 3.3                | 147 | 1.93       |
|              | Kicking        |                      | 54.0               |                   | 48.9            | 5.1  | 3.4                | 147 | 1.50       |
|              | Throwing       | 33.2                 |                    | 23.1              |                 | 10.1 | 2.4                | 147 | 4.21       |
|              | Throwing       |                      | 40.2               |                   | 37.3            | 2.9  | 3.21               | 147 | .90        |
|              | Jump and reach | 31.6                 |                    | 35.0              |                 | 3.4  | 2.79               | 147 | 1.22       |
|              | Jump and reach |                      | 49.6               |                   | 52.9            | 3.3  | 3.37               | 147 | .98        |
|              | Zigzag         | 24.7                 |                    | 39.3              |                 | 14.6 | 2.80               | 147 | 5.21       |
|              | Zigzag         |                      | 46.1               |                   | 42.1            | 4.0  | 2.64               | 147 | 1.51       |

\*In order to be significant at the .05 l/c the t must be 1.96 for a two-tailed statistical test.

TABLE II (continued)

| Test battery | Test item     | Ten min. group Sept. | Ten min. group May | Block group Sept. | Block group May | diff | SE <sub>diff</sub> | df | <u>t</u> * |
|--------------|---------------|----------------------|--------------------|-------------------|-----------------|------|--------------------|----|------------|
| Heartometer  | area          | .194                 |                    | .287              |                 | .093 | .120               | 25 | .78        |
|              | area          |                      | .245               |                   | .377            | .132 | .381               | 25 | .34        |
|              | area/sur area | .153                 |                    | .224              |                 | .071 | .163               | 25 | .44        |
|              | area/sur area |                      | .176               |                   | .289            | .113 | .230               | 25 | .49        |
|              | sys amp       | .670                 |                    | 1.009             |                 | .329 | .069               | 25 | 4.76       |
|              | sys amp       |                      | .830               |                   | 1.106           | .276 | .284               | 25 | .97        |
|              | r:w           | 1.857                |                    | 1.908             |                 | .051 | .071               | 25 | .72        |
|              | r:w           |                      | 2.640              |                   | 3.333           | .690 | .905               | 25 | .76        |
|              | obl $\angle$  | 25.22                |                    | 22.74             |                 | 2.48 | .803               | 25 | 3.09       |
|              | obl $\angle$  |                      | 20.13              |                   | 20.08           | .05  | .219               | 25 | .23        |

\*In order to be significant at the .05 l/c the t must be 2.06 for a two-tailed statistical test.

increased their mean 14.2 points; whereas, the Ten Minute group's mean increased 7.0 points. Therefore, the May  $\bar{t}$  was not significant but the Block group must be accredited with the better improvement in their eye-hand coordination.

3. Jump-and-reach test. The Ten Minute group's September mean was 31.6. The September mean for the Block group was 35.0. The difference between means was 3.4. The  $\bar{t}$  was 1.22 and it was not significant at the .05 level. The May mean for the Ten Minute group was 49.6. The Block group's May mean was 52.9. The difference between means was 3.3. The  $\bar{t}$  was .98 and not significant at the .05 level. Neither group was statistically superior in the jump and reach skill. Each made about the same improvement. The two physical education programs appear to have had about the same effect on development of explosive power of the legs.

4. Zigzag run test. The September means for the Ten Minute group and Block group were 24.7 and 39.3 respectively. The difference between the means was 14.6. The  $\bar{t}$  ratio of 5.67 was significant at the .001 level. The Ten Minute group was significantly superior. The Ten Minute group's mean in May was 46.3. The Block group's mean was 42.1. The difference was 4.0 between means. The  $\bar{t}$  was 1.51. It was not significant at the .05 level. Even

though the May  $t$  was not significant, by examining Table II it may be seen that the Ten Minute group showed a greater loss in their agility skill from September to May (21:4). During the same time span, the Block group remained more consistent. Their loss was 2.8. Therefore, the Block group maintained their agility skill to a higher degree than did the Ten Minute group.

### Heartometer test.

1. Area under the curve. The September mean for the Ten Minute group was .194. The Block group's mean was .287 in September. The difference between the means was .093. The  $t$  of .78 was not significant at the .05 level. In May the Ten Minute group's mean was .245. The Block group's mean was .377. The difference was .132. A  $t$  of .34 was computed and it was not significant at the .05 level. Neither the September nor the May  $t$  ratio was significant but the Block group appeared to benefit more from their type of training as far as tone and resiliency of the artery walls and cardiac stroke volume improvement were concerned.

2. Area under the curve divided by surface area. The Ten Minute group's September mean was .153. For the Block group the September mean was .224. The difference

between means was .071. The resulting  $\underline{t}$  of .44 was not significant at the .05 level. In May the Ten Minute group's mean was .176 and the Block group had a mean of .289. The difference between means was .113. The  $\underline{t}$  ratio of .49 was not significant at the .05 level. Due to the relationship between this measurement and the area under the curve measurement the Block group's greater gain carried over. The effect of this measurement was to divide out body size, which permits the conclusion that the greater gain shown by the Block group is related only to program effects rather than to a combination of program effects and body size.

3. Systolic pulse wave amplitude. The September mean for the Ten Minute group was .670. The Block group's September mean was 1.009. A difference of .329 was computed between the means. The  $\underline{t}$  was 4.76 which was significant at the .001 level. In May the Ten Minute group's mean was .830. The Block group's May mean was 1.106. The difference between means was .276. The  $\underline{t}$  was .97 and not significant at the .05 level. The comparative improvements in means of the two groups helps to explain why the May  $\underline{t}$  ratio was not significant. It appears that the cardiac ventricular action associated with the activities and requirements of the Ten Minute program equaled the gain of the Block group during the school year.



4. Rest to work ratio. The September mean for the Ten Minute group was 1.857. The September mean for the Block group was 1.908. A difference of .051 was computed between the two means. The  $\underline{t}$  was .72 and not significant at the .05 level. In May the means for the Ten Minute and Block groups were 2.640 and 3.333 respectively. The difference between means was .690. The  $\underline{t}$  was .76 and not significant at the .05 level. Over the course of the school year the Block group showed a greater mean improvement than did the Ten Minute group. The comparative  $\underline{t}$  ratios were not significant but the Block group made more progress in developing superior cardiac efficiency than did the Ten Minute group.

5. Angle of obliquity. The ten Minute group's September mean was 25.22. The Block group's September mean was 22.74. The difference between means was 2.84. The  $\underline{t}$  was 3.09 and significant at the .01 level. The Block group was significantly superior. In May the mean for the Ten Minute group was 20.13 and the Block group's mean was 20.08. The difference between the means was .05. The  $\underline{t}$  was .23 and not significant at the .05 level. Even though the May  $\underline{t}$  ratio was not significant for either group, by examining the mean improvement one can note that the Ten Minute group gained considerably more from their program than did the Block group. The obliquity angle is apparently a measure of internal resistance of the arterial blood column.

### Kruskal-Wallis One-way Analysis of Variance by Ranks (H)

As shown by Table II many of the  $t$ 's approached the .05 level of significance. That is, the  $t$  ratios were too high to be discounted and because of this the writer felt a different statistical approach might be useful in order to obtain more definitive statistical results. The H test was employed to analyze the data for this purpose. The H test is useful for deciding whether independent samples are from the same population by ranking the samples taken together. Siegel describes it in the following manner:

Sample values almost invariably differ somewhat, and the question is whether the difference among the samples signify genuine population differences or whether they represent merely chance variations, such as are to be expected among several random samples from the population (26:184).

In this study the differences between scores for each group at  $T_1$  and  $T_2$  were ranked by combining them using rank 1 for the greater loss or lesser improvement between  $T_1$  and  $T_2$ . The writer used the H test to determine if the  $T_1$  and  $T_2$  changes on the physical fitness tests and the skills tests, when ranked, could have arisen from the same population of changes. The formula is:

$$H = \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1)$$

(26:189).

Physical Fitness Index. The comparison of change

in PFI between  $T_1$  and  $T_2$  for the Ten Minute group and the Block group was made by use of the H test. The respective R values were 6454.5 and 5182.5 for the Ten Minute group and Block group, respectively. The H statistic was 43.6, significant at well beyond the .001 level of confidence, indication that the change in PFI associated with the Ten Minute group was far greater than that made by the Block group. Therefore, the former group's program developed muscular strength more efficiently than did the latter group's program. Table III summarizes the above information.

Hall's Quotient Drop-off Index. For the comparison of change in "Q" Index between  $T_1$  and  $T_2$  the writer used the H test. The R values for the Ten Minute group was 6052 and for the Block group 5280. The H statistic was 14.47, significant at well beyond the .001 level of confidence. The results indicate the Ten Minute group made greater improvement than did the Block group in functional cardiovascular respiratory endurance. That is, the Ten Minute group's program enabled them to maintain their short run speed longer during a long run. Table IV summarizes the latter information.

TABLE III

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
 PHYSICAL FITNESS INDEX: INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |       | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|-------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank  | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 172              | -28  | 144            | 3     | 183            | -44  | 139            | 1     |
| 134              | -26  | 108            | 5     | 118            | -36  | 82             | 2     |
| 91               | -26  | 65             | 5     | 141            | -26  | 114            | 5     |
| 177              | -21  | 156            | 9.5   | 105            | -24  | 81             | 7     |
| 159              | -21  | 138            | 9.5   | 111            | -22  | 89             | 8     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| 82               | 36   | 118            | 142   | 76             | 25   | 101            | 136.5 |
| 106              | 40   | 146            | 144.5 | 123            | 27   | 150            | 138   |
| 77               | 41   | 118            | 146   | 91             | 39   | 130            | 143   |
| 104              | 42   | 146            | 147.5 | 108            | 40   | 148            | 144.5 |
| 115              | 51   | 166            | 149   | 120            | 42   | 162            | 147.5 |
| R = 6454.5       |      |                |       | R = 5182.5     |      |                |       |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{149(150)} \left[ \frac{6454.5^2}{75} + \frac{5182.5^2}{74} \right] - 3(150) \\
 &= 493.09 - 450 = \chi^2 = 43.09 \quad P = >.001 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> quotients appear in the first column and the T<sub>2</sub> quotients appear in the third column. The difference between the quotients appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 43.6.

TABLE IV

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
 HALL'S QUOTIENT DROP-OFF INDEX  
 INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |       | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|-------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank  | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 1.01             | -.30 | 1.31           | 1.5   | 1.29           | -.30 | 1.59           | 1.5   |
| 1.12             | -.29 | 1.41           | 3     | 1.39           | -.23 | 1.62           | 5.5   |
| 1.33             | -.24 | 1.57           | 4     | 1.18           | -.20 | 1.38           | 9     |
| 1.35             | -.23 | 1.58           | 5.5   | 1.62           | -.17 | 1.79           | 12    |
| 1.29             | -.22 | 1.51           | 7.5   | 1.34           | -.17 | 1.51           | 15.5  |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| 1.58             | .32  | 1.26           | 142   | 1.50           | .30  | 1.20           | 140.5 |
| 1.65             | .34  | 1.31           | 143.5 | 1.61           | .30  | 1.31           | 140.5 |
| 1.91             | .49  | 1.42           | 146   | 1.59           | .34  | 1.25           | 143.5 |
| 1.72             | .51  | 1.21           | 147   | 1.64           | .39  | 1.25           | 145   |
| 1.79             | .56  | 1.23           | 149   | 1.94           | .55  | 1.39           | 148   |
| R = 6052         |      |                |       | R = 5280       |      |                |       |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{149(150)} \left[ \frac{6052^2}{75} + \frac{5280^2}{74} \right] - 3(150) \\
 &= 464.47 - 450 = \chi^2 = 14.47 \quad P = >.001 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> quotients appear in the first column and the T<sub>2</sub> quotients appear in the third column. The difference between the quotients appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 14.47.

Johnson Fundamental Skills Tests for Boys and Girls.

The H test or Kruskal-Wallis one-way analysis of variance by ranks was used for each of the four test items in the Johnson test. Tables V through VIII summarize the  $T_1$  and  $T_2$  statistical information on those test items. That information is as follows:

1. Throw-and-catch test. Table V shows the Ten Minute group's R value was 5061.5 and the Block group R value was 6113.5. The H statistic was 5.39, significant beyond the .05 level of confidence. The Block group was favored; that is, they demonstrated a more finely developed eye-hand coordination skill.

2. Kicking test. Table VI shows the R value for the Ten Minute group was 6402.5 and the Block group R value was 4812.5. The H statistic was 11.48, significant well beyond the .001 level of confidence. Again the Ten Minute group was favored. This group's development of foot-eye coordination was superior to the Block group.

3. Jump-and-reach test. Table VII shows the respective R values for the Ten Minute and Block groups were 5989 and 5186. The H statistic was 1.75, which was not significant for either group. Apparently, neither

program of activities produced significantly superior results in development of explosive power.

4. Zigzag run test. Table VIII shows the Ten Minute group's R value was 7125 and the Block group R value was 4050. The H statistic was 32.42, significant well beyond the .001 level of confidence, indicating superiority of the Ten Minute group. This group's ability to change direction quickly was greater than the Block group.

TABLE V

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
JOHNSON'S THROW-AND-CATCH TEST  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |      | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 45               | -7   | 32             | 2    | 39             | -7   | 32             | 2     |
| 42               | -7   | 35             | 2    | 46             | -6   | 40             | 5     |
| 40               | -6   | 34             | 5    | 40             | -4   | 36             | 8.5   |
| 47               | -6   | 41             | 5    | 46             | -3   | 43             | 11    |
| 45               | -5   | 40             | 7    | 36             | -2   | 34             | 16.5  |
| .                | .    | .              | .    | .              | .    | .              | .     |
| .                | .    | .              | .    | .              | .    | .              | .     |
| .                | .    | .              | .    | .              | .    | .              | .     |
| 36               | 14   | 50             | 134  | 20             | 19   | 39             | 143.5 |
| 35               | 15   | 50             | 136  | 21             | 19   | 40             | 143.5 |
| 36               | 16   | 50             | 138  | 27             | 20   | 47             | 145.5 |
| 24               | 21   | 45             | 147  | 28             | 20   | 48             | 145.5 |
| 19               | 27   | 46             | 149  | 42             | 22   | 60             | 148   |
| R = 5061.5       |      |                |      | R = 6113.5     |      |                |       |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{149(150)} \left[ \frac{5061.5^2}{75} + \frac{6113.5^2}{74} \right] - 3(150) \\
 &= 455.39 - 450 = \chi^2 = 5.39 \quad P = >.05 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> scores appear in the first column and the T<sub>2</sub> scores appear in the third column. The difference between the scores appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 5.39.



TABLE VI

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
JOHNSON'S KICKING TEST  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |       | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|-------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank  | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 33               | -13  | 20             | 2.5   | 37             | -19  | 18             | 1     |
| 35               | -13  | 22             | 2.5   | 35             | -10  | 25             | 4.5   |
| 33               | -10  | 23             | 4.5   | 31             | - 9  | 22             | 6.5   |
| 25               | - 6  | 19             | 14.5  | 37             | - 9  | 28             | 6.5   |
| 26               | - 4  | 22             | 23.5  | 35             | - 8  | 27             | 8.5   |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| 28               | 15   | 43             | 141   | 29             | 12   | 41             | 134   |
| 25               | 16   | 41             | 143.5 | 20             | 13   | 33             | 136.5 |
| 25               | 18   | 43             | 145.5 | 27             | 16   | 43             | 143.5 |
| 22               | 19   | 41             | 147   | 23             | 18   | 41             | 143.5 |
| 15               | 20   | 35             | 148   | 15             | 24   | 39             | 149   |
| R = 6402.5       |      |                |       | R = 4812.5     |      |                |       |

$$H = \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1)$$

$$= \frac{12}{149(150)} \left[ \frac{6402.5^2}{75} + \frac{4812.5^2}{74} \right] - 3(150)$$

$$= 461.48 - 450 = \chi^2 = 11.48 \quad P = >.001 \text{ 1/c}$$

Within each section the T<sub>1</sub> scores appear in the first column and the T<sub>2</sub> scores appear in the third column. The difference between the scores appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the ranking appear as the R values in each section. The H value was 11.48.

TABLE VII

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
JOHNSON'S JUMP-AND-REACH TEST  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |       | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|-------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank  | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 9                | -1   | 8              | 3     | 15.5           | -5.5 | 10             | 1     |
| 13               | -.5  | 12.5           | 4.5   | 11             | -2.5 | 8.5            | 2     |
| 9                | 0    | 9              | 7.5   | 11             | -.5  | 10.5           | 4.5   |
| 6                | .5   | 6.5            | 14.5  | 10             | 0    | 10             | 7.5   |
| 11               | .5   | 11.5           | 14.5  | 11.5           | 0    | 11.5           | 7.5   |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| 10.5             | 5.5  | 16             | 144.5 | 7.5            | 5    | 12.5           | 138.5 |
| 11               | 5.5  | 16.5           | 144.5 | 9              | 5    | 9.5            | 138.5 |
| 11               | 5.5  | 16.5           | 144.5 | 6.5            | 5.5  | 12             | 144.5 |
| 12               | 5.5  | 16.5           | 144.5 | 11.5           | 5.5  | 16             | 144.5 |
| 8                | 6    | 14             | 148.5 | 6.5            | 6    | 12.5           | 148.5 |
| R = 5989         |      |                |       | R = 5186       |      |                |       |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{149(150)} \left[ \frac{5989^2}{75} + \frac{5186^2}{74} \right] - 3(150) \\
 &= 451.75 - 450 = \chi^2 = 1.75 \quad P = >.20 \quad 1/c
 \end{aligned}$$

Within each section the T<sub>1</sub> scores appear in the first column and the T<sub>2</sub> scores appear in the third column. The difference between the scores appears in the second column, while the consecutive rankings between groups appear in the last column. The H value was 1.75.

TABLE VIII

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
JOHNSON'S ZIGZAG RUN TEST  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |       | BLOCK GROUP    |      |                |       |
|------------------|------|----------------|-------|----------------|------|----------------|-------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank  | T <sub>1</sub> | diff | T <sub>2</sub> | rank  |
| 7.0              | -1.0 | 8.0            | 7     | 8.0            | -2.4 | 10.4           | 1     |
| 8.2              | - .5 | 8.7            | 16.5  | 8.4            | -1.7 | 10.1           | 2     |
| 8.8              | - .2 | 9.0            | 25.5  | 7.4            | -1.6 | 9.0            | 3     |
| 8.8              | - .1 | 8.9            | 28    | 7.6            | -1.4 | 9.0            | 4     |
| 8.5              | .0   | 8.5            | 34    | 7.7            | -1.3 | 9.0            | 5     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| .                | .    | .              | .     | .              | .    | .              | .     |
| 11.1             | 2.3  | 8.8            | 143   | 10.2           | 1.8  | 8.4            | 131.5 |
| 10.2             | 2.5  | 7.7            | 144.5 | 8.9            | 2.0  | 6.9            | 137   |
| 11.0             | 3.0  | 8.0            | 146   | 9.7            | 2.2  | 7.5            | 140.5 |
| 10.8             | 3.5  | 7.3            | 147.5 | 10.8           | 2.5  | 8.3            | 144.5 |
| 11.5             | 4.0  | 7.5            | 149   | 10.5           | 3.5  | 7.0            | 147.5 |
| R = 7125         |      |                |       | R = 4050       |      |                |       |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{149(150)} \left[ \frac{7125^2}{75} + \frac{4050^2}{74} \right] - 3(150) \\
 &= 482.42 - 450 = \chi^2 = 32.42 \quad P = >.001 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> scores appear in the first column and the T<sub>2</sub> scores appear in the third column. The difference between the scores appears in the second column, while the consecutive rankings between groups appear in the last column. The H value was 32.42.

Heartometer Test. The Kruskal-Wallis H Test was also used to evaluate the comparisons between  $T_1$  and  $T_2$  for the measurements listed below. Tables IX through XII summarize the following statistical information on the heartometer test items.

1. Area under the curve. The R value for the Ten Minute group was 95 and the Block group R value was 283. The H statistic was 3.23 which was not significant for either group. Table IX summarizes this information. Apparently neither program of physical fitness produced significantly superior results in development of artery wall resiliency and cardiac stroke volume.

2. Area under the curve divided by surface area. Table X shows the respective R values for the Ten Minute and Block group were 92 and 313. The H statistic was 18.13, significant at well beyond the .001 level of confidence. The Block group was statistically significant. This measurement when compared to body size by dividing shows the superiority of the heart muscle's strength, as shown on a heartograph.

3. Systolic pulse wave amplitude. The Ten Minute group's R value was 138 and the Block group R value was 240. Since the H statistic was 1.06, neither group was

significantly favored. Table XI summarizes this information. Neither program appeared to be significantly superior in developing a vigorous, strongly-acting systolic stroke.

4. Rest to work ratio. Table XII shows the Ten Minute group's R value was 101 and the Block group R value was 277. The H statistic was 2.53 and therefore the two groups were not significantly different.

5. Angle of obliquity. Table XIII shows the R value for the Ten Minute group was 167.5 and for the Block group 210.5. The resulting H statistic was 5.26, significant at the .05 level of confidence favoring the Ten Minute group. The manner of conduct of the activities of the Ten Minute group appears to have been beneficial to them at a level significantly greater than for the Block group, in terms of lack of peripheral resistance to blood flow.

TABLE IX

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
HEARTOMETER; AREA UNDER THE CURVE  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |       |                |      | BLOCK GROUP    |       |                |      |
|------------------|-------|----------------|------|----------------|-------|----------------|------|
| T <sub>1</sub>   | diff  | T <sub>2</sub> | rank | T <sub>1</sub> | diff  | T <sub>2</sub> | rank |
| .206             | -.006 | .200           | 1    | .387           | -.013 | .374           | 2    |
| .245             | -.103 | .142           | 3    | .374           | -.115 | .259           | 4    |
| .232             | .007  | .239           | 5    | .323           | .026  | .349           | 9    |
| .148             | .013  | .161           | 6    | .349           | .038  | .387           | 10   |
| .181             | .016  | .197           | 7    | .284           | .039  | .323           | 11   |
| .196             | .017  | .213           | 8    | .277           | .046  | .323           | 12   |
| .148             | .091  | .239           | 16   | .265           | .058  | .323           | 13   |
| .181             | .211  | .392           | 24   | .220           | .070  | .290           | 14   |
| .206             | .214  | .420           | 25   | .259           | .083  | .342           | 15   |
|                  |       |                |      | .323           | .102  | .425           | 17   |
|                  |       |                |      | .310           | .115  | .425           | 18   |
|                  |       |                |      | .196           | .120  | .316           | 19   |
|                  |       |                |      | .136           | .129  | .265           | 20   |
|                  |       |                |      | .330           | .152  | .482           | 21   |
|                  |       |                |      | .316           | .161  | .477           | 22   |
|                  |       |                |      | .265           | .185  | .450           | 23   |
|                  |       |                |      | .233           | .217  | .450           | 26   |
|                  |       |                |      | .310           | .220  | .530           | 27   |
| R = 95           |       |                |      | R = 283        |       |                |      |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{27(28)} \left[ \frac{95^2}{9} + \frac{283^2}{18} \right] - 3(28) \\
 &= 87.23 - 84 = \chi^2 = 3.23 \quad P = >.10 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> measurement appears in the first column and the T<sub>2</sub> measurement appears in the third column. The difference between the measurements appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 3.23.

TABLE X

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
HEARTOMETER: AREA DIVIDED BY SURFACE AREA  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |       |                |      | BLOCK GROUP    |       |                |      |
|------------------|-------|----------------|------|----------------|-------|----------------|------|
| T <sub>1</sub>   | diff  | T <sub>2</sub> | rank | T <sub>1</sub> | diff  | T <sub>2</sub> | rank |
| .191             | -.009 | .182           | 1    | .263           | -.090 | .173           | 2    |
| .194             | -.083 | .111           | 3    | .302           | -.019 | .283           | 4    |
| .194             | -.016 | .178           | 5    | .262           | .002  | .264           | 6.5  |
| .109             | .002  | .111           | 6.5  | .186           | .014  | .200           | 10.5 |
| .163             | .006  | .164           | 8    | .239           | .014  | .253           | 10.5 |
| .163             | .010  | .173           | 9    | .231           | .031  | .262           | 12   |
| .125             | .073  | .198           | 16   | .209           | .042  | .251           | 13   |
| .099             | .110  | .209           | 21   | .191           | .047  | .238           | 14   |
| .136             | .124  | .260           | 22.5 | .224           | .049  | .273           | 15   |
|                  |       |                |      | .267           | .076  | .343           | 17   |
|                  |       |                |      | .200           | .087  | .287           | 18   |
|                  |       |                |      | .148           | .098  | .246           | 19   |
|                  |       |                |      | .126           | .102  | .228           | 20   |
|                  |       |                |      | .268           | .124  | .392           | 22.5 |
|                  |       |                |      | .272           | .126  | .398           | 24   |
|                  |       |                |      | .222           | .147  | .369           | 25   |
|                  |       |                |      | .169           | .152  | .321           | 26   |
|                  |       |                |      | .250           | .164  | .414           | 27   |

R = 92

R = 313

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{27(28)} \left[ \frac{92^2}{9} + \frac{313^2}{18} \right] - 3(28) \\
 &= 102.13 - 84 = \chi^2 = 18.13 \quad P = >.001 \text{ 1/c}
 \end{aligned}$$

Within each section the T<sub>1</sub> measurement appears in the first column and the T<sub>2</sub> measurement appears in the third column. The difference between the measurements appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 18.13.

TABLE XI

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
HEARTOMETER: SYSTOLIC PULSE WAVE AMPLITUDE  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |      | BLOCK GROUP    |      |                |      |
|------------------|------|----------------|------|----------------|------|----------------|------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank | T <sub>1</sub> | diff | T <sub>2</sub> | rank |
| .86              | -.41 | .45            | 1    | 1.40           | -.32 | 1.08           | 2    |
| .73              | .02  | .75            | 6    | 1.30           | -.30 | 1.00           | 3    |
| .72              | .03  | .75            | 7    | 1.40           | -.13 | 1.21           | 4    |
| .68              | .11  | .79            | 12.5 | .93            | -.10 | .83            | 5    |
| .62              | .15  | .77            | 16   | 1.19           | .04  | 1.23           | 8    |
| .46              | .22  | .68            | 19   | 1.39           | .05  | 1.44           | 9    |
| .46              | .42  | .88            | 24   | .95            | .05  | 1.00           | 10   |
| .79              | .43  | 1.22           | 25.5 | .93            | .08  | 1.01           | 11   |
| .71              | .47  | 1.18           | 27   | .79            | .11  | .90            | 12.5 |
|                  |      |                |      | 1.00           | .13  | 1.24           | 14   |
|                  |      |                |      | 1.10           | .14  | 1.13           | 15   |
|                  |      |                |      | .81            | .20  | 1.01           | 17   |
|                  |      |                |      | .69            | .21  | .90            | 18   |
|                  |      |                |      | .72            | .23  | .95            | 20   |
|                  |      |                |      | .89            | .25  | 1.14           | 21   |
|                  |      |                |      | .89            | .30  | 1.19           | 22   |
|                  |      |                |      | .93            | .37  | 1.30           | 23   |
|                  |      |                |      | .86            | .43  | 1.29           | 25.5 |
| R = 138          |      |                |      | R = 240        |      |                |      |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{27(28)} \left[ \frac{138^2}{9} + \frac{240^2}{18} \right] - 3(28) \\
 &= 85.06 - 84 = \chi^2 \quad 1.06 \quad P = >.30 \quad 1/c
 \end{aligned}$$

Within each section the T<sub>1</sub> measurement appears in the first column and the T<sub>2</sub> measurement appears in the third column. The difference between the measurements appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 1.06.



TABLE XII

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
HEARTOMETER: REST TO WORK RATIO  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |      | BLOCK GROUP    |      |                |      |
|------------------|------|----------------|------|----------------|------|----------------|------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank | T <sub>1</sub> | diff | T <sub>2</sub> | rank |
| 1.82             | -.91 | .91            | 1    | 2.43           | -.05 | 2.38           | 5    |
| 1.75             | -.63 | 1.12           | 2    | 2.50           | .07  | 2.57           | 6    |
| 2.58             | -.58 | 2.00           | 3    | 1.75           | .29  | 2.04           | 7    |
| 3.00             | -.22 | 3.22           | 4    | 2.23           | .53  | 2.76           | 9    |
| 1.63             | .43  | 2.06           | 8    | 1.77           | .83  | 2.60           | 10   |
| 1.75             | 1.30 | 3.05           | 17   | 2.05           | .88  | 2.93           | 11   |
| 1.28             | 1.88 | 3.16           | 19   | 2.38           | .95  | 3.33           | 12   |
| 1.78             | 2.22 | 4.00           | 22   | 2.31           | .96  | 3.27           | 13   |
| 1.12             | 3.13 | 4.25           | 25   | 1.76           | 1.01 | 2.77           | 14   |
|                  |      |                |      | 1.95           | 1.05 | 3.00           | 15   |
|                  |      |                |      | .91            | 1.25 | 2.16           | 16   |
|                  |      |                |      | 1.77           | 1.60 | 3.37           | 18   |
|                  |      |                |      | 1.63           | 1.93 | 3.56           | 20   |
|                  |      |                |      | 1.70           | 2.06 | 3.76           | 21   |
|                  |      |                |      | 2.05           | 2.61 | 4.66           | 23   |
|                  |      |                |      | 2.36           | 2.77 | 5.13           | 24   |
|                  |      |                |      | 1.19           | 3.28 | 4.47           | 26   |
|                  |      |                |      | 1.60           | 3.65 | 5.25           | 27   |
| R = 101          |      |                |      | R = 277        |      |                |      |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{27(28)} \left[ \frac{101^2}{9} + \frac{277^2}{18} \right] - 3(28) \\
 &= 86.53 - 84 = \chi^2 \quad 2.53 \quad P = >.20 \quad 1/c
 \end{aligned}$$

Within each section the T<sub>1</sub> measurement appear in the first column and the T<sub>2</sub> measurement appear in the third column. The difference between the measurements appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 2.53.

TABLE XIII

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS  
HEARTOMETER; ANGLE OF OBLIQUITY  
INTER-GROUP COMPARISONS

| TEN MINUTE GROUP |      |                |      | BLOCK GROUP    |      |                |      |
|------------------|------|----------------|------|----------------|------|----------------|------|
| T <sub>1</sub>   | diff | T <sub>2</sub> | rank | T <sub>1</sub> | diff | T <sub>2</sub> | rank |
| 24.1             | 1.1  | 23.0           | 7    | 22.0           | .0   | 22.0           | 1    |
| 22.8             | 1.5  | 21.3           | 9.5  | 22.8           | .1   | 22.7           | 2    |
| 24.5             | 2.0  | 22.5           | 11   | 21.7           | .2   | 21.5           | 3    |
| 23.0             | 3.4  | 19.6           | 20   | 21.3           | .3   | 21.0           | 4    |
| 23.4             | 3.9  | 19.5           | 21   | 23.0           | .5   | 22.5           | 5    |
| 26.3             | 5.1  | 21.2           | 23   | 22.2           | 1.0  | 21.2           | 6    |
| 25.5             | 5.5  | 20.0           | 24.5 | 22.9           | 1.4  | 21.5           | 8    |
| 29.0             | 5.5  | 23.5           | 24.5 | 22.2           | 1.5  | 20.7           | 9.5  |
| 28.4             | 6.9  | 21.5           | 27   | 21.1           | 2.1  | 19.0           | 12.5 |
|                  |      |                |      | 23.1           | 2.1  | 21.0           | 12.5 |
|                  |      |                |      | 22.4           | 2.2  | 20.2           | 15   |
|                  |      |                |      | 22.8           | 2.2  | 20.6           | 15   |
|                  |      |                |      | 23.7           | 2.2  | 21.5           | 15   |
|                  |      |                |      | 23.8           | 2.3  | 21.5           | 17   |
|                  |      |                |      | 22.8           | 2.8  | 20.0           | 18   |
|                  |      |                |      | 23.2           | 3.0  | 20.2           | 19   |
|                  |      |                |      | 23.5           | 4.1  | 19.4           | 22   |
|                  |      |                |      | 24.8           | 6.0  | 18.8           | 26   |
| R = 167.5        |      |                |      | R = 210.5      |      |                |      |

$$\begin{aligned}
 H &= \frac{12}{N(N+1)} \sum \frac{R^2}{N} - 3(N+1) \\
 &= \frac{12}{27(28)} \left[ \frac{176.5^2}{9} + \frac{210.5^2}{18} \right] - 3(28) \\
 &= 89.26 - 84 = \chi^2 \quad 5.26 \quad P = >.05 \quad 1/c
 \end{aligned}$$

Within each section the T<sub>1</sub> measurement appear in the first column and the T<sub>2</sub> measurement appear in the third column. The difference between the measurements appears in the second column, while the consecutive rankings between groups appear in the last column. The summation of the rankings appear as the R values in each section. The H value was 5.26.

## III. SUMMARY

Because the writer felt the  $\bar{t}$  test results camouflaged the outcome of the study the Kruskal-Wallis one-way analysis of variance by ranks was employed. The  $\bar{t}$  test results did not consistently favor either of the groups at a statistically significant level. However, the H test showed the Ten Minute group to be quite consistently superior over the Block group. Between the two groups, the Ten Minute group and the Block group, the former was significantly superior on five of the tests. They were: (1) PFI, (2) Hall's Quotient Drop-off Index, (3) Kicking Test, (4) Zigzag Run Test, and (5) Angle of Obliquity. The Block group was significantly superior on two tests, the Throw-and-catch Test and the Area Under the Curve Divided by the Surface Area. Neither group was statistically superior on the four following tests: (1) Area Under the Curve, (2) Systolic Pulse Wave Amplitude, (3) Rest to Work Ratio, and (4) Jump-and-reach Test.

## CHAPTER V

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Purpose. The emphasis on physical fitness for the people of America has been discussed a great deal in the past few years. No one group of Americans has been overlooked. American people are becoming fit in order to subdue the "flabby American" image and ward off heart attacks. Physical fitness programs from jogging to more detailed exercises are available.

In the schools physical fitness is being dealt with in the physical education classes. Briefly restated, the purpose of this study was to investigate the effect of varied proportions of physical exercise equated in type and duration, on two groups of fifth and sixth grade boys.

Procedures. The study covered a two year period. The Ten Minute program was followed in 1967-1968 and the Block program was followed in 1968-1969. The boys participating in the study were classified by age, height, and weight and by means of a  $\pm$  ratio statistic the Ten Minute and Block groups were shown to be statistically equated maturationally and structurally. Following classification the boys were administered a series of pre-tests that included the: PFI, Hall's Quotient Drop-off Index, Johnson

Fundamental Skills Tests, and for some the Heartometer Test. The pre-tests were administered in September and identical post-tests were administered in May.

After the completion of the two programs over the two years the tests were evaluated by use of the  $\underline{t}$  ratio for significance of difference between uncorrelated means. No definite pattern emerged showing statistical significance of one program over another. Several of the  $\underline{t}$  ratios approached the .05 level of significance. Because of this it was felt that a different statistical attack might show more definitive results. Therefore, the Kruskal-Wallis one-way analysis of variance by ranks was employed to re-examine the test data. The Kruskal-Wallis H test ranks the differences between individual  $T_1$  and  $T_2$  scores from least improved (rank 1) to most improved (highest rank). By ranking the differences between the scores of the various physical fitness tests significant statistical results were noted. The Ten Minute group was quite consistently superior over the Block group and in many cases the superiority was statistically significant.

## II. CONCLUSIONS

The research hypothesis was accepted due to the following results.

### P.F.I. Test Results

As a result of the H test it was found that the Ten Minute group was significantly superior to the Block group at well beyond the .001 level of confidence. Therefore, ten minutes of continuous physical fitness exercise daily was of significantly greater value to the strength development of fifth and sixth grade boys than was the Block program.

### Hall's Quotient Drop-off Index

The H test showed the Ten Minute group to be significantly superior at well beyond the .001 level of significance. The functioning cardiovascular respiratory endurance of this group enabled them to attain and hold their short run speed longer than the Block group. Therefore, daily exposure to functional cardiovascular respiratory endurance was more beneficial than exposure for five two week segments spaced every month and a half throughout the school year.

### Johnson Fundamental Skills Tests for Boys and Girls

Throw-and-catch test. The H statistic showed the Block group to be significant at the .05 level of confidence. The Block group's eye-hand coordination was significantly better developed than that of the Ten Minute group.

Kicking test. The Ten Minute group's H was significant well beyond the .001 level of confidence. The skill demanded in this test was foot-eye coordination. The Ten Minute group developed their ability significantly better than did the Block group.

Jump-and-reach test. The H test showed the groups were not significantly different. Therefore, neither group out-performed the other in jumping ability significantly.

Zigzag run test. The Ten Minute group's H was significant at well beyond the .001 level of confidence. The ability of the Ten Minute group to quickly change directions, that is, their agility, was significantly superior to the Block group.

### Heartometer Tests

Area under the curve. There was no significant difference between groups according to the H test. Neither group's artery wall elasticity or stroke volume area was significantly superior to the other group.

Area under the curve divided by surface area. The Block group's H test was significant at the .001 level of confidence. Their overall increase of this measurement was significantly greater than the Ten Minute group. Table II

shows the area under the curve of the Block group to be larger than the Ten Minute group both in September as well as in May. The same conclusion is true when area under the curve divided by surface area is examined. Apparently when body size is divided out the superiority of the Block group over the Ten Minute group is conclusively shown.

Systolic pulse wave amplitude. The H test was not significant. Therefore, neither program was significantly superior in developing a strong acting left heart contractile force.

Rest to work ratio. Neither program was statistically superior in developing cardiac efficiency.

Angle of obliquity. The Ten Minute group's H test was significant at the .05 level of confidence. Apparently the Ten Minute group encountered significantly less resistance to the flow of blood through the body. The strong upward stroke followed by the quick downward stroke resulted in a smaller angle of obliquity.

The results of this study show that the Ten Minute group's exercise program was effective in providing a high level of physical fitness development for fifth and sixth grade boys. In a majority of statistical comparisons the Ten Minute group was superior, often significantly so.



The research hypothesis tested stated there would be significant differences between the two groups in both physical fitness and motor skills abilities. The Ten Minute group upheld the research hypothesis on many of the tests used in this study. Their muscular strength, their ability to maintain their top speed during a distance run, their eye-foot coordination, their agility, and the development of the cardiovascular system were statistically superior to that of the Block group. The daily physical fitness activities in which the Ten Minute group participated provided them with a high level of physical fitness. As they became more fit their fundamental motor skills continued to grow also.

The writer wishes to make one observation about the two groups. The Ten Minute group was composed of a group of boys of great athletic ability and competitiveness. The boys enjoyed the daily program and looked forward to seeing how much they improved as the year passed. They were amazed at their ability to put out so much effort in ten minutes and still have energy left for the other activities. The Block group grew tired of the concentrated physical fitness program after the first week of each segment. It was much harder to motivate them to do their best on the twenty minute workouts. As the workouts became tougher they grew more lax.

### III. RECOMMENDATIONS

The results of this investigation have affirmed the writer's belief that there would be significant differences between the two groups in both physical fitness and motor skill abilities. The group that was most significant in the above items was the Ten Minute group. The outcomes of this research have led the writer to make the following recommendations.

1. All elementary schools should include at least ten minutes of sustained physical fitness activities in each physical education period throughout their school year.

2. The ten minute program should be incorporated into a physical education program where it appears to be obvious that the development of motor skills will not be sacrificed for physical fitness attainment.

3. The physical fitness activities should be administered by a qualified instructor and they should be geared to the grade level of students participating.

4. Finally, due to the disinterest the Block group showed during each second week of a Block segment it is recommended that the study be replicated with the following change in the Block program: have one week of concentrated physical fitness activities once a month throughout the school year. That is, eight one week blocks instead of five two week blocks.

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## APPENDIX A

OREGON SIMPLIFICATION OF THE STRENGTH AND  
PHYSICAL FITNESS INDEX TESTS

Back Lift

1. With the feet in the proper position on the base of the dynamometer, the subject should stand erect with the hands on the front of the thighs, fingers extended downward. The tester should then hook the chain so that the bar level is just below the finger tips. The subject should grasp the handle firmly at the ends of the bar, with thumb clenching fingers and with one palm forward and one palm backward. When the subject is in position to lift, the back should be slightly bent at the hips, so that he will not completely straighten when lifting, but the legs should be straight with no bend at the knees. The head should be up and eyes directed straight ahead.

It is highly important not to bend the back too much, as the resultant poor leverage is conducive to a poor lift as well as to the possibility of strain. With the back properly bent, however, there is very little likelihood of injury from lifting.

2. The subject should lift steadily. Care should be taken to keep the knees straight. The tester should grasp the subject's hands firmly during the lift.



3. The subject's feet should be flat on the platform. It is necessary to retest after shortening the chain, if he attempts to lift by standing on his toes. Any initial lateral sway should be immediately checked.

4. At the end of the lifting effort, the back should be almost straight (4:149-150).

### Leg Lift

1. The subject should hold the bar with both hands together in the center, both palms down, so that it rests at the junction of thighs and trunk. Care should be taken to maintain this position after the belt has been put in place and during the lift.

2. The loop end of the belt is slipped over one end of the handle or crossbar; the free end of the belt should be looped around the other end of the bar, tucking it in under so that it rests next to the body and the resultant friction of the free end against the standing part holds the bar securely. The belt should be placed as low as possible over the hips and gluteal muscles.

3. The subject should stand with his feet in the same position as for the back lift. The knees should be slightly bent. Maximum lifts occur when the subject's legs are nearly straight at the end of the lifting effort. Experienced testers become adept at estimating the potential

lift by noting the degree of muscularity of the subject's legs; as a consequence, they will start the stronger subjects at a lower chain link, so as to allow for the extra distention in the dynamometer. If too high a link is used, the subject's knees may snap into hyperextension during the lift, although an alert tester can always anticipate such an occurrence and interrupt the performance.

4. Before the subject is instructed to lift, the tester should be sure that the arms and back are straight, the head erect, and the chest up (4:150-151).

#### Push-up Test for Boys

1. The bars should be adjusted at approximately shoulder height.

2. The subject should stand at the end of the parallel bars, grasping one bar in each hand. He jumps to the front support with arms straight (this counts one). He lowers his body until the angle of the straight-arm position (this counts two). This movement is repeated as many times as possible. The subject should not be permitted to jerk or kick or stop and rest when executing push-ups.

3. At the first dip for each subject, the tester should gauge the proper distance the body should be lowered by observing the elbow angle. He should then hold his fist so that the subject's shoulder just touches it on repeated takes.

4. If the subject does not go down to the proper bent-arm angle or all the way up to a straight-arm position, half-credit only is given, up to four half-credits (4:155).

### Technique for Using the Planimeter

1. Carefully assemble the planimeter on a smooth surface, placing tracer arm perpendicular to the weighted pole arm.
2. Hold tracer knob between thumb and middle finger, leaving index finger free to depress tracing point.
3. With tracing point depressed on "A" of pulse wave, set scale on vernier wheel to 0-0. (Use magnifying glass for greater accuracy).
4. Carefully trace the pulse wave ten times.  
CAUTION: Heartogram must be securely held in place and the planimeter must not be tilted.
5. Depress the tracing point at "A" after the tenth tracing and read scale to the nearest tenth square centimeter (7:263-264).

### Technique for Using the Vernier Calipers for Linear Measurements

1. Hold calipers between thumb and last three fingers of the right hand, leaving the index finger free to operate the adjusting wheel, if there is one.
2. Place left point of the caliper on "D" and adjust right point until it sets precisely on "E". NOTE: "E" is projection of "D" made by paralleling the radiating blue lines until AC is intersected. AC and DE should be

ruled in with a sharp pencil before the measurement is made.

3. Read the vernier scale:

- a. "o" on the vernier is the indicator to the scale. Make reading where "o" contacts the scale.
- b. The ten evenly spaced marks on the vernier cover exactly nine spaces on the scale. This facilitates interpolation to hundredths.
- c. After the first whole number (if so indicated) and the nearest tenth have been noted, observe which line on the vernier most nearly coincides with one of the graduations on the scale. This is the hundredths measurement. Count off the graduations on the vernier to obtain the number for the second decimal place. This is where the lines are exactly even.
- d. To measure systolic amplitude, place left point of calipers on "B," extend other point to base line AC, measuring parallel to blue radiating lines that pass through "B" (7:264-265).

Technique for Measuring the Obliquity Angle with the Protractor

1. Using a hard pencil, draw a line through A and B.
2. Draw a line from B to center O of graph.
3. Place the origin of the protractor on intersection of lines AB.
4. Adjust protractor until the line connecting OB is directly under the zero line of the protractor.
5. Measure off the degrees between OB and BA (extended).
6. Place a dot bisecting AB.
7. If dot is on 220 mm. line, circle angle measurement. This indicates that the angle is correct.
8. However, if center of AB of pulse wave is above or below 220 mm. line, a correction must be made.
  - a. For every 10 mm. above the 220 mm. line, subtract  $\frac{1}{2}$  degree from the angle measurement and encircle the corrected angle measurement.
  - b. If the center of AB is below 220 mm. line, add  $\frac{1}{2}$  degree for each 10 mm. below 220 line and encircle corrected angle measurement (7:266).

DIRECTIONS FOR ADMINISTERING JOHNSON'S  
FUNDAMENTAL SKILLS TESTS

Zigzag Test

Equipment: Four folding chairs and one stop watch.

Markings: Four folding chairs are placed 6 feet apart on a gymnasium floor, between a starting line and an X placed on the wall of the gymnasium. The first chair is placed 6 feet from the starting line, and the last chair is placed 6 feet from the wall. The X, 6 inches in size, is 4 feet from the floor and placed on the wall. The length of the starting line is one foot. There should be an area 20 feet long behind the starting line that is free from obstruction.

Directions for performance: The subject is instructed to stand behind the middle of the starting line and, on the command "Go," to run either to the right or to the left of the first chair, to zigzag around the three remaining chairs, to touch the X, to return in the same manner, and to touch the starting line with his foot.

Scoring: Time to the nearest tenth of a second required for running the course. Three trials are given, with the shortest time being the score. For any of the following fouls the subject is required to run the course again: having any part of the forward foot over the

starting line when the command is given; not zigzagging around the chairs in the prescribed manner; and not touching the X on the wall before returning toward the starting line.

### Jump-and-reach test

Equipment: Chalk dust, and one piece of construction paper, 6 inches wide and 3 feet high, ruled off in half inches.

Markings: Horizontal lines are drawn on the construction paper one-half inch apart. The paper is fastened to the wall at such a height that the 0 line on the chart is just below the point that represents the standing reach of the shortest performer.

Directions for performance: The subject stands with one side of his body parallel with the wall chart. He dips his forefinger in chalk, reaches as high as possible, and makes a chalk mark on the chart. He then jumps as high as possible and makes a mark on the wall at the peak of his jump.

Scoring: The score is the inches (to the nearest half inch) between the two chalk marks. The subject is given five jumps, with the highest jump recorded as his score. The subject is not allowed to make any preliminary steps forward before the jump.



### Kicking Test

Equipment: One soccer ball.

Markings: On a flat wall space, a target area five feet high and ten feet wide is marked with one-half inch tape. This area is divided into five equal rectangles placed perpendicular to the floor. The number 5 is taped in the center rectangle of the target, number 3 is taped in the rectangles adjacent to the center rectangle, number 1 is taped on the two remaining rectangles. On the floor three lines 3 feet long are marked: one is 10 feet from the wall; one, 20 feet; and one, 30 feet from the wall.

Directions for performance: The subject places the soccer ball behind the 10 foot line marked on the floor. From that position he attempts to kick the ball in such a manner that it may hit the wall target. The subject kicks three times from each of the lines marked on the floor. Two practice kicks are made at each line before the three kicks for the record are made.

Scoring: The subject receives the number of points indicated on the target area into which the ball is kicked. If the ball is kicked on a line between two area, the score is that for the area with the larger number. A ball kicked from in front of the restraining floor line counts zero, and another trial is given.

### Throw-and-catch Test

Equipment: One 8½ inch playground ball (grades 1, 2, and 3) and a regulation sized volleyball (grades 4, 5, and 6).

Markings: A 3 foot square is placed on a flat wall with one half inch tape. Its bottom line is 4 feet from the floor. An inner square, 10 inches in from all four sides, is placed on the wall target. Starting 3 feet from the wall, and in line with the wall target, there are placed five 2 foot squares, each 1 foot behind the other.

Directions for performance: With both feet inside the first square the subject stands facing the wall target and throws the ball at the wall target; keeping both feet inside the square he attempts to catch the ball in the air when it rebounds from the wall. The throw should be made with an underhand motion. After two practice trials the subject is given three trials for record when he is in each of the five squares.

Scoring: Two points for successfully throwing a ball in or on the inner wall target square; two points for successfully catching the rebounding ball in the air while standing in the floor square; one point for successfully throwing a ball in or on the outer wall target square; one point for successfully catching the rebounding ball in the air, on or outside the floor square. The subject's score

is the total points scored from all five squares. If the subject steps out of the square while throwing, the throw is nullified and another trial is given (17:98-101).

## SAMPLE PROGRAM

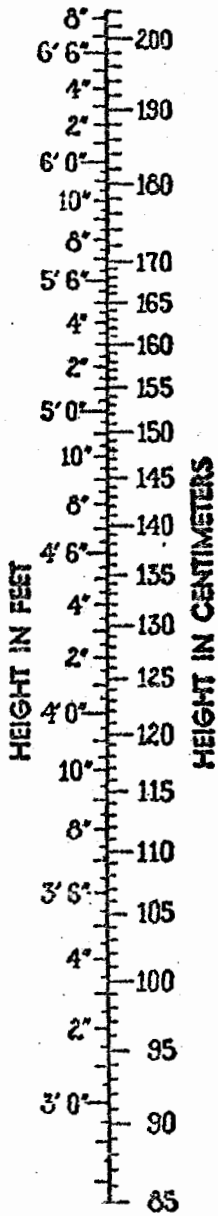
The only difference between this exercise program which is for the Block group and the ten minute program is the length of time it is administered.

1. Walk, long steps, swing arms
2. Arms overhead, shake arms and shoulders
3. Flip kick (pretend to kick stones)
4. Swing arms across chest
5. Slow jog, arms up in runner's position
6. Walk, arms back of head, sway, breathe 5 min.
7. Go the other way, jog
8. Arms in swimming motion, breathe deep
9. Other way jog--a little faster
10. Stop! Toe touchers--15 repetitions
11. Bend over, knees straight--bounce
12. On floor--5 push-ups
13. Jog--medium speed
14. Walk--hands over head--poke up
15. Other way jog
16. Skip and kick--arms loose--loosen up
17. Jog--faster--faster
18. Slow--slower--slowest possible jog
19. Walk--deep breathing
20. Stop! 10 sit-ups
21. 5 push-ups
22. 5 burpees
23. Jog, rest, get wind, shake arms
24. Stop! 10 toe touchers
25. On back, 10 double leg raisers
26. 5 push-ups
27. Jog--run faster--2 laps real fast
28. Jog--breathe deep 15 min.
29. Walk arms up hard, pull arms up and down train down
30. Arm circles forward and back
31. Swimming strokes
32. Stop! sit on floor--flutter kicks
33. On side--side leg raisers--other side
34. Walk--hold breath 10 paces
35. Walk bent over, arms hung loosely
36. Hold breath 20 paces
37. Walk, stretch--twist shoulders
38. Walk hold breath 40 paces
39. Sit down, roll calves
40. Shake thighs
41. Bring one knee to chest--other one
42. Turn to from leaning rest--bounce on toes
43. End of workout 20 min.

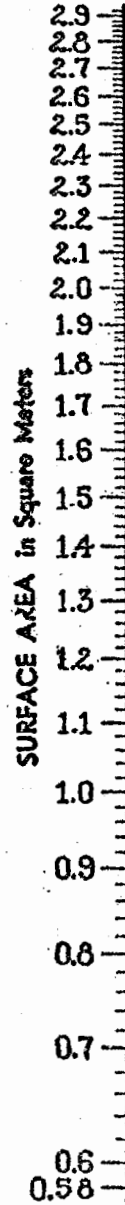
# TABLE "A"

## DUBOIS BODY SURFACE CHART

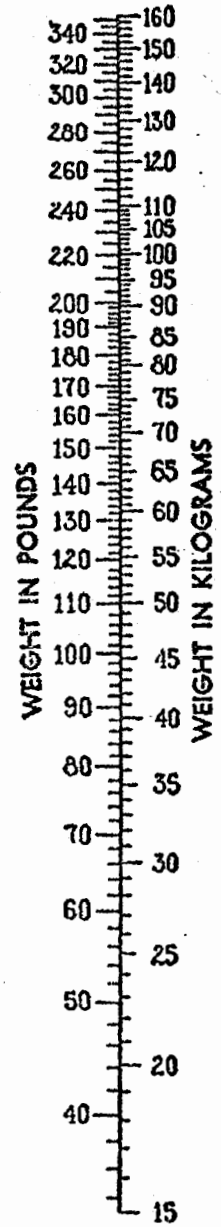
(As prepared by Boothby and Sandiford of the Mayo Clinic)



I



III



II