Photochemical adaptation: the sensitivity of the eye to light is largely a function of the percentage of unbleached pigment in each photoreceptor. Under conditions of steady retinal illumination, the concentration of photopigment produced by the competing processes of bleaching and regeneration is in equilibrium. When the retinal irradiance is changed, pigment is bleached and regenerated so as to re-establish equilibrium. Because the time required to accomplish the photochemical reactions is of the order of minutes, changes in the sensitivity can lag behind the irradiance changes. The cone photoreceptors adapt much more rapidly than do the rod photoreceptors. Exactly how long it takes to adapt to a change in retinal illumination depends on the magnitude of the change, the extent to which it involves different photoreceptors and the direction of the change. For changes in retinal illumination of about 2–3 log units, neural adaptation is sufficient so adaptation should be complete in less than a second. For larger changes photochemical adaptation is necessary. If the change in retinal illumination lies completely within the range of operation of the cone photoreceptors, a few minutes will be sufficient for adaptation to occur. If the change in retinal illumination covers from cone photoreceptor operation to rod photoreceptor operation, tens of minutes may be necessary for adaptation to be completed. As for the direction of change, once the photochemical processes are involved, changes to a higher retinal illuminance can be achieved much more rapidly than changes to a lower retinal illuminance.

When the visual system is not completely adapted to the prevailing retinal illumination, its capabilities are limited. This state of changing adaptation is called transient adaptation. Transient adaptation is unlikely to be noticeable in interiors in normal conditions but can be significant where sudden changes from high to low retinal illumination occur, such as on entering a long road tunnel on a sunny day or in the event of a power failure in a windowless building.

2.2.2 Photopic, scotopic and mesopic vision

This process of adaptation can change the spectral sensitivity of the visual system because at different retinal illuminances, different combinations of retinal photoreceptors are operating. The three states of sensitivity are conventionally identified as follows.

Photopic vision: this occurs at luminances higher than approximately 3 cd/m^2. For these luminances, the retinal response is dominated by the cone photoreceptors so both colour vision and fine resolution of detail are available.

Scotopic vision: this occurs at luminances less than approximately 0.001 cd/m^2. For these luminances only the rod photoreceptors respond to stimulation so colour is not perceived and the fovea of the retina is blind.

Mesopic vision: this is intermediate between the photopic and scotopic states, i.e. between about 0.001 cd/m^2 and 3 cd/m^2. In the mesopic state both cones and rod photoreceptors are active. As luminance declines through the mesopic region, the fovea, which contains only cone photoreceptors, slowly declines in absolute sensitivity without significant change in spectral sensitivity, until vision fails altogether as the scotopic state is reached. In the periphery, the rod photoreceptors gradually come to dominate the cone photoreceptors, resulting in gradual deterioration in colour vision and resolution and a shift in spectral sensitivity to shorter wavelengths. The relevance of the different types of vision for lighting practice varies. Scotopic vision is largely irrelevant. Any lighting installation worthy of the name provides enough light to at least move the visual system into the mesopic state. Most interior lighting ensures the visual system is operating in the photopic state. Current practice in exterior lighting ensures the visual system is often operating in the mesopic state.