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The effect of light on the permeability of lecithin.

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Plant protoplasm changes its permeability in the light (Lepeschkin,[1] Tröndle,[2] Blackman[3]). These changes in permeability account for changes in turgor, and inasmuch as turgor-changes precede or accompany the photo-growth reactions in plants, the latter reactions might ultimately be traced to changes in permeability.

After Hansteen-Cranner's[4] careful ultra-microscopic observations, once more our attention is called to the importance of the lipoid component of plant protoplasm. The universal distribution of these lipoids justified our choice of lecithin as a material for permeability studies.

Membranes of lecithin-collodion were prepared in the following way. An ether solution containing 5 percent lecithin and 5 percent collodion, was carefully poured on glass plates, yielding membranes from 10 to 20 μ thick. The manipulations were carried on in the dark.

The dry membranes were mounted in the following way (Fig. 1). Rims were blown on pyrex glass tubes. After grinding the rims and covering them with soft paraffin the membranes were pressed between two pyrex cells, one of which contained a pair of platinum electrodes. The electrode compartment was filled with twice distilled water, the other compartment with .02 M KCl. Both compartments were sealed with cover slides by means of paraffin. The apparatus was mounted in a vertical position (electrode compartment below) in an asbestos box.

The KCl diffusing through the membrane caused a decrease in the resistance between the electrodes, which decrease could be measured by the Wheatstone Bridge and telephone. Fig. 2, Curve I, shows the rate of diffusion through a non illuminated

[1] Lepeschkin, W., *Ber. d. Bot. Ges.*, 1910, xxviii, 28.

[2] Tröndle, A., *Jahrb. Wiss. Bot.*, 1910, xlviii, 171.

[3] Blackman, V. H., *Ann. Bot.*, 1918, xxxii, 69.

[4] Hansteen-Cranner, B., *Ber. d. Bot. Ges.*, 1919, xxvii, 1.

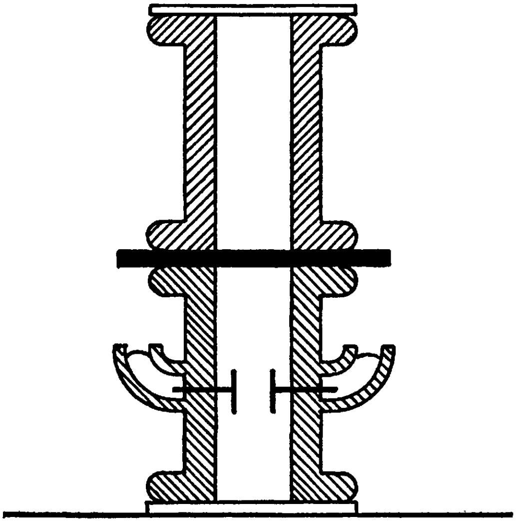

FIG. 1.

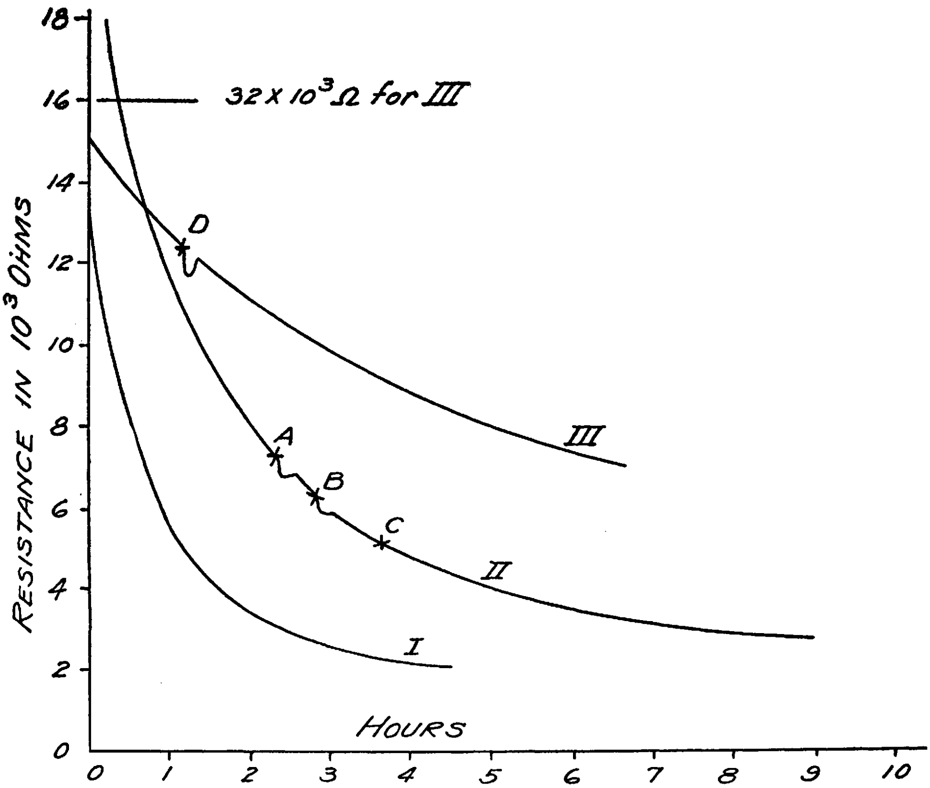
32 X 10³Ω for III
RESISTANCE IN 10³ OHMS
HOURS
D
A
B
C
I
II
III
0
2
4
6
8
10
12
14
16
18
1
3
5
7
9

FIG. 2.

membrane. Depending on the nature of the membrane, equilibrium is reached after 9 to 24 hours.

The diffusion curve cannot be represented by a logarithmic line, possibly because of the fact that lecithin dissolves in the surrounding liquid. If x be the conductivity of the liquid, t the observation time in hours, a the initial resistance, we have

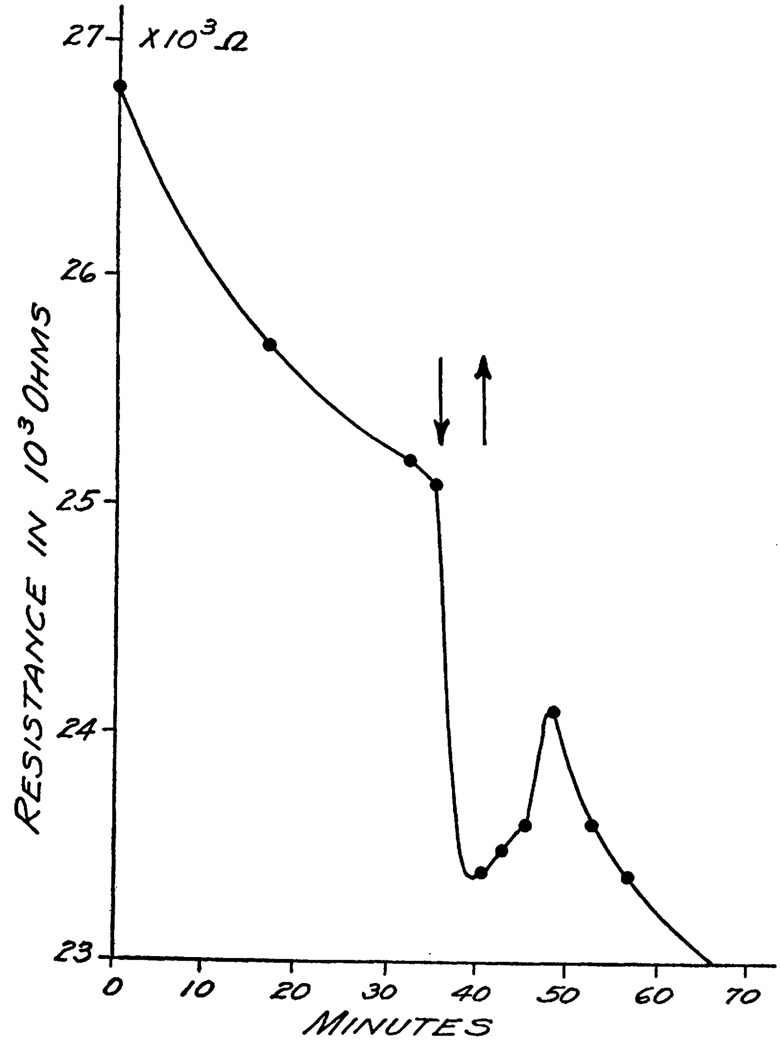

FIG. 3.

been able to represent the diffusion of .02 M KCl through collodion-lecithin by

$$\left(\frac{x}{a} + \frac{1}{c}\log\frac{a}{a-x}\right) = bt,$$ in which b, c, and d are constants. In this case

$$t = 9.9\left(\log\frac{a}{a-x} - .013\,x\right) \quad a = 32.5 \times 10^3\Omega.$$

a-x	t found	t calculated
15.4 × $10^3\Omega$	1 hours	1.10 hours
10.6	2	2.00
7.6	3	3.04
5.7	4	4.03
4.4	5	4.98
3.6	6	5.92
2.9	7	6.81

This general type of curve apparently expresses the resistance-time relation in the majority of cases. Abnormal results, caused by apparent heterogeneity of the membrane, were found when the ether solution contained 15 percent lecithin.

The continuity of the diffusion curve is disturbed by illumination. A water jacketed 300 Watt hydrogen filled bulb was placed at 50 cm. distance from the KCl compartment. Temperature fluctuations during illumination kept within $\pm 1°$ C. Curve II at A, B and C, curve III at D show the effect of five minute illumination of the membrane. There is an increase in conductivity, followed by a more or less pronounced decrease, after which the diffusion assumed its original rate. The effect is more marked on the steep end of the curve, till it becomes imperceptible when the curve flattens out. The effect at III D is represented on a larger scale in Figure 3. The period of illumination is indicated by the arrows. The membranes apparently lose their sensitivity after six to seven days. The experiments, which are still in progress, indicate that lecithin-collodion membranes change their permeability to potassium chloride on illumination.

The lecithin used was one of Dr. P. A. Levene's preparations. We are also indebted to Dr. D. T. Mac Dougal, whose hospitality enabled us to carry out part of the work at the Coastal Laboratory of Carmel, California.