involves adaptive changes in the central nervous system[7].

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BIOPHYSICS

Elimination of the Liquid Junction by using Glass Electrodes

IT is assumed in measuring potential with hydrogen or alkali-sensitive glass electrodes[1] that the salt bridge which connects the reference electrode to the solution generates a negligibly small potential at the liquid junction. This is a reasonable assumption so long as the unknown solution contains no colloids, and its ionic strength is approximately that of the buffers used in standardization. Unfortunately these ideal conditions are seldom met in biological systems. The resultant error is often of a serious magnitude, as shown in experiments on *p*H in colloidal systems[2,3].

In many inorganic systems the liquid junction potential has been eliminated by the use of silver–silver chloride and other metallic reference electrodes placed directly into the unknown solution without a salt bridge[4]. The metallic reference electrodes function poorly in most biological systems because of the various interfering oxidizing and reducing substances which are present.

Glass electrodes are not affected by oxidation-reduction reactions and are well suited for use in biological media. With these advantages in mind, a system was designed and tested in which a hydrogen-sensitive glass electrode functioned as a reference electrode for sodium activity measurements with a sodium-sensitive glass electrode. The *p*H of the solution being tested was kept at 7·21. Any error in sodium determination which might have occurred if the *p*H were allowed to shift would tend to be automatically balanced out because the sodium-sensitive glass is also sensitive to hydrogen ions. The sodium concentration was varied by addition of 1 *N* sodium chloride to the buffer solution (*tris*-hydroxymethyl-aminomethane buffer[5]).

The sodium-sensitive glass electrode was of the bulb type (Electronic Instruments, Ltd., glass *BH* 104) while Corning 015 glass was fused to a lead glass stem to form the hydrogen-sensitive MacInnes–Dole type electrode. All potentials were measured with the Vibron model 33*B* electrometer and model *C*33*B* 'bucking' circuit.

Hydrogen ion sensitivity of the Corning 015 glass electrode was checked with buffers from the National Bureau of Standards (from *p*H 4·65 to 9·18), using a saturated potassium chloride–calomel reference electrode. The liquid junction between the saturated potassium chloride and buffer being tested was made through a porous ceramic plug. The sodium ion sensitivity of the *BH* 104 glass was tested in a *tris* buffer solution (*p*H 7·21) by varying the concentration of sodium with 1 *N* sodium chloride. The reference electrode was again the saturated potassium chloride–calomel with a porous ceramic plug. Representative data (circles) for the sodium-sensitive glass electrode and calomel reference are shown in Fig. 1. The hydrogen ion-sensitive glass electrode was then substituted for the calomel reference and the sodium ion measurements repeated in the *tris* buffer solutions (triangles in Fig. 1).

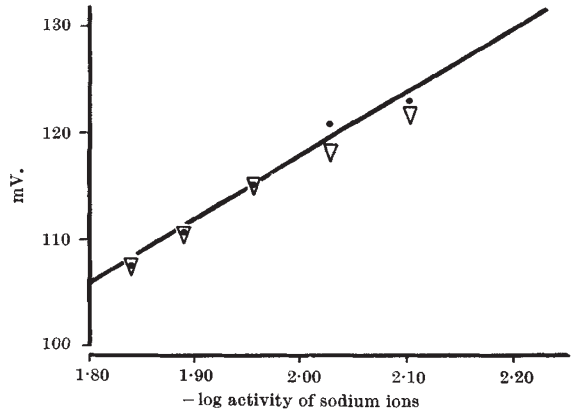

Fig. 1. Representative sodium-sensitive glass electrode potentials (circle) using a calomel reference electrode and (triangle) using a Corning 015 MacInnes–Dole glass electrode as the reference electrode. The straight line plots the slope of the theoretical potential given by the Nernst equation $E = E^0 + 2{\cdot}303RT/F$ (log a_{Na^+}) while the points are experimental measurements. The value of $2{\cdot}303RT/F$ was taken as 59 mV. at 23° C. The negative logarithm of the activity of Na^+ is plotted on the abscissa using an activity coefficient of 0·73 based on the presence of a constant 0·2 *M* buffer solution

The equivalent response of the sodium ion electrode with either the standard saturated potassium chloride–calomel reference or the Corning 015 glass reference illustrates the ability of the glass electrodes to function in a system as both an ion-specific electrode and reference electrode. The simplicity of this method of eliminating the liquid function should prove useful to workers in many fields, especially when the specific cation to be measured is a solute in a complex solution.

This work was aided by U.S. Public Health Service research training grant No. *HTS* 5454.

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Mechanism of Nicotinic Action at the Adrenal Medulla: Calcium as a Link in Stimulus-secretion Coupling

IN experiments to probe the mechanism of transmission of sympathetic activity at the adrenal medulla we have found that acetylcholine, which is believed to be the chemical transmitter, evokes catecholamine secretion through some calcium-dependent process. Our evidence, obtained in experi-