

B. Effects of Exercise

Physical training produces certain long lasting effects. Besides the immediate responses of the circulatory and respiratory systems it has a definite effect on the muscles themselves. They grow to a larger size by virtue of an increased size of the individual fibers comprising the muscle. This makes the muscle stronger and more capable of doing its work.

Even more important than this are changes in the central nervous system associated with learning. Repeated practice of any muscular act leads to such changes in the manner of performing the act that it is accomplished with less energy expenditure. Better co-ordination of muscle groups and nicer adjustments of rate and degree of contraction to the requirements for smooth performance of the act are effected.

Exercise increases the heart size, and in trained subjects beats more slowly both during rest and activity. A given amount of muscular action in the trained subject produces less cardiac acceleration than in the untrained. However, both at rest and during work, the cardiac stroke volume is greater. During exercise the total cardiac output is increased to a larger extent by more forcible beats than by more rapid beats. This is considered as being the more economical way of increasing cardiac output.

The trained subject breathes more slowly but more deeply than the untrained, and the increase in respiratory exchange during exercise is accomplished to a greater extent by an increased depth than an increased rate of breathing which is again probably more efficient.

The net result of this is to enable the trained subject to bring oxygen to the active muscle cells and to eliminate wastes from those muscles more effectively and rapidly. Lactic acid accumulation is less because it is burned or reconverted to glycogen to a much larger extent during the