TECHNICAL PAPERS

Color Adaptation to Stimuli of Different Spectral Composition But Equal Tristimulus Values

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Color adaptation experiments using the color adaptometer have been previously reported (*1*). It has been found that the results of extensive experiments may be predicted by the use of three general laws:

(I) The course of color adaptation consists of a gradual, but never complete, loss of saturation, with no change in hue, and an increase in intensity.

(II) The rate and degree of desaturation depend upon the hue, relative intensity, and relative saturation of the stimulus color.

(a) The loss of saturation is most rapid for a green stimulus, less for a red stimulus, and least for a blue stimulus.

(b) The less intense the stimulus, the greater the loss of saturation.

(c) The less saturated the stimulus, the more rapid is the initial rate of desaturation; the equilibrium position, or point of lowest desaturation, is independent of the saturation of the stimulus.

(III) The rise in intensity is dependent on the saturation and intensity of the stimulus and independent of the hue of the stimulus.

(a) If the saturation and intensity of the stimulus are both high or both low, the rise in intensity will be greater than if one is high and the other is low.

In a summary of the color adaptation literature (*2*), it was shown that, among the approximately 40 previous investigators, there is very little agreement. This situation may have been brought about by the fact that most investigators describe their stimuli in terms of tristimulus values, *i.e.* the color as it appears to the observer, and not in terms of spectral composition. Colors which look alike may be composed of vastly different physical radiations. Although the retina is being stimulated by different wave lengths, if the two sets of radiations bear certain mathematical relationships with each other, the two stimuli will appear to be identical. Color theories predict this mathematical relationship, but only under standard conditions, and tell us nothing concerning the peculiar integrating mechanism involved. It may be that the adaptation phenomenon is dependent not on the color as it appears but on the particular receptors which chance to be stimulated.

In testing experimentally the hypothesis that the color adaptation of the eye is a function of the spectral composition of the stimulus and not of the tristimulus values of the stimulus, we propose to plot curves of the adaptation function (similar to those in *1*, pp. 103–105), by use of our color adaptometer, to two stimuli equated with respect to tristimulus values but with different spectral composition.

Two filters,[1] the spectrophotometric curves of which are shown in Fig. 1, were obtained. The color of these

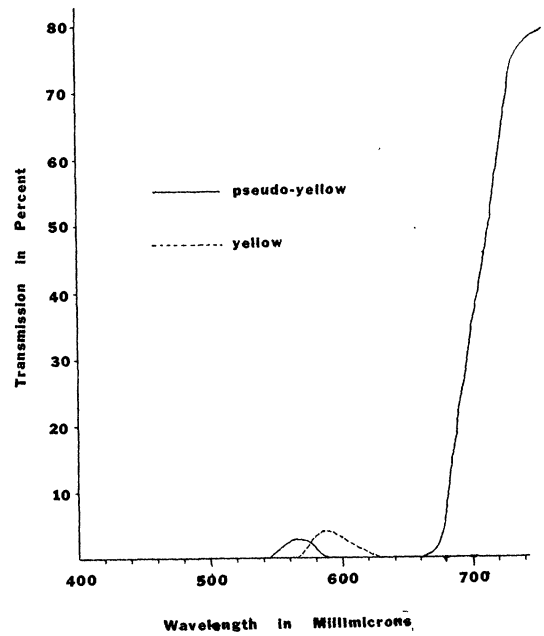

FIG. 1. Spectrophotometric curves of the filters used as stimuli. The curves integrate to give equal tristimulus values.

filters is yellow; their transmissions are, however, quite different. The filter having most of its radiation at 580 mμ is termed 'yellow'; the other is termed 'pseudo-yellow.' If the red filters are removed from the filter holders in front of the left continuous source in the color adaptometer (see *1*, p. 93) and either the yellow or pseudo-yellow filter placed in the filter holder, the left test patch will appear yellow to the observer. If the color temperature of the left continuous source be adjusted, the resulting yellows may be made to look exactly alike.

The yellow and pseudo-yellow filters were placed one at a time in the filter holder and two sets of adaptation curves obtained by the procedure previously explained (*1*, pp. 100–101), wherein the observer matches the color seen on the left test patch at various time intervals by

[1] The writer is indebted to H. P. Gage, of the Corning Glass Works, for the loan of these filters and to David L. MacAdam, of the Eastman Kodak Company, who was kind enough to furnish a number of sets of Wratten filters with similar characteristics.

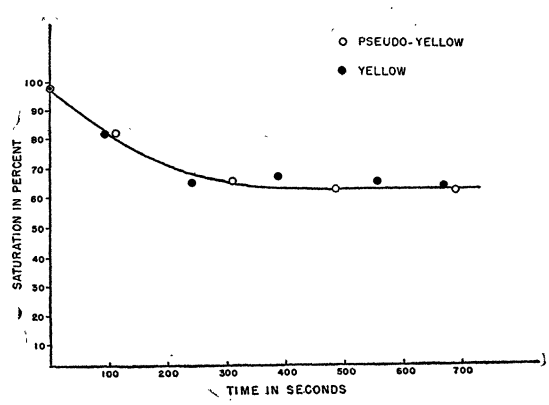

FIG. 2

adjusting the primaries (radiations at 436 mμ, 546 mμ, and 700 mμ) of the right test patch. The observer was the author.

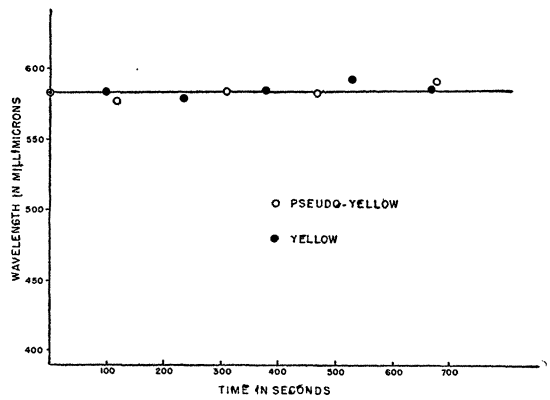

FIG. 3

Figs. 2, 3, and 4 give the resulting curves for both the yellow and pseudo-yellow filters. Fig. 2 indicates the loss of saturation for both stimuli; Fig. 3, the constancy

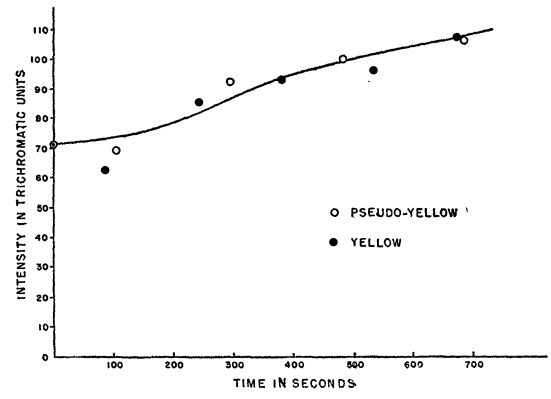

FIG. 4

of hue for both stimuli; and Fig. 4, the gain in intensity for both stimuli.[2]

[2] These results are not to be compared with our previous curves (*1*, pp. 103–105), since no attempt was made to equate these stimuli with those used before.

The divergence of the yellow and pseudo-yellow curves appears to be well within the experimental error, and we conclude that, as far as our experimental work has gone, the color adaptation phenomenon is a function of the tristimulus values of the stimulus and not of the spectral composition of the stimulus. There is, of course, an internal check. If the filters are placed one on either side of the colorimeter so that the observer may fixate the yellow and pseudo-yellow stimuli simultaneously, then, although the colors appear to change with time, they should always look alike. This has been done, and, indeed, the colors always do look alike.

The eye has always failed to resolve a stimulus into its components and it has here failed again. But we wonder about a mechanism which is so complex that it always fulfills this ideal, even under the most elaborate experimental conditions. It constitutes the great enigma of color vision.

References

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Chloromycetin in the Treatment of Scrub Typhus[1]

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The antibiotic Chloromycetin (*1*) has been shown to have a beneficial chemotherapeutic effect when administered to mice or embryonated eggs infected with a number of rickettsial agents (*3*) or with two viruses of the psittacosis-lymphogranuloma venereum group (*4*). The drug is rapidly absorbed when given by mouth to human beings and readily reaches concentrations in the blood of the order of 40 γ/cc (*2*). No obvious toxic effects attributable to the drug have been observed in the normal men or the patients who have been studied to date. A report of the encouraging results observed in a few cases of epidemic typhus who were treated with Chloromycetin early this year in Mexico has been submitted (*5*).

Methods commonly employed in the ward and clinical laboratory were used in most of the work. Mice were inoculated intraperitoneally with defibrinated blood cells from the patient in attempts to demonstrate rickettsemia. Results were considered positive when mice of the original

[1] Read before the Section on Virus and Rickettsial Diseases, Fourth International Congress on Tropical Medicine and Malaria, May 11, 1948.