depending on particle frequency (Grant, 1987). The large variability of plant surface structures, for instance, brought about by epicuticular wax crystals or leaf hairs (trichomes), result in manifold types of surface reflection to which both specular reflectance and Rayleigh scattering can contribute to various degrees. A further complication arises when photons which are transmitted by the outer surface of a plant organ are redirected back to this surface by multiple reflection and scattering in deeper tissue. This is known as diffuse reflection; that is, the reflected radiation intensity in any direction varies according to Lambert's cosine law and it is not polarised. A study of light scattering by leaves led Gates *et al.* (1965) to conclude that whole leaf diffusion was more of the Mie rather than of the Rayleigh type, because radiation at all wavelengths was scattered more or less equally.

Leaf specular reflectance has been analysed using instruments that allow measurements of direction and polarisation of radiation (Woolley, 1971; Liang *et al.*, 1997; Jacquemoud and Ustin, 2001; Raven *et al.*, 2002). Results obtained with leaves and individual plants are taken into account in radiative transfer models for vegetation canopies in which the contribution of specular reflectance to radiation fluxes has been considered (Gastellu-Etchegorry *et al.*, 1996; Andrieu *et al.*, 1997). Because the fraction of polarised radiation to total leaf reflectance may vary markedly between species (Grant *et al.*, 1993), it was also suggested that discrimination between specular and diffuse radiation in remote sensing could help to distinguish between different types of vegetation (Barnes and Cardoso-Vilhena, 1996).

Many studies on leaf optics, however, do not differentiate between specular and diffuse radiation but they measure total reflectance from perpendicularly illuminated leaves using integrating spheres. To understand reflectance characteristics, it is important to realise that, at wavelengths of efficient absorption inside a leaf, the probability of multiple scattering events of a single photon is reduced and, hence, reflection from internal structures is low (Grant, 1987). This explains why whole reflectance is low in the blue and red spectral range where photosynthetic pigments absorb strongly (Figure 6.1). Reduction of diffuse reflection by chlorophyll absorption also accounts for the close association between reflectance in the far-red spectral range and chlorophyll concentration (Buschmann and Nagel, 1993; Carter and Knapp, 2001; Gitelson *et al.*, 2003).

In the UV spectral region, absorption by UV-screening phenolics in the epidermis is additional to chlorophyll absorption in the leaf mesophyll (Cerovic *et al.*, 1999, 2002). Hence, UV reflectance of leaves is assumed to originate at or near the leaf surface (Grant *et al.*, 2003) and, therefore, non-absorptive attenuation of radiation by the plant surface can be assessed from whole-leaf reflection measurements in the UV.

Glabrous surfaces. Upper surfaces of many glabrous (or smooth) leaves from mountain and alpine plants exhibit reflectance values in the UV-A below 7% (Caldwell, 1968). These data have been supported by others: leaves of *Z. mays*