larger animals, well-differentiated results can probably be obtained by this method, whereas an extensive chromatolysis can often only be observed when a nerve is severed close to the spinal cord, making a high resolution hardly possible. As a cartographical method, retrograde transport seems to offer several advantages, including the possibility of a combination with other histological methods.

Zusammenfassung. Der retrograde axonale Transport wurde als Methode zur Kartographie von Neuronen bei der Ratte verwendet. Mit Evansblau gekuppeltem Albumin konnten Karten der Perikaria von Neuronen, welche Muskeln der Vorderextremität der Ratte innervieren, angefertigt werden. Die Ergebnisse stimmen mit denen aus Chromatolyse-Versuchen erhaltenen überein.

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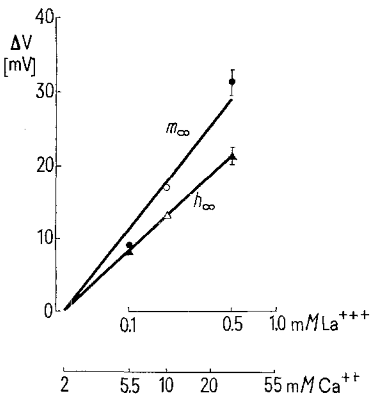
Effect of Lanthanum at the Nodal Membrane

Voltage clamp experiments were done on myelinated nerve fibres of the toad, *Xenopus laevis*. The normal Ringer solution contained 2 m*M* Ca^{++}. The 3 test solutions were: Ringer solution with 10 m*M* Ca^{++}, Ca-free Ringer with 0.1 m*M* La^{+++}, or Ca-free Ringer with 0.5 m*M* La^{+++}. The normal leakage conductance was reduced to 91% in 10 m*M* Ca^{++} and to 73% in 0.5 m*M* La^{+++}; this reduction was not completely reversible. In the sodium current-voltage curves, the negative resistance branches were shifted towards more positive internal potentials and the maximum inward currents were reduced in the sequence (in m*M*): 0.1 La^{+++}-10 Ca^{++}-0.5 La^{+++}. In seven experiments, the maximum sodium permeability was reduced to 80% in 10 m*M* Ca^{++} and to 54% in 0.5 m*M* La^{+++}. The sodium equilibrium potential was not affected.

The steady state values of the activation (m_∞) and the inactivation term (h_∞) of the sodium permeability, according to the HODGKIN-HUXLEY model[1], were calculated from the current records and plotted as a function of the membrane potential, V. These curves were shifted in the test solutions by ΔV in the depolarizing direction; the shift was completely reversible on returning to normal Ringer solution (2 m*M* Ca^{++}). Cooling from 19 to 8 °C did not significantly influence ΔV. In the Figure the shifts of the activation and the inactivation are plotted versus the logarithm of the Ca^{++} and La^{+++} concentrations. In the range of the tested concentrations, the experimental points can be reasonably fitted by straight lines under the assumption that 1 m*M* La^{+++} be equivalent to 55 m*M* Ca^{++}. In lobster axons the ratio 1:20 has been found[2]. It should be noted that lanthanum, like calcium[3], causes the h_∞-curve to shift less than the relation m_∞ (V).

Shifts of the permeability parameters have been interpreted as changes in the surface potential of the excitable membrane due to the screening effect of cations on negative surface charges[4–6]. The experimental points of ΔV_m, except that for 0.5 m*M* La^{+++}, which is 10 mV off, can be fitted by curves as calculated for screening from the GRAHAME[7] equation, assuming 1 electronic charge per 70 Å^2, approximately. Additional binding of Ca^{++} or La^{+++} would require an even larger charge density. For crayfish axons $-1/43$ Å^{-2} has recently been found[8]. The activation curve of the potassium permeability, n_∞ (V), was shifted by 10 ± 1.1 mV ($n = 4$) in 10 m*M* Ca^{++}, corresponding to an approximate charge density of only $-1/200$ Å^{-2} near the potassiun channel. Similar values, $-1/600$[5] and $-1/300$[6] Å^{-2} have been reported, suggesting the effective charge density near the potassium channels to be lower than in the vicinity of the sodium channels.



Voltage shift as a function of Ca^{++} and La^{+++} concentration. Ordinate: voltage shift, ΔV, of the m_∞ or h_∞-curves. Abcissa: Ca^{++} and La^{+++} concentration on logarithmic scales. The lanthanum abcissa has been displaced by a factor of 55 relative to the Ca scale. Open circle: ΔV_m in 10 m*M* Ca^{++} (16.8 ± 0.7 mV, $n = 8$), filled circles: ΔV_m in 0.1 m*M* La^{+++} (9.2 ± 0.5 mV, $n = 5$), and in 0.5 m*M* La^{+++} (31.2 ± 1.8 mV, $n = 5$), open triangle: ΔV_h in 10 m*M* Ca^{++} (13.1 ± 0.5 mV, $n = 12$), filled triangles: ΔV_h in 0.1 m*M* La^{+++} (8.1 ± 0.5 mV, $n = 10$), and in 0.5 m*M* La^{+++} (21.2 ± 1.3 mV, $n = 11$), mean values of 19° and 8 °C. The vertical bars give $\pm$ S.E.M. The slopes drawn by eye to fit the measuring points are 11.0 mV and 8.3 mV per e-fold change in concentration.

Zusammenfassung. An der Schnürringmembran sind Lanthanionen etwa 55mal wirksamer als Calciumionen. Die Ergebnisse lassen vermuten, dass die Dichte negativer Festladungen in der Nähe des Natriumkanals grösser als am Kaliumkanal ist.

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