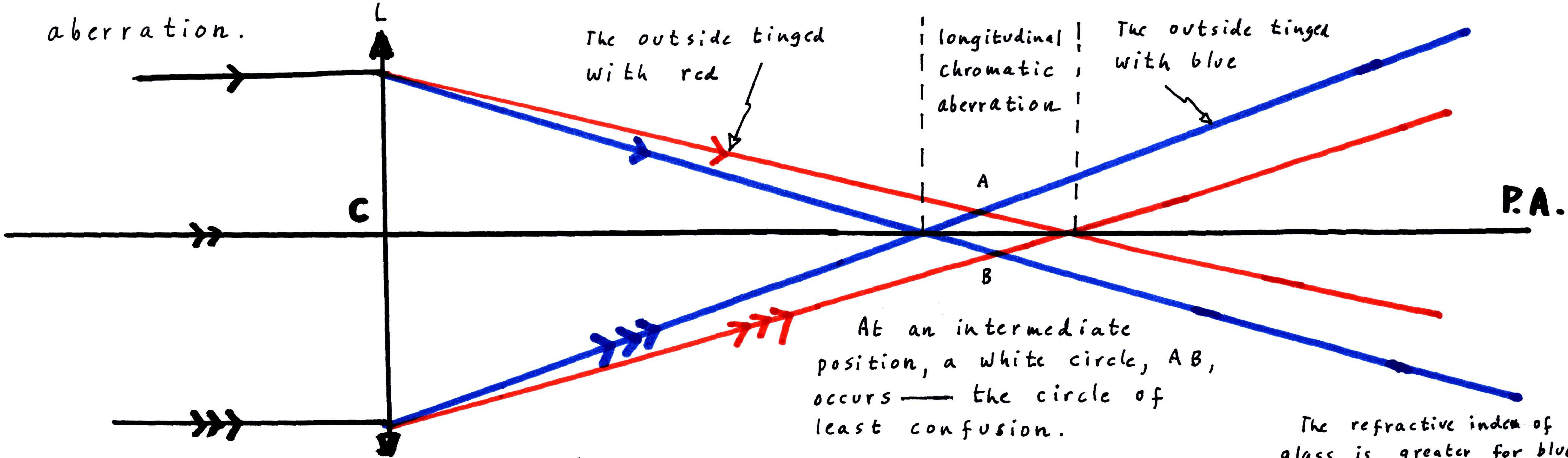
Chromatic aberration (or Chromatism)

Since the refractive index of a refractive medium depends on the wavelength (dispersion of light), the principal focal length of a lens varies according to the colour of the incident light. The image of a point source of light is therefore blurred and appears coloured; tinged with a surround of blue or red. The distance between the foci for these colours is the longitudinal chromatic aberration.



At an intermediate position, a white circle, AB, occurs —— the circle of least confusion.

The refractive index of glass is greater for blue light than for red. Typically, $n_b = 1{\cdot}524$ and $n_r = 1{\cdot}514$

Experimentally, the angles between the red and blue refracted rays are around 1·5°.

For the sake of clarity, these angles have been exaggerated.

For monochromatic light,

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right),$$

Where r_1 and r_2 are the radii of curvature of the two surfaces of the lens, and n the refractive index for a particular colour.

For blue light,

$$\frac{1}{f_b} = (n_b - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$

For red light,

$$\frac{1}{f_r} = (n_r - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

From the Lens Makers' Equation, the principal focal length will be less for the blue end of the spectrum than for the red end.

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