# LOOKING FOR TRAINING GUIDANCE

By Prof. Dr. Atko Viru

*Dr. Atko Viru, Professor of Biology at University of Tartu, Estonia, discusses physiological and biochemical problems in the organization of training processes and draws attention to several aspects awaiting a solution in order to improve training efficiency. The article is a slightly condensed and edited translation from Kehakultuur, published by Periodika, Tallinn, Estonian S.S.R.*

A coach can predict reasonably well what can be expected to be achieved in order to compete in 10 to 12 years time at a high performance level. He also has a sound understanding of how to organize training. At the same time, there is always some doubt whether the present approach will continue to be successful in the future. Thinking coaches are therefore never sure about the efficiency of their work.

## COACHING EFFICIENCY

How to improve coaching efficiency? Firstly, it is important to apprehend what to aim for. The expected performance improvements in seconds and centimeters are predictable, but this knowledge alone is not sufficient. It is important to understand what will be required from the organism in order to develop a person into a “Homo Olympicus”. The current sport sciences knowledge can answer this question reasonably well, as far as contemporary high performance athletes are concerned. Even the future can be explored, keeping in mind the following aspects:

1. The level of performances can improve in leaps and bounds, when new techniques are developed.

2. The possibilities to improve some functional capacities can be exhausted and further development can take place only by shifting emphasis to another physiological system or function. The maximal oxygen consumption and movement speed are typical examples. Further development in these capacities is very limited and performances are improved by emphasizing the improvement of the anaerobic threshold in the first and the development of power in the second case.

3. A genuine world wide distribution of the knowledge of training technology could help to eliminate “pharmaceutical” and doping problems. This, in turn, could be responsible for actually lowering the performance levels.

The first listed aspect of new techniques can be eliminated by a sound biomechanical analysis of an event. Such an analysis should avoid looking at the techniques of the present top performers as the only correct approach. The most

rational application of forces, according to the known biomechanical principles, should be the deciding factor.

The second aspect can be clarified by studies that establish, according to the present theoretical understanding, the maximal possible parameters of one or another performance indicator. This should take into consideration the structures and functions of different organs, the intensity of metabolism, the speed of restoration processes and so on.

## RECENT STUDIES

Recent studies, for example, indicate that maximum oxygen consumption depends mainly on the minute volume of the heart, while the anaerobic threshold, on the other hand, is dependant on the intensity of oxidation processes in the muscles. The level of the minute volume is closely related to the size and contraction capacity of the heart, a deciding factor because the highest heart frequency at which the maximal minute volume can occur is within 175 to 195 beats a minute.

A large minute volume requires a large heart with strong muscles. The large heart reduces the space left for the lungs and, if the chest area is increased to accommodate larger respiratory muscles, then body weight is also increased. This indicates clearly that an optimal relationship must exist and disproportions created through emphasizing one parameter will bring no benefits.

The improvement of the intensity of oxidation processes in the muscles also has a limit. This parameter depends on the mitochondrial volume and the activity of its enzymes. Here again there are restrictions as the development of the mitochondrial volume can reach the stage where it will have a negative influence on the functions of other cell structures.

These examples indicate the positive importance of future studies in high performance sport in two main directions. Firstly, such studies can help to discover new possibilities of how to intensify the development of performance capacities. Secondly, athletes can be told when a certain direction in training has taken them close to their limit and future improvements are possible only by changing to exercises that assist in the development of other performance components.

Next comes the question of what depends on genetics and what can be achieved with training. Inherited characteristics alone will not lead to medals, but the genetic program determines individual symptoms that assist in the adjustment of training in a direction that secures a maximal development of performance capacities.

For example, a muscular structure dominated by white fibers restricts the anaerobic threshold level because red muscle fibers are more sensitive to endurance training. As can be seen, the methods that correspond to individual trainability have to be determined according to the genetic limits of an athlete.

## FURTHER SOLUTIONS

Training tasks have to be planned for a period of 10 to 12 years. The basic principles here are clear and we are informed how the development should take place according to the athlete's age. Nevertheless, several details are still awaiting further studies and solutions. Meanwhile, it is important that the coach understands what changes in the organism have to be achieved, when these changes occur, in what order they should occur, and which training means and methods are responsible for the expected changes.

The specific influences of training means and methods have been reasonably well clarified. The problem here is not lack of information, but a continuous control of training that frequently requires help from sport medicine and sport scientists, and is not always available. Coaches should therefore never underestimate the principle that improvements in the performance capacities of an athlete are based on the changes in the organism that occur through the employment of specific training exercises.

Presuming that a coach understands the specific influence of the exercise on the organism is not sufficient. He also must be aware of how large the influence (load) must be in order to produce a training effect. There are general recommendations available in the literature on this subject, but the better a coach can control his work, the better will be the chances for success.

We are still unable to employ fast methods to discover the best possible dosages for each training exercise, although endurance events have made good progress by using blood lactate levels and pulse rates to determine intensity. But even here we are faced with shortcomings, as the possibilities to estimate the most suitable training volume are rather modest.

## PROTEIN SYNTHESIS

To proceed from the viewpoint that training is based on adaptive protein synthesis opens the possibility to evaluate the training load by the accumulation of metabolites, triggered by protein synthesis and the appearance of several hormones in the blood. Although this involves complicated investigation methods, such an approach should not be underestimated.

The blood lactate level, for example, allows us to come to reasonably clear-cut conclusions. If the lactate level remains below 4 mmol/1 (accepted as the approximate equivalent to the anaerobic threshold) there will be no development

of anaerobic work capacity. If the lactate level is well below 4 mmol/1, the only training effect can be the development of general endurance.

The closer the lactate level gets to 4 mmol/1, the more can we expect that the exercise has a positive influence on the anaerobic threshold and maximal oxygen consumption. The development of anaerobic work capacity begins when this level is exceeded. The higher the lactate values, the stronger is the training effect. However, it should be kept in mind that the training influence also depends on the duration of an exercise, a factor that can't be estimated by lactate tests.

Next to the lactate, one of the most frequently used biochemical parameters is the urea concentration in the blood. Urea is the basic end product of protein metabolism. The use of this parameter is justified because the realization of a training effect is closely related to protein metabolism. Yet, the production of urea can be associated with other processes that are not connected with the changes of protein metabolism that occurs in muscular work.

In addition, studies have shown that urea levels in the blood do not always correspond with the dynamics of other indicators reflecting the breakup of muscle proteins. Also, changes in protein metabolism can continue in the recovery period when the urea level has already turned back to normal.

Studies into the changes of urea levels have made it possible to establish that anaerobic metabolism restrains the production of urea and eliminates any increases. Only when work is performed by using aerobic energy sources does the urea level increase in proportion to the intensity and duration of the effort. Consequently, an increased urea level does not necessarily reflect the size of the workload. It reflects only the training effect of the aerobic exercise, during which the anaerobic exercises can actually be responsible for reducing it.

AMINO ACIDS

From the amino acids released in the breakdown of muscle proteins, tyrosine and 3-metahistidine deserve attention. The first is a general product, released in the breakdown of all proteins. The other is released only in the breakdown of contractive proteins. According to the studies of E. Varrik, an increased production of 3-metahistidine does not take place during the effort phase, but during the recovery, and is related to the renewal processes of muscle proteins. It indicates that more studies are needed to clarify the training effect, of this metabolism.

A specific strength and power development study on this subject was recently conducted by N. Seli. The study showed that, if the training load was sufficiently high to secure the development of muscular strength and muscle mass, then the level of 3-metahistidine in the urine samples at night had increased considerably. Another important problem, still looking for a solution, is an overall evaluation of

the development potential of the organism and to what extent this information could be utilized. There is no doubt that the organization of training processes, even if only at a high performance level, would benefit considerably from such information. Unfortunately we still have a long way to go in this direction.

This paper, while it discusses several coaching problems, was not written so much to advise coaches than to draw attention to the still unsolved important aspects in the field of sport sciences. As far as the coaches are concerned, it would definitely be important not only to understand the outlined problems, but to demand solutions for them.