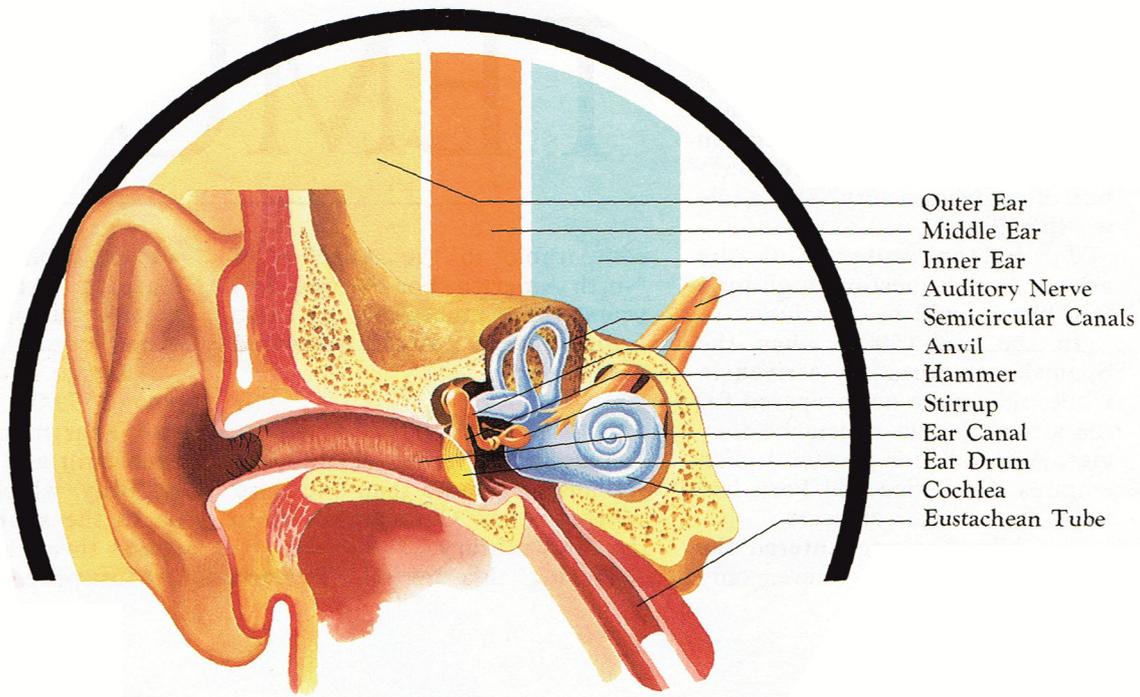


# Ears – Our Incredibly Advanced Sound System



When the Krakatoa volcano erupted in 1883, 5 cubic miles of rock were hurled high into the air with a horrendous roar.

That roar demonstrates the amazing range of the human ear. Because not only could human ears on nearby islands withstand the awesome shock, but people thousands of miles away could also detect a faint rumbling.

If an engineer could design and construct an ear, he would have to squeeze an advanced sound system into roughly 1 cubic inch (16 cubic centimetres).

This system would have to include a wide-band signal analyser, a multichannel electromechanical transducer, a matching transformer, a mobile amplifier and switching system, a delicate hydraulic balancing system and a two-way signal system!

If such a miracle of microminiaturisation were accomplished, it is doubtful it would even come close to the fabulous performance of the human ear. Let's examine some facts about this amazing sensory organ.

## **An incredible range**

Our ears respond to loudness in a way that allows us to hear an incredible range. Without this ability, the ear would easily be damaged by loud sounds and would not be sensitive enough to hear very faint sounds.

How is it possible to hear such a wide range? Basically, this works because for a sound to seem twice as loud, the intensity must be not just doubled, but squared (multiplied by itself).

Look at some examples of what this means. If we were to measure the energy or sound intensity of a soft whisper and then say that this equalled one, then the intensity of normal conversation would be

10,000. The intensity of heave traffic would be 1,000,000,000 and that of a nearby aeroplane engine, 1,000,000,000,000.

If we likened the sound energy of that soft whisper to 6 inches (15 centimetres) of distance, then the loudest sound intensity that the human ear could hear without hurting would be equal to the distance to the sun!

In its most sensitive region, the eardrum can detect sound levels so small that they cause it to vibrate less than the diameter of a hydrogen atom or less than a wavelength of light!

Another important thing the ear allows us to do is to concentrate on what a friend is saying while ignoring the noise of a crowd around us. We can do this because the human ear can locate where a sound is coming from. It is extremely sensitive to small differences in the arrival of sound and, working with the brain, can at the same time suppress or ignore sounds we are not interested in.

Our hearing mechanism continues to work with amazing efficiency even while we sleep. The brain continues to process sounds received by the ear. These sounds are interpreted and selected in such a way that a person can sleep soundly through noisy traffic or even the roar of a nearby airport, but awake promptly at the ringing of an alarm clock.

### **How it works**

How does the ear work? When sound waves enter the outer ear, they travel through the ear canal to the eardrum. The outer ear helps amplify the sound, and the pressures of these sound waves cause the eardrum to vibrate.

The eardrum passes these vibrations to the bones of the middle ear – the hammer, anvil and stirrup. They are held together by delicate muscles and connective tissues that cushion the inner ear from the vibrations of loud sounds.

The Eustachian tube, which connects to the middle ear, acts as a pressure-relief valve to maintain equal air pressure on both sides of the eardrum.

The tiny, pea-sized cochlea, in the inner ear, receives the vibrations next. It is filled with liquid and also contains 30,000 microscopic hair cells that play a part in transforming the vibrations into electro-chemical impulses. These impulses then travel along the auditory nerve to the brain at close to the speed of light.

Finally, the brain decodes the volume, pitch, tone and arrival time from both ears to locate and identify the incoming sound waves.

Through hearing and talking, man is able to communicate. The ear warns us of danger. Is it possible for something as remarkable and complex as an ear to develop by accident?

Our ability to hear is only a small part of the whole creation and we have only looked at one function of the ear – hearing. Did you know that your ear also gives you your sense of balance?

**With all the amazing things it does, the human ear is one of the many great tributes to the Creator God – the Master Audio-engineer!**