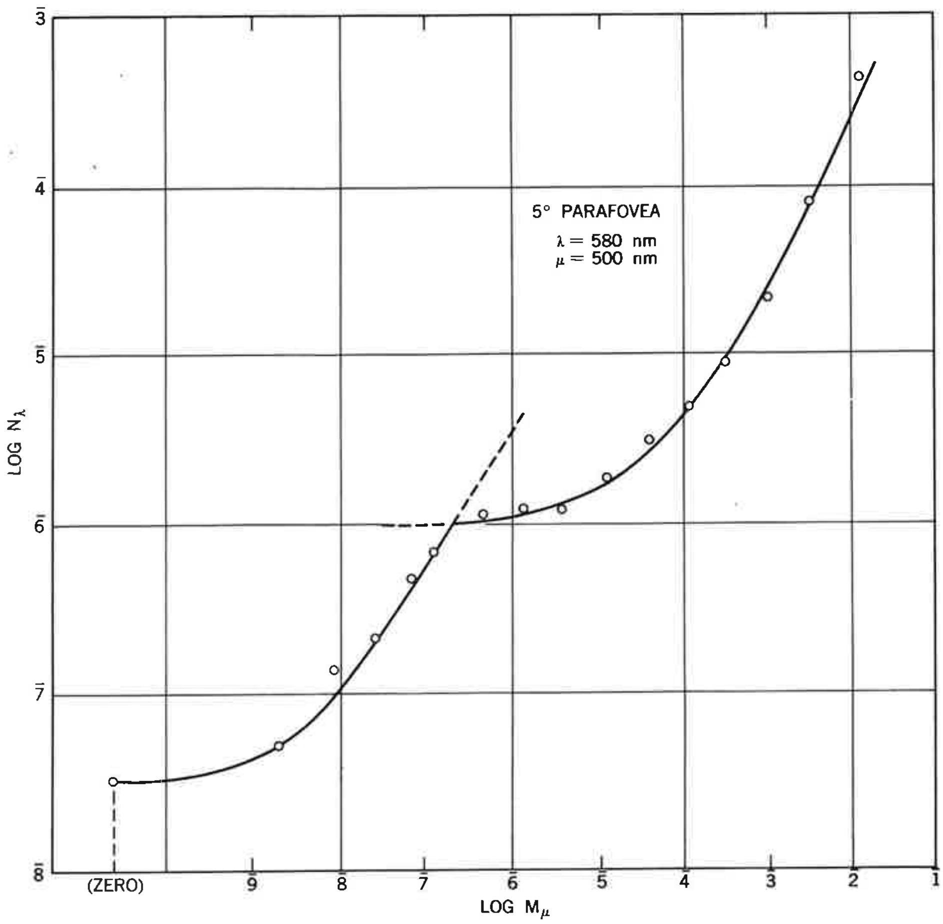

Fig. 2(7.4.1). Rod and cone branches in the t.v.r.-curve for a 1°, 0.06 s test stimulus imaged 5° from the fovea. Wavelengths of test and field stimuli 580 and 500 nm, respectively (Stiles, 1939).

(max 570 to 590 nm), it has proved necessary to admit the following:

(i) There are three blue-sensitive mechanisms with different absolute thresholds and with spectral sensitivites that diverge widely at long wavelengths ($\lambda > 500$ nm). This divergence makes possible their separation by the threshold method.

(ii) For the green- and red-sensitive mechanisms, some modification (a narrowing) in the shape of the spectral sensitivity curves takes place in going from low to high conditioning levels [as shown in Table 1(7.4.1)]. Another complication examined by Boynton, Ikeda, and Stiles (1964) relates to the derivation of resultant thresholds from component thresholds when the latter have nearly the same value. The resultant log-increment threshold may differ from the value to be expected from probability summation of independent mechanisms (see Section 8.4.7) by perhaps 0.1 to 0.2 log units, and the discrepancy may be in the direction of inhibition rather than summation.

7.4.2 Basic Formulae

The following formulae express the theory of increment threshold sensitivity deriving from the basic concept discussed in Section 7.4.1, in a precise form suitable for quantitative application and for future modification to meet some of the difficulties.

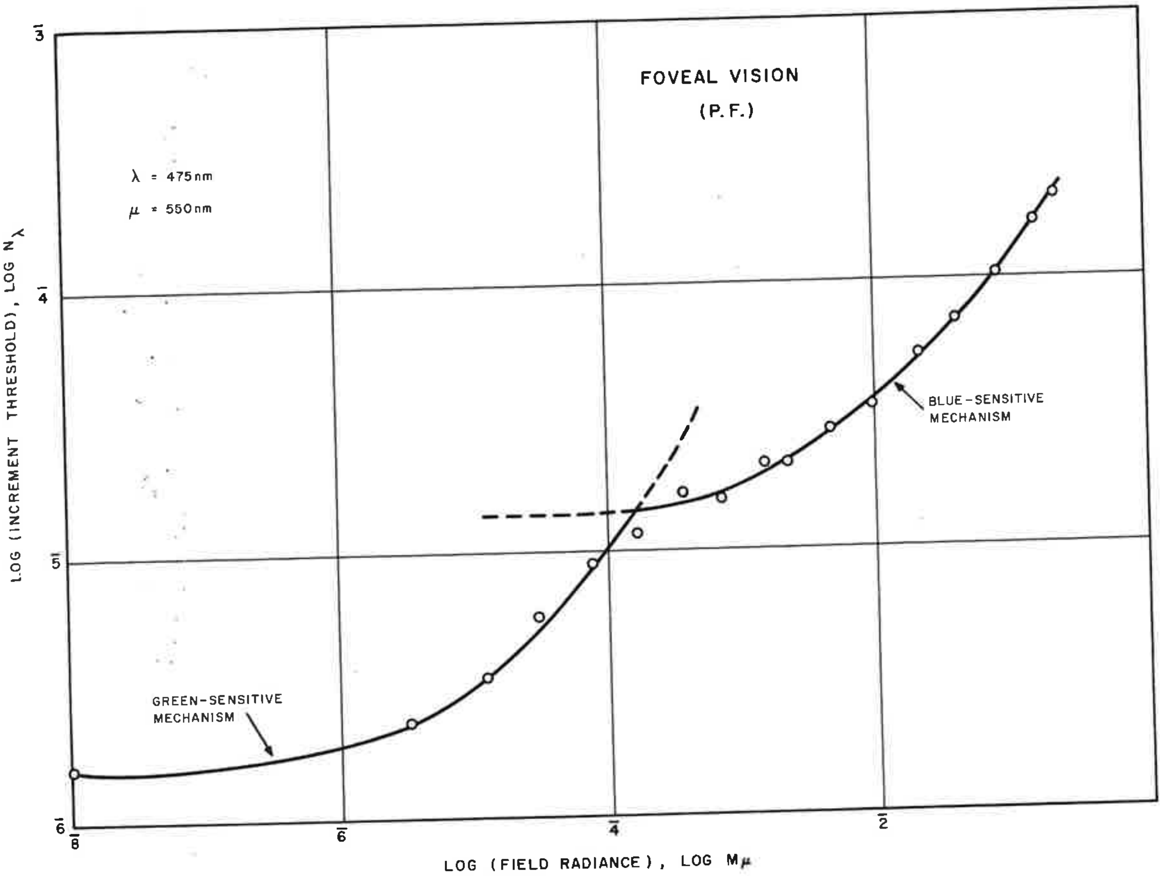

Fig. 3(7.4.1). Foveal t.v.r.-curve with $\lambda = 475$ nm and $\mu = 550$ nm showing two branches attributable to blue- and green-sensitive cone mechanism, respectively (Stiles, 1961).

For the ith component mechanism, the increment threshold $N_{i\lambda}$ of a monochromatic (λ) test stimulus of fixed characteristics exposed on a uniform monochromatic (μ) field of radiance M_μ is given by

$$\frac{1}{N_{i\lambda}} = \pi_{i\lambda}\zeta_i(M_\mu \Pi_{i\mu}) \qquad [1(7.4.2)]$$

The function $\zeta_i(x)$ defines the *shape* of the t.v.r.-curve of the mechanism and can be taken without loss of generality so that

$$\zeta_i(x) = 1 \qquad \text{when } x = 0$$
$$\zeta_i(x) = 0.1 \qquad \text{when } x = 1 \qquad [2(7.4.2)]$$

Thus, if $M_\mu = 0$, $\pi_{i\lambda}$ is the reciprocal of the increment threshold on zero field (absolute threshold) and regarded as a function of λ, it represents the *test spectral sensitivity*. Similarly, if the field M_μ raises the increment threshold to 10 times its zero field value, then from conditions defined by Eq. 2(7.4.2), it follows that $M_\mu \Pi_{i\mu} = 1$. The quantity

$$\Pi_{i\mu} = \frac{1}{M_\mu}$$

as a function of μ, represents the *field spectral sensitivity* of the mechanism.

According to the basic concept, $\pi_{i\mu}$ and $\Pi_{i\mu}$ correspond to the same relative spectral sensitivity so that the ratio $(\Pi_{i\mu}/\pi_{i\lambda})_{\lambda=\mu}$ equals a constant, which is closely related to the Weber–Fechner fraction. When $M_\mu = 1/\Pi_{i\mu}$, the increment threshold $N_{i\lambda}$ equals $10(N_{i\lambda})_0$, where $(N_{i\lambda})_0$ is the absolute threshold, and the Weber–Fechner fraction or the ratio of the increment threshold