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Le bilan énergétique des contractions musculaires avec travail positif ou négatif,

Par X. AUBERT et G MARÉCHAL. *Laboratoire de Physiologie générale, Université de Louvain, Belgique*

Translated from French.

The energy balance of muscular contraction with positive or negative work.

The simple maintenance of an isometric contraction is accompanied by an expenditure of energy in the form of continuous thermogenesis. If the muscle can also be shortened, additional energy appears in two forms: the mechanical work and a small supplement of heat linked to the shortening but often compensated by secondary phenomena. Conversely, if the muscle is lengthened during the contraction, thus receiving work from the outside, only a fraction of this work is dissipated in additional heat so that the release of energy initiates (heat less labor) decreases .

These classical results of FENN and the HILL school suggest the existence of a tightly-coupled chemical-chemical coupling between the sources of muscle energy and the deformations of its contractile structure (cf. AUBERT, 1956). However, it is imprudent to draw such radical conclusions from an incomplete assessment such as this, which on the one hand takes into account only mechanical and caloric energy and on the other hand neglects the phenomena of delayed recovery (see WILKIE, 196o). We have, therefore, attempted to complete it in the case of the frog sartorius, the classical object of these investigations, by data concerning the phosphocreatine and the heat of recovery.

In a first series, we studied the hydrolysis of phosphocreatine (PC) under conditions where most known restorative reactions are suspended (0°C, nitrogen atmosphere, 0.4 mM monoiodoacetate poisoning). At the isometric thermogenesis corresponds a hydrolysis of PC in the proportion of about 10 kcal per mole (MARÉCHAL and MOMMAERTS, 1963). The positive work provoqued a supplement of hydrolysis compatible with the hypothesis that the work originated from the source of energy as heat (average 8.5 kcal / M, confidence limits from 5 to 19 kcal / mole at the 95% level). On the other hand, the absorption of negative labor far from reducing the hydrolysis observed in an equivalent isometric contraction increased slightly but significantly (0.93 ± 0.34 v.114 / g for a total work of about 30 mcal).

In another series, carried out at 20°C, we followed the aerobic recovery heat. It is known that, after an isometric contraction, a heat in constant proportion to the initial

heat (1.2 to 1,3) appears in 30 Inn. Positive work execution increases the heat of recovery exactly in the proportion corresponding to the initial supplement of energy observed, which confirms former observations of HARTREE (1928). In the case of contractions with negative labor, the late heat does not diminish in proportion to the labor absorbed but increases more or less

These preliminary results make the hypothesis of reversibility suspicious: it appears that energy absorbed during the performance of negative work does not imply any economy of the available chemical reserves

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