in the Queen Elizabeth National Park, and the Nuffield Unit of Tropical Animal Ecology for the use of laboratory facilities in the park.

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Temporal Reversal of Land Effect Colour Rules

LETTVIN[1] has reviewed the central facts of colour constancy, colour contrast, Mach bands[2], colour adaptation, colour brightness[3] and the Land effect[4]. He formed a hypothesis to accommodate these phenomena in a single law. The only temporal effects he considered were adaptations of the type which produces after-images. The chief postulate that enabled Lettvin to accommodate the Land effect was that "subjectively brighter than adaptation level, L", is equivalent to "subjectively yellower than L"; and "subjectively dimmer than L" is equivalent to "subjectively bluer than L", as long as these relations are applied locally and only in aperture mode. There can be no sharp line boundaries between adjacent colour patches the subjective colours of which are governed by the equivalences.

We felt that interactions among boundary mechanisms, adaptation mechanisms, the Lettvin static equivalences and temporal colour mechanisms should be investigated. We hoped that time domain effects could be exchanged for spatial adaptation effects to study the curious yellow-blue asymmetry in Lettvin's equivalence relations.

First a case was found where the Lettvin equivalent of "subjectively dimmer than L" was reversed from "subjectively bluer than L" to "subjectively yellower than L". This was a glossy finish cardboard disk painted with cerulean blue and medium hansa yellow (approximately sodium yellow) Testor's high saturation artist's dope (Fig. 1). The disk was mounted on a motor shaft by screwing a wing nut tightly against the face of the disk so that its wings were permanently aligned along colour boundaries as shown in Fig. 1*A*. The disk was next levelled outdoors under a direct February noon Sun so that the wing nut cast a sharp shadow on the disk which was about twice as long as the height of the wing nut.

Bringing the disk up to speed under the control of a rheostat, it was observed that well before sector flicker was lost (about 900 r.p.m.) the western lobe of the wing nut shadow turned a saturated dark blue and the eastern lobe a slightly unsaturated bright yellow. The regions of these colour effects are outlined in Fig. 1*A*. At all rotation speeds between flicker fusion and 1,500 r.p.m. (when each point on the disk's retinal image records the same colour quadrant for about 10 ms), the two coloured shadow lobes maintained their strikingly bright, constant appearance and the rest of the disk looked a light tan. The effect is reproducible in a fluorescent lit room with a flashlight replacing the Sun.

The point of rotating the wing nut with the disk was to diffuse its shadow boundaries and thereby approach an aperture mode experiment in which no relevant colour adaptation was present. With each half disk revolution, the western shadow lobe reached its greatest extent against a yellow background, and the eastern lobe its greatest extent against a blue background. The dimming effect in the western lobe produced subjective blue as expected, but the dimming effect in the eastern lobe gave a subjective yellow approximately the complement of both the blue in the western lobe and the blue of the blue dope. This yellow was more yellow than the light overall colour of the rotating disk. It was yellower than any possible adaptation colour even though it occurred in a shaded region.

We suspected that the two lobe colours were simply complements of the disk background colours against which their associated shadows reached their greatest size. To confirm this, red and green were substituted for yellow and blue on another disk, and complementary colours were produced by rotation.

Apparently the Lettvin equivalences did not apply to temporally diffused shadows on rotating disks. The new effects reported here await a detailed physiological explanation together with the growing list of other temporal colour effects.

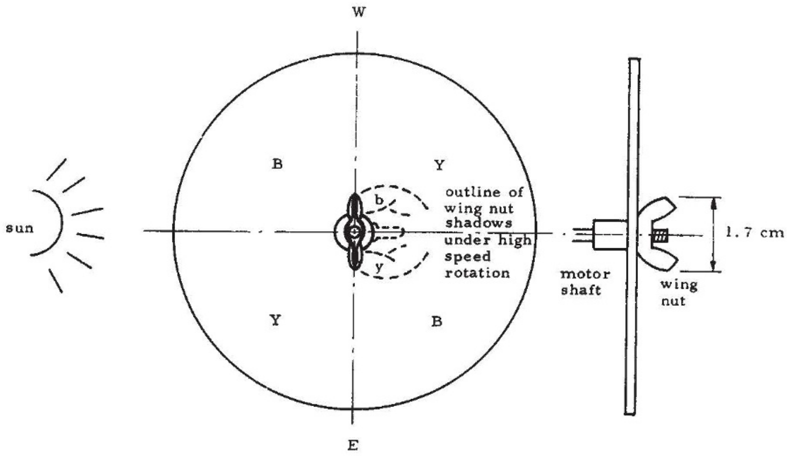

Fig. 1. Rotating disk experiment. Static legend: B, saturated blue; Y, saturated yellow; E, east; W, west. Rotation legend: solid colour at high rotation speed, slightly unsaturated tan; b, saturated dark blue; y, slightly unsaturated bright yellow.

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