Compound Microscope:

The essential parts of a compound microscope are two convex lenses of different focal length. These lenses are referred to as:

- the objective lens or objective
- the eye piece or lens

Construction of a Compound Microscope:

A compound microscope consists of the following parts:

- Objective lens

The objective lens of a compound microscope is a convex lens of very short focal length (f_o). The object to be seen is kept very close to the objective lens.

- Eye piece

The eye piece of a compound microscope is also a convex lens of short focal length f_e. But $f_e > f_o$.

- Microscope tube

The objective lens and the eyepiece are mounted at the ends of two tubes which can be made to slide into each other so that the distance between the two lenses can be adjusted.

Working

The ray diagram given below gives the principle of a compound microscope. The object is placed very nearer to the objective so that the objective lens forms a real, inverted and magnified image (I_1) of the object. The image I_1 acts as an object for the eye piece. The position of the eyepiece is so adjusted that the image lies within the focus of the eyepiece (F_e). The eyepiece acts like a magnifying glass and forms a virtual erect and magnified image of the object.

As a property of convex lens image formation when an object lies very close to the lens or with in the focal length of lens it forms virtual and erect image of the object on the same side of the lens

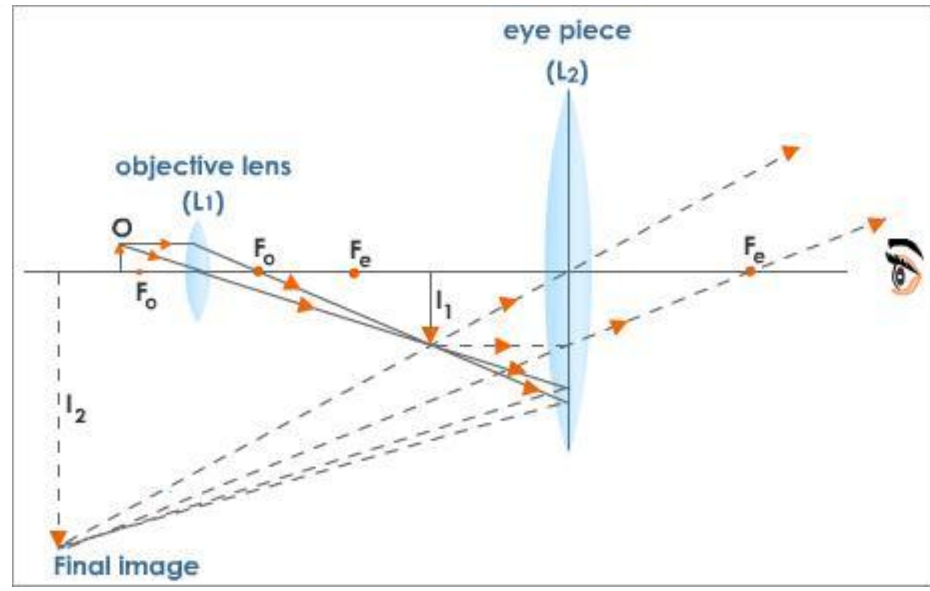

Image Formation in a Compound Microscope

- The object (O) is placed just outside F_o, the principal focus of the objective lens.
- F_e is the principal focus of the eye lens.
- A real, inverted magnified image I_1 is formed. The magnified image I_1 acts as an object for the eye lens.
- The final image I_2 is virtual and is magnified still further. It is inverted compared with the object. I_2 may appear 1000 times larger than the object.

Magnifying Power of a Compound Microscope

The magnifying power of a compound microscope is defined as,

"The ratio of the size of the final image (I_2) as seen through the microscope to the size of the object as seen with a naked eye"

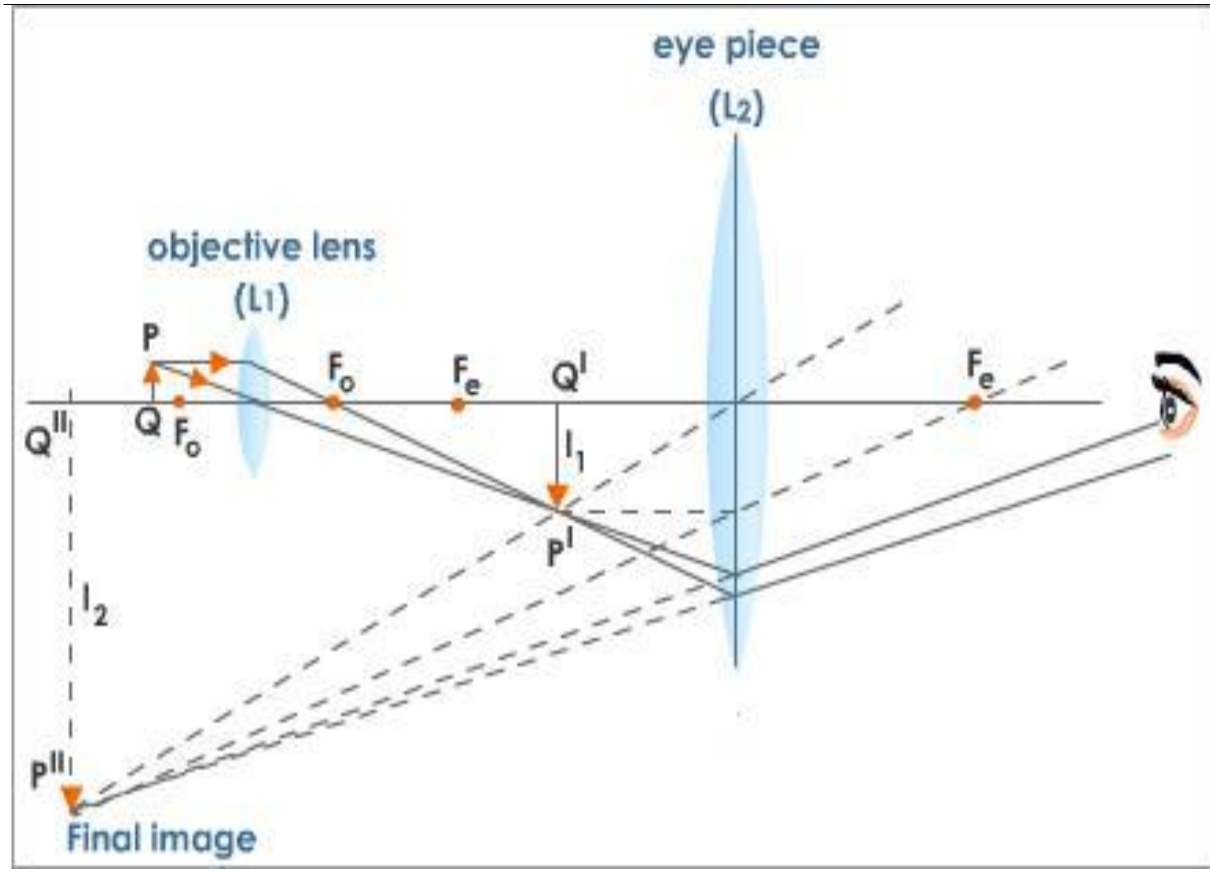

Image Formation in a Compound Microscope

$$m = \frac{\text{size of the final image as seen through the microscope}}{\text{size of the object as seen with a naked eye}}$$

$$m = \frac{h_I}{h_O} = \frac{P''Q''}{PQ}$$

$$= \frac{P'Q'}{PQ} \times \frac{P''Q''}{P'Q'}$$

$= m_{objective}$ x $m_{eyepiece}$

$= m_o$ x m_e

Where $m_{objective}$ (m_o) and $m_{eyepiece}$ (m_e) are the magnification produced by the objective and eyepiece respectively.

$m = m_o \times m_e$

Eye piece is nothing but a simple microscope

$$\therefore\ m_e = \left(1 + \frac{D}{f_e}\right) \quad \ldots\ldots\ldots (1)$$

The lens formula is

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_o}$$

But distance between the object and the lens is -u.

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Multiply equation (2) by V

$$\frac{v}{v} + \frac{v}{u} = \frac{v}{f_o}$$

$$1 + \frac{v}{u} = \frac{v}{f_o}$$

$$\frac{v}{u} = \frac{v}{f_o} - 1$$

$$m_o = \frac{v}{u} = \frac{v}{f_o} - 1$$

$$m_o = \left(\frac{v}{f_o} - 1\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$m = m_o \times m_e$

$$= \left(\frac{v}{f_o} - 1\right)\left(1 + \frac{D}{f_e}\right) \{\text{Substituting for } m_o \text{ and } m_e \text{ from 3 \& 1}\}$$