

Jack (F. L.)

REMARKABLE IMPROVEMENT IN HEARING
BY REMOVAL OF THE STAPES,

BY
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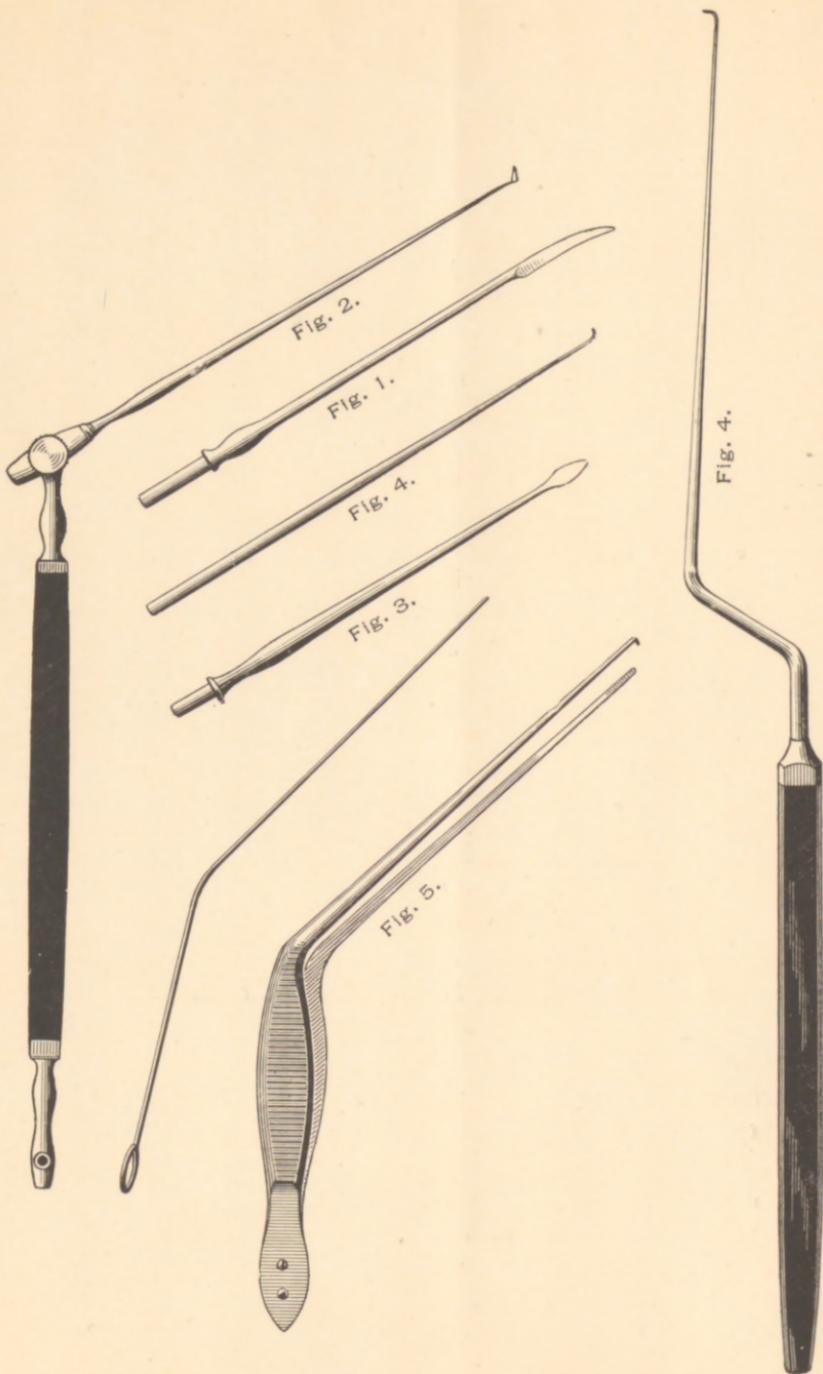
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REMARKABLE IMPROVEMENT IN HEARING BY REMOVAL OF THE STAPES.

By FREDERICK L. JACK, M. D., *Boston, Mass.*

In 1875, Dr. Kessel of Jena called the attention of the medical public to a case in which he had removed the drum membrane, malleus, and incus. Further attention to the same subject was again called in 1885 by Dr. Schwartz, who added the result of his own experience in performing the operation. July 20th, 1886, Dr. Sexton read a paper before this Society, describing what is practically the same operation as that performed by Dr.'s Kessel and Schwartz, although with a different object in view. This object was the cure of chronic otorrhoea.

During my term of service for Dr. Blake last spring at the Massachusetts Charitable Eye and Ear Infirmary, I had occasion to perform this operation about twenty-five times with general success. About June 19th I undertook the operation on I. D., aged 12, whose ear had been discharging constantly since babyhood, the result of an attack of scarlet fever. Having removed portions of the membrana tympani, malleus, and incus, and curetted a few granulations from the attic, an examination with the probe showed the head of the stapes to be carious. Fearing the operation would not be successful if the stapes in such a condition were left in the ear, I determined to remove it. By passing a slender knife around the head of the bone, it was loosened from its adhesions; after this a very small hook was introduced behind it, and it was extracted with little effort. However, in its removal, there was observed an amount of suction which led me to fear that a portion of the bony wall might have adhered to it. But

this proved ungrounded. The removal of the stapes was undertaken in this case with the greater hope of success, as I had in mind an article recently published by a Frenchman,* in which it was stated that the stapes had been removed from animals, and that their hearing had been thereby improved. Careful tests made before the operation had shown that there was very little hearing in the ear, as will appear by the report of the case later. On the morning following the operation the patient informed me that she now heard sounds which she had never before noticed. This fact struck me so forcibly that I was led to hope for good results from the removal of the stapes in other cases.

Some weeks previous to performing the above operation, I had two cases of chronic non-suppurative inflammation of the middle ear, from which had resulted a marked degree of deafness. From the ear in the worse condition I removed the entire drum membrane, malleus, and incus. The history of this case is as follows: B. S. Thirty-five years old. Had been hard of hearing for fifteen years, but has grown rapidly worse within the last two years. Loud voice heard at a few feet. Both drum heads were dull in color and slightly sunken. Operation, April 2nd, 1892. Left membrana tympani, malleus and incus removed.

Operation followed in a few days by pain and slight mucous discharge. No improvement in hearing. Two months after the operation the ear remaining without treatment during the time, granulations were discovered on the promontory. These were partially removed, touched with a solution of copper and dermatol insuffiated. At the present time the ear is healed, but the hearing remains the same as before the operation.

CASE II. D. S. Fifty years old. Hearing much impaired for eight years by chronic non-suppurative inflammation of

*Boltey (Ricaedo). Expériences d'avulsion de l'étrier chez les animaux. *Annales des maladies de l'oreille* No. 1, Jan. 1891.

the middle ears. The drum heads were thickened and retracted. May 18th, 1892. Operation on the right ear the same as in the preceding case. The hearing was improved for several days and then gradually returned to the same condition. Patient experienced considerable pain for two nights and was annoyed for four weeks by a purulent discharge from the ear, which up to the present time continues to form crusts.

Notwithstanding the fact that these operations were performed with all care, and that there was in the second case an improvement in the hearing for a few days, both cases subsequently developed otorrhœa, and the second tinnitus. Furthermore, in the second case, the drum membrane had been entirely reproduced, with the exception of an extremely small opening in the centre. Led by these results, I resolved in future cases to see what would be the effect of removing but a small portion of the drum membrane and the stapes only, leaving the malleus and incus; since which time I have performed operations in this way, with uniformly good results. Recently I suggested to the two patients above mentioned the benefits to be derived from the removal of the stapes with the hope of thus securing what would be perhaps the very best basis of comparison of the two operations. Unfortunately they declined to submit to further surgical treatment.

Not only is the removal of the stapes much better in its results, as shown by the operations already performed, but on the ground of conservative surgery, it is also much to be preferred. It produces greater improvement in the hearing; and, according to my experience up to the present, there has been no inflammatory re-action whatever, or any other bad results. So far as I have been able to discover, just such an operation as has been performed in these cases, has never been heretofore reported. Accordingly, the operation in detail may be here described, and is as follows:

The first step is to make a cut shaped like an inverted V in the drum membrane, just over the incudo stapedial joint and allow the part so loosened to fall outwards. This gives a clear view of the long process of the incus and incudo stapedial articulation, and also affords an excellent opportunity to observe the pathological conditions in this, the most important part of the ear for hearing. In fact, as one or two of the following cases illustrate, a condition is sometimes found which none of the ordinary tests for hearing could have revealed. It might be well then, in certain instances, for diagnostic purposes, to make such an exploratory opening. But to return to the operation. It is important next to separate thoroughly the stapedius muscle from the head of the stapes. This is done by passing a very slender knife (Fig. 1) behind the head of the bone and then carefully cutting the muscle at a short distance from the neck of the bone. Experience shows that this muscle must be completely severed, otherwise, when the stapes is loosened, the muscle will pull its head out of sight and cause great trouble in its subsequent removal. Having cut the muscle, the articulation with the long process of the incus is then severed by passing through the joint from behind forwards a very small triangular knife bent in the shape of an obtuse angle (Fig. 2). If the stapes is not yet perfectly loose it can be made so by passing a small pointed knife around the head (Fig. 4). A small hook (Fig. 4, or sometimes forceps shown in Fig. 5) now introduced behind the head will, with gentle traction remove the stapes. However, in one case, the foot plate remained. The bone usually comes away with some suction. It has been found but seldom necessary to use cocaine to prevent bleeding in the small field of operation. Slowing of the pulse was noticed in two or three cases upon touching the stapes. This may have arisen because the patient was not thoroughly under ether. The patients usually remained quietly in bed two or three days, keeping the ear plugged with cotton undis-

turbed. A clot of blood was generally seen in the wound for a few days, but gradually disappeared. Experience has shown that in the cases where the ear has suppurated the operation is rendered much more difficult by the conditions thus produced, than in cases of so-called chronic catarrh.

In performing these operations valuable assistance and suggestions have been received from Dr. W. Bryant, for which I desire here to acknowledge my obligations.

CASE I. I. D. aet. 12 otitis media suppurativa chronica in the left ear for eight years. Hears only moderately loud voice. Ear continually discharging. The upper portion only of the drum membrane is left.

Operation June 3rd, 1892. Remnant of the drum membrane with the malleus and incus removed. Small amount of granulations curetted from the attic. Head of stapes found carious. It was separated from adhesions and removed with the hook. Slowing of pulse was noticed upon moving the stapes. Soon after the operation, slight dizziness, probably due to the ether. No pain in the ear. Can now hear voices better than she can remember to have heard them before. Ear ceased discharging in two days. Nineteen days after the operation the middle ear was found perfectly dry.

Ordinary voice heard at 21 ft.

Five weeks after the operation the ear was still found perfectly dry and a moderately loud voice could be heard at 25 ft.

CASE II. A boy twelve years of age in poor physical condition. Chronic suppurative inflammation in the right ear for several years. Only a small portion of the membrana tympani was left and the manubrium of the malleus had sloughed away. He could distinguish words spoken in an ordinary voice at ten feet.

Operation June 6th, 1892. The remains of the membrane and the malleus were removed after some difficulty because of thick bands of tissue around the head of the bone. The

incus was found after long searching firmly adherent to the anterior superior portion of the attic. It was freed from its attachment by means of a slender curved knife and removed by a bullet tipped hook. The head of the stapes was next loosened and the bone removed. Nothing peculiar was noticed about the pulse. The ear was syringed with a solution of corrosive sublimate (1 to 3,000) and sealed with absorbent cotton. The operation lasted one hour and fifteen minutes. For the next twenty-four hours patient had considerable vertigo. Said, that on moving his head on the pillow objects in the ward went "round and round."

June 15th, nine days after the operation the hearing remained good and the ear was only slightly moist.

July 8th, 1892. Hearing had improved since the operation; could then hear

Whis. vo. 8 ft.

Or. " 18 ft.

Ear slightly moist and had not been syringed for one month.

CASE III. A boy about twelve years old, with chronic suppurative inflammation in the left middle ear for nine months. A small perforation was discovered high up in the membrana flaccida but the membrana tensa was whole.

Whis. vo. 18 in.

Or. vo. 20 ft.

H. a. s. $\frac{4}{80}$.

T. F. R. C. verter 3 plus.

Mastoid s "

Operation June 18th, 1892. The entire membrana was separated from the auditory ring. The tensa tympani was divided and the malleus brought forward by passing a blunt hook behind the neck. The incus was removed by means of a hook without difficulty. The head of the stapes was next loosened and removed by means of hook and forceps. It came away in three pieces, leaving in the window a small por-

tion of the foot-plate. The attic was found crowded with granulations, a condition which was suspected before the operation. These were carefully removed with forceps and curette. Three weeks afterwards the ear was discharging slightly and the hearing was as follows :

Whis. vo. 8 ft.

Or. vo. 20 ft.

T. F. Bone s plus.

Mastoid, s plus.

H. a. s. $\frac{2}{80}$.

CASE IV. Female. Anæmic and worn out with pain from syphilitic iritis. The left middle ear showed the effects of an old suppurative process. Through a thin cicatrix the long process of the incus and the head of the stapes were seen.

Loud vo. heard at 15 ft.

H. a. s. $\frac{3}{80}$.

König's rods 35,000, T. F. by bone in left ear.

A triangular opening was made through the cicatrix. The tendon of the stapedius muscle was cut, then the incudo stapedial joint divided and the head of stapes freed from sychneial bands. The bone was now quite movable, but eluded all attempts to engage the hook behind the head. It was, however, at last captured and removed entire. The trouble experienced here was undoubtedly due to the action of the stapedius muscle, which was not wholly divided. The bone being loosely held in the oval window, the action of the muscle naturally pulled the head out of sight. No change in the pulse was noticed. There was no bleeding. Nausea and vertigo were complained of for twenty-four hours. She was somewhat dizzy in walking for six days. Hearing much improved.

H. $\frac{1}{80}$.

Whis. vo 8 ft.

Or. vo. 20 ft.

Improvement in König's rods of 5,000.

Ear showed no signs of inflammation at the end of a week. Sixteen days after the operation the hearing remained good.

CASE V. Male, about forty years old. He gave a history of having had chronic suppurative inflammation of the right middle ear for twenty five years. He had been very hard of hearing in the ear ever since that time, and said he considered the ear dead. Complained of a disagreeable pressure on that side of the head. Examination of the ear showed extensive destruction of the membrana tympani. Malleus retracted and firmly adherent to the inner wall of the middle ear. The long process of the incus was not visible. Head of the stapes covered with a thick cicatricial membrane. Hearing very defective for

H $\frac{0}{80}$, contact Whis. vo. not heard.

Or. vo. 1 ft.

K. rods 35,00.

T. F. by aer 5", bone, d plus.

Operation June 20th, 1892. A triangular opening was made in the membrane over the stapes. A very slender knife was carried around the head and the tendon of the muscle divided. Owing to the prominence of the head it was grasped with small forceps and all but about one-half of the foot-plate was removed. This piece remained in the fenestra and was easily felt afterwards with the probe. Owing to this state of affairs it was a surprise on the morning after the operation to find a marked improvement in all but one of the tests of hearing previously tried.

H. $\frac{1}{80}$.

L. Whis. 2 ft.

Or. vo. 9 ft.

L. vo.

K. rods 30,000, a loss of 5,000.

Four days after returning home, his hearing remained the same and the pressure previously complained of in the head had disappeared. He volunteered the story that before the

operation his wife had complained very much of the squeaking made by a pair of new slippers. He failed to hear the noise at that time, but on his return home, he, also, found them too noisy.

July 8th, 1892. Said he had thrown the new slippers away. Hearing remained good and practically the same as when last tested. The ear was perfectly healed. The membrana tympani had somewhat contracted from the fenestra ovalis and was adherent to the inner bony wall of the middle ear. The anterior segment of the membrane was somewhat more sunken than when seen shortly after the operation. This condition made no apparent difference in the power of hearing and did not tend to produce the pressure in the head complained of before the operation.

CASE VI. Female, twenty years of age. Deafness due to the effect of a chronic suppurative inflammation. No discharge from either ear for two years. Said she could not hear anything in the left ear. Everything had ulcerated away except the stapes, the head of which was made out through a somewhat thick cicatrix. Hearing in the left ear as follows :

Whis. vo. not heard,
 Or. vo. " "
 L. vo. 1 foot.
 T. F. aer, not heard,
 Bone in the better hearing ear.
 H. a. s. $\frac{0}{80}$.

Operation June 11, 1892. Head of stapes loosened and stapedius muscle divided. A hook readily brought away the bone. June 20, 1892, no pain or vertigo,—hearing greatly improved.

Whis. vo. 1 foot.
 Or. vo. 15 ft.
 L. vo. 20 plus.
 T. F. ear 2".
 Bone still heard in better hearing ear.
 H. a. s. $\frac{1}{80}$.

One month after the operation hearing remained as when last tested. Ear perfectly dry with no crusts. Said she could now carry on her work of stenography without trouble.

CASE VII. A boy, eighteen years of age. Patient was first seen on June 19th, for deafness in the right ear. Upon examination the right drum membrane was found partially destroyed and the remaining portion was calcified. Thick tissue over the fenestra ovalis. Ear had ceased discharging some years ago and the hearing had been gradually growing worse.

Hearing H. $\frac{c}{80}$.

K. rods 35,000.

Or. vo. 9 ft.

T. F. R. plus by bone.

Opération June 20th, 1892. Head of stapes found with difficulty after cutting almost calcareous bands of tissue. The bone was found very firmly held in place. Crura were found so firmly fixed in the window that only portions could be removed. The head of the bone came away readily. The pulse was noticed to go slower upon moving the stapes.

June 21, 1892. No pain complained of. Hearing much improved. Tests as follows:

H. A. D. $\frac{8}{80}$.

K. rods 40,000.

Whis. vo. 4 foot.

Or. vo. 30 ft. plus.

Only slight redness observed at seat of operation.

CASE VIII. Girl, seventeen years of age. Deafness in the right ear due to the effects of a chronic suppurative inflammation. A large perforation was found in the posterior half of the membrana tympani through which the head of the stapes was distinctly seen. Complained of a buzzing tinnitus.

Hearing for Whis. vo. 4 ft.

Or. vo. 20 ft.

H. a. d. $\frac{1}{2}$.

K. rods 35,000

Operation June 21, 1892. The head of the bone was thoroughly separated from adhesions and easily removed by means of a small hook inserted behind the head. No bleeding. Pulse was perceptibly slower while moving the stapes. June 22, no symptoms.

Hearing H. $\frac{1}{8}$.

L. Whis. 15 ft.

Or. vo. 25 ft. plus.

K. rods 30,000.

June 29th, hearing remained good and tinnitus nearly gone. No moisture in the ear. Improvement in hearing said to be noticed by members of her family and friends.

Seventeen days after the operation. ear was perfectly healed. Less tinnitus. Hearing the same as when last tested, except for the watch. Here there was apparently a loss of ten inches.

CASE IX. Male, thirty-five years old. Deafness in the left ear since boyhood, the effects of a chronic suppurative inflammation, following an attack of scarlet fever. A large perforation was found in the posterior upper quadrant of the drum membrane. Head of stapes easily seen and removed in the manner previously described. Hearing before the operation for watch.

H. $\frac{1}{8}$.

Whis. vo. not heard.

Or. vo. 2 ft.

L. vo. 12 ft.

On the next morning after the operation the patient complained of slight dizziness when sitting up in bed. Hearing for the voice improved.

June 27th, no dizziness. Hearing better than immediately after the operation, no signs of inflammatory re-action in the ear. Can now hear

Whis. vo. 1 ft.
 Or. vo. 25 ft. plus.
 T. F. by bone d plus.
 T. F. aer 35 sec.
 H. $\frac{c}{80}$.
 K. rods 30,000.

He was last seen nine days after the operation and was found to hear as well as when previously tested.

CASE X. J. M., nineteen years old. She has been troubled with chronic suppurative inflammation off and on for fifteen years and has had trouble about hearing for two years. The posterior segment of the membrana tympani had ulcerated away. The round window and the long process of the incus were easily seen.

Hearing for H. $\frac{x}{80}$.
 Whis. vo. 2 ft.
 Or. vo. 6 ft.
 T. F. bone d plus.
 K. rods 30,000.

Operation June 22nd, 1892. Stapedius muscle was first cut and then the incudo stapedial joint. Some trouble was experienced in removing the stapes from behind the long process of the incus. The incus was found so loose that in passing a hook above the head to remove it, it fell from its position to the bottom of the middle ear behind the drum and could not be removed with any instrument at hand. It was finally removed by syringing. On the following day she complained of some dizziness. Hearing better, with exception of watch which could not be heard on contact.

Whis. vo. 3 ft.
 Or. vo. 9 ft.
 L. vo. 25 ft. plus.
 T. F. ver. s. plus T. d. plus.

July 1st, slight dizziness; hearing the same, slight moisture in the ear. In two weeks the wound was found perfectly healed. Hearing remained good.

CASE XI. Female, thirty-five years of age. This case is one of the most interesting in the series. She gave a history of sudden loss of hearing in the left ear, six months before accompanied by tinnitus and vertigo. Membrana tympani somewhat thickened. The hearing of this ear was very carefully tested by Dr. Bryant and others, and found to be absolutely gone for all sounds, except a very loud shout through a conversation tube. Tuning-fork by bone heard only in the right ear. The operation for removal of the stapes was performed on the morning of June 23, 1892. In the evening, much to our surprise, she could hear the voice in the ear, but the hearing was not carefully tested until the next morning when it was found as follows:

H. a. s. $\frac{c}{80}$ lightly.

Voice.

Whis. 7 ft.

Or. 10 ft.

L. 20 ft.

Tuning-fork.

Ver. & T. s plus.

aer " 15".

K. rods 45,000.

The patient was tested by the same gentleman who saw her before the operation with the results practically agreeing. She was entirely free from dizziness and tinnitus.

July 8th, fifteen days after the operation, the hearing remained good. Tuning-fork by bone now heard louder in the ear which was operated upon. Has had no attacks of dizziness and tinnitus. Wound perfectly healed.

CASE XII. F. D. Twenty years old. For some years her hearing, in spite of treatment for the nose as well as the ears, had been growing slowly worse. It was the result of chronic non-suppurative inflammation of both middle ears. The left was the worse,—ringing tinnitus at times in the left ear. No history of otorrhœa but a small cicatrix was ob-

served directly over the head of the stapes on the left side. Her hearing in the right ear was fair, and in the left ear, as follows:

Or. vo. about 1 ft.
 L. vo. 4 ft.
 H. a. s. $\frac{2}{86}$.
 T. F. aer. 15" through teeth in left ear.
 K. rods. 30,000.

Operation June 26th, 1892. Triangular cut through the cicatrix and head of stapes separated from all attachments and the bone removed in one piece from the fenestra ovalis. No change in the pulse rate was noticed.

June 28th, complained of slight pain in ear. Seat of operation covered with a dry clot of blood. Was somewhat dizzy on moving the head quickly. Temperature night before one degree higher than normal. Said she had noticed a great improvement in hearing. It was found to be as follows:

Low Whis. 1 ft.
 Or. vo. 10 ft.
 L. vo. 18 ft. plus.

T. F. by bone heard louder in right ear, just the reverse was found before the operation.

H. Heard only on contact.
 K. rods 30,000.

July 1st, still a little dizzy. Hearing the same. Ear a little tender to touch and secreting slightly a thin bloody fluid.

Ten days after the operation the hearing for the voice was found much better than when last tested. Could now hear

Whis. vo. 12 ft.
 Or. vo. 30 ft.

Other tests about the same. No vertigo or tinnitus. July 10th, two weeks after the operation. Dry clot of blood covering seat of wound. A little tinnitus at times. Said that hearing had greatly improved since the operation. On re-

Whis. vo 7 ft.
 Or. vo. 12 ft.
 L. vo. 20 ft.
 T. F. by bone in the left ear.
 H. a. s. $\frac{c}{80}$.
 K. rods. 45,000.

July 5th. Eight days after the operation the hearing was as follows :

Whis. vo. 5 ft.
 Or. vo. 15 ft.
 T. F. Bone s plus.
 H. $\frac{2}{80}$.
 K. rods 50,000.

CASE XIV. A lady, forty-five years old. She had been very deaf for twenty years, the result of otitis media insidiosa. The membrana tympani looked fairly well, though somewhat dull in color.

Hearing a. d.
 Whis. vo. not heard.
 Or. vo. 6 inches.
 L. vo. 5 ft.
 Or. vo. only 5 ft. through large ear trumpet.
 T. F. by bone and aer. in the right.
 Watch not heard in close contact.
 K. rods 20,000.

Operation June 28th, 1892. Small triangular opening made in the drum membrane. Stapedius muscle was first divided and then the incudo stapedial joint. A few adhesions were also separated from the head of the bone. The stapes was removed in the usual way. Examination showed the absence of foot-plate. No attempt was made, however, to remove it, for a case already reported was in mind, where with a portion of the foot-plate remaining, marked improvement in hearing resulted. Patient was up and dressed on the next morning, having experienced no dizziness or pain.

Hearing considerably improved.

Whis. vo. 1 ft.

Or. vo. 7 ft.

L. vo. 20 ft.

T. F. vertex s plus. Teeth d plus.

K. rods 40,000.

H. $\frac{0}{80}$ contact.

Says she can hear voices much clearer than before. No sign of inflammation in the ear. Nine days after the operation the hearing was found the same as when last tested, except for tuning-fork and rods T. F. by bone was now heard alike in both ears. K. rods only 30,000. Ear perfectly dry.

CASE XV. Female. Effects of a suppurative inflammation. In this case the stapes was not found. What was supposed to be the long process of the incus proved to be the displaced handle of the malleus. The end was somewhat bifurcated. The bone was freed from its attachments and removed, after which careful search with the probe failed to discover any trace of the incus or stapes. Slight dizziness was complained of for twenty-four hours.

Nine days after the operation, by careful tests the hearing was found improved 6 in. for the watch, and a few feet for the ordinary voice. This slight improvement was probably due to the loosening of the tissues about the round window. Slight discharge from the ear but less than three days before.

CASE XVI. Miss K. M.; age forty-seven. She had been gradually growing more and more deaf for five years, the result of a progressive non-suppurative inflammation of both middle ears. Both drum membranes were somewhat thin and lacked lustre. The incudo stapedia joint seen in both ears. In the right ear she heard

L. vo. only at 3 ft.

Watch not heard at all.

T. F. aer. about 3" bone D. plus.

K. rods 30,000.

The usual operation was performed on June 30th, 1892. After removing the stapes the incus seemed to drop down from the attic and being very loose was removed. On the next day hearing for voice had wonderfully improved.

Whis. vo. 6 ft.

Or. vo. 19 ft.

L. vo. 30 ft.

T. F. by bone heard equally well in both ears.

By aer. in the right 10".

A. D. $\frac{6}{86}$ contact.

K. rods 35,000.

No inflammatory re-action in the ear. Said she was made dizzy by lying on the right side. In a week the hearing for the voice seemed to have improved still more.

While recognizing the possibility of error in all human calculations, the results obtained in the cases whose history has been presented to you, are of such a nature as to lead me to be very hopeful of the future possibilities of this operation. Any fear of danger connected with the operation is obviated by the fact that even in two of the above mentioned cases, where there was considerable suppuration at the time of performing the operation, there were absolutely no bad results; on the contrary, one of them healed entirely within four or five days, and the other was greatly improved. In three cases the patients complained of vertigo after the operation, which, however, entirely disappeared within four or five days. In general, the cases showed little tendency toward inflammatory re-action, and were, after a few days, entirely dry.

The effect of the operation on the hearing, as tested by the watch, in some was not marked in either way, indicating in some cases a slight gain, in others, a slight loss.

The test by König's rods met with a similar result.

In one of the above cases, a curious fact was brought to light. During the bone test with the tuning-fork before the operation, the patient entirely failed to hear it in the worse

ear; but on a repetition of the test after the operation, she heard it better in the ear operated upon than in the other one.

Many of these cases were tested both before and after the operation by others than myself, with nearly the same results.

There still remains to be mentioned the one result of this operation which gives it its importance and has led me to report these cases to this Society, and that is the very marked improvement in hearing the human voice, which is thereby accomplished. If persons who have heretofore heard only with difficulty can be made to hear with ease, by treatment unattended with danger, the operation as above described, which has accomplished this result, is certainly worth consideration. As to the reason why this effect is produced by the operation, I have no theory to offer, other than the simple supposition that it is by the removal of a mechanical obstruction to the sound-waves.

TABULAR VIEW.

(Tests of hearing before and after the operation.)

BEFORE.

CASE I.

AFTER.

Moderately loud voice 1 foot. Moderately loud voice 25 feet.

CASE II.

Ordinary voice 10 feet. Whispered voice 8 feet.
Ordinary " 18 feet.

CASE III.

Whispered voice 18 inches. Whispered voice 8 feet.
Ordinary " 20 feet. Ordinary " 20 feet.
Watch a. s. $\frac{3}{60}$ Watch a. s. $\frac{2}{60}$
Tuning-fork, vertex s plus. Tuning-fork, vertex s plus.
Mastoid s plus. Mastoid s plus.

CASE IV.

Loud voice 15 feet. Whispered voice 8 feet.
Watch a. s. $\frac{3}{60}$ Ordinary " 20 feet.
Tuning-fork by bone in left ear. Watch a. s. $\frac{10}{60}$
König's rods 35,000. Tuning-fork by bone left.
König's rods 40,000

CASE V.

Whispered voice not heard. Whispered voice 2 feet.
Ordinary " 1 foot. Ordinary " 9 feet.
Watch a. d. $\frac{0}{60}$ ^{contact} Loud " 20 feet.
Tuning-fork by air 5 seconds. Watch a. d. $\frac{1}{60}$
By bone d. plus. König's rods 30,000.
König's rods 35,000.

CASE VI.

Whispered voice not heard.	Whispered voice.....	1 foot.
Ordinary " "	Ordinary "	15 feet.
Loud "	Loud "	20 feet plus.
Watch.....	Watch.....	a. s. $\frac{1}{80}$
Tuning-fork by air not heard.	Tuning-fork, air.....	2 seconds.
By bone in the better hearing ear.	By bone still in better hearing ear.	

CASE VII.

Ordinary voice.....	Whispered voice.....	4 feet.
Watch.....	Ordinary "	30 feet plus.
Tuning-fork by bone, right ear.	Watch.....	a. d. $\frac{8}{80}$
Königs rods.....	Königs rods.....	40,000.

CASE VIII.

Whispered voice.....	Whispered voice	15 feet.
Ordinary "	Ordinary "	25 feet plus.
Watch.....	Watch	a. d. $\frac{5}{80}$
Königs rods.....	Königs rods.....	30,000.

CASE IX.

Whispered voice not heard.	Whispered voice	1 foot.
Ordinary "	Ordinary "	25 feet plus.
Loud "	Watch	a. s. $\frac{contact}{80}$
Watch.....	Tuning-fork, air.....	35 seconds.
	By bone	d. plus.
	Königs rods.....	30,000.

CASE X.

Whispered voice	Whispered voice	3 feet.
Ordinary "	Ordinary "	9 feet.
Watch.....	Loud "	25 feet plus.
Tuning-fork, bone	Watch	a. s. $\frac{contact}{80}$
Königs rods.....	Tuning-fork.....	s. plus.

CASE XI.

Hearing absolutely gone for all sounds, except for very loud voice through a conversation tube.

Whispered voice..... 7 feet.
 Ordinary " 10 feet.
 Loud " 20 feet.
 Watch a. s. $\frac{C}{80}$ lightly
 Tuning-fork, air..... 15 seconds.
 By bone s. plus.
 Königs rods..... 45,000.

CASE XII.

Ordinary voice..... 1 foot.
 Loud " 4 feet.
 Watch a. s. $\frac{9}{80}$
 Tuning-fork, air 15 seconds.
 By bone in left ear.
 Königs rods..... 30,000.

Loud whisper..... 10 feet.
 Ordinary voice 30 feet.
 Watch $\frac{contact}{80}$
 Tuning-fork, air..... 50 seconds.
 By bone in left ear.
 Königs rods..... 30,000.

CASE XIII.

Whispered voice..... 2 feet.
 Ordinary " 4 feet.
 Loud " 10 feet.
 Watch a. s. $\frac{C}{80}$ lightly
 Tuning-fork by bone s. plus.
 Königs rods..... 35,000.

Whispered voice..... 5 feet.
 Ordinary " 15 feet.
 Loud " 20 feet.
 Watch... a. s. $\frac{9}{80}$
 Tuning-fork, bone..... s. plus.
 Königs rods..... 50,000.

CASE XIV.

Whispered voice not heard.
 Ordinary " 6 inches.
 Loud " 5 feet.
 Ordinary voice only 5 feet through ear-trumpet.
 Watch a. d. $\frac{O}{80}$ contact
 Tuning-fork by bone and air in the right.
 Königs rods..... 20,000.

Whispered voice..... 1 foot.
 Ordinary " 7 feet.
 Loud " 20 feet.
 Watch..... a. d. $\frac{O}{80}$ contact
 Tuning-fork, vertex . . . s. teeth d. plus.
 Königs rods..... 40,000.

CASE XV.

Stapes not found.

Slight improvement in hearing.

CASE XVI.

Loud voice.....	3 feet.	Whispered voice..	6 feet.
Watch.....	a. d. $\frac{0}{60}$ contact	Ordinary “	19 feet.
Tuning-fork, air.....	3 seconds.	Loud “	30 feet.
By bone.....	d. plus.	Watch.....	a. d. $\frac{0}{60}$ contact
Königs rods.....	30,000.	Tuning-fork, air.....	10 seconds.
		By bone alike in both.	
		Königs rods.....	35,000.

Since the printing of this report the right ear of Case XII has been operated on. It seems to me that the results in this case show conclusively the great value of the procedure. The patient returned to the Infirmary in September, of her own accord and asked for the operation on the right ear. This was done on September 27th, 1892.

Results as follows:—

BEFORE.	AFTER.
Whispered voice 6 inches.	Whispered voice 6 feet.
Moderate voice 10 feet.	Moderate voice 30 feet.
Watch $\frac{c}{80}$.	Watch $\frac{c}{80}$.

The peculiar value of this case as evidence lies in the fact that there is no stapes in either ear. In each instance immediate great improvement followed the removal. Further, the conditions in the two ears were different, the left having had a suppurative inflammation and the right a chronic catarrh.

Many of the cases mentioned in the paper have been seen recently. The hearing power in all is as good as when reported and in some a still further improvement has been noticed; *e. g.*—hearing in the left ear of the case above, three months after previous record:—

Whispered voice 20 feet.
Watch $\frac{1}{80}$.

