

of the nation, but it goes to the making of character and conscience in school and nation. The plays and sports of a people, when guided by conscience, make for toleration and forbearance; for strength which makes littleness and petulance unseemly; for world relations which are self-conscious and direct; and for an effectiveness on occasion which uplifts free institutions in the eyes of all mankind. Life in the open gave us Lexington and Concord and Bunker Hill, and life in the open must make good the assurance that "there they will remain forever."

PHYSICAL TRAINING AT HARVARD.

BY

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If the work of Dr. D. A. Sargent, the director of the Hemenway Gymnasium, at Cambridge, Mass., were expunged from the field of gymnastics it would be found that America's original contributions to the cause of physical training have been comparatively, until recent years, few. But with his inventions America is able to make a very respectable showing of originality. His "chest weights" in their various forms, and his other machines in the American gymnasium, give it an individuality and a national character that it would otherwise lack.

The athletic clubs, the Young Men's Christian Associations, and most of the college gymnasiums have adopted Dr. Sargent's ideas very largely, and the following extracts from his address before the Physical Training Conference are, therefore, useful in describing the practices of those gymnasiums as well as that at Harvard under Dr. Sargent's immediate supervision:

That you may understand what the system is in its present form, as carried out at Harvard University, let me ask you to follow me through one of the physical examinations of a student, and see what we do for him. Every student who enters the university is entitled to an examination, and 87 per cent. of the whole number avail themselves of this privilege.

As soon as the student presents himself at the director's office (which is done by application and appointment), he is given a history blank, which he fills out, giving his birthplace, nativity of parents, occupation of father, resemblance to parents, natural heritage, general state of health, and a list of the diseases he has had, all of which information is absolutely necessary in order for the examiner to put a correct interpretation upon the observations to follow. The student is then asked to make certain tests of the muscular strength of the different parts of his body and to try the capacity of his lungs.

He then passes into the measuring room and has his weight, height, chest girth, and fifty other items taken. His heart and lungs are then examined before and after exercise, and a careful record made of the condition of the skin, muscles, spine, etc., which the tape measure fails to give.

All the items taken are then plotted on a chart, made from several

thousand measurements, and the examiner is then able to know the relative standing of this individual as compared with others for every dimension taken, also his deviation from symmetry and the parts which are in special need of development.

To confirm the plotting of the chart, and to awaken in the young man a genuine interest in his physique a photograph of each student desiring it is taken in three positions, and preserved for comparison with those to be taken of him later.

From the data thus procured a special order of appropriate exercises is made out for this student, with specifications as to the movements and apparatus he may best use. At the present time this special order consists for most students of an illustrated handbook, in which the apparatus, the weights for it, and the times to use it, are carefully prescribed, together with such suggestions as to exercise, diet, sleep, bathing, clothing, etc., as will best meet the needs of the individual under consideration.

Now I think it will be admitted by all thoughtful persons that one-half the battle for mental education has been won when you arouse in a boy a genuine love for learning. So one-half the struggle for physical training has been won when he can be induced to take a genuine interest in his bodily condition, to want to remedy his defects, and to pride himself on the purity of his skin, the firmness of his muscles, and the uprightness of his figure.

Whether the young man chooses afterwards to use the gymnasium, to run, to row, to play ball, or saw wood for the purpose of improving his physical condition matters little, provided he accomplishes that object.

The modern gymnasium, however, offers facilities for building up the body that are not excelled by any other system of exercise. The introduction of the new developing appliances has opened up the possibility of the gymnasium to thousands to whom it was formerly an institution of doubtful value. The student is no longer compelled to compete with others in the performance of feats that are distasteful to him. He can compete with himself, that is, with his own physical condition from week to week, and from month to month. If he is not strong enough to lift his own weight, the apparatus can be adjusted to a weight he can lift. If he is weak in the chest or the back, he can spend his time and energy in strengthening those parts without fear of strain or injury.

In fact he can work for an hour, going from one piece of apparatus to another, keeping always within the circuit of his capacity, and adding slowly and surely to his general strength and powers of endurance. If the heart is weak, the lung capacity small, the liver sluggish, the circulation feeble, or the nervous system impaired, etc., special forms of exercise can be prescribed to meet these conditions.

Gentle running is usually advised as a constitutional exercise for all of those who can take it. This is usually severe enough to start the

perspiration and make a bath of some kind desirable. A tepid sponge or shower bath is generally advised; and in my opinion, the bath which regularly follows the exercise at the gymnasium, and the habit of bathing established thereby, is almost as valuable as the exercise itself.

After a period of six months or more the student returns again to the director's office, and has another examination, in order to ascertain what improvement he has made and to receive any new suggestions.

This, in brief, is the educational part of the system of physical training carried on at the Hemenway Gymnasium. . . . Now let me invite your attention to a consideration of some of the theories and principles upon which it is founded.

"The characteristic physiological property of muscular tissue, and that for which it is employed in the body," says Martin,* "is the faculty possessed by its fibres of shortening forcibly under certain circumstances." This property is called contractility, and upon the full performance of this function depends not only the healthy condition of the muscles, but of the various parts of the body with which they are connected.

Now, what are the circumstances under which a muscle performs its greatest contraction?

First. There must be a succession of strong and oft-repeated stimuli. Second. The muscle must have a load to carry or resistance opposed to its shortening.

This can be illustrated by the experiment so often conducted in the physiological laboratory. Take a muscle without a weight attached to it, and apply a stimulus. The muscle will contract, say a quarter of an inch. Now apply a weight of 1 pound to it and apply the same stimulus. The muscle will contract half an inch. Attach a still heavier weight, say 2 pounds, and apply the same stimulus, and the muscle will contract 1 inch.

And so the experiment could be carried on until a weight was attached which would cause the contractions of the muscles to be less and less until they finally ceased. "So that up to a certain limit, resistance to the shortening of a muscle makes it more able to shorten, and the greater extension of the muscle due to the greater resistance opposed to its shortening puts it into a state in which it is able to contract more powerfully."

Upon the interpretation of this simple physiological fact depends the foundation of two great systems of physical training—one faction advocating that the antagonizing muscles in free movements, without apparatus, furnish all the resistance that is necessary; while the other faction claim that the resistance afforded by opposing muscles is not sufficient, and that weights of some kind, or apparatus, are necessary to bring out the working force of the muscle used.

I believe that the last conclusion is the correct one. . . .

*"The Human Body" (chapter x.), by H. Newell Martin, D. Sc., M. A., M. D.

We saw in the laboratory experiment that when the muscle simply lifted its own weight it did no work, and that nothing was accomplished when it tried to lift a weight too heavy for it, but that there was an intermediate weight that it lifted to the greatest height and did the greatest amount of work.

What is true of this single muscle is true of all the muscles of the body; there is a certain weight with which the different groups of muscles can do the most effective service in a given time. If the weight is too light or too heavy the best effect of the exercise is not realized.

This may be illustrated by the familiar use of the chest-weights (so called). If you go through the movements without any weight the exercise is insipid. If, on the other hand, you load the boxes up to their full capacity you will find that there are only one or two movements that you can do, and these only for a minute or so. Now, if you have carefully gauged your strength to about five pounds (which is, perhaps, the average weight used in these appliances), you will find that you can go through the full set of exercises (comprising some forty or fifty separate movements) and feel that you have accomplished something that will be a benefit to you. This statement is equally true of all the different developing appliances found in a well-equipped gymnasium, and to the fact that our modern apparatus can be adjusted to the strength of the strong and the weakness of the weak, may be attributed a large part of the value and popularity of those thriving institutions.

But there is another principle now taken advantage of, to which the modern gymnasium owes a great part of its efficiency. In view of the tendency of the times I cannot help thinking that it is a valuable one.

In primitive races individuals of the same tribe bear a close resemblance to each other. As they progress in civilization difference of function begins to work a difference in structure, and we begin to get a marked variation in size, form, and feature.

In highly civilized communities the minute division of labor carries this variation still further, so that it is not only possible in many cases to distinguish individuals by their calling, but the particular branch of work in which they are engaged can be easily determined by its influence upon their physical structure. In other words, men are moulded by their trades and occupations, and many of the diseases with which they are afflicted arise from physical defects due to faulty positions and want of appropriate exercise. Perhaps no class in the community have their physical characteristics more marked than the student class. The type may be distinguished by a drooping head, flat chest, hollow back, and constricted ribs just over the stomach. It is not necessary to look for the causes of these defects. They are faulty positions while studying, pressure of the desk against the body, the constriction of clothing during the growing period, the relaxed state of certain muscles, and the overstrained condition of others.

Most occupations, including that of the student, tend to overuse the flexor muscles and to compress and constrict the body, thus lessening its internal capacity and interfering with the functions of important organs. Thus, the resistance of the clothing, weights lifted and borne on the back or shoulders, and even the use of heavy dumbbells for health's sake all tend to force the ribs downwards and lessen the diameter of the thorax. To remedy this evil a system of artificial exercise is necessary.

Just here we touch upon a principle that has escaped the attention of most teachers. If this deformity is brought about by the natural action of the muscles—that is, by their acting centripetally from their origin to their insertions—surely the remedy is to make them act centrifugally from their insertions to their origins. By grasping a bar or a pair of rings above the head, the parts where the muscles are inserted become fixed, and if the muscles contract, the parts from which they originated must move.

In this case all the diameters of the thorax are increased and the chest capacity enlarged. In this principle lies the value of the rings, trapeze, ladders, parallel and horizontal bars, and, in fact, all of the climbing appurtenances, to those who are able to use them. By the invention of the chest-expander, chest-developer, quarter-circle, high pulleys, and inclined planes, travelling parallels, and similar apparatus, the same principle can be applied by any one, however weak, and the same result can be accomplished. It requires a little more time, but the effect is likely to be more durable.

By the use of the pulley-weight system resistance can be applied to any part of the body from any direction. In this peculiar property lies its great value as a means of enlarging the thoracic cavity and counteracting the cramping and constricting tendencies of modern occupations.

I have dwelt upon these principles at some length because I have reason to believe they have not been well understood by persons interested in the subject. Some of the other theories that have guided me in formulating a system of exercises I shall state briefly in the form of a summary, together with those I have just mentioned.

As far as I have been able to discover, they are based on sound physiological principles.

(1) The person should be sufficiently interested in the exercise to give it his attention in order to secure the necessary volitional power to start the movement. Whether the exercise is interesting in itself is a matter of little consequence.

(2) There should be a weight or resistance to overcome in order to bring out the working force of the muscle. In using a weight the muscle gradually acquires the force with which it tries to contract.

(3) The exercise must be performed with sufficient vigor and rapidity to engage the energetic contraction of the muscles employed. When this is done, old tissue is broken down and its place is supplied

with new material in increased quantity, thus augmenting the size and strength of the muscles. The brain gains the power and energy which the exercise requires it to put forth.

(4) Weak parts must first be strengthened, and then as many muscles as possible must be brought into action in order to secure a full-orbed and harmonious development of the whole body. One-sided development is usually attained by robbing some other part of its just share of the body's nutriment. Most persons in their daily occupations use the flexor muscles more than the extensors, thereby cramping the vital organs and interfering with their functions. To remedy this tendency the muscles should be made to act from the centre as far as possible in all forms of artificial exercise.

(5) A sufficient number of muscles should be called into action at one time to stimulate the action of the heart and lungs and increase the circulation and respiration. This is one of the most important considerations to bear in mind in regard to exercise. To keep up this increased respiratory activity, and to aid the heart in removing the waste material and hastening forward the new, the limbs and walls of the chest must be absolutely free from any ligatures or constrictions. The slightest interference with the action of the respiratory muscles at this time embarrasses the functions of the lungs and heart. This is the reason why loose clothing is always advised for exercise.

(6) As a latent period precedes the contraction of a muscle, so a momentary period of rest should as far as possible precede movement in exercise. This is best secured where there is an alternation in the movements, as in walking, running, rowing, etc. All tetanized movements, such as holding weights, attitudinizing, standing or sitting in a constrained position, etc., tend to impair the tone of the muscles by interfering with the nutrition of both muscles and nerves.

(7) The exercise of the young should be of such a composite nature as to bring about the coöperation and coördination of the muscles. This involves principally the training of the central nerve system. All gymnastic sports and athletic games that require skill, dexterity, coolness, courage, and presence of mind, are included in this list, and are exceedingly valuable to any system of physical training as adjuncts in the development of character.

(8) All vital processes depend largely upon the maintenance of animal heat. But animal heat is now known to be generated in the blood while passing through the muscles, and not in the lungs, as was once supposed. The full contraction of the muscles greatly aids this function, and helps to force the warm blood through the tissues and back again to the heart.

(9) In order to realize the best results from physical exercise and keep up the general nutrition of the body, all muscular effort should be followed by a bath or vigorous stroking and rubbing.

(10) In every kind of physical exercise the qualities at first required

are the qualities at length developed. Thus, if the exercise requires strength, strength will be the result; if courage is exacted, courage will be the outcome; if quickness, quickness; and so through the whole range of faculties exercised.

Knowing what is desired, it is an easy matter to prescribe the appropriate training. . . .

What America most needs is the happy combination which the European nations are trying to effect; the strength-giving qualities of the German gymnasium, the active and energetic properties of the English sports, the grace and suppleness acquired from the French calisthenics, and the beautiful poise and mechanical precision of the Swedish free movements, all regulated, systematized, and adapted to our peculiar needs and institutions.

The highest development of strength, activity, and grace is not compatible in the same individual, and consequently many persons prefer to sacrifice one in order to gain the other. But life's forces are well adjusted and well balanced.

PHYSICAL TRAINING.

SPECIAL ADVICE TO BEGINNERS, WITH CORRECTIVE EXERCISES.

BY

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WE need no statistics to prove that never in the world's history has there been a greater need of strong, vigorous men; nor has there been a time when the mode of living had a greater tendency toward the degeneration and decadence of health. This age of rapid transit and living fast in the crowded cities calls loudly for a mode of life that shall counteract the baneful tendencies of this great expenditure of neural force.

The relation of gymnastic exercise to the neuro-muscular requirements of the present-day conditions of life will be made clear if we consider briefly the object of proper exercise.

Proper exercise will train the muscles to obey promptly the dictates of the will. This is important, as almost one-half of the entire weight of the body is muscle, and the muscles are the only organs under the control of the will. The development of huge muscles and great strength, however, is wasted energy.

Proper exercise will increase the functional activity of the heart, lungs, digestive and excretory organs, and the life growth and function of the cells, and so increase the nutrition, furnish more oxygen, and free the system of poisonous waste products. It prevents the in-