

of such a fibre was some distance from the electrode tip toward the periphery of the retina. The typical slow changes of ganglion cells were absent, the potentials rose sharply and were all or none. Further, there was no sign of synaptic noise which was always present in ganglion cells.

The present observations may be compared with those in a variety of nerve cells. Thus, Eyzaguirre and Kuffler², recording from the cell body of the stretch receptor of crayfish, showed corresponding excitatory and inhibitory changes which determined the discharge frequency. Further, Hartline, MacNichol and Wagner⁴ and Fuortes⁵, leading from the eccentric cell in the *Limulus* eye, described a similar graded depolarization during illumination which was directly related to the discharge frequency. Corresponding slow potentials, both with excitation and inhibition, have been reported by Kolmodin and Skoglund⁶ in the motoneurons and interneurons of the cat's spinal cord. The cortical cells studied by Phillips⁷ also had similar slow potentials.

The retinal ganglion cells are the final points of convergence from the neuronal network of the receptive fields, which can extend over an area up to several mm. in diameter. The cells can integrate the excitatory and inhibitory synaptic influences in terms of slow changes in their membrane potential. Presumably, these in turn control the discharge frequencies of the optic nerve fibres.

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Bacterial and Testicular Hyaluronidase

In papers from this laboratory, the actions on dermal connective tissue^{1,2} and on ocular structures^{3,4} of different kinds of hyaluronidase have been studied. In these experiments, 'Hyason', manufactured by Organon, Oss, Holland, was used as a source of staphylococcal hyaluronidase. This is also preparation D of Chauncey *et al.*⁵

We have recently been informed that batches of 'Hyason' released after January 29, 1958, contain testicular instead of bacterial hyaluronidase and we write this communication in order to prevent confusion arising from the change in composition. The manufacturer keeps a stock of the old preparation, and samples are available for research purposes.

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Excitation of the Squid Axon Membrane in Isosmotic Potassium Chloride

THE interesting recent findings in the frog node of Ranvier of an 'action potential' in isosmotic potassium chloride by Müller¹, and of two stable states in 20–40 mM potassium chloride by Stämpfli², raise the question as to whether or not similar phenomena are to be found in the squid axon membrane.

I have made a preliminary study of the approximate steady-state voltage-current relationship for the squid (*Loligo pealii*) giant axon membrane in 0.5 M potassium chloride. When the potential was controlled ('E-LOC') and varied, a continuous variation of the current is found, including a negative resistance region. The characteristic shape seen in Fig. 1 is typical, although there are some minor variations in the *E-I* curves depending upon the previous potential history and the rate and direction of sweeping. When the current was controlled ('I-LOC') and varied the voltage showed the hysteresis loop to be expected about the unstable negative resistance region. This is in complete agreement with Segal's³ recent finding of two stable potentials for the squid axon membrane in high potassium under current control.

Franck⁴ has compiled examples of dynode type characteristics with a negative resistance region which give excitation phenomena. The squid axon membrane in sea water with normal sodium concentration exhibits such a characteristic⁵ and gives a normal action potential. Thus, it would also be expected that the squid axon in 0.5 M potassium chloride with a similar but displaced characteristic should exhibit excitation under the proper conditions. If the membrane is subjected to a constant hyperpolarizing current, an 'excitation' threshold for superimposed depolarizing current pulses should be found when the net current is less than about 0.15 m.amp./cm.² Fig. 2 demonstrates the threshold and also shows a recovery so that the process may well be called an 'action potential'.

At present, the description of the processes involved in the 'action potential' in 0.5 M potassium chloride seems to be as follows: If the squid axon

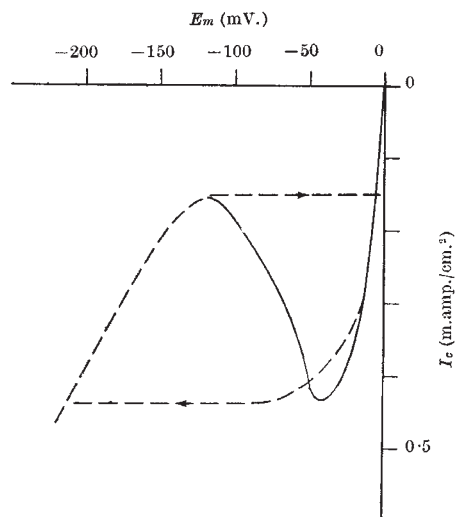


Fig. 1. Voltage-current characteristics of the squid axon membrane in 0.5 M potassium chloride. The continuous line was obtained with potential control; the dashed sections with current control. Arrow heads indicate abrupt changes