

Note on the Graphical Treatment of Experimental Curves

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DISCUSSION.

Mr. WHETHAM said there was one form of membrane which is quite permeable to water, and yet does not allow either salts or the ions to get through. He referred to the free surface of the solution itself. The water being volatile can get out, but the salt cannot.

Dr. DONNAN said the author seemed to have discovered things well known; for instance, the integral $\int VdP$ is generally taken as proportional to E.M.F. He expressed his interest in the explanation of the difficulty in the logarithmic formula.

Dr. LEHFELDT, in reply, said Goodwin had used the integral $\int VdP$, but had not made any numerical calculations by means of it, or given any satisfactory proof of it.

XXXVII. *Note on the Graphical Treatment of Experimental Curves.* By R. A. LEHFELDT*.

WHEN as the result of experiments a relation between two quantities

$$y=f(x)$$

has been found, it is sometimes desirable to calculate from it some other function of x of a kind that involves differentiating y . The form of the function f being unknown, it is necessary to deal directly with the numerical observations, or with the curve expressing them. This is often done by finding an empirical equation for $y=f(x)$ and differentiating it, but to find a satisfactory empirical equation is not always possible; and if the subsequent treatment involves integration, the choice of forms is closely limited by the possibilities of the integration. There remains of course the method of differentiating the experimental curve graphically, by drawing tangents; but this should be avoided if it is in any way possible to do so, because the errors of the experimental curve

* Read November 9, 1900.

the time, occurs in my paper "On the Vapour-Pressure of Liquid Mixtures" (Phil. Mag. [5] xlv. p. 61, 1898), where the relation

$$x \frac{d \log p_1}{dx} + (1-x) \frac{d \log p_2}{dx} = 0$$

was to be verified: here x is the molecular fractional composition of a binary liquid mixture, p_1, p_2 the vapour-pressures of the two components. It is sometimes much easier to measure one of the vapour-pressures than the other. Suppose p_1 to be measured, then

$$\log p_2 = - \int \frac{x}{1-x} \frac{d \log p_1}{dx} dx.$$

Hence

$$\log p_2 = \left[\frac{-x}{1-x} \log p_1 \right] + \int \frac{\log p_1}{(1-x)^2} dx,$$

and the numerical solution becomes practicable.

XXXVIII. *On a Phase-Turning Apparatus for use with Electrostatic Voltmeters.* By ALBERT CAMPBELL, B.A.*

[Abstract.]

ELECTROSTATIC voltmeters are particularly insensitive at the lower parts of their ranges, the divisions closing in very much towards the zero point. When measurements of small direct-current potential-differences have to be made it is an easy matter to add to the voltage to be measured a constant voltage large enough to bring the deflexion to an open part of the scale. If the small voltage to be measured is an alternating one it is necessary that the auxiliary voltage should alternate with the same frequency and be in phase with it. The apparatus described enables the phase of the auxiliary voltage to be turned until it agrees with the one to be measured. The phase-difference referred to is not the time lag, but the angle whose cosine is the power-factor, and

* Read November 9, 1900.