

yellow and grey, the discrimination between yellow and various other colours, particularly between yellow and blue, is also due to differences in wave-length bands reflected, independent of differences in degree of lightness.

A spontaneous feeding response to various colours, with a high peak in yellow, has been shown to exist in the butterfly *Vanessa polychloros*<sup>7</sup>. Without using insects bred from pupae, it cannot be decided whether the results mentioned thus far could not perhaps have been caused by a similar inborn response to yellow in *Eristalis*. However, this explanation does not hold good for the results obtained after an attempt to train the insects to blue, which unfortunately could not be completed owing to the end of the season. In a last series of tests carried out with *Eristalis* fed on blue 14 na for several days, blue shades which had been practically neglected in previous tests received at least as many visits as yellow shades (total number of visits on coloured models, 69). This proves that a certain amount of training must have been involved. Thus there is every reason to hope that *Eristalis* may prove a very suitable object for a systematic study of its colour discrimination which it is intended to carry out in this Department during next spring.

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<sup>1</sup> Hamilton, W. F., *Proc. U.S. Nat. Acad. Sci.*, **18** (1922).

<sup>2</sup> van Herk, A. W., *Arch. neerl. Physiol.*, **10** (1926).

<sup>3</sup> Knoll, F., *Abh. zool.-bot. Ges. Wien*, **12** (1922).

<sup>4</sup> Schleghtendal, A., *Z. vergl. Physiol.*, **20** (1933-34).

<sup>5</sup> v. Frisch, K., *Zool. Jahrb. Abt. Allg. Zool. u. Physiol.*, **35** (1914).

<sup>6</sup> Kuehn, A., *Z. vergl. Physiol.*, **5** (1927).

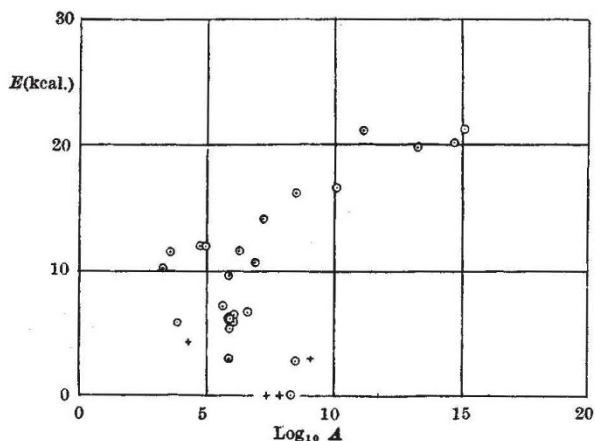
<sup>7</sup> Ilse, D., *Z. vergl. Physiol.*, **8** (1928).

## Frequency Factors in Radical Reactions

THE frequency factors and activation energies for reactions in the polymerization of styrene and vinyl acetate have been determined in these Laboratories<sup>1</sup>. By combining the values for chain propagation with the results of Lewis, Mayo, Walling and their collaborators<sup>2</sup>, activation energies and frequency factors can be calculated for a number of transfer and propagation reactions of the styryl radical. The accompanying diagram is a plot of  $E$  against  $\log_{10} A$  for the twenty-nine reactions. It will be seen that the frequency factors are in general low, the mean value of  $\log_{10} A$  being 7.4, instead of the normal value c. 12. As Gregg and Mayo<sup>3</sup> point out, there is, however, a tendency for reactions with high activation energies to have higher frequency factors.

Attention has often been directed to the fact that frequency factors in polymerization reactions are usually low, but this has been ascribed to steric effects in the reactions of large molecules. However, any size effect should be most marked in the termination reaction in a polymerization, whereas, in the cases quoted, the latter has the highest frequency factor.

The values reported above for the autoxidation of tetralin are also plotted (crosses in the diagram). The mean value of  $\log_{10} A$  for the four reactions is



7.1, in good agreement with the mean for the polymerizations. Here no size effect would be anticipated.

It seems reasonable to infer that organic radical reactions with activation energies less than about 20 kcal. in general have frequency factors of the order of  $10^7$ , and not  $10^{12}$  as is commonly assumed. Steacie<sup>3</sup> has tentatively suggested that this is also true in gas reactions.

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<sup>1</sup> Bamford and Dewar, *Proc. Roy. Soc., A*, **192**, 309 (1948). Unpublished work by Mr. G. Dixon-Lewis.

<sup>2</sup> Lewis, Walling, Cummings, Briggs and Mayo, *J. Amer. Chem. Soc.*, **70**, 1519 (1948). Gregg and Mayo, Faraday Society Discussion on the Labile Molecule (1947).

<sup>3</sup> Steacie, Faraday Society Discussion on the Labile Molecule (1947).

## Rate of Hydrogenation in Solutions and the Mass of the Catalyst

IN order to clear up the remarkable relation between the rate of hydrogenation and the mass of the catalyst, found by Kailan and Hartel<sup>1</sup>, as well as by Csürös and co-workers<sup>2</sup>, we made a systematic investigation on the hydrogenation of crotonic acid and sodium cinnamate in aqueous solutions in contact with hydrogen gas in the presence of palladium precipitated on finely dispersed barium sulphate. It was found that the product of the hydrogenation (namely, butyric acid in the experiments with crotonic acid) accelerates the reaction autocatalytically.

The initial rate of hydrogenation ( $v$ ) as a function of the mass of catalyst ( $m$ ) has, in pure aqueous solutions, in agreement with the authors above mentioned, a maximum and a minimum (see graph). We found that the value of  $v$  and the shape of the curve  $v = f(m)$  is greatly influenced by the velocity of stirring, the ratio  $r$  of the surface to the volume of the solution, and the nature of the electrolytes present in the solution. If the velocity of stirring is moderate (magnetic stirrer moving in a circle 300 times per minute) and  $r$  being small ( $1-3.4 \text{ cm.}^2/\text{cm.}^3$ ), the curve  $v = f(m)$  has a maximum and minimum.