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LETTER TO THE EDITORS

# ON SEARCHING FOR "MACH BAND TYPE" PHENOMENA IN COLOUR VISION

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THE APPEARANCE of Mach bands at sudden changes in a spatial brightness gradient and the fact that spatial brightness modulations are best perceived in the low frequencies, are both very probably due to inhibitory lateral influences in the retinal structures. Earlier VAN DER HORST *et al.* (1967) reported measurements on spatial chromaticity-contrast sensitivity. We demonstrated that a corresponding maximum sensitivity did not show up in the spatial frequency characteristics of the chromaticity-contrast transfer at threshold. Consequently we suggested that spatial inhibitory influences, corresponding to those in the brightness channels, do not occur in the colour mediating channels. This raises the question whether "Mach band type" of phenomena are visible in an equiluminous stimulus field with a sudden change of a chromaticity gradient in it.

In the wavelength region beyond about 530 nm, spectral hue discrimination is to a fair approximation dichromatic. The $R/G$ ratio in this region, in which $R$ and $G$ are the quanta inputs in the red and green receptor systems, is therefore unique to the apparent colour sensation. Since the brightness-Mach bands are observed at a sudden change in a brightness gradient, i.e. a change of R+G, we look for the possible appearance of colour-Mach bands at a sudden change in the chromaticity gradient, i.e. a change of $R/G$. Some data in the literature refer to colour gradients, but these were not related to these $R/G$ transients. In a literature survey RATLIFF (1965) reported [ERCOLES-GUZZONI and FIORENTINI (1958), FRY (1948), KOFFKA and HARROWER (1931), THOULESS (1922)] the absence of colour-Mach bands in all of these studies. In order to come closer to a definitive conclusion, we made the following special experiment.

Monochromatic lights of 529 nm and 625 nm were brought together in a stimulus field, such that over a distance of 3° the mixture gradually changed from hundred per cent 529 nm to hundred per cent 625 nm. For this purpose we used the uniformly illuminated images of two specially designed templates. These images were projected on to a screen and their relative position adjusted. By spreading out the images with a rapidly rotating

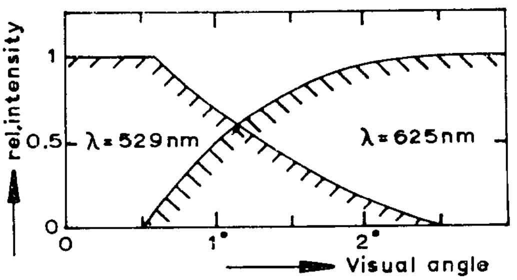


FIG. 1. The measured luminance distributions of the two colours λ=529 nm and λ=625 nm on a relative scale.

mirror, we obtained the luminance distributions given in Fig. 1. The illuminances of the two monochromatic light sources were very carefully matched by the conventional flicker technique. When covering one of the illuminated templates, we could clearly observe the brightness-Mach bands in the luminance distribution of the remaining colour.

Starting from the mixture-ratios of the luminance distributions of Fig. 1, we computed the resulting objective $R/G$ ratios based on PITT's (1944) fundamental response curves, as revised by WALRAVEN and BOUMAN (1966). These are represented by the curve in Fig. 2.

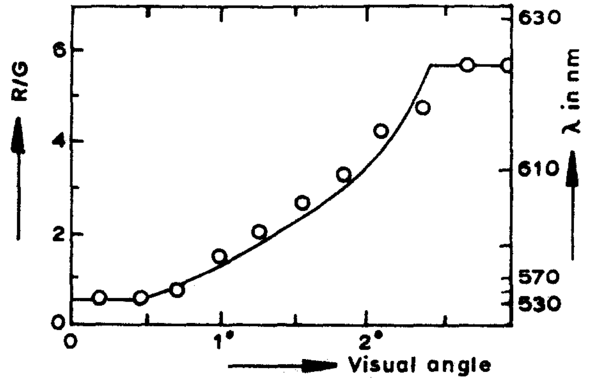


FIG. 2. The curve represents the objective $R/G$ variation, calculated from the mixture-ratios of the luminance distributions of Fig. 1. The open circles represent the measured $R/G$ ratios. A wavelength scale is plotted along the right hand ordinate.

For the actual measurement of the apparent colour sensation, we projected the exit-slit of a monochromator directly above the colour wedge. By moving this slit along the top of the wedge and by adjusting the wavelength and luminance of the monochromator to match the colour of the particular wedge location, we found the apparent $R/G$ variation along the wedge. These measurements are represented in Fig. 2 by the open circles. All experiments were done by one observer with natural pupil, having normal colour vision.

There is no significant difference between the calculated and the measured $R/G$ ratios. (Related experiments, done by superimposing linear luminance gradients, point to the same conclusion.) We consider this as a negative result for the appearance of "Mach band type" of phenomena in colour vision. They support our previous suggestion [VAN DER HORST *et al.* (1967)] that spatial inhibitory influences, such as those which are responsible for the appearance of the brightness-Mach bands, are lacking in the colour mediating channels.

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