

Summary and Conclusions. 1. The intravenous injection of curare produces a marked inhibition of the choline esterase of human serum. 2. The inhibition of this esterase activity gradually diminishes at a variable rate in different patients, but is still present 5 to 6 hours after the injection of curare. 3. The degree of inhibition of the esterase activity was similar to that obtained in *in vitro* experiments previously reported. 4. A method is indicated for estimating the amount of the choline esterase inhibiting constituent of curare in the blood by the use of its inhibiting effect on esterase activity. Some of the possible applications of the method are pointed out. 5. The relation between the effect of curare on choline esterase and the production of muscular paralysis is discussed.

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Strychnine Tetanus and the Mechanism of Neuronal Synchronization.*

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Oscillographic study indicates that spinal strychnine tetanus is the most perfect expression of the synergy of elementary electrical activities in a mass of nerve cells. Strychnine tetanus was studied in the curarized cat under light dial anesthesia (10 to 20 mg per kg) with the special purpose of analyzing the mechanism of neuronal synchronization. The following facts were demonstrated:

1. Tetanic waves, recorded from any segmental level of the spinal cord by means of an active electrode thrust into the grey matter of the anterior horn, have regularity of form, amplitude and rhythm of an alternating current. Their frequency varies from 30 to 10 per second, their voltage from 500 to 100 microvolts. Usually there is an inverse relationship between voltage and frequency. This relationship becomes most apparent when the frequency of the tetanic waves has been increased as the result of an intravenous injection of nicotine.

2. With each tetanic wave there is a corresponding strong discharge of centrifugal action potentials in the anterior roots. This

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discharge begins with the rising phase of the tetanic wave and is maximal at its peak.

3. Cell groups of the posterior horns do not participate in the strychnine tetanus. They are likewise refractory to the synchronizing action of other agents.

4. Waves simultaneously recorded from cervical, dorsal and lumbosacral regions of the cord are practically synchronous. They are never out of phase by more than 3 milliseconds.

5. This synergy cannot be explained by synaptic transmission of intraspinal impulses from a focus playing the rôle of a pacemaker, for the following reasons: (a) The cervical and lumbar reflex waves produced by stimulation of a posterior lumbar root (break shocks) are separated by a time interval which is never less than 8 milliseconds even if the spinal cord is strongly strychninized with a just subtetanic dose. (b) Strychnine tetanus is abolished by depressor agents (ether anesthesia for 30 seconds; anelectrotonus) at doses or intensities which do not affect, or only slightly diminish the amplitudes of spinal reflex waves. Conversely, a strong tetanus may continue in the absence of all electrically demonstrable reflex activity in the intervals between tetanic discharges. (c) Synchronization of the tetanic waves produced by two adjacent spinal segments may persist after complete separation of the segments by spinal transection.

6. During the short phase of a few seconds which follows the injection of the tetanizing dose and immediately precedes onset of the tetanus, reflexogenous stimuli (break shocks) produce synchronous lumbar and cervical waves which by their form and by the constancy of their amplitude can be recognized as evoked tetanic waves. The onset of the tetanus is characterized by the appearance of spontaneous waves, which are all similar and occur in increasing numbers during the intervals between the evoked waves.

From these experimental data one may conclude that the mechanism producing synchronism of electrical pulsations throughout the entire ventral spinal grey matter is independent of all synaptic transmission of impulses. Everything suggests that this neuronal synergy is effected by an intercellular action, truly electrical in nature, which spreads from an occasional focus with the speed of an explosion and synchronizes, over wide areas, the pulsations of autorhythmic elements possessing nearly identical individual frequencies.