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Many are the definitions of physical training : for an unknown English coach it is "a means of breathing correctly, bracing the heart, removing excess fat and water and increasing strength". The Italian physiologist, Angelo Mosso (1845-1910), defined it as "an unconscious capacity of the nervous system, teaching the muscles to contract in the right measure with the aim of wasting a minimum of energy". For us, it is "the periodical repetition of a given action, aiming at its perfection to obtain the maximum of results with the minimum of energy expenditure". [2]

In the practice of sport, *basic training* increases *strength* and *endurance* through an adaptation of the muscular and cardio-respiratory systems, while *technical training* improves the *execution* through an adaptation of the nervous system, the end result of which is the athlete's *style.*

The aim of correct training is the *athletic condition,* a state of physiological equilibrium in the face of the work achieved, in which energy expenditures are balanced by the calories consumed. Athletic condition is different from *form,* because this involves other factors—chiefly psychological—which are inconstant and unforeseeable. Form, in fact, is a temporary state of grace which calls to action all the potential capacities of the athlete, while condition is a constant result of correct training and can be assessed by physiological tests.

Performances are also the result of the athlete's *class* or *biotype,* ie. all the physical and psychological characteristics which make a subject particularly suitable for a given sports discipline.

[1] International Federation of Sports Medicine.
[2] G. La Cava : « L'allenamento ». Il Policlinico, Sez. Pratica - October 1951.

Factors of athletic condition

Athletic condition is the result of a general adaptation of the body, in which virtually all the various organic systems take part.

In the *muscle,* the adaptation is both *morphological,* with the hypertrophy of all its fibres, the disappearance of fat, the widening of the capillary bed, and *functional,* with an increase in strength and endurance.

In the *cardiovascular system* the adaptation is characterised by :

the increased delivery capacity of the heart with an augmentation of the quantity of blood pumped in the aorta at each systole *(systolic range),*

the augmented quantity of blood circulating in the time unit *(volume per minute),*

the peripheral vasodilatation (in the muscles and skin) with compensatory vasoconstriction in the internal organs *(circulatory balance).*

In the respiratory system the adaptation is characterised by :

a) the increased quantity of air which can be introduced to the lungs with a single inspiration *(vita/ capacity),*
b) the increased pulmonary ventilation in the time unit *(volume per minute),*
c) the improved respiratory exchanges, ie. the absorption of oxygen and elimination of carbon dioxide *(respiratory quotient).*

The most remarkable effects of the adaptation in the cardio-respiratory systems are :

1. the active *tonogenic* hypertrophy of the heart,
2. the relative bradycardia and bradypnea,
3. the systolic and diastolic reduction in blood pressure,
4. the automatism of cardiac and respiratory rhythm during effort (second wind),
5. the diminution of the *recovery time* after effort, a consequence of the easier payment of the *oxygen debt.*

In the *nervous system* the process of adaptation is more complex. In fact, the serial repetition of a given movement gives way to a sequence of adjustments, such as the centralisation of the motor impulsions by the cerebral cortex, their easier transmission along the nervous peripheral pathways, their coordination and finally their automatism.

The end result of these adjustments is the development of the *motor ideogram—a series* of automatisms by which the more or less complex movements, pertinent to each sport, are *commanded globally by the will,* without analysing the various muscular groups involved. The motor ideogram is the final step in technical training : when reached, the attention of the athlete is freed from the care of the motor execution and can be concentrated on the conduct of the competition.

In the process of adaptation to physical effort these are the most important factors.

Naturally they involve adjustments in other sectors, such as in *metabolic* or *hormonal* activities which are closely connected to them.

Central and peripheral training

The primary phase of physical training is the muscular contraction which can be isotonic or *isometric.*

The isotonic contraction is also called *motor* because it gives way to movement. The training methods, based on movement, consequently require an adaptation of the central organs-particularly cardio-respiratory—aiming to respond to increased demands for oxygen. These methods increase endurance through a growing capacity for paying the oxygen debt and are called *central training.*

The isometric contraction, also called *static* because it does not produce movement, is of short duration. Therefore the training methods, based on a series of isometric contractions, induce only local effects on the muscles, increasing their volume and strength without affecting the cardio-respiratory organs : these are called *peripheral training.*

This classification is schematic. In the common practice of sport, isometric and isotonic contractions are often associated, with the prevalence of one or the other. For instance, in running or swimming central training prevails, while in weightlifting or body-building peripheral training predominates.

From the sports-medical point of view, however, the two methods have different peculiarities and indications. In fact, central training, because of the required cardio-respiratory apparatus, needs medical con-

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trol, especially in some periods of life (puberty and maturity) ; while peripheral training, when limited to a series of isometric contractions circuiting the various muscular groups, can be practised at every age and also when cardio-respiratory meiopragy is apparent.

Another important difference between the two methods of training concerns the adaptation of the nervous system and the development of the motor ideogram. In central training, the complex movements peculiar to some highly technical sports (diving, fencing, etc.) are commanded globally by the cerebral cortex, without analysis of the various muscles involved. In peripheral training, on the other hand, the contractions are limited to isolated muscular groups, and the cerebral cortex *must* analyse the impulsions, ascertaining through the peripheral sensitivity that the contractions correspond to the cerebral orders. It is a process similar to that of learning to read : one can recognise the words *globally* because they are associated with the image of an object or animal, or single out each letter of the alphabet before connecting it to the others in the construction of the words.

Conclusions

Central and peripheral training have different peculiarities and indications. Central training increases endurance and facilitates the acquisition of complex movements but needs important adaptations in the central organs, particularly in the cardio-respiratory apparatus. Peripheral training increases the volume and strength of the muscles and their control, with few effects on the central organs.

The best results are obtained by a combination of both methods. This combination is especially useful in sports which require only a regional or monolateral participation of the muscular apparatus (such as tennis, fencing, football, cycling, etc.).

Competition sports, in which central training prevails, are the domain of the young, but should be practised with caution and under medical supervision in childhood.

Peripheral training is indicated in childhood and puberty fur a safe development of the body and in maturity for the maintenance of good general trophism.

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