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A METHOD

OF USING

MEDICATED EUSTACHIAN BOUGIES.

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A METHOD
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MEDICATED EUSTACHIAN BOUGIES.

BY ALBERT H. BUCK, M. D., NEW YORK CITY.

PERHAPS one of the greatest obstacles encountered by the aurist in treating affections of the middle ear, in which the membrana tympani remains entire, is the difficulty of bringing his remedies in contact with the diseased mucous membrane. Almost all if not all the methods in use for applying remedies to the middle ear are liable to more or less serious objections. When even simple water, of a temperature but little below that of the body, cannot be introduced without the danger of setting up an acute and sometimes very serious inflammation of the ear, the surgeon is certainly justified in feeling some hesitation about injecting water to which some irritating substance like alum, sulphate of zinc, or nitrate of silver has been added. In the great majority of cases, it is true, no harm comes from these injections through the Eustachian catheter, either because the quantity of fluid injected is very small, or because it never enters the tympanum at all, or finally because the Eustachian tube happens to be so roomy that the products of any inflammation that may be set up readily find a way of escape. The danger, then, lies in the circumstance that an irritating fluid is introduced into what may be practically termed a closed cavity; for where the membrana tympani is perforated, we do not hesitate in some cases to introduce

solutions of almost caustic strength. Aside from the question of danger, other objections may be raised against the method of injecting fluids through the Eustachian catheter. In the first place, the solution, which must be very weak, oftentimes — possibly even in a majority of the cases — does not reach the tympanum, but regurgitates back into the nasopharyngeal space. If the orifice of the Eustachian tube happens to be filled with mucus, the injected fluid probably goes no further than merely to bathe the lips of the pharyngeal end of the tube. In the next place, we have no certain means of knowing whether the solution has reached the cavity of the tympanum or not; for a congested condition of the membrana tympani may arise in consequence of a simple inflation with air, and it is almost impossible to determine whether the gurgling sounds heard on auscultation are due to the entrance of the fluid into the tympanum or to the commingling of air and fluid within the tube. Finally, very distressing attacks of coughing are occasionally caused by the falling of a drop of the solution upon the vocal cords or into the larynx, from the end of the catheter. All these objections apply also, though perhaps to a less degree, to the method of spraying the middle ear. In addition, however, we have the difficulty of successfully producing a spray at the distal end of the catheter. This alone is a sufficient reason why the spraying method is not likely ever to come into general use among aurists.

By means of the so-called tympanic catheter, — a small, flexible catheter which can be passed through a medium-sized Eustachian catheter, and thence through the Eustachian tube into the tympanum, — it is possible to apply fluid remedies either to the tube or to the cavity of the tympanum. The same objections, however, apply here: we cannot restrict the direct action of the remedy to the tube alone; and besides, if we employ a solution of nitrate of silver, it will be found difficult to manipulate it with sufficient ease and safety (to our clothing) for every-day use.

Vapors of different kinds can, of course, be introduced

into the middle ear without any special difficulty or danger. Whether the introduction of such vapors, however, accomplishes any better results than are obtained by the simple introduction of air is a question which I am not able to answer. The points to which I desire to call attention are these: How far can we safely push our local treatment of the middle ear and Eustachian tube, and What is the safest and most effective method of accomplishing it?

The diseased process which we are anxious to abate is one that is characterized by several or all of the following conditions: increased vascularity, œdema, ulceration or simple casting-off of pus-cells from the unbroken mucous membrane, increased secretion of mucus, and proliferation of the tissues. Now, the remedy which *par excellence* is able to restrain these processes, provided, of course, it be judiciously applied, is nitrate of silver. But who would think of introducing this re-agent in a free form, no matter how diluted, into a middle ear which still possessed an entire membrana tympani? This brings us, then, to another question: Is it best to make any attempt to bring our remedies into direct contact with the mucous membrane of the middle ear? While I would, perhaps, not be justified in answering the question very decidedly in the negative, I have no hesitation in saying that in my own practice I abstain from making such direct applications, preferring the safer course of restricting them to the Eustachian tube and naso-pharyngeal space. The effects produced by remedies applied to these parts are unquestionably felt by the parts situated within the tympanum, for they are directly continuous with one another, and derive their vascular and nervous supplies from the same sources. From these parts, moreover, there is an outlet, which is not likely, as in the case of the middle ear proper, to become obstructed by any undue irritation set up by our remedial applications. In other words, if we should err in applying too strong a solution to the pharyngeal and middle portions of the Eustachian tube, the inflammatory reaction is not likely to involve the middle ear.

In regard to the safest and most effective method of making these applications to the Eustachian tube, whalebone or catgut bougies, not exceeding 1 mm. in thickness and armed with cotton-wool, appear to me to fulfil all the requirements of the case. By roughening the sides of the bougie near one end no difficulty will be experienced in twisting the cotton-wool firmly round the instrument; the cotton serves not only as a soft covering for the point of the bougie, but also as a sponge for holding a sufficient quantity of the remedy to be used.

In the next place, some suitable marks should be made along the shaft of the instrument in order that we may know when the distal end emerges from the catheter, as well as how far we have pushed it into the Eustachian tube. After arming the end of the bougie with cotton-wool, and ascertaining that the bulb thus created will pass through the catheter, our next step is to saturate the cotton with the solution to be used, and then to place the instrument within easy reach of the right hand. The catheter is next to be introduced, and when once it is in position, we are to hold it there firmly by resting the middle and third fingers of the left hand on the bridge of the patient's nose, while with the forefinger and thumb we grasp the catheter. This leaves the right hand free to manipulate the bougie, which is to be passed into the Eustachian tube a distance of about five eighths of an inch beyond the end of the catheter, or fairly to the membranous or osseous portion of the tube. The instrument should remain there for a few seconds or perhaps a minute, and then be withdrawn. After removing the bougie I usually inflate the middle ear a few times through the catheter. If, upon withdrawal of the bougie, the cotton is found to be smeared with whitish mucus, I often introduce a second bougie, in the belief that the solution on the first bougie has spent its strength on the mucus.

In introducing the bougie into the Eustachian tube, it will often be found that after passing it a distance of about a quarter of an inch beyond the distal end of the catheter, the

instrument encounters some firm obstacle. In a few cases I have been unable to push the instrument beyond this point, but usually, after a little manipulation, it slips past the obstacle, and then no difficulty whatever is encountered until the narrow osseous or membranous portion is reached. At this point the finger readily becomes aware of the fact that the bulbous end of the bougie is entering a narrower portion of the tube. The moment this sense of tightness is experienced by the finger, it is best to push the instrument no farther, for I have found that when I did so the cotton bulb almost always afterwards showed traces of blood upon it. Where the bulb of cotton, therefore, measures as much as $2\frac{1}{2}$ millimetres in diameter, the sense of touch may be more satisfactorily followed as a guide than any stated measurements of distance. If on the other hand the bulb is small, the measurements on the shaft of the bougie should be consulted, as we might otherwise pass the instrument into the cavity of the tympanum before encountering any appreciable obstacle.

As already intimated, I have used in these cases nitrate of silver in preference to any other remedy. In the following reports of cases, it will be seen that, in two instances, I was able to use even the solid salt without setting up any unpleasant reaction. I doubt, though, whether any special advantage is to be gained by the use of very strong solutions or the solid salt itself. Judging from the results of the same treatment applied to the naso-pharyngeal space, I should think that a solution of from twenty to forty-five grains to the ounce of water would accomplish all that could be expected from the remedy under the circumstances we are here considering. In some cases, after using the nitrate of silver for a time, I have substituted ferric alum (ζii to ζvi of water).

Now, as regards the results of this plan of treatment, I have certainly nothing extraordinary to report. I can simply claim that by this method I am better able, without fear of exciting a dangerous reaction, to bring that valuable remedy, nitrate of silver, into close proximity to the middle ear than is possible by any other method known to me.

The following briefly-stated cases have been selected simply because of their value as illustrating the *average* results of treatment in every-day practice, not the *exceptionally successful* ones.

Medicated Eustachian bougies have been in use, I believe, for many years, but I am unable to say when or by whom the method here advocated was first introduced.

CASE I. July 24, 1873. Male, æt. 40. Dry-goods clerk, in good health. Has been troubled for a month past with a peculiar clicking sound in the ears when swallowing or engaged in conversation. H. D. W. R. 4-20, = L. 6-20. No appreciable deafness in conversation. No tinnitus. Both memb. tym. normal in color and texture, though slightly sunken. Follicular pharyngitis. Tubes open to Politzer's method of inflation. *Diagnosis*: Clicking sound due to a catarrh of the Eustachian tubes. *Treatment*: Application of nitrate of silver in solution (gr. xx to the ounce of water) to tubes by means of a slender wire armed with cotton; inflations through catheter; applications of nitrate of silver (same solution) to naso-pharyngeal space. Eleven applications, on alternate days. Moderate pain in ears for a few hours after the fifth application. Air passes very freely through both tubes. Hearing distance the same. Clicking sound entirely removed.

CASE II. Female, æt. 35. In good health. Four months previous began to be troubled with tinnitus in R. ear, associated with slowly increasing deafness. H. D. W. = R. 0.5-20, L. 6-20. Air passes very imperfectly through the right tube; r. memb. tym. sunken and of a dull, greenish hue; fauces congested. *Diagnosis*: Otitis media catarrhalis and Eustachian catarrh. *Treatment*: Bougie with solution of nitrate of silver (gr. x to the ounce) to tube on alternate days; nitrate of silver (gr. xx—3 j aquæ) to naso-phar. space; inflations through catheter. Eleven applications. H. D. W. = R. 6-20. Tinnitus almost gone. Politzer's method continued for a few days longer, and tinnitus entirely relieved. At no time pain following applications.

CASE III. Female, æt. 40. In good health. Slowly increasing deafness with tinnitus during past four or five years. H. D. W. = R. 0.25-20, L. 0.33-20. In conversation with her I am obliged to raise my voice. Both memb. tym. opaque; cicatricial spots. Air passes with difficulty through tubes. *Diagnosis*: Otitis media catarrhalis chronica. *Treatment*: Bougies with 20-grain solution of nitrate of silver; inflations through catheter; applications of silver solution (same strength) to naso-phar. space. Ten applications in the course of two weeks. Air passes very freely through both tubes. No improvement appreciable in either the hearing or the tinnitus.

CASE IV. Male, æt. 47. In vigorous health. Constant and very distressing tinnitus in left ear (chiefly) for past eighteen months. No appreciable deafness for conversation. H. D. W. = R. and L. 0.33-20. Right tube open, left closed to Politzer's method of inflation. Rhinoscopic examination shows mouth of left tube very much swollen and red. *Diagnosis*: Otitis media catarrhalis chronica with Eustachian catarrh (L.). *Treatment*: Bougie with silver solution (gr. cxx — $\frac{3}{4}$ i aquæ) to left tube daily; silver solution (gr. xx $\frac{3}{4}$ i) to naso-phar. space; inflations through catheter. Ten applications and then a respite of two weeks, followed by ten more applications. Left tube freely open to catheter and Politzer's method; tinnitus still present, but very markedly diminished; hearing distance unchanged. On one occasion, instead of using the bougie with a 120-grain solution, I substituted a slender wire, on the end of which the nitrate of silver had been fused in the form of a solid bead. This was passed through the entire length of the tube. Neither this nor any of the other applications was followed by more than momentary pain.

CASE V. Male, æt. 51. In rather poor health. Two years previous hemiplegia. For past three years constant tinnitus in the right ear. No noticeable deafness for ordinary conversation. H. D. W. = R. 0.5-20, L. 1.5-20. Marked naso-phar. swelling and congestion. Both memb. tym. opaque. *Diagnosis*: Otitis media catarrhalis chronica. *Treatment*: Bougies with nitrate of silver (at first gr. xx, afterwards gr. lx to the ounce of water) on alternate days; inflations and usual naso-phar. treatment. Six applications. Tinnitus appreciably diminished but not entirely removed. H. D. W. = R. 1.5-20.

CASE VI. Male, æt. 23. In vigorous health. Two months previous became decidedly deaf in the right ear, without any special pain. Was suffering at the time from a pretty severe nasal catarrh. H. D. W. = R. C-20. Memb. tym. of a milky hue, almost calcareous in appearance; peripheral and manubrial plexuses of vessels markedly congested; upper part of pharynx red and swollen. Politzer's method unsuccessful. *Diagnosis*: Otitis media catarrhalis (with exudation into tympanum) and Eustachian catarrh. *Treatment*: free vertical incision through posterior half of memb. tym., followed by Politzer's method of inflation, which was then successful in driving out into the meatus, and even out as far as to the lobe of the ear, a pinkish mucus of but slight viscosity; nitrate of silver (gr. xx to the ounce) to naso-pharyngeal space. The following day, the incision having healed in the mean time and the fluid being apparently as abundant as before, the incision was repeated. The amount of fluid evacuated was the same and the improvement in hearing as marked as after the first incision. On the third day, same accumulation of fluid, same treatment, same results. The following six days: Politzer's method, inflation through catheter, — both of which were invariably unsuccessful, — and application of nitrate of silver to the nasopharynx. On the tenth day after I first saw him, passed bougie (nitrate

of silver, 120 gr. to the ounce) through R. tube. Eleventh day, passed wire with bead of the solid salt; also applied solid stick to naso-pharyngeal space. Repeated the same on the twelfth, thirteenth, and fourteenth days. On the fifteenth day patient complained of soreness of throat in swallowing. Tried air-douche (Politzer) and was able to inflate R. middle ear. Sixteenth day, air-douche alone. Soreness of throat nearly gone; air enters middle ear freely. H. D. W. = R. 4-20. Whispered words heard correctly in R. ear a distance of thirty feet. Peripheral and manubrial portions of memb. tym. still a little congested, but the central portions have recovered their natural transparency.

CASE VII. Male, æt. 7, healthy, measles four years before, followed by otorrhœa from both ears. Constant discharge. R. ear: medium-sized central perforation; no granulations; discharge moderate in quantity. L. ear: large central perforation; mucous membrane swollen and showing some tendency to the formation of granulations; discharge abundant. *Diagnosis*: Otitis media purulenta chronica: *Treatment*: Application of nitrate of silver (solid bead on probe) daily to visible mucous membrane of both middle ears; application of the same in solution (gr. xx to the ounce) to the naso-pharyngeal space. Three applications made. During the three following days substituted powdered alum for the solid nitrate of silver. Discharge still present, though decidedly less than before. On the seventh day passed bougie (nitrate of silver, gr. lx to the ounce) through both tubes as far as to tympanum. No pain, except on left side while withdrawing bougie. The instrument passed in easily but seemed to be grasped pretty firmly by the walls of the tube when I attempted to remove it. No subsequent pain. Same treatment repeated on the eighth day, although both ears had ceased to discharge. Patient returned ten days later; both ears still remained dry, there being simply enough secretion to keep the mucous membrane of the middle ear moist. No evidence of any attempt at repair of the perforations in the membranes.

The boy was to have been brought to me again in case of relapse, but as he has never appeared, I am disposed to believe that the discharge was permanently checked.

CASE VIII. Male, æt. 11, healthy. Moderate deafness and tinnitus in L. ear for some time past. No recollection of ever having had a discharge from either ear. L. membrana tympani opaque and very much sunken. R. ear normal. Air enters left tympanum through catheter, but not very freely. After inflation H. D. W. = L. 0. 5-20, while before it was C-20. Tonsils moderately enlarged. *Diagnosis*: Otitis media catarrhalis chronica with slight Eustachian catarrh and probably retraction of the tensor tympani tendon. *Treatment*: Bougie with solution of nitrate of silver (gr. cxx. to the ounce), introduced only once; inflations; applications of nitrate of silver (gr. xx. to the ounce) to the naso-pharynx. The patient reported on the following day that after leaving my office (6 p. m.) his left ear began to ache and that the pain had continued up to about midnight. On examination at this second visit, the L. memb. tym. was found to present precisely the same appearance, as regards vascularity, transparency, and

position, that it did when first examined. The applications to the naso-pharynx and Politzer's method of inflation were continued daily for a week longer, but without any appreciable benefit. The improvement in hearing following inflation lasted but a few minutes, and to the naked eye the membrana tympani always appeared to maintain the same markedly sunken position.

CASE IX. Male, æt. 10, healthy. Moderate deafness, for, perhaps, a year past; recently aggravated by the measles. H. D. W. = R. 0 5-20, L. 1-20. Naso-pharyngeal catarrh, with moderately enlarged tonsils. Both memb. tymp. dull and opaque, but not appreciably sunken. *Diagnosis*: Otitis media catarrhalis chronica. *Treatment*: Bougie with nitrate of silver (gr. lxxx to the ounce); naso-pharyngeal applications; inflations through catheter, repeated daily for ten days. Afterwards daily inflations (Poltzer) and naso-pharyngeal treatment for eight days. H. D. W. = R. and L. 4-20. Conversation heard perfectly well, so far as the parents can judge.

CASE X. Female, æt. 7, healthy but not robust. During past two weeks has been suffering from a severe naso-pharyngeal catarrh. About a week ago she had a moderately severe ear-ache, lasting the greater part of one night, and followed by pretty marked deafness. No otorrhœa. H. D. W. = R. and L. 0.1-20. In conversing with her I am frequently obliged to repeat what I say. Both memb. tymp. sunken. Manubrial and peripheral portions red, while the central are of an almost chalky appearance. Politzer's method unsuccessful. Pharyngeal mucous membrane red and somewhat swollen. Patient breathes chiefly through her mouth. *Diagnosis*: Otitis media catarrhalis acuta with Eustachian catarrh. *Treatment*: Bougies with nitrate of silver (120 gr. to the ounce) daily; nitrate of silver (gr. xx to the ounce) to the naso-pharynx; inflations through catheter. Four applications made. No pain. Marked improvement in the hearing, H. D. W. = R. and L. 5-20. Both membranes nearly normal, the chalky appearance having disappeared; the peripheral and manubrial portions, however, are still moderately congested. Patient can now breathe through her nostrils. Politzer's method is now successful; bougies, therefore, discontinued. During the night of the seventh day (counting from the first visit), probably from having exposed herself at night while returning from a party, she suffered with a pretty severe ear-ache (in both ears). On the eighth day I found her again quite deaf, though free from pain. R. memb. tymp. convex outwardly from accumulation of fluid beneath dermoid layer. A small puncture gave escape to a serous fluid. No communication demonstrable between this cavity and that of the tympanum. Râles audible on both sides during inflation through catheter. Bougies resumed.

On the eighteenth day, finding that the râles continued and that there was no improvement in the hearing, I incised both membranes and evacuated by inflation a drop or two of thin, only slightly tenacious mucus. Immediately afterwards H. D. W. = R. and L. 4-20. Conversation heard with

perfect distinctness. During the following six days the incision was repeated three times on each side, and each time the amount of mucus evacuated was about the same as at first. Bougies continued in the mean time, with nitrate of silver (gr. lx to the ounce). On the *twenty-fifth day*, there being no evidence of improvement, incised the left membrane, and by pressure with finger forced a ten-grain solution of nitrate of silver through tympanum into Eustachian tube. As soon as patient tasted the solution, the pressure was withdrawn, inflations by Politzer's method administered, and ear syringed with lukewarm water. *Twenty-sixth day*. Instead of a mucous secretion there is now a purulent one. No pain following introduction of solution. Repeated the operation with a 20-grain solution, also incised the R. membrane, evacuating a scanty drop of mucus, decidedly less than after previous incisions. Politzer's method entirely successful on both sides. Bougies stopped. *Twenty-eighth day*. Hearing steadily improving on the R. side. On the left side there is still a slight purulent discharge through a small perforation. Forced a 60-grain solution through into tube. *Twenty-ninth day*. Pain only for a short time after last application to left ear. Discharge still present. *Thirty-fifth day*. Since last date treatment has been restricted to inflations (daily) by Politzer's method and applications of a 20-grain solution of nitrate of silver to the naso-pharyngeal space. Discharge has ceased entirely on the left side; a small scab still remains at seat of former perforation. H. D. W. = R. 2-20 L. 1-20. Whispered words heard correctly a distance of thirty feet. No trouble whatever now in hearing ordinary conversation. Active treatment stopped.

Looking at the case retrospectively, I am disposed to believe that the left ear would have improved more rapidly had the intra-tympanic applications of nitrate of silver been omitted.

CASE XI. Female, æt. 4. Healthy. Deafness, pretty well marked, of nearly a year's standing. No pain, no discharge, except about a year before. Both memb. tym. sunken, uniformly congested, and swollen. Landmarks barely recognizable. Air passes with difficulty through tubes. Tonsils moderately enlarged. *Diagnosis*: Otitis media catarrhalis chronica with Eustachian catarrh. *Treatment*: Bougies with a 20-grain solution of nitrate of silver; inflations; applications of the 20-grain solution to the tonsils and naso-pharynx. Five applications in all of the bougie to each tube, never followed by pain. Bougies then stopped, as air passed freely through both tubes. Politzer's method and applications to naso-pharynx continued for a few days longer. Both membranes have nearly resumed their natural appearance. The parents experience no difficulty in communicating with the child.

CASE XII. Male, æt. 54. Healthy. Double tinnitus of several years' standing. Steadily increasing deafness. No pain; no discharge. H. D. W. = R and L. 0-20. Am obliged to raise my voice in conversing with him. Both tubes imperfectly pervious to air. Pharyngeal mucous membrane red and plastered with mucus; enlarged follicles. Memb. tym.

presented nothing special. *Diagnosis*: Otitis media catarrhalis chronica. *Treatment*: Bougies with a 20-grain solution of nitrate of silver, on alternate days; 60-grain solution to naso-pharynx and pharynx; inflations. Seven applications in all. Tinnitus very much diminished in intensity, though not entirely relieved. H. D. W. = R. and L. c-20.

CASE XIII. Male, *æ*t. 20. Healthy, but suffers often from nasal catarrh. For past few days has suffered from moderate deafness in both ears. No pain; no tinnitus; no discharge. H. D. W. = R. and L. 0 75-20. Upon inflation according to Politzer's method the air passes through the left tube, but not through the right. After the inflation patient complained of a permanent sense of fulness in the left ear. Pharyngeal mucous membrane red and somewhat swollen. R. memb. tymp. of a dull, leaden hue, not appreciably sunken nor congested. L. membrane presents about the same appearance, except that in the posterior superior quadrant a curved line stretches like a hair from the middle of the manubrium to the periphery of the membrane. This line maintains its horizontal position, whatever be the position of the patient's head. *Diagnosis*: Otitis media catarrhalis sub-acute and Eustachian catarrh, with serous exudation in the left tympanum. *Treatment*: Evacuation of contents of left ear through an incision in posterior half of membrane; bougie with a 20-grain solution of nitrate of silver; same solution to be applied to naso-pharynx; inflations. Two applications of bougie. No return of fluid. Both tubes easily pervious to Politzer's method. No difficulty in understanding conversation. Nasal catarrh still continues. H. D. W. = R. 2-20, L. 3.5-20.

CASE XIV. Male, *æ*t. 33. Healthy, and not a sufferer from nasal catarrh. Marked deafness of ten years' standing. No tinnitus. Hearing varies to a certain extent with the weather. Am obliged to speak quite loudly to him. H. D. W. = R c-20, L 0-20. Vibrations of tuning-fork, conducted through cranial bones, scarcely heard at all. Air passes through both tubes, though not freely. Both membranes nearly normal in appearance. No appreciable pharyngitis. *Diagnosis*: Otitis media catarrhalis chronica, probably with ankylosis (incomplete) of stapedo-vestibular joint or rigidity of membrana tympani secundaria. *Treatment*: Bougies daily with a 20-grain solution of nitrate of silver; solution of same strength to naso-pharynx; inflations. Ten applications. No improvement whatever. No appreciable increase in size of tubes, as ascertained by auscultation.

CASE XV. Male, *æ*t. 50, health poor. Three months before began to suffer from deafness and tinnitus in the left ear. No pain; no discharge. H. D. W. = R. 10-20, L. c-20. Vibrations of tuning-fork referred very decidedly to the R. ear. R. tube open freely to Politzer's method, left closed. Pharyngeal mucous membrane swollen and covered with mucus. Both memb. tymp. nearly normal in texture and position. *Diagnosis*: Nature of trouble not clear. *Treatment*: Applications of nitrate of silver

(gr. xx to the ounce) to the naso-pharyngeal space on alternate days. These applications were continued for about two weeks by the patient's physician and resulted in affording him entire relief from the tinnitus. Eight weeks later patient returned for further treatment. The tinnitus, he said, had returned, and was as bad as ever. The left membrane was found, on examination, to be somewhat red throughout the manubrial and peripheral portions, while the intermediate portions presented a dull and œdematous appearance. Bougie with a 20-grain solution of nitrate of silver applied to left tube on alternate days; same solution to naso-pharynx; inflations. Five applications. Tinnitus entirely relieved. Pharynx of a decidedly healthier appearance. Memb. tymp. free from all redness and œdema. H. D. W. = L. 0.5-20.

