ZOOACOR03T- NON CHORDATES II

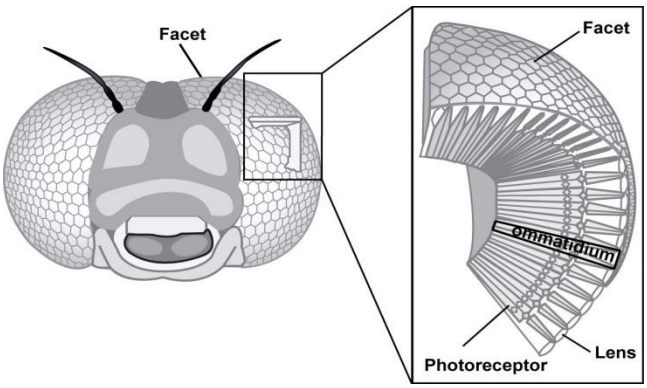
UNIT 3 ARTHROPODA

VISION IN ARTHROPODA

Phylum Arthropoda has two types of eyes for the purpose of vision- simple eye and compound eye. Of these, the compound eye has evolved as a unique feature in this phylum and is not found elsewhere. The compound eye is fund most commonly in insects as well crustaceans.

The following is a brief description of compound eyes.

Compound Eyes



Each compound eye is made up of hundreds to thousands of tiny independent photoreception units or visual units called **Ommatidia** or **Facets**, which are connected to the optic nerve.

Each ommatidium unit consists of a cornea, lens and photoreceptor cells which can distinguish between brightness and colour. The ommatidia can be divided into an **optic part** and a **sensory part**.

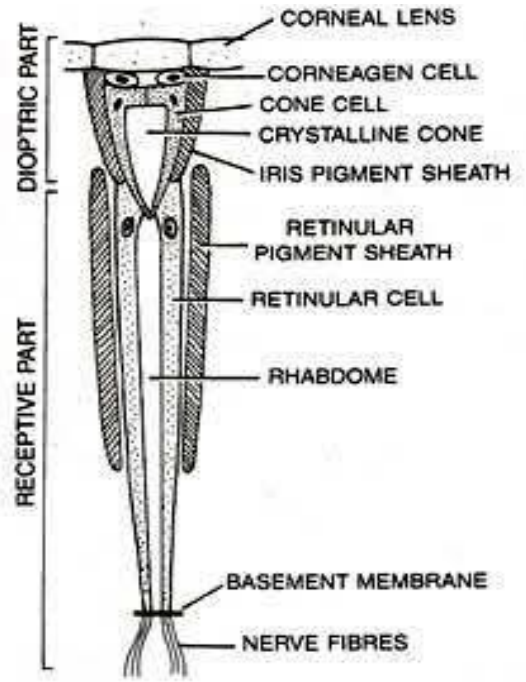
The optic part is the outer dioptrical region which is capable of receiving and focusing light rays while the sensory part is the inner part which is capable of perceiving light and sending the nerve impulse to the brain via the optic nerve, which then analyses the image as an object.

The **cornea** of the ommatidia is the modified cuticle on the surface. This gives protection to the ommatidia and being transparent allows light rays to enter. There is a pair of cells below the cornea known as **corneagen cell** which secretes fresh cornea in case of injury or wearing away.

Beneath the corneagen cells a **lens-like crystalline cone** is situated which focuses the incoming light rays inwards. This crystalline cone is surrounded by four cone cells that provide nourishment to the lens.

Next layer commences the sensory part of the ommatidia. It consists of sensory cells called **Rhabdomes** which are elongated in shape and transversely striated to form a channel. There are **retinula/retinal cells**, generally 7-8 in number surrounding the rhabdome and are light sensitive.

Chromatophores are pigment cells which are located around the cone and retinal cells. They can shrink or expand to increase or decrease intensity of light entering the eyes.



Section through an ommatidium

Image Formation

The ommatidia are packed side by side into bulges that create a wide field of view as much as 360º overall for each compound eye. Since each facet or ommatidia is oriented in a slightly different direction, all the ommatidia together make up a honeycomb like structure which creates a mosaic image. Each ommatidium produces an image of a small part of the object seen and not the entire object. All these small images from all the ommatidia are combined in the brain to form a complete image of the object seen, just like the dots in a mosaic picture, hence the name mosaic vision.

This type of image lacks depth and therefore is poor in resolving details but is excellent at detecting movement. The compound eye has distance range of about a foot. On the other hand, high flicker fusion rate is a characteristic of the compound eye where it can perceive action of an object as successive independent frames of images and not as a continuous motion. For Arthropod compound eyes, this rate is about 50 frames per second as compared to 12-15 frames per second of the human eye. Thus the compound eye is much more efficient in picking up motion of the object which helps the arthropod to escape predators and catch prey.

Types

Compound eyes may be broadly dvided into two types on the basis of the kind of image formed. They are

a. Superposition Eyes/ Scotopic Eyes and

b. Apposition Eyes/ Photopic Eyes

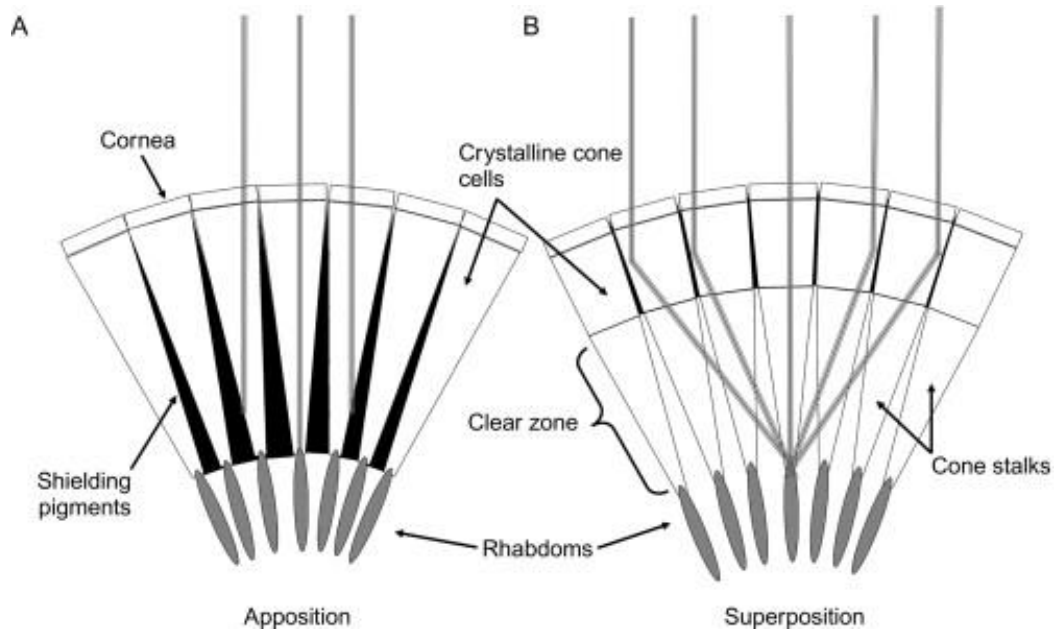
Scotopic Eyes

In this type, the pigment cells shrink to allow more light into the eye, so that ommatidia are not fully isolated from one another. This also enables oblique rays to enter more than one ommatidia. This

results in overlapping or superpositioning of images by the different ommatidia. Therefore, the final image is hazy and not sharp. This type of eye is used for seeing in dim light by mostly nocturnal arthropods.

Photopic Eyes

In this type, the pigment cells spread out/ expand and completely separate the ommmatidia from one another. So each ommatida has an angle of vision of 1º only and light rays coming directly from that front can only enter the ommatidia. Light rays coming at an angle or oblique rays are absorbed by the pigment cells before they can reach the rhabdome. The image formed is a mosaic of tiny dots which are grouped together by the brain into a single, whole object. The images are generally sharp and this type of eye is used for bright light vision.



Other types of eyes

Good flying insects like honey bees, dragon flies, house flies etc have specialised zones of ommatidia organised into a fovea which gives acute vision. In this zone, the facets are larger and flattened instead of dome shaped which helps to form images of higher resolution.

Simple eyes can be found in insects where they possess 1-3 pairs of such, also known as Ocelli on the top of their heads. in addition, they have one pair of compound eyes. Other than insects, arthropods of class Arachnida, especially Scorpions possess only simple eyes.