

In recovery, tremors, tetanic spasms, or both, and marked hyperexcitability are noted.

The results support the view that the increased ammonia in the blood of parathyroidectomized animals is directly responsible for the tetany and depression symptoms, as the concentration of the ammonia in the blood of parathyroidectomized cats and dogs is sufficient to cause tetany, tremors and depression in the normal animal.

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The daily curve of nitrogen elimination in the pregnant, as compared with the non-pregnant dog.

By **J. R. MURLIN.**

Comparison of the daily nitrogen output in periods of three hours in pregnant dogs as compared with the same dogs non-pregnant, on the same diet and living under identically the same conditions, shows that the form of curve is essentially the same in the two conditions. In the pregnant condition the total curve runs below that of the non-pregnant condition at a fairly uniform distance, showing that the retention for the embryos and auxiliary structures is fairly uniform from hour to hour.

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Contraction of muscle during voluntary innervation.

By **HORATIO B. WILLIAMS.** (By invitation.)

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This communication is a preliminary report of studies on the frequency of contraction of voluntary muscle under voluntary innervation.

The muscles studied were the flexors of the forearm, and the problem has been approached from three directions :

1. The frequency of the action currents.
2. The frequency of the sound accompanying muscular contraction.
3. The frequency of the mechanical variations over the surface covering the contracting muscles.

The action currents were registered photographically as excursions of the quartz "string" of a large Einthoven galvanometer, and the results are in consonance with those of Piper, who found the rate to be 47 to 50 variations per second.

The muscle sound was made to register itself as electrical variations by use in connection with the galvanometer of a very delicate microphone, carefully protected against external vibrations and connected with a stethoscope placed over the contracting muscles.

The rate of the sound as so determined is from 46 to 52 per second, which agrees fairly well with the rate obtained by the preceding method.

Unless great care is exercised to allow free ingress and egress of air to and from the stethoscope, large waves of frequency, 10 to 13 per second, complicate the sound record.

The mechanical movements were registered in the usual manner with receiving and recording tambours and also with a small telephone applied to the flexor surface of the forearm and connected with the galvanometer. This is an extremely delicate method of registering mechanical movements.

The frequency obtained over contracting muscles was about 12 per second with both methods.

Using the telephone method, curves of similar character and frequency were obtained over the surface of the resting arm during electrical stimulation of the flexor group of the other arm, and also for a short time following such stimulation.

These movements were also readily evoked in the resting arm during voluntary contraction of the flexors of the opposite arm.

The records of the action current do not show variations of the slow rate when the galvanometer is so adjusted as to give an optimum record of the 47 to 50 rate, but slow variations appear on increasing its sensitiveness.

It appears as a result of this study, that in voluntarily contracting muscle there are two distinct sets of rhythmic phenomena. One, occurring at the rate of 47 to 50 per second and due to voluntary impulses from the central nervous system; the other, reflex and occurring at a rate of from 10 to 13 per second. It appears extremely probable that the latter are variations in tonus.