other mechanisms of detoxification are involved will be investigated.

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PHYSIOLOGY

Relationship between Changes in Muscle Volume and Muscle Action Potential

The method which was developed for measuring small rapid changes in volume occurring in a muscle during a single twitch[1] has been applied to the case of a frog sartorius muscle immersed in hypertonic Ringer's solution. As reported by various authors, one of the principal effects of hypertonic Ringer's solution on a muscle is to eliminate the twitch tension on stimulation, but not to interfere with the propagation of the muscle action potential. This provides a method of determining whether or not the previously reported muscle volume changes are a direct consequence of the action potential and are thus not connected with contraction as such.

The method used to measure these volume changes has been described elsewhere[2]. In this experiment, the same method was used except, after determining the changes in volume in normal Ringer's solution, hypertonic Ringer's solution (2·5 times the regular concentration) was added to the muscle chamber. Since this addition took approximately 30 sec., the changes in volume were not measured until this point. Thirty seconds after the addition of the 2·5 Ringer's solution the muscle was stimulated by a single stimulus and the volume changes recorded.

After the addition of hypertonic Ringer's solution to the muscle, the magnitude of the tension slowly decreases. In addition to the decrease in magnitude of tension, the rate of development of tension is greatly prolonged. After the muscle has been in the hypertonic Ringer's solution for approximately 15 min., no tension can be developed on twitch stimulation. Paralleling these changes in tension, the changes in volume slowly decrease in magnitude and increase in duration, as does the twitch tension. After 15 min., when the twitch tension has been reduced to zero, the changes in volume are not detectable. Both the previously reported increase in volume and the decrease in volume are no longer visible. This effect is completely reversible. If normal Ringer's solution is then added in place of the hypertonic Ringer's solution the changes in volume and the twitch tension return to normal within a few minutes. All these experiments have been carried out at 20° C.

These results indicate that the changes in volume relate to contraction in a muscle, and are not directly the result of the propagation of the action potential. Previously, it has been postulated that the increase in volume may be an indication of the process linking excitation to contraction in the muscle. Evidence has been presented by Hill (1957) indicating that, in hypertonic Ringer's solution, the activation heat is still present. It must be pointed out that in order to obtain this activation heat one needs to stimulate the muscle with ten times the normal stimulus. In the measurement of changes in volume this is not possible, since this quantity of stimulus would produce a change in volume due to heating.

This work has demonstrated the close correlation between both the increase in volume and the decrease in volume and the actual contraction of the muscle. It may be postulated that the changes in volume are a direct indication of the protein reorganization which occurs during the contraction of a muscle. It must be emphasized that the action potential does not in itself appear to be responsible for any of the observed changes in volume which occur during a single twitch of a frog sartorius muscle.

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Influence of Various Stimuli on Lactic Acid, Alanine and Gamma-Aminobutyric Acid Levels in Rat Brains

As has previously been shown[1,2], an increase of lactic acid, alanine and γ-aminobutyric acid in the brain of rats occurred when, after tying both carotids, stimuli were applied to the cortex which caused electroencephalographic depression. This communication is concerned with the way in which the aforementioned metabolites are influenced after stimuli causing depression (3 and 0·3 *M* solutions of potassium chloride, rubidium chloride, cæsium chloride and ammonium chloride), after stimuli not causing depression (3 and 0·3 *M* solutions of lithium chloride and sodium chloride), after stimuli blocking the spreading of the depression (3 and 0·3 *M* solutions of magnesium chloride and calcium chloride[3]) and after stimuli causing the increased activity of the nervous system (1 and 10 per cent solutions of pentamethylentetrazol and 0·1 and 1 per cent solutions of strychnine), when both carotids were tied. All stimuli were applied on the exposed cortex by placing a piece of filter paper dipped in the used solution on the cortex for 30 min. The brains were then fixed in liquid air. In ethanol extracts of the frozen brains the free amino-acids were determined by paper chromatography according to the method of Rindi and Ferrari[4] and in trichloroacetic acid extracts lactic acid was estimated according to the method of Barker and Summerson[5]. All results are expressed as μmoles of the compound investigated per gram of protein nitrogen, which was determined by the micro-Kjeldahl distillation method. For statistical evaluation Student's *t* test, unpaired variates, was used.

As it was established that no differences could be found in the investigated metabolites between the experimental and the opposite intact hemispheres of the same amine, the latter were used as controls.

The results showed that the 3 *M* chlorides of the alkali metals caused an increase of lactic acid, alanine and γ-aminobutyric acid (Table 1). When 0·3 *M* solutions of the same compounds were applied, the increase of lactic acid, alanine and γ-aminobutyric acid occurred only after the solutions causing electro-encephalographic depression, namely, chlorides of