Semester I

Chapter 1

Compound Microscope

Study the different parts of a compound microscope and its uses.

COMPOUND MICROSCOPE

The compound microscope is called so because it has two-lens system, i.e. the eyepiece and the objective lenses.

Broadly, the parts of compound microscope are divided into:

a. Supporting parts (Fig. 1.1)
b. Focusing parts
c. Optical parts
d. Illumination parts

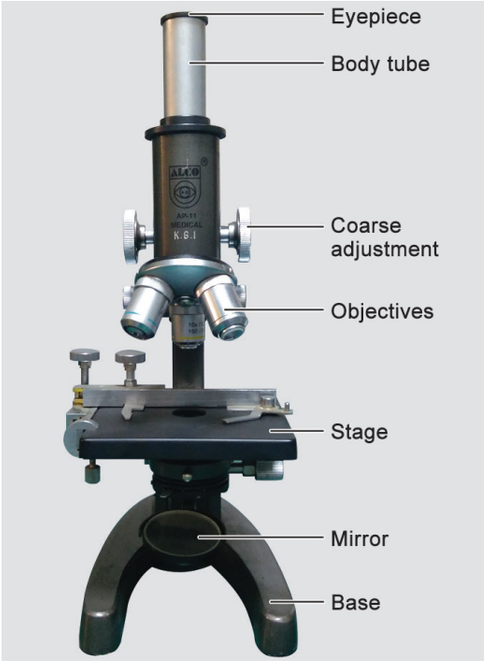

Fig. 1.1: Monocular compound microscope (front view)

A. Supporting Parts

i. **Base:** It is a horseshoe or U-shaped structure. It supports the microscope and provides stability.
ii. **Pillars:** There are two pillars between the base and handle. It is an upright structure. It is attached to the handle by a hinge joint.
iii. **Handle:** It is a curved, C-shaped structure and it helps in tilting the microscope.
iv. **Body tube:** It is a wide tube attached to the C-shaped handle at the upper part. At the lower end it is attached to the nosepiece. Eyepiece is placed at the upper end.
v. **Stage:** Stage is comprised of two parts:
   a. **Fixed stage:** It is a fixed square stage and has a round aperture at the centre. Object is placed at the centre for study. The light rays coming from below cross this aperture and strike the object which is to be focussed.
   b. **Mechanical stage:** It is a calibrated stage (Vernier scale) and is fitted on the fixed stage. There is a clip attached to it which holds the object. There are two screws attached to it which control sideways, forward and backward (to and fro) movements of the object. Movement of the object can be determined by engraved Vernier scale on the mechanical stage.

B. Focusing Parts

Coarse and fine adjustment screw: If one side screw is moved then the other side screw also moves along with it automatically. These screws work in "rack and pinion" method. Circular movement (pinion) of these screws helps in upward and downward movements (racking) of body tube.

a. **Coarse adjustment screw:** There are two coarse adjustment screws mounted at the top of the handle on either side. The focussing of an object is always done by using coarse adjustment screw first. The body tube is moved in upward and

downward direction by the coarse adjustment screws.

b. **Fine adjustment screw:** There are two fine adjustment screws mounted at the top of the handle on either side. These are small-sized screws and help in fine and sharp focussing after coarse focussing has been made with the coarse adjustment screws.

C. Optical Parts

Optical parts of microscope help in image formation (Fig. 1.2).

i. **Body tube:** It is also considered as a part of optical system.

ii. **Eyepiece lens:** It is placed at the uppermost part of the body tube. The eyepiece lens has different magnifying power, i.e. 5X, 10X, etc. which can be changed according to the requirement. It is comprised of two lenses:
   a. **Eye lens:** It is attached at the top most part of eyepiece lens.
   b. **Field lens:** It is present at the lower most part of eyepiece lens.

iii. **Nosepiece:** It has two parts—fixed nosepiece and revolving nosepiece.
   The fixed nosepiece is attached on the lower end of body tube.
   Revolving nosepiece is fitted below the fixed nosepiece. Different objective lenses are attached to the revolving nosepiece.

iv. **Objective lenses:** There are four or three objective lenses with the different magnifying powers attached to the revolving nosepiece. The magnifying power and the numerical aperture are engraved in each and every objective lens (Table 1.1).

D. Illumination Parts

i. **Light:** The source of light may be external or internal, i.e. light is attached with microscope itself (Fig. 1.3).
   Sunlight or artificial light can be used as external source for microscope.

ii. **Planoconcave mirror:** It is a double-sided mirror. One side is plane and the other side is concave in nature. That is why, it is known as planoconcave mirror. The plane mirror is used when sunlight is used as light source. Because sunlight rays are parallel in nature and reflected parallel

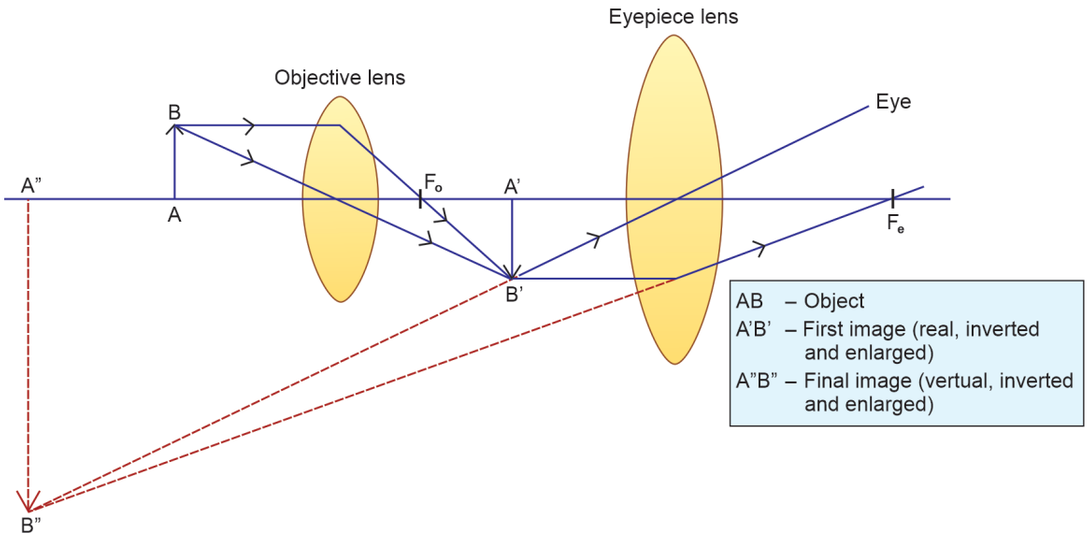

Fig. 1.2: Monocular compound microscope (front view)

Table 1.1: Magnification power, focal length and numerical aperture of objective lenses

Objective lenses	*Magnification power*	*Focal length*	*Numerical aperture (NA)*
Scanning objective lens	3X	40 mm	0.10
Low power objective lens	10X	16 mm	0.25
High power objective lens	40X or 45X	4 mm	0.65
Oil immersion objective lens	100X	Less than 2 mm	1.30

Total magnification power = Magnification power of eyepiece lens × Magnification power of objective lens

to the condenser by plane mirror. The concave mirror is used in artificial light. Because artificial light rays are divergent in nature and reflected as parallel to the condenser by concave mirror.

Fig. 1.3: Monocular compound microscope (front view)

iii. **Condenser:** It is just below the central aperture of fixed stage. It is a combination of two lenses fitted in a short cylinder. The function of condenser is to converge light at the central aperture of fixed stage. It also reduces the spherical and chromatic aberrations. By the help of a screw, fitted at one side, condenser can be moved in upward and downward direction. This screw also work in rack and pinion fashion.

While using scanning objective lens, the condenser should be at the lowermost position. During the use of low power objective lens, the condenser should be little bit upper from lowermost position. Position of condenser should be midway during the use of high power objective lens and at uppermost position while using oil immersion objective lens.

iv. **Iris diaphragm:** It is present just below the condenser. It controls the amount of light. Its size of aperture can be changed by moving a small lever fitted on the side.

It is opened least while using scanning objective lens. It is opened partially while using low power lens, almost open in high power and fully opened when oil-immersion objective lens is used.

PROCEDURE: TO USE THE MICROSCOPE

Using of Low Power Objective Lens

- Place the microscope in working table towards the light source.
- Select the mirror depending upon the source of the light.
- Move the condenser little bit upper from the lowermost position.
- Open iris diaphragm partially.
- Bring the low power objective lens in alignment by listening click sound (when low power objective lens is brought in the path of light then a click sound is heard on its rotation).
- Adjust light by looking through the eyepiece and by tilting the mirror towards light source.
- Now, place the object at the centre on fixed stage.
- Lower the body tube (low power objective lens also moves with body tube), gradually by coarse adjustment screw up to 3–4 cm away from the object.
- Then look through eyepiece.
- The field should be equally and fully illuminated.
- Rotate coarse adjustment screw very slowly to move the body tube downward gradually until rough focus the object is done.
- Use high power objective lens and fine adjustment screw to have an improved and clear focussing.
- Bring the high power objective lens in alignment (in the path of light) by listening click sound.
- Bring the condenser at midway position.
- Open iris diaphragm almost fully.
- Lower the body tube gradually by coarse adjustment screw as far as possible without touching the object while looking from the side.
- Then look through eyepiece.
- The field should be equally and fully illuminated by little bit adjusting mirror if required.
- Now, elevate the objective lens, i.e. body tube slowly with the help of coarse adjustment screw until the object is visible.
- Then use the fine adjustment screw to have an improved and clear focussing.

Using of Oil Immersion Objective Lens

- Elevate the body tube at least 2 inch from the object.
- Bring the oil immersion objective lens in alignment (in the path of light) by listening click sound.
- Put one drop of cedar wood oil over the object (the part of the object which is just above the centre aperture). Cedar wood oil has approximately same refractive index as that of glass and it replaces the thin layer of air which is present in between the object and oil immersion objective lens. Hence, it prevents the refraction of light and object will be more clearly visible.
- Bring the condenser at highest position.
- Open iris diaphragm fully.
- Lower the body tube gradually by coarse adjustment screw until the tip of the oil immersion object touches the cedar wood oil drop while looking from the side.
- Then look through eyepiece.
- The field should be equally and fully illuminated by little bit adjusting the mirror if required.
- Then, use the fine adjustment screw to have an enhanced and clear focusing.