

air throughout and being secured by another membrane in the fenestra ovalis. Thus, as before noted, the whole mechanism of the ear seems not to transmit sound vibrations — any substance would do that — but to transmit them with the greatest conservation of their force. A sonorous vibration, then, conducted through the meatus, strikes upon the tympanum to which the long arm of the malleus is attached. The malleus — which is a lever with a short arm fitting into a pocket in the surrounding bone as a fulcrum — applies the power transmitted through its head to the incus, which in turn passes it on to the stapes and at the base of the stapes, the work is performed, where that bone pushes into the oval window on whose other side lies the labyrinth.

The delicate and beautiful arrangement of the various parts of the middle ear is worthy of the highest wonder and admiration. If, for instance, the tympanum were a flat membrane stretched across the end of the meatus, then the vibrations would be of the greatest amplitude at its centre and diminish towards the border. To offset this we find that while the membrane as a whole bulges inwards, it is composed of fibres so arranged as to present to the incoming sound waves a convex surface. Hence a small change in the pressure of the air will produce a considerable tightening of the fibres and of the whole membrane. In this way, the feeblest of tones can vibrate the tympanic membrane sufficiently to transmit themselves to the inner ear. Examine also the mechanism of the series of bones of the middle ear. The power is applied at the long arm and the work done by the short arm of the series. In this way power is gained, and space is used in the middle ear where it can be spared to save space in the wall of the inner ear where the base of the stapes enters. The whole arrangement of these bones is such as to diminish the amplitude of the vibrations at the oval window, while doing the work in a smaller area than that of the tympanic membrane. Another remarkable provision of nature is the remarkable joint between the incus and the head of the malleus. Its nature and construction are such that if the tympanic membrane be pushed in violently as by a very loud sound, the malleus and incus rotate at the joint in such a way as to lock and prevent any further movement. On the other hand, if the drum head be pushed outwards violently, as may be done by filling the middle ear with air through the Eustachian tubes, the little joint opens up and the head of the malleus is free from connection with the incus. In either contingency the stapes cannot be driven too forcibly into the oval window nor can it be pulled too