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SIMULATED ENTRAINMENT OF THALAMOCORTICAL CELLS BY REPETITIVE CORTICAL SHOCKS. W. W. Lytton*, T. J. Sejnowski, and M. Steriade, University of Wisconsin, Madison, WI, 53792, The Salk Institute, La Jolla, CA, 92037, Laval University, Quebec City, Canada, G1K7P4.

Intrinsic properties and synaptic input both aid in determining the major oscillatory behaviors of thalamocortical relay cells: the 8-10 Hz spindle oscillations seen in early sleep and the 1-3 Hz slow oscillations seen in slow-wave sleep. We simulated the effects of cortical shocks, including both the initial excitatory component and feedforward inhibition. We were able to match intracellular recordings by placing both synapse types at sites about 100 microns out on the dendrites, with activation of $GABA_A$ feedforward inhibition at 30 ms following the EPSP and activation of $GABA_B$ at 50 ms. In order to obtain the smooth transition between EPSP and IPSP observed electrophysiologically, we had to activate multiple $GABA_A$ inputs over a 20 ms range of time intervals. A low-threshold spike followed the inhibition. Cortical shocks could reset the phase of either the spindle-frequency oscillations seen at resting membrane potential (V_m) or the slow waves occurring with D.C. hyperpolarization. The slower rhythm could also be entrained by rapid repetitive cortical stimulation to above 10 Hz in the model, though the responses were subthreshold for sodium spikes above 7 Hz. Cortical stimulation could not slow the frequency. Simulated repetitive cortical shock with the thalamocortical neuron model at resting V_m produced repeated damped oscillations at spindle frequencies.

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