THE EFFECTS OF RHYTHMIC GYMNASTICS ON THE PHYSICAL FITNESS OF COLLEGE WOMEN

by

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A Thesis Submitted to
the Faculty of
the Consolidated University of North Carolina
in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Physical Education

Greensboro
1959

Approved by

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APPROVAL SHEET

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ACKNOWLEDGEMENTS

The completion of this thesis was made possible only through the cooperative efforts of many very fine people, to whom the writer wishes to express her most sincere appreciation:

To Dr. Celeste Ulrich, whose skillful guidance, valuable criticisms, and ready encouragement have pointed the way to the facts, figures, and fun of it all;

To the students at the Woman's College, who enthusiastically contributed both time and energy as subjects in this study;

To the graduate students, without whose capable assistance the testing could never have been accomplished;

To the Physical Education staff members, who willingly served as posture judges;

To the Physical Education major students, who kindly aided in the administration of the fitness tests; and

To Miss Elizabeth Booker, who typed the completed study.

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CHAPTER I

INTRODUCTION

> We are being called upon pre-eminently for one task—to improve physical vigor—through the medium of exercise. First things must come first once again. . . . Our unique contribution to education is physical, not intellectual, technical, esthetic, or ethical. (31:119)

A voice from the past decade, perhaps, but a voice that today is being echoed and re-echoed throughout the physical education profession as the demands of American society once again present our profession with a challenge. The challenge is that of helping to develop within American youth a level of fitness which will enable them to function effectively and efficiently in the modern world.

This concept of fitness, or total fitness, encompasses such areas as emotional, social, mental, and physical fitness; it is with the latter element that the physical education profession is concerned.

> Organically, physiologically, we still have, in spite of electric eyes, automatic cardshufflers, and airplanes, the same physiological needs which are answered, in part, only through exercise, muscular activity. This is a requirement, a basic requirement, for successful and productive living. (47:40)

Concern with physical fitness is in no way a new development or a novel idea to physical educators. The objective of developing organically sound and physically fit individuals has long been an accepted aim of physical education programs throughout this country. Dr. C. H. McCloy, one of the profession's most outstanding spokesmen, stated in 1940 that "we need to raise the physical fitness index of Americans high enough so that they can blaze through a day's work at the pace America is probably going to continue to demand, carry their bodies around, and wind up the

day without undue fatigue." (13:97) Nor is this concern with fitness recognized as the sole objective of the physical education program, for the profession is concerned also with the attainment of social, emotional, and psychological goals through physical activities. Today, however, few would deny the development of physical fitness a place high on the list of the objectives of physical education. The pendulum has swung once again toward a re-emphasis of this objective within our country, as reflected by the activities of the President's Council On Youth Fitness (21:35), and within the physical education profession, as evidenced by the current mobilization of professional interest in Operation Fitness, U.S.A. (49:25)

As a result of this renewed interest in the physical fitness objective of physical education, there has arisen a need to re-evaluate the physical education curriculum to determine how effective it is in attaining this particular goal. The activities included within the physical education curriculum have increased in number and variety as the profession has developed until today,

> . . .the number of available activities is far in excess of the number which can be included in the limited time usually made available and for which there are qualified, trained personnel to direct. Hence, activities must be chosen which make the greatest contribution to the greatest number of people, to the greatest number of objectives, and in the greatest amount. (3:51)

In view of this fact some research has been conducted to determine the value of various physical education activities in terms of their contribution to the development of physical fitness. The majority of such research has, however, been concerned with the various sports and games enjoying current popularity in this country and already receiving

major attention in high school and college physical education programs.

Although gymnastic activities once occupied a popular position in physical education programs in this country, they have gradually given way to more modern influences and been replaced by activities of a less disciplined, and often of a less strenuous, nature. Criticized for their apparent lack of concern for and attention to the individual, for their formal, stilted style, and for their dearth of creativity, gymnastics have succumbed to the pressure of such criticisms and all but disappeared from the physical education scene.

Physical education leaders in the Scandanavian countries, however, have continued to include gymnastics as an important part of their curricula and, in the process, have contributed much toward the modification of these activities in an attempt to alleviate some of the conditions which caused their drop from popular status in the United States. The modern gymnastics in the Scandanavian countries stress a more flowing, rhythmic style, a freer response, a less formal approach, and an increased awareness of individual differences in performance and ability.

Interest in this more modern type of rhythmic gymnastic activity has prompted a desire to determine its possible value as a contributing factor to the objectives of physical education programs in this country and, in particular, to the objective of physical fitness. Since it is true that "we need more research information on how fitness is best achieved and maintained by the non-athlete through the resources of the school and college physical education programs," (28:27) this study was

undertaken in an attempt to determine what effects rhythmic gymnastics might have on the physical fitness level of college women and whether the contribution of gymnastics to the physical fitness development of the subjects would warrant consideration of their inclusion in high school and college physical education programs for girls and women.

Of interest, also, was the relationship between extended and concentrated participation in gymnastics. The study was designed in the hope that physical educators might find some basis for determining whether or not a two-day-a-week program in physical education is as effective in terms of developing physical fitness as is a four-day-a-week program.

CHAPTER II

STATEMENT OF PROBLEM

This study was conducted to determine what effects participation in rhythmic gymnastics would have on the physical fitness level of college women as measured by selected physiological tests and by a physical fitness test battery.

The statistical evidence derived from such measurements was to be used to indicate whether or not this particular activity made any contribution to the development of physical fitness significant enough to merit its inclusion in high school and college physical education programs for girls and women.

The study also proposed to compare the relative effects on physical fitness of a short-term, concentrated course of rhythmic gymnastics, in which the subjects met four days a week for five weeks, and a long-term, extended course, in which the subjects participated in the same gymnastic activity twice a week over a ten-week period of time.

Statistical evidence from such a comparison was to be considered as a basis for recommending either a two-day-a-week physical education program or a four-day-a-week program as superior in developing physical fitness.

CHAPTER III

REVIEW OF LITERATURE

INTEREST IN PHYSICAL FITNESS

If pictured in graphic form, American interest in the physical fitness status of its citizenry--from early colonial times until the current period--would present an uneven, "up-and-down" appearance reflecting the influence of the various economic, social, and educational philosophies which have predominated at various stages of this country's historical development.

Evident in this picture of fluctuating interest has been the tendency of the national emphasis on physical fitness to reach a peak during periods of war-time, when the rigors of military service, combat duty, and "home-front" economy have demanded higher standards of physical endurance and strength than were required during normal, peace-time periods.

At the present time, however, this country is experiencing a period of concern over the physical fitness status of its citizens which resembles the interest usually accorded this particular phase of American life only during periods of war or eras of great nationalistic fervor.

The current emphasis on physical fitness may be traced, in part, to the research report of Dr. Hans Kraus and Ruth P. Hirschland, which was published in May, 1954 (34); this report made public the results of a test of minimum muscular fitness which had been administered by the authors to approximately 3,000 European children and 4,000 American children. The

results showed the incidence of failures to be from 33% to 36% greater for the American children in the flexibility and strength items of the test. The inferred inferior physical fitness status of American youngsters which was drawn from the publication of this study has resulted in an effort on the part of physical educators, interested citizens, and government officials to examine more closely and improve, if possible, the physical fitness status of American youth.

President Eisenhower has established the President's Council on Youth Fitness and the President's Citizens Advisory Committee on Fitness of American Youth to study this aspect of American life and to help promote an improvement in the fitness of our youth. (21:35) Speaking to the Youth Fitness Conference in June, 1956, the President said:

> National policies will be no more than words if our people are not healthy in body as well as of mind, putting dynamism and leadership into the carrying out of these major decisions. Our young people must be physically as well as mentally and spiritually prepared for American citizenship. (18:cover)

The organization of national resources to promote fitness has in turn prompted many states to accept the charge presented to them by the President's Council; they have begun to mobilize their forces in a co-operative effort toward the achievement of the goal of fitness. A recent report in The Journal of Health, Physical Education, and Recreation (30: 41) cites the numerous and varied physical fitness activities currently being carried on and/or being planned by various state Associations of Health, Physical Education, and Recreation.

In carrying out part of its Code of Action, that dealing with its attempt "to encourage the assistance of public and private groups for the

support of programs to aid youth fitness," (21:35) the President's Council has also received "tremendous support from professional and volunteer organizations, such as the American Association for Health, Physical Education, and Recreation, the American Medical Association, the American Recreation Society, Boy and Girl Scouts, Boys' Clubs of America, and the National Recreation Association." (21:35)

This emphasis on physical fitness at a national and state level has also influenced a re-examination of public school physical education programs in terms of their responsibility toward and success in meeting the physical fitness needs of American youth. With physical fitness serving as the theme of many district, state, and local conventions, the American Association of Health, Physical Education, and Recreation has stressed a re-emphasis of one of the basic objectives of the physical education program as stated by Dudley A. Sargent in 1920, when he urged that the profession seek to attain the physically perfect individual through achieving "that prime physical condition called fitness--fitness for work, fitness for play, fitness for anything a person may be called upon to do." (41:60)

GYMNASTICS AS HUMAN ACTIVITY

This interest in physical fitness has been by no means only a recent development. It has been said that "even primitive man felt the need of keeping the body fit for self-preservation and the beauty of form created by it." (63:429) His life was full of physical activity which included the running, jumping, throwing, climbing, and balancing exercises

necessary for self-protection and combat. These same elements of running, jumping, climbing, and balancing have been evidenced in the gymnastic and apparatus activities in which men of more modern times have engaged.

The concept of "apparatus" has often been confused with that of "gymnastics," perhaps because of the close historical development of the two, although in reality the terms represent two separate and different activities.

"Apparatus" activity refers to stunts performed on stationary, mechanically-devised structures such as vaulting boxes, horses, bucks, stall bars, and parallel bars.

"Gymnastics" includes the type of activity often referred to both as "free exercise" and/or as "calisthenics." It involves "exercise-type" activities utilizing only the body or small portable devices such as jump ropes, balls, or hoops.

"Rhythmic gymnastics" refers to the method of performing these gymnastic movements, specifying a continuous, flowing style of movement utilized sometimes in accompaniment to appropriate music, as opposed to a stilted, formal style in which definite postures are vigorously assumed and changed upon command or by count.

The first actual uses of apparatus remain hidden in the obscurity of early civilizations, but history witnesses that one of the earliest known uses man made of mechanical apparatus devices was to train people in skills required to use efficiently the things for which the apparatus stood. (63:431) The Romans, for example, are said to have originated the wooden horse as a means of training their cavalry in proper techniques

and procedures of horsemanship. It was also in the process of military training that the ancient Romans began the use of artificial instruments for developing the coordinations which were used in their games. (63:432)

The early Greek civilizations, interested in the physical development of all their male citizens rather than just the training of the military, practiced with rather than on apparatus; the javelin, spear, bow and arrow were found in their games and in their program of universal training. The Greek Palaestrics included running, jumping, and throwing activities, as well as boxing and wrestling, and their Orchestics involved dances stressing skill and agility of body movement. (63:432)

During the Dark Ages, knighthood preserved some of these activities in their riding, climbing, tilting, and jousting, wrestling, and fencing activities, although physical training of the common people was practically non-existent during this period of history. The high degree of physical development and muscular coordination requisite for acrobatic stunts, which have been known to exist at all times, was exemplified at this time in the persons of the court jesters.

The systems of gymnastics upon which our modern programs are based, while they may trace their origin back to the activities of these earlier civilizations, actually developed in Europe in the early 1800's under the dynamic leadership of several outstanding men. The countries whose systems of gymnastics have had the strongest influence in America are Germany, Denmark, and Sweden; the programs developed in these nations were greatly influenced by each other, yet were developed along original lines by the forceful and creative personalities responsible for their growth and popularity.

In Germany, the work of Friedrich Ludwig Jahn (1778-1852), often referred to as the "Father of Gymnastics," is particularly well-known and outstanding. "Chiefly a patriot, he was able to present to the German people a gift in the form of a physical training system that they have since cherished and that has made its influence felt in all civilized countries." (63:402) Jahn invented and built the first parallel bars, horizontal bar, and other well-known pieces of German apparatus, and organized the "Turnen" societies throughout Germany. He hated systems and the organization of material; his gymnastics, devoted to creating liberty-loving, social and independent thinking men, stressed freedom of movement, choice of activity, and creative use of the apparatus. The motto which Jahn applied to his"Turnen"groups, "Frisch, Frei, Frohlich, Fromm," expressed his hope that through this system of gymnastic activity the German people would become "strong in body, free in spirit, cheerful, intelligent and good." (63:489)

The famous and much publicized work of Jahn was actually preceded by that of another German, Johann Christian Friedrich GutsMuths (1759-1839), who has been referred to as "the great-grandfather of gymnastics." (63:434) GutsMuths, a teacher of gymnastics, based his program on the exercises of the Greeks, but also developed new movements; he described these activities in one of the first text books of the more modern gymnastic systems, Gymnastik Fuer Die Jugend, published in 1793. (11:9) The aim of GutsMuths "was to create a system of gymnastics for children--school gymnastics. As the first man to work toward this goal he gained a great, if somewhat indirect, influence of a very rousing character." (11:10) Strangely enough, his system was not adopted in his native

country, but enjoyed its greatest popularity in Denmark and served as the foundation upon which the later gymnastic system of this country developed.

Two other men, actually of Swiss origin, deserve mention for the influence they exerted on German gymnastics. The first was Johann Freidrich Pestalozzi (1746-1827), who "was clearly the founder of the so-called calisthenics or free exercises." (63:437) His system, based on the movement and exercise of the joints, was later rejected by Jahn as being "a mere mechanical system of movements." (63:437) Adolph Speiss, (1810-1858), made his contribution to the development of gymnastics by arranging gymnastic material, including free exercises, marching tactics, and dancing steps, into a graded sequence for different school ages and for both sexes. He was the first to arrange free exercises to different musical rhythms; he stressed group exercises in which "the whole class performed, upon the command of the teacher, such exercises as can be done in unison, preferably in rhythm." (63:557)

GutsMuths' book, Gymnastics for Youth, was translated into Danish and became the basis for Franz Nachtegall's (1777-1847) development of a system of gymnastics for Denmark. Nachtegall, although primarily interested in school gymnastics, devoted much energy and talent to the founding and growth of the Military Gymnastic Institute in 1804 and to its subsequent development. "This institute, which still exists, is the oldest gymnastic institute in the world of modern times." (11:12)

It was from Nachtegall that Per Henrik Ling, the founder of Swedish gymnastics, received his first training in this type of activity. (11:14) Early in his life Ling, a well-educated, literary-minded individual,

acquired a passionate interest in Norse mythology and in the vigor and strength of his Scandanavian forebears. When the Russians, in 1808, invaded and conquered Finland, which had been Swedish territory for years, Ling's intense patriotism and his hatred of Russia inspired in him a powerful "desire to see his country-men strong in body and soul and hence prepared to meet the enemy. This was the inspiring motive of his poems and his gymnastics alike, though in the latter he saw a means of restoring health as well as developing the race and defending his fatherland." (39:231)

The system of gymnastics developed by Ling was based on his knowledge of anatomy and physiology and on his realization that "in order to develop the human body by gymnastics one must know that body." (11:15) In 1813, with the financial support of the Swedish government, he founded the Royal Gymnastic Central Institute in Stockholm as a "center of influence for the physical training of the young." (39:232) His program was separated into several areas, including military gymnastics, medical or therapeutic gymnastics, aesthetic gymnastics, and educational or pedagogical gymnastics; these latter "comprised only a few strong movements, in which the pupil himself and his fellows constituted the most important apparatus," (39:234) and which emphasized the development of "power, alacrity, and ability to endure strain." (20:247) These "pedagogical gymnastics were designed to develop the innate potentialities of the body, creating a well-balanced and perfected organism. They were to teach the individual to hold his body erect and bring it under control of his own will. Aesthetic gymnastics, which were left to be cultivated by more modern successors, were to give bodily expression to

inner feelings, emotions, and thought." (20:247)

Ling regarded these four areas of gymnastics as being very closely inter-related and stated that "to disregard the unity that should exist among these parts was merely to base a gymnastic system on whim and fancy." (20:247) The four fundamental principles on which he based the development of his system were stated as follows:

a. The aim is all-around harmonious development of the body.

b. The attainment of this is sought by means of biologically and physiologically grounded physical exercises of definite form and, as far as possible, of known effect.

c. The exercises must have developmental and corrective values, be easily understood and satisfy our demands of beauty.

d. The exercises must be carried out with a gradually increasing degree of difficulty and exertion. (59:625-626)

While Per Ling performed the pioneer tasks of establishing his gymnastic system in Sweden, it is to his son, Hjalmar Freidrik Ling, that the credit for organizing the mass of gymnastic material originated by his father is given. The younger Ling selected the most suitable exercises, arranged them in groups, with an orderly progression within each group, and combined them into complete lesson-plans--the original "Day's Order." (39:239) He also did much to adapt the nature and arrangement of school gymnasium apparatus to permit its use by large numbers at the same time.

> The Swedish system as developed by the Lings and adapted by their successors was characterized by the great care given to the selection and arrangement of exercises. The activities for a single "day's order" were carefully coordinated not only in regard to one another but in respect to the tables that had preceded and those that were to follow. This is the principle of "progression" that characterizes Swedish gymnastics. (20:256)

Today in Sweden "the Ling system, as originally conceived by Per

Henrik Ling, is basically intact. Ling's general principles are held in very high esteem and deemed as applicable today as they were over one hundred years ago." (68:26) However, in the twentieth century, Swedish physical educators have been engaged in revising some of the aspects of Swedish gymnastics and physical education programs. "Elin Falk, Maja Carlquist and Major J. S. Thulin have been outstanding Scandanavian leaders in this endeavor." (20:256)

The direction of this revision has been stated by Klas Thoresson, (68:115) Senior Lecturer at the Royal Gymnastic Central Institute in Stockholm, in a tape-recorded interview of July, 1953. "From the discipline of drill which formerly characterized gymnastics, one has now changed to a freer method of work. This is expressed, for example, in free-standing exercises (free exercises) which are performed rhythmically rather than rigidly." (68:115) Modern objectives of the program also include the attempt to "encourage good carriage and posture and to further character and the development of personality, to preserve mental balance, to promote lust of life and joy of work by giving the exercises an interesting . . . content and by making them stimulating." (59:630) "Modern Swedish physical education has broken away from a system of gymnastic movements executed to harsh commands and has moved to a broad program of varied activities which include gymnastics, games and sports. Current gymnastic teaching stresses gracefulness, freedom of movement, and enjoyment." (68:150)

Exercises are chosen not only for their physiological and psychic value, but also for their contribution toward developing a sense of beauty.

> The idea of beauty implies the idea of some perfectly coordinated whole. It must be remembered that the training of a sense of

> beauty . . . is intimately bound up with the main aim of physical education. To get beauty in gymnastics, it is essential to do the exercises not only with certainty, but also with ease, grace, and spirit. (1:29)

Rhythmic movement has become important in the modern Swedish system because of "the compelling power of rhythm, its efficacy in banishing fumbling movements and making them sure and easy, graceful and purposeful, and its liberating effects on the mind." (2:6) Maja Carlquist states that "rhythm is the keynote in the modern Swedish program of physical education. Its fundamental principle today is to sharpen and train the fine sense of movement, to enable the children to relearn their natural way of moving." (5:7)

This fairly modern emphasis on a more flowing, rhythmic style of movement, which is quite different from the sharp movements and static postures executed briskly to command which Per Ling required of his pupils, has perhaps resulted from the influence of other Scandanavian systems upon that of Sweden. The Danish leaders, in particular, stress rhythmic activity. Niels Bukh, one of Denmark's outstanding gymnastic leaders, has said:

> Rhythm is, and has from the origin of primary gymnastics been, the condition of a satisfactory result. Rhythmic work, instead of strained and rigid attitudes, assists the function of the heart and the respiration during the work, and it is necessary to tax these functions rather heavily if gymnastic exercises are to develop them naturally and well. (24:634)

These various European gymnastic systems have all made their influence felt within the United States at some time: on occasion being introduced to Americans by prominent European instructors visiting this country for the express purpose of demonstrating and popularizing their

particular type of program; sometimes brought to our shores by the thousands of European immigrants who preserved and promoted their native gymnastic systems as part of their old-country tradition; and sometimes being advocated by Americans who considered them a worthwhile and beneficial contribution to the physical education of our youth.

Catherine Beecher, sister of Harriet Beecher Stowe, was one of the early promoters of gymnastic work in America. In her school for girls she stressed calisthenics performed to musical accompaniment as a means of providing her students with exercise, relaxation, and a lesson in musical rhythm. "Although many of Beecher's exercises were taken from European sources, she was perhaps the first native American to formulate a comprehensive gymnastic system adapted to American needs." (20:370)

In 1860, Dr. Dio Lewis, primarily on the strength of his energetic and dynamic personality, succeeded in convincing the American Institute of Instruction that his system of New Gymnastics should be adopted for general use, with the result that some Eastern cities adopted his program as part of their daily school curriculum. (20:371)

The cause of gymnastics found another American champion in the person of Dr. Dudley A. Sargent, whose pioneer work in physical education remains one of the outstanding contributions ever made in the field. From the time of his appointment as assistant professor of physical education at Harvard University and director of the Hemenway Gymnasium, Dr. Sargent did much to improve both the gymnasiums and the apparatus of his time and to invent new mechanical devices to promote physical exercise. His private gymnasium, founded in 1881, was among the first to train women teachers in the theory and practice of physical education. (20:394)

The German system was originally presented in this country in the early 1800's by Charles Beck, Charles Follen, and Francis Leiber, three disciples of Jahn, who concentrated their efforts within the Harvard and Boston gymnasiums. However, the wave of popularity which the German system later experienced in this country was due to the establishment of numerous "Turnvereins" by the German immigrants, who came to America in great numbers in the 1840's.

Many names are associated with the spread of Scandanavian gymnastics throughout American school systems. These systems became the rival of German gymnastics through the work of such men as Harting Nissen, who introduced Swedish school gymnastics in Washington, D. C., in 1883; Baron Nils Posse, who literally "sold" the Swedish system in Boston to Mrs. Mary Hemenway, who, in turn, generously established and financially supported the Boston Normal School of Gymnastics for training teachers in Swedish gymnastics; and William Skarstrom, well-known instructor at Wellesley during the 1920's. Other Americans who enthusiastically supported the Swedish cause included Amy Morris Houmans, Dr. William G. Anderson, and Dr. Edward M. Hartwell. (20:393)

In 1923, a group of Danish students toured the United States under the direction of Niels Bukh and stimulated a popular interest in the Fundamental Danish gymnastics which this man had developed in Denmark as a means of combating the undesirable postural and muscular effects of some types of farm work. His system enjoyed a certain degree of success in this country for a short period, particularly in the women's physical education programs and among coaches, who used the exercises as conditioning activities

for their athletic teams. The Danish gymnastics were revised by the United States armed services during World War II as part of their physical fitness program. (20:454)

The sports and athletic boom which mushroomed in America after World War II has continued to grow in popularity and scope since that time; this factor has combined with the current emphasis on leisure-time and recreational activities to relegate gymnastic programs to a status of comparative obscurity in this country. However, apparatus and tumbling activities are still maintained in some high school programs, particularly as part of the boys' physical education curriculum, and some larger universities, notably the Big Ten schools, continue to engage in gymnastic competition. "Warm-up" activities, indulged in briefly and often sporadically prior to activities deemed more strenuous, recall the influence of early gymnastic programs in this country. Gymnastic activities for adults are confined primarily to a few YMCA programs and the Turner's organizations remaining active in communities possessing a large population of German descent. Complete programs or courses in fundamental rhythmic gymnastics as such have, for the most part, long since passed out of existence.

THE CONTRIBUTIONS OF PHYSICAL ACTIVITIES TO PHYSICAL FITNESS

With the current emphasis on fitness and the resultant re-evaluation of public school physical education programs, there has arisen a need to ascertain the comparative contributions of various types of physical education activities to the attainment of the physical fitness objective.

The terms "fitness" and "physical fitness" have been defined in numerous ways by many authors; an examination of these definitions shows them to be often contradictory and over-lapping. For purposes of this study the following has been accepted as a definition of general or "total" fitness:

> Fitness implies freedom from disease or significant deviations from normal structure and function; enough strength, speed, agility, endurance, and skill to accomplish the maximum tasks that the day may bring; and mental and emotional adjustment appropriate to the age of the individual. (57:299)

"Physical fitness" is considered one of the phases or types of fitness comprising this totality. A most comprehensive listing of the component parts of "physical fitness" may be found in the American Association for Health, Physical Education, and Recreation publication, Fitness for Secondary School Youth. (3:16) This list includes such qualities as good muscular development and muscle tone, normal bones and joints for growth level, fit heart and circulation system, good fundamental motor abilities (balance, flexibility, agility, speed, rhythm, power, and accuracy), and at least average basic skills (running, jumping, climbing, crawling, and throwing).

The attempts to confine and isolate physical fitness components have been accompanied by attempts to measure or test these same items in as scientific a manner as possible in order to promote their development and improvement. "As early as November, 1885, a group met in Brooklyn, N. Y., to consider a scientific approach to the development of physical fitness." (3:31) Early testing involved anthropometric measurements, made in an attempt to define the "ideal man," and grip dynanometers, used to measure

hand strength. As an understanding of the qualities inherent in physical fitness has gradually developed, much research has been conducted in an attempt to determine the degree to which these physical fitness qualities are apparent in individuals.

Many tests of physical fitness have been devised and combined into test batteries. The components of fitness most often mentioned in these batteries include: balance, flexibility, agility, speed, rhythm, power, strength, accuracy, and coordination. When devising his motor fitness test, T. K. Cureton (3:37) chose the components of balance, flexibility, agility, strength, power, and endurance as the factors to be tested. The New York State Physical Fitness Test includes accuracy, strength, posture, agility, speed, balance, and endurance as test items. (19) The majority of fitness tests devised by the armed services include items measuring strength, endurance, speed, agility, and power. (12:173-181)

Interest in physical fitness testing was high during World War II, and the armed services originated and used many combinations of test items to evaluate both the physical condition of their personnel and the results of their physical training programs. The Army devised a test battery, involving both indoor and outdoor items, for a total of ten tests. (12:164) The U. S. Air Force Physical Fitness Test included some seven fitness variables, notably cardiovascular endurance, muscular endurance, muscular power and strength, agility, speed, and coordination. (37:147) Two Naval tests were devised--the Standard Physical Fitness Test of five items, measuring strength, endurance, stamina, and agility, (12:177) and the Naval Aviation Physical Fitness Test, also of five items, designed to

measure shoulder and abdominal strength, power, coordination, and cardiovascular endurance. (12:173) The WAC Physical Fitness Test, (12:179) with established norms for college women, and the short Women's Reserve, USNR, Physical Fitness Test (12:181) were the two physical fitness batteries developed by the female service branches during the war.

"Physical Performance Levels for High School Girls," (61) published during the war period by the U. S. Office of Education, presented an eight item physical fitness test battery and norms for high school girls established on the basis of published data.

Cureton and O'Connor have developed two motor fitness tests for high school girls, one a shorter six item battery and the other a more inclusive twelve item battery. (48) A research study on physical fitness (54) makes use of the following tests to measure fitness: obstacle race, pull-ups, vertical pull, sit-ups, chair-stepping, left grip, right grip, push and pull, bounce, and leg strength.

The NSWA Research Committee, in attempting to establish physical performance levels for girls, published a battery of tests measuring strength, agility, and coordination. (51) More recently, the current emphasis on physical fitness has stimulated the development of several test batteries by various state departments of health and physical education, including the California Physical Performance Test, the Indiana Fitness tests, the New York State Physical Fitness Test, the Oregon Motor Fitness Test Battery, and test batteries devised by the Fitness Committee of the Washington State AHPER. Both North Carolina and New Mexico are in the process of developing state fitness tests and establishing norms. (30:

41) The AAHPER Physical Fitness Test, although relatively new, shows indication of widespread adoption. (30:24-5)

In addition to these test batteries, much research has been done on the direct physiological measurements of fitness. Tests evaluating cardio-vascular-respiratory status and endurance utilize primarily blood pressure and pulse rate, vital capacity and breath-holding measurements. Measurements of blood pressure have been found by McCurdy and Larson to be objective, reliable and sufficiently accurate to be used in scientific studies. (45:9) Salit and Tuttle indicated that the most valid measure of fitness for men was increase of pulse rate due to exercise and pulse rate one-half minute after exercise, and, for women, was pulse rate two minutes after a standard exercise. Their study was done to determine the validity of heart rate and blood pressure determinations as measures of physical fitness. (53:256) According to this latter study, "blood pressure measurements appear to be altogether useless in distinguishing between healthy young adults who obviously differ in physical fitness." (53:256)

Breath-holding after exercise, measured with a flarimeter or U-shaped manometer, has been used as an indication of potential endurance, but these tests have been found by McCloy to have low reliability and to measure will power as much as physiological resistance to acidosis. (14: 239) The Flack Test includes a breath-holding item; candidates for pilot training who cannot hold their breath longer than 45 seconds are rejected on the basis of this test. Cureton also has devised a breath-holding test in which the subject himself indicates the extent of breath-holding. (14: 239)

McCurdy and Larson, in their study of organic efficiency, measured breath-holding, diastolic pressure, pulse rate before and after exercise, and sitting and standing pulse pressure, and based their rating of an individual's physical condition on the results of these test items. (43) The ability of the cardiovascular system to return to normal after a stair-stepping exercise was the test employed by Harriet Clarke in her measurement of physiologic fitness. (25)

Direct measurement of muscle strength usually involves the use of the grip dynamometer, the grip dynamometer with push-pull attachment, the back and leg left dynamometer (12:89), and the tensiometer. (6) The vertical pull with spring scale is also used as a measure of strength, but shows less reliability than dynamometer tests. (17:176)

The most current device designed to measure the flexibility of specific joints and their resulting range of movement is Leighton's flexometer. (38)

The use of these scientific devices for the direct measurement of physical fitness components has resulted in fairly definite statements regarding the physically fit individual. Larson (36:20) has determined, through physiological measurements, that evidence shows the physically fit individual to have a larger minute volume, slower pulse rate, lower blood pressures, larger surface area of lungs, more red blood corpuscles and hemoglobin, and a greater buffering capacity of blood and muscle. A research study presented by Dawson (29) indicates also that slow heart beats, sometimes as low as 50 and not uncommonly ranging between 60-66, are often found, especially among endurance athletes, whereas weight lifters are apt to have rapid pulses.

Cureton's research, involving cardio-vascular-respiratory tests administered mainly to college men, (7) brings out the following points in regard to fitness:

a. The pulse rate tends to be slower in the athlete or trained person than in the non-athlete or untrained man.

b. The stroke volume is larger during rest and during exercise in a trained man than in an untrained man.

c. In the fit person, there is a quick recovery of normal pulse rate after exercise.

d. Exercise must be relatively strenuous to give reliable results in determining the ratios of the pulse rates before and after exercise.

e. Sleep helps to normalize blood pressures.

f. Pulse rate recuperation tests are of little value in predicting all-out performance. (3:35)

The review of respiratory fitness research, prepared also by Cureton, (7) reveals the following facts:

a. Lung capacity tends to vary with flexibility and strength of chest muscles.

b. Lung capacity increases with training.

c. The value of lung capacity in indicating status of fitness is not agreed upon. A few studies indicate that measurement of the post-exercise decrease in lung capacity is a more valid measure of fitness than resting lung capacity. It has been found to reflect the condition of a trained man.

d. Lung capacity can be increased by swimming, deep-breathing exercises and by chest stretching.

e. Persons with low lung capacity need a good physical examination. (3:36)

It has also been stated by Steinhaus (56) that vigorous activities such as games, competitive athletics and vigorous dances often "drive the individual into 'second wind.' The consequent changes in structures and

function of the heart and lungs account for the improvement in cardio-respiratory endurance." (56:175)

The effect of physical activity on the physical fitness status of participants is of special interest. According to Steinhaus, "exercise is one of the factors contributing to total fitness," (57:300) and its contributions include the development of strength, speed, agility, endurance, and skill in persons who are physiologically sound. Individuals may vary in their capacity to benefit from exercise due to individual differences in body size, strength, and structure. It is felt, also, that "the training undergone in preparation for an athletic event contributes more to physical fitness than does the actual event." (57:345)

Emil Rath's study involving the contribution of two different types of physical education programs for high school boys, in which each program emphasized a different type of activity, determined that "the quantity and kind of activity comprising a program determines its value for physical development. A program planned to achieve specific results can produce a strong, efficient body." (52:177)

Several studies have been conducted to determine the relative contributions of physical education activities offered in the men's program to the physical fitness of male students.

Cureton (26) administered the Larson Test Combination to all the men's service classes at the University of Illinois in 1940-42 to measure significant aspects of motor fitness. Students whose composite test scores fell in the lower twentieth percentile range were then required to take two hours in the Physical Fitness Clinic per week in addition to their

regular two hours of physical education class work. The Clinic work included Danish exercises, indoor steeple-chase, endurance tests, and assorted activities aimed at improving balance, flexibility, agility, strength, power, and endurance. Students scoring above the twentieth percentile range took only two hours of regular physical education per week. Re-testing at the end of the selected time period showed a gross over-all improvement for all service classes of 6.78% and an improvement of those engaged in the Clinic work of 30.25%, this latter gain being greater than any due to growth, age, educational effect, or normal physical education class work. Since the composite test scores correlated .447 with the all-around Inventory of Motor Fitness score, "the improvement may be thought of as representing some gain in Physical Fitness." (26:156)

A comparative study of the results of the sports method versus the apparatus method in physical education, with regard to their relative contribution to physical fitness, was reported by Wilbur. (62) The former method included instruction in boxing, wrestling, track and field, soccer and swimming, and the latter included activities on the parallel bars, tumbling mats, climbing ropes, horizontal ladder, Swedish box, side horse, horizontal bar, and rings. The 366 male college freshmen subjects were tested at the beginning and end of participation in either one or the other of the methods; the test items were selected to measure arm and shoulder strength, power, coordination, agility, body control, endurance, and speed, with the result that the sports method was judged to be superior to the apparatus method for improving physical fitness.

A study of 1,650 men at Louisiana State University was conducted by J. W. Kistler; (33) he studied the effects resulting from eight weeks of participation in a program designed to promote improvement in strength and endurance and agility. The results showed 77% improvement in the ability to perform sit-ups and 74% improvement in the push-up test, while 61% improved in the chinning test and obstacle-race, and only 36% showed an increase in ability to perform the five-minute run. On the basis of these results the author stated that significant improvement could be achieved in the physical fitness elements of strength, endurance, and agility through a specific training program devoted to these elements.

An early study by D. H. MacKenzie (40) concluded that a general corrective program, including exercises, cross-country, and hockey yielded greatest dividends in physical development, while football and wrestling were discovered to be least productive of results. Three investigators, J. W. Masley, A. Hairabedian, and D. N. Donaldson (42) produced evidence to indicate that a six week period of weight training increased strength more than a similar period of volleyball and that a larger increase in speed and coordination resulted from six weeks of weight training than from volleyball.

In a recent study, C. W. Landiss (35) compared eight selected physical education activities in their development of physical fitness and motor ability. Results of the study showed that only the tumbling-gymnastic group evidenced significant gain between the initial test and the post-test means for each of the individual items of both measures used. The other groups—swimming, boxing, weight training, tennis,

wrestling, volleyball, and basic conditioning course--failed to record significant gain in at least two or more of the items. Tumbling and gymnastics ranked equal to conditioning in developing physical fitness, while the subjects participating in swimming, tennis, and boxing showed the least improvement on the physical fitness test.

In a review of physical fitness testing, Marion R. Broer (23) reports the following studies:

Fordham (69) and Berrafato (66) studied the effect of basic conditioning, badminton, apparatus, individual tumbling stunts, weight lifting, and volleyball. The two studies used the same experimental pattern and same tests; according to the final test scores the relative contribution of the activities to muscular endurance was ranked as follows: basic conditioning - 19, apparatus - 13, weight lifting - 11, boxing - 11, individual tumbling stunts - 8, wrestling - 6.5, volleyball - 5, and badminton - 3.

Harrison (70) reported that moderate endurance swimming was not adequate to build strength but improved mainly the circulatory-respiratory responses, ability in vertical jump, and total body-reaction time.

In a study on volleyball, Wolbers (74) found that improvement in physical fitness was not impressive, and expressed doubt that volleyball at the beginning level is of much value in developing fitness.

Brodt (67) has found weight training effective in improving strength, Schneider and Brohua test scores, vital capacity and speed in agility run.

Similar studies have been published by women studying the effects on physical fitness of their physical education programs.

A test battery of nine items (50) was administered to college freshmen women at the University of Oregon; this battery tested arm strength, power, speed, agility, abdominal strength, and dynamic fitness. These students then participated in ten weeks of "Basic Physical Education," which included tumbling, apparatus, relays, endurance running, and exercises for strength, flexibility, and posture correction. At the end of ten weeks the students were re-tested, and it was found that three-fourths of them had gained in ability to perform four of the test items and one-half of them had gained in ability in five different items. The lower ability group was shown to have improved more than the higher ability group, but it was felt that "a longer period of activities coming more frequently than three days a week, would probably result in gains for those in the high group along with increased gains by those in the medium and low ability groups." (50:265)

Harriet L. Clarke (25) reported a study in which a functional fitness test was administered in October and again in March to 250 college women. In the interim these students engaged in regular physical education classes twice a week. The re-test scores demonstrated that 205 girls maintained or raised their original scores and 45 showed a decrease in scores. This study was further broken down into an investigation of the average improvement in each activity, and it was found that those students participating in swimming, field hockey, and crew showed the greatest improvement. The author states that "although just two periods of physical education a week does not represent an ideal program, it does seem to be worthwhile in making some contribution toward raising the level of physical fitness in college women. (25:394)

Jeanette and Marian Smalley conducted a study involving the freshmen and sophomore women in the physical education program at the University of Southern California. (55) These girls were tested, using the Burpee test for endurance and the push-pull dynamometer for arm and shoulder strength, and then participated in ten different physical education activities (each student in only one activity) before being re-tested at the end of eight weeks. The results showed that women engaging in individual or dual activities improved more in endurance than those taking a team sports activity. Students participating in swimming, fencing, and folk dance showed the greatest improvement in endurance, while those in volleyball, dance fundamentals, archery, and badminton showed greatest improvement in strength. The total improvement of the entire group, however, was considered more significant than the analysis of the separate activities.

A comparative study of the development of certain elements of physical fitness on the part of college women at Southern Illinois Normal University was reported by Emma Jean Stehr in 1945. (72) The subjects, freshmen and sophomore women enrolled in physical education, were tested in arm and shoulder-girdle strength, leg and abdominal strength, endurance, and agility; the author employed the Burpee test, the jump and reach, sit-up, modified push-up, and Clarke step-test to measure these fitness components. The tests were administered at the beginning of the study and were re-administered after an eight week period of activity during which half of the experimental group participated in a basketball class two periods per week and the other half took part in a modern dance class twice weekly. The final results showed "no conclusive evidence to indicate more

improvement on the part of individuals participating in modern dance or less improvement on the part of individuals participating in basketball. In this study any individual improvement was felt to be almost entirely a matter of individual effort rather than the result of the activity." (72:67)

Two studies reviewed by Broer (23) include one by C. L. Bennett (65) in which she studied the relative contributions of modern dance, folk dance, basketball, and swimming to agility, coordination, strength, flexibility, and speed. On the basis of her results she concluded that swimming, modern dance, basketball, and folk dance contributed to these qualities in that order. Swimming was found to be more effective than folk dance in developing all elements studied and more effective than either modern dance or basketball in developing abdominal strength and back flexibility.

Modern dance, basketball, and skiing were studied by A. E. Ball (64) in comparison with a non-activity group. She found that the skiing group increased most in both P.F.I. and the strength index, while modern dance was second and basketball third. The non-activity group had no significant increase in either. C. E. Walters reported a study of the effects of a prescribed program of strenuous activity on the physical efficiency of college women (61); it was discovered that training improved the physical efficiency as measured by physiologic responses to exercises, including oxygen debt, heart rate, work efficiency, and ventilation volume, with this improvement lasting through two weeks of de-training. Training, however, effected no immediate significant change in physical efficiency

as measured by performance tests on the grip dynamometer and bicycle ergometer.

Lucille Lee (71) conducted a study at the State College of Washington in 1946 in an attempt to determine whether cardio-vascular efficiency in an unselected group of college women was affected by specific activities in the physical education program. The activities involved included badminton-tennis, modern dance, swimming, and Danish gymnastics. The results indicated that the total amount of exercise obtained by college women in two periods of physical education per week was not sufficient over a ten week period to increase cardiovascular efficiency as measured by the Tuttle Pulse-Ratio test. The author concluded that "if conditions are favorable for significant changes, the study indicates these changes are more likely to be progressively less in this order for the following physical education classes: swimming, badminton-tennis, modern dance, and Danish gymnastics." (71:44)

The effects of one semester of physical activity upon the strength, endurance, and agility of 256 high school girls was studied by Evelyn Sturtz. (73) Subjects from the ninth through the twelfth grades were included in the study. One group, composed of freshmen and sophomore girls, participated during the semester in recreational sports, stunts and tumbling, apparatus, and a choice of outdoor activities including archery, tennis, and softball, while the second group, composed of juniors and seniors, engaged in badminton, modern dance, folk dance, and a choice of outdoor activities--archery, tennis, or softball. Classes were held two one-hour periods per week for both groups, and each class included ten

minutes devoted to specific exercises to improve fitness. Exercises closely related to the test items were not used during this period. Results showed that the freshmen and sophomore girls improved only in arm and shoulder-girdle strength, whereas the junior and senior girls improved in all components of fitness measured except that of endurance. There was no significant improvement in endurance for either group. The author felt that the main contributing factors to the greater improvement of the junior-senior group were the smaller classes and the fact that this group had previously been required to take only one period per week of physical education. She recommended that the time allotment for physical education be extended, with two periods per week regarded as a minimum requirement for high school girls.

A study by Dorothy R. Mohr (46) involving 686 freshmen and sophomore college women participating in swimming, recreational sports, dance, and team sports, found no conclusive evidence to suggest the superiority of any one type of activity in its effect on improvement of endurance, strength, or agility. The author also found that only for arm strength was there evidence to suggest the superiority of three periods per week of activity as compared with two periods per week.

SUMMARY

Gymnastics as human activity has enjoyed its greatest popularity in the western European nations, where its development has been influenced by the dynamic leadership of such men as Jahn, Nachtegall, GutsMuths, and Ling. In recent years in Sweden, the more rigid style of execution originally taught by Ling has been modified to encompass a more relaxed,

rhythmic approach to gymnastics, emphasizing gracefulness and freedom of movement.

In the past four years a great deal of interest in the physical fitness of American youth has been evidenced at both a national and state level. This interest has stimulated some concern over the degree to which the physical fitness objectives of physical education are being met by existing programs.

Although much research has been conducted to isolate the components of physical fitness and to establish tests to measure these components, evidence as to the effect of various physical education activities on the qualities of physical fitness has not been conclusive. The wide variation of experimental patterns, the different tests used to measure physical fitness, the different elements of fitness measured, as well as the varying influences of the teacher, the skill level of the classes, the motivation of the students, and the teaching methods involved have all contributed to the difficulty of arriving at definite conclusions.

Investigators have been found to disagree as to the value of gymnastics and related activities in improving physical fitness. Fordham (69) found apparatus and tumbling stunts to rank rather high in contributing to muscular endurance, and Cureton (26) found Danish exercises, in combination with other activities, to be effective in aiding in physical fitness improvement. The study by Landiss (35) credited the tumbling-gymnastics group with more gains in fitness than any other activity group measured. However, Wilbur (62) judged the sports method superior to the apparatus method for improving physical fitness, and Lee

(71) ranked Danish gymnastics lowest among the activities she studied as contributing to cardiovascular efficiency.

Opinion appears to be divided also on the question of the relative value of the amount of time devoted to physical education. Clarke (25) stated that two periods per week of physical education does make some contribution toward raising the level of physical fitness of college women, although it does not represent an ideal program, and Sturtz (73) recommended that the time allotment for physical education be increased from two periods per week, which should be regarded as a minimum requirement only. Petrosky (50) also felt that more than three periods per week of physical education would probably result in increased gains in physical fitness. However, Mohr's study (46) produced no evidence to suggest the superiority of three periods per week of activity as compared with two periods per week.

CHAPTER IV

PROCEDURE

This study was conducted to determine what effect participation in a course in rhythmic gymnastics would have on the physical fitness level of college women as measured by a physical fitness test battery and by selected physiological tests. Its purpose also was to compare the relative effects on physical fitness of a short-term course, in which one experimental group met daily Monday through Thursday for a five week unit of gymnastics, and a long-term course, in which the other group met twice weekly for a period of ten weeks. Both groups participated in a total of twenty lessons of rhythmic gymnastics; they were taught by the same instructor, and the material presented to each class was kept as nearly identical as possible.

Subjects were selected at random from the general college population, excluding physical education majors, none of whom participated in this study. Subjects were drawn primarily from the Freshman, Sophomore, and Commercial classes by offering two rhythmic gymnastic courses in the physical education service program during the second semester of 1958-59. Those students who registered for these two courses then became experimental groups for this study. Group I was composed of 18 Commercial students, eight Freshmen, and three Sophomores, for a total of 29 students; Group II had 15 Commercial students, seven Freshmen, three Sophomores, two Juniors, and three Seniors, for a total enrollment of 30 students.

Group I met on Mondays and Wednesdays for the entire second semester--a total of sixteen weeks; each class period was approximately 50 minutes long. Twenty lessons were devoted to instruction and practice in gymnastics, and the remaining class periods were devoted to physical fitness testing. Group II also participated in a total of twenty, 50-minute gymnastic lessons and the same physical fitness testing program during class periods, but their work was completed in the shorter time of seven weeks since they met four days each week for a more concentrated course.

Both groups were tested at the beginning and at the end of their rhythmic gymnastic course; a physical fitness test battery and a series of direct physiological measures involving strength, flexibility, and cardiovascular-respiratory endurance were used in both the preliminary and final testing programs. The physiological tests were administered to both groups outside of class time; the physical fitness test battery was administered during class periods. The tests used were selected on the basis of their validity, reliability, ease of administration, and practicability in terms of economy of time, ease of scoring, availability of necessary equipment, and number of personnel needed for efficient administration.

The physical fitness test battery used in this study was the New York State Physical Fitness Test. (19) This test battery was developed by Dr. Saul Ostrow (19:7), who did much of the basic research work as part of his doctoral dissertation under the direction of Dr. Leonard A. Larson of New York University. Dr. Ostrow worked on this test in connection with the New York State Physical Education Standards Project,

sponsored by the New York State Association of Health, Physical Education, and Recreation and the State Education Department. In the development of this test battery sixty-nine components of physical fitness were first classified into three major categories:

1. Medical or physiological function
2. Anthropometrical condition pertaining to physique or appearance
3. Physical or motor function

Tests of the sixty-nine components thus classified were then judged against criteria of suitability for use in the public schools in New York State, criteria such as time, equipment, and leadership necessary for administration. Seven of the components were selected for measurement; these included posture, accuracy, strength, agility, speed, balance, and endurance.

In a pre-testing procedure, items of high validity and reliability were used to measure these components of physical fitness. On the basis of this pre-testing, the following individual performance-type tests were selected for their validity, reliability, and administrative feasibility:

1. Accuracy

   The Target Throw was used to measure accuracy. The student made ten overhand throws with a regulation softball at a circular target, rested while her partner made her first ten throws, and then the first student threw ten more balls. Her score was the total number of hits in twenty trials.

2. Strength

   Modified Pull-Ups were used to measure strength of girls above the sixth grade level. The student slid her feet under the horizontal bar until her legs were extended and her arms formed a right angle with her chest. With her weight resting on her heels, she pulled up to the bar,

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touching her chest, and then returned to her starting position as many times as possible. No definite rate was required; however, the action, once started, had to be continuous. The student's score was the number of complete pull-ups she was able to perform successfully.

3. Agility

The Side-Stepping test was used to measure agility. Starting from a position astride a center line, the student side-stepped alternately right and left between two lines eight feet apart. Her score was the number of lines crossed in ten seconds time.

4. Speed

The 50-yard Dash was the measurement of speed used; the student's score was her time to the nearest half second.

5. Balance

The Squat-Stand was used to measure balance. The student squated, facing a mat, with her hands on the floor and elbows against the inner surface of her knees. She leaned forward until her feet were raised off the floor and she was in a balanced position. Her score was the number of seconds she was able to maintain this balanced position. If she failed to hold her balance for at least five seconds on her first trial, she was permitted a second attempt and the longer of the two trials was recorded as her score.

6. Endurance

The Treadmill was used to measure endurance. On a mat the student assumed a front-leaning-rest position with one knee flexed to her chest and the other leg extended behind her. She then exchanged the position of her feet as rapidly as possible. Her score was the number of leg changes made in thirty seconds.

7. Posture

A Posture Rating Chart was used to evaluate posture and body alignment. Each student was given a subjective rating from observations of both a lateral and an anterio-posterior view. The student was compared with figure drawings illustrating posture for thirteen different body segments. Each body segment was scored as 5, 3, or 1, with 5 indicating no deviation; 3 a slight deviation; and 1 a marked deviation. Total scores could thus range from 13 to 65.

The primary emphasis of the test was upon total physical fitness rather than upon the separate components of fitness. The score on each item was converted to an achievement level score and the sum total of achievement levels provided a general physical fitness score. Achievement level norms were based on the test results of 12,626 pupils in New York State schools. Norms used in this study were those based on scores of twelfth grade girls. At the time this test was developed in New York State correlations between each component score and the total physical fitness score were shown to range from .35 to .67 (19:50), indicating that each of the scores contributed substantially to the determination of the total physical fitness score, but that no one component score was closely indicative of the physical fitness score. Inter-correlations between the components ranged from -.02 to .49, indicating in general a desirable lack of similarity of functions measured. (19:50)

This test battery was administered to the experimental groups by physical education major students working under the supervision of the author; a total of three class periods was necessary to complete the battery. Prior to the first actual test administration one class period was devoted to an explanation and demonstration of each test item and practice in unfamiliar items. When the testing began, each student was given an individual score card and her scores were recorded on this card immediately upon the completion of each test item. A sample score card is included in the Appendix.

During the first testing period the softball throw, pull-ups, and side-stepping tests were administered; all students took the tests in

this order. Three accuracy testing stations were used; the three target circles, each with a two-foot diameter, were painted on the wall with the center of each circle four feet from the floor surface. Balls were thrown from behind a thirty foot restraining line. Students performed as partners, with one recovering the first ten balls thrown by her partner and then making her own first ten throws. This procedure was repeated for a total of twenty trials per student. A tester at each one of the three stations administered this test, watching for fouls, scoring, and recording each student's performance on the individual's score card.

Since no horizontal bar was available, pull-ups were administered on the parallel bars, which were adjusted to the height of each student before she began her test. Two students were tested at a time, each using one of the bars and each one's performance being checked, counted, and recorded by a separate tester. Three agility testing stations were marked on the floor; each one consisted of a set of three parallel lines approximately five feet in length with a space of four feet between each pair of lines. One timer and three testers were required to time, score, and record for three students simultaneously.

The second day of testing included the 50-yard dash, the squat-stand, and the treadmill items; all students performed these tests in this order. Because of adverse weather conditions, the 50-yard dash was performed in an inside corridor with students running the distance in pairs. A starter, two timers, and one recorder administered and recorded this test. Two students, performing on opposite sides of the testing mat, were tested simultaneously in the squat-stand for balance; a tester for each

individual administered, scored, and recorded this item. The treadmill test was also administered to two students simultaneously; each student performed the test on a mat, and two scorers plus one timer were required for its administration.

The final testing period was devoted to the posture screening test. It was felt that the use of three examiners would increase the reliability of this subjective evaluation, and, accordingly, the author and two other physical education instructors scored this test item. Each student was rated individually while standing between a plumb line and a grid background. The examiners stood approximately six feet from the student and scored each individual on the thirteen different body segments included on the Posture Rating Chart. At the conclusion of this final test item, each student's scores on the fitness components measured were converted to achievement level scores, and the total of the achievement levels provided a total fitness score for each individual.

The direct physiological measures used to evaluate strength, flexibility, and cardiovascular-respiratory endurance were administered to the two experimental groups during two separate three and one-half hour testing periods outside of class time. Students were scheduled for this laboratory testing at ten minute intervals, and each student performed the test items in the same order. These tests were administered by physical education graduate students; each item was administered by the same tester to both groups in both the preliminary and final testing periods.

During this laboratory testing period the McCurdy-Larson Organic Efficiency Test was used to evaluate the student's cardiovascular-

respiratory endurance, the hand dynamometer with push-pull attachment was employed as a measure of strength, and the Leighton flexometer was used as an indication of flexibility and range of movement.

The McCurdy-Larson Organic Efficiency Test was first published in May, 1935 (43) and revised in December of that year. (44) It was based on five organic functional measures; these measures, together with their reliability coefficients as determined by Ferguson in an unpublished Master's thesis in 1939 (27:101) were as follows:

Test Item	Reliability Coefficient
1. Sitting diastolic blood pressure	.963
2. Breath holding twenty seconds after exercise	.982
3. Standing pulse rate minus pulse rate two minutes after exercise	.670
4. Standing pulse pressure	.965
5. Vital capacity	.956

The multiple correlation of these five items with "condition" as expressed by two typical physiological groups, one a group of varsity swimmers considered in "good" condition and the other a group of infirmary patients considered in "poor" condition, was found to be .947 (15:316)

An Organic Efficiency Index Score was obtained from scores on these five test items by converting the raw scores to standard scores, weighting each standard score, and adding the weighted scores algebraically. (15:318) The reliability coefficient for this Index Score as obtained by Ferguson was .914. (27:101) Each Index Score was then given a classification of excellent, good, average, poor, or very poor; classification scales were devised for three age groups: 18-35; 35-49; and 50-80 years. (15:326, 331, 336) The validity of the Organic Efficiency Test was determined by the

degree of differentiation between the same two physiological groups used as a criteria of "condition"; a validity coefficient of .8334 was indicated. (12:56) Scoring tables and norms were devised for three different age groups. (15:321) Research showed that the Organic Efficiency Index was applicable to both sexes without re-norming the scoring tables. (44:86)

At the beginning of the test administration each student was given a score card on which her age, height, and weight had been previously recorded. The same score card, a sample of which is included in the Appendix, was used for each student in both the preliminary and final testing periods, and the following testing procedure (12:69) was followed closely each time.

1. The first examiner recorded the student's standing pulse rate, which was taken for 15 seconds and multiplied by 4. Sitting systolic and fourth-phase diastolic blood pressures were then measured using a mercury sphygmomanometer; the same blood pressure measurements were then recorded with the student in a standing position.

2. The second examiner recorded the student's vital capacity as measured by the Propper Compact spirometer. The student held the spirometer in both hands, took three deep breaths, and then blew out into the instrument as long and as hard as possible. A second trial was given after an interval of one minute; both scores were recorded and the best score was used in the treatment of the data.

3. The student then exercised for a period of 90 seconds. The exercise consisted of climbing a standard set of stairs made up of three steps, with the middle stair 18 inches high and the two side steps 9 inches from the floor. The stairs used were constructed solely for the purpose of this study in accordance with the standard dimensions. (12:69) The rate of exercise was based on the student's weight; the number of ascents for each individual had been read from the prepared table (12:464) and recorded on each score sheet prior to the test. At the time of the exercise an electric metranome, set at the appropriate rate as indicated by the number of ascents designated on each score card, was used to help each student maintain the proper rate of exercise.

degree of differentiation between the same two physiological groups used as a criteria of "condition"; a validity coefficient of .8334 was indicated. (12:56) Scoring tables and norms were devised for three different age groups. (15:321) Research showed that the Organic Efficiency Index was applicable to both sexes without re-norming the scoring tables. (44:86)

At the beginning of the test administration each student was given a score card on which her age, height, and weight had been previously recorded. The same score card, a sample of which is included in the Appendix, was used for each student in both the preliminary and final testing periods, and the following testing procedure (12:69) was followed closely each time.

1. The first examiner recorded the student's standing pulse rate, which was taken for 15 seconds and multiplied by 4. Sitting systolic and fourth-phase diastolic blood pressures were then measured using a mercury sphygmomanometer; the same blood pressure measurements were then recorded with the student in a standing position.

2. The second examiner recorded the student's vital capacity as measured by the Propper Compact spirometer. The student held the spirometer in both hands, took three deep breaths, and then blew out into the instrument as long and as hard as possible. A second trial was given after an interval of one minute; both scores were recorded and the best score was used in the treatment of the data.

3. The student then exercised for a period of 90 seconds. The exercise consisted of climbing a standard set of stairs made up of three steps, with the middle stair 18 inches high and the two side steps 9 inches from the floor. The stairs used were constructed solely for the purpose of this study in accordance with the standard dimensions. (12:69) The rate of exercise was based on the student's weight; the number of ascents for each individual had been read from the prepared table (12:464) and recorded on each score sheet prior to the test. At the time of the exercise an electric metranome, set at the appropriate rate as indicated by the number of ascents designated on each score card, was used to help each student maintain the proper rate of exercise.

standing position, in order to eliminate any forward bending or loss of contact between the trunk and the wall. Scores for each measure were read aloud by the examiner and entered on the student's score card by a recorder.

The testing procedure followed at the completion of the rhythmic gymnastic course was identical with this preliminary procedure; the same examiners administered each test item and the same testing progression was maintained. In the interim between preliminary and final testing, the subjects participated in twenty lessons of rhythmic gymnastics as outlined in the Appendix.

The material presented in these lessons was based on Swedish gymnastics and included free-exercise routines, jump-rope, and ball exercises all performed to musical accompaniment. Details of the routines taught and descriptions of the exercises are included in the Appendix. No attempt was made to include or practice any of the specific test items involved in this study; at the same time the objectives of the course, based on the principles of Swedish gymnastics as listed in Chapter III, page 14, necessarily involved an attempt to develop some of the fitness components tested. Exercises were presented, learned, combined into routines, and practiced during the first part of the course, progressing from simple to more difficult and demanding skills. The last few lessons provided an opportunity for the students to develop original routines to musical accompaniment by building creatively upon the skills and knowledges they had acquired. At the conclusion of the course, the students performed and were graded on certain of the routines taught as well as the routines

they had composed themselves. Marking criteria included skill of performance, grace and relaxation, rhythmic response, and knowledge of routines.

The twenty lessons of rhythmic gymnastics were taught by the same instructor to two experimental groups, with Group I meeting twice a week for instruction and Group II meeting four times a week. Selected physical fitness tests, consisting of the New York State Physical Fitness Test battery and laboratory tests of strength, flexibility, and cardiovascular-respiratory endurance, were administered to each group prior to and at the conclusion of their instruction in gymnastics.

CHAPTER V

PRESENTATION AND ANALYSIS OF DATA

In order to determine what effect participation in rhythmic gymnastics would have on the physical fitness status of college women, two groups of college women were tested in certain specific physical fitness items; these two groups then took part in a twenty-lesson course in rhythmic gymnastics with Group I meeting twice weekly for a period of ten weeks, and Group II meeting four times per week for a five-week period. Following this course in gymnastics both groups were re-tested in the same fitness variables.

At the conclusion of the preliminary testing period raw scores had been recorded for each subject in Group I on the following items:

1. McCurdy-Larson Organic Efficiency Test

   Six measurements were involved in this test. They included Sitting Diastolic Blood Pressure, Breath-Holding 20 Seconds After a Standard Exercise, Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, Standing Pulse Pressure, Vital Capacity, and a Total Organic Efficiency Index Score. Vital Capacity scores were recorded in cubic centimeters and in all cases the final two zeros, representing the ten's and hundred's digits, were dropped to facilitate computations; thus a score of 15 on Vital Capacity represents 1500 cc.'s and a score of 45, 4500 cc.'s.

2. Dynamometer

   Two measurements were recorded for each subject on this instrument; the first, a score of "Push" strength, and the second, a "Pull" score.

3. Flexometer

   Five flexibility scores were recorded; they included the range of movement for Right Shoulder, Right Ankle, Right

Thigh, Trunk and Hip Forward and Backward Flexion and Extension, and Trunk and Hip Sideward Flexion and Extension.

4. New York State Physical Fitness Test

The fitness scores recorded in this test battery included Posture, Accuracy, Strength, Agility, Speed, Balance, Endurance, and Total Fitness.

The mean and standard deviation for each test item was then calculated from the raw scores recorded for Group I. These means and standard deviations, as well as the raw score ranges for the test items, have been recorded in Table I under Preliminary Tests.

After participating twice weekly in rhythmic gymnastics for a period of ten weeks, Group I was re-tested in the same fitness items; the raw score ranges, means, and standard deviations for the various test items as recorded after participation in gymnastics by Group I have been recorded in Table I under Final Tests.

Fisher's "t" formula (9:220) for use with thirty subjects or less was employed to calculate the significance of difference between the mean of each test item in the preliminary testing as compared with the mean of the same item in the final testing; these "t" values for Group I may be found in Table III on page 58. Throughout this study values of "t" at the 5% level of confidence or below have been accepted as being statistically significant and in this case were regarded as indicative of a change in mean scores between preliminary and final testing periods which was greater than any change that might have been due to chance factors alone.

Analysis of these significance of difference scores for Group I shows that the mean scores for this group changed significantly in six

TABLE I

RAW SCORE RANGES, MEANS, AND STANDARD DEVIATIONS
IN PRELIMINARY AND FINAL TESTING FOR GROUP I

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
McCURDY-LARSON OET						
Sitting Diastolic Pressure	58-78	66.845	6.348	54-80	66.429	5.250
Breath Holding 20 Sec. After Exercise	3-15	7.07	2.97	4-16	7.929	3.359
Standing Pulse Rate Minus PR 2 Min. After Exercise	-24-+16	-4.897	10.166	-28-+12	-1.679	10.121
Standing Pulse Pressure	22-60	43.724	8.884	22-58	37.357	9.094
Vital Capacity	15-45	30.845	6.498	30-47	37.679	4.473
INDEX SCORE	-110-+108	8.551	50.577	-110-+154	45.928	59.774
DYNAMOMETER						
Push	25-72	39.793	3.742	22-58	39.071	9.006
Pull	25-63	45.1	9.399	25-55	42.857	8.178

TABLE I (CONTINUED)

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
FLEXOMETER						
Shoulder	219-346	266.828	19.993	238-319	268.965	14.659
Ankle	54-90	70.224	10.540	58-91	74.857	9.305
Thigh	92-140	114.483	12.705	105-144	117.786	9.244
Trunk & Hip Flexion and Extension	160-250	197.310	22.935	165-235	207.357	18.319
Trunk & Hip Sideward Flexion and Extension	80-165	125.276	22.942	102-165	127.715	15.852
N. Y. STATE FITNESS TEST						
Posture	39-63	52.167	5.612	29-61	48.431	6.464
Accuracy	1-11	6.3	2.734	0-13	5.793	2.905
Strength	5-19	10.833	2.806	6-20	12.069	3.503
Agility	12-19	15.333	1.758	14-20	16.621	1.400
Speed	10.0-7.5	8.650	.579	10.0-7.5	8.603	.515

TABLE I (CONTINUED)

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
N. Y. STATE FITNESS TEST (Continued)						
Balance	0-16	4.333	4.563	0-39	5.241	7.820
Endurance	15-56	37.800	10.038	28-62	44.155	6.348
TOTAL FITNESS	24-45	34.5	4.705	25-48	35.328	5.052

items: in Standing Pulse Pressure, Vital Capacity, and the Organic Efficiency Index Score as part of the McCurdy-Larson Organic Efficiency Test, and in Posture, Agility, and Endurance as measured by the New York State Fitness test. The greatest degree of change occurred in Vital Capacity, Agility, and Endurance measurements.

Experimental Group II was tested in the same fitness items as Group I, and the data for Group II were treated in a similar manner. After the preliminary testing, Group II also participated in a twenty-lesson course in rhythmic gymnastics, but this group met daily Monday through Thursday and thus completed the course in a five weeks' period of time. Raw score ranges, means, and standard deviations for all test items as recorded for Group II on both the preliminary and the final tests have been presented in Table II.

The mean scores for Group II for each test item in the preliminary testing were statistically compared with the mean scores for the same item in the final testing through the use of Fisher's "t" formula for significance of difference between the means. The results of this comparison, as demonstrated in Table III, page 58, show that Group II changed significantly in ten test items, including the Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, the Pulse Pressure, and the Vital Capacity measurements in the McCurdy-Larson Organic Efficiency Test; the Dynamometer "Push" test; Shoulder flexibility, and Trunk and Hip Sideward Flexion and Extension as recorded on the Flexometer; and the Strength, Agility, Endurance, and Total Fitness items of the New York State Physical Fitness Test. The greatest change in mean

TABLE II

RAW SCORE RANGES, MEANS, AND STANDARD DEVIATIONS
IN PRELIMINARY AND FINAL TESTING FOR GROUP II

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
McCURDY-LARSON OET						
Sitting Diastolic Pressure	48-90	69.500	8.084	54-88	72.367	6.428
Breath Holding 20 Sec. After Exercise	3-17	6.3	3.002	3.5-19	7.1	3.380
Standing Pulse Rate Minus PR 2 Min. After Exercise	-44-+8	-10.000	11.018	-20-+32	.900	10.202
Standing Pulse Pressure	28-52	40.367	7.173	22-50	36.3	7.973
Vital Capacity	14-46	34.7	5.862	31-52	37.833	5.473
INDEX SCORE	-189-+99	15.166	69.920	-64-+168	47.999	58.215
DYNAMOMETER						
Push	20-47	32.1	7.041	17-64	39.000	10.964
Pull	22-58	39.433	9.248	25-62	43.5	9.821

TABLE II (CONTINUED)

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
FLEXOMETER						
Shoulder	243-285	260.900	11.131	247-312	274.167	15.583
Ankle	53-87	71.1	8.814	49-98	70.400	9.821
Thigh	100-136	117.433	9.712	100-139	121.600	11.020
Hip & Trunk Flexion and Extension	156-265	194.333	20.555	175-234	210.834	16.457
Trunk & Hip Sideward Flexion and Extension	74-144	111.334	15.370	100-150	123.700	13.380
N. Y. STATE FITNESS TEST						
Posture	43-63	54.77	4.494	41-63	53.879	5.307
Accuracy	1-13	5.6	3.287	0-13	5.759	3.07
Strength	0-13	6.1	3.208	4-21	11.724	3.463
Agility	12-18	15.23	1.585	14-19	16.241	1.568

TABLE II (CONTINUED)

Variables	Preliminary Tests			Final Tests		
	Range	M	S.D.	Range	M	S.D.
N. Y. STATE FITNESS TEST (Continued)						
Speed	11.0-7.5	8.80	.8718	10-7.0	8.638	.776
Balance	0-30	7.567	9.161	0-33	8.776	9.479
Endurance	18-52	37.5	9.930	20-54	42.776	6.802
TOTAL FITNESS	18-42	33.033	5.772	25-46	36.431	5.445

TABLE III

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF PRELIMINARY TEST RESULTS AND FINAL TEST RESULTS FOR GROUP I AND FOR GROUP II

Variables	Group I "t"	Group II "t"
McCURDY-LARSON OET		
Sitting Diastolic Pressure	.2645	1.4944
Breath Holding 20 Sec. After Exercise	1.0060	.9528
Standing Pulse Rate Minus Pulse Rate 2 Min. After Exercise	1.1761	3.1918***
Standing Pulse Pressure	2.6264**	2.0416*
Vital Capacity	4.5278***	2.1054*
INDEX SCORE	2.5065**	1.9429
DYNAMOMETER		
Push	.3904	2.8512***
Pull	.9423	1.6230
FLEXOMETER		
Shoulder	.4507	3.7297***
Ankle	1.7258	.2856
Thigh	1.0992	1.5271
Trunk & Hip Flexion and Extension	1.7911	1.5336
Trunk & Hip Sideward Flexion and Extension	.4571	3.2673***

TABLE III (CONTINUED)

Variables	Group I "t"	Group II "t"
N. Y. STATE FITNESS TEST		
Posture	2.3324*	.6846
Accuracy	.6787	.1881
Strength	1.4725	6.3643***
Agility	3.0529***	2.4214**
Speed	.3207	.7405
Balance	.5377	.4898
Endurance	2.8462***	2.3328*
TOTAL FITNESS	.6404	2.2847*

*Significant at 5% level of confidence.
**Significant at 2% level of confidence.
***Significant at 1% level of confidence.

scores for Group II occurred in Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, in arm and shoulder-girdle strength as measured by the Dynamometer "Push" test; in shoulder and trunk and hip flexibility, and in strength as evaluated by the New York State Physical Fitness Test.

In addition to discovering any changes within each of the experimental groups after participation in rhythmic gymnastics by statistically comparing their preliminary test results with their final test results, this study also statistically compared Group I with Group II in an effort to determine whether or not one group changed significantly more than the other group. Fisher's "t" formula was used to calculate the significance of difference between Group I's mean scores on the Preliminary Tests and Group II's mean scores on the Preliminary Tests. The results of these calculations have been reported in Table IV under Preliminary Tests, and they indicate that prior to instruction and participation in rhythmic gymnastics the two groups differed in only four of the physical fitness components measured: in Vital Capacity, arm and shoulder-girdle strength as measured by both the Dynamometer "Push" and Dynamometer "Pull," in trunk and hip sideward flexion and extension, and in strength as measured by the New York State Physical Fitness Test. Group II had a higher mean score in Vital Capacity, while the mean scores of Group I were higher in the other three fitness components.

Significance of differences between the means of Group I and Group II on the Final Tests were calculated after both groups had completed their gymnastic courses; these "t" values can be found recorded

TABLE IV

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF GROUP I AND GROUP II IN PRELIMINARY TESTING AND IN FINAL TESTING

Variables	Preliminary Tests "t"	Final Tests "t"
McCURDY-LARSON OET		
Sitting Diastolic Pressure	1.3908	3.7718***
Breath Holding 20 Sec. After Exercise	.9805	.9198
Standing Pulse Rate Minus Pulse Rate 2 Min. After Exercise	1.8329	.9492
Standing Pulse Pressure	1.5831	.4635
Vital Capacity	2.2979*	.1155
INDEX SCORE	.4127	.1314
DYNAMOMETER		
Push	5.1945***	.2650
Pull	2.3137*	.0265
FLEXOMETER		
Shoulder	1.3947	1.2850
Ankle	.2669	1.7413
Thigh	.9933	1.3986
Trunk & Hip Flexion and Extension	.5204	1.1888
Trunk & Hip Sideward Flexion and Extension	2.7183***	1.0366

TABLE IV (CONTINUED)

Variables	Preliminary Tests "t"	Final Tests "t"
N. Y. STATE FITNESS TEST		
Posture	1.9367	3.4462***
Accuracy	.8726	.0432
Strength	5.9218***	.0117
Agility	.2433	.9545
Speed	.7626	.1959
Balance	1.6779	1.5215
Endurance	.1135	.7843
TOTAL FITNESS	1.0460	.7858

*Significant at 5% level of confidence.
**Significant at 2% level of confidence.
***Significant at 1% level of confidence.

in Table IV under Final Tests. This final test comparison showed that at the conclusion of the study the two groups differed only in two variables: Group II had a significantly higher mean score in the Sitting Diastolic Blood Pressure measurement and in the Posture test item.

In addition to a comparison between the mean scores for Group I and Group II prior to and at the conclusion of gymnastic participation, the amount of individual change within Group I and individual change within Group II was calculated statistically by using the "t" formula for differences of paired observations. (9:220) The means and "t" values of significance of difference for these difference scores for each group have been recorded in Table V. They indicate that the subjects in Group I evidenced a statistically significant degree of individual change between preliminary tests and final tests in the following ten variables:

1. Sitting Diastolic Pressure
2. Standing Pulse Pressure
3. Vital Capacity
4. Organic Efficiency Index Score
5. Ankle flexibility
6. Trunk and Hip Flexion and Extension
7. Posture
8. Strength
9. Agility
10. Endurance

The greatest degree of change, as represented by "t" values accepted at the 1% level of confidence, occurred in the Sitting Diastolic Pressure, Standing Pulse Pressure, Vital Capacity, Posture, Agility, and Endurance measures.

Table V also demonstrates that the subjects in Group II showed statistically significant changes between preliminary and final test scores in fifteen of the test items:

TABLE V

MEANS AND SIGNIFICANCE OF DIFFERENCES FOR DIFFERENCE SCORES BETWEEN PRELIMINARY AND FINAL TEST RESULTS FOR GROUP I AND FOR GROUP II

Variables	Group I		Group II	
	Mean	"t"	Mean	"t"
McCURDY-LARSON OET				
Sitting Diastolic Pressure	4.5714	6.4925***	5.0667	6.3270***
Breath Holding 20 Sec. After Exercise	.7500	1.8727	1.0667	3.3660***
Standing Pulse Rate Minus PR 2 Min. After Exercise	1.1071	.6155	2.1334	.9486
Standing Pulse Pressure	6.8571	7.8872***	6.8667	7.2456***
Vital Capacity	7.1429	7.0485***	3.7667	3.6407***
INDEX SCORE	34.0714	2.1639*	- .3000	- .0200
DYNAMOMETER				
Push	- 1.3571	- .7550	6.8333	4.8470***
Pull	- 2.7500	-1.9209	4.0333	3.3152***

TABLE V (CONTINUED)

Variables	Group I		Group II	
	Mean	"t"	Mean	"t"
FLEXOMETER				
Shoulder	2.5357	1.0901	12.7667	5.8277***
Ankle	4.3214	2.3374*	- .5333	- .3145
Thigh	3.8929	1.7224	4.4667	2.1360*
Trunk & Hip Flexion and Extension	8.0357	2.1532*	7.9000	2.3508*
Trunk & Hip Sideward Flexion and Extension	1.6429	.5554	12.3000	5.0104***
N. Y. STATE FITNESS TEST				
Posture	- 3.5172	- 4.3401***	- .9655	- .9842
Accuracy	- .6552	- 1.3385	- .0345	- .0509
Strength	1.3448	2.1956*	5.2069	11.6225***
Agility	1.3448	4.8460***	1.0690	3.4980***

TABLE V (CONTINUED)

Variables	Group I Mean	Group I "t"	Group II Mean	Group II "t"
N. Y. STATE FITNESS TEST (Continued)				
Speed	.0690	.8498	.2069	2.8957***
Balance	1.0345	1.0469	1.6552	1.4225
Endurance	6.2414	3.6514***	4.4483	2.8349***
TOTAL FITNESS	1.1379	2.0480	3.6207	4.8295***

*Significant at 5% level of confidence.
**Significant at 2% level of confidence.
***Significant at 1% level of confidence.

1. Sitting Diastolic Pressure
2. Breath-Holding 20 Seconds After Exercise
3. Standing Pulse Pressure
4. Vital Capacity
5. Dynamometer Push
6. Dynamometer Pull
7. Shoulder Flexibility
8. Thigh Flexibility
9. Trunk and Hip Flexion and Extension
10. Trunk and Hip Sideward Flexion and Extension
11. Strength
12. Agility
13. Speed
14. Endurance
15. Total Fitness

The "t" values for significance of difference were acceptable at the 1% level of confidence or better for all of these items with the exception of thigh flexibility and trunk and hip sideward flexion and extension; these latter two measurements were accepted at the 5% level of confidence.

An overview of Table V indicated statistically significant individual changes within both groups in:

1. Sitting Diastolic Pressure
2. Standing Pulse Pressure
3. Vital Capacity
4. Trunk and Hip Flexion and Extension
5. Strength
6. Agility
7. Endurance

In these seven variables the subjects in Group I demonstrated a greater degree of change than the Group II subjects in all but the Trunk and Hip Flexion and Extension and the Strength items. In addition, Group I subjects showed statistically significant changes not shown by Group II in the Organic Efficiency Index Score, Ankle Flexibility, and Posture. The subjects in Group II evidenced significant changes in six items in

which Group I subjects failed to record significant change; these items included Breath-Holding 20 Seconds After Exercise, Dynamometer "Push," Shoulder Flexibility, Thigh Flexibility, Trunk and Hip Sideward Flexion and Extension, and Total Fitness Score.

CHAPTER VI

INTERPRETATION OF DATA

This study was conducted to determine what changes might occur in certain specific physical fitness components of college women after they had participated in a twenty-lesson course in rhythmic gymnastics. Physiological measurements of cardiovascular efficiency, muscular strength, and flexibility, and the New York State Physical Fitness Test battery, which evaluated Posture, Accuracy, Strength, Agility, Speed, Balance, and Endurance, were used to test each of the two experimental groups prior to and at the conclusion of their gymnastic participation. Experimental Group I took part in rhythmic gymnastics twice weekly for a period of ten weeks; Group II participated in the gymnastic activities four times per week for a five-week period of time.

The raw score data from both preliminary and final tests for each group were treated statistically to determine changes within each group and to compare the changes evidenced by Group I with those indicated by Group II.

One of the influencing factors which may be of major importance in any study such as this involving a test-retest situation, was the factor of motivation. The possibility of affecting the performance level of one group more than that of the other group through the use of various motivating devices present in one situation and absent in the other was recognized, and an attempt was made to equalize the motivating factors for each group as much as possible insofar as the teaching situation itself was concerned. The subjects in each group were requested before

both the preliminary and final testing period to perform at their optimum level each time—to "do their best." No reference to their previous scores or to the scores of the other group was made; the subjects were told only that the study was being conducted to determine any changes which might have occurred in the interim between testing and re-testing. Performance on the test items was not associated with marking or grading in the course; this fact was made clear to the subjects before each testing period. Throughout the duration of the gymnastic courses any motivating activities used with one group were also employed with the other. Despite this attempt to standardize as much as possible the external forms of motivation, it was recognized that motivation is ultimately an internalized process and that individual reactions to the activity, the instructor, and the testing procedures would necessarily differ considerably from person to person and could not possibly be completely controlled by the instructor.

When interpreting the data compiled for the McCurdy-Larson Organic Efficiency Test, it should be recognized that scores on the five physiological measurements which comprise this particular test were of considerable interest when regarded as individual criteria of cardiovascular-respiratory efficiency but were of primary importance in terms of their relationship to each other and their relative contribution to the Organic Efficiency Index Score. No one of the items alone could be accepted as a reliable or valid evaluation of cardiovascular-respiratory efficiency; when weighted and combined in a regression equation to arrive at the Index Score, however, they were considered to be valuable contributing factors to cardiovascular-respiratory efficiency.

This implies, then, that while changes in the scores of the individual items may be of some significance when analyzed separately, they are of greater value when interpreted in terms of the effect any change in score might produce on the Organic Efficiency Index Score. It is important in this respect to note that primary emphasis in the test battery has been placed on the item of Sitting Diastolic Pressure, with the Difference Between Standing Pulse Rate and Pulse Rate 2 Minutes After Exercise, Breath-Holding 20 Seconds After Exercise, Vital Capacity, and Standing Pulse Pressure receiving gradually decreasing weightings in that order. Scores and changes in scores on these items were interpreted to be significant in their contribution to the Index Score according to these relative weightings.

It is also a pertinent observation that, in dealing with certain physiological variables, interpretations of measurements may be made in terms of a normal range of scores rather than in relation to an arbitrarily designated optimum score. Thus, modern medical and research personnel recognize both the complexity of physiological processes, such as cardiovascular-respiratory functions, and the difficulty of obtaining accurate and precise indirect measurements of these functions. They accept individual variations of scores on such physiological evaluations provided these variations do fall within the limits of a specific range of scores regarded as sound and healthy. In discussing the measurement of blood pressure, Millard and King (16:269) refer to these difficulties:

> . . . it is doubtful whether indirect readings may be relied upon to give results which are nearer than ten mm. of mercury above or below the true value, which could be measured only by far more elaborate methods. Since this is generally known by those experienced in making and interpreting the measurements, they are

guided accordingly in distinguishing between normal and abnormal or pathological values. Normal values, then, represent an order of magnitude rather than a precise figure.

This concept of a normal range of individual differences has importance in the interpretation of two test items in the McCurdy-Larson Organic Efficiency Test. A change in individual scores or in the mean of a group's scores in the Sitting Diastolic Pressure item or Standing Pulse Pressure measure may be of little significance when considered of and by itself as long as it does not result in a score below or above the accepted normal range; due to its lack of significance it may be termed a "non-directional" change in this instance. Such a change, however, may become significant when its resultant effect upon the Total Index Score becomes apparent; thus a raw score of 70-71 mm. Hg. in Sitting Diastolic Pressure receives the highest standard score when computing the Total Index Score, and measurements above and below this number are awarded gradually decreasing values. (15:321) Similarly, a score of 37 mm. Hg. receives optimum value in the Standing Pulse Pressure item, with higher and lower scores, even though they may fall within the normal range, making a gradually decreasing contribution to a high Index Score. (15:324)

The value of scores recorded for the Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise increases as the scores approach the zero point, since a score of zero indicates that within two minutes after the standard exercise was performed heart rate had returned to its normal, resting status. This return represents a successful and efficient cardiovascular adaptation to exercise.

Changes in the scores of Breath-Holding 20 Seconds After Exercise and in the scores of Vital Capacity may be considered "directional"

changes both as regards their significance when treated as individual items and their significance in terms of contribution to the Index Score. A higher score in both of these items is considered more indicative of good cardiovascular-respiratory efficiency than is a lower score.

Group I showed significant change in mean scores from preliminary to final testing in a total of six items. In the McCurdy-Larson Organic Efficiency Test this group demonstrated a significant degree of change in three items: Standing Pulse Pressure, Vital Capacity, and Index Score.

Pulse pressure, which may be defined as the arithmetic difference between the systolic and diastolic blood pressures, was found to change in Group I from a mean score of 43 mm. Hg. to a mean score of 37 mm. Hg. McCurdy and Larson (15:68) stated that "the ordinary normal range of pulse pressure is from 35 to 55 mm. Hg.," while Karpovich (10:199) lowered these limits slightly to include a range of 30 to 50 mm. Hg. and stated also that "these pressures are slightly lower in women than in men." Thus the mean pulse pressure scores for Group I were found to fall within a normal range and the "non-directional" change of six points between preliminary and final test scores was not felt to be great enough to be of special significance when this test item was considered alone. When considered in terms of the effect it had on the Index Score, however, this change may be regarded as an improvement in cardiovascular status since the final score made a greater contribution to a high Index Score than did the preliminary score.

Vital capacity is composed of the tidal, complemental, and supplemental air volumes and may be defined as "the maximum volume of air which may be exchanged in a single respiration." (16:312) Millard and King

listed 4100 cc. as the average vital capacity, stressing that this was a representative value and large variations might exist in normal persons. McCurdy and Larson (15:107) stated that the average vital capacity of women may be expected to be approximately one-third less than that of men, while Karpovich (10:118) reported that "vital capacity in normal people varies from 1400 to 6500 cc. The average, however, for the adult male may be accepted as 4000 cc. and for the college woman student 3400 cc. Observations made on college girls indicated that, on the average, those with higher vital capacities were also physically better than girls with lower vital capacities." Group I's change in mean score from 3000 cc. in the preliminary test to 3700 cc. in the final test may then be interpreted both as falling within the normal range and as representing an improvement in respiratory status. This improved score in vital capacity made a significant contribution to the higher mean Index Score achieved by Group I in its final testing.

While Group I made no significant improvement in the other three variables in the McCurdy-Larson Organic Efficiency Test, their significant gains in the above two items served to raise their mean Index Score from 8.5 to 45.9, representing a decided improvement in cardiovascular-respiratory efficiency as measured by this particular test. This significant gain between preliminary and final showings may be attributed in part to the intervening gymnastic activity, which apparently was strenuous enough and far enough in excess of the normal demands made upon the subjects in their previous daily activity to produce a significant improvement in the cardiovascular-respiratory efficiency component of their physical fitness status--even though the gymnastics involved only two periods per

week for this group. These results would seem to refute those found by Lee (71), who conducted a similar study, using the Tuttle Pulse-Ratio test as the measuring instrument, and reported that the amount of exercise obtained by college women in two periods of physical education per week was not sufficient over a ten-week period to increase cardiovascular efficiency.

In the New York State test battery, Group I made significant gains in both the Agility and Endurance components. The jump-rope activities, which involved rapid change of weight and shifting of feet, and the various exercises which included leg-bouncing and repeated change of foot positions, as well as the many transitional movements from one exercise to another and one level or plane to another may be regarded as contributing factors in this improved agility status.

The significant improvement in endurance, as measured by the treadmill exercise, may be interpreted as being a result of the combined effect of the total program of gymnastics rather than the effect of a few specific exercises. This improvement in endurance may be regarded as primarily an improvement in muscular endurance, or muscle "staying-power" and work capacity, and is another indication that the exercise provided by rhythmic gymnastics proved to be strenuous enough to cause an increase in the ability of the subjects to engage in activity over a long period of time before becoming fatigued. This ability was most probably developed gradually over the entire ten-week period as each lesson involved an increasing number of progressively more difficult exercises and placed greater demands of exertion on the subjects in terms of actual practice time.

The remaining New York State test item in which a significant change was recorded by Group I was the Posture measurement; a significant change from a mean score of 52 to a mean of 48 represented a loss rather than any improvement in posture. It was possible that the subjects in Group I did actually regress in this component of fitness in the ten weeks between preliminary and final rating periods. However, since some attention was devoted to this element of fitness during the gymnastic course and since it was probable that the gross defects meant to be detected by this screening procedure were probably well established in the college-age subjects, it was felt that some other explanation for this decrease in score should be sought. The author felt that the most logical explanation for this significant loss lay in the subjective nature of the measuring process and in the equally subjective human element involved. A more objective means of evaluating body alignment, such as photographic or alignometer evidence, might have been expected to have resulted in at least a maintenance of status quo in this test item; the screening process used, however, was the one included in the New York State battery for the purpose of screening out students with either slight or marked posture deviations. It was also felt by the author that the judges evaluating posture were much more critical and exacting in their final examination than they had been in their preliminary observations, and this was probably the primary reason for the significantly lower scores in the final test.

Group II, which met four days per week for gymnastic activity between their preliminary and final testing period, demonstrated a significant change in mean scores for a total of ten test items. In the McCurdy-

Larson Organic Efficiency Test these altered variables included Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, Standing Pulse Pressure, and Vital Capacity.

The change in the mean score for the Pulse Rate test item, from a -10 to a +.9, may be interpreted as an improvement in the ability of the cardiovascular system to return quickly to a normal resting status after exercise. Karpovich (10:186) stated that "the time required for the pulse rate to return to normal after exercise depends upon the intensity of the exercise and upon the condition of the individual. Increasing the intensity of the exercise increases the time required for recovery. On the other hand, better physical condition tends to shorten the period of recovery." "The time necessary for the return of the pulse rate to normal has a wide range. After a half-minute of stepping up on benches 12 to 20 inches high the rate should be back to normal within a minute. After exhaustive exercise it may not be back to normal for several hours." (10:188) In a study conducted by Salit and Tuttle (53:256) the best measure of fitness for women was found to be the pulse rate two minutes after a standard exercise. The final score achieved by Group II in this item represented a significantly greater contribution to a high Index Score than did their preliminary score.

The non-directional change evidenced by Group II in the Standing Pulse Pressure item, moving from a mean score of 40.3 mm. Hg. to one of 36.3 mm. Hg., may be interpreted as falling within the normal range of pulse pressure but having no significance as a single item. When regarded as one factor in the total Index Score, however, it may be seen that this change may be considered an improvement in status, since it contributed

significantly to an improved Index Score. The increase in Vital Capacity recorded for Group II represented an additional factor in the improvement of the Index Score.

Despite the gains achieved by Group II in these three Organic Efficiency items, there was no significant improvement in the mean Index Score, although there was a definite tendency in this direction. It may be assumed, therefore, that although some significant gains in cardiovascular-respiratory efficiency were made during the five-week period of gymnastics, the duration and degree of activity involved were not sufficient to raise the subjects' level of cardiovascular-respiratory efficiency as measured by the McCurdy-Larson Organic Efficiency Test.

Group II showed significant improvement in arm and shoulder-girdle strength as measured both by the dynamometer and by the modified pull-up test item in the New York State test battery; the degree of improvement in the mean score for Group II in the latter measurement was greater than improvement in any other single test item for either group. It appears reasonable to attribute this high degree of improvement to the influence of the intervening gymnastics. Several specific activities might be designated as particularly valuable in developing arm and shoulder-girdle strength; exercises such as the Bridges, the Bicycle, Leg Bounces, Side-Roll Extensions, and several of the transitional movements, as described in the Appendix, in which the entire weight of the body was supported by the arm and shoulder-girdle muscles may have been responsible for the gain in strength which these muscles demonstrated. These same muscles were involved in many arm-swinging exercises and in the Swan Arches, as well as being in almost constant use in the jump-rope and ball activities, and it

is possible that all of these contributed additional influence to the improved strength scores.

The many arm-swinging exercises, the jump-rope and ball routines, and such specific exercises as the Trunk-Twisters and the Swan Arches were regarded as the primary factors in the improvement achieved by Group II on the Shoulder Flexibility component as measured by the flexometer. It is probable, also, that the one other flexibility item in which Group II evinced significant improvement, that of Trunk and Hip Sideward Flexion and Extension, showed this significant change because of the stretching activity of the lateral-flexor muscles of the trunk required in such exercises as the Side-Bend, the Side Swoop, the Side-Bend Progression in the Blue Danube Routine, and the Side-Bend Bounces, Back Tosses, and Standing Side Swoops in the ball routine.

The improvement in the Agility item of the New York State test demonstrated by Group II may be attributed to the same gymnastic activities discussed as contributing factors to the agility improvement as shown by Group I. Group II's improvement in the mean score for the New York State Endurance test item may also, as in the case of Group I, be regarded as an outcome of the total program of gymnastics. In addition, due to the nature of this particular test item, it is possible that the improved mean score in arm strength achieved by Group II and the exercises which involved much activity in all the leg muscles may have contributed to some degree to the improved muscular endurance score.

It is evident that the degree of improvement recorded by Group II in three of the New York State Fitness components--Strength, Agility, and Endurance--was sufficient to result in a significant improvement in the

Total Fitness score for the entire test battery. The improvement in Total Fitness may thus be ascribed to those factors previously mentioned as contributing to improved mean scores in each of these three items.

In summary to this point, it may be seen that Group II, participating in rhythmic gymnastics four days per week for five weeks, made a significant improvement in a greater number of physical fitness components measured in this study than did Group I, which participated in the same gymnastic activities twice a week for ten weeks: Group II improved in ten test items and Group I in but five items. It is possible that the improvement shown by Group II in a greater number of items may have been due to the effects of a more concentrated period of time in which this Group received gymnastic instruction.

The comparison between the mean scores of Group I and Group II in the preliminary tests and between the two groups in the final tests was made to determine whether there was any evidence to indicate that the amount of improvement made by either group in any one item was significantly greater than that made by the other group. In comparing mean scores in the preliminary testing period it is apparent that, with the exception of five test items, there was no significant difference in scores between the groups prior to their participation in rhythmic gymnastics; they may, therefore, be considered equated in these fitness items at the start. Of the five components in which the mean scores of the two groups were shown to be of significant difference, Group II demonstrated superiority only in the Vital Capacity component, while Group I evidenced the higher score in the dynamometer "Push" and "Pull" tests, the Trunk and Hip Sideward Flexion and Extension measurement, and the New York State Strength

item. These differences may be attributed primarily to a chance sampling factor.

Analysis of the significant differences in final mean scores for the McCurdy-Larson Organic Efficiency Test shows that, while there was no difference in the preliminary mean scores, Group II recorded a significantly higher final mean score in the Sitting Diastolic Pressure test item. This higher score (72 mm. Hg.) actually represented another "non-directional" physiological change; it fell within the normal range of diastolic pressures, from 60 to 90 mm. Hg., as listed by Karpovich (10:199), and the final mean score of Group I (66 mm. Hg.) also fell within these limits. Karpovich stated that apparently "the effects of training on the resting blood pressure are neither striking nor constant." (10:208) In connection with this statement he cited a study on 202 Olympic athletes which showed that these athletes, after having undergone rigorous training routines, had diastolic pressures within the ranges common to non-athletes of similar ages. According to the McCurdy-Larson interpretation of test scores, the higher mean score of Group II does, however, represent a score superior to the lower score of Group I and is more indicative of desirable cardiovascular-respiratory efficiency.

Further analysis of the Organic Efficiency Test shows that neither group demonstrated significantly greater improvement in Breath-Holding and that, while Group II did show some improvement in Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, their improvement was not great enough to be significantly more than the slight improvement exhibited by Group I in this item. In the same manner, the improvement in the Total Index Score recorded by Group I was more than that shown by Group II but

was not sufficiently more to be of any statistical significance.

Both groups improved in the Standing Pulse Pressure Item with neither group showing greater improvement, as is indicated by lack of any significant difference in both preliminary and final mean scores. Group II had a higher mean score in Vital Capacity on the preliminary test yet failed to improve enough to register the same superiority in the final tests. There was no significant difference in the final mean scores of the two groups in this item, which indicates that Group I was successful in raising their lower preliminary mean score to a level comparable to but not significantly above that achieved in the final test by Group II. This may have been due to the fact that Group I, beginning at a lower level, had better opportunity and more room for improvement by virtue of this lower beginning status than did Group II, which in turn may have been already operating closer to its optimum level of efficiency in Vital Capacity.

It may be said that, while one or both groups made some significant improvement in four of the six categories of the Organic Efficiency Test, only in a single instance did one group make a gain significantly greater than the other group. This gain was recorded by Group II in Sitting Diastolic Pressure and was shown to be of little significance as a single physiological measurement. Since this was the only item in which a significant difference was indicated, it may be said that there was no apparent evidence to indicate that one group made significantly greater gains in the Organic Efficiency Test than did the other.

The pattern of change in both the "Push" and the "Pull" dynamometer tests was the same; in both cases Group I had a higher preliminary mean

score but there was no difference between the groups in the final mean score indicating that Group I was able only to maintain its status while Group II was able to improve from a much lower preliminary status up to a level comparable to or greater than that of Group I. Although Group II was not able to achieve a significantly higher final score than Group I, they did register a greater amount of improvement in these two items—perhaps due to the fact that Group II's more concentrated period of gymnastic activity had a greater influence on strength improvement than did the more extended time limit of Group I or perhaps due to the fact that, at the time of the preliminary testing, Group I was already performing near their upper limit of strength and the additional exercise provided by rhythmic gymnastics was not strenuous enough to improve this level of performance at the same rate as it affected Group II's lower level of achievement.

Analysis of flexibility scores shows that neither group improved significantly in three of the items, either within themselves or in comparison to each other. In Shoulder Flexibility Group II did register some change, but not enough to be significantly more than any shown by Group I. In Trunk and Hip Sideward Flexion and Extension, Group I had a significantly higher preliminary mean score, but Group II again made a greater amount of improvement to approach the level of Group I on the final score but not to achieve any significantly higher score. It may be said, then, that the statistical evidence indicated that Group II made a mean score improvement in two flexibility items greater than that made by Group I but Group II's improvement did not result in final scores significantly higher than those of Group I.

In the New York State Fitness Test, since there was no significant difference between the groups in either preliminary or final testing in Accuracy, Agility, Speed, Balance, Endurance, or Total Fitness, it may be assumed that participation four times per week did not produce any greater improvement in these particular items than did participation in gymnastics twice a week. In the Strength component Group I was unable to maintain the superior score recorded in their preliminary test; at the time of the final testing Group II had raised their score almost to a level equal to the final score of Group I, due possibly to the fact that they had more room for improvement because of their lower beginning status, or due possibly to the beneficial influences of a four-day-a-week program.

The fact that Group II showed a significantly higher final mean score in the Posture item has been attributed to the fact that the more critical subjective ratings by the Group I judges in the screening test resulted in a lower score for Group I rather than to any actual superiority or greater improvement of Group II in this item.

In summarizing the influences of rhythmic gymnastics on the physical fitness components measured in both groups it may be seen that the activity contributed to an improved status in one or both groups in a total of nine items measured. Group II, meeting four times weekly, showed improvement in a greater number of fitness components than did Group I, meeting twice weekly. Only in the case of Sitting Diastolic Pressure can it be said that one group made any improvement statistically more significant than that made by the other group. Group II's superior score in this single case is regarded as of little physiological significance since the actual raw scores represent merely a "non-directional" change and are unaccompanied

by significant changes in other components of this test which would have indicated some tendency to a greater improvement in cardiovascular-respiratory efficiency on the part of Group II.

Analysis of the difference scores shows that the subjects in Group I improved significantly in a total of nine test items as compared to individual improvement of subjects in Group II in fifteen items. Individual improvement in the various items may be attributed to the same effects of the various gymnastic activities as were mentioned as being responsible for the improvement in mean scores previously discussed. Significant individual improvement, as represented by the "t" values for the difference scores, was found in five test items not previously discussed: Breath-Holding, Ankle and Thigh Flexibility, Trunk and Hip Flexion and Extension, and Speed.

Breath-Holding 20 Seconds After Exercise was included in the Organic Efficiency Test by McCurdy and Larson as a measure of respiratory efficiency; together with the Vital Capacity test item it is accepted as an indication of the status of the respiratory system. Improvement in the difference scores of Group II in this item was statistically significant, as was their improvement in Vital Capacity scores, indicating a pattern of general improvement in respiratory efficiency for this group during the period of gymnastics. The subjects of Group I did not show any corresponding improvement in Breath-Holding difference scores.

Group II's subjects evinced improvement also in two other items in which Group I showed no change; the difference scores for Group II were statistically significant at the 1% level in the Speed component of the New York State Fitness Test. Although the rhythmic gymnastics course

included no practice in running as such, it is possible that the numerous exercises involving the leg muscles, including the jump-rope activities, may have served to develop additional strength and power in these muscles. Since the elements of leg muscle-power and speed are so closely related, improvement in leg strength might conceivably have contributed to an increase in speed.

The other item in which Group II alone demonstrated improvement in difference scores was the Thigh Flexibility component as measured by the flexometer. Several of the specific exercises included in the gymnastic program might very possibly have accounted for this change, notably the Egg Sit and the Bridge (resting position) in Skaters Waltz I, the Toss Under Leg and Roll Across with the balls, and the Bicycle, Leg Lifts, and Leg Bounces in the second part of the Skaters Waltz routine.

The subjects in both Group I and Group II displayed statistically significant gains in difference scores in Trunk and Hip Flexion and Extension as measured by the flexometer. It is very probable that this improvement may be attributed to such gymnastic exercises as the Egg Sits, Back-Straighteners, Bounce Reaches, Rope Bob-Stretches, Leg Lifts, Bridges, Swan Arches, Swan Arch Chest Rolls with the balls, and Side Swoops.

Group I did show an improvement in difference scores in the item of Ankle Flexibility, while Group II failed to register any significant change in this fitness component. The jump rope activities included in the gymnastic program may have contributed to this improvement in ankle flexibility; the Bicycle exercise, in which the pedaling action of ankles and toes was emphasized, may also have accounted for an improvement in

ankle flexibility scores.

Group I improved significantly in only two items in which Group II registered no significant change. In the first such item, the Organic Efficiency Index Score, Group I subjects improved in only three of the items which combine to produce this Index Score as compared to an improvement in four of the component items recorded for Group II; yet Group I subjects made a significant improvement in the Total Index Score while Group II's did not. Apparently the amount of improvement Group I subjects achieved in the three items was great enough and the three items they improved in were weighted heavily enough to produce such a result, yet, while Group II subjects made statistically significant improvement in four items, the degree of their improvement was evidently not great enough or the relative weight of the items in which they improved was not sufficient to produce a corresponding difference in Group II's Index Score. It may be noted that Group I's mean difference score and significance of difference value for Vital Capacity was much larger than Group II's, and in the relative influence of these two values may lie the difference between the two Index Scores.

No explanation could be found for the greater improvement shown by the subjects in Group I in ankle flexibility. The difference scores show that Group II subjects actually lost in ankle joint range of motion. Since Group II registered improvement in all the other flexibility items, this loss was regarded as circumstantial rather than as indicative of any real restriction caused by the same exercises which produced a significant improvement in the other group.

Group II subjects improved significantly in a total of eight different items in which Group I subjects showed no change. These items included:

1. Breath-Holding
2. Dynamometer Push
3. Dynamometer Pull
4. Shoulder Flexibility
5. Thigh Flexibility
6. Trunk and Hip Sideward Flexion and Extension
7. Speed
8. Total Fitness

Such improvement, in addition to improvement in the seven other items in which both groups registered change, may be regarded as providing definite statistical evidence that rhythmic gymnastics was effective in promoting improvement of individual status in certain physical fitness components and more effective in achieving this result when participated in four days per week than when engaged in only twice per week.

CHAPTER VII

SUMMARY AND CONCLUSIONS

This study was conducted to determine what changes might occur in certain specific physical fitness components of college women after they had participated in a twenty-lesson course in rhythmic gymnastics. Two experimental groups took part in the study, with Group I participating in gymnastics twice weekly for a period of ten weeks and Group II participating in gymnastics four days a week for a five-week period.

Physiological measurements of cardiovascular-respiratory efficiency, muscular strength, and flexibility, and the New York State Physical Fitness Test battery, which evaluated Posture, Accuracy, Strength, Agility, Speed, Balance, and Endurance, were used to test the subjects in each group prior to and at the conclusion of their gymnastic participation.

The raw score data from both preliminary and final tests for each group were treated statistically to determine changes which might have occurred within each group and to compare changes evidenced by Group I with those indicated by Group II. The resulting statistical evidence indicated that:

1. Group I, participating in gymnastics twice a week for ten weeks, showed significant changes in mean scores on a total of six of the fitness items measured: Standing Pulse Pressure, Vital Capacity, Organic Efficiency Score, Posture, Agility, and Endurance. These changes represented improvement in each of the physical fitness components for which they were recorded

with the exception of the Posture measurement, in which the change represented a significant loss in status for this group rather than any improvement.

2. Group II, participating in gymnastic activities four days a week for five weeks, showed significant changes in mean scores on a total of ten of the fitness variables including: Standing Pulse Rate Minus Pulse Rate 2 Minutes After Exercise, Pulse Pressure, Vital Capacity, Dynamometer "Push" test, Shoulder Flexibility, Trunk and Hip Sideward Flexion and Extension, Strength, Agility, Endurance, and Total Fitness. In all ten instances the changes recorded for this group represented statistically significant improvement in the physical fitness components involved.

3. A comparison of mean scores between the groups prior to participation in gymnastics indicated that the two groups could be considered equal in all the fitness components measured with the exception of four items; Group I had a higher mean score in arm and shoulder-girdle strength as measured by the Dynamometer, in Trunk and Hip Sideward Flexion and Extension, and in the Strength item on the New York State Test. Group II evidenced a higher preliminary mean score on Vital Capacity. At the conclusion of the study the two groups differed only in two variables; Group II showed a significantly higher mean score in Sitting Diastolic Blood Pressure and in the Posture test item. It was shown that, while Group II improved in a greater number of fitness components than did Group I,

their improvement was not significantly greater than that made by Group I.

4. Comparison of individual improvement between the groups indicated that the subjects in Group I improved significantly in a total of nine test items as compared to individual improvement of subjects in Group II in a total of fifteen items. The subjects in both groups improved in:

(1) Sitting Diastolic Pressure
(2) Standing Pulse Pressure
(3) Vital Capacity
(4) Trunk and Hip Flexion and Extension
(5) Strength
(6) Agility
(7) Endurance

Group I showed improvement in two additional items:

(1) Organic Efficiency Index Score
(2) Ankle Flexibility

Group II achieved gains in eight additional items:

(1) Breath-Holding 20 Seconds After Exercise
(2) Dynamometer "Push" test
(3) Dynamometer "Pull" test
(4) Shoulder Flexibility
(5) Thigh Flexibility
(6) Trunk and Hip Sideward Flexion and Extension
(7) Speed
(8) Total Fitness Score

Since both groups participated in the same type and amount of gymnastic activity, the more beneficial effect of a concentrated five-week program was regarded as the primary factor in Group II's superior achievement.

On the basis of these findings the following conclusions were drawn:

1. Participation in twenty lessons of rhythmic gymnastics afforded sufficient exercise to appreciably improve the

physical fitness of college women. This improved fitness status was evident when subjects participated in gymnastic activity twice a week as well as when they participated four times per week.

2. Significantly greater gains in physical fitness status were achieved within a concentrated five week unit of time than were recorded within a more extended ten week unit of time although the type of activity and length of practice period were identical in both cases.

Several practical implications may be derived from these conclusions. Since the development of a high level of physical fitness is one of the major objectives of physical education programs in both high schools and colleges, activities included in the physical education curriculum must be selected with this objective in mind. On the basis of this study it may be suggested that rhythmic gymnastic activities for girls and women be re-evaluated in terms of their obvious contribution to physical fitness and be included within programs where this objective is accepted as being an important aim of physical educators.

This recommendation is not to imply that such gymnastic activities should become the total program or receive over-emphasis within the physical education curriculum, but rather that they should receive intelligent and worthy attention as one activity within the total program that is capable of making significant contribution toward the improvement of the physical fitness level of students.

The conclusions indicate, also, that physical education programs

which include strenuous activities, such as rhythmic gymnastics, in order to realize the objective of a high physical fitness status for all students are of more value in attaining this objective when students are scheduled for participation in physical education four days a week than when they are scheduled to meet only twice weekly.

RECOMMENDATION FOR FURTHER STUDY

1. It is recommended that, in any further studies concerned with physical fitness which include posture as a component of fitness, a more objective means of evaluating this variable be utilized. It is felt that some type of photographic or alignometer technique would provide a more objective measurement and help to eliminate such inconsistencies of subjective judgment as were possible with the type of screening process used in this study.

2. It is recommended that the raw data in this study or a similar study be further analyzed statistically to determine the relationship of the various fitness components measured to each other and to determine the correlations between the different measurements used to evaluate the same element of fitness.

3. Further studies might be conducted to determine the value of rhythmic gymnastics as compared to other activities in the physical education program in regard to their relative contribution to the improvement of physical fitness.

4. A study to determine how long after gymnastic activity is discontinued the improvement in physical fitness is maintained and whether

this period of time would be any different for a group participating in daily activity than for a group participating in the same activity only twice weekly would be of interest.

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APPENDIX

LESSON PLAN

OUTLINE

APPENDIX

LESSON PLAN OUTLINE

A. Lesson #1

1. Class organization
   a. Assign students to place in line formation
   b. Six lines; five people in each line
2. Introduction to course
   a. Pictures of Swedish gymnastics
   b. Activities to be included in course
   c. Values of gymnastics
   d. Testing requirements
3. Skaters Waltz, Part I
   a. Present first three exercises; practice
      (1) Forward arm swing progression
      (2) Side-bend progression
      (3) Trunk-twister progression
   b. Practice first three exercises to music

B. Lesson #2

1. Class organization
   a. Attendance in line formation
   b. Move to double circle formation
2. Body alignment and relaxation
   a. Relaxation on floor
      (1) All parts of body
      (2) Differential relaxation
   b. Sitting alignment
      (1) Tailor sitting
      (2) Long sitting position
      (3) "Egg-sitting" position
   c. Standing alignment
   d. Walking in circle to changing drum tempo
   e. Running in circle
   f. Back to line formation
3. Review first three exercises - Skaters Waltz, Part I
   a. By count
   b. To music
4. Present new exercises
   a. Transition to prone position
   b. Swan arches
5. Combine and practice all exercises
   a. By count
   b. To music with instruction
   c. To music with no instruction

C. Lesson #3

1. Class organization
   a. Attendance in line formation
   b. Move to double circle formation
2. Rhythmic response to drum beat
   a. Walking
   b. Running
   c. Movement patterns
      (1) 8 steps; 4 jumps
      (2) 4 steps; 4 hops
      (3) 4 steps; 1 hop
      (4) 2 steps; 1 hop
      (5) Step, hop; step, hop
   d. Schottische pattern to drum
   e. Schottische to music
   f. Back to line formation
3. Review Skaters Waltz, Part I to music
4. Present new exercises
   a. Bridge
   b. "Egg-sits"
   c. Ending

5. Practice last three exercises in routine to count
6. Whole routine to music - with counting

D. Lesson #4

1. Class organization: line formation
2. Skaters Waltz, Part I
   a. Talk through
   b. Review any exercises needed
   c. Practice to music
   d. Half of class perform; other half observe
   e. Other half perform; group one observe
3. Jump ropes; spread formation
   a. Exercises
      (1) Jump over and back-rope on floor
      (2) Arm circle swings
      (3) Bobs and stretches
   b. Jumping
      (1) Practice jumping without ropes
      (2) Instruction in use of ropes
      (3) Right foot-rocking-horse
      (4) Left foot-rocking horse
      (5) Alternate foot-rocking-horse
      (6) Feet together - with bounce
      (7) Feet together - no bounce
   c. Jump rope; short routine
      (1) Practice individually to polka music
      (2) Practice together to music

E. Lesson #5

1. Class organization; spread formation
2. Jump ropes; Beloved Vienna routine
   a. Present and practice
      (1) Beginning
      (2) Jump-overs
      (3) Arm swings
      (4) Bob-stretches
   b. Practice to music
      (1) With instruction
      (2) Without instruction
   c. Collect ropes; move back to line formation
3. Practice Skaters Waltz, Part I
   a. To music - with instruction
   b. To music - without instruction

F. Lesson #6

1. Class organization
   a. Attendance in line formation
   b. Move to double circle
2. Rhythmic response to drum
   a. Walking
   b. Running
   c. Schottische pattern
   d. Skipping
   e. Back to line formation
3. Spread formation; jump rope routine
   a. Review first part
      (1) Talk through
      (2) Practice to music
   b. Teach and practice second part - jumping
      (1) To count without music
      (2) With music
   c. Teach and practice schottische jump pattern
   d. Practice whole routine
      (1) To count
      (2) To music without instruction

G. Lesson #7

1. Class organization
2. Jump rope routine
   a. Teach and practice "discus" swing
   b. Practice routine from jumping to end without music
   c. Whole routine to music with instruction
   d. Collect ropes; back to line formation
3. Blue Danube routine
   a. Teach and practice new exercises
      (1) Arm circle swings
      (2) Swan balances
      (3) Back-straighteners
      (4) Transition to kneeling position
   b. Combine and practice first part of routine
      (1) By count
      (2) To music with instruction
      (3) To music without instruction

H. Lesson #8

1. Class organization; spread formation
2. Jump rope routine
   a. Practice schottische jump

b. Practice routine from schottische to ending
   (1) To count
   (2) To music
c. Practice entire routine
   (1) To music with instruction
   (2) To music without instruction
   (3) Collect ropes; line formation

3. Blue Danube routine
   a. Teach and practice new exercises
      (1) Transition to kneeling
      (2) Kneel side-bends
      (3) Transition to sitting position
      (4) Bounce-reaches
      (5) Ending
   b. Practice whole routine
      (1) To music with instruction
      (2) To music without instruction

I. Lesson #9

1. Class organization; line formation
2. Skaters Waltz, Part I
   a. Talk through as review
   b. Practice to music
3. Blue Danube
   a. Practice to music
   b. One half of class perform; other half observe
   c. Other half perform; group one observe
4. Balls
   a. Teach and practice exercises
      (1) Two hand toss and catch
      (2) Right-hand toss; left-hand toss
      (3) Right- to left-hand toss
      (4) Circle and bounce
      (5) Drop-catch
   b. Practice exercises to music - Follow the Leader
   c. Individual practice; combine exercises in any order and practice to music

J. Lesson #10

1. Class organization; line formation
2. Ball routine; Two Hearts in Three-Quarter Time
   a. Teach and practice exercises
      (1) Forward arm swings
      (2) Toss under leg
      (3) Side-bend bounces
      (4) Toss behind back
      (5) Under-arm-back toss

b. Combine and practice in routine
   (1) To count
   (2) To music with instruction
   (3) To music without instruction
   (4) Collect balls

3. Choice of either Skaters Waltz or Blue Danube routine to music

K. Lesson #11

1. Class organization; line formation
2. Ball routine
   a. Review first part
      (1) Talk through
      (2) To music with instruction
   b. Teach and practice new exercises
      (1) Transition to squatting position
      (2) Roll-across
      (3) Transition to prone position
      (4) Swan-arch roll-under
      (5) Transition to standing
      (6) Side-swoops
   c. Practice second part in routine
      (1) To count
      (2) To music with instruction
   d. Combine first and second parts
      (1) To music with instruction
      (2) To music without instruction
3. Students make-up ending for routine with balls
   a. Listen to remaining music
   b. With partner make-up ending
   c. Practice to music

L. Lesson #12

1. Class organization; spread formation
2. Jump rope routine
   a. Review by talking through
   b. Practice to music
3. Ball routine
   a. Review first and second parts
      (1) Talk through
      (2) Practice to music
   b. Partners review own ending
   c. Practice whole routine to music with own endings
   d. Each set of double lines pick ending like best; all learn and show to class
   e. Whole class learn ending liked best
   f. Practice whole routine with one ending

M. Lesson #13

1. Class organization; line formation
2. Review ball routine
   a. Talk through
   b. Practice to music
3. Skaters Waltz, Part II
   a. Teach and practice new exercises
      (1) Leg lifts
      (2) Bicycle
      (3) Transition
      (4) Leg bounces
   b. Combine and practice in routine
      (1) By count
      (2) To music with instruction
      (3) Practice any exercises needed most
      (4) Practice again to music with instruction

N. Lesson #14

1. Class organization; line formation
2. Review ball routine to music
3. Skaters Waltz, Part II
   a. Review first part
      (1) To count
      (2) To music with instruction
   b. Teach and practice exercises in second part
      (1) Transition to leg-bounces
      (2) Kneeling side-swoops
      (3) Transition to supine tuck position
      (4) Side-roll extensions
      (5) Ending
   c. Practice second part of routine by count
   d. Practice whole routine to music with instruction

O. Lesson #15

1. Class organization; line formation
2. Review all routines learned for test
3. Test marks based on:
   a. Knowledge of routines
   b. Skill of performance
   c. Rhythmic response
   d. Grace and relaxation in movement
4. Routines
   a. Skaters Waltz, Part I
   b. Jump Ropes
   c. Blue Danube

d. Balls
e. Skaters Waltz, Part II
f. Continued practice on exercises needed

P. Lesson #16

1. Class organization; testing by groups
2. Test; individual marks assigned
   a. Skaters Waltz, Part I; two lines at once
   b. Blue Danube; two lines at once
   c. All perform ball routine together

Q. Lesson #17

1. Class organization; line formation
2. Review Skaters Waltz, Part II
   a. Talk through
   b. Practice to music without instruction
3. Group work
   a. Divide class into five groups
   b. Discuss exercises learned and formation variations possible
   c. Analyze music - Tales of Vienna Woods
   d. Work on own group routines to music

R. Lesson #18

1. Review jump rope routine
2. Group work on routines

S. Lesson #19

1. Practice in groups
2. Routines presented for group mark based on:
   a. Originality of formation and exercises
   b. General skill level of group
   c. Excellence of performance
   d. Knowledge of routine

T. Lesson #20

1. Review of all material covered in course

EXERCISE ROUTINES

AND

DESCRIPTION OF

SPECIFIC

EXERCISES

SKATERS WALTZ*
PART I

1. Forward Arm Swings: 8

2. Side Bends: 8
   a. 4 Stepping right with right foot
   b. 4 Stepping left with left foot

3. Trunk Twisters: 6

4. Transition: 8 counts
   a. #1: Squat; knees bent, hands on floor under shoulders
   b. #2: Extend left leg backwards
   c. #3: Extend right leg back; in front leaning rest position
   d. #4: Flex elbows and lower body slowly to floor
   e. #5-#8: Resting position; prone lying position; toes together, heels dropped outward; hands under head, head turned to one side

5. Swan Arches: 4

6. Transition: 8 counts
   a. #1-#4: Roll over right shoulder to supine lying position
   b. #5-#8: Resting position; knees to chest; arms at sides, palms facing upward

7. Bridges: 2

8. Egg-Sits: 2

9. Bridges: 2

10. Conclusion: Egg-Sits: 2
    a. On last Egg-Sit stay in tuck position on counts #5 & #6
    b. 4 counts: Spin one-quarter turn to right; extend legs
    c. 2 counts: Return to tuck position
    d. 4 counts: Spin one-quarter turn to right; extend legs
    e. 2 counts: Lie down; lower extended legs to floor
    f. 2 counts: Clap hands in air; clap hands on floor to sides

*Record Reference
"Magic Violins," Helmut Zacharias, Decca Record, 33 rpm, DL 8431

SKATERS WALTZ
PART I

A. FORWARD ARM SWINGS

1. General Description:
   a. Starting position: standing; feet together; arms at sides; head down
   b. Arms swing alternately forward and back to shoulder height and back to sides; swing to straight arm position over head on last two counts

2. Analysis by count:
   a. #1: Left arm swings forward toward ceiling to shoulder height; feet together; slight knee bend as arm swings forward
   b. #2: Right arm swings forward to shoulder height; slight knee bend
   c. #3 & #4: Left arm swings slowly from side to extended position over head; head is raised as arm swings upward
   d. Repeat: starting with right arm swing forward on first count

B. SIDE-BENDS

1. General Description:
   a. Starting position: standing; feet together; arms relaxed at sides
   b. One step is taken to the side as the arm swings over the head; trunk bends to the side as far as possible on the last two counts

2. Analysis by count:
   a. #1: Swing right arm across body to left shoulder with right elbow flexed; extend elbow as right arm swings back to right across body
   b. #2: Step to right with right foot and swing extended right arm in arc to right and on over head toward left side
   c. #3 & #4: Bend trunk to left side twice; right arm over head; left hand resting lightly on left leg
   d. Repeat to left; as right arm swings down and across in front of body on count #1, feet come together ready for step to right on count #2

C. TRUNK-TWISTERS

1. General Description:
   a. Starting position: standing, feet together; arms at sides
   b. Trunk twists to alternate sides as arms swing from side to side and then up to extended position over shoulder; two trunk twists are taken with arms in this position

2. Analysis by count:
   a. #1: Trunk and shoulders turn so that right shoulder twists in front of body; arms swing in relaxes manner to left side and wrap around body loosely; head facing straight ahead; both knees bend slightly
   b. #2: Twist trunk to right with relaxed arm swing around to right of body; left shoulder twists in front of body; head straight ahead
   c. #3 & #4: Twist body again to left as both arms swing diagonally up across body to a position with left arm extended toward ceiling and right arm flexed with right hand reaching toward left elbow; twist twice in this position; head straight ahead
   d. Repeat: swing arms down and across body to right side as trunk twists on first count

D. SWAN ARCHES

1. General Description:
   a. Starting position: prone lying position; heels apart; toes together; arms bent with hands under chin; head turned to side with cheek resting on hands
   b. Arms are lifted to side as chest and legs are slowly raised off floor into back-arch position

2. Analysis by count:
   a. #1 - #4: Raise arms to side and slowly lift legs and chest off floor by arching back; toes pointed; legs together; knees extended
   b. #5 & #6: Return slowly to lying position
   c. #7 & #8: Rest in starting position

E. BRIDGES

1. General Description:
   a. Starting position: supine lying position; knees bent to chest; toes pointed; arms relaxed at sides with palms facing upward

b. Hands are placed on floor under shoulders; feet placed on floor with knees flexed; push off floor into back-bend position

2. Analysis by count:
   a. #1: Place hands on floor under shoulders with thumbs near ears; feet on floor close to seat
   b. #2 - #4: Extend arms and legs pushing off floor into a back-bend position; head is back
   c. #5 - #8: Return slowly to starting position

F. EGG-SITS

1. General Description:
   a. Starting position: supine lying position; legs extended; arms at sides
   b. Trunk and legs are raised to a tucked sitting position; legs are extended into air with hands resting behind trunk on floor for balance; return to tucked sitting position and then to starting position

2. Analysis by count:
   a. #1 & #2: Roll up to tuck sitting position; back rounded and head tucked to knees; only toes rest on floor; arms wrapped around knees
   b. #3 & #4: Extend back and lift head; lean slightly backward supporting trunk by extending arms backward and resting fingertips on floor; extend legs into air at same time as close to trunk as possible
   c. #5 & #6: Return to tucked sitting position with back rounded and hands resting on knees
   d. #7 & #8: Roll down to starting position

SKATERS WALTZ*
PART II

1. Leg Lifts: 4

2. Bicycle: 32 counts

3. Transition: 20 counts
   a. #1 & #2: Knees bent to chest
   b. #3 & #4: Right leg extended into air
   c. #5 - #8: Right leg to chest and rest
   d. #1 & #2: Left leg extended in air
   e. #3 - #6: Left leg to chest and rest
   f. #7 & #8: Both legs extended into air
   g. #1 - #4: Kick out and in and roll up to leg bounce position

4. Leg Bounces: 4

5. Transition: 3
   a. #1 - #3: Three leg bounces
   b. #4: Turn and sit
   c. #5 - #8: Roll back and up to bounce position with left leg forward
   d. Repeat twice; on last roll up roll forward to kneeling position; arms to right side on floor

6. Side-Swoops: 6

7. Transition: 8 counts
   a. #1 - #4: Roll over left shoulder
   b. #5 - #8: Rest in tucked position

8. Side-Roll Extensions: 4

9. Conclusion: Egg-Sit
   a. #1 & #2: Straighten legs
   b. #3 & #4: Roll up to tuck position
   c. #5 & #6: Extend legs
   d. #7 & #8: Lie down, legs straight
   e. Clap hands; clap floor

*Record Reference
"Magic Violins," Helmut Zacharias, Decca Record, 33 rpm, DL 8431

SKATERS WALTZ
PART II

A. LEG-LIFTS

1. General Description:
   a. Starting position: supine lying position; legs extended; arms at sides
   b. Leg is raised toward ceiling in extended position, then lowered as trunk lifts to sitting position; trunk is bent forward and head bobs twice toward ankles; return to starting position

2. Analysis by count:
   a. #1 & #2: Raise extended right leg into air toward ceiling as far as possible keeping knee straight
   b. #3 & #4: Lower extended leg back to floor and at same time lift trunk to sitting position with chest leading; back is arched and head comes up last; hands slide along floor with thumbs up and sides of hands in contact with the floor
   c. #5 & #6: Relax trunk forward rounding back and dropping head; place hands on ankle and bob twice toward ankles
   d. #7 & #8: Roll back down to lying position with back rounded and arms sliding back to sides
   e. Repeat: raising left leg on first count

B. BICYCLE

1. General Description:
   a. Starting position: supine lying position; arms at sides; legs extended
   b. Roll up into a shoulder balance position and pedal with legs and toes reaching toward ceiling; roll down to position with legs about six inches off floor and repeat pedaling

2. Analysis by count:
   a. #1 - #4: Roll up slowly to shoulder balance position and support hips with hands
   b. #5 - #8: Pedal with legs in this position reaching toward ceiling with legs and toes; flex and extend ankles in pedaling motion
   c. #1 - #4: Roll down to position with back on floor and legs as close to floor as possible without lifting small of back off floor; pedal in this position
   d. #5 & #6: Lower right leg in extended position slowly to floor

e. #7 & #8: Lower left leg same way
f. #1 - #4: Resting position

C. LEG BOUNCES

1. General Description:
   a. Starting position: squatting position; right leg flexed, left leg extended behind; trunk erect; hands resting lightly on right knee
   b. Four bounces are taken in this starting position; hands are placed on floor and position of legs is exchanged in three jumping movements so that left leg is forward

2. Analysis by count:
   a. #1 - #4: In starting position bounce four times by extending knee and ankle joints; keep trunk erect; head up
   b. #5: Lean slightly forward; place hands on floor under shoulders
   c. #6: Change position of legs with a jumping movement so that left leg is flexed and right leg is extended behind
   d. #7 & #8: Change position of legs in same manner on these last two counts; end with left leg forward

D. SIDE SWOOPS

1. General Description:
   a. Starting position: kneeling position; sitting back on heels; arms relaxed at sides
   b. Trunk twists to right side; arms sweep across in front of body parallel to floor as trunk twists to left; right arm is raised over head, hips lift; left hand on left ankle as two side bends to left are taken

2. Analysis by count:
   a. #1: Bend trunk to right as both arms swing down to floor and back to ankles on right side; back rounded; head down
   b. #2: Sweep arms around to left side parallel to floor surface; stretch arms while sweeping in arc; twist trunk toward left side
   c. #3 & #4: When hands reach left side left hand grasps left ankle; right arm lifts over head; hips are lifted off heels; back is arched; two side bends are taken, head facing back over left shoulder; look toward left ankle

d. Repeat: starting both arms on left side and sitting back with weight on heels as arms sweep across to right side

E. SIDE-ROLL EXTENSIONS

1. General Description:
   a. Starting position: supine lying position; knees drawn to chest; toes pointed; arms relaxed on floor at sides
   b. Roll is taken to left side into kneeling position; hips are lifted into air with weight supported by hands and dorsal surface of toes; head is raised; return to kneeling position and roll back to starting position

2. Analysis by count:
   a. #1 & #2: In tucked starting position roll over left shoulder to left; bring hands under shoulders as roll is taken; back rounded; head down
   b. #3 & #4: Lift hips high in air; support weight on hands and dorsal surface of toes; lift head
   c. #5 & #6: Lower hips to tucked position; back rounded; head down
   d. #7 & #8: In tucked position roll back over left shoulder to starting position
   e. Repeat: roll over right shoulder to right

BLUE DANUBE*

1. Arm Circle Swings: 4

2. Swan Balances: 4

3. Back-Straighteners: 4

4. Transition: 8 counts
   a. #1 & #2: Bring legs together; kneel on left knee
   b. #3 & #4: Extend right leg to side

5. Side-Bend Progression: 2

6. Transition: 8 counts
   a. #1 & #2: Bring right leg into kneeling position
   b. #3 & #4: Sit to left side of legs
   c. #5 & #6: Swing legs to front; extended position
   d. #7 & #8: Place left hand just below right knee

7. Bounce-Reaches: 4

8. Ending: 4 counts
   a. #1 & #2: Raise right arm over head and lower to right ankle
   b. #3 & #4: Raise left arm over head; lower arm to left ankle; bend trunk forward and lower head to knees

*Record Reference
"Blue Danube," Al Goodman and His Orchestra, Columbia Album, "Strauss Waltzes in Dance Tempo," 78 rpm, 35416-WCO 26579

BLUE DANUBE

A. ARM CIRCLE SWINGS

1. General Description:
   a. Starting position: standing position; left foot forward; left arm extended forward at shoulder height; right arm relaxed at side
   b. Arm swings forward and back to shoulder height twice; arm circles twice over head as in wind-up for underhand pitch

2. Analysis by count:
   a. #1: Right arm swings forward to level of left arm
   b. #2: Right arm swings back behind body to shoulder height; head if turned in direction of arm swing
   c. #3 & #4: Repeat first two counts
   d. #5 - #8: Circle right arm at side over head as in underhand pitch wind-up; circle arm as close to head as possible; slight knee bend as arm circles; head straight ahead

B. SWAN BALANCES

1. General Description:
   a. Starting position: standing position; arms relaxed at sides; feet together
   b. Step is taken on supporting foot and other leg is raised from the floor and extended upwards in back as high as possible; arm on side of supporting leg is extended forward at shoulder height; opposite arm is extended backwards toward hip; balance is held in this position for two counts before returning to starting position

2. Analysis by count:
   a. #1 - #4: Step forward on right foot; bend right knee as left leg is raised and extended backward to maximum height; trunk is inclined forward to position almost parallel to floor; right arm is extended forward to shoulder height; left arm extended backward at shoulder height; both hands have palms facing downward; head is up
   b. #5 & #6: Extend supporting leg to straight knee position; balance for two counts; focus eyes on stationary object
   c. #7 & #8: Return slowly to starting position
   d. Repeat; stepping forward on left foot and extending left arm forward, right arm backward

C. BACK-STRAIGHTENERS

1. General Description:
   a. Starting position: standing; feet together; arms relaxed at sides
   b. Relax trunk forward; bend at waist and bounce toward floor; hands on knees; lift head, flatten back and bounce forward in this position

2. Analysis by count:
   a. #1 - #4: Bend at waist and relax trunk forward; arms hanging relaxed toward floor; knees bent; bounce toward floor in this position for four counts
   b. #5 - #8: Place hands on knees; elbows and knees extended; straighten back; lift head; stretch in this position four counts

D. SIDE-BEND PROGRESSION

1. General Description:
   a. Starting position: kneeling on left knee; right leg extended to side; arms relaxed at sides
   b. Relax head to right and then to left; relax head and drop shoulder to right and then to left; bend toward extended leg; raise opposite arm over head and bend toward extended leg four times

2. Analysis by count:
   a. #1 & #2: Relax head to right; bounce toward right shoulder twice
   b. #3 & #4: Relax head to left; bounce twice
   c. #5 & #6: Relax head and drop shoulder to right, twice
   d. #7 & #8: Relax head and shoulder to left side twice
   e. #1 - #4: Raise left arm over head; place right hand on right ankle; bend toward right side four counts
   f. #5 - #8: Slowly raise left arm over head and down to left side; bring right leg back to kneeling position in two counts; extend left leg to left side in last two counts
   g. Repeat progression with head relaxing first to left side

E. BOUNCE-REACHES

1. General Description:
   a. Starting position: sitting position; left leg extended; right leg bent with right toes touching left heel; left hand resting just below right knee; right arm relaxed at side; head up; trunk in good alignment

b. Round back and reach forward with right hand twice; arch back and reach back along floor with right hand; reach forward twice again; rest hands on floor behind hips; reverse position of legs and repeat reaching forward with left hand first

2. Analysis by count:
   a. #1 & #2: Round back and drop head forward; reach forward with right hand; bob forward as far as can reach twice
   b. #3 & #4: Arch back and lean back; turn slightly to right and watch right arm as it is swung back along the floor, palm up; reach back as far as possible; bob twice
   c. #5 & #6: Right hand again sweeps forward close to floor as back rounds and head drops forward; reach forward twice
   d. #7 & #8: Sit up as in starting position; rest hands on floor behind hips, elbows extended; lift both legs off floor and reverse position bending left knee
   e. Repeat; reaching forward with left hand first

BALL ROUTINE*

1. Forward Arm Swings: 8
2. Under-Leg Toss: 4
3. Forward Arm Swings: 4
4. Side-Bend Bounces: 4
5. Back Tosses: 4
6. Transition: 16 counts
   a. #1 - #4: Left arm extended forward at shoulder height; toss ball under left arm with right hand and catch in right hand twice
   b. #5 - #8: Toss under left arm; scoop behind back with left hand and over right shoulder to right hand
   c. #1 - #4: Bounce ball in front of left foot; squat on left heel
   d. #5 - #8: Extend right leg to right side
7. Front Roll Across: 4
8. Transition: 8 counts
   a. #1: Lower left knee to floor
   b. #2: Place ball to left side on floor
   c. #3 & #4: Place hands on floor to left; move feet in line with shoulders in front leaning rest position
   d. #5 & #6: Lower body slowly to floor in prone position
   e. #7 & #8: Extend arms to sides on floor; ball in left hand
9. Chest Rolls: 4
10. Transition: 8 counts
    a. #1 & #2: Roll over right shoulder to supine lying position
    b. #3 & #4: Roll legs back over head
    c. #5 & #6: Roll up to standing position
    d. #7 & #8: Step to left stride position with left foot
11. Standing Side Swoops: 8

*Record Reference
"Two Hearts Beat in Three-Quarter Time," Erwin Halletz, "Vienna, City of Dreams" Album, Decca Record, 33 rpm, DL 8771

12. Endings: as developed by two Experimental Groups

a. Group I
   (1) Turn and face partners
   (2) Forward Arm Swings: 4
   (3) Toss Across to Partner: 4
   (4) Arm Circles and transition to kneeling position
   (5) Roll diagonally across to partner; shift weight to side
   (6) Front Roll Across
   (7) Head down; hands down on ball

b. Group II
   (1) Turn and face partners
   (2) #1 - #4: Right hand; bounce ball once in two counts; toss under left leg two counts; catch in left hand
   (3) #5 - #8: Left hand; bounce ball once in two counts; toss under right leg and catch in right hand
   (4) Toss to partner twice
   (5) Toss to partner and step to right side in circle four times
   (6) Toss ball in air; clap hands and catch; bend knees to squat position
   (7) Bounce to partner twice
   (8) Toss in air; clap; catch; head down and lower hands to floor

BALL ROUTINE

A. FORWARD ARM SWINGS

1. General Description:
   a. Starting position: standing; feet together; hands at sides; ball in right hand
   b. Alternate arms are swung forward with palms facing floor; ball is dropped out of one hand and scooped downward into other hand on backswing

2. Analysis by count:
   a. #1: Swing both arms forward to about shoulder height with palms facing downward; ball in right hand; as arms swing forward bend knees slightly and rise to toes as arms reach height of forward swing
   b. #2: Drop ball from right hand
   c. #3: Scoop into left hand as left arm swings down and back
   d. #4: Right arm remains extended forward at shoulder height; left arm swings back to left side with ball now in left hand

B. UNDER-LEG TOSS

1. General Description:
   a. Starting position: standing; feet together; ball in right hand
   b. Ball is tossed from right hand under left leg and caught in left hand; repeat, tossing to right hand under right leg

2. Analysis by count:
   a. #1: Flex left knee; lift leg to hip height with toes pointed to floor; with circular motion of right hand toss ball under left leg and up in front of left shoulder
   b. #2: Catch ball in left hand
   c. #3 & #4: Repeat tossing under right leg to right hand

C. SIDE-BEND BOUNCES

1. General Description:
   a. Starting position: standing; feet together; ball in right hand

b. Right arm is swung across body to left and then out to right side and over head as step is taken sideward to right on the right foot; ball is bounced to left side at arm's distance from body and caught in left hand on first bounce; feet are brought together and exercise is repeated stepping to left side

2. Analysis by count:
   a. #1: Swing right arm across body to left shoulder with right elbow flexed; extend elbow as right arm then begins to swing back to right side
   b. #2: Step to right side with right foot and continue swing of extended right arm in arc out to right side and on over head toward left side
   c. #3: Bend trunk to left side; drop ball from over head to floor at a point at arm's distance from left foot
   d. #4: Extend left arm to side and catch ball with left hand at waist height; move left foot into closed position next to right foot
   e. #5 - #8: Repeat swinging arm and stepping to left and bending trunk to right side

D. BACK TOSS

1. General Description:
   a. Starting position: standing; feet slightly apart; ball in right hand
   b. With slight knee bend, toss ball behind back in arc over left shoulder and catch in left hand

2. Analysis by count:
   a. #1: Bend knees slightly; sweep right hand behind back and toss ball in arc over right shoulder
   b. #2: Catch ball in left hand directly in front of left shoulder
   c. #3 & #4: Repeat tossing behind back over right shoulder

E. FRONT ROLL ACROSS

1. General Description:
   a. Starting position: squatting position; right leg extended to right side; weight over flexed left leg; ball in left hand; right arm extended and raised sideward to shoulder height, palm down

b. Ball is rolled across in straight line in front of body as weight is shifted to position over right leg and left leg is extended; ball is stopped by right hand as left arm is raised sideward after releasing ball

2. Analysis by count:
   a. #1: Ball is rolled in straight line across floor in front of body by left hand; right arm is extended and raised sideward to shoulder height with palm down; as ball moves across body weight is shifted from position over left to position over right leg
   b. #2: When ball reaches right side it is stopped by right hand while left arm is raised sideward to shoulder height with palm down; weight is now over flexed right leg and left leg is in extension sideward to left
   c. #3 & #4: Repeat; rolling ball back across in front of body and shifting weight from right to left side

F. CHEST ROLLS

1. General Description:
   a. Starting position: prone lying position; arms extended sideward resting on floor at shoulder height; ball in left hand; head turned toward left side
   b. Ball is rolled in straight line across floor under chest as back is arched to lift chest, head, and shoulders high off floor; as ball is caught body relaxes to starting position

2. Analysis by count:
   a. #1: Arch back to lift head, shoulders, and chest high off floor as in Swan Arch; feet and legs remain on floor; roll ball from left hand in straight line across floor under chest to right hand
   b. #2: Stop ball with right hand; keep right arm extended and wait until ball reaches hand; relax body to starting position with head now turned toward right side
   c. #3 & #4: Repeat rolling ball across under chest from right to left side

G. STANDING SIDE SWOOPS

1. General Description:
   a. Starting position: standing; feet in stride position and ball in left hand

b. Trunk bends to left side as ball is tossed to right side under raised right arm; right hand then scoops ball down as trunk is bent to right and ball is tossed under left arm

2. Analysis by count:
   a. #1 & #2: Trunk bends sidewards to left and left shoulder drops as left arm sweeps down and across in front of body near floor; right arm is simultaneously raised forward to shoulder height with elbow slightly flexed and back of right hand facing body; ball is tossed from left hand under raised right arm
   b. #3 & #4: Ball is caught in scooping motion in right hand as right arm begins to sweep down toward floor and back across in front of body to left side; trunk is now bent to right side and left arm is raised forward to shoulder height with elbow slightly flexed and palm facing away from body
   c. #5 - #8: Repeat; sweeping arms and bending trunk alternately to right and left as ball is tossed under arms

JUMP ROPE ROUTINE*

1. Jumps Across: 4

2. Transition: 4 counts
   a. On last jump take only five jumps backward
   b. #1: Bend and pick up rope in left hand
   c. #2: Fold rope into quarters with right hand and hold in right hand
   d. #3: Pivot one-quarter turn to right; rope in right hand at side
   e. #4: Step forward on left foot so feet are in forward stride position; left hand resting on left leg

3. Forward Arm Circle Swings: 2

4. Bob Stretches: 2

5. Transition: 4 counts
   a. From position over head move rope around behind back ready to jump
   b. Arms are extended sideways so that rope is held off floor

6. Jumping
   a. Right foot forward: 4
   b. Left foot forward: 4
   c. Alternate right and left: 8
   d. Swing to right; jump right foot forward three times
   e. Swing to left; jump left foot forward three times
   f. Swing to right and then to left with jumps between in same manner again
   g. Feet together; jump with bounce: 8

7. Transition: 4 counts
   a. Rope in position behind body ready for schottische

8. Schottische Jump: 4

9. Discus Swing: 4

*Record Reference
"My Beloved Vienna," Erwin Halletz, "Vienna, City of Dreams" Album, Decca Record, 33 rpm, DL 8771

JUMP ROPE ROUTINE

A. JUMPS ACROSS

1. General Description:
   a. Starting position: rope on floor folded in half; standing position at end of folded rope; feet together; arms at sides
   b. Jump across folded rope on floor jumping forward and back with two slow and three quick jumps while moving to the right down length of rope; jump in same pattern back to left moving back down length of rope; turn one-quarter turn to right and using same pattern jump sideways down and back length of rope; repeat pattern twice more making a one-quarter turn each time

2. Analysis by count:
   a. #1: Jump forward over rope; land lightly; spring from toes; keep head up
   b. #2: Jump backward and slightly sideward to right; head up while jumping
   c. #3 & #4: Three quick jumps--forward, back, and forward--while continuing to move to right along length of rope
   d. #5 - #8: Jump back to left along length of rope in same pattern of two slow and three quick jumps
   e. #1 - #4: Turn one-quarter turn to right and jump sideways to left over rope; jump back to right on second slow jump and take three quick jumps moving forward along length of rope
   f. #5 - #8: Jump backwards along length of rope from this position by jumping alternately from right to left in same pattern
   g. #1 - #8: Turn one-quarter turn to right; jump forward and back in same pattern moving down length of rope to left and back to right
   h. #1 - #4: Turn one-quarter turn to right; jump backwards down rope from right to left
   i. #5 - #8: Transition; bend and pick up rope; fold in quarters; pivot turn to right; step forward on left foot

B. FORWARD ARM CIRCLE SWINGS

1. General Description:
   a. Starting position: standing; feet in forward stride position with left foot forward; rope folded twice

and held in right hand at right side; left hand resting on left thigh in front

b. Rope is swung forward and back to shoulder height by right arm and then circled over head with arm and shoulder rotation

2. Analysis by count:
   a. #1 - #4: Rope is swung forward to shoulder height and back with right arm; left arm swings in opposition
   b. #5 - #8: Rope is circled over head in complete forward circle twice; right arm is stretched over head at height of circle as close to head as possible; knees bend slightly on each swing
   c. #1 - #4: Swing forward and back with right arm again
   d. #5 - #8: Circle over head in forward arm circle once; swing to position in front at shoulder height and change rope to left hand as right foot is brought forward to left in closed position; swing rope backwards in left hand and step back with left foot in preparation for forward swing
   e. Repeat; with left arm swinging forward and back twice and then circling twice over head; rope swings to position over head on last circle and is grasped there by right arm

C. BOB STRETCHES

1. General Description:
   a. Starting position: standing; feet in side stride position; rope folded twice and held with a hand on either end of rope and both arms stretched over head; head is lifted upward looking toward rope
   b. Body is relaxed and trunk dropped forward; arms bob four times toward floor with rope; knees remain extended; rope is then lifted over head and body is stretched upward toward ceiling for four counts

2. Analysis by count:
   a. #1 - #4: Body is relaxed as trunk bends forward; head is dropped forward; arms bob four times toward floor; knees remain extended
   b. #5 - #8: Arms and rope are raised and extended over head; body is lifted to toes and stretched upward toward ceiling for four counts; small steps may be taken on toes to maintain balance while stretching

D. JUMPS

1. General Description:
   a. Starting position: standing; feet together; rope held behind back; arms parallel to ground fully extended sidewards at shoulder height
   b. Rope is swung primarily by wrist action; rope should not hit floor; knees are flexed only slightly and feet are kept close to floor; feet are used as in pedaling, with toes pointed downward when foot is in air

2. Analysis by count:
   a. #1 - #8: With right foot in front of left, jump rope four times in a rocking motion
   b. #1 - #8: Repeat with left foot in front of right
   c. #1 - #8: Repeat alternating right and left feet forward
   d. #1 - #8: Swing rope out and circle to right side; then swing back in and jump three times with right foot forward
   e. #1 - #8: Swing rope out and circle to left side; then swing back in and jump three times with left foot forward
   f. #1 - #16: Repeat d and e
   g. #1 - #8: Feet together; jump rope eight times with high jump as rope passes under feet and low jump as rope swings over head

E. SCHOTTISCHE JUMP

1. General Description:
   a. Starting position: standing; feet together; rope behind back ready to be swung forward over head
   b. Rope is swung as feet move in schottische pattern; step, step, step-hop; step, step, step-hop; step-hop; step-hop; step-hop; step-hop

2. Analysis by count:
   a. #1 & #2: With right foot forward step on right foot and then on left foot in rocking motion as rope passes under feet once
   b. #3 & #4: Step on right foot as rope passes under feet; lift left knee and hop on right foot as rope swings over head
   c. #5 - #8: Repeat with left foot forward and hop on left foot

d. #1 - #8: Four step-hops in place alternating steps on right and left feet with rope passing under feet on each step

e. Step analysis:

Step-Step	Step-Hop	Step-Step	Step-Hop
Swing	Swing	Swing	Swing
Step-Hop	Step-Hop	Step-Hop	Step-Hop
Swing	Swing	Swing	Swing

F. DISCUS SWING

1. General Description:
   a. Starting position: Rope folded twice; held in right hand at right side; weight on right foot; left leg extended sideward to left
   b. Rope is swung forward and back and then up diagonally across body to position over left shoulder where it is changed to left hand and movement is then repeated swinging forward and back at left side and then diagonally up across body to position over right shoulder

2. Analysis by count:
   a. #1: Rope is swung forward with right arm to shoulder height in front of body; shoulders turn as right arm reaches forward to follow-through motion of swing; left arm swings in opposition out to left side
   b. #2: Rope is swung straight back with right arm; left arm swings forward in opposition
   c. #3 & #4: Repeat forward and back swing
   d. #5 & #6: Right arm is swung forward and upward diagonally across body to position over left shoulder where rope is transferred to left hand; hip lead initiates movement as in discus swing; weight shifts to left foot as right is extended sidewards to right; head is turned looking backward over right shoulder toward right heel as swing across is made
   e. #7 & #8: Left hand grasps rope above left shoulder and swings down and back to left side as right arm swings forward in opposition and right leg reaches full extension to side; weight is now left leg in preparation for repetition of movement

f. Repeat swinging forward and back twice and then across body to right shoulder
g. Repeat swinging forward and back three times and across body to left shoulder
h. Repeat swinging forward and back twice and then up across body to right shoulder; transfer rope to right hand; swing back and then up to position over head and grasp other end of the rope in left hand; bring rope down with both hands to position in front of hips as music ends.

SAMPLE SCORE CARD

PHYSIOLOGICAL MEASUREMENTS

NAME _____ AGE _____ WT. _____ HT. _____

I. McCURDY-LARSON ORGANIC EFFICIENCY TEST

A. Pulse Rate Standing Normal 1. _____ 2. _____

B. Blood Pressure
a. Systolic pressure b. Diastolic
Sitting 1. ___ 2. ___ 1. _____ 2. _____
Standing 1. ___ 2. ___ 1. _____ 2. _____

C. Vital Capacity
1. a. First trial _____ 2. a. _____
b. Second trial _____ b. _____

D. Exercise
a. Number of ascents 1. _____ 2. _____
b. Metranome setting 1. _____ 2. _____
c. Breath expiration 20 sec. after exercise 1. ___ 2. _____
d. Pulse rate (standing) 2 min. after exercise 1. ___ 2. ___

II. DYNAMOMETER

1. Push _____ 2. Push _____
Pull _____ Pull _____

III. FLEXOMETER

a. Shoulder flexion and extension
1. _____ 2. _____

b. Ankle flexion and extension
1. _____ 2. _____

c. Thigh flexion and extension
1. _____ 2. _____

d. Trunk and hip flexion and extension
1. _____ 2. _____

e. Trunk and hip flexion and extension sideward
1. _____ 2. _____

SAMPLE SCORE CARD

NEW YORK STATE PHYSICAL FITNESS TEST

NAME _____ AGE _____ WT. _____ HT. _____

NEW YORK STATE PHYSICAL FITNESS TEST

COMPONENT	RAW SCORE		ACHIEVEMENT LEVEL	
	FIRST TEST	RE-TEST	FIRST TEST	RE-TEST
A. POSTURE				
B. ACCURACY				
C. STRENGTH				
D. AGILITY				
E. SPEED				
F. BALANCE				
G. ENDURANCE				
TOTAL FITNESS				