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G. MARÉCHAL et X. AUBERT. — **Influence de la fatigue sur la thermogénèse du muscle strié** (*Laboratoire de Physiologie, Université de Louvain ; Dir. J. P. Bouckaert*).

Translated from French.

Effect of fatigue on the thermogenesis of striated muscle.

G. MARÉCHAL et X. AUBERT.

The maximum force exerted by the sartorius muscle of *Rana temporaria* subjected to prolonged tetanization evolves characteristically. After quickly reaching its maximum,

The isometric tension decreases in two distinct phases: during the first phase, which lasts about four seconds at 18°C., it decreases moderately at a slower and slower rate; Then the myogram shows a point of inflection, and the tension begins to fall again, very quickly at first, then more slowly. This second phase seems to extend until the complete exhaustion of the muscle which occurs in a few tens of seconds. After a suitable period of rest (10 minutes to one hour) in oxygenated Ringer, the muscle can recover almost entirely its initial tension, and in any case the evolution of the tension during successive tetanus remains substantially parallel to that of the first tetanus.

The heat rate production also evolves in two distinct phases: approximately constant for the first four seconds, then it decreases proportionally to the force throughout the second phase. In the course of a single tetanus, the law of thermogenesis is therefore particularly simple, since the ratio of heat production per unit of time to the average force maintained remains constant. This same law is found in successive tetani, but with one important difference: the coefficient of proportionality between the heat flow and the force decreases with each tetanus, even in cases where the force has fully recovered its initial value. The muscle therefore releases less heat to sustain an identical force. Four tetanos of ten seconds are thus sufficient to double the efficiency of the isometric contraction, the ratio $\Delta H / (P\ l_o\ \Delta t)$ passing from 0.70 to 0.35 sec^{-1} at about 18°C. (H is heat in gcm, P, isometric force in g., l_o, the length of the muscle in cm, and t, time).

These phenomena appear to have their seat at the level of the contractile mechanism proper: they are identical after curarization and supramaximal excitation, in nitrogen as in oxygen. The first phase of the fall of tension corresponds, no doubt, to the internal shortening of the contractile elements, which continues slowly at the expense of the elastic elements of the muscle: one of us has proved the intervention of this mechanism (Maréchal, 1957). The simultaneous drop in tension and thermogenesis during

The second phase suggests the existence of a second mechanism: the progressive decrease in the number of active contractile elements. But neither of these two mechanisms can explain the growing economy of contraction during successive tetanus. This implies an effective slowing down of the elementary reactions within each element still active. It is important to note that the phenomenon of postulated slowing does not occur during the contraction but in the interval between the tetanus. In this hypothesis, the rate of isotonic shortening must decrease more strongly from one tetanus to the next than the isometric tension.

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