

## What the Ear Reveals About the Creator

By Andy McIntosh

### THE WAY WE HEAR

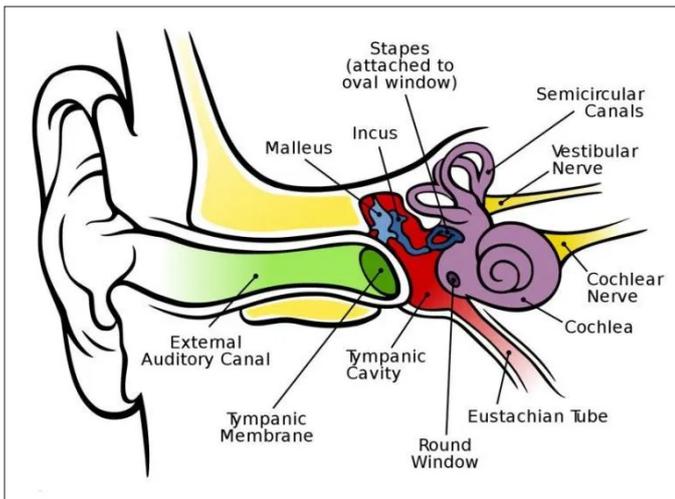


Fig. 1 Diagram of the workings of the human ear

All human senses are remarkable and illustrate that we are fearfully and wonderfully made (Ps 139:14). The human ear is one of the most intricate examples of miniature and sophisticated engineering. The Lord clearly states in scripture that the ear and the eye are both made by Him: “The hearing ear, and the seeing eye, the Lord has made them both” (Prov.20:12).

We hear sound as small cyclical pressure changes in the air which reach the ear drum inside the ear. These small pulses travel into the ear canal and reach the eardrum as shown in figure 1.

The small vibrations of the eardrum are then transferred through tiny ossicle bones into the inner ear. All mammals have a system like this. However there are large differences within the

mammals. Certain length of tubes will vibrate at different natural frequencies. Depending on where you press open the keys, a flute will change its natural frequency. The ear canal in humans is about 2 cms (approx. 0.8 ins) long while the ear canals in cats and dogs are of a different shape such that there is a bend in them. Thus they have a vertical and horizontal ear canal which is designed for a different range of frequencies. Humans hear over a wide range (9 octaves) from approx. 20 cycles per second (Hz) to nearly 20,000 Hz. Dogs hear from approx. 65Hz – 44,000Hz (again over 9 octaves but shifted compared to humans), while cats have one of the widest ranges of all of over 10 octaves from 55Hz to 77,000Hz. Our ears are designed for low frequency as well as high frequency sound and resonate in the range of 4000 Hz which is right in the centre of the human speech range!

Human ears are such that when we are even in our twenties we are beginning to lose the capability of hearing very high frequencies (in the region of 12,000 Hz and above). The fundamental frequency range is from 125 to 400 Hz but what is called the “harmonics” of the vibration (multiples of the fundamental) extend the frequency range of human speech. Any voice is unique for each individual because of these harmonics. This includes the voice of Christ Himself which all Creation obeys as is demonstrated even when He commanded the wind and the waves to obey Him in Mark 4 – the same voice that spoke all into existence at Creation!

The harmonics of the human voice are particularly important in the region of between 2000 Hz and 5000 Hz since in this region different vowel sounds are distinguished, with the even higher frequencies enriching the quality of the sounds, particularly in music. What is remarkable is that the ear canal is just the

right length to resonate (that is vibrate in sympathy) with these frequencies.

### THE MIDDLE EAR – OSSICLE BONES

The acoustic signal causing the eardrum to vibrate, now pushes on the malleus (hammer) attached behind, which itself then pushes onto the incus (anvil) bone, which then moves the stapes (stirrup) horizontally. These bones are of the order of 5mm long with the stapes smaller still, and all three can fit on a 1 cent piece with ease! These are the only bones in the body which do not grow. They are the same size as when each of us was born as a baby. Those believing in evolution try to argue that upper and lower parts of the jaw bones of a reptile moved to become the malleus and incus bones, but quietly ignore the biggest hurdle to such a story, which is that jaws of reptiles never stop growing!

The ossicle bones amplify the signal. Each of the three are shaped specially so there is a lever mechanism such that the stapes (attached to a membrane called the oval window in the cochlea), moves approximately three times the distance travelled by the malleus.

Why the need to amplify the signal? This is because the signal is now going to pass into a liquid medium in the inner ear.

### THE INNER EAR – COCHLEA

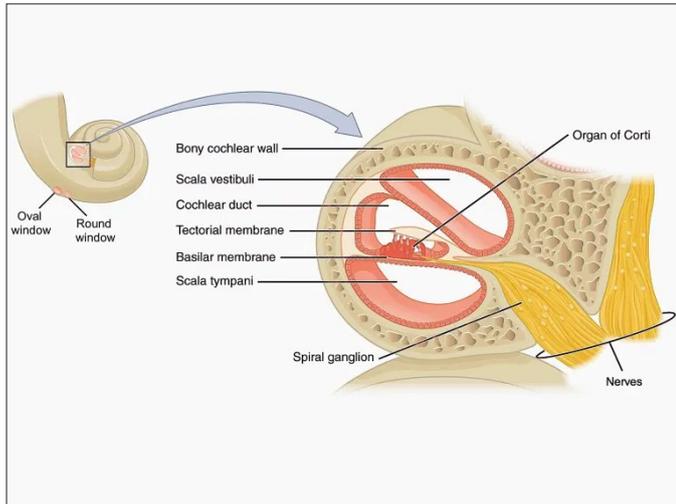


Fig. 2 The Cochlea

Liquid is a barrier to sound, and the stapes acts like a pump on the oval window membrane and cleverly the membrane of the round window (see figure 2 showing the Cochlea) expands to compensate for the movement of the liquid inside the cochlea.

If we were to unwind the cochlea, we would see an ingenious basilar membrane which tapers for higher frequencies inside the cochlea, rather like a xylophone, so that whatever combined frequencies come in from the oval window vibration, are immediately split up into their component frequencies! This is effectively an instantaneous frequency analyser, so that whatever signal is coming in composed of many frequencies, immediately causes different parts of the basilar membrane to vibrate! Such an ingenious device will make any electrical engineer marvel, since unlike digital frequency analysers used often today, this instantaneously splits the incoming sound up into its component frequencies, rather like having a miniature gremlin (but a concert pianist!) playing a keyboard in your inner ear!

The final part of the hearing system is achieved by the organ of Corti running along on top of the basilar membrane. This has tiny little hairs (stereocilia) on it which send an electrical signal according to each frequency excited by the incoming signal. It is astonishing that each cilia (0.00025 mm thick – this is less than 1/70th of the thickness of a human hair! ) when disturbed by the tectorial membrane (which touches the cilia above), has a little trapdoor at its side which opens with a spring attached to an adjacent hair! This allows electrical ions in the electrically charged fluid, within that part of the cochlea, to then excite a set of nerves to send the signal to different parts of the cerebral cortex in the brain, depending on whether it is music or speech.

Such a system involving air vibrations, mechanical, chemical and electrical engineering is frankly astonishing and confirms the intelligent design of the ear. Surely we can only echo the glorious statements from Proverbs and the Psalms, as cited above: “The hearing ear, and the seeing eye, the Lord has made them both” and “I will praise thee; for I am fearfully and wonderfully made: marvellous are thy works; and that my soul knoweth right well.”

*A version of this article has also appeared in one section (pp. 180-183) of the book Wonders of Creation – Design in a fallen world co-authored with Professor Stuart Burgess and Brian Edwards and published by Day One, 2017.*

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