

The cure of chronic suppuration of the middle ear without removal of the drum or ossicles or loss of hearing : with ten cases / by Charles J. Heath, F.R.C.S. Eng., Surgeon to the Throat Hospital, Golden Square, London.

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Publication/Creation

London : The Lancet Office, 1906.


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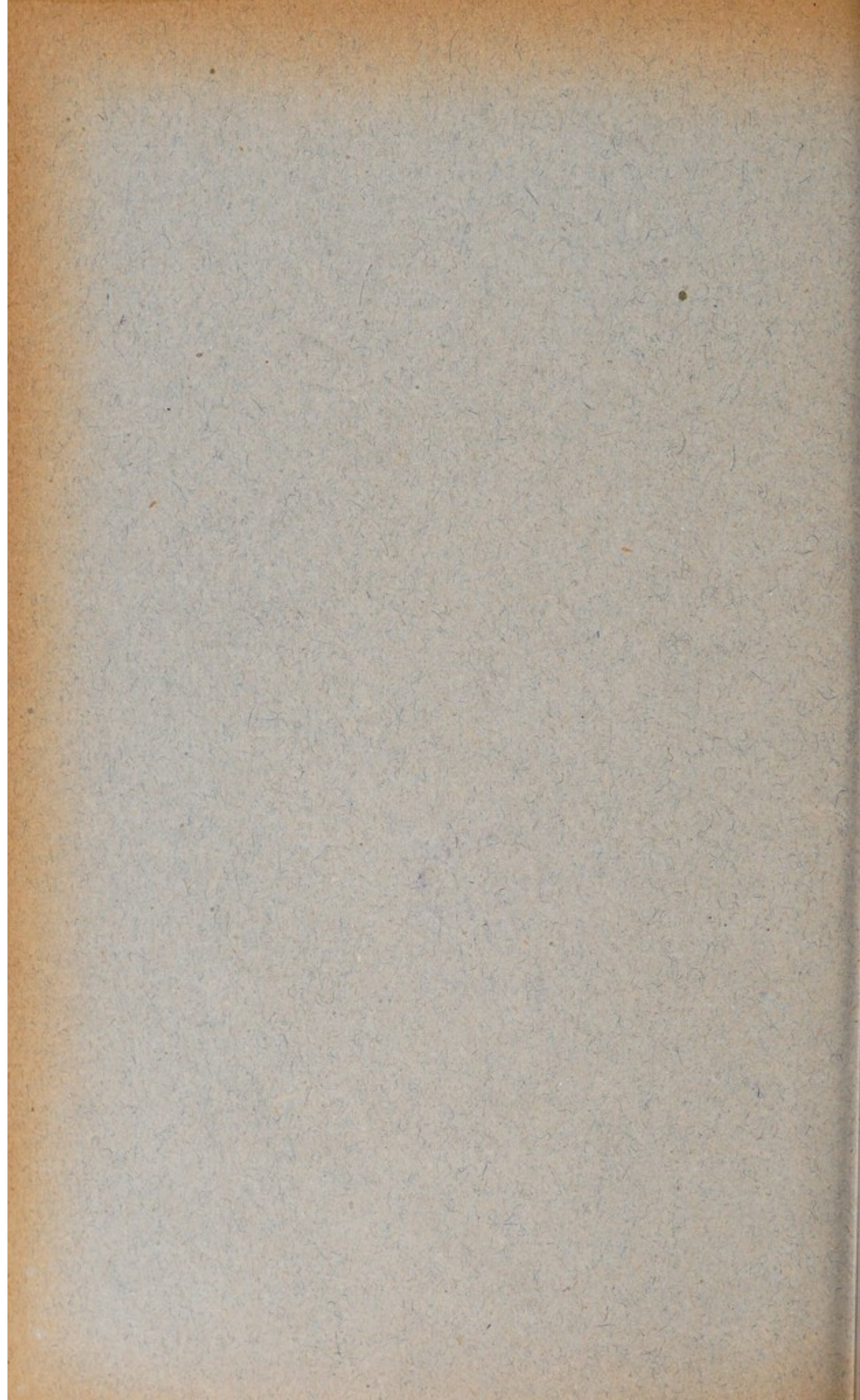
WITH TEN CASES

BY

CHARLES J. HEATH, F.R.C.S. ENG.

SURGEON TO THE THROAT HOSPITAL, GOLDEN SQUARE, LONDON

Reprinted from THE LANCET, August 11, 1906



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ON Dec. 5th, 1904, I read a paper before the Otological Society of the United Kingdom, which afterwards was published in *THE LANCET*,¹ on "The Restoration of Hearing after Removal of the Drum and Ossicles by a Modification of the Radical Mastoid Operation for Suppurative Ear Disease" (founded on the experience of 400 operations). Early in that communication occurred the following passage: "The system I adopt, or some slight modification of it, will ultimately be adopted as a means of restoring hearing to large numbers of persons afflicted with suppurative ear disease." The modifications described below and the cases quoted, which have been examined by several otologists, will show that forecast to have had some foundation, for the change in procedure has resulted in the improvement in the hearing power of all the patients (ten) on whom this operation has been performed.

Much time was spent in studying the subject before the measures described below were put into practice. First, a glance was taken at the physiology of the mucous cavities of the ear, and their drainage was found to be dependent on one small channel, no doubt effective in health but not capable of expansion to meet the requirements of disease, and, indeed, liable to be contracted as a result of the very disease which

¹ *THE LANCET*, Dec. 24th, 1904, p. 1767.

increases the strain upon its capacity. The modifications which were introduced by disease were brought under observation, including the additional drainage of the tympanum resulting from a perforation of the membrane. The changes most commonly found in the condition of the walls and contents of the tympanum were considered as well as the possibility of recovery from these conditions. Next, the characters of the discharge came under observation and their effect on the freedom of drainage through the Eustachian tube, and especially through the aditus, should granulations or other form of obstruction arise in that passage. Observations had previously been made to the effect that the same condition had frequently appeared to be present after suppuration of three months' duration as after three or even 30 years; much instruction was derived from cases which had been seen on the operating table and these also gave hints as to possibilities. Notes had been taken concerning the methods and routes adopted by nature, either alone or assisted by surgery. Memoranda were made on all these and other points, but it is impossible even to allude to them here, much more discuss them in the small space available; therefore these remarks are mainly in abstract form and much that is important has to be excluded.

As the result of a long consideration of this subject one salient feature has always stood out prominently—namely, the importance of the cavity of the antrum—inasmuch as the persistence of the disease appeared to depend on this chamber rather than on the tympanum and therefore it became necessary to regard it as the key of the position. A few remarks concerning it will therefore not be out of place. It seemed to me that if the cavity of the antrum remained unaffected there was a good prospect that the tympanum might not become diseased past recovery and that if it became seriously diseased no treatment of the tympanum through which antral discharges must pass could be relied upon to effect a cure.

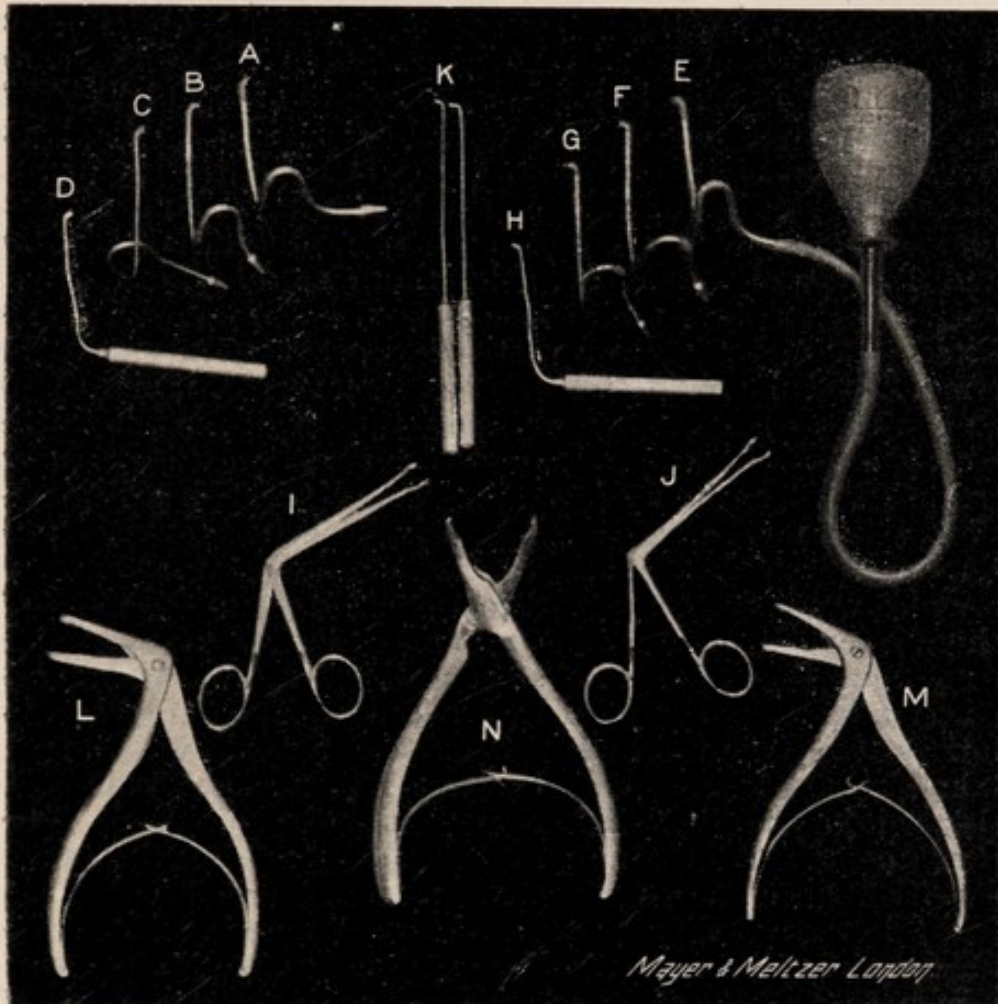
The drainage of the antrum, which from its proximity to, and liability to involve, the most vital parts should be called the danger zone of this disease, takes place through a small unyielding bony passage, the aditus, which may be obstructed more or less easily according to its size, which is variable. It does not need to be completely and rigidly obstructed for enlargement of the cavity behind it to take place. A little pressure long continued may expand it in any direction; upwards to the middle fossa less than one-eighth of an inch away, downwards and outwards to the

mastoid process, backwards, or backwards and downwards to the lateral sulcus and sinus. Among the cases recorded below are examples of all these conditions. It was observed that erosion through the bone above the antrum into the middle fossa was very common and that erosion from the attic into the middle fossa above was very rare in spite of the fact that the thickness of the bone over the latter cavity was less than over the former. Surely there must needs be something to account for this fact; and it is not unreasonable to attribute it, partly or mainly, to an interference with the drainage through the aditus. Such obstruction may be slight, probably it is not often complete enough to stand pressure sufficient to cause pain, for the antrum is a sinus of but little sensibility, yet it appears to be enough to cause expansion in that direction which is most facilitated by the arrangement of the bone cells in this locality. Further, it is a cavity endowed with just those conditions which are favourable to the propagation of bacteria when they have once found entrance, and these too may bear a share in the course of this disease and should they penetrate the inflammatory protecting zone which is usually present they may travel far and wide without the process being associated with much pain to indicate the danger and thus lead to disastrous results. It is a frequent occurrence during the performance of operations on the mastoid process for chronic suppuration for observation to be made regarding the futility of expecting to cure the disease there and then exposed by any treatment through the meatus. The question may be asked, What prospect is there that the antrum will resume a healthy condition after it has once become infected and therefore the source of discharges which will by their irritating qualities lead to such an alteration in the mucous membrane of the aditus, tympanum, and Eustachian tube, as to prevent those passages allowing of proper drainage? And conversely, what chance has the tympanum of recovering a healthy condition if it has to serve as a drain for the transmission of such irritating productions of the antrum as get forced out through the aditus? It must be allowed that the prospect and the chance are not enough to be relied upon as probabilities. Then what is to be done? "Let us eliminate the antrum, the danger zone." Well, suppose the antrum eliminated and the passage of all irritating discharges from it through the tympanum stopped, what then? Is the condition of the tympanum (the attic is included) such that there is no probability of repair? My experiences lead me to the

opinion that in the majority of cases it is not. This opinion is the result of personal observations of hundreds of mastoid operations and therefore of an acquaintance with the great damage to walls and contents of tympanum occasionally seen after scarlet fever and other diseases but which are fortunately not the rule, also of a knowledge of the fact that the radical operation is based on the assumption that the tympanum in chronic suppuration of the middle ear is usually in such a condition that it cannot recover health and function and must be emptied of its contents in order that the suppuration may be cured, an assumption which is surely supported neither by pathology nor clinical experience. Further, the paramount position which the radical operations hold in the estimation of otologists is a tacit acquiescence in the opinion that chronic suppuration of the middle ear is generally considered to be incurable by any other means. The various pathological conditions which may exist in the tympanum in this disease are well known but that they are frequently of a kind that prohibits any probability of recovery is not in harmony with my own observation and experience and it is these alone that have led me to the opinion, firstly, that the tympanum and its contents are not, as a rule, so far diseased as to be beyond repair; and secondly, that the condition of the Eustachian tube has a most important bearing on the result, for unless that passage be in a thoroughly efficient condition, the perforation of the membrane cannot heal nor the tympanum be restored to health. Naturally, therefore, the following conclusions were arrived at: that, given elimination of the antrum with its foul discharges and consequent improvement in the patency of the tympanum and Eustachian tube; given also operative provision of access to the tympanic membrane, for observation and treatment, and to the aditus for the purpose of carrying out the treatment described below, it was considered more than probable that the remaining tympanic disease would offer no great difficulties and that the cavity would therefore resume its health and function. Having come to these conclusions it was determined to put them into practice by instituting an operation combining these essential points and thus to learn if the before-mentioned observations were reliable and deductions well founded.

Operation.—The procedure followed in the operation which has been practised in this investigation is in its opening stages similar to the early stages of the radical

operation referred to above² but later there are modifications which will be described hereafter. The same cap can be used to obviate the need of shaving the head and most of



A, Large cannula for right aditus. B, Medium ditto. C, Small ditto. D, Bent probe ditto. E, Large cannula for left aditus (with air bag attached). F, Medium ditto. G, Small ditto. H, Bent probe ditto. I, Large polypus or granulation forceps. J, Small ditto. K, Long slender bent probes for preventing or breaking adhesions between tympanic granulations and the membrane. L, Long bone forceps. M, Short ditto. N, Avulsion ditto.

the same instruments are suitable. The antral probes, however, must not be used to locate the antrum through the tympanum, otherwise the hearing apparatus may be damaged.

² THE LANCET, Dec. 24th, 1904, p. 1767.

After the exposure and necessary treatment of the antrum and any communicating cells and cavities (as described in the paper referred to) any granulations found in the aditus must be removed and the orifice shaped to fit the cannula (see illustration). If this passage be unusually long it may be shortened by removing bone at its posterior end and then it should be plugged to prevent the entrance of blood or bony fragments. Next, a tiny wet cotton swab should be placed on the perforation of the tympanic membrane to keep fragments from entering the cavity through that aperture. Most of the posterior part of the bony meatus must now be removed and, if necessary, even portions of the upper and lower walls, according to the size of the meatus, until complete freedom of access to the drum membrane is obtained. Any polypi or protruding granulation should be removed with the special polypus forceps (see illustration) and with these also by pressing the blades against the membrane above and below the perforation the nearest granulations can be made to protrude through the perforation, when they, too, should be caught in the forceps and removed. These are the granulations which, if allowed to remain, would be likely to become adherent to the edge of the perforation and must therefore be removed or the membrane might afterwards become drawn inwards by contraction of those granulations. (See Case 9, where a granulation was left in the perforation in order to see what would take place.) In removing bone near the tympanic ring the risk of injury to the facial nerve must not be forgotten. The plugs on the membrane and in the aditus should now be removed, a cannula with a bag attached (see illustration) fitted in the aditus, and while the membrane is under close observation a blast of air should be sent through the attic and tympanum and the effect on the drum membrane observed. If the perforation appears to be too small to allow of egress of the contained tympanic secretion it can be enlarged; if in an unfavourable situation an entirely new opening can be made for the purpose of facilitating the exit of any material within the tympanum which is capable of expulsion by a powerful blast through the aditus. A syringe having been attached to the cannula, the whole tympanic passage should next be irrigated in the same direction with some bland antiseptic, and this fluid should finally be expelled by the air douche and the plugs replaced in the aditus and deep meatus. The cartilaginous meatal flap should be fashioned on the same plan as that advocated for the radical operation above referred to but should include

rather more of the superior quadrant in order to allow throughout the entire after treatment of that uninterrupted view of the membrane which will insure the prevention of any untoward complication, such as an adhesion of the membrane to a granulation. The wound behind the ear must be completely closed with sutures and all after treatment carried on through the cartilaginous meatus, which should be enlarged sufficiently to permit the use of a drainage-tube about five-eighths of an inch in diameter, and as less bone is removed in this than in the radical operation this tube occupies a more oblique position. A wet dressing in this operation is the best and should be continued in diminishing sizes as long as an external dressing is needed.

After-treatment.—As the operation will have rendered the whole of the tympanic membrane visible the after-treatment has thereby been made interesting, not to say instructive; it will also be found to be of shorter duration and less painful than after the radical operation, for there is generally but little of the slow-healing pars petrosa involved and the sensitive tympanic cavity will not be exposed. On the day following the operation the dressing and the tube are removed, the entire cavity is cleansed and dried, swabbed with cocaine solution, and after a short interval dried again. Then the patient is ordered to hold his nose and blow air through the ear by Valsalva's method, while the effect on the membrane and perforation is carefully watched. The discharge expelled in this way is removed with tiny mops and the odour and consistency are noted; the cannula is then passed into the aditus and observation again taken of the effect on the membrane and perforation of the passage of a blast of air from this direction. The material thus expelled, which may be more purulent than that blown out by the patient's effort, should be removed, its odour and appearance noted and recorded, and if matters are progressing favourably the disagreeable qualities will no longer be present.

The condition of the hearing power should next be tested and recorded and it will usually be found to have already improved. Finally, after seeing that the membrane is free from the liability of adhesion to any granulation, a precaution necessary for several days, the cavity may be swabbed with iodoform emulsion, the same tube replaced, and a dressing applied. After trying several methods the following conclusion has been arrived at—viz., that after the initial

cleansing patients who have undergone this operation recover as quickly without as with fluid douches through the ear, and this should not be surprising when it is remembered that air is the natural occupant of the free parts of the tympanum. Certainly no applications should be used which are likely to retard the growth of ciliated epithelium. If the aditus becomes prematurely blocked with granulations the passage of a probe will insure the freedom necessary for the use of the cannula but the probe (see illustration) should not be allowed to pass as far as the attic for fear of injury to the attachments of the incus. There is no difficulty in inserting the probe or cannula into the aditus without seeing it, if the drainage-tube be shaped properly, kept in position, and the soft parts fixed during the operation with the object of providing this necessary access. Within a day or two of the operation the discharge will often be seen to come mainly or entirely from the bone and soft parts and the secretions of the tympanum to have diminished to such an extent that the Eustachian tube is adequate for their removal.

The meaning of the sounds given out by the perforation when air is blown through the aditus is soon understood and a day or two after the operation it is usually found that nothing but mucus comes through; the sound during inflation will then probably be moist at the beginning only, for the amount of mucus being necessarily small it gets blown out at the commencement of the inflation. When passing a probe or cannula into the aditus the mucus in the perforation, and even the drum membrane itself, can be seen to bulge outwards. The granulations which at the operation were visible through the perforation shrink and in a few days disappear. May it not be presumed that those in the attic which cannot be seen will do the same? After trying various methods of after-treatment this plan through the enlarged cartilaginous meatus has been adopted as the simplest and most direct in all cases of mastoid disease when the antrum is opened, and if the lateral sinus should be situated far forward this is the only practicable route, and anyone who sees for the first time the ease and accuracy with which the after-treatment can be carried out in this way will wonder how he ever managed satisfactorily through an opening behind the ear, for then, if the meatus should happen to be small, it is impossible either to treat or to see the tympanic condition. As might be expected, the part of the wound in which the healing is most delayed is the bony cavity in the mastoid process, the

aditus usually being closed, the perforation healed, and thus the hearing apparatus made safe, some time before the antral cavity has filled and granulated, but though unhealed the discharge given off by the granulations when not irritated by the contact of mucus is so trifling that a piece of wool placed in the concha to cover the tube has been found to be a sufficient dressing.

Nine of the cases, abridged details of which are given below, are numbered in the order in which the operations were performed during the four or five weeks which ended on June 17th, 1906.

CASE 1.—The patient was seven years old; sent up from the country; suppuration three months; cause unknown; no adenoids; a discharging sinus over the mastoid process; granulations visible in the tympanum; perforation at the back of the membrane three-sixteenths of an inch in the longest diameter.

At operation: Large cavity in mastoid process continuous with the antrum, filled with granulations and pus; granulations not removed from tympanum; cannula used regularly; perforation healed in 14 days. Hearing before operation watch on contact, after operation seven inches, which for this watch is excellent hearing. The patient's hearing is probably improving. She is in the country. A letter dated July 26th, 1906, says that she now hears the watch at 30 inches.

CASE 2.—The age of the patient was eight years. Suppuration during whole life; foul discharge for years; polypus in meatus hiding membrane; no adenoids.

At operation: Very large antro-mastoid cavity, filled with granulations; polypus removed from meatus; large perforation at the back of the membrane. Granulations removed through perforation which afterwards healed in three weeks. Hearing before operation watch on contact; after operation 12 feet. Hearing equal in both ears. A remarkable result.

CASE 3.—A patient two and a half years old. Suppuration three months. Admitted with swelling behind the ear and a high temperature. Adenoids removed. Swelling and temperature abated after one week in hospital. Discharged but readmitted at the end of another week with displacement of pinna and usual acute mastoid symptoms. Temperature 100·8 F.

At operation: Large antral cavity full of pus and granulations; sinus leading to it through the cortex; perforation at the back of the membrana tympani; granulations seen in the tympanum but not removed. Perforation healed in less than one month; much improved in appearance since operation. Entire drum still visible. Hearing before operation and since, not satisfactorily ascertained, but hears whisper well at a distance in both ears, apparently equally, but watch tests are unreliable for both ears on account of extreme youth.

CASE 4.—The patient was 29 years of age. Totally deaf in the right ear; six months' suppuration in the left ear. Hearing steadily getting worse; could only hear a loud shout in the affected ear; labyrinth defective; watch not heard on contact; most of the membrane gone; fetid discharge; much pain.

At operation: Dura mater of lateral sinus exposed close to the bony meatus, over half an inch forward of the usual position; the small antrum extended beneath the front of the lateral sinus. As to the present condition there is now no external discharge, all mucus being removed by the Eustachian tube; perforation probably too large to have healed so soon after the operation, but has contracted. Hearing before operation required a loud shout in the ear; at present the patient hears a whisper at six feet and conversation anywhere in a room. This patient was so deaf that she lost her employment and though not a favourable case for any operation an attempt was made to improve the hearing, which has succeeded. This perforation is rapidly diminishing in size.

CASE 5.—A patient aged 14 years. Nine years' suppuration after scarlet fever; most of the tense membrane gone. Adenoids removed for ear symptoms in April. On May 17th pain and tenderness over the mastoid. Admitted to hospital; fomented; improved; discharged. Returned June 7th with tenderness and swelling over the mastoid and high temperature; granulations seen in the perforation.

At operation: Antrum deep and small, the deeper part extending beneath a very forward lateral sinus. The perforation is not yet healed on account of its large size but the drainage goes by the Eustachian tube. Hearing before the operation watch one inch, after operation eight inches; the other ear 24 inches. This perforation is steadily diminishing in size.

CASE 6.—A patient aged 40 years. Totally deaf in the right ear; six months' suppuration in the left ear. Hearing getting steadily worse and now useless. Tiny meatus; nothing to be seen through it; carious bone felt in the tympanum; labyrinth defective; watch not heard on contact. Operation performed solely with a hope of improving the hearing; whole of the mastoid process diseased and removed; membrane observed to be of only about half the usual area. The organ of hearing in this patient is probably congenitally small. Eustachian tube is still usually found to be obstructed but can be cleared with the air bag; this prevents the perforation, which is not large, from healing. Hearing before operation needed a shout close to the ear; after operation the patient could hear conversation anywhere in the room and it was with the hope of this satisfactory improvement that the operation was performed. The disease was not acute.

CASE 7.—The patient was 18 years old. Suppuration ever since infancy. Admitted with unusually acute symptoms; displacement of ear; great pain; hard granulations entirely filling the meatus.

At operation: Enormous cavity in the mastoid process extending to the tip with pus under considerable pressure. The cavity appeared to have previously communicated with the meatus near the membrane and with the tympanum through the aditus; both routes were now blocked which accounted for the compression of the contents of the cavity. The posterior wall and the posterior part of the inner wall of the cavity pulsed freely, indicating extensive exposure of the middle and posterior fossæ of the skull. A temporary gutta-percha tissue drain was used in the lower end of the post-auricular incision for 48 hours in addition to the large drainage tube through the cartilaginous meatus. The perforation was healed in less than one month. Hearing before operation, watch on contact; afterwards seven feet; the other ear five feet. This case shows that after even prolonged suppuration the middle ear may not be in such a damaged condition as to be incapable of complete recovery.

CASE 8.—The patient was 12 years old. Suppuration several years. Admitted with an acute attack; pain, occipital and mastoid; view of the membrane obstructed by granulations.

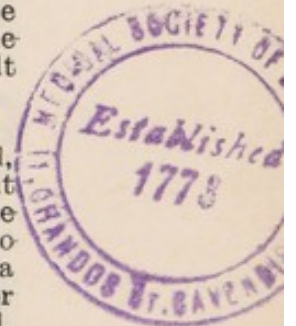
At operation: Pus found beneath the pericranium; the mastoid disease was continuous from the antrum to the tip of the mastoid process and this space was filled with granulations and pus; the lateral sinus was freely exposed in the abscess. A temporary gutta-percha tissue drain was used in the lower end of the wound in addition to the drainage tube in the meatus. The perforation was healed 12 days after operation. Hearing before the operation, watch one inch; since operation, eight inches and is steadily improving.

CASE 9.—The patient was 49 years of age. Six months' suppuration. Admitted with all the usual acute symptoms; labyrinth involved.

At operation: The cortex was discovered to be undermined before removal. A large cavity was opened extending from the antrum to the tip of the mastoid process with the lateral sinus lying bathed in pus. A polypus in the meatus was removed but a round granulation which appeared to fit into the large perforation at the back was left to see what would result. In three or four days it had adhered to the edge of the perforation and when the patient inflated the ear the air came out through the aditus and not by the perforation; the granulation was then separated from the edge of the perforation with a probe and the patient was again told to blow. The granulation on this occasion entered the perforation, acted as a ball-valve and again obstructed the passage of air; it was left thus and has adhered and blocks this large perforation. Hearing before the operation required a loud shout and the watch was not heard on contact; since the operation half an inch; with the other ear only two and a half inches. In the best ear there is a gouty catarrh and the labyrinth also is not in good order. The patient is a hammerman and the loud ringing of the anvil may have injured the labyrinth, for it is defective on both sides and therefore deafness would surely have resulted if the radical operation had been done, for only if the labyrinthine trouble is of a transient nature is any other result probable.

CASE 10.—The patient was 29 years of age. This case should be added, although the operation was performed in 1902 in a somewhat different way, the posterior bony meatus being removed right down to the perforation, which was situated posteriorly, was crescentic, extended to the tympanic ring, upwards into Shrapnell's membrane, and was a third of an inch long. It looked as though it never would heal, for more than a quarter of the membrane appeared to have been destroyed. There had been six months' suppuration and there was a foetid rhinitis. The discharge from the ear was very foul; there were abundant granulations and the patient was admitted with acute symptoms.

Now the membrane is intact, there is little but irregularity of the new portion to show the great extent of the disease that previously existed and, further, the patient can hear the watch at a distance of six feet. It was impossible to avoid the conviction that if the grave and extensive disease of the tympanum which this patient exhibited before operation was not incompatible with the complete recovery which followed, then there are grounds for assuming that there can be but few pathological conditions of that cavity which are. This patient's ear on account of the large size of the perforation of the membrane was a long time healing; there was, however, no otorrhœa after the operation while the aperture was closing, for the efficiency of the Eustachian tube was fully restored. It was an encouraging fact that this enormous



perforation should heal at all, and that this patient completely recovered from the disease proves that elimination of the antrum was all that was required. She now has an intact hearing apparatus of excellent quality and it is probable that one or more of the only remaining three out of ten patients with, as yet, unhealed perforation will recover. (The two patients in whom the Eustachian tube is clear already show considerable reduction in the size of the tympanic perforation.) This patient (Case 10), who was exhibited at the Otological Society two and a half years ago, has been of much interest and the encouragement derived from her recovery has had much to do with the persistence of this investigation over a period of four years.

The opinion can safely be expressed that all the cases recorded above were in such a condition and had such a history as would, with the experience hitherto available, suggest to the surgeon the necessity of the radical operation, yet the results of the methods which were adopted seem to prove that in the majority, if not in all of them, the radical operation would not have resulted so favourably.

Cases 4 and 6, both delicate women with defective sight, though their tympanic perforations are not yet healed, one because it is so large and the necessary time for extensive healing has not elapsed since the operation and the other because the Eustachian tube is obstructed, are in a far better condition as to hearing and their lives are just as safe as they would be after a radical operation. The labyrinth in each of them is defective and when this is the case half a drum is better than none if the incudo-stapedial connexion is intact, for it keeps the stapes moveable and in proper position, and this will react beneficially on the round window and on the condition of the whole labyrinth.

In Cases 5, 7, and 8 the patients were admitted to the Throat Hospital, Golden-square, on account of acute symptoms, by order of my colleagues Dr. H. Lambert Lack and Mr. Charles A. Parker, who kindly handed them over to my care. My thanks are also due to our house surgeon, Dr. H. F. Shorney, for the care which he displayed in recording the notes of these cases.

The improvement in the hearing of all these patients should not be surprising when it is recognised that no part of the hearing apparatus was removed or injured at the operation and that the source of the discharges which were the cause of the tympanic irritation and deafness was taken away. The list includes all the patients who were operated upon in this manner. They may or may not show better results than are to be expected in the future. A confident opinion may be expressed that they will be im-

proved upon but, such as they are, they are presented for consideration. These ten persons have not only been relieved of the dangers of this disease but this end has been attained without the sacrifice of the hearing of one of them and in the short period that has elapsed since the operation the perforations of the membranes of seven out of ten patients have healed.

Remarks.—What is the procedure described above? It is an adaptation to this part where the anatomical difficulties are so great of those surgical principles which are successful elsewhere. It is also a stage in the process of differentiating the larger number of patients who do not appear to require the radical operation from the smaller number who do. For what surgeon would subject a patient to a radical operation if there were a probability of a better result by any other measure. Unfortunately, hearing of such fine quality as that exhibited by several of the ten patients referred to above has never been observed to follow the radical operation. The practice of new methods usually results in increased knowledge and the proceedings above related are no exception to this rule, for they have resulted in recoveries which point to the necessity of a more searching examination of patients before proceeding to the radical measure, even though that examination may only be completed during the progress of an operation, when the necessary information should be forthcoming to show whether there is or is not a possibility of saving or restoring the hearing and this examination is urgently demanded on behalf of those persons in whom the other ear is in a condition to indicate a possible or probable failure of function, for though the removal of danger in these cases is a surgeon's first duty the preservation of the power of hearing is the second. Far be it for me to suggest that the radical operation will no longer be needed; it will still be of use for those whose hearing has been entirely destroyed or whose disease has not been found amenable to the treatment herein described which by avoiding the removal of any part essential to hearing permits such prospects of retention of the hearing power as the radical operation, associated as it is with its removal of drum and ossicles, cannot possibly afford. Confronted by the facts and experiences recorded in this communication, the otologist will no longer have the excuse of anxiety concerning the safety of the hearing to induce him to delay interference until that hearing may be destroyed, or even the patient's life in danger.

in consequence of which an operation may have to be immediately undertaken under such conditions that parts must be sacrificed, or have already been destroyed by the disease, which, if the operation had been performed earlier, might have been retained to the patient's great advantage. (Five of the patients referred to above were operated upon under these unfavourable conditions.) Therefore, surely it will be right in dealing with the antrum to do as the general surgeon does with regard to the appendix—that is, to recommend operation as soon as there is proof that the part is diseased and has become an abiding source of danger, for by so doing there can be no doubt that every year a great many valuable lives will be saved.

The duration of the suppuration, which before the experience gained during the years of this investigation had been considered of some moment, though observations of a large number of radical operations did not support this view, has not in itself been proved to be of much importance, for of the three cases mentioned above, with as yet unhealed perforation though improved hearing, two of them were cases of short duration, and the third though of longer standing was the result of great damage wrought by an attack of scarlet fever.

On the other hand, the patients in Cases 2 and 7 with a history of eight and 18 years' suppuration respectively, very long periods, are now well, have sound ears, and the best hearing of all (hearing for watch 12 feet and seven feet) and indicate also that duration of the disease alone does not necessarily bring about such changes as are incompatible with complete recovery. The hearing of the two persons (Cases 4 and 6) the duration of whose suppuration was of short standing had steadily got worse, and the watch not being heard on contact also indicated that the labyrinth had suffered along with other parts. Now a radical operation on those patients would probably have made their hearing worse, for the labyrinth must be in fine order for the hearing after the radical operation to be good, and one of these patients had previously undergone a radical operation on the other ear and the hearing on that side was *nil*. Surely these points encourage the opinion that, given the continuity of the ossicular chain, half a drum is better for such persons than none, as they cannot hear by the small fenestræ after the radical operation, the labyrinth is not sufficiently sensitive, and the impressions conveyed by these small windows are not sufficient to stimulate a defective labyrinth. In cases where the acute disease has caused

great destruction of bone and the resulting cavity in the mastoid process is large, healing may be hastened by skin grafting on Thiersch's plan through the meatus, for the cavity can be thoroughly sterilised and grafting made effective as soon as the leakage of mucus has been arrested by the closure of the perforation and aditus.

The appearance of the thickened and granular tympanic mucous membrane need cause no alarm; it has a protective purpose and is therefore desirable; it is of the nature of an inflammatory zone around an abscess, a strengthening of defensive works occupied by defensive cells; and are not inflammatory conditions analogous to these, seen everywhere in the body where there is suppurative disease and therefore repair required? If this rational view of this disease be taken there need be no surprise at the rapid healing which followed operation in several of the cases quoted above; the tissues were vascular and ready to proceed with repair as soon as the cause of the persistence of disease was removed. As remarked above, it appeared to be reasonable to expect the tympanum to recover as soon as the cause of irritation was removed.

The presence of cerebral or extradural abscess, lateral sinus thrombosis, and the treatment which these conditions entail are no bar to the performance of this operation in its essential parts, and the complications which for their adequate treatment demand removal of tympanic contents, such as labyrinthine suppuration, are rarely present, and when they are the hearing will usually be found to have been already destroyed by that disease. Finally, it may be claimed that this plan eliminates disease and danger as effectually as a radical operation without destroying the power of hearing.

The results as far as appearance within the meatus is concerned would naturally be better in the persons who are subjected to operation before extensive destruction of bone has taken place as a result of acute disease; though with regard to the power of hearing there is no appreciable difference this tends to show that the acute disease was entirely behind the tympanum and is in favour of the early contention that the antrum was the key of the position. The hope may again be expressed that the experience gained by a study of these operations may induce other otologists not to allow suppuration in the ears to go on until the hearing is jeopardised nor if urgent symptoms arise—as in so many of the cases recorded above—to recommend the radical operation, for thereby hearing may be sacrificed, while from the

foregoing it will be seen that an operation is now available which can be expected to improve the hearing in most persons and make it worse in none, and at the same time remove that risk of acute disease, to prevent which the radical operation, in spite of its risk to the hearing, is so frequently performed.

It might have been unwise to draw important conclusions from so small a number as ten operations were it not for the fact that they were so far above average severity that no other series of that number is likely to exhibit less favourable results and for the fact that the preliminary remarks and the whole design of the investigation evinced an expectation of such results.

In these concluding remarks not a tithe of the important matters bearing on this subject have been touched upon which have been recorded with a view of discussion, but if enough has been said to induce other otologists to try this method of operation it is improbable that their experiences will materially differ from those given above.

Though the preliminary remarks will have shown that most of these results were foreseen, this investigation has been interesting from the very beginning. When, however, a stage was reached in which the operations were performed new phases developed which required consideration and management and it became quite engrossing. At last there was the satisfaction of knowing that it would certainly result in information which could be relied upon to place the treatment of this terrible disease on a safer and more satisfactory foundation.

The after-treatment of these cases being of such importance, and the information those duties must necessarily convey being of such value, I was constrained to undertake them myself and increased thereby the arduous nature of the task, and it is difficult even now to estimate fully the importance of this question during the short time that has elapsed since the facts were discovered.

It is mainly to the unequalled opportunities afforded at the hospital to which I have the honour to belong that this work has so rapidly resulted in definite and valuable conclusions.

