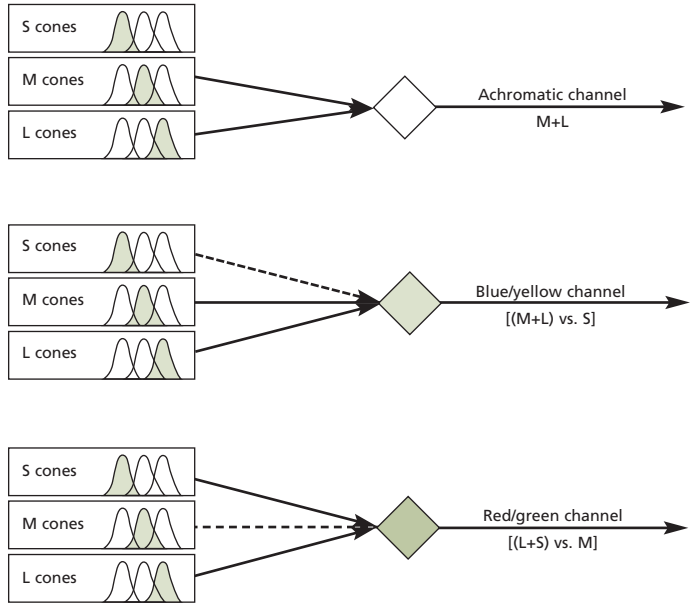

Figure 2.9 The organisation of the human colour system showing how the three cone photoreceptor types are believed to feed into one achromatic, non-opponent channel and two chromatic, opponent channels (after Sekular and Blake, 1994)

The ability to discriminate the wavelength content of incident light makes a dramatic difference to the information that can be extracted from a scene. Creatures with only one type of photopigment, i.e. creatures without colour vision, can only discriminate shades of grey, from black to white. Approximately 100 such discriminations can be made. Having three types of photopigment increases the number of discriminations to approximately 1,000,000. Thus, colour vision is a valuable part of the visual system, and not a luxury that adds little to utility.

2.2 Continuous adjustments of the visual system

2.2.1 Adaptation

To cope with the wide range of luminances to which it might be exposed, from a very dark night (10^{-6} cd/m^2) to a sunlit beach (10^6 cd/m^2), the visual system changes its sensitivity through a process called adaptation. Adaptation is a continuous process involving three distinct changes.

Change in pupil size: the iris constricts and dilates in response to increased and decreased levels of retinal illumination. The maximum change in retinal illumination that can occur through pupil changes is 16 to 1. As the visual system can operate over a range of about 1,000,000,000,000 to 1, this indicates that the pupil plays only a minor role in the adaptation of the visual system.

Neural adaptation: this is a fast (less than 200 ms) change in sensitivity produced in the retina. Neural processes account for virtually all the transitory changes in sensitivity of the eye at luminance values commonly encountered in electrically lighted environments, i.e. below luminances of about 600 cd/m^2. The facts that neural adaptation is fast, is operative at moderate light levels, and is effective over a luminance range with a maximum to minimum ratio of 1000:1 explain why it is possible to look around most lit interiors without being conscious of being misadapted.