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of Multiple Paracentesis of  
the Drum Membrane on the  
Hearing in Chronic Aural  
Catarrh, with Remarks.

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CASES EXHIBITING THE RESULTS OF  
MULTIPLE PARACENTESIS OF THE DRUM MEMBRANE  
ON THE HEARING IN CHRONIC AURAL CATARRH,  
*WITH REMARKS.\**

By OREN D. POMEROY, M. D.

PARACENTESIS of the drum membranes in very chronic cases of aural catarrh, where there is not only no increase in the secretion but an almost total absence of even the normal amount, has been done for some years. The object so far has been to relieve deafness and tinnitus aurium. It has heretofore accomplished very little for the hearing and less for the tinnitus.

In the "Transactions of the American Otological Society" for 1873 I published some cases in which a single puncture of the drum membrane had been made, with only very moderate effect on the hearing and somewhat less on the tinnitus. I have employed the operation occasionally since that time with varying results.

Within the year one of my assistants, Dr. Bates, hearing the explanation I gave of the cause of relief to the sunken membrane—that is, the diminution of the superficial area of the membrane consequent on cicatricial contraction

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at the site of the punctures, thus exerting a degree of outward traction on the more or less impacted stapes in the oval window—suggested that several punctures at a sitting would be likely to increase this effect. I replied that it would, and gave my consent to have the matter tested on some of my patients at the Manhattan Eye and Ear Hospital. The result was sufficiently satisfactory to lead us to continue the operation. At about this time Dr. Bates reported four cases in the "Medical Record" for January 23, 1886, operated on in a similar manner to what had been suggested, and calling it a new method, etc., for curing deafness. No acknowledgment was made of what I myself had done in the matter. The method recommended by the doctor, however, extended to numerous incisions of the membrane, after the manner of Gruber and Politzer, resulting in an amount of traumatism which I could not approve of, and in at least one of the doctor's cases considerable inflammatory reaction resulted, which is not likely to occur in the method by paracentesis.

On an average, about four punctures of the membrane were made, generally in the postero-superior portion, although some were made in front of the manubrium. Where any part of the membrane was in apposition with the inner wall of the tympanum, some other portion for puncturing was sought out, for the sufficient reason that little or no aperture was likely to be made in the former location. The puncture of the membrane opposite to a less sunken part would of course allow the knife to penetrate deeper and make a larger opening. It has been insisted upon that a tolerably distinct perforation whistle should be produced after the punctures by inflation.

In a considerable number of cases it was found that the membranes were sunken so as to rest upon the promontory. In these instances, in order to make a proper puncture of

the membrane, many points needed to be sought out to find where the membrane inclosed a cavity—that is, if a puncture were attempted opposite a totally collapsed portion, naturally no aperture was likely to be made, or, if so, it would be too minute for any useful purpose.

In carrying out this procedure it became necessary in some cases to make from five to eight essays before a sufficient number of actual punctures could be made. In not more than two or three cases was it impossible to produce the perforation whistle. The duration of time between the punctures at a given sitting was from three days to three weeks. It was not considered proper to repeat punctures as long as there was any considerable hyperæmia or tenderness in the membrana. Where there was great collapse of the membrane the performance of inflation aided in some cases in the operation. The pain of the operation was ordinarily trifling, but when the patient seemed sensitive a few drops of a four- to eight-per-cent. solution of cocaine, placed upon the membrane by means of a dropping tube, sufficed to make the operation tolerable to the patient, or even in some cases absolutely painless. It has been urged by some that repeated punctures of the membrane were likely to lead to adhesions to the promontory. This may be the case where active adhesive processes are at work in the tympanum, but I infer that in all the cases operated upon nothing of this kind existed, the patients being in a too advanced stage of inflammation for this to occur. Certain it is that nothing of the kind has resulted, but, on the contrary, the membrana in several instances has been drawn outward sufficiently to demonstrate by the touch of a probe that the membrane no longer rested upon the promontory as at first. This in the hands of one at all experienced in the manipulation is not difficult. In not a single instance has a considerable amount of inflammation of the membrana

or drum cavity resulted, and the hearing has not been lowered. I could not at first credit the assertion made that the hearing was so much improved in some of the cases, but, on a careful examination myself, I was compelled to admit the truth of the observation.

Nothing is more difficult than to make a perfectly reliable test of the hearing; the patient is in a hopeful state of mind, and is ready to say he hears better when the facts do not always warrant the assertion. Usually the hearing was lowered for from two to four days after the operation, although, as has been observed before often enough, the hearing may be better *immediately* after the punctures, the thickened membrane offering obstruction to sound waves, and the puncture at first removing this obstruction. In all these cases a Graefe's very narrow cataract knife was used. The reason for this was, first, a straight instrument may be used with the infliction of less violence than one with the handle placed at an angle with the blade; and, second, the Graefe knife punctures with the infliction of less violence perhaps than any other instrument. It was not the object of the operation to make any large punctures or considerable incisions, for fear the membrane might be deformed or caused to adhere to the promontory; another point was carefully kept in mind—not to excite inflammation by unnecessary traumatism. It is not necessary to discuss the question as to whether the punctures were likely to remain open, for this rarely occurs, the tendency of the membrane to repair almost immediately being well known. In some instances the punctures allowed air to be forced through for only a few hours, while in others several weeks elapsed before no air could be forced through the membrane.

One effect of multiple puncture of the membrana tympani I hope will be found to be the *permanent* improvement to the hearing resulting from inflation. As is well known,

many patients come to us with the hearing much lowered, but susceptible of great improvement by inflation. The tubes seem pervious enough—nay, in many instances, too pervious. The hearing seems not to be at its best unless there is a sufficient amount of intra-tympanal air-pressure to push the membrane outward and in a measure draw the base of the stirrup from its impaction in the oval window. The membrane, being elastic, presses against this condensed air, and the moment the Eustachian tube opens from any cause whatever, the excess of air in the tympanum is, so to speak, pressed out of the middle ear into the throat by the elasticity of the membrana tympani (and also by its own elasticity), and the stapes returns to its former position of impaction. Many devices have been employed to correct this faulty position of the membrana tympani, such as exhaustion of the air in the meatus, hermetically closing the meatus (Poltzer), painting the membrane with collodion, division of the tendon of the tensor tympani, division of the posterior fold, etc., and all with only a measure of success. Some of our cases, notably Case II, seem to show that the numerous punctures have caused a real diminution in the superficial area of the membrana tympani, where the disappearance of the excessive movement (bleb-like) of the membrana tympani during inflation occurred. In those reported cases where the membrana tympani rested on the promontory previous to the punctures, and subsequently to the operations remained some distance from it, as determined by the touch of a probe and Siegle's otoscope, further evidence seems to accumulate confirmatory of this proposition. Is the improvement to the hearing permanent? Some of these cases have been under observation two years, and there seems little or no tendency toward relapse unless we reject the recurring cases of catarrhal otitis, which would not invalidate this proposition.

CASE I.—J. S., aged forty, otitis media chronica. Membranes so much sunken that during inflation their movements were so considerable as to cause a loud clicking sound easily audible at some distance. H. D. R. n.  $\frac{1''}{60''}$  (the clicking of the finger-nails together may be heard at about sixty feet), L. the same. After inflation, H. D. R. w.  $\frac{P.}{40''}$ , L. n.  $\frac{3''}{60''}$ , but this was momentary. On September 24th two punctures were made in the R. and three in the L. Four days afterward, H. D. R. n.  $\frac{3''}{60''}$ , L.  $\frac{2''}{60''}$ , two punctures were made in each drum-membrane. October 4th, made five punctures in the R. and three in L.

*October 10th.*—H. D. R. n.  $\frac{10''}{60''}$ , L.  $\frac{6''}{60''}$ . Three punctures made in the R. and four in the L.

*20th.*—H. D. R. n.  $\frac{14''}{60''}$ , L. n.  $\frac{12''}{60''}$ . This makes a gain in R. of 14'' against 1'', and in L. about the same.

CASE II.—Dr. W., aged thirty, has had an otitis media chronica in R. for many years. The membrana tympani has a cicatricial look as though there had been an old suppurative inflammation. The history confirms this. The H. D. is w. 2'', after inflation 36''. The Eustachian tube is too pervious, and interchange of air between the middle ear and tympanum too frequent, and it is also too readily forced by Valsalva's operation. The act of deglutition immediately lowered the hearing to two inches. On November 11th four or five punctures were made in the membrane. Three days after this the hearing was lowered, and was not improved by inflation. Before the punctures were made the membrane moved outward excessively during inflation, presenting a bleb-like bulging.

On November 15th, H. D. w. 4'', after inflation 20''. Membrana tympani did not move outward during inflation except very slightly. Deglutition with the nostrils closed did not lower the hearing as at first. No bulging of the membrana tympani has been noticed since the punctures were made. On the 24th



of November the H. D. was w. 8" to 9", not improved by inflation nor lowered after swallowing. November 27th, H. D. w. 6" to 7", after inflation 14" to 16"; here was a permanent gain from watch 2" to watch 6 to 7". The constant voice-hearing was also greatly improved.

CASE III.—Mary F., aged thirty-three, otitis media chronica for several years. On admission, January 4, 1886, H. D. R. w.  $\frac{1\frac{1}{2}''}{30''}$  Left  $\frac{1\frac{1}{2}''}{30''}$ , not improved by inflation.

*January 8th.*—Punctured both membranes four times each, two in front and two behind the malleus handle. The left membrana tympani touched the promontory, and the right was so sunken that no air escaped after the punctures.

*15th.*—Both membranes punctured and perforation whistles elicited; membranes not so much sunken. On January 17th, H. D. R. w.  $\frac{5''}{30''}$  L.  $\frac{1\frac{1}{2}''}{30''}$ ; a considerable gain in right and none in left.

CASE IV.—Ellen B., aged thirty-five, otitis media chronica of long duration. Applied December 16, 1885. H. D. R. w.  $\frac{\frac{1}{2}''}{30''}$  L. w.  $\frac{1\frac{1}{2}''}{30''}$ . On December 28th four punctures were made in each membrane, two in front and two behind mal. handles. Cocaine was used, which produced some anæsthesia. Hearing lowered by the operation.

*January 4th.*—H. D. R. w.  $\frac{2''}{30''}$  L. w.  $\frac{4''}{30''}$ . January 6th, four punctures made in each as before; caused some pain. January 11th, H. D. R. w.  $\frac{8''}{30''}$  L. w.  $\frac{3''}{30''}$ . On same date did four punctures as before. Cocaine was used, which relieved any pain which might otherwise have resulted from the operation. This showed a gain of six inches and a half in the right and two inches and a half in the left.

CASE V.—Peter McE., aged forty-six, otitis media chronica. Applied for treatment November 18, 1885. H. D. R. w. contact, L. n.  $\frac{2''}{60''}$ . Paracentesis of right membrana tympani as done in

previous instances. On December 6th, left done in the same manner. On the 16th of December the left membrana tympani somewhat reddened. On same date both membranes again were punctured, four times in each; tinnitus somewhat diminished. On December 18th, H. D. R. w.  $\frac{5''}{30''}$ , L. n.  $\frac{4''}{60'}$ . On 23d, H. D. R. w.  $\frac{5''}{30''}$ , L. n.  $\frac{6''}{60'}$ . On this date repeated the punctures in each. In this instance the right gained five inches and the left two inches.

CASE VI.—Edith H., aged thirty-five, otitis media chronica and desquamative inflammation of meatus externus. Was treated in the usual way until December 4th, when each membrane was punctured. Previous to this the H. D. was R. w.  $\frac{1\frac{1}{2}''}{30''}$  after inflation  $\frac{4\frac{1}{2}''}{30''}$ ; L. w.  $\frac{1\frac{1}{2}''}{30''}$ , after inflation  $\frac{4\frac{1}{2}''}{30''}$ . On December 14th H. D. R. w.  $\frac{8''}{30''}$ ; after inflation, w. the same. L. w.  $\frac{6''}{30''}$  after inflation  $\frac{8''}{30''}$ . By January 27th both membranes had been punctured three times, and the hearing had risen to 6''–8'' in each ear, and was unaffected by inflation.

*February 5th.*—Both membranes punctured; no change in hearing.

*March 17th.*—Recorded that the tinnitus had been relieved.

*April 28th.*—H. D. R. w.  $\frac{12''}{30''}$ , L.  $\frac{11''}{30''}$ ; neither improved by inflation.

*May 21st.*—R. and L. hear the watch about  $\frac{15''}{30''}$ , not perceptibly modified by inflation. Here was a gain from  $\frac{1}{2}''$  in each, increased to  $4\frac{1}{2}''$  after inflation, to  $15''$  in each, not improved by inflation. The treatment was continued five months. At first there was great difficulty in making her hear ordinary spoken words, but at the termination of the treatment ordinary conversation could be heard with great comfort. In this instance the maintenance of the improved hearing by inflation was accomplished, and considerable hearing added to this.

CASE VII.—Mr. G., aged fifty-eight, a porter, has had chronic middle-ear disease for several years, although he has never noticed that the right ear was affected. Right hears w. in contact, left not at all; not improved by inflation. Has had tinnitus in the left for three months, which came on suddenly from having caught cold. Bone-conduction weakened in left. The tinnitus was not relieved, though potassium bromide, hydrobromic acid, and paracentesis were employed. The left membrane was punctured on three different sittings at intervals of from four to six days, four punctures being made each time. No cocaine was used; the operation was scarcely painful at all, and no inflammation or soreness resulted from the operations. The improvement was from w. 0 with poor voice-hearing to w: contact and comparatively good voice-hearing. Eustachian tubes at all times pervious, and could be inflated by Valsalva's operation more easily than in normal cases.

CASE VIII.—Miss K. L. F., aged twenty-six. Otitis media catarrhalis chronica in both for the space of three years. Tinnitus constant in left ear; never any in right. Signs of excessive sinking of drum membranes.

Hearing, right w.  $\frac{2}{48}$ ; left, not hear watch at all. Little or no improvement on inflation.

On March 17, 1886, did double multiple paracentesis. Two weeks after, repeated the operation on the left. This was repeated, at intervals of ten days, four times, making six operations in all. At each sitting five punctures were made. Cocaine was used, which diminished the pain of the operations, but did not render the patient insensible to them. After the third series of punctures on the left ear, the hearing rose to watch in contact, with voice-hearing very much improved. The voice was readily heard at two feet. The noise is still constant, but does not trouble as much as formerly. At first she could not sleep in consequence of it, but now there is no difficulty in sleeping. Bromides and hydrobromic acid had no effect on the tinnitus. Pharyngeal catarrh has been treated, more, however, for the benefit of the right ear. Hearing fluctuates in both ears with atmospheric changes, less so in the left than the right.

CASE IX.—J. Van D., aged thirty, otitis med. chron.; tinnit. in both. R. hears finger-nails at 2'', and L. at 20''. R. membrana tympani touched the promontory.

Four punctures made in each membrana tympani on January 11, 1886, and January 29th, H. D. R. n. 30'', L. n. 30''.

CASE X.—Henry V., aged twenty-eight, applied June 3, 1885, with otitis med. chron. for five or six years. Tinnitus in both. Had syphilis five years ago. Hearing, R. and L. n. 1½''. Paracentesis was done on each membrana tympani (four to six punctures each) on November 25th, November 30th, December 4th, and December 16th. No special reaction from the punctures, and as a result the tinnitus was diminished and the hearing somewhat improved.

CASE XI.—Bridget R., aged fifteen, applied for treatment June 26, 1885, with chronic middle-ear catarrh since early childhood. H. D. R. n. 4'', after inflation 10''; L. n. 1'', after inflation 8''. Ordinary treatment not succeeding in accomplishing anything, paracentesis of both membranæ was done on October 4th. This was repeated on October 7th on the R., and on the L. on October 9th. On October 12th paracent. of R. Paracentesis was done three times on each membrana tympani between this date and October 30th, when H. D. R. was n. 5'', after inflation 8''; L. n. 1'', after inflation 4''. The result here was altogether *nil*, and, in spite of the large number of paracenteses in each (nearly forty), the hearing was not lowered nor was there any considerable reaction.

CASE XII.—Jane L., aged twenty-five, has chronic middle-ear disease in both, with tinnitus in R. Commenced treatment on January 4, 1886. H. D. R. w. c. not improved by inflation; L. w. 3'', and not improved by inflation. On January 6th paracent. on R., and on January 11th paracent. on L. On February 5, 1886, H. D. R. w. c., after inflat. w. 1''; L. unchanged. Patient says hears voice better in R. There evidently was no improvement in L. Did not return for further treatment.

CASE XIII.—Mary B. Van H., aged sixty-eight, has chronic middle-ear disease in both, with tinnitus; the latter seems to cause headache. Malleus-handles almost horizontal, with other signs of sinking of membrana tympani. Applied for treatment

January 8, 1886. H. D. R. and L. n. contact. On January 15th paracentesis in both. January 22d, H. D. R. and L. n. 1". Noises much less, and do not cause headache as before. The gain to the hearing in this case is almost too slight to record.

CASE XIV.—August K., aged twenty-seven, otit. med. cat. chron. January 4, 1886, H. D. R. w. pressed, after inflat.  $\frac{1}{2}$ "; L. n. 2", after inflat. 4". January 15th, paracent. of R., and on 20th both were punctured. On January 25th both membranæ again punctured; R. membrana tympani resting on promontory. Punctured again on February 5th. On February 8th H. D. R. w.  $\frac{1}{2}$ ", slightly improved by inflation. L. w. contact, increased to w.  $\frac{1}{2}$ ", which was at first n. 2", increased to 4" by inflation. There was a decided increase in L. In this ear bone conduction was reported to be somewhat weak.

CASE XV.—J. J. F., aged thirty-five, otitis med. cat. chron. January 18, 1886, H. D. R. n.  $1\frac{1}{2}$ ", after inflat. 2"; L. n. 4", after inflat. 20". January 20th paracent. done on both. This operation was repeated on January 25th, February 14th, and February 28th. Cocaine, a four-per-cent. solution, used without relieving the pain from the operation. The H. D. in this case was unaffected by the punctures.

CASE XVI.—Henry Van D., aged twenty-eight. January 3, 1885, applied on account of a chronic otitis med. with labyrinthine complications. Hears neither watch nor nails in each ear, but the tuning-fork may be heard six seconds in each by aerial conduction. Bone-conduction absent in R. and just perceptible in L. Suspected syphilis. October 10th, both membranæ punctured. October 19th, punct. R. Again punctured R. on October 21st. October 24th, both were punctured. On February 8, 1886, H. D. R. n. 1", after inflat.  $1\frac{1}{4}$ "; L. n.  $1\frac{1}{2}$ ", after inflat.  $1\frac{1}{4}$ ". On December 18th the record places the H. D. R. n. 10", after inflat. 9"; and of the L. n. 20", after inflat. 30". I conclude that this patient might have been still further improved had treatment been continued. The signs of labyrinthine disease in this case seemed to indicate that it was secondary to middle-ear disease, and possibly connected with a syphilitic condition.

The following cases are from the practice of Dr. Neil J. Hepburn, assistant surgeon to the Manhattan Eye and Ear Hospital, who has kindly placed them at my disposal:

CASE XVII.—J. F., a lawyer, aged thirty-five, has a chronic otitis media, presenting the usual appearances on examination.

H. D. R. w.  $\frac{2''}{40''}$  L. w.  $\frac{15''}{40''}$ ; after inflation, R. w.  $\frac{3''}{40''}$  L. w.  $\frac{20''}{40''}$

Two minutes after the last observation the hearing dropped to the first statement. Treatment of the Eustachian tubes failing to maintain the improvement gained by inflation, paracentesis of the membranes was tried on September 20th, when five punctures were made in each membrane with the temporary effect of lowering the hearing, but one week afterward there was improvement. On October 25th four punctures were made. On November 1st the H. D. R. was w.  $\frac{24''}{40''}$  L. w.  $\frac{22''}{40''}$

After two months the patient again reported with H. D. R. w.  $\frac{20''}{40''}$  L.  $\frac{26''}{46''}$  Mt. much less retracted in right, not attached to the promontory, fewer signs of sunken membrana tympani; other in similar condition.

CASE XVIII.—C. S., tobacco-wrapper, aged twenty-one, was first seen September 15, 1886. Both membranes much retracted, but under inflation moved outward promptly with a click-like sound. R. heard the snapping of finger-nails at  $\frac{1''}{60''}$ ,

after inflat. heard the w. pressed on auricle; L. nails  $\frac{3''}{60''}$ .

Punctured membranes on September 24, 1885, September 28th, October 4th, October 10th, and October 20th. On December 13th the hearing was R. w.  $\frac{20''}{40''}$  L. w.  $\frac{14''}{40''}$  (This improvement seems to me almost unaccountable, and, as will be seen, is far above the average.—O. D. P.)

CASE XIX.—W. H. G., aged twenty, has otitis med. chron. of three years' duration, mostly of the right ear. The left soon rose to perfect hearing by other treatment, so it is not recorded.

The right membrana tympani much sunken in front and behind the malleus handle, so that the latter appeared as a ridge dividing the membrana tympani into two unequal portions. There was a light reflex in front and another behind the manubrium.

Hearing, w.  $\frac{1''}{40''}$ , not improved by inflation. On October 10th

made three punctures in the membrana tympani. It was found adherent to the promontory (or in contact with?), there being no movement under inflation, and the touch of the knife showed no yielding of the membrana tympani. October 17th,

hearing of the R. w.  $\frac{8''}{40''}$ ; four punctures made in the posterior

portion. October 24th, hearing w.  $\frac{20''}{40''}$ . Membrana tympani no

longer resting on promontory, but may be freely indented on pressure with a probe. November 21st hears the watch at 25'', and is so satisfied with the result as to discontinue further treatment.

CASE XX.—E. F., a domestic servant, applied November 11, 1885, with chronic middle-ear disease dating back to childhood. Treatment by ordinary means failed to improve, so she had to

leave her place. R. hears w.  $\frac{1''}{40''}$ , L. nails  $\frac{1\frac{1}{4}''}{60''}$ . No special im-

provement on inflation. November 25th, five punctures of left membrana tympani; one week later heard a watch at  $\frac{5''}{40''}$ .

Subsequent to this two punctures were made in the right and three in the left. December 12th, R. heard the watch  $\frac{10''}{40''}$ ,

L. w.  $\frac{12''}{40''}$ . Some tinnitus in left. She returned to service with

sufficient improvement of hearing to retain her place, but was unable to continue treatment. Bone-conduction was at first better in the ear with the better aerial hearing, but I do not conclude that the examination was complete enough to prove that the worse ear had labyrinthine complication.

CASE XXI.—Mrs. M., aged forty-eight, chron. otitis media

for several years, for which she has been treated without benefit. R. hears the watch  $\frac{4''}{40''}$ , L.  $\frac{6''}{40''}$ . Inflation does not improve, and the membranæ move only slightly. December 7th made three punctures in each membrane, which lowered the hearing. By December 18th the hearing had increased to R.  $14''$ , L.  $20''$ , when two punctures were made in each membrane. Ten days subsequent the hearing of the R. was w.  $24''$ , L.  $30''$ . Was ordered to return if hearing lowered.

CASE XXII.—Miss G., with chronic middle-ear disease of R. Left normal. Commenced treatment December 8, 1885. Hearing w.  $\frac{11''}{40}$ . After inflation,  $\frac{3''}{40''}$ . No further improvement could be gained by ordinary treatment, so on December 15th two punctures were made. On the 19th hearing was w.  $\frac{8''}{40''}$ ; three more punctures were made. On the 22d the hearing rose to  $18''$ , when two more punctures were made. On December 29th heard a watch at  $21''$ , and was not improved by inflation. Reported on January 17th, with H. D. w.  $\frac{23''}{40''}$  but was rendered lower by inflation. Dismissed.

CASE XXIII.—Mrs. M., aged thirty-one, applied September 20, 1886, for a tinnitus, vertigo, and hardness of hearing in the left ear; right nearly normal. The symptoms of vertigo have worried her very much, she fearing brain trouble. The membrana tympani is much retracted, and adherent to the promontory.

Hears a watch at  $1\frac{1}{2}''$ , increased to  $2\frac{1}{2}''$  after inflation. Two punctures were made in the membrana tympani with little effect on the hearing, but by October 5th the vertigo was much lessened.

October 18th.—Again punctured, and by November 1st the hearing was w.  $5\frac{1}{2}''$ , and there was no vertigo.

December 14th.—About as on last note. Patient refuses further treatment, as she thinks she hears well enough, and has no unpleasant symptoms; moreover, the pain of the operation seems to have intimidated her. She has the impression that



the hearing is constantly improving. Result, permanent improvement, from watch  $1\frac{1}{2}''$  to  $5''$ , the latter not-affected by inflation, and the vertigo completely relieved.

CASE XXIV.—H. McG., aged thirty, applied October 17, 1886. Right ear suppurating; left, chronic middle-ear disease for a long time; hears w.  $3''$ , increased to  $7''$  by inflation, but, on swallowing, the hearing returned to former distance. Mt. sunken, but movable during inflation. Five punctures were made; these were two in front and three behind malleus-handle.

*October 24th.*—Hears a watch  $5''$  before and  $9''$  after inflation. On October 31st, H. D. w.  $10''$ , increased to  $14''$  by inflation. Two punctures made.

*November 14th.*—H. D. w.  $15''$ ; not improved by inflation.

Subsequent punctures were made, but no further improvement was gained.

The patient did not return. Here was a permanent gain of from w.  $3''$  to w.  $15''$ , and no loss of hearing on emptying the tympanum of air by the act of deglutition, as at first.

This series of cases seems to me exceptionally good, but it will be observed that none of them belong to the order of somewhat desperate cases for which the operation is thought to be more applicable.

*Summary.*—There were in all twenty-four cases, of which eleven showed decided improvement to the hearing in both ears, namely, Cases I, IV, V, VI, IX, XVI, XVII, XVIII, XIX, XX, XXI.

There was considerable gain in the hearing of one ear in Cases III, XII, XIV, but no improvement in the other. In Case II there was great improvement to the hearing in one ear by inflation, but it was not maintained until after the punctures, when the hearing permanently rose from  $2''$  to  $15''$  (this was the case where the bulging of the membrana tympani during inflation ceased after the punctures of a single sitting). In Cases V and XIII the tinnitus was somewhat diminished.

Case VI showed most extraordinary improvement to hearing, which was maintained without the necessity of inflation. The observation was made in this case with great care, and is undoubtedly reliable.

Case VII showed decided improvement in the hearing of the one operated on, but the tinnitus was unaffected.

Case VIII showed considerable improvement to the hearing, and some diminution of the tinnitus.

Case X showed some improvement to the hearing in each ear, and the tinnitus was diminished.

In Case XI there was no improvement whatever; but no diminution of hearing followed, although more than forty punctures were made.

Case XIII showed little or no improvement, and Case XV was not improved at all. In Cases XVII and XIX, where the membranes were in apposition with the promontory, the operations resulted in removing them from contact with the inner tympanic wall.

In Case XXII, where one membrane only was operated on, the hearing rose from watch 3" to watch 23". Similar observations for Case XXIV.

In Case XXIII the one ear operated on was much improved in the hearing, and a very unpleasant vertigo was relieved.

Gruber and Politzer, who have written more on the subject of similar operations on the drum membrane than perhaps any other, seem to exhibit some confusion in stating conditions—one insisting that the membrane is relaxed, while the other speaks of it as in a state of tension. I believe both are right, under certain limitations. When the membrane is at first sunken from closure of the tube, there is great pressure on its outer surface, and naturally it is put upon the stretch—is in a state of tension. Subsequently, when the tube becomes pervious, as in most of my cases,

there certainly is no more *tension* of the membrane, although it undoubtedly is stretched and increased in its superficial area; there is, then, at this stage *relaxation*. During the stage of active collapse of the membrane the stapes must be driven more or less into the oval window, and, if this continues long, impaction results. After restoration of the intra-tympanal air-pressure from restored perviousness of the tube, the stapes may still be driven into the oval window, requiring a certain amount of tractile force to draw it sufficiently outward; this the membrane no longer can accomplish, as it is stretched and unable to fall into a normal position, which would practically result in drawing the stapes from its impaction in the oval window. This seems clear enough from the condition of many of my patients where the hearing was good so long as air was forced into the tympanum; but, on opening the tube by the act of deglutition, the air would escape, and collapse of the membrane result, with the previous deafness. The improved position of the membrane, with augmented hearing, seems to almost prove that the drum membrane had been shrunken up to a degree, consequent on cicatricial contraction, the result of the punctures.

I have followed Politzer and Gruber somewhat in these operations, but they are not quite identical; neither is the explanation thereof. I believe this operation is a justifiable one, and entirely free from danger. I am indebted to Dr. J. L. Barnes, of the Manhattan Eye and Ear Hospital, for carefully prepared notes of many of these cases.









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