

**Analyse de la contraction isométrique du muscle isolé strié  
dans différents types d'épreuves de fatigue,**

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*Translated from French.*

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in various types of fatigue tests,**

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Curarized frog sartorius muscles are suspended in oxygen atmosphere or held in Ringer's solution (16°C). They are exhausted by a series of isometric tetani of constant duration (0.5, 2 or 8 seconds) at regular intervals (0.2, 1 or 5 minutes).

The maximum tension  $P_0$  (force per unit muscle cross-section area) of each tetanus of a series constituting the fatigue test is plotted according to the order number  $N_p$ . This fatigue curve evolves in two steps. In a first phase, the maximum tension rises, and the fatigue curve exhibits a sloping plateau. During the second phase, the tension drop accelerates sharply and then gradually slows down. We can represent this phase by an exponential equation in  $P$ :

$$N_p = C \exp \{ (P_0 - P) / \alpha P_0 \}$$

where  $P_0$  is the initial maximum tension, and  $\alpha$  a constant. The composition of the medium greatly influences the appearance of these phenomena's. If the muscle is exhausted in the Ringer's solution, the initial plateau of the fatigue curve is shorter, but the consequent fall is quicker than if the muscle is fatigued in humid oxygen.

The duration of the tetanus exerts a much more marked influence upon the fatigue curve, and the interval which separates them. The number of tetani  $N_p$  necessary to lower the initial tension to a certain level decreases if the duration  $D$  of the tetanus increases or if the interval  $I$  between the tetani decreases, according to the following equation:

$$N_p = C \sqrt[4]{I/D^3}.$$

It is thus possible to compensate for the effect of the extension of the tetanization duration, for example by 1 to 2 seconds, by increasing the resting period between each tetanus from 1 to 8 minutes.

The same factors also affect the recovery of tension after a period of rest. If the muscle has been exhausted in a gaseous atmosphere, the repair is obtained only if the rest is combined with a washing with Ringer's solution. If the medium contains bicarbonate and  $\text{CO}_2$ , and in it is almost total. It is all the more complete when the interval between the tetanus is shorter (0.2 s), and the resting duration is longer (8 s). On the other hand, if the muscle has been exhausted in liquid medium, there is little or no repair, even in the presence of bicarbonate -  $\text{CO}_2$ .

Most of these results can be explained if we suppose that during excitation, two substances diffuse from the cells towards the extracellular spaces. The former would be indispensable to the normal metabolism of the contraction, and would be reabsorbed at a very low rate during the rest interval, in such a way that it did not diffuse in a large liquid volume. The second would be a waste substance which, accumulating in the extracellular spaces, could progressively depress contractility, from the suspended muscle into gaseous atmosphere.