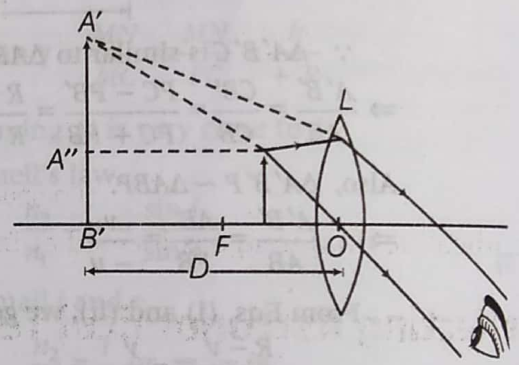
Near Point and Far Point of Human Eye

- **Near Point** (D) The minimum distance from the eye at which an object can be seen most distinctly without any strain. For a healthy normal eye, it is 25 cm. Its also known as least distance of distinct vision.
- **Far Point** The farthest point from the eye, at which an object can be seen clearly by the eye is called the far point of the eye. For a normal eye, the far point is at infinity.

Simple Microscope (Magnifying Glass)

It is a converging lens of short focal length, held close to the eye.



Case **I** When image is formed at the near point. Then,

$$M = 1 + \frac{D}{f}$$

In the case of when eye is placed behind the lens at a distance a, then

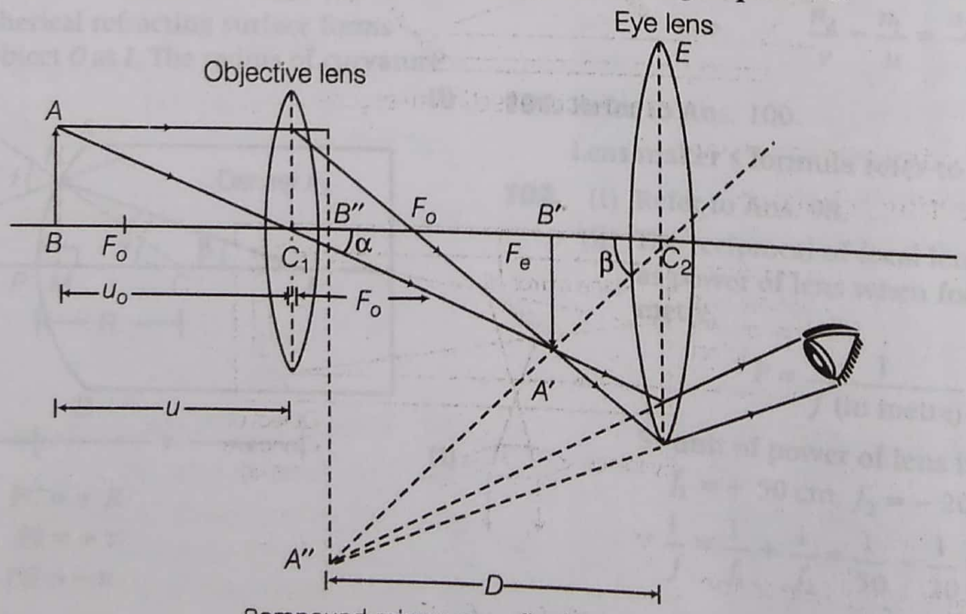
$$M = 1 + \frac{(D-a)}{f}$$

Case **II** When the image is formed at, the infinity.

$$M = \frac{D}{f}$$

Compound Microscope

Its an optical device which consists of two convex lenses, one objective of very small focal length with short aperture and one eyepiece, E of moderate focal length and large aperture.



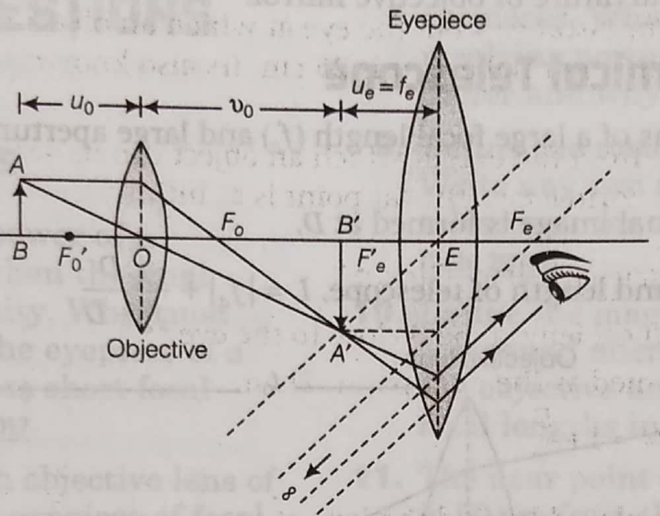
Compound microscope, final image at D.

Magnifying power, $M = m_e \times m_o$

where, m_e and m_o are the individual magnifying powers of objective and eye lens.

$M = \frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right)$, when final image is at near point $\quad M = \frac{v_o}{u_o} \times \frac{D}{f_e}$, when final image is at the infinity

$= -\frac{L}{f_0} \times \frac{D}{f_e}$, where L = Distance between the two lenses = tube length

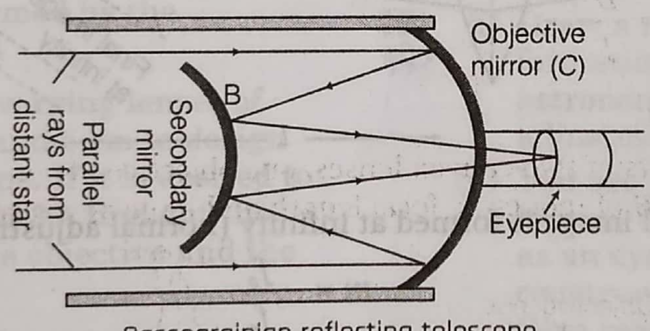


Compound microscope, final image at infinity.

i.e. when the final image is formed at infinity, the length of the compound microscope, $L = v_o + f_e$

Reflecting Astronomical Telescope

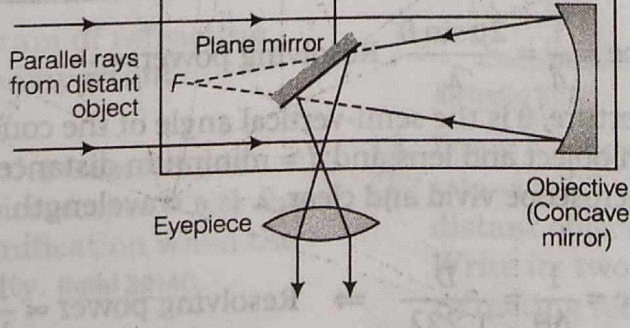
These telescopes form image free from chromatic aberration and spherical aberration.



Cassegrainian reflecting telescope

The two types of reflecting telescopes are

(i) Newtonian reflecting telescope.



(ii) Cassegrainian reflecting telescope.

$$\text{Magnification, } m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right)$$

For final image formed at infinity,

where, $f_o = \frac{R}{2}$ and $m = \frac{f_O}{f_e} = \frac{R/2}{f_e}$

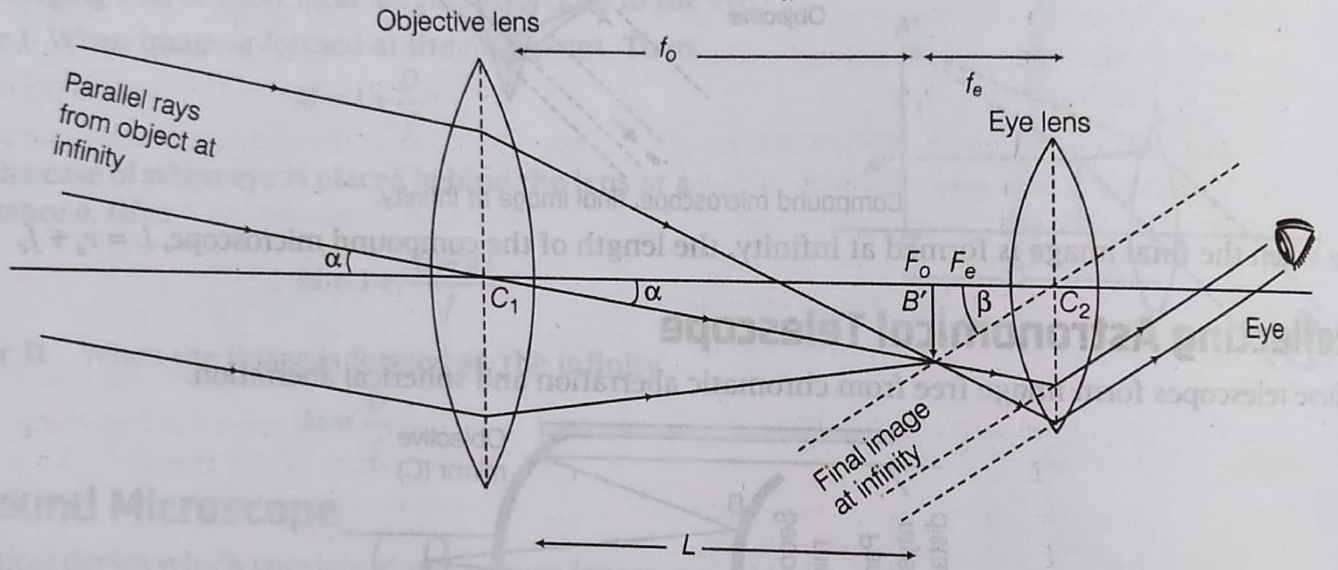
and R is the radius of curvature of objective mirror.

Refracting Astronomical Telescope

It consists of an objective lens of a large focal length (f_o) and large aperture, also an eye lens of small aperture and focal length.

(i) Magnification when final image is formed at D,

$\Rightarrow$ $m = -\frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right)$ and length of telescope, $L = |f_o| + \frac{f_e D}{f_e + D}$



(ii) Magnification when final image is formed at infinity (normal adjustment)

$$m = -\frac{f_o}{f_e}$$

$$L = |f_o| + |f_e|$$

Resolving Power

- Resolving power of microscope $= \frac{1}{d} = \frac{2\mu \sin\theta}{\lambda}$, Resolving power $\propto \frac{1}{\lambda}$

where, $\mu \sin\theta$ = numerical aperture, θ is the semi-vertical angle of the cone formed by object at objective, $\mu = RI$ of the medium between object and lens and d = minimum distance between two objects whose image can be seen through microscope vivid and clear. λ is a wavelength of light used to illuminate the object.

- Resolving power of a telescope $= \frac{1}{\Delta\theta} = \frac{D}{1.22\lambda}$ $\Rightarrow$ Resolving power $\propto \frac{1}{\lambda}$

where, D is the diameter or aperture of objective lens and λ is the wavelength of light used.