

Lecture 9

To correct for transverse chromatic aberration, we require that the effective focal length of the pair remain independent of refractive index, or

$$\frac{d(1/f)}{dn} = 0 \quad \dots\dots\dots (2-13)$$

From Eq. (2-12),

$$\frac{d(1/f)}{dn} = K_1 + K_2 - 2LK_1K_2(n-1) = 0 \quad \dots\dots (2-14)$$

This condition is met, therefore, when the lenses are separated by the distance

$$L = \frac{1}{2} \left[\frac{1}{K_1(n-1)} + \frac{1}{K_2(n-1)} \right] \quad \dots\dots\dots (2-15)$$

or, more simply, when

$$L = \frac{1}{2} (f_1 + f_2) \quad \dots\dots (2-16)$$

This condition is valid independent of the lens shapes, leaving the choice of shapes as latitude for compensating other aberrations.

Example

A Huygens eyepiece uses two lenses having focal lengths of 6.25 cm and 2.50 cm, respectively. Determine their optimum separation in reducing chromatic aberration, their equivalent focal length, and their angular magnification when viewing an image at infinity.

1- Microscopes

The magnification of small objects accomplished by the simple magnifier is increased further by the compound microscope. In its simplest form, the instrument consists of two positive lenses, an objective lens of small focal length that faces the object and a magnifier functioning as an eyepiece. The eyepiece “looks” at the real image formed by the objective. Referring to Figure (2-6), where the object lies outside the focal length f_o of the objective, a real image I is formed within the microscope tube. After coming to a focus at I , the light rays continue to the eyepiece, or ocular lens. For visual observations, the intermediate image is made to occur at or just inside the first focal point f_e of the eyepiece. The eye positioned near the eyepiece—at the E_xP — then sees a virtual image, inverted and magnified, as shown. The objective lens functions as the aperture stop and entrance pupil of the optical system. The image of the objective formed by the eyepiece is then the exit pupil, which locates the position of maximum radiant energy density and thus the optimum position for the entrance pupil of the eye. A special

aperture, functioning as a field stop, is placed at the position of the intermediate image I . The eye then sees both in focus together, giving the field of view a sharply defined boundary.

If a camera is attached to the microscope, a real final image is required. In this case, the intermediate image I must be located outside the ocular focal length f_e .

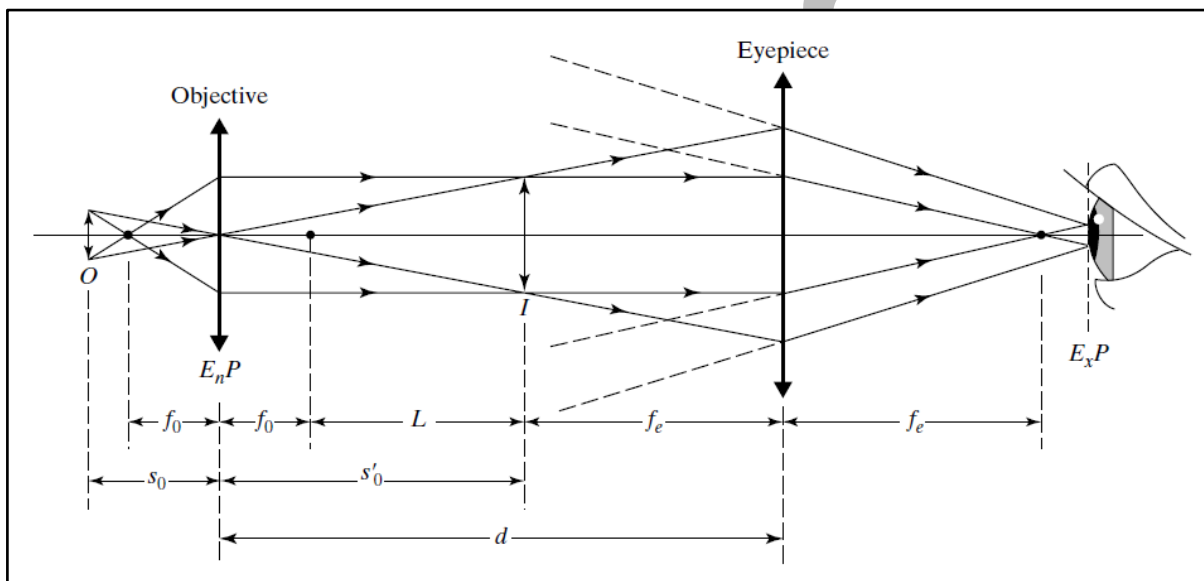


Figure (2-6) Image formation in a compound microscope.