Readings in Neroinformatics

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Hodgkin, Alan L & Andrew F Huxley. 1952. A quantitative description of membrane current and its application to conduction and excitation in nerve. *The Journal of physiology* 117(4). 500–544.

Abstract

When excited, the surface membrane of a nerve fibre carries electric current. Giving rise to complicated phenomena such as the action potential and refractory period, this has been associated with changes in in- and outward movement of ions. For a precise understanding, a mathematical description of these ion movement changes in relation to a given membrane potential is necessary. Our work shows that the quantitative behaviour of a model nerve can be predicted under a variety of conditions and that the responses to electrical stimuli can be explained by reversible alterations in sodium and potassium permeability arising from the changes in membrane potential. To this end, equations and parameters were fitted to experimental curves from previously obtained voltage clamp data. Agreement with fair accuracy was found for electrical properties of the squid giant axon such as form, duration and amplitude of both 'membrane' and propagated spike, conduction velocity, impedance changes during spike, refractory period, ionic exchanges, subthreshold responses and oscillations. In addition, many of the phenomena of excitation, including anode break excitation and accommodation can at least qualitatively be accounted for. These observations provide a solid basis for refined models of membrane function and examination of higher-level processes in nerve.