A similar transformation occurs between the volume or surface modes of appearance and the aperture mode. Even non-self-luminous objects seen in the aperture mode are perceived as having a brightness but not a lightness. When seen in the object mode they have a lightness but not a brightness. This is important because lighting can be used to change the mode of appearance. For example, a painting hung on a wall has a lightness attribute when lighted so that both it and the wall appear in the object mode (surface). However, if the painting is illuminated solely with a carefully aimed framing spot so that the edge of the beam coincides with the edges of the painting, the painting is seen in the aperture mode and takes on a self-luminous quality with a brightness attribute. Adjusting the modes of appearance is an important technique in display lighting, both indoors and outdoors.

## 2.8 Anomolies of vision

All the capabilities of human vision discussed above assume normal vision. However, there are a number of forms of defective vision that occur due to either genetics or ageing.

### 2.8.1 Defective colour vision

About 8 percent of males and 0.4 percent of females have some form of defective colour vision. People with defective colour vision are classified into three categories: monochromats, dichromats, and anomalous trichromats, according to the number of photoreceptors present and the nature of the photopigments present in the photoreceptors.

Monochromats, although very rare, occur in two forms: rod monochromats, where there are no cone photoreceptors, only rod photoreceptors; and cone monochromats, where there are rod photoreceptors and only one type of cone photoreceptor, usually the short-wavelength cone. Rod monochromats are truly colour-blind and see only differences in brightness. Cone monochromats have a very limited form of colour vision in the luminance range where both rod and short-wavelength cones are operating.

Dichromats have two cone photoreceptors. They see a more limited range of colours than people with normal colour vision and have a different spectral sensitivity, depending on which cone photoreceptor is missing. Dichromats with the long-wavelength cone missing are called protanopes. Dichromats with the medium-wavelength cone missing are called deuteranopes, while dichromats with short-wavelength cones missing are called tritanopes.

Anomalous trichromats have all three cone photopigments present, but one of the cones contains a photopigment that does not have the usual spectral sensitivity. Anomalous trichromats who have a defective long-wavelength photopigment are called protonamalous. Anomalous trichromats who have a defective medium-wavelength photopigment are called deteuranomalous, while anomalous trichromats who have a defective short-wavelength photopigment are called tritanomalous. The colour vision of anomalous trichromats can vary widely from almost as bad as a dichromat to little different from someone with normal colour vision.

People with defective colour vision have trouble with some everyday tasks (see Table 2.2) and are prohibited from some occupations. Defective colour vision is usually inherited, although it can also be acquired through age, disease, injury or exposure to some chemicals.