

Note of the Editors: The preceding article of C. Hamburger is concerned with an interesting problem of a field where mathematics and sports overlap. We therefore welcome a comment on this result - which of course also depends on the underlying model - from the viewpoint of medicine by L. Pickenhain, presented in the following. We comprehend these remarks in conformity with the author as a suggestion to improve the model and enrich the discussion.

Observations on the preceding paper of C. Hamburger: The Optimal Runner: a Control Problem with Phase Constraint

L. PICKENHAIN

As a physiologist I take the liberty of adding some remarks to the paper mentioned in the title:

1. The assumption that the energy needed for muscular work is produced by the aerobic metabolism of carbohydrates is not the whole truth. Under certain circumstances, when not enough oxygen is available, for instance during the starting phase, the finish phase, and phases of maximal effort, the energy generation is accomplished in an anaerobic way, that is, by decomposition of glucose without oxidation. This decomposition works more quickly but its effectiveness is 16 times smaller since powerful lactose arises. Owing to the accumulation of lactose this form of energy generation has to be stopped quickly. In any case, one has to take this form into consideration, if one is talking about maximum efforts (of short duration). C. Hamburger is not doing so (for example considering the finish) and is looking for other interpretations. For instance a 100-metros dash is accomplished only by anaerobic generation of energy.

Carbohydrates are not the only sources of energy for the organism. Throughout the calculations one possibly has to pay attention to the fact that especially during persevering efforts the energy is obtained by degradation of lipids (sebacic acids) for a great part.

2. It is not true that the blood oxygen represents a limiting factor for the energy generation in running. Oxygen is never stored in the blood but only transported. A decrease down to 0 (see p. 381) is an unreasonable assumption because even a decrease by a few per cent would lead to a bad damage of the brain functions. The author has to take into consideration the existence of the brain.

3. Concerning the mathematical calculations I cannot express my opinion. But the physiological facts are not sufficiently taken into consideration and the totality and high adaptability of all (even of the seemingly elementary) functions of the organism are not adequately reflected. At the bottom of p. 379 C. Hamburger indicates that the considerations could be applied to machines. This is surely justified, but not the application to living organisms.

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