

Further information which may help to elucidate the origin and spread of the phenomenon would be welcome. For example: (d) For how many years was an observed *Daphne* bush at first free from attack? (e) Did the attack have a different pattern in the first year from that of subsequent years? (f) How many adult or juvenile birds take part? (g) After the first season of despoliation, was the bush ever spared? The opening of milk bottles by tits (*Parus*)⁷ was preceded by the introduction of milk bottles; there is no equally clear initiating factor in this instance.

It is hoped that the survey will provide information as to how far *de novo* discoveries by individual birds, on one hand, and cultural diffusion, on the other, have contributed. Besides recent instances, positive and negative, information from earlier years and from outside Britain would be especially appreciated. Appropriate lines of protective action by the horticulturist are discussed elsewhere⁸.

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¹ Clapham, A. R., Tutin, T. G., and Warburg, E. F., "Flora of the British Isles" (Cambridge, 1952).

² Witherby, H. F., et al., "The Handbook of British Birds" (London, 1940).

³ *Brit. Birds*, 1-48 (1907-1955); *J. Brit. Trust Orn.*, 1-2 (1954-1955).

⁴ Pettersson, M. L. R., *J. Roy. Hort. Soc.*, 81, 36 (1956).

⁵ Monk, J. F., *J. Brit. Trust Orn.*, 1, 2 (1954).

⁶ Pettersson, M. L. R., *J. Roy. Hort. Soc.* (in the press).

⁷ Fisher, J., and Hinde, R. A., *Brit. Birds*, 42, 347 (1949).

Colour Illusions and Aberrations during Stimulation by Flickering Light

THE production of illusions of colour by intermittent visual stimulation has been familiar since the description of the 'artificial spectrum top' by Benham¹ in 1895; but with the traditional arrangement of rotating black-and-white chequered disks the subjective sensations are not particularly vivid. Since the introduction of the electronic stroboscope to psychophysiological experiment by Walter, Dovey and Shipton² in 1946, thousands of normal and clinical subjects have been subjected to intensive visual stimulation by flickering white light, and all report sensations of pattern, movement and colour. The descriptions vary greatly from subject to subject; in some, the impressions are particularly intense only at certain frequencies. Most subjects have no difficulty in recognizing the illusory character of the colours: Margiad Evans³ describes them as "... pure ultra unearthly colours, mental colours, not deep visual ones. There was no glow in them but only activity and revolution". None the less, the colours are 'real' enough to act as conditioned stimuli, for Brady⁴ has shown that subjects who have been conditioned to give a psycho-galvanic skin response to red light will give the 'red' response when stimulated with white light flickering at a particular frequency and at multiples of the critical rate.

The relation of these phenomena to the various theories of colour vision is by no means clear, and a few simple experiments have been made to see whether the illusory colour sensations affect the results of tests for colour blindness administered to normal persons. The hidden-figure colour mosaic cards devised by Ishihara (English edition)⁵ were

presented successively to a number of subjects and were viewed only by the light of an electronic stroboscope giving blue-white flashes lasting about 20 μ sec. and with a peak illumination of about 80,000 ft.-candles. The flash-rate was set at 1 flash per sec. and the subject was asked to comment on the pattern seen, the flash-rate being increased gradually after each comment. In general, the subjects found no difficulty in identifying the figure in the orange-grey contrast cards (Nos. 1 and 32), but were confused and often mistaken when viewing the more complex brown-green and blue-yellow cards. Several subjects with full normal colour vision by steady light gave a number of 'colour-blind' responses during flicker at less than 20 flashes/sec., suggesting various degrees of temporary protanopia or deuteranopia depending on the flicker-rate. The relation between the aberration of colour vision and flicker frequency was not consistent, though most subjects gave particularly erratic reports at frequencies between 5 and 10 flashes/sec. One subject, for example, viewing card 2, saw a 3 (the red-green blind response) at 9 flashes/sec. and an 8 (the normal response) at 12-15 flashes/sec. The same subject gave fifteen other 'colour-blind' or anomalous responses to the thirty-two cards; the commonest effect was a combination of the normal and colour-blind responses to provide an 'original' response; for example, a card containing the figure 5 for normals and 2 for colour-blind was seen as a 3.

In the absence of a rigorous and detailed neurophysiological theory of colour vision, it is difficult to account for this effect; but in view of the dramatic and often paradoxical effects of rhythmic as opposed to steady stimuli⁶, it is not surprising that the visual channel should give an equivocal output when supplied with intermittent signals. Careful analysis of the effect should, however, provide a clue to the code relations between the retinal colour analysers and the cerebral receiving zones.

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² Walter, W. Grey, Dovey, V. J., and Shipton, H. W., *Nature*, 158, 540 (1946).

³ Evans, M., "A Ray of Darkness" (Morrison and Gibb, London, 1952).

⁴ Brady, J. S., *EEG Clin. Neurophysiol.*, 6, 473 (1954).

⁵ Ishihara, S., "Tests for Colour Blindness" (H. K. Lewis, London).

⁶ Walter, V. J., and Walter, W. Grey, *EEG Clin. Neurophysiol.*, 1, 57 (1949).

Structure of Collagen

AN arrangement of three non-coaxial helical chains linked to one another by hydrogen bonds approximately perpendicular to the length of the chains was suggested as the basis of the structure of collagen two years ago¹. This structure explained the occurrence of a fraction of more than one-third of glycine residues and could readily accommodate proline and hydroxyproline residues, besides explaining the infra-red dichroism. The exact nature of the helices (namely, three residues per turn) was later found not to be quite correct for collagen, the X-ray pattern of stretched collagen² indicating the occurrence of $3\frac{1}{2}$ residues per turn³. The presence of such a non-integral number of residues per turn required that the three chains must all be further coiled around. The coiled-coil structure⁴ retained the