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B.Sc HONS Part-III Paper-V
Topic :- Physiology of hearing
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**Q. Give a detailed account of the physiology of hearing.**

**Ans.** Ear is a powerful sensitive instrument for detecting sound vibration and it does this with remarkable activity. As ear receives sound stimulus, it is called phonoreceptor.'

The external ear and middle ear function more to conduct sound vibrations. The sound perception is actually done by the spirally coiled portion of the inner ear called cochlea.

Pinna directs the sound waves into the external auditory meatus. When the sound strikes the tympanic membrane, the membrane vibrates. These vibrations are transmitted by the ear ossicles to the fenestra ovalis. This sets in a wave of movement in the endolymph of vestibular canal, of the cochlea.

The Cochlea is a spirally coiled tube. The cavity of cochlea is divided into three longitudinal parallel canals, namely vestibular canal, middle canal and tympanic canal. The vestibular canal is connected with the fenestra ovalis and the tympanic canal is connected with the fenestra rotunda. These canals are separated by membrane. The vestibular and middle canals are separated by Reissner's membrane. The middle and tympanic canals are separated by basilar membrane. The actual sound receiving organ is located in the middle canal on the basilar membrane. This organ is called organ of corti. It consists of specialised hair cells. There are about 23500 hair cells. Each hair cell has about 20 tiny hairs projecting into the middle canal. The hair cells are separated by pillars. A membrane overhangs the free ends of the hairs of hair cells. This membrane is called tectorial membrane.

The sound vibrations passing through the fenestra ovalis agitate the endolymph of vestibular canal. This canals moment of Reissner's membrane which in turn agitates the endolymph of middle canal. This in turn causes the movement of basilar membrane. Movement of basilar membrane distorts the hair cells. As a result the free ends of hairs rub the tectorial membrane. This causes the hair cells to produce action potentials that travel along the auditory nerves to the brain for interpretation and hairing is effected.

**Discrimination of pitch :**

The pitch of the sound is determined by the frequency of the sound waves i.e. wave length. High tones are caused by sound waves of high frequency. Low tones are caused by sound waves of low frequency. The discrimination of sounds depends on the stiffness of the basilar membrane. The stiffness of the basilar membrane is responsible for the discrimination of sound. The stiffness gradually decreases from the base of the cochlea to the apex. It is said that the movement of the ear ossicles sets up a travelling wave which passes along the basilar membrane for a certain distance and then dies out. The distance travelled depends on the frequency. High frequency waves travel only a short distance, while low frequency waves travel much further. This could result in different parts of the cochlea responding to different frequencies. During very loud low pitch sound, the whole of the cochlea may be activated. As a results there is an increase in the frequency of impulses to a single nerve fibre and also an increase in the number of fibres which carry the impulses. Sound waves of low intensity, can vibrate only a small band of basilar membrane and hence only few fibres are stimulated. With increase in loudness, a larger segment of the basilar membrane is set into vibration and hence a larger number of fibres are stimulated.

This implies that the hair cells are arranged in sequence, the hair cells stimulated by low frequency waves are located at the base of the cochlea, the hair cells stimulated by high frequency sounds are located at the apex rather like the keys of a plano.