case of the citrate. It could be by synthesis of adenosine triphosphate.

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Correlation of the Effects of Insulin and of Muscular Contraction *in vitro* on Uptake of Glucose by the Frog

Heimreich and Cori[1] and later R-Candela[2] among others have shown that the specificity to sensitive sugars is similar both with insulin and muscular contraction. On the other hand, the great resistance of toads to insulin injections is known from the work of Rapela *et al.*[3]. We have confirmed this finding in frogs injected with up to 40 U./100 gm. without showing any signs of hypoglycæmia.

These results inspired us to examine the possible correlation of the effects of insulin *in vitro* and of muscular contraction *in vitro* on uptake of glucose by the frog recti abdominis muscle.

Frogs (*Rana esculenta* L.) weighing 28–35 gm. were used. After killing, the muscles were removed and weighed; one of the muscles was always used as control of the other. They were incubated in small vessels in a Dubnoff shaker at 37° C. and stirred for 2 hr. The incubation medium was 2 ml. of frog-Ringer containing 3 mgm./ml. glucose. Contraction was elicited by incorporation of 10^{-5} *M* acetylcoline. Insulin was used at a concentration of 0·1 and 0·5 mU./ml.

In another series of experiments alternating 15-min. periods of contraction and relaxation were induced in the same muscle, by transferring it from the buffer containing acetylcholine to the relaxation buffer and vice versa, after very careful washing and blotting on filter paper.

Determinations of glucose were carried out by the Somogyi–Nelso method.

The results shown in Table 1 are different from those described for mammals:

(*a*) Gemmill *et al.*[4,5] showed that uptake of glucose and synthesis of glycogen are stimulated in the rat diaphragm *in vitro* by the addition of insulin. Our results, on the other hand, show that insulin does not increase uptake of glucose by frog muscle.

(*b*) Helmreich[1] and R-Candela[2] have shown, using different experimental conditions, that muscular contraction increases the uptake of glucose sugars with a specificity similar to that found when using insulin.

Table 1

	Without insulin	With insulin (0·5 U./ml.)	Alternative contraction and relaxation without insulin
Contraction	0·171 ± 0·041 (20)	0·180 ± 0·047 (20)	Contraction every 15 min. 0·158 ± 0·036 (20)
Relaxation	0·170 ± 0·041 (20)	0·201 ± 0·047 (20)	Relaxation every 15 min. 0·148 ± 0·036 (20)

No significant differences.

In the case of the frog, muscular contraction does not increase uptake of glucose.

Though Gemmill[6] and Beloff-Chain[7] state that insulin does not increase oxygen consumption by mammalian muscles, Hall[8], Gourley[9], Fisher[10], Smillie and Manery[11] find that insulin increases significantly the consumption of oxygen by frog skeletal muscle.

These experimental findings indicate the existence of a correlation between the effects of insulin and muscular contraction on uptake of glucose by muscle.

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Reversible Blocking of Nerve Conduction by Alternating-Current Excitation

In recent years, the attention of control engineers has been attracted to the communication characteristics of nerves, particularly in regard to their function in the feedback control of muscle. Muscles are highly non-linear power amplifiers, which require complex nervous control circuitry to permit smooth and continuous movement of the limbs. This control circuitry consists of multiple feedback loops, and the problem is to determine experimentally the function of individual loops. One approach is to open circuit specific peripheral neural paths and observe the effect on over-all performance.

This can be done, and problems encountered with surgical and pharmacological methods avoided, by subjecting the nerve to alternating-current excitation. This method offers the advantage of reversibility, and also enables fibres to be selectively blocked according to their size. An investigation has been undertaken on peripheral nerves to study the effect of alternating-current excitation on axonal conduction. The sciatic nerves of large green frogs were used and a section of nerve, approximately 8 cm. in length, extending from the thigh to the peroneal and tibial extensions, was supported on an array of six platinum electrodes in a bath of mineral oil (see Fig. 1*a*). A pulse was applied repetitively to the stimulating electrodes and the response at the recording electrodes was amplified and displayed on an oscilloscope. The centrally located blocking electrodes were excited from an audio oscillator. Since the signal at the recording electrodes contained, superimposed, both the time-response of the nerve and an alternating-current component due to the ohmic coupling with the oscillator, a subtraction circuit was incorporated