pared for direct stimulation by wires fastened to the tendon and to the origin of the muscle. Care was taken to prevent drying of the nerves and muscle. Supermaximal stimuli were used in every instance. An automatic interrupter which completed the primary circuit, about 3 times a second furnished the stimulus. Both make and break shocks were used. The right sciatic was stimulated until the left gastrocnemius failed to give further contractions, upon which the stimulus was immediately switched to the right sciatic. When the left gastrocnemius again failed to respond, the muscle was directly stimulated. This arrangement enabled us to determine the fatigue time of the reflex arc, myoneural junction and the muscle itself.

The average times of completed tests are given in Table I.

TABLE I. *Average Time Required for Fatigue.*

Series	No. of cases	Reflex (min.)	Myoneural Junction (min.)	Muscle (min.)
Cortin	10	124	234	255
NaCl	9	19	37	43

The difference in the 2 series is significant, since the cortin series required 6 times as long to fatigue in every instance.

There is evidence that more frequent injections of cortin will increase the difference between the 2 series, but the number of animals used is too small to draw any further conclusions.

5766

The Recovery Oxygen Consumption of Muscles Poisoned with Brom-acetic Acid.

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Lundsgaard[1] reported that the resting oxygen consumption of the intact frog was unimpaired by brom-acetic acid poisoning while glycolysis was completely inhibited. Fischer[2] using electrical stimulation was unable to find a recovery heat production in isolated frog muscle poisoned with 0.05 to 0.1% brom-acetic acid. Heg-

[1] Lundsgaard, E., *Biochem. Z.*, 1930, **227**, 51.

[2] Fischer, E., *Pflüger's Arch.*, 1931, **226**, 500.

nauer[3] stated that 0.01% brom-acetic acid completely inhibited the lactic acid formation which usually followed KCl stimulation but had no effect on the excess oxygen consumption. In view of the apparent contradiction between the work of Fischer and of Hegnauer a considerable series of experiments was run to determine the excess oxygen consumption and lactic acid production of muscles treated with brom-acetic acid in several concentrations up to 0.2% and then stimulated electrically or chemically. While this work was in progress Hill and collaborators[4] reported a normal recovery heat production in muscles poisoned with 0.004% iodoacetic acid.

Sartorius muscles were soaked in Ringer's solution containing brom-acetic acid or its sodium salt for half an hour at a temperature of 8°C. They then were placed in a differential volumeter, a resting rate determined (½ to 1 hour), stimulated, and the excess oxygen consumption measured. Chemical stimulation was accomplished by dumping 0.9% KCl from a side arm of the experimental bottle. The tension developed by matched muscles similarly treated was recorded on an isometric lever. The excess oxygen consumption and the tension development of electrically stimulated muscles were measured simultaneously on the same muscle. This was accomplished by leading a fine wire from the muscle through a mercury-sealed capillary to an isometric lever. Another respirometer without this mercury seal and containing matched muscles acted as a control on the oxygen consumption. A. H. Hegnauer, to whom I am greatly indebted for his collaboration, made lactic acid determinations on muscles treated and stimulated in an exactly similar manner.

Brom-acetic acid or its sodium salt in concentrations above 0.02% completely inhibited the lactic acid production that usually results from electrical or chemical stimulation.

Forty-four experiments using chemical stimulation at 22°C. showed that there was a definite decrease in excess oxygen consumption as the concentration of brom-acetic acid increased. The tension developed likewise fell off with increased poisoning. Both tension and excess oxygen fell to zero at about 0.08% brom-acetic acid. Whenever tension was developed there was an excess oxygen consumption but the muscles became rapidly non-irritable at this temperature. Fourteen experiments on muscles chemically stimulated at

[3] Hegnauer, A. H., *J. Pharm. and Exp. Therapeutics*, 1931, **42**, 99.

[4] Cattell, Feng, Hartree, Hill and Parkinson, *Proc. Roy. Soc., B.*, 1931, **108**, 279.

14°C. showed an excess oxygen consumption 70% of normal when treated with brom-acetic acid of 0.04 to 0.2%. At this temperature the muscles retained their irritability for several hours after poisoning.

Normal muscles electrically stimulated for 5 sec. at 14°C. gave an average value (6 determinations) of 0.0035 for the quotient

$$\frac{O_2 mm^3}{\text{Tension (gm.)} \times \text{length (cm.)} \times \text{time (sec.)}}$$

where the oxygen represents the excess consumption by the weight of muscle used. Muscles poisoned ½ hour with brom-acetic acid in concentrations of 0.01 to 0.2% gave an average value of 0.0024 for this quotient or approximately 70% of the normal value.

5767

Influence of Carbon Dioxide upon the Respiration of Nerve.*

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The influence of carbon dioxide upon the respiration of the lateral line nerve of the smooth and spiny dogfish has been studied by the tonometric method. Fifteen cc. tonometers which contained besides the nerves one-tenth of a cc. of isotonic solution were placed in a water bath, the temperature of which varied from 20.5 to 23.7°C. in the different experiments. The gas mixture present in the tonometers was analyzed at the beginning and at the end of each experiment on a modified Haldane-Henderson analyzer. The measurement was begun 2 to 3 hours after the removal of the nerves and lasted for 4 or 5 hours. Eight or more hours after the isolation of dogfish nerves the rate of oxygen consumption rapidly increases.

The tonometric method has been checked by burning ethyl alcohol in the tonometers and determining the respiratory quotient. These quotients vary from 0.630 to 0.678 with an average of 0.655.

Ten control experiments showed that the maximum difference in the rate of respiration of matched nerves was 16%. Forty-five experiments were carried out on nerves in air-oxygen gas mixtures. The rate of oxygen consumption varied from 25.1 to 157.0 cu. mm. per gm. of fresh weight per hour, depending upon the size of the

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