

3. This holds good for the fresh femur with soft parts adherent as well as for the macerated bone.

The conditions of sound conduction in the skull are next studied—first on a macerated and then on a fresh skull. The tuning-fork handle is in these experiments passed through the external auditory canal and screwed into the promontory wall of the middle ear, and the stylet of the microphone is placed at various points on the skull. Two tuning-forks of different pitch, and consequently giving off waves of different length, are used for greater exactness, but the results are relatively the same. The following results are obtained:

1. The direction which waves of sound conducted directly to the bones of the skull take is dependent on the density of the bone-substance.

2. When, therefore, waves of sound proceed from the hearing organ of one side they spread out over the whole skull, but they are conducted *especially* to the symmetrical point of the other side of the skull.

3. There exists, therefore, a conduction of sound from one ear to the other by bone. This may be carried by conduction through the bone alone without the chain of ossicles (*Schalleitungskette*) playing necessarily any essential part.

4. This is true of the macerated skull, and as well of the fresh skull with adherent soft parts. Frey believes that his experiments show that the peculiar construction of the bone in the vicinity of the ears (the pyramids consist of the hardest bone of the body) explains the conduction of sound from one ear to the other.

Two Physiological Reports Concerning Acoustics.—A. LUCÆ (*Archiv. f. Ohrenheilkunde*, Band liv., Heft 3 und 4). The first of these reports is concerned with the function of the membrane of the round window.

1. A hitherto unrecognized way in which the so-called artificial drum membrane acts. Lucæ is here not concerned with the well-known action of the artificial drum membrane in cases of isolated stapes where the piece of cotton or rubber making the artificial drum membrane is placed directly on the head of the stapes, and where the improvement in hearing is, in the author's opinion, due to increase of intralabyrinthine pressure. He is concerned with the results which he has obtained by placing a wad of cotton on the promontory wall in cases of chronic middle-ear suppuration which have run their course, leaving a loss of drum membrane and absence of the malleus and iacus. In a series of such cases, under observation for several years, Lucæ has been struck by the improvement in hearing which has resulted when the wad of cotton rested upon the forward part of the promontory wall without touching either the stapes or round window. In some cases—those where the presence of the wad of cotton sets up a slight reaction with consequent thickening of the mucous membrane covering the promontory—the improvement in hearing was permanent even after the cotton was removed. The results in these cases can, according to the author, be explained in the following way: In these cases the waves of sound are conducted to the interior of the cochlea simultaneously through the promontory and the two windows, of which two latter probably only the round window plays any considerable part. In the cochlea, on account of this double conduction, the

two sets of waves come to interfere, and hence a lessened perception results. By means of the wad of cotton the conduction through the promontory wall is excluded, the interference no longer takes place, and, therefore, an improvement in hearing comes about.

2. A successful operation on the round window. The operation was performed on a woman forty-one years old, suffering from progressive deafness, with distressing subjective noises. The whispered voice was heard on the affected side 0.8 m. Drum membrane was relaxed. Lucae's hammer tuning-fork c' was heard $3\frac{2}{3}''$. Since, notwithstanding treatment for one month with massage, no improvement resulted, the excision of the drum membrane and extraction of the malleus and incus were undertaken. No improvement followed this operation, and, accordingly, since the first operation showed that the round-window niche, which was easily accessible, was blocked by two exostoses arising from the borders of the niche and touching in the centre, wholly occluding it, a second operation was performed. The exostoses were removed by means of a small burr driven by an electric motor. There was no escape of labyrinthine fluid, which showed that the membrane of the round window was not punctured. The improvement in hearing after the operation was considerable (from 0.8 m. before the operation to 3 m. for the whispered voice about two months after the operation), and the distressing character of the subjective noises was lost. The same c' hammer-fork was heard after the operation $32''$, an increase of $10''$.

Lucae believes that a bony closure of the niche of the round window may be found in any age, even in children, and that in cases of so-called sclerosis the condition of the niche of the round window should be examined, and, when necessary, the above operation, which is quite free from danger, undertaken.

The second report concerns the vibrations of the drum membrane in the living ear, caused by tones, and is an extension of the author's work on the movements of the sound-conducting apparatus when the movement is caused by condensation and rarefaction of the air in the external auditory canal (*Archiv f. Ohrenheil.*, Band liii.). By means of the simultaneous conduction of the sound from two closed whistles of 128 d.v. and 133 d.v. by means of a T-rubber tube to a Siegle speculum, and so to the drum membrane, the latter will receive five beats in the second. By means of the stroboscope and looking through the Siegle speculum one can directly observe that the posterior-superior quadrant of the drum membrane, and that only, vibrates in sympathy with the five beats. Now, according to Helmholtz, beats can come about in an elastic body through sympathetic vibration only when both the tones which arouse the beat are near enough to pitch to the fundamental tone of the elastic body, so that the latter can be set in sympathetic vibration by both tones. It therefore follows that for deep tones the posterior-superior quadrant of the drum membrane is set in sympathetic vibration, and this agrees with the anatomical facts. For it is the posterior-superior quadrant of the drum membrane which is the most loosely stretched of any part, as is shown, for example, by the often-observed fact that in pathological retraction this part is frequently thrown into folds. Lucae promises further investigation with high tones.