the doctor to certain facts in the physiology of respiration for proof in part. A strong robust adult can by forced expiratory effort raise the air-pressure in an accurate air-gauge from 3 to $3\frac{1}{2}$ pounds. Therefore, by the Valsalva method we are right in inferring that this is about the maximum pressure obtainable.

Very few persons can tolerate all the pressure that they can bring to bear in this process of self-inflation without pain or rupture of the membrane. Here then, is an indication of the maximum pressure that can be safely used, namely, 3 or $3\frac{1}{2}$ pounds.

The basis of the Politzer method is the fact that the Eustachian orifices are made patulous by the very act of swallowing. The doctor ignores this and consequently must employ much higher pressure than is necessary, although I cannot believe that he gets one-tenth of the pressure that he would lead us to believe.

Dr. Bishop in closing the discussion said: The gentlemen who have participated in this discussion have emphasized the point upon which I have laid special stress, that is the danger in using air from reservoirs under very high pressure without being able to determine the amount of pressure and the volume of air used. In other words, the dosage. It takes these two elements to make up the dose-pressure and volume. That is my apology for calling your attention to this very simple little device pictured in the cuts that are distributed among you. Dr. Hubbard thinks I use a dangerous pressure when I speak of 75 or more pounds. It would be dangerous in the absence of any means of controlling the amount of air used.

Does it make any difference, gentlemen, whether you use a cubic foot of air under high pressure or a cubic inch? Does it make any difference whether you throw a pebble or a rock at a pane of glass? Shall we make no distinction between a high pressure column 1-16 of an inch in diameter and one large enough to constitute a cyclone?

Without this air meter to put both pressure and volume under our entire control I would not advocate the use of high pressure. But with it one can use air from my reservoir which is filled every day with air under 100 pounds pressure to the square inch with as much safety as lies in the low pressure receivers mentioned by Dr. De Vilbiss.

Granting this, which I am prepared to demonstrate, you must concede that the possibilities of breaking up adhesions and ankylosis and overcoming immobility of the ossicles and restoring the sunken drum membrane to its normal position, are greatly increased.

Since it requires 4 to 8 pounds to bulge forward a healthy drum head, many times the pressure is necessary to affect these old thickened, leather-like membranes that have been held retracted by ankylosed ossicles for years. I have often removed such membranes and have found them thick, tough and sometimes gritty from chalky deposits. What effect can you expect to produce on such ears by one pound of pressure on the inner side of the drum head while there is constantly an opposing atmospheric pressure of fifteen pounds to the square inch on the outer side of the drum?

The gentleman at my right speaks of having had inflammation and even rupture of the membrana tympani from the use of Politzer's method. I have had no such experience, but I do not make use of strong inflations in children or in the acute stage of inflammation.

One of the two principal conditions upon which I predicate the safe use of high pressure seems to have been forgotten in the discussion. That is the ability to control the amount or volume of air used at each dose. While I use only the minutest column of air under high pressure, I am able to cut off a dose of this column, or subdivide it, so as to limit it to a fraction of a cubic inch. You can open the valves 1-32 or 1-64 of an inch if you like.

This air meter may be compared to the milliampère meter which makes it possible to obtain therapeutic effects from electricity which would be otherwise impossible or dangerous, because the dosage can be determined and definitely controlled.

MUCHOLD reports a case of Grave's disease in which he removed the posterior half of one of the inferior turbinate bones with the galvano-cautery, with immediate improvement in all the symptoms except the goitre, which was, however, readily reduced by a mild galvanic current. He suggests the possibility of the disease being sometimes due to some reflex disturbance.

SOME OBSERVATIONS UPON EXCISION OF THE MEMBRANA TYMPANI, AND THE TWO LARGEST AUDITORY OSSICLES.

Read before the Section of Laryngology and Otology, at the Forty-third Annual Meeting of the American Medical Association, held at Detroit, Mich., June, 1892.

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A year ago I read in this Section a paper upon excision of the membrana tympani and the two largest auditory ossicles, in which two sets of indications for the operation were set forth as follows:

1. The deafness, tinnitus and vertigo of chronic catarrhal otitis media, especially when adhesions exist between the membrana tympani and the promontory in the inner tympanic wall, or when there is evidence of synechia between the ossicles.

2. This operation is indicated in the suppuration, deafness, tinnitus, vertigo, headache, and recurring earache of otitis media purulenta chronica.

Conclusions regarding the results of the operation in cases of chronic catarrhal otitis media were presented as follows:

1. The operation of excision is attended with no bad results, even if it do no good, and its effects are superior to massage, mobilization, plicotomy, etc., etc., applied to the membrana and the ossicles.

2. The most constant result of the operation is a relief from a sensation of pressure and fulness in the ear.

3. There is generally a more or less prompt, entire and permanent relief of tinnitus and aural vertigo (so-called Ménière's symptoms).

4. The least frequent and permanent result is improvement in hearing. Sometimes, however, this is marked. In some instances the improvement in hearing is maintained after regeneration of the membrana tympani. In those cases of chronic catarrh of the middle ear, in which everything else has been tried without benefit, it would seem rational that the patient should have the chance of improvement offered by this harmless operation, for harmless it certainly has been in all my cases, even if the benefit has been slight or nil.¹

Conclusions regarding the results of the operation of the excision of the membrana tympani and the two largest ossicles, in chronic purulent otitis media.

1. The operation has not failed either to greatly diminish or check the suppuration in all the cases of chronic otorrhœa in which the writer has applied it.

2. In attic cases with normal atrium, the sole perforation being in the membrana flaccida, this operation has shown itself to be the *only* sure means of cure. I would add that in attic cases, with diseased atrium and with perforations, both in the membrana flaccida and membrana tensa, this operation has also effected a radical cure after the disease had defied all other remedies.

3. By this operation in chronic purulent otitis media, especially in cases in which the perforation in the membrana tensa is comparatively small and while the disease is limited to the drum cavity, the

¹ Since writing this paper, I have been forced to conclude that in many cases of chronic catarrhal otitis media better results can be obtained by the removal of the stapes, as well as the incus. In some of such cases it may be well to let the membrana and malleus remain.

suppuration can be directly reached and treated and drainage improved by the removal of the membrana tympani and malleus, before the purulent disease has attacked the posterior portion of the drum-cavity and the antrum. Thus mastoid inflammation, and necrosis, sinus-thrombosis, pyæmia and cerebral abscess are prevented.

4. If any hearing exists before the operation in purulent cases it invariably improves after the excision of the necrotic membrana and ossicles. Vertigo, headache, tinnitus and the attacks of ear-ache from gatherings, so common in chronic otorrhœa, are entirely and permanently removed. The general health which is nearly always impaired in these cases by a form of mild chronic septicæmia from the chronic purulency in the ear, is always improved by the antiseptic effects of the operation which removes the septic nidus and makes it possible to render the drum cavity entirely aseptic by the improved drainage and direct medication.

I have seen no reason for changing any of these conclusions; on the contrary I am more firmly convinced of the great benefit especially in chronic purulent cases, to be derived from the operation of excision of the necrotic membrana and the diseased malleus and incus. The latter bonelet, however, is readily destroyed by purulency in the drum-cavity and hence, in chronic cases, is rarely found when the operation is performed.

Instruments.—Straight instruments have been found preferable to those set at an angle with the handle. As the operation is one largely performed by fingers the straight instrument is more easily managed by the slightest movement between the fingers. The tactile impressions conveyed through the easily-moved straight instruments are much more definite and useful than those conveyed through the awkward and angular instrument-handles, which have to be managed by hand and wrist to some extent and hence cannot be so delicately manipulated. The incus-knife of the writer, consisting of a short blade set at right angle to the shaft, can be used as both knife and hook with which to pull out the incus after it has been detached, even when it has slipped back out of sight towards the mastoid cavity.

The recumbent position favors the slipping backward of the incus after it is detached from the stapes, and especially if it be already detached from the malleus. Therefore it is much more convenient for the operator to lift the head and shoulders of the patient up as high as the anæsthetic state will permit. This can be done very easily by having the head- and shoulder-portion of the operating table hinged so as to lift it to any angle desired.

I would merely mention here that I have always employed ether in my operations, the illumination of the ear being effected by a six-volt electric head-lamp supported on the forehead.

Teeth.—The teeth should be in good condition before the operation, especially when performed for the relief of the symptoms in a case of chronic aural catarrh. In a case of this kind operated upon last November (1891), and in which iodoform blown into the ear immediately after the operation, and renewed several times soon afterwards, seemed to prevent regeneration and in which the improved hearing and diminution in the tinnitus were maintained, a diseased and painful tooth, apparently caused irritation in the operated ear.

The patient sought the aid of a dentist for relief of toothache in January, two months after the operation. The tooth was extracted roughly, as it appeared to me. Pain in the jaw and throat ensued with ear-ache and suppuration in the ear in which the excision had been performed. During the mucopurulent discharge which ensued, and which was followed at last by regeneration of the membrana, the patient, a woman of thirty-three, showed symptoms of secondary syphilis evidently contracted from her husband. The regeneration of the membrana tympani was not followed, however, by diminution of hearing, nor increase in the tinnitus, which had been measurably diminished by the operation. Though, in this case, the acute inflammation in the ear operated on, may have been induced by the secondary syphilis, bad teeth are competent to act prejudicially in any case of excision of the membrana tympani, and hence, they should be examined and put in good order, before the operation.

Operation on both ears.—In two cases of chronic catarrhal otitis media, one in December, and the other in January last, I excised the membrana tympani and malleus in both ears. In the first case, a woman forty-five years old, operated upon in the Presbyterian Hospital, there was no relief. Regeneration was prevented in both ears by insufflations of iodoform, retained for weeks. In the worse ear there was some reaction upon leaving the hospital and taking cold in January. This was promptly checked by iodoform insufflations and total regeneration prevented. A new membrana formed excepting a small central hole. In the better ear no regeneration has yet occurred, six months after the operation.

In the second case, a woman sixty-five years old, operated upon in the Presbyterian hospital, in January last, both membranæ and mallei were excised without relief. The woman was the subject of great cranial neuralgia and debility from hard work. The operation afforded no relief. Regeneration was prevented in this case by the use of iodoform insufflations. In March of this year, three months after the operation on the ears, the patient left the hospital, without regeneration of the membranæ. She went to work, took cold, and early in May suddenly developed in the worse ear an acute otitis media, with pain and copious discharge. The case has been readmitted to the Presbyterian hospital and is now under observation. Regeneration, at least partial, will ensue. Inflammation occurring in these cases in the worse ear, though months after the operation, would seem to indicate that 1, in all chronic aural catarrh there is an inclination to acute suppurative processes in proportion to the degree of sclerosis, or trophic change; and 2, that this tendency is always likely to be a menace to success of the operation in chronic catarrhal otitis media; 3. The only hope of combating this tendency, so far as my experience extends, lies in the immediate application and prolonged retention of iodoform in the seat of the operation.

In two cases of chronic catarrh of the middle ear, I have recently removed the *malleus and incus* for the relief of deafness and tinnitus. In the first case, a woman thirty-two years old, I removed May 9, 1892, the malleus and incus, and insufflated iodoform, the hearing was improved by the second day for clicking sounds and for the voice. A clicking sound could

be heard twenty feet away from the ear operated on, while it was audible about half the distance in the other ear. The voice was heard a foot away in the ear operated upon, and the impact of sound was novel and somewhat disagreeable on this side. Before the operation it was a question whether isolated words were heard in this ear. The tinnitus was not materially lessened. Notwithstanding a severe reaction in the ear on the fifth day after the operation, the improvement in hearing was maintained.

In the second case, a woman twenty-four years old had complained of tinnitus and deafness in both ears, for eighteen months. In the left ear there was considerable ankylosis and tinnitus. The hearing was eighteen inches to two feet for isolated words. Some hypertrophic nasal catarrh. Tinnitus quelled for five minutes in the left ear by using the pneumatic speculum. May 13, 1892, excised the membrana, malleus and incus, and insufflated iodoform. Tinnitus was not entirely quelled by operation. No improvement in hearing the first two days. By the third day tinnitus less and hearing improved. In a week the hearing was eight and ten feet for isolated words. On the ninth day after the operation patient went to church and was able to hear better than she has for over a year. No reaction in this case by the twelfth day, the iodoform was dry in the fundus of the ear and the patient went home to another city well satisfied with the result of the operation.

The improvement in hearing when it occurs as the result of the operation in cases of chronic sclerotic otitis media, is always *progressive*. It would seem from this that the direct transmission of sound to the stapes effected by the removal of the membrana tympani, mobilizes the ossicle in an effectual manner. The passive motion thus conveyed to the stapes gradually overcomes the ankylosis which has been hindering its movements, rendering it consequently more vibratile and responsive to sound-waves. The nerve of hearing too, by the renewed reception of sound impressions thus once more conveyed to it, probably becomes more sensitive to aerial sound waves, its normal stimulus.

Results in chronic purulent otitis media.—In cases of purulent otitis media the results of the operation of excision of the membrana and the malleus are usually eminently satisfactory as shown by the history of the following case: Thomas B., aged 12 years, an intelligent lad, has suffered from chronic otorrhœa and deafness of the left ear for some years. No account of the inception of the disease could be obtained. Examination revealed a uniformly swollen, red, flat and dry membrana tympani, with a large and narrow oval perforation in the anterior inferior quadrant of the membrana very near the periphery. No signs of the malleus could be seen in the flat, even surface of the swollen membrane. Through the perforation a little muco-pus could be seen, and when this was mopped away with cotton on the holder, the granulating inner wall of the tympanic cavity could be seen and made to bleed by a touch from the probe. Hearing for isolated words in the diseased ear was two feet. At times the discharge was copious enough to appear at the meatus.

On April 12, 1892, the lad was etherized and the greatly thickened and diseased membrana with the malleus excised. No trace of the incus could be seen, or felt with probe. The membrana was greatly thickened and tough, and its inner surface was

studded with granulations. The inner tympanic wall was also granular; but the hæmorrhage during the operation was comparatively slight for a purulent case, in which as a rule, the hæmorrhage is considerable for so small a field of operation. Iodoform was insufflated and the ear let alone for a day or two, when it was mopped clean with hydrogen dioxides and more iodoform insufflated.

On April 28, a test of the hearing revealed an ability to hear isolated words eight feet from the ear operated on. There was no discharge. On May 16, another test revealed a hearing distance of twenty feet for isolated words. The inner wall of the tympanic cavity had lost its granulations and had become gray and smooth and there was no discharge. The patient was dismissed from the Presbyterian hospital where he had been operated upon, and resumed his duties in school.

THE OPERATION FOR EXCISION OF THE OSSICULA IN CHRONIC AURAL CATARRH WITH INSTANCE OF A FAILURE.

Read before the Section of Laryngology and Otology, at the forty-third annual meeting of the American Medical Association, held at Detroit, Mich., June, 1892.

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Before taking up the subject matter of my paper I would like it to be distinctly understood that I intend casting no aspersions upon aural operative procedures. My standing upon this subject may perhaps be known.¹⁹ I refer more particularly to excision of the ossicles in chronic suppuration and in chronic aural catarrh. I have had marked success both previous to and since the one disastrous result which forms the nucleus of this paper.

Sexton,¹⁴ Burnett,^{4 5 6} Colles⁷ and others in this country do not mention any bad results, from the operation occurring in their practice. The latest article⁹ that I have seen relating to operative interference in chronic aural catarrh says: "With reference to surgical procedure I can truly say that in no case have I seen a bad result follow any of the operations, either immediately or subsequently, and in nearly all cases there has been a certain amount of improvement either in diminishing the tinnitus or in improving the hearing". Most papers go on in this strain and say that while we can never promise in a given case what the amount of improvement will be, we can promise that the condition will not be aggravated and that the chances for improvement are certainly favorable.⁹ This was and is still, my opinion for cases that I accept for operation.

In all the literature of the subject at my command, I can discover but little mention of accidents occurring during or after the operation, and these have all been in suppurative cases. I can find, in only three instances, the admissions of but two operators, of unfavorable results upon the hearing. In 1889 Wetzel¹⁸ reported two cases in which the hearing had been made worse, in the one where the mastoid antrum had been opened during the excision and in the other where the stapes had been interfered with. Yet the latter has occurred in other instances without ill effects and the bonelet has been bodily removed experimentally in animals whose hearing was still preserved.³