both in the gaseous state and in paraffin solution, and that the Arrhenius equation $k_f = A \exp - E/RT$ is obeyed. The 'constants' of the equation are given in Table 2.

The solubility of the gaseous *cyclo*pentadiene-*cyclo*pentadiene transition state in paraffin is defined by the ratio concentration solution / concentration gas = $C_t \exp \lambda_t/RT$ and can be estimated, using the following relationships which were deduced by Evans and Polanyi[4] and Wynne-Jones and Eyring[5].

$$C_t \sim \frac{A_s}{A_g}(C_a)^2 \text{ and } \lambda_t \sim E_g - E_s + 2\lambda_a.$$

Here C_t is a measure of the statistical probability of dissolution of the transition state, λ_t is the heat of solution, and the subscripts g and s refer, as above, to gas and paraffin solution.

As the solubility of *cyclo*pentadiene, the kinetic A values and the activation energies are known, it follows that

$$C_t \sim 1 \times 10^{-5} \text{ and } \lambda_t \sim 14 \text{ kgm.-cal.}$$

If these values are compared with the non-exponential solubility term and with the heat of solution of di-*cyclo*pentadiene, it can be seen that the solubilities of the transition state and of the product are similar.

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Origin of the Cochlear Effect

IN 1934 Hallpike and Rawdon-Smith advanced a tentative theory to account for the production of synchronous potential waves within the mammalian cochlea, in response to auditory stimuli[1]. According to this, the potential waves were held to be set up by movements of a membrane, thought to be polarized, and bounded on either side by the cochlear fluids. It has now proved possible to show that a membrane, polarized in such a fashion, will in fact yield potential waves of the required type.

The apparatus employed was arranged in the following manner. A piece of the skin of the common frog was stretched over the mouth of a glass tube approximately 1 cm. in diameter. The mouth of a second tube was caused to press lightly over this, in such a way that a fluid-tight seal was produced. The two tubes were then filled with frog's Ringer solution at pH 8. Into each tube a small platinum electrode was sealed so as to dip into the solution. It was then found that a steady potential of some 35 millivolts existed across the electrodes, and therefore across the skin, in the manner first demonstrated by du Bois Reymond[2].

Sounds generated by a heterodyne oscillator and loudspeaker were led by means of pressure tubing to a rubber membrane sealing off the opposite end of one of the glass tubes. The opposite end of the second tube was left open. On attaching the platinum electrodes to the input of a high-gain amplifier, the output of which was connected to a cathode ray oscillograph tube, it was found that potential waves of considerable magnitude (up to 0·5 millivolt) were produced by a stimulus of low frequency. As the stimulus frequency was increased, the efficiency of the mechanism fell off, as would be expected from a consideration of the inertia of the fluid system employed, many times greater than that of the mammalian ear.

The record shown in Fig. 1 was obtained using a stimulating frequency of approximately 140 ~ per sec. Its close resemblance to oscillograms produced in a similar fashion by the mammalian ear may be noted. A further point of similarity is provided by the fact that the application of ether to the skin abolished this effect; abolition of the steady potential previously referred to also ensued.

It is felt that this demonstration that a polarized membrane will yield such an effect lends indirect support to Hallpike and Rawdon-Smith's original theory.

Changes in frog skin potential were first observed by Motokawa[3] to arise from variations in the pressure head across the skin; a similar variation was observed for alteration of tension in the skin. Motokawa's results, and further data obtained here, indicate that such changes in potential are primarily due to changes in the values of the internal 'short-circuiting' (or local action) currents. These changes in turn result from changes in the local, and therefore also in the total, skin resistance. Support is lent to this contention by the fact that the required changes in total resistance can, in fact, be readily demonstrated.

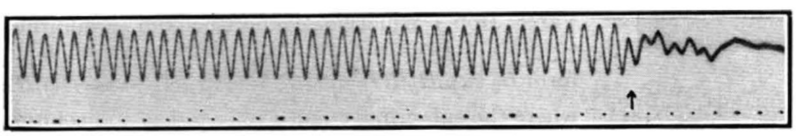

Fig. 1.

CATHODE RAY OSCILLOGRAM SHOWING RESPONSE FROM FROG'S SKIN TO PURE TONE STIMULUS OF FREQUENCY 140 ~ PER SEC. SOUND SWITCHED OFF AT ARROW. TIME MARKER: SMALL DOTS = 0·01 SEC.

From this evidence it appears that the potential waves recorded in response to acoustic stimuli may perhaps be ascribed primarily to such variations in local resistance, these in turn resulting from variations in pressure head and/or in tension set up by the vibrations communicated to the skin by the fluid with which it is surrounded. It is not impossible therefore that the cochlear effect may also be ascribed to some such mechanism.

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