EXERCISE

IN

EDUCATION AND MEDICINE

BY

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"Man is the sum of his movements."—F. H. Robertson.

"That which those who minnow wheat do for it, gymnastic exercises accomplish in our bodies for us."—Solon (*Dialogues of Lucian*).

"Intrepidity, contempt of softness, surrender of private interests, obedience to command, must remain the rock upon which states are built."—William James.

"It is to be considered that some medicines may require exercise in order to enhance their virtues or remove some inconveniences attending their operation. Exercise, in such cases, is like the just and exact incubation to the egg; that which animates the drug and gives it power to produce the desired effect."—Fuller.

PREFACE TO THE SECOND EDITION

During the four years since the publication of this book physical education has changed ground so rapidly that an almost complete rewriting of the work seems necessary to keep the reader in touch with recent progress along old lines of investigation and the development of ideas that are new.

Unusual activity in the physiology of exercise has thrown such a flood of new light on the effects of muscular work on the heart, vessels, and excretory organs that it has been necessary to expand the single chapter on Physiology into four.

The increasing recognition of athletic sports by the school and the college makes them a potent factor in education, and the boy's school day is more and more approaching that of the Athenian lad, with its intimate blending of mental and physical training.

The supervision and organization of play under school and municipal control is making necessary a new profession, in which the study of psychology and physiology takes an important place.

The eurythmics of Jacques Dalcroze, widely popularized in Europe, introduce a new note into physical education that demands notice if this contribution is to be saved from the over-exploitation by the partiality inspired, which made the name of Delsarte a byword forty years ago, and more recently killed the interest in jiu jitsu.

The chapters on Medical Gymnastic Movements and Massage have been expanded and rearranged. New chapters have been added on respiratory gymnastics, the treatment of visceroptosis, and functional disorders of the nervous system.

Where possible, acknowledgment is made in quoting the work of others, to whom I herewith extend my thanks for the many courtesies received, but for a more complete bibliography on physical education I would refer the reader to "Physical Training Bibliography," by Dr. James Huff McCurdy, brought up to 1911 by Dwight F. Bridges, and brought up to date every year by G. B. Affleck, and published in the "American Physical Education Review."

For the most complete list of works on medical gymnastics one cannot do better than consult the "Bibliographic Gymnastica Medica," by Edgar F. Cyriax, of London; also brought up to date yearly in the "American Physical Education Review."

R. T. M.

PHILADELPHIA, PA.,
June, 1915.

PREFACE TO THE FIRST EDITION

The following pages are addressed to students and practitioners of physical training; to teachers of the youth; to students of medicine and to its practitioners, with the purpose to give a comprehensive view of the space exercise should hold in a complete scheme of education and in the treatment of abnormal or diseased conditions.

The recognition of physical education by teachers has been retarded by dabblers and self-elected professors of one or other systems, whose extravagant claims have done much to obscure the real educational value of neuromuscular training; for the result of physiologic research in the growth and development of the nervous system is just beginning to be applied in the classification and design of exercise, to harmonize it with the conclusions of proved science.

Exercise has so many points of contact with education, it is so intricately related to mental, moral, and social training, each of which alone is so partial and incomplete, that the progressive educationalist is now compelled to study its bearing on all three.

It is of vital importance that the student of physical training should have a broad and catholic foundation on which to build the structure of his experience, and that he shall consider and balance the merits and limitations of systems and ideas coming from diverse lands. The normal schools and colleges of physical training are lengthening their courses and broadening their curriculum to meet this increasing need, and, with more thoroughly educated instructors, there will be less seen of a certain superciliousness with which the whole subject is regarded by some otherwise well-informed physicians.

The progress of medical science has been most notable in the great questions of national health and prosperity involved in the feeding, housing, and exercise of the people. School boards are appealing for medical inspection of the children to discover correctable defects and to prevent the spread of disease. The pernicious influence of indoor life on growth has been proved, and measures are now taken to remedy it by exercise and play; city slums are replaced by playgrounds, colleges and universities are placing on their curriculum instruction in physical education, both practical and theoretical, since the necessity for exact knowledge of the physical characteristics which differentiate the child from the youth, and both from the adult, has become patent to the thoughtful physician whose advice is so constantly asked.

Exercise and massage have been used as remedial agencies since the days of Æsculapius, but definite instruction in their use has seldom been given to medical students. Perhaps a certain laziness which is inherent in both patient and physician tempts to the administration of a pill or draught to purge the system of what should be used in normal muscular activity, but there is a wide dearth of knowledge among the profession of the scope and application of exercise in pathologic conditions, and the necessity of care in the choice and accuracy of the dosage will be emphasized throughout the second part of this book.

I have endeavered to acknowledge in the text the sources from which facts are culled, but I must especially acknowledge my indebtedness to the inspiring friendship of my colleague, Dudley A. Sargent, to E. M. Hartwell, from whose classic reports to the U. S. Bureau of Education, much of the historical data relating to gymnastic systems was obtained; also to Fred. E. Leonard, of Oberlin, whose historical researches on physical education have been mined with rich results. The studies of Luther Halsey Gulick, on the development of plays among children, and G. Stanley Hall's work on Adolescence have been most serviceable sources of inspiration, while the chapters on exercise for the blind, deaf, and mental defectives have been founded on the work of Edward Allen, Grace Green, and Maurice Barr, in their respective specialties. In the section on medical treatment I have striven to credit other workers in the field with the contributions they have made, but much of it is my own experience, gathered from a special practice in the application of exercise.

I trust that this book may help to place before the profession this cinderella of the therapeutic family in her true character.

R. T. M.

PHILADELPHIA, PA.

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PART I

EXERCISE IN EDUCATION

CHAPTER I

THE DEFINITION AND CLASSIFICATION OF EXERCISES

The term "exercise" as here employed comprises all movements, voluntary or passive, including manipulations by the hand of an operator or by a machine, designed to act on the muscles, the blood-vessels, the nervous system, the skin, and the abdominal organs.

This wideness of definition is necessary to cover its application and its efficacy as a medicinal agent.

It naturally falls into the two main divisions given by Plato—active and passive.

1. Active exercise requires a definite exertion of the will-power, whether in its more complicated form of games and gymnastics, or in simple duplicate directed movements with assistance or resistance by the hands of an operator or by a machine.

2. Passive exercise does not require any exertion of will-power. The various manipulations of massage, by means of the hands, or by the machines of Zander and others, by which contracted ligaments or muscles are stretched and nourished, local nutrition improved, nerves stimulated, and the abdominal organs affected, are restful rather than exhausting to an overwrought brain.

Active exercise may be subdivided into, first, those involving a single *effort* of one or more muscle groups, such as lifting a weight or performing a feat on the parallel bars; and, second, exercises of *endurance*, consisting of motions rhythmically repeated without great muscular expenditure for each one, and depending for their effect upon continuous repetition.

Exercises of effort may be more or less violent in character or compound in motion, each one starting from and ending with rest. They are in endless variety, from simple movements of lifting and throwing to the complicated combinations on the parallel bars and horizontal bar. In them the element of skill plays a leading rôle, and what would be a mild exercise for the expert may be a severe strain to the beginner, whose inaccuracy means the clumsy employment of many muscles that help little in its accomplishment, the contraction of some groups actually retarding success. Even in the accurate performance of an apparently simple movement, the distribution of muscular effort is wide, and increases tremendously with the difficulty of the feat. In pushing a heavy dumb-bell to arm's length above the shoulder, the extensors of the elbow-joint are the ones usually considered, but the entire muscular system shares in the effort. The grasping muscles of the hand are required, also the muscles that raise the shoulder and rotate the scapula. These are attached to the spine and ribs, which in turn must be supported by the pelvis, steadied on the hips, while the balance of the body is preserved by the muscles of the thigh and legs.

A single, simple effort, then, may give rise to fatigue of more than the muscles most obviously employed.

Education should be directed to teaching skill in the performance of such movements—skill that tends to economize the amount of effort required—for it is the common experience of shot-putters to find that their record performance is accomplished with the greatest ease, owing to the smooth, accurate application of group after group of muscles at the proper time, and the perfection of balance and speed of the body's movement.

Muscle strains and ruptures frequently follow a sudden contraction where the movement is retarded by an untimely antagonist.

However skilful the performer may be, the whole muscular system participates in any violent exercise of *effort.* During the intense concentration so necessary for success, the chest-walls

Fig. 1.—The typical face of violent effort seen in sprinting, hammer-throwing, or spurting in a distance race (modeled from life by the author)

are fixed; the glottis is closed, the lungs acting as an air cushion for the surrounding cage of ribs and diaphragm, all the muscles of the trunk are steadied, and when the effort is made there is an explosive discharge of nervous energy, the intensity of which is mirrored in the muscular rigidity of the athlete's face.

The face of such a man will show a general converging of the lines to the root of the nose, with transverse wrinkles over the bridge. The frowning brows are drawn down and the eye is narrowed to a mere slit. The outer angle of the eye shows the "crow's feet" accompanying all violent action of the muscles that close it. The nose and upper lip have a snarling expression, the nostrils are distended, and the lower lip is drawn tightly across the clenched teeth, except at the angles of the mouth, where there are little pouches caused by the pulling of the platysma, which stands out along the neck like cords. The general impres-

Fig. 2.—The expression of effort seen in throwing the hammer.

sion of the face is repulsive and corresponds closely to the face of *rage*, as described by Darwin.[1] The lips, however, are more retracted than during the purely emotional state and the clenched teeth are exposed, presenting the appearance of one in readiness for tearing or seizing the enemy.

In his drawing of *rage* Sir Charles Bell[2] shows a face corresponding closely in many respects to this one of strain.

[1] Expression of the Emotions in Man and Animals.
[2] Expression of the Emotions.

The eyes are shut with force in all violent effort, such as shouting, sneezing, crying, or laughing, where the compression of the heart and lungs, by the muscular contraction of the chest-walls, drives up the blood-pressure to the point of seriously endangering the delicate vessels of the eye from overdistention, the hammer-thrower or the sprinter would shut them if he could. Indeed, the hammer-thrower often does close his eyes at the moment of greatest effort. The great skin muscle of the neck, the platysma, springs into action wherever violent effort is performed, as in delivering a blow, and sometimes even in testing the grip by the dynamometer. It is the muscle of emphasis.

Games and feats of speed, in which many movements must be repeated as quickly as possible in a certain limited time, may well be classed as exercises of effort, since practically all the conditions of a single effort apply to them.

In a 100-yard dash, occupying about ten seconds, the concentration of attention is continued at its highest point throughout. The breath is held, and the whole muscular system is convulsed with supreme effort, while the blood-pressure rises, much as it does in the single effort of throwing the hammer or putting the shot. If, however, the rate be reduced and the runner be allowed twenty seconds or more to cover the 100 yards, the nervous tension disappears; the blood-pressure is but little affected; there is no nervous explosion, and the face remains calm and smiling.

The same exercise becomes, under these conditions, one of *mild* endurance; and the possibility of this transition in the same exercise from effort to endurance, or from endurance to effort, must be constantly borne in mind, much confusion having occurred by the careless use of these terms.

Feats of skill, such as juggling, are composed of isolated efforts which may be so mild in nature and so often repeated that they insensibly shade off into feats of endurance, especially when skill and practice render them automatic. The striking of a fortissimo chord on the piano is an exercise of effort. The practice of one scale for an hour would be an exercise of endurance, but the playing of the thirteenth rhapsody of Liszt combines both effort and endurance.

The qualities cultivated by exercises of effort, whether of strength, skill, or speed, include mental concentration; the rapid response of the muscle to the will-power; the ability to learn complicated co-ordinations and the knowledge of the easiest and most economic way of performing difficult movements. Their practice is followed by increase in the size of the muscles employed up to their physiologic limit. If carried past the limit of power, the muscles will refuse to contract, or may actually tear, and if habitually overworked they may atrophy, and become hard and fibrous, with weak, uncertain movements. When muscles are overdeveloped they become parasites on the vitality, which is sapped in the struggle to provide for their nourishment (Fig. 3). Exercises of effort do not cultivate constitutional vigor to the same extent as those of endurance.

Fig. 3.—Extreme muscular development without a corresponding increase in heart and lung power. This man could not float in sea water and died prematurely.

In exercises of *endurance* the range and variety of movement are usually much more limited. They are confined to a few well-known varieties, such as walking, running, and rowing, and though each movement is well within one's power, the total amount of muscular work is great, but as the contraction and relaxation is comparatively slow, the poisonous waste matter producing fatigue is removed from the muscles as it accumulates. In exercises of *effort* there is no time for the scavengers to work, fatigue of the most active muscles setting in rapidly, while in exercises of endurance they can, at least, postpone its onset.

This class is, then, milder and more general in character. It deals with co-ordinations familiar from infancy. It is not necessary to concentrate the attention on every movement in walking, running, and rowing—typical exercises of endurance—in them the mind may be occupied with other thoughts. Breathing, which is a muscular action of endurance, is entirely automatic, but is not subject to the ordinary laws of fatigue.

The qualities cultivated by exercises of endurance are different from those required in effort. Skill is not prominent among them. Concentration is replaced by the attempt to liberate the attention, and the development of any one group of muscles is secondary to the indirect effect on the circulation and respiration in training them to remove the fatigue products of muscular contraction.

When carried to excess, exercises of endurance are accompanied by acute constitutional exhaustion, shown in breathlessness, from which recovery is rapid; by fatigue of the whole muscular system, from which a rest of a day or two is necessary, and by the chronic or nerve fatigue known as "staleness" among trainers, from which recovery may be a matter of weeks or even months.

Fatigue appears in one of these three ways.

If the exercise be sufficiently active, the amount of waste material suddenly thrown into the circulation is greater than can be eliminated by the lungs. The breathing becomes rapid and shallow, the pulse quick and fluttering, and the runner feels a sense of constriction around the chest; his head swims and throbs and his face takes on the anxious expression so eloquently telling of the thirst for air.

The face of the breathless man is unmistakable. The smoothness of the forehead is broken by wrinkles spreading out over the inner end of the updrawn eyebrows. The general direction of the eyebrows is just the reverse of that seen in violent effort. They are drawn upward and inward by what the French call "the muscle of pain," whose action is seen in the expression of grief, mental distress, anxiety, or bodily pain. The upper lids in breathlessness droop and half cover the eyeball, giving a look of great lassitude to the suffering expressed by this region. The nostrils are widely dilated, and the mouth gapes, with lips retracted in the mad struggle for air. The raised upper lid adds to the look of sorrow and pain, while the down-drawn mouth angle, the tongue closely pressed against the teeth, the sunken cheek, and the open mouth, all go to increase the exhausted, haggard look so characteristic of this state, in distinction to mere bodily pain or mental suffering. The general poise of the head is backward, the chin thrust forward, and the neck strained or convulsed.

Fig. 4.—The typical face of breathlessness as seen in any race above 200 yards (modeled from life by the author)

With the re-establishment of equilibrium between the production of waste and its elimination, the urgency of breathlessness fades and the runner gets what is called his "second wind." The look of distress disappears from his face. The lungs regain fresh power to expand, the head becomes clear, and the muscles act with renewed vigor and elasticity.

He can now continue running until he feels the symptoms of general fatigue.

If the pace has been slow enough, the runner may escape the acute poisoning shown by breathlessness, but sooner or later the

Fig. 5.—The typical expression of breathlessness is seen in the last man.

Fig. 6.—The typical face of fatigue seen after acute breathlessness has passed off in a distance race (modeled from life by the author).

products of tissue waste accumulate, the heart beats fast and weak, the nervous system is stupefied, and the muscles relax.

This may, in extreme cases, end in death from overexhaustion, as has been reported in soldiers after long and forced marches.

The same condition may be studied in the face of the runner during a long-distance race. After the urgency of breathlessness has passed, the expression of his face changes (Fig. 6). The eyebrows show a slight frown, and the eyelids are heavy, as with sleep; the upper lip is still retracted from the teeth, giving a slight look of pain to the cheek, otherwise relaxed and flaccid. The mouth is half open, the jaw drops, and the lower lip hangs loosely over the parted teeth. The general expression is one of vacancy.

Fig. 7.—Both faces show the typical expression of fatigue.

As fatigue becomes more profound, his effort is centered in an endeavor to prevent the eyes from closing, as a consequence of the increasing paralysis of the muscles of the upper eyelids. The long, doubly curved wrinkles across the forehead of this mask (Fig. 8), which shows advanced fatigue, or the last stage of exhaustion, are associated with the expression of surprise and astonishment in most faces, but here they illustrate the endeavor to raise the drooping eyelid. The nostrils are dilated, the lips are drawn downward and outward, the lower part of the face expressing the distress of failing respiration. The head is thrown backward and the chin thrust forward in the endeavor to balance the head without muscular effort. Both pose and facial expression are characteristic of the last effort to fight off collapse. When this last effort is exhausted, the muscles of expression cease to act, the circulation fails, the color becomes pale, the lips livid, and the runner falls in a faint.

The effect of this general fatigue does not usually pass away for a day or two. The body temperature rises several degrees, the patient is tired, perhaps delirious, and his night is sleepless

Fig. 8.—The typical face of exhaustion seen just before collapse in a distance race (modeled from life by the author).

or disturbed by troubled dreams. The urine passed is of high specific gravity and contains albumin, casts, and blood. The soreness and stiffness of the muscles and joints remain for several days, and gradually fade away as the constitution recovers its tone.

This may be said to represent the second form of general fatigue—the subacute. The third or chronic form is found in men during a course of training in which the amount of endurance required daily is more than can be regained during the periods of rest. The exhaustion that finally comes on is slower, but more profound in its effects and more difficult to counteract than either the acute form, corrected by a few minutes' rest, or the subacute form, which recovers in a couple of days. In this condition the temperature becomes subnormal, the weight goes down, the skin looks pale and flabby, the muscles lose their elasticity, the eye becomes dull and listless, interest in exercise ceases, every effort becomes a burden, and the patient sits without ambition or the power to rouse himself from his lethargy. His sleep is broken and his appetite capricious; his blood-pressure is low and his pulse increases rapidly on slight exertion.

Recovery from chronic fatigue, or *overtraining*, is a matter of weeks, and since the nervous system is profoundly affected, a change of air, surroundings, and occupation, with complete muscular rest, may be necessary.

It is a well-founded rule among trainers to give long-distance runners a rest three or four days before a race to recover completely from the fatigue of the last practice run.

Long-distance running has been taken as the typical exercise of endurance, but just as we found that an exercise of effort might become one of endurance, so long-distance running may vary sufficiently in its pace to make it an exercise in which effort plays a more important part than endurance. In a mile race the runner will carefully regulate his pace so that the waste matter of muscular contraction can be eliminated almost as quickly as it is produced, and his resources husbanded for the moment when experience teaches him he can exert all his latent power in the final spurt. This is so timed that the finish line will find him completely breathless and exhausted.

A mile race is, then, an exercise of endurance throughout most of the distance, and at the finish an exercise of effort, the change showing by the expression of the face. It is in finding out the pace and the point at which effort must begin that the genius of the true athlete is seen or the skill of the trainer is shown.

Exercises of endurance, then, have much more profound influence on the general system than exercises of effort.

In the typical exercises of effort, such as feats of strength or skill, the resulting fatigue is principally a local one, and includes soreness of the muscles most strongly in action, which refuse to function when the effort becomes too great.

In exercises of endurance the constitutional fatigue is greater, and powerfully affects the heart, lungs, general muscular and nervous systems.

Passive exercise finds its widest field of usefulness in conditions of fatigue, where the elimination of waste matter must be as-

Fig. 9.—The finish of a race, showing effort on the right, exhaustion in the center, and collapse on the left.

sisted, and where nutrition of the part is impaired or destroyed. The patient remains inert and is acted upon by the operator or his mechanical substitute. Muscles can be improved in size, tone, and nutrition by this means, ligaments stretched and strengthened, the general circulation quickened, and overloaded veins made to disgorge their blood. The digestive tract can be stimulated to more active habits, and overwrought nerves soothed and relieved of their hypersensibility.

These effects being more medical in character, a detailed account of massage and manipulation will be reserved for chapters in Part II of this book.

CHAPTER II

THE BEHAVIOR OF THE MUSCLES AND THE LUNGS DURING EXERCISE

Movements of the body affect profoundly the voluntary muscles, the vessels which supply them with nourishment in the form of blood and lymph, the apparatus of respiration, the storehouses of nutrition in the abdomen, and the brain and nerves which control and direct them.

The impetus to contract a muscle begins at the motor center in the brain or the spinal cord, and is carried to it by a motor nerve. Each muscle-cell shortens and thickens, scattering some of its used-up contents into the lymph-space encircling it and absorbing new nourishment from its surrounding plasma. By repeated contractions the cells thus increase both in size and number. The perimysium is strengthened, the fibrous walls surrounding the bundle of cells are toughened, and fresh power is imparted to the sheath enclosing the entire muscle. The result is an increase in bulk, strength, and elasticity.

The normal tone of a healthy muscle keeps it in slight contraction, even when at rest, so that antagonistic groups retain the inactive limb in normal position. The arm of the performer on the horizontal bar hangs at rest with elbow bent and fingers curved from the constant action of the flexors of the arm and hand, and when paralysis wipes out completely the action of a group, this normal tension of the opposing muscles slowly contracts and deforms the limb.

Muscular action may be accompanied by actual rupture of the cell walls and exudation of blood and lymph, especially in exercises involving single and complete contractions. This is one of the two causes of *muscle soreness* found after severe straining exercise, and when due to this cause the soreness persists until the tear is healed and the pressure on the nerve-endings caused by the swollen fibers lessened. Occasionally, the entire muscle may be torn from its attachment to bone or tendon during violent exercise.

In the slang of the trainer, these injuries are known as "*charleyhorse*," and the lumps which can sometimes be felt, or even seen, take a month to disappear, leaving a scar in the muscle which frequently impairs its full elasticity.

In riders the adductors of the thigh are frequently so affected. Runners are always in dread of "pulling" the hamstrings at the junction of muscle and tendon, while the deltoid and other scapular muscles must be carefully prepared for action in ball-players to prevent this accident.

A cold, inactive limb is endangered by any severe athletic test without preliminary massage or light exercise, and the lack of this precaution in cold weather is the cause of most ruptured muscles and tendon strains. Galen recognized this fact in the second century and writes quaintly:

"If anyone immediately after undressing proceed to the more violent movements before he has softened the whole body and thinned the excretions and opened the pores, he incurs the danger of breaking or spraining some of the solid parts, but if beforehand you gradually warm and soften the solids and thin the fluids and expand the pores, the person exercising will run no danger of breaking any part."

The other cause of muscle soreness is the presence of irritating waste matter imperfectly carried off by the blood-stream. This may be accompanied by the fever and malaise described under subacute fatigue, when the large muscle groups of the thighs and back are involved.[1]

Elimination is hastened by massage and made easier if the muscle be kept warm artificially, but as muscular action generates heat, this usually regulates itself.

[1] Theodore Hough, "Ergographic Studies of Muscle Soreness," American Journal of Physiology, vol. vii, p. 1.

When one raises a light weight, it is not jerked or flung upward unless we expect to find it much heavier than it is. It is lifted easily and smoothly at the first attempt, because we unconsciously adapt the means to the end. The shortening of a muscle does not involve the simultaneous contraction of all its fibers,[1] for single muscles are really compound, and the number of fibers in contraction vary according to the intensity of the action and to the skill and condition of the performer. When an individual improves his condition by exercise he merely increases the number of muscle-fibers which he can put into service. He obtains control over more and more fibers. The untrained muscle has many idle strands that would lie in curves among the shortened and thickened members, and a muscle which appears to be fatigued might thus be one in which those fibers most accessible to the end-plates of the motor nerve are exhausted, while there may still be large areas which have not been within the range of stimulation. This would account for the enormous and otherwise inexplicable strength developed under delirium and in cataleptic conditions. Neuromuscular education by exercises of effort can thus bring the athlete more closely up to his maximum of contractibility, and in consequence makes him a more efficient machine, in addition to increasing the size and number of the muscle-cells.

As the intensity of a simple movement increases, group after group of unassociated muscles contract in sympathy.[2] The grip dynamometer tests the flexors of the hand and forearm, but in the strife for additional force muscular contraction spreads through the arm and shoulder, the entire muscular system becomes rigid, muscles that can have no influence whatever upon the accomplishment of the task contract and may impede the desired movement, the intensity of which is expressed by the face.

The cultivation of skill and promptness shortens the latent period between impulse and contraction and economizes this waste of muscular effort. Not only does muscular power vary

[1] Kieth Lucas, Journal of Physiology, vols. xxxiii and xxxviii.

[2] Fernand Lagrange, Physiology of Exercise.

with the intensity of the stimulus, but Storey has shown a normal rise and fall of muscular power each day, high tide being registered about eleven in the forenoon and again in the late afternoon.[1]

In exercises of *endurance* the single movements are comparatively mild. There is less tendency to shortening and stiffening of the muscles, and development is general rather than local. The long-distance runner is not noted for the thickness of his calves.

Prolonged and severe exertion leads to progressive enlargement of the heart by increasing the size and number of its muscle-fibers. During habitual exercise a new equilibrium is thus established, and the heart is able to accomplish without too great effort tasks with which it could not have coped in its untrained state.[2] The general nutrition of the heart is improved by this increased rhythmic contraction and relaxation, while every muscle is a throbbing heart, squeezing its vessels empty while in motion and relaxing to allow them to fill up.[3]

Skill does not play an important part in such habitual or automatic movements of endurance as walking or running, so that their value in its promotion is comparatively slight, though their value in nutrition is great. Passive exercise improves the nourishment of the muscle-cell artificially by alternately forcing out the products of fatigue under pressure, and thus keeping it bathed in a renewed stream of arterial blood sufficient to prevent wasting where active movements are impossible.

Alternate contraction and relaxation accelerate the interchange of products between blood and muscle, and vessels remain substantially enlarged in an active muscle even after contraction has ceased (Fig. 10) as measured by Mosso's plethysmograph. Not only is this true, but the actual oxygen-carrying power of the blood is augmented by this heightened activity.

[1] Thomas A. Storey, "Daily Variations in the Power of Muscular Contraction," American Journal of Physiology, vol. vii, p. 4.

[2] Rudolph Krell, Principles of Clinical Pathology.

[3] Weir Mitchell, Fat and Blood.

Philip Hawke,[1] in his interesting experiments on the blood-count of athletes in training at the University of Pennsylvania, compared various forms of athletic exercise and showed an average of 16.8 per cent. in the number of red blood-corpuscles during exercise, the greatest increase being 26 per cent. in a water-polo player after a three-minute game. The least increase he found after long runs and bicycling. Thus, if exercise be sufficiently

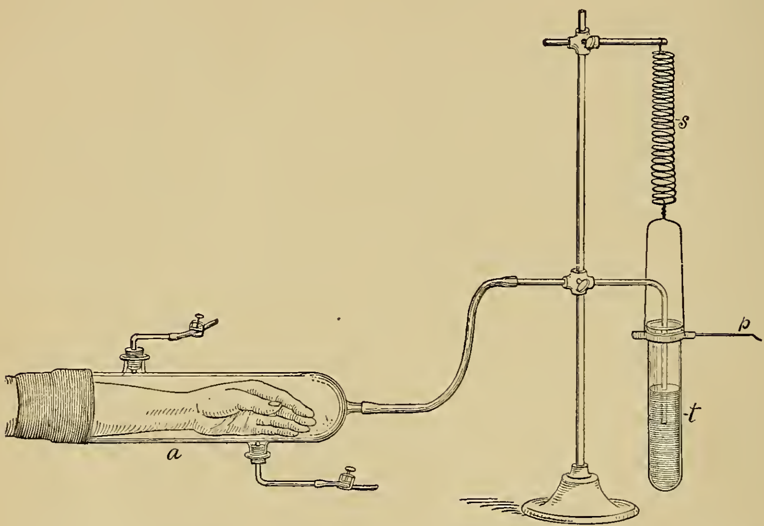


Fig. 10.—A schematic diagram of Mosso's plethysmograph for the arms: *a*, The glass cylinder for the arm, with rubber sleeve and two tubulatures for filling with warm water; *s*, the spiral spring swinging the test-tube *t*. The spring is so calibrated that the level of the liquid in the test-tube above the arm remains unchanged as the tube is filled and emptied. The movements of the tube are recorded on a drum by the writing point *p* (Howell).

prolonged, this increase slows down, stops, and finally decreases, because a large number of red cells lying inactive in various parts of the body are quickly brought into the circulating blood, increasing the count; a similar increase was found by John K. Mitchell[2] after massage; but this reserve army, as well as the

[1] American Journal of Physiology, vol. x, No. 8.
[2] American Journal of the Medical Sciences, vol. cvii, 1894.

original circulating number, are finally reduced by the warfare of muscular action.

In active exercise a larger blood-supply is required and furnished, and its purification must be more thorough. The rate of the heart-beat and of the breathing is accelerated, the heart driving the blood into the arteries with a more powerful stroke and the lungs eliminating more of the poisons of fatigue. The waste consists largely of CO_2, about 4 per cent. of which is replaced by an almost equal amount of oxygen at each breath. In response to stimulation of the respiratory center by the products of muscular action, an additional amount of CO_2 can be eliminated by using a larger surface of lung tissue than is employed in ordinary life without any great increase in rate of breathing. Here the lung cells act somewhat in the same way as do the muscle-cells under training. Increased power of elimination can be acquired by movements of artificial or forced respiration which strengthen the accessory breathing muscles of the chest and stretch the thoracic cavity. Where respiration is suspended the passive and artificial movements used in resuscitation may bring it back. Alternate pressure on and relaxation of the lower ribs after Schäffer's method can maintain the exchange of air in the lungs indefinitely, and by rapid and forced deep breathing an excess of oxygen can be stored in the lungs for a short time. This washing out of the lungs by deep breathing undoubtedly produces a temporary change in the constitution of the blood. It also produces a mental stimulation and definitely postpones the approach of muscular fatigue. If pure oxygen be inhaled the effect is markedly increased, as shown by Leonard Hill in his remarkable experiments on athletes. It is, however, only with great respiratory need that the absorption of oxygen takes place, and it will not be absorbed unless the conditions arise to produce increased tissue waste.

Muscular training, especially exercises of endurance, improves the quality of the muscles so that they produce less waste, and it also increases the capacity of the heart and lungs to take care of the increased demand. If the amount of muscular work be increased beyond the rate of elimination, acute general fatigue or breathlessness is inevitable even if the man be in the best possible condition.

During breathlessness the left ventricle gives short abortive beats, the blood collects in the veins of the neck and abdomen and also in the right heart. Breathing becomes rapid and shallow, and the pulse fluttering and thready. The athlete suffers from a form of *respiratory madness*, with singing in the ears, dizziness, a sense of impending suffocation, mental anxiety, confusion, and even unconsciousness. His facial expression has already been described (see Fig. 4). This period of physical distress is preceded by one of stimulation, in which the eye is bright, the skin flushed, and the power of the heart-beat increased. This increased tension of the arterial system is also reflected by the improved irritability of the muscle itself (Fig. 11), noticed during competition in athletes before breathlessness becomes acute.[1]

The phenomenon known as "second wind," by which the runner experiences a sudden relief from the agony of breathlessness, is a readjustment of elimination to the increased production of waste. The movements of the chest and abdominal walls are amplified. The diaphragm makes increasing excursions for each breath. Ventilation by the lungs is improved. The heart dilates, steadies, and adapts itself to the increased task, and equilibrium of waste and elimination is established on a higher plane. The mile runner usually gets this relief during the third quarter of his race, or about three minutes after the start.

In short and intense *effort*, such as a sprint race, breathing, if any, is thoracic in character.

The heart-beat sends a small volume of well-aërated blood through the central nervous system and the coronary arteries. The blood-pressure is high and the peripheral arteries are contracted, and the effects of non-aëration of the blood does not at once appear.

In long-distance races the oxygenation of the blood and the demands of exertion keep pace. The breathing becomes ab-

[1] Thomas A. Storey, American Journal of Physiology, vol. ix, 1903.

dominal. The peripheral arteries fill and the heart beats more fully. The respiration and the heart do better team work, and fatigue is not due so much to oxygen hunger as to gradual fatigue of the cardiac muscle. Deep breathing or inhalations of oxygen will give great relief to the man who runs himself out in a quarter- or half-mile race, but in Hill's experiments on Wolf, during his attempt to swim the English Channel, where his respiration was obstructed by the choppy sea which interfered with his breathing, inhalations of oxygen gave him temporary relief only.

In a twenty-four-hour walk of 100 to 126 miles by the Black Heath Harriers, oxygen showed no restorative effect. A runner

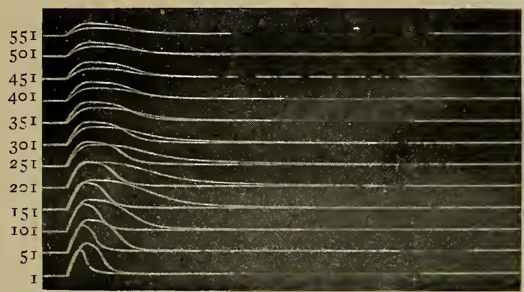


Fig. 11.—Record of fatigue of companion gastrocnemius muscles of the frog—one normal, the other under the influence of carbon dioxid. The longer, or, in the later contractions, the lower curves, are those of the poisoned muscle. Every fiftieth contraction is recorded (Frederick S. Lee).

who can hold his breath under ordinary circumstances for about 120 yards, after breathing oxygen for a few minutes, can hold it while running 220 or 300 yards, thus giving him the mechanical advantage of a fixed thorax for a longer time, and enabling him to stand a higher CO_2 tension without discomfort. It can thus make exertion easier, although the effect rapidly passes off.[1]

It takes the lungs about twenty seconds to respond to exer-

[1] Leonard Hill and Martin Flack, "Influence of Oxygen Inhalations on Muscular Work," Journal of Physiology, vol. xl, 5.

cise by increased respiration. This may be put as their latent period, and the maximum is reached in about two minutes.[1]

The effect of CO_2 has been graphically shown by Lee in his work on the action of fatigue products on muscular contraction. In Fig. 11 the preliminary stimulation of the poison already referred to is seen in the higher curve of contraction found in his poisoned muscle at the lower part of the diagram. This period soon gives place to the slow and lowered line shown in the upper part of the diagram.

[1] G. O. Higley and W. P. Bowen, "Changes in Excretion of CO_2 Resulting from Bicycling," American Journal of Physiology, vol. xii, No. 4.

CHAPTER III

THE ESTIMATION OF HEART EFFICIENCY

THE normal pulse-rate ranges from 50 to 90 beats to the minute, with an average of 78.9 standing, 70.5 sitting, and 66.6 lying,[1] while directly after exercise the pulse may jump to 180 beats to the minute, quickly returning to normal in the well-trained man.

In the untrained man the rate remains high and often irregular for some time, with a tendency to miss beats,[2] so that the examination of the pulse before and after a measured amount of exercise affords a ready means of testing the efficiency of the heart to do muscular work.

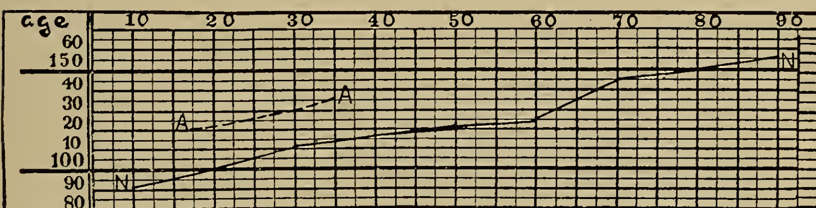


Fig. 12.—Chart showing averages of blood-pressure at different age periods. The line A–A indicates a higher than average blood-pressure in trained athletes (Barach and Marks).

The increased muscular expenditure required to stand up increases the heart-rate 12 beats to the minute, and a variation of more than 20 beats in the lying and standing positions would, under ordinary conditions, indicate staleness. The heart-rate of men in athletic condition is usually 6 to 8 beats lower than in the same men out of condition, and the increase after exercise is also lessened. In 465 observations by Meylan at the begin-

[1] Ery, Encyclopedia of Anatomy and Physiology, vol. iv, 126.

[2] F. Cooke and M. S. Pembrey, "Observations on the Effects of Muscular Exercise on Man," British Journal of Physiology, vol. xlv.

ning and end of a course of exercise[1] the first test showed an average pulse of 89 before exercise, and 135 after a strength test. At the end of the course the figures were 82 before and 132 after, although almost double the amount of foot-pounds was lifted in the second test. In a football squad he found an average decrease of 6 beats after eight weeks' training.

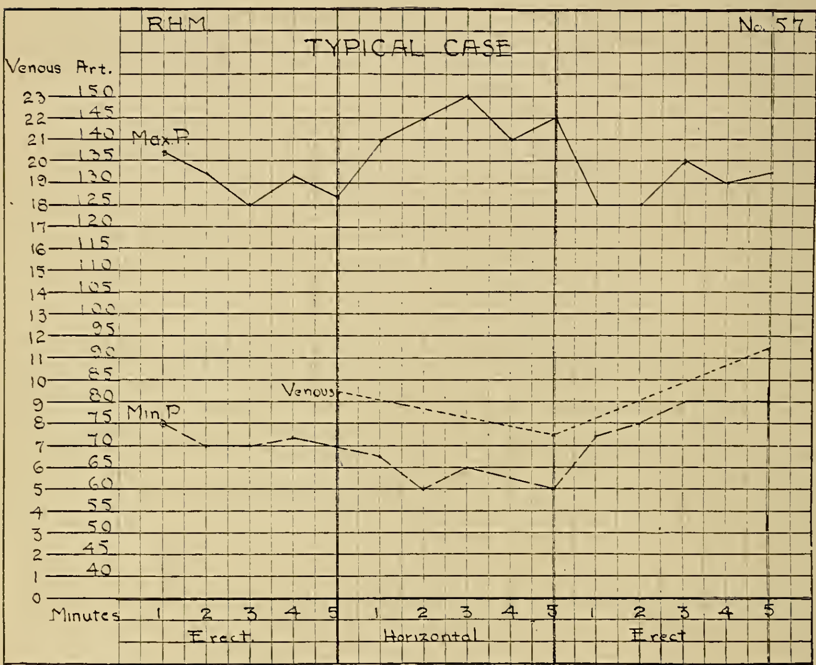


Fig. 13.—Chart showing maximum and minimum pulse-pressure in the erect and horizontal positions in a typical case. The maximum pressure goes up in the horizontal, and drops in the erect, position (Barach and Marks).

A man who suddenly springs to his feet from the lying position may sometimes be seen to stagger or even fall. He experiences a feeling of dizziness or faintness, which soon passes off, leaving him slightly flushed and ashamed of himself. There has been a temporary anemia of his brain because the vasomotor nerves which govern the contraction of the walls of the blood-

[1] George L. Meylan, Effects of Muscular Exercise on the Heart.

vessels have been caught "napping" and the vessels of the abdomen and legs have been flooded before their walls could contract, drive the blood up to the head, and preserve the equilibrium for the changed position. This readjustment to different postures is partly a hydraulic problem, depending on the height of the column of blood to be maintained by the elastic vessel walls.

If a man be strapped to a tilting table and the pressure required to fill his brachial artery in the horizontal position of the

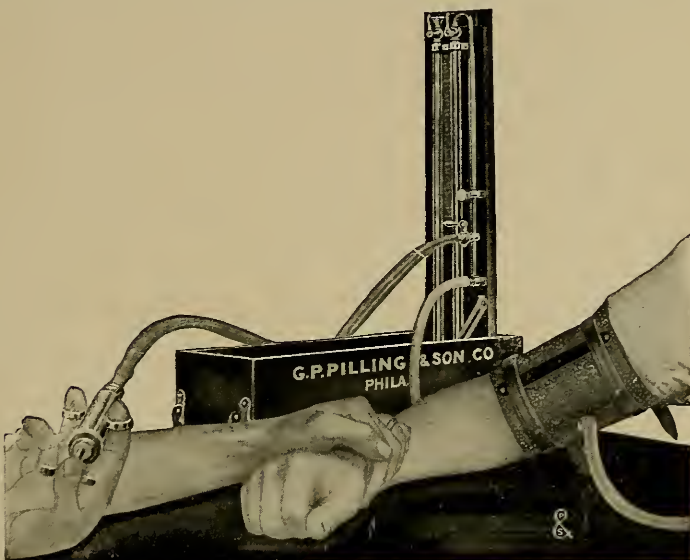


Fig. 14.—Faught's sphygmomanometer, showing the leather cuff in place on the arm; the air-pump for raising the pressure in the tube under the cuff to obliterate the pulse and the glass tube graduated to show the height of the column of mercury required; the surgeon's finger is on the patient's pulse.

body measured (Fig. 13), it will be found that the pressure is higher than when the body is tilted to the upright posture. The force of gravity has full sway and increases the pressure in the lower extremities at the expense of the upper. If, however, he stands up by muscular action and maintains himself upright, his heart does more work, the vessels contract in protection, and the pressure in the brachial artery is greater. The pressure on the arterial walls caused by the powerful heart action of a man in athletic condition will also be greater than in others (Fig. 12), and the alertness and response of the vasomotor nerves to a change of posture or to provide for an increase in muscular work would be correspondingly marked,[1] lying and standing.

The accurate measurement of arterial tension is done by a *sphygmomanometer* (Fig. 14). The brachial artery is compressed by strapping round the arm a leather collar, 4 inches in width, beneath which is a rubber tube, the air being pumped into it until the radial pulse is obliterated. The amount of pressure required to do this is measured by the height of a column of mercury forced into a graduated vertical glass tube, or on a dial in the aneroid form of instrument.

Instead of palpating the artery at the wrist, a stethoscope may be applied just below the compressing cuff, and the sounds noted as they reappear during the gradual fall of the mercury from a point above the maximum pressure as the air is slowly let out of the cuff.

The first pulse-sound heard or felt represents the systolic or maximum pressure exerted by the heart, and the disappearance of the pulse-sound, the diastolic or minimum pressure.[2]

The systolic pressure ranges from 110 to 130 mm. in the young normal adult. Sir Lauder Brunton's observations, taken in the sitting posture, give 120 as normal for a young adult and from 115 to 140 for men in middle life, and for the following ages:

Eight to fourteen years	90 mm.
Fifteen to twenty years	100 to 120 mm.
Twenty-one to sixty-five years	120 " 150 "
Above sixty-five years, if arteries are rigid	150 " 200 "
In women	10 " 15 " lower.
In athletes	15 mm. higher.

An easy rule is to add 10 mm. for each 10 years, starting with 120 for the age of twenty.

A test for athletic condition based upon the relation of the

[1] Barach and Marks, "Effects of Change of Posture Without Active Muscular Exertion on Arterial and Venous Pressures," Archives of Internal Medicine, vol. ii, 1913.

[2] Goodman and Howell, American Journal of Medical Sciences, September, 1911, and George William Norris, "Modern Instruments of Precision in the Study of Cardiovascular Disease," International Clinics, vol. iv, 63.

pulse-rate and the blood-pressure has been designed by C. Ward Crampton.[1] In this he notes the rise or fall of the blood-pressure on assuming the erect posture, varying from plus 10 to minus 10, also the rate of increase in the heart-beat, on the assumption that the heart comes to the rescue of a falling pressure by beating faster, its rate increasing with the necessity. Weakened tone in the heart and vessel walls would thus be indicated by increased pulse-rate or falling blood-pressure, or both, but only by taking both into consideration may we arrive at a correct estimation of the weakness. In the scale, the "100" marks a perfectly efficient working of the circulation and the figure "0" approximately the point where the erect posture cannot be maintained.

PERCENTAGE SCALE, BLOOD-PRESSURE, VASOMOTOR TONE
(Crampton)

	Blood-pressure										
Pulse-rate. *Increase:*	10	8	6	4	2	0	*Decrease:* 2	4	6	8	10
0–4	100	95	90	85	80	75	70	65	60	55	50
5–8	95	90	85	80	75	70	65	70	55	50	45
9–12	90	85	80	75	70	65	60	55	50	45	40
13–16	85	80	75	70	65	60	55	50	45	40	35
17–20	80	75	70	65	60	55	50	45	40	35	30
21–24	75	70	65	60	55	50	45	40	35	30	25
25–28	70	65	60	55	50	45	40	35	30	25	20
29–32	65	60	55	50	45	40	35	30	25	20	15
33–36	60	55	50	45	40	35	30	25	20	15	10
37–40	55	50	45	40	35	30	25	20	15	10	5
41–44	50	45	40	35	30	25	20	15	10	5	0

In case of increase in pressure higher than plus 10, add 5 per cent. to the "10" column for each 2 mm. in excess of 10.

The sphygmomanometer is adjusted over the brachial artery, and the patient is placed on a comfortable couch and the pulse counted by quarter-minutes until two successive quarter-minutes are the same. This is multiplied by four and recorded. The systolic pressure is then taken, preferably by auscultation. The patient then stands, the pulse-rate is again counted as before, and the blood-pressure is again taken. The differences are

[1] Medical News, September, 16, 1905.

calculated and reference is made to the scale. For example, Case 24, aged seventeen years:

	Pulse-rate	*Blood-pressure*
Horizontal	68	100
Vertical	104	94
Difference	plus 35	minus 6
Percentage record		20

This is a very poor record, taken from an apparently normal strong young football player of exceptional ability who had previously given records above 80. He looked quite as fit as usual. He was absent next day and remained home for a week ill with a cold and fever. It is evident that the test revealed a weakened vasomotor tone, the beginning of acute illness, before any other symptom could be noted.[1]

A series of observations on athletes in training was taken at Springfield College, Mass., and embodied in a thesis by Alfred Weyman (1913). He found the normal blood-pressure higher in the standing position at the beginning of training, but in the course of training it changed, and by the end of the season it had become higher in the recumbent position. The pulse-rate was always higher in the standing position and after exercise. Testing this group of men by Crampton's test, the condition seemed to become poorer throughout the season, although the subjects expressed themselves as feeling well and their athletic records steadily improved. Improvement in skill more than counterbalanced condition.

I have also seen a mile runner, undoubtedly stale and run down by all other tests, show a percentage of 75 under this test.

This test must be strictly limited to an estimation of the vasomotor tone only; it is liable to grave fallacies owing to the nervous condition of the subjects, and further investigation is necessary to determine its range and reliability.

A more reliable test is obtained by observing the rapidity with which the normal pulse-rate is restored after such an exercise as high knee stationary running.[2]

[1] C. Ward Crampton.

[2] Wilfred L. Foster, "Physical Efficiency," P. E. Rev., vol. xix, 9.

Severe muscular exertion increases the weight and capacity of the heart just as it increases the weight of the general musculature, and hypertrophy and dilatation of the heart always result from prolonged muscular exertion. This is accompanied by a slowing of the heart-beat and a higher pressure in the arteries as has already been shown.

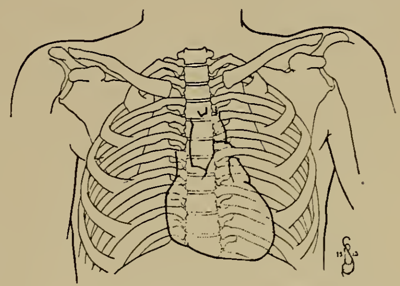


Fig. 15.—Heart outline of a normal non-athletic man of sedentary habits (Shumacker and Middleton).

The heart dilates as a matter of economy whenever its work is increased. This economy results, first, from the fact that any muscle works at an advantage when somewhat elongated, and, secondly, because the volume of the spheric mass changes faster than its surface.[1]

From this it is clear that as the organ dilates the volume of blood pumped out by each contraction increases faster than the stretching of its walls, whose inherent elasticity also tends to preserve their integrity. It is only when the dilatation becomes excessive that harm may result. Such a dilatation of the heart is really an overstrain from which recovery is usually rapid in the young and healthy individual.

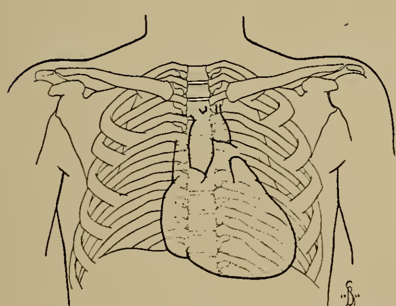


Fig. 16.—Outline from an athlete active in football and basket-ball for seven years (Shumacker and Middleton).

Sir Clifford Allbutt, in writing of his observations on Cambridge students, says: "The dilatation is, I think, concerned in *second wind*. The healthy heart increases its output, the

[1] Roye and Adami.

lungs expand, resistance falls, the right ventricle pulls itself together, and second wind is established. This process, trying enough to an unsound or defective heart or to elderly men, is perhaps never injurious to the healthy heart in young adults. I have many times seen undergraduates and others look ghastly at the end of a long spurt of exercises, but never saw a sound young man the worse for temporary distress of this kind. If, as in a few cases that I have seen again and again in growing youths, dilatation of the heart occurs leading to cyanosis, the attending confusion or vertigo is generally sufficient of itself to stop the exercise in time."

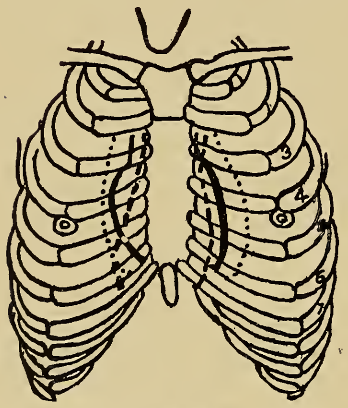


Fig. 17.—Fluoroscope study by John W. Boyer and George W. Grier of heart before, after, and one week after a marathon race. An average case. Solid line, before; dotted line, after; dashes, one week after.

One case of acute dilatation reported by Stengel occurred in a young man sound and in condition who had been repeatedly examined. In the course of a very trying foot-ball game, both physically and mentally, he collapsed suddenly. When seen, he was bleeding at the nose, cyanosed with weak fluttering pulse, both sides of the heart enlarged $\frac{3}{4}$ inch each way. He was completely prostrated and hysteric and did not gain control of himself for several hours. He then became rapidly better, and in a few days seemed quite well. After ten days' rest he resumed practice and regular play without any apparent evil after-consequences. He has engaged in athletics more or less actively ever since, and is now, fifteen years afterward, in excellent health. This is the most severe case of which I have any personal knowledge, although frequently a dilatation lasting one or two days is found, relieved by rest, without apparent after-effects.

After the most severe strain one can seldom find any measurable injury in a week's time in a heart originally sound if the athlete has not passed thirty (Fig. 17). It is in those unprepared for violent exercise, and especially when approaching middle life, that the danger of heart strain is most imminent. An ex-football player out of condition suddenly tries to repeat the exploits of his former days sometimes with alarming results. One, a physician, after such an attempt, writes as follows:

"As we finished, I became conscious of a sensation of extreme vertigo, in addition to the breathlessness which I had hitherto tried to disregard, and sat down just in time it seemed to prevent falling. The chest appeared full to the bursting-point, breathing entirely inadequate, and respiration very rapid. I remember feeling my pulse at the onset of the vertigo, and finding it almost indistinguishable. The heart-beats soon became strong and almost painful in their intensity, but breathing remained difficult for perhaps one-half hour. I sat still for that length of time before I felt equal to walking to the dressing-room, and even then my legs were weak and unsteady. I had marked nausea, but did not vomit. There was a little bloody tinge to the scanty sputum, and several people remarked my pallor. I was uncomfortable and shaky all that evening, but after a night's rest I felt as well as ever and have continued so."

This is, undoubtedly, an acute dilatation of a heart on which strain has been put in the unfounded expectation that the resiliency of twenty will be found fifteen years later.

Sometimes an elderly man fresh from his office goes mountain climbing, and at the end of a hard climb he finds himself in such distress as just described, a distress which does not disappear when he rests. His heart is found badly dilated, and recovery is slow if it ever takes place. Only too often the dilatation remains or recurs on the slightest exertion, and he remains a partial or complete invalid for the rest of his life. Cases are on record of rupture of valves in men of forty, but I have found no record of such a case in the young.

Shumacker and Middleton[1] report 3 cases of acute dilatation

[1] Shumacker and Middleton, "Cardiac Effects of Immoderate College Athletics," with bibliography, Amer. Med. Assoc. Jour., 1914, vol. lxii, pp. 1136–1144.

with imperfect recovery, in a squad of 200 students active in heavy competitive athletic rowing at Wisconsin. They conclude that it is possible for injury with imperfect recovery from this cause to take place even in the hypertrophied heart of the athlete in training, although a weak heart will dilate more quickly and remain dilated after relatively slight exertion. Frequently athletes whose hearts are relatively small and weak unjustly suffer from imputations on their courage, which should be justly put down to lack of horse-power (Fig. 15). The inability of a man whose spirit is stronger than his flesh to rise above his limitations and drive himself in an emergency is often a cause of chagrin to himself and his friends.

The presence of heart murmurs after exercise without other symptoms is so common as to be almost habitual in the young, and by its misinterpretation the necessary activity of many young people has been harmfully curtailed.

Observations were taken on students at the University of Pennsylvania by Doctor Ira Ayer and myself[1] to determine their frequency in different postures of the body, and under conditions of rest and exercise[2] in individuals in whom no heart lesion was known to exist. Murmurs were found in 74 out of the 266 men examined, or 27.8 per cent., much more frequent in the recumbent position, and when audible in standing, sitting, and lying postures, they were accentuated when the patient lay down and as the pulse became slower and stronger.

No marked difference could be found between men who had led an active athletic life and those whose occupation had been sedentary, although murmurs seemed rather to haunt those of inactive habits rather than the more vigorous and athletic. The presence of murmurs in nearly 28 per cent. of normal young men even on slight exertion should, however, lead to caution in giving an unfavorable prognosis when they are found immediately following severe strain or fatigue.[3]

The appearance and disappearance of murmurs by change

[1] "Influence of Exercise on the Heart," Am. Jour. Med. Sci., vol. cxlv, No. 1.

[2] "Fifty Steps of High Knee Stationary Running."

[3] "Therapeutics of the Circulation," by Sir Lauder Brunton.

of posture alone is significant of their unreliability to determine the presence of a real heart lesion when other symptoms are absent.

A heart in a state of physiologic hypertrophy (see Fig. 16) contains a reserve of power which, while not needed under ordinary conditions, becomes of the greatest importance at times of prolonged severe muscular exertion. Athletic training thus becomes a process of building the heart up in size, capacity, and efficiency for the special purpose in view. This is shown both by the pulse and the blood-pressure as well as in its size (see Fig. 12).

In a community the stronger individuals show, as might be expected, a higher blood-pressure. Those with the total strength over 541 kg. show an average blood-pressure of 124 standing, while the average for those under that total is only 120.5. For this reason the change from active or athletic habits to a comparatively sedentary life should be gradual to give the heart and circulation time to readjust itself to the lessening work, and the man is foolish indeed who during youth does not learn sports and muscular occupations that he can carry on in the years that follow school and college life.

CHAPTER IV

THE EFFECTS OF EXERCISE ON THE HEART

EXERCISES of effort and speed differ materially in their effect on the circulation from those in which endurance is the predominant factor.[1]

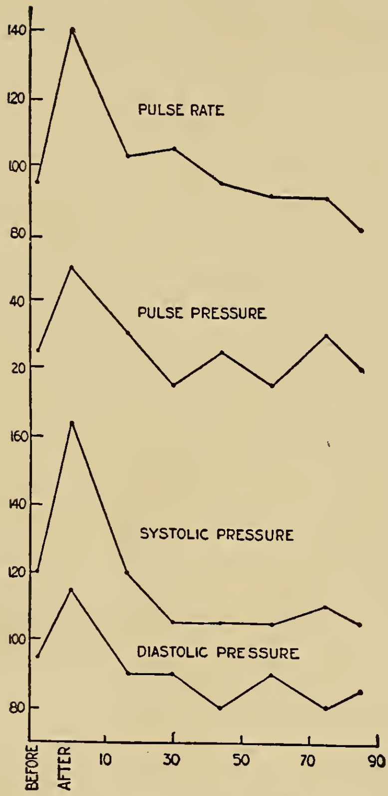


Fig. 18.—Effect on blood-pressure of a hundred-yard run, showing rapid return to normal, followed by short period of subnormal pressure. (Oswald S. Lowsley, American Journal of Physiology, vol. xxvii, No. 5.)

In such an exercise as lifting a heavy weight, wrestling, throwing a hammer, or sprinting, the muscles of the chest wall that support the shoulder girdle come into energetic contraction, pressing the ribs on the elastic cushion of the lungs until the arm muscles have a firm base of action. The teeth are clenched and the larynx is closed, corking up the air in the lungs, where it is still further compressed by the contraction of the abdominal muscles.

The left ventricle of the heart empties more quickly and completely under pressure, but the blood in the right heart cannot so easily be forced into the compressed lungs, and this side of the heart with the great vessels

[1] A. Albu, V. Beiträge zur pathologischen Physiologie des sports, f. klin. Medl., 1913, lxxviii, 151; Jundell and Fries, Nord. Mek. Arkl., 1911; and Jundell and Sjorgen, ibid., 1912.

that enter it becomes distended, and the engorged veins of the neck, temples, and forehead swell up like cords, the face flushes and darkens to a dusky purple.

In a back-and-leg lift, in which the effort was maximum, the blood-pressure mounted to over 200 in McCurdy's experiments,[1] but as soon as the obstruction to the return flow was removed the blood-pressure fell to normal and little acceleration of the pulse-rate remained (Fig. 19).

The blood-pressure in eleven men before, doring, and after lifting with maximum strength; the pulse rate[1] before and after the lift. Average of several observations made on each individual.

Name.	Age.	Weight in kilos.	Weight lifted in kilos.	Before lift.		During lift.	2-3 minutes after lift.		No. of beats in distal artery between compression and disappearance of pulse.	Condition of arm.
				Pulse rate.	Blood-pressure, mm. Hg.	Blood-pressure.	Pulse rate.	Blood-pressure.		
Sk.	31	70	216	69	109	210	74	113	1-4	Moderate size, muscular.
Ma.	23	61	118	93	109	165	94	107	1 4	Small, not muscular.
De.	30	60	131	75	93	146	76	95	1	Small, not muscular.
Sa.	31	68	188	67	100	175	67	101	1-2	Large, muscular.
McC.	33	75	170	78	124	178	81	125	1-2	Moderate size, muscular.
Ar.	21	75	178	77	117	207	80	117	1-3	Large, muscular.
St.	41	83	149	78	122	202	77	114	1-3	Large, muscular.
Hi.	25	60	155	84	100	154	80	107	1-2	Small, not muscular.
Be.	26	61	133	77	108	157	78	108	1	Moderate size, muscular.
Me.	27	72	249	76	107	188	78	110	1-4	Large, muscular.
Ja.	26	75	152	73	127	197	74	130	1-2	Moderate size, muscular.

[1] The pulse rate was recorded in the recumbent as well as the standing position. It seemed necessary to give here only the figures for the standing position. The glottis was closed during each lift.

Fig. 19.—Summary of experiments made by J. H. McCurdy.

Lowsley showed this tendency in a 100-yard dash (Fig. 18).

In a 220-yard race Harley Stamp showed the following figures in Joe Guyon, an Indian athlete in good condition:

	Systolic.	Diastolic.	Pulse.	Blood-pressure.
Before	120	80	84	40
After	165	50	168	115
Fifteen minutes after	135	75	108	60
Thirty minutes after	130	80	84	50
Forty-five minutes after	120	80	84	40

As the distance increases the subnormal pressure following the exercise becomes more marked and more prolonged (Fig. 20).

[1] American Journal of Physiology, March, 1901.

We find, then, the greatest strain on the heart and blood-vessels in exercises of strength and speed, more especially in feats where the arms lift or pull great weights or support the body-weight, such movements involving fixation of the chest walls and interference with, or arrest of, the respiration.

All exercises requiring sudden and great muscular effort should be used with increased caution, therefore, in those whose

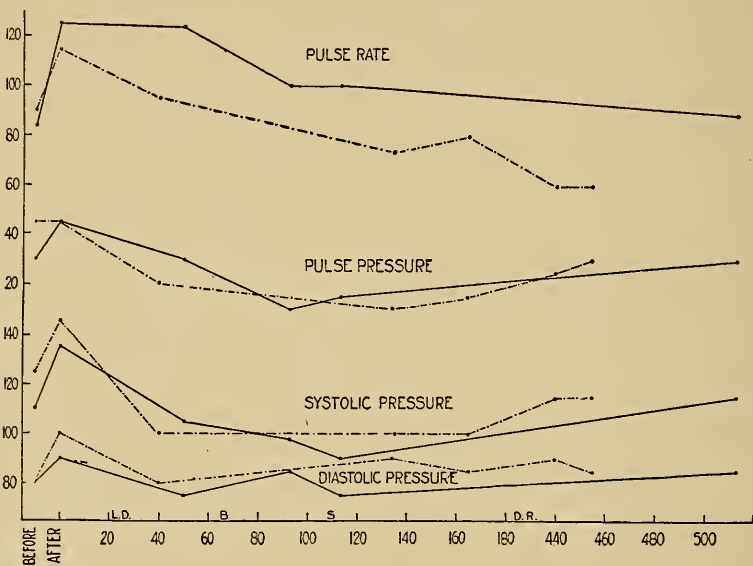


Fig. 20.—Effect on blood-pressure and pulse-rate on two athletes, C—— and D........, of a twenty mile run. Note the long subnormal stage and the slow return to normal shown in all the curves. Ordinates = mm. Hg. pressure and rate per minute. Abscissa = time in minutes. (Oswald S. Lowsley, American Journal of Physiology, vol. xxvii, No. 5.)

arteries have lost the first resiliency of youth, for in them damage may easily occur, as explained in Chapter III, although in youth no voluntary effort can be violent enough to burst a healthy vessel. Such exercises are a test of their quality rather than a means of systematically developing them, and no system of physical education composed exclusively of such exercises can lay just claim to completeness.

It is to exercises of *endurance* that we must look for the systematic development of strength and resistance in the heart and arteries. In mild rhythmic movements the blood-pressure rises gradually and never attains a great height. It remains high after the exercise is finished, but drops to subnormal much more quickly than the pulse-rate. The pulse-rate rises abruptly, remains high, and drops slowly at the end of the exercise. During this period the circulation is carried on with increased force and rapidity, but without great overstrain.[1]

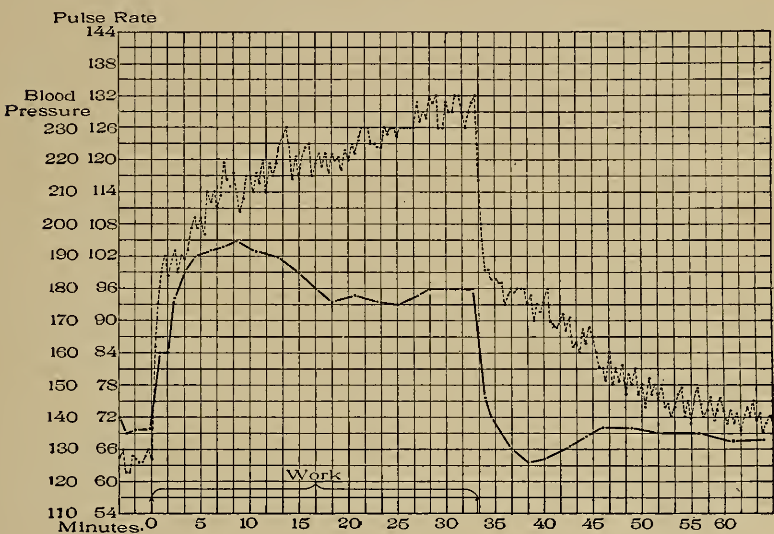


Fig. 21.—Curves of blood-pressure and pulse during bicycling and for thirty minutes afterward. Note that the pulse-rate (broken line) descends only part way on the cessation of work, and does not become subnormal as does the blood-pressure.

Most exercises of endurance distribute the activity widely among the great fleshy groups of the thighs and legs, gradually approaching the maximum without interfering markedly with the respiratory movements. They do not require supreme efforts, and they never accelerate the activity of the heart and lungs suddenly or to the same extent as do typical exercises of effort. The aggregate of work done is very much greater, how-

[1] W. P. Bowen, "Changes in Heart-rate, Blood-pressure, and Duration of Systole, Resulting from Bicycling," American Journal of Physiology, vol. xi, 1.

ever, than in exercises of strength, except in such exercises as require small muscle groups only.

Tom Burroughs could swing 3-pound Indian clubs twelve hours a day for six days with but little effect upon the heart and pulse. C. A. Gordon[1] found no enlargement of his heart. The pulse remained at 84, and the daily rise in blood-pressure was only from four to five points every evening. The muscle groups used were not large enough to profoundly influence it.

Many rhythmic movements give a definite automatic massage to the large vessels by the action of the limbs as well as the muscles. Eversion and extension of the thigh stretches the deep fascia and presses on the crural vein underlying it. If the thigh be turned inward and flexed, the fascia relaxes, drawing the vein wall connected with it upward and thus mechanically enlarging it. If the thigh be now completely flexed and inverted, pressure is again exerted on the vein. The rhythmic repetition of these motions of the thigh pumps the blood toward the heart, the valves of the veins allowing it to flow inward only. This process is continually at work in such movements as climbing, rowing, sliding, skating, and swimming, all exercises of *endurance.*

Occupations that involve long hours of standing allow the law of gravitation to have full force without this self-massage of muscular action, and the veins of the legs become distended and varicose from the constant pressure of the column of blood they contain, and if a walk be listless enough there may not be enough muscular contraction to counteract this pernicious influence, and the walker comes in tired and exhausted instead of buoyant and refreshed.

Exercise should also be regulated with great care in relation to the age of the patient. The volume of the heart in children is proportionally smaller to the diameter of the arteries than it is later on. During adolescence the volume of the heart is increased twelvefold, while the diameter of the arteries increases only threefold.[2] The child's growth is in relation to and de-

[1] Edinburgh Medical Journal, July, 1907. [2] Benke.

pendent upon this rapid development of the heart and its power to produce increased pressure of blood in the arteries. This ability increases with age, but there is always the danger of overfatigue in young and growing children.

Rivière[1] carefully examined the hearts of 40 boys, well built and sound, for a school-holiday excursion lasting one week, their ages ranging from seven to fourteen years. Expeditions of 5 to 7 miles were taken daily and included a 400-foot climb. On two days the walking for the bigger boys was increased to 12 miles. In addition to excursions, any available time was given over to football and games. In short, the boys were subjected to considerable physical strain, while the eight hours of sleep proved decidedly insufficient. Five days after their return, 20 out of 33 showed cardiac enlargement of various grades. This was to be expected, but at the end of two, four, six, and ten weeks only a few of the hearts each time had returned to normal, and 10 of them, nearly all among the younger boys, still remained appreciably dilated two and one-half months after the excursion. It is clear that the normal limit of endurance in these boys was surpassed, and that the heart would require one or two years to recover again its normal relationship to the needs of the circulation.

Leo Zuntz[2] reports on a somewhat similar excursion by 32 excursionists, all physicians, from thirty-five to sixty, who made the ascent of the Brocken, a heavy snow-storm considerably increasing the labor of their ascent. The fourth decade of life was represented by 8 men, who, for the most part, had had insufficient sleep during the previous days and had indulged more freely in alcohol than usual. In spite of this, 6 of them regarded the ascent as easy, and even the 2 others, who found the exertion severe, observed no bad after-effects, although one shortly before reaching the top had a fainting spell. The 16 men in the fifties made still more favorable reports, probably because they had taken better care of themselves in their previous days. Only 2 considered the ascent difficult, while the majority noted

[1] C. Rivière, British Med. Jour., Sept., 1909. [2] Zeitschrift für Balneologie.

an increase of vigor after the march. Five of the participants were in the sixties, and those accomplished the ascent best who had been trained for it by gymnastic and Alpine exercise. Zuntz himself, the oldest of the mountain climbers, being sixty-five, suffered a light febrile attack after the undertaking, because he had to take a rapid journey to Berlin in his wet clothing.

Here endurance was well maintained by those whose circulation was well established by age and experience, even with poor preparation for the test. Such a spell of exercise would have dilated and injured the hearts of boys of eight, just as there would have been risk of serious overstrain in the older men if they had attempted to force the pace beyond the rate at which their heart and respiration could take care of the increased stream of waste matter from the unusual muscular action.

The immediate and remote effects of competitive athletics on the heart has always been the subject of much discussion, and recent investigation has done much to clear up the mist of conjecture and prejudiced opinion with which this whole subject has been befogged.

The heart has been observed under severe exercise both in the laboratory and in actual athletic competition.[1] Selig found the temporary disturbances following severe exertion replaced by normal conditions five minutes after a wrestling match in 22 professional wrestlers at Prague.[2] The apex resumed its normal place and the area of dulness became normal, as did the blood-pressure, respiration, and pulse. The short rests with which the wrestling matches were interrupted were sufficient to maintain equilibrium of circulation. In no case did he find a pathologic dilatation of the heart.

Doctor Captaine and Miss Pokrychkina conclude that in a normal individual it is nervous strain that produces the acute cardiac pain, tendency to faint, and irregular pulse in the runner rather than the muscular work itself.

[1] "Importance of Daily Physiologic Control During Training for Athletics," P. Torgersen, Norsk Magazin for Laegevidenskaben, Christiania, April, 1914.

[2] La Semaine Medicale, February 27, 1907.

Theodor Schott investigated wrestling as an exercise in which endurance is combined with repeated maximum muscular strains. He noted dilatation of the heart both right and left of 1 to 2 cm. or more, but also noted that all symptoms gradually disappear in a healthy man, and that the severest exercise, even if accompanied by compression of the abdomen by means of a belt, had but a temporary effect. All symptoms of heart insufficiency disappear in a few minutes, and the dilatation tends to disappear readily and naturally, the time required depending on the elasticity of the tissues. Lehrbecher's[1] observations on oarsmen are, in the main, confirmatory.

By far the most thorough and painstaking investigation of the effects of prolonged violent exercise on the heart was that directed by Watson L. Savage, the subjects being 59 competitors in a Marathon race of about 25 miles at Pittsburg, which was run in circles that brought the competitors four times during the race past the tents in which the physicians were stationed. The ages of the men were from eighteen to fifty-two years, averaging twenty-one, and they averaged about 3½ pounds below the normal weight for their height. During their preliminary training they lost on an average about 6½ pounds, although one 6-footer had lost 23 pounds. The thorough and complete examination of the pulse, blood-pressure, and heart outline by the *x*-ray threw much interesting light on the subject.

The hearts were divided into *four classes*, as shown in the illustrations (Figs. 22–25). Of 6 men with small hearts, none finished; of 8 with medium hearts, 4 finished; of 7 with large hearts, 4 finished; of 2 with very large hearts, both finished. One week after the race 11 men were re-examined. Of these, 2 still showed a heart of the same size as immediately after the race, one a man of fifty-two years, which agrees with the previous statement as to the danger of men of advancing years engaging in violent exercise. The remaining 9 had hearts smaller than they were before the race, showing that the temporary enlarge-

[1] A. Lehrbecher, "Beobachtungen beine Ruder-training," Arch. f. Hyg., 1913, lxxxi, 1.

ment to provide for additional work ceases as soon as the extra necessity is relieved.

The tracings taken in the illustration (Fig. 17) show the

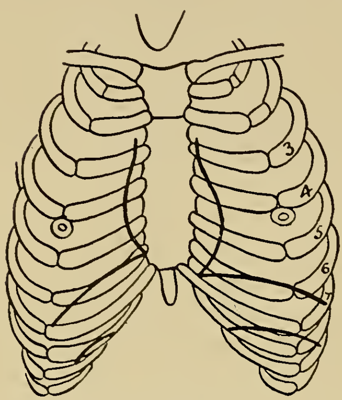


Fig. 22.—Small vertical heart; one of six, none of whom finished the race.

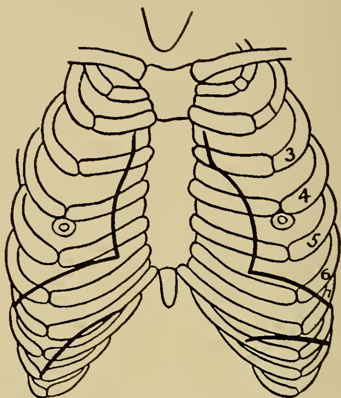


Fig. 23.—Medium-sized heart; one of eight, of whom four finished the race.

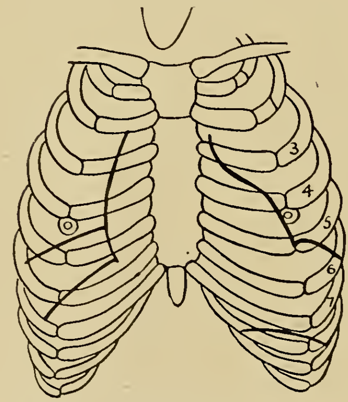


Fig. 24.—Large horizontal heart; one of six, of whom five finished.

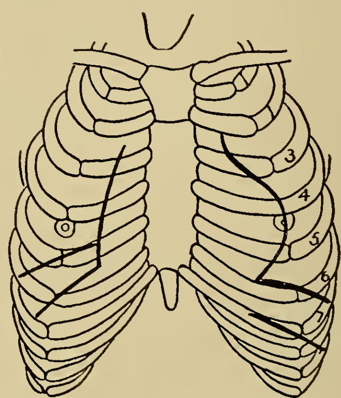


Fig. 25.—Very large heart; one of two, both of whom finished.

Figs. 22–25.—John W. Boyce and George W. Grier's observations by *x*-ray on twenty-three Marathon runners. ("Physiological and Pathological Effects of Severe Exertion," Watson L. Savage, P. E. Review, vols. xv and xvi.)

variations in the size of the heart before, after, and one week after the race.

In these cases the physiologic changes were observed, which, in some cases, become pathologic, and it was clearly demonstrated that the average individual who has trained for such a contest will show a pulse moderately slower than the normal. His blood-pressure will be higher than the average. He will have a compensating hypertrophy, and in many cases heart murmurs will be present. As soon as the race is over a recession into the normal follows, in some cases quickly, in others slowly, while in a few not at all.

No more prolonged and exhausting test of endurance could be devised than such a race, and yet in former Marathon races Blake and Larabee found no permanent injury resulting from the three races they observed.

A single cardiac overstrain with acute dilatation has no immediate after-effects, further than those already described, on the healthy young adult, but the remote after-effects of strenuous exercise has also been the subject of much controversy, and a brief review of the facts at our disposal will be of value.

Dr. Harlow Brooks[1] makes the following statement:

"During one year I examined in this organization (a National Guard regiment) 12 different men, all at one time famous football players at college, and 6 of them ex-captains of their teams. Of these 12 famous athletes but 1 could be rated physically up to the average of his comrades of his own age. This one exception, a Yale man, has since died, in his early thirties, of diabetes mellitus. The defects, as I have observed them, are chiefly confined to lesions or disturbances of the heart and other circulatory organs, to adiposity, and joint diseases."

The first careful investigation to determine the after-effects of athletic competition was on university oarsmen at Oxford and Cambridge. The crew man is required to row repeatedly a distance of 4 miles at top speed, the twenty-five minutes being spent in a posture which impedes full freedom of the lungs and heart action.

E. H. Morgan[2] took the contestants of the interuniversity

[1] American Practitioner, November, 1912.
[2] University Oars.

boat races between Oxford and Cambridge from 1829 to 1869 as his field, and communicated directly with 151 of the 255 survivors, as well as the relatives of the 39 who were dead, making a total of 294 reports received. Of these, 7 either speak of themselves as probably injured or were so described by their relatives, sometimes with considerable reservation. On tabulating the crews with reference to expectation of life, as compared with *Farr's English Life Insurance Tables*, which place the expectation of a man of twenty at forty years, he found that the expectation of these oarsmen was forty-two years. Of the 39 deaths, he found 11 died of fever, 7 of consumption, 2 of other forms of chest disease, 6 of accident, 3 of heart disease, 1 of Bright's disease, and 8 of various causes not connected with athletics. Of the 7 deaths from consumption, it was found that nearly all had a strong personal or family history. This was about the average mortality from diseases of the circulatory apparatus, as well as from consumption, as disclosed by the registrar-general's report, and it must be remembered that they rowed without preliminary medical examination, the unfit being weeded out by the more costly elimination of the oar. There were no sudden deaths nor rapidly fatal heart cases.

In America, similar but much more complete observations were made on Harvard oarsmen by George L. Meylan of Columbia,[1] who interviewed every survivor personally where possible or had reports made out by their medical attendants. He found that 152 men had rowed from 1852 to 1892, of whom 123 still survived (November, 1902), thus allowing eleven years to elapse after the last race observed to give time for any evil effects to show. He interviewed 76 men personally, and sent to all a questionnaire that was most admirable in its completeness. In longevity, the first crew (1852) showed an increase of 1.6 years per man as compared with the selected lives of the insurance tables in which a man of twenty has an expectation of 42.2 years. His results were interfered with by a number of deaths of men in their prime during the Civil War. By allowing to

[1] P. E. Review, June, 1904.

those killed in battle the ordinary expectation of men of their age, the advantage would be increased to 5.39 years per man. Of the 32 deceased oarsmen, 2 died of heart disease, 1 of consumption, 2 of Bright's disease, 8 were killed in the Civil War and by accident, 3 died of pneumonia, 2 of apoplexy, 1 of dissipation, 1 of paresis, 1 of cancer, and 10 of unknown causes. In neither of the 2 cases of heart disease was rowing given as the cause. The after-health was most satisfactory in 68, good in 36, and poor in 1. Two believed that rowing had injured them, 1 claiming to have dyspepsia and the other an enlarged heart, which, however, had caused him no inconvenience since he left college. These results would seem to prove conclusviely that rowing is not a serious factor in the production of early death from disorders of the circulation, but it must be remembered that these were lives doubly selected, first for constitutional vigor, and secondly for muscular strength.

Dr. William G. Anderson[1] found that the graduates of Yale who had won their "Y" on athletic teams showed a mortality considerably less than that of the general graduate class.

Armstrong, of Wellington College, in 198 cross-country and steeplechase runners found, of the 13 deaths from 1870 to 1904, that none died from heart disease. Hammet,[2] in his exhaustive compilation of distance runners, found similar results.

Ex-Surgeon General Stokes believes that the prolonged course of training required for athletic competition is dangerous in its effect upon those who indulge in it sufficiently to excel therein. The statistics he quoted are discussed in a symposium on the subject.[3] The rate of mortality and disability among the 625 athletic midshipmen is, however, less than that based among the 750 non-athletic midshipmen living under similar conditions, so that all available evidence would indicate that there is but little reason for alarm, except in cases where the test is flagrantly

[1] Yale Alumni Weekly, January 2, 1907.

[2] Chas. E. Hammet, "Middle and Distance Running," Pop. Sci. Monthly, July, 1910.

[3] Medical Times, New York, March, 1912.

unfitted to the age and condition of the competitor, or when the training is notoriously overdone or neglected.

In the danger scale suggested by Dr. Bartsch[1] for different sports, the "Gefahrenskala," whereby one could determine the relative likelihood of damage or injury to be encountered in rowing, running, or football, would have a real value.

Athletic competition is conducted with such intensity in many American schools, academies, and colleges that there is always danger of overexhaustion by undertaking contests that should be reserved for maturer years, and repeated overstraining of the immature heart must be injurious to its structure and function, its marvellous recuperative power alone preventing such effects from showing more clearly than they do.

Rubner, the physiologist, and Kraus,[2] the clinician of Berlin, in a report to the Prussian Government condemn in no uncertain terms the whole competitive idea in sport, forbidding races of $\frac{1}{4}$ mile to 1 mile among school boys. While one is disposed to agree with such a prohibition for young boys, a general condemnation will always be considered far too radical a step for peoples in which competition has always been, and always will be, an important factor in their systems of physical education.

There are also dangers that accompany the later years of a man's athletic life. Having accustomed himself to a high rate of physical activity, it is dangerous to stop all exercise suddenly as so many college graduates do when they enter business. The combination of overnourishment and underelimination that is sure to follow upsets the digestion, brings on palpitation, and helps in the rapid accumulation of fat, and these symptoms often make him introspective, morbid, and neurotic, and I have no doubt that some at least of the conditions noted by Doctor Brooks were due to this cause.

[1] H. Bartsch, "Sports und Unfall—Eine Hygienisch-chirurgische Frage," Berlin. Klin. Wochenschr., January 19, 1914.

[2] M. Rubner and F. Kraus: Gutachten der Königlichten wissenschaftlichen Deputation für das Medizinalwesen vom February 11, 1914, betreffend sportliche Uebungen von Schülern, Vrtljschr. f. gerechtl. Med., 1914, xlviii, 304.

CHAPTER V

THE CONTROL OF MOVEMENT, NUTRITION, AND EXCRETION DURING EXERCISE

The muscles are the slaves of the nerve-centers and the will tires long before the contractile power of the muscle is lost through fatigue.

If the motor nerve to an apparently fatigued muscle be cut, the failing contractions can be at once strengthened by the electric current. Sudden anger frequently acts as a stimulus, making possible exertion which would otherwise be beyond one's power, while the muscular power displayed during the cataleptic state cannot be otherwise explained.

Fundamental movements, such as breathing, eating, speaking, and walking, become automatic early in development, and the management of them is turned over to lower centers in the hind brain and spinal cord, so that the motor area of the highly developed cortex may be free to supervise those more lately acquired co-ordinations that never become automatic and need long training to become habitual, such as piano-playing, juggling, or balancing.

The acquirement of skill is, then, a training of the nervous system rather than of actual muscular power if it be permissible to speak of them separately. The mental process involved in solving a problem in geometry is very much the same as the process of thinking out a complicated attack in fencing. Fencing, however, cultivates the additional co-ordination of the hand, arm, and body to carry out the process of reasoning by which the fencer calculates the movement, time, and distance necessary to touch the plastron of his opponent without interference.

The simplest movement means not only a nerve impulse to the acting muscle, but a wave of impulses to the accessory and antagonistic groups which act as brakes to steady the movement. If the movement is unfamiliar, this combination of forces is not very well adjusted. Contraction is jerky and inaccurate, instead of unerring and graceful or physiologically economical. Many useless muscles are employed and the expense in nervous energy is out of proportion to the result.

The first attempt at comparatively simple motions rapidly exhausts the attention. The apparently aimless and uncertain movements of a child learning to walk illustrate the amount of concentration required in what afterward becomes automatic. Exercises of skill cultivate habits of economy in the expenditure of nerve force, and we instinctively admire a difficult exercise performed with thrifty ease just as we unconsciously censure the nervous prodigality of the unskilful tyro. The same effect produced by mental excitement or worry on fine muscular adjustment is seen in the broken shoe-lace of the hurried man or the failure of the nervous pianist before a critical audience. When a certain degree of skill or co-ordination is learned in a set of movements the interest passes on to what is more difficult, and this is one reason why any course in physical training should begin with simple and easily learned movements, progressing to those more difficult and complicated feats that serve to keep alive the attention and interest of the pupils.

The possibilities of muscular development and co-ordination are incredible. An acrobat after unremitting labor succeeded in accomplishing the following feat of balance: The upper end of a walking-stick was arranged to fit the hand. Standing balanced on a slack wire, he placed on it the lower end of this stick and gradually raised himself to a single hand balance. It is only by analyzing the strength of the muscles immediately involved and the fine judgment in muscular co-ordination required in pushing up to the final position with feet in the air, as well as the control and alert sense of equilibrium that we begin to realize a little what possibilities exist in neuromuscular control, and yet a dissection of the back and side of this man would not show anything more than a well-developed group of scapular muscles. The important element is nervous control rather than actual muscle size.

New co-ordinations require constant attention, but when they become automatic they allow the attention to be transformed to refinement of the form and finish. Most pupils perform a new exercise correctly in a general way, but distinction of style always requires conscious effort, and by emphasizing such points a teacher can invest with renewed interest a gymnastic drill which has become mechanical and dull.

Exercises should be designed to develop and educate movements peculiar to the limb—the lower limb for support and leaping, the upper limb for grasping, striking, throwing, and catching.[1]

In other words, the movements should be natural and utilitarian. It is because this great principle is so much neglected that the interest is difficult to maintain in formal gymnastics. In free play it takes care of itself.

Exercises of strength and skill would be employed to train co-ordination and the economy of effort, as well as that alertness of mind so necessary in ordinary life. They shorten the period between thought and action and give that condition known as presence of mind. A corresponding mental strain is inevitable. The man who is held alert too long on the starting line before a race, tense and straining for the signal, finds such a rapid exhaustion of his powers of concentration that in a second or two the strain becomes intolerable. The alertness required at first in learning to box rapidly exhausts the nervous system and it is only when the movements of countering, ducking, and sidestepping become habitual that the exercise can be continued for any length of time. Baseball is, above all, a training in quick thinking and alert action. Football is a game of the same nature, and getting the jump on an opponent is a matter of mental concentration and alertness rather than of actual strength. Much of the exhaustion of a game is due to this brain fag, for the actual playing time in a match is not more than one-fourth of the total

[1] Baron Pierre de Coubertin, La Gymnastique Utilitaire.

period. In gymnastic exercises imitation is a cheap form of instruction from the standpoint of nervous expenditure, because the pupil learns more easily through the eye than by translating a verbal command into a picture of the movement, while exercises by command are much more exhausting to the attention of the pupil, although they have thus an additional educational or disciplinary value. The wars between the German and Swedish systems of gymnastics have been fought upon the relative value of imitation and command.

Griesbach's experiments[1] show that the mental fatigue caused by the lesson in Swedish gymnastics was almost as great as that of the more purely mental exercises, a result doubtless of the concentrated attention required, but without this possibility of fatigue the educational value might not be so great. Exercises of endurance, which are simple, habitual, or even automatic, do not require great nervous concentration. A man can walk or run slowly and have his mind on other things, but when he pushes his powers to the point of acute fatigue the phenomena of breathlessness already described takes place. If the exercise be continued after breathlessness has disappeared the runner soon begins to notice a sensation of lassitude creeping over him, an increasing lethargy and paralysis of the will-power. His muscles become slower and slower in their response to his will, each effort requiring a greater concentration of his attention. This lassitude gradually deepens. Group after group of muscles refuse to perform their work, until he staggers along with relaxed grip, yielding ankle, fallen jaw, and drooping eyelids, drunk with the poisons of fatigue.

Repeated attacks of fatigue produce that chronic poisoning referred to in Chapter I as *staleness* or *overtraining*, which is, above all, a slow poisoning of the nervous system, just as sub-acute fatigue is a general intoxication by the products of muscle waste and acute fatigue, an intoxication of the breathing apparatus.

[1] Energetik u. Hygiene des Nerven Systems in der Schule, Munich and Leipsig, 1895, p. 97; International Magazine of School Hygiene, 1905, vol. i, 317–417.

During *staleness* the life of the athlete has but little ambition. Supper is enjoyed the least of the three meals. The vitality declines as the day progresses. He is unable to concentrate on study or work and takes but little interest in the world about him. He awakens tired after sleeping and his sleep is frequently broken. He finds it difficult to hold his attention on any subject. The physician notes that the eye is sunk deep in its socket, the face is pinched, the appearance dejected, the temper peevish and distrustful, aggravated by little things. Wounds and scratches heal slowly. Sudden rise to the standing position shows an increase in the pulse-rate of 20 beats or more. Blood-pressure is low and falls markedly when the man stands up, although to this rule I have seen some notable exceptions in men who were evidently over-trained. There is a gradual loss of weight from day to day, and the weight lost during exercise is not replaced within twenty-four hours as it should be. Rest and feeding alone can bring the former elasticity, although much can be done by the mechanical nourishment of the muscles by massage.

The rôle of *passive* exercise is one of relief to the nervous system, for the nutrition of muscles is maintained without the expenditure of the nervous force required to make them contract, and massage acts on the central system through the nerves of sense, stimulating or soothing according to the nature and amount of the manipulation.

The burning up of carbohydrates and proteins by muscular action causes a hunger for food just as the destruction of oxygen produces a hunger for air. With an increased supply of food the muscles increase in size and strength, and the amount remaining unused is either excreted or stored up in the tissues as fat. If training be severe, not only is the daily supply of food and drink used, but the normal reserve horde of fat is speedily expended until a man in fine athletic condition is considerably below his normal.

Athletic training aims to produce a machine to run, leap, fight, or row, and fat would only be an incumbrance like extra ballast, so that a man in fine athletic form is not in the best condition to rise from a depleting illness or to resist the siege of an exhausting infection like typhoid fever or pneumonia, where the stored-up fat of the normal individual becomes his most valuable asset.

The immediate loss of weight, mostly water, during athletic exercise, may be from 5 to 8 pounds in less than one-half hour; a loss which continues more slowly after exercise is stopped if no food or drink is taken. In a series of observations made by Wm. J. Cromie on football players during daily practice at the University of Pennsylvania he found that the loss averaged about 3 pounds, the highest being $5\frac{1}{10}$ pounds and the lowest, $\frac{8}{10}$ pound, the weight being taken immediately before and after exercise. During the next hour they showed a further loss of about $\frac{1}{2}$ pound, and in no case was any gain found.

In the foot-ball squad of the Springfield College every man gained in weight during one playing season, the average being $8\frac{6}{10}$ pounds. There was in most cases a loss of weight at first, and then a slow gain, attributable to the increased muscular development which more than counterbalanced the initial loss of fat. Almost without exception the men gained their daily loss before going to bed. One man lost $6\frac{1}{2}$ pounds in an afternoon and regained it that night.[1]

Trainers rely on changes in weight more than any single indication of an athlete's condition, always looking with well-grounded suspicion on the man whose weight keeps going down from day to day.[2]

A high state of continued muscular activity uses up the nitrogen supplied by the proteins of the food and stored for emergencies like the fat already alluded to. Edward Payson Weston, the pedestrian, during a six-day walk consumed much more nitrogen than was taken in from his food; in other words, he lived on the combustion of his own tissues. During the rest period which followed, the balance was quickly restored.[3] Blythe,

[1] F. J. Gray, "Diurnal Variations in Weight," P. E. Rev., 1910, and T. A. Storey, "Loss of Weight During Exercise," P. E. Rev., vol. vi, 29.

[2] E. H. Nicholls, Boston Medical and Surgical Journal, January, 1907.

[3] Austin Flint, Proceedings of Royal Society, 1884.

Atwater, and Sherman have since confirmed the observation that athletes draw upon the body for nitrogen unless it is supplied in excess, although the actual loss of body weight may not be great.

In a six-day bicycle race C. W. Miller lost 4 pounds on the first day and maintained his weight after that for the rest of the week, although he rode 2007 miles with only twenty-four hours rest, of which eight were spent in sleep. Frank Albert, one of his opponents, lost $3\frac{5}{10}$ pounds in the first two days, but got it all back at the end of the week under an excessively nitrogenous diet. This discovery led trainers to supply a highly nitrogenous diet consisting largely of meat and eggs.[1]

McCurdy's experiments (over ten years) on foot-ball teams would indicate that the amount of proteins supplied in response to this discovery has been excessive, and that the strain on the excretory function of the bowels and kidneys has been made too great in consequence. This he relieves by increasing the fats and curtailing the supply of milk, cheese, and meats,[2] while Professor Irving Fisher has shown that men on a vegetarian or low protein diet show powers of endurance that surpass the meat eaters almost beyond the limits of credulity.[3]

The first two organs to act in the elimination of the poisons of muscular waste are the lungs and the skin, the former giving off heat, CO_2, and water vapor, and the latter water, urea, and other constituents of minor importance. Both these organs also neutralize by evaporation the excessive heat produced by muscular action. Every hour we sit still we lose about 40 gm., or $1\frac{1}{2}$ ounces; this loss of weight from the skin and lungs goes on even during sleep, as shown by Warren P. Lombard on his delicate balance (Fig. 26).

The normal loss of weight during the night is nearly 1 pound.[4]

[1] W. G. Atwater and H. G. Sherman, "Effects of Prolonged and Severe Muscular Work on Food Consumption, Digestion, and Metabolism," U. S. Bull. No. 98, Dept. of Agriculture.

[2] Elmer Berry, "Effects of a High and Low Protein Diet on Physical Efficiency," P. E., Rev., May, 1909; and Otto Folin, "Theory of Protein Metabolism," Am. Journal of Physiology, February and March, 1905.

[3] Yale Medical Journal, March, 1907.

[4] Thomas A. Storey, P. E. Rev., December, 1902.

The function of excretion as carried on by the kidneys is greatly increased by any form of exercise. The by-products of muscular action removed by the kidneys are water, uric acid, urea, oxalates, lithates, and numerous other substances. These show as reddish deposits, principally uric acid, in the urine, especially of those not habituated to fatigue.

While albumin is present in all normal urine, it is scarcely detectable in a large percentage of cases until it is increased by changes in diet, by cold baths, exposure, mental worry, strain, and exercise.[1]

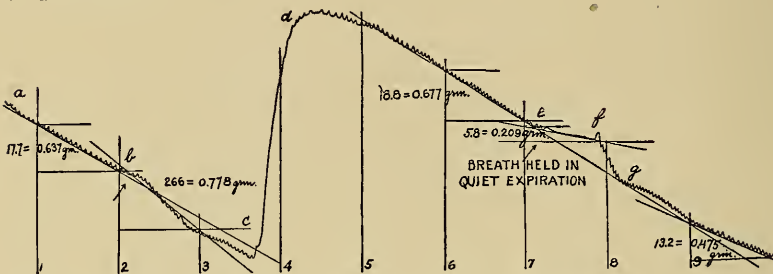


Fig. 26.—Curve of loss of weight of F. M. A. (aged twenty-nine, weight 72 kilos), 5.30 P. M., May 24, 1906. Room temperature, 24.5° C.; hygrometer, 55 degrees. The small oscillations were caused by the respirations. Time is marked in minutes at the bottom of the curve: *a–b*, Subject asleep; *b–c*, waking curve; at *c*, 4 grams added; *d–e*, waking curve; at *e*, breath held in quiet expiration; at *f*, a large inspiration when subject begins to breathe; *f–g*, curve shows rapid loss of weight following the holding of the breath. At *b*, he was partly asleep, eyes closed, lids twitching. He was told to open his eyes and did so. He was not startled and was not seen to make any other movement (Warren P. Lombard).

The frequency and extent of albuminuria depends almost directly on the extent and severity of the exercise.[2] The albumin does not persist after the first urination following exercise, as a rule, although there are many exceptions, and the amount is greatly increased where, in addition to the exercise, there is the nervous tension of an exciting contest.

Seventy-three per cent. of basket-ball players show an appreciable amount of albumin after match games, but only

[1] Edwin Wells Dwight, "The Significance of Albumin and Casts in the Urine of Apparently Healthy Applicants," New England Life Insurance Co. Bulletin.

[2] Elmer Berry, "Athletic Albuminuria," with bibliography, P. E. Rev., January, 1912.

29 per cent. after the daily practice. The amount also varies with the duration of the game, a thirty-five-minute game giving a cloud, while a seventy-minute game will give a heavy cloud.[1]

In Savage and Barach's experiments on Marathon runners, blood was found in several cases after the race and albumin was found in every specimen from a mere trace to a heavy cloud, whereas in 19 specimens examined a week afterward 4

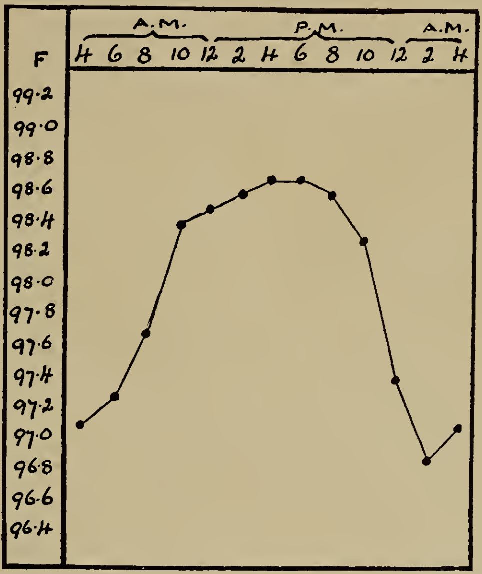


Fig. 27.—Curve showing the daily variation in temperature of nine normal individuals at complete rest. ("Some Observations Upon the Deep Temperature of the Human Body at Rest and After Muscular Exertion," Bardwell and Chapman, in British Medical Journal, May 13, 1911.)

showed light clouds. The presence of albumin is closely associated with a rise of temperature. After the Marathon race at the Olympic games of 1904, the temperature of 12 contestants was taken per rectum and a rise from 2 to 3.40 degrees was noted. This rise, also noted by Bowen, is, I believe, constant, although it may not show if the mouth temperature alone be taken. This constant fever after exercise may go as high as 104

[1] E. Fred Moller, Thesis, 1910, Sprinfield International Y. M. C. A. College.

in healthy persons, and remain up for an hour or more. The internal temperature in the normal healthy person has a daily normal fluctuation of about $1\frac{1}{2}$ degrees, being lowest at four and highest at ten o'clock, remaining up until about six o'clock in the afternoon (Fig. 27), the rise having definite relation to muscular activity.[1] The rise of temperature is in direct proportion to the severity of the exercise: in basket-ball it went up to 2.40 cm., handball to 1.94 cm., and after light exercise 1.35 cm. Savage found that the man who finished his Marathon race in the best condition and said that he felt no distress had a rectal temperature of 104 degrees. Bardwell was able to foretell the exact degree to which it would be raised by definite doses of exercise.

This would go to prove that after severe exercise there is always a nephritis, lasting from a few hours or days to a week, according to the severity of the exertion and the condition of the subject.

The sediment present after exercise resembles the sediment in severe nephritis, and this condition is evidently due to the high tension induced in the circulation by the exercise.[2]

Training can modify this nephritis by limiting the amount of waste, but in our understanding the place occupied by conditioning and elimination we have not advanced much even in phraseology on Hippocrates:

"The untrained have moist flesh, and when they exert themselves the body becomes heated and they yield the product of liquefaction in abundance. Of this, whatever is sweated or purged away with the breath causes no trouble except to so much of the body as has undergone the unusual depletion, but whatever remains causes trouble not only to the unduly depleted part of the body, but also to whatever part receives the liquid in question, which is not akin to the body, but hostile."

[1] N. D. Bardwell and J. E. Chapman, British Medical Journal, and W. L. Caldwell, Thesis, 1912, Springfield College.

[2] Christensen, "The Urine Sediment in Athletes and Nephritics," Hospitalstidende, Copenhagen, lii, July 21, and August, 1912.

CHAPTER VI

AGE, SEX, AND OCCUPATION

The growth and development of a child is directed by the play instinct, an automatic system of physical education composed of spontaneous exercises of his own devising. The first movements of the infant consist of kickings and squirmings, with aimless motions of the arms, hands, and head, for almost the only co-ordinations that he has from birth are those of sucking and grasping, both intimately associated with his survival.

Fig. 28.—An infant three weeks old which supported its own weight, suspended by its arms, for two minutes (after Dr. L. Robinson). "Infancy of Animals," Pycroft, Henry Holt & Co.

Each infant should have several hours daily for free exercise, encumbered by little or no clothing. Place the child on a bed and guard him from falling off, or place him on the floor protected by a warm rug. Give him something to kick against, the wall or footboard, and a ring or handkerchief to pull on with his hands. A small but increasing amount of time should be spent playing with the baby, pressing the hands against the feet to excite the pushing reflex, rolling the baby over, moving the arms up and down, or presenting a finger for the little hands to grasp and clutch. Some children tend to lie still for long periods, and may require to be played with more than those who are spontaneously active. Long clothes or tight clothing interfere with normal creeping and should be discarded at least during exercise. There should be the side of a crib, a rail, or a chair to grasp in pulling himself up to a stand. This partial support is specially useful for heavy babies, and helps to prevent the bowed legs that result from the efforts of too ambitious parents. He should be taught to climb a step 5 or 6 inches high, and should be allowed to fall off the step on to a thin pillow, and, so safeguarded, will learn about falling and will handle himself better than if he had never learned the self-control that can come only with opportunity. As he progresses more complicated movements should be taught, like the picking up and throwing of objects, and this stage of his growth culminates in learning that supreme accomplishment of man, the conquest of the upright position. He should not be stimulated to stand too long upon his feet at first, and it is at this point that the pile of clean sand begins to assert its importance. In it he should stand and fall, dig and build with large and simple toys, like blocks, sticks, stones, and boxes. Four hours a day is not too much for free play in the fresh air, with the utmost possible freedom from clothing, loose canvas jumpers at most.

The amount of muscular work done by an infant in the course of the day is quite as great as that done by an active adult, weight for weight, as proved by Schlossman's tables, and the researches of W. E. Custer, at Clark University, and any curtailment of this necessary activity must be harmful.

This routine may continue up to the age of seven, when, in most cases, the responsibility of the child's day is shared by the school. About this age catching and all games of ball begin to engage the child's attention, irrespective of sex, also individual games, like tag, hide and seek, leap frog, and other tests in which the awakening powers are tried, but it is not until about twelve that the boy begins to find his medium of expression in competitive games, and in those that demand the sacrifice of the individual to the team. This evolution of the play life is graphically shown in Dr. Luther Halsey Gulick's chart of the play of Anglo-Saxon boys; in other words, boys having the most highly developed play traditions and customs. He divides the child's life into three periods: from birth to seven, from seven to twelve, and from twelve to maturity. The spaces enclosed by the curved lines include the games that are acquired at each stage and also those that are retained to a more advanced age. These lines

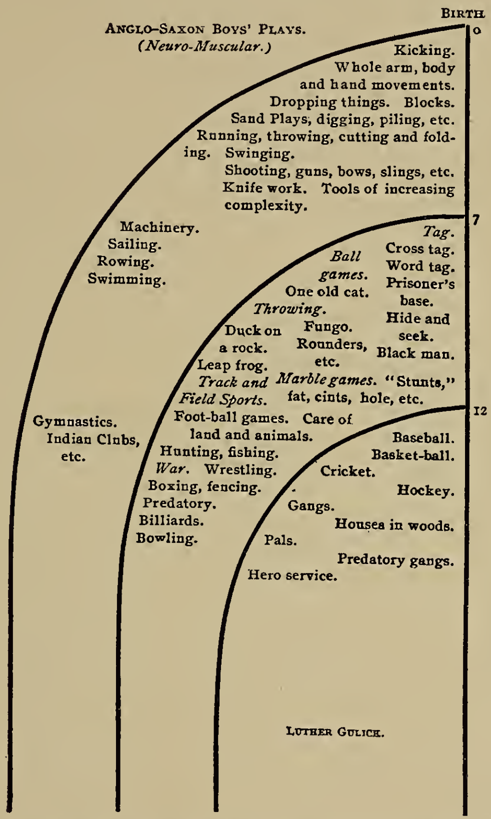


Fig. 29.—Luther Gulick's table, showing the age at which various games and sports begin, are most popular, and wane in interest among boys.

must not be considered final, since in many individuals the beginning of interest in any play may be earlier or later than the time stated, and in all children they begin gradually, come to a climax, and shade off just as gradually. As age progresses, they drift from plays that center in the individual to plays in which they consider themselves as related to others. Growth is accompanied by an increased complexity in the movements required, and in the third division, beginning approximately at the age of twelve, the start of what is termed the "gang" instinct, is seen, boys conducting their sports in groups, team work being the keynote of this stage, as individual excellence was of the preceding.

It must not be forgotten, however, that the games acquired in the second period also persist and often dominate the boy throughout his entire growth. Gulick has pointed out that savages who have reached the stage of co-operation required for fighting under a chief in organized tribes are really doing what the Anglo-Saxon boy does at the age of twelve. All the higher forms of sport involving team work and specialization are merely a physical expression of the law of evolution that governs the business and social life of a civilized community.[1]

In outlining a course of physical education for any child the first consideration must always be given to this law of physical evolution, and his natural plays and games must be studied and used educationally for his welfare. Froebel[2] recognized this fundamental law and developed it into his kindergarten. Until the age of twelve there is but little difference in the spontaneous play of boys and girls, but with the consciousness of sex and the accelerated growth of puberty their interests rapidly diverge. Girls retain their individualism, and do not come under the domination of the "gang" instinct to the same extent as boys. The fighting reflex is not so dominant. They do not inherit the ability to throw straight and strike hard, and thus are put at a disadvantage in games requiring these activities. Their periods of temporary disability make them take less interest in active and competitive games, and they have much less endurance. Their dress limits their stride. They cannot fall and roll over with propriety. This differ-

[1] Karl Groos, "Play of Man" and "Play of Animals," D. Appleton & Co. G. Stanley Hall, "Adolescence," D. Appleton & Co.

[2] F. W. A. Froebel, "Education of Man," D. Appleton & Co.

ence increases as they come under the social influence of the community, but doubtless part of it is instinctive. Their interest turns to more feminine accomplishments, requiring grace and lightness, and much pleasure is found in swimming and dancing in all its forms and in games in which rhythmic movement is prominent.

It is not until a comparatively mature age physically that the more formal gymnastics can be introduced and applied to correct the confinement of school, shop, or home life. During adolescence, sports and games play so large a part in the physical development that a definite classification of the outstanding effects of the most familiar of them will be of value for guidance in their selection. It is impossible to give any great degree of exactness to such a table without cumbering it with wearisome explanations. In a familiar exercise like walking the change in speed from 3 to 5 miles an hour will elevate an automatic listless occupation into a vigorous exercise, employing many new muscle groups and stimulating the heart, lungs, and skin, while the change from a smooth level road to the broken ground of a mountain side may be dangerous for one who might walk at moderate speed on level ground.

The muscles employed are named approximately according to the intensity and duration of their action. The notes in the column marked "Demand on the Nervous System" refer to the concentration required, its degree varying with the difficulty of the movement. The "Influence on Respiration and Circulation" of an exercise is indicated by the onset of breathlessness and increase in blood-pressure and pulse-rate during its practice. The "Physical Characteristics Cultivated" by the constant repetition necessary for success in such games come in the fourth column, and the "Age Limits" within which they should be contained are placed in the last but one. The time of life for beginning and leaving off any exercise must vary greatly with the individual, but the ages mentioned are not far out for the average man. The upper age limit in all cases is placed at sixty. If by that time a man has not determined what form of exercise is most suitable for his condition and constitution, he is not likely to be capable of receiving guidance from this chart.

There is always *danger* of exhaustion and overstrain from excessive athletic competition, but early adolescence and middle age are the danger periods. The heart of the boy of fifteen is in no condition to withstand the exhaustion of extreme tests like the so-called Marathon races. Any distance-run for boys should be broken by rests or changes of pace, as explained in the chapter on athletics. About this time a lad's ambition is apt to outstrip his vitality, and although immediate recovery is usually good, repeated and continued overstraining of the heart must always be bad. As we advance in years our heart adapts itself to an habitual rate, just as the range of movements in the joints slowly lessens and the danger of overstrain from an unusual call on either heart or muscle becomes greater as their adaptability and resistance become more and more limited. Preparation for any unusual muscular test or strain should then be made with added care as the years accumulate. Fortunately, Nature generally reduces this danger to a minimum by decreasing the desire and ability to drive one's self beyond the margin of discomfort, and by prompting the question, "What's the use?" in face of a supreme test of strength, speed, or endurance. Striking examples are continually quoted of exceptional men who have long passed the "dead line" and are still active in such sports as cricket, baseball, and boxing. If indulgence in a sport has been continued with regularity, a man's own feelings as to when it must be abandoned are better indications than any fixed rule. It is dangerous, however, for an elderly gymnast to attempt his youthful feats after a long interval of idleness and disuse. However long he may have lain fallow, he is often unwilling to accept the limitations of his years. This danger was once strikingly illustrated to me on the person of an authority on gymnastics, who, in attempting a simple feat with which he had been familiar, strained the muscles of his neck so badly that he was incapacitated for several weeks.

CLASSIFICATION OF ATHLETIC GAMES AND EXERCISES

Exercise.	Chief regions of the body used.	Demand on nerve control.	Influence on pulse, blood-pressure, and respiration.	Physical characteristics cultivated.	Best age for practice.	Remarks.
Baseball.	Right or left forearm, shoulder, and the whole muscular system to a lesser degree.	Great.	Moderate.	Accuracy, speed, and agility.	12–30.	Amount of exercise depends on the position played; pitcher has his pitching arm constantly overworked.
Bowling.	Right forearm, arm, shoulder, and back.	Great.	Slight.	Accuracy and strength.	14–60.	
Boxing.	All of forearm, arms, shoulders, chest, back, and thighs.	Extreme.	Great.	Alertness, agility, strength, courage.	16–40.	
Cricket.	The whole muscular system moderately: right or left forearm, arm, and shoulders.	Great.	Moderate.	Accuracy, speed, and agility.	12–60.	Depends on position played; exercise obtained by bowler is different from that of the fielder.
Cross-country running.	Thighs and legs.	Slight.	Extreme.	Endurance, speed, and strength.	18–25.	A severe test of the heart.
Dancing.	Thighs and legs.	Extreme.	Great.	Endurance and agility.	14–60.	Clog and soft shoe exercise only the legs, but many acrobatic, postural, and esthetic dances bring in the trunk and arms.
Fencing.	Thighs, back, shoulders, and arms.	Extreme.	Moderate.	Speed, agility, alertness.	18–50.	When fencing is done with alternate arms all tendency to one-sided development is avoided.
Football (soccer).	Thighs and legs.	Moderate.	Great.	Agility, speed, and strength.	12–35.	In this game the ball is not touched by the hands, but is kicked by the feet and butted by the head only.
Football (Rugby).	The whole muscular system.	Extreme.	Great.	Accuracy, endurance, speed, agility, and courage.	16–30.	The most severe field game on the heart and lungs.
Golf.	The whole muscular system moderately.	Extreme.	Slight.	Accuracy.	18–60.	The walking interrupted by the strokes of the game make it peculiarly valuable for those living a sedentary indoor life.
Hammer-throwing.	Shoulders and back, also arms and thighs to a lesser degree.	Extreme.	Slight.	Accuracy and strength.	16–50.	A difficult feat of coordination as now practised, *i. e.*, from a 7-foot circle.
Hand-ball.	The whole muscular system, particularly the back.	Great.	Extreme.	Accuracy, speed, and agility.	16–40.	
Hockey.	The whole muscular system, especially the back and right (or left) forearm.	Extreme.	Extreme.	Speed, agility, accuracy, and endurance.	12–30.	An extreme test on the heart and lungs.

CLASSIFICATION OF ATHLETIC GAMES AND EXERCISES

Exercise.	Chief regions of the body used.	Demand on nerve control.	Influence on pulse, blood-pressure, and respiration.	Physical characteristics cultivated.	Best age for practice.	Remarks.
Hurdling.	The whole muscular system, especially the abdominals, thighs, hamstrings, and calves.	Extreme.	Great.	Speed, agility, and endurance.	16–25.	The high hurdles (3 ft. 6 in.) require great accuracy.
Jumping (high).	Thighs, lower back, and shoulders.	Extreme.	Slight.	Agility and speed.	14–25	Jumping without a run cultivates agility only.
Jumping (broad).	Thighs, calve, back, and shoulders.	Great.	Slight.	Agility and speed.	14–25	
Lacrosse.	All the muscles of the legs and arms.	Great.	Extreme.	Speed, endurance, agility, and accuracy.	12–30.	A running game with frequent intervals for rest.
Mountain-climbing.	Thighs, legs, and back.	Slight.	Extreme.	Endurance.	16–40.	A severe test on the heart and lungs, particularly in high altitudes.
Pole-vaulting.	Forearm, arms, shoulders, abdomen, thighs, and legs.	Extreme.	Slight.	Agility and strength.	14–25.	
Riding (horseback).	Back, abdomen, and thighs.	Slight.	Slight.	Balance.	14–60.	The mechanical shaking has a distinct therapeutic effect.
Polo (pony).	Right or left arm, back, abdomen, and legs.	Extreme.	Great.	Accuracy, balance, strength, and courage.	16–30.	
Running, 100–200 yds.	Whole muscular system, especially the thighs and calves.	Extreme.	Great.	Speed and alertness.	12–30.	A typical exercise of effort.
Running, 440–1000 yds.	The whole muscular system except the arms.	Great.	Extreme.	Speed and endurance.	19–30.	A severe test on the heart and lungs.
Distance running (1 mile and upward).	Thighs and calves.	Moderate.	Extreme.	Endurance.	19–30.	A severe test on the heart and lungs.
Rowing.	Back, forearm, arm, flexors, shoulder muscles, and thighs.	Slight.	Extreme.	Strength and endurance.	16–40.	Thighs are practically unused, except with the sliding seat.
Shooting (hunting).	The whole muscular system, especially the thighs, legs, and back.	Slight.	Moderate.	Endurance.	16–60.	Value depends on tramping over irregular ground and open air.
Shooting (target).	The whole muscular system, very moderately. Arm flexors and all of forearm.	Extreme.	Slight.	Accuracy.	18–60.	
Shot-putting.	Right (or left) forearm, triceps, shoulders, back, and thighs.	Great.	Slight.	Strength, speed, and agility.	16–50.	
Swimming.	The whole muscular system.	Moderate.	Great.	Endurance and strength.	12–60.	Racing and diving are extreme tests on the heart and lungs. Swimming for distance at a moderate speed is a test of endurance and stamina.

Exercise.	Chief regions of the body used.	Demand on nerve control.	Influence on pulse, blood-pressure, and respiration.	Physical characteristics cultivated.	Best age for practice.	Remarks.
Tennis.	The whole muscular system, especially right (or left) forearm and arm.	Great.	Moderate.	Accuracy, speed, agility, and endurance.	14–40.	Tennis-elbow is caused by constant repetition of back-hand stroke, producing strain of pronator radii teres muscle.
Walking.	Thighs, legs, and back.	Slight.	Moderate.	Endurance.	16–60.	Two to four miles an hour is mild exercise. Four to six miles may be exhausting, if kept up very long or if road is rough.
Water polo.	Whole muscular system.	Extreme.	Extreme.	Endurance, strength, agility, and courage.	18–25.	An extreme test of the heart.
Wrestling.	Whole muscular system, especially neck, back, arms, shoulders, and abdomen.	Extreme.	Great.	Strength, endurance, agility, speed, and courage.	16–40.	

From the standpoint of therapeutic effect, or even rapid development, most athletic games are inaccurate and wasteful of time. For these purposes they do not compare with the accurate movements of gymnastics. During a baseball game an outfielder may spend four-eighths of his time standing with his hands on his hips, another three-eighths sitting on the bench, and the remaining one-eighth at the bat, on the bases, or in the practice of throwing the ball. For an expenditure of two hours or more he gets nothing but fresh air and a little exercise for his right arm and shoulder. In one hour of football the time occupied in actual play is about ten minutes, the rest of the time being spent in discussion, disentangling the team after a play, and in preparing for the next play, the exhaustion following a game being largely nervous.

Games and gymnastic exercises especially designed for a specific purpose can be applied to remedy defects or weakness more quickly and surely than sports whose object is recreation alone. No game growing up in a community of children could teach alertness like Doctor Sargent's "curtain-ball," a game in

6

which two courts are separated by a curtain 8 feet high, each side attempting to throw a basket-ball so as to touch the floor of its opponent's court and at the same time defend its own from a similar fate. Gymnastic apparatus was originally made to imitate the tools and appliances of the outdoor world. The horizontal bar was at first the branch of a tree, the climbing pole a mast, and the ropes its rigging. The wooden horse of the gymnasium dates from the days of chivalry, but the agile and complicated movements that give it interest and value would be impossible on its living prototype. Many of the exercises on the horse would indicate that it also represents a log on which to balance and from which to leap.

In the following table the main characteristics of the more familiar pieces of gymnastic apparatus are classified as they were in athletic games:

CLASSIFICATION OF GYMNASTIC APPARATUS, EXERCISES, AND GAMES

Exercises.	Chief regions of the body used.	Demand on nervous control and co-ordination.	Influence on blood-pressure, pulse, and respiration.	Physical qualities cultivated.	Approximate age limit.	Remarks.
Basket-ball.	The whole muscular system, especially legs, thighs, and lower trunk.	Extreme.	Extreme.	Agility, accuracy, and endurance.	16–30.	An extreme test on the heart.
Bom (Swedish).	Flexors of fingers, wrist, and forearm, flexors of arm, all of shoulder, and abdomen.	Moderate.	Slight.	Strength and balance.	16–50.	
Buck.	All of forearm, arm, and shoulders; thighs and legs.	Moderate.	Slight.	Agility, balance, accuracy, and precision.	12–40.	Thighs and legs exercised principally during approach and finish of movement.
Curtain-ball.	The whole muscular system, especially thighs and legs.	Extreme.	Moderate.	Alertness, speed, and agility.	12–40.	
Dodge ball.	The whole muscular system, especially thighs and legs.	Great.	Moderate.	Alertness, speed, and agility.	12–40.	
Flying rings.	Flexors of hand, wrist, forearm, arm, shoulders, and abdominals.	Great.	Moderate.	Strength, rhythm, balance, and courage.	16–30.	
Horizontal bar.	Flexors of fingers, wrist, forearm, arm, pectorals, latissimus dorsi, and abdominal muscles.	Extreme.	Moderate.	Strength, balance, rhythm, and courage.	16–30.	

Exercises.	Chief regions of the body used.	Demand on nervous control and co-ordination.	Influence on blood-pressure, pulse, and respiration.	Physical qualities cultivated.	Approximate age limit.	Remarks.
Horse (long).	All of forearm, arm, shoulders, abdomen, thighs, and legs.	Moderate.	Moderate.	Agility, balance, strength, and courage.	14–30.	These exercises are vaulting and leaping, and so develop thighs and legs more than side horse.
Horse (side).	All of forearm, arm, shoulders, abdomen, thighs, and legs.	Extreme.	Slight.	Balance, accuracy, rhythm, agility, and strength.	12–40.	Thighs and legs developed in the approach and finish, but much less than arms and shoulders.
Ladders.	Flexors of fingers, wrist, forearm, arm, pectorals, and latissimus dorsi.	Slight.	Slight.	Strength.	14–60.	
Medicine ball.	All of forearm, arm, shoulders, back, abdomen, and chest.	Slight.	Slight.	Strength and accuracy.	14–60.	An excellent exercise for developing all muscles above the pelvis.
Parallel bars.	All of forearm, arm, shoulders, pectorals, abdomen, and latissimus dorsi.	Great.	Moderate.	Strength, balance, accuracy, and rhythm.	16–30.	Influence on co-ordination depends greatly on the intricacy of the exercises practised.
Rope-climbing.	Flexors of hand and arm; latissimus dorsi.	Slight.	Slight.	Strength.	12–40.	
Spring-boards.	All of thighs, legs, and lower back.	Great.	Moderate.	Agility and accuracy.	12–30.	
Tag games.	The whole muscular system, especially legs and thighs.	Moderate.	Great.	Speed and agility.	12–18.	
Trapeze.	Flexors of hand, wrist, forearm, and arm; all of shoulders, the abdominals, and latissimus dorsi.	Extreme.	Moderate.	Balance, strength, accuracy, and courage.	12–30.	One set of exercises are for equilibrium only; another are like the typical horizontal bar exercises in their effect.
Tumbling.	The whole muscular system, especially legs, back, and neck.	Extreme.	Great.	Rhythm, agility, strength, balance, accuracy, and courage.	14–30.	One of the best all-round exercises.

Here again it must be borne in mind that, in addition to the circles on the horizontal bar, the swinging exercises on the flying rings, vaults on the horse, and balancing exercises on the parallel bars, the same exercise may be interchangeable from one piece to another.

The choice of exercise will depend then not only on its known effects upon the heart and circulation, but also upon the stage of development of the nervous system.

The "lower level" (Hughlings Jackson), consisting of the spinal cord and lower part of the brain governing the co-ordinations that early become reflex, is developed during the first years of life. The "second level," or sensory motor level, involving the cortex, has its great development from seven to twelve, and all the finer motor and sensory development takes place during these years. The "upper level," which involves judgment, control, association of ideas, is only of later growth.

There is no hygienic reason why a boy of twelve should not play golf or fence, but, as a matter of fact, few boys will choose these games of themselves. They are "upper-level" games, and for the same reason it is the exception to find an eighteen-year-old boy interested in the activities of the sand pile.

For the healthy boy or girl of eighteen or thereabouts the best development would be obtained by a judicious mixture of gymnastic and athletic exercise in the open air. A course should be designed so as to employ all the activities of the muscular system—strength, accuracy, speed, agility, and endurance—as naturally as possible. A period of gymnastic exercise should begin with a ten-minute drill, including movements for both arms and legs, with special emphasis on correct carriage of the body and on deep breathing. This should be followed by exercises in rope-climbing, on the parallel bars, horizontal bar, or flying rings, in which the arms are used. Following this, exercises of agility like vaulting over bars or the German horse, and simple ground tumbling. Each lesson should conclude with running or with a gymnastic running game of sufficient speed to test the endurance. The period should occupy one-half to three-quarters of an hour and should be repeated at least three times a week. If alternated with walks or out-of-door games, as described in a subsequent chapter, the maximum development and general education of the physical powers should be obtained. The mental exhilaration arising from the emulation and competition that is found in a large class is an influence by no means to be neglected, especially in the young, although exercise will have its effect whether this be present or not just as surely as iron or castor oil.

For those of mature age and a sedentary life exercise should be directed principally to the muscles of the arms and trunk, care being taken not to overtax the circulation. Such exercises as throwing the medicine ball, a large ball weighing from 7 to 12 pounds, hand-ball, and other ball games, combined with

Fig. 30.—The use of the medicine ball for class work.

simple apparatus work, are usually effective and interesting. If combined with the leg work and the fresh air obtained in a game like golf, tennis, or a brisk walk in the country once or twice a week, the result would be increased efficiency in business and a general feeling of well being. For those of advancing years the necessity for exercises becomes less urgent, and the individual usually develops some plan to suit his own case.

In a lecture given at the age of eighty-three, Sir Hermann

Weber spoke as follows on his method of using exercise for the prolongation of life:

"I have mostly commenced," he said, "with moderately deep inspirations and expirations, continued during three to five minutes once or twice a day, and have gradually increased the exercises to ten minutes or one-quarter of an hour. The depth of each inspiration and expiration and the duration of holding the breath are likewise to be only gradually increased. At the beginning one-quarter of a minute for every inspiration or expiration ought to be sufficient. If this is well borne, each act may gradually be prolonged in duration so that in the majority of cases each inspiration and each expiration may be brought up to a minute. All the movements are to be made slowly, not rapidly. I usually advise to inspire in an upright position, with raised arms and closed mouth, to bend down the body during the expiration so that the fingers touch the ground or the toes. By degrees one can do several up-and-down movements during every inspiration and bend and raise the body several times during the expiration. By this alternate bending and raising of the body we can gently strengthen the lumbar muscles, and through this successfully combat the tendency to lumbago.

"Another useful combination with the respiratory exercises is the turning of the body around the axis of the spinal column alternately, with deep inspirations from left to right and with expirations from right to left, the arms being half raised. By this movement we bring into action some of the muscles of the spine, which are apt to be only imperfectly used by most persons in advanced years, and the stiffness of the neck and spine and the tendency to stooping so common in old persons can be to some degree corrected by this kind of movement. If commenced in good time and practised regularly and thoroughly, swinging the arms around the shoulder-joint is likewise useful, and other combinations with muscle and joint movements will occur, but they should have accustomed themselves to these respiratory movements. The latter ought always to have our principal attention, since to them the beneficial effect on the heart and lungs is mainly due. In addition to the influence on the circulation, the respiratory movements keep up the nutrition and efficiency of the lungs, which undergo in old age a kind of atrophy. The walls of the smallest divisions and air-cells become thinner, and a kind of senile emphysema is developed which by this exercise is to some degree prevented. Another important influence consists in maintaining the elasticity of the chest walls, which are apt to become stiff in old age and thus to interfere with free movements of the lungs and pleura. If, for some reason, the erect position should be inconvenient, respiratory movements can be made also in the horizontal and sitting positions."

In addition to these exercises, taken regularly every morning, he strongly advises a walk lasting from one-half to three hours, part to be taken in the morning and part later in the day, and once a week he recommends a day of more prolonged exercise and a holiday once or twice a year spent in a walking or climbing tour of three or four weeks.

Occupation should have equal weight with age in choosing exercise.

In the natural occupations of man, like farming, fishing, and lumbering, a great deal of muscular exertion in the open air is required and the need for it is thus naturally provided for. During the last hundred years, however, the proportion of town dwellers in America has risen from 2 to nearly 60 per cent., and the artificial and confining conditions of a crowded city life must be faced. The segregation of masses of people limits the amount of space and air for each, and the necessity of further economizing energy by the use of machinery reduces muscular activity to a minimum. This applies especially to the most "civilized" part of a civilized community, so that there has arisen a whole series of defects and diseases due to this suppression of natural muscular activity or its concentration on a few movements.

School children are taken for five hours a day from their natural occupation of outdoor play and confined more or less strictly to a sitting or standing position, making their bodies fertile soil for the growth and development of postural defects. It is necessary, then, that exercise in the open air for city children of the school age should be obtained by playgrounds situated in the more congested districts.

The construction of roof gardens, recreation piers, and other open-air breathing spaces is also directed by this same need, and the gymnastic exercises for school children described in detail in a subsequent chapter are designed primarily for correcting the physical deterioration inevitably associated with confined school life.

The difference between the physical life of a factory employé who tends a machine and of a man whose active life is spent on the farm or in a lumber camp is at once apparent, but even among business men the effect of underexercise and overeating is familiar to the physician whom he consults for his constipation, biliousness, and headache, while the increase in nervous disorders in both men and women of a highly civilized community shows the disastrous effects of city life on the overstimulated nervous system. Among the influences that help to produce these conditions are the ease of intercommunication by mail, telephone, and telegraph. By these means alone a man may double or treble the amount of business done before their use, but at an added nervous expenditure. The constant harrowing of the emotions by the press, with its daily tale of horror, is a morbid addition to his load.

Those who live the confined indoor life of the office or study, overtaxing the brain and slighting the muscular system, will derive benefit from any exercise sufficiently vigorous to stimulate the circulation and the skin. It is to such men and women that correspondence schools are most ensnaring with their promises of incredible results from the modest expenditure of a few moments daily, while the secrecy with which they are shrouded and the high price demanded for instruction adds not a little to their allurement. The exercises are never complicated or elaborate. They are usually simple, definite, clearly described, and illustrated. Although there is little originality in their design, there is a novelty in the manner of their statement that appeals to the uninformed and partly informed with the force of a new truth. In a circular sent by one, the writer begins by stating that "all movable parts of the body have muscles to move them and also muscles to move them back again," so that by using one muscle or group to resist the action of its antagonist the same development can be reached as by the use of weights.

Fig. 31.—Flexion of arms with resistance of the extensors and contraction of the thigh and leg muscles.

The use of one muscle group to antagonize another is the principle upon which this and other systems are built.

A typical exercise would be the simple flexion and extension of the arm, during which attention is concentrated on the flexors of the arm (Fig. 31). The fist is tightly clenched and the arm is slowly flexed with intense resistance from the lengthening triceps, so that during the movement the entire arm is in a state of tension. To increase the effect, the subject stands with knees everted and slightly bent and the muscles of the thighs in vigorous contraction.

The advantage of such movements is evident to a business man who is not ambitious to excel in games or sports, but who wishes to get his necessary exercise in "tabloid" form, and it is to him that such a proposition makes its appeal. Great numbers can be treated at their homes through written directions sent by mail, and ephemeral institutions are formed in the business sections of cities and filled with patients by a personal canvass from office to office. Twenty minutes daily of this intense work, involving the large muscle groups of the legs, trunk, and shoulders, powerfully stimulate the heart and respiration, draw the blood out to the extremities, and cause profuse perspiration. When followed by a shower-bath and a rub down it produces the same good effect both physically and psychically that would be derived from an equal amount of other exercise. Increased strength of a certain kind is sure to follow such a course, a strength to grip or to lift, and the drudgery of it is not without its good points. These exercises will quickly develop the muscles, and they interest for a time many who would not otherwise take any form of exercise. Their utility to cultivate the qualities most useful for the habitual muscular movements of every-day life and their ability to give all-round development is another matter. In this respect they do not stand the test well. In such a course there are no movements requiring fine or complicated co-ordination, and there are none that aim at the acquirement of skill or dexterity. For a man who wishes to excel in playing a game like golf, tennis, or other games requiring lithe, graceful, and accurate motion, these exercises are not only valueless, but detrimental. They make him muscularly self-conscious and break up that fine adjustment of co-ordination so necessary for quick, strong, unerring movements. They ignore the law of muscular relaxation and economy of energy essential to the precise and graceful accomplishment of any muscular act, and they overlook the importance of the free and far extension of the extremities characteristic of such actions as throwing, thrusting, and striking, so necessary to counteract the constant posture of flexion produced by sedentary occupations. The stress put upon the circulation by this excessive contraction is also great, and may overstrain a heart organically weak or encumbered by deposits of fat.

The design of a short course of exercises without apparatus for the average business man of mature age and sound constitution has been undertaken by Dr. Luther Halsey Gulick in his "Ten Minutes' Exercise for the Busy Man," and by J. P. Müller, of Klampenborg, Denmark, in his "Fifteen Minutes' Work a Day for Health's Sake," where the first eight movements terminate in a bath and are followed by ten exercises in self-massage, and by William J. Cromie, in his "Fifteen Minutes Invested Daily for Health."

The following list has been compiled and found of proved value by the author for those to whom the more interesting and varied but time-consuming exercises and games are prohibited by circumstances. These exercises may be done in the morning on rising, or late in the afternoon, before dinner, and should occupy about fifteen minutes.

They aim to stretch the thorax and expand the lungs, to give the heart some vigorous work, and to agitate and massage the abdominal organs, but one should begin gradually, take long rests, and use few movements at first.

Exercise 1.—Position: Standing. Arms at sides, chin to neck, abdomen in, and chest carried well forward without contracting the shoulders.

Fig. 32.

Movement: Arms forward raise, palms down, upward stretch, rise on tiptoe (Fig. 32), inhale. Sideward lower, palms back, keeping arms straight, slowly exhale and lower heels. *Repeat twenty times.*

Exercise 2.—Position: Standing, arms behind back, hands resting in small of back, fingers interlocked, with palms facing backward (Fig. 33).

Movements: Straighten arms, turning palms in, then down and then out, keeping fingers interlocked. Roll shoulders and arms into supination, extend neck (Fig. 34). Hold this position for a moment and then reverse slowly back to starting position.

Note.—When the fingers cannot be kept in this position, start by holding a loop of cord in the hands instead of interlocking the fingers. *Repeat twenty times.*

Fig. 33.

Fig. 34.

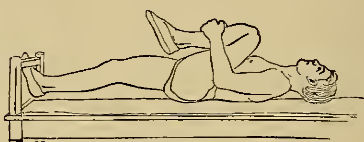


Fig. 35.

Exercise 3.—Position: Lying on back, hands on hips.

Movements: Raise each thigh alternately with bent knee until it touches the abdomen. Clasp hands around leg and press in on abdomen (Fig. 35). Relax. *Repeat twenty times.*

Exercise 4.—Position: Standing, hands behind head.

Movements: Bend sideward to right, then forward, then to left (Fig. 36), and then backward, circling five times each way. Keep feet together and the knees straight. Get far down on each side. *Repeat twenty times.*

Exercise 5.—Position: Standing, hands clasped behind head (Fig. 37).

Movements: Force the head and elbows back strongly, relax, letting the elbows come forward. *Repeat twenty times.*

Exercise 6.—Feet 30 inches apart, arms at sides.

Movements: Raise arms above head, bend forward and touch floor with both hands (Fig. 38). Rise slowly and bring hands to position. *Repeat twenty times.*

Exercise 7.—Position: Arms forward (Fig. 39), then out and then up, stationary run.

Fig. 36.

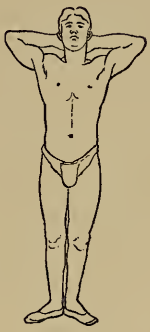


Fig. 37.

Movement: At the rate of fifteen steps in five seconds, take fifty steps for each position of the arms.

Fig. 38.

Fig. 39.—Stationary running.

Fig. 40.

Exercise 8.—Position: Standing, hands clasped across abdomen.

Movement: Inhale, pressing in abdominal wall (Fig. 40). Exhale, relaxing abdomen. *Repeat twenty times.*

Exercise 9.—Position: Sitting on stool or on side of bed, hands clasped behind the back.

Movement: Trunk rolling, forward to right; backward, and then to left (Fig. 41); then up to starting position. *Repeat twenty times.*

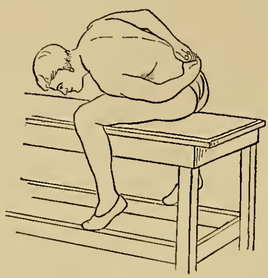


Fig. 41.

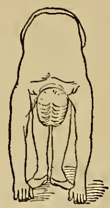


Fig. 42.

Exercise 10.—Position: Standing.

Movement: Arms sideward raise, upward stretch, inhale. Forward bend (Fig. 42), and rise. Arms sideward lower, exhale.

To Finish.—Wring out a Turkish towel in cold water, take it by both ends and rub hard the back, chest, abdomen, and thighs.

CHAPTER VII

THE GERMAN SYSTEM OF PHYSICAL TRAINING

It is to Germany that modern physical education must look for one of the most powerful influences in its development, and the somewhat acrimonious discussions that fill gymnastic literature, between its supporters and the followers of Ling, the Swede, have done much to clarify the principles on which the German system is based.

It is necessary here to review briefly the origin and growth of German gymnastics and their introduction to America.

To Basedow belongs the honor of first combining physical and mental education in the general training of the European youth. In 1774 he founded, at Dessau, the "Philanthropinum," to realize Rousseau's method of nature, "so that the training of the mind and body shall serve to assist each other." He employed the knightly exercises of riding, fencing, vaulting, and dancing in educating the sons of the burghers. He also drew his exercises from popular German sports, rowing, swimming, skating, and games of ball, and copied from the gymnastics of the Greeks, notably the "Pentathlon," which he compiled from running, jumping, climbing, balancing, and carrying heavy weights.

Among his disciples were Salzman and Guts-Muths, Jahn and Spiess in Germany, Pestalozzi and Fellenberg in Switzerland, Nachtegall in Denmark, and Ling in Sweden.

Salzman, one of Basedow's assistants at Dessau, established a school at Schnepfenthal, near Gotha, in 1784, and here Guts-Muths received his inspiration. As he himself writes:

"I entered, when still a youth, the school of Schnepfenthal, and thereupon Salzman, its head, conducted me to a place, saying, 'Here are our gymnastics; within this little space we amuse ourselves daily with five exercises, though they are still in their rudiments.'"

It was here that he wrote his first book, entitled "Gymnastics for the Young" (in 1793), the first German manual of gymnastics. He afterward wrote a book on plays and games, which is still a classic, as well as a third on manual training.

Many private and a few public teachers began to introduce gymnastics into their schools, and in 1799 Nachtegall established a private gymnastic institute in Copenhagen, at which Ling had his first lessons in gymnastics.

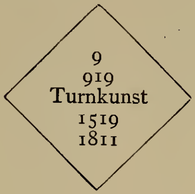
Guts-Muths had two distinct aims, which may be stated in his own words as—"(1) Work in the garb of youthful play, and (2) a system of exercise having bodily perfection as their aim." The first of these principles appealed particularly to Jahn, while Ling worked more in the spirit of the second.

Friedrich Ludwig Jahn was born in 1778, in the village of Lanz. He was a man of aggressive, restless, and self-sufficient disposition, quick-witted, but capricious in his reading. His career as a student was wild and irregular, and, owing to quarrels with the members of the student societies at Halle, he became a wanderer from university to university. From Halle he went to Jena, where he was forced to leave the university and become a private tutor, directing his pupils' studies and partaking in their sports. His first publication, on the promotion of patriotism, appeared in 1800, and showed his tendency to engage in popular agitation. For the next ten years he roved about, working at his book on German nationality. In this book he extolled the value of bodily exercise, and seized upon the idea of making physical training a dominant force in national regeneration.[1]

In the spring of 1811 he opened his first "Turnplatz" in a pine forest on the outskirts of Berlin. Friesen, whose untimely death by assassination he deeply lamented, and others of his admirers and pupils, aided in its management. From the first,

[1] Fred. E. Leonard, P. E. Rev., vol. x, No. 1.

vigorous and war-like games were assigned a leading rôle and special costumes were adopted. Their badge bore the word "Turnkunst," and the figures "9–919–1519–1811."



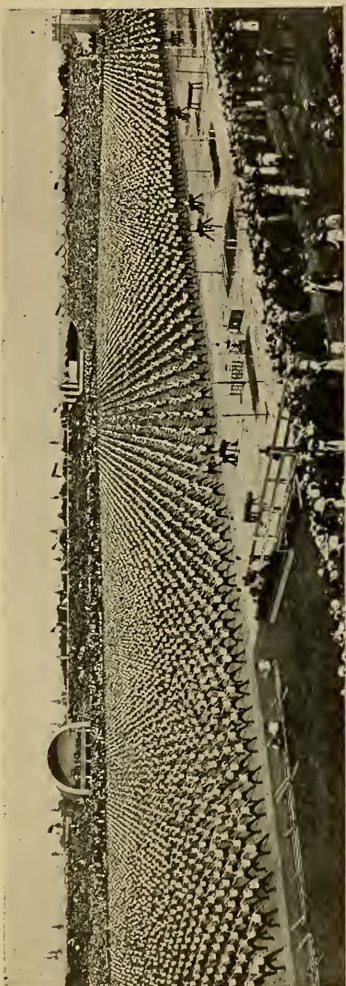
These figures served as reminders of Hermann's rout of the Roman legions, under Varus, 9 A. D., the introduction of tournaments into Germany, 919 A. D., the last of the German tournaments, 1519 A. D., and the revival of "Turnen," or turning, in 1811.

In a year the number of turners rose to 500. Jahn and Friesen organized a German union, hostile to all foreign rulers, and extended it to the students of various German universities. In the war of liberation members of this union were the first men enrolled in the famous free corps of cavalry, where Jahn commanded a company recruited by himself.

In the five years preceding 1816 he labored incessantly, writing and publishing his book, "Die deutsche Turnkunst," which sums up his aims and accomplishment. In speaking of the beginning of his work he says: "Love to my fatherland and my own inclinations made me a teacher of youth. During the beautiful spring of 1810 a few of my pupils began to go out with me into the woods and fields on the holiday afternoon of Wednesday and Saturday. The number increased at the various sports and exercises. Thus we went on until the dog-days, when the number was very large, but soon fell off again. But there was left a select number and nucleus who held together even during the winter, with whom the first turning ground was opened in the spring of 1811 in the Hasenheide."

In this work he pays willing tribute to Guts-Muths, the main source of his inspiration.

In 1819 plans were perfected for establishing turning grounds



The Congress of the Sokols in Prague: A nation determined to be fit—twelve thousand men at drill.

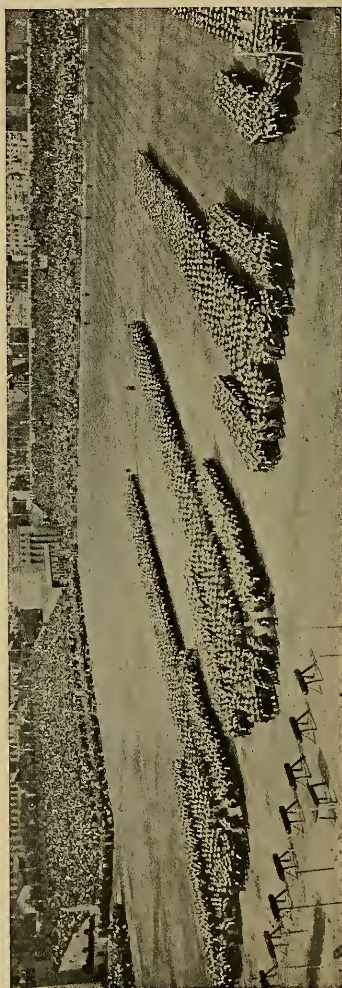


Fig. 43.—Women are anxious to be fit—six thousand women members of the Sokol Society marching for class formation in calesthenics. (Reproduced from "Slet.")

throughout Prussia in connection with the schools, but because of a murder committed by one of the turners, to which political significance was attached, the student societies and Turnvereins were put under the ban as being hot-beds of liberalism. Jahn was arrested, as well as Francis Lieber, a youth of nineteen, one of his oldest and most favorite pupils. Lieber was exiled, and chose the United States for his new home in 1827. He came with a recommendation from Jahn for the express purpose of taking charge of a gymnasium in Boston, where he also established a swimming-school.

Jahn's case dragged on for nearly six years, but he was acquitted in 1825, although with certain restrictions. In 1840 he was finally released and awarded the iron cross in recognition of his service during the war of liberation. Though he issued many pamphlets showing his continued interest in turning, his declining years were passed in poverty and obscurity. His last publication appeared in 1848, entitled "Schwanenrede" (swan song), closing with these words:

"Germany's unity was the dream of my awakening life, the morning glow of my youth, the sunshine of my manhood, and is now the evening star which guides me to eternal rest."

The formation of gymnastic societies, however, continued to grow, and Turnfests were celebrated, until in 1861 nearly 6000 turners took part in them. The movement also spread to Spain and France under Colonel Amaros in 1826, to Switzerland, from which, indeed, it had originated, and to England under Captain Clias, and to Russia and, to a lesser extent, to Italy, who have founded their gymnastic systems on German ideals.

The German System has appealed very strongly to the Slav race, and every five years, up to the war of 1914, as many as 10,000 gymnasts have taken part in the great Sokol gymnastic display at Prague, dressed in their white and blue, while at the last fête, 6000 women gymnasts were on the field at one time. This Sokol festival had grave political significance, however. It was the Pan-Slavic cry for freedom from threatened German domination over Bohemia, a cause championed by the hero of every Sokol, François Palacky, the historian.

At present it is as common to find a Turnverein among

German colonists and peoples of German extraction as cricket and athletic sports among Englishmen living abroad.

The Turnfests at Frankfort and Leipsig had 30,000 turners in line, drawn from every land to which there has been German immigration. The exercises, which continued for six days, opened by a mass drill of about 20,000 men. Although all the societies, drawn from distant lands, had never performed together before, the exhibitions were faultless. On succeeding days group com-

Fig. 44.—A mass drill of school-children at the Turnfest, Frankfort, 1908.

petitions and drills were given by children (Fig. 44) and by picked squads representing their societies, with individual and group competitions on the horse, horizontal and parallel bars, running, and vaulting. Prizes in the form of wreaths and diplomas were given to the successful societies and competitors.

The turners place great emphasis on mass work, and the social side has not been neglected. For a time they ceased to be political clubs, holding themselves entirely aloof from the consideration of party questions, but the national importance of the societies has never been absent from their minds.

They are divided into two main sections: boys from seven to sixteen years and men. Classes are subdivided in squads, each squad being led by a "foreturner," whose business it is to make the members of his squad as expert as possible, and, above all, to secure to each an erect form and aggressive carriage of the body.

The introduction of the German gymnastics into the school system was the work of Adolph Spiess, a Hessian, born in 1810. He was influenced by Pestalozzi and trained in the methods of Guts-Muths. In 1829 he became acquainted with Jahn, and in the following year, while still a student, formed a class of boys at Giessen, and made a beginning by teaching what is known as common exercises, the simultaneous performance of movements in response to the word of command, either with or without the aid of apparatus. He is sometimes called the creator of gymnastics for girls. These gymnastics he introduced into the public schools of Burgdorf, in Switzerland, where he became acquainted with Froebel. They include free gymnastics, dumb-bell drills, exercises on the suspended ladder, and see-saw, besides running, jumping, and swinging.

In 1848 he returned to Germany, and at Darmstadt carried on special normal classes to train assistants for his work, until his death in 1858. He was highly successful in teaching gymnastics to the girls of his schools.

He applied his principle of common or class exercises to the apparatus work, as well as to the free movements, and made use of music for all suitable rhythmic combinations. His distinctive work was to systematize German gymnastics and to adapt them to pedagogic purposes and methods.

The problem of training teachers was early recognized, and the Royal Central Gymnastic Institute was finally opened in Berlin, under the joint control of the ministers of war and education, after two unsuccessful attempts. Captain H. Rothstein, of the Prussian army, was placed at its head. Rothstein was a warm partisan of the Swedish system of gymnastics as developed by Ling and his followers, in distinction to the Jahn-Eiselen system, and early antagonized the turners by banishing the horizontal bar and parallel bars from the institute. This act gave rise to a long and bitter controversy in which gymnasts, medical men, and university professors took an active part, notably Professor Virchow and Du Bois-Réymond, who savagely defended the German system and the bars, declaring that if the parallel bars had not already been invented they would be a

Fig. 45.—The Russian gymnasts in a memorized drill founded on German principles (Olympic Games, Stockholm, 1912).

necessity. In 1862 a commission of the most eminent medical men declared that the bar exercises, from a medical point of view, should not be excluded. As a result of this Rothstein left the Central Institute, and died in 1865.

Gymnastic instruction in the elementary schools was made obligatory in 1862 in many of the cities of Germany, and is taught by teachers specially educated for this duty, there being now more than 1500 trained teachers in Berlin alone.

The exercises are carefully adapted to the age and sex of the pupils. The youngest pupils—from six to ten—engage in a great variety of simple games, easy, free movements, marching, jumping, and climbing exercises, and the fundamental exercises on the gymnastic machines. These exercises grow more complicated and difficult for advancing age, and the expertness of the boys in the upper classes is often astonishing, fencing being taught in the upper schools. Singing is almost always combined with gymnastic instruction.

Outdoor games have been accorded a place in the German system from the first, but interest in them has increased to an extraordinary degree from the year 1891, when the Central Committee for the Promotion of Youthful and Popular Sports in Germany was organized under the presidency of Baron E. von Schenkendorff. Facilities for school games have been provided, and provision has also been made for their management and maintenance. The movement resulting in the American Playground Association may be traced to the labors of this committee and its distinguished president.

Fig. 46.—Typical pose in German wand drill.

The invitation to hold the Olympic Games in Berlin in 1916, and the engagement of an American coach, Doctor Alvin Kraenzlein, to instruct the Sports Clubs in track and field athletics, marked a new emphasis on athletic competition which, although present, has always been kept in the background among the turners, and the introduction from England of cricket, football, and rowing has still further distracted attention from the more purely gymnastic side of exercise which had up to this time, almost entirely absorbed the Teutonic mind and body.

It must always be remembered that the voluntary athletic activities of American and English young men are in Germany replaced to a great extent by the arduous and practical military training that occupies the best hours of the best years of their lives, and has been responsible for the marvelous efficiency of their army as shown in the war of 1914.

Fig. 47.—Typical swing and balance exercise on the parallel bars.

The introduction of German gymnastics in America began with the arrival of Dr. Follen, a German exile, at Harvard, in 1826. The Boston Gymnasium in Washington Gardens seems to have been the first public gymnasium of any note in the United States.

In 1827 Dr. Francis Lieber, already referred to, succeeded Follen. Gymnastic grounds were established at Yale, Williams, Amherst, and Brown about the same time, while a dozen or more schools followed suit. This movement, however, was short-lived, and closed about 1830, when both Dr. Follen and Lieber left the field and followed other pursuits.

The subsequent history of German gymnastics in America is that of the growth of German immigration and the establishment of the Turngemeinden in large American cities, such as St. Louis, Milwaukee, Philadelphia, and Cincinnati. The Normal College of the North American Gymnastic Union, established in 1861, and now conducted at Indianapolis, is graduating educated teachers trained in this system by courses

Fig. 48.—Typical circling exercise on horizontal bar.

extending from one to four years, and the official organ of the movement, a monthly, called "Mind and Body," carries on an active campaign to introduce physical training into the school system and disseminate knowledge on the subject.

William A. Stecher, its editor and director of physical education in the schools of Philadelphia, divides the German system into six large groups or classes:

1. Tactics, embracing marching in all its forms.

2. Free exercises, embracing all forms with hand apparatus, like short and long wands, dumb-bells, rings, and clubs.

3. Dancing steps, principally for girls, including all the move-

ments from the simple gallop to the most complicated forms executed by expert dancers.

4. Apparatus work on the horizontal bar, parallel bars, long and side horse, buck, suspended rings, ladder, poles, rope, round swing, see-saw, balance board, swinging board, pulley-weights, storming board, and vaulting table.

5. Track and field work, such as high, broad, and deep jumping, hop, step, and jump, running, hopping, putting the shot or stone, throwing the javelin or discus, lifting and putting up of iron weights and stones, pole-vaulting, swimming, skating, fencing, boxing, wrestling, and shooting.

Fig. 49.—Typical vaulting exercise on German horse.

6. Games and plays, the enumeration of which would take too long. The first collection of games was published by Guts-Muths in 1793.

The exercises for children are divided into six or eight grades, to correspond with the number of years in the common or grammar schools.

Inclusive as it is of almost all forms of indoor and outdoor activity, the characteristic apparatus that will always be associated with German gymnastics, because invented and most largely used by them, are the *parallel bars*, where the typical exercises are those in which the weight is supported by the arms in vaulting and balancing. The *horizontal bar*, the glorified limb of a tree, in which the weight is also supported by the arms in circles and levers; and the *vaulting horse*, borrowed from the days of chivalry, on which circles, vaults, and pirouettes are practised and carried to a high point of development, the weight being again supported by the arms.

Exercises on these machines emphasizes the development of the muscles of the shoulder-girdle by the almost constant use of the arms in supporting the body weight, and in this, together with the large use of music to govern the rate and rhythm of the free exercises done in classes, lies the main difference between the gymnastics that are known as "German" and those derived from other sources. Singing and turning are inseparable, especially with the children, and the system has become more cosmopolitan of late years to fit the local conditions and national temperament in America. They now may be said to include everything except the medical application of exercise and massage, which has been left entirely in the hands of the Swedes.

For full bibliography, see Bibliographie des gesamten Sports, 1911, Weissbein und Roth; mit einem Vorwort von. Geh. Reg-Rat., Prof. Dr. Zuntz, Veit & Company, Leipzig, 1911.

CHAPTER VIII

THE SWEDISH SYSTEM OF GYMNASTICS

The Swedish system of gymnastics had its first impulse from patriotism, as was the case with the German, but in the hands of its scholarly founder it became much more finished as a gymnastic system, and comprises recreative and school gymnastics, military gymnastics, and, most distinctive of all, medical gymnastics, or the application of movement to the treatment of disease.

Peter Henry Ling, its founder, was born in 1776, two years before the birth of Jahn, in Smaland, one of the southern provinces of Sweden.[1] A dreamy, imaginative boy, he entered the Latin school at Wexiö, where he distinguished himself in his classical course by his mental ability, strong individuality, unyielding will, and reckless enterprise. He was suspended or expelled from this school, along with some companions, on account of a breach of discipline. Leaving Wexiö on foot, he seems to have wandered for some years in Sweden, Denmark, Germany, France, and even England, acquiring the languages of the countries in which he sojourned, and we find him, in 1801, enrolled as a volunteer in the naval defense of Copenhagen against the English. Here he remained for ten years, becoming a skilled fencer under the instruction of Montrichard, a French refugee, from whom he obtained a diploma endorsing his ability to give instruction in the art. While there he visited and attended the gymnasium of Nachtegall, and recognized the national importance of the new art, striving to classify and develop its practice according to anatomic laws and to give it the precision of mathematics.

In the fall of 1804 he returned to Sweden, to act as a substitute for the aged fencing master of the University of Lund,

[1] Fred. E. Leonard, P. E. Review, Dec., 1904.

whom he soon succeeded. He also taught gymnastics and riding, and applied himself diligently to the study of anatomy and physiology, putting his conclusions into practice in the system of fencing taught to his pupils. The new exercise became popular, and it was not long before interest in it and in his gymnastics spread beyond Lund. Invitations to introduce the *double art* were received from Gothenburg, Malmö, and Christianstad, where he gave instruction during the summer vacations in the arts of swimming, fencing, the saber, and gymnastics.

The eight years of his stay in Lund were also fertile in literary activity, for it was then that he first began to know and love the Scandinavian mythology, and to compose patriotic poems in French, German, Danish, and Swedish. One of his poems, "Gyfle," deals with the loss of Finland, which the Swedes bitterly deplored. These plays and poems show the intensity of his patriotism and his desire to see his countrymen strong in body and soul, with power to meet her enemies. Fervid patriotism was the inspiring motive of his poems and his gymnastics alike, though in the latter he saw a practical means of restoring the health as well as of developing the physique of the race to defend the fatherland. During these eight years he thought out the principles upon which his later work was based, seeking first to understand the human body and discover its needs, and then to select and apply his exercises intelligently with these needs in view.

He conceived the idea of opening in Stockholm a central institute based on the one already in operation in Denmark for the training of teachers of gymnastics for the army and school. He took as his pattern the institute of Nachtegall, in Copenhagen. His plan was successfully carried out, and the school was opened in 1814 on the site occupied ever since. Here he equipped the necessary rooms, gymnasium, fencing hall, and offices, in some old buildings which had once belonged to a cannon factory. By increased grants from the Government he was soon furnished with an assistant, and two others were added from time to time, until, in 1830, he had three.

Ling believed that gymnastics had a rightful place in education, medicine, and national defense, and almost from the start instruction was given in these three branches. In spite of a good deal of jealousy and opposition he continued to teach fencing and gymnastics to the Swedish army, under the sympathetic encouragement of Bernadotte, who afterward reigned as Charles XIV. When it was shown that the French and Prussian soldiers were being drilled in bayonet fencing, his method of teaching this exercise was investigated and chosen in preference to all others, and it became an established part of their regular training.

In 1836 he published a manual of bayonet fencing for use in the army, and another of gymnastics, in which he found it necessary to limit the exercises to simple forms that required little or no apparatus.

He commenced the development of medical gymnastics after the first year of the Institute in Stockholm, against bitter opposition on the part of conservative physicians.

His school gymnastics comprised only a few stretching movements, sometimes assisted or resisted by another pupil, but with little apparatus, the Swedish educational gymnastics in its present form being a comparatively recent growth.

During all this time his literary activity was intense, and always in the realms of mythology and the ancient legendary history of the Scandinavian race. His literary labors were rewarded by membership in the Swedish Academy, where he also received the grand prize. The title of professor was conferred upon him, and he was decorated with the Order of the North Star. His collected writings fill three large volumes, of which only about 350 pages have to do with gymnastics.

From his first marriage he had one surviving daughter, Jetta, and by his second wife, three of his seven children became teachers of gymnastics—Hjalmar, Hildur, and Wendla, the first two at the Central Institute. In 1839, after some years of impaired health, he died and was succeeded at the Central Institute by Branting and Georgii, who, in company with Dr. Liedbeck, one of his pupils, and husband of his daughter Jetta, arranged his literary remains for publication. The year after his death they published his principles of gymnastics in the incomplete and often fragmentary form in which he left them, a treatise begun as far back as 1831.[1] This book, after an opening section devoted to the laws of the human organism, takes up in order the principles of educational, military, medical, and esthetic gymnastics, and closes with a few pages of miscellaneous suggestions and comment.

Ling's system was constructed in the light of the physiology of his day, which often sounds fantastic in the presence of modern discoveries. His physiology with regard to the nature of life, the laws of organic unity, and the relation of parts seems quaint to modern thinkers, and is not easily translated into the scientific terms of to-day. His work relating to gymnastics is, however, of a thoroughly practical nature, and he must have been a most inspiring teacher. He never completely expressed his scheme of esthetic gymnastics, and the school gymnastics were the life-work of his son Hjalmar.

Immediately after his death Branting was appointed director, a position he retained for twenty-three years. A student of the largest medical college in Sweden, a fluent linguist, and a wide traveler, he devoted himself with marked enthusiasm to medical gymnastics in accordance with the theories of his predecessor, and brought that department to a high degree of perfection. He insisted that the beneficial effects of exercises were due not alone to changes produced in the muscular system, but mainly to the influence exerted upon the nerves and blood-vessels—a novel view at that time. He also worked out a terminology which, with a few changes, is still employed in Sweden. At this period the work of the institute began to awaken the attention of other countries. Two Prussian army officers, Lieutenant Rothstein and Techow, were sent from Germany to Stockholm to take the regular course of instruction, and Rothstein afterward wrote extensively on the Ling system. His connection with the Berlin Central Institute has already been alluded to in the previous

[1] Gymnastikens Allmäund Grunder (1840). Translated by Richard F. Cyriax. P. E. Review, Dec., 1912; Jan., 1913; May, 1914.

chapter. He endeavored to model it on the pattern of the Swedish school, but without its department of medical gymnastics.

Many other foreigners came for visits of varying duration—physicians especially were attracted, among them Dr. Matthias Roth, of London, the father of Bernard Roth, F. R. C. S., whose work on scoliosis is referred to elsewhere.

Among the teachers at the Central Institute were Karl August Georgii (1808–81), a lieutenant in the army, who became head teacher in 1839, giving instruction in anatomy and the three branches of practical gymnastics. He published a treatise on the Ling method of *kinesitherapy* and physical education. Three years later he removed to London, where for twenty-eight years he had a private institute, teaching fencing and school gymnastics in addition to his medical work. Here he published, among other things, a biographic sketch of Ling, the "new movement cure," and a book on rational gymnastics. Branting's successor was Colonel Gustave Nyblaeus (1816–1902), under whose directorship the course was increased from one year to two years, and practical gymnastics finally reorganized, with its three sections, educational, medical, and military, each having a head teacher and a second teacher.

John Hartelius (1818–96), a graduate of the institute, who afterward completed a course in medicine, took charge of the medical gymnastics in 1864. During his term he wrote, besides small manuals on anatomy, physiology, histology, and hygiene, a larger work on medical gymnastics, which was translated widely. He also founded and edited the "Tidskrift i Gymnastik," a magazine devoted to gymnastics, contributing many articles on his own and related subjects.

To Hjalmar Frederick Ling (1820–86) Swedish educational gymnastics is largely indebted for its present form, and the school gymnasium for the nature and arrangements of the equipment now in use. At first a pupil of his father, he afterward attended Claude Bernard's lectures on experimental physiology at the Hôtel Dieu, in Paris, and lived for a year in Berlin, whither he went to introduce the Swedish method of medical gymnastics.

After his return to Stockholm, in 1864, he was assigned the section of school gymnastics. His task was to devise new forms of apparatus adapted to the need of the school, and to so arrange them that large numbers could exercise at the same time. He largely increased the number of useful exercises, and brought them within the reach of every pupil. He is the originator of the grouping of exercises known as the "day's order," which is so characteristic of the Swedish system. Familiar with the whole range of gymnastic literature, he was an industrious compiler, and left behind a carefully arranged collection of nearly 2000 pen drawings of positions and movements used in gymnastics, all made by his own hand. He died in 1886.

Hjalmar Ling's successor was Lars Mauritz Törngren (1887). A third year was now added to the course. His writings included a manual of gymnastics for the navy and a book on school gymnastics. The second teacher in the section on school gymnastics, Major Karl Silow, has been very active and successful in the work of his department, and has made further improvements in the construction and arrangement of apparatus. Hartelius was succeeded in 1887 by Robert Murray, also a regularly trained physician, in the section of medical gymnastics, and Colonel Viktor Gustaf Balck about the same time assumed control of the section on military gymnastics. The latter has been an ardent advocate of outdoor and other sports for the young, and has been active in organizing societies for their cultivation, editing a series of a dozen illustrated volumes devoted to a description of their various forms. He founded, in 1881, the "Sporting Times," and has been the most enthusiastic promoter of those popular gymnastic societies that have spread the fame of Swedish gymnastics to other countries, accompanying squads of his fellow-countrymen to exhibitions in Brussels, Paris, London, Copenhagen, and Berlin. He was president of the Swedish Committee of the Olympic Games in 1912.

The Swedish gymnastics were introduced into the United States by the late Baron Nils Posse, and Boston has been the center from which their influence has spread. A most active propaganda was started by Baron Posse, who lectured and wrote widely on the subject, and as a result the Boston Normal School of Gymnastics was founded in 1889 by Mrs. Mary Hemenway, to provide the means whereby those masters and submasters who desired it might make a thorough study of the Ling system for the benefit of the schools. This resulted in the introduction of the Swedish system of gymnastics in the Boston public schools in 1890, under the direction of Hartwig Nissen. After two years' service, Baron Posse resigned and

Fig. 50.—Free movement by the Danish girls team, Stockholm, 1912.

was succeeded by Claes Enebuske, he himself founding a normal school, the Posse Gymnasium, which is still carried on by the Baroness in Boston, giving a two-year course in both theory and practice, and including a wide range of subjects in its curriculum. The Boston Normal School has now become a department of Wellesley College for women, with Amy Morris Homans as first dean.

Although Swedish gymnastics have been considerably modified by Ling's successors, and particularly by his son, the development has closely followed the lines marked out by its originator.

He classified movements into groups, as they were directed to the muscles of the trunk, head, arm, or leg, making use of a table which was the forerunner of the present "day's order." His first table consists of three order movements, afterward increased to five; then follows, sixth, a leg movement; seventh, an arm movement; eighth and ninth, leg movements; tenth and eleventh, arm movements—all of a respiratory nature. His tables also show a forecast of the progression which is the other characteristic of the Swedish system.

Fig. 51.—The Royal Guard of Sweden at work in the gymnasium (Lefebure).

His long experience in training military cadets strongly influenced the character of his theories. E. M. Hartwell justly observes that Swedish gymnastics still bear witness to their semimilitary origin. Ling's peculiar aims are more completely reflected and his methods more fully embodied in the physical training of recruits and soldiers than in any other department of Swedish gymnastics. The military element in Sweden has in turn served to add dignity to physical training as a profession, and to raise the intellectual and social standing of gymnastic instructors.

The three distinguishing points of the Swedish system of educational gymnastics are:

1. The day's order.

2. Gymnastic progression.

3. The use of the word of command for movements instead of imitation.

The exercises of the day's order are always arranged under the following ten classes, each of which can be made more difficult or complicated, as is deemed advisable by the progress of the pupil. The order is:

Fig. 52.—Introductory exercise position, neck firm.

Fig. 53.—Span bending at the stall bars.

1. Introductory exercises, class formations, facings, and marching steps (Fig. 52).

2. Span bendings, consisting of backward flexions of the trunk, executed by the arching of the spine, done either with or without apparatus (Fig. 53).

3. Heaving movements, designed to cultivate elasticity of the chest and increase respiratory power. Usually exercises of hanging and climbing (Fig. 54).

4. Balance movements, or exercises of equilibrium, requiring high co-ordination, rather than force, and especially directed to improve the posture of the body (Figs. 55, 56).

Fig. 54.—Heaving movement on ropes.

5. Shoulder-blade movements, exercises for the arms, usually done in some position producing isolation of the chest and head, the object being to raise and widen the chest (Fig. 57).

6. Abdominal exercises, bringing into play the muscles of the abdomen, and by that means acting upon the digestive organs and improving the natural support of the viscera (Fig. 58).

7. Lateral trunk movements, consisting of rotation, sidewise flexion of the trunk, and exercises derived from these types (Fig. 59).

Fig. 55.—Balancing exercise.

Fig. 56.—A typical balance exercise for equilibrium (Swedish ladies' team, Stockholm, 1912).

Fig. 57.—Shoulder-blade movement.

Fig. 58.—Abdominal exercise on stall bars.

8. Leg movements, for the purpose of relieving the engorged veins of the fatigued legs (Fig. 60).

9. Leaping and vaulting over a string or Swedish horse (Fig. 61).

10. Respiratory exercises, accompanied by movements to assist respiratory activity. They are designed to restore normal

Fig. 59.—Lateral trunk movement.

respiration after the more active work that has gone before (Figs. 62, 63).

This order may be slightly varied by introducing, after the balancing exercises, marching and running, or by introducing a series of heaving movements after the lateral trunk movements, thus increasing the groups in a day's order to twelve. The Stockholm Gymnastic Society introduces marching, running, and gymnastic games into the day's order, and by repeating the

Fig. 60.—Leg movements.

Fig. 61.—Leaping exercise.

shoulder-blade and abdominal movements brought the divisions of the day's order up to fifteen.

Fig. 62.—Respiratory exercise No. 1.

Fig. 63.—Respiratory exercise No 2.

The order of exercises is the basis of the Swedish method, and may be depicted graphically by the following diagram, representing a forty-minute lesson period, the height of the curve showing the intensity of the effect on the circulation and respiration. The height of the line for the abdominal exercises is probably insufficient in this diagram (Fig. 64).

The apparatus used differs in certain important respects from that of the Germans. The parallel bars, horizontal bar, and spring-board are eschewed, while the horse is modified in form; instead of these are introduced stall bars, boom, climbing ladders, and poles, while much use is made of the inclined rope and the

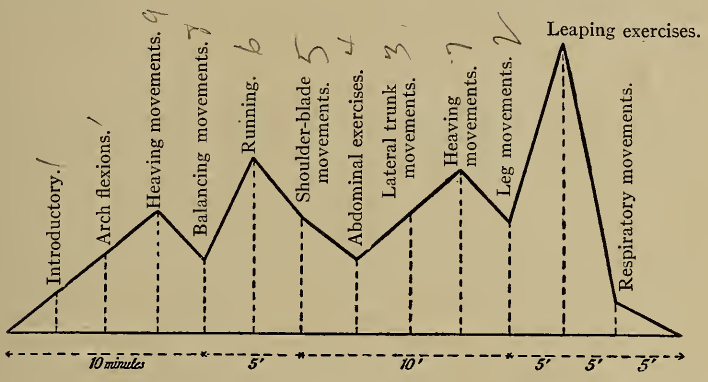


Fig. 64.—Diagram of the day's order, showing the time devoted to each division and the amount of effort required for each (Lefebure).

balancing board. The exercise table or plinth, used in medical gymnastics, is either flat or adjustable to different angles.

The Swedish system considers of first importance the regions affected by the exercises; the Germans consider the attributes the exercise cultivates.

The movements are classified according to the effect they have on the body, and not as in the German system, according to apparatus. The Swedes use various forms of apparatus to secure a physiologic result. The Germans see what variety of exercises can be done on each piece of apparatus.

Ling intended that his system of gymnastics should form a complete method of physical education designed to develop all the bodily powers, but he did not live to complete his intentions. In the fragmentary state in which his plans were left, and in which they have remained in the hands of his followers, Swedish gymnastics as a complete system are open to the criticism that insufficient emphasis is laid upon endurance, and excessive emphasis laid on the constant voluntary attention of the pupil. Their accuracy makes them peculiarly efficient in correcting the tendency of school children to assume abnormal and hurtful

Fig. 65.—Drill of the Swedish team, Stockholm, 1912—a typical exercise.

postures, and the stress laid upon the proper carriage and movements of the trunk undoubtedly serve as an antidote to the evil effects of the school desk.

It may be justly said in criticism, however, that the stress laid upon an overcorrected carriage of the body gives the "pouter-pigeon" posture, with hollow back and protruded chest, which is unnatural, stiff, and leads to strain in the lower back. The free movements are static rather than dynamic, consisting of a series of long-sustained exhausting poses.[1]

Little account is paid to the importance of rhythm in the

[1] Culture Physique, Francis Heckel, Masson, Paris, 1913.

movements which are angular and do not follow the long and sweeping curves of natural actions. Few of the movements used occur in an isolated form in real life. In consequence of this they are less interesting than movements based on fundamental activities and done in a natural way. The keynote of the system is precision, sometimes obtained at the cost of grace. The interest in a mass drill is more in the extraordinary uniformity

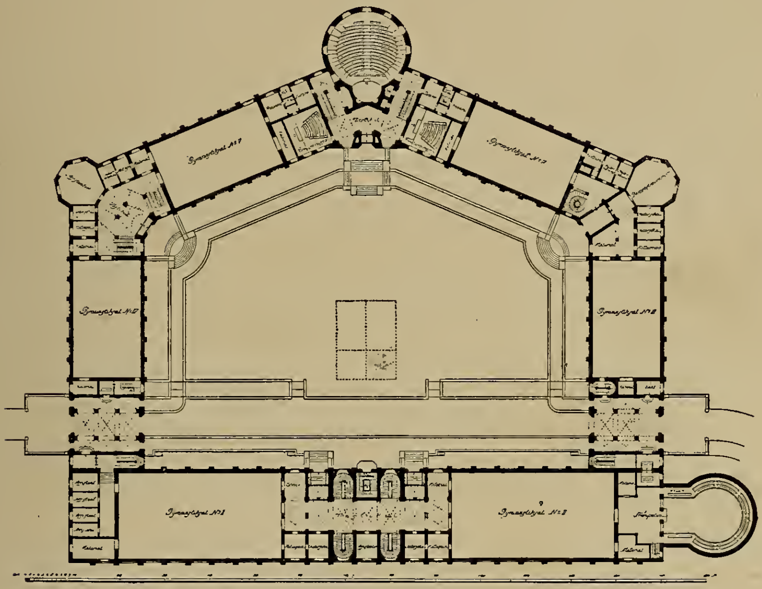


Fig. 66.—The plan of the new gymnastic high-school, Stockholm, showing six gymnasium halls, lecture rooms, amphitheatre, and swimming-pool. On the floors above and below are other lecture rooms, laboratories, and library, with dressing-rooms and offices. Facing it is the stadium and dressing-rooms for outdoor sports.

acquired than in the exercises themselves (see Figs. 65 and 57), for they demand and exact a discipline of the most rigid kind, which gives them a military or soldier-like value and which must not be forgotten.

Swedish gymnastics are educational because they are progressive, definitely arranged according to a fixed law, and require a prompt response to the word of *command*. To be called a complete system they must be considerably modified from their present form, and include the free outdoor sports and games on which so much emphasis has been laid by Colonel Balck who, recognizing this lack, has done much to correct it.

The new gymnastic high-school, which is to replace the old building at 19 Hamgatan, Stockholm, will complete the architectural group begun by the stadium in which the fifth modern Olympic games were held. It will be the most perfect and comprehensive institution in the world for the teaching of physical education. Ample provision is made for practice and instruction in track and field athletics, sports, and games, as well as gymnastics, and the theoretic side will be amply provided for.

In many cases the gymnastic lesson of the Swedish school is now replaced by an hour of skating, long walks, or gymnastic games and dancing; and in the training-schools for teachers the introduction of dancing steps and other movements to music, which may be termed esthetic, is not regarded with the horror that it would have excited a few years ago. It may be looked upon as the modern development of esthetic gymnastics which Ling had in mind, but never worked out.

The military gymnastics need not be dwelt upon here, as they consist largely of fencing with the bayonet, foil, and saber, riding, and other military exercises which are not exclusively Swedish in character, but the medical gymnastics, which are so widespread in their application, deserve a more careful consideration.

Classification and practice of the movements of massage described in another chapter have been largely the work of Swedish practitioners, and all the duplicate movements were described and named by Ling with extreme exactness, so that the prescription of exercise may be written with clearness and accuracy.

Plans for the new gymnastic high-school do not provide for the clinical teaching of medical gymnastics as heretofore. This will in future be carried on in the hospitals instead of in the institute as at present.[1]

[1] For complete bibliography, see E. F. Cyriax, P. E. Rev., vol. xvii, 447–454; and Bibliographia Gymnastica Medica Wörishofer, 1909.

CHAPTER IX

THE WAR OF THE SYSTEMS IN FRANCE

THE SEARCH FOR HARMONY AND RHYTHM

France has been the battleground of ideas on physical education for the last one hundred years. Both German and Swedish gymnastics have had their day. The revival of athletic sports has been a notable event in her history, but it was only in the ten years preceding the war of 1914 that anything like a national system in harmony with Latin ideals and temperament was taking definite form.

The pioneer of physical training in France was Don Francisco Amaros (1770–1848), a Spaniard by birth and a cadet in the Spanish Army. In 1806 the king established at Madrid a Pestalozzian institute, with Amaros at its head. The Napoleonic wars broke up this institute, and in 1814 Amaros, who sided with the French, fled to Paris. He became a naturalized Frenchman, opened a gymnasium in Paris (1818) close to the military school. The success was instantaneous, and a great open-air gymnasium furnished with apparatus like that of Jahn was constructed for military purposes in 1820 with Amaros in charge.[1] The gymnasium continued for seventeen years, and was closed in 1837 owing to disagreements with the government, but he opened a new gymnasium, which he continued till his death. He laid the foundation of French military, institute, and school gymnastics, devised a great deal of apparatus, and made much of singing as an exercise.

Another man who was instrumental in furthering physical education in France was Phokion Heinrich Clias, born in Boston of Swiss and Huguenot parents in 1782, sent to a school in Holland.

[1] See Manual d'Education Physique et Morale, Paris, 1830.

In 1814, as an officer of the Light Artillery, he began free instruction in gymnastics to the men under his charge, as well as to the boys in the orphan asylum at Berne. He met with great success, and in 1817 moved to Paris, where Amaros had already opened a gymnasium. He did not meet with success there and was induced to go to London in 1822, where he attained the rank of captain and was made Superintendent of Physical Training in the army and navy schools, teaching there until obliged to go into retirement crippled by an accident. In spite of this he emerged from his retirement in 1841, being then almost seventy years old, and taught gymnastics in city schools for a year or two, removed to Paris, and received the appointment of Superintendent of Gymnastic Instruction in the elementary schools. His books contain little that is original or of permanent value, and show his overweening vanity and his bitterness toward such rivals as Amaros. His greatest strength lay in his ability as a practical gymnast and teacher.

Both these *gymnasiarchs* worked under methods which we think of as German, although it all came from the institutes of Pestalozzi and Salzman. After the Napoleonic wars France was in a desperate state, but overtopping all the political hatreds and intrigue that held the country in bondage for the next fifty years there was a craving for peace and rest. Over 1,000,000 men had met untimely death on the battlefield or in camp, recruits having been enrolled down to the age of fourteen, and the perpetuity of the race was reserved to the weak and infirm who had escaped the recruiting officer's net. Even as late as 1867, one-third of all recruits had to be rejected as unfit for military service. It is not surprising then that the attempt at the semimilitary form, in which the gymnastics of Amaros and Clias were presented, told against their popularity and ultimate success.

It was not until after the war of 1870 that France really awoke to the vital importance of a national system of physical training. The first efforts were purely military, but they soon found the rigidity of military exercises executed at command, the prolonged immobility in the ranks, and the violence of some of the exercises, unsuited for the best training of children or for adults either, and three policies began to gather advocates about them.

One wished to import the Swedish system as it was, another to introduce and encourage the athletic games of the English and American schools, and a third to discover the laws of movement, and to work from them to a national system that would emphasize self-expression by harmonious movements, grace, and utility.

The Swedish system was first introduced in its entirety, and became the official system in the Army Training-school at Joinville about 1890, and a strong training school in that system was established at Bordeaux under the direction of Dr. Philip Tissie. The physical training at the military school at Joinville included, however, special gymnastics and athletics, although their calisthenics remain largely Swedish in nature. They added setting up drills with the rifle, jumping over heights, obstacles races, boxing, La Savate, and jiu-jitsu.

A somewhat similar but much more practical and perfect method was worked out for the navy by Lieutenant Hebert, involving such exercises as crawling, springing, carrying, and other exercises useful for life at sea. In this, little or nothing has been borrowed from Swedish sources (Fig. 67).

About 1880 Baron Pierre de Coubertin, after a visit to England where the widespread practice of athletic sports in the schools is in vogue, essayed the difficult task of introducing them into the school system of France. Beginning with L'Ecole Monge, he and his associates formed clubs in track athletics, football, rowing, and swimming. He interested and allied himself with men of influence and enthusiasm in the cause, and was largely responsible for the renaissance of athletics in France, which was the beginning for the international movement for the revival of the Olympic games. Recognizing the tendency to artificiality and specialization in athletic competition, he strongly advocated keeping as nearly as possible to natural conditions. For example, the jumping over a fixed bar or fence in the high jump instead of over a bar that could be easily displaced, the jumping of an actual ditch in the broad jump, and running without special spikes in the shoes.

Recognizing the importance of teaching instructors in this exercise, the Marquis de Polignac established at Rheims a college

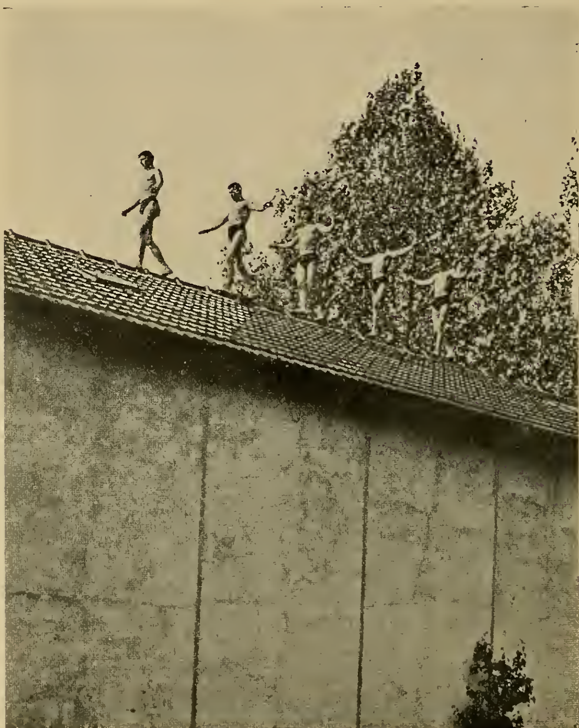


Fig. 67.—Lieut Hebert's method of training against dizziness (Guide Practique d'Education Physique, George Hebert).

fitted with all the equipment necessary for athletic sports, with a track and stadium for exhibitions, and here until the outbreak of the war of 1914 could be seen the best English and American methods of training in all field and track sports. While under Lieutenant Hebert, the useful gymnastics and physical feats of his system were carried to a high degree of perfection.

To such a point had athletic sports and games been revived that France once more began to take its place among the foremost sport-loving peoples. I say "once more" advisedly, for as far back as 1637 the master of Charter House School, England, after a visit to Paris, commented in no complimentary way on the wide extension of sports and the prevalence of such games as tennis in France, where, he says, "it is more common than throughout the rest of Christendom. The country is sown with tennis grounds. They are more numerous even than churches. There are, he declares, more tennis players in France than there are drunkards in England."[1]

The most valuable and noteworthy contribution to scientific physical training in France has been the work of George Demeny, who has taken issue in no uncertain terms with the Swedish gymnastics as usually taught. As a result of his studies with Professor Marey of men and animals in motion observed by

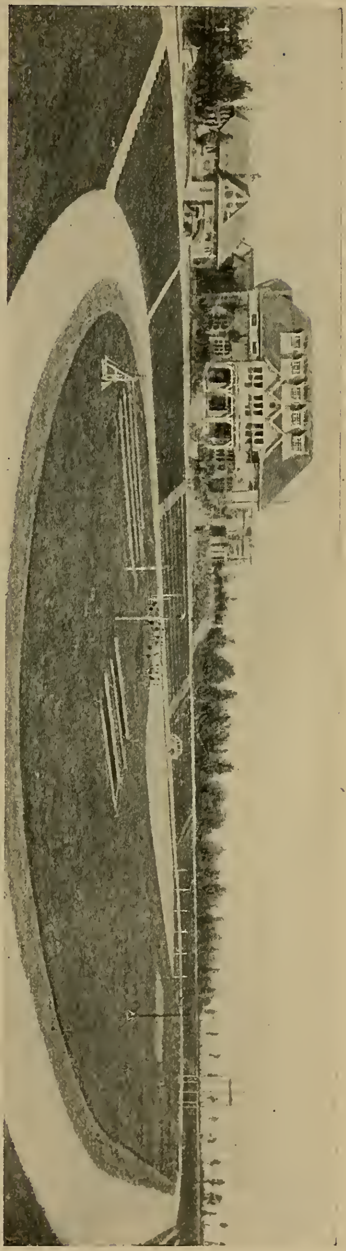


Fig. 68.—The college and stadium at Rheims for training instructors in gymnastics and athletics.

[1] Sports and Exercises in Ancient France, by J. J. Jusseraud.

Fig. 69.—Curvilinear and harmonious movements (from "Education et Harmonie des Mouvements, by George Demeny).

the cinematograph, he lays down the following as the principles for a natural physiologic system of exercise:

1. Movements should be dynamic and not static or jerky.

2. Movements should be extended, complete, and continuous in every possible direction.

3. Movements should be executed with ease, relaxing the muscles that do not directly influence their accomplishment.

4. The extremities of the segments, like the arm and the trunk, describe in space sinuous lines and not sharp angles, approaching in direction the center of an ellipse, the figure eight, and the spiral.

5. Movements of the arms or legs are simultaneous or in rotation, symmetric or asymetric.

6. The speed of different segments of the body is in the inverse proportion to their mass. The harmony of a movement is the perfect relation between the attitude of the body, the muscular action, the resistance to be cleared, or the work to be accomplished.

To summarize, muscular development is obtained by continuous working of the muscles from their complete extension to their complete contraction. Suppleness is the consequence of careful localization of muscular contraction and reduction to the indispensable minimum required for a given movement. In consequence, he believes that the holding of fixed positions is exhausting to the nervous system and bad for the circulation. Continuous movements are less fatiguing for the amount they accomplish, it being easier to change its direction than to stop a movement which has begun and to start a new one. He lays great stress on the relaxation of antagonistic muscles. From these principles he describes the fundamental positions of the legs, arms, trunk, and head, with exercises for developing and making more supple the body, beginning with the shoulders and arms, and always following his rule by using directions that are curvilinear, spiral, or circular. Following these are exercises for the legs by the same rules. Many are asymmetric to encourage the independence of the right and left side, and so become difficult feats of co-ordination. This principle of asymmetry in exercise, especially where the rhythm of the arms and legs is different, is an important part of the "Eurythmics of Jacques Dalcroze," to be described later on.

According to Demeny, physical education should be based on the doing of work, on the synthesis of movements into actions rather than on the taking and holding of positions, and on analysis of movement. This is the point on which he takes issue with the Swedes, and it has been the cause of more than one bitter controversy.

The genius of the French people has been strongly individualistic rather than social, and the other extreme from competitive sports and social games was also voiced fifty years ago by François Delsarte.

From time to time certain men arise who, by the force of their personality, make a deep impression upon the educational world. Whether or not this impression fades after their death depends largely upon the vitality of the idea, and the application of movement to the expression of emotion found its voice in such a man.

François Delsarte was born at Solesme in 1811. At the age of twelve he was sent to Paris to study painting on china, but his tastes carried him in other directions, and he became in 1825 a pupil of the "Conservatory," a government institution for instruction in acting, music, and the ballet. Here he lost his singing voice, and finding himself incapacitated for the stage he resigned that career to study and teach elocution and dramatic art. After many years of thought and observation he succeeded in formulating what he termed the laws of esthetic science, which had, he claimed, the precision of mathematics. Like all enthusiasts he remained until his death, in 1871, on the eve of a series of discoveries which he felt would revolutionize dramatic expression. He never published an adequate account of his researches, but his scattered and fragmentary notes were collected by Alfred Giraudet of the Grand Opera, Paris (his favorite pupil), and by his daughter Marie (Madame Geraldy).

Delsarte believed that the perfect reproduction of the characteristic posture will produce the emotion depicted by the actor, and much of his work may be described as an attempt to classify and make scientific the empiric rules of the pantomine. Positions of the fingers, hands, and legs are named and classified, and the expressions of the mouth, nose, and eyebrows are discussed in a way that recalls Levator's quaint studies on physiognomy.

Gesture as a form of language was his constant study. He writes: "When a man says to you in interjective form 'I love, I suffer, I am delighted,' etc., do not believe him if his shoulder remains in a normal attitude. Do not believe him no matter what expression his face may assume. Do not believe him. He lies. His shoulders deny his words. That negative form betrays his thoughts."

The system designed by him and carried on by his immediate followers analyzed form, poise, and gesture, in relation to emotion. Although much of his writings show the enthusiast and the dreamer, his theories were made practical by his strong personal magnetism and the social gifts that made him a welcome guest at more than one royal table. He himself did not elaborate any system of gymnastics to develop the body, but he did teach a few principles and exercises necessary for stage-falling and other maneuvers in acting.

The work of Delsarte was brought to the attention of Americans by his most ardent disciple Steele Mackaye, who planned to bring his master to America to lecture and demonstrate his ideas. Unfortunately, the Franco-Prussian War intervened and he died during the Commune. His teachings were made into a system of physical culture, the motto of which was *relaxation*, by Steele Mackaye, Genevieve Stebbins, Emily Bishop, Anna Payson Call, but when his daughter Marie was induced to make a tour in America she found her father's theories so distorted and misrepresented that she refused to identify his name with the movement, and confined her attention to giving semi-private lectures and parlor entertainments in elocution and the interpretation of La Fontaine's fables according to the rules taught by him.

In its Americanized form, the so-called Delsarte method had a great vogue in schools for young ladies, although at present it is rather in eclipse, and it is largely through the writings of Genevieve Stebbins, Anna Payson Call, and Emily Bishop that it has been called "the doctrine of limpness."

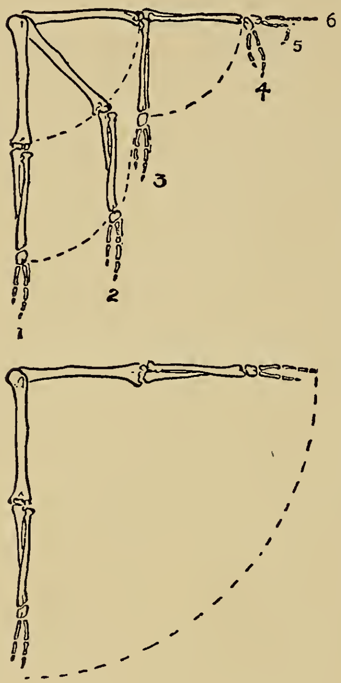


Fig. 69*a*.—The right and wrong ways of raising an arm according to the Delsartian teaching of relaxation (Cassell's "Physical Educator").

Here is a typical exercise from Emily Bishop's book: "Hold some thought of tranquillity, sitting erect, so that the feet easily rest upon the ground. Look steadily at some point in the ceiling and take five slow, deep breaths. Let the eyelids droop heavily and the head sink gently, the chin resting upon the chest. The back relaxes as far as possible, vertebra by vertebra. Last of all the hip-joint relaxes, causing the head to sway forward until it reposes in the lap. In returning to the original position, reverse the order of action. The hip-joint acts first; the motion creeps up the back until the spinal column regains its double curve, which lifts itself to its normal poise, after which the eyelids languidly open as they do in babies, when a little one seems unwilling to surrender to heavy drowsiness.

"This exercise secures a threefold benefit. It develops singleness of attention. It partially stupefies the brain, and directly soothes the nerves. When accurately done it always produces a sensation of sleepiness. Such an exercise should occupy from three to five minutes. From three to five repetitions should produce the drowsiness sufficient to make one reservedly relax and sleep."

Here we have an excellent example of self-hypnotism. Anna Payson Call, who also preached the gospel of relaxation, emphasized self-suggestion to overcome the chronic condition of nervous tension so frequent among American women, and it is this thought that has been a real contribution to physical education, and is suffering at present from overexploitation.

Delsarte may be said to have been the greatest influence in directing attention to the value of muscular action to express thought, and his principles continually crop out in other schemes of gymnastics. Self-expression by movement was the object of his teaching, this intense individualism being characteristic of the Latin temperament.

The importance of *rhythm in exercise*, while considered by Delsarte and emphasized strongly by Demeny, has been taken as the starting-point of the system of *eurythmic gymnastics* designed by Emil Jacques Dalcroze, a musician born in Vienna in 1865. His musical education was accomplished in Paris and Vienna, and later he became musical director of a small theater in Algiers, where he became familiar with the peculiar rhythm of Arabian music. From there he returned to a position as Professor of Harmony at the Geneva Conservatory, and wrote a series of gesture songs in response to his observation of the joy children took in their singing when they themselves illustrated or accompanied it by movements. He noted the feeling of unison it gave between the singer and the music. In 1910 he came to Dresden, where, in the suburb of Hallerau, the late Dr. Wolf Dorn and his brother Harold built a college in which he could exploit his ideas.

The training of advanced and complicated co-ordination is the essence of his method which deals with problems of time, rhythm, and movement, not as an accompaniment to music, but as a means of expressing it. To do this, he realized that the body

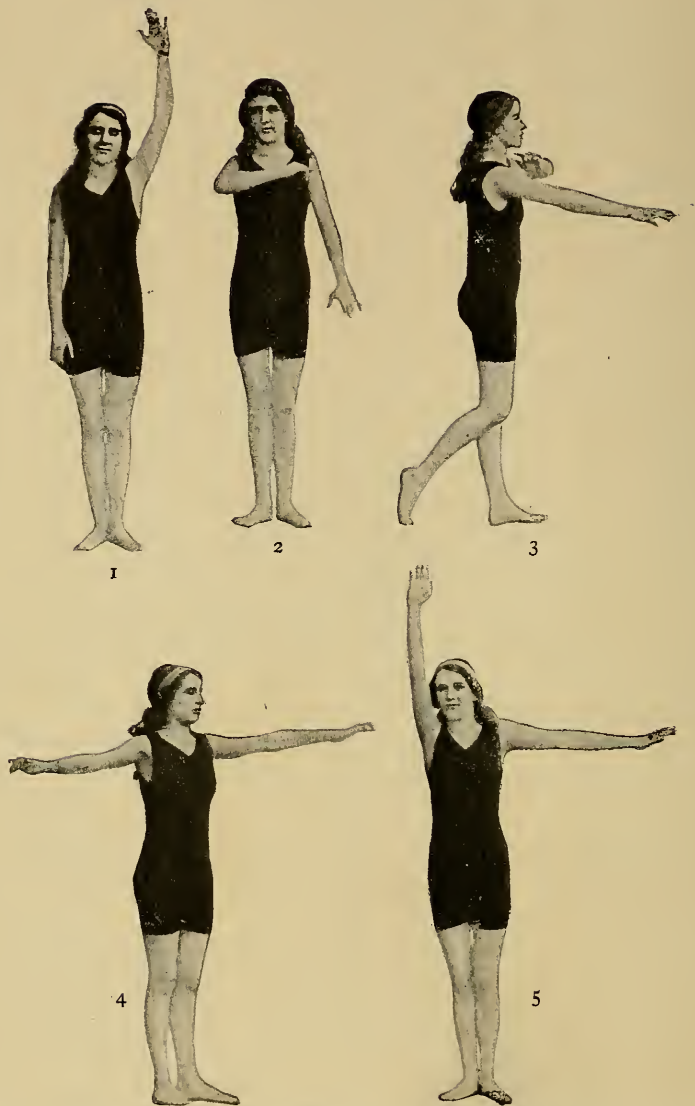


Fig. 70.—Beating $\frac{5}{4}$ canon without expression. The alphabet ("The Eurythmics of Jacques Dalcroze").

must be sensitized to every rhythmic impulse and trained to lose itself in the music. His method falls into three divisions

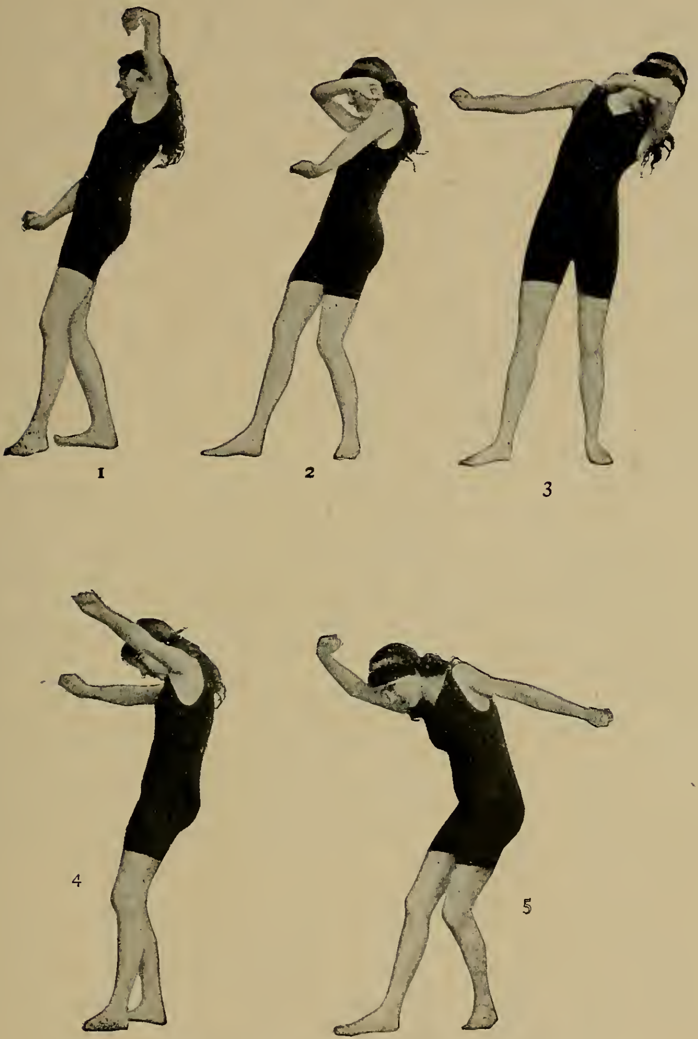


Fig. 71.—Beating $\frac{5}{4}$ canon with expression. The phrase.

—(*first*) rhythmic gymnastics, (*second*) ear training, and (*third*) improvisation or practical harmony.

These exercises are in their simplest form based upon two ideas:

First, Time is indicated by movements of the arms and sometimes the head, distinct movements show time from $\frac{2}{4}$ to $\frac{12}{4}$.

Second, The actual notes, their length, grouping, etc., are shown by movements of the lower limbs, each note, whatever its length, is shown by a step forward, a crotchet by a simple step, a minim by a step and a knee-bend, a dotted-minim by a step with one foot and two movements with the other foot. Notes, from groups of six to eight to the beat, up to whole notes of twelve beats, can thus be represented.

The most elementary exercise consists of marking the time of a bar with the arms and number of notes with the feet. For instance, in a bar of common or four-four time, such as the following—

the arms would beat four and the feet take five steps forward, two steps being taken on the second beat. Simple movements to indicate time and notes are learned as one would learn an alphabet. The alphabet consists of about twenty gestures with the arms, done in many varying combinations. As soon as these movements become automatic they are used as units to build up more elaborate movements and phrases; thus mechanical repetition is avoided and more advanced studies in plastic expression become possible, but no progress can be made until individuals who are rhythmically uncertain, whose muscular system is slow or irregular in its response to mental stimuli, have conquered their limitations. This part of the training is directed to improving the sense of rhythm; the pupil is taught to arrest movements suddenly, to move alternately forward or backward, to spring at a given signal, to lie down or stand in exact time to a bar of music, in each case with a minimum of muscular effort and without losing the feeling for each time unit of the music.

Variations and new combinations of movements keep them interesting, nor can they be done mechanically, because if the mind wanders, the pupil at once becomes lost and can find the place only with difficulty. He must think quickly and definitely. When the elementary exercises are mastered time is beaten in canon, one arm being one or more beats behind the other, or different times may be beaten by each arm and another by the head and feet; for example: four different times are beaten simultaneously, a truly remarkable feat of co-ordination for either young or old.

Dalcroze did not start out deliberately to express feelings and emotions by movements of the limbs as did Delsarte, but it is

Fig. 72.—"Elation" expressed by movement (from Dalcroze College Journal).

one of the results of his method, and these rhythmic movements undoubtedly help to deepen the intellectual and emotional life of the pupil. As the pupil advances, the more mechanical movements of the arms become softened and rounded, and more and more expressive of the rhythm and emotion of the music. The whole body thus becomes a means of plastic expression. (See Fig. 71.)

The other aspect of the work at Hellerau, ear training and improvisation, fascinating points of the general system, must not tempt us from our main subject, but from the standpoint of physical training his work presents certain well-marked differences from gymnastics as usually taught. In most systems of gymnastics the movements are done at a definite rate, which does not vary. Dalcroze continually changes the tempo to accustom the pupil to the ready adjustment to a changed speed, for when a movement is rapid, balance is less important and certain muscular contractions are instinctively eliminated. When it is slow, a greater number of co-ordinated contractions must be introduced. If we are to avoid clumsiness in changing from one to the other, both must be made interchangeable. Most gymnastic movements are prearranged and not spontaneous, and so give us no natural or artistic expression. Individual interpretation of the movement is strenuously cultivated by Dalcroze. He attempts to systematize the natural rhythms of the body, and by constantly repeating them to render them automatic in every degree of speed and energy; in other words, to give the brain definite rhythmic images. Looking upon the body as the best instrument for expression, he finds music as essential for this purpose as the bow is to the violin. This method gives the pupil musical expression rather than musical knowledge, and Dalcroze seeks to reclaim that natural poise of the body so often lost.

The place of this system in physical education will naturally be with those to whom the sense of rhythm is of overwhelming importance. Gestures and attitudes of the body have always been used instinctively by artists in singing, but in the more complicated forms of music like grand opera, the importance of rhythmic movements for expressing the sentiment and emotion of the music must naturally be of vital importance. No one who wishes to cultivate a sense of rhythm and the finer co-ordinations of the neuromuscular system could find a better way for doing it.

CHAPTER X

PHYSICAL EDUCATION BY ATHLETICS

THE exercises described in the last few chapters are more or less artificial in character, and in proportion as their artificiality is marked their hold on the average youth is lessened.

Running, jumping, throwing, catching, climbing, fighting, and tussling are the natural activities to which boys turn for the development and expression of their physical powers. It is these activities codified and regulated that we call *athletic sports*.

The group games demanding co-operation, as described in Chapter VI, are a development of the individual contest, and wrestling under its many rules—Græco-Roman, catch-as-catch-can, collar-and-elbow, glima, and jiu-jitsu—is but a regulation of the natural desire to pull, push, and throw an opponent, according to the temperament of the people who practice it. Ball games, like tennis, cricket, baseball, lacrosse, hockey, hand-ball, and paloma, are developed from throwing and striking a small ball with a club of some kind. The indiscriminate kicking of a football has developed into soccer, and the more highly organized carrying game of Rugby school, from which the college game in America originated, has been carried to a point hitherto unsurpassed for tactics and team work.[1]

Teachers have been slow to recognize the possibility and necessity of directing the play instinct for the better education of the child. Too frequently it is ignored or looked upon as a nuisance.

In America athletic sports recall to men not yet old only the Caledonian gathering, where the few professional athletes went from place to place collecting and dividing the meager purses, and the practice of running, jumping, and throwing weights was the accomplishment of but few.

The present high development of athletic competition is a

[1] Football, the American Intercollegiate Game, Parke H. Davis.

long stride from such primitive picnics. It is within the last hundred years that records of any kind have attracted notice. The "Rugby Crick Run" was first mentioned in 1837. Games were held at Sandhurst in 1840, steeple-chase, sprints, scurry and hurdle races at Eton in 1845, followed rapidly by Woolwich, Marlborough, Cheltenham, Durham, and Oxford and Cambridge from 1852 to 1857. A year later "Bell's Life" speaks of the revival of "good old English sports." Scotland followed with a University Union in 1871. Occasional professional athletes came from America to England and flashed like meteors across the athletic firmament. George Seward, of New Haven, in 1844, ran his disputed 100 yards in nine seconds in England, and Deerfoot, in 1836, ran in mocassins his 10 miles in fifty-one minutes and twenty-six seconds.

It was not until 1858 that the Amateur Athletic Union[1] was formed of fifteen clubs for the practice and encouragement of sport. The London Athletic Club had preceded it by ten years, and the collegiate body soon followed.

The first American Intercollegiate games were held at Saratoga in 1875. At that time athletic competition was not distinguishable from horse-racing, if we may judge from the letter received by the committee of that meet from President Buchan, explaining why the University of Vermont was not represented in the sports. He explained that the students were for the most part swinging the scythe in the hay fields, or handling the compass and chain on the railroads at the time the regatta and sports were held, and he concludes by saying, "though they are poor they are proud, and would regard it as beneath the dignity of a free-born Vermonter to expose their muscles in public like gladiators in the amphitheatre for 'Mrs. Morrisey' and other high-born dames to bet on. If you will get up a contest in some honest and useful work and insure us against the intrusion of gamblers and blacklegs, we will engage to be represented. Mean-

[1] History of Amateur Athletic Union, Schroeder, Springfield College Thesis, 1912; Physical Training in Athletic Clubs, Augustus Maier, 1904; Rise of Track Athletics in Colleges, T. E. Jones' Thesis, 1904.

while we must plead that we are too busy, too poor, and too proud."

Athletic sports took strong hold upon the imagination of the students, but their educational possibilities were not grasped by many of the faculties, and their wayward organization grew up, untempered by the riper experience of older men, rank with those abuses and extravagances of which the critics of athletic sports still complain.

Within the last ten years, college after college has taken over the athletic training of its students and incorporated it into the regular college work, providing equipment in buildings and playgrounds, skilled direction, and academic credit for the regular practice of this form of exercise, and there is now a close resemblance between the athletic education of the Spartan or Athenian boy and the youth who is educated at the English public school or American preparatory school and college.

At Sparta the boy was taken away from home at seven and put in a boarding-school of about sixty-four boys, where rough contests with his fellows rubbed off the individual peculiarities and brought out a national type. Among the Spartans the education was almost entirely physical. Scouting was taught by the foraging expeditions to which they were early introduced, a most valuable training for their future military life.

Riding, hunting, and swimming were systematically taught, as well as boxing and wrestling, although the Pancration, which corresponded to rough-and-tumble fighting, was early discouraged. They had a game of football which had a close resemblance to actual fighting, and, although they opposed specialization in athletics, they were systematically pugnacious. Similar schools were provided for girls, although they took their meals at home. They shared in the sports of the gymnasium, wrestled, ran and swam, threw the discus or javelin, and even raced on horseback. They also indulged in a rhythmic drill, a dance to the music of the flute. As a nation they deified pluck and endurance just as boys do to-day, and used it to train a standing army of which every citizen was an efficient member.

The Athenian boy, on the other hand, went to school daily, taking his meals at home. He was accompanied by his attendant slave, called a pedagogue, and after his lesson in literature and music he was taken to the palestra for his athletics. Instead of the scanty one-half hour or hour allowed by our grudg-

Fig. 73.—Scene in Palaistra, showing athletes with halterers, discus, javelin, and strigil, and the pick-axes for loosening the ground (from a Kylix at Munich, attributed to Euphronios).

ing boards of education, he had from three to five hours in the open air, spending the greater part of it in purely athletic exercises. The physical education of the Athenian was athletic in character. The casting of the javelin and discus, sprinting and running long distances, jumping with dumb-bells, boxing, punching the *Korykos*, or punching-bag, wrestling, and the

Fig. 74.—A dozen teams of boys practising football at Andover.

Pankration were studied and practised in turn, and the bath and massage concluded his day. Overspecialization was combated by the *Pentathlon*, or all-around contest in running, jumping, throwing the discus, the javelin, and in wrestling.[1]

The widest application of athletics to educational ends is found in the colleges, public school athletic leagues, and municipal playgrounds, described fully in subsequent chapters.

At Amherst, a college of 600 students, there are twenty palestræ for football and baseball. At Andover (see Fig. 74) and Lawrenceville every boy is drafted into the athletic teams and given opportunity for play.[2] At the University of Pennsylvania a system of intensive athletics is practised in which the various

Fig. 75.—"Taking the first hill" in an intercollegiate cross-country championship run at Princeton (Edward R. Bushnell).

activities are used for their educational value (see Fig. 157), while extensive tracts are laid aside for athletic purposes at Wisconsin, Princeton, Harvard, Yale, and Chicago.

Cross-country running, hare and hounds, and steeplechase, so characteristic of the English public school boy's education, have been largely responsible for making athletics popular throughout the British Isles. It was after a visit to Rugby that Baron de Couberton was inspired to advocate the introduction of running, cricket, and football into the French schools, where such activities were at that time opposed or prohibited. He

[1] Kenneth J. Freeman, The Schools of Hellas.

[2] "Control of Competitive Sports in Secondary Schools," G. S. Lowman, P. E. Rev., vol. xii, 141.

founded an International Olympic Committee and systematic international competition in sport had its beginning. Within the last twenty years the interest in organized athletic sports has spread so rapidly that the word Olympic has taken on a new meaning, and is used for games in Manila, Pekin, Tokyo, Stockholm, London, Paris, St. Louis, as well as for the classic festivals of Greece, and the International Federation of Sports adopted a uniform code of regulations at Paris in 1914 to minimize the constant friction caused by the different interpretation of rules and varying methods in practice, and to standardize the distances and implements of athletic competition. (See Handbook, Spaulding's Sports Library.)

A field and track are necessary for the practice of athletics. The track should be constructed to insure rapid and free drainage. A safe rule is to have a 12-inch foundation of rough stone and clinkers covered with 6 inches of clay and cinders, and ending with a top dressing of cinders and clay firmly rolled down. This allows for free drainage and also for a springy surface. The width of the track should be about 18 feet, and it should have a straightaway on one side of 220 yards if possible, but never less than 100 yards. The turns of a circular track need not be banked for running, and the back stretch may be narrower than the homestretch.

The field contained within this track should be provided with jumping pits of earth loosely dug up. The take-off for the broad jump should be a joist of wood sunk flush with the ground approached by a 30-yard path of cinders. For the high jump and pole vault, standards should be supplied capable of being raised to 14 feet, since the pole vault record has now passed 13 feet. Shot putting and hammer throwing require a 7-foot circle, with a footboard at the front for the shot-put. A heavy wire cage, 20 feet in diameter, should surround three sides of the circle to reduce the chance of accidents in the hammer-throw. The javelin, which is much used in Europe, has taken but little hold in America, although its inclusion in the Olympic program will probably increase its popularity.

Detailed training for special events cannot be covered here,[1] but reference to p. 79 will show the various qualities cultivated by each of the athletic events.

The usual program in track and field athletics consists of running short and long distances, jumping for both height and distance, pole vaulting, throwing the discus, the hammer, the 56-pound weight, the javelin, putting the shot, and hurdle-racing.

The sprinting distances are 100 and 220 yards, and in training for them special emphasis should be placed on the concentration of attention at the start, the cultivation of the proper stride, and the determination required for the final spurt. It is the usual custom to practice the starts frequently when preparing for a sprint, and Murphy always had his sprinters run less than the full distance in practice.[1] Great care must be taken during cold weather to prevent sprains and ruptures in muscles imperfectly warmed by preliminary movements. A fair runner should cover the 100 yards in 12 seconds; a good one, in $10\frac{4}{5}$ seconds; the world's record is $9\frac{3}{5}$ seconds. In the 220

Fig. 76.—The starting pose for a sprint race. (Copyright, 1902, R. Tait McKenzie.)

[1] Athletic Training, M. C. Murphy, C. Scribner's Sons; and Track Athletics in Detail, Harpers.

corresponding times would be 26, 24 seconds, and the record is $21\frac{1}{5}$ seconds.

The $\frac{1}{4}$ mile, or 440 yards, is the hardest race on the program. It is really a sprint, although endurance is a most important factor in it. This is one of the most popular of the track events, but it should not be practised by boys under seventeen. In fact, it is better to wait another couple of years before running this exhausting distance. A fair runner should complete the distance in 60 seconds; a good runner, in 54 seconds; the record is 47 seconds.

Fig. 77.—The finish of the 100-meter race, Stockholm, 1912.

The $\frac{1}{2}$, 1, and 2 mile are the usual distances for long races. They are primarily tests of endurance, and are run as much as possible on the ball of the foot in order to avoid the shock and consequent muscle soreness due to running flat-footed. The breathing is done for the most part through the mouth. It is in the longer distances, the 1 and 2 miles, that the phenomenon of *second wind* described in a previous chapter takes place. In the mile it usually occurs in the third quarter, and is a great relief to the respiratory apparatus. It was Murphy's practice to let athletes training for these races run about three-fourths of the distance in practice, relying on the excitement of the contest to carry them the entire distance to the finish. A fair runner should be able to run the half in 2 minutes 15 seconds, the mile in 5 minutes 10 seconds, and the 2 miles in 14 minutes; a good runner should be able to make them in 2 minutes 5 seconds, 4 minutes 50 seconds, and 10 minutes 30 seconds; the

Fig. 78.—The finish of the 400-meter race, Stockholm, 1912.

records are: for the $\frac{1}{2}$ mile, 1 minute 51$\frac{3}{5}$ seconds; for the mile, 4 minutes 12$\frac{3}{4}$ seconds; and the 2 miles, 9 minutes 9 seconds.

The winning of the race from Marathon to Athens by a Greek at the Olympic games in 1896 resulted in a craze for the so-called Marathon races. Clubs, newspapers, and communities organized them for boys and men of all ages and conditions, and but little care was taken in the preliminary training or in the conduct of the races themselves.

The great exhaustion resulting from the 25-mile run cannot but be detrimental to boys who have not attained their full growth. Even in the seasoned and mature athletes the strength of the competitor must be husbanded, and the distance he runs in practice gradually increased from 5 to 12 or 15 miles, followed by plenty of rest. A much more sane and beneficial form of long-distance running is found in Paper Chases or Hare and Hounds, where the runners vary their pace frequently by climbing fences, walking over ploughed ground or through woods.

Fig. 79.—The American team training for the Marathon race, Stockholm, 1912.

Runners should go out for practice in packs, the pace being set by some one experienced in setting a moderate pace.

Competitive walking has been discontinued largely because of the difficulty of judging fair heel-and-toe walking in which the heel of the forward foot must be down before the toe of the rear foot leaves the ground. The pace is unnatural and difficult to acquire, but no exercise in its non-competitive form has been so widely enjoyed.

The hurdle-race is confined to two distances, 120 yards over ten hurdles, 3 feet 6 inches in height, the first and last being placed 15 yards from the start and the finish, with a 10-yard interval between each hurdle. The second race is the 220-yard hurdles, with ten hurdles 2 feet 6 inches high and 20 yards apart. The hurdles are made movable so that striking them does not mean a bad fall on the cinders. In the shorter race, practice is confined to the method of clearing the obstacle and acquiring the three strides between the hurdles. Attention is concentrated on clearing each one as closely as possible without being disqualified by knocking down two hurdles in ten. In the low

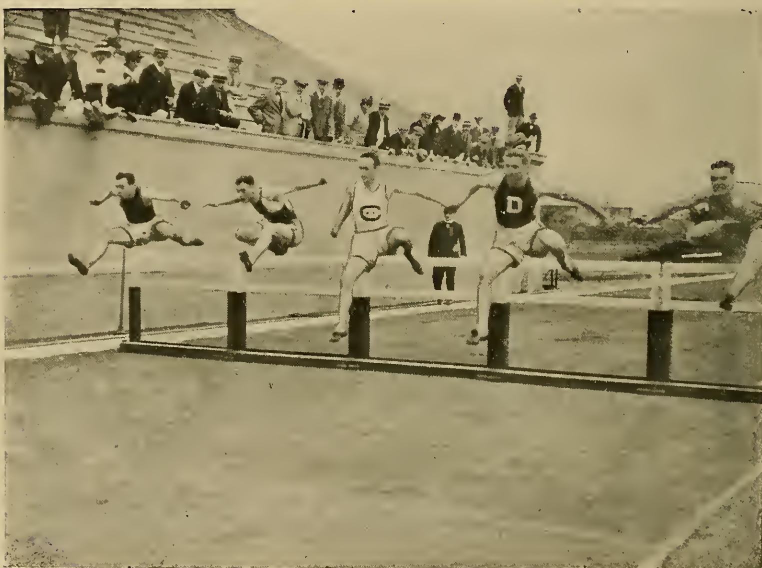


Fig. 80.—Clearing the high hurdles in good form. (Photograph by Edward R. Bushnell, courtesy of I. C. A. A. A. A.)

hurdles seven strides are taken before each leap, but being only 2 feet 6 inches high they are cleared with little disturbance to the stride. The most successful hurdlers are usually men of good height and length of leg, for the fixed distances cannot be accommodated to the length of a short man's legs. This is an instance in which the type of figure must accommodate itself to the apparatus used. A fair performance for the shorter distance would be 20 seconds; a good one, 17 seconds; the record is $15\frac{1}{5}$

seconds. For the longer distance the figures would be 31, 28, and $23\frac{3}{5}$ seconds.

The broad jumper takes off from an 8-inch joist sunk level with the ground and lands in loosened soil, because rough or hard ground may turn an ankle or break down the arch of the foot. It is well to have the heel of the shoe padded to absorb part of the shock. The distance cleared is measured from the take-off to the first break in the ground made by any part of the body, so that men

Fig. 81.—Clearing the low hurdles in good form. (Photograph by Edward R. Bushnell, courtesy of I. C. A. A. A. A.)

are taught not only to measure off their running distance, but also to get height and balance in the jump so as to prevent their falling backward in landing. In the first turnplatz Jahn used for the broad jump a ditch narrow at one end and gradually increasing in width, the winner being the one who could clear the widest point. This approaches more nearly to the practice of the broad jump under ordinary conditions. Eighteen feet is a fair jump, 20 feet is a good one, and the record is 24 feet $11\frac{5}{8}$ inches. The standing broad jump is measured from the

Fig. 82.—Good form in the broad jump.

Fig. 83.—Good form in the high jump.

take-off to the nearest point touched by any part of the body. This is a test of the actual spring of the body much more than the running jump in which the question of speed is paramount. Ten feet is a good jump, and the record is 11 feet 2 inches.

In the high jump the competitor clears a crossbar, which is easily displaced, and alights in soft earth. In this the teaching of the technic is most important—the approach, the measurement of the last few strides, and the method of clearing the bar, so that the hips and shoulders may in turn evade the bar. While each competitor has some peculiarity of style all his own, the best jumpers run at a right angle toward the bar, spring from and alight on the same leg, turning in the air and land with face to the bar.

Fig. 84.—The standing high jump, showing the "scissors" style.

The side or "scissors" jump is universally condemned by the best trainers, although in the standing high jump the competitor stands sideways to the bar and clears it in this way. Any style in which the head and shoulders go over the bar before the feet is prohibited because it is a dive and not a jump. Five feet is creditable; to clear 5 feet 6 inches is good, although the record stands now at 6 feet 7 inches.

The pole vault is done from a run, and the body is raised by the arms and lifted over a bar on a 15-foot pole of spruce or bamboo. The pole is released while the athlete is in the air and falls back as the competitor clears the bar without touching it. Any displacement of the bar by the pole or the body counts as a failure. Any vaulter should clear 9 feet; 10 feet 6 inches is good, and the record is over 13 feet.

Fig. 85.—The pole vault, clearing the bar.

The javelin is thrown from a short run, the weapon being grasped about the middle. This ancient sport played an important part in the athletics of the Greeks. With them it was thrown with either hand, and usually by means of a thong or amentum, which doubtless increased the throwing distance. A fair throw is 100 feet; the record is over 170 feet. Among the Greeks it was a practical method of teaching one of their favorite methods of attack, but the frequent accidents that are reported among them would make it of questionable value as a means of exercise, especially as the same muscles are constantly used in throwing the baseball.

The discus throw has also come down from antiquity. Its style was a result of the flinging of a stone or any other object too heavy to be thrown in the ordinary way. The first discus was a heavy piece of iron. As now used it is a circular disc, 8 inches in diameter, weighing $4\frac{1}{2}$ pounds. It is thrown from an 8-foot circle and with one or two turns. The absurd and ridic-

Fig. 86.—Throwing the javelin.

ulous Greek style, which was at first insisted upon at the modern Olympic games, was the result of an attempt to reconstruct the ancient method from such fragmentary evidence as the Discobolos by Myron and certain Greek coins and vase paintings. It resulted in a style closely resembling bowling and could never have been in use among the ancient Greeks. The "Discobolos" undoubtedly threw his discus with a spin of the body toward the left, and the modern athlete has instinctively amplified that by adding one or two turns borrowed from hammer throwing. It is an excellent exercise for balance and strength. A fair performer should hurl it 100 feet; a good one, 125 feet; the record is about 150 feet.

Throwing the hammer seems to have originated on the village greens of Scotland, where the blacksmith's hammer was always at hand. As now used the hammer is changed beyond recognition, consisting as it does of a ball, 12 or 16 pounds in weight,

Fig. 87.—Preparing to throw the discus.

connected by a swivel with a wire handle which terminates in two triangular wire loops gripped by both hands. It is thrown from a 7-foot circle by a spinning movement, and the accuracy required in maintaining the balance, making two, or even three, rapid turns, is so great that few hammer throwers approach reasonably near to perfection. The frequency of accidents resulting from wild throws have, in consequence, rendered it so unpopular that it may yet be dropped from the list of standard field sports. A fair throw is 100 feet; a good one, 140 feet; the record is 189 feet.

The heaving of the 56-pound weight, a ball of iron attached by a triangular iron handle, is another throwing contest. At first

Fig. 88.—Throwing the 56-pound weight.

thrown by one hand, it soon became the custom to throw it from both hands for height against a suspended drum, and also for distance. Its devotees soon learned to swing it around the head with a movement like the hammer throw in technic, but this requires a man of great strength and weight. The record is 16 feet 8 inches for height and 38.8 feet for distance.

The discus, hammer, and 56-pound weight all exercise the pulling muscles of the back and leg, while putting the shot brings into action the opposite groups. This feat is a development of an old Scottish sport called "putting the shoulder stone," and the stone or "shot" of iron or lead has been standardized into weights

Fig. 89.—The delivery of the shot in shot-putting.

of 12 and 16 pounds, the lighter weight being for school boys from fifteen to eighteen. This missile is "put" or shoved from the shoulder, the competitor *standing* within a 7-foot circle. Around 4 feet of its circumference is a footboard from the inside of which the distance of the put is measured. Any throw in which the competitor oversteps the circle counts as a foul. Much time must be spent in learning the movements that lead to the final throw.

These consist of a hop across the circle and a quick reverse of the legs after the shot is delivered, and requires fine co-ordination, speed, and balance, as well as strength. Thirty-two feet is a fair distance to put the 16-pound shot; 38 feet is good; the record is over 50 feet. The movement of shot-putting is opposed to that of the last three throwing events, so that training for one is not a preparation for the other. In fact, it is almost impossible for an athlete to show supreme ability in both at the same time.

High specialization in any of these events inevitably places competition in the hands of the very few experts if unchecked. The less successful drop out, and are content to watch the exploits of those whose physical endowment and pertinacity puts them in a class by themselves. This tendency can be controlled by handicapping the swift or the strong until they are put on a level for competition, and also by teaching the movements of athletics in classes (Figs. 157, 158) where the awkwardness of the individual is not conspicuous.[1]

[1] 1. Track Athletics in Detail, Harper Brothers; Athletic Training, M. C. Murphy, C. Scribner's Sons. 2. E. J. Hjertzberg, Training for Athletics. 3. Greek Athletic Sports and Festivals, E. Norman Gardiner, MacMillan. 4. Spaulding's Athletic Handbooks.

CHAPTER XI

PHYSICAL EDUCATION IN YOUNG MEN'S CHRISTIAN ASSOCIATION, CAMPS, BOY SCOUTS, AND CAMP-FIRE GIRLS

In addition to the gymnastic and athletic clubs formed for the practice of German or Swedish gymnastics, or for athletic sports, voluntary associations, founded for religious or social purposes, make use of the desire for a better physique and a higher level of physical life to make their membership attractive.

The longing for outdoor life has dotted the mountain and lake shore with summer camps. The imagination of boys has been stirred to enthusiasm by the Scout movement, and the Camp-fire Girls keep alive the spirit of romance while making their bodies strong, active, and valiant.

Of all these voluntary organizations, The Young Men's Christian Association has had the most far-reaching influence, and the inclusion of systematic physical education has added the third side to the *triangle of mind, spirit,* and *body,* which has become their badge.

The New York City association was the first to establish a regular gymnasium in addition to the more purely religious program, as a "safeguard against the allurements of objectionable places of resort." In Brooklyn the classes were first conducted by "Professor" Andrews to the music of his own fiddle. It was not until 1870, however, that the systematic education of the body was seriously considered as part of the regular program for each club, and the association was at once confronted with the difficult question of obtaining proper supervision and instruction. The applicants for these positions were drawn from the prize-ring, the wrestling mat, and the circus, for the most part. Even the occasional ex-college athlete was little better, because he was usually a specialist in one branch, and had little or no preparation for teaching either gymnastics or athletics. The recent medical graduate had not had the best training and preparation for the cultivation of health habits, and in many cases he was not a good teacher.

A teacher in the physical department of a Young Men's Christian Association deals with a floating membership which changes completely in three years. The members join at any time in the year and are irregular in their attendance. Some devote too little time to exercise and desire only the hygienic effects. Others are ambitious to become experts. They vary in age from twelve to sixty, and must be organized in a dozen different classes. About 1880 Robert J. Roberts began his lifework as an instructor and trainer of teachers in the gymnastics that he considered peculiarly suited to association needs. He championed the light gymnastics of Dio Lewis against the heavier work of the weight lifter and the German turner. He laid special emphasis on the *middle third* of the body, designing his various "liver-squeezing" twists and bends with dumbbells to counteract the sluggishness of sedentary habits, especially among business men, and his formula which has since become famous was that exercises should be "short, safe, easy, pleasing, and beneficial." In the two years 1886 and 1887 he sent out twenty-eight teachers to other associations.

The increasing need having been demonstrated, the International Young Men's Christian Association Training-school at Springfield, Massachusetts, organized a course of training for physical directors under Dr. Luther Halsey Gulick in 1887. The two-year course was soon extended to three years, and the school has developed into a well-equipped and efficient college, with thorough courses in anatomy, physiology, theory, and practice of physical education, all given by a well-trained faculty, with model class-rooms, gymnasium, pool, track and field, and lake for water sports, and a splendid reference library on the subject. Its students and faculty have already been responsible for much original and valuable research on the history and physiology of exercise, and anthropometry.

Another training-school was established in Chicago in 1890, and summer courses and conferences are held yearly at Silver Bay, Lake Geneva, and elsewhere to keep directors in touch with the rapid progress of their subject.

The great expansion in the organization of recent years has given the Young Men's Christian Association physical director the task of meeting the physical needs of almost every boy and young man in many communities, both at home and abroad,

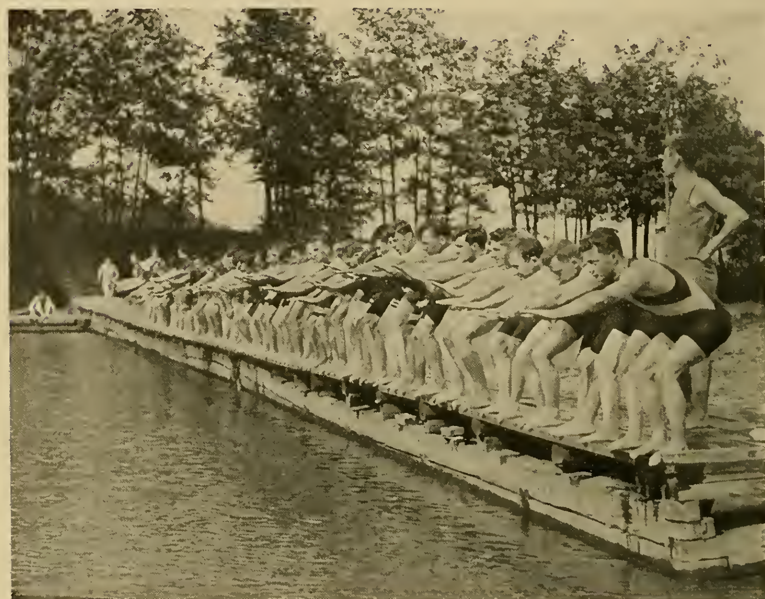


Fig. 90.—A swimming class at Silver Bay (from "At Home in the Water," Corsan).

and his technical training fits him for a place on committees for promoting municipal playgrounds and physical education in both schools and colleges. In Brazil it is the Young Men's Christian Association director who organized and conducts the physical exercise of the public schools. In 1908 Dr. Max Exner introduced the teaching of physical training in Shanghai, and began the systematic education of teachers under government encouragement.

The dark basement gymnasium with which the first buildings were equipped has been discarded, and light and ventilation are now the first consideration in planning the one or two well-equipped halls devoted to this department. A medical examination is always advised before joining any of the gymnastic or athletic classes. This is usually given as a volunteer service by a doctor, who is rewarded by an increased acquaintance among possible patients. Emphasis is placed on the thorough

Fig. 91.—Members of the gymnastic class in the Y. M. C. A. of Tien-Tsin, China.

examination of the heart and lungs and tests of the eyes, ears, nose, and throat, while the measurements and strength tests that at first occupied a large share of the examination have been curtailed and in many cases dropped.

The program of exercise must be comprehensive to accommodate a membership of such widely varying ages. Boys are not small men, physiologically speaking, nor is the boy of twelve a pocket edition of the youth of eighteen. The boy must be given exercise that will suit his comparatively small heart and limited powers of endurance. The circulation must not be overtaxed by long-distance races; his concentration must not be tested by too long periods of close attention, for his neuromuscular system has not yet ripened nor has he arrived at the age for complicated team games like football or basket-ball. From eighteen to twenty-two is the time for team games and competitive athletics. They are the last years in which he is likely to acquire those habits of exercise and personal hygiene that will serve him

Fig. 92.—School children of Rio de Janeiro under instruction by the Y. M. C. A.

in adult life. This is the time when he must build up his physical powers and endurance by vigorous exercise, bringing into full play the heart and lungs. The mature business man, however, needs relaxation rather than effort. The exercise must not tax his heart and lungs to exhaustion. The recreation games requiring no great specialization seem best for him. He does not need a large amount of exercise, and severe and exhausting work should be avoided lest the flabby and untrained muscles be strained and stiffened. The lameness following a bout of exercise quickly discourages an older man who only too often has lost the power to punish himself in this way, an ability in which a youth glories.

Most business men live irregular and unhygienic lives. In many cases their digestion is disordered from overeating, and their nervous system by debauches of work, the abuse of narcotics, and irregular sleep. Many of them exercise to correct the sluggishness due to overeating, and many others are sent by their doctors to counteract symptoms of overwork and nervous exhaustion.

Fig. 93.—A class of business men in class dancing under Oliver E. Hebbert, Providence, R. I.

In gymnastics, the Young Men's Christian Association has borrowed largely from the German and Swedish systems, but they have changed them without hesitation to meet more accurately their conditions. German calisthenic work is designed for esthetic effect. The movements are slow, graceful, and done with Teutonic precision, and always present a fine effect when seen in mass drills. Most of the Young Men's Christian Association drills are jerky and ungraceful and done without adequate attention to form. Their devotion to heavy gymnastics gives the Germans a mastery over all exercises on the bars and the horse, and a grace and form for which one will look in vain in most Young Men's Christian Association gymnasiums. Their obsession for symmetry makes them repeat with right and left hand every movement. With this thoroughness the utilitarian American youth has but little patience, and the splendid discipline of the German classes is but faintly re-echoed.

From the Swedes the association has borrowed much of their emphasis on posture and their corrective work. The slow movements and strained artificial positions held to count are, however, distasteful and difficult and the consequent training of attention and discipline is not attained. The members come voluntarily and casually. Their interest is superficial rather than serious. There is a feverish desire for constant change and recreation, a spirit of intolerance for any form of restraint, a repugnance to hard and exacting work with a strong leaning to utility, which makes the problem of administration at once alluring and discouraging. While erect carriage is insisted upon and corrective exercises for postural defects enter largely into the gymnastic drills, this hook must be baited with a liberal allowance of play. Such games as volley ball, battle ball, and indoor baseball, games of comparatively low organization, provide adequate muscular activity with the minimum risk, and do not require great skill, while the rivalry between teams does not diminish with age. The medicine ball, which is used in many of them, is well named, and is perhaps the most valuable single piece of apparatus in the gymnasium (see Fig. 30).

The regular program of exercise is arranged in a day's order of seven divisions, ending with a bath and rub down. The means employed are free movements, calisthenics, gymnastic and athletic apparatus, and play or recreation. The movements of calisthenics aim to secure attention, correct posture, to improve respiration and control. The gymnastic and athletic period cover the activities of the main muscle groups by exercises on the gymnastic apparatus.

The recreation period provides relaxation through gymnastic and athletic games in the gymnasium, on the field, or in the swimming-pool. The following proportion is used:

	Calisthenics. Per cent.	Gymnastics. Per cent.	Recreation. Per cent.
Boys, twelve to fourteen years	20	20	60
Boys, fourteen to sixteen years	20	25	55
Employed boys, sixteen to eighteen years	25	25	50
Clerks and office workers, eighteen to twenty-one years	33	50	17
Younger business men, twenty-one to twenty-five years	70	..	30
Business men, twenty-five years and over	70	..	30

In this scheme it will be noticed that emphasis is placed on the first two divisions in those whose life is more sedentary, and also that the heavier muscular tasks of the gymnasium and field are discontinued after twenty-one.[1]

The Young Men's Christian Association has carried the organization of the Leaders' Club or Corps to a high state of perfection. In Canada the National Leaders' Corps standardizes the uniform and grade of its members and conducts an annual examination for membership. The National Leaders' Club of the United States also standardizes the course in theory and practice. In many cities the association supplies from its Leaders' Corps instructors for churches, clubs, settlements, and playgrounds, and where it is not possible to get a fully trained director these volunteer leaders are widely employed. Their practical training is thorough, their interest can be counted upon, and they in turn gain valuable experience if they wish later to take up seriously the work of physical education as a vocation.

The athletic league of the association, organized in 1896, has done much to standardize athletic competition and influence for good the athletic life of the young American. The league aimed primarily at the harmonious development of the body, and for this purpose devised a modern pentathlon, consisting of a 100-yard dash, 12-pound-hammer throw, running high jump, pole vault, and 1 mile run, also an indoor decathlon, consisting of

[1] "Physical Education in Young Men's Christian Associations of North America," Associated Press.

marching, calisthenics, parallel bars, side horse, horizontal-bar exercises, $\frac{1}{4}$ mile, potato race, three standing jumps, running broad jump, long horse, pole vault. One of these standard tests had to be passed before an athlete could specialize. While this form has been abandoned, it must be looked upon as the first of the standards that have been so generally adopted on the playground and by the public school athletic leagues to encourage all-around development. The official handbook of the league (1913) contains the best definition of the *amateur* yet formulated, namely:

"An amateur athlete is one who participates in competitive gymnastics or athletics for pleasure only, and for the physical, mental, moral, and social benefits directly derived therefrom. A professional athlete is a person who promotes or participates in gymnastics or athletics for any other purpose than the above."

This league now governs about one-half million members (1914). The tests for boys, especially in rural communities, enables groups, such as schools, Sunday-schools, boys' clubs, and other such organizations, to compare their athletic ability by means of percentages where they could not meet in actual competition. The plan and standards as tested by E. L. Allen in 1910, and revised by Dr. John Brown, Jr., in 1913, are as follows:

OUTDOOR ATHLETIC TESTS FOR BOYS IN RURAL COMMUNITIES, BY JOHN H. BROWN, Jr., M. D.[1]

SCORING TABLE

80-pound Class

	0 Points.	Honor Standard.	100 Points Scoring.
50-yard dash	10 seconds.	8 seconds.	6 seconds.
Standing broad jump	3 ft. 5 in.	5 ft. 6 in.	7 ft. 7 in.
Running broad jump	5 ft. 10 in.	10 ft.	14 ft. 2 in.
Base-ball throw	70 ft.	120 ft.	170 ft.

[1] From Official Handbook of Y. M. C. A. Athletic League, 1913, Spalding Athletic Library, No. 302.

95-pound Class

75-yard dash	13 seconds.	11 seconds.	9 seconds.
Standing broad jump	3 ft. 11 in.	6 ft.	8 ft. 1 in.
Running broad jump	6 ft. 10 in.	11 ft.	15 ft. 2 in.
Baseball throw	100 ft.	150 ft.	200 ft.

110-pound Class

100-yard dash	16 seconds.	14 seconds.	12 seconds.
Standing broad jump	4 ft. 5 in.	6 ft. 6 in.	8 ft. 7 in.
Running broad jump	7 ft. 10 in.	12 ft.	16 ft. 2 in.
Running high jump	2 ft. 8½ in.	3 ft. 9 in.	4 ft. 9½ in.
Baseball throw	130 ft.	180 ft.	230 ft.

125-pound Class

100-yard dash	15 seconds.	13 seconds.	11 seconds.
Standing broad jump	4 ft. 11 in.	7 ft.	9 ft. 1 in.
Running broad jump	8 ft. 10 in.	13 ft.	17 ft. 2 in.
Running high jump	2 ft. 11½ in.	4 ft.	5 ft. ½ in.
Baseball throw	145 ft.	195 ft.	245 ft.
Putting 8-pound shot	15 ft. 6 in.	28 ft.	40 ft. 6 in.

Unlimited Class

100-yard dash	14 seconds.	12 seconds.	10 seconds.
Standing broad jump	5 ft. 5 in.	7 ft. 6 in.	9 ft. 7 in.
Running broad jump	9 ft. 10 in.	14 ft.	18 ft. 2 in.
Running high jump	3 ft. 3 in.	4 ft. 4 in.	5 ft. 4½ in.
Baseball throw	160 ft.	210 ft.	260 ft.
Putting 8-pound shot	22 ft. 6 in.	35 ft.	47 ft. 6 in.

Points shall be scored on the following basis:

All dashes for every ⅕ second better than the minimum	5 points
Standing broad jump, for every inch better than the minimum	2 "
Running broad jump, for every inch better than the minimum	1 point
Running high jump, for every inch better than the minimum	4 points
Baseball throw, for every foot better than the minimum	1 point
Putting 8-pound shot, for every 3 inches better than the minimum	1 "

An interesting extension of the athletic work of the Young Men's Christian Association is seen in the Far Eastern Olympic Games, held at Manila, P. I., in February, 1912, under the direction of E. S. Brown, of the Manila Young Men's Christian Association, in which China sent 40 competitors, Japan a baseball team and some track athletes, and the Philippine

Islands the rest of the 150 competitors. The regular track and field events were held, and a baseball game, pentathlon, and decathlon. Great interest was aroused and physical education in the schools stimulated. The director of education estimates that 300,000 schoolboys are now definitely engaged in some form of physical education, and the great play-fields that have replaced the moats surrounding the walls of Manila now re-echo to the shouts of the players of baseball, volley ball, and other athletic games.

Fig. 94.—Some savage Igorrote boys playing baseball at Manila.

The physical activity of the Young Men's Christian Association is not limited to the gymnastics and athletic competition. Campaigns of various kinds are started. In one season 50,000 boys were taught to swim by the association. In one such project for summer sports an interesting speaker was secured to address a meeting of members on how to enjoy a vacation. The stage was set with a tent and camp-fire, a canoe, rods, nets, tennis, racquets, bat balls, and golf clubs. Before the evening closed cards containing a list of summer sports were passed to all the members with the request to make a mark for their favorite sport. The cards were collected, the lists were classified, and the different groups were called together. The dozen who wanted golf met and appointed a committee to investigate and report on what could be done. They found a course furnished by the city and organized a group to play on them; and so with boating and the track and field sports. All these groups reported at a subsequent meeting and a summer of organized sports resulted. Camping and trips to the seashore can thus be organized at the smallest possible expense. Vacant lots and unused fields can be obtained for these purposes and a space that is useless or worse is thus turned to good account.

The Young Men's Christian Association was early in the field of establishing summer camps for their membership, a movement that has grown to enormous proportions. In these camps the association director, the playground supervisor, and the social worker labor hand in hand, and the city child and young man, besides learning to practice all kinds of outdoor sports and games, can make excursions into the forest and hills and learn the mysteries of woodcraft, scouting, and bush life. The whole country from Maine to California is dotted with summer camps. Besides those established by the Young Men's Christian Association, churches, and settlements, experimental camps both for boys and girls were started by the Playground Associations of Philadelphia and elsewhere, and there are numerous camps, the result of private enterprise, where certain school studies may be combined with an outdoor life, supervised exercise, and the practice of games and woodcraft.[1] In fact, the real pioneers of this movement were the proprietors of private boys' camps who, about thirty years ago, began organizing small groups and taking them out to the woods. A conservative estimate made by Meylan places the number of boys in these private camps at about 50,000.

Two elements combine to make a successful camp: First, the supervision and program of occupation; and, second, the location and care of the sanitary arrangements.

[1] G. L. Meylan, P. E. Review, December, 1912.

The site of a camp should be on high dry ground, with a moderate growth of pine, if possible, close to the shore of a body of water and preferably on a point of land exposed to the prevailing summer breezes. It should be as free as possible from mosquitos and flies, and should have an abundant supply of drinking-water that is above reproach, and near a farm that can supply fresh fruit, vegetables, eggs, milk, butter, etc. (Meylan). There should be two roomy buildings with open fireplaces, one containing a large sitting room, office, workshop, dark room, etc., the other containing the dining room and kitchen. The sleeping quarters should be tents, varying in size to accommodate anywhere from two to ten boys. Small tents are preferable, as there is usually less noise and disturbance when the boys wake up

Fig. 95.—War canoes racing. Camp Tecumseh. (Courtesy of Dr. George W. Orton.)

early, although a large tent, accommodating five to ten boys, permits the master to exercise closer supervision. Small bungalows, accommodating six or seven boys and a master, are sometimes used instead of tents and have their advantages in rainy and cold weather. The sanitary arrangements are of the utmost importance. It is customary to have a resident camp physician, who makes a thorough examination of every camper at the opening of the camp. This examination should include height, weight, and simple tests of efficiency, with notes on the condition of the heart, lungs, and other important organs. The camp physician should be on the watch for excessive fatigue, loss of weight, lack of appetite, and accidents. He may also give short talks on diet, bathing, exercise, and clothing. The daily life should include a large amount of physical activity and ten hours' sleep, with a rest period after the midday meal. Bathing is a very important part of camp life, and a short dip before breakfast, a swim of ten or fifteen minutes before dinner, and even a third before supper are beneficial. In no case should a boy be allowed to stay in the water until chilled.

Camp life gives the best possible opportunity for teaching the management of boats, canoes, and scouting, but they also give an opportunity to supervise the diet, hours of exercise, rest, and daily occupations of boys in whose homes these things are neglected. The drills, outdoor games, and swimming may be

Fig. 96.—Off for a trip. Camp Tecumseh. (Courtesy of Dr. George W. Orton.)

supplemented by cross-country marches, mountain climbing, the carrying of packs, sleeping in tents, walking through the rain or heat, the best possible means to harden the muscles and accustom the boy to standing hardships without whimpering. The day's program in such a camp as Dr. George Orton's "Camp Tecumseh," or Dr. Meylan's on Lake Sebago starts with the bugle call at 6, short setting-up drill at 6.30, breakfast at 7; details of campers attend to their duties about the camp from 8 to 9, games or study from 9 to 11, swimming and boating from 11 to 12.30, dinner at 1, rest hour until 2.30, baseball, tennis, athletic sports, canoeing, and walks until 6, dinner at 6.30. After dinner the whole camp assembles before the camp-fire for talks and singing, and lights are put out at 9.

This routine is necessarily elastic, and parties frequently go off for a day's picnic under a councillor, usually a college student whose athletic prowess makes him a natural leader for younger boys. Even longer trips of several days may be undertaken by groups.

In 1911 the Playground Association of Philadelphia established two camps in which boys and girls between the ages of twelve and sixteen years were eligible for membership. The expense was four dollars a week per individual, and one day of

Fig. 97.—Morning gymnastics at camp Tecumseh (Dr. Orton's camp).

service a week was required from each camper as assigned by the Camp Director.[1]

These summer camps are not merely places to which boys and girls may be sent in order to keep them off the streets, but like the well-supervised playground, described in the next chapter, they may be made veritable training grounds for the teaching of proper habits of rest, sleep, and diet combined with gymnastics, athletics, and instruction in natural history. The foundation for a good character can often be laid in this familiar intercourse of camp life.

[1] The particulars about outfit, regulations, equipment, and program were published in the pamphlet of the association, 1912.

It is in this way that the Boy Scouts and the Camp-fire Girls have a real mission to perform. The Boy Scouts were founded by Lieutenant-General Sir Robert Baden-Powell, whose experience in the Boer War made him realize the helplessness of the average city dweller when called upon to take care of himself in the woods or on the plain. He started to train up boys in the art of scouting, woodcraft, teaching them observations of the birds and beasts, the management of boats, canoes, camping outfit, ropes, and arms. In America Ernest Thompson

Fig. 98.—Tomahawk throwing. (Courtesy of Dr. J. C. Elsom.)

Seton had his band of Seton Indians, to whom he taught the art of scouting and the signs of the woods, and with Dan Beard and a committee of sympathizers the modern Boy Scout movement began. It has spread with amazing rapidity, and has enlisted the enthusiastic support of every boy who can pass the tenderfoot test and scrape up the amount for a uniform, which he must buy himself. The movement has been popular throughout Europe as well as America, and has done much to build up the physique as well as the morale of its members.

The main object of the Scout movement is to teach boys to do things for themselves, to cultivate observation, and the deduction of results. Its real aim is essentially as patriotic as are the gymnastics of Sweden and Germany, and the romance of the scout and the pioneer is the peg on which hangs instruction in first-aid, tracking, signaling, woodcraft, seamanship,

Fig. 99.—Boy Scouts on the march. Philadelphia Troop. (From 1914 Year-Book of Philadelphia Troop.)

swimming, and team play. Loyalty to his country is taught through its history, and obedience breeds the necessary discipline. There are eight boys in a patrol, one of whom becomes the patrol leader. Three or more patrols form a troop, lead by a scout master. The motto is "Be Prepared," and a Scout earns in turn the badge of Tenderfoot, Second Class Scout, First Class Scout, Patrol Leader, and even Scout Master.

Badges are given for expert knowledge of rope splicing, athletics, drawing, trailing, tent pitching, etc.

Fig. 100.—The ceremonial costume of the Camp-fire Girls.

While the first idea was military and in Europe the military utility must ever be uppermost in the thoughts of its organizer, in America every effort has been made to divorce it from every military alliance, and the natural history and athletic sides have been made much more prominent. Under wise scout masters in many of our cities it has succeeded in turning street gangs of roughs into eager and alert scouts, and it has given new and absorbing interests to the boys of the village and country.

The Camp-fire Girls supplement the Boy Scouts without imitating them. They came into being to meet the demand for something for girls to correspond to the scouting for boys.

This organization, which owes its beginning to Dr. and Mrs. Luther Halsey Gulick, is now three years old, is self-supporting

Fig. 101.—The bathing costume of the Camp-fire Girls.

and self-governing, and already 2318 camps have been founded, with a membership of 29,012 (October, 1914).

The dominant idea is to keep alive the fire of the hearth and dignify the activities that surround it. Not only is the outdoor habit cultivated, but the state of mind that makes for simplicity of life, physical accomplishment, self-reliance, and cooperation. She learns to take long walks and to sleep in the open. The conquest of the water is accomplished by canoeing and the art of swimming. The Camp-fire Girl must swim

100 yards before she is allowed in a canoe, and she must learn to upset and right her craft. The care of the body is the central part of "Wohelo" (*wo*rk, *he*alth, and *lo*ve), their call, and just as the friendships which boys in their teens formed in the team work of their games lead to co-operation based on personal trust

Fig. 102.—The salute of the crew of Camp-fire Girls.

and knowledge in men, so girls are forming groups in which the spirit of team work and co-operation will appear later in women who understand each other, and are able to do team work for the home, the country, and the nation.

CHAPTER XII

MUNICIPAL PLAYGROUNDS AND BATHS

City life means biologic death. People multiply like bacteria in a culture-medium until they poison themselves with their own waste. Their marriage-rate falls, the birth-rate falls, and the death-rate rises, until the race would die out were it not kept up by a constant influx from the country and from foreign lands.

The physical degeneracy resulting from city life has been graphically shown in English army statistics by an alarming shrinkage in the height and chest measurement of young men in London and Manchester, and Germany, early recognizing this menace, legislated to prevent the overcrowding of the slum districts in her cities and has provided outlets for surplus population when overcrowding occurred.

A century ago in America only 4 per cent. of the people dwelt in towns, while in 1900 more than 30 per cent. were town or city dwellers, so that not only must the city be made fit for children to live in, but means must be taken to lessen the rush to the cities.

Far and wide rural districts have been depleted of their population until in many sections there are not enough men to exploit the natural resources of the land. Organization of play and recreation with adequate opportunities for enjoyment will undoubtedly help to check this exodus from the farm.[1]

The segregation of city life weighs most heavily on the children of all but the rich, and the survival of a strong and healthy race depends on providing breathing spaces and play for them. Most cities have grown up without having borne this in mind, and city councils are now confronted with the

[1] Henry S. Curtis, Play and Recreation for the Open Country, Ginn & Co.

need for buying ground for playgrounds in the most densely populated wards where it is most difficult to obtain.

Fig. 103.—City conditions showing need of playgrounds (Playgrounds Association of Philadelphia).

A casual visitor in Stockholm cannot but be struck at the numerous sand piles scattered about the public parks in which the children daily amuse themselves, their mothers and nurses being the only supervisors.

In London the open spaces of all sizes are eagerly acquired for this purpose. Russell Court, Drury Lane, the site of that old graveyard so graphically described by Dickens in "Bleak House," is now a playground.

Sporadic attempts for playgrounds in America may be said to have begun with the equipment of the Charles Bank Gymnasium in Boston in 1886 by the Boston Park Board. It consists of a running track, open-air gymnasium, and a small interior park with shrubs and grass; at the other end a playground

Fig. 104.—An improvised shower-bath (Playgrounds Association of Philadelphia).

for women and children with a small running track around the outside. The women's gymnasium is protected from observation by a thicket of shrubs.

In 1898 the John Dickinson Playground was established in Philadelphia. It consisted of a city block surrounded by large trees, a playground for women and children on one side and one for men and boys on the other. On account of lack of supervision and defects in construction the playground was severely criticized and finally closed up, and the whole movement received a setback until the foundation of the Playground Association of Philadelphia in 1908, and the establishment of a Municipal Board of Recreation in 1912 to supervise the twenty-four playgrounds that have been founded and equipped since then.

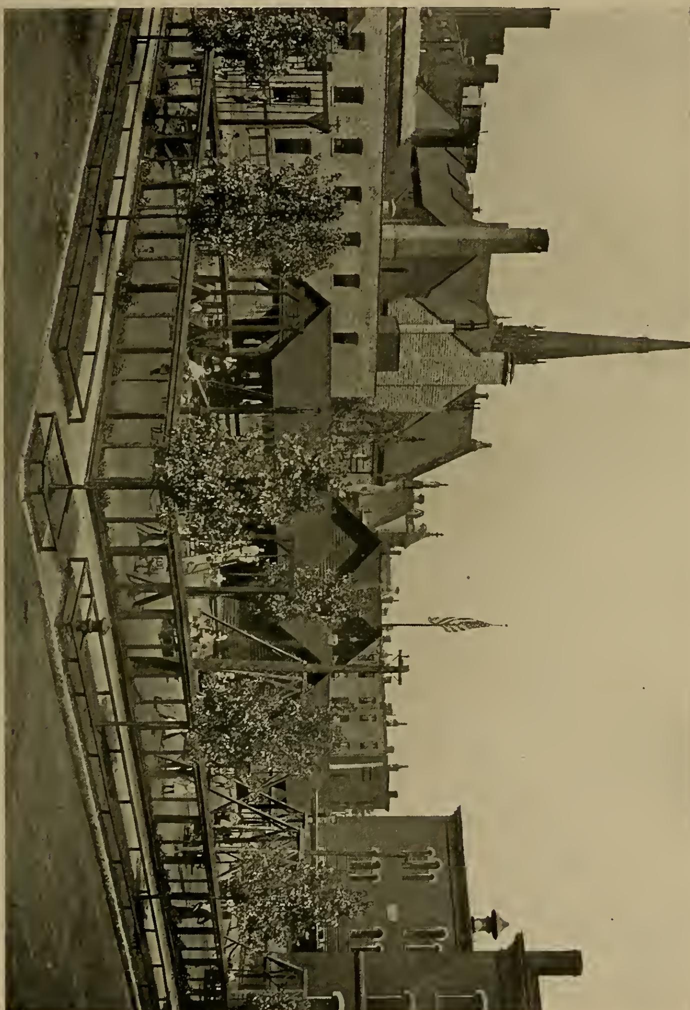


Fig. 105.—A model playground in Chicago under the special Park Commission, illustrating Type I.

The American Playground Association was established in 1906 to unite the various local bodies in one great concerted campaign to interest every American city in playgrounds and to co-operate in starting them; to plan the best equipments for various sized playgrounds; to provide model courses in playground administration for normal schools; to collect books, models, photographs, etc., as a reference library, and in general, to act as a national consulting board. In almost all cases, however, playgrounds have been obtained for a city as a result of private initiative.

Fig. 106.—Municipal playground and swimming-pool, Dayton, Ohio.

According to Joseph Lee, the plan of interesting people in the playground movement is one of *concentric circles*, the center being the pioneer desiring the playground, the *first circle* consisting of the people who are interested by him or by her in playgrounds and who will actively work to influence others; the *second circle*, composed of the organizations that should be interested naturally in the question—women's clubs, Young Men's Christian Associations, boys' clubs, associations and charities, antituberculosis societies, antichild labor organizations, juvenile courts, and trade unions; the *third circle*, city officials and leaders, officers of teachers' associations, and superintendents of education; while the *fourth circle* is the mayor and city councilmen in their official capacity, who cannot be approached

Fig. 107.—A wading pool in Fairmount Park, Philadelphia.

Fig. 108.—Sand pile (Waterview Park, Germantown, Pa.).

with success until public opinion is aroused to the point of influencing their re-election.

The usual procedure is to map out possible playground sites by wards according to population, to collect statistics of accidents, disease, and juvenile crime, to use in the plea. For

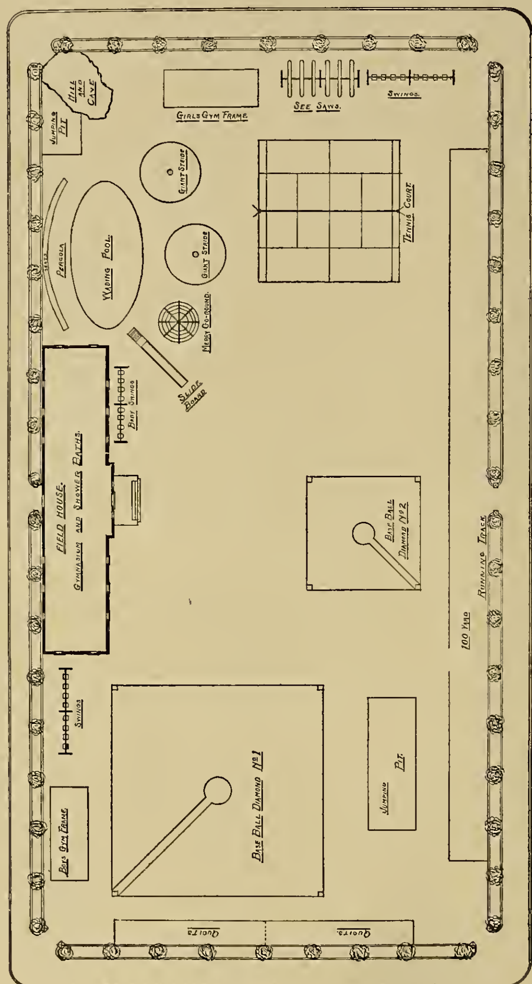


Fig. 109.—Starr Garden, Philadelphia, Type II of playground. An ideal playground except for the absence of a swimming-pool (Playgrounds Association of Philadelphia).

example, a record of twenty-one months in New York shows forty-six children between the ages of one and sixteen killed by automobiles, 140 injured: 20 killed and 17 injured by trolleys, 104 killed and 23 injured by wagons. With the adequate supervision and provision of playgrounds the greater part of this unnecessary loss of life could have been avoided.

Without playgrounds the rallying place for children is the street corner, the railway yards, and the docks. For the older boys and girls, the saloon, the pool room, the bowling alley, and the dance hall. The smashing of three windows with as many stones becomes the equivalent to pitching three balls over the home plate. The stealing of second and third base is

Fig. 110.—A swimming-pool, 42 by 100 ft., floored over as a winter gymnasium, St. Louis, Mo.

replaced by stealing fruit from the stand at the corner and outfooting the proprietor. The streets become schools for the training of criminals, who would become good citizens with adequate opportunity for play under good conditions. The introduction of playgrounds thus has a direct relation to the reduction of juvenile crime. A small neighborhood park, such as those on the South Side of Chicago, can be accepted to coincide with a 28 per cent. decrease of delinquency within the radius of $\frac{1}{2}$ mile. Over a larger area the small parks have a tendency to decrease delinquency about 17 per cent.

"In a study of fifty convictions for juvenile delinquency in Montclair, the record of each case being carefully analyzed to find out just how much of the delinquency was due to faulty recreation conditions, twenty-four, practically one-half, were due primarily to this cause. In twelve cases the primary cause was found to be laxity or lack of home-training or influence of companions; even here the matter of recreation conditions

Fig. 111.—A portable steel recreation house, 20 by 40 ft., divided into two parts for boys and girls by a removable petition. Comfort stations, 12 by 12 ft., of similar construction, are divided into four sections containing two toilets and two shower baths (Newark Playground Commission Report, 1913).

influenced the juvenile delinquency since the bad companions were often picked up during recreation hours."[1]

Many other interesting figures have been compiled by Allen T. Burns, dean of the Chicago School of Civics and Philanthropy, comparing the cost of playground maintenance with the cost of handling cases of juvenile delinquency, all of them proving it a most profitable investment financially.

In Philadelphia a gang of youths, known as the "Swamp

[1] Extract from recreation survey of Montclair made by Rowland Haynes, field-secretary of the Playground and Recreation Association of America.

Fig. 112.—Portable bath-house used in Baltimore, Md. The outside (courtesy of Playground Association of America).

Fig. 113.—Portable bath-house used in Baltimore, Md. The inside (courtesy of Playground Association of America).

Poodles," ruled with a strong arm the neighborhood of Sedgeley Avenue and Twenty-second Street. An open lot was the favorite battle-ground for this and several hostile gangs. A year ago this lot was secured by the Board of Recreation, equipped and manned, as the "Fun Field" Playground. The "swamp poodles" disputed the rights of the newcomers to interfere, but after a sharp contest and the exercise of tact and common sense these once, feared bullies became the self-constituted guardians of the playground and helped to supervise the attendance of 191,000 children, who used the ground during the following nine months.

Fig. 114.—Construction of a swing for little children in the playground.

America is confronted with the necessity of teaching the language and customs of their adopted country to the hordes of foreigners who arrive in a constant stream and congregate in such cities as Chicago and New York. The playground, or municipal gymnasium, forms the most valuable means for their education, and the experience of Chicago among the Bohemian, Lithuanian, and Polish population has justified the large annual expense. The dream of Walter Besant, in his book "All Sorts and Conditions of Men," has come true in the South Park Recreation Center. There the people's palaces are supported and paid for by all sorts and conditions of men, and the opportunities, which cannot exist in the home to entertain, to play games, to exercise, to dance, and to bathe, are provided at nominal expense. They become more than mere baths, playgrounds, and gymnasiums. They become civic homes for the people. Playgrounds may be divided into *three groups*—small, medium, and large.

Numerous small spaces of ground are to be obtained in all cities by utilizing vacant lots. They can be transformed into playgrounds for children of both sexes, and should be equipped with a few small swings, seesaws, and sand pile under canvas awning, with toilet facilities and a portable house equipped and used as a shelter for rainy weather. (See Fig. 112.) If possible, a shallow wading pool should be provided. The expense of such an equipment need not exceed fifty dollars, and in many cases can be obtained from interested supporters of the movement, some of the things being made by the children.

A typical equipment for a small playground is as follows:

	Cost.
A 10-foot double swing frame with triangular ends braced and two swings	$10– $21
Two children's 6-foot swings with canvas scups for little children to swing or sleep in, well protected from sun	10– 35
Two or three seesaws, with 14-foot boards	5– 10
Sand box varying in size and shape according to place, filled by one or two loads of fine white sand	5– 14
Awning for protection from midday sun and shelter for rainy weather	10– 60
Total cost	$40–$140

Provision must be made for rainy weather as well as bright, and the materials used by the younger children for whom such playgrounds are especially designed would consist largely of kindergarten materials, such as blocks, sand, clay, shells, boxes, spoons, cardboard, and such necessary tools as hammer, saws, nails, shovels, and buckets. An effort should be made to encourage the children to decorate and beautify these plots as much as possible. They should be scattered about the city at distances of not more than three or four blocks at the furthest from their homes. Small children cannot go more than 200 or 300 yards to their playgrounds, and for this reason city parks can be used only on rare occasions. Where vacant lots cannot be found the back yards of houses can be utilized (Fig. 115), and sometimes part of a street can be closed for heavy traffic during certain hours of the day to permit with safety games and dancing on the pavement (Fig. 115*a*).

The *second* type of playground should consist of a piece of ground from 2 to 10 acres, with a more substantial shelter containing a gymnasium and room for indoor games, toilet rooms,

Fig. 115.—The sand modeler at work in a back yard playground.

Fig. 115a.—Street closed for play, New York. Dancing to the music of a Hurdy Gurdy. (Courtesy of Playground Association of America.)

shower baths, and an office for the supervisor. The ground itself should be provided with a wading pool, sand pile or court for

Fig. 116.—The giant stride in use.

Fig. 117.—Sand pile and wading pool at Happy Hollow playground, Philadelphia.

the young children, swimming-pool for those who are older. The sand pile here may be extended to the dignity of a garden

Fig. 118.—An up-to-date equipment for second type of playground.

Fig. 119.—Apparatus in use (Gymnasium, Washington Park, Pittsburgh).

or court fenced in and provided with simple toys, buckets, shovels, and building blocks. The sand should be exposed to the sun and rain, and great care should be exercised to prevent the spread of communicable disease through this medium by changing or airing it frequently. The center of the field should be supplied with fixed apparatus. This consists of a framework of iron upon which are suspended ladders, rings, and ropes, as well as permanent sets of parallel bars and horses of varying heights, jump stands, giant strides, merry-go-rounds, circle bars, and slides.

Fig. 120.—The ever-popular slide.

Where the ground is large enough there should be a running track surrounding the field.

These playgrounds are necessarily fewer in number than the *first type*, but should not be more than ½ mile apart in the crowded sections of the city. They are intended for boys and girls from twelve to eighteen years of age, with special quarters for the younger children.

With the co-operation of the Board of Education, the school yard may well be turned into a playground of this type because the schools are placed where the children are thickest. They belong to the municipality and have the necessary conveniences already installed, with the possibility of using the basement in rainy weather. The yards are already enclosed and the janitor can look after the apparatus when the ground is not in use by the children, prevent wanton destruction, and materially lessen the cost of administration, the ground being used summer and winter. Boards of education will then be encouraged to enlarge

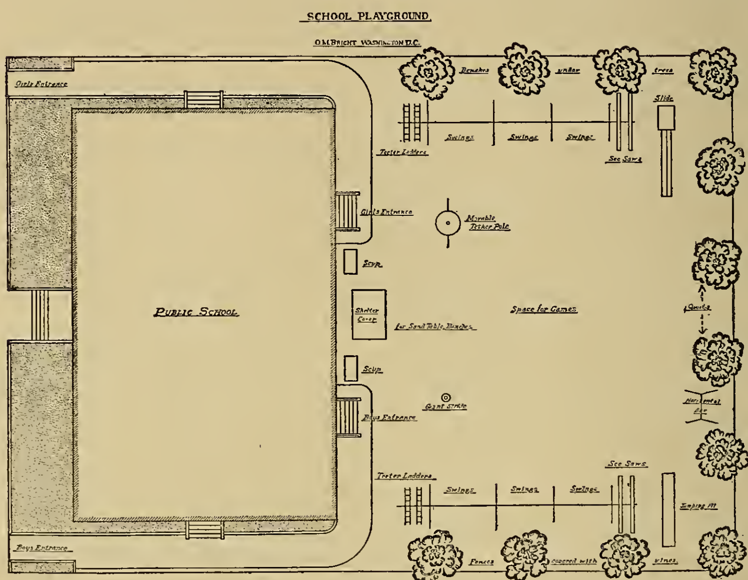


Fig. 121.—Type I of playground, combined with school yard (Elizabeth Rafter).

them by securing neighboring property, as has already been done in Philadelphia and elsewhere, and both municipality and school board profit from the combination. In the second type of playground a swimming-pool should be provided for the older boys and girls, approachable only through a room containing showers, and the utmost care should be exercised in insisting upon the preliminary shower with soap and water before entrance into the pool. Where the ground is large enough a running track should surround the field. This may be either of clay or cinders, and the best surface dressing should consist of clay and cinders mixed.

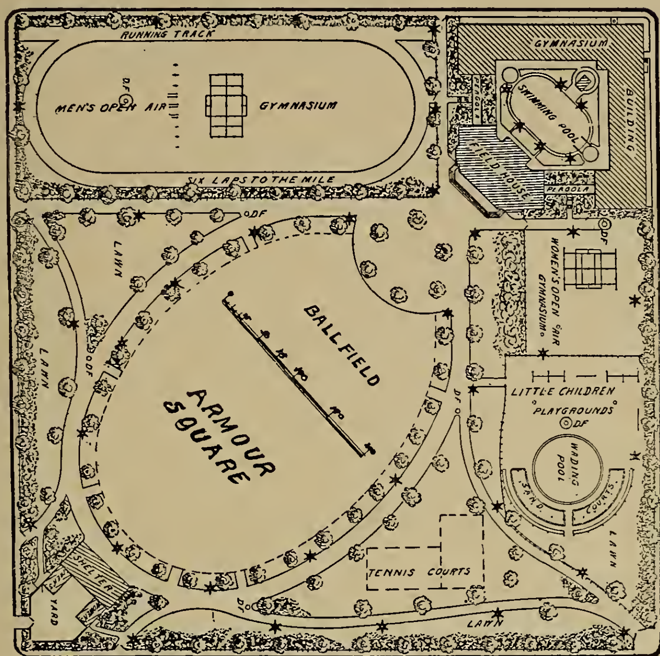


Fig. 122.—Armour Square, Chicago, showing division of space for little children, men, and for playing ball games, with the recreation building in one corner (Type II).

The following equipment is recommended by Mr. Lee F. Hanmer. The cost would be about $230, after the buildings and pools are installed:

1 shoot-the-shutes.
4 box swings for small children, under shelter.
4 sand bins for small children, under shelter.
4 large swings.
1 horizontal bar.
3 teeter boards.
1 jump pit.
1 basket-ball ground and equipment.
1 quoit ground.
Bean-bags, skipping-ropes, etc.

Facilities for boys and girls from twelve to eighteen years should be provided, although provision for the younger children must also be made in specially protected parts from which the older children cannot dislodge them.

The following would equip an ideal playground for girls of all ages and little boys:

(Size of playground, 200 by 350 ft., 1.60 acre. Capacity, 500 to 600 children.)
4 sand courts 8 by 16 ft., cement shelves at sides for sand modeling and playing jacks.
1 wading pool, 50 ft. in diameter.
4 giant strides.
12 rope swings, 10 ft. high.
2 sliding boards.
4 climbing ropes and 4 climbing poles.
2 sets (5 each) traveling rings.
1 set basket-ball goals.
4 vertical ladders and 4 inclined ladders.
6 teeter boards.
4 sets ring toss or quoits.
1 cement or wood platform for dancing, 50 ft. square.
Continuous supply of balls, bats, basket- and volley balls, nets, and bean-bags.
Approximate cost outside of pool and platform, $1200.
Pool, 18 in. deep, 50 ft. square, 17 cents per square foot, bottom and sides 7 in. thick.
Platform about 13 cents per square foot, cement.

An ideal playground equipment for boys and young men:

(Size, 200 by 450 ft., 2.06 acres. Capacity, 300 to 450 boys.)

1 quarter-mile track.	4 climbing ropes.
2 high and 2 broad jump sets.	4 climbing poles.
2 pole-vault sets.	4 vertical ladders.
30 adjustable hurdles.	4 slanting ladders.
4 rope swings.	1 buck.
3 horizontal bars.	1 horse.
2 shot-put sets.	1 parallel bar.
2 sets traveling rings (5 each).	1 set basket-ball goals.
4 sets flying rings.	4 sets quoits.
2 trapezes.	1 stop watch.
2 giant strides.	1 revolver.

Tape. megaphone, continuous supply of bats, balls, etc.
Approximate cost, $1500. Swimming-pool, 17 cents per square foot.

The *third type* of playground, which has its best examples in such places as South Park Field houses in Chicago, Boston Common, Central Park, N. Y., and Fairmount Park, Philadelphia, should be of such size as to allow large numbers of children to play at the same time. Here, great play pageants may be held and space for innumerable tennis and baseball games provided. The smallest should be large enough to allow of two baseball diamonds, a $\frac{1}{4}$-mile track with apparatus, described in the two previous types, as well as a big swimming-pool and field house.

Such a building should be the social center of the district, the spacious hall used for lectures, dances, and other social gatherings. Club rooms, gymnasium for boys and girls, offices for the administration should be included. The swimming- and wading pools should be large enough to use as a skating rink in winter. One swimming-pool, in Chicago, is $\frac{1}{2}$ acre in size, and ranges in depth from 3 to 8 feet. It is surrounded by a beach of white sand, and the only entrance is through a room containing fifteen shower-baths. The pool is lighted and kept open until 9.30 in the evening.

Play itself is neither good nor bad, but it has all the possibilities of either, so that the profession of playground supervisor is one of the most important in the whole range of the teaching profession. It has become a distinct specialty in physical education, and besides requiring unusual natural gifts it requires thorough technical preparation, which is now provided in most good normal schools of physical education. According to recent statistics it is taught in 17 schools and colleges as part of their curriculum. Courses at Wisconsin and other colleges of the Middle West and Pacific slope especially designed for this work are largely attended.

There were 900 teachers and students at the Summer School at University of California in 1913, most of them preparing for work as playground supervisors.

The director of a playground should be a trained social worker, with an understanding of the value of exercise and fresh

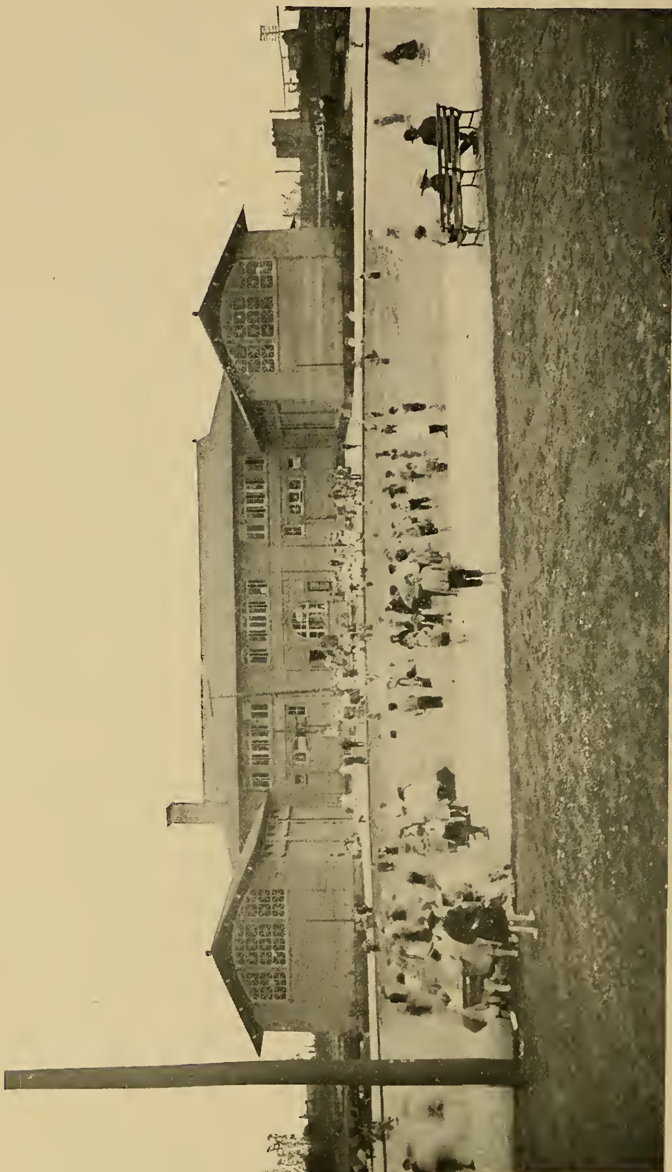


Fig. 123.—Hamilton Park Recreation Center—the Playground. Chicago spent $4,000,000 in 1905 in south side neighborhood centers. This is one of a number of neighborhood houses costing about $75,000 each. The wading pool for summer becomes a skating pond in winter. (Type III.)

air, with a knowledge of dancing, games, and all varieties of industrial work. The supervisor of a small playground for young children should be familiar with kindergarten methods. She should teach them the simple kindergarten games, direct them in their play on the sand heap, modeling or building castles with blocks, lead them in singing and dancing games, tell them stories, and take part with them in the many natural occupations that appeal to young children. This may well be combined with visiting the children's homes and tactfully instilling in the parents' minds the importance of cleanliness and personal hygiene. It is above dispute that the director makes the playground.

A good course for supervisors should include the practical use of play for conservation, for development, and for education; its relation to the public health, morals, and ideals; to school, church home, and settlement, their seasonal rotation and their application to the varying ages of the children and to the conditions peculiar to the school, the playground, the social settlement, and the church. The history of the play movement should be learned, the administration of recreation systems, including its relation to city departments and to other organizations like the Boy Scouts, Camp-fire Girls. Planning, equipment, and care of grounds should be studied and the organizing and conducting of games, athletics, dances, parties, pageants, field work, and outdoor holidays.

A typical afternoon's activity on a playground may be gathered from the program adopted for the playgrounds of Newark, New Jersey. The teachers report at 12.45, the playgrounds opening at one. The boys and girls are collected during the first twenty minutes, and a short talk is given them on some subject related to athletics, hygiene, or conduct, followed by the salute to the flag. This may be varied by some short story selected from the fairy tales, like "Uncle Remus" or the Greek legends, followed by a song. It is a moving sight to see a large number of children, many of whom have but an imperfect knowledge of the language, unite in the salute to the flag, which is given every day at the beginning of the exercises. All stand at "attention" and repeat in unison, "We the children of many lands who find rest under thy folds do pledge our lives, our hearts, and our sacred honor to love and protect thee, our country, and the liberty of the American people forever." After the salute to the flag the children go through simple marching evolutions, which bring them into position for a simple 10-minute drill either free hand, with wands, or with other apparatus. After this the boys and girls march to their own yards or playgrounds, or if the weather is inclement, to the club rooms. The children do most of the mechanical work of the playground by clearing it, raking it, watering it, digging jumping pits, preparing the baseball diamonds and running track. The girls make the bases for baseball, bean bags, and other simple apparatus. The indoor occupations consist of kite making, whittling of boats, swords, playing checkers, the use of the scroll saw, basketry, or weaving. In addition to this the girls may do plain or fancy sewing, paper cutting, and weaving. The material used is not taken home, and the children are urged to finish the work they begin. Where possible, they supply their own material and take the finished objects home.

Out on the playground volley ball is played, also basket-ball, playground ball for boys, throwing the basket-ball for distance, and dodge ball for boys and girls.

These may be enriched by many of the games described by Jessie H. Bancroft in her book on "Games for Playground, Home, School, and Gymnasium" (Macmillan & Co.), the particular game used depending on the interest shown after the game has been thoroughly tried.

For the small children kindergarten work runs all day in groups, changing periodically. Story telling is one of the most popular forms of entertainment, and the works of Hans Anderson, Sir George Besant, Maud Lindsay, Louis Carroll have unfailing interest. For the older children the "Jungle Book" of Kipling, the animal stories of Thompson Seton, with such stories as Hiawatha, Robin Hood as told by Howard Pyle, the "Wonder Book" of Hawthorne, the "Norse Stories" of Hamilton Mabie, are all most popular.

Games should be systematically taught and led by the director herself. Folk dances are taught the girls in the late

Fig. 124.—"Highland fling" by 150 children from Hamilton Park, Chicago (Graham Romeyn Taylor, in "Charities and the Commons").

afternoon. These can be taught either indoor or outdoor accompanied by the music of a phonograph.[1] A complete collection of

[1] "Bibliography of Folk Dances," P. E. Rev., vol. xiv, 1909; Folk Songs and Dances, Cecil J. Sharp (W. H. Gray & Co., N. Y.).

these dances with the method of teaching may be found in Miss Elizabeth Burchenal's,[1] or C. Ward Crampton's,[2] book.

At four o'clock in the afternoon organized and match games begin. Teams are organized and progressive tournaments arranged in basket-ball, playground ball, volley ball, and base-ball for boys, and end ball, dodge ball, and captain ball for girls. These give opportunity for teaching sportsmanship, the spirit

Fig. 125.—A hurdle-race under difficulties.

of fair play, and obedience to law. The scores of these games are posted so that the progress of each team can be followed. In the choice of games attention should be focused upon a few rather than many games. The recognized seasonal variations should be followed. There is a "top season," a "marble season,"

[1] (*a*) Dances of the People; (*b*) Folk Dances and Singing Games (G. Shirmer).
[2] The Folk Dance Book (A. S. Barnes & Co.).

a "shinny season," a time for baseball, and another for football. The more individual competitive sports should be late in the afternoon, from 4.30 to 5.30. For boys under thirteen, running, broad jumping, standing jumping, the hop, step, and jump, rope climbing, 50-yard dash, relay racing with a limit of 40 yards; for boys over thirteen and under fifteen, the running high jump, running broad jump, the running hop, step, and jump, rope climbing, the 75-yard dash, the 60-yard hurdle-race (hurdles 2 feet 6 inches), and relay racing limited to 100-yards. For girls, basket-ball throwing for distance, corn-bag throwing for height and distance, and folk dancing in groups of sixteen or more are used.

The American Playground Association has adopted a series of standard feats which every well-built boy should be able to do. A boy of twelve must pull up and chin a bar four times, clear

First test. Second test. Third test.

Fig. 126.—Form of badges designed by the author and adopted by Playground and Recreation Association of America, and which are awarded for tests of standard feats. (Copyright, 1912, by Playground and Recreation Association of America.)

5 feet 9 inches in a standing broad jump, and run 60 yards in eight and three-fifths seconds. The second test for boys of thirteen consists of pulling up and chinning six times, a standing broad jump of 6 feet 6 inches, a 60-yard dash in eight seconds, or 100-yard dash in fourteen seconds. The third test for boys of fifteen increases the pull up to nine times, and introduces a running high jump of 4 feet 4 inches and a 220-yard dash in twenty-eight seconds.

Badges are awarded for these three different classes, as shown in the illustration (Fig. 127). They are supplied at a nominal figure.

In this way the association encourages every boy to be proud of his physical efficiency, and the practice of these tests has distinctly raised the average of physical efficiency in more than one community.

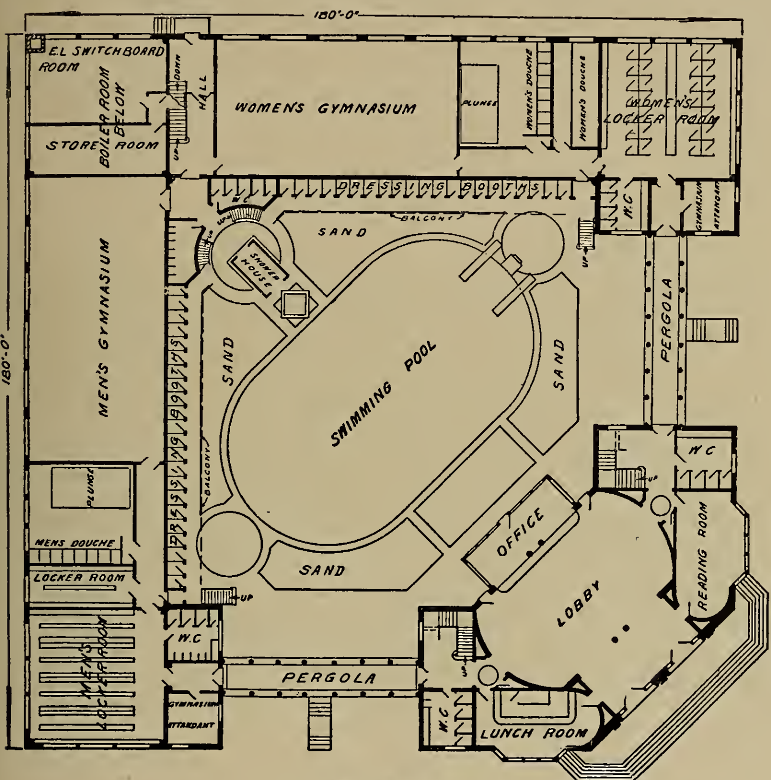
From time to time exhibitions are given which may take the form of an athletic meet, circus, or pageant. Different wards of a city are brought into friendly rivalry by relay races from playground to playground, or combine for great mass drills or processions led by bands of music organized by themselves.

A playground should be used for such national patriotic celebrations as have been designed to replace the indiscriminate use of

Fig. 127.—The swimming-pool at Sherwood Playground, Philadelphia.

fireworks on the Fourth of July. The killed and injured at the Battle of Bunker Hill were only 1474 as compared with 1622 killed and injured while celebrating the Fourth of July in 1909, and the organization of parades and pageants, such as those in Washington, Springfield, St. Louis, and St. Paul, might well be followed in other cities.

The teaching of swimming should be part of the daily program, and such games as water polo or basket-ball as designed by Dr. A. E. Garland are much in vogue. Certain days should be set apart for girls if they cannot have their own pool. Both the swimming- and wading pools can be systematically used for games of tag, leap frog, racing, and the like, and many children learn to swim instinctively or are taught by their companions. The sani-



FIRST FLOOR PLAN

Fig. 128.—Recreation building, Armour Square, Chicago, showing the only entrance to the pool from the dressing-rooms through the shower-room, where bathers can be inspected.

tation of the swimming-pool is of the utmost importance, as it is always possible to spread contagious diseases by its indiscriminate use. Each child should take a soap-and-water bath before going in. The only entrance should be through the shower-bath room, and an attendant should stand at the door to inspect each bather.

Soap, towels, and trunks should be furnished and laundered, and the bather made to come out when shivering and blueness of the lips appear. The water should be changed as often as is feasible, and there should be a continuous stream running in. The surface should be skimmed daily. If the water cannot be changed sufficiently often, the use of hypochlorid of lime will disinfect it. A cheese-cloth bag filled with the powder dragged through the pool until dissolved will destroy all bacteria, although this immunity works off in about forty-eight hours. The proportion used is 20 pounds to 1,000,000 gallons.

Fig. 129.—Municipal swimming-pool and dressing-rooms, Brookline, Mass.

In some communities public baths are the only provision made for exercise and hygiene, and the city of Brookline, Massachusetts, began its campaign for recreation and good health by building a municipal bath-house equipped with showers and swimming-pool. Free instruction was given to the residents of the town, and a smaller pool was constructed for the younger children. Closely following this bath-house a large gymnasium was built by the municipality, and organized instruction in gymnastics also free to the residents was begun. Following this provision for outdoor play was made and a playground system was organized.

Excursions may well form part of the playground activity of large cities. These may be undertaken once a week, and in this way walking trips to various points of historic interest may be made. A leader is appointed to take charge of the party, and a walk of from 3 to 5 miles is taken. Such excursions are popular in Rochester, Chicago, Buffalo, and Philadelphia, and are made the occasion for the study of botany and geology of the region, and a knowledge of plant life may thus be obtained by city children not possessed by their country-bred relations.

On the playground the child lives. In the school he only prepares to live. Watch how a child plays and you will know how he will work later on. That is why supervision by the director, who will cultivate all that is fair and honest and courageous in children, is an imperative necessity for every playground.

It is the unsupervised playground that becomes a nuisance, where the *bully* holds sway and the worst accidents and injuries occur. Without supervision the stronger boys take possession of the equipment and give no opportunity to the smaller ones, and the whole value of these laboratories for character building is destroyed and their use perverted.

CHAPTER XIII

PHYSICAL EDUCATION IN SCHOOLS

THE school and playground must divide the responsibility for the child's normal growth and physical welfare with the home.

The normal life of a child during its waking hours is one of constant muscular activity, but the teacher must inevitably suppress much of this restlessness so fundamentally related to growth if discipline is to be maintained. The lessening of natural movements by school limitations during the years of growth is harmful, not only because muscular exercise is decreased, but because nervous tension and strain are more than correspondingly increased,[1] and this tension should be repeatedly relaxed by periods of physical exercise designed with three objects in mind:

First.—To counteract all evil tendencies of the school life itself, such as the effect of the school desk on the spine, the effect of inactivity upon the abdominal organs and generally bodily growth, and, lastly, the debilitating effects of indoor life.

Second.—To give the neuromuscular training appropriate to his age, and to develop bodily control and the education of his growing powers by those simple exercises from which dances, gymnastic feats, and athletic sports and games are built.

Third.—To provide facilities for the children to practice those natural and instinctive voluntary games and activities described in the last chapter, on which their normal growth of body, mind, and spirit depend.

In the building of schools the sanitary engineer should see that every schoolroom has 15 square feet of floor space and 300 cubic feet of air for each pupil, and a system of ventilation capable of supplying him with 30 cubic feet of pure air every minute. It is his duty to see that the window area is at least one-fifth

[1] E. G. Brackett, P. E. Rev., vii, No. 3.

of the floor space, and the light arranged to come from behind or over the left shoulder and not reflected directly from the paper on the desk into the eyes; that the desks are designed to fit not only the child of normal size for his grade, but also those who are abnormally large or small. C. L. Scudder, in his investigation of school seating in Boston, found girls differing seven years in age and nearly 22 inches in height sitting at desks and seats of exactly the same size, and discovered gross misfitting of the desks in nearly every room he examined. In most schools there are still found seats so high that the pupil cannot touch

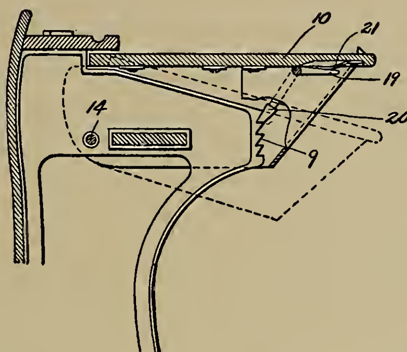


Fig. 130.—Showing mechanism for adjustment of the Garber desk: 10, Adjustable top; 14, pivot of attachment for adjustable portion of top; 19, lever pressed up by fingers to overcome the spring 21 and release the rod 20 from the serrations 9, allowing the desk to be raised or lowered at will.

the floor with his heels, desks of such height that the book is forced close to the eyes and myopia encouraged. Again, there are found desks so low that the round shoulders, the drooping heads, and the flat chests of their occupants are sadly noticeable.

Tables showing variations in each school grade have been compiled from actual measurement by W. E. Stecher.[1] They show that the desk may vary as much as 8 inches in one grade.

The relation of the seat height to the desk height should be such as to permit the elbows to rest on the desk without stooping forward or unduly raising the shoulders, and the desk edge

[1] P. E. Review, October, 1911, p. 457.

should overlap the front edge of the seat. In a carefully appointed schoolroom at least one row of seats and desks should be made adjustable in order to fit pupils that are not of the regular grade size. By this is avoided the unsuccessful and burdensome method of having all the school furniture made adjustable, which adds an additional weight to the teacher's already overloaded shoulders and is generally neglected. Most of the difficulty in seating pupils can be overcome by a self-adjusting desk and foot-rest like that invented by J. J. Garber,

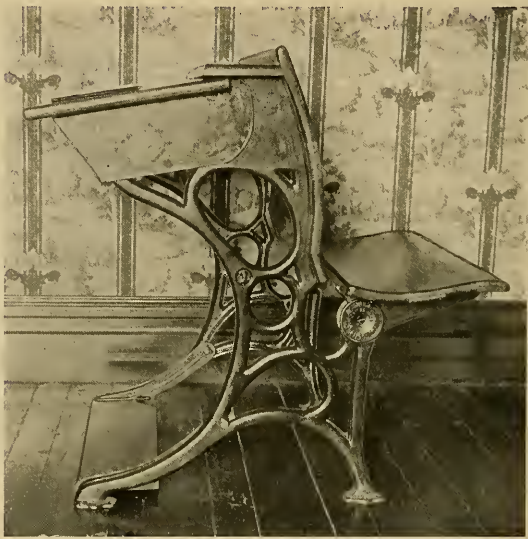


Fig. 131.—The Garber desk, adjustable by the pupil.

of Philadelphia, which can be changed to fit by the pupil himself with little noise or loss of time, the two great objections to adjustable furniture (Figs. 130, 131).

A perfect fitting seat and desk can guarantee only that the child shall be in the correct sitting position occasionally throughout the school day, for however well the desks may fit, pupils rapidly slump unless study periods are repeatedly interrupted by opportunities for movement and exercise. The upper part of the body leans forward upon or against the desk, constricting the chest, crowding the abdominal organs, and impeding the venous circulation. The weight is supported by the arms, and the head, neck, and spine hang by the muscles of the shoulder-blades in abnormal curves. To relieve this overstrain of the back and shoulder muscles the pupil changes to a pose resting the entire weight of the trunk on the shoulder-blades and lower end of the spine (Fig. 132). The back sags down in a single long curve, the chest contracts, the breathing is impeded, and the circulation made sluggish. This position stretches the muscles

Fig. 132.—Faulty posture (Shaw).

and ligaments of the spine, rounds the back and shoulders, and shoves forward the chin.

The correct sitting posture is one in which the pupil sits erect, the pelvis resting equally on the seat, with the arms beside the hips and the head poised so as to bring the center of gravity within a line joining the seat bones. This posture is economic on muscular energy and most conducive to correct carriage, but the demands of school life do not permit the pupil to keep it long. Reading, writing, and drawing are exercises that require deviations from the ideal, and if we add to these requirements ill-fitting desks and long periods of sitting, in which bad posture becomes habitual, the mischievous result cannot long be in doubt.

The work of the school day should be arranged with these things in mind.

Fig. 133.—Posture required to get support for the small of the back in the ordinary chair (American Posture League).

The first year of the child's school life should not have more than one-third of the time in confinement at the desk (Shaw).

Short periods of sitting, followed by double that time spent in muscular activity out of the seat, should be the rule. This activity may in most cases consist of movements correlated with intellectual exercise. In the kindergarten the exercise is admirably combined with mental culture by the teaching of imitative games in which the large muscle groups are exercised in hopping, jumping, and running, and in imitating with the arms the flight of birds and insects. The circulation is stimulated and postural faults are prevented, while at the same time the child is taught valuable lessons in natural history in which his interest never lags. The names of these games are suggestive of the action—"The windmill's fans around they go" (Blow), "Mow, mow the

Fig. 134.—Unsupported back while in the correct sitting position (American Posture League).

oats" (Hofer), "Little ball pass along" (Jenks and Walker). They may be divided into:

1. Games of pursuit—"Chasing the squirrel."

2. Imitation games—"Shall we show you how the farmer?" (Blow).

3. Rhythmic and dancing games—"Tick-tack" (Hubbard).

4. Marching games—"Left, left, listen to the music" (Gaynor).

5. Ball games—"In my hand a ball I hold" (Jenks and Walker).

They are always accompanied by music, and most of them can be carried on to the primary schools.

In the succeeding years of the elementary school the proportion of time spent at the desk may be gradually lengthened, but short periods of respite from sitting should be frequent and

Fig. 135.—A kindergarten game in the school yard.

devoted to brisk physical exercise. In the last year of the elementary school course there should be three stated periods of five minutes each during the morning and three during the afternoon session devoted to exercise corrective in character and designed to bring into use muscles inactive or overstrained at the desk. In addition to this, there should be a recess in both morning and afternoon session of not less than fifteen minutes so that the schoolroom may be thoroughly aired during recess. In this way, one-half hour morning and afternoon is spent in

Fig. 136.—A recess game at the Thompson Street School, Philadelphia.

exercise that is both corrective and recreational. All the pupils, if the weather and climate permit, should go out of doors and

Fig. 137.—Method of using the school furniture to replace gymnastic apparatus in Philadelphia schools. The "dip" between the seats.

engage in spontaneous play, where they can run, shout, and give vent to their pent-up animal spirits, quicken their circulation, and relieve the nervous tension caused by keeping still, and so rest and invigorate all their nervous and muscular system.

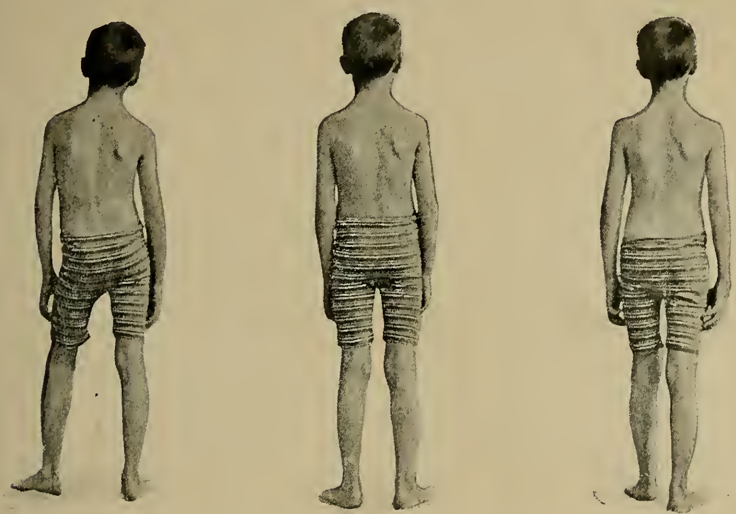
Fig. 138.—"Follow your leader" through the seats and aisles of the schoolroom. The alternate files in the picture should be reversed, and the game continues until the players are back to their own desk.

Special games have been designed and collected by Doctor E. H. Arnold, Jessie H. Bancroft, and William A. Stecher, in some cases original, in others, adapted from old and popular children's

Fig. 139.—A roof playground in a crowded section of New York (Playground Associations of New York).

plays, and changed for the use of the many children who have to occupy the confined space of the playground. These games should be taught and practised during the recess period, although it is not so much the number of games that is necessary as their supervision, organization, and the time and space to play a few good ones. The classification of schoolroom and recess games has been carried to a high degree of perfection by H. Randall Worden, of Newark.[1]

The school day of children in the higher grades should have two five-minute periods of corrective exercise at least in addition to the games of the recess above described. These exercises should be designed to promote quick, strong, muscular



1 2 3

Fig. 140.—Mosher's postures in standing.

control; to expand and enlarge the chest by deep breathing; to bring the blood from the abdomen out into the extremities; to correct spinal deformities, and to teach the proper carriage of the body.

It is not possible for a child to remain long at rest with the weight equally on both feet (Fig. 140, 2), because the tension on both legs being the same the muscles rapidly tire. The pupil instinctively rests his weight on the right, placing his left leg

[1] P. E. Review, June, 1911.

with bent knee out to the side as a prop (Fig. 140, 1). This resting position lowers the right shoulder, curves the spine, and may start the first stage of a permanent scoliosis.

The best resting pose to teach is that recommended by Doctor Eliza Mosher (Fig. 140, 3), in which the inactive foot is placed in front instead of at the side. In this the feet can be changed as the weight-bearing leg tires.

Fig. 141.—Chart issued by the American Posture League.

A series of three tests are described by Jessie H. Bancroft, of Brooklyn, to diagnose bad posture, and to apply the teaching of correct habits of standing and walking to large numbers of school children by the regular school teachers themselves.

The *triple test* in use throughout the schools of New York has made it possible for even the untrained teacher to give an accurate estimate of a child's posture. The first part of the test is designed to find the pupil's ability to take the erect attitude. The long axis of the trunk should be in a perfectly vertical line and should continue the long axis of the head and neck. As seen from the side, the shoulder-blades should lie flat on the back and the middle of the round or the tip of the shoulder should lie back of the forward border of the ear. To assist the eye of the observer, a vertical line may be dropped from the front of the ear to the forward part of the foot. In poor posture the axes of the head, neck, and trunk will form a zigzag instead of a straight line. This can be demonstrated by placing the extended hand on the shoulder vertically with the ulnar side down.

Another simple way to estimate the extent of the deformity is to stand the patient beside an upright pole or rod. The variations from correct posture are three: the so-called fatigue, or *gorilla type*, in which the head is shoved forward, the chest sunken, and the abdomen protruded; the *round back* posture, in which the hollow at the small of the back is obliterated, a posture cultivated by faults of seating already described; and the *bantam*, or *pouter pigeon* type, in which the chest is pushed forward and upward and the lower spine overextended, forming a marked exaggeration of the natural lumbar curve. This posture is always the result of faulty teaching, and is an exaggeration of the correct standing posture caused by the mistaken efforts on the part of the teacher to overcorrect the first two faults.

The *vertical line test*, then, is the first element in standardizing posture. A child who can assume a good posture for a few moments may not be able to hold it, so that some test of endurance is obviously necessary. The maintaining of good posture while marching is added as a second requirement, and following this the test of correct posture under exercise (Fig. 142) is added to complete the test. An entire class may be taken at once, or else they may be taken row by row. The standing pupils are looked over in profile. Those who do not stand in the correct position are asked to sit down or move to one side. Those who pass the first test move forward and form a single line across the front of the room, and are given marching exercises for four or five minutes. An effort is made during the march to distract their attention from any artificial effort for correct carriage by drilling them in facings, marking time, halting, etc. As the march proceeds, old muscle habits reassert themselves and many pupils who could hold the correct posture for a few minutes fall back into habitual faults. Heads will drop forward, shoulders droop, and chest sink as they march. As these faults appear the child is taken out of the marching line. Those who pass the standing and marching tests are then put through the third test, designed to show the action and endurance of the muscles of the spine and shoulders that are usually the first to yield to fatigue. When the arms are raised upward these *postural muscles*, if weak, allow the chin to come forward and the chest to sink backward, so that a few minutes spent in raising the arms forward and upward fully extended, lowering them sideward and downward to the position at the start, will bring this weakness to the surface.

Fig. 142.—Correct posture with forward arm raising.

Pupils showing the faults just mentioned should be dropped from the group. The survivors of these three tests are put in Division 1, and the remainder of the class in Division 2. This triple test should be given once a month, and should occupy from ten to twenty minutes in a class of forty or fifty pupils. Determining the posture is merely the first step, although a most important one, and the next is the systematic training of the muscular sense whereby a child may know whether or not he has corrected it, teaching him to assume it voluntarily, and the strengthening by exercise of those muscles whose weakness allows him to lapse.[1]

[1] C. Ward Crampton's "elevation cues" are of great value to establish the correct standing posture. They are as follows: Head—up; chest—up; waist—flat; weight—forward (Syllabus on Physical Training, New York schools).

The fatigue posture is the most common, and this may be corrected in the class exercises by having the entire class stretch the arms strongly sideward at the shoulder level with palms turned downward. In this position the pupils sway forward as far as possible without losing the balance. Swaying forward and backward will almost always bring the chest forward into the correct position, although a considerable number of pupils require individual help in assuming it. When each

Fig. 143.—Sunken chest position with weight on heels.

Fig. 144.—Forward swaying with weight on the balls of the feet and correct chest position.

pupil in a class has learned to stand correctly, a short drill or lesson to fix it in their minds together will be of service to fix it in their minds, together with certain home exercises described in detail in Miss Bancroft's[1] book on the subject.

This system has been in use for some time in the schools of New York, Newark, Detroit, and elsewhere, with most gratifying results. In a review of 33,000 Brooklyn children the first test

[1] Jesse H. Bancroft, The Posture of School Children (McMillans, 1913).

showed 43 per cent. who were unable to take the first standing position correctly. In the following June 83 per cent. of them passed the triple test in standing, marching, and gymnastic exercise. The following year the methods were extended to upward of 200,000 children from the second to the eighth grades with commensurate results.

This test standardizes posture and takes it away from the individual opinion of each teacher. It furnishes the basis for comparing class with class. By putting the results on the blackboard the class has its percentage always before its eyes, the interest of the pupils is stimulated, and an incentive supplied that relieves the overconscientious teacher of the necessity for continual nagging. It is found by experience that about 85 per cent. of efficiency is the average figure, although some special classes have attained a percentage of 100.

About 40 per cent. of high-school boys and girls require the correction of some postural defect. An analysis of 2000 consecutive examinations of children in one of the best high-schools in New York showed 32 per cent. of scoliosis with slight flat-foot, while in 12 per cent. the foot arches were badly broken down. In many cases the postural defects were merely a local symptom of a more profound constitutional weakness.

Physical training in the schools is, however, not merely a matter of health. It is necessary for the education of the fundamental nerve-centers of the body and the building of character. During the whole of childhood these centers are developing and their growth is not completed until adult life, as has been explained in Chapter VI. For this reason not less than one hour in five should be devoted to training the motor area of the brain, in addition to the time allowed for free play. This should take the form of both gymnastics and athletics.

Gymnastics, in addition to their corrective or medical character, have a value in discipline and also in the accurate application of exercise for a given purpose; they are less diffuse than athletics, more concentrated, and for this reason they cannot be applied closely to the very young except in the guise of play.

The schoolroom has been the battle-ground on which the Germans and Swedes have fought the most vigorous campaign in favor of their respective systems. Both have a place in the day's work. The more purely corrective exercises done to word of command and designed to prevent or remedy flat chest, round shoulders, and faulty standing positions stick more or less closely to the Swedish system, while rhythmic exercises done to music and the teaching of movements by imitation are more characteristic of the German system.

The tendency in America is away from the Swedish day's order, in which movements are grouped according to the regions exercised, and toward the German idea which places emphasis on the object to be achieved. The day's order in the New York schools, designed by C. Ward Crampton, divides the period into five: (1) Introductory; (2) corrective; (3) educational; (4) hygienic; (5) recreative, in which rhythmic and static exercises are mingled. The strong German influence in St. Louis is seen in the physical training of her schools.[1]

In the Philadelphia schools recreation drills are used in addition to the more corrective work, and sometimes the children are allowed to run freely in the school yard, or to take jumping and vaulting exercises with the desks as apparatus. Rhythmic exercises to music or gymnastic games are also employed, but all gymnastic work in the schoolroom is short, light, and corrective in character, and must stop short of perspiration. It is at best a makeshift, and should be looked upon as a substitute for the more vigorous exercise of the gymnasium or playground.

Every school should be provided with a gymnasium large enough to allow vigorous work for an entire class or for several classes together, as in the Woodward School, in Cincinnati. Here the dressing-rooms and lockers for each sex permit a complete change of clothing with the liberal use of the shower and swimming-pool.

The school gymnasium should be in a separate building if

[1] E. Kinderwater, P. E. Rev., vol. xv, 302.

possible, as in the Berringer School at Newark, but when this is not feasible the upper floor should be used in preference to the basement. The ventilation should be abundant with forced draft, and the ceiling should be at least 20 feet high. A gallery containing a running track should surround the room, and vaulting bars, ladders, and suspended parallels may be attached beneath to it. The vaulting horses, jumping standards, parallel and horizontal bars should be in groups from four to six as at West Point and in the University of Pennsylvania (see p. 260) and Lawrenceville

Fig. 145.—Dancing to the phonograph. Part of the regular physical training of the New York schools. (Dr. C. Ward Crampton, Director of Physical Training.)

School gymnasiums to facilitate the handling of large classes, and these should be set in floor sockets and easily removable so that the floor may be cleared for mass drills, marching exercises, and games. Around the walls chest weights and other developing appliances should be set, with the boom, stall bars, dumb-bells, clubs, bar-bells, and wands. There should be an abundant supply of mats. The equipment will vary with the conditions, however, and a reliable gymnasium outfitter should be consulted for the design and instalment of the apparatus.

The playground must provide 60 square feet of space for each pupil, or a plot 600 by 200 feet for a school of 1000 pupils, and the apparatus should be like that of a playground of the second class already described, except that there should be a strip of cement at least 25 feet wide adjoining the school house, and the rest of the ground should be built on a foundation of 18 inches of cinders, rolled and top dressed with finely crushed stone, with 8-inch sand-pits under the horizontal bars and rings, and for jumping.

The need for playgrounds about school buildings becomes more and more urgent as the population of a city increases, and in Philadelphia and New York the roof itself is used, caged in by wire netting. These roof playgrounds give the only opportunity many children have for engaging in outdoor games and athletics, especially in New York City where the population is so dense.

Courses of instruction for teachers of physical education are given in the Summer Schools at Harvard, Pennsylvania, Wisconsin, McGill, and elsewhere, and many grade teachers add this to their other equipment and take charge of playground direction during the summer vacation and during the winter, where they direct the voluntary exercises of pupils either in the gymnasium or playground after school hours, usually without extra pay.

The Public School Athletic League of the city of New York was founded in 1903 by Doctor Luther Halsey Gulick, then superintendent of physical education. The organization was perfected by the election as officers of men influential in the political and financial world, and by securing the co-operation of teachers and principals. The first athletic meet was held at Madison Square Garden and brought about 1500 entries. Since then the league has given thousands of meets and often well over 600 athletic meetings in one year. At many of them over 1000 competitors take part, and now a single school may hold a meeting with 700 competitors, the games covering all kinds of athletic competition. Running and relay racing constitute a majority of the events not only because of their value as exercise, but also because they enable a large number of boys to be handled rapidly. Boys are classified by weight instead of age. The scales are set at the weight limit and competitors pass over them like sheep over a gate, each one being branded by a rubber stamp on the shoulder if he succeeds in standing on the platform of the scales without raising the bar. This is quick and conclusive and prevents all possibility of discussion. There are contests also in high jumping, pole vaulting, putting the shot,

Fig. 146.—Weighing competitors for the midget class before a race (the Public School Athletic League of New York).

basket-ball, soccer, football, cross-country running, swimming, ice and roller skating, and shooting. Baseball is perhaps the most popular, and hundreds of baseball teams compete against each other in the league. Trophies and medals have been secured for competition, and many other devices are used for extending the exercise to as many boys as possible. In order to minimize excessive competition, especially between individual boys for whom the strain and excitement might be too great, prize buttons were given to all boys who achieved a certain standard of merit. To win a button he must pass standards that have been set as follows:

(*A*) *For elementary school boys under thirteen years:*

1. Run 60 yd. in eight and three-fifth seconds.
2. Chin the bar four times.
3. Standing broad jump, 5 ft. 9 in.

(*B*) *For all other elementary school boys:*

1. Run 60 yd. indoors in eight seconds.
2. 100-yd. dash outdoors, fourteen seconds.
3. Chin bar six times.
4. Standing broad jump, 6 ft. 6 in.

(*C*) *For high-school boys:*

1. Run 220 yd. twenty-eight seconds.
2. Chin bar nine times.
3. Running high jump, 4 ft. 4 in.

These tests have been extended to class competition, where all boys in the class compete to make an average.

Teachers have been astonished as well as pleased with the improvement in discipline among these young and ambitious athletes, and this alone has insured their active co-operation as well as the enthusiastic support of the boys. The league aids in the maintenance of discipline by requiring a certificate from the principal stating that the boy has reached a passing mark in his studies and deportment before allowing him to compete either for a button or other prize.

Systematic instruction in military rifle shooting has been made possible by the invention of the *subtarget machine.* It consists of a standard with an ordinary Krag military rifle attached to a mechanism on top. This is so adjusted that when aim is taken with the rifle at a target across the room and the trigger pulled the machine registers upon a miniature target the exact relative place that would have been hit if the gun were loaded, as well as the oscillation of the muzzle while aiming. As there is no danger connected with it the practice is rapid and

Fig. 147.—Argument in favor of weight classes—the small boy is the older by three months (Handbook Public School Athletic League, New York).

Fig. 148.—Teaching New York school boys track athletics after school hours. In 125 school centers the attendance for one month (June) was 2,043,973 boys. (Dr. C. Ward Crampton, Director of Physical Training.)

economical, the mechanism being easily set up in any school room. The instructor standing at the boy's side is able to follow the manner in which he is aiming and to correct his defects. Instruction in the holding and sighting of the rifle is given and annual interschool contests are held, ending in a final contest among the winning schools at Creedmoor with the actual rifle

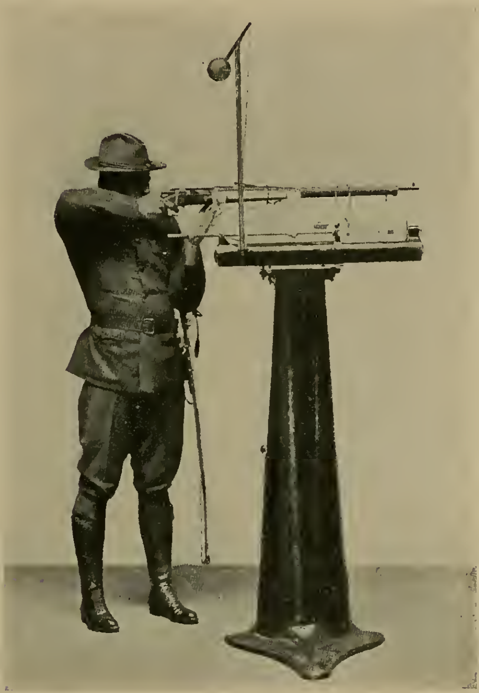


Fig. 149.—Subtarget gun machine for rifle practice in high schools (Handbook of Public School Athletic League, New York).

at distances of 100 to 400 yards. The boys thus have an opportunity for acquiring the knowledge of wind, atmosphere, and light necessary for good shooting in the field. This has been made part of the program for the School Athletic League and has been a source of keen interest to the boys, many of whom have acquired great skill. Upon attaining a certain degree of efficiency each competitor is given a badge. The national importance of having an army of boys graduated every year, each one knowing the feel of a rifle in his hand and having a knowledge of its use, a knowledge that never leaves him, need not be dwelt upon here.

The Public School Athletic League has extended its work by the formation of the girl's branch. Voluntary classes in gymnastics, games, and dancing have been introduced among the girls attending the public schools, from which teachers are by no means excluded, and many of them attend, leading classes of

Fig. 150.—The English ribbon dance (Public School Athletic League, New York). (American Sports Pub. Co.)

their own. Exercises most popular and generally practised by the girls are the peasant dances of Sweden, Scotland, Ireland, and Spain, involving much gymnastic work, and developing strength, agility, and grace. Games adapted for indoor and outdoor spaces are practised, and relay races between classes and schools have become a favorite feature. Athletic competition in public between girls or teams of girls has been discouraged, and its place taken by dancing fêtes in Central Park that have become so attractive a sight.

Owing to the difficulty of finding a spacious ground for

Fig. 151.—Relay race, Girls' Branch Public Schools Athletic League.

Fig. 152.—Field day for school children, Franklin Field, Philadelphia, June 20, 1908 (Playgrounds Association of Philadelphia).

their athletic competitions and exhibitions, the Public School Athletic League has been the means of drawing attention to the need of good playgrounds in New York City. Largely through the influence of its officers, $500,000 was appropriated by the city for the purchasing and equipping of four athletic fields.

Fig. 153.—Ten acres of dancing girls (Public School Athletic League, New York).

It was impossible to procure sites on Manhattan Island, so that one was built in Astoria, one at Crotona Park, another at Stapleton, Staten Island, and a fourth in south Brooklyn.

These fields are equipped with running tracks, grand stands, and dressing-rooms, but if adequate provision had been made as the city was built it would not have been necessary to go so far afield.

Leagues similar in objects and character have since then been formed in Newark, Chicago, Cleveland, and elsewhere. In Newark, where the work is particularly active and well organized, a medical examination of all contestants is required, about 80 boys out of 2000 competitors being found physically unfit. In Philadelphia an athletic committee of the Playground Association organized the athletic interests of the schools, both public and parochial, on rather different lines, both sexes being included in one league, and the first field day was held in June, 1908, with 5000 children of both sexes taking part. A yearly festival has been given ever since on Belmont plateau. It differs from the leagues of New York, Newark, and Cleveland by laying more stress on exhibition drills and interschool competition in drills and games, after the German custom, where as many as 400 pupils from one school take part in a drill in competition with groups of 50 to 100 from smaller ones. In addition to this there are group contests, relay races, and individual events. By such means the play life of the child can be provided for in addition to the more purely literary exercises that come more obviously into the province of the schools.

CHAPTER XIV

PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES

There is a distinct break between school life and the life of the student.

Most school children go into business or into a trade on leaving school, and many men enter college who have had but meager experience of school life. The long hours of school work, the nervous exhaustion of teaching, the nights spent in study, and the days in the office, factory, or shop, all leave their imprint so deeply that the knowledge, or even the desire, for a fuller and larger physical life may be atrophied or stamped out in the very youths whose success in after-life vitally depends on the development and conservation of their physical powers.

The college student must then be educated in personal hygiene. His remediable defects must be corrected and his physical powers trained to the highest point of efficiency. He must be taught that graceful carriage characteristic of the well-bred man. His powers of self-preservation and efficiency must be increased. If he has not learned it already, he must be given the capacity for physical recreation by knowledge of sports and games, for athletic activity should be the safety valve of a sedentary life, and should also teach those social and moral qualities which can be cultivated so well in no other way.

The necessity for physical training to go hand in hand with the other courses of the college curriculum has been recognized by advanced thinkers from the earliest times. Benjamin Franklin, in writing the pamphlet in 1749 that led to the founding of an academy for the education of the youth, now the University of Pennsylvania, expressly states "*that to keep them in health and to strengthen and render active their bodies they be frequently exer-*

cised in running, leaping, wrestling, and swimming." Nearly forty years later Thomas Jefferson wrote to Peter Carr concerning his studies:

"Give about two hours of every day to exercise, for health must not be sacrificed to learning."

In drafting the plans for the University of Virginia Jefferson did not forget the place of exercise, but advocated military drill and maneuvers as the best means of exercise to meet conditions then existing.

The wave of interest in German gymnastics reached America about 1825, as already described in a previous chapter, and the catalogue of Harvard College (1827–1828) contains the name of Dr. Charles Follen, superintendent of the gymnasium and instructor in German. About this time these exercises were introduced into Brown, Williams, and Yale, as well as many secondary schools, but the German pioneers soon found that their status in America was not considered equal to the teachers of more purely intellectual subjects, and soon tired of teaching boys to turn somersaults when the rewards for more purely intellectual work were greater.

In 1860 the first chair of Physical Education and Hygiene in an American college was established at Amherst. Its occupant, Dr. Hooker, was succeeded within a year by Dr. Edward H. Hitchcock, who retained the professorship until his death in 1911. His collection of vital statistics are the longest continuous series of observations on college men yet made, and the conclusions from them, embodied in charts and reports compiled by him and his successor, Dr. Paul C. Philips, show a consistent improvement in the students' health and proportions from freshman to senior year under systematic exercise. From them we have been able to conclude that the height and weight of the Amherst student at least has gradually increased during the last fifty years.

In 1879 Dr. Dudley A. Sargent was given the direction of the Hemenway Gymnasium at Harvard, and he at once began the patient accumulation of vital statistics now reduced to chart

No......................... **UNIVERSITY OF PENNSYLVANIA** *Date*..

DEPARTMENT OF PHYSICAL EDUCATION.

Present this card to Dr. McKenzie at the hour for physical examination with all questions answered.
ANSWER EVERY QUESTION. The information obtained will be considered strictly confidential.

Name in full...Class and Department...

Date of birth...Father's age...Mother's age...
(If deceased, age and cause of death)

Derivation...Do you resemble physically your father's or mother's family?...
(English, German, French, Italian, Spanish, Hebrew, Chinese, Japanese, Negro,)

What relatives have had consumption, rheumatism, disease of kidneys, disease or disorder of the nervous system?...

In what forms of manual work have you been engaged?...Can you swim?...

What sports or games have you practised?...
(foot ball base ball, track, rowing, tennis, hand ball, boxing, wrestling etc.)

In what form, if any, do you use tobacco?...What is your daily average?...At what age did you begin?...

Do you use alcohol in any form?...To what extent daily?...When were you last vaccinated successfully?...

What illnesses have kept you in bed for two weeks or more?...
(rheumatism, scarlet fever, typhoid, pneumonia, pleurisy, appendicitis, etc.)

Have you any remaining effects from a previous illness, accident or operation?...
(strains, operation wounds, heart weakness, etc.)

Are your appetite and digestion good?...Are you subject to constipation?...diarrhoea?...bilious attacks?...

Are you subject to colds in the head?...throat?...chest?...Have you any obstruction in either nostril?...

Do you suffer habitually from cold hands and feet?...Have you ever fainted? State particulars...

Have you ever had your eyes examined?...Do you wear glasses?...Do you suffer from sleeplessness?...Headaches?...

Have you ever had earache, discharge from ears or other trouble with hearing?...

Have you ever had any disorder of kidneys, bladder or any venereal diseases?...

Write here any facts bearing on your past or present health that may not have been covered in the preceding questions...

....

....

....

Fig. 154.—History card given the student when his appointment for examination is made, and filled by him.

UNIVERSITY OF PENNSYLVANIA

DEPARTMENT OF PHYSICAL EDUCATION

DATE .... NAME ....

Weight					Girth—Upper Arm, L., flexed				
Height					" Forearm, L.				
Body Length, episternal					" Thigh, R.				
Breadth of Shoulders, bi-deltoid					" Calf, R.				
" " Chest, normal					" Thigh, L.				
" " Waist					" Calf, L.				
" " Hips					Lung Capacity				
Depth of Chest, normal					Strength of Legs				
" " Abdomen, normal					" " Back				
Girth—Neck					" " Arm Flexors				
" Chest, normal, above nipple line					" " " Extensors				
" Lower Chest, expanded					" " Grip, R.				
" " " contracted					" " Grip, L.				
" Waist					Total Strength				
" Hips					Index—Weight—Height $\frac{W}{H}$				
" Upper Arm, R., flexed					" Strength Weight=$\frac{TS}{W}$				
" Forearm, R.									

MEDICAL EXAMINATION.

General posture.................Shoulders.................Spine.................Chest.................Abdomen.................

Legs (R).................(L).................Feet (R).................(L).................

Condition of skin.................Fat.................Veins.................Muscles.................

Muscular development of Back.................Chest.................Abdomen.................Arms.................Legs.................

Condition of lungs.................External condition of ears.................Hearing (R).................(L).................

Condition of heart.................Pulse reclining.................Standing.................Blood pressure { standing................. lying.................

Urinalysis, Sp. Gr.................Reaction.................Albumen.................Sugar.................Casts.................

NOTES.................

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Credits Yr. P.N. .... Yr. P.N. .... Yr. P.N. .... Yr. P.N. ....

STANDARD INDEX CARD CO. 146490

Fig. 155.—Examination form filled by the examiner and containing blanks at the bottom for his yearly record of credits in physical education.

form and available for reference. Owing to the extreme development of the elective system at Harvard no requirement for physical exercise was made, all work being voluntary and carried out according to Dr. Sargent's system of individual exercises in contrast with the usual class instruction.

In the last ten years there has been a marked development in the attention paid to physical training in American colleges. The Division of Physical Education and Athletics in the University of Chicago was founded in 1892, and by the construction of the Bartlett Gymnasium in 1904 it became possible to carry out a definite undergraduate requirement, and also to provide for the adequate supervision and control, financial and otherwise, of university athletics. This is the ideal relationship between gymnastic training and competitive athletics, each having its place in a complete system of physical education.

The Department of Physical Education, reorganized in 1904 at the University of Pennsylvania, requires from the four undergraduate years and from the primary years in the professional schools, except those holding a bachelor's degree, a minimum of two hours of exercise a week.

The Department of Hygiene in the College of the City of New York, organized in 1906, has a two-year requirement and rigorous system of examination and health supervision, while the Department of Hygiene and Physical Education at Princeton, founded in 1910, has begun with a freshman requirement of three periods a week.

In 1912, 94 per cent. of the colleges on the Carnegie Foundation had established definite instruction in physical training, while 75 per cent. of the officers in charge were members of the college faculty. Regular exercise is prescribed for the whole four years in some cases or, more frequently, for the first two years only, and one-half of them have provision for the care of the physically defective. Definite scholastic credit is given in over 50 per cent. of all these colleges.[1]

[1] Meylan, "Status of Physical Education in American Colleges," P. E. Rev., February, 1912.

A university course in physical education should begin with a careful examination to find the exact bodily condition of the student, and so to give an intelligent foundation on which to base advice and instruction. The student should be measured and his strength tested to see how he compares with his fellows in proportion and power. His posture and muscular development should be noted and his heart, and lungs examined for any latent weakness or disease. The acuteness of his sight and hearing should be carefully calculated, for he must know if there be any serious obstruction of the two most important avenues by

Fig. 156.—Exercise to develop the abdominal muscles on the Swedish stall bars (University of Pennsylvania gymnasium).

which his knowledge is to come to him. At the College of the City of New York, Dr. Thomas A. Storey lays stress on the medical examination and the examination of the teeth, while the examination of the nose and throat is conducted as a routine measure at Haverford and at Michigan.[1]

The examination of the student is not complete without a test of his ability to accomplish certain muscular feats that cover the main activities of the body, both in exercises of maximum effort and of endurance.

[1] George E. May, M. D., "Results of One Thousand Examinations of the Nose and Throat at University of Michigan," P. E. Rev., vol. xiv.

An analysis of the examination of 1000 freshmen at the University of Pennsylvania showed that about 30 per cent. had lived a sedentary life, and it is all too common to find the broken-down arch of the foot, the flat chest, and protruding abdomen of the anemic school boy, with his round shoulders, protruding chin, and flabby muscles, the drooping shoulder and the curved spine, or the dull hearing and faulty sight that have been the unsuspected cause of headaches, nervous irritability, and exhaustion. It is the province of the Department of Physical Education to bring this defective physique up to its normal level. For specific defects corrective exercises are required. Recently, a young man came to college having been rejected at West Point because of flat-foot and lateral curvature. A six months' course of prescribed exercise, lasting about one-half hour daily and carried out faithfully, enabled him to pass the required physical examination easily.

Another freshman, entering on the study of architecture, complained that he could not study on account of frequent headaches, especially after reading or drafting. His eye examination showed less than one-half the normal acuity, unsuspected and, of course, uncorrected by glasses.

A third-year man reported a progressive loss in weight, with distinct signs of incipient tuberculosis in the apex of one lung. A course of forced feeding, rest, and other treatment enabled him to regain his lost weight and to overcome the disease in a month or two, whereas if left to himself he would have broken down during the course of the winter's work.

Hundreds of similar cases come under the medical examiner's eye each year, and proper advice at the beginning of his course will prevent the appalling waste of time and energy inevitable for the man who struggles along with these handicaps uncorrected. Constant personal counsel about exercise and other questions of personal hygiene go far to safeguard the comfort and efficiency of these students. The main work of the director must, however, be devoted to the average man coming from the farm, office, factory, shop, or school with no athletic ambitions, but wanting to make every moment of his time count. The college must provide him with facilities for exercise of the right sort to put him and keep him at the highest level of physical efficiency, without involving too great an inroad upon his limited time.

A course of exercise of progressing difficulty should be carefully designed and graded for the average man, who is neither subnormal like the defective nor supernormal like the athlete, who has neither the desire nor the ability to represent his university on the track or field, but who wishes to be at his highest point of physical vigor throughout his college course. A fixed requirement is essential with credit on the basis of laboratory work, because a course of exercise requires guidance quite as much as the other subjects of the college curriculum. The student's attitude will be antagonistic to required work of any kind, unless credit be given for the time taken from those studies which he thinks have a more direct bearing on his life-work.

Two objects must be kept in view in planning such a course:

First.—The correction of those bad physical habits that come with the student's sedentary life.

Second.—The systematic education of those bodily powers that will be most useful to him during his college life and after graduation.

The sudden change from the active outdoor life of the country-bred boy to the confinement of college work is not unattended with dangers to health, as shown by the tendency to constipation and other disturbances of digestion, headaches, and other common ills for which the college medical examiner is continually consulted. The long hours spent in the lecture rooms, not always too well ventilated, or bent over the laboratory table, must also be corrected by exercises that will strengthen the tired back and stimulate the sluggish heart and inactive digestion, that will draw the blood from the tired brain and congested abdominal organs into the pulsating muscles and expanded lungs, and, at the same time, it should give a real education to his physical powers. A successful course must develop those racially old co-ordinations that have given man his supremacy over brute creation, and civilized man his superiority over the savage, for, contrary to popular opinion, the civilized nations are as dominant physically as they are intellectually.

It is by the cultivation of the great fundamental and vital activities that civilized man has asserted and maintained his superiority over more primitive races, and the rehearsal of these activities must form the basis for a course in physical education if it is to be interesting to the student and sound from the standpoint of the pedagogue. These are the exercises of locomotion, like running, jumping, swimming, and climbing; of fighting, throwing, dodging, catching, striking, and wrestling; of co-operation under a leader in group games where men are organized in a team, individual excellence being sacrificed to the common good.

The cultivation of physical intelligence can never lose its value, no matter how artificial may be the conditions of the community in which one lives. It is what teaches a man to escape injury in the many emergencies of daily life. It saves what would be a broken arm or a sprained wrist in one who has not learned to keep his feet on the slippery pavement or who cannot fall without hurting himself, while many costly lives are lost annually through inability to swim, jump, climb, or dodge. These fundamental actions of locomotion and fighting form the basis of all games that have survived to the present time, and are more fully described in the chapters on athletics and age, sex, and occupation.

Exercise for the college must be put in such form as to get the greatest possible result from the time expended. Games must often be modified and intensified to fit the conditions of college life. It takes a field 100 by 60 yards to accommodate 22 men in football, 24 in lacrosse, or 18 in baseball, but 1000 men can be exercised in the same space in similar movements by modifying them for class work, and the course thus made progressive and logical from the teaching standpoint.

In the illustration (Fig. 157) a class of nearly 500 students is seen engaged in athletic exercise on Franklin Field, University

Fig. 157.—Class instruction in athletics on Franklin Field. In the foreground a rank of sixteen have just put the shot and are running to roll it back, after which they will wheel right and left in eights to the sides. Behind this squad another is taking the high jump, and in the rear a third rank, three standing broad jumps. At the sides and facing in the opposite direction are ranks of eight sprinting and hurdling. After clearing the hurdles they wheel right and left to the rear of the broad jumpers in a rank of sixteen.

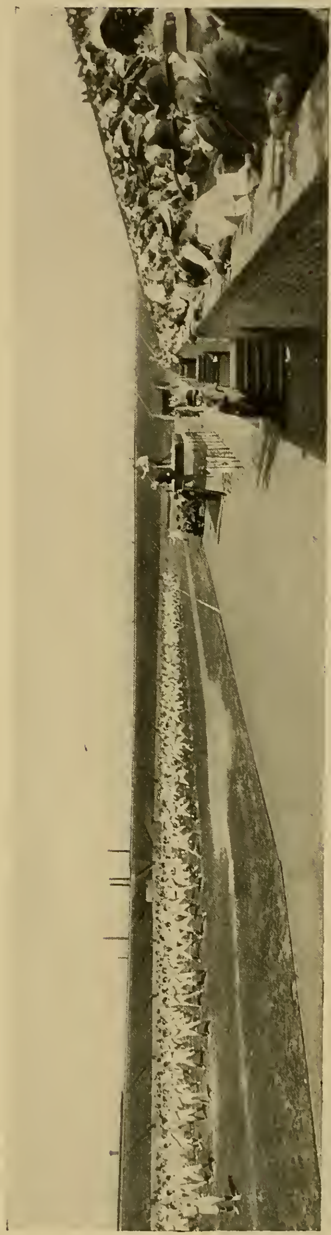


Fig. 158.—Boxing drill outdoors. The class is given the various leads and guards in turn singly, and then they are paired off and go through the movements in order, numbers one and two leading and parrying in turn. In this way the rudiments of boxing may be taught and the student's interest aroused in this form of exercise. (University of Pennsylvania.)

of Pennsylvania. Each man in turn sprints 30 yards, clears a hurdle, takes a standing broad jump, a running high jump, and puts the 12-pound shot, a short pause taking place between each act. The signal is given by a whistle, and at each signal nearly 100 men perform one of these various feats in groups.

At smaller colleges, especially those surrounded by fields, the problem of providing athletic instruction for all the students is not so difficult. At Amherst, where sports are part of the regular work, the men are organized into groups by fraternities

Fig. 159.—Freshmen playing hockey as part of the course of required exercise at the University of Wisconsin. (Courtesy of George W. Ehler.)

and departments, and a series of progressive tournaments are carried on in football, baseball, basket-ball, and tennis, each team playing the other, and in this way every man is provided for and required to take definite training in sports and games.

Plans have been put in operation at various colleges to make the athletic work progressive, and so comparable with the rest of the college work.

At Pennsylvania a wide range of election is allowed to men, especially in their two final years, but a student choosing track athletics has definite instruction in the technic of running, jumping, and throwing weights. To enter, he must pass the test in one track and two field events, making a total of more than 60 per cent., according to the table given on page 252.

PERCENTAGE SCALE FOR TRACK ATHLETES

Percentage rating.	30 per cent.	40 per cent.	50 per cent.	60 per cent.
100 yards.......	12.1 sec.	12. sec.	11.4 sec.	11.3 sec.
220 yards.......	26.4 sec.	26.2 sec.	26 sec.	25.3 sec.
440 yards.......	71 sec.	69 sec.	67 sec.	65 sec.
880 yards.......	2 min. 45 sec.	2 min. 40 sec.	2 min. 35 sec.	2 min. 30 sec.
1 mile..........	6 min. 30 sec.	6 min. 20 sec.	6 min. 10 sec.	6 min.
120 hurdles.....	20 min. 30 sec.	20 min. 1 sec.	19 min. 4 sec.	19 min. 2 sec.
High jump......	3 ft. 9 in.	3 ft. 11 in.	4 ft. 2 in.	4 ft. 4 in.
Broad jump.....	12 ft. 6 in.	13 ft. 4 in.	14 ft. 2 in.	15 ft.
Pole vault......	6 ft. 3 in.	6 ft. 8 in.	7 ft. 1 in.	7 ft. 6 in.
Shot put........	24 ft.	25 ft.	26 ft.	27 ft.
16-lb. hammer...	55 ft.	60 ft.	65 ft.	70 ft.

Percentage rating.	70 per cent.	80 per cent.	90 per cent.	100 per cent.
100 yards.......	11.2 sec.	11.1 sec.	11 sec.	10.4 sec.
220 yards.......	25.1 sec.	24.4 sec.	24.2 sec.	24 sec.
440 yards.......	63 sec.	61 sec.	59 sec.	57 sec.
880 yards.......	2 min. 25 sec.	2 min. 20 sec.	2 min. 15 sec.	2 min. 10 sec.
1 mile..........	5 min. 50 sec.	5 min. 40 sec.	5 min. 30 sec.	5 min. 20 sec.
120 hurdles.....	19 sec.	18.4 sec.	18.1 sec.	17.4 sec.
High jump......	4 ft. 7 in.	4 ft. 9 in.	5 ft.	5 ft. 2 in.
Broad jump.....	15 ft. 10 in.	16 ft. 8 in.	17 ft. 6 in.	18 ft. 4 in.
Pole vault......	7 ft. 11 in.	8 ft. 4 in.	8 ft. 9 in.	9 ft. 2 in.
Shot put........	28 ft.	29 ft.	30 ft.	32 ft.
16-lb. hammer...	75 ft.	80 ft.	85 ft.	90 ft.

At the end of his year he must pass in two track and three field events or three track and two field events, his grading being marked according to the results of this examination.

The same method of teaching should be employed in swimming, a most important exercise, which has as yet been made part of the required work of only about fifteen American colleges. Here the requirement varies from the ability to swim 100 feet up to the ability to swim 200 yards, knowledge of the various strokes, with instruction in the most improved methods of life-saving, breaking the holds that would be taken by a drowning man in the water, and resuscitation of the apparently drowned by the Schaeffer method.

Examination should be made of the swimmer's knowledge and versatility rather than of his speed only.

Fig. 160.—The march past of the swimming squad (Athletic Pageant, University of Pennsylvania, 1913).

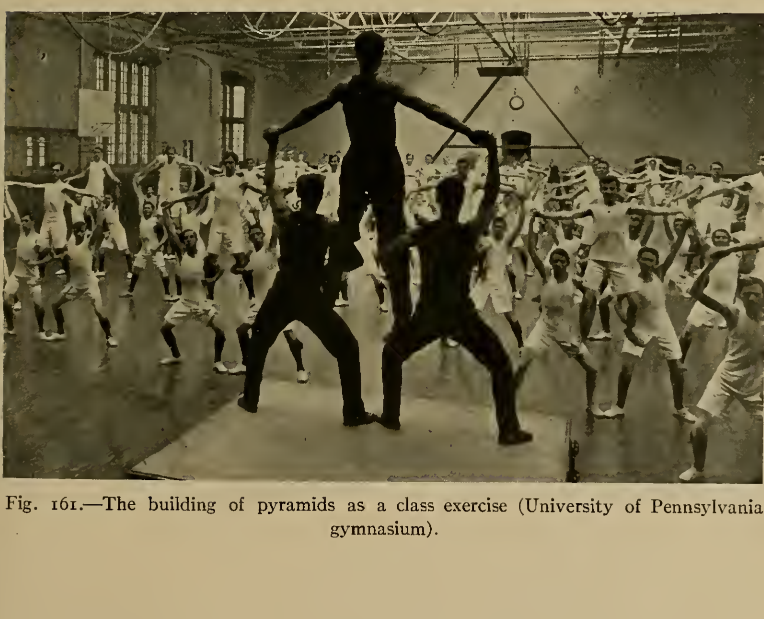


Fig. 161.—The building of pyramids as a class exercise (University of Pennsylvania gymnasium).

The following scale is designed for those who elect swimming at Pennsylvania:

SWIMMING

Entrance examination	Swim 100 feet any style.
To enter second year	Swim (*a*) 100 yards any style.
	(*b*) 100 feet on back.
	(*c*) Dive from springboard or floor.
	(*d*) Tread water or float, using hands only.
To enter third year	Swim (*a*) Breast stroke, 200 yards.
	(*b*) Overarm single, 150 yards.
	(*c*) Swimming on back, arms, and legs.
	(*d*) Dive from springboard or 6-foot platform.
To enter fourth year	Swim (*a*) Trudgeon stroke, 100 yards.
	(*b*) On back, legs only, arms only, sculling 50 yards.
	(*c*) Swim under water, 30 feet.
	(*d*) Dive from 10-foot platform.
Final examination	Swim (*a*) Crawl stroke, 100 yards.
	(*b*) Pick up two objects in 8 feet water.
	(*c*) Tow a man 50 feet.
	(*d*) Break four holds in the water.
	(*e*) Shaeffer's method of respiration.
	(*f*) Dive, front and back, each.
	(*g*) Swim 440 yards any style.

For those whose exercise should not be more active than walking a series of excursions of increasing length is arranged, taking in the various points of interest in the neighborhood, a short walk on Wednesday, and a longer walk on Saturday, throughout the second college term.

The exercises of the gymnasium are more purely gymnastic and educational in character, and can be more closely designed for their purpose. Class work should be made progressive in difficulty, each movement leading to the next. In teaching a movement like *rope climbing* the student should be first examined and marked as to his ability to climb a rope by his arms. If he cannot do so at all (usually 40 per cent.), he should begin by pulling his weight up by both arms and dropping to the floor. He should then learn to jump and catch the rope, pulling his weight up several times, afterward learning to catch the rope with the arms and legs and climb by the use of both, and

Fig. 162.—Indoor practice for crew candidates during the winter. Rowing tank, University of Syracuse. The water is circulated by propellors as well as by the oars.

so on, until he is able to climb with ease by using the arms and legs or the arms alone, to carry the rope up with him, to tie a

Fig. 163.—A class drill in free movements and elementary dancing steps (University of Pennsylvania gymnasium).

loop in which he may rest, or to descend with one arm disabled, or carrying a bundle. He is then re-examined and passed in that method of locomotion.

Fencing is part of the regular class work at West Point, and boxing can be analyzed for class purposes and taught as a class drill. The positions of defense, leads, and guards, first simple and then complex, with and without foot work, until a fairly good knowledge of this method of defense is obtained.

Fig. 164.—Holding by the legs and one hand in rope climbing.

The rudiments of wrestling should also be taught in the form of a gymnastic drill, and gymnastic games should be freely used to train every man to know his powers and limitations in all the activities of running, leaping, climbing, and dodging, while no course would be complete that failed to recognize the educational value—physical, mental, and ethical—of those athletic sports that cultivate courage, pluck, and tenacity of purpose. Where possible all such exercises should be conducted in the open air, or failing that, in a spacious well-ventilated and well-lighted gymnasium. The college gymnasium should be pro-

Fig. 165.—Class work in fencing in the gymnasium at West Point, Captain Koehler director.

vided with several exercise rooms to accommodate the many activities that would otherwise clash, the best and most popular hours being the late afternoon. Where this is not possible, much

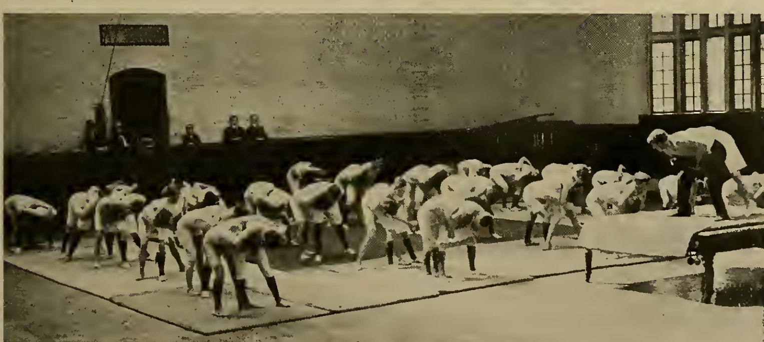


Fig. 166.—Wrestling used as a class exercise (University of Pennsylvania gymnasium): The chancery hold.

may be done by the use of nets dividing a large hall into separate courts for basket-ball, wrestling, gymnastics, and other games, and permitting the entire floor to be supervised by one man.

Separate rooms are necessary for fencing and boxing, and for indoor practice by the crew, hockey team, baseball teams, etc., while corrective exercises are better done apart from the noise and confusion of the main exercise hall with its constant succession of classes.

Each building should be provided with a pool at least 60 feet in length and 25 feet in width, although 100 by 30 feet is better. The water should be frequently changed, and from time to time

Fig. 167.—Gymnasium floor divided into three courts by nets, thus permitting basketball in the central court and wrestling and gymnastics at the two ends. This allows of supervision of the whole floor by one man (University of Pennsylvania).

bacterial counts should be made and care exercised in avoiding the possibility of infection.[1]

In the practical management of classes the multiplication of the apparatus in sets of six or ten is valuable. The largest class may thus be divided so as to prevent the waste of time that occurs when a long line of men must wait their turn to perform their exercise on a single horse or pair of parallels.

[1] Ravenal and Lyster, "Disinfection of Swimming Pools," American Medical Association Journal.

A year's course of exercise will of necessity vary considerably with the special conditions to be found in each college or university, but the following plan, which is in use at the University of Pennsylvania, will be found to contain the main essentials of progression:

October: Physical examinations. Examination of the eyes, instruction in swimming to first-year men, prescription and demonstration of special exercises for round or uneven shoulders, constipation, flat-foot, weakness of abdominal walls, etc., athletic examination given by instructors on the gymnasium floor.

November: Class work in the gymnasium. Marching tactics, quick time and double time, free setting-up exercises, and gymnastic games.

December and January: Examination and first arrangement of apparatus. Low horizontals, climbing ropes, flying rings, and vaulting horse. Men are graded as a result of this examination into *first, second, third,* or *leaders,* and *fourth (gymnastic team) grades.*

February: Examination and regrading for second arrangement of apparatus. High horizontal bar, tumbling, buck, long horse and parallel bars, class drill with wooden wands or Indian clubs.

March: Third arrangement of apparatus. Pyramids, boxing or wrestling drill, iron dumb-bells, steel wands, dancing steps, and gymnastic games.

April: Free drill, gymnastic games, and athletic sports, outdoors when possible.

May: Physical examination of graduating class.

Such a game as dodge ball is peculiarly adapted to a class of small or large numbers when played out of doors in spring. The start in sprinting, hurdling, broad and high jumping, putting the shot, dancing steps, are here introduced, as well as progressive tournaments in baseball and tennis.

In some gymnasia, such as Northwestern University and University of Wisconsin, provision is made for the practice of outdoor athletic sports under cover. At Dartmouth there are three running tracks, with 120-yard straightaway, one circular track, six and two-thirds laps to the mile, a full size baseball diamond, and provision for field athletics, under the same roof as the gymnasium, enabling students to take any form of gymnastic or athletic exercise independent of weather conditions.

At Toronto University the Department of Physical Education has been associated under the same roof as the Young Men's

Christian Association and the various student clubs, literary, social, and athletic. This combination cannot but lower the position held by physical education in the college curriculum, divorcing it in the minds of the student from its educational place and making it merely a part of the other voluntary social activities of student life.

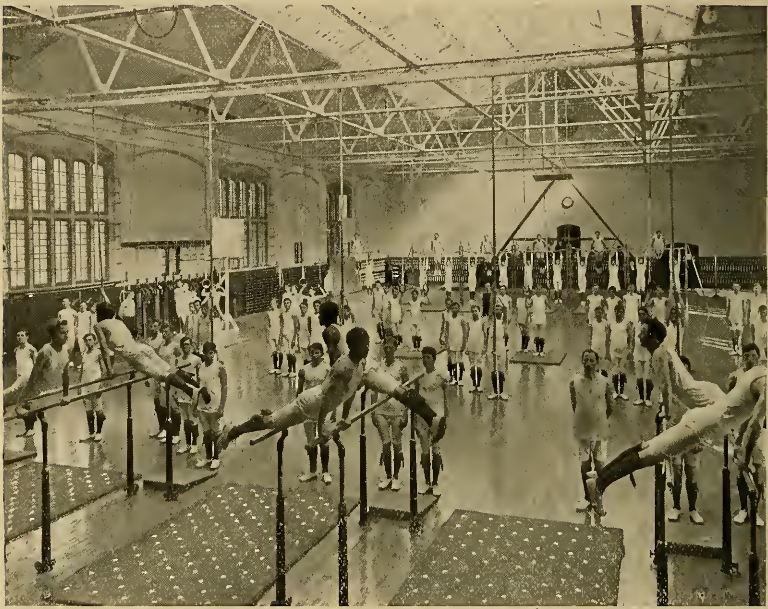


Fig. 168.—Gymnasium floor, showing apparatus in place for class work. Beginning with the background they are horizontal bars, flying rings, climbing ropes, and parallel bars arranged in gangs of six. The parallel bars are placed in floor sockets and can be replaced by the buck or long side horse (University of Pennsylvania).

The year's work at Pennsylvania usually concludes with an outdoor exhibition of the united classes. This may take the form of an athletic pageant, such as the one held in 1913, in which all the classes and athletic teams of the university, after parading in their characteristic uniforms, gave an exhibition covering the entire range of gymnastic and athletic sports.

It is found that after two or three years of the regular educational classes men drift into specialties, and devote themselves

Fig. 169.—The march past of the gymnasts (Athletic Pageant, University of Pennsylvania, 1913).

to advanced boxing, wrestling, fencing, and swimming, or join the crew, football, or baseball squads. A high standard of excellence is required to qualify in most of these specialties; many try for a team and, failing, drop back into the class work.

The following table shows the distribution of men in the different sports and games at Pennsylvania during the year 1913:

	Reporting.	Retained.
Baseball	130	81
Basket-ball	94	24
Boxing	40	25
Crew	203	31
Fencing	44	14
Football	150	87
Golf	20	16
Gymnastic team	18	9
Soccer	45	20
Swimming	97	37
Track	297	94
Wrestling	89	24
Lacrosse	34	26
Rifle	15	7
Mask and Wig Dancing Chorus	62	62
Total number in athletics, etc.	1338	557

Number of men in gymnastics	1282
Number of men taking corrective exercises	400

Of the 1338 candidates for various teams, only 557 were retained. Those who are not retained on a squad return to the class work in gymnastics or athletics.

The men who have the physique and constitution necessary to become intercollegiate athletes, as shown by the 557 retained on the varsity squads, number less than 10 per cent. of the total enrolment of the college, for the severity of competition in intercollegiate athletics and the high standard of merit required for success separates them almost into a special class. The average weight of a football player on a college team is about 174 pounds, 35 pounds more than the average man. The oarsman weighs about 164 pounds, or 25 pounds more than the ordinary student, whose height he also exceeds by about 3 inches. The light routine exercise suitable for the average student is not enough for them, and facilities should be given them for practising their chosen specialties, but the necessity for advice and direction, and, in some cases, restriction, has time and again been tragically shown.

The actual conduct of competitive intercollegiate athletics may, to a great extent, be left in the hands of the students themselves as part of their social training, if the final court of appeal be a representative committee chosen from both faculty and students. The university should, however, require two things before allowing a student to enter his name on an athletic squad:

First—A careful examination of his physical condition.

Second—A **rigid standard of scholarship** for every man who may represent the institution in an intercollegiate contest.

Nearly 10 per cent. of all candidates for athletic honors are prevented by the preliminary medical examination from endangering health or life in violent competition, and this alone shows the value of such a precaution wherever the more strenuous forms of athletics are practised.

Students frequently present themselves as candidates for teams who have unsuspected organic lesions of the heart, dangerous hernias, or incipient tuberculosis—men who have no place in the exhausting struggle of a game like football, or a boat race, or a half-mile run, but for whom regular judicious light exercise would have the greatest value.

The medical examiner should, of course, have complete authority to decide on the best course to pursue in each case, and he will usually find with added experience that he may permit many a man to engage in vigorous sports with advantage to his health whose condition would be condemned by one who went entirely by the standard text-books. This question is more fully discussed in the chapters on Physiology and Disorders of the Circulation.

The university may undertake the supervision of the diet of all men in training, even to the extent of establishing a training table, although it is too often considered a special privilege by the athlete who, supposed to pay the full board, frequently pays little or nothing.

The question of scholastic and amateur standing is scarcely within the scope of this chapter, but some colleges and universities require even a higher standard among their athletes than from the general student body, and the tendency in most academic councils is toward greater stringency in the requirements and more rigid enforcement of the regulations. The worst abuses of intercollegiate athletics may be controlled by requiring one year's residence, with satisfactory class standing, before

Fig. 170.—The march past of the football squad (Athletic Pageant, University of Pennsylvania, 1913).

allowing a man to represent the university in intercollegiate athletics. About 60 per cent. of the colleges have this one-year rule more or less rigidly enforced, while about the same percentage of colleges debar graduate and special students and students in the professional schools from representing their institution.[1]

In rough games like football there will always be accidents

[1] F. W. Nicholson, "Report on College Athletic Administration," December, 1912 (National Collegiate Athletic Association).

to deplore. The chance of a twisted ankle or knee, a broken collar-bone, arm, or leg, or even concussion of the brain, is one of the things that make such games attractive to the healthy and courageous young man; but if we put against these accidents the escapes that every old player of forty can recall from an injury that a clumsy slow movement would have precipitated, the balance will surely be on the other side, and permanent disability from accident is comparatively rare in men who, properly examined and found to be sound, are sent into a contest well prepared by an adequate course of training.

Fig. 171.—A class leader (University of Pennsylvania).

The director of the department of physical education should be a college-bred man, preferably a physician, who, in addition to his medical training, has had practical experience in athletics and gymnastics.[1] An analysis of the training of college directors of physical education, made so long ago as 1908 by Clarence Baker,[2] showed that about 80 per cent. have held captaincies of teams, while one-half have been team managers during their undergraduate life. With this training, he should also have enthusiasm, interest in men, patience, determination, and ability to lead. He should not be without a good physique. In smaller colleges he should be able to coach one or more teams himself, while in large institutions, where this is impossible, he should be able to organize and direct his staff of examiners, instructors, and coaches, and conduct the teaching through them and a corps of class leaders or voluntary student assistants, the organization of which is a most important part of the departmental machinery.

[1] T. A. Storey, "Technical, Academic, Professional Training Needed on the Staff of a Department of Physical Education," P. E. Rev., vol. xiv, p. 6.

[2] Thesis, Springfield College.

At Pennsylvania candidates for class leadership receive one period a week of extra instruction in addition to their regular gymnastic class work. After serving one year they receive a star, to be worn on the gymnasium shirt, in addition to the bar of ribbon which is their distinguishing mark; after two years, another star; and during the third year they attend a course of ten lectures on the theory of physical training, which is followed by a written examination and an examination in practice of gymnastics and leadership on the gymnasium floor. Upon the successful passing of these the student receives the insignum of the leaders' corps and a certificate. In addition to this, members of the

Fig. 172.—Floor talk before the beginning of class (College of the City of New York).

athletic teams act as volunteer assistants for the classes in track and field sports.

Practically, all colleges and universities that have such a department organized give some instruction in the theory of physical training and personal hygiene, their courses forming part of the regular teaching, either elective or compulsory, while the application of exercise and massage in medicine and surgery now has a recognized place in every well-equipped medical curriculum. Doctor Storey of the College of the City of New York gives every class a floor talk of ten minutes once a week, in which he discusses the common causes of disease, the carriers of disease, the defenses against disease, and the nature of the more common diseases. The theory of cleanliness and health is illustrated and made to apply to the dirty uniform and the soiled towel. At Haverford Professor James A. Babbitt gives a course on the theory and practice of gymnastics, consisting of anatomy and physiology as applied to exercise, together with the practical application of exercise. The lectures are accompanied by practical laboratory work, and the final examination includes a two-hour written test counting 60 per cent., and a practical examination on the gymnasium floor counting 40 per cent. At Princeton the freshmen have a course on personal hygiene, including the influence of diet, exercise, and bathing, the effects of alcohol, tobacco, venereal disease, and a study of the more common infections from Professor Raycroft. Dr. Meylan has courses on hygiene and physical education counting as required work at Columbia. Similar courses are given at the University of Nebraska and elsewhere. At Wisconsin Professor Ehler has organized a course in theory for teachers that counts toward the college degree. At Pennsylvania a course on the theory of physical education is given to postgraduates in the course on public health. Another course, already referred to, is given to class leaders, and two lectures a week throughout the year on the therapeutic application of exercise to students in medicine.

Summer courses on physical education, of about six weeks, for students, teachers, playground supervisors, and social workers, have been given for the last twenty years at Harvard, where it began with a one-season course, and is now extended over three summers of progressive work in theory and practice.[1] Summer courses are also given at Columbia, McGill, Pennsylvania, Wisconsin, and University of California. Owing to the imperfect and superficial training received by most teachers of physical training these summer schools are most valuable and deservedly popular.

[1] "Contributions of the Hemenway Gymnasium to the Cause of Physical Education," Harvard Illustrated Magazine Supplement, vol. xiv.

In addition to the supervision of the health and the teaching of the students, a department of physical education should seize its unusual opportunities for original research in psychology, physiology, and anatomy, and association with other departments in solving them should not be neglected. The occurrence of physical defects in the supposedly normal, investigation on heart and lung conditions, and the effects of different forms of exercise both on the body and mind can be studied here to advantage. A list of such investigations is contained in the Register of the Society of Directors of Physical Education in Colleges.

Fig. 173.—The ideal college athlete. (Copyright, R. Tait McKenzie.)

The taking of certain measurements from time to time is useful to stimulate in the student a pardonable pride in his expanding chest and swelling biceps, but it is also of use to determine the proportions of the average student and his variations from this average. Hitchcock, Seaver, and especially Sargent, have done pioneer work on this subject.

Dr. Sargent's complete set of charts, containing the principal measurements of students for each year from sixteen to twenty-five, and selections from his statistics for the youth and maiden of twenty-one, have been embodied in two life-size statues modeled by Henry Kitson, showing the medium measurements for that age. The variations from that type have been noted by Doctor Paul C. Phillips, in his observations on sprinters,[1] by the author in speed skaters,[2] and by Doctor Sargent in his "Physical Proportions of the Typical Man" and "Physical Characteristics of the Athlete."[3]

The search for a physical ideal was undertaken by the Society of Directors of Physical Education in Colleges, who, in 1902, commissioned the modeling of a statuette embodying the average measurements and proportions of the pick of the student body, selected by taking the best fifty men in the all-around strength test for a period of eight years. These 400 sets of measurements of Harvard students, supplied by Doctor Sargent, were used to determine the proportions of the *typical college athlete* (Fig. 173), who is represented as placing in his right hand the spring dynamometer with which he is about to test his grasping muscles. This youth may be said to embody the proportions and girths of the physically ideal American student of twenty-two. With a height of 5 feet 9 inches he carries a weight of 159 pounds. The girth of his neck, knee, and calf are the same, with the upper arm $1\frac{1}{2}$ inches less. The girth of his thigh is $\frac{1}{2}$ inch less than that of his head. His expanded chest is 40 inches, the girth of his waist 10 inches less, his hip girth almost the same as his unexpanded chest, while the breadth of his waist barely exceeds the length of his foot, and the stretch of his arms measures 2 inches more than his height.

[1] Outing, May, 1903.
[2] Popular Science Monthly, December, 1905.
[3] Scribner's, July and November, 1887.

CHAPTER XV

PHYSICAL EDUCATION IN GIRLS' SCHOOLS AND WOMEN'S COLLEGES

Physical education for women too often follows slavishly the scheme planned for men, not because it is best for women, but because it is the same. This is a deplorable mistake, because bodily training of the two sexes must differ radically in order to fit each for its own future life and environment.

A woman's training should develop those characteristics of growth, poise, speech, carriage, and dress peculiar to her, and cannot with impunity ignore the psychologic and physiologic differences between the boy and the girl and between man and woman.

Even at the age of eight or nine girls begin to work out their own set of activities and their social plays and games, individual, competitive, and co-operative, by which they secure self-confidence, skill, and control. At twelve or thirteen the co-operative spirit appears in her, although in a much less-marked degree than it does in boys.

Owing to the necessities of modern conditions, in which so many women are required to hold their place in commercial, professional, and political life, this spirit of co-operation must be encouraged, and the team games, requiring obedience to a leader, and team work as opposed to individual play, are of inestimable value for this purpose.

The first twelve years of a girl's life need differ very little from that of her brother's in physical habits. She may lead the same outdoor life, climbing, swimming, running, playing ball, without distinction as to sex, and nothing will prepare her so well for the great physical and mental change which takes place with the attainment of puberty. Outdoor games and exercises establish nervous stability and poise, and give the best possible foundation on which to build her future womanhood. For reasons largely beyond her control, those occupations that involve the use of large muscle groups have been taken away from the girl and the woman even more than from the boy, and she is hemmed in on every side by limitations of social usage, dress, and deportment, and confined to occupations requiring smaller and more monotonous movements, such as running a loom or sewing-machine, manipulating a typewriter or telephone exchange, piano practice, or reading, all of which require her to sit still for long periods, in addition to continuous close attention and nervous strain. This muscular starvation and nervous tension cannot but cause an abnormal, supersensitive, and morbidly introspective condition, for which no better corrective can be given than the athletic games and sports in which no opportunity for reflection or analysis of the feelings is allowed, where the great muscle masses of the body are exercised in long, free, and sweeping movements, and the circulation drawn out from the abdominal organs and spine and distributed to the muscles, lungs, and heart. As Dr. Anna M. Galbraith[1] says, "Every girls' school and women's club which provides for games and sports erects barriers against nervousness, morbidity, and introspection."

Boys are taller and heavier than girls from birth up to about the eleventh year. Girls then begin a period of rapid growth and soon pass them both in height and weight, maintaining this physical advantage until about the fifteenth year, when the more slowly maturing boy catches up, and from that time forges ahead both in height and weight as well as in strength, so that at maturity he has an advantage of about 4 inches in height and from 20 to 30 pounds in weight, with strength to correspond.

At maturity woman has a relatively longer trunk and shorter legs, less muscular, but more adipose tissue about the hips and thighs and a much smaller lung capacity. The shoulders are

[1] Personal Hygiene and Physical Training for Women (Saunders & Co.).

narrower and more sloping, the bones lighter, and the chest much less muscular. The center of gravity in the body is lower, and all these differences put women at a distinct disadvantage in exercise where weight is supported by the arms, while all exercises in which speed with endurance is required quickly tell on the smaller lung capacity. Series of measurements, ex-

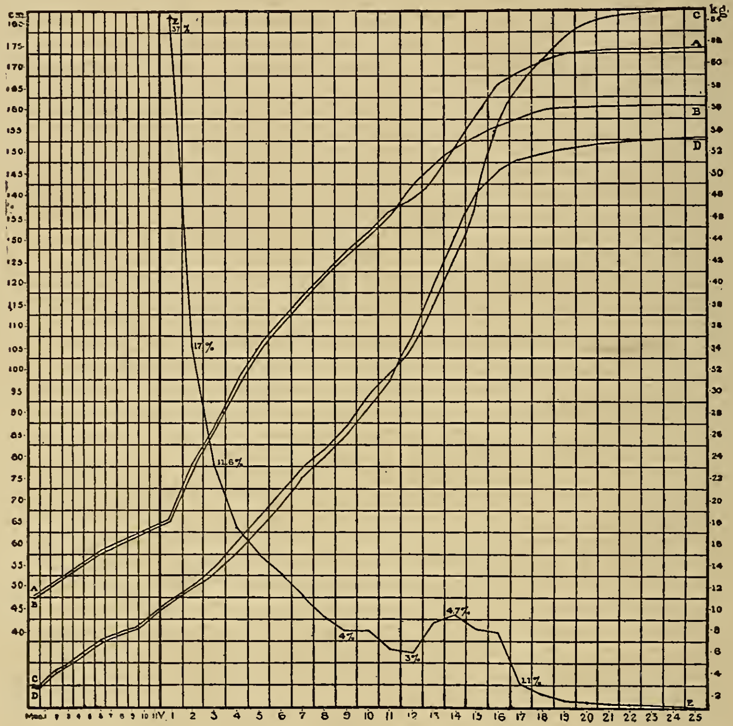


Fig. 174.—Height and weight of boys and girls from birth to twenty-five years: A, Height of boys; B, height of girls; C, weight of boys; D, weight of girls; E, percentage of growth for various years (Bowditch).

tending over forty years, show that the increased exercise and outdoor life to which young women have been admitted in that time have added 1 inch to their height and about 5 pounds to their average weight, but, making every allowance for lack of practice and play traditions, they cannot possibly hope to do more than give a feeble imitation of what men will always do infinitely better.

Comparing the athletic records made by women with those made by men one is impressed by the fact that they are not really comparable.

The best running broad jump of 15 feet 3 inches is not much more than one-half the distance cleared by a man in the same event. The high jump is 4 feet 6 inches for women and 6 feet 7 inches for men. The record 100-yard dash was run in 12 seconds by a woman, which is not very fast when compared with the $9\frac{3}{5}$ seconds of the college man.

Fig. 175.—Drill in the movements of fencing by a class of teachers in training. (Courtesy of Miss Amy M. Homans.)

Women cannot stand prolonged physical or mental strain as well as men, but with frequent rests they can in the end accomplish almost as much. Certain games, such as football, boxing, pole vaulting, and heavy gymnastics, are obviously unsuited for their temperament and build, but in dancing, swimming, calisthenics, archery, skating, and fencing they come much more near to competing with men on equal terms. While they are less adapted for arduous muscular work, their larger amount of fat enables them to stand exposure to cold and moderate physical hardship of long duration even better than men. Their vital endurance is better, so that the disadvantages they have in other activities is made up for by this greater tenacity to life.

As a general rule, girls are not naturally fond of sports and games. They have much less of the spirit of adventure or combat than boys, although they have more of the spirit of romance.

One of the first difficulties noted by Miss Harriet Ballentine of Vassar[1] was to realize how very little exercise the student would take if left to her own inclination. A small minority were enthusiastic, a much larger number would exercise if the work was pleasant, but were usually poor in practice, and a larger

Fig. 176.—A Swedish drill by a class of teachers in training. (Courtesy of Miss Amy M. Homans.)

number were interested only in seeing the others work. This condition has changed for the better in recent years.

Provision has always been made in most women's colleges for some form of exercise, usually light and innocuous calisthenics, alternating with the "crocodile," the familiar formal procession in twos, with a pair of teachers at the tail. We find reference to this method, which is still to be seen in most convents and boarding-schools, as early as 1837 at Mount Holyoke, where one hour daily of such exercise was taken, and the calisthenic movements used were collected and printed by

[1] P. E. Rev., vol. v.

Miss Titcomb (1853).[1] Many of the steps which closely resembled dancing were introduced as calisthenics, so that the prejudice against this godless art should not take active form. In 1862 the "New Gymnastics" were introduced. This system, gathered from German and Swedish sources, developed and elaborated by Dio Lewis with many exercises of his own invention, seemed peculiarly suitable to a girls' school. They secured attention, enthusiasm, accuracy, and a good posture and gait. About 1875 boats were given to the school, and tennis was introduced, while the three under classes were required to do gymnastic work from November to June. In this way boating and tennis began to supplement the monotonous walk. In 1891 gymnastics were changed to include Swedish work and outdoor games; fencing and basket-ball were introduced. An athletic association now took charge of hockey, skating, tennis, and other outdoor games.

Similar growth can be shown at Vassar, at Bryn Mawr, and at Wellesley.

In 1891 physical training was introduced at Wellesley, with three hours a week of instruction in the gymnasium for freshmen, under the direction of Lucille Hill.

Boats were bought and crews were organized among the students to row on the lake. The recording and tabulating of vital statistics was undertaken by Dr. Anna M. Wood, and the comparative tables showed satisfactory increases in the girth and depth of the chest, the lung capacity, and other items after exercise.

In 1909 the Boston Normal School of Gymnastics was affiliated with Wellesley College, becoming the Department of Hygiene, with required work having credit toward the B. A. degree; and the present most efficient system was introduced by its dean, Miss Amy Morris Homans.

Outdoor sports at Vassar are a special feature, and the gymnasium and playing fields at Bryn Mawr are kept actively employed, while in co-educational institutions, like Wisconsin,

[1] P. H. McCurdy, P. E. Rev., vol. v.

Chicago, California, and Michigan, equal provision is made for men and women.

The *physical examination* that should precede every course of exercise given in a women's college should vary somewhat from that suitable for men. An analysis of the examination blanks used at seven of the most prominent women's colleges shows that emphasis is placed in discovering disabilities that would prevent exercise, or that may be improved by it, rather than the estimation of strength and physical efficiency. Besides questions about sleep, digestion, and general health, the history

Fig. 177.—Field hockey game at University of Wisconsin. (Courtesy of Miss Blanche M. Trilling.)

and regularity of the menstrual function is carefully inquired into. Irregularity is frequently the result of a disturbed circulation and digestion, and may, in many cases, be improved by judicious exercise. Inquiries are made about the wearing of corsets, braces, or any other form of confining clothing. Stress is laid upon the condition of the feet and spine, the heart, lungs, vision, and hearing. The measurements are usually fewer in number than in the examination in men's colleges, but should include height, weight, girth of chest during inspiration, girth of the waist and hips, depth of the chest and waist, and a test of the strength of the back, legs, forearms, concluding with the lung capacity.[1]

The history blank employed at Wellesley is exceedingly elaborate and comprehensive. When the student comes to college she receives an appointment for examination. At the appointed hour she removes her clothing in a dressing booth, takes down the hair, puts on a fresh white gown, which is supplied her, and a bath robe. The student is then seated on a revolving stool and the medical examiner notes the nutrition and general condition. The bath robe is then discarded and the patient reclines on a table. The chest and abdomen are palpated and the patellar reflexes tested. The student then stands up barefooted, and the back, shoulders, and hips are inspected for curvatures and unevenness, the feet for abnormalities, and a few measurements are taken.

In these supposedly normal young women the most frequent orthopedic defect found was pronated ankles (70 per cent.). This large percentage is attributed by the examiner to the habit of instructing children to toe out and to faulty footwear, as well as to constitutional weakness; 53 per cent. showed uneven or round shoulders, with uneven hips in 43 per cent., and curvature in 35 per cent. Most of these were remediable by corrective work in the gymnasium. Chronic defects of the hearing were found in only 2.5 per cent. Congestion of the nasal cavities occurred in about 13 per cent., while the throat conditions were abnormal in 28 per cent. Only 1 per cent. of these young women had poor or irregular teeth, which is interesting as showing the value placed by the average American young woman on the care of her teeth. The lymph-nodes were enlarged in about 12 per cent., but only three of them were sufficiently large to require attention. About 16 per cent. showed enlargement of the thyroid gland, most of them coming from the thyroid district, which includes Michigan, Illinois, Iowa, and Kansas. Certain nervous manifestations, such as biting the

[1] "Medical Data on Supposedly Normal Women at Wellesley," V. M. Canavan, M. D., Medical Examiner at Wellesley, P. E. Rev., November, 1912.

nails, twitching of the facial muscles, choreiform movements, and nervous instability, as shown in weeping and fainting spells, were also found; 28 per cent. showed some heart murmur, usually without enlargement.

BRYN MAWR COLLEGE HEALTH DEPARTMENT

SPORTS LIST

Miss .... is classed as **C.**

MAY play ONLY the sports not crossed off on this card.

Hockey. Goal, 1st team. Fullback and goal 2d, 3d, or 4th team.

Archery. Easy tennis and swimming.

Goal or full in soccer. Throws in track.

MAY NOT enter any other sports, or any meets, tournaments, or matches without first obtaining a special Authorization Card.

Signed ....

Date ....

For the examination of those girls who wish to compete for a place on the college crew, hockey, baseball, tennis, and golf teams, or in track athletics, the following method is now in force. All who are sufficiently sound at the preliminary examination and have had no illness since, and who are doing regular gymnasium work, are certified without further examination. Those doing corrective or light gymnastics are re-examined. Those who have not attained an "A" in their gymnasium work, or who are reported to have been ill or previously disqualified, are re-examined. No one is disqualified except when it is absolutely necessary, and only 3 per cent. of those wishing to take part in sports have been restrained from engaging in them.

The onset of menstruation occurred before thirteen years in 17 per cent., before twelve years in only 5 per cent., while some menstrual irregularity was found in 23 per cent.

Dr. Clelia Mosher,[1] Medical Examiner at University of Michigan, in speaking of the relation of exercise to the menstrual

[1] P. E. Rev., vol. xvi.

period, is of the opinion that the percentage suffering from disability is much less than is generally supposed, and that much of the pain is due to the attention which is unfortunately directed to this function. "Until we can treat this periodic flow as an accident rather than the central idea of life," she says, "morbid apprehension will continue to produce general disability." Her opinion is strengthened by the extensive investigation made by Dr. Angenette Parry.[1] Her questionnaire, addressed to leading obstetricians, college physicians, and directors of physical training, and to others who have the supervision or who engage in regular and strenuous physical exercise, brought out some interesting facts on this subject. The consensus of opinion was that girls may indulge in physical sports and games to a considerable extent during their periodic sickness, but should refrain from exhausting athletic contests or competition.

With some few exceptions girls accustomed to athletics or gymnastics could continue exercise without detriment during menstruation. In the majority of cases the flow was increased by gymnastic exercises, but in one circus gymnast it was lessened. None of these professional circus performers who were interviewed desisted from their exercises during their periods.

As to the effect of systematic exercise as a preparation for normal child-birth, forty answers from physicians showed that athletic patients got along much better and more than one-half believed that athletic exercise in moderation favors easy labor. Most of them agreed that convalescence was quicker. Five out of twenty gynecologists consulted believed that pelvic displacement could be caused by violent exercise, but the consensus of opinion was that it did not produce it, and by some it was recommended as part of the treatment for this condition.

It is probable, then, that athletics indulged in moderately and under proper supervision are not dangerous to girls and women even during their periods, and it is only the more strenuous competitive athletics in which the futile attempt is made to imitate the more violent sports of boys and men that the

[1] American Journal of Obstetrics, September, 1912.

danger is likely to arise. This is borne out by the long and careful observations of Dr. E. H. Arnold, Principal of the New Haven Normal School of Gymnastics, who has had unusual opportunities of observing large numbers of girls engaged in regular and exacting daily exercise. His opinion, fortified by many statistics, coincides with the one just stated.[1]

Girls should be divided into groups according to their ability for exercise. Those in whom certain marked defects are present are taken either individually or in small squads for special movements aimed at the correction of their fault. Flat-foot, lateral curvature, unusually weak muscular development, weakness of the abdominal walls, tendency to hernia, flat chest,

Fig. 178.—Dancing steps to music by a class of teachers in training. (Courtesy of Miss Amy M. Homans.)

and other such deformities should be vigorously treated in this way during a college girl's life. For the general gymnastic class work, emphasis should be laid upon rhythm and music. They do not require the prolonged and exhausting attention that Swedish gymnastics demand.

Esthetic dancing, as developed by the late M. B. Gilbert, beginning with the five fundamental positions of the feet and the arms, with its attitudes, arabesques, and poses, deservedly occupies a large place in a course. Nothing is so valuable for freeing the awkward and stiff carriage of the body, bringing the shoulders back into place and giving an easy and elastic tread

[1] P. E. Rev., 1914.

in walking. Under its influence weak backs are straightened, and students gain in alertness, co-ordination, and judgment as well as agility, and, above all, in rhythm.

The "Eurythmic Gymnastics" of Jacques Dalcroze, described in Chapter IX, carry this training in rhythm to a much higher point, and bring the teaching of gymnastics and music together in a way that gives joy and exhilaration to what is usually dry and uninteresting. The animation and gayety obtained from these means are strong points in their favor.

Fig. 179.—Dancing in the spring pageant at University of Wisconsin. (Courtesy of Miss Blanche M. Trilling.)

Closely allied to these exercises are the folk dances, Morris dances, and pageants, in which exercise is put in a form that is beautiful, and may even be symbolic and approach the art of pantomine, appealing to the esthetic and romantic side of a girl's nature as well as to the joy of mere physical expression.

It is more particularly for girls and young women that the gymnastic principles laid down by George Demeny, of France, and described in Chapter IX, apply, and anything which is angular or which involves holding fixed positions for long periods of time should be avoided. Exercises on fixed apparatus in which the weight is balanced or handled by the arms should be avoided, as a rule. The musculature and proportions of women give them a peculiar disability for such work as the parallel bars, the horizontal bar, and the flying rings, and those who do succeed have always a masculine build. On the other hand, exercises on the balance beam, the trapeze, or even on the slack rope are both graceful and valuable to teach equilibrium and muscle control, and the stretching of the body through the swinging on the traveling rings is most valuable. Class running, jumping, and vaulting are good if care is taken to provide a soft landing place.

Fig. 180.—A contest with the hurl-ball at University of Wisconsin. (Courtesy of Dr. J. C. Elsom.)

Dr. Sargent of Harvard believes that no athletic sport need be barred for fear of injury, and all are practised by his students, but undoubtedly the feminine type of figure is a handicap in many athletic tests. Gymnastic games are of the utmost value. Basket-ball, playground ball, and dodge ball cultivate co-ordination, speed, activity, and co-operation, and should be encouraged. Public competition in a game like basket-ball tends frequently to run riot, and the nervous excitement caused by intercollegiate or interscholastic competition, together with the publicity of them, is distinctly a bad influence. It also means that members of the team may be called upon to play when they are in no physical condition for such a test. Among the least objectionable contests is that with the hurl-ball, in which the movement is free and graceful and not too severe.

Outdoor exercise should vary from walking, preferably over broken ground and with some object in view, such as botanizing

Fig. 181.—Class in archery, University of Wisconsin. (Courtesy of Miss Blanche M. Trilling.)

or the study of birds or rocks, up to a game like field hockey, perhaps the finest outdoor game for girls, introduced and popularized in American colleges by Miss Constance Applebee of Bryn Mawr. Such games as tennis and golf are ideal, but the team play required in hockey or even association football gives them an added value, although the number who will practice them voluntarily will always be limited.

Individual competition in track athletics is, I believe, a thing to be discouraged. It is seldom that girls will of their own volition put the shot, do high or broad jumping, or even run a 100-yard dash, and when they do so it is usually done without conviction and in imitation of their brothers.

Archery cultivates a good posture, and is a graceful, interesting, and exhilarating exercise that should be more practised than it is. It is popular at Wisconsin and Wellesley; so is the pitching of quoits and bowling.

Swimming is one of the best exercises for women, calling into action most of the muscles of the body, but sparing those

Fig. 182.—A University of Wisconsin student pitching quoits. (Courtesy of Miss Blanche M. Trilling.)

of the back so commonly overworked in the standing and sitting postures. Women stand the cold much better than men, but the instructor must always be on the lookout for the appearance of blue lips, pinched face, and shivering limbs, a warning to come out. The water should be kept at about 70° F., and fans for rapidly drying the hair have made swimming more popular than it was.

At Vassar gymnastic work begins in November and continues until the end of March. The wands and dumb-bells vary in weight from 12 ounces to $2\frac{1}{2}$ pounds, but are used for special classes only. Instruction in classic dancing is an important part of the course, as is swimming. Students learn to swim in six lessons on an average.

Outdoor sports like hockey occupy three hours a week in October, and in the spring the list of elective games includes croquet, lawn tennis, basket-ball, rowing, and riding, which is chosen yearly by about 200 of the students. Riding lessons begin at any time throughout the year. A man's saddle is used, but somewhat narrower and with a higher front. During their periodic sickness girls are forbidden to take part in any athletic exercise.

Fig. 183.—Bloomer costume for women (Galbraith).

The gymnastic dress is a bloomer costume and jumper, with long stockings and thin flat shoes without heels. The costume is loose and cut low at the neck, with sleeves to the elbows.

In conclusion, I may say that an important duty of the department of physical education and hygiene of a girls' school or college is to supervise the amount and nature of their rest, as is now done at Wisconsin and at Wellesley. It is quite as important to prescribe an hour of absolute rest recumbent for a student whose nervous and muscular system is overwrought, and in whom hysteria is imminent, as it is to recommend and supervise her exercise.

By providing, then, for her physical care from absolute rest to the most active competition, a department of physical education will fulfil the duty that the college owes to every young woman put in its charge.

CHAPTER XVI

THE PHYSICAL EDUCATION OF THE BLIND AND THE DEAF-MUTE

Having described the physical education of the normal child of both sexes from infancy to maturity, there remains only a description of the modifications required for the training of those unfortunates to whose minds the avenues of sight and hearing are closed; and of those others whose minds are dulled or who have already taken the first steps in the path that leads to the penitentiary or the mad-house.

Since the world of the blind is limited by the horizon made by the reach of his arms, his supremacy within this circle must be supreme.

Physical education does him a triple service by increasing the courage and confidence which he so sadly lacks, by developing his muscular powers, and by fortifying his body against those infirmities to which enforced idleness and a sedentary habit render him peculiarly prone.

It is within comparatively recent years that the physical education of the blind has been studied with care, and that methods have been adapted to their possibilities and limitations.

The most striking characteristic of the blind child is a certain timidity or fear of appearing at a disadvantage before others, especially in making an unaccustomed movement, so that the only exercise they undertake voluntarily is walking backward and forward in some confined place with which they are familiar. They are liable to sit still for long periods of time, and usually develop certain rhythmic habit movements of the head and hands difficult to repress and correct.

They must either *feel* or *hear* a movement in order to learn it, for they have not the mirror of their companions from which to correct faults in their own posture or action.

In the measurement of boys at the Overbrook School for the Blind it was found that their height, weight, and lung development were under the average of normal boys of the same age, as shown in the Sargent charts (Allen). The blind boy has thus even a greater need for physical training than the boy who can see.

In many blind children exercise must begin with the simplest acts, such as dressing and undressing, which have been neglected in many homes where the blind child is waited on and not trained in movements that make for accuracy and tidiness.

A course must pay special attention to the improvement of posture in walking, standing, and sitting, for the blind walk with the head inclined forward, the chest contracted, and usually come down hard upon their heels at each step. It must embrace free movements for the chest, arms, and shoulders, including all

Fig. 184.—The playground of the Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa., showing the arrangement of brick walks in front of the rows of trees to warn the pupils of their whereabouts and prevent accidents.

possible games and other forms of reaction that can be conducted with safety and abandon.

The chief difficulty in such a course is the cultivation of that physical confidence necessary for success in active sports like running, jumping, and gymnastics.

Various devices are required in the construction of the gymnasium and field to prevent accidents and to foster freedom of movement. The gymnasium hall should be constructed with a wooden floor, surrounded by a band of cement 7 feet wide,

Fig. 185.—The cock-fight and other gymnastic games. The band of concrete at the edge of the floor is also shown (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

on which all the heavy apparatus should be placed when not in use (Fig. 185). In this way a blind person is made aware of his approach to the wall, and of the presence of danger, when walking, running, dancing, or skating. A running track should have a hand-rail of convenient height to serve as a guide, and in the play-fields the presence of trees should be shown by having a brick walk about 10 feet in front of or around them, so that the child may run and play with perfect freedom and confidence until warned of the approach to danger by the bricks under foot (see Fig. 184).

Outdoor apparatus should also be fixed, the child soon learning their place, and avoiding the collisions that would inevitably occur if their position were a matter of conjecture.

Physical education for the blind should be compulsory at all institutions as it is at Overbrook, Pa., the classes being small and arranged in the order of their age, and with some partially blind pupils mixed with the totally blind to act as leaders. In his classes for blind in the Milwaukee Public Schools Wittig confined the number to 12. The formation of a class in the gymnasium need not differ very much from that of children with

Fig. 186.—Method of alignment in a class of the blind in Sweden (Lefebure).

sight, except that in lining up they should keep in touch with one another by each pupil placing the hand on the shoulder of the one in front, or, where a class is formed up in ranks, by placing the right hand on the companion's shoulder and the left hand on the waist, as is done in Sweden (Fig. 186).

When a number are lined up in single file a regular class formation can be obtained without difficulty by giving the order "right turn," and counting off, and this can easily be reversed to the original line-up when the exercises are over.

Gymnastic apparatus work may be used with considerable advantage, but the leader should be able to see a little, and members of the class must learn the movement by passing the hand over the leader while he is doing it. By this means a wide range of work can be done on the horse and parallel bars, and such exercises as falling, rolling, and simple tumbling may be extensively developed, but the Swedish gymnastics, in which the exercise is performed in response to command, must be used sparingly, because of the great and rapid mental exhaustion produced in blind children.

Fig. 187.—100-yard dash. Start, showing handles and cables to direct their course. Overbrook record, 100 seconds (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

Music has a peculiar value in cultivating confidence and rhythm, both of which is sadly lacking in the blind.

Formal gymnastics and apparatus work should play, however, a comparatively small rôle in their day's exercise, and games should be freely interspersed when symptoms of exhaustion appear. Among the most popular games is the cock-fight, and a game invented at Overbrook by Lindblad, called the Japanese torpedo, in which a small bag of sand covered by emery cloth is attached to a long string, and swung around in a circle by one pupil while the others jump over it as it passes, being guided by the sound of the emery cloth on the floor.

The soft rubber ball is a valuable piece of apparatus. Throwing and catching it, bounding it against the floor or wall, have an unending interest (Wittig).

Running, roller-skating, and dancing can also be practised if comparatively few skaters or dancers are allowed on the floor

Fig. 188.—100-yard dash. Finish. The racers are able to give unhampered attention to speed by means of the device shown above. Upon the wire cables, stretched the full length of the track, are rings to which are attached short chains and handles. The racers hold these handles and run the course with perfect freedom. They are warned of the end of the track by the fringe of cords like that used on railroads to notify brakemen on top of freight cars of "low bridges" (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

at one time, and all are required to circle in one direction only, the presence of the concrete margin on the floor being sufficient protection when heavy apparatus is carefully put back in its place against the wall after class use. Another protection against running into the wall is the changed resonance due to the presence of the running track, a phenomenon which the blind use continually for their protection.

Among the outdoor sports walking is almost the only one blind children will voluntarily undertake, although they can be taught almost all the field sports, with but few restrictions.

Fig. 189.—Blind boy preparing to jump.

Clarence E. Van de Walker, the instructor at Overbrook, writes on this subject:

"To me, watching and directing this work from day to day, the sight of strong, active boys, learning to run in much the same way that a baby learns to walk, and experiencing about the same difficulties, was both amusing and pathetic; but the smile and shout of triumph which burst forth simultaneously from the boy who had succeeded in really running were ample proof of his delight to discover that he possessed a power dormant so long that he doubted its existence."

Foot-racing was practically impossible until the invention of a method in one of the institutions of Edinburgh, by which a three-stranded cable as light as was consistent with strength was stretched breast high between well-guyed end-posts 110 yards apart. The runner holds in one hand a wooden handle attached by a short flexible chain to the long wire. As he runs the ring slips along and the feeling and sound enable him to hold his course. At the end of the 100 yards a cord is stretched across, about 7 feet high, from which hangs a fringe of hammock twine long enough to strike the runner in the face as he passes. This fringe covers the two parallel lanes, so that competitors may run in pairs, and prevents those accidents that were at best too frequent in the open field.

High and deep jumping are practicable, and even the running broad jump may be practised, the measurement being made from the starting foot instead of from a fixed board.

Other popular field sports are putting the shot, throwing the discus, and throwing the hammer—with a stiff wooden handle and thrown from a stand.

A strange phenomenon for the psychologist is the popularity of a modified form of baseball, in which, at a signal, the pitcher throws the ball, the batter strikes, and the catcher catches.

Fig. 190.—Putting the shot (12 lbs.). Overbrook record, 35 ft. 1½ in. (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

As a rule, no one accomplishes anything but the pitcher, and yet boys will play this for hours at a time. Football is also played by choosing sides and kicking the ball back and forth until the goal-line of one side is crossed. This is also popular, and can best be done by choosing one, at least, on each side who has partial sight.

Swimming is an excellent exercise for the arms and shoulders, and is practised with success among the blind.

Fig. 191.—The swimming-pool (Pennsylvania Institution for the Instruction of the Blind. Overbrook, Pa.).

Fig. 192.—Trolley coasting on the athletic field (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

Fig. 193.—Ring game. Kindergarten building in the background (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

Fig. 194.—A game of "blind man's buff" in the girls' cloister (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

Athletic sports are quite as popular among the girls as they are among the boys. They enjoy jumping and running, and athletic and gymnastic apparatus, like the trolley-coaster, swings,

Fig 195.—Rocking boat (Pennsylvania Institution for the Instruction of the Blind, Overbrook, Pa.).

and see-saws, should be provided for them in the gymnasium and out of doors, while the rocking boat is safe and an endless source of pleasure to the younger children.

The Deaf-mute.—A system of physical training designed for deaf-mutes must take into consideration the peculiarities incident to deafness that divide them from the rest of humanity into a class by themselves. It must also bear in mind the fact that in almost every respect they resemble other children. A deaf child thinks in gesture and pictures, and so expresses his thoughts, but his verbal memory is undeveloped. His chest and all the apparatus of articulation are, in consequence, under the average, and they are peculiarly liable to disorders of the respiratory tract accompanying this underdevelopment.

Fig. 196.—Deaf-mutes playing basket-ball.

In girls of sixteen one series of observations by Miss Grace Green showed an average lung capacity of 118.3 cubic inches, as compared with 130 cubic inches of the normal girl of the same age.

Their powers of co-ordination, particularly of equilibrium, are not up to the normal, and they have a peculiar characteristic slouch of the figure and a shuffling gait.

Physical education would then include and emphasize the teaching of articulation, which is an art by itself; the development of the respiratory system; the cultivation of balance and the correction of postural defects.

The education of the deaf is carried on better in an institution than at home, and as the great majority of such cases come from the poorer classes, and have to be made as efficient as possible as wage-earners, I shall write more particularly of institutional work.

No formal drill should be given to the very youngest pupils, who have no "*language*," but games and free play seem to suit them best. To the class next youngest, whose *language* is limited, work should be given by word of command, followed by the execution of the movement, which the children imitate. In this way the movement of the lips is associated with the exercise, and the child is trained to read the lips in such wise as to learn the response to the command without further demonstration.

The teaching of lip-reading is part of the instruction in every institution for deaf-mutes.

The last census of the United States shows that of 89,287 deaf, only 13,986 could read the lips, and speech-reading was confined almost entirely to the totally deaf, since the partially deaf or those who have acquired deafness in later life do not learn it, but depend on the use of some device like the ear-trumpet in preference.

About 39 per cent. of the totally deaf have been taught lip-reading at institutions like Mount Airy, Pa., and elsewhere, and as every means is taken to practise the children in this art, physical training gives valuable opportunities.

In the more advanced grades, as their language becomes better, the significance of the command is apprehended and its full meaning realized. Exercise by word of command is then of double value for deaf-mutes, since it teaches lip-reading and trains their verbal memory. There are two things to be remembered, however, in teaching a class of deaf children. The teacher must always be in front of the class, on a platform elevated at least 1 foot above the floor, so that each pupil may have a clear view of her mouth without having to lose the correct attitude in standing. Commands for marching and turning movements must always bring the class back to a position facing the platform, as the pupils have only the teacher's face to depend upon for direction. Her face should be well lighted, and the commands should be given with full force, so that the natural facial expression may be maintained. This, while an advantage, is not essential, as I have repeatedly seen a class respond promptly and accurately to a command given by the lips only without any sound.

Fig. 197.—The gymnasium at Mount Airy, showing the balance boards for teaching equilibrium, in the foreground.

The shuffling gait and bad posture are corrected by setting-up exercises, taken in the standing and sitting positions. Close attention should be given to the correct carriage of the head and shoulders; to the rhythm and length of the stride; to the position of the feet and the distribution of the body weight.

Balance movements are most useful for encouraging a better equilibrium and improving the manner of walking, requiring, as they do, a high degree of co-ordination. Whether a lack of co-ordination and equilibrium is or is not a direct result of deafness is not proved, although in many cases it would appear to be the case.

In a series of experiments conducted by Miss Grace Green, at Mount Airy, 60 pupils were chosen from the intermediate department of the institution on account of their untrained sense of equilibrium. From this number 16 were excluded, classed as semideaf. Of those remaining, 27 were congenitally deaf and 17 were semimutes. Of the 27 congenitally deaf, 20 could sustain equilibrium with little difficulty and 7 could not, while of the 17 semimute, only 2 were able to keep in balance.

It is also worthy of note that of the 44 cases, 32 were unable to maintain equilibrium on the balance beam or board.

These experiments emphasize the importance of balance exercise in the training of the deaf, for they rapidly respond to systematic training.

Deaf-mutes do not compare favorably with hearing people in the matter of longevity. They die in a larger proportion from diseases due to bad feeding, poor housing, and unsanitary conditions. Mouth-breathing is exceedingly common among them, and there is a high mortality, due to chronic affections of the respiratory tract. Great emphasis should thus be laid upon good food, warm clothing, the cultivation of speech, and the use of respiratory exercises, both free and by the aid of apparatus.

It is to be remembered that one of the chief characteristics of the deaf is the lack of speech. The hearing child who is laughing, singing, and shouting in his play all day is unconsciously giving to the lungs one of the most healthful exercises. The power of speech is a great incentive to the use of the lungs, and the acquirement of speech is one of the first things that should be taught the deaf child; it can be greatly aided by exercises of deep breathing, together with movements of the arms, chest, abdomen, and lateral trunk, with special training in tone production and control of the respiration. The patient is thus given increased power to resist disease, and acquires better speech through this development of the entire respiratory tract.

Miss Green has shown at Mount Airy a rapid and gratifying increase in the chest capacity of the girls of that institution under the influence of physical training and instruction in articulation. Her pupils showed an average lung capacity of 118.3 cubic inches on entrance, in comparison with the average 130.3 for normal girls of the same age. With training the average was raised to 139.6 cubic inches from one season's work.

Games and play are used freely, both to relieve the tedium of the more formal gymnastic work and to give that development which can be produced by free play alone. They differ little from the plays of the normal child, and should be designed so as to involve the actions of large muscle groups, training the children in alertness, decision, and accuracy.

For boys and young men all the games and sports of the normal child are available, and it is not uncommon to see the foot-ball or basket-ball team of such an institution taking its place with that of a preparatory school or college of the same size, although the silence with which they play forms a striking contrast to the noise of their opponents.

CHAPTER XVII

PHYSICAL EDUCATION OF MENTAL AND MORAL DEFECTIVES

It is during the early years of school-life that the condition known as mental dulness, backwardness, arrested development, or feeble-mindedness develops sufficiently to be capable of definite diagnosis. It is there also that the first steps can be taken to correct mental sluggishness and to train the neuro-muscular system of these atypical children. The backward child is always much older and bigger than the other children of his class, hopelessly behind in his standing, usually remaining two or three years in one grade, and sometimes promoted only when the desks and seats of the room have become too small for him.

Mental dulness may be due to physical weakness following severe illness, or to other curable conditions that may not have been recognized by the parent or family physician. Again, certain children in good physical health develop slowly at certain ages, afterward catching up with their fellows. This may be due to a period of rapid physical growth, and should be carefully distinguished from the more serious conditions. Teachers all recognize a class of children who remain distinctly backward for several years. When they wake up, as they eventually do, they frequently show unusual ability. When these cases are accounted for, and their types of temporary slowness or abnormality noted, there still remains a group of pupils who, while not actually idiotic, are so deficient mentally as to be entirely incapable of profiting by ordinary school methods.

In the examination of 100,000 school children in London in 1890, Dr. Francis Warner showed over 1 per cent. of actual mental defectives, and similar investigations show that this ratio holds good in America.

The symptoms of mental deficiency are characteristic: Backward children are fatigued by any mental effort and lose

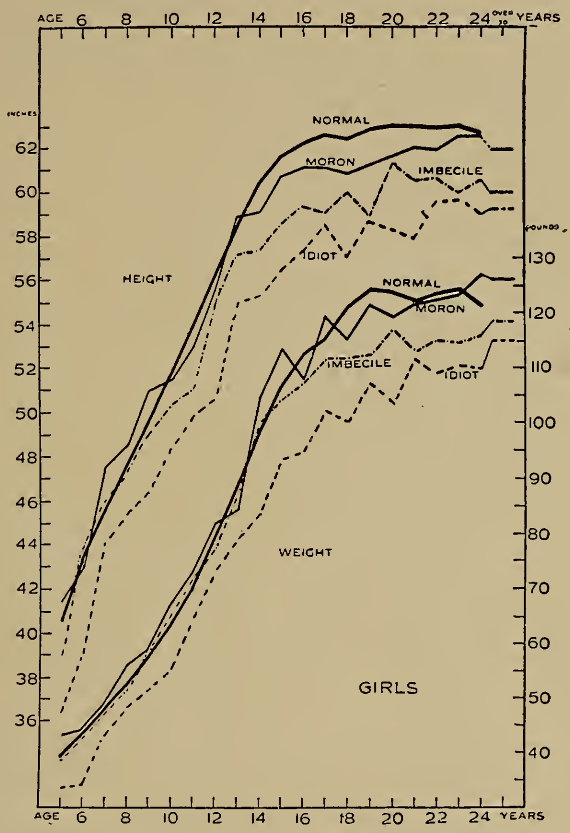


Fig. 198.—Size and efficiency go together (Goddard).

interest quickly. They are not observant, are not able to discriminate quickly and accurately color, weight, form, or size. They may be unduly idle and listless or overexcitable. They are often disobedient, wilful, and liable to attacks of stubbornness and bad temper. They are untidy in their personal habits

(Fernald), awkward in their gait, movement, and attitude. In grasping they are either feeble or they may clutch the object and seem to be unable to let it go. Inco-ordination is plainly shown in drawing and writing, in the lack of skill and dexterity

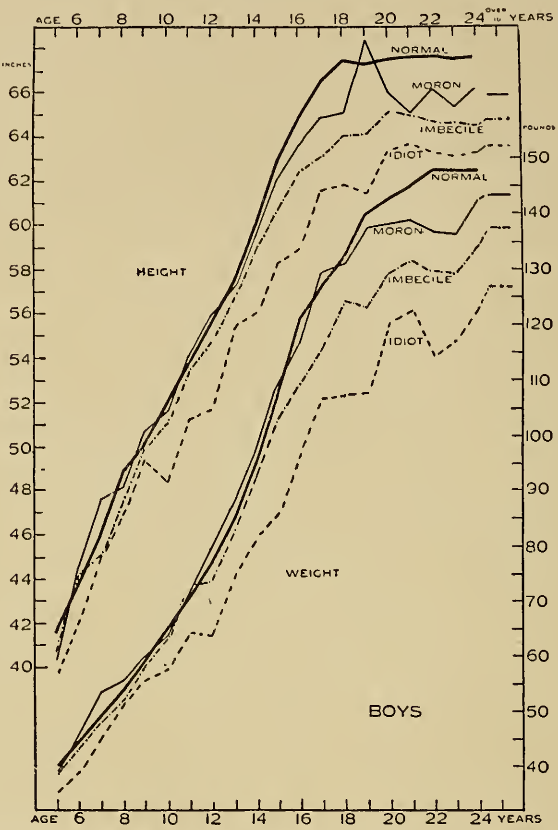


Fig. 199.—The lower the grade of mental efficiency, the greater is the deficiency in height and weight (Goddard).

in simple gymnastics, and in the lack of initiative and spontaneity. They do not show the strength, vigor, alertness, and courage of normal childhood. They are undersized.

A distinction must be made between those temporarily retarded from poor health or unfavorable surroundings, to whom a change of circumstances means the recovery of their place in the class, and those who are permanently subnormal.

The feeble-minded are divided (according to Goddard) into those who are totally arrested before the age of three, so that they show the attainments of a two-year-old child or less. These are the *idiots*. Those who are so retarded that they become permanently arrested between the ages of three and seven. These are the *imbeciles*.

Fig. 200.—Typical adenoid face. The open mouth, expressionless appearance, impairment of hearing, and evil effects upon the general health have produced the condition known as aprosexia (Barnhill and Wales).

Those so retarded that they become arrested between the ages of seven and twelve. They were formerly called feeble-minded, but are now called *morons*, a Greek word for "fool," one who is deficient in judgment and sense.

The idiots never get into the public school. They are of too low grade. The truant, the incorrigible, and the dullard may belong to any one of the three grades. The incorrigibles and dullards are sometimes temporarily subnormal, but more often are morons or imbeciles.

Any child that is not able to profit by the ordinary methods of instruction given to children of his own age should be considered backward or defective, and all such cases should be carefully observed, and a record of their habits and mental characteristics should be made in co-operation with the medical inspector, or, if necessary, with an expert on mental conditions. A thorough examination should be made of the special senses and throat; adenoid growths where found should be removed, and defective vision or hearing corrected. The removal of these remediable obstructions is frequently sufficient to permit the backward child rapidly to regain his normal grade standing.

Every child, then, who is more than a year behind his grade should be examined. Usually a sufficient reason will be found in some defect of sight or hearing or previous sickness; but 1 to 2 per cent. of all school children show actual feeble-mindedness. While the opinion of the teacher or the evidence shown by retardation of grade is of value, the final diagnosis should be made by the Binet-Simon measuring scale for intelligence, because it is of the utmost value to be able to state to parents and friends that a fifteen-year-old child has the measurable intelligence of a child of five or six years.

These tests have been revised by Dr. Henry H. Goddard[1] and tried out on 1547 supposedly normal children, of whom 554 tested exactly at age; that is, they answered the questions for their respective ages; 329 tested one year above and 312 tested one year below.

The following table shows graphically the results.

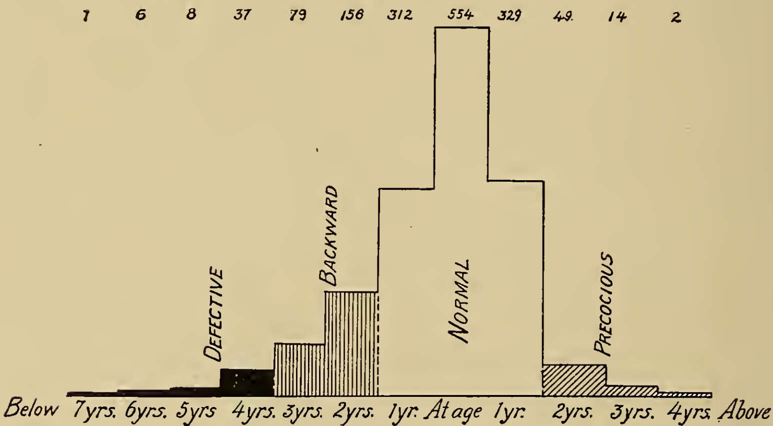


Fig. 201.—Goddard's scale, showing the accuracy of the Binet-Simon test with his modifications (from Pedagogical Seminary, June, 1911, vol. xviii).

To one familiar with statistical methods this curve amounts to a mathematical demonstration of their accuracy.

[1] Described by Professor Binet in the bulletin, "De La Société Libre Pour l'Etude Psychologique de l'Enfant," April, 1911.

Briefly, these tests consist of a series of questions, increasing in difficulty with the age of the child. The questions are four or five in number, and include the muscular sense by having the child sort out blocks of wood having the same size but different weights. He must also copy a geometric figure, a sentence, count and match objects and spaces.[1]

In testing the emigrants at Ellis Island for feeble-mindedness, use is made of the Seguin form board (Fig. 202) and of various modifications of it, by such as Knox's *Imbecile Test*, Healy's *Frame Test*, and Knox's *Moron Test*, all of which require the putting of irregular blocks in their places within a definite time limit and so testing motor ability.

Fig. 202.—The Seguin form board in use (Henry H. Goddard).

It is found that a certain number of children in every school are what might be called motor dullards. They lack the average physical intelligence, are clumsy and inefficient. They almost invariably show a mental slowness or deficiency, and inspection of a large number bring out cases of anemia, chorea, mouth breathing, and general nervous insufficiency, shown in speech defects, habit movements, and other such symptoms. Where possible, these pupils should be weeded out and put in special classes for backward children. Two such boys in a Manhattan school were trained in vigorous athletic work, and were thus enabled to raise their scholarship from zero to B plus, becoming alert, vigorous, self-confident, and resourceful. Similar results could doubtless be obtained in many others. The necessity of a physical examination in the discovery of defects previously unknown to pupil or parent is shown by the report in one high-

[1] Mental Deficiency, Henry H. Goddard, 1914.

school in New York, in which out of 384 boys examined 40 per cent. required treatment.

When a diagnosis has been made the parents should be frankly and tactfully taken into the teacher's confidence, the use of opprobrious terms to express the mental defectiveness being carefully avoided. The parents should be impressed with the fact that the child is not doing well at school, and that for his own sake he should have special attention to prevent him from going backward as well as to train such powers as he has.

In Detroit it is the custom, after the Binet-Simon test has been used and the child found backward, to send a notice to the parents asking them to consult their family physician concerning the child. If no result follows, the principal calls upon the school physician to give the child an examination for remediable defects. This examination is reported to the parent. If the parent is unable to provide proper medical attention, the principal reports the case to the Child Study Committee and a specialist is called in. The parent is then consulted by the principal, and questions regarding ancestry and peculiarities are discussed and a report sent to the Child Study Committee, who either exclude the child or put him in special classes.

Unless retardation is sufficient to require treatment and protection in an institution for the purpose, cases of backwardness may be taught in classes composed of children who show about the same degree of mental deficiency. They should, however, be put in a special room or, where possible, in special schools. In this way the low-grade children are prevented from interfering with the regular work of the class. They are given the advantage of some educational training, combined with a large amount of manual and physical work selected with the view to provide them with some means of livelihood later on. Very little can be required of them in purely intellectual work, and their life is made miserable by trying to teach them something which is beyond their mental capacity and which can only put them at a disadvantage before their comrades.

Their physical education would vary with the degree of the defect. In a school system special classes should be provided for them, and teachers should be specially prepared to take charge of these atypical pupils. Public schools for them have been in successful operation in Germany, Norway, Sweden, Denmark, France, Switzerland, and England. In London alone there are more than sixty classes, and such classes are also in successful operation in Philadelphia, Providence, Boston, Chicago, and elsewhere.

Backward children are segregated for their own benefit, and also for the benefit of the other pupils of the school whom they would hold back. The classes should be small, not over fifteen in number, and great attention should be paid to improving the child's surroundings in the home as well. His physical condition should be kept as favorable as possible by nourishing food, regular outdoor exercise, bathing, ample sleep, and careful attention to bodily functions and habits. The mental awakening resulting from an improved state of nutrition and bodily vigor alone is often striking. The education of the special senses and the training of the voluntary muscles to prompt and accurate response must precede and prepare the way for the more purely intellectual training. The unseeing eye, the unhearing ear, and the other obstructed avenues of approach to the central intelligence must be opened up by a series of carefully arranged *sensorial gymnastics*.

The ultimate aim of these exercises is to train the child to acquire knowledge from his sensations. Next in importance comes the discipline of the muscles, not only for muscular growth and practical co-ordination, but to strengthen the well-recognized relationship of thought to muscular movement, motor training being one of the most potent factors to arouse the feeble powers of voluntary attention, observation, and comprehension. This motor education should begin with the common games and occupations of normal childhood. The child should be taught to throw and catch a ball, to kick a football, to jump and run, and, in fact, to perform larger movements calling for the natural use of the various muscle groups, progressing with an eye to the normal evolution of the play instinct, as described in the chapter on Age, Sex, and Occupation.

Music and rhythmic marching are preferable to more formal gymnastics involving close and continued attention, prompt obedience, and accurate motor response. Mentally deficient children frequently show a more acute feeling for rhythm than the normal child. Music holds their attention, and they respond quickly to such rhythmic exercises as those of Dalcroze, which might well be employed in their education. These qualities must be cultivated by the simplest movements or the good effect

Fig. 203.—Crippled and defective children gardening (Playgrounds Association of Philadelphia).

still be lost. Gymnastics by commands are at first entirely beyond most of these children, whose attention quickly lags and whose co-operation and interest it is impossible to maintain.

What has been said of general motor training applies with special force to the training of the finer co-ordinations of hand and forearm. This can best be done by kindergarten methods and by manual occupations, such as Sloyd, basketry, and weaving. Indeed, there are no other means of influencing so profoundly the mental growth of the defective. Instruction must always begin on a very low plane, and progress at best will be slower than in the normal child. At an early age much of this neuromuscular training by gymnastics may be directed to the various handicrafts and simple manual labor, which will enable many of these children, especially in institutions, to become self-supporting in after-life who would otherwise become a burden on the community. Under this course of education some children develop up to the grade classes and return to them, completing a fairly satisfactory school course. When, however, the degree is extreme, and the condition is congenital or the result of disease or injury, these brain abnormalities remain permanent, and no really feeble-minded person ever was or can be entirely cured (Fernald).

It is always a question of how much improvement is possible in each individual case. Many of them may be trained to be at least self-supporting if not self-controlling, but the greater number need oversight and supervision as long as they live. A large proportion become public charges, and it is important that they be kept in institutions as they approach adult life that they may not have an opportunity to yield to the physical temptations to which they are so peculiarly susceptible and so propagate their own kind. Cases of gross defect are always better treated in institutions than at the school or in their own homes, but even in aggravated cases much can be done by motor training to improve their bodily habits and to increase their range of usefulness, making them more observant and appreciative of their surroundings. According to Barr's experience,[1] the best results are obtained from military drill, games, and gymnastics, with manual training varying in difficulty with the grade of backwardness, the relationship of the grades in mental defectives being somewhat like the successive ages in children so far as their helplessness is concerned. The lower grades are like the youngest children, but their physical conformation does not correspond with their mental backwardness.

The more educational movements should be directed, *first*, to the posture and gait of the patients. Their most charac-

[1] Mental Defectives, Martin W. Barr (Blakiston & Sons).

teristic defect is the shambling walk, with dragging feet and slouching figure. This may be corrected by running to *command* up or down hill, by walking contests on tiptoe indoors or outdoors. Such exercises briskly carried out awaken the attention and make a good break in a long occupation period. The use of a springboard supplementing walking drills develops elasticity in the dragging step. Stooping may be corrected by balancing a book or basket on the head and the poise and ease of bearing thus improved. The placing of a ladder horizontally on the floor is a valuable way of correcting a slouching gait. The child steps between the rounds and must raise the foot well at every step. The stepping on bricks placed at regular distances is another device for the same purpose.

Military drill has a peculiar educational value for a defective. The boy learns a certain standard of precision, attention, and readiness of movement. The emulation brought about in these movements is important. The stimulation of his ambition to attain to the power of the others, to present arms in order that he may not disturb the general movement of the squads, is alone one of the most important means of character building.

This discipline is also obtained by gymnastic exercises in which prompt obedience to command is insisted upon. These drills should be practised only for a few minutes at a time, and varied in difficulty to suit the grade of the class. The training for skill and co-ordination of the arms and hands (Fig. 204) may be accomplished by the horizontal and parallel bars and the use of ladders for climbing.

One of the most defective co-ordinations in the atypical child is found in the power of grasping. The weak and nervous fingers of the untrained imbecile can retain nothing within its grasp, or the nervous clutch, unconscious of its violence, is equally expressive of mental incapacity.

It is necessary, then, to train this co-ordination by simple and strong exercises of hanging and climbing, catching and throwing, before giving to the child a hammer, a saw, or a chisel. The throwing and catching of balls, from the baseball to the medicine ball, are useful, as are the simpler exercises on the bars and rings.

In high-grade defectives this power of regulating the grasp is better controlled, but it may be still further trained by weaving, club-swinging, or blackboard drawing with both hands, after the system of J. Liberty Tadd.

Active sports are to be warmly encouraged, the exhilaration to the onlookers as well as to the participants being a good antidote to the lethargy and the timidity of the feeble-minded. The

Fig. 204.—Defective class. Nine to fifteen years. First grade work. Sideward bending, showing the poor co-ordination in the carriage of the head and arms (Krogh).

circulation is stimulated thereby, and the muscles, which are inclined to be flabby and cold, are improved in nutrition.

Dancing is an amusement in which most of these children delight, and many excel, and its good effect is evident at once. Running, racing, swimming, leaping, vaulting, quoits, tennis, croquet, are all most suitable, while football, baseball, and basketball are frequently well played and eagerly discussed by children even of a very low grade, but lack of initiative is the outstanding characteristic of the great mass of incapables.

During a recent visit to an institution for the feeble-minded a group of boys were seen working in the field. Their attention being attracted, they all stopped, some with bent back about to lift a shovelful of earth, others in various stages of arrested movement. Thus they remained until called back to their work by the shout of the foreman. This mental apathy expressed by sluggish physical movement is present in nearly all low grades of intelligence, and can only be reached by such means as have been described.

The other type of mental defectives shows an abnormal excitability, seen in restlessness, insubordination, and truancy, and it is these children that so frequently find their way into the Juvenile Court, the reformatory, and the jail.

Blunted intellect and moral failure, as a rule, go hand in hand, and it is a mistake to suppose that the criminal child or man is naturally bright. If apparently bright, it is usually in a narrow line and self-repeating—more allied to animal cunning than to intellectual power. He is vacillating, without fixed purpose or aim, incapable of pursuing a consistent plan, and of a rudimentary or atypical mental development.

Physical training, then, is specially indicated in the case of the youthful delinquent who so often enters the school poorly nourished, anemic, with muscles soft and flabby, from a life passed in the dark and unsanitary tenement house, homeless on the street, or uncared for in the village. Along with this common city type there will also be found in the Juvenile Court or special training-school the apathetic dullard, stupid and shambling, whose every motion expresses mental lethargy and physical incapacity. As a rule, these cases detest exercise or anything that disturbs their stupor, and for them discipline must be Spartan in character, for exercises need not be agreeable to be beneficial, as has been well insisted upon by Sargent and is daily proved in the reformatories.

A course of physical training for such children acts beneficially in three ways: By awakening the brain activity of those who are mentally defective; by bettering the badly nourished and flabby muscular system by developing the heart and lung power;

and by demanding alert and prompt response to command, a most important lesson, to be taught so well in no other way.

The course of training for the incorrigible youth or young criminal would begin with military drill, in which the boys are formed into companies with sub-officers selected from their own number. These companies are taught the usual evolutions of marching, countermarching, and the manual of arms. The authority of the officers selected from among the boys should cease with the end of each drill, and promotions should be made with the greatest care. There is always a temptation to bully if the giving of this temporary authority is not rigidly guarded. The perfection to which the military drill can be carried is shown by the attainment of the boys in the industrial school at Glen Mills, whose evolutions on the field would do credit to regular soldiers.

The second means of training is by gymnastic exercises, and those in use at Glen Mills are semimilitary and founded on the German plan, rather than the Swedish. The boys are lined up and marched to the gymnasium, which has a concrete floor. Coats, hats, shoes, and stockings are removed, and a brisk drill is given either with wands or dumb-bells. This is followed by a five-minute period of free play, in which the noise of the boys is in marked contrast to the comparative silence of the class work. Following this is apparatus work on the parallels, horse, and horizontal bar, class leaders being promoted from among the boys. After another period of free play the lesson ends by gymnastic games. The boys are then lined up, shoes and stockings are put on, and they are marched back to their various occupations.

The third means of training is by outdoor sports and games, in which great freedom of organization and conduct is allowed, although strict supervision is still kept and the boys are punished for misbehavior by being made to stand along the side line of the playground with the back to it for periods of five or ten minutes. If the offense is a severe one, the salutory exercise of continuous, slow, deep knee-bending is added during their

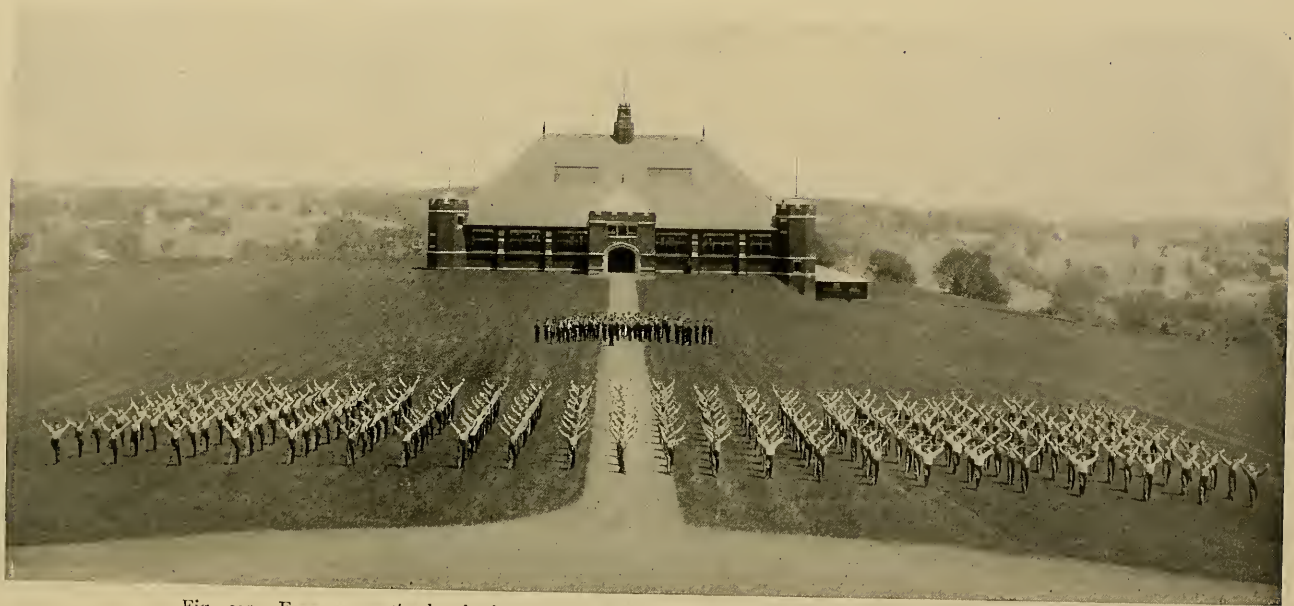


Fig. 205.—Free gymnastics by the boys at Glen Mills. The band and gymnasium in the background.

period of punishment. Competitive games with outside institutions are arranged, and track and field sports are freely indulged in, giving good opportunities for moral and ethical training, which are not neglected. The results have been so satisfactory that physical training is now established on an equal footing with industrial training and the school of letters in the regular days' curriculum of these incorrigible boys.

Physical training has a marked effect on the physique, mentality, and conduct of criminals who have attained their full growth, as proved by the experiments of Hamilton D. Wey, at the Elmira State Penitentiary. His description of the criminal is illuminating:

"The average youthful criminal, as encountered in the prisons of the State, is an abnormal production, physically, mentally, and morally. Generally under weight, with repulsive features in some one or more lines, and asymmetric head; he is coarse in fiber and heavy in his movements. His mind, while not diseased, is undeveloped, or it may be abnormally developed in certain directions, the smartness resulting therefrom partaking of low cunning and centering about self. He is deficient in stability and will-power, and incapable of prolonged mental effort and application. His intellect travels in a rut and fails him in an emergency. His moral nature shares in the imperfections of his physical and mental state. He does not possess the power to discriminate between right and wrong, or if so, it is in favor of himself and avails nothing to society. It is easier for him to incline to evil rather than to good, to the animal rather than to the intellectual, and in this he is true to himself. His is a perverted moral nature—a blunted mind and a crude body."

It is to physical training that we must look for the awakening of those powers that can be directed by firm discipline to the physical, mental, and moral betterment of these derelicts.

During a period of sixteen months a class of 43 dullards was given a course of physical training at Elmira. This comprised baths at frequent intervals, in conjunction with passive exercise, kneading the muscles, working the joints, and general friction by a professional trainer; and a manual drill in calisthenics to supplement the shop work, from which they were excused, although their school work was taken as usual. They were put on a specially nourishing diet. The physical exercise lasted for about two hours a day. They began with the ordinary marching, and in time were taught other evolutions, although it was a matter of weeks to teach them to keep step. When they could do this well, they were given setting-up movements and exercises with dumb-bells up to three pounds in weight. The first experiment lasted from June until November, and showed a net average gain of 1.23 pounds a man. Various skin diseases disappeared, the muscular condition and the carriage improved, and the response to command became much more rapid and accurate. The whole expression of the face improved, the dull, stolid look assumed a more intelligent expression, and the eye gained in brightness and vivacity.

A mental awakening accompanied this, and their progress in school rapidly showed the effects. During the five months they were under observation their average marking in school was 74.16 per cent., as against 45.2 per cent. for five months immediately preceding their course of special training.

This improvement was continued to a remarkable degree, and the stimulation of the physical powers in the case of three of the class impressed their mental organization to such a degree that it enabled them to earn their release on parole, whereas if left to themselves their minds would never have been so quickened.

To train these dullard's legs and arms to act with precision and in unison was more than the mere rehearsal of mechanical movements. It was *mental* as well as physical training, and Dr. Wey is of the opinion that in the prisons and reformatories of the country "there is a class of youthful felons who can thus be reached in their growth period and improved primarily through the training of the body, the cultivation of the head following in good time. If penal institutions in their educational work could more often look upon bodily training as a powerful agent for the physical, mental, and moral reformation of their charges, more men would be released at the expiration of their time competent to maintain themselves honestly."

This result is only to be obtained by careful physical training with an educational purpose, for, as F. H. Nibecker, the superintendent of Glen Mills School, so well puts it, "Hard work of any particular kind is not complete exercise, nor is it equivalent to physical training, by which the perception is quickened and mental training results, quite as pronounced in effect as from efforts that have mental training more directly in view."

PART II

EXERCISE IN MEDICINE

CHAPTER XVIII

THE APPLICATION OF EXERCISE TO PATHOLOGIC CONDITIONS

The efficacy of both active and passive exercises in the treatment of pathologic conditions depends on their power to change anatomic structure and to stimulate physiologic function. This anatomic and physiologic effect is very differently expressed in exploits of endurance, in feats of strength or skill, and in the passive procedures of manipulation and massage.

Exercises of strength requiring little co-ordination rapidly add to the bulk of the muscle tissue, but in exercises of skill the nervous system receives accurate training while the muscle girth is increased but slightly. Contrasted to them, mild automatic exercises of endurance train the heart and expand the lungs more surely than do either supreme efforts of strength or the cultivation of skilful muscular control.

Passive exercise has a purely mechanical effect on the muscle tissue and circulation which is obtained without that mental concentration required to educate or re-educate atrophied and undeveloped co-ordinations, and without taxing the heart and lungs. By it the nutrition of a part is maintained or improved through its blood-supply alone.

The use of exercise has had an important share in the treatment of disease since Hippocrates used it at the sanatorium at

Cos, and Galen advocated it in words that are as true now as they were eighteen hundred years ago, but it is Ling and his successors,[1] Brandt, Hartelius, Kleen, Wide, Kellgren, Cyriax, and Graham, who have done the most to bring it to its proper place as one of the valuable means in the modern treatment of disease.

Exercises of strength require maximum contractions. They alternately contract and relax a muscle, squeezing out the blood and waste material and allowing the muscle to fill again. They require great concentration of attention, and in consequence are of especial value for weakened or undeveloped muscle groups. It is on exercises of this class that we depend for development of the weakened and inactive muscles of the abdomen, which yield to the pressure of the viscera and permit distention of the abdomen and certain forms of hernia. It is to this class of exercises that we turn to develop the muscles of the chest, back, abdomen, and legs in that large group of deformities which result from yielding of the structures of support at the foot, hips, back, and neck; in paralysis these simple concentrated movements of carefully selected groups are the chief hope for a continuance of a partial recovery of lost power. They are of value in the general development of parts put into disuse by more grave surgical necessity, and can do much to shorten postoperative convalescence. Their value after appendectomy has been interestingly shown by Dr. Eugene H. Pool, in the report of his own case, in which he began simple free movements on the third day after the operation. He practised them three times a day, was out of bed on the eighth day, and experienced so little fatigue that on the thirteenth and fourteenth days he was able to cover 60 miles over a rough trail by wagon and on horseback with no ill effects. His patients have been unanimous in showing shorter convalescence, feeling better from the very beginning of the exercises. The movements he used are typical exercises of strength reduced to their simplest form, as seen in the following list:

[1] See Bibliographia Gymnastica Medica, E. F. Cyriax.

(1) Ankles flexed and extended.
(2) Lower extremities rotated separately.
(3) Hips flexed and extended.
(4) Knee flexed and extended.

Nos. 3 and 4 to be used with caution and sometimes restricted to one side only, and omitted on the right side after a right hernia or appendectomy.

(5) Fingers flexed and extended.
(6) Wrists flexed and extended.
(7) Forearms pronated and supinated.
(8) Forearms flexed or extended.
(9) Arms flexed and extended.
(10) Neck flexed by raising head.
(11) Neck flexed from side to side.
(12) Deep breathing.

Each exercise to be done ten times, increasing up to twenty-three times, and repeated three times a day. They should never be continued beyond the point of moderate fatigue, and some of them should be given with resistance. By this means the circulation is improved, muscular weakness and atrophy diminished, and the return to normal made more rapid than after the usual procedure of absolute inaction. They may well be supplemented by massage and manipulation.

This is merely one example of the employment of exercises of strength in pathologic conditions, and many more will be cited in the detailed account of the treatment of such special conditions as diseases of the heart.

In order that prescriptions of exercises may be made intelligible it is necessary that the various positions and movements be named and defined, for only in this way will it be possible to write uniform prescriptions that can be readily carried out by an attendant when it is not possible for the surgeon to administer them himself.

The fundamental positions of the body are *five* in number—standing, sitting, lying, kneeling, and hanging.

In standing (Fig. 206), the patient stands with the heels together, feet at 60 degrees, and knees straight, trunk erect, chest well arched forward, head erect, and chin drawn in. The arms straight and the hands at the side, palms in.

In the *sitting* position (Fig. 207) the head, neck, and chest are as described above, the buttocks and thighs resting on the horizontal seat, feet on the ground or on some other support, legs close together, arms hanging freely downward.

In the *lying* position (Fig. 208) the patient rests on a horizontal couch supine, arms at sides as before.

Fig. 206.—Standing.

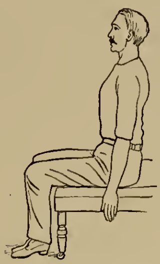


Fig. 207.—Sitting.

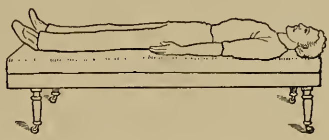


Fig. 208.—Lying.

In the *kneeling* position (Fig. 209) the position is the same for the head, trunk, and arms. The knees are bent at right angles and the weight rests upon the legs, the feet being extended.

In the *hanging* position (Fig. 210) a bar above the head is grasped by the hands divided by the breadth of the shoulders. The weight is carried by them, and the rest of the body is as in the standing position, except that the feet are extended.

Fig. 209.—Kneeling.

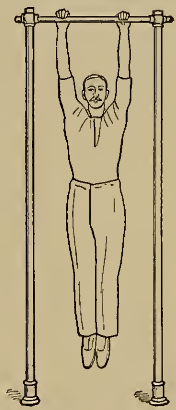


Fig. 210.—Hanging.

The derived positions of the *arms* are:

(1) *Hips firm*—the hands placed upon the hips with the thumbs directed downward (Fig. 211).

(2) *Bend standing*—forearms in, extreme flexion and supination (Fig. 212).

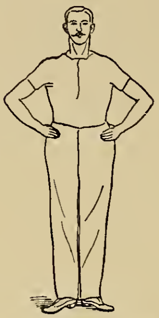


Fig. 211.—Standing; hips firm.

Fig. 212.—Bend standing.

Fig. 213.—Swim sitting.

(3) *Swim standing*—the arms placed in front of the chest, elbows at the height of the shoulders, forearms in extreme flexion, palms directed downward (Fig. 213).

(4) *Yard standing*—arms stretched outward horizontal, palms downward (Fig. 214).

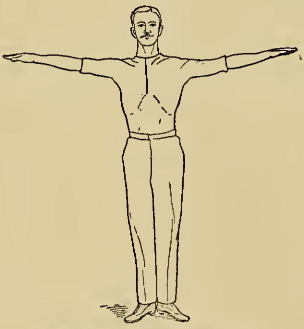


Fig. 214.—Yard standing.

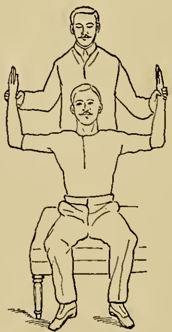


Fig. 215.—Heave sitting.

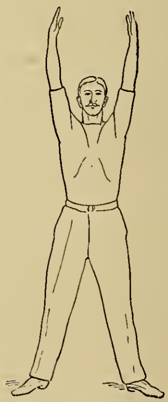


Fig. 216.—Stretch-stride standing.

(5) *Heave standing*—upper arms stretched horizontally outward, elbows fixed at a right angle and directed upward (Fig. 215).

(6) *Stretch standing*—arms stretched vertically upward, palms in (Fig. 216).

(7) *Neck firm*—elbows raised and carried backward, hands touching behind the head, palms forward (Fig. 217).

Fig. 217.—Neck firm.

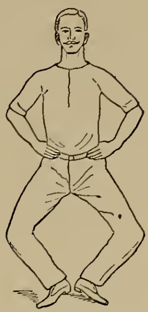


Fig. 218.—Knee-bend toe standing.

Fig. 219.—Walk standing.

The derived movements of the *legs* are:

(1) *Toe standing*—raising heels.

(2) *Knee-bend standing*—bending the knees to a right angle (Fig. 218).

(3) *Walk standing*—one foot placed two foot-lengths directly forward, the weight carried upon both feet evenly (Fig. 219).

Fig. 220.—Stretch-stride standing, side bending.

Fig. 221.—Fall-out standing.

(4) *Stride standing*—feet placed two foot-lengths apart (Fig. 220).

(5) *Fall-out standing*—the body lunged forward three foot lengths, the anterior knee bent until over the toe-tips, the other

leg kept in full extension, and the toe carried forward and outward above the bent knee, the corresponding arm stretched forward, upward, and outward. The arm, trunk, and extended leg lie in the same plane, the downward stretched arm parallel with the upper arm (Fig. 221).

Positions obtained by moving the trunk are:

(1) *Arch standing*—the spinal column overextended.

(2) *Side bending*—the trunk flexed laterally (Fig. 220).

(3) *Turn standing*—trunk rotated to one side without moving the hips.

(4) *Stoop standing*—trunk flexed at hip-joints, legs straight.

All these movements of the arms and trunk may be obtained in the sitting position. In addition, a *ride sitting* is taken by sitting astride a couch or chair with the feet fixed (Fig. 222).

Fig. 222.—Ride sitting.

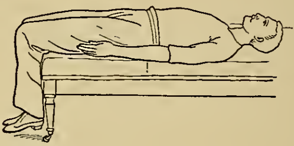


Fig. 223.—Sit lying.

Long sitting—the patient rests with the legs supported throughout their entire length. *Sit lying*—the head, trunk, and thighs are horizontal, the knees and legs hanging over the end of the couch (Fig. 223). *Half-sitting*—the patient stands on one leg which carries the weight of the body, the rest of the body being in the sitting position. *Spring sitting*—the patient in the fall-out standing position, with the thigh and buttock of the forward leg supported on a chair (Fig. 224).

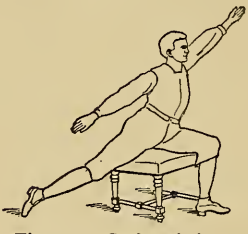


Fig. 224.—Spring sitting.

The same movements may be obtained in the lying position, and in addition:

(1) *Crook lying*—the patient's knees drawn up with the heels resting upon the couch (Fig. 225).

(2) *Forward lying*—the patient prone and the weight supported by the forearms.

(3) *Side lying*—the patient lying on one side, the head supported by the bent raised arm on the underside.

(4) *Leg lying*—forward or side, the patient lying over the end of the couch from the hips up (Fig. 226).

By raising part of the couch the body may be raised into the half-lying position (Fig. 227).

Fig. 225.—Crook half-lying.

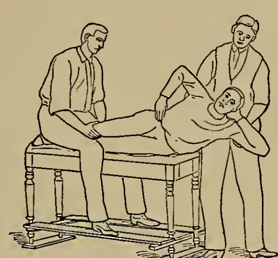


Fig. 226.—Leg lying.

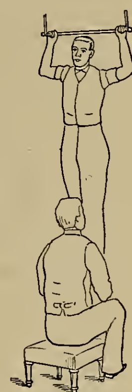


Fig. 227.—Heave hanging.

The characteristic derivative position from hanging is the heave hanging, in which the weight is pulled up until the upper arms are horizontal (Fig. 227).

From these fundamental and derivative positions practially any combination can be made, but there are many movements and positions in gymnastics and games that are so complicated that they pass beyond the compass of this chapter.

Exercises of skill enter into the treatment of disease, especially in the re-education of co-ordinations that must be learned for the first time or that have been impaired or lost by disease.

Many children have never learned the proper standing posture, and must be educated to maintain it with the least strain to muscles and ligaments. Others have lost it through conditions beyond their control—in the school or factory—and the long train of symptoms in the feet, legs, back, chest, and neck are to be met in great part by re-education. The relaxed abdomen must be put in proper relation to the thorax if ptosis of the abdominal organs is to be avoided, and this is best accomplished by *exercises of skill* in which the trick of correct standing is taught and impressed on the growing child.

In paralysis exercises of skill come in to supplement the more purely mechanical contraction and relaxation of the muscle groups, and in many of the neuroses, like stammering, chorea, and tic, the only treatment available is the slow and systematic re-education of the complicated co-ordinations that have become disordered or lost through disease. In tabes dorsalis this training in skill is our only available treatment for the ataxic gait, and here its value has had a triumphant demonstration in a field in which the neurologist is too often content with a hair-splitting diagnosis as the ultimate aim of his efforts.

It is in this class of cases that many of the games and sports described in previous chapters have a value that is hard to overestimate. Judgment of speed, distance, weight, and force can be cultivated by the various games with light and heavy balls better than in any other way, and they enter largely into the treatment of many conditions, while the power of rhythm over disordered co-ordination has always been gladly used by all intelligent physicians.

Exercies of endurance have another field to fill. Their influence on muscular development, on skill and nerve training, is quite overshadowed by their general tonic effect, and by the profound influence they exert on the respiration, circulation, and excretion. The value of walking and hill-climbing is primarily on the heart and lungs. For this reason Oertel devised his walking cure for diseases of the heart, realizing that whatever may be the anatomic condition of a heart, if it can be trained to do its normal work it becomes to that extent functionally sound. Hence, his gradual development of heart and respiratory power, and the reduction of encumbering fat burned off in the slow fire of comparatively mild but long-continued muscular action.

It is to *exercise of endurance*, like walking, climbing, and riding, that the gouty or diabetic patient must turn for relief.

GOUT

Like obesity, with which it is so often associated, gout is usually a disease of overnutrition and underelimination, and the indications would be to decrease the intake and increase the output of waste by all the avenues.

The rules for diet are still the subject of dispute, but all writers agree that exercise is of great value in reducing the weight of the gouty patient when obese and of increasing the activity of the skin and lungs. The great majority of patients will require exercises of endurance like walking regulated in distance and speed. Golf has a peculiar value from the fascination it possesses for individuals of all ages, a point not to be lost sight of in the management of self-indulgent cases. Horseback riding has the added advantage of vigorous massage, especially if the horse be trotted, and if the ravenous appetite resulting from the open-air exercise be kept within the limits of discretion. In young and vigorous subjects almost any of the active athletic sports appropriate to their age may be engaged in. These are enumerated in the table of sports and games in Chapter VIII. It must not be forgotten that a debauch of exercise in a valetudinarian may precipitate an acute attack by suddenly throwing the fatigue products into the circulation and causing an acute poisoning, so that great care should be observed to begin gradually and increase the amount as the system accommodates itself to more active exertion.

DIABETES

In the hygienic treatment of diabetes, exercises of endurance have an important place, since muscular action favors the combustion of sugar from whatever source it may be derived. When present, constipation should be corrected by local and general massage daily, and by the simpler forms of free or duplicate movements. Professor Finkler, of Bonn,[1] tried general muscle kneading in fourteen diabetics daily, a twenty-minute treatment being given at first, afterward increased to twice a day. They remained on a mixed diet. There was a constant diminution of urine, decrease of thirst, increase of body weight, and return of perspiration. When the patient is sufficiently strong he should be made to live as much as possible out of doors in a dry, warm climate, and a daily task should be set for him. The exercise should be gentle in character and carried out systematically. Gardening and walking, golf or tennis, should be the forms selected, but the patient should be warned to stop within the limits of fatigue.

A course can be carried on. to the best advantage in a sanatorium, with conveniences for bathing, massage, and exercise, where the habits of life can be regulated with greater hope of success.

Suitable cases of pulmonary tuberculosis can have their metabolism quickened and their nutrition improved by such light exercises as have been just described, and the general tonic effect can be regulated with great nicety and accuracy.

The simple free or resistive exercises of strength already referred to are combined so frequently with massage that together they are frequently referred to as the Swedish movements, and it remains only to describe.

Passive movements which include massage and manipulation, whose effects are nutritive on the muscle substance through the stimulation of the local circulation. Any conditions that would be improved by a heightened local circulation would be benefited by this form of exercise. The stimulation of the peripheral nerves up to the point of anesthesia is another outstanding effect, but the detailed action of the separate manipulations must be reserved for the next chapter. The power of massage over the blood-supply of muscles gives it a peculiar value in infantile paralysis, where the circulation is slowed and the parts

[1] Schmidt's Jahrbücher, Bd. 213, p. 218.

affected are undernourished, while in a sprained or disabled joint, where the circulation is also subnormal and the process of repair is delayed on account of the enforced immobility of a structure whose natural function is movement, massage is the most valuable and widely used means of hastening recovery.

SPRAINS

The swelling and tension that follow a sprain can be quickly absorbed by gentle and careful massage, accompanied by elastic pressure with the application of heat between the treatments. The tension disappears as the fluid is carried off, the temperature falls, and the pain caused by pressure on the sensory nerves is relieved. Extravasated blood is broken up, and can be seen as discoloration following the lines of the lymphatics; the adhesions usually found between torn and mangled surfaces are prevented, although time is always needed to firmly repair structures that have been actually lacerated.

If the sprain be recent adhesions are prevented altogether, but if they have already formed they may thus be stretched slowly and gradually by repeated gentle movements, or may be actually torn, with instantaneous relief to the patient. It is in these manipulations that bone-setters have acquired their reputation for supernatural skill, many miraculous instances being recorded of the immediate recovery of long-disabled joints. After perfect freedom of movement has been obtained, the voluntary power is sometimes slow in returning, and the recovery must be completed by active voluntary exercise in accordance with the natural movements of the joint.

In older cases, where the synovial membranes have lost their resiliency from long-continued distention, where the tissues are sodden and edematous and the effusion dense and firm, massage can be used with greater freedom to disperse the chronic congestion and raise the tone of the tissues. This improvement is often surprising in its rapidity. The joint that has remained for weeks cold and inactive, incapable of performing its proper movements, the seat of constant wearing pain, recovers its flexibility, loses its pain, and allows itself to be handled and used with freedom. Manipulating the joint, moving it throughout the greatest extent of its normal range, should be added to massage in recent cases as well as those of long standing. These movements stretch or snap small adhesions that limit the excursion of the joint or press upon nerve-endings, causing acute pain. Few minor operations give such instantaneous and striking relief when used with care and judgment.

In an old sprain the tissues are matted together; the surface of the skin is dry and harsh, bluish, livid, and shrunken in appearance. The stagnant blood circulating slowly through the obstructed and narrowed vessels is unable to give the tissues sufficient nutrition or to remove the accumulated débris of a month's inaction. Manipulation and massage act upon the muscles, nerves, blood-vessels, and skin, and the circulation at once renews its power. With the application of friction and kneading the life of the part is quickened, the veins and absorbents are emptied first, and the fluid contained is driven on toward the heart; the pressure falls in the smaller vessels and tiny irregular lymph-spaces, extending through the tissues in all directions. Their contents are driven into the emptied veins. The circulation becomes more rapid. Metabolism is carried on with greater energy. The tissues become full and sensitive to the touch, and the parts regain the even and rounded contour of active health. The skin loses its harshness, becoming soft and pliable, and after a single application the muscles are capable of working with less fatigue, while the joints become pliant and the ligaments relaxed. Adhesions are permanently stretched or broken down and the encumbering waste materials thrown into the circulation, while the effect upon the nervous system is indicated by the disappearance of the pain and sense of insecurity.

Dr. W. H. Broad reports rapid recovery of knee injuries with effusion by massage beginning on the third day, and accompanied by movement, increasing daily with pressure in the intervals of active treatment.

In the same way massage is used to quicken the mending of fractures; the splint being removed, the part gently massaged and a slowly increasing dose of movement administered, the splint being placed again in position.[1]

In the general inactivity required by the *rest-cure* of Weir Mitchell massage has taken its place as a necessary part of the triple treatment, the other agents being rest and overfeeding, and it may be said thus to correspond to the other postoperative exercises.

RHEUMATISM

Among the most prominent diseases for which passive movement, massage, and vibration can be used is *rheumatism*, in some of its myriad forms.

The manifestations of rheumatism, whether they appear in the muscles or in the joints, may often be treated by vibration and massage with every considerable success.

In *muscular rheumatism* the sternomastoid, the erector spinæ muscles, and the lumbar fascia are favorite sites for the attack. There is probably a coagulation of the semifluid muscular substance, with adhesions and retention of waste products, of which uric acid is the worst, causing pressure upon and irritation of the nerve filaments and spasm of the muscles. The pain of this condition is exceedingly severe and requires rest and counter-irritation. Vibration may be applied to inhibit the pain by using the ball attachment (Fig. 242, 3), a medium stroke, and deep pressure several times a day over the spinal centers governing these parts, and the soft brush and rapid stroke over the affected parts themselves several times a day if the pain is acute. Massage is also useful after the acuteness has abated in soothing the irritation by gentle stroking and friction, increasing in force with the improved toleration of the subject. The evils resulting from forced inaction in patients who are suffering from muscular rheumatism, either in the lumbar region or elsewhere, is also counter-

[1] See Dr. Lucas Championiere, Traitement Des Fractures par le massage et la mobilization; James B. Mennell, Treatment of Fractures by Mobilization and Rest; Sir Wm. H. Bennett, Massage in Recent Fractures.

balanced by general massage. The movements used vary from gentle stroking to deep kneading of the muscle masses, with manipulation of the stiffened joints.

Arthritis deformans is an incurable disease, but the inevitable progress of deformity can be held back, and great comfort can be given to the patient by vibration, massage, and manipulations. Ankylosis may be prevented by checking the formation of adhesions and the stretching and breaking down of those already formed, while atrophy of the muscles, always a pronounced symptom, may be delayed.

Douglas Graham reports most encouraging results in a number of cases treated by himself, five out of six showing marked improvement. His mode of procedure was deep manipulation without friction, passive motion as far as the pain would allow, and sometimes farther, and resistive movements as soon as they could be done. He disregards pain if it rapidly disappears after the treatment. If it persists, treatment must be suspended. He recommends kneading with one hand to break up indurations or disperse effusions, while the other pushes along the circulation in the veins and lymphatics above the joint. Massage would not be used, of course, when the disease is very active.[1]

The power of massage to stimulate or anesthetize nerves, and to act on the reflexes, is such that it has been raised to the dignity of a system about which more will be said in the next chapter.

Treatment of disease by *exercise* and *massage* has suffered from the ignorance of its undereducated practitioners, but more often from the vague and indefinite way in which its prescription has been given. A prescription should be written in detail, giving the nature, strength, and number of movements, and each movement should be carefully supervised. Only too often a slight difference in position may bring into action muscles that should be at rest, or *vice versa*. Every move should be pushed to its full limit of efficiency. The séances should be frequently repeated; one-half hour daily is better than one and

[1] Douglas Graham, Massage, fourth ed. (Lippincott).

one-half hours every third day. Every attendant condition should be made as favorable as possible. Fresh air should be supplied in abundance, and treatment given in the open air if possible.

The personality of the operator must be an inspiration to the patient, for without co-operation but little can be expected from exercises of strength, skill, or endurance. He must insist on accuracy and precision in every movement, however simple it may seem to the casual observer. The value of this discipline for the patient is not to be lost sight of. It was shown among the mental and moral defectives, described in a previous chapter, and in the MacLean Asylum Edward Colles[1] noted not only the marked increase in appetite, improvement in digestion, heart action, and carriage of inebriates under his charge, but also a quicker mental response, a better moral stamina, which leads him to believe that gymnastic exercises demonstrate their therapeutic value in the restoration not only of physical vigor, but also of mental and moral health.

[1] "Drunkenness and Inebriety," P. E. Review, vol. v, No. 3.

Bibliography

Medical and Orthopœdic Gymnastics, Anders Wide (Funk & Wagnalls Co.).
Treatment by Physical Methods, T. S. Dowse (Treat & Co., N. Y.).
The Elements of Kellgren's Manual Treatment, E. F. Cyriax (Bale & Sons).

CHAPTER XIX

MASSAGE AND VIBRATION

THE word "massage"—Greek, *massein*, to knead—is applied to the systematic manipulation of the body surface by the hands in movements of stroking, pinching, kneading, and striking.

Passive motion consists in flexion, extension, and other movements of joints and limbs by an operator or machine without the co-operation or resistance of the patient. Both have been widely used since the beginning of history. Travelers have brought accounts of their employment in Turkey, Africa, Siberia, Lapland, Japan, China, and the islands of the Pacific. The *Lomi Lomi* of the Sandwich Islands is spoken of with enthusiasm, for its powers of relieving the stiffness and soreness of fatigue and procuring rest and sleep.

The history of massage has been checkered. The priests of Egypt used friction and kneading for rheumatic pains and neuralgia, and the priestly caste of India have always known and practiced it. The Greeks had a class of *paidotribes*, or trainers, who acquired great skill in the manipulation of the body, just as at the present time the call of the blind masseur is a familiar sound in the streets of Tokyo. The Romans followed the Greeks, from whom so many of their customs were borrowed, but with them it often became a means of escaping the more rigorous forms of exercise and of removing the effects of overeating and drinking, the forenoon of the luxurious patrician being devoted to the bath and general massage.

It has had its eras of popularity and its seasons of neglect—popularity usually due to the personality and skill of an operator or school of operators, and neglect following its indiscriminate use by unskilled persons.

A great impetus was given to its employment by Ling and his disciples in Sweden, and it now forms part of the Swedish system of remedial gymnastics.

In the middle of the last century Beveridges' rubbers were well known in Edinburgh, and their success carried it from that medical center throughout Europe. It then declined, but has been revived on a more solid and scientific basis by Fox, Norstrom, Kellgren, Douglas Graham, and especially by Mezger, of Amsterdam, whose classification is the one habitually followed to the present day.

Its recognition as a therapeutic agent has been delayed by the failure to distinguish between true massage and unskilled rubbing, which merely requires muscular strength, a certain manual dexterity, and good will. To be a successful masseur, one must possess these qualities before beginning the training necessary to learn its possibilities, but its practice should be preceded by an intimate and special knowledge of anatomy, the disposition and thickness of muscle groups, their septa, the point where muscle changes to tendon, the situation and course of the veins and arteries, their anastomoses, the location of the nerve-supply, the movements of a limb, the changes about the joint caused by movement, and the situation and extent of synovial cavities and tendon-sheaths.

This knowledge should be practical and continually confirmed or corrected when the parts are at rest and when at work. In addition to this there must be that touch, firm, insistent, yet gentle, that adapts itself to the hills and hollows of the body surface, as if by instinct, and a buoyant constitutional vigor to withstand the exhausting character of its practice. Strong physique and good health are essential. Personal cleanliness is of the utmost importance, while thoroughness in carrying out a prescription to the minutest detail is necessary to insure the confidence of the doctor and patient. No one can hope to be a successful masseur who has not a highly developed muscular sense and who is not clever with his hands. A perfect hand for massage should be soft, smooth, dry, and fleshy. It should have great muscular power, suppleness, flexibility, and firmness of grip. A damp, cold, and clammy hand is totally unfit for such work. Talking with the patient during a treatment is distracting and undoubtedly mars the good effect of the operation, although the business success of some operators is due as much to their conversational powers as to their real ability. The successful practice of this art will always be limited to the few who are willing and able to devote the time and study necessary for the thorough acquirement of its technic.

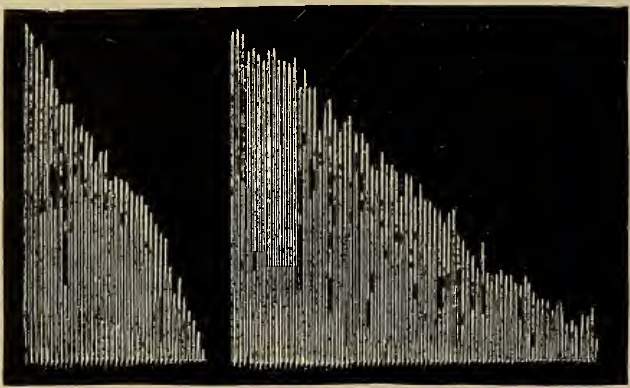


Fig. 228. Fig. 229.

Fig. 228.—Normal voluntary curve of fatigue of the flexor muscles of the middle finger of the left hand, with a weight of 3 kilos and rhythm of two seconds.

Fig. 229.—Curve of the same muscles with the same weight and rhythm, after massage for three minutes (after Maggiora).

The action of massage was studied by Mosso and Maggiora, who chose for their experiments the fatigue curves of the right and left middle fingers in maximum voluntary flexion, every two seconds, with a weight of 3 kilos.[1] These records were taken at 8 and 11 in the morning and at 2 and 5 in the afternoon, without massage, and the following day, under the same conditions, after a friction and kneading of three minutes. The average of these results proved that the muscles did twice as much work after the massage. Maggiora (Figs. 229–231) discovered that extension of the period of massage did

[1] Graham, Recent Developments in Massage.

not produce any greater results in the capacity for work, five minutes obtaining all the needful effect. His experiments on the comparative value of the various manipulations proved that little difference existed in the effect of friction and percussion. There was a greater increase of working capacity after the use of petrissage than from either of the other movements, but the best results were obtained by using in turn all three. The effect of massage upon muscles weakened by fasting was such as to restore them temporarily to their normal condi-

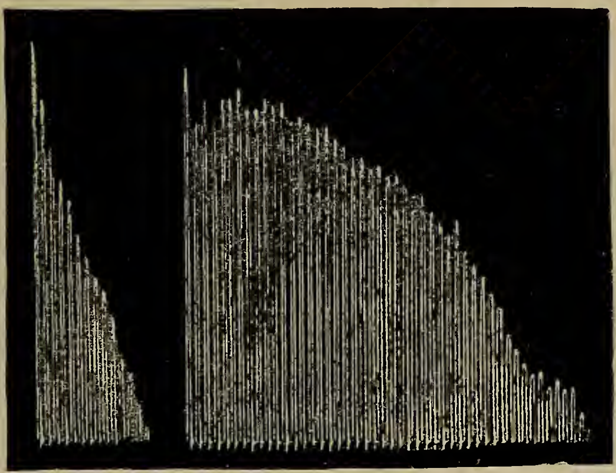


Fig. 230. Fig. 231.

Fig. 230.—Fatigue curve of flexors of right middle finger after a walk of 10 miles.
Fig. 231.—Shows the influence of massage for ten minutes upon the same muscles already indirectly weakened by walking. Weight, 3 kilos; rhythm, two seconds (Maggiora).

tion. It also restored a normal fatigue curve reduced and shortened by a wakeful night (Figs. 232, 233). After an intense prolonged intellectual strain of five hours, in the final examination of medical students, Maggiora's fatigue curve was one-fifth of the normal. An hour later, after ten minutes of massage, the fatigue curve was almost completely restored. Perhaps the most interesting results obtained were in his studies of artificial anemia of the muscles. After compressing the brachial artery the finger could contract only 11 times in comparison to 265 times under normal conditions. While the arterial current was still shut off three minutes of vigorous massage was given, after which the finger could contract only 9 times, proving that massage had no effect when the blood-supply was intercepted. From these experiments, it is evident that massage essentially affects the local circulation by bringing a greater quantity of nutrition to the muscles and removing the poisonous products loosened by their action. Its action in improving muscle tone, in postponing the onset of fatigue and hastening recovery from it, has long been recognized by athletic trainers. In preparing athletes for

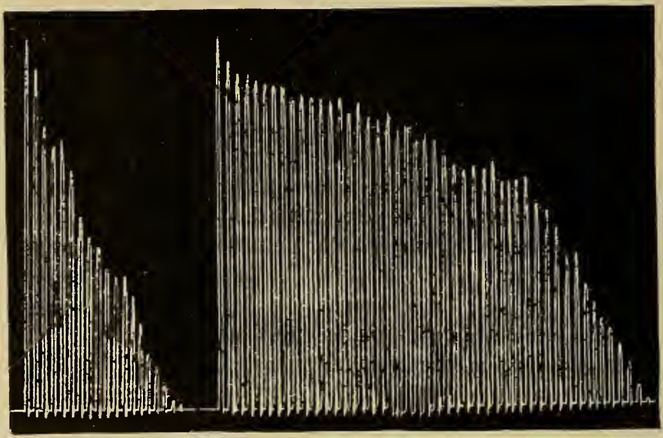


Fig. 232. Fig. 233.

Fig. 232.—Fatigue curve of flexor muscles of middle finger of right hand after being awake one night.

Fig. 233.—Shows the effect of ten minutes' massage upon the same muscles (Maggiora).

a contest, general massage is always given by friction, kneading, pinching, and stroking, lubricating the surface with some oily liniment. After a hard race or other contest it is a matter of common knowledge among trainers that a five-minute treatment will enable an athlete to repeat or continue a performance otherwise impossible.

Massage differs radically from active exercise in its capacity to feed muscular tissue without fatiguing or even employing the will-power of the patient. It is the most economic form of exercise on the nervous system, and yet its potency is shown by the increase of red blood-corpuscles and hemoglobin, and by the exalted rate and force of the heart-beat without a corresponding change in the arterial tension. It accomplishes these results by decreasing resistance in the peripheral vessels, by the removal of the poisons of oxidation, and by mechanically moving the blood-current forward in the lymph-spaces and venous channels. It thus stimulates the circulation, respiration, nutrition, and excretion.

Fig. 234.—Effleurage of the forearm. Note the distention of the veins above the hand that is passing upward.

There are four principal forms of manipulation:

(1) *Stroking—effleurage*—in which the hand is passed lightly over the skin, with pressure from the periphery to the center, following the course of the venous circulation and the long direction of the muscles from their insertion to their origin. It may be performed by stroking with the palm of one or both hands, with the thumb or tips of the fingers (Fig. 234). The two hands are used upon the large fleshy parts of the thighs and buttocks or upon the chest, back, and neck. The thumb is used on small muscles hemmed in by bones, such as the interossei of the hand

or foot or the anterior muscles of the leg. The tips of the fingers are used around the joints of the knee, ankle, elbow, or wrist, the fingers adapting themselves to the shape of the part worked upon.

Effleurage is a surface manipulation. The fingers are brought into light contact only with the skin of the patient. Its value consists in its lightness and delicacy of touch. It is like stroking a cat. For that reason the tips of the fingers are peculiarly adapted on account of their sensitiveness. The movements are

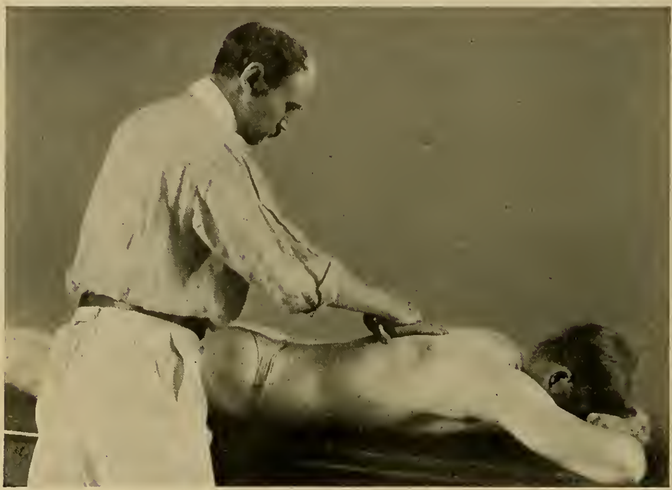


Fig. 235.—Friction of the erector spinæ.

adapted to such parts as the forehead, temples, face, and other parts in which the bone is close beneath the skin. They are soothing and sedative, while engorged veins and lymph channels are also unloaded (Fig. 234). This form is employed at the beginning of treatment for fractures, sprains, and freshly inflamed synovial membranes, and in all chronic cases where the tissues are matted and sodden, requiring the absorption of an exudate.

(2) *Friction.*—A firm, deep circular movement performed by the thumb, tips of the fingers, or by one hand opened or

clenched. The thumb is employed on the small surfaces of the face or extremities. Friction by the tips of the fingers is used around joints, the fleshy part of the thigh, the arm, and the lumbar region requiring the entire hand. (See Fig. 235.) Friction should proceed in the same general direction as the stroking movements, which should always immediately precede or follow it. The products of fatigue congregating in the deep muscular tissue are thus thrown into the circulation, the gentle manipulations of stroking readily carrying them into the superficial veins. It affects all deep-seated structures embedded in muscular masses,

Fig. 236.—Pétrissage of the calf muscles.

and should be used along the sciatic nerve in the treatment of sciatica and over the abdomen to unload the colon.

(3) *Pétrissage, Pinching, or Grasping.*—Performed by picking up the skin and subcutaneous tissue between the thumb and fingers and manipulating it with an amount of force not sufficient to cause pain. In this movement the skin moves with the hand of the operator, and the underlying structures are thus massaged by it under the pressure of the fingers. It is most advantageously done by the thumb opposed by the first finger, by the fingers opposed to the palm of the hand, or by the two hands opposed to one another. The thumb and fingers are used to reach individual muscles and small groups, such as the

muscles of the hand, foot, forearm, and upper arm. The larger muscle masses of the thigh and calf require the use of the fingers opposed to the thumb and hand (Fig. 236), or both hands, the muscle being rolled beneath them and pressed against the bone. This has the same effect as friction on the deep structures, and is better for sensitive, easily irritated surfaces, the skin moving with the hand like a glove. The movement should always be gradual, proceeding from the periphery inward. It should follow the course of the venous blood and lymph, but in the chest and back the course of the muscle-fibers and ribs. The hand should never be removed entirely from the surface, but while the pressure is being given the skin should be moved with the hand and the part squeezed inward or toward the direction of the venous flow. The tissues acted upon by this manipulation are both superficial and deep—skin, fat, and muscles of the thorax and extremities, as well as the nerves, arteries, veins, and lymphatics. While the manipulation is firm, it should not be hard enough to give pain or even discomfort. In using the hand make the thumb the fixed point, and draw the hand to it, or make the fingers the fixed point, drawing the rest of the hand to them. It is the favorite means used to improve muscular nutrition in conditions of fatigue, in atrophy, in obesity, or other forms of muscular degeneration.

(4) *Striking—Tapotement or Percussion.*—This manipulation comes under many names, such as clapping, beating, knocking, or hacking. It is done for small surfaces by patting with the open hand, or by slapping with the palm cupped to leave a layer of compressed air between the hand and the surface to be manipulated, a bombastic movement that is familiar to every frequenter of the Turkish bath. Its action on the skin, superficial nerves, and vessels is stimulating. Hacking is performed with the ulnar border of the hand, and is used along such nerve-trunks as the sciatic or spinal nerves (Fig. 237). Where the bone lies close to the skin at the ankle- or knee-joints, or in manipulations of the scalp, this movement should be performed by the tips of the fingers, but over the fleshy regions of the thigh and buttocks

the clenched hand may be used. Each blow stimulates the nerve powerfully and causes involuntary contraction of the muscle. When the blow is heavy and rapidly repeated it may even produce local anesthesia. The blows should be quick and sharp, but not strong enough to bruise the muscle and produce after-soreness. All striking movements should be done with a loose wrist, and where the closed hand is used the flat of the fingers should be parallel with the surface and the movement sharp and snappy rather than strong and heavy, swinging freely

Fig. 237.—Tapotement of the back with the ulnar surface of the hands.

from the wrist, the arms kept close to the sides. The stimulating effect of *tapotement* on the reflexes is very different from that of the other forms of massage already described and it can be used strongly and effectively over the large muscle masses of the buttocks, back, and trunk. It is commonly used in cases of neuralgia, neuritis, and paralysis, in which stimulation is needed.

The use of tapotement has been elevated into a system of therapeutics, named by Abrams *spondylotherapy*,[1] and by Louis von Cotzhausen *reflexotherapy*, a better term, by the use of the percussor, plexor, or even the knuckles applied over the spinous processes.

The relation of certain symptoms to pain at the exit of

[1] Spondylotherapy, A. Abrams, Philopolis Press, San Francisco.

the spinal nerves was noted in 1834 by William and Daniel Griffin, of Edinburgh and London, whose report of 148 cases brought them to the conclusion that tenderness in the region of the spine may be secondary to visceral disease.

The Swedish gymnasts had observed tenderness over the fourth and fifth dorsal nerves in cases of heart disease, and over the sixth, seventh, and eighth in affections of the stomach.

It is a well-known fact that repeated blows over the seventh cervical stimulates the vasoconstrictors of the heart and lessens its size. This has been described by Abrams as the heart reflex of contraction. The same phenomenon can be obtained in the heart by the application of friction over the pericardium or by the application of cold. It is a frequent experience to find the area of heart dulness become smaller after continual percussion in the examination of a patient's lungs, due either to reduction in the heart size or to dilatation of the lungs. Similar reflexes for the lungs and abdominal organs can be obtained by this form of tapotement at different levels of the spine, although with less distinctness. Abrams' method is to use rapid blows for about five minutes, broken by short intervals of rest, and by this means he claims that contraction or dilatation of an organ can be governed almost at will.

A *fifth manipulation* might be added—that of *shaking* or *vibration*. Shaking involves movement of the whole body or region to be treated, while vibration is a lesser motion, in which the body or region remains at rest while the surface and structures immediately beneath it are affected. The term "tremble pressing" accurately describes it. These manipulations are exhausting to the operator and difficult to perform skilfully.

Vibration in a simple form was used by Ling, but it has been importantly developed by Henrik Kellgren and his school, new and improved manipulations being added especially for the treatment of the nerve-trunks.[1]

Two or more finger points are kept in continuous contact with the part to be manipulated, the joints of the finger, wrist,

[1] The Elements of Kellgren's Manual Treatment, Edgar T. Cyriax (Bale & Sons).

and elbow being kept loose. The movement is produced by a contraction and relaxation of the muscles of the forearm or shoulder, the excursion at the wrist-joint varying from $\frac{1}{8}$ to 1 inch. The amount of muscular force employed by the operator is slight and the movement delicate. The rate is about twelve to the second. This may be executed over one point, stationary vibration, the vibration being exceedingly small, as in the treatment of conditions of the eye. Where much pressure is desired the forefinger and thumb are brought together and the tip of the thumb is applied to the part. Stronger pressure can thus be used to reach such deep-seated structures as the spinal nerves or the great sciatic nerve in the buttock. Running vibrations with the fingers are used along the course of nerves.

Fig. 238.—Stationary up and down nerve vibration, using thumb and finger for a spinal nerve.

Other complex forms are described under the name of suction, dispersing, and nipping vibrations, the speed running from six to twelve to the second. Running nerve frictions can be given to any region of the body, arms, head, or legs, and they are frequently used in a general treatment by one or two operators working simultaneously. The operator begins at the sides of the head by rapid cross movements, in which the finger-tips are drawn across the course of the nerve-trunks down the side of the neck, over the shoulder, down the palmar surface of the forearm, back up the dorsal surface, down the side of the spine, across and over the back of the leg, coming up the anterior surface of the leg and along the trunk in the anterior axillary line, and so on to the finger points. When both hands are used the path of movement may vary, as shown in Fig. 239.

These running frictions are stimulating to the cerebral, spinal, and sympathetic nervous system, and are accompanied by constriction of the vessels followed by dilatation. The patient always experiences a sense of exhilaration after their use. All these movements require great skill and long training, and it is for that reason more than any other that the various mechanical forms of vibration have been designed. These machines have the advantage over the rapidly tiring and uncertain human hand of keeping the amount of resistance constant, diminishing or increasing it as desired, while the rate may also be increased. They will be described fully in the next chapter.

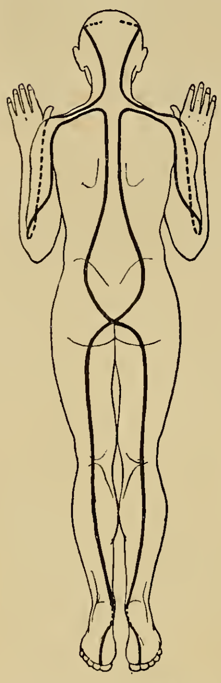


Fig. 239.—Course taken in running nerve frictions (Kellgren).

General massage is best given at an hour midway between meals and never immediately after eating. The order in which the manipulations are given is as follows:

The operator starts with the feet and gently but firmly pinches up the skin and subcutaneous tissue, rolling it between the fingers and thumb until both surfaces of each foot have been covered. With the thumbs and fingers the small muscles of the foot are kneaded, special attention being devoted to the interosseous groups, which require slow deep pressure from the thumbs. Care should be taken to avoid bruising of muscle and skin against the underlying bones. The foot is then grasped and all the natural movements of the toes and ankle are rehearsed. Next the region of the ankle is dealt with in the same fashion, and stroking movements are made from the toes to the leg to empty the superficial veins of the foot. The leg is next treated by circular friction with the fingers, by deeper grasping of the areolar tissue, and, last, by industrious and deep pinching of the larger muscular masses, which for this purpose are put in a position of complete relaxation (Fig. 236).

For the large muscles of the calf and thigh both hands act, the one contracting while the other lessens its grip. The firm muscles in the front of the leg are rolled under the cushions of the finger-tips. At brief intervals upward stroking is given from ankle to knee to favor the flow of venous blood-currents. The same process is continued for the hands and the arms. Especial care is now given to the muscles of the loins, back, and neck, which are subjected to frictions, kneading, and striking with the ulnar border of the open hand (Fig. 237), followed by upward stroking of the loins and back, the same manipulation being directed downward and outward from the head to the shoulders. The abdomen is then treated by pinching the skin and underlying tissue, deeply grasping the entire muscular walls with both hands, pinching and rolling them. Massage of this region concludes with deep kneading by the heel of the hand in a succession of rapid, deep movements, passing clockwise in the direction of the colon. The chest is then manipulated upward from the sternum along the line of the pectoral muscles by pinching and kneading of the muscle masses of each side. The face is not usually treated in general massage, but the sides of the neck are gently stroked from above downward along the course of the internal jugular veins. Each part operated upon should be carefully covered after treatment.

Weir Mitchell, in his treatment of neurasthenia by rest, overfeeding, and general massage, describes a constant rise of temperature after each treatment, and noted a rapid improvement in the tone and reaction of the whole muscular system.

Massage can be applied to special parts and organs, such as the eye and the ear. Delicate circular friction over the eyelid accompanied by light pressure with the finger-tips may be applied, but should never be painful. Stroking movements horizontally outward, rather fast, may be performed for from two to five minutes once a day for suitable conditions of the eyeball. The eyelid itself may be massaged by inserting a smooth flattened glass rod between the lid and the eyeball, massage being applied to the lid with the rod as a foundation instead of the eyeball, which thus escapes undue pressure. Various mechanical vibrations may be applied directly to the eyeball at a rate up to nine thousand to the minute. Pagenstecher notes a decreased tension of the eyeball as a result. This depleting effect, which is followed by stimulation, would cause the absorption of old inflammatory exudates.

Alexander Randall[1] describes a simple and valuable method of treating the tympanic membranes by vibrations applied by the surgeon, or by the patient, in which the amount can be governed in accord with the response of the ear. The pulp of the middle finger of one or both hands simultaneously is introduced into the meatus, drawing the tragus forward by slow rotation, pressed as deep as the opening will permit. Gentle pumping movements in and out furnish a massage which is mainly by suction, and can be safely continued for thirty to sixty seconds at varying rates. It can be as slow as sixty per minute or as quick as ten per second, while the degrees of the excursion will regulate the force. Another form of this pneumatic massage is performed by the flat of the palm stretched out, laid in contact with the auricle, and alternately pressed and released with a pumping movement. It is one of the readiest means to relieve certain forms of vertigo, faintness, and frequently lifts the burden of deafness and tinnitus when such help is most desired.

The usual fault in giving massage is that too much is given at one time, especially in vibrations. The rule of some masseurs is to give the patient as much as he can stand. Maggiora's experiments prove that the maximum effect on a part is obtained in five minutes. Another mistake is in employing too heavy a hand. Zabludowski's dictum that when massage becomes painless it ceases to be massage is false. A patient should never feel bruised or exhausted, although a pleasant lassitude is one of the most valuable effects.

The use of lubricants, such as cocoa butter or vaseline, can

[1] Alexander Randall, "More Efficient Methods of Aural Massage," Annals of Otology, September, 1911.

in most cases be dispensed with. Talcum powder will dry a moist surface and prevent the pulling on hair, and practically all manipulations can be given equally well through a light cotton or silk undergarment.

Massage should be avoided in certain skin affections, as eczema, acne, and other skin eruptions, in wounds, burns, and erysipelas, in tumors and purulent inflammations, and in acute disease of the bone tissue. It should not be used in the acute stages of severe constitutional or local diseases where complete rest is necessary, and it should be allowed only with great precaution in pregnancy and in the presence of renal disease. Its place in the treatment of sprains, fractures, and other surgical conditions and its value in medicine are considered more fully in their appropriate places.

CHAPTER XX

MECHANICAL MEANS FOR MASSAGE AND EXERCISE

THE progress of treatment by vibration and massage was and is retarded by the difficulty in securing any uniformity of method. The practice is an art, and not all of its practitioners are artists, with the result that too often extravagant claims are built on most inadequate foundations of knowledge and experience and discredit is brought on a most valuable therapeutic procedure.

Mechanical means have been devised to standardize the amount and strength of vibration and movement, and so allow of the prescription of a definite dose by the physician who may lack the skill to give the necessary manipulations himself. This is what gave the Zander Institutes their vogue in Europe, and has been even more true in the case of treatment by vibration in which the mechanical ingenuity of so many has had free play. Its very ease of application has, however, led to a notorious abuse of vibration by applying it to unsuitable cases, and still more commonly by making the application too long and too severe. The power of properly applied vibratory movement over the heart-rate and pulse volume, over pain, and over deep-seated organs, through the spinal nerves, has been well established for many years, and about 1878 Dr. J. Mortimer Grenville began his experiments in the relief of pain by vibration. Acute pain he likened to a high note in music produced by rapid vibrations. Dull aching pain he likened to low notes produced by slow vibrations. He attempted to bring discord into the rhythm of morbid vibrations by means of his *percutor*, in which the rate of the blows could be changed at will. The modern vibrator is a development and expansion of this idea with others added to it.

All forms of vibration lessen nervous sensibility, even to the relief of acute pain, and for the time being abolish the sense of fatigue just as does massage.

Vigoroux attempted to apply the same principle by placing a large tuning-fork on a resonating box opening at both ends, into which was placed the part to be treated. Good results were obtained in the lightning pains of ataxia and in hysteric conditions.

Boudet devised a helmet, with vibrations at the rate of 100 per second, which gave a sedative effect, normal patients being put to sleep by this means.

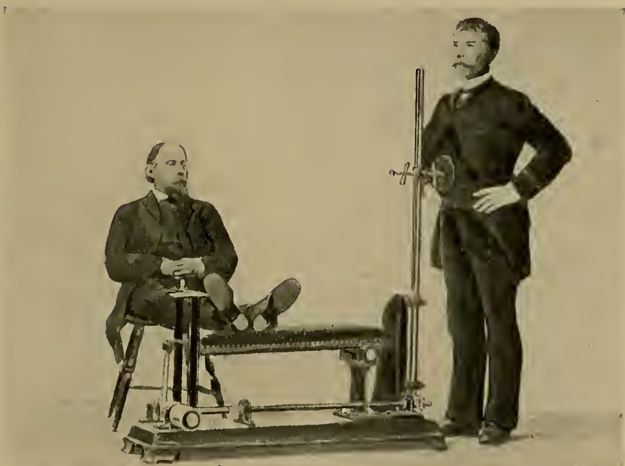


Fig. 240.—The Zander vibrator.

While a great many machines have been invented, they fall under *two* main types—*first*, the rigid arm vibrator, illustrated by the machines of Zander and Kellogg, and, *second*, the portable vibrator, like the dumb-bell vibrator, as designed by Kellogg (Fig. 241).

A good portable machine should be readily adjustable in rate and length of stroke, and should be capable of giving percussion and a rotary boring movement. The weight of the vibrator has been much discussed, but Eberhart, of Chicago, happily compares them to various-sized hammers.

"If one wishes to drive a small nail he could do so with either a sledge hammer, an ordinary hammer, or a tack hammer. The sledge hammer would drive it at one blow, but there would be much superfluous power; the ordinary hammer would drive it in four or five strokes; the tack hammer would possibly require a dozen blows. The final result would be the driving of the nail."

This is not a complete parallel, however, for three points must be considered in the application of any instrument—(1) the

Fig. 241.—Kellogg's dumb-bell vibrator.

length of the stroke; (2) its rate; (3) the amount of pressure. All three can be varied within very wide limits by a mechanism of adjustment, and modified in their effect by the applicator used, the chief attachments for a well-designed machine being a rubber brush, a ball of hard rubber, and a second ball of soft rubber for the throat and for the large muscle masses like the erector spinæ, a hollow rubber ball for the treatment of the eye, a flat disk, a vacuum cup, and special vibratodes of hard and soft rubber for rectum and vagina (Fig. 242).

The late Maurice F. Pilgrim, in his little work on vibratory stimulation, classifies the movements into (1) stimulation, (2) vibratory stimulation, and (3) vibration.

Stimulation is produced by a medium stroke and light pressure with the brush attachment for increasing the blood-supply to a region improving its tone and nutrition. To produce mild stimulation an application should last from three to seven seconds.

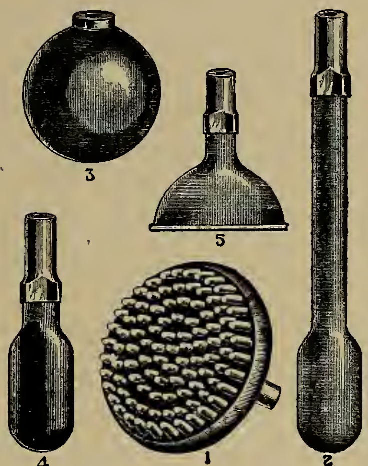


Fig. 242.—Various attachments recommended for use in the application of mechanical vibratory stimulation to the various organs and cavities of the body (Pilgrim): 1, Rubber brush; 2, rectal and vaginal attachment (rubber); 3, rubber ball; 4, throat attachment (rubber); 5, eye-cup (rubber).

Vibratory stimulation is applied by a rubber ball with a medium stroke and deep pressure, the treatment lasting from eight to twelve seconds over one spot. This is recommended for cases in which the viscera are to be reached by acting on the spinal nerve roots (Fig. 243).

Vibration is produced by a heavy stroke and deep pressure with the hard-ball attachment. It should not be given for more than fifteen to twenty seconds, and is used to inhibit a nerve that is giving pain. Overstimulation is the besetting sin of most operators, and while not permanently harmful it ruins the therapeutic effect for which we strive. Vibration is given by direct percussion in which a series of blows fall upon the skin in rapid succession. This is a refinement of *tapotement* and of the percussing hammers invented by Graham and used so extensively by

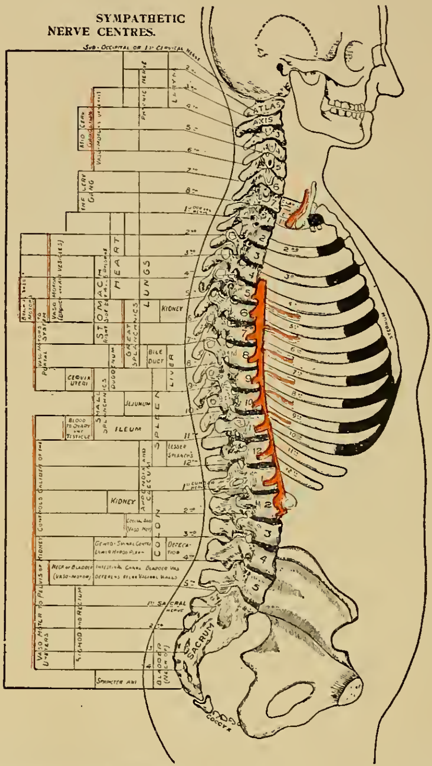


Fig. 243.—Diagram showing areas in the spinal cord from which the nerves controlling the various organs and parts of the body are given off. The red lines in the table indicate vasomotor areas. Stimulation of the centers, indicated in the diagram, will affect the organs controlled by them, see table at the left of the diagram (Pilgrim).

Abrams. When much force is used the deep structures can be profoundly affected. It is given also by lateral oscillations where the part vibrates with the instrument from side to side. A boring circular movement can also be produced by the portable machine, in which a revolving shaft is thrown out of balance by carrying on one end an arm or wheel overweighted on one side. As the shaft revolves the end goes in a circle instead of on a fixed axis, and by holding it at right angles to the part to be operated upon the movement given to the tissues is circular or boring in character.

The rate used in most vibrators is from one thousand to six thousand vibrations per minute. Dr. J. H. Kellogg has been experimenting by means of air-pressure on higher rates of vibration than can be obtained in a machine. This pneumatic vibration produces a musical note, ranging in tone as the rate varies from two thousand to two hundred thousand per minute. With a column of from 40 to 60 pounds pressure it depresses and blanches the skin, emptying it of blood and lymph while the pressure is applied at right angles to the surface. When the air is applied parallel to the skin, with from 30 to 60 pounds pressure, the skin rises in ridges or folds, and blisters may be produced if the application is continued.

Both these forms are useful to produce reflex or derivative movements. When applied over the nerve-supply of special viscera, such as the lungs or the liver, it is always followed by a sense of warmth and tingling. This pneumatic vibration of Kellogg's is the most rapid form known, and the only objection to it is the somewhat loud musical note which accompanies it.

The principle of circular movement, as described in the portable vibrator, was applied by Kellogg in 1880 to a vibratory chair placed upon a platform supported by rubber balls to prevent transmission of the movement to the room, and a rate of 100 vibrations per second was secured. The patient who seats himself in this chair for four or five minutes will experience stimulation to the peristalsis, improvement of the circulation, as shown in the warming of cold feet and hands, and disappearance of fatigue. The effect can be concentrated on one part by grasping the chair and contracting the muscles. If the feet are fixed to the chair the patient experiences numbness and tingling. If the patient stands on the foot-board, or sits on an ordinary chair with feet against the vibrating chair and with muscles contracted, the effect goes from the feet to the legs (Fig. 244). If the patient seats himself bent forward, vibration of the abdominal viscera can be obtained, and if the patient leans backward against the chair-back the effect on the spinal cord can be emphasized. The patient standing by the chair with the hands grasping the chair-back can increase the effect by the closeness of the grip and the rigidity of the hands and arms. By applying the same mechanism to horizontal bars from 4 to 10 feet in length,

Fig. 244.—Vibratory chair, showing application of vibration to the feet only (Kellogg).

vibrations of the fingers can be obtained by placing the hands on the upper part of the bar with the fingers widely separated. This can be extended to the hands by grasping them with the wrist and forearm relaxed, and to the arms, shoulders, chest, spine, and head by contracting the muscles of the chest, arms, shoulders, and head (Fig. 245). Treatment is always followed by a feeling of numbness, tingling, and then warmth. When properly applied, with precautions against overstimulation, these forms of vibration have great therapeutic value. The heart-rate can be lessened and its force increased, although care must be taken of the depressing effect produced by percussion directly over the heart. By means of vibration over the submaxillary region a copious flow of saliva can be produced, and a sense of hunger stimulated when the vibrator is applied over the epigastrium. The fatigue of neurasthenia can be relieved, and certain forms of backache, when due to muscular strain, yield quickly to its influence, while the effect of stimulation and vibrations around the course of the colon is most marked.

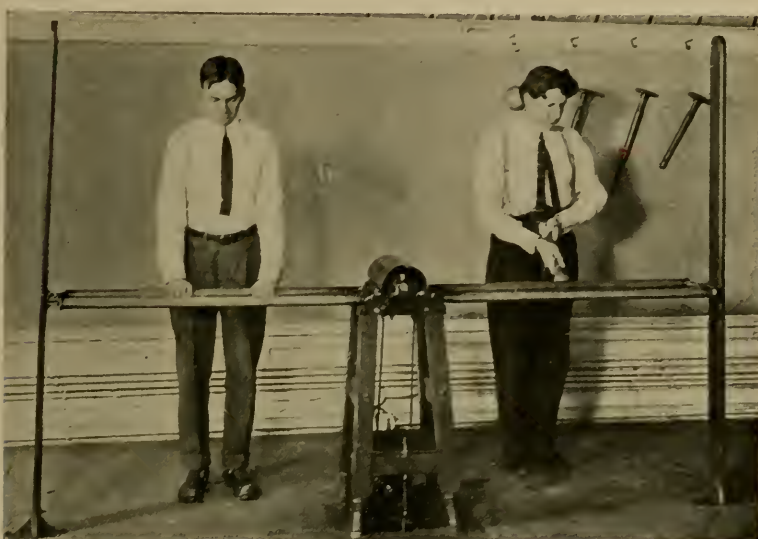


Fig. 245.—The vibrating bars (Kellogg).

Among the special applications of vibration may be mentioned that of the tympanic membrane. Many instruments have been invented for this purpose, using the mouth, the hand, and electricity as the motor power. The vibrations from the voice form the normal massage which sets the membrane in motion, many of the appliances for improving the hearing doing so by transposing the rate of vibration or pitch out of an ill-heard register to a higher key.

In all forms of rhythmic massage applied by mechanical power there is great danger of causing nerve degeneration from overstimulation, and for this reason it is better to use the manual treatment described by Alexander Randall in the last chapter.[1]

A form of vibration or, more properly, a form of exercise is obtained from the *sinusoidal current*, in which the electricity is applied intermittently, the current being reversed after each intermission. This form has the advantage of being painless and of producing most vigorous muscular contractions. Its discovery was the joint work of Drs. J. H. Kellogg and d'Arsonval. By its means groups of muscles can be exercised while the patient is passive. The muscles under its influence contract with as much vigor as though one were chopping wood or climbing a hill, although the patient may be lying quietly on a lounge. Its value is greatest in cases of obesity, diabetes, or advanced heart diseases, where the patient is too feeble to take the requisite amount of exercise by walking or other forms of muscular activity. It can also be applied successfully to increase muscular activity of the intestinal tract.

The use of mechanical means for the application of exercise in therapeutics was first systematized and employed in a complete way by Dr. Gustaf Zander, of Stockholm, about 1857.

He there established and directed the first Zander institute, and has been actively engaged in the practice of medico-mechanical gymnastics, lecturing on the subject at the medical school in Stockholm until his retirement, when he was succeeded by his eldest son. Zander has devised nearly one hundred machines to give his exercises and manipulations, and his system of mechanotherapy has enjoyed a wide popularity in Europe and has a considerable following in America. Zander institutes are found in Boston, Baltimore, Philadelphia, St. Louis, San Francisco, and elsewhere, while over seventy sanatoria are supplied with some of his apparatus. The machines are in three series.

First Series.—Apparatus set in motion by the muscular power of the patient.

[1] Annals of Otology, September, 1911.

Second Series.—Apparatus set in motion by means of some motor.

Third Series.—Apparatus exercising by the weight of the patient's body or by mechanical arrangements, a corrective pressure or tension.

They are classified according to their physiologic effects into four sections.

(1) *Apparatus for Active Movements.*—To exercise and develop arms, legs, trunk, and balance. These machines are

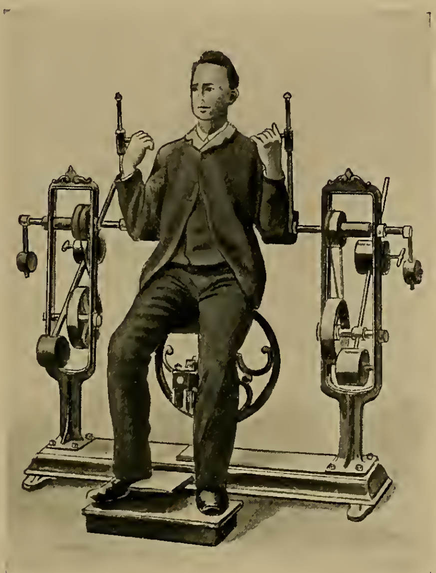


Fig. 246.—Machine for flexion and extension of the forearms.

thirty-eight in number. A typical example is Fig. 246 for forearm flexion. Its application may be reversed and used to exercise forearm extension. A number of other machines are made reversible, a necessary economy that is at once apparent. In the balance machine the patient sits astride a saddle-shaped seat, grasping a fixed handle-bar. A rolling rotary movement is given the seat by motor power, and to preserve the equilibrium the patient must use all the muscles of the loins and abdomen in turn.

(2) *Apparatus for Passive Movements.*—To manipulate the hands and fingers for chest dilatation, trunk rotation, and pelvic elevations. The machine for chest dilatation merits more than passing notice. It is called "The Tower" (Fig. 317), and the movement is performed by two crutch-like appliances passing beneath the arm-pits and retracting both shoulders, while the chest is thrust forward rhythmically by a cushion applied against the back of the patient, as shown in the illustration. The rate is

Fig. 247.—The "horse," to give vibration of the whole body (sitting saddleways).

set to correspond with normal respiration, and the thoracic walls are expanded and stretched by its use.

(3) *Apparatus for Mechanical Operations, Including Vibration, Percussion, Kneading, and Friction.*—Vibration is given to the whole body by the jolting movement of a saddle-shaped seat (Fig. 247), and the Zander vibrator (Fig. 240) is adjusted to give about 500 strokes a minute to the feet, legs, chest, or abdomen. Four machines are devoted to percussion. Fig. 248 is provided with four beaters for tapotement along the spine. This machine

has been called the "digitalis of the medical gymnast," from its action in slowing the heart-beat. One machine is devoted to kneading the abdomen, and six to friction of the arm, fingers, leg, foot, back, and abdomen.

(4) *Orthopedic Apparatus*.—They are eleven in number, and are designed for suspension, rotation, and lateral pressure.

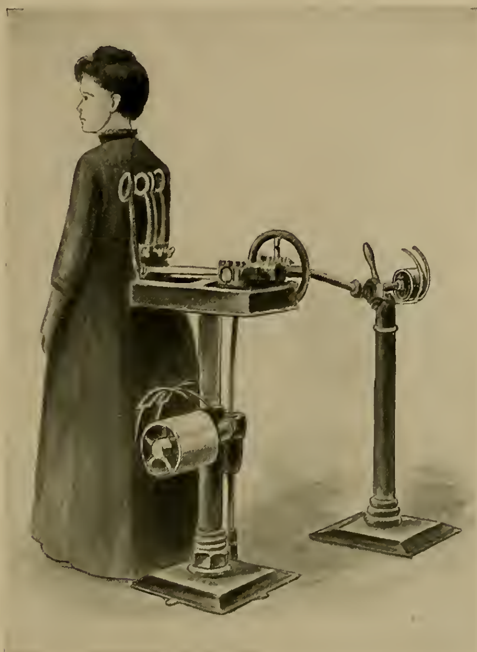


Fig. 248.—Zander's back percussor.

A complete outfit requires at least 3000 square feet of space, with consulting and resting rooms and a gas engine or other motor. The resistance is supplied by a weight and lever instead of a pulley weight in all the machines requiring voluntary action from the patient. This can be augmented by moving and clamping the weight at any point of the graduated scale marked on the lever. They are arranged to comply with Schwann's law of muscular contraction, which states that with increasing contraction the muscle is able to accomplish less work. The resistance is then made to diminish during the latter half of the movement, a principle neglected in all machines whose resistance is furnished by friction or elastic traction. In the machine for developing the flexor power of the leg upon the thigh the greatest resistance occurs when the leg is bent about 30 degrees from complete extension, this being estimated as the point of greatest power in the knee flexors. Many objections to the use of duplicate movements may be overcome by employing these machines. The amount of resistance is always constant, and can be diminished or increased as desired according to the strength of the patient. The dose can be accurately prescribed and the uncertainty of the human hand, governed as it must be by the operator's varying physical condition, can be eliminated. The amount of resistance forms a curve, the apex of which is at the point of greatest physiologic efficiency, thus making it more scientific in its application than the varying hand of the operator. A number of similar machines were designed by Herz, C. F. Taylor, and Kellogg, and numerous modifications have been made to simplify the somewhat cumbersome mechanism of the originals.

Most widely used are those machines in which the pulley-weight is the mechanical principle, employed usually to give accurate corrective exercises, but frequently to give an all-around muscular development. Like the Zander machines they take into account the law of "physiologic load," which affirms that a certain resistance is required before a muscle can make its maximum contraction. This load is increased if the movements are to be few in number and slow in rhythm, and decreased for frequent rapidly repeated motions. Many so-called *free exercises*, such as deep knee bending, use the body weight for resistance.

Dumb-bells have been used since the time of the Greeks for the purpose of shortening the period required to develop a muscular group. Their application is crude and limited, however, in comparison to the accuracy and versatility of machines employing the principle of the lever or pulley-weight. The direction of a dumb-bell pull is always downward, whereas with the shoulder attachment of the pulley-weight the drag is lateral and the high attachment of the pulley reverses the direction of the force of gravity. By changing the position of the pulley it is thus possible to isolate the action of all the important muscle groups.

We have records of Captain Chiosso as early as 1829 at work in London on a machine which he finally perfected and called the

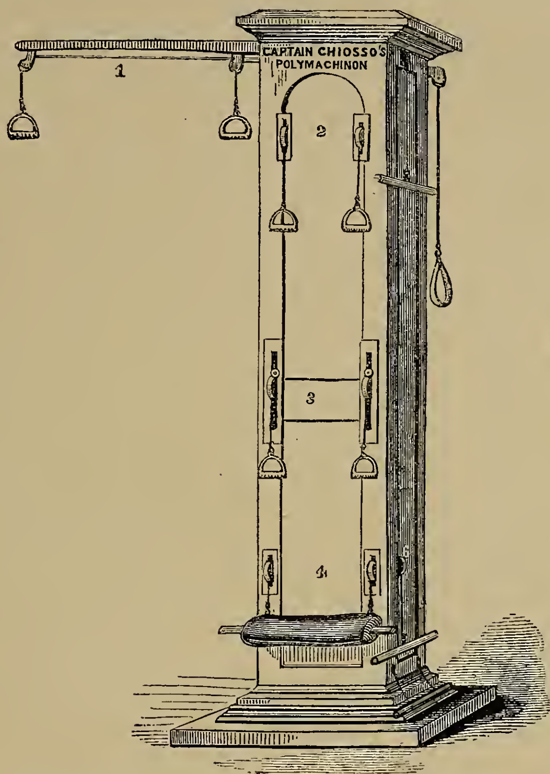


Fig. 249.—The polymachinon of Captain Chiosso. An early attempt at a universal exerciser, employing the pulley-weight principle.

polymachinon, a portable chest-like instrument of ropes, weights, and pulleys (Fig. 249). Among the advantages claimed for it were its convenient size, "the space required for it being of so little import that it may with ease be employed in an ordinary room," and its beauty of line, "the elegant and ornamental structure of the whole fits it for a prominent position in the dining-room, library, or boudoir." In spite of these advantages it did not make a permanent impression as an exerciser, an article of furniture, or as a means of treating the dozen maladies for which it was claimed to be most beneficial.

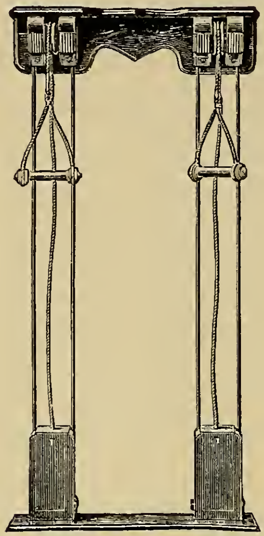


Fig. 250.—Dr. Sargent's first design for the pulley-weight, with adjustable weights in wooden boxes.

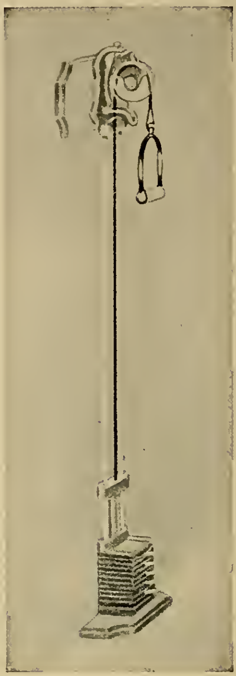


Fig. 251.—The perfected pulley-weight machine (Narragansett Co.), with weights attached by moving a foot lever. Single.

Other machines designed on this principle have been constructed and used for the last fifty years, but the improvement of their design, their systematic application to gymnastic training, and their wide employment in physical education are undoubtedly due to the efforts of Dr. Dudley A. Sargent of Harvard, who has perfected the numerous developing appliances that are known by his name.

In its simplest form the pulley-weight shows one pulley attached to the wall at the shoulder level, over which runs a rope with a handle at one end. The other end of the rope is fastened to a weight carrier, steadied by guiding rods which may be loaded with iron plates (Fig. 251). This rope may be compounded by means of another pulley attached to the weight carrier so that its excursion is half that of the arm (Fig. 252, A).

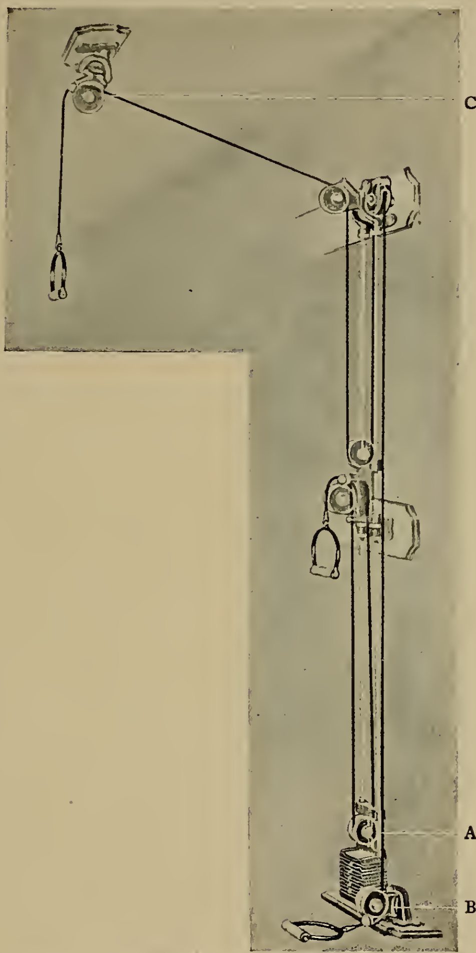


Fig. 252.—Triplex pulley-weight (Narragansett Co.).

In this way the height to which the weight is lifted is halved, allowing twice the range of movement with the same length of guiding rod.

A further elaboration of the pulley-weight uses the floor attachment, the rope turning about the pulley at the level of the floor, making a downward resistance (Fig. 252, B).

A third variation, called the intercostal attachment, uses the overhead arm pulley, which draws the arms upward (Fig. 252, C). In the triplicate machines all three varieties are used at will (Fig. 252). Attachments are designed for the head by which the muscles of the neck may be developed, also for the foot, to exercise the muscles of the leg and thigh. The quarter circle (Fig. 318) is an attachment that goes with the pulley-weight machine for keeping the trunk overextended during the arm movements.

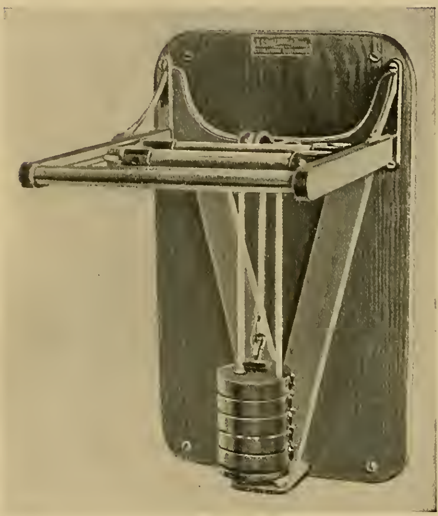


Fig. 253.—Finger machine to develop flexors of the fingers and grasping power (Spalding).

Pulley-weight machines have been designed by Dr. Sargent for strengthening the flexors of the fingers (Fig. 253) and for the pronation and supination of the forearm. Others are used for practising the movements of pushing downward on the parallel bars (Fig. 254) and chinning the horizontal bar. In these machines the bars are set on sliding rods and balanced by counterweights, while the resistance may be increased with the strength of the user. They are designed for the man who is too weak to engage in the heavy exercises on the parallel and horizontal bars, and by their assistance he is enabled to develop gradually strength sufficient for the usual feats.

All movements on the pulley-weights must be of the simplest character and slow in rhythm. Unless the movement is slower than the falling of the weight, a jerky, inefficient action is produced. They need but little co-ordination and may be repeated indefinitely without great mental exhaustion. The repeated contracting and relaxing pumps the blood through the muscles, which rapidly increase in size, but if the entire muscular system be developed to its physiologic limit a very considerable drain on the vitality is inevitable. A man may have powerful muscular

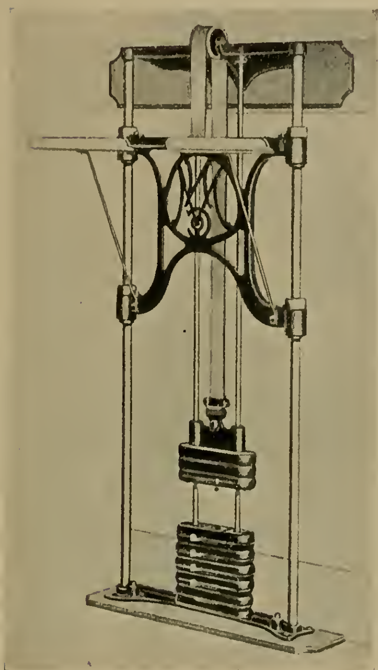


Fig. 254.—Traveling parallel bars (Narragansett Co.), invented by D. A. Sargent for developing purposes.

Fig. 255.—The nautical wheel in action. The resistance is furnished by friction.

development without a capacity for prolonged exertion (Fig. 3). These exercises should then be combined with others requiring skill and endurance if an all-round development is to be obtained. The simplicity of the movements is such that they are easily mastered and the interest in them soon flags. It needs a strong determination buoyed with the hope of increased strength to continue their use.

In order to help the imagination, apparatus has been designed to imitate the movements of paddling, rowing, sculling, and bicycling, using the principle of the pulley-weight or lever. Others employ friction to give resistance to the stroke of the oar or the turn of the wheel (Fig. 255).

In the *inomotor* Dr. Sargent has devised a machine capable of exercising all the muscular system while allowing the exclusive use of selected muscle groups. He uses the principle of the lever

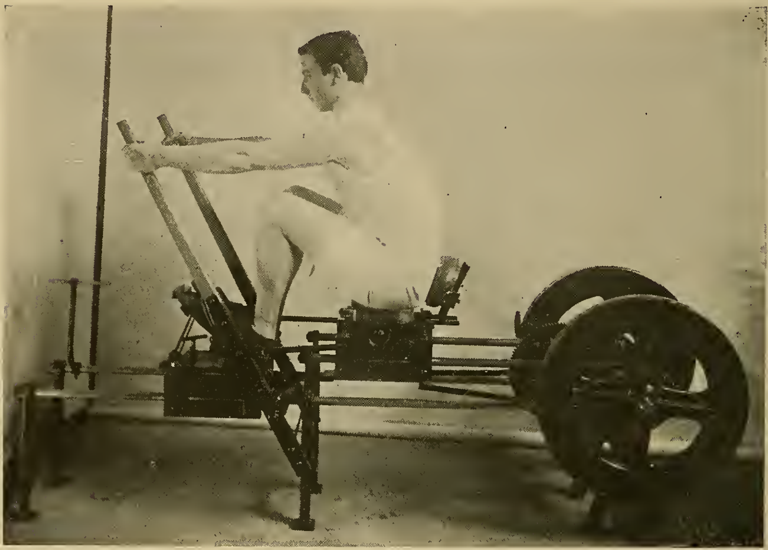


Fig. 256.—The Sargent inomotor with fly-wheel in place.

as applied to rowing and bicycling. After taking his seat the operator grasps the handles and pulls. As he braces his feet the foot-rest moves forward, turning the heavy fly-wheel. At the same time the seat is forced backward by straightening the thighs. When extension is complete the wheel is turned by shoving on the handles and pulling on the foot-rest by flexing the legs (Fig. 256). Work and rest may thus alternate in opposing groups, and any combination of flexors or extensors may be used.

CHAPTER XXI

FLAT-FOOT AND CLUB-FOOT—THEIR TREATMENT BY EXERCISE

The advantage of the upright position is somewhat offset by the frequency of deformities due to a yielding of the structures concerned with support. The body may yield at the spine, which becomes bent and distorted; at the knee-joints, which knock together (genu valgus); or at the arch of the foot, which becomes broken down and flattened, causing the deformity known as pes planus, flat-foot, everted foot, or pronated foot.

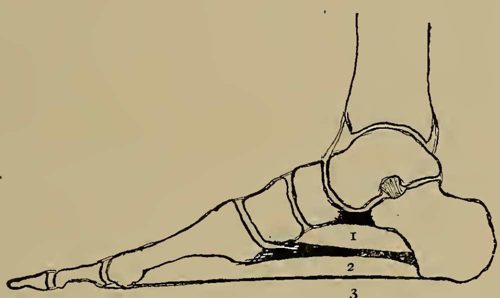


Fig. 257.—Anteroposterior arch: 1, Short plantar ligament; 2, long plantar ligament; 3, plantar fascia.

The bony structure of the foot is arranged in the form of two arches, anteroposterior and lateral. The anteroposterior arch (Fig. 257) is formed by the os calcis, the scaphoid, the three cuneiform bones, and the metatarsals, with the astragalus as a keystone. It is supported by the ligaments extending between the adjacent bones like ties, but more directly by the short plantar ligament (Fig. 257, 1) binding the os calcis to the navicular. This powerful ligament completes the socket formed by the navicular and the os calcis, into which fits the head of the astragalus, or keystone of the arch. The other main ligament of support is the long plantar (Fig. 257, 2), which extends from the body of the os calcis to the proximal, and indirectly to the distal, end of the metatarsal bones, through its connection with the tendon-sheaths. These may be termed the first line of defense in preserving the anteroposterior arch.

The second line of defense consists in some of the short muscles of the foot—the flexor brevis digitorum (Fig. 258, 3) and the flexor brevis hallucis (Fig. 260, 3)—assisted by the

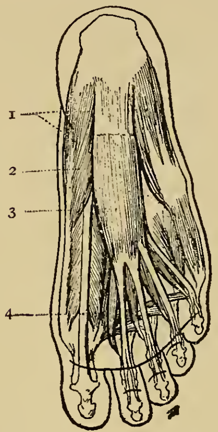


Fig. 258.—The superficial muscles of the foot: 1, Abductor minimi digiti; 2, abductor hallucis; 3, flexor brevis digitorum; 4, tendon of flexor longus hallucis (Richer).

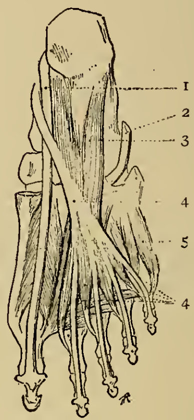


Fig. 259.—Second layer of muscles of foot: 1, Tendon of flexor longus hallucis; 2, tendon of peroneus longus; 3, accessorius; 4, tendon of the flexor longus digitorum and lumbricales; 5, flexor brevis minimi digiti (Richer).

tendons of the flexor longus hallucis (Fig. 258, 4), the flexor longus digitorum (Fig. 259, 4), and of the tibialis posticus, passing around the inner malleolus, and binding together by its expanded tendon all the bones of the tarsus except the astragalus. The tibialis anticus (Fig. 261, 1) also helps by lifting the proximal end of the first metatarsal bone. These muscles, by their action, all lift the inner side of the foot and draw together the limbs of the anteroposterior arch, like the string of a bow.

The lateral arch of the foot (Fig. 262) is imperfect, in that its support is at the outer side only, the weight being borne by the os calcis, the cuboid, and the fifth metatarsal. It is only one-half

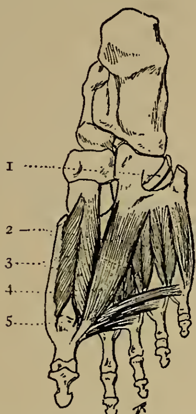


Fig. 260.—Deep layer of muscles of the foot: 1, Peroneus longus; 2, interossei; 3, flexor brevis hallucis; 4, 5, adductor hallucis (Richer).

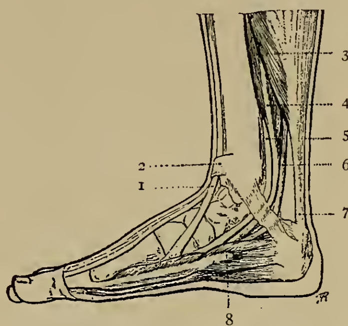


Fig. 261.—The tendons that support the arch: 1, Tibialis anticus passing under annular ligament (2); 3, soleus; 4, flexor longus digitorum; 5, tibialis posticus; 6, flexor longus hallucis; 7, tendo Achilles; 8, abductor hallucis (Richer).

the arch completed by placing the feet together. The arch rises upward and inward, and its free, unsupported edge is represented by the astragalus, the navicular, the internal cuneiform, and the first metatarsal. The lateral arch is supported principally by the tendon of the peroneus longus (Figs. 259, 2; 260, 1), crossing the foot diagonally from the cuboid to the internal cuneiform, and by the ligaments binding together the adjacent bones; it also receives some support from the tibialis anticus.

Fig. 262.—Lateral arch. Pull of peroneus longus.

The body weight is transmitted through the tibia to the astragalus. This pressure on the keystone tends to spread the members of the arch, and, in so doing, to stretch the long and short plantar ligaments. As the structures yield the inner side of the foot comes down, and the lateral arch shares in the flattening process. It is, however, the unsupported part of the arch that is chiefly affected, and the flattened instep also projects inward, causing the inner line of the foot to bulge at its center, the outline becoming convex instead of straight or concave. Pressure is thus put on surfaces of the bone that are not accustomed to it, and severe crippling pain is one of the most common results, while corns and callosities add their dis-

Fig. 263.—Direction of the body weight on the unsupported part of the lateral arch.

Fig. 264.—Transferring the direction of the body weight to the outer side, or supported part of the arch, by raising the inner side of the shoe.

comfort to the unnatural pressure and friction of the abnormal position.

A typical case of flat-foot would then show a turning out of the line of the heel (Fig. 267), a convexity of the inner contour of the foot, and a concavity of its outer margin. A tracing of the foot would show no instep (Fig. 266, A). While this deformity is sometimes caused by paralysis of the posterior tibial group of muscles, or by the peroneal group, and is also the result of traumatism in broad jumpers whose arch is broken down by the shock of landing on hard ground, still the great majority of cases are what might be termed static, and are found in nurses, clerks, waiters, barbers, motormen, and all others whose long hours of continual standing keep the muscles and ligaments of the foot constantly upon the strain. The pernicious habit of standing with the toes turned out always makes it worse. It is also found in the very fat, whose weight is too much for their ligaments. It is a comparatively frequent condition, and is usually associated with other deformities of the apparatus concerned in support.

Fig. 265.—Flat-foot (Fowler).

Bernard Roth, in his series of 1000 cases of scoliosis, found it in 76 per cent. of them. In an examination of 1000 supposedly normal students I have found it in 217 cases. Among men applying for military service in the United States, about 3.4 per cent. are rejected for this cause. These figures, however, do not include men who are suffering from flat-foot, but who are rejected for some major trouble. An applicant suffering from hernia and flat-foot would be rejected, but the cause of his rejection would be given as hernia. Lovett has found many cases among hospital nurses, who are peculiarly susceptible to it.

A B

Fig. 266.—Print of a normal foot-sole (A) and of a flat-foot sole (B) (Albert).

The symptoms are very varied. A considerable degree of flat-foot may be present without causing much irritation, and again great pain may be caused by comparatively slight degree. Painful points are found at the attachments of the calcaneo-navicular ligament, the anterior end of the os calcis, at the attachments of the short plantar ligament, and at the base of the first metatarsal, while there may be shooting pains up the calf of the leg. The heels, as seen from the back, are characteristic, the line of the tendo Achilles, with the ball of the heel, usually making a sharp turn outward (Fig. 267). This is emphasized when the weight is borne on the foot. It may very often be detected by examining the shoe only, the flat-footed patient tending to wear down the inner side of the heel and sole.

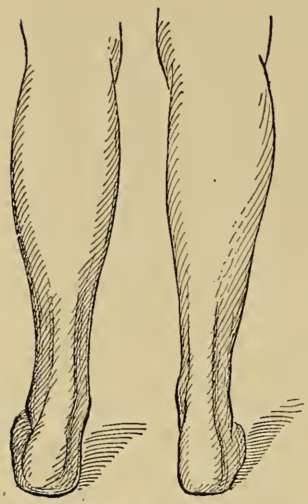


Fig. 267.—Showing one of the first signs of flat-foot. The outward deflection of the lower end of the tendo Achilles when weight is put on the foot (E. H. Ochsner).

A patient should be examined with the foot uncovered, walking backward and forward in order that the foot may be seen in action from all positions. The inner line of the foot, and the extent to which the instep is destroyed, should be noted.

Cases are best recorded by making a print of the weight-bearing foot as follows: Prepare a solution of perchlorid of iron in glycerin. By means of a brush or cotton-wool wrapped on a small stick paint the sole of the foot with this solution, place the patient's foot on a sheet of paper, having him put the full weight down upon it. Brush the resulting print with a solution of tannic acid, and the tracing becomes black and legible, and forms a convenient means of following the progress of treatment.

The appearance of the foot is not the only thing to be considered, for the arch of a baby's foot has an appearance of flatness, because the pad of fat which occupies the arch is not absorbed until the child has begun to walk.

Flat-foot is liable to be confused with tenosynovitis, the pains from corns and callosities, and with neuralgia of the metatarsus or the tendo Achilles. The most frequent mistake in diagnosis is rheumatism, which seldom affects the foot alone, although I have seen it in one case in which the diagnosis of rheumatism was confirmed by its subsequent appearance in other joints.

Although not a fatal disease, it is the cause of great pain and discomfort, and sometimes the patient becomes chair or bedridden.

Treatment must support the arch and correct the deformity, so that no treatment is complete which does not develop the structures involved in the normal preservation of the arch.

The market is flooded with patent devices for the support of the broken-down arch, but no mechanical treatment should be employed unless it accurately fits the individual case. More harm than good has been done by the use of ill-fitting and imperfectly supporting foot-plates. A foot-plate or bandage of any kind must be looked upon in the light of a splint, to be discontinued as soon as possible, and to be used only in conjunction with other means of treatment.

In most cases treatment by exercise should be begun by manipulation, stretching and massaging the foot; but where the pain is too severe, it may be necessary to give the foot a complete rest for two weeks or more by incasing it in a plaster bandage. When tenderness is sufficiently lessened, the following manipulations and active exercises may be started:

Exercise I.—Patient sitting, leg extended and supported just above the ankle. Grasp the right foot just above the ankle with the left hand. Place the right hand on the sole of the foot. With the thumb pointing toward the toes grasp the foot firmly, circumduct the foot slowly in the following order: (1) Extension; (2) inversion; (3) flexion; (4) eversion.

This should be done with as much force as can be used without producing pain, and repeated up to about thirty times. Each part of the movement should be separated from the next by a distinct pause. When this has been learned it may be replaced by the active movement.

Fig. 268.—Extension of the foot.

Fig. 269.—Inversion of the foot.

Fig. 270.—Flexion of the foot.

Exercise II.—Foot in the same position. Circumduction in the same order without assistance. *Repeat fifty times.*

The operator should supervise this movement and encourage the patient to make the extension and inversion as complete as possible, so that the long and short flexors and tibial muscles may have complete contractions at each movement (Figs. 268–271).

Fig. 271.—Eversion of the foot.

Fig. 272.

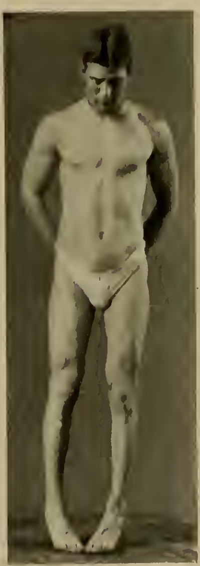


Fig. 273.

Exercise III.—Patient standing with toes in, heels out, and about 12 inches apart (Fig. 272). Rise on the toes and press out slowly (Fig. 273). *Repeat fifty times.*

Exercise IV.—Patient standing, feet parallel and 6 inches apart. Raise the inner side of the foot, throwing the weight on the outer border. *Repeat fifty times.*

This transfers the weight from the ligamentous support to the bony ridge of the outer edge of the foot (see Figs. 263 and 264), and should be followed by—

Exercise V.—Patient standing, feet parallel, weight resting on the outer side of the foot (Fig. 274). Walk forward and

Fig. 274.—Walking on the outer sides of the feet.

Fig. 275.—As the knee is bent the forward part of the foot is kept on the ground as long as possible. Twisting it downward and inward.

backward fifty steps, keeping the feet parallel and forcing down the ball of the foot.

This exercise is also valuable in throwing the weight of the body on the solid part of the lateral arch, and is one that is often instinctively taken by patients to relieve the intolerable pain caused by the overstretching of the ligaments.

Exercise VI.—Patient standing, feet 12 inches apart and parallel, knee bending and outward pressing (Fig. 275).

Exercise VII.—Patient standing, feet 6 inches apart and turned in as in Fig. 272. Rise on toes and walk forward and backward fifty steps, crossing the feet and keeping the toes turned in.

Exercise VIII.—Patient right lunge standing, neck firm. Forward bend with right knee bending until heel is forced from the floor, keeping the weight, on the outer side of the foot. Ten times. Repeat with the left (Fig. 276).

Fig. 276.—Lunge standing, knee bending, and heel raising.

This exercises the lower back, thighs, and legs as well as the feet, and cultivates correct balance of the weight which is important.

Exercise IX. — Patient yard standing, feet parallel, 6 inches apart. Sway slowly forward and backward on heels and ball of the foot, chest active and chin in. This is a balancing exercise to get the proper relation of the thorax, abdomen, and hips in the bearing of the body weight. (See Figs. 143, 144.)

Exercise X.—Raise the heel 1 inch from the ground and walk without bringing the heel down at all, as if the heel were painful.

This exercise may be practised indefinitely, the patient walking for 100 yards without letting down the right heel, and then the next 100 yards without letting down the left, or raising the heels when crossing the street, or other plans that will readily suggest themselves. A little practice will enable him to walk in this way without limping or otherwise attracting attention.

These exercises should be repeated daily, and in slight cases should be carried on for at least three months, whereas in severe cases they should be kept up as a daily routine for at least one year. In favorable cases this may be all that is required (Figs. 277–

280), but usually it will have to be combined with some form of specially designed shoe, with strapping or other mechanical sup-

Fig. 277.—M. March 6.

Fig. 278.—M. April 3. After one month's exercise only.

port to retain the gain and to prevent the original cause of the deformity from undoing the corrective work of the exercises.

The shoe should present a straight inner line, allowing perfect freedom to the toes, and high heels should be avoided.

The heel should be low and broad, and should project forward on the inner side to help in the support of the arch (the Thomas heel). A broad shank and stiff counter should be added, although a counter always sags with wear.

The "ground gripper" shoe exaggerates the inversion of the foot and is most comfortable and efficacious, although not very beautiful. It has a flexible shank.

Fig. 279.—A. M. November 4. Before beginning treatment.

Fig. 280.—A. M. March 10. After exercise treatment for five months.

An excellent shoe was devised by Small, of Boston, in which the rigid shank from the heel to the sole of the shoe is replaced by one that is flexible, allowing free movement to the whole foot and yet giving adequate support. The inner side of the heel and sole may be thickened, or a cork insole may be made to lift the inner side of the foot. This places the thrust of the body weight outward toward the supported side of the foot-arch and lessens the strain on the ligaments.

Among the many rigid plates designed to support the foot, undoubtedly the best is the one described by Royal Whitman[1]

[1] American Journal of Orthopœdic Surgery, Oct., 1913.

(Fig. 281). A plaster cast of the foot is taken, and an iron plate is fitted to it, with bearing points at the head of the first metatarsal, under the heel, and behind the fifth metatarsal bone. From these bearing points the plate fits into the arch of the instep, and may be trimmed to suit the convenience of the wearer.

Fig. 281.—Whitman's plate to support the arch of the foot in flat-foot (Fowler).

It is easily removable from the shoe, and does not press upon the foot except when it is bearing the body weight.

A bandage which has proved exceedingly useful in the hands of Dr. E. H. Ochsner is described by him as follows:

"I first select a good make of zinc oxid adhesive plaster in 12-inch rolls. After measuring the patient's leg I mark off the

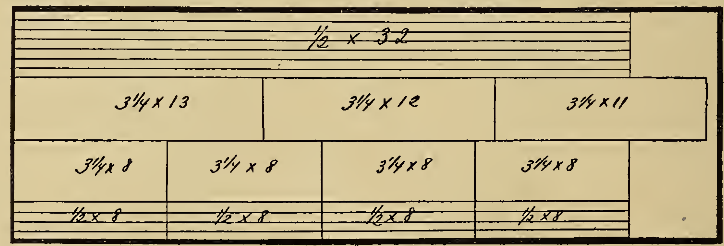


Fig. 282.—Showing how the zinc oxid plaster is marked off preparatory to cutting strips for strapping an adult male patient's foot (E. H. Ochsner).

adhesive strips according to the size of the extremity. For the purpose of strapping a male patient of ordinary size I mark off 7 strips ½ inch wide by 32 inches long, with a cross line at its middle; 16 strips $\frac{1}{2}$ inch wide and 8 inches long; 1 piece $3\frac{1}{4}$ inches by 13 inches; 1 piece $3\frac{1}{4}$ by 12 inches; 1 piece $3\frac{1}{4}$ by 11 inches; and 4 pieces $3\frac{1}{4}$ by 8 inches (Fig. 282). I do this as a matter of convenience, and in order to prevent the unnecessary handling of adhesive plaster after the facing is once removed.

"The heel of the patient's foot is now placed on the chair, with the knee flexed, and a short, hard, roller bandage is looped around the foot. I direct the patient to draw the foot upward, thus placing the foot at a little less than a right angle to the leg, moderately inverted and adducted, the patient holding the bandage himself.

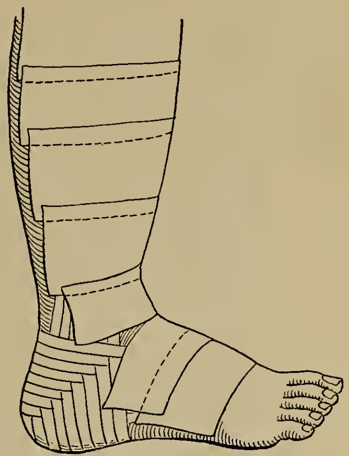


Fig. 283.—Showing arrangement of the $3\frac{1}{4}$-inch strips over the narrower strips (E. H. Ochsner).

"I now put the middle of the 32 by $\frac{1}{2}$ inch strip over the bottom of the heel, about 1 inch from its posterior border, one-half up the outer surface of the leg, without tension, and the other up the inner surface of the leg, as tight as I can. I then place one of the shorter narrow strips on the inner surface of the foot, parallel with the sole, and on the outer surface. The remaining narrow strips are placed in the same manner, each one slightly overlapping its predecessor. When these are all in place I cover them with the 7 remaining strips, beginning at the upper part of the leg, as illustrated in Fig. 283. These strips will remain in place and be effective from four to eight weeks, when they may be removed with benzin. The foot is washed with soap and warm water, carefully dried, and it is again restrapped the following day. A foot may require from two to ten strappings, and the relief is almost immediate. This strapping tends to supinate the foot and relieve the pain by relaxing the muscles and supporting the ligaments."

I have quoted this at length, because the best results can be obtained by a combination of this treatment with exercise. From the perishable character of the plaster, one is less apt to depend upon it alone, as is so frequently done with the metal flat-foot supports, while the danger of injury to the foot from bruising and formation of callosities arising from the use of plates unskilfully applied is completely avoided.

A flat-foot plate or bandage must, as already emphasized, be regarded in the same light as a crutch, cane, or splint would be for a joint unable to bear the strain of use, and it is to be discarded when the normal strength has returned and undue irritability has disappeared.

Fig. 284.—Manipulation for talipes equinovarus.

To continue the support after the indications for its use have disappeared is to hamper the normal functioning of the muscles and ligaments of the foot and leg.

The contraction of the plantar fascia, so frequently seen at birth, produces the opposite deformity from that just described, and the conditions of talipes equinus and varus and their combination in varying degrees can be greatly improved, and in many cases completely cured, by stretching manipulations of the child's foot. These should be taught the mother, and she should perform them at frequent intervals during the day, carrying the pressure to the point of pain. The two following are directed to correct the *equinus*, and the third is for the *varus*.

Exercise I.—Grasp the right ankle with the right hand, thumb toward the foot. Place the left hand on the sole of the foot, with the ball of the thumb on the ball of the foot. Grasp

Fig. 285.—Manipulation for talipes equinovarus.

the foot with the left hand and press the foot upward in dorsal flexion, twist the foot inward and outward as far as possible, relax, and repeat twenty times (Fig. 284).

Fig. 286.—Manipulation for talipes equinus.

Exercise II.—Grasp the ankle with the right hand as in Exercise I, place the left hand flat on the sole of the foot, press the foot upward into dorsal flexion, relax, and repeat twenty times (Fig. 285).

Exercise III.—Place the foot, outer side down, on the knee, grasp the heel and ball of the foot and press downward, stretching the contracted plantar fascia and ligaments. Repeat twenty times (Fig. 286).

In certain cases a corrective bandage or boot is necessary. It should be worn in the intervals of treatment by manipulation.

Very severe cases in infancy usually require operative interference as well, and in adults, where the bones have become adapted to the distorted posture, surgical treatment will always be necessary. The manipulations described above are especially adapted to mild and moderate cases in infants.

CHAPTER XXII

THE CAUSE AND TREATMENT OF ROUND BACK, STOOPED, AND UNEVEN SHOULDERS

If an infant be placed upon its back, it will lie with a straight spine and thighs flexed to nearly 90 degrees. If it be placed in a sitting posture the thighs remain flexed and the spine shows a single convex backward curve involving its entire length, but in the standing posture the right angle between the trunk and thighs must be extended to a straight line, and this is effected by a compromise between the lumbar spine and the hip-joint, both yielding part of the way.

When the hip-joint is extended the iliopsoas muscle is stretched, though this extension is not sufficient to preserve the convex backward curve of the sitting posture. A sharp forward curve develops in the lumbar region. The anterior vertebral ligaments are stretched, the intervertebral disks thicken anteriorly, and the erector spinæ muscle becomes active and powerful. This curve, which is very marked in young children, gives them their characteristic "pot-bellied" appearance, and is accompanied by a localization of the compensating backward curve to the dorsal region, and by the formation of a third in the cervical region, showing the same forward convexity as the lumbar curve. These three curves are physiologic and are always found in the adult normal spine, and it is their exaggeration or imperfect development that will be considered in this chapter.

The shoulder girdle is constructed to permit the widest range of movement with the utmost lightness of structure, but the pelvic girdle, whose chief office is that of support, is firm and archlike, with powerful ligaments, heavy bones, and scarcely perceptible movement. The entire weight of the head, neck, upper extremities, and shoulders hangs upon the flexible and growing spine during the standing and sitting positions, and the muscles that steady the spinal column rapidly become fatigued when thus kept on the strain and allow the shoulders to droop forward, bending the neck and back with them. The resulting deformity is called stoop shoulders, slant shoulders, round back, faulty attitude, *kyphosis*, or bowed back, and when the deviation is to the side, either right or left, it is known as *scoliosis*, or lateral curvature.

The condition of round shoulders can be determined only after the normal standing attitude is clearly defined in the mind, and deviations from this normal attitude can then be noted and accurately described.

In the normal standing position the long axis of the head, trunk, and leg will form a straight line. A plumb-line should touch the dorsal spine and the sacrum at their greatest projection. It should be the attitude in which there is the least strain, in which the head is erect and balanced, relieving the neck muscles; the shoulders should be back so that their center is distinctly posterior to the center of gravity, the chest held high, and the abdomen flat. The pelvis should be inclined forward so that the axis from the promontory of the sacrum to the top of the pubic bones is 30 degrees downward and forward from the horizontal, the knees straight, and the center of gravity in front of the ankle-joints, as determined by Reynolds and Lovett in their two hundred observations on balance.

Lovett determined the standard normal standing posture by marking the following points—(1) the external malleolus, (2) the head of the fibula, (3) the great trochanter, (4) the fourth lumbar spine, (5) the seventh dorsal spine, (6) the spine of the vertebra prominens, and (7) the middle of the mastoid process, and having the patient stand with the malleolus opposite an upright standard, the relative position of each of these points being noted (Fig. 287).

A composite of seventy-two normal boys (Greenwood) between the ages of fifteen and nineteen years shows the following tracing (Fig. 288).

By means of this standard faulty attitudes are classified into (1) round back, showing a general curve backward without lordosis (Fig. 291, *b*); (2) round hollow back, with the backward projection greatest in the middorsal region and with pronounced lordosis, the forward projection of the head bringing

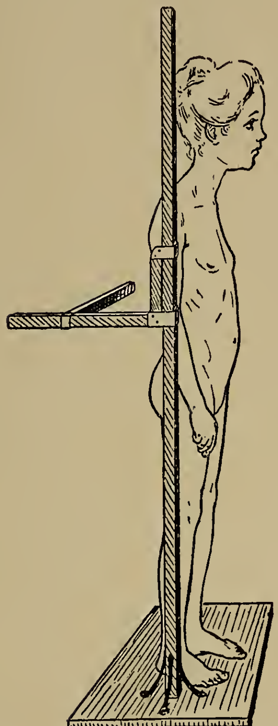


Fig. 287.—Lovett's apparatus for measuring variations from normal attitude in the anteroposterior plane.

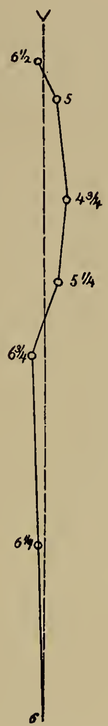


Fig. 288.—Composite curve of seventy-two normal boys (Greenwood).

Fig. 289.—Curve of young adult female of good carriage (Lovett).

the upper three measurements almost in line; (3) forward displacement of the shoulders, the scapulæ and clavicles being displaced independently of the condition of the spine. This condition may exist either with or without a rounded back. A graphic tracing of these curves may also be obtained by the pantograph method, described in the following chapter (Fig. 290), or by the rods and frame used by Lovett (Journal A. M. A., March 26, 1910).

From the standpoint of treatment, these deformities may be classified into flexible and resistant. During the years of growth posture will usually take care of itself if constant change be allowed, for change is instinctive and automatic in the child and his varied activities may be trusted to lead him along normal lines. If from inherent weakness or confinement of school life without the relief of games and play this normal development be hindered, the spine is one of the first parts of the anatomy to reveal it.

Fig. 290.—Making a tracing of the anteroposterior curves of the spine by the pantograph method.

Fig. 291.—Anteroposterior tracings of the spine: *a*, Correct posture; *b*, first type of round back; *c*, extreme resistant round back in a young girl.

The *causes* of round shoulders are then those general conditions that produce muscular or constitutional weakness, like rapid growth, overwork, bad air in schools or home, acute illness, myopia uncorrected by glasses, poor hygiene at home, or general lack of exercise, and, secondly, occupations that demand long-continued fixation during the period of growth. Among these may be mentioned the use of ill-fitting school furniture, long-continued writing and drafting, or work with the microscope; in fact, the requirement of any fixed position for more than a few minutes at a time in a young child. His restlessness in school is his only means of protest, and is the object of much misapplied correction by those school teachers who believe that quietness and goodness are synonymous. The third cause, more direct than either of the others, is the wearing of clothing supported by suspenders bearing on the points of the shoulders, tending to pull them downward and forward.

Fig. 292.—Showing a common underwaist with the straps bearing upon the outer part or movable part of the shoulders (Goldthwait).

It is a very frequent deformity among school children, and it occurs in almost 20 per cent. of university students uncomplicated with other postural defects. Where a greater deviation is present, such as lateral curvature, a note is usually made of the scoliosis only, so that its occurrence is more frequent than these figures would indicate. It is frequently discovered in girls about the age of puberty, when especial attention is apt to be paid to their figure and carriage.

Round shoulders are not likely to be outgrown, and patients usually become permanently and structurally set in the faulty posture, with flattened chest walls and distorted figure.

An examination of the back should begin by testing the spine's range of movement forward, backward, and lateral. The patient should then take his habitual standing position, which he should retain until his self-consciousness abates. The overcorrected standing posture should then be tried. This may be done by having him force the chest forward and upward to touch the surgeon's hand, held just far enough in front of and

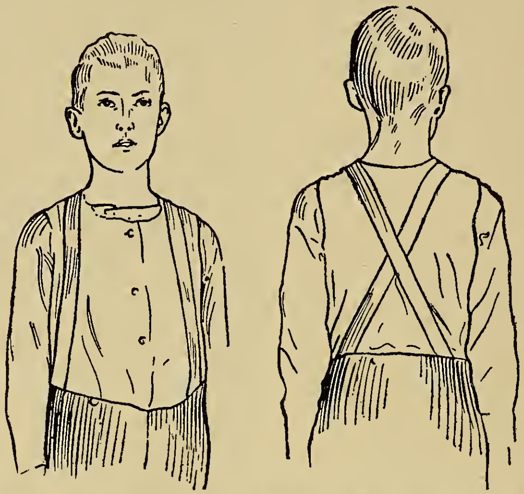


Fig. 293.—Correct support of clothing. The weight comes on the root of the neck instead of the shoulder-tips (Goldthwait).

parallel to the chest wall to bring the contour of the thorax directly above that of the abdomen. This maneuver should always be done before a mirror, that the patient may associate the sensation with the picture of the correct posture, and it will take time and patience on the part of both. He should then be taught to take several long breaths without relaxing the pose. If the child be placed face downward, with the arms at right angles to the body, flexibility of the shoulders can be tested by attempting to force the arms back of the middle line of the body. They should then be lifted upward beside the head and forced backward. During these movements the whole spine should be narrowly observed. In resistant cases the arms cannot be brought behind or even up to the median plane of the body. It can only be simulated by hollowing the lower part of the back and protruding the abdomen, flattening the chest, and projecting the chin. In non-resistant cases there is usually a general relaxation of the ligaments, as shown in hyperextension of the elbows and knees, as well as of the spinal ligaments, and if the patient can voluntarily assume a correct position the case may be pronounced non-resistant. In resistant round shoulders and forward displacement, however, there is always more or less structural change, involving a forward curvature of the upper part of the scapula, a shortening of the coraco-acromial ligament, or, according to Fitz, a tightness of the serratus magnus muscles associated with weakness of the rhomboids and trapezius.

By adequate treatment all cases are capable of improvement, and almost all, except the most resistant, are capable of complete cure. Exception must be made in the case of those congenital cases where they have never adapted themselves to the upright position, where all the ligaments are relaxed, where the ptosis of the abdominal organs indicates the lack of tonicity of the system, and where the vitality is so low that the necessary exertion is too exhausting to the patient. In such cases additional muscular effort is translated into pain and backache. Any irritable condition of the spine should be looked upon with suspicion, and girls and women often require the services of a gynecologist as well. All such cases should be given a rigid and thorough examination and kept under observation for weeks before severe exercise is prescribed.

Before beginning treatment it is important to differentiate between the flexible and the resistant cases, and between both and arthritis where pain is a prominent symptom.

Treatment may be divided into (1) hygienic, (2) exercise, and (3) stretching.

Hygienic.—The patient should have the best available surroundings as to light, air, and food, because, as a rule, they are underdeveloped muscularly and have not the constitutional resistance nor the will-power of the average child. The muscle fatigue that comes on from strained fixed positions among school children must be avoided by every available means. School furniture should be adjusted to prevent undue flexion of the back and forward bending of the head during reading and writing. Errors of refraction should be corrected. The clothing should be examined, and when found to be supported from the tip of the shoulders the garments should be altered to bring the pressure in toward the root of the neck instead of out on the shoulders (Fig. 293).

Fig. 294.—Outline drawing of a bad corset applied to a model (Reynolds and Lovett).

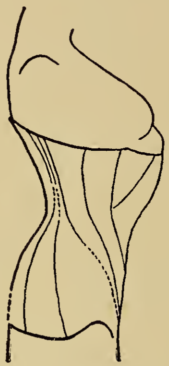


Fig. 295.—Outline drawing of a good corset applied to a model (Reynolds and Lovett).

Miss Bancroft has pointed out ("The Posture of School Children") that the cut of most ready-made clothing causes pressure on the back of the neck and tip of the shoulders, constantly tending to produce this deformity, while the investigations of Reynolds and Lovett on balance throw interesting light on the corset and high-heeled shoe as articles of dress.

They divide corsets, according to their effect on posture, balance, and backache, into good and bad. The bad corset is long behind, especially at the top, short in front, especially at the bottom. It exerts its greatest pressure at the waist, and at the top and bottom is capable of exerting pressure only against the wearer's back (Fig. 294). It has a strongly marked sacral curve, but is otherwise straight in the back and is highly incurved at the waist in front. It moves the center of gravity of the body back, throwing the hips far back of the normal, and thus giving the illusion of forward shoulders (Fig. 297). The good

Fig. 296.—Position induced by bad corset in dotted outline; normal, in solid line. In this instance the shoulders are thrown back of the normal a little, but not so much as the hips. On this and all following records the solid vertical indicates the original position of the center of gravity; the dotted vertical, the induced position (Reynolds and Lovett).

Fig. 297.—Position induced by bad corset in dotted outline; normal, in solid line. In this instance the shoulders are thrown forward of the normal and the hips back (Reynolds and Lovett).

corset is short behind, especially at the top, and long in front, especially at the bottom. It fits tightly around the pelvis between the iliac crest and trochanters and decreases regularly in pressure to its upper edge, where it is very loose, especially behind. It is considerably incurved at the waist line, at the back and sides, but shows no waist curve in front (Figs. 295, 298). It moves the center of gravity uniformly back. The rules for construction are given in detail, and the clinical test is comfort to the wearer and the approximate outline shown in Fig. 295.

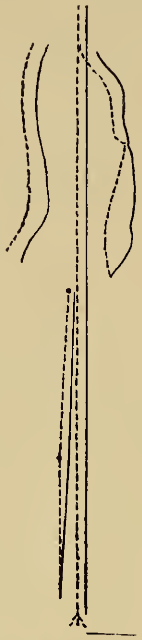


Fig. 298.—Position induced by good corset in dotted outline. Normal, in solid line. The apparent flattening of the lumbar curve in the dotted line is due to the bulging of the soft tissues through the open space at the back of the corset (Reynolds and Lovett).

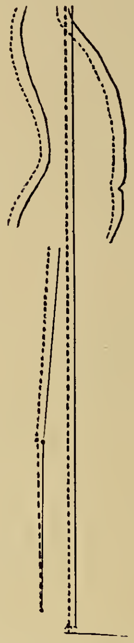


Fig. 299.—Record of the normal position and that induced by high-heeled shoes: the normal in solid line, the induced position in dotted line (Reynolds and Lovett).

High-heeled shoes tip the body back as a whole without making any appreciable change in the lumbar curve (Fig. 299), and so exert less influence on the production of abnormal anteroposterior curves of the spine than has been placed to their discredit. A patient in a bad corset will be more comfortable with high heels than without them, because they displace the center of gravity backward. Balance is maintained by the action of the muscles of the neck, back, and calf, and anything that will relieve this strain, especially where the muscles are weak, will come in the nature of a relief. The bad corset does this only apparently, for the work of the spinal muscles is really increased and the backache and postural troubles in consequence aggravated.

Exercise.—In the treatment by exercise, expansion of the lungs by deep breathing to round out the flattened chest should

Fig. 300.—Correct standing posture.

Fig. 301.—Incorrect standing posture.

be emphasized. These exercises are described fully in Chapter XXVII. The correct standing position and carriage of the body should be continually and persistently insisted upon. This must not be done by contracting the retractors of the shoulders, but rather by bringing in the chin and forcing the thorax forward and upward (Fig. 300), as already described. The muscles of the upper back must be strengthened to carry out their function of support, and the abdominal muscles must be developed and trained to overcome the weak and relaxed carriage of the protuberant belly. The following exercises would constitute a daily prescription:

Exercise I.—Patient standing in his habitual faulty position (Fig. 302). Place the hand about one inch in front of the sternum and tell him to raise the chest and shove it forward to touch the hand without swaying the body. In doing this at first he will try to draw the shoulders back, contracting the

Fig. 302.—Diagram showing the relation of the head, thorax, and pelvis in the incorrect standing position.

Fig. 303.—Diagram showing the relation of the head, thorax, and pelvis in the correct standing position.

trapezius and rhomboids. This fault must be overcome at the very beginning, and the shoulder muscles must be kept relaxed. Gradually increase the distance to which he can bring the chest forward, repeating it again and again until he can take the position without difficulty and without contracting the muscles of the back. While in this position make him breathe deeply five times and then relax. This should be done before a mirror, so that he will recognize the feeling of the correct posture and associate it with the proper attitude as seen in the glass. He should then try to take it without looking at the mirror. This posture should be drilled into him until it becomes habitual and until he can maintain it without discomfort.

R. J. Roberts, of Boston, was accustomed to tell his young men to press the back of their neck against their collar-button, considering this as the keynote of the position. In whatever way it

Fig. 304.

Fig. 305.

is accomplished, the object is to get the proper relation between the thorax and the pelvis.

After repeating *Exercise I* twenty times, take *Exercise II.*

Exercise II.—Arms forward raise, upward stretch, rise on tiptoes, inhale. Sideward lower, slowly press the arms back and exhale (Figs. 304, 305, 306).

Fig. 306.

Fig. 307.

Fig. 308.

This exercise when done correctly expands the chest, bringing in all the extensors of the back and the levators of the shoulders.

Exercise III.—Patient standing, arms downward and backward, fingers interlocked and palms outward (Fig. 307). Extend the neck, roll the shoulders backward and forearms into supination, the palms being first in, then down, and then out (Fig. 308). Reverse to starting position and relax.

This exercise is valuable for projecting the chest forward, stretching the shortened ligaments and drawing in the abdomen. Care should be taken to have the chin pressed backward when the arms are brought downward and turned outward. In resistant cases, where this exercise cannot be done with the fingers interlocked, a handkerchief tied in a loop may be substituted and held in the fingers (Fig. 372).

Fig. 309.

Fig. 310.

Exercise IV.—Patient standing with the arms at the sides. Arms sideward raise, upward stretch, inhale, forward bend and rise. Arms sideward, lower, exhale (Figs. 309, 310).

In this exercise the lungs are filled when the chest is in the most favorable position for expansion. The breath is retained when the trunk is flexed, forcing the air into the cells of the lungs under pressure. The bending and rising bring into powerful action the extensors of the back and neck and the retractors of the shoulders.

Exercise V.—Patient lying prone upon a couch with the feet strapped or fixed by an attendant. Hands clasped behind the

Fig. 311.

head. Raise the head and extend the spine, pressing the elbows backward (Fig. 311). Relax.

This exercise is a severe one on the extensors of the back and the retractors of the shoulders, and should be followed by a deep breathing exercise (Fig. 312).

Fig. 312.—Deep breathing exercises introduced between two extension movements.

Exercise VI.—Patient lying in a prone position, arms at the sides. Raise the head (Fig. 313), bringing the arms forward (Fig. 314). Imitate the breast stroke in swimming (Fig. 315).

In this exercise the erector spinæ is kept in static contraction, while the retractors of the shoulder are alternately contracted and relaxed.

Fig. 313.

Fig. 314.

Fig. 315.

Stretching exercises that require the services of an assistant, or a machine designed for the purpose, should be associated with these voluntary movements. Sylvester's method of artificial respiration (Figs. 411, 412) may be employed with good effect, the upper dorsal region being supported by a hard pillow, the surgeon pulling at the end of the upper movement, stretching the thorax to its utmost. The intercostal machine (Fig. 316) is invaluable for securing the same kind of movement. Zander's machine, the *tower* (Fig. 317), straps the shoulder backward and forces the rest of the body, imitating closely the movement and

Fig. 316.—Triplicate chest weight, overhead or intercostal attachment.

rhythm of ordinary respiration. The quarter-circle (Fig. 318) is another gymnastic machine designed to give breathing exercise with the body held in an overcorrected position. Taylor's *spinal assistant* (Fig. 319) produces the same effect by suspending the weight from the arms with accented pressure on the dorsal region, either from behind, forward, or laterally, as shown in the illustration.

The main value of these stretching movements is on the ligaments rather than on the muscles.

In slight cases of round shoulders the strapping described by Goldthwait to draw the shoulders backward is of real value. It is composed of firm webbing, 1 inch wide, carried as a loop around each shoulder, the bands crossing in the back and being

Fig. 317.—The "Tower," for respiratory movements. The shoulders are held firmly, while pressure is applied to the back.

attached to the belt of an ordinary stocking supporter. The attachment of the shoulder-strap to the belt should be at the side directly over the stocking straps, and the belt should be worn about the hips and not about the waist as is usual. The straps should be sewed where they cross at the back over the angles of the scapulæ, but should not be sewed where they cross in the mid-line. This allows body movements both to the side and forward without straining upon the straps or changing the position of the belt level.

An ingenious device for a similar purpose is the invention of Jessie Bancroft, and has the approval of the American Posture League. It consists of a strip of elastic webbing attached to the

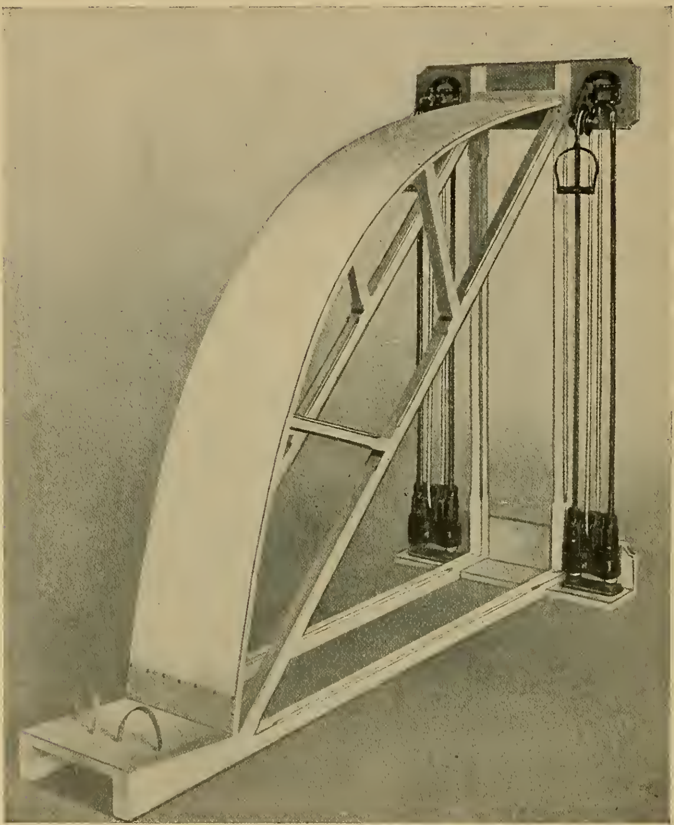


Fig. 318.—Quarter-circle (Spalding).

coat between the shoulders. It exerts gentle tension whenever they come forward.

For more resistant cases, where very active stretching is necessary, Lovett's apparatus is the best. It consists of an oblong gas-pipe frame. Hinged to this near the middle is another section of gas-pipe, of the same shape and size as the upper half of the frame. To this movable section is fastened at right angles a gas-pipe bridge, rising about 18 inches above it and movable on it (Fig. 320). When prepared for use, two strips of webbing, lying one over the other, run from each of the two buckles at the bottom end of the frame. The lower pair are tightly drawn and run through buckles at the upper end of the movable section. The upper two are loosely fastened to the bridge. The patient is

Fig. 319.—Taylor's spinal assistant for suspension and lateral pressure.

laid face downward on the webbing strips, protected by a piece of sheet-wadding if uncomfortable. The thighs are flexed and the feet rest on the floor, so that the lumbar spine is flattened. Two pieces of webbing are placed over the middorsal region from side to side, tied to the lower non-movable frame on each side, thus furnishing the resistance for the straightening of the spine when the upper end of the movable frame is raised, carrying with it the head and upper chest. After the patient is in place the upper part of the frame is lifted, the amount of force permissible being not beyond the point of mild discomfort. Several stretchings are made of a few seconds each, the movable part of the frame being let down to rest the patient.

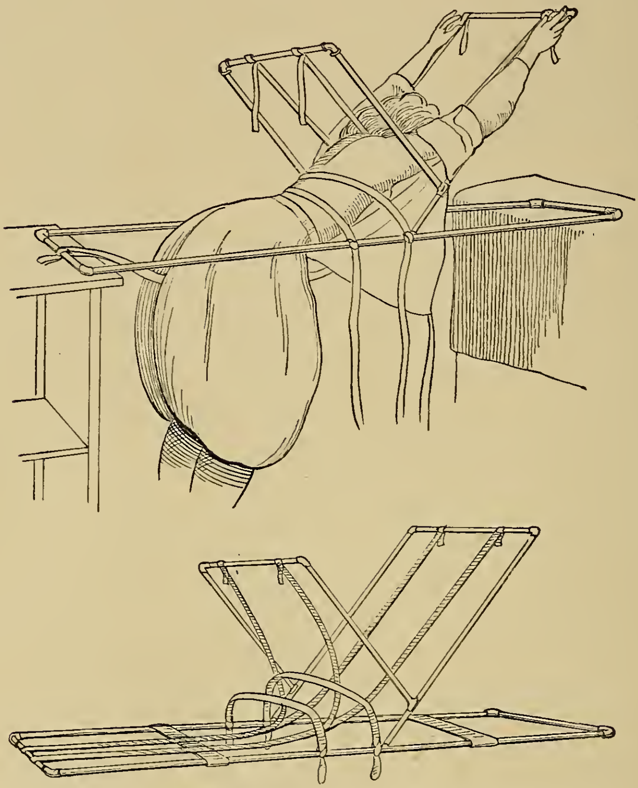


Fig. 320.—Apparatus for stretching round shoulders (modified from Lovett).

Flexible round shoulders in most cases yield to exercise alone, extending over a period of three to six months of daily treatment, but it may be advisable to maintain the improvement for a time by means of some such simple brace as the one described by Goldthwait, although fixation without exercise is irrational and leaves the condition worse than it found it.

Some resistant cases will require stretching by the Lovett apparatus, and fixation in the corrected position combined with vigorous development of the muscles of the back and prolonged training in the corrected standing position.

Occasional cases in which there is structural deformity have been treated by cutting the coraco-acromial ligament, but such cases are the exception and need not enter into the discussion.

After active treatment has ceased the patient should be kept under supervision, reporting progress at least once a month for two years.

Fig. 321.—Lowering of the right shoulder from carrying a rifle and pressure of a bandolier for two years.

It is the rule rather than the exception to find associated with round shoulders some inequality in their height. In 1000 consecutive examinations of supposedly normal young men the right shoulder was low in 104 cases and the left in 20, and tailors tell me that it is almost the rule to put extra padding in the right shoulder of coats for the sake of appearance. The causes of an irregularity, varying from $\frac{3}{4}$ to 2 inches, are sometimes difficult to disentangle, but the carrying of weights like school books and bad habits in sitting and standing are among the most potent. The position of the child sitting at the school-desk during writing favors it, since the left arm and shoulder are supported and the right lowered. Habitual standing with the weight on the right leg contributes to a good many cases, as will be seen in the description of scoliosis, but weights carried in the hand or pressure on the right shoulder are the most direct, and it is a common thing to see this deformity in soldiers after carrying the rifle and bandolier during long marches. Figure 321 shows a man, otherwise powerful, symmetric, and well developed, who acquired it in two years' active military service, during which he had to make long marches with his rifle and cartridge belt pressing down on the right shoulder.

The great specialization of some games in which the right arm is almost exclusively used is blamed for many cases. Fencing, baseball pitching, and putting the shot are ready examples.

In response to an inquiry sent to 21 men who had the left shoulder lowered, only 3 acknowledged to left-handedness.

The patient placed before a mirror can almost always assume the correct standing posture by voluntary muscular effort, but to him it does not feel normal or natural, and he quickly relapses if left to himself.

Fig. 322.

Fig. 323.

In all straight and symmetric exercises the weaker side will get more work than the stronger, so that movements described for flat chest and round shoulders, all of which bring in equally the muscles of both sides, would be of some value in these cases.

It is necessary, in addition to this, to develop the upper part of the trapezius, the rhomboids, and the deltoid of the lower side and the latissimus dorsi and inferior part of the pectorals on the opposite side, and for this purpose the following exercises should be given for a lowered right shoulder:

Exercise I.—Position, standing, arms down at the side. Right arm forward raise; inhale (Fig. 322). Rise on tiptoes, stretch, sideward lower; exhale. The left arm should be shoved downward while the right arm is raised.

This exercise brings into action the upper part of the trapezius, deltoid, rhomboids, and serratus magnus of the right side, and the latissimus dorsi and lower part of the pectoralis major on the left.

Exercise II.—Position, standing, arms down. Right arm sideward raise; inhale. Forward bend (Fig. 323), upward stretch, arm sideward lower, exhale.

This exercise has the same effect as the first, with the additional advantage of stretching the right side of the trunk more than the left as the body is bent forward.

Fig. 324.

Exercise III.—Position—prone—lying on plinth, right arm elevated, left arm forced downward. Extend the neck and back and relax (Fig. 324).

Exercise IV.—Position, back to chest-weight floor attachment. Push upward with the right arm (Fig. 325). This brings into action the right deltoid, the upper part of the trapezius, the rhomboids, and the serratus magnus of the right side.

Exercise V.—Shrugging the right shoulder while holding a dumb-bell of 40 or 50 pounds (Figs. 326, 327) has the contrary effect from continually holding the weight and keeping the muscles in tension. The intermittent contraction and relaxation of the muscles tend to strengthen and develop them, and so

Fig. 325.

make them shorter when at rest, while continuous tension rapidly stretches them and destroys their tonicity.

The putting up of a light dumb-bell, of 5 or 10 pounds, from the floor to arms' length above the head is another valuable exercise (Fig. 328). The nautical wheel (Fig. 255) turned counterclockwise, also will help to raise a lowered right shoulder. Hanging exercises, in which the weight is borne by the right arm with counterpressure on the left side, are of slight assistance in stretching the latissimus dorsi on the right side, but do not affect the upper part of the trapezius or the serratus magnus, both of which are relaxed in this position.

The *prognosis* is good in all cases, if these exercises be followed persistently and faithfully in the form of a daily prescrip-

Fig. 326.

Fig. 327.

Fig. 328.

tion for three to six months. Most of the failures are caused by the carelessness of both surgeon and patient and the readiness of the tailor to act as their accomplice.

CHAPTER XXIII

SCOLIOSIS—ITS CAUSES, VARIETIES, DIAGNOSIS, AND PROGNOSIS

The spine is protected against lateral deviation by three lines of defense of increasing strength—(1) the muscles forming

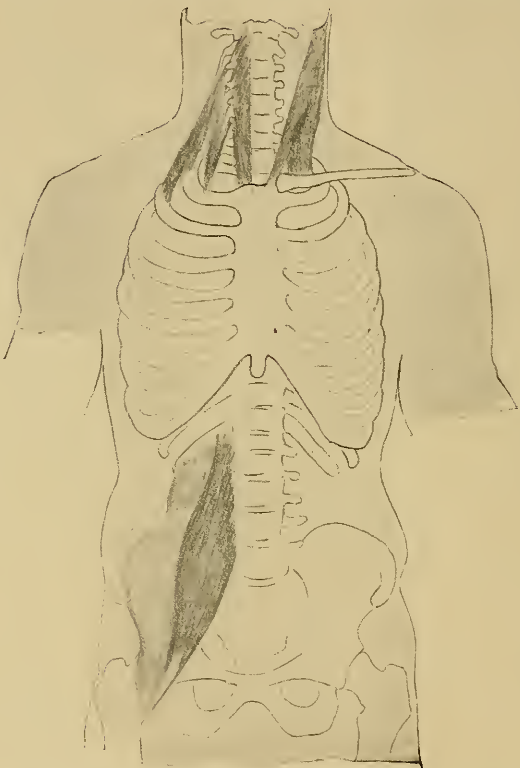


Fig. 329.—The anterovertebral muscles, showing the iliopsoas and quadratus lumborum in the lumbar region, and in the cervical the longus colli, the scalenus anticus medius and posticus on the right, and the sternomastoid on the left.

an advanced mobile series of outposts brought into service in relays, powerfully but intermittently; (2) the ligaments, more resistant but less mobile, requiring long-continued and persistent attacks to overcome their normal protective action; (3) the bones, which may be compared to a citadel yielding to the influence of deformity only after the other two lines of defense have long since been carried.

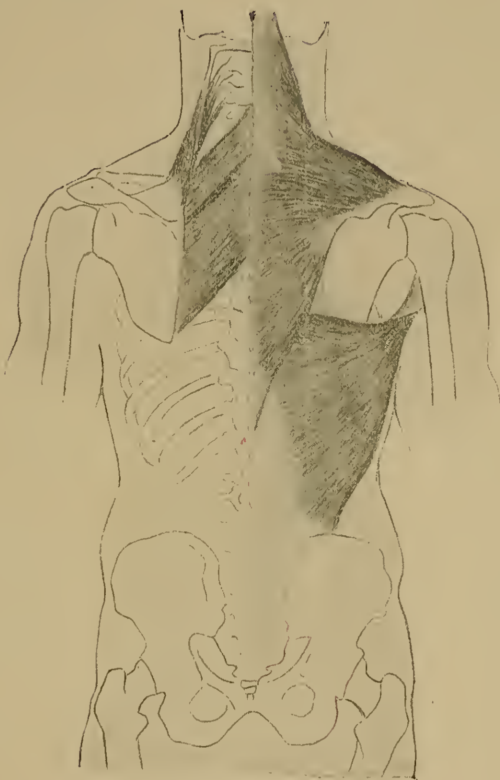


Fig. 330.—The superficial and deep layers of the spinoscapular muscles; on the right the latissimus dorsi and trapezius, on the left the rhomboideus major and minor and the levator anguli scapulæ.

The muscles acting upon the spinal column fall naturally into *three groups*—first, the anterovertebral, consisting of the psoas in the lumbar region, the three scaleni, the longus colli, and the sternomastoid in the cervical (Fig. 329); second, the spinoscapular in two layers, the trapezius and latissimus dorsi superficially, the rhomboids and levator anguli scapulæ beneath them (Fig. 330); third, the spinal, consisting of the two posterior serrati, superior and inferior, and the erector spinæ mass, thick and fleshy in the lumbar and cervical regions, but thin and tendinous in the dorsal (Fig. 331). Some of the deeper muscles well

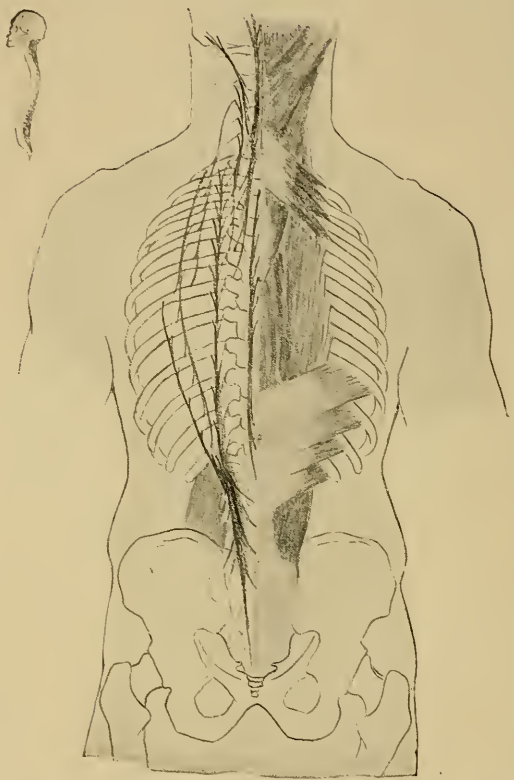


Fig. 331.—The erector spinæ covered by the serrati postici, superior and inferior. On the left the attachments are shown diagrammatically.

developed in the cervical and lumbar regions become ligamentous in the dorsal, illustrating the principle of regression, and this is significant of the relative amount of movement in the three regions.

The most freely movable regions are most abundantly provided with muscles, and it is to the analysis and application of their action that treatment of deviations by exercise must be directed.

Fig. 332.—In overextension of the spine the bending takes place principally at the neck and loins (Dwight).

In childhood the spine is very flexible, and can be placed in almost any position or combination of positions. As age progresses this habitual posture becomes more and more fixed and the bones adapt themselves to the distortion.

Movements of the spine are flexion, extension, side bending, and torsion.

Flexion in the spine takes place equally throughout its length (Fig. 333). Extension is lumbar and cervical. Even in contortionists the dorsal region remains almost straight (Fig. 332). Side bending takes place almost equally along the spine, with

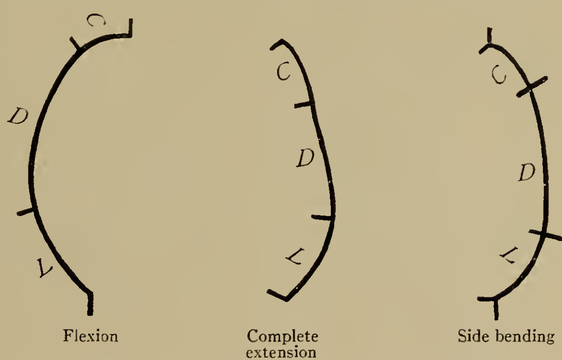


Fig. 333.—Normal movements of the spine—cervical, dorsal, and lumbar (E. G. Abbott, Amer. Jour. of Orthopedic Surgery, July, 1913).

accent at the twelfth dorsal and first lumbar. In side bending, with rotation from the erect position, the dorsal vertebræ follow the movement, slowly diminishing to the twelfth, but the lumbar vertebræ, and even the twelfth dorsal rotate in the *opposite* direction. In forward flexion, side bending, and rotation the spine is unlocked and all the vertebræ rotate equally and in the same direction. Extension of the spine locks the vertebræ, both dorsal and lumbar, and limits rotation, especially of the lumbar vertebræ. The vertebræ are not freely movable then except in the forward and side bending position, which unlocks the articulations and permits extensive rotation. It

Fig. 334.—Lateral curvature from uneven extremities and deformed pelvis. The black spots mark the posterior superior spine of the ilium.

Fig. 335.—The result of raising the foot 3 inches to bring the spines of the ilium to the same level.

is least movable in hyperextension. For this reason the forward position or flexion is chosen for forcible correction of the deformed spine.

Torsion in the erect position is greatest in the cervical region, gradually disappearing through the dorsal. In the lumbar region it is diminished by extension, and is slight even in the erect position.

The *causes* of scoliosis are both congenital and acquired. Among them may be mentioned wry neck, defective hearing, and vision, especially astigmatism (Gould), asymmetry (Figs. 334, 335) or faulty development of the bones, rickets, con-

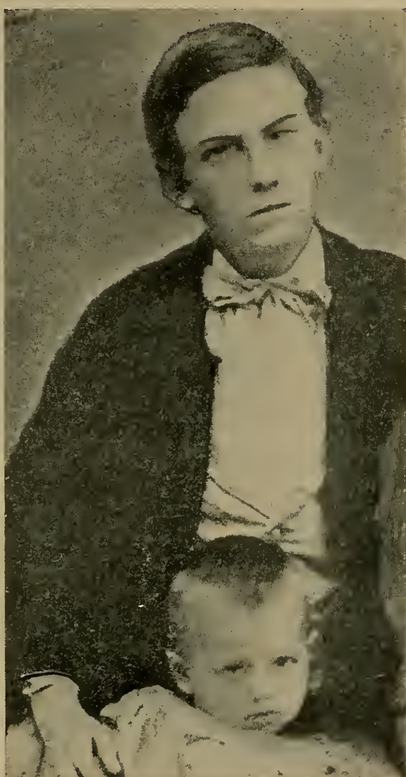


Fig. 336.—Showing tilting of head due to astigmatism and producing spinal deformity (Gould).

genital dislocation of the hip, arthritis, uneven development of the lower extremities from joint disease or other causes, empyema, and infantile paralysis. These causes give rise to the most severe and intractable cases, and are the least amenable to exercise except as an accessory form of treatment.

It is to bad posture by long-continued standing, sitting, and lying, joined with the carrying of weights in the hands or suspended from the shoulder, that we must look for the origin of the vast majority of cases which may be classed under the general heading of the *scoliosis of fatigue*.

A frequent fault in the standing posture is the habitual employment of one leg, usually the right one, as a base, the other foot being used as a prop (Fig. 337). This produces a C-shaped curve, with marked lowering of the right shoulder and prominence of the right hip. Many children assume this position, in which the strain is borne by the ligaments of the hip and spine for long periods, and feel uncomfortable when the weight is

Fig. 337.—Lowering of the right shoulder from resting the weight on the right leg. One way in which a C curve begins.

Fig. 338.—Pose from an antique statue of a boy illustrating the attitude of rest with the weight on the right foot. The right hip projected and right shoulder lowered, forming a C curve.

transferred to the other foot. Such cases are nearly always accompanied by rounding of the shoulders, flattening of the chest, protrusion of the abdomen, and rotation of the vertebræ —all signs of muscular fatigue and ligamentous strain.

The sitting posture is beset with possibilities for deformity. The common habit of sitting with one foot tucked up on the seat is responsible for some cases, but, above all, the compulsory holding of any fixed position for long periods of time. We know that if we hold the arm out at right angles the pain and fatigue soon become intolerable, and few can stand the strain so long as five minutes. The greatest strain falls upon the deltoid, which has no relief from continuous action. The same condition occurs in the back and shoulders of the school child forced to remain sitting for any unusual length of time. The complicated system of spinal muscles, by working in relays, postpones fatigue very considerably, the slightest change of movement bringing into action a new set and relieving the tired ones; but the constant desire for rest by movement is the most striking quality of all young animal life.

With the beginning of school life the child is made to sit from three to six hours with but momentary rests at long intervals, and the resultant restlessness must be suppressed by the teacher for the sake of discipline. The rapid fatigue of the undeveloped muscle and the irregular compression of the growing bones go far to fix the faulty posture, especially in those who are weak and delicate.

The onset of this deformity is hastened by mental fatigue, which is faithfully reflected in the posture, the face, and the general listlessness of the child.

The influence of a bad sleeping posture in the causation of curvature has been well pointed out by G. W. Fitz (Fig. 339). The hips and shoulders, being the broadest part of the trunk, serve as points of support and leave the middle portion of the body suspended between them, and, as the period of sleep occupies one-half to one-third of the child's growing time, this influence is of importance. Observations on the attitude of 320 healthy sleeping children—156 boys and 164 girls—made by E. G. Brackett, showed that about 20 per cent. more lie on the right than on the left side, while more lie on the back than on either side. These figures were confirmed by Hare, but the greater frequency of the lying position on the right side is partly explained by the fact that the boys observed were all required to lie upon the right side when they went to bed to prevent conversation. Two hours later they had turned on the face, the back, or the left side.

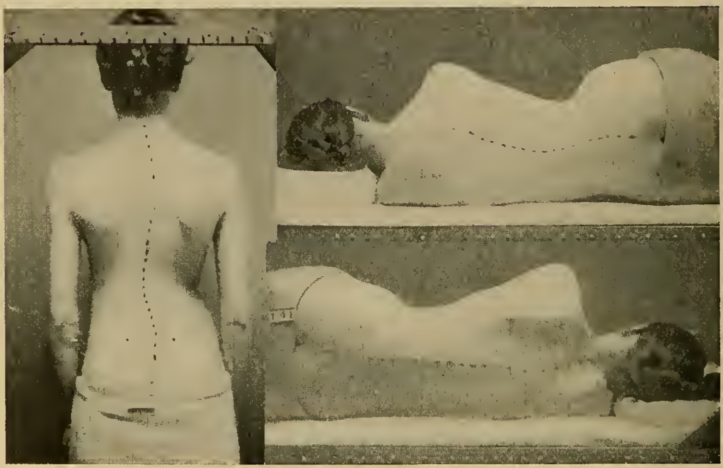


Fig. 339.—A double curvature encouraged by bed-posture, as seen in the upper picture, and corrected by turning over on the other side (Fitz).

As will be seen by the illustration, a patient with left convex curve in the lower dorsal region should not lie habitually upon the left side.

Curvature may begin at either end of the spinal column, the most flexible parts being in the lumbar and cervical regions. If it begins in the cervical region from torticollis or from eye defects, other curves will be secondary, while if the curvature begins in the lumbar region from unequal support of the pelvis, either in sitting or standing, the dorsal curvature will again be secondary. An S-shaped curve can be produced experimentally by raising the left side of the seat to tilt the pelvis, making a lumbar curve with the convexity to the right and a compensating curve in the opposite direction (Figs. 340, 341).

The frequency of scoliosis among school-children and youths may be gathered from the fact that in an examination of 122 high-school boys entered for an athletic meet I found it in 32 cases, or 19 per cent. In an examination of 446 athletic college students it was found in 19 per cent. In another series of 200 college students it was well marked in over 8 per cent., and

Fig. 340.—Straight spine with even support of the pelvis.

Fig. 341.—S curve caused by uneven support of the pelvis in a normal individual.

slight in an additional 16 per cent. In a girls' high-school, out of 160 examinations, it was found in 31 cases, or 19 per cent., accompanied by severe backache in 17 cases. The figures of other observers, like Gullam Krug, Hagman, Kalback, Schotter, Eulenberg, Roth, and Whitman, give an average of about 27 per cent. among school-children, and place the period of greatest frequency between the ages of seven and fourteen.

The most frequent form of scoliosis is the total C-shaped curve, involving the entire back (Fig. 342).

In his series of 1000 consecutive cases, taken from a large private practice, Bernard Roth found 523 presenting this type; 329 presented a right dorsal and left lumbar (Fig. 343), 72 of his cases showed a total right curvature, while 33 might be classed as irregular. This is substantially the same proportion as in Scholder's examinations of school-children at Lausanne. His entire table is as follows:

Among 571 school-children with lateral curvature, out of 2134 children examined, 60.3 per cent. showed curves convex

Fig. 342.—C curve in a young woman.

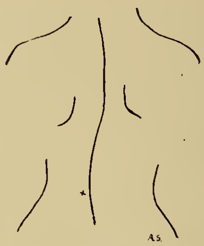


Fig. 343.—Tracing of typical S-shaped curve.

to the left, 21.1 per cent. showed a right convex curvature, and 8.5 per cent. showed compound convex curves. His totals are:

	Left convex. Per cent.	Right convex. Per cent.	Total. Per cent.
Total scoliosis	48.1	7.8	56.0
Dorsal scoliosis	8.4	4.3	12.7
Lumbar scoliosis	11.8	8.5	20.3
Combined scoliosis	8.5	...	8.5

The total curve is most commonly found in school-children, and is followed by the right dorsal and left lumbar. Transitional cases are nearly always preceded or accompanied by round shoulders, flat chest, and protruding abdomen, and by general carelessness in carrying the body weight when standing at rest, as in Fig. 337. This alone would tend to produce a well-marked total curve, with the convexity to the left. As this posture becomes fixed the bodies of the lumbar vertebræ rotate to the left, and this part of the curve tends to become more pronounced and localized, a compensating curve developing in the opposite direction in the dorsal region. This process happily may be arrested at any stage of its course.

Curvatures beginning at the upper end of the spinal column are usually caused in school-children by torticollis, deafness, or by uncorrected astigmatism, and by faulty positions in sitting and in writing, where the head is tilted to the left and twisted to the right, as in facing a strong wind. This causes a rotation of the bodies of the cervical vertebræ to the right, carrying with it the bodies of the dorsal vertebræ, producing the characteristic right dorsal curvature with rotation to the right and followed by a left convex lumbar, the level of the greatest deviation in these cases being usually from the sixth to the eighth dorsal.

In *total curvatures* the deviation is greatest lower down, about the ninth or tenth dorsal, or even at the twelfth. In curvatures beginning from some distortion of the pelvis or irregularity in its support the curvature is usually situated low down in the lumbar region (Fig. 344).

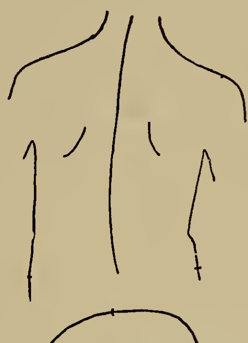


Fig. 344.—Tracing illustrating a C curve as a result of uneven extremities.

Scoliosis is frequently found in more than one member of a family, in twins or sisters, in mother and daughter, or aunt and niece, so that such facts should be obtained at the examination, as well as the susceptibility to illness and fatigue, rapidity or retardation of growth, and time of dentition.

Signs of rickets, like bow-legs, the "rosary," or the characteristic shape of the head, should be well noted, and the history of any severe constitutional diseases, as well as the general habits of life, such as the length of the school hours, the amount and nature of exercise, and the habitual standing and sleeping posture. The mother should be asked how the curvature was noticed, for it is frequently discovered first by the dressmaker in some casual way, such as the slipping of the clothing, inequality of the two sides of the skirt, or unevenness in the shoulders, and in all such cases it has probably existed for a long time unrecognized. The patient should then be stripped, the length of the legs measured, the presence or absence of flat-foot should be observed, as well as any marks on the body from pressure or faulty support of the clothing. The spinous processes should then be marked by a flesh pencil, and the levels of the shoulders and inferior angles of the scapulæ should be noted, while the patient stands in a natural position with the heels together. Slight projection of one hip can be quickly detected by noticing the variation in the size and shape of the space between the arm and side, seen from behind, as pointed out by Jakob Bolin. Flexibility should be tested by having the patient bend to either side and then forward, with the knees straight (the Adams position), which best displays any rotation, and the examiner's hands may pass up and down the sides of the spine to feel any irregularity. The habitual posture having been found, the patient should be placed in the best possible position, the *keynote* for future treatment, as Bernard Roth has so well insisted.

Before beginning a course of treatment the extent of the curvature must be recorded accurately if we are to follow the effects of treatment. This record must show the difference in the height of the acromia and inferior angles of the scapulæ, the deviation of the spinous processes from the straight line, the difference in outline and level of the hips and iliac crests, rotation of the vertebræ, both dorsal and lumbar regions, and, if necessary, the condition of the anterior and posterior curves.

For this purpose photographs are much employed, usually with a screen, but the most vital objection to their use as a routine practice is their expense, both in time and money, and the difficulty of getting them, and their liability to mislead the observer by imperfections or changes in the lighting of the figure at different times. Spellissy has devised a uniform photographic method which would be of value if the conditions he requires were observed—(1) A standard focal length of lens; (2) a standard focus and distance of subject from lens front; (3) a standard direction of lighting for recording purposes; (4) a standard size of image and of division of chart for comparative illustrations; and (5) a standard series of poses in faulty, habitual, and corrective posture. The use of plumb-lines is the cheapest and simplest, deviations from the vertical line being noted at different levels, and rotation can be recorded by molding a flexible strip

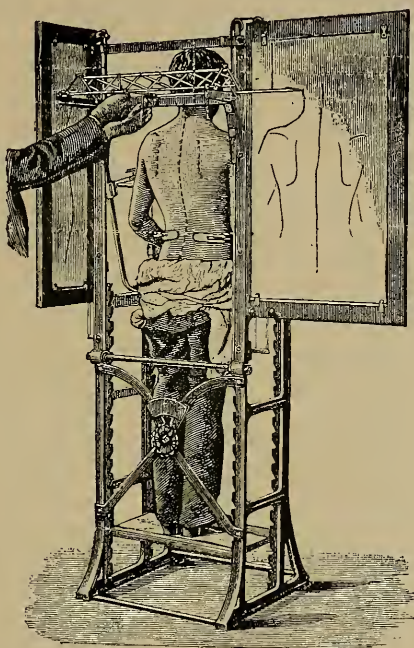


Fig. 345.—Schulthess apparatus for recording lateral curvature (Lüning and Schulthess).

of tin across the back at the desired level and making a tracing from this upon paper after the method of Bernard Roth. A rapid method of recording the deviation is by attaching a strip of adhesive plaster to the spine and marking the position of the spinous processes on it.

The most accurate and convenient instruments are those employing the pantograph method, of which the most elaborate is that of Schulthess, which gives a life-size tracing of all the contours. Its size and expense, however, make its general introduction impossible (Fig. 345).

An attempt has been made to fulfil these conditions in an instrument which I have employed for some years. It consists

Fig. 346.—Making a tracing of the lateral deviation by the author's scoliosiometer: *a*, Pointer which follows the line of the spinous processes and tips of the scapulæ; *b*, pencil recording the tracing on paper to the scale of 1 to 4; *c*, fixed point of the pantograph.

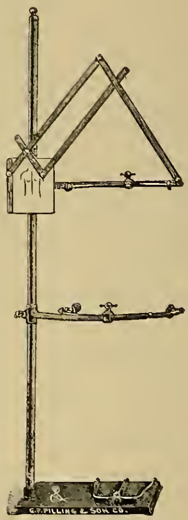


Fig. 347.—The author's scoliosiometer, showing the clamps for hips and shoulders and the pantograph in place.

of a horizontal iron stand into which a rigid upright rod is firmly screwed. To this rod two jointed arms are attached by movable collars clamped by thumb-screws. The lower arm passes behind the patient and fixes the hips by means of clamps preventing any sideward movement. The upper arm passes in front of the patient and fixes the shoulders. To the collar of the upper arm a plate is hinged for the attachment of the pantograph, set to make the tracing in the proportion of 1 to 4. Ruled paper is stretched over the plate and held by clips behind. The pointer should be adjustable in length, short for the tracing of the spine and scapulæ, and capable of being lengthened for tracing the outline of the shoulders and hips.

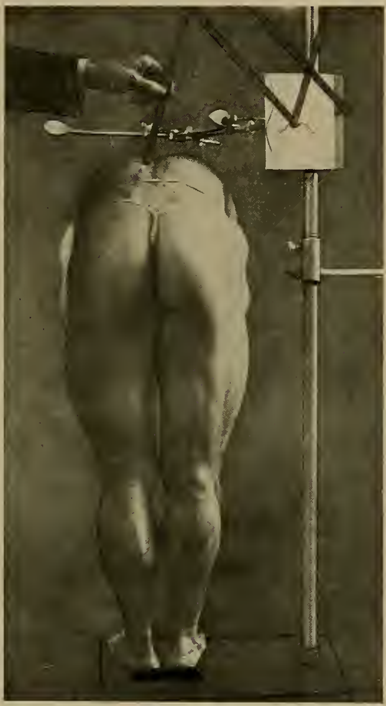


Fig. 348.—Making a tracing of the rotation at the lumbar region.

To take a tracing the spinous processes are first marked with a flesh pencil. The patient is placed on the stand with the heels together, the hips clamped at the level of the trochanters, and the shoulders clamped after the patient has settled into the habitual position. The line of the spine is followed by the short pointer, the gluteal cleft and the points of the scapulæ are marked, then an outline of the shoulders and hips is rapidly traced by lengthening the pointer to touch the most prominent parts. Cross-sections may be taken to show rotation by passing the end of the pantograph across the back, at the desired level, the patient bending forward (Fig. 348). A tracing of this kind gives an accurate map of the back, showing the difference in levels, deviation, and rotation, their extent being to scale, and estimated by counting the squares on the ruled paper.

Fig. 349.—Case of tubercular spondylitis simulating scoliosis, showing lateral and rotary deformity. The onset was very rapid and the rigidity great. The diagnosis was not made until treatment by exercises had increased the deformity and rigidity. The deformity was gradually corrected under treatment by immobilization (Ridlon and Jones).

These tracings should be repeated from month to month throughout a course of treatment.

Diagnosis.—Scoliosis must be carefully distinguished from Pott's disease or tuberculosis, symptoms of which are spasm of the muscles and loss of mobility in the spine, with pain on motion or jar, pains in the chest and abdomen, fever, and impairment of the general health. Lateral deviations occur in the course of this disease, but it is usually a leaning of the body to one side rather sharply instead of a true gradual curve. In later stages a knuckle of bone develops at the seat of the disease, but the danger of mistaking it lies before this has developed.

In rickets the malformations of the various bones may usually be discovered by examination and measurement, and the other constitutional symptoms are characteristic, the curves of the spine being generally rather sharp and often accompanied by great thoracic deformity.

Fig. 350.—Tracing of scoliosis due to collapse of right side after empyema and resection of ribs.

In infantile paralysis there is a manifest loss of power in the affected muscles which renders its diagnosis comparatively easy, especially by the aid of electricity. In these cases the deformity usually becomes great and the condition is resistant of treatment. Curvatures resulting from pleurisy and empyema are always toward the convex healthy side of the chest (Fig. 350), and are easily distinguished by the history and appearance.

The *symptoms*, apart from the deformity, may not be very prominent in slight cases. The dressmaker conspires to conceal it by making one side of the skirt longer, or by changing on one side the distance of the armhole to the waist-band, but patients usually have a feeling of one-sidedness. They are often observed to have a distinct limp, and a very considerable number, especially young women, complain of backache more or less severe, sometimes bilateral, sometimes on one side only, usually situated in either the lumbar region or about the point of the scapula. In severe cases there may be pressure upon the nerve-roots causing pain. The early onset of fatigue, with shortness of breath, is common on account of the diminished capacity of the lungs and interference with the heart action, but these symptoms are peculiar to the more aggravated cases. As the deformity tends to increase during the growing period these symptoms may not become insistent until the approach of adult life, when the patient is prone to develop phthisis or to have disturbance of the digestion, impairment of the general vigor, and slow increase of asymmetry, with pains in the back, as senile atrophy of the intervertebral disks progresses.

Prognosis.—Total functional curves may continue as such throughout life, increasing slightly, although, as a rule, they change to structural curves and become compound in form as they progress. Some permanent deformity is certain in all cases where a functional curve has become structural and the vertebræ have become distorted. By exercise, rest, and sometimes forcible correction, all but structural cases should be capable of permanent cure, and even they should be in every

Fig. 351.—Course of the S curve under treatment.

case greatly improved, the deformity masked and corrected, and the general health and efficiency retained.[1]

This applies more especially to children who have not yet acquired their full growth. When full growth has been attained before the case comes under observation complete cure is not always to be hoped for, and the only thing to be expected is some improvement in the general condition and a variable diminution of the deformity. Cases due to infantile paralysis, or to the collapse of one side of the chest from empyema, are peculiarly resistant and must be treated with great caution. Cases due to rickets are also resistant, although most of them are capable of considerable improvement.

[1] "Report of Committee on Scoliosis," American Journal of Orthopædic Surgery, July, 1914.

CHAPTER XXIV

THE TREATMENT OF SCOLIOSIS

THE treatment of scoliosis falls naturally into two divisions—(1) The reformation of the physical habits and improvement of the general condition; (2) the correction of the deformity by exercise, stretching, and support.

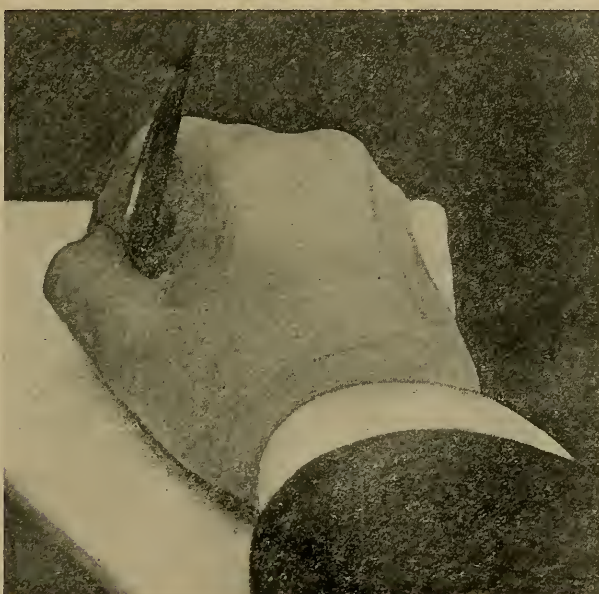


Fig. 352.—The hand in the writing posture as usually ordered, but not practised, because to the writer the writing field is hidden by the thumb, finger, and holder (Gould).

Correct standing posture must be taught by the aid of a mirror, as described in the chapter on Round Shoulders. This must be insisted upon in season and out of season until it can be maintained without fatigue. Astigmatism should be at once corrected where it is the cause of tilting of the head, and the habits of school life should be carefully regulated to allow frequent rests.

The writing posture favors the formation of fatigue scoliosis to a marked extent. Schanz does not believe that there is any difference between the slanting and vertical script as a cause, but the usual directions given for the correct writing position place the hand between the eye and the writing field, which is hidden

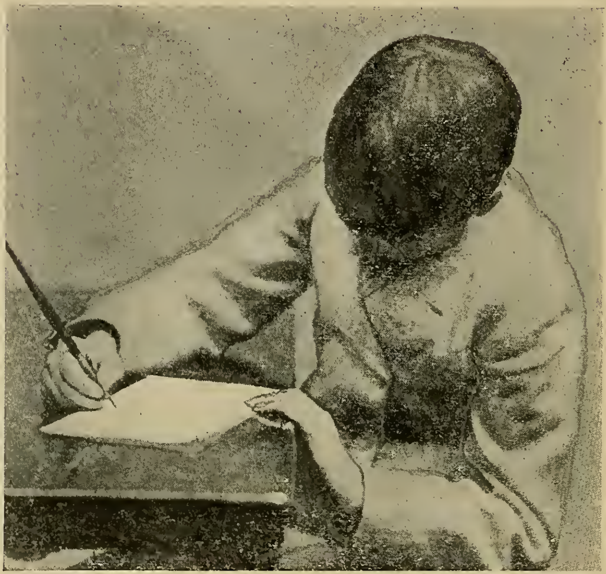


Fig. 353.—Change of posture of body and head, the paper shown, and the penholder angled in order to bring the writing field into view (Gould).

by the thumb and finger and the penholder (Fig. 352). As a consequence, the pupil turns the paper to the left and the pen to the right, accompanying this by twisting of the head further to the left, with the chin tilted to the right (Fig. 353). If the paper, instead of being placed in front of the pupil, be placed to the right of the body line, these difficulties are overcome and the child obtains a clear view of the writing field, the only possible deformity then being a forward bending of the head.

The rule for the construction of a well-fitting desk is so simple that there seems no excuse for neglecting it. The height of the seat from the floor should be such that in sitting the feet rest easily on the floor or on a foot-rest. The slope of the seat should be backward and downward in the proportion of one in twelve, the depth being about two-thirds the length of the thighs and the width that of the buttocks. Making it concave adds to the comfort. The back of the seat should have a slope backward of about one in twelve from a vertical line, and the back support should come to the middle of the shoulders and touch the small of the back. The height of the desk should be such that the back edge allows fair room to rest the forearm naturally with the elbow at the side, and the slope should be about one to six forward and upward, the edge overlapping the front edge of the seat by about 1 inch. The desk may well be made adjustable for distance (Fig. 354, *a*, *b*), so as to allow freedom in getting in and out by pushing the desk-lid forward. These points are covered in the Garber adjustable desk, described in the chapter on Schools.

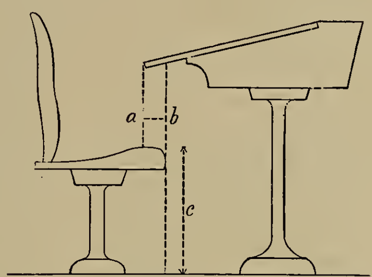


Fig. 354.—To show the measurements required in determining desk proportions, *a-b* is the distance which is here minus, because the edge of the desk overlaps the front of the seat.

Poor lighting of the schoolroom is a third source from which scoliosis begins. If the pupil cannot see clearly he bends forward or twists his back, and the same effect is produced if he sits in his own light. A well-designed schoolroom should have windows placed high enough to let the light fall over the left shoulder, and never directly from in front or behind.

The raising of one side of the seat will reverse a beginning curvature (Figs. 340, 341), and this may be used as an auxiliary means of treatment by placing the patient upon such a seat from one-half to one hour daily. Where one leg is short the foot should be raised by wearing an insole of cork in the boot, and a child who habitually rests with the weight on the right leg (Fig. 337) should be trained to reverse the resting posture by using his left leg as the habitual base of support.

The main corrective treatment of scoliosis must, however, be by active exercise and stretching, and the muscles must be developed and trained to maintain the correct posture with ease. Treatment must be thorough and regular, extending from one-half to one hour daily, and, even after an apparent cure

Fig. 355.—A girl aged seven years with severe osseous lateral curvature of the spine, in the "habitual" posture (Bernard Roth).

Fig. 356.—Girl aged seven years, with severe osseous lateral curvature of the spine, when placed in the "keynote" posture (Bernard Roth).

has been obtained, the patient should be kept under close observation for at least two years to check the first signs of relapse.

Every course should begin with what is known as "straight work," such as is described for round shoulders, in which the muscles on both sides are equally employed, with special emphasis laid upon chest development, but in a few days one-sided movements should be introduced in appropriate cases, such as are described for the raising of the right shoulder, and gradually stretching movements should be taught, like those pictured in Figs. 365 and 412, the right or left foot only being used and the surgeon grasping the left or right hand, producing a diagonal tension on the spine. All free movements should be done in the *keynote position*, which is found experimentally by holding the arms so as to give the greatest correction of the curvature. This may be with the right arm up and the left arm out, or with the right arm up and the left arm down, or with both arms above the head, or the right arm out and the left up (Figs. 355, 356). It must be found after repeated trials for each individual case.

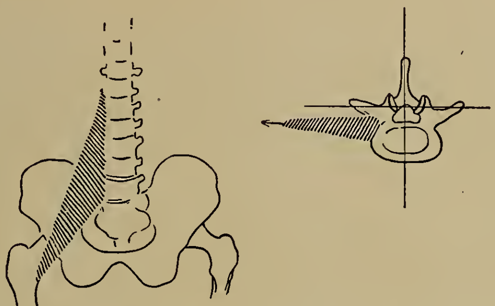


Fig. 357.—Direction of the pull of the psoas on the lumbar spine.

As most children suffering from scoliosis are below the normal in strength and resistance, it is essential that exercise should not be pushed beyond the point of general fatigue, and the greatest care should be taken to limit the number of muscle groups exercised to those more directly affected, so that the resulting fatigue may be localized to them and not spread over the whole muscular system. Much of the discredit under which the exercise treatment of scoliosis labors has been due to the inaccuracy of the exercises.

In applying asymmetric exercises it is to be remembered that the most freely movable regions of the spine—the cervical and lumbar—are the most abundantly provided with muscles, some of which can be isolated in action. In the lumbar region the femur can be used as a lever to pull on the bodies of the vertebræ by means of the psoas (Fig. 357). As rotation of the lumbar spine takes place about the articular facets acting as a pivot and behind the origin of the psoas, the right psoas could thus be made to pull the bodies of the lumbar vertebræ over to the right, and would help to unwind a rotation to the left. The problem is to put into action the right psoas muscle without involving too many additional muscle groups. If we flex one or both thighs, the abdominal muscles do most of the work. If, however, the right thigh only be flexed and the left heel pressed backward against the table, the patient being recumbent, the abdominal muscles may be relaxed, and a comparative isolation of the right psoas obtained with a little practice (Fig. 358).

Fig. 358.—Raising right foot with weight attached to exercise right psoas muscle.

The intrinsic muscles of the back, known collectively as the erector spinæ, are most complicated in their distribution, their very complexity being useful because its strands may be employed in relays, the tired fibers being replaced by fresh parts and the onset of fatigue accordingly postponed. It is very thick and fleshy in the lumbar region, where its two main divisions are defined, the outer tendons going to the six lower ribs just outside their angles and prolonged upward to the head in relays, and the inner division, more thick and fleshy, going to rib and transverse process throughout the entire dorsal region, with an additional bundle going from the second lumbar spine to the first dorsal (Fig. 331). The deeper layers of this inner division fill the hollow between the transverse and spinous processes, the general direction being forward and inward, while in the lumbar region muscular slips go between adjacent transverse processes as well as between the spines. The general action of this muscular mass is to act like a bowstring on the spine, and to pull down the ribs on the active side, at the same time increasing lordosis. The quadratus lumborum is a depressor of the last rib and acts with the erector spinæ of the same side.

The lumbar and lower dorsal portions of the erector spinæ are isolated in action alternately in the act of walking, as can

Fig. 359.—*a*, Erector spinæ in action during forward bending; *b*, left erector spinæ in action during support on right leg in standing or walking.

be demonstrated readily by placing the hands over the loins and feeling them spring into action at each step (Fig. 359, *b*). Support of the weight on the right leg involves a contraction of the left lumbar erector spinæ. Support of the weight on the right arm and the feet, as in the diagram (Fig. 360), brings into action the right erector spinæ, but if the support be at the hips the action is reversed, except in the cervical region (Fig. 361). In the dorsal region the muscles are much thinner, more tendinous, and parts degenerate into ligamentous bands, the dorsal spine being much less directly moved by muscular action than either the lumbar or cervical. The ribs can be employed as levers on the dorsal region, and the thoracic cage, with its muscular attachments, can thus be made an active means for correcting deviation and rotation.

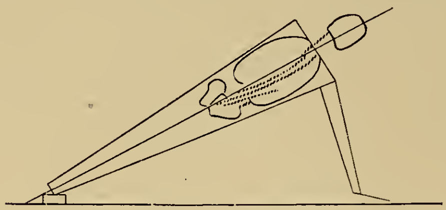


Fig. 360.—Action of right erector spinæ in dorsal crossing to left side during support at feet and shoulders.

In movements where the humerus is fixed and the spino-scapular muscles contracted, the spinous processes are pulled over to the active side by the trapezius, the latissimus dorsi,

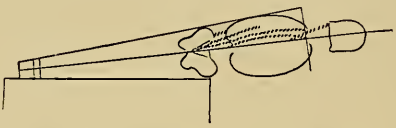


Fig. 361.—Left erector spinæ in action during support at hip.

and the rhomboids. If the pectorals of the opposite side be contracted, an additional torsion is exerted on the dorsal spine. The dorsal region can also be reached through the action of the

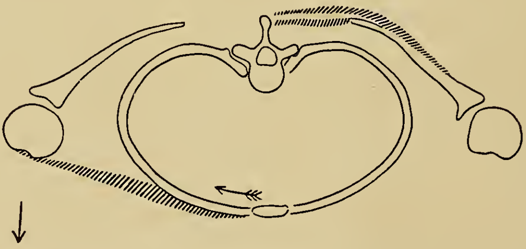


Fig. 362.—Torsion of thorax by muscular action.

respiratory muscles. The upper ribs being first fixed in forced inspiration by the scaleni, serratus posticus superior, and the sternomastoid, the thorax is flexed toward the convex side, the walls of the collapsed side forced out, and the rotation of the ribs and deviation of the spine lessened by this movement.

In the cervical region the erect spine is extended by the splenius capitis and colli, by the complexus, and by the reappearance of muscles ligamentous in the dorsal region, in addition to the obliques and recti of the suboccipital triangle, all forming the thick, fleshy mass of the back of the neck. Movement here is very free in all directions, notably rotation or torsion, which takes place largely at the first two cervical joints through the action of the inferior obliques and the more superficial muscles, which are all directly accessible to exercise.

A muscle can be *developed* only by active contraction and relaxation. Continuous tension quickly tires and lowers its tone, as has been already stated, so that in prescribing exercise it is necessary to distinguish between those given for the purpose of increasing muscular tissue and power, which should be comparatively quick and frequently repeated, and those which aim at the stretching of muscles and ligaments, which should be slow and long maintained.

In describing the *gymnastic treatment* of scoliosis the curves will be considered in the order of their frequency, and, without attempting to give an exhaustive list of all possible exercises, those that are described will be arranged in the form of prescriptions for typical cases and illustrated by case reports.

All exercises and stretching movements should be given daily, with a period of rest after three or four movements. They should be so alternated and combined that no two employing the same muscles in the same way should follow one another and so cause excessive fatigue.

The most frequent deformity is a total left scoliosis or C-shaped curve, and the following prescription of exercise would be indicated:

Exercise I.—Position, standing, hands at the side. Right arm forward and upward raise, inhale, upward stretch, rise on tiptoes, and raise left foot sideward, upward stretch, arm and foot sideward lower to the standing position (Fig. 363).

This movement will develop the upper part of the trapezius, rhomboids, and deltoid of the right side, raising the shoulder and stretching the thorax. At the same time, the uneven support brings into strong action the lower part of the left erector spinæ.

Exercise II.—Position, standing, fingers interlocked behind the back. Roll the shoulders backward, supinating the arms (Figs. 307, 308), and then bend body to the left.

This exercises stretches all the anterior muscles and ligaments of the shoulder-girdle, improves its flexibility, and reverses the curve.

Fig. 363.

Fig. 364.

Exercise III.—Position, standing, left foot forward, lunge, hips firm. The right arm sideward, raise, inhale, upward stretch, forward bend until the right hand touches the floor in front of the left foot; upward stretch, exhale. This may be varied by bending from the standing position with left arm extended backward (Fig. 364).

This movement, besides developing the upper right shoulder muscles, improves the lung power by filling the lungs in their most favorable position and compressing the air in the downward bending movement. The right side of the thorax is stretched during the forward bending movement, and the left latissimus dorsi is contracted by pressing downward on the left hip with the left hand.

Exercise IV.—Patient supine on the plinth (sit lying), with the right knee over the end, the left arm behind the back, and the right hand grasped by the surgeon. Starting with the elbow at the side, the surgeon pulls the arm up slowly sideward and upward, the patient resisting. When fully extended above the head the surgeon exerts as much tension as possible, counting

Fig. 365.—Stretching of right side.

five. The patient then draws the arm down to the starting position, the surgeon resisting (Fig. 365).

In this stretching movement the two points at which the stretching power is applied are the right hip and the right shoulder, so that this tension will reverse the curve and stretch the right side of the trunk.

Each of these exercises should be repeated at least twenty times, and should be followed by a short rest, after which the following should be given:

Exercise V.—Patient's right leg lying, strapped to the plinth, the right neck and the left hip firm. Side flexion of the trunk (Fig. 366).

In this exercise it will be necessary for the surgeon to assist most patients at first, and to urge them to bring the body as high as possible. The entire erector spinæ mass on the left side

Fig. 366.

is powerfully employed, and the effect may be still further increased by placing both hands behind the head.

Fig. 367.

Exercise VI.—Patient prone (forward lying) with both feet strapped to the plinth, right arm extended upward. Movement: Trunk extension, forcing the right arm forward and the left arm backward (Fig. 367).

Exercise VII.—Patient supine. Raise the right arm forward, upward stretch, inhaling slowly, sideward lower, exhaling.

This should be repeated at the rate of twelve to the minute, and the maximum amount of chest expansion secured at each repetition.

Exercise VIII.—Patient prone, the left foot only fastened. Trunk extension with the movement of swimming, as in Figs. 313–315. This should begin by repeating the swimming

Fig. 368.—Self-suspension with pressure on the left side to correct rotation.

movement five times, followed by a rest. Gradually patients will be able to go up to twenty or thirty times without resting. These exercises should be followed by a rest.

Exercise IX.—Suspension with lateral traction. The patient puts the head in a Sayre sling and grasps the cord preparatory to self-suspension. A band of webbing is placed about the point of the greatest deviation on the left side, usually about the tenth dorsal (Fig. 368). Movement—the patient pulling on the cord raises himself from the ground, while the surgeon, by means of a cord and pulley, draws him sideways, stretching the right side. Repeat ten times. This should be followed by a rest. (See Fig. 319.)

Fig. 369.

Exercise X.—Position, right neck firm, left hip firm; movement, side bending to the left.

The treatment should end by deep firm stroking from above downward, about ten or twelve times on each side, using one hand to press upon the other.

The following is a typical case report:

V. O., aged twenty-one, consulted me April 20th. At the age of eight years she fell down-stairs and was confined to bed for three months. She states that since then she has been suffering from pains in the back at the point of the right scapula, burning or boring in character, much worse after sitting still for any length of time. Has been unable to attend school or do any work on account of pain and fatigue.

Examination.—Ill nourished and anemic, flat chest, prominent abdomen, projecting chin, and round shoulders. Right scapula $1\frac{1}{2}$ inches lower than the left (Fig. 370). Total left scoliosis, with deviation greatest about the ninth dorsal. Rotation slight, flexibility good, the iliac crests even in height. Patient winces on pressure over the point of the left scapula and left lumbar region.

Treatment.—Prescription of exercises, such as described, with one hour rest daily, recumbent, in the afternoon.

May 28th.—She has been at work daily for one month. Right shoulder still lower, but the improvement very marked, and the spine almost straight (Fig. 370). Occasional pains, not constant in location or duration, probably hysteric in character.

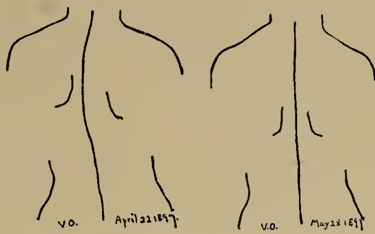


Fig. 370.—Tracings taken at the beginning and after one month's treatment by rest and exercise only.

General condition much improved. To continue daily work at home for one month.

Fig. 371.

Fig. 372.

June 30th.—Improvement retained. Can attend to social duties without any discomfort. The salutary effect of the exercises on the general condition of this young woman was most marked.

In a right dorsal and left lumbar curvature (Fig. 343) the following prescription would be applicable:

Exercise I.—Position, standing, hips firm; movement, left arm and left leg sideward raise, inhale, and upward stretch, sideward lower, exhale (Fig. 371).

In this the left side of the thorax, which is contracted by the rotation of the ribs on the right, will be stretched, and the left

Fig. 373.

lumbar curve will be reversed by the tilting of the pelvis and the contraction of the left erector spinæ mass in the lumbar region.

Exercise II.—Patient standing, with fingers interlocked. Rolling of the shoulders into supination, with forward bending and twisting to the right (Fig. 372).

Exercise III.—Position, standing, hands at the sides. Forward lunge with the left foot, the right hand on the hip. Left arm sideward raise, inhale, forward bend, touching floor; rise and exhale, returning to standing position (Fig. 373).

The lunge tilts the pelvis down to the right, reversing the lumbar curve, and the raised left shoulder reverses the dorsal curve.

Exercise IV.—Position, supine on the plinth. Raise the right foot 12 inches from the plinth, pressing back with the left heel, hips firm.

The tension on the right foot should be increased by placing shot-bags across the ankle, starting with a weight of 5 pounds and increasing it to 10 or 15 as the strength allows (Fig. 358). The patient should be carefully instructed to relax the abdominal muscles so that the strain may fall upon the right psoas, which will pull the bodies of the lumbar vertebræ over to the right and so unwind a lumbar rotation to the left.

Fig. 374.

Exercise V.—Position, prone, the right foot fixed, the left arm up and the right arm down. Movement: Trunk extension, with the stretching of the right arm backward and left arm forward (Fig. 374).

Exercise VI.—Position, supine (sit lying), right knee over the end (Fig. 365), right arm behind the back, left arm grasped by the surgeon. Movement: The left arm is pulled upward and strong tension is exerted by the surgeon. The patient pulls the arm forward and downward, the surgeon resisting. In this way the rotation is unwound by the diagonal tension running from the right hip to the left shoulder, reversing the curves.

Exercise VII.—Position, left leg lying (Fig. 376), but with right hip firm, left neck firm. Movement: Side flexion to the right.

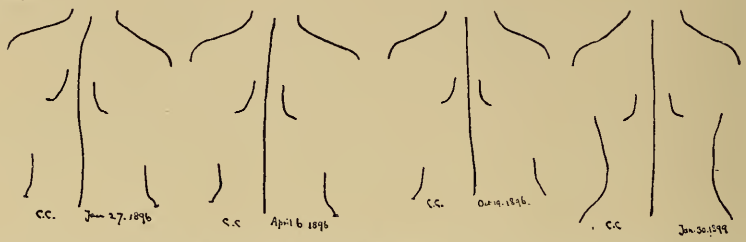


Fig. 375.—Four tracings illustrating the progress of an S curve under treatment for three years.

This exercise is aimed at the lumbar curve, which will be reversed by the side bending to the left in the extended position of the spine, essentially a motion of the lumbar region, the bodies of the vertebræ turning toward the concavity of the curve.

Fig. 376.—Movement for left dorsal and right lumbar curve.

Exercise VIII.—Position, supine. Raise the left arm and the right leg, inhale, lower, slowly exhale. This should be followed by a rest.

Exercise IX.—Suspension by the Sayre sling or spinal assistant (Fig. 319). Movement: Side traction, pressure being placed on the left lumbar region. Repeat from ten to twenty times.

Exercise X.—Position, left neck firm, right hip firm; side flexion to the right.

This should be followed by kneading and stroking, as previously described.

In a left dorsal and right lumbar curve (Fig. 377) practically the same exercises may be used, except that in every case the opposite leg and arm are employed.

Case Report.—C. C., aged thirteen, consulted me January 27th. Examination showed the right scapula low, left dorsal and lumbar curves with rotation, round shoulders, flat chest, protruding abdomen and chin, and general relaxation of the

Fig. 377.—Course of triple curve under treatment: Left lumbar, right dorsal, and left cervical.

ligaments. General health had not been very good. Two sisters had already been treated for spinal curvature.

The indications here were to develop the erector spinæ and extensors of the neck, to expand the chest and develop the abdominal muscles, and raise the right shoulder, reversing the curves. The best possible position was one in which the right arm was raised and the left stretched horizontally out at the side.

After daily treatment lasting over two months the second tracing was obtained, the lumbar curvature being practically corrected, although there was still a dorsal curvature with the right scapula low. She reported twice a week for two months, taking a modified daily prescription at home. She then left the city for the summer, and the following October a third tracing was taken, showing that the improvement was retained. During that winter she reported once a week, and continued her exercise at home. Three years later a fourth tracing was taken, showing that the correct position had been maintained. It will be noticed that the patient has developed from a child of thirteen to a young woman of sixteen (Fig. 377).

Curves due to infantile paralysis will require long-continued treatment, especially where they are severe and structural, localized, and fixed. In some of these cases the best that can be hoped for from gymnastics is to develop the general muscular system and to form compensating curves above and below the

Fig. 378.

primary curve, thus giving a general appearance of symmetry to the outline of the back.

S. M., aged nine years, consulted me in September. Six years ago he had left hemiplegia, lasting six months, which, to all appearances, gradually passed away. About two years ago he noticed while walking that the left shoulder protruded (Fig. 378, 1). Examination showed a left lateral curvature high in the dorsal region, marked rotation, some pain over the convexity, and diminished flexibility. A slight compensating curve in the lumbar region was present.

After two months of daily exercise and stretching a second tracing was taken, showing the development of the compensating curve and the lowering and partial replacing of the left scapula. The improvement continued from September until March, when a third tracing was taken, showing a lowering of the scapula at the expense of an increase in the lumbar curve (Fig. 378, 2). This was the extent of the improvement obtained, but the general appearance of the back, especially when dressed, was very much better and the muscular development and general efficiency greatly improved.

Where the curvature is due to inequality of the extremities, it must be corrected by raising the heel of the shortened side, which is sometimes all that is necessary (Figs. 334, 335, and 344).

One of the most important points in the treatment of all these cases is the development of the thorax, and it is remarkable how much improvement can be obtained in this direction by respiratory and stretching exercises.

Fig. 379.—Tracings at the beginning and after three months of daily treatment for chest expansion and curvature.

One case, S. R., aged eighteen, came with persistent wearing pain in the back, round shoulders, and lateral curvature. There was a strong family history of tuberculosis.

On October 7th her lung capacity, tested by the spirometer, showed 80 cubic inches. On November 28, after a little over one month of steady work, it was 110, and on January 3, 125 cubic inches. The pains in the back had disappeared, the curvature was corrected, and her general health excellent (Fig. 379).

Here was an increase in lung capacity of 45 cubic inches in three months.

While such a result is unusual, still, after going over 30 consecutive cases, I find an average gain of 21 cubic inches, and among these were several that have increased from 30 to 35 cubic inches in less than three months by daily work.

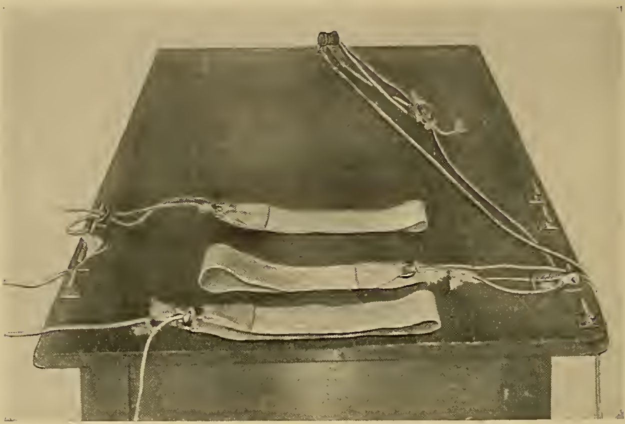


Fig. 380.—Stretching board with loops, ready for application to a *left* dorsal curve (Lovett).

In *structural* cases, where the treatment by gymnastics and posture is insufficient, stretching and retaining apparatus are necessary. Among the simplest is the following (Figs. 380, 381):

Fig. 381.—Stretching board with loops, applied to a patient with *right* dorsal curve (Lovett).

The patient lies face downward, with the knees flexed, on a board 3 feet wide and 4 feet long. Assuming the case to be a right dorsal curve, a broad canvas strap is passed around the left upper thorax, over and under the patient, and fastened to a cleat on the right side of the board. This furnishes a point of resistance against the left side of the upper thorax at the level of the axilla. A broad canvas strap is then passed around the left side of the pelvis, above and below, and is fastened to a cleat on the right side of the board. This furnishes a point of pressure against the left side at the level of the pelvis. A broad canvas strap is then placed around the thorax, on the right side, at the level of the greatest point of the curve. Its upper end is fastened to a cleat at the left side of the board; its lower end, passing beneath the thorax, is fastened by a string into a pulley attached to a cleat at the left side of the board. By means of this pulley any reason-

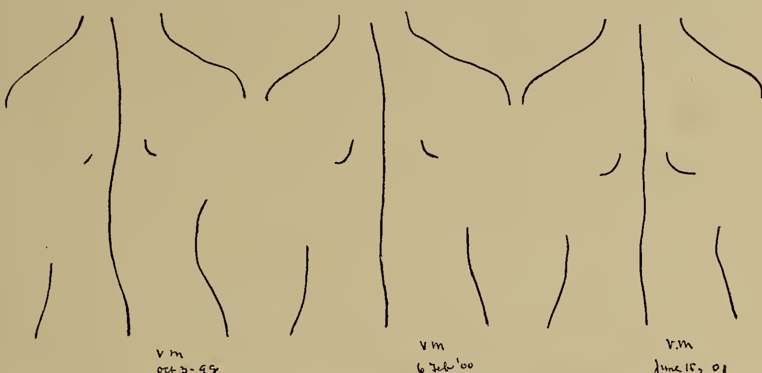


Fig. 382.—Course of triple curve under treatment by exercise and stretching only.

able degree of force may be exerted against the right side of the thorax, pulling it to the left and at the same time reducing the rotation, because its upper end is fastened, its lower end moving toward the pulley. The efficiency of this apparatus is greater than the same movement done during suspension, because stretching is done more easily when the spinal muscles are relaxed. Patients should be stretched up to the point of mild discomfort daily, and kept in the corrected position for fifteen or twenty minutes.

The application of apparatus in severe cases for retaining the improvement obtained by gymnastics and for overcorrection of a resistant curve has been carried to a high point of efficiency by

E. A. Abbott, who flexes the spine and bends it to the side, thus making intervertebral movement as free as possible. In this position he unwinds rotation by means of straps and bandages attached to a frame and puts on a plaster jacket in which windows are cut. Over the convexity felt pads are placed under the jacket, and over the concavity a window is cut to allow the ribs to expand under respiration. By inserting pads from time to time a severe deformity may frequently be completely corrected, and even overcorrected, the bones gradually changing their shape as the concave side fills the opening left for it in the jacket.

The direction of the pull in untwisting the rotation is a matter of dispute. Abbott's method is as in Fig. 383. Mackenzie

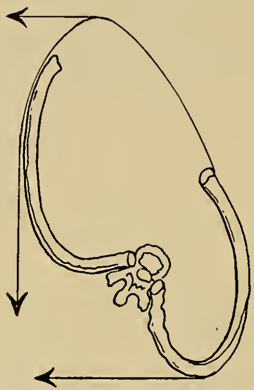


Fig. 383.—Direction of forces applied by E. G. Abbott.

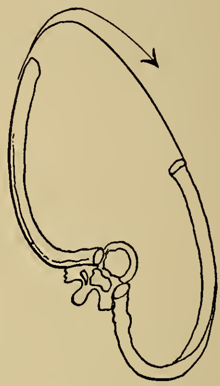


Fig. 384.—Direction of forces applied by A. Mackenzie Forbes.

(Z. B. Adams, in Amer. Jour. of Orthopedic Surgery.)

Forbes, in what he terms his *rotation treatment*, also flexes the spine, fixes the pelvis, and rotates the spine toward the convexity of the curve, thus endeavoring to reverse the curve (Fig. 384). In both cases the fixation in the overcorrected position must be followed by a long course of gymnastic exercises, to develop again the muscles weakened by the splinting of the spine in the jacket, and so preserve the improvement obtained by force. Improvement or cure should not be considered permanent until the correct position is maintained without apparatus from month to month, as shown by repeated records.

CHAPTER XXV

THE TREATMENT OF ABDOMINAL WEAKNESS AND HERNIA BY EXERCISE

THE upright position is not preserved by the muscles of the back alone. The muscular girdle of the abdomen by its tonic contraction is also required to keep the thorax and the abdomen in their proper relative positions.

When this girdle becomes relaxed through underdevelopment or disuse it yields to the constant pressure of the movable internal organs, and this force of gravity, taking the lines of least resistance, enlarges the rings or openings through which normally pass the vessels and spermatic cord or round ligament. It may even stretch the muscle-sheaths, spread apart the weakened muscles, and thus allow hernia or protrusion of the abdominal contents.

The four pairs of abdominal muscles have a common aponeurosis in the linea alba, which is fused with the sheath of the rectus. The aponeurosis is pulled flat by their action, but if weakened and stretched the obliques lose their firm point of action and the abdomen bulges forward.

During pregnancy in women of poor muscular tone and development it is not infrequent to have the two recti abdominis thus spread apart.

In giving exercise for this condition, care would be taken to isolate the action of the recti and to limit as much as possible the side-pull of the obliques, which would only increase the trouble. The following exercise is used for this purpose:

Patient supine, preferably with head lowered. Movement: Raise the head and shoulders (Plate I, Figs. 1, 2, 3), exhaling during contraction, and taking care not to hold the breath at any time. Relax. Slowly increase the excursion of this movement until the body is slowly raised to the sitting position and slowly lowered. Repeat up to twenty times.

This exercise should be repeated three or four times a day and pushed up to the point of moderate fatigue.

Frederick W. Harvey reports several cases in which this form of hernia or diastasis was reduced in two months by this means with no recurrence.[1]

When hernia takes place at the umbilicus there is a stretching of the fibrous tissue alone. When it takes place at the femoral ring it is merely a dilatation of the innermost compartment of the

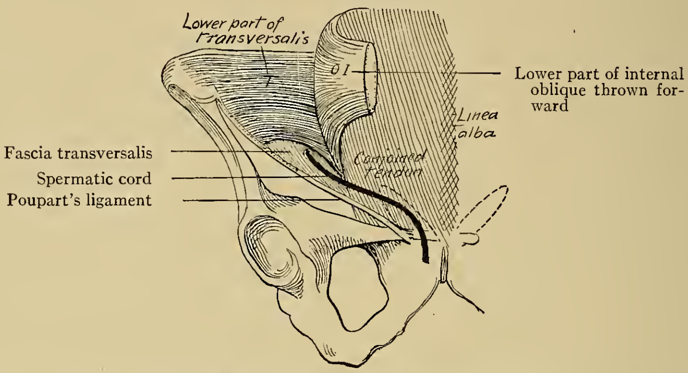


Fig. 385.—Deep layer, showing internal ring and transversalis muscle. The dotted line shows the attachment of internal oblique.

femoral sheath; but *inguinal hernia*, which is very much the most common form, is permitted only by a stretching and spreading apart of muscle and tendon, and exercise may be of marked assistance in strengthening and closing the internal and external abdominal rings, to guard against its advent or prevent its return.

A careful diagnosis is essential to exclude femoral hernia, congenital arrest of development, and certain cases in which the bowel does not enter the internal ring, but breaks through the conjoined tendon directly beneath the external ring.

The internal abdominal ring is found just beneath the cres-

[1] P. E. Rev., June, 1912.

centic arch of the inferior border of the transversalis muscle. It is at this point that the vas deferens in the male and the round ligament in the female enters the abdominal wall. The transversalis takes its origin from the outer third of Poupart's ligament. The internal oblique has its origin from the outer half, so that its lower fibers cover the internal abdominal ring like a lid, and the development of this muscle has a distinct influence on the ring's integrity. The external abdominal ring is a slit between the tendinous pillars of the external oblique, and every contraction of this muscle pulls these pillars together, closing it like a buttonhole. This action of the muscle serves as an automatic protector of the opening during active exercise.

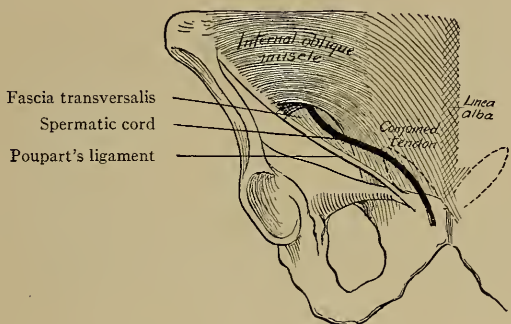


Fig. 386.—Attachment of internal oblique, showing the covering of the cord.

The inguinal canal, which is normally collapsed, is bounded then superficially from within outward—first by the external and internal oblique, second by the external oblique alone. Hernia may enter the canal at the internal ring or break in through the fascia that guards its center or inner end, tearing ahead of it or pushing aside the weakened conjoined tendon of the transversalis and internal oblique, but in all cases it makes its exit by spreading apart the columns of the external abdominal ring.

About 95 per cent. of all hernias are inguinal, and of these about 95 per cent. are indirect, although in infancy the inguinal canal is practically non-existent, the inner and outer rings being almost opposite. As the ilia grow and extend outward and upward the internal ring follows them, and in adult life the canal may be $1\frac{1}{2}$ inches in length. In any lateral flexion of the trunk, where the oblique muscles are in action, the whole region is flattened, and the pillars of the external ring snap together with the first beginning of contraction in the external oblique. Flexion of the trunk is done mainly by the recti, and, especially at the beginning of the movement, the obliques remain relaxed and the lower inguinal regions tend to bulge symmetrically and evenly (Plate I, Figs. 1, 2, 3). This general yielding of the region just above the Poupart ligament gives color to the belief that in hernia acquired in adult life or in late childhood there is nothing

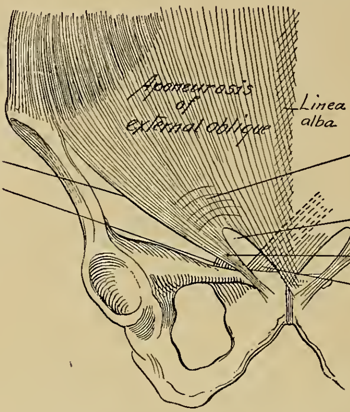


Fig. 387.—Superficial layer and external abdominal ring.

but the most casual connection with the spermatic cord. Some dissections have shown the breach to occur 1 inch outside the internal ring, and every clinician has experienced the difficulty of determining the exact point of entrance of the hernial sac, especially after the involved structures have been stretched and displaced.

In the movements of straight flexion of the trunk the rectus muscle only is employed at the beginning and the relaxed oblique muscles are distended, forming two distinct pouches or weakened areas over the lower abdomen (Plate I, Fig. 2), and by the time they contract in self-protection the mischief may have been done.

PLATE I

Fig. 1.—Patient lying with abdominal muscles relaxed.

Fig. 2.—The beginning of flexion of the trunk, showing the recti in powerful contraction with the obliques relaxed, allowing the lateral parts of the lower abdominal zone to bulge forward and distend the rings.

Fig. 3.—The continuation of flexion showing the obliques in contraction at this later stage of the movement.

It is in such conditions and under such circumstances that hernia is likely to be acquired, because hernia, like other swellings, enlarges in the line of least resistance. Perhaps one of the most potent causes is a standing posture in which the abdomen is protruded and the chest sunken, forcing down the abdominal contents on the relaxed lower zone, and I have been struck with the number of cases in which hernia came on unconsciously, without apparent cause, other than perhaps a long walk or a fatiguing day's standing. Even repeated and violent effort seems less fruitful of cases than the dull and steady pressure on the relaxed abdominal walls.

Muscular atony may of course follow severe illnesses, especially where there is a great loss of fat, but there is also the atony that accompanies sedentary habits and begins to tell on those approaching middle life, especially choosing the unused abdominal muscles as the place where the deposit of fat will be undisturbed, smothering their powers of contraction, resistance, and control.

Symptoms.—In a great number of cases there seems to be plenty of warning in the shape of vague pains in the region; it is a frequent experience to be consulted for these pains and to find the ring patulous, but showing no definite hernial protrusion. This condition is closely associated with ptosis of other abdominal organs, and with other signs of general ligamentous and muscular relaxation. This dull and aching pain, either in one or both inguinal regions, is most common in patients who, on examination, show unusually dilated external rings. There is tenderness and a distinct impulse on coughing, but no actual hernia. Others, again, in whom actual hernia is present, complain of no inconvenience from it.

One man played football for years with an enormous scrotal hernia which he did not even support. He then went to Cuba, did a great deal of horseback riding and other violent exercise, during which it disappeared. He is now quite sound, with no return during the past nine years and no necessity for wearing a truss. This is, however, far from being a typical case, for strangulation may occur at any time and forms a constant menace.

Altogether, the impression I have gathered from several hundred cases coming under my own observation is that the onset, except in rare cases, is much less dramatic than has generally been thought.

The most suitable cases for this treatment are among children and adolescents, where the condition is not congenital and where natural growth assists in the process of repair, although good results have been obtained up to fifty years of age, either where hernia is actually present or where there seem to be the premonitory symptoms. The great majority of cases tend to improve if the hernia can be reduced and kept in place long enough to give the rings time to recover from the stretching to which they have been subjected, and if in addition to this the oblique muscles be symmetrically strengthened by accurately applied exercise.

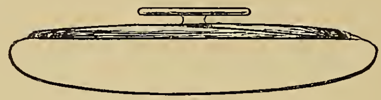


Fig. 388.—Seaver's flat truss pad.

All hernias should of course be reduced, and retained, preferably, by a truss that does not present a convexity of surface great enough to enter and spread the abdominal ring. The flat hollow rubber pad, two inches in diameter, recommended by Jay W. Seaver (Fig. 388), is comfortable to the patient, can be kept clean at all times, and can be worn in the water without damage. It is especially suitable for young men.

In a recent hernia, where pain is present, the patient should remain quiet for a week or two to get accustomed to the feel of the truss, and should then begin a course of light work for the abdominal muscles, as well as more general exercise for the whole muscular system. These exercises should be done daily, and should be increased in number, complexity, and resistance. The object of the exercise treatment for acquired inguinal hernia is twofold:

(1) To strengthen and increase the number of muscle-fibers in the transversalis and two oblique abdominal muscles, and so to reinforce the aponeuroses with which they are connected.

(2) To cultivate alertness, control, and self-consciousness in these muscles, thus causing them to respond instantly and automatically to any sudden strain that may be thrown upon them. More harm may come from surprising a strong muscle which is relaxed and out of control than can come from the same strain on a weaker muscle that is ready for it, nor must one lose sight of the general effect of these exercises in stimulating the intestines and regulating the action of the bowels.

Great stress should be laid on teaching control of the abdominal muscles by forced breathing and abdominal exercises. The extent to which specialization and rhythmic contraction of these muscles can be carried is shown in the movements of the Oriental *danse du Ventre*. As the strength and control of the abdominal muscles increase the work is intensified and extended. Seaver allows his patients the most trying gymnastic feats, such as the lay-out on the horizontal bar. The movements must be varied and asymmetric. Such a movement as lying on the back and raising both legs to a perpendicular position does not produce the desired result, as the strain falls chiefly on the rectus abdominis and psoas muscles. The most effective movements are those in which flexion of the trunk is accompanied by side twisting. Great stress should also be laid on the deepening and raising of the chest, thus drawing up the abdominal contents and relieving the downward thrust of the thorax and upper abdominal structures.

The chief precaution to be observed is to teach the patient how to support the dilated ring with the finger during exercise (Plate II, Fig. 1), but if it seems inadvisable to trust to his intelligence a truss should be worn throughout the treatment.

The following exercises have proved to be of value in overcoming the premonitory symptoms already described, and in curing the actual hernia even in severe cases:

Exercise I.—Patient lying on back. Place one hand across abdomen, the other protecting the ring. Inhale deeply. Exhale by pressing on the abdominal wall until voluntary contractión

Fig. 389.

has been acquired when this movement can be done without placing the hands over the abdomen (Plate II, Fig. 1).

Exercise II.—Patient lying on back, one hand across the abdomen, the other protecting the ring. Inhale and exhale without drawing in the abdomen. In this way, control of the

Fig. 390.

abdominal wall is obtained while the hernia is protected by placing the finger over the external ring. In most patients it is possible to teach them in one or two séances how to find the external ring and how to protect it in the various exercises (Fig. 389).

PLATE II

Fig. 1.—Abdominal breathing, illustrating method of protecting the right abdominal rings by the second finger of the right hand held flat against the wall as in Exercise 1.

Fig. 2.—Position described in Exercise 4, showing the correct position of the legs and of the right hand.

Fig. 3.—Left side lying, showing right hand protecting the right abdominal rings, the surgeon assisting in trunk flexion to the right.

Exercise III.—Patient lying on back, one hand behind the neck, the other covering the external ring. Raise the head and shoulders, twisting in the opposite direction from the hernia. In this way the oblique muscles of the affected side are put into strong contraction, but if the movement be symmetric the rectus alone will receive the strain (Fig. 390).

Fig. 391.

Fig. 392.

Exercise IV.—Patient lying on back, external ring protected. Without bending the knees raise both feet 6 inches from the table. Alternate the raising and lowering of the feet 12 inches five times without touching the table (Plate II, Fig. 2).

Exercise V.—Patient lying on back, ring protected. Raise body from the lying to the sitting position, with the shoulders twisted so that the shoulder of the affected side is forward.

Exercise VI.—Left side leg lying for hernia on right side. Left neck firm, right hand protecting ring. Side flexion of the trunk (Plate II, Fig. 3).

Exercise VII.—Patient standing, one hand protecting the ring, the other behind the head. Circumduction of the trunk, with the side bending from the affected side emphasized.

Fig. 393.

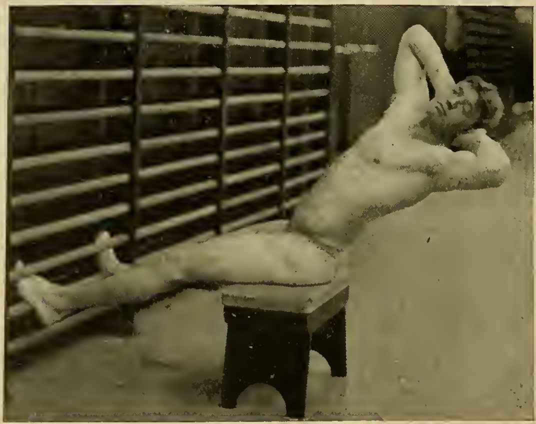


Fig. 394.

Where the ring is protected by a truss the arms may be placed in the neck firm position (Fig. 393).

Exercise VIII.—Patient seated, hips firm, or, where a truss is worn, neck firm (Fig. 394). Backward bending and twisting right shoulder forward in a right hernia.

Each exercise should be repeated twenty times.

Exercise IX.—Massage, consisting of circular kneading movement, beginning at the external abdominal ring and passing upward and outward to the anterior superior spine.

The general regulation of the physical life of these patients is also of importance. Perhaps the greatest mistake is to forbid all active exercise. There are few forms of exercise that such patients may not indulge in, not only with safety, but with great benefit. It may be laid down as a safe rule that the two things in exercise to be avoided are sudden and severe strain requiring the breath to be held, and, secondly, the maintenance of standing positions for long periods. One can engage in such games as tennis, golf, or even bowling, cricket, gunning, dancing, swimming, canoeing, and most forms of gymnastics without danger if reasonable precautions as to support are used, but one should avoid football, hammer throwing, jumping, riding, shot-putting, and wrestling. This last sport may be considered as the most dangerous exercise that could be taken by such patients.

The exercise *par excellence*, recommended by Dr. Lucas Championniere in his admirable work on hernia, in which he also takes up the treatment by trusses and by operation, is bicycling, and he lays great stress on the fact that the weight is not supported by the legs, that there is no possibility of violent and unsuspected strain, and the dose can be accurately indicated.

The following are four typical cases:

Case A.—Mr. G., aged twenty-five, acquired a complete right inguinal hernia at five, coming on after a long and exhausting walk. This remained down for several years, but under active exercise he has been entirely free from it ever since. The external rings on both sides are still larger than normal, admitting two fingers, but his muscular system is well developed, and he is able to go into the heaviest gymnastics without symptoms.

Case B.—Mr. K., aged twenty-three, at the age of twelve shortly after climbing and swinging in a tree noticed a visible protrusion, which remained in the same condition ever since. For five years he wore a truss, which had no *curative effect*, and the hernia remained much in its original condition up to the date of consultation. Walking made it painful, but he took part in games like baseball and canoeing without inconvenience. After three months' daily practice of the exercises described above he reported the hernia as retained without truss. The cure was confirmed a year later.

Case C.—L. M. was referred to me three years ago by Dr. Robert G. Le Conte. The patient was fifty-four years of age, had a double hernia for ten years, but did not wish to undergo operation. He came to me wearing a truss, and after practising these exercises for six months the sense of insecurity left him and he dispensed with the truss, except during violent exercise. After three years his abdominal wall is in excellent condition, with no signs of return.

Case D.—J. M. W., also referred to me by Dr. Le Conte, March, 1911, complained of severe pains of a dragging character in the right inguinal region of three and one-half years' duration, during which time he wore a truss. He had to give up riding, walking, and golf, and confined himself to office work. An examination showed patulous abdominal walls and distended right external ring, with a distinct impulse on coughing. There was, however, no actual hernia. A course of three months with the exercises described banished these pains, and gave him a sense of security which has enabled him to take part in the many activities from which he has hitherto felt himself debarred. He has had no return of his symptoms.

The prognosis for cure in these cases is about 70 per cent., according to Seaver, but the percentage would naturally depend largely on the care with which the cases are selected.

The development of the muscular protection, which normally prevents hernia, is the surest guaranty against its return.

CHAPTER XXVI

TREATMENT OF VISCEROPTOSIS AND CONSTIPATION, AND DISORDERS OF THE DIGESTION, BY MASSAGE AND EXERCISE

The attainment of the upright posture is attended by the faults of posture already described, but any disturbance of poise invariably reacts on the contents of the abdomen as well. The flat chest has as its sequel the protruding abdominal wall with its weak, flabby muscles. The drooping shoulders and relaxed muscles are inevitably followed by the downward displacement of the abdominal organs and interference with their functions. In some cases this condition is congenital.[1] The patient has never conquered the mechanics of the upright posture, in which the chest is raised, the lower ribs flared out, and the abdomen flat. The organs are held in place normally by the correct relative position of the chest wall and pelvis and the tonic contraction of the abdominal muscles.

Fig. 395.—Attitude of patient with congenital visceral ptosis. Note downward inclination of the ribs, backward inclination of the body, narrowing of the upper abdomen, prominence of the lower abdomen (Goldthwait).

[1] Joel E. Goldthwait, "Orthopedic Principles in the Treatment of Abdominal Visceroptosis and Chronic Intestinal Stasis," Surgery, Gynecology, and Obstetrics, June, 1913, and "The Relation of Posture to Human Efficiency," Amer. Jour. of Orthopedic Surgery, vol. vii, No. 3; also "The Recognition of Congenital Visceral Ptosis," Amer. Jour. of Orthopedic Surgery, November, 1911.

Above the last lumbar vertebra the abdominal cavity deepens, and each solid organ lies in its appointed place, the kidneys resting on their shelves are directed backward and upward, the liver is supported by the right kidney, by its peritoneal ligaments, and by the grasp of the lower ribs, the hollow viscera hang by their mesenteries also at their natural levels. In the flat-chested posture the shape of the abdominal cavity shows a pathetic change. The ribs are inclined downward and backward. The diaphragm moves down with them. The space beneath it is lessened, and the liver and stomach are crowded downward. The ligaments are stretched, pressure is put on the kidneys, causing absorption of the retroperitoneal fat, and the organs, both solid and hollow, slide forward and downward to fill the new space made by the relaxing muscles and protruding abdomen. The movable part of the colon is forced downward, and the hepatic and splanchnic flexures made sharp or even shut off, so that the contents are delayed and constipation results, while pressure is brought to bear on the uterus and ovaries, sometimes causing prolapse, often displacement, and always congestion.

It is to correction of the poise that we must look to remedy these symptoms, and the special exercises for this purpose and the principles of the clothing required have already been illustrated, described, and discussed in the chapter on Postural Defects, although in many cases it is not possible by exercises alone to correct this condition when long standing.

Goldthwait recommends the employment of a splint or brace to keep the parts in proper relation in the intervals of exercise and massage and to avoid fatigue for weak and debilitated cases. After becoming accustomed to this brace, exercises are begun in small doses and gradually increased until the correct poise can be maintained without undue fatigue or artificial aid. Resting should be taken in the *knee-chest* or the *prone-hanging* positions, and recumbent exercises should be taken on the inclined table, with the head down, thus relieving the tension on the ligaments and allowing the abdominal organs to find their way back to their proper place by the force of gravity (Fig. 396).

Treatment must be carried on for a long time and the vicious habit replaced by the normal. Relapses are frequent unless the greatest care be taken to keep the clothing correct,

Fig. 396.—Patient resting on Kellogg's inclined table with pad under the back, giving overextension of the spine and relief of pressure on the lower zone of the abdomen.

build up the muscular powers, and impress correct habits of standing and sitting upon the child.[1]

CONSTIPATION

Perhaps the most persistent symptom of these cases is constipation, due partly to the blocking of the intestines, kinking at the angles of the colon, and partly due to the displacement and crowding on the lower zone. A general atony of the intestines accompanies weakness of the abdominal muscles, and goes far toward causing the lassitude, headache, and debility that attend it; but constipation may also be due to sedentary habits alone or accompanied by a faulty diet, and to neurasthenia, anemia, and certain chronic affections of the liver, stomach, and the abuse of purgatives. It must also be remem-

[1] F. H. Martin, "Visceral Prolapse," Surgery, Gynecology, and Obstetrics, December, 1906; and Eliza Mosher, New York Journal of Gynecology and Obstetrics, November, 1893.

bered that constipation of an extreme degree may exist without other symptoms. Individuals differ greatly in this respect, and a careful inquiry should be made into the probable causes in all cases of constipation. About 12 per cent. of college students complain of it at their preliminary physical examination, due to sudden change of diet and occupation on leaving home, and in most cases a few simple exercises and the following hints on diet are sufficient to re-establish regularity.

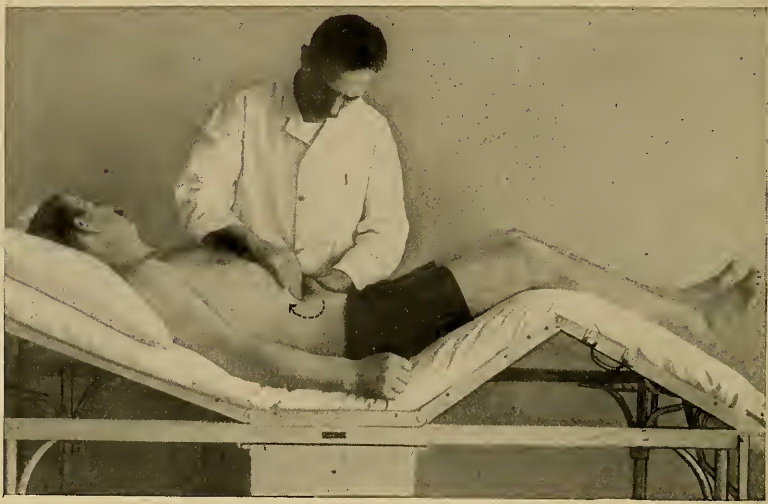


Fig 397.—Deep rotating pressure massage (Gant).

(1) Drink freely of water, a glass or more on rising and retiring.

(2) Eat carrots, cabbage, lettuce, celery, turnips, asparagus, sterilized bran, and other bulky foods.

(3) Eat grains, fruits, figs, prunes, and other laxative foods. Masticate thoroughly.

(4) Avoid fried foods, meat overdone, hard-boiled eggs, pastry, and much sugar.

(5) Cultivate habits of regularity in hour of evacuation.

When the causes are complicated and the condition persistent ali the resources of exercise should be brought to bear on the case, as well as regulation of the diet and even the use of mineral waters or other light laxatives.

The application should be in the form of massage, vibration, duplicate and active movements, and the cultivation of regular and systematic habits. The massage should be very deep and slow, following the course of the colon, beginning in the right iliac region, passing upward to the ribs, across the abdomen, just above the umbilicus, and down the left side, terminating in deep, slow, circular movements in the left iliac region over the sigmoid flexure and the rectum. These kneading movements should be done very slowly, with firm, deep, and

Fig. 398.—Abdominal massage.

insistent pressure, the knees of the patient being drawn up and the abdominal walls relaxed.

When there are impacted feces the movement should begin over the sigmoid, with the object of breaking up the mass in this region first. The tips of the fingers of one hand can be used (Fig. 397) in a series of jerking, circular pressure, friction movements, done not too quickly, and following this the descending colon should be kneaded between the hands, one well behind and the other in front of the abdomen, the heel of the hand making the pressure (Fig. 398).

The reflexes can be stimulated also by light tapotement along the margin of the ribs throughout the entire costal angle from right to left (Fig. 399), and along the spine with deep tapotement from the eighth to the twelfth dorsal. The administration of tapotement or vibrations along both sides of the spine from the first to the fouth lumbar will alone give immediate relief in some cases.

Fig. 399.—Tapotement of rib margin.

Graham recommends self-percussion with the ulnar border of the fist night and morning for several minutes (Fig. 400). Massage must be deep and insistent or the effects will be negligible, except to irritate the skin to no purpose.

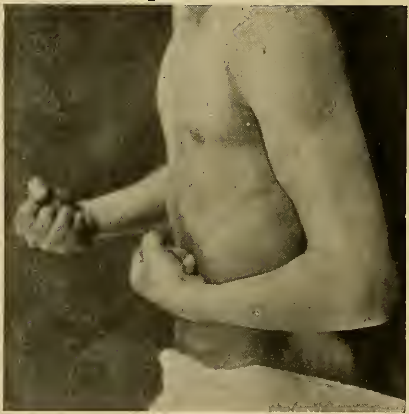


Fig 400.—Self-percussion over the subcostal region.

A cannon-ball covered with chamois leather has been used for the same purpose, and most sanatoriums have the Zander machine, on which the patient lies face downward, the abdomen resting on a loose leather diaphragm, beneath which a ball set in motion by a motor follows the course of the colon, giving continuous upward pressure. These movements are not so effective, however, as the trained human hand.

PLATE III

FIG. 1.

FIG. 2.

Massage alone is scarcely ever sufficient in the treatment of constipation, and certain active movements are necessary to supplement the more passive forms.

Among the *exercises* that have proved of value may be cited the turning of the nautical wheel (Fig. 255) and the trunk rotation, described in the exercises for abdominal weakness (Figs. 391, 392, 393, 394).

Two additional exercises may be described that act directly by pressure on the abdominal contents:

Exercise I.—Patient lying supine on a couch, arms at the sides. Raise the right leg with knee bent. Clasp the hands over it and press it against the abdominal wall. Repeat with the left (Plate III, Fig. 1). *Repeat twenty times.*

Exercise II.—Patient astride a plinth, arms behind the back. Trunk circumduction, bending well forward to the right, then forward, and then to the left (Plate III, Fig. 2). *Repeat twenty times.*

Circumduction of the pelvis is given most effectively by Zander's *camel*, the patient sitting on an excentrically moving saddle, or on the *horse* which is a substitute in movement for the trot, and riding on horseback itself is to be strongly recommended when available.

In cases due to sedentary life a game of golf or a walk of a couple of miles over uneven ground may be enough, and deep respiratory exercises are of great value through the automatic massage given the abdominal contents by the excursion of the diaphragm and abdominal walls.

Jueltner[1] advises his patients to drink several glasses of fresh water immediately after rising in the morning. In some cases hot water with a little salt answers better, this to be followed by a brisk half-hour walk. The patient takes a rather light breakfast, laxative in character, followed by a fifteen-minute walk. After this he makes a determined effort to defecate. If unsuccessful, he irrigates the colon at night, the patient lying on the back with knees drawn up; then beginning at the left

[1] Journal of Advanced Therapy, New York, 1905, xxiii, 446.

iliac space, he gently kneads along the course of the descending transverse and ascending colon, to distribute the water and soften the fecal matter and stimulate peristalsis. Savage[1] advocates one exercise in which the patient hangs head down by the knees on a ladder; he also advises leg circles in the lying and standing position.

GASTRITIS

In advising massage or active movements for cases of chronic gastritis great care should be taken, as in diabetes, to stop all exercise before reaching the point of exhaustion, because bodily as well as mental fatigue may be one of the causes of the condition, and it nearly always aggravates it. For this reason massage is preferable to any but the mildest exercises.

In nervous dyspepsia, which is so frequently a symptom of neurasthenia or hysteria, the *rest cure* of Weir Mitchell, with careful regulation of the diet, massage, and light resistive exercises leading on to more active movements are useful. In all such cases of gastritis massage should be given about two hours after a meal, and should include pressure and kneading of the hypochondriac and epigastric regions from left to right and downward.

These movements give immediate relief in some cases. They force the stomach contents into the duodenum, stimulate the action of the liver, and alternately compress and relax the gall-bladder. They should be followed by kneading along the course of the colon, and vibratory massage over the spine, from the fourth to the tenth dorsal, whenever tender points can be made out. The relief from the feeling of oppression and the more distressing symptoms so frequently present in these conditions is often rapid and complete.

Light tapotement with the finger-tips along the costal margin on the left side from the tenth to the sternum and down the right side to the tenth will be followed by contraction of the dilated stomach[2] (Fig. 399).

[1] Journal of Advanced Therapy, New York, 1904, xxii, 736.

[2] Percy Mitchell, Lancet, January 28, 1911.

CHAPTER XXVII

TREATMENT OF RESPIRATORY DISEASES BY EXERCISE AND FORCED RESPIRATION

The bacilli of tuberculosis are so nearly omnipresent that practically all are infected from time to time, and the development of the disease depends on the nature of the soil offered by the individual and on the activity or inactivity of the respiratory tract. The level of resistance and vitality must be raised if infection is to be successfully resisted, and this can be done best by improving living conditions, supplying good food, good air, and sufficient exercise. As already pointed out, the school cannot provide sufficient corrective exercise for all forms of disease amenable to such treatment. It should provide correction for the defects brought on by school life, and should, by good ventilation and frequent spells of corrective exercise, build up those powers that will help the pupils to throw off the constant infection to which they are subjected. This, in conjunction with the playground conducted by the school or city, should provide the exercise necessary for prevention.

In the college cases of incipient tuberculosis should be detected on entrance and individual treatment begun. In 8 cases discovered last year at the medical examination, which is given to all men entering the University of Pennsylvania, treatment was begun at once, and only one man was compelled to give up the course, which would have become impossible for all of them had their cases been neglected.

There is a responsibility then resting on school and college for the prevention of this disease, for its discovery when present, and sometimes for its care and treatment in incipient stages.

Civilization has made an outdoor life impossible for most of us, but the construction of outdoor sleeping porches and other such devices make it possible for indoor workers to sleep under conditions that approach out of doors so far as fresh air is concerned.

Many people have the idea that the more they exercise the quicker they will get well from tuberculosis. For this reason many young men are instructed to take part in violent athletic sports as a remedy, and the exhaustion following hard rowing, football, or running goes far to hasten the course of the disease.

Many *tubercular young men* have a peculiar muscular intelligence which makes them brilliant athletes, just as the mental alertness sometimes seems to be increased by the disease, and for this reason athletics are frequently blamed for causing tuberculosis when they have been mistakenly prescribed as a treatment. No patient should be allowed active exercise who has lost one-fourth of his weight, who had a temperature of 100 at any time during the day, or if light work sends his pulse above 110. Rest is more important than work in these cases. "The healthy man sits down because he is tired. The consumptive should sit down so as not to become tired" (Brehmer).

Overexertion of any kind is poison. The acceleration of the pulse, perspiration, palpitation, rise of temperature, feeling of weakness, discomfort, and headache are all signs that he has overstepped the safety limit.

Just when exercise should be begun should be decided only by testing the patient. A bad effect is shown by an increase in temperature, rapid heart, loss of appetite, an increased cough and expectoration, or by a hemorrhage. Any of these occurrences would show that the rest period should be continued, except possibly when only an increased rapidity of the pulse results. A patient who shows no disadvantage from exercise, except an increased heart action, should take graduated walks to strengthen the heart. In other words, a long-rested heart must be trained gradually to acquire sufficient strength to allow the patient to work.

The *first exercise* a patient should take is a sponge bath in the morning, first with tepid water, later with cool water, and, finally, often with cold water to be followed by a brisk rubbing with a towel until the skin is aglow. The warmer the skin is and the better the circulation in the skin, the less likely is the patient to become chilled or take cold.

The next exercise should be ordinary walking, graduated according to his strength, to educate his heart to endure increasing muscular work.

Next comes calisthenics or games that require more or less exertion, and finally some light labor. Driving or automobile riding may also be advantageous if facilities are offered.

Breathing exercises or lung gymnastics are to be used with the greatest caution. The tuberculous lesion heals by contraction and not by expansion. Persons who have no active tuberculosis, who are insufficiently aërating their lungs, who are becoming hollow-chested and whose breathing is shallow, should take deep-breathing exercises, but a patient undergoing a cure for tuberculosis of the lungs should not. A patient receiving tuberculin treatment should also be at rest; that is, he should not take exercise on the days of the injections.[1]

It is always of advantage to arrange a patient's daily routine if he is out of bed. He should have his meals and intermediate nutriment at regular intervals. He should have such rest times and such exercise times as prescribed, and he should retire at the hour ordered. It is also well to know absolutely what his exercise is, what his play consists of, and how absolute is his rest.

Some sanatoriums endeavor to offer some simple, self-sustaining work so that patients may pay for their treatment at the same time that they take the cure. Such facilities allow an impecunious and partially healed patient to remain long enough to perfect his cure.

In the treatment of pulmonary tuberculosis the place of ex-

[1] Edward O. Otis, "Use and Abuse of Pulmonary Gymnastics," Boston Medical and Surgical Journal, vol. clv, 3.

ercise has been well defined by Kinghorn,[1] who, after speaking of the open-air treatment and the treatment by rest, advises the patient to begin with walking at first on level ground for ten or fifteen minutes every second day for several weeks, then every day for several weeks, and at last twice a day. When the patient stands these little walks without harm, and when the weight increases or holds its own, the exercise may be extended under careful supervision, but hard mountain climbing should never be permitted.

In cases where no lesion can be found, but where the tendency is shown by the history of exposure to infection, by family history, or by the formation of the chest, much good may be expected from open-air exercise accompanied by training of the respiratory powers. Deep breathing is a muscular act capable of education, and the capacity of the lungs or mobility of the thoracic walls can be increased as well as the strength of any other part of the muscular system, while the general circulation, the skin, the appetite, and the digestion all share in the heightened activity, and healthful sleep is insured by the resultant moderate fatigue. Exercise for this purpose should be general and special. Singing and elocution lessons are valuable, and the practice on a wind instrument has been recommended. Running and climbing are of the greatest value for increasing the breathing capacity if kept within the limits of fatigue.

Daily supervised exercises are necessary to increase rapidly the power of chest expansion and vital capacity. They should be directed to a training in the best methods of breathing, to developing the chest and abdominal muscles, and should be preceded and followed by accurate measurements and spirometer records. All exercises should be prescribed in writing, with the most minute directions as to time, frequency, and severity, and a record of the patient's weight should be kept and frequent examinations made to determine his progress, a rapid loss of weight being followed by a reduction or abandonment of exercise. They should include both active, duplicate, and

[1] Montreal Medical Journal.

passive movements, but it must be remembered that however deep the respiratory movement may be, the amount of oxygen absorbed is only in proportion to the need of the body. The oxygen in the blood remains measurably constant, and the only way to increase its absorption by the tissues is to do work that causes the breaking down of oxygen compounds. Deep breathing would result naturally from more demand, but would not create this demand. Its rôle will be to strengthen the intrinsic and accessory muscles of respiration, to teach the co-ordination necessary for deep breathing, and to massage the abdominal contents by wider excursions of the diaphragm.

Enforced deep breathing for a period of several minutes materially increases the length of time the system can do without respiration, serves as an effective mental stimulant, and raises the frequency of the pulse-beat. Violent deep breathing for several minutes so overcharges the system with oxygen as to make respiration unnecessary for perhaps as much as five minutes after this preparatory breathing is over.

In one case, four minutes of enforced breathing made it possible to hold the breath for nearly four minutes, whereas without this preparation fifty-six seconds was the limit. The time during which it is possible to do without respiration increases, of course, with the length of time during which the preparatory breathing is carried on. The increase does not go on indefinitely, but reaches a definite limit, beyond which further length of time given to preparatory breathing does not increase the time which the breath may be held. Below is one series of experiments:

A—Length of time in minutes devoted to deep breathing.
B—Time in minutes and seconds during which the breath was held after preliminary breathing was stopped.

A.	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	3	1	2	3	4
B.	0.56	1.24	1.39	1.54	2.12	3.00	3.26	3.54

The preparatory breathing is effective long after the washing out of the lungs has been completed. There is a mild temporary intoxication of the entire system. The effect as a mental stimulant is very pronounced. Mental fatigue may be postponed beyond the usual point by two minutes of rapid breathing at half-hour intervals, and a feeling of sluggishness or sleepiness may be almost completely dispelled. The effect on muscular fatigue is also striking. A difficult arm exercise with heavy weights, which could not be repeated under ordinary circumstances more than twenty times, after a few minutes of this preparatory deep breathing could be performed twenty-seven times; this is about 30 per cent. more. The pulse-beat goes up very rapidly while the breathing is continued—in the case quoted above from 65 to 106 beats after four minutes of breathing.

Fig. 401.

Deep breathing alone repeated a number of times during the day may be useful, and its practice should be made part of every day's régime in those cases in which there is no danger of overstretching an active lesion and bringing on a hemorrhage.

Turbaus' method is to take ten to twenty deep breaths five to ten times daily, the patient reclining.

The normal respiratory act is a composite of two distinct types of breathing—(1) thoracic and (2) abdominal.

The thoracic type predominates almost to the suppression of the other among all, irrespective of sex, who wear constricting clothing about the waist line, and the first care must be to re-establish control of the diaphragm and abdominal walls. The following exercises should be practised before a mirror:

Exercise I.—Patient standing. Place the hands across the abdomen. Inhale deeply. Exhale by pressing on the abdominal wall, keeping the thorax fixed in the position of inspiration (Fig. 401). Repeat this movement five times slowly with the thoracic wall fixed, using the movement of the abdominal walls only. Rest. After a little practice this movement should be done with the hands at the sides.

Exercise II.—Patient standing. Place the hands across the abdomen. Inhale forcibly by pushing out the abdominal walls,

Fig. 402. — Inhalation — abdominal. The abdomen is protruded without expanding the thorax.

Fig. 403. — Exhalation — abdominal. The abdomen is indrawn and the breath expelled without contracting the chest.

keeping the thoracic wall fixed as in expiration. Exhale by drawing in the abdomen. Repeat five times slowly. Rest. As soon as control has been obtained, practice this exercise with the hands placed behind the back (Figs. 402, 403).

Fig. 404.—Thoracic breathing—inhalation.

Fig. 405.—Thoracic breathing—exhalation. The girth of the abdomen remains unchanged.

Exercise III.—Patient standing with the hands across the abdomen. Inhale forcibly, using the thorax only, without movement of the abdominal wall. Repeat five times slowly and rest. As soon as control of the abdominal walls has been obtained do this exercise with the hands behind the back (Figs. 404, 405).

Thoracic breathing can be forced still further and the walls of the chest stretched by using the arms in the following exercise:

Exercise IV.—Patient standing with the arms at the sides.

Fig. 406.

Fig. 407.

Raise both arms forward (Fig. 406) until they are above the head, inhaling. Hold the breath and stretch upward. Rise on tiptoes (Fig. 407). Lower the arms sideward, pressing backward and exhaling (Fig. 408). Repeat twenty times at the rate of about five to the minute.

Patients will sometimes have a feeling of dizziness, and may even stagger and fall at the sudden change of the blood-pressure in the head, but this need cause no alarm.

Exercise V.—Patient standing with the arms at the sides. Raise both arms sideward, pressing back and inhaling (Fig. 409)

Fig. 408.

Fig. 409.

Fig. 410.

until they are above the head. Hold the breath and bend forward, keeping the knees straight, until the hands touch the floor (Fig. 410). Rise, keeping the arms above the head. Lower the arms sideward, pressing backward and exhaling. Repeat twenty times at the rate of five to the minute. This exercise compresses the air on the lungs and forces it into the cells that are little used in ordinary breathing.

The following duplicate and passive movements may be employed for increasing the chest mobility and improving the respiration.

Exercise VI.—Patient lying supine on a plinth with feet fixed, arms bent, and palms up. The surgeon grasps the hand,

Fig. 411.—Artificial respiration. Surgeon pulling up and patient resisting.

palm to palm, and pulls upward to full extension of the arms, the patient resisting (Fig. 412). The patient then pulls downward and forward to the first position, the patient resisting. Inhale as the arms go up and exhale as they come down.

Exercise VII.—Patient lying supine on a plinth, the lower part of the thorax supported by a roller 4 inches high, the arms behind the head, and the chest expanded in inhalation. The surgeon presses on both sides of the lower thorax, directing the patient to exhale (Fig. 413). Repeat twenty times at the rate of about ten to the minute.

Schaeffer's method of artificial respiration is of use to make more resiliant the chest walls, and Weinlander describes a

Fig. 412.—Stretching of the thorax by traction on the arms in the movement of artificial respiration.

Fig. 413.

method used in resuscitation that could in some selected cases be employed to stretch the chest walls:

The patient is placed supine, with the head over the end of the table. He grasps the arms at the elbows, pushes them up and back toward the back of the head, thus drawing on the pectoral muscles and ribs and inducing powerful inspiration. The grasp is released and the arms swing down, the chest wall relaxing. This is repeated to the rhythm of about twelve to the minute.

A valuable exercise is that given by Zander's machine, known as the *tower*, in which pressure is placed on the back by a cushioned pad and the shoulders are drawn upward and backward rhythmically with the respiration (Fig. 317).

While the effects of breathing exercises are excellent, the patient loses interest only too often in movements taken alone and without supervision. Pescher has invented a simple and practical method for stimulating the patient's interest and following his progress, which he described at one of the recent meetings of the Société de l'Internat des hôpitaux de Paris. A bottle filled with water and inverted in a receptacle containing a little water does not empty itself on account of the pressure of the atmosphere; but by blowing into the interior of the bottle through a tube, a volume of water is displaced about equal to the amount of air introduced. This is the principle of the wet spirometer. By the use of bottles graduated to all capacities this exercise can be prescribed in progressive amounts in accordance with the condition of the patient's lungs.

The patient is made aware from day to day of his progress, not only subjectively, but objectively. He begins with receptacles of medium capacity, ½ liter in the case of children and 1 liter with adults. He goes as far as 2 or 2½ liters with children and 4 to 4½ liters with vigorous adults. Inspiration should be made through the nostrils and should be slow and rhythmic. After each exercise of inhalation and exhalation he should rest for a time equal to that taken in the exercise. From ten to one hundred exercises should be done two or three, or perhaps four, times in every twenty-four hours. They should be taken not less than one and one-half hours after eating. Ten exercises done carefully require about one-quarter of an hour. Those who get the most benefit from the exercises are narrow-chested children —those who have difficulty in respiration—the pretuberculous, and even the tuberculous.

The effects of deep-breathing exercises alone are tonic and stimulating and have a marked effect on the weight. Richter, in his classes for voice-training, uses deep-breathing exercises as a routine measure. He finds that in two and one-half months there was an average gain of 9 pounds in a whole class of students, attributable almost entirely to the increased respiratory activity. In my own practice on scoliotic patients it is not uncommon to see an increase of 30 per cent. in the lung capacity, indicating a greater reserve movement and control in the abdominal and thoracic walls, and in the diaphragm, which is of undoubted value in all conditions requiring respiratory power.

Butler, of Brooklyn, has reported many cases of incipient phthisis in which deep breathing has been used as an accessory to overfeeding and rest, with marked improvement in weight and general health, but one must never forget that when the disease is active in the lung, deep breathing will only irritate and aggravate what nature attempts to splint by limiting the movement over the affected area, and in some cases a hemorrhage may be brought on from the ruptured walls of a cavity.

Hofbauer has devised an apparatus to record the expiration, neglecting inspiration. This stresses the expiration phase of breathing, and has been found extremely useful in curing emphysema and asthma. In some of the worst chronic cases a complete cure was realized with no recurrence.[1]

Rosenthal[2] gives the details of 19 cases of primary tuberculous pleurisy, in which great benefit was derived from respiratory exercises. They are a powerful means of influencing both the acute phase and convalescence of serofibrinous pleurisy while

[1] L. Hofbauer, "Exercises to Strengthen Expiration in Treatment of Asthma," Die Summtherapie des Bronchilasthmas.

[2] "Physiologic Respiratory Exercises in Serofibrinous Pleurisy," Archives Generales de Medicine, Paris, xlix, no. 1.

entirely harmless if done cautiously. The exercises should be unilateral, progressive, diaphragmatic, supplementing the ordinary measures during the acute phase and beginning with five or ten respirations through the nose with the patient reclining. The active dose is from forty to sixty respirations in series of ten. During convalescence these exercises can be repeated from three to seven times a week. These exercises counteract the tendency to adhesion of the pleura and to chronic pneumonia and local sclerosis. If supervised and kept up, the patients do not develop pulmonary tuberculosis later. The chest measure soon shows the benefit derived.

In the application of respiratory exercises every attendant condition should be made as favorable as possible at all times to get the best therapeutic results. Fresh air should be supplied in abundance, and treatment should be given in the open air or a well-ventilated room, for many of the disorders of the respiratory tract are due to the impurity rather than to the temperature of the air breathed.

In a letter to Miss Shipley from Benjamin Franklin, he anticipated the modern sleeping porch so widely used by a fanciful story in which an angel comes to Methusalem and says, "Arise Methusalem, and build thee a house, for thou shalt live yet five hundred years." And Methusalem answered and said, "If I am to live but five hundred years it is not worth while to build me a house, I will sleep in the air as I have been used to do"; and he concludes with the hope that we may be cured of the aërophobia that at present distresses weak minds and makes them choose to be stifled and poisoned rather than leave open the window of the bed-chamber or put down the glass of a coach.

CHAPTER XXVIII

EXERCISE IN THE TREATMENT OF DISEASES OF THE CIRCULATION

THE heart is a muscle capable of development and liable to overwork, and the arterial system shares intimately in changes taking place in the central organ of the circulation.

The heart may suffer from:

(1) Acute or chronic overstrain with dilatation, hypertrophy, and leaks at the valves.

(2) The accumulation of fat in the walls and pericardium.

(3) A slow hardening and degeneration of the heart wall and a lessened resiliency of the arteries with increased blood-pressure, known as arteriosclerosis.

(4) Anginal attacks, accompanying dilatation and caused by bodily or mental overexertion, frequently associated with arteriosclerosis.

(5) Actual distortion of the valves due to inflammatory action, associated with acute rheumatism, chorea, and certain other acute diseases.

In the fifth class the valves may become crumpled and the orifice reduced in size, causing stenosis, or the flaps may fail to meet, the blood-stream leaking back when the contraction of the chamber walls is over; and sometimes both conditions may exist in the one valve, each of these defects giving rise to a characteristic sound or murmur.

In the order of their seriousness, valvular defects may be classified as, first, and least dangerous, stenosis of the aortic valve (Fig. 414), overcome by a compensating thickening of the left ventricular wall; second, mitral insufficiency (Fig. 415), the blood regurgitating into the left auricle through an imperfect closure of the valve between it and the left ventricle during systole, causing overdistention of the left auricle, pul-

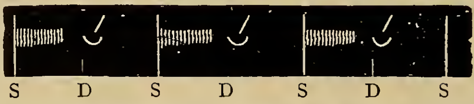


Fig. 414.—Endocardial heart-murmur. Stenosis of the aorta. A systolic murmur in the right second intercostal space (Vierordt and Stuart).

monary circulation, and right heart; third, stenosis, or narrowing of the mitral valve (Fig. 416), followed by an increase in

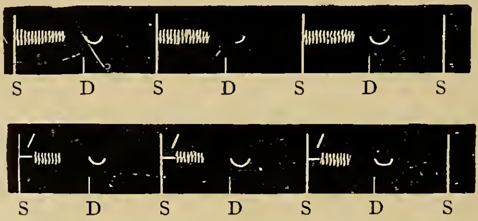


Fig. 415.—Endocardial heart-murmur. Mitral insufficiency. A systolic murmur at the apex of the heart (Vierordt and Stuart).

wall thickness and dangerous dilatation of the left auricle, embarrassment of the pulmonary circulation and right heart;

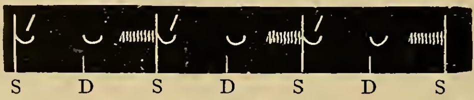


Fig. 416.—Endocardial heart-murmur. Mitral stenosis. A diastolic murmur at the apex, the first sound valvular or approximately so, if the second sound is heard at all (Vierordt and Stuart).

and last, insufficiency of the aortic valves (Fig. 417), which throws such an increased burden on the left ventricle that any

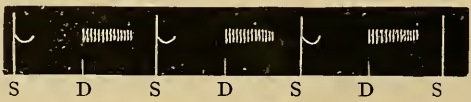


Fig. 417.—Endocardial heart-murmur. Aortic insufficiency. A diastolic murmur at right second intercostal space or, better, lower down to the left of this over the sternum (Vierordt and Stuart).

overstrain is liable to be suddenly fatal. This last condition is the usual consequence of the first, since the hypertrophy resulting from aortic stenosis soon gives place to dilatation of the aortic orifice and consequent regurgitation of blood in the left ventricle. The following table[1] shows the blood-pressure changes in most common cardiac affections. In combined lesions the change is usually that of the lesion that predominates. The normal pulse pressure is about one-third the systolic pressure.[2]

Nature of disease.	Systolic pressure.	Diastolic pressure.	Pulse pressure.
Aortic incompetence	Very high.	Low.	Much increased.
Aortic stenosis	Low.	Relatively high.	Much decreased.
Mitral stenosis with cyanosis	High.	High.	Decreased.
Mitral incompetence	Variable.	Variable.	Variable.
Heart-block	Very high.	High.	Much increased.
Dilated heart.	Low.	Low.	Decreased.

The physician in treating structural disease of the heart should be more interested in the ability of the heart muscle to do its work than in the structural changes of the affected valve. The heart muscle, if kept in a healthy state, will compensate for a damaged valve by doing extra work, and the function of all organs will be performed in a normal manner. So long as this compensation is complete the patient is, physiologically speaking, not diseased, and Sutherland has pointed out the frequency of irregular heart action and the occurrence of movements without other symptoms in young children.[3]

The heart takes part in a general strengthening of the musculature, and the proper use of rest and exercise as well as diet is of the utmost importance.[4]

In the chapter on Physiology of Exercise it was explained that by exercises of effort the blood-pressure was suddenly raised to nearly double the normal, falling quickly to its usual level with the cessation of the action; by exercises of endurance the rise of the blood-pressure followed the rise of pulse-rate,

[1] Table by G. A. Gordon, Edinburgh Medical Journal, January, 1910.

[2] Francis Ashley Faught, "Relationship and Value of the Systolic, Diastolic, and Pulse Pressure," N. Y. Med. Jour., Feb. 27, 1915.

[3] G. A. Sutherland, The Heart in Early Life.

[4] Joseph H. Pratt, M. D., "The Advance of Physical Therapeutics," International Clinics, vol. iv.

gradually declining until the end of the test, when it fell to subnormal and slowly recovered. Accompanying tests of either effort or endurance there is always a temporary dilatation of the heart as a matter of economy, and it is only when the dilatation becomes excessive and is accompanied by greatly decreased blood-pressure that harm results. The marked acceleration of the onset of fatigue and the slow recovery in the untrained or overtrained man is familiar to all who have seen such cases after violent and prolonged exertion. The difference between one acute overstrain and the continuous overtaxing of the circulatory apparatus was also explained. When the heart walls have acquired a certain degree of rigidity overstraining may produce permanent deterioration by breaking up the elastic fibers and causing the characteristic lesions of arteriosclerosis.

Arteriosclerosis must be expected among those in whom hard and exhausting labor is carried on for long hours under unsanitary conditions, among the mentally overworked, in whom worry and exhaustion is habitual, and in those whose advancing age and hardening tissues do not permit of the rapid recovery from overstretching that is found in the normal healthy youth. It is said to be the cause of death elected by great men, and the roll of its victims contains many distinguished names.

This obscure and ill-understood disease is ascribed to habitual overstrain of the heart, either from the excessive use of alcohol, overeating, continued mental strain, or from prolonged muscular overwork. It was first described by Peacock, about thirty-five years ago, as a result of observations made by him on Cornwall miners, who are especially subject to continual severe muscular strain. His observations have been confirmed by the investigations of Myers, Sir Clifford Allbutt, Da Costa, and others.

Arteriosclerosis is characterized by hypertrophy of the heart, high tension of the pulse and wide pulse pressure, rigidity of the walls of the blood-vessels, and the formation of calcareous deposits in the arterial walls. The process seems to begin by a breaking up of the elastic fibers of the vessel walls and the formation of scar tissue, which finally becomes calcareous. In the condition of atheroma the artery becomes hard and feels like a string of beads under the finger. The cause of this lowered nutrition in the vessel walls has been ascribed by Sir Lauder Brunton to the diminished pulsation of the vessel wall, caused by the high tension and the loss of the normal massage which produced in them a constant interchange of the lymph in the encircling sheath. Each time that the artery is dilated by the blood forced into it by the heart-beat the lymph is driven out of this sheath, while with the following contraction of the artery more fluid again flows in (Fig. 418). It is evident, he says, that if the difference between the size of the artery in expansion and contraction is great, there will be a correspondingly free circulation of lymph in the sheath of the vessels, but if the difference is very small the movement of the lymph will be slow and imperfect, the oscillation of the vessel being diminished, and it is a fact that con-

Fig. 418.—Diagram of the effect of the arterial pulse in aiding the circulation in the veins and self-massage of the artery: *A* is the artery, *V* the vein, and *S* the fibrous sheath which encloses them both, and also a lymph-space, which is shaded in the diagram. *A* shows the artery contracted during cardiac diastole with the vein distended with blood, and the space with lymph; *A'* is the artery distended with blood by the cardiac systole, which at the same time drives the venous blood along and empties the lymphatic space (Sir Lauder Brunton).

tinued high tension within the arteries leads to arteriosclerosis, to degeneration of the vessels, fibrosis, and atheroma, with increased liability to rupture causing apoplexy, or to cardiac hypertrophy and subsequent degeneration.

Prolonged muscular overwork may act as a cause of this condition by throwing into the circulation the products of muscular waste, particularly hypoxanthin, which itself, when injected into the vessels experimentally, will produce abnormally high-tension and atheroma. The continual presence of a systolic pressure of over 150 mm. of mercury must always be regarded with suspicion. When the diastolic pressure is low the suspicion of arteriosclerosis will be strengthened, and if the radial pulse cannot be entirely obliterated by pressure of the finger it will be confirmed.

Exercise Treatment.—The aim of exercise is to reduce a high pulse-rate by flushing the peripheral vessels, to postpone the onset of breathlessness by deepening the respiration and improving the muscular tone of the heart, to remove the encumbering fat which muffles its movements, and to prevent palpitation by acting both directly and indirectly on the cardiac nerves. For this purpose, exercises of effort and of endurance each have had their advocates.

Exercises of effort have been employed from the time of Ling to the present, with such advocates as Stokes, Bezly Thorne, Heineman, Groedel, Satterthwaite, and the brothers Schott at Bad Nauheim. They have always been confined to single efforts of the most simple kind with rests between, accompanied by massage and combined with regulation of diet and the administration of simple and carbonated brine baths.

It is in the method of giving and the dosage of exercise that authorities differ. Wide recommends kneading, rolling, and respiratory movements. He uses abdominal massage which, according to Levin's researches, can reduce an overexcited heart-rate, while Schott and others claim that abdominal massage should be prohibited, because it tends to inhibit the heart's action and so prevent aëration of the blood. Kellogg obtains good results from electricity in very fat patients by applying the sinusoidal current to different regions, and thus exercising the muscles without the exhaustion of voluntary effort.

All movements of the extremities, especially the legs, draw the blood out from the heart and abdomen and act as depletive influences. The back trembling given by Zander's vibrator has a powerful influence in reducing a rapid pulse, as have vibrations given along the back from the first to the fourth dorsal, or tapotement over the first dorsal. These procedures have the added advantages of being applicable to a patient who is bedridden, and to whom movements of the arms and legs must be given with the greatest caution. In slighter cases, particularly those in which the heart's action is impeded by deposits of fat, the endurance required for Oertel's *terrain cure* may be called upon. Sir William Stokes, as early as 1854, wrote of the necessity for such patients to "pursue a system of graduated muscular exercises" for the symptoms of breathlessness. He states: "This treatment by muscular exercise is obviously more proper in younger persons that in those advanced in life. The symptoms of debility of the heart are often removable by a regulated course of gymnastics or by pedestrian exercise, even in mountainous countries, such as Switzerland or the Highlands of Scotland or Ireland."

While the Swedes and the brothers Schott have since then emphasized the baths and the gymnastic side of this treatment, the *pedestrian exercise* was developed by Oertel into a system in which he combined walking and hill climbing with restriction of fluids. To the treatment by exercise he added the drying out of the tissues. He made his patients walk on mountainous roads of different steepness for a period strictly regulated, gradually increasing the time and steepness of the road. It is a form of athletic training beginning very cautiously and based on the principle that function makes structure, although in these pathologic conditions it must be kept strictly within the limits of resistance by the watchfulness of a physician. His system was founded on the result of treatment in his own case. He had kyphosis from a fall when a child, rickets, and a hereditary tendency to obesity, which became so marked when he was thirty years of age that the onset of dyspnea, cyanosis, edema of the legs, and a diminution of urine caused him to give up his practice. In 1875 he left for a mountainous district and spent there the month of August, where he first experimented with his ideas against the advice of his attendants, for at that time absolute rest was enjoined for such cases. The account of this first month is interesting.

The first and second days he made short excursions in the morning and afternoon on level ground and climbed a hill

100 meters high. Breathlessness and palpitation made him stop after taking about twenty steps on level ground and after ten in going up hill, while the heat and effort made him perspire profusely. The third day he climbed a hill 157 meters high. When suffocation seemed inevitable, he rested and found relief in taking forced breathing while resting. This excursion lasted six hours and he lost much weight from perspiration, but that night he had neither irregularity nor palpitation. In the second week he could climb a hill 527 meters high, but it took him four

Fig. 419.—Oertel's pulse tracing before beginning treatment (Lagrange).

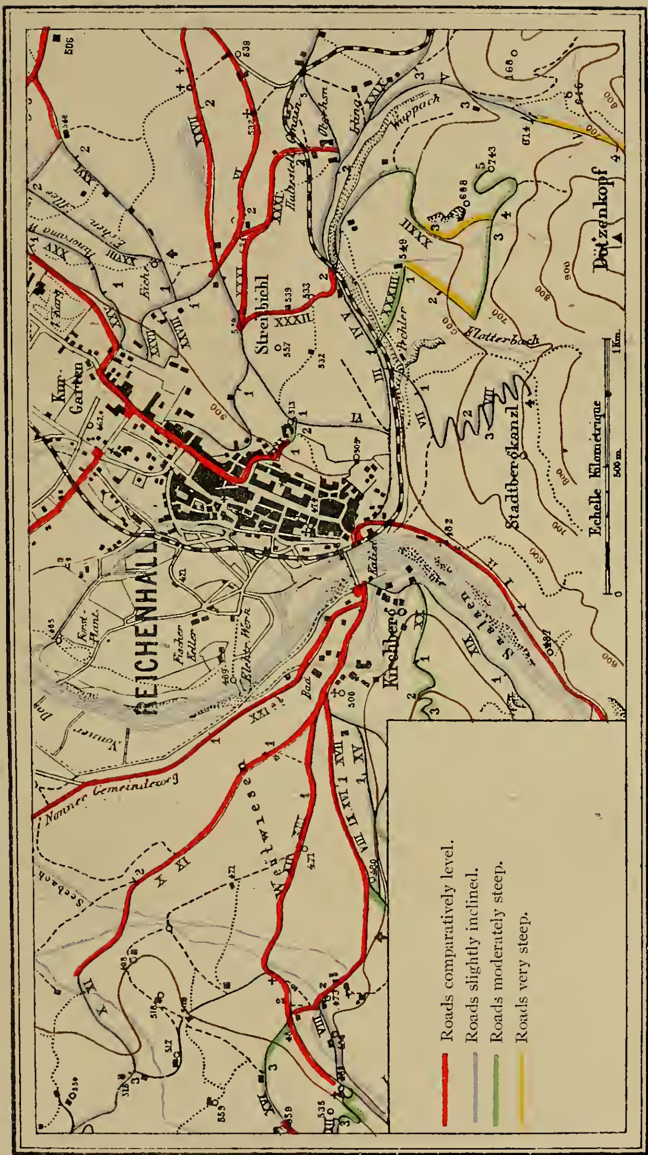
hours, twice the time for an ordinary person. He had to stop and rest 150 times. He had no evil effects that night. Owing to the profuse perspiration he had great thirst, which he relieved by gargling cold water, but he did not drink any more than usual.

After four weeks he began to take longer excursions and found that he could endure them with comparative ease, and, although breathlessness came on more quickly than it should, the normal action of the heart was rapidly re-established by resting.

Fig. 420.—Oertel's pulse tracing after six weeks' treatment (Lagrange).

In six weeks' time he returned to Munich and again took up practice, having reduced his weight 8 kilos. His pulse remained normal in ordinary walking (Fig. 420), and he could go up two flights of stairs without breathlessness. This improvement was kept up by periods of training and rest for eighteen years, when Lagrange saw him and reported him in excellent health.

PLATE IV



Red, roads comparatively level; purple, roads slightly inclined; green, roads moderately steep; yellow, roads very steep (Lagrange).

Shortly after his return to Munich he established his cures. The one at Reichenhall is typical, and a map shows the details (Plate IV). The course was regulated with care and minuteness. The paths were marked with stations, benches were placed for resting, and the trees beside the road had banks or flags of red, purple, green, or yellow, the colors representing the degree of its slant. The exercise was thus prescribed in degrees of increasing distance and steepness.

At the Battle Creek Sanatorium surveys have been made for a series of walks of increasing length and difficulty, and a formula given for calculating the amount of work done in foot pounds. This is given to the patient in pamphlet form, with hints about walking and cautions which greatly increase its value. According to the Kellogg formula, walking at the rate of 3 miles an hour on a level road is equivalent to lifting the body one-twentieth of the distance, so that if we divide the distance in feet by 20, add to this the height of hills climbed, and multiply by the body weight, the result will be the work done in foot pounds. As the country about Battle Creek is comparatively level, the walks must make up in distance what they lack in elevation. The following is a typical walk:

A $3\frac{5}{8}$-MILE WALK.

Street.	Distance. Feet.	Elevation. Feet.
Main entrance to Washington Ave.	155	
On Washington from Sanatorium Ave. south to Van Buren	672	
On Van Buren and Hart east to Union	6,723	
On Union south to Marshall	2,577	6.5
On Marshall west to Soldiers' Monument	3,550	
On Main west to Washington	4,135	15.2
On Washington north to Sanatorium Ave.	1,168	35.4
To main entrance	155	8
Totals	19,135	65.1

19,135 ÷ 20 = 956.7

Equivalent number of feet body is lifted 1022

Distance in rods 1160

Multiply 1022 by .... (body weight) = Amount of work done in foot pounds ....

The range of the Oertel cure is strictly limited. It is, first of all, a preventive measure, and can be employed with advantage to improve the general nutrition and to prevent fatty infiltration from becoming localized in the heart. Even in cases where this has already occurred it is still of great value, as it also is where the compensation has been already established by milder means.

Where compensation is broken down, and where the patient is compelled to remain in bed, massage and the milder treatment by gymnastics, which are under more accurate control, have better results. They act more directly upon the peripheral circulation by unloading the engorged veins without unduly overworking the heart itself, and such a course may serve as a good preparation for the Oertel treatment where it would have been dangerous to begin with it.

The application of massage and gymnastics has been taught and employed since the time of Ling, but it has been most carefully studied and perfected by Auguste and Theodor Schott[1] at Bad Nauheim. The treatment consists of regulated movements of the body, beginning at the extremities and employing the large muscle masses, combined with massage and the systematic use of carbonated brine baths, such as are found at the Nauheim springs. The effect of the baths is to stimulate and flush the skin, and so reduce the frequency of the pulse and increase its force. They can be prepared artificially.

The exercises are all duplicate movements, and each one must be slowly and evenly made, with a definite, firm effort on the part of the patient. A short interval should be left between them to enjoin slow and regular breathing and to prevent the possibility of heart-strain. The patient should be constantly warned of the danger of holding his breath during the effort, for by this act an undue and unnecessary strain is put on the heart walls already impaired by disease. The exercises should stop short of perspiration and palpitation, and the operator should

[1] Balneogymnastic Treatment of Chronic Diseases of the Heart, by Prof. Theodor Schott.

be on the lookout for dilatation of the nostrils, drawing down of the corners of the mouth, duskiness or pallor of the cheeks and lips, yawning, sweating, or palpitation.

The pulse should be frequently examined during treatment, and examination before and after treatment should show a constant reduction in the dulness over both the heart and the liver, accompanied by a sense of general relief and freedom lasting several hours. The pulse is increased in volume as its rate is reduced, and the breathing is made slower and deeper. The color of the lips and face is improved, and the size of the liver, when congested, is notably diminished. Marked diuresis usually follows after a few days' exercise.

The movements cover in regular order, first, the muscles of the arms and forearms; then those of the trunk, thighs, and legs, exercising mildly every important group in the body by single contractions.

While there are slight differences in the order as given by different practitioners, all unite in combining exercise with deep breathing; for example, in flexion of the knee the breath is slowly drawn in through the nose, and in extension it is expelled through the mouth. Each exercise is thus given slowly, at the rate of ordinary respiration, and is given once only, a minute's pause being allowed for rest.

The following is the order of the exercises given by Bezly Thorne, in his book on the "Schott Methods of Treatment." For further instruction in the position of the operator's hands and other particulars, the reader is referred to the illustrations. All the movements are done with resistance from the patient. This resistance must be made very mild at the beginning of the treatment, the tendency being to employ too much force. As the patient shows capacity for enduring the fatigue the amount of resistance may be gradually increased, but treatment should, if anything, err on the side of safety, especially if any signs of distress are noticed.

Fig. 421.

Fig. 422.

Figs. 421, 422.—*Exercise I.* Spread the arms (Fig. 421) until they are in line at the level of the shoulders. Bring them together (Fig. 422).

Fig. 423.

Fig. 424.

Figs. 423, 424.—*Exercise II.* Flex the forearm (Fig. 423). Extend the forearm (Fig. 424).

Fig. 425.

Fig. 426.

Figs. 425, 426.—*Exercise III.* Raise the arm sideways, palms upward (Fig. 425), until the thumbs touch above the head. Sideways lower (Fig. 426).

Fig. 427.

Fig. 428.

Figs. 427, 428.—*Exercise IV*. Press together the knuckles of both hands with the fingers flexed at the second joint. Raise the arms (Fig. 427) above the head. Lower the arms (Fig. 428) to the starting-point, in front of the abdomen.

Fig. 429.

Fig. 430.

Figs. 429, 430.—*Exercise V.* Arms forward raise (Fig. 429) until vertically above the head. Forward lower (Fig. 430).

Fig. 431.

Fig. 432.

Figs. 431, 432.—*Exercise VI.* Forward flexion of the trunk (Fig. 431). Extension (Fig. 432).

Fig. 433.

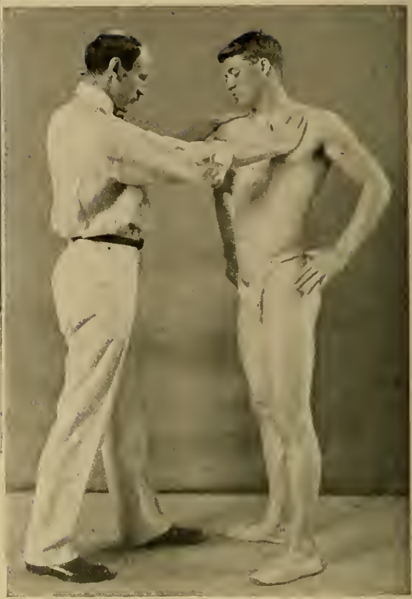


Fig. 434.

Figs. 433, 434.—*Exercise VII.* Trunk rotation. The operator must change his position from Fig. 433 to Fig. 434, as the patient turns, keeping up even resistance throughout the entire movement, and passing partially around him.

Fig. 435.—*Exercise VIII.* Flex the trunk to the right and to the left alternately. Straighten.

Exercise IX.—This movement is identical with Exercise II (Figs. 423, 424), except that the fists are clenched.

Exercise X.—This movement is the same as Exercise IX, except that the arm is at the side.

Fig. 436.—*Exercise XI.* Rotate the arm forward, upward, backward, and downward.

Fig. 437.—*Exercise XII.* Push both arms backward; draw them forward.

Fig. 438.

Fig. 439.

Figs. 438, 439.—*Exercise XIII.* Flex the thigh, with knee bent (Fig. 438). Relax. Extend the thigh (Fig. 439).

Fig. 440.

Fig. 441.

Figs. 440, 441.—*Exercise XIV.* Extend the leg and bring the straight leg forward (Fig. 440). Draw the leg backward (Fig. 441).

Fig. 442.

Fig. 443.

Figs. 442, 443.—*Exercise XV*. Flex the leg and thigh (Fig. 442). Extend the leg (Fig. 443).

Fig. 444.—*Exercise XVI.* Abduct the leg. Adduct the leg.

Exercise XVII.—Arms extended horizontally. Rotate forward and backward with resistance.

Fig. 445.—*Exercise XVIII.* Extend the hand. Flex the hand.

Fig. 446.—*Exercise XIX*. Flex the foot. Extend the foot.

This completes the full set of exercises. Each exercise is done once only and given very slowly. The resistance is strong, but the movement must not be jerky. A minute's pause is

Fig. 447.

allowed after each exercise and the pulse is taken after every three exercises. The resistance should be increased only as the patient shows the capacity to endure it. The rate should be slow and uniform, and abundant rest given until the individual's limitations have been gauged. Most of them may be done in bed if necessary.

Some form of artificial respiration may be profitably added to any treatment of these conditions, either in the forms already described or in the chest-raising or shoulder-raising (Fig. 447) described by Satterthwaite,[1] in which the patient inhales as the operator lifts and exhales as the operator relaxes. This is repeated eight to sixteen times, with one or two natural respirations between each movement. Satterthwaite has further modified the technic of the Schott treatment by arranging the exercises in series of progressing difficulty, all of which include massage of the thigh and back.

The following is a brief outline of the course of exercise carried on for the first two weeks:

Scheme No. I

1. Chest lifting, lying or sitting	2 minutes.
Intermission	1 minute.
2. Foot and leg massage	2 minutes.
Intermission	1 minute.
3. Forearm flexion and extension	1 "
Intermission	1 "
4. Hand and forearm massage	2 minutes.
Intermission	1 minute.
5. Leg and thigh flexion and extension	2 minutes.
Intermission	1 minute.
6. Arm and shoulder massage	2 minutes.
Intermission	1 minute.
7. Thigh flexion and extension	2 minutes.
Intermission	1 minute.
8. Chest percussion	2 minutes.
Intermission	1 minute.
9. Trunk flexion and extension	2 minutes.
Intermission	1 minute.
10. Thigh and back massage	2 minutes.
Total length of séance	28 minutes.

[1] Thomas E. Satterthwaite, Diseases of the Heart and Aorta.

This is increased in severity and the order slightly changed in Scheme II, which is carried on for the third and fourth weeks:

SCHEME NO. II

1. Chest lifting, lying or sitting	2 minutes.
Intermission	1 minute.
2. Foot and leg massage	2 minutes.
Intermission	1 minute.
3. Forearm flexion and extension	2 minutes.
Intermission	1 minute.
4. Hand and forearm massage	2 minutes.
Intermission	1 minute.
5. Leg abduction and adduction	3 minutes.
Intermission	1 minute.
6. Arm and shoulder massage	2 minutes.
Intermission	1 minute.
7. Trunk rotation	3 minutes.
Intermission	1 minute.
8. Chest percussion	2 minutes.
Intermission	1 minute.
9. Arm separation	3 minutes.
Intermission	1 minute.
10. Thigh and back massage	3 minutes.
Total duration of séance	33 minutes.

SCHEME NO. III

1. Chest lifting	2 minutes.
Intermission	1 minute.
2. Foot and leg massage	2 minutes.
Intermission	1 minute.
3. Quarter circling (forward and backward)	4 minutes.
Intermission	1 minute.
4. Hand and forearm massage	2 minutes.
Intermission	1 minute.
5. Head rotation or flexion	3 minutes.
Intermission	1 minute.
6. Arm and shoulder massage	2 minutes.
Intermission	1 minute.
7. Trunk twisting	4 minutes.
Intermission	1 minute.
8. Chest percussion	2 minutes.
Intermission	1 minute.
9. Trunk flexion (laterally)	4 minutes.
Intermission	1 minute.
10. Thigh and back massage	3 minutes.
Total duration of séance	37 minutes.

For the fifth and sixth weeks a further change in the series is made, and some new exercises are introduced that might not be well borne at the beginning of the course, particularly quarter circling and head rotation.

It will be noticed that in this final series the exercises involve newer and larger groups of muscles, and that all the great muscles of the body have been exercised. The duration of the séance is also longer, and more force should be applied. The movements should be very slow, and the intermission should be carefully observed, the fault of the operator being usually in shortening the intermission, increasing the amount, and using undue force. The patient should also be urged to breathe freely and naturally, and the operator should be on the lookout for irregular breathing, pallor, blueness of the lips or face, or any sign of personal discomfort or disturbance on the part of the patient. Upon the appearance of any of these signs exercise must be suspended, since they indicate that there has been undue resistance or that the movement has been too rapid or the intervals of rest curtailed. Heineman, of Nauheim, was strongly of the opinion that no exercise should be used in which the hands are brought above the level of the shoulders, on account of the increased work required of the heart in raising the column of blood to this unaccustomed height. With this opinion Satterthwaite agrees.

The exercise treatment is unusually successful in conditions of heart weakness complicated by obesity, where improvement should be noted from the first. It is of undoubted value in most valvular disease, with signs of failing compensation, the dilatation of the peripheral vessels resulting from the exercises being followed by an improvement in the strength of the pulse and a lowering of the rate, an improvement that may be maintained for years. In most cases the patients may return to their ordinary occupations and duties, and if signs of relapse begin to appear, the taking of a course is sufficient to re-establish the equilibrium until the heart shares in the inevitable degeneration of advancing age.

CHAPTER XXIX

OBESITY: ITS CAUSES AND TREATMENT

The excessive accumulation of fat must be considered as a symptom rather than as a disease. It is due to overnutrition, to underoxidation, or to a combination of both acting together.

When the allurements of the table are too great for the body's needs, the surplus is stored up as fat in the tissues least disturbed by muscular action, like the omentum and mesentery, and local deposits are made in the region of the abdomen and hips or in a general layer throughout the subcutaneous tissue of the entire body.

Heredity has a marked influence in this fat-making tendency, about 60 per cent. of cases reported by Anders having this history, while its association with gout, that other disorder of overfeeding and underexercising, was found in 43 per cent. of his cases.[1]

The normal oxidation of the ingested food may be hindered by a sedentary life involving little tissue waste from muscular exercise, or by the mental and physical torpor and habitual inactivity of the too ardent pupils of Silenus, whose fat is also protected from combustion by the rapidly oxidizing alcohol, which retards all tissue waste and so favors increase in bulk. It may also be hindered by lack of the proper functioning of the thyroid gland.

Fat is a cheaper form of tissue than muscle, requiring as it does a less abundant blood-supply, and its presence should be considered as an evidence of lowered nutrition.

As the amount of fat increases the desire for exercise diminishes, and the capacity for activity is lessened because of the speedy exhaustion that follows any unusual muscular work.

[1] See System of Medicine, Osler and McCrae, vol. i, 846.

the size of the thyroid gland noted, and a series of physical measurements taken, including the weight and girths.

In all diseases that impose increased work on the heart, like arteriosclerosis or emphysema, there is hypertrophy, with danger of dilatation and insufficiency, especially when the body is encumbered by excessive fat. The reduction of this fat constitutes one of the most valuable means in the treatment of most circulatory diseases, unless they are so far advanced as to render restoration of the heart to its functional activity impossible. Cases in which slight disorders of the circulatory apparatus are present give the most satisfactory results, while, even in advanced cases, improvement can be obtained by beginning gradually and watching the heart condition carefully. When complicated by diseases of the kidneys, like atrophic nephritis, obesity is a real menace, and the reduction is not contra-indicated, but advised (Von Noorden).

Chronic bronchitis is a frequent complication of obesity, and the removal of superfluous fat will enable the patient to breathe more deeply, encouraging a free circulation of blood through the lungs, so that such cases sometimes heal under this treatment alone.

Chronic articular rheumatism favors obesity by preventing the patient from moving freely, particularly if the regions of the legs or pelvis are affected. Anders found it in 35.5 per cent. of his cases. The same may be said of gout, the reduction treatment of which, through diet and exercise, is of the first importance. Most gouty middle-aged men present a history of violent indulgence in physical exercise during youth, followed by a luxurious and inactive later life, with overfeeding and excessive indulgence in alcoholic liquors.

In diabetes a reduction cure should never be undertaken, especially if the obesity be only slight or moderate, although in cases where it is excessive, accompanied by heart symptoms, the patient should, where possible, be relieved of any excessive fat. Only in this way can the heart be protected from excessive strain, but it should be used with the greatest caution.

In selecting cases for the reduction cure three considerations should be held in mind: first, the amount of inconvenience the obesity causes; second, the presence and extent of the complications referred to above; and third, the age and general nutrition of the patient.

When obesity is moderate or extreme the physician may be consulted from vanity, which may thus become one of the most powerful levers in his hands to insure the thorough and complete carrying out of the irksome rules that the patient must follow if the desired result is to be obtained. This seemingly trivial consideration is one on which the success of the treatment often hinges in the ease-loving, luxurious class from which so many of these patients come. In young and sound adults active courses of five weeks or more may be repeatedly undertaken with safety, allowing intervals during which the loss of weight is merely maintained. In those of advancing age, where the obesity is extreme and the vital energies are beginning to fail, a reduction cure would only accelerate decay and lead to rapid loss in strength and functional power, with the continual added risk of heart failure.

Reduction cures may be divided into three classes or degrees of rapidity:

1. The first degree, in which the loss is very slow, the patient losing 2 or 3 pounds a month. It applies to those with an enviable amount of fat which shows a tendency to increase. It does not require great sacrifice from the patient, who must alter her diet by the reduction of fat, starchy, and sweet foods, restrict or abandon alcoholic beverages, take only foods of small caloric value, and engage in regular active physical exercise.

2. The second degree, in which loss should be from 5 to 10 pounds a month, applies to strong, plethoric subjects, who can safely indulge in active exercise. The diet is more strict, and the exercise more varied. It is especially valuable for individuals in whom complicating disorders of the heart, arteries, bronchi, or digestive apparatus render it impossible to take from the start the more rapid or—

3. The third degree of the reduction cure, which should be carefully supervised and may be carried out at an institution with advantage. As much as 30 pounds a month can be lost with safety, but five or six weeks is the longest time during which it should be put in force. In most cases it will be necessary to carry it on for four to six weeks and then have a month or two of less strenuous exercise and regimen, repeating the course thus intermittently until the desired loss of flesh has been attained.

The reduction treatment falls under the three heads of diet, exercise, and drug therapy.

In diet the caloric requirements are reduced to four-fifths of the normal in the first course described, in the second to three-fifths, and in the third to two-fifths. This is obtained by substituting for more nourishing food such articles as bouillon, coffee, or fruits, which have small caloric value. Lean meats should be given preference. Cheese often serves a useful purpose, particularly in small quantities, as it is very filling. Milk is a useful addition to the bill of fare, buttermilk being still more useful. Among vegetables, those varieties that grow under ground, as well as those that grow in a pod, should be restricted, because they contain a large amount of carbohydrates. All the other vegetables are exceedingly useful articles of diet if they possess small caloric value in proportion to their bulk, and consequently fill the stomach rapidly, producing a sense of satiety. They also act favorably on the function of the bowels. Fruits of all kinds, with the exception of bananas, sweet grapes, figs, dates, and raisins, are permitted without reserve, as they have a low caloric value, are filling, and act well upon the digestive apparatus. Bread is satisfying to the eye without possessing great caloric value.

The intake of liquids must be strictly limited. The weight of an obese subject is rapidly reduced by restricting the liquids to a minimum. This loss of weight is apparent during the first four or five days of a cure, being due to a direct loss of water from the tissues by the air-passages, skin, and kidneys, and to the fact that one is inclined to eat less when not drinking freely. This rapid initial loss is of great value to the physician in giving a patient confidence in the method employed. She is put in the right frame of mind to persevere in carrying out the distasteful but stringent rules that must be enforced.

Boxers and jockeys who have to reduce their weight rapidly to a set figure, much below their normal, accomplish it by profuse sweating and abstaining from liquids. When excessive this is most exhausting to the system, and in making matches or contests it is frequently stipulated that the man be weighed six or eight hours before a fight, so that this abnormal loss of weight may be regained in part and the strength restored by eating and drinking copiously of fluids before the beginning of the contest. From 5 to 10 pounds may thus be gained in a few hours. Losses of weight up to 14 pounds in one and one-half hours have been reported during football games in men at the beginning of training by Professor A. A. Stagg of Chicago University and Dr. James Naismith of the University of Kansas, entirely and rapidly regained after eating and drinking.

The patient's general mode of life must be regulated, always a difficult feat to accomplish. Habits of ease and indolence should be replaced by greater general activity, and interest in outdoor games, like golf and walking excursions, should be created to impel her to take a large amount of general exercise. Not many patients have either the courage or perseverance to voluntarily undertake and persist in such a course of diet as that described by Sam G. Blythe in his interesting book, "The Fun of Getting Thin."

The influence of massage is very problematic, according to Von Noorden's experiment, referred to in Chapter XIX. He believes that the effect is more on the metabolism of the masseur than on that of the patient.

All the methods of treating obesity rest on the double rule of diminishing food and increasing elimination. Dr. Bergonié, professor of biologic physics and medical electricity at the Bordeaux medical school, obtains artificially intense muscular activity by causing an alternating electric current of 8 to 12 volts and of an intensity of 50 milliamperes to pass through the body of the patient with a frequency of 40 to 100 per second. The patient reclines over a large electrode, the other electrode covering the greater portion of the anterior surface of the body. Under the influence of the current all the important muscular masses (thighs, calves, buttocks, back, shoulders) are animated with muscular contractions sufficiently energetic to elevate the body, even when weighted down at the level of the thighs by a weight of 88 pounds (40 kilos) or more.

According to Dr. Bergonié's recent communication to the Academy of Sciences (*Académie des sciences*), and to the French Association for the Advancement of Sciences (*Association française pour l'avancement des sciences*), this treatment will cause a very rapid diminution of the weight of fat, if the patient is careful to maintain his diet at a ratio inferior to that which corresponds to his muscular outlay; it will, moreover, increase strength and resistance to fatigue. Kellogg obtains the same result by the sinusoidal current, which is less painful. It is, however, to the more active forms of exercise we must go for the best results.

When the accumulation of fat is unevenly distributed, a daily prescription of ten exercises should be given, to include the entire muscular system, but with emphasis on the regions where the deposit is thickest, for fat tends to accumulate in the subcutaneous tissue covering the groups that are dormant, like the abdominals or muscles of the neck. Such exercises have been shown in Figs. 255, 390, 392, 394, 401, 406, 407; Plate II, Fig. 2; Plate III, Figs. 1, 2.

When the omentum, mesentery, and abdominal walls are excessively overburdened, the exercises shown in Plate II, Fig. 2, and Figs. 392 and 394 are of special value. To these may be added the three following, and selection of about ten in all made to suit the special case:

Exercise I.—Patient lying supine, arms above the head, grasping a support. Raise both feet 12 inches without bending the knees. Alternately raise and lower the feet (Fig. 450) ten times without touching the table. The extent of the raising and lowering should not be more than 12 inches.

This brings the abdominal muscles into action, and should be repeated with rests up to thirty minutes.

Fig. 450.

Exercise II.—Patient lying supine, hands on the hips. Raise the head and shoulders until the feet can be seen. Twist to the right, to the left, and slowly return to the starting position (Fig. 451). This may be used as an introductory exercise to the next, in which the same muscles are employed with greater vigor.

Fig. 451.

Exercise III.—Patient lying supine with the feet fixed and hands clasped behind the head. Raise the body to the upright position, and slowly lower to the starting-point (Fig. 452). This may be accentuated by having the trunk overextended, as in Fig. 451, which is a form of the same exercise rendered more difficult by having the arms behind the head as shown in the position of Fig. 394.

A prescription should begin with the lightest exercise, and the dosage should be increased rapidly in length and severity according to the muscular strength and the condition of the pulse.

After each of the first two or three treatments massage is of distinct value in relieving the muscular soreness, but it seems to have no direct effect in reducing the weight.

Accompanying this gymnastic treatment, regulated walking, at first on level ground and then up an increasingly steep incline, is of the utmost value, beginning with a climb sufficient to produce moderate breathlessness, and increasing the length and

Fig. 452.

steepness as the patient's ability improves. Von Noorden calculates that an individual of 100 kg. climbing to an elevation of 1000 m. consumes at least 700 calories. This is the Oertel "terrain cure," as described fully in the previous chapter.

The elimination of fluids may be increased by the use of such aperient waters as those of Kissingen or Vichy, which are used on alternate days, one glass every morning before breakfast or at night.

The principal medicinal agent employed in reduction cures is extract of thyroid gland, given in doses up to 5 grains three times a day in thyrogenous cases, and stopped promptly if any sign of heart distress or weakness appears.

A daily treatment, such as outlined above, accompanied by proper regulation of the diet, should steadily and consistently bring down the weight in moderate and even extreme cases of obesity.

In one of my patients, a young lady aged twenty, it was reduced by these means from 208 pounds to 167 pounds in a period of four months, which included several weeks lost by interruptions. By a very much modified home prescription this improvement was maintained at the last examination, taken six months afterward.

The most remarkable case of reduction reported is that of George Cheyne, born in Scotland in 1671. By the time he was thirty his excesses in eating and drinking had brought his weight up to more than thirty-two stone (448 pounds), and made him very short breathed, lethargic, and listless. He dieted on milk and vegetables, exercised freely, and so reduced himself to almost one-third (150 pounds). He recovered his strength and lived to the age of seventy-two, writing an essay on health and long life.

During a reduction cure the heart should be carefully examined from time to time, and the work decreased if signs of palpitation or edema of the extremities are found. Otherwise the heart may be injured, and such a dilatation is apt to remain where there is but a small reserve of power on which to draw. It may be necessary to discontinue the exercises entirely or reduce them to slow-breathing movements alone.

An obese individual who attempts to reduce weight merely by undernutrition always incurs the danger of sacrificing body albumen and of reducing the strength of the whole body. This is avoided if muscular exercise is included in the course (von Noorden). Sometimes, when loss of weight is rapid and obtained by means of drugs and diet alone, without care to improve the muscle tone and so to support the viscera, certain complications arise (constipation, hernia, and gastroptosis), particularly in middle-aged and flabby women. Displacement of the kidneys and uterus may also be traced to the rapid absorption of the surrounding fat, and symptoms caused by such ptoses have in rare cases been found to be more troublesome than the obesity itself.

CHAPTER XXX

EXERCISE IN THE TREATMENT OF NERVE PAIN AND EXHAUSTION

Massage, vibration, and active exercise have a large place in the treatment of disorders of the nervous system as exhibited by pain or exhaustion, both local and general; by perversion of movements and function, or by actual destruction of the conducting mechanism for motion and sensation. By these means pain may frequently be controlled, jangling nerves attuned, exhaustion relieved, vagrant nervous manifestations brought back into their proper paths, and damaged or lost co-ordinations re-established.

Headache.—In myalgic headache the treatment is pre-eminently massage, which must begin by the gentlest form of effleurage. The points of induration having been made out and the painful areas outlined,[1] the treatment should begin by strokings with the thumbs or finger-tips, starting from the supra-orbital ridge upward and outward; the infra-orbital and mental nerves should be treated in like manner, also the occipitals. Such a treatment will last for four or five minutes, and may be varied by using the flat of the hand in slow circular frictions as tolerance is established. The temporal artery, which is hard and cord-like under the finger, will be found to relax slowly and the cold and bloodless area of its supply becomes suffused and soft.

Vibration can here be of value if the light brush applicator is used centrifugally along the course of the affected nerves, and care taken not to use too much force. The time should be only a few seconds, followed by a pause, and the entire treatment should not last more than two or three minutes at the most. The congestion may well be diverted by deep kneading

[1] White and Jelliffe, page 149.

of the muscle masses of the neck, throat, and shoulders. Many congestive headaches are accompanied by stiffness of these muscles, amounting in some cases to spasm, and slow, deep, and insistent kneading, with frictions along the course of the internal jugular veins, re-establishes the normal circulation and relieves the nervous tension. Drugs can reach such conditions but indirectly or not at all, and osteopathy and other manual cults fatten on these cases so often neglected by the average physician.[1]

Neuralgia.—In true neuralgia massage is of more value between the paroxysms, tending to lengthen the intervals (Graham) and lessen their severity, but one must not expect great results in a

Fig. 453.—Kneading and friction along the jugular veins to relieve congestion in the head.

condition which may depend on disturbances of the bony canals through which the nerves pass, or on such conditions as decayed teeth. The cause must be treated. The best manipulation is light effleurage, followed by gently kneading with the warm open hand. Firm pressure on the painful point at the exit of a nerve instead of aggravating it frequently benumbs it.

Vibration has taken an important place in the treatment of neuralgia since the experiments of J. Mortimer Granville. Acute sharp pain he likened to a high note in music produced by rapid vibrations, while a dull heavy or aching pain he likened to a low note produced by slow vibrations. A slow rate of mechanical vibration upon the nerve interrupts the rapid vibrations

[1] Jelliffe, Modern Treatment of Nervous and Mental Diseases.

of acute pain, while quick vibration arrests the slower ones of dull pain. He attempted to bring discord into the rhythm of morbid vibrations, and so relieve or cure the neuralgia by his instrument, the "percutor," in which the rate of blows could be changed at will. This was the forerunner of the modern vibrators.

Fig. 454.—Stretching the sciatic nerve.

Neuritis.—Vibration over the lower lumbar and sacral regions for inflammation of the sciatic nerve is frequently followed by immediate relaxation of the pain and muscular spasm.

In sciatic neuritis this treatment has been used with great success, either in the form of vibrations, as described above, or after the method of A. Symonds Eccles;[1] who starts with two daily treatments of five or ten minutes after the first few days of the disease, gradually increasing them to twenty minutes each. He uses friction and kneading directly along the course of the nerve and its branches, beginning at the heel and working upward.

Before giving a prognosis or undertaking treatment the diagnosis between neuritis and rheumatism should be made.

Muscular rheumatism is aggravated by motion and relieved by rest and warmth, whereas in a true neuritis the pain is worse at night, while the patient is warm and at rest, and wears off when he is up and moving about.

The relief from discomfort and the freedom of motion experienced after each massage is great, although but temporary,

[1] The Practice of Massage.

and repeated massage, extending throughout the necessarily slow recovery, increases materially the patient's comfort. In the later stages, when the pain is almost gone and stimulation is well borne, hacking movements and deep vibration across the nerve are added. Passive movements in which the thigh is flexed, the knee-joint being kept in extension, stretch the nerve and frequently give relief (Fig. 454); and, finally, toward the end of the treatment, active movements are of value in counteracting the atrophy that results from inaction and the disease itself.

Graham deprecates the use of massage over the sciatic nerve, and confines his manipulations to the muscle masses of the front and sides of the thigh, with gentle stroking only on the posterior aspect of the limb. Where hacking and percussion are used the movements should be gentle, and any increase in the pain after massage should be a sign to desist.

Massage is not well borne in brachial neuritis, especially during the acuteness of the attack, and absolute rest is then essential. Only in the later stages may it be employed, and then with precautions to avoid a re-awakening of the inflammatory process.

Rheumatism.—In muscular rheumatism or myositis massage causes absorption of the exudate. The hard nodules that can be made out in the lumbar fascia and muscles disappear, pressure on the nerve filaments is relieved, and minute adhesions are broken down. The relief is frequently instantaneous in acute cases, and in chronic the progress is steady toward cure, unless the treatment be made too severe and the tissues unduly irritated or bruised.

Occupation Palsies.—Among the most easily awakened and persistent pains due to the interference with the nerve is that due to *exhaustion*, caused by the persistent overwork of one group of muscles, known collectively as *occupation neuroses*.

Scriveners' palsy has become comparatively rare with the increased use of the typewriter, but exhaustion neuroses are frequent among piano-players and violinists, baseball pitchers, and telegraph operators.

While no morbid anatomic change can be made out, this trouble appears to be the result of an exhaustion or overexcitability of the centers controlling the muscular movements most involved. The symptoms are cramps and spasms of the muscles, weakness and debility, extending even to paralysis, tremors, a feeling of great tiredness, with acute shooting pains, and sometimes a subacute neuritis with pain, numbness, or tingling in the fingers. These conditions run at best a chronic course, which can be greatly shortened if perfect rest from the habitual movement and daily massage and manipulation with simple gymnastics be applied. Lauel also recommends superheated air. One of my cases, a violinist, a nervous girl of fourteen, had fatigue pains coming on rapidly and numbness of the third and fourth fingers of the left hand. A daily course of friction and kneading of the fingers and small muscles of the hand, forearm, arm, and shoulder, accompanied by manipulation of the joints separately with a few simple gymnastic exercises for the fingers separately and together, brought about a complete recovery in about two months, enabling her to resume her study. This is an unusually favorable result, and under the best of conditions the tendency to relapse must be kept in mind.

In another of my cases, a student, the weakness and pain was confined to the flexor surface of the thumb and first finger and the flexor surface of the forearm, with occasional tremors; after writing for ten minutes the pen would drop from his hand. These symptoms came on again after a five months' rest, in which no writing was done. His hand was cold and weak, and he was quite unable to go on with his college course. Daily treatment with massage of the hand and forearm enabled him to finish the five months necessary to complete his session, but the danger of relapse was always imminent if he undertook any unusual task.

Much trouble could be prevented by avoiding the cramped style of writing that keeps the muscles of the thumb and fingers in continuous contraction. An attempt has been made to do this by J. Liberty Tadd, who teaches drawing by great free-arm movements, using either or both hands at the blackboard, and also by the Palmer method of writing for school children, which is designed to enable the pupil to write a clear, legible, and graceful hand, while at the same time he gains the commercial rate of speed.

This method of writing brings the entire arm into play. The hand is not allowed to rest on the paper. While the strength of the fingers alone moves the pen, several additional sets of muscles are brought into action. The physical effort of writing is thus distributed among several groups and the local fatigue is greatly reduced. A much freer swing is imparted to the hand and a greater speed may be obtained. The commercial writer, the clerk who has worked for years, often falls unconsciously into this method, which he finds will enable him to write faster and with less effort than others. The pupil who is trained by such a method from the beginning therefore learns what the skilful clerk has taught himself as the result of years of experiment.

The whole arm is used in writing instead, as is often the case, merely the finger muscles. The movement of the muscles of the fingers is extended as far as the shoulder. The fulcrum should be below the elbow. The movement of the arm is, therefore, comparatively slight; the forearm moves back and forth like a piston, with short, rapid strokes. If the movement be directed from the upper arm and the shoulder, the effort is unnecessarily increased. This system also makes it possible to sit erect, with the body free from strain.

The regularity of movement is as carefully watched as in music. A jerky, spasmodic motion may be found reflected in the letters. Many teachers use some regular method of marking the time of making parts of letters. In some cases a metronome or musical instrument is employed, while others merely beat time with a ruler and a chalk box.

Neurasthenia.—The exhaustion of a single group produces a local effect only, but with a general exhaustion we find the long train of constitutional symptoms that may be grouped under the heading of *neurasthenia*, or general exhaustion of the nervous system with its distressing train of pains and perversions of nerve function.

The discovery of the "rest treatment" by Weir Mitchell in 1874, and its development in America and abroad following publication and translation into seven languages of his book "Fat and Blood" in 1897, attracted attention to rest and massage for these conditions. Rest could not be given without providing means for the assimilation of the increased amount of food given in his system of overfeeding. Elimination of waste would not take place unless stimulated by artificial means to meet the artificial conditions under which the patient was placed, so that hysteria or neurasthenia require massage and resistive movements for their complete management.

In Weir Mitchell's treatment for these disorders he first counteracts the evil effects on the digestion of overfeeding and continual rest in bed by massage and gymnastic movements, to reaccustom the patient gradually to the muscular tasks of daily life.[1]

His custom was to begin with a general massage after the first few days of milk diet, the hour chosen being midway between two meals, the patient remaining in bed. The operator starts with the feet, continues the manipulations up each leg, then to the muscles of the loins, spine, abdomen, and chest. The order of movements is described in the chapter on Massage. The entire treatment lasts about one-half hour, and is gradually increased up to one hour, followed by one hour of rest. This is continued for at least six weeks, and then one-half hour is devoted to massage, and the other one-half to movements of flexion and extension of the limbs and trunk with resistance. In the less severe cases confidence is put in the more active forms of exercise. One young man referred to me by him began by wrestling exercises, in which at first he did little more than gently resist the various positions, locks, and throws. The resistance gradually increased in force and duration until, at the

[1] S. Weir Mitchell, Jour. Am. Med. Assoc., June, 1908.

end of three months, he had gained 16 pounds in weight, and had improved so much in strength, courage, and vigor that he was sent home cured. Other cases derive the greatest benefit from an active outdoor life, in which camping, swimming, walking, riding, and wrestling form a great part of the day's program.

Exercise should be made as simple and interesting as possible, the object being to improve the nutrition to the utmost without unduly exhausting the attention or overtaxing the coordination. For this reason, exercise demanding skill and concentration like fencing should be avoided.

CHAPTER XXXI

TIC, STAMMERING, AND CHOREA

There are certain functional disturbances of the nervous system that show themselves in spasmodic habit movements of the face and body like blinking and torticollis, in disordered co-ordination of speech like stammering and stuttering, and in choreiform movements of the body.

They may be classified under the general term *tic*, and are all psychoneuroses, often varying directly with fatigue and partly restrained by the will. They are physiologic acts that have become meaningless through inco-ordination and pernicious habit. The treatment must be the re-education of co-ordinate movements and the training of the patient to break up the harmful neuromuscular custom.

The inhibition gymnastics of Oppenheim lay great stress on training the patient to voluntarily inhibit a reflex. A pointed instrument is approached to the eye of a blinking patient, who is admonished not to blink. The patient is touched and instructed not to start away as formerly. The exercises aim to train the will and control. In his exercises Brissand strives to replace abnormal by normal movements, and especially to train the patient in immobility where they have an uncontrollable desire to move, just as does Oppenheim. He gives them treatments three times a day, each one short enough to avoid fatigue and to maintain the interest of the patient. In these exercises the antagonistic movements should be used; for example, drawing the mouth to the left where the habit is to twitch it to the right. Slow, deep breathing with the back to the wall, arms raising and lowering as in Figs. 406, 407, Pitres' method, makes a good introduction to a treatment, while sports and games demanding attention, skill, and accuracy (p. 79) are of marked value.

Under treatment the prognosis is good, except in defective subjects.

Certain special forms of *tic* require special treatment. Charles K. Mills[1] treats aphasia in a purely pedagogic way by repetition of letters, words, phrases, and sentences, recognized by the patient in reading or after seeing or touching.

Cramps and hypertonicity of the breathing muscles, of the laryngeal muscles, and of those of the palate, tongue, and lips used in articulation, must be treated in somewhat the same way. In E. W. Scripture's *melody cure* he begins to teach the patient to speak melodiously, using little verses and sliding the voice somewhat excessively. Then he is taught to speak and converse with melody, to break up his old habits of speaking. He makes great use of gestures to distract the mind from the vocal apparatus and the snap and vigorous beating of time to music. He begins with an exercise, such as forearm raising, inhaling and lowering, exhaling. This is repeated, singing "Ah," and then with the other vowels, then singing "Ah" on middle "C," running up to upper "C" over the octave with words of one syllable, in order to break the monotony of the voice and give it flexibility.

The high-pitched falsetto or eunuchoid voice, which occasionally occurs in men otherwise normal, can be corrected, according to E. E. Clark, by a course of vocal gymnastics and singing exercises, beginning with a note of high pitch and then singing down the scale until the lowest possible note on the register is reached. The voice is then kept at this pitch, and the low notes are repeated ten or fifteen times. The patient is then taught to read aloud in the deep tone secured by singing his way down the scale. G. Hudson-Makuen secures the same result by training the patient to lower the position of the larynx during phonation.

Where the utterance of intelligible speech is hindered or prevented by the convulsive and disorderly contraction of the muscles of respiration, phonation or articulation exercises of

[1] Journal of the American Medical Association, December 24, 1904.

skill must be employed almost exclusively, to restore the disordered co-ordinations and to teach correct habits of breathing, phonation, and articulation.

Stammering occurs in about 1 per cent. of school children. The London County Council report (1909), covering 19,303 children, showed speech defects of some kind in 1.95 per cent., of which 1.3 per cent. were stammerers. Statistics show about 1.22 per cent. in the German schools, whereas Hartwell's figures show about 0.78 per cent. among the children of Boston.

Stammering is exceedingly contagious in a class and rapidly spreads among school children, making schools veritable nurseries for stuttering, according to Melville Bell.

Fig. 455.—The points of contact between the tongue and palate in the formation of the sounds L, R, and K (G. Hudson-Makuen).

It has been attributed to the forcing of their education before the brain is sufficiently developed to govern the power of vocal utterance, so that a course of treatment would begin with gymnastic exercises such as described in Chapter XXVII for the breathing muscles, the first to function in the development of the child, while, later on, the muscles of phonation, and, lastly, those of articulation are trained. Treatment would thus be based on the preliminary development of the fundamental and intermediate mechanisms, ending with the finest and most specialized co-ordinations.

Audible speech is caused by the blast of air driven from the lungs by the muscles of expiration through the slit of the glottis, bounded by the vocal cords, whose approximation is varied by the laryngeal muscles, into the mouth, where it is formed and modified by the muscles of the palate, tongue, and lips. The complete production of speech then is effected by a co-ordination of muscles in the chest, throat, and mouth respectively.

Stammerers will tell you that a prolonged struggle to speak is followed by a cramped exhausted feeling at the waist line, below the point of the sternum, a direct result of abnormal action of the diaphragm.

G. Hudson Makuen lays special emphasis on the difference between ordinary passive breathing and the breathing of voice production or "artistic breathing," the function of passive breathing being simply to aërate the blood and eliminate waste matter, while breathing for voice production is to set the machinery of the voice in motion and to control this motion as a definite voluntary muscular process. The first muscular act in

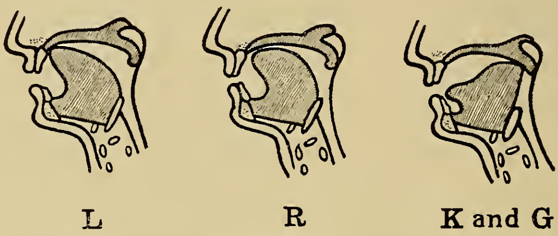


Fig. 456.—The position of the tongue in producing the sounds L, R, and K (G. Hudson-Makuen).

breathing for voice production is a slight inhalation, putting the respiratory muscles and the thorax into active position. He finds that nearly all speech defectives fail at this point. When this is done properly the column of breath raised upon the diaphragm is ready for its impact against the vocal cords, an impact which must be made with the greatest nicety and control. This movement of expiration for voice production he attributes to the depression of the lower ribs by the diaphragm, a muscle of inspiration in ordinary respiration but of expiration in artistic breathing, in which it pulls the ribs downward and inward. Proper co-ordination of the intercostal and abdominal muscles, in addition to this action of the diaphragm, is, of course, essential to the production of good tone.

Among the respiratory exercises given at the Lewis Phonometric Institute of Detroit are high-chest breathing, costal breathing, abdominal breathing, holding the palms over the region which is to be emphasized (Figs. 401, 402, 403). In diaphragmatic breathing the breath is inhaled by forcing down the diaphragm and expanding the entire circle of the waist. In this he is not in accord with Makuen's theory of artistic respiration. Effusive breathing is also practised, a natural emission of the breath on the sound of the letter H. This is increased to expulsive breathing, a more forcible or explosive breathing violently exhaled on the sound of the letter H.

Treatment of stammering should start by training respiratory co-ordination by itself—first, by articulating a series of syllables, using for each a single expiratory effort, next by exercising the muscles that control the vocal cords, and then by training the co-ordination between the muscles of expiration and the laryngeal muscles, since many stammerers vocalize at the wrong time, there being no column of air ready when the cords are in the right position, or vice versâ. Finally, the muscles of the pharynx, the palate, the tongue and the lips, the organs of articulation which mold the voice into speech, are trained for their work. Where there is an organic defect in them, such as a shortening of the muscles, cleft palate, or harelip, this must be corrected, and the rest becomes a purely educational process.

Care must be taken to distinguish between lack of development, faulty habits, and disease in the speech center of the brain, for in the last class of cases the outlook is hopeless.

The entire treatment of functional stammering and stuttering is based on the physical training and co-ordination of the mechanisms of speech, the proper use of the muscles of respiration with reference to voice production, the training of the vocal muscles, and the education of the muscles of articulation. Exercises are given to instruct the patient in the elementary sounds of the language, how to shape the lips, or where the tongue is to be placed, and this training requires patience and perseverance until the defect is finally overcome. The success that has attended Hudson Makuen's clinic on speech defectives is in great part due to the care with which the breathing and vocal exercises are graded, and the excellence of his discipline in enforcing their accurate, thorough, and persistent practice.

There goes on hand in hand with these exercises a progressive training of the will, of concentration, of attention, and of self-confidence. The training of confidence spells victory in many cases. Mental uncertainty and doubt are inveterate enemies to the stammerer, the training of concentration and will-power being necessary if he is to maintain his improvement and prevent the constant tendency to relapse.

Chorea is a disturbance of co-ordination characterized by irregular involuntary contractions of the muscles, accompanied by psychic disturbances and frequently by endocarditis. It occurs especially in abnormally bright, active-minded children, who are forced ahead of their grade in school and are subject to the excitement of competition for prizes. Girls are three times as liable as boys. Will S. Monroe sent an inquiry to twenty-one teachers, thirteen of whom had 1 or more cases in each of their schools. Of the 24 cases, 16 were girls.

While there are no constant anatomic changes found in the nervous system, the tendency to endocarditis is such that in 110 cases of autopsy the effects were noted in nearly 100. Because of this great liability to endocarditis the heart should be carefully examined in all cases. The presence of a murmur, however, does not indicate endocarditis, since the disease occurs most frequently in nervous young girls in whom heart murmurs are almost the rule. The duration of an attack is very variable, from two or three weeks to the same number of months, with an average of about eight or ten weeks.

The disease is easily spread by psychic contagion, hence the necessity for early diagnosis and isolation.

Every choreic child passes her novitiate of restlessness—muscular twitching of the arms, shoulders, and legs, awkwardness in the execution of delicate tasks, exaggerated movements of the face muscles, wrinkling of the forehead, and knitting of the eyebrows, early evidences that are apt to be overlooked or misunderstood.

Teachers should be on the lookout for abnormal movements in the muscles of the face and hands, alteration in the pupil's temper, the loss of willingness and ability, unusual signs of mental or bodily degeneration, headache, or pains in the limbs. Perhaps the best index is the hand. Bid the child to hold up both hands openly with extended arms and palms toward you. If this is done steadily, both hands upright and both alike and nothing to choose between the positions of the two, then the child has not, nor is it near, St. Vitus' dance. If there is tremor of the thumbs and fingers when the hand is placed on yours, palm to palm, suspicion would be aroused.

The treatment of the acute attack consists of rest, isolation, and tonics. Where the jerky movements have abated the application of general massage is of value, and the importance of gymnastic exercise cannot be overestimated during convalescence. When the acuteness of the attack has subsided, the treatment should begin with massage for the first few days, followed by simple, slow, passive or resisted movements, in which the limb is held quiet for a few minutes, and then rhythmic passive movements in which the patient should take no active part. The patient will oppose these movements by the inco-ordinate jerky efforts due to the disease. Later on, rhythmic exercises sufficiently active to tire the muscular system moderately will be in order. These should be done with the patient by herself, if possible, and any excitement or competition of class drills should be sedulously avoided. If the exercises are taken in company with others, the patient should be placed in the back row of the class.

The keynote of such treatment is the rhythmic repetition of simple movements to overcome the irregularity of the twitching, and great strain on the attention or fatigue of the patient should be eschewed. The practice of simple dancing exercises to music is of the utmost service, emphasizing the rhythm and taking away the mental strain necessary to follow movements done to command.

CHAPTER XXXII

INFANTILE PARALYSIS FROM ANTERIOR POLIOMYELITIS

ANTERIOR poliomyelitis is a lesion which destroys or impairs the motor paths found in the anterior horns of the spinal cord.

It is probably a specific infection, although the history of a fall or other accident so frequently precedes an attack that it is difficult to consider it as a mere coincidence. When no such history exists the onset is without warning, and varies from slight feverishness to violent vomiting, high fever, and retraction of the head. The resulting paralysis follows in its severity the severity of the acute attack in a general way. Next morning the paralysis may be noticed, or it may not be observed for weeks, especially in young children in whom the wasting of the muscles is completely masked by the presence of fat, and the coldness of the limb may be the first symptom to cause anxiety.

While the paralysis is "characteristically random" (Gowers) and seems to vary in different epidemics, the following statistics shows the relative frequency of the regions involved:

TABLE SHOWING THE DISTRIBUTION OF PARALYSIS IN 1322 CASES OBSERVED BY DICHENNE, SULIZMULLER, SINKLER, STARR, MACPHAIL, LOVETT, AND LUCAS.

Region.	Cases.
Left leg	382
Right leg	348
Both legs	345
Arm and leg, same side	59
All four extremities	54
Right arm	35
Abdomen and trunk	32
Left arm	28
Three extremities	16
Arm and leg, opposite sides	15
Both arms alone	8
Total	1322

In the Lovett and Lucas series of 478 cases, in which the legs were affected, the anterior group (extensor longus digitorum and proprius hallucis) were affected in 92; the internal group (tibialis anticus and posticus), in 40; the external and peroneals, in 31; and the posterior group, in 45, the most frequent combination being the posterior and internal (34), the anterior and internal (29), and the anterior and external (27). The tibialis anticus alone was affected in 95 cases.

It will thus be seen that the internal group are most frequently affected, either singly or in combination. The quadriceps of the thigh was the muscle most frequently attacked (305 cases) by itself, or as one among several groups.

Deformities make their appearance sooner or later in neglected cases. They result from the weight of the body coming on the structures imperfectly supported by paralyzed or weakened muscles, or by the weight of some part dragging and stretching these structures. The foot may turn in, the knee may become overextended, the hip dislocated, or scoliosis and winged scapulæ may appear. Another series of deformities are the result of muscular action unopposed by their natural antagonists. These unopposed muscles cause distortion of one or more joints by their continual pull, which is not balanced by their paralyzed or weakened opponents. Such deformities are flexion of knee and hip, scoliosis, and various distortions of the foot, accompanied by muscular contractions on the shortened side.

It can be predicted in advance what deformity a definite muscular paralysis will produce. The following table from Lovett and Lucas[1] gives the chief deformities of the foot and their causes:

Deformity.	Resulting from paralysis of—
Varus	Peronei.
Valgus	Anterior tibial. Posterior tibial. Both tibials. Flexor longus hallucis. Whole leg (weakened). Complete paralysis.

[1] Journal of American Medical Association, vol. li, 20.

Deformity.	Resulting from paralysis of—
Equinus	Anterior muscles paralyzed or weak. Complete paralysis (from dangling).
Equino varus	Anterior muscles (with persistance of flexor longus hallucis). Anterior and external group. Paralysis apparently complete. Anterior and internal muscles. Anterior muscles and weight-bearing.
Calcaneus	Posterior muscles.
Calcaneo valgus	Posterior muscles and one or both tibials.

The groups involved may be discovered by wasting of the muscles, by electric stimulation, and by careful examination of the actions that the patient can perform. The voluntary movement present must be estimated with great accuracy, and

Fig. 457.—Incorrect position for testing the action of the triceps.

Fig. 458.—Correct position for testing the action of the biceps.

the difficulty of this has been insisted upon by Beevor, in his Croonian Lectures on Muscular Movements (1903).

Among the fallacies that may occur are the confusing of the action of gravity for muscular action. A slow relaxation of the active biceps may be confounded with contraction of the triceps when the bent arm is slowly straightened when hanging at the side, whereas if the arm be first flexed, and the elbow be held at the level of the shoulder and the patient told to extend it, he will be unable to do so (Figs. 457, 458).

Another error that must be guarded against is the crediting of a muscle with contractile power when the movement is the result of the action of accessory muscles. In flexing the arm

Fig. 459.—Correct position for testing the action of the flexors of the elbow. The swinging of the arm is thus prevented.

where the biceps is affected, the contraction of the supinator longus and brachialis anticus may disguise the true lesion. The habit that patients acquire of jerking the arm or leg upward or forward, and so simulating the movement of muscles which are actually inert, must also be detected (Fig. 459). These fallacies should be demonstrated to the patients themselves or their parents, in order that they may not be deceived as to the actual condition present. During the acute onset of the disease, and the days of pain and sensitiveness that follow, absolute rest, with support of the limb in its normal position, is essential to prevent the overstretching of the weakened muscles. In a week or ten days, when friction and movement can be borne without pain, the *reconstruction* treatment may be started. The weakened muscles must be kept in a relaxed position, for overstretching has a marked influence in producing degeneration of an impaired group. A splint should be fitted on the leg and foot to keep the ankle at right angles and prevent the pressure of the bedclothes from overextending it. This point has been well insisted upon by A. H. Tubby and Robert Jones.[1] The circulation must be fostered by extra covering. A paralyzed limb is colder than its fellow. An extra flannel sleeve or leg or a sheath of rabbit skin will raise the temperature and give the muscles and joints the blood-supply necessary to keep up their nutrition and prevent atrophy. By such means the shortening of a leg during the growing period may be avoided. The action of impaired muscles must be cultivated with the greatest solicitude, keeping up their tone and nourishment by massage, voluntary movement, and electricity.

There is almost always present in a paralyzed limb some muscular power and action that is latent and unsuspected, and it will not become available unless cultivated and developed.

In this part of the treatment the co-operation of the parents and patient is essential. It is an educational rather than a medical problem, and what can be done by intelligent co-operation of doctor and parent has been well described by Earl Barnes in the account of his little daughter's case, which I can recommend for the encouragement of parents with a similar problem.[2]

Both ingenuity and perseverance are required in devising

[1] Modern Methods in the Surgery of Paralysis (Macmillan & Co).

[2] Earl and Anna Barnes, "A Case of Infantile Paralysis" (privately printed); also "The Education of A Partially Paralyzed Muscle," Earl Barnes, Transactions of International Congress on Hygiene and Demography, Washington, D. C., 1912.

and carrying out the voluntary exercise so necessary to awaken the latent action of an impaired muscle. Strapping the feet to a tricycle which is pushed about; supporting the weight under the arms by a frame on wheels which just allow the feet to touch the floor, will help to start the first movements in the limb. Placing the child in a bath and having the movements done under water will sometimes reveal a slight action that was prevented by the weight of the leg. This may be advantageously combined with salt and the benefits of salt-water bathing added. Exercise may be done before a mirror, and care must be taken in designing them not to overexercise the strong groups and so increase the deformity.

A daily program of massage and exercise should be written out and conscientiously adhered to; as Earl Barnes says, "Nowhere in the long process of recovery is there any place to stop nor any reason to be discouraged."

Massage should be started as soon as the pain and sensitiveness have disappeared. It should be done twice a day if possible and not less than once in twenty-four hours. Deep pressure and rolling of the tissues in one or both hands alternating with slow frictions from the periphery to the center are best, the object being to act on the blood-supply and nutrition of the muscles and joints. The heat of the hand in massage and manipulation also has a helpful influence on the circulation. Owing to the expense of a trained masseur the mother should take instruction in the art, so that it may be kept up continuously at home or abroad, and from time to time her work should be inspected and corrected by an expert. Manipulation of the joints should also be systematically practiced to keep the muscles and ligaments normally stretched and to prevent contractures and deformity. It is probable that the passive movement of a joint throughout its normal range has a direct influence on the nerve-centers whether normal or impaired.

Vibration is of value in stimulating the circulation and its administration is readily learned, although the tendency is usually to give too much. Two minutes over and about a joint with the medium stroke of the vibrator is sufficient for a treatment.

One of the chief difficulties in the administration of electricity is the pain, which is badly borne by young children. The sinusoidal current is the least painful form, and by its means rhythmic contractions of the muscles can be obtained sometimes where voluntary action is impossible. While its use is limited to this action it should not be ignored. The groups to be treated should first be placed in a relaxed and shortened position, and the application should never continue more than two minutes on one muscle.

The *prognosis* for complete recovery in a long-paralyzed group is not good, but gradual restoration of power may continue throughout years, depending on the thoroughness of the treatment. Neglected cases quickly develop contractures and deformities, with stretching and strophy of the weakened muscles and shortening of the affected limbs.

The treatment by braces and tendon transplantation does not come within the scope of this work, but braces at least are almost always required during some part of the treatment.

In Earl Barnes' carefully observed case we find that "M," at eighteen months, had a complete paralysis of all four limbs, with recovery in arms only in two weeks, then slow recovery in the right leg and later on in the left. After eight years persistent treatment her back is straight, and the only persistent deformity is a slight shortening of the left leg ($\frac{7}{8}$ inch) and absence of power to flex the left foot. She can walk miles, swim, and play all the games of other children of her age. If neglected she would have had club-foot, the left leg would have been greatly shortened with pelvic displacement and marked scoliosis, and consequently more or less invalidism.

This case is typical of many in which similar good results are obtained by the intelligent and persistent application of these corrective and educational methods.

CHAPTER XXXIII

TREATMENT OF LOCOMOTOR ATAXIA BY EXERCISE

Habitual movements, such as walking, are accomplished with harmonious muscular action and the least possible muscular effort.

The movements are performed accurately, exactly, economically, and gracefully. When such movements become jerky, exaggerated, wavering, or chaotic we call them *ataxic*. This condition or symptom is present in many diseases of the nervous system. Lesions of the cerebrum, cerebellum, spinal cord, and peripheral nerves may induce it, but the most frequent cause is *tabes dorsalis*, or degeneration of the posterior roots and columns of the spinal cord, produced by exposure to cold, syphilis, or some other acute poisoning of the nerve tissue.

In reading the literature on this subject one is struck by the multitude of theories and the inadequacy of any one of them to explain all the symptoms.

The hypothesis that is of most interest in connection with the application of exercise is that of Edinger, called the *exhaustion theory*, which is that the cells of the body are normally in a state of equilibrium, one with the other, so that if a cell becomes weakened by disease other cells lying about it will crush it out in their growth. Again, when the amount of work required from a group of cells is too great, even if their vitality be perfectly normal, they may succumb simply from their inability to recuperate and regain the loss of tissue due to their excessive activity. A similar condition is found in occupation palsies. The nutrition of the cells may be impaired through toxins circulating in the blood, especially if they have a selective action on certain parts of the nervous system, and nearly 90 per cent. of tabetic patients show a history of *syphilis*. The *exhaustion* theory would help to explain the frequency of the first appearance of ataxia in the lower extremities, the neurons governing them being constantly employed in the maintenance of equilibrium.

Cases may be cited where ataxia has first appeared in the arms owing to overfunctioning. One case reported by Mott occurred in a mounted policeman, in whom the symptoms started in the arm with which he held the horse's reins.

In tabes the sensory nerves may be affected, and the eyes show a characteristic optic atrophy with the Argyll-Robertson pupil. Men being more exposed to these fatigue influences than women, we would expect to find its frequency greater among them, and the proportion is actually about ten to one. James Stewart noted its frequency among lumbermen who have lived a hard life in the logging camps during the winter and spring months.

The relief of ataxia does not affect the underlying structural change, yet this symptom is so distressing that its alleviation is among the greatest boons of therapy.

The motor symptoms are first noticed as increased clumsiness, especially in the dark, or difficulty in maintaining the equilibrium when washing the face with the eyes shut (Osler). When the patient stands with feet together and eyes closed he sways to the point of falling if the surgeon does not steady him (*Romberg's symptom*). On turning or stopping quickly he is apt to fall. He leans upon a stick in walking, the eyes fixed on the ground, the body inclined forward, and the legs wide apart. The leg is thrown out violently, the foot raised too high and brought down with a stamping movement on the heel. In the arms it may be first noticed through his difficulty in buttoning his collar, or in other simple acts. With comparatively advanced ataxic symptoms he shows little alteration in the size, strength, or nourishment of the muscular system. There is, however, always present in typical cases along with certain sensory disturbances *hypotonia*, or lack of muscular tone, which allows the stretching of muscles and permits the joints to move far beyond their normal range (Fig. 460).

The ataxic symptoms may be classified as (*a*) abnormally rapid movements; (*b*) exaggerated muscular exertion in performing simple actions; (*c*) prolonged contraction, continuing after the movement has been completed; and (*d*) jerky staccato progression.

Although ataxia is the only symptom of tabes dorsalis that can be reached by exercise, it is frequently the one symptom which keeps a patient bedridden, the others not being severe enough to interfere with his regular course of life.

The exercise treatment is based on the possibility of educating the impaired central nervous system and re-establishing the

Fig. 460.—Hypotonia of the muscles of the pelvis and spinal column (Frenkel).

lost or enfeebled co-ordination and sensibility. The symptom against which it is directed is a motor disturbance, which has its origin not in a diminution of the muscle's motor power, but in a loss of sensibility in them, and it is based on the capacity of the neuromuscular system for education so long as the motor apparatus itself is intact. It consists in relearning the habitual movements disorganized by disease, a task which in principle is identical with the acquisition by a healthy person of a complicated feat involving a nice adjustment of muscular action, such as juggling or balancing. Reliance must then be placed mainly on exercises of skill, alternating with passive movements and massage, as a relief to improve the nourishment of the muscles without continuing the demand on the rapidly tiring will-power.

The exercise treatment of ataxia has been popular for many years in Sweden, and was used forty years ago in America by Dr. Weir Mitchell, but many of the devices employed have been invented by Frenkel, of Heiden, and are for the first time described in his work on tabetic ataxia,[1] from which some of the accompanying illustrations are taken. The treatment depends on *four rules*—namely:

(1) The initial movements are simple and uncomplicated.

(2) The succeeding movements are carefully graduated in difficulty.

(3) The movements are conscientiously performed.

(4) The movements are directed by the aid of vision.

Fig. 461.—Walking exercise.

The initial simplicity of the exercise varies with the extent of the disability. In attempting to rise from a chair the tabetic patient usually neglects to draw the feet backward, and so finds himself unable to rise without assistance. He has to learn this simple co-ordination all over again.

Movements of walking forward, backward, and to the side with steps of measured distance should next be practised. For this purpose the floor may be painted with black lines, or with footprints at measured distances (Fig. 461). If lines be drawn zigzag on the floor the continual change of direction makes this walking exercise much more exacting to the patient, and any irregular pattern on a carpet can be used for this purpose. When these simple movements have been mastered, walking up- and down-stairs with the use of a banister should be practised. A special stairway, designed by von Leyden, has two

[1] Tabetic Ataxia, by H. S. Frenkel (Blackiston & Co).

banisters, and the steps are cut so that the foot must be placed down accurately at each step (Fig. 462).

The greatest precautions must be taken to prevent the patient from falling in this exercise and so becoming timid or discouraged. A belt with a handle or strap attachment should

Fig. 462.—Dr. von Leyden's stairway used for exercises to re-educate the lost co-ordination in locomotor ataxia cases (Pennsylvania Orthopædic Institute and School of Mechano-Therapy (Inc.), Phila.). (Courtesy of Dr. Max J. Walter.)

be placed about the waist, and an attendant should always be ready to catch him if he shows signs of losing his balance. Exercise of the lower extremities can be carried on in bed, where the disease is too far advanced to permit of walking or standing. He is told to touch the great toe of one foot with the heel of the other, then to run the heel upward along the front of the shin to the knee (Fig. 464) and back again. Another exercise is the placing of the heel of either foot in notches cut in a board, as shown in the illustration (Fig. 465). If the patient be seated in

Fig. 463.

front of a set of movable pins, he can exercise by kicking them in turn, the attendant naming the one that he must touch with his foot (Fig. 466).

Fig. 464.

Simple movements such as these will cause rapid exhaustion, and the pulse-rate must be carefully watched and the exercise stopped short of fatigue.

The upper extremity may be trained by taking a wooden block, about 18 inches long and triangular in section, so pre-

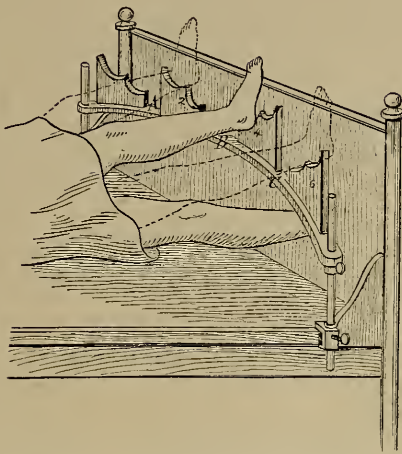


Fig. 465.—Notched board (Frenkel).

Fig. 466.—Dr. von Leyden's ten-pin arrangement used for the re-education of lost co-ordination in locomotor ataxia cases (Pennsylvania Orthopædic Institute and School of Mechano-Therapy (Inc.), Phila.). (Courtesy of Dr. Max J. Walter.)

pared that one edge remains sharp, a second beveled off, while the third has a curved groove. The block is placed on a table in front of the patient in a position indicated by the drawing (Fig. 467), with the grooved edge up. He is requested to draw the point of a stout pencil or pointer along the groove from the farther end of the block toward him, at the same time holding his fingers and wrist-joint perfectly stiff. The object of the exercise is to teach him to keep his arm raised in a definite position and to make simple excursions in the horizontal plane.

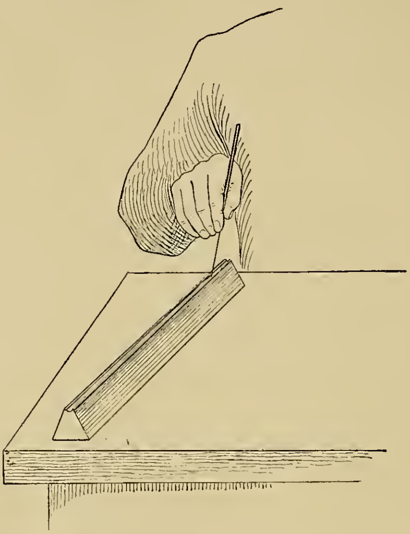


Fig. 467.—Triangle block for the hand co-ordination (Frenkel).

This exercise is by no means easy, especially when the pencil has to be held with the slightest force. At first it will often leave the groove, but with practice its progress becomes more steady, although scarcely ever free from wabbling.

It is usually a great surprise to a patient on his first examination to find that he is unable to place his finger to his nose with the eyes closed. This simple exercise may be practised and varied in numerous ways. Frenkel uses a perforated board (Fig. 468), the tip of the forefinger being placed in the numbered hole called out by the attendant. It can be made more difficult by having him insert pegs into the holes.

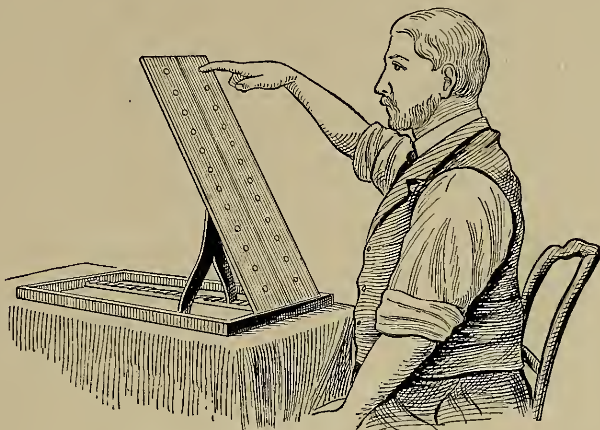


Fig. 468.—Perforated board (Frenkel).

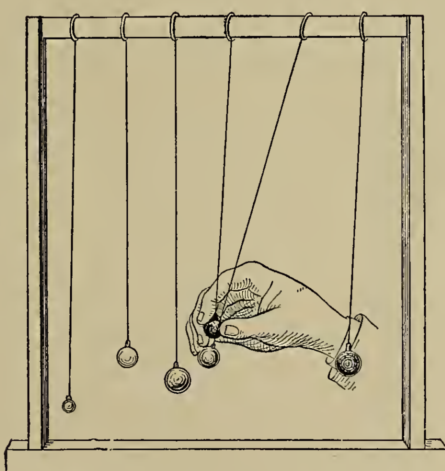


Fig. 469.—Colored balls swinging (Frenkel).

When this co-ordination is sufficiently improved he may be advanced to the catching of colored balls swung from a horizontal bar and caught on the swing (Fig. 469), and he may be set to copying diagrams with a pencil. As soon as he shows signs of flagging interest his task should be replaced by another set of exercises.

Along with these set of exercises he should be trained in the useful operations of dressing and undressing himself, helping himself at the table, using pen and ink, and other procedures that come up in the course of the day.

The exercises are useful only when the attention is fully concentrated on them. This necessity for concentration, and the excessive muscular exertion required to perform simple acts, the fear of accidents, and the annoyance which he feels, especially at the beginning of the treatment, because his limbs will not obey orders, all combine to produce rapid and profound fatigue, and the practice of any movement should not be continued for longer than three or four minutes. In severe cases, where nutrition is impaired, one-half to one minute will be quite sufficient until he has become strong enough to bear the strain of longer-continued practice, and no new exercises should be begun until there is complete recovery from the excitement and fatigue of the previous one.

John K. Mitchell[1] gives the exercises used in the Philadelphia Orthopædic Hospital, recommending their simplicity and availability for use in a private house. The only apparatus used is a short flight of steps and a wall ladder. In bad cases exercises begin with simple flexions of the legs, the patient recumbent, head raised so as to see the lower limbs. These are continued in mild cases for three or four days, alternating with massage. As he says, "An ataxic may collapse without a moment's notice."

Maloney advocates certain important modifications of the *Frenkel treatment*, based on the fact that the blind show less impairment of co-ordination than patients whose vision is normal. He also emphasizes the power of fear to aggravate or precipitate ataxia in those not previously afflicted. His treatment consists of:

[1] A. P. E. Rev., vol. xiv, p. 346.

(1) The teaching of muscular relaxation.

(2) The instruction of blindfolded patients in co-ordinate movements.

(3) The minimizing of fear.

The only apparatus he requires is a mask to blindfold the patient and some strips of linoleum of varying width. So blindfolded, the patient is placed recumbent and instructed to relax in turn the muscles of the neck, trunk, upper and lower extremities, to eliminate all misdirected muscular contraction which may have arisen from ill-judged attempts to balance and concentrate the attention upon the muscular sense impressions.

This differs from Frenkel. By blindfolding the patient he claims that the enormous amount of attention pre-empted by vision is liberated and can be devoted to the more accurate interpretation of posture. The movements given are first passive, then duplicate, and, finally, active, the joints being taken in turn. He begins progression by creeping with carefully padded knees on a strip of linoleum, which serves to give direction. From creeping the patient graduates to walking barefoot on linoleum strips, which is narrowed as skill advances.

Tabetic patients have more or less completely lost the sense of fatigue, consequently, in determining whether he is tired or not, signs of inattention, quickened breathing, and rapid action of the heart will be the most reliable guides. The pulse usually rises to 120 or even 160 beats a minute, in direct proportion to the difficulty of the movement. It should be the routine practice, therefore, to examine the pulse at the beginning of the treatment and frequently throughout it, and to interrupt the work by a period of rest as soon as the pulse-beats approach 150.

The interval of rest should last until the heart-rate approaches normal again, although in most cases the pulse will remain a trifle above its usual rate. If it becomes unduly frequent after slight exertion it is a sure sign of tabetic cachexia, and such patients must be treated with the greatest caution.

The exercises are for co-ordination and not to increase the muscular power, therefore exercises requiring much expenditure of strength are not of proportional value as a training in co-ordination and so must be considered harmful.

Two periods of exercise a day are the average rule of practice. To go beyond that is to go into the danger zone, unless each séance be made short and the patient is robust and determined to make rapid progress, in which case three periods may be given. In the morning he takes the movements designed for the recumbent position, which are the easiest. In the afternoon he may have fifteen minutes of walking exercise with frequent rests. If the amount be properly regulated, each successive exercise should be followed by an increase in control, so that at the end of a period he should feel more fresh and vigorous than before starting. It is wise in some cases to substitute for one period a general massage or electric treatment, which has the great advantage of resting the patient's will and attention and improving the nutrition.

The unfailing certainty of the improvement, and the fact that it is the improvement of a symptom caused by an organic lesion, attaches unusual interest to this treatment. The hypotonia and common sensory symptoms may remain practically unaffected, although very frequently they seem to improve, probably because the patient's mind is diverted from pain and directed to the acquirement of muscular skill. The improvement in muscular control may remain for years, and when the ataxia does increase again a course of exercise will once more bring it under control.

The ideal result would be the restoration of the normal accuracy, control, and velocity of the movements, a result which Frenkel claims to have achieved in many cases. The restoration in locomotion is, however, generally sufficient to enable the patient to resume his usual business or profession, and this is all that may be expected. In one case coming under my own observation, treated by John K. Mitchell at the Orthopædic Hospital of Philadelphia, and not by any means an unusual one, a miner from California, who came bedridden accompanied by an attendant, improved to such an extent that he was enabled to travel across the continent by himself and resume the active management of his mines.

In giving a forecast of the progress to be expected in any case the natural disposition, the alertness, and the ability for muscular exercise must be found out and given full weight by the surgeon. The more skilful patients will make more rapid progress, and the best results are obtained among those who have been accustomed to work demanding dexterity, or who have been successful devotees of athletic sports, men who have lived a good deal in their muscles, and who have at one time had the muscular sense well developed.

Another important factor is the patient's personal courage. Apprehensive or cowardly patients will not risk the slightest movement without support or attention, and will have to practice for a long time before much definite improvement can be noticed. William Burdick reports the case of a contractor and builder who, from a houseridden invalid, recovered to the extent of being able to walk along the 2-inch stringers in the third story of a house he was building.[1]

The longer and more thoroughly a course is continued, the more certain and lasting will be the improvement, and the closer will the patient approach to the normal in motor capacity and accuracy of movements.

[1] "A Study of Functional Exercises in Some Nervous Diseases," New York Med. Journal, September 10, 1910.

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