

Frankenhaeuser B & Hodgkin A L. The action of calcium on the electrical properties of squid axons. *J. Physiol.—London* 137:218-44, 1957.

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The membrane potential of isolated squid giant nerve fibres was changed in rectangular steps (voltage-clamp experiments). The membrane currents associated with the potential changes were measured and analysed. The effects of calcium on the current-potential relations are described quantitatively. [The SCJ® indicates that this paper has been cited in over 980 publications since 1957.]

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The knowledge of the excitable nerve membrane increased in a single giant step with the publication of the voltage-clamp analysis of the ionic currents in the squid nerve fibre by Hodgkin and Huxley.¹ I was working then with the excitability of the isolated myelinated nerve fibre of the frog. The accommodation of the nerve fibre to a lasting stimulus was at the time explained through an assumed increase in threshold. I had made the surprising observation that a lasting polarization of about threshold strength made the fibre inexcitable.

It was known that the calcium concentration affects the accommodation of the nerve; the mechanism was, however, unknown. The powerful voltage-clamp technique seemed suitable for an analysis of this mechanism.

During the 1952 Cold Spring Harbor symposium on "The Neuron," Alan Hodgkin and I agreed to carry out together a voltage-clamp analysis of the effect of calcium on the squid giant nerve fibre. The experiments were done from August to October in 1954 at the

laboratory of the Marine Biological Association, Plymouth, during the "squid season."

Our goal was to obtain sufficiently complete experimental measurements to define the calcium effects in the short time available—one squid season. Our daily working time was very long, which was, without a doubt, necessary. It was a full-time job for both of us. In spite of the pressure, surprisingly few nerve fibres were electrocuted due to mistakes in running the experiments.

My most vivid recollections from the months in Plymouth are the intense concentration required during the experiments, the continuous need to trim and service the electronics, the making of new spiral electrodes, and measuring cells. I remember the regular midnight discussions in the laboratory's lunchroom during the pause between two experiments. The details of the next experiments were fixed while we "enjoyed" canned tomato soup (i.e., our "dinner"). During several "dinners," we were distracted by our efforts to understand a propagation artifact. This artifact is described on less than one page in the paper.

The exciting and exhausting three-month period of experimental work was followed by two years of struggle with the analysis of the measurements and with the manuscript.

The manuscript was written for the *Journal of Physiology*. The referee's only comment was in essence: the manuscript is too long; compress it to half its length.

I think that this paper has been so frequently cited because neurophysiologists are interested in excitability and in the effect of calcium on excitability. Evidently, the paper was published at a suitable time. Neurophysiologists were ready for it.

1. Hodgkin A L & Huxley A F. A quantitative description of membrane current and its application to conduction and excitation in nerve. *J. Physiol.—London* 117:500-44, 1952. [See also: Hodgkin A L & Huxley A F. Citation Classic. *Current Contents/Life Sciences* 24(28):19, 13 July 1981.]