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ON FINDING THE EQUATION OF THE CHARACTERISTIC BLACKENING CURVE FOR A PHOTOGRAPHIC PLATE

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In 1890 Hurter and Driffield [1] proposed the following equation for the density [2] "D" of a photographic plate exposed for a time "t" to light of constant intensity:

$$D = 1/a \ \mathrm{Log}_e(b - [b-1]e^{-ct})$$

where "a", "b", and "c" are parameters.

This equation has since been quite generally employed by other investigators,[3] but its one great disadvantage lies in the difficulty of finding numerical values of the parameters for an experimentally determined plate-curve. Sheppard and Mees [4] give methods of approximating values of "b" and "c" only when "a" equals 1.

This contribution points out two ways of obtaining values of the constants from an empirical curve which has the form of the equation given above by (1) an algebraic and (2) a graphical process.

Assuming that the experimental curve is of the form above, and selecting four points (t_1, D_1), — —, (t_4, D_4), so that $t_2 = t_1 + \Delta t$, $t_3 = t_1 + 2\Delta t$, and $t_4 = t_1 + 3\Delta t$, by elimination it can readily be shown that

$$(e^{aD_2} - e^{aD_3})^2 - (e^{aD_1} - e^{aD_2})(e^{aD_3} - e^{aD_4}) = 0.$$

$$c = \mathrm{Log}_e (e^{aD_1} - e^{aD_2})^{\frac{1}{\Delta t}} - \mathrm{Log}_e (e^{aD_2} - e^{aD_3})^{\frac{1}{\Delta t}}$$

and $$b = \frac{e^{aD_1} - e^{-ct_1}}{1 - e^{-ct_1}}$$

so the parameters are thus determined in terms of D_1, — —, D_4, and Δt.

The graphical method, superior to the algebraic method in actual practice, can be very conveniently established.

1 Journ. Soc. Chem. Ind. 9, 455; 1890.

2 Density of a plate equals logarithm to the base 10 of the ratio of the incident light to the light transmitted by the plate.

3 See, for example, "Theory of the Photo. Process." Sheppard and Mees, p. 288; 1907.

4 *Loc. cit.*

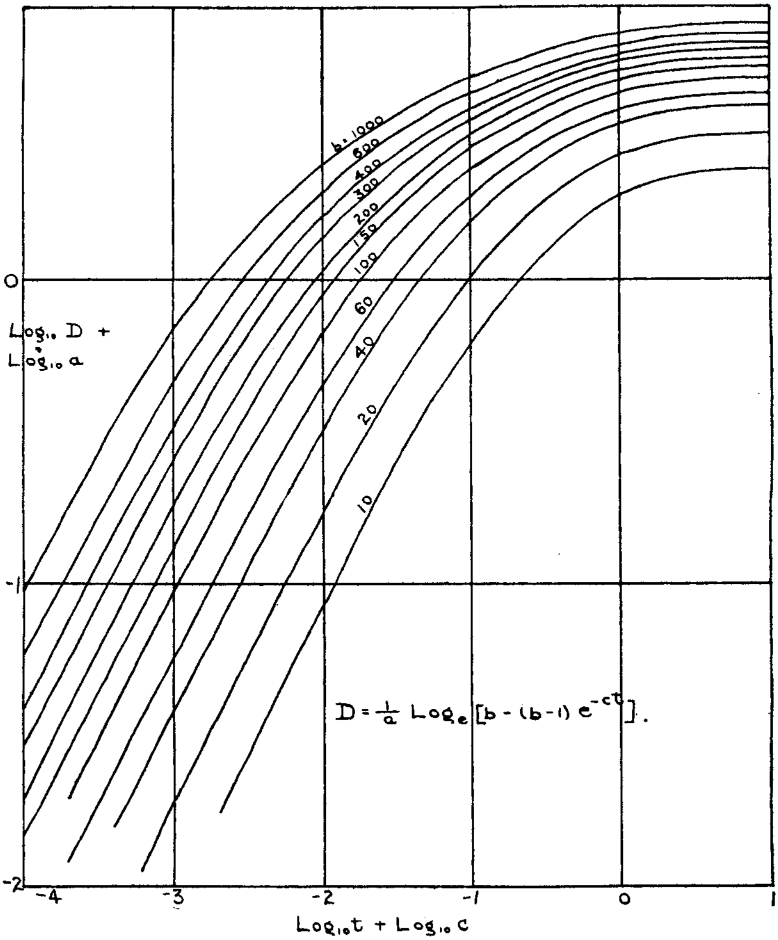

Fig. 46

A family of curves is plotted, as in the figure, with ordinate and abcissa Log aD and Log ct respectively, with "b" a parameter. The experimental curve is plotted upon tracing paper with Log D and Log t as ordinate and abcissa respectively. The tracing paper curve is now shifted over the family of curves,—preserving parallelism of axes,— until it coincides with a part of one of the family. The "b" is determined by the particular curve of the family chosen for coincidences, and the "a" and the "c" are given by the intercepts of the axes of the experimental curve upon the axes of the family of curves.

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