Short communication

Measurement of Absolute Membrane Potential with the Potential Clamp System of Nonner

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A commercially available version of the potential clamp system of Nonner (distributed by Medica GmbH, Saarbrücken, West-Germany) enables the measuring of membrane potential changes V, relative to the resting potential E_r (Nonner 1969). If E is used for absolute membrane potentials, $V = E - E_r$ (Dodge and Frankenhaeuser 1959).

The resting potential E_r may be measured by destroying the membrane electrically at the end of the experiment (Stämpfli 1974). A more frequently used

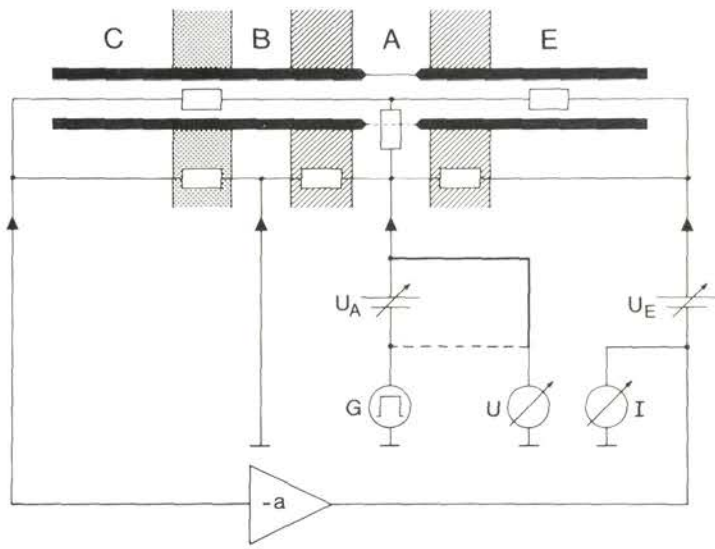

Fig. 1. Circuit diagram of the recording system introduced by Nonner (for comparison, see Nonner 1969, Fig. 1). E, A, B, C: fluid pools, separated by vaseline seals or an air gap (hatched and dotted areas respectively). The node under investigation is located in pool A. The two adjacent internodes are cut. Filled triangles: electrodes. U_A and U_E: adjustable batteries. G: pulse generator. U, I: potential and current measuring instruments respectively. -a: feedback amplifier. Dotted line: connection of U in the conventional fashion. Bold line: suggested connection of U.

method, however, is to define arbitrarily $E_r = -70$ mV for a sodium inactivation, h_∞, of 0.7 to 0.8 (e. g., Kniffki et al. 1981; Hu et al. 1983; Schmidtmayer et al. 1983).

Fig. 1 shows a simplified diagram of a potential clamp system for single Ranvier nodes (Nonner 1969). The adjustable batteries U_A and U_E enable a change from the potential clamp to the current clamp configuration. In the commercially available version, the potential measuring instrument U measures membrane potential changes, V, only (dotted line). For graded changes of the holding potential E_h, e. g. for investigations of the slow sodium inactivation (Neumcke et al. 1976; Fox 1976), scaling of U_A is necessary, the reference potential E_r still remaining arbitrarily fixed. However, if the device U is connected as shown, (bold line), the absolute potential in pool A can be measured. Assuming the potential drop across the nodal series resistance to be negligible (the potential drop being proportional to the membrane current), the potential in pool A equals the absolute membrane potential E (Salzberg and Bezanilla 1983; Wiese et al. 1984; Zaciu et al. 1981).

Experiments revealed that the potential in pool A can easily be controlled by an appropriate LED voltmeter connected as shown.

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