# SOCIETIES' PROCEEDINGS

## ROYAL SOCIETY OF MEDICINE—SECTION OF OTOLOGY

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*President*—F. W. WATKYN-THOMAS, F.R.C.S.

### A Study of the Activities of the Intratympanic Muscles

F. W. KOBRAK

IN 1925 the author described a series of cases in which deafness of internal-ear origin was associated with middle-ear signs; in this series there were cases of Ménière's syndrome and of pontine and circum-pontine lesions such as bulbar palsies, disseminated sclerosis and encephalitis lethargica. As a result of these observations it was suggested that in the control of the tonus of the intratympanic muscles there was an element provided by the vestibular mechanism. After this preliminary work clinical observations showed that in some cases of genuine cochlear deafness there were signs of middle-ear disease and that such cases were often improved by treatment of the middle ear.

Following the experimental work on animals of H. Kobrak (1930), Hallpike (1935) and others on the intratympanic muscles (1930-1935) the earlier clinical work was supplemented by the administration of drugs which were known to have effect on impaired muscle tonus; special attention was paid to tetrophan (Schering) a coal-tar derivative. As a result of these observations a clinical relationship was detected between alterations of middle-ear muscle tonus and some varieties of otosclerosis (the "spasmophile" form) and "middle-ear inefficiency" in some cases of cochlear deafness (1938). Further information was given by a new method of testing hearing, which was intended primarily to extend the use of tuning forks in regard to loudness rather than intensity. The results obtained support the possibility of a muscular factor in some cases of deafness. This work (*J. Laryng. & Otol.*, 1940, lv, 405) may be summarized thus: If a tuning fork is struck with a force of constant intensity it is heard for X seconds. It is then struck again, and after a lapse of X seconds is held to the ear. In the normal ear it is generally heard only for a short period, Y seconds. Again the fork is struck, and after X + Y seconds is held to the ear for the third time. In the normal subject it is seldom heard at all; if it is, the third "Z" period of hearing is very short indeed, even shorter then the "Y". In many pathological cases the "steppage" of the periods is quite different, and additional periods are often found.

This "protraction of the hearing period" cannot be ascribed to fatigue; it strongly suggests an active inhibition of hearing, and such an inhibition could be produced most easily by the action of the intratympanic muscles.



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Hitherto the action of the tympanic muscles has been regarded as a damping effect against sounds of dangerous intensity—a protective mechanism. But the animal experiments show an interesting discrepancy; the full effect of the muscle activities, as registered by the contractions, do not come into force until the damping, as shown by the Wever-Bray effect, has passed its climax or is nearly over. This suggests a dual muscular effect—a linked reflex of "protective" and "corrective" damping. It seems possible that the protective damping is more dependent on vestibular stimulation, the corrective damping more on cochlear stimulation. It is not suggested that corrective damping in any way resembles visual accommodation; it is not an adaptation for "near hearing", but it is a mode of response to quickly changing sound intensities. Damping adaptation is slowly developed during the first months of life, and with increasing auditory experience reaches a stage of muscular automatism. For the quickly changing sound intensities of speech and music to be appreciated, a ready flow of change in damping intensities seems indispensable to give elasticity in hearing; and such muscular automatism must be correlated with the vestibular-balanced tone of the intrinsic muscles. It will be realized that there are essential differences between testing hearing for speech, which is more dependent on elasticity of hearing and therefore on the integrity of the tympanic musculature, and testing for hearing of pure tones. Without some corrective type of damping, apart from the gross, protective damping, it is difficult to see how basic perception of music is possible. In orchestral music coinciding piano and fortissimo would only be perceptible, if protective damping changed to corrective damping in some 20 milliseconds.

It is clear that the participation of the intrinsic muscles in hearing has not only a theoretical but also a clinical significance, especially in some forms of progressive deafness hitherto found refractory to treatment. If there is any interference with the activity of the reflex arc which controls the intrinsic muscles some effect on hearing is inevitable. Even apart from the question of corrective damping, hyperexcitability of the arc would bring the protective damping mechanism into action for intensities far below the normal threshold of stimulus; this might account for the protracted period of hearing. Moreover cochlear hypo-excitability would be deleterious. Instead of the muscles being thrown into a premature spasm (vestibulogene), the cochlea would be deprived of a valuable protection, and fatigue would come on far more quickly and last longer.

Routine measures of treatment provide a field for research by analysing the detailed effects of such therapy. The assessment of the improvement of hearing by inflation in cases of cochlear deafness without any concomitant middle-ear change needs further consideration. The same applies to the results sometimes obtained in cases of dry perforations by the use of an artificial drum.

The effect of medication as well as of mechanical treatment in such cases needs investigation. So far no direct evidence is available as to changes in the structure of the cochlear nerve in cases of deafness by therapy in the way of arrest of or recovery from the degenerative process, or of regression in the otosclerotic changes in the labyrinthine capsule; but it is hoped that



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clinical evidence may be afforded by an application of varied forms of the numbering effect. Audiometer tones of highest intensity failed to produce conclusive results. Thereupon, the numbing effect was investigated in the following way: The tuning fork c4 (Edelmann) was hammered close to the ear over a period of some thirty seconds, until there was a definite sensation of giddiness and pressure in the ear. Air conduction figures of the audiogram pointed to lesions in the organ of Corti. However, the figures of bone conduction were not analogous to those of air conduction; they pointed to a second extracochlear numbing effect, which seems to improve, relatively, the figures of bone conduction against those of air conduction. Here, once more, damping activities of the tympanic muscles are suspected. Dual intracochlear and extracochlear effects are suggested to be in operation not only with the experimental shock stimuli of numbing, but also with the mitigated "numbing effects" of ordinary hearing, on which further research is now in progress.

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## Deafness Due to Central Lag

W. M. MOLLISON

There is a type of deafness found especially at the age of 50-60 which is not revealed by the usual tests of spoken words. Slowly spoken sentences may be heard well, but rapidly spoken sentences are not grasped. The first word or two are heard and the rest is lost. The conducting and perceiving apparatus appears to be normal, but the central receptive apparatus is sluggish; that is to say, there is a central lag.

One case is that of a highly intelligent man, aged 57, who complained of deafness, saying that he could not hear what was said at committees of which he was chairman. I found he heard quietly spoken words at 18 ft. on each side, but whole sentences he heard only at about 6 or 8 ft. Although he had been working hard he was not at all an exhausted subject. In the audiogram the lowest part of his scale was at 4096.

These cases are characteristic of quite a large number of people. At a Section meeting (*Proc. Roy. Soc. Med.*, xxxv, 245) papers read by representatives of the R.A.F. pointed out that a great many flying personnel had this loss at 4096. After that discussion I looked at some of my audiograms and found that exhausted cases had a drop at 4096.

A lady, aged 54, heard spoken words at 16 ft. on one side and 20 ft. on the other. Here again there was an enormous drop at 4096—very little drop above that.

A man, aged 25, a soldier, heard spoken words at 20 ft. on the right side



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and 18 ft. on the left, but he could not hear his watch on the left side, and he had a marked drop at 4096 in the left ear and a slight drop in the other.

A man, aged 40 had some tinnitus, the note of which fluctuated up and down the scale, and certain noises vibrated in his ears. For instance, the music of a band heard with the right ear was quite distorted, but, heard with left, it was normal. His audiogram, again, shows a drop at 4096, and not much drop until that point is reached.

A motor driver had always been very deaf. His upper tone was lowered both by air and bone. Here again there was a drop at 4096—quite a stepping down at that level.

A riveter, aged 27, had been engaged on this trade for three years. His history was that while he was riveting he suddenly noticed that his right ear became deaf. He is now completely deaf in that ear. There is also a drop at 4096 in his left or "good" ear. Is that a danger signal? Should he give up his work?

A boy of 14 had a blind right eye due to congenital hæmorrhage. He complained of a tendency to deafness, but heard conversation at 20 ft. with both ears. Bone conduction was normal. But here again there was the extraordinary drop at 4096. The boy's father complained of much the same thing, but the drop was less.

The next case was a lady of 67, who had had some deafness for many years. She heard spoken words at 12 ft. Again there was this drop at 4096.

The last case is another soldier, aged 30, who complained of slight deafness in the left ear. He heard with the right ear conversation at 20 ft., with the left, conversation at 18 ft. His lower tone limit was normal, his upper tone limit on the left side greatly reduced. Here again there was a large drop at 4096.

## Discussion

The President suggested that the two papers be discussed together in the hope that some member might be able to correlate the curious hearing lag of which Mr. Mollison had spoken with Dr. Kobrak's observations. He thought that they were not so correlated. The function of the intrinsic muscles was primarily protective, and anything that could be done in the way of improving hearing must be regarded more or less as a bonus. At the same time, Dr. Kobrak's paper did afford some most valuable suggestions regarding matters which had never been quite understood. Why occasionally did one find a patient with apparently a patent Eustachian tube who was unquestionably improved by inflation? This did happen, and was not due to a purely psychological effect.

Again, there were the odd cases in which a patient's hearing was definitely improved by faradism. That, again, did happen, although in his experience, rarely. There was also the extraordinary effect on the otosclerotic of amyl nitrite or occasionally of excessive alcohol.

In Dr. Kobrak's paper lay the germ of an explanation of these things.

As to the lag in hearing, the psychological element had to be taken into account, by which he meant in this case the element of guessing. Anybody with a fairly extensive vocabulary, if he heard two syllables of a four-syllable



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