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ABSTRACTS OF MEMOIRS

RECORDING WORK DONE IN THE PLYMOUTH LABORATORY

KEYNES, R. D. & ROJAS, E., 1974. Kinetics and steady-state properties of the charged system controlling sodium conductance in the squid giant axon. *Journal of Physiology, London*, **239**, 393–434.

Asymmetries in the early time course of the displacement current passing across the membrane after application of equal voltage-clamp pulses in the two directions have been investigated in the squid giant axon. Before making the measurements, Na current was blocked by removal of external Na and treatment with tetrodotoxin. Potassium current was usually blocked by perfusion with CsF, but some experiments were done with intact axons. A signal averaging technique was used to eliminate the symmetrical components of the membrane current.

The asymmetrical current had a contribution of appreciable size attributed to the movement of mobile charges or dipoles in the membrane. This was manifested as an outward current rising rapidly to a peak on depolarization of the membrane and then declining exponentially to zero, followed at the end of the pulse by an inward surge of current with a similar time course. There was also a sustained flow of current outwards during the pulse, arising from ionic leakage with a rectifying characteristic.

The identification of the exponentially changing current component with the displacement of charged particles forming an integral part of the membrane was supported by the demonstration that the total transfer of charge was equal and opposite at the beginning and end of the pulse, that it reached saturation when the internal potential was taken to a sufficiently positive value, and that its size was unaffected by temperature, although its time constant had a large temperature coefficient.

The disposition of the mobile charges in the steady state was shown to obey a Boltzmann distribution. At the midpoint of the distribution curve, the proportion of the charge displaced underwent an e-fold change for a 19 mV change in potential. The effective valency of the particles, that is their actual charge multiplied by the fraction of the electric field acting on them, was therefore 1·3.

The total quantity of mobile charge was estimated as about 1500×10^{-12} C for 0·05 cm^2 of membrane, corresponding to some 1900 charges/μm^2.

The identification of these mobile charges with the gating particles responsible for controlling Na conductance was supported by the findings that (*a*) their time constants were the same as those of Hodgkin & Huxley's '*m*' system, both in absolute magnitude and in their dependence on potential and temperature, (*b*) the transition potential at which the charges were evenly distributed on the two sides of the membrane also agreed with that for the '*m*' system in intact axons, and its value was similarly shifted in a positive direction by a reduction in internal ionic strength or by raising the external Ca concentration, (*c*) comparison of the steepness of the curves governing on the one hand the steady-state distribution of the mobile charges and on the other the Na conductance, suggested that an effective cooperation of the charges in groups of three was involved, again in excellent agreement with the '*m*' system.

Displacement of the mobile charges was unaffected by external pH over the range 5–8, but preliminary observations showed that 1 % procaine reduced the total charge transfer to somewhat less than 40 % of the initial value, and roughly halved the time constant.

SOUTHWARD, A. J., 1974. Changes in the plankton community of the western English Channel. *Nature, London*, **249**, 180–1.

The chaetognath *Sagitta elegans*, together with associated plankton 'indicators', returned in abundance to the Channel waters off Plymouth in 1972 and 1973 after a lapse of over 40 years. This change appears to complete a cycle of events which has involved not only the macroplankton community but also the local populations of pelagic and demersal fishes. There appears to be an overall link with corresponding fluctuations in the climate of the Northern Hemisphere.

WHITFIELD, M., 1974. Accumulation of fossil CO_2 in the atmosphere and in the sea. *Nature, London*, **247**, 523–5.

A number of models have predicted gross accumulations of fossil fuel carbon dioxide in the oceanic mixed layer over the next fifty or one hundred years. As a consequence, it has been suggested that the surface layers of the oceans will become undersaturated with respect to calcium carbonate by the end of this century causing severe stress in animals and plants that maintain calcareous skeletons or tests. A thermodynamic analysis is used to show that at 25 °C the predicted atmospheric and oceanic surface concentrations are not likely to lead to a dissolution of calcareous material in the foreseeable future.

WHITFIELD, M., 1974. Temperature, fossil CO_2 accumulation and carbonate ion concentration of the oceanic mixed layer. *Nature, London*, **249**, 818–20.

The earlier analysis (Whitfield, M., *Nature, London*, **247**, 523–5) is used to formulate a self-consistent model for the accumulation of fossil fuel carbon dioxide in the oceanic mixed layer over the next century. This model is used to predict the influence of temperature and carbonate alkalinity on the degree of supersaturation of calcite and aragonite in the mixed layer. Using the most recent values for the solubilities of these minerals in sea water the calculations suggest that, for a carbonate alkalinity of 2·25 m-equiv. l^{-1}, waters with a mean annual temperature greater than 5 °C are likely to remain supersaturated with respect to calcite and those with a mean annual temperature greater than 12 °C will remain supersaturated with respect to aragonite. The detailed analysis is critically dependent on the values assumed for the solubilities of the various minerals. These values are currently in dispute and are themselves dependent on the exact nature of the mineral phase investigated.