

ances may generally be ascribed to the usual cause of perforation, viz., the outbreak of fluid from the tympanum. Such an occurrence is very common; and the history of any flow from the ear generally points to such perforation. Few children escape one or more attacks of ear-ache; and these acute inflammations are as often relieved by an escape of exudate through the drumhead as by one that follows the channel of the Eustachian tube. The quantity of the fluid which escapes is, in many instances, not more than a drop or two; consequently it may be wholly unnoticed, and the denial that there has been any discharge may be entirely honest, however unequivocal the evidence of perforation. In this connection we must insist that there is no anatomical or clinical basis for the claim that a "foramen of Rivinus" should normally be present above the short process. It is absent in the embryo and the infant and appears with increasing frequency only as the child grows older (in ten per cent. of the children—most of them over ten years of age—which were examined by me for this purpose). In adults such an opening or scar may be noted by careful scrutiny in twenty-five per cent. of all drumheads. Most of these cases can give no history of discharge; but we



FIG. 1725.—Delicate Bleb on the Drumhead in Acute Myringitis.

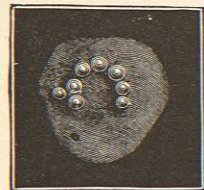


FIG. 1726.—In a young man whose ear affection had lasted a year, there was a tiny perforation in the lower anterior quadrant of the left membrana tympani, and upon the upper part of the drumhead were eight glistening globular bodies of pinhead size arranged in a semicircle. These were found with the probe to be hard and firmly seated upon the membrane. (Poltzer.)

often find even grosser lesions with a like negative history. The presence of such an opening or scar confirms my claim that disease in the attic is not necessarily severe and intractable, bad as certainly are many attic suppurations with perforation in the flaccid membrane (Fig. 1733).

The tense membrana vibrans is much the more frequent seat of such an outbreak of discharge from the tympanum, and most authorities state that it is most common in the lower anterior or light-spot region. A summary of 1,000 consecutive cases in my practice was made by Dr. Barton H. Potts and it shows only 25 per cent. at this part as against 37 per cent. down and back, and 16 per cent. up and back. The Shrapnell perforations were 10 per cent. and those called central (often too large for their region of origin to be longer determinable) were less than 7 per cent. I feel confident that more extended observation will show that the upper posterior region, which is the site of the most common and conspicuous distention, will be found to have a larger proportion of perforations than that which has just been given.



FIG. 1728.—Rupture of the Left Membrana Tympani. A vertical gap extends almost across the posterior half of the membrane, and the vessels are full, especially behind the manubrium.



FIG. 1727.—Irregular Linear Rupture of Posterior Portion of Right Membrana Tympani, with its Edges in Apposition. (Toynbee.)

While the form of the opening is as varied as its site, it generally begins as a small round yielding of the distended tissues (Plate xxv., Fig. 51), and only in the very septic conditions, as in scarlet fever and diphtheria, is there a rapid loss of substance by ulceration

to enlarge it or even to destroy almost every vestige of the drumhead. Almost always in infancy, and frequently throughout childhood, the perforation is but a pinhole at the apex of the bagging portion of the membrane; and this nipple-like or pouting perforation may be recognized only by the drop of discharge which forms upon it almost as fast as it can be wiped away (Plate xxv., Fig. 52). The persistence of such a protrusion after an opening has formed doubtless marks some impediment of free drainage; and in adult cases this often has its serious aspect (Fig. 1732). In early life, however, and in the presence of mucopurulent discharge of no great virulence, it may be regarded with less concern. It serves as a complete bar to penetration of medicaments from without, and therefore is an indication for the use of heat by the douche as our best astringent; for the heat can penetrate where the fluid which conveys it to the bottom of the canal fails to pass. It is claimed that such openings are specially liable to clogging under insufflations of powdered boric acid, a phenomenon which depends principally on the insolubility of boric acid in mucus, and which therefore brings it in all such cases under the ban which forbids the use of any insoluble powder. Such incomplete drainage may also afford an indication for operative enlargement of the opening; but incision through such a perforation may serve only to freshen its edges for premature closure and wholly defeat the intention of the operator. It is better to incise, if at all, freely at the periphery of the membrane, avoiding the site of the perforation; but in many cases it seems simpler and better to introduce a pair of fine forceps into the perforation and by separating the blades to cause slight divulsion, thereby securing a more patulous condition with lessened tendency to close. As there is frequently a tendency of the swollen mucous membrane to prolapse into the opening and limit the exit, the application of silver or other astringents to the edges of the perforation may cause the tissues to retract and thus favor drainage. The same result may be attained at times by light dusting with boric acid, and the assertion that this medication will enlarge perforations testifies in some measure to its efficacy.

With any increase in the size of the opening a dark hole may be seen when the occluding discharge has been removed; and in all acute cases any fluid within the opening can generally be seen to pulsate (Plate xxv., Fig. 48), in evidence that the arterial pulse is propagated into the distended cavity



FIG. 1729.—Double Rupture of Right Membrana Tympani in a Woman of Thirty, Produced by a Fall upon the Ear—seen on the Third Day. The two tears have radiating directions, and show marked gaping. (Poltzer.)

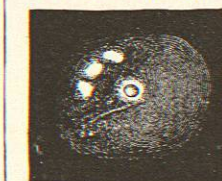


FIG. 1730.—Interlamellar Abscesses of Right Membrana Tympani, one at Umbo Showing the Pitting caused by Pressure of a Probe. Three others are seen backward and upward. (Schwartz.)

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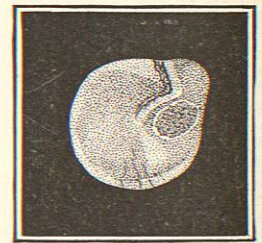


FIG. 1731.—Ulceration of the Right Membrana Tympani of a Man Sixty Years of Age after the Removal of a Hard and very Adherent Plug of Cerumen. A dark red rough and moist surface was seen in front of the malleus handle, bounded by a raised edge of cuticle. The remainder of the membrane was nearly normal except for injection, and the light spot was merely lacking in brilliancy. Examination of the ceruminous plug showed that it had been in contact with the ulcerated surface. Healing was prompt under boric acid powder.

illaries of the tympanum. The proximity of the carotid has been cited as a cause for this visible pulsation (which may be as throbbingly felt in the inflamed finger tip). Such pulsation is therefore usually indicative of perforation and is noted only in or near the opening; yet in rare cases the unruptured membrane has been observed to pulsate, but only when thinned to the verge of rupture. (Compare Fig. 1749.) Further enlargement of the opening is apt to assume a more oval form, partly because of the obliquity of the membrane and its foreshortening. Near the upper back margin this may make the perforation appear even slitlike; or, if its margin be swollen, no visible opening may be noted (Compare Fig. 1738), although the curved probe can be readily carried through it. This is the more important since the peripheral perforations at this locality are apt to indicate carious involvement of the shank of the incus (Plate xxv., Figs. 55, 56) or of the bony tympanic margin, and to demand prompt recognition and vigorous treatment. Still larger openings are commonly reniform (Figs. 1738 and 1746) and embrace the tip of the hammer handle (Plate xxv., Figs. 58 and 59), which may seem to protrude naked into the opening. Such denuding of the malleus is not in reality very common and the cotton-tipped probe will not catch upon it, for the condensed drumhead tissues still cover it and are well nourished by its vessels. Caries and visible truncation usually follow quickly actual denudation. Destruction of the drumhead may be complete, leaving no visible remnant; but more



FIG. 1732.—Right Membrana Tympani of a Man Thirty-two Years of Age, Recently Recovered from Typhoid Fever. Mucopurulent catarrh of the middle ear of two weeks' duration. Below the umbo is a reddish-yellow protrusion, yielding but little on pressure, from the point of which the discharge flows, and on being cleansed, a minute opening is visible. General injection of membrane, especially behind the manubrium. Treatment failed until a good-sized opening was made with a paracentesis needle; then prompt recovery ensued.

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FIG. 1733.—Right Membrana Tympani of a Boy of Five Years, with Constant Discharge for Three Years. A perforation about 1.5 mm. in diameter is with difficulty seen above the short process, and intratympanic injections bring away epithelial flakes and masses of foetid secretion. The rest of the membrane is slightly opaque, thickened, and injected.

often there is a rim of the thicker tendinous annulus recognizable throughout more or less of the circumference (Plate xxv., Fig. 64), and this may form a perfect basis for regeneration of a cicatricial membrane after the destructive process has exhausted its force.

The perforation of the drumhead is generally single, but it is not unnatural,

when one opening is ill-placed for draining the complex cavity, that another should result from the action of retained fluid (Plate xxv., Figs. 61, 62, 72, and 73). Especially is this the case as regards the attic with its subdivided area, which may require several openings in the flaccid membrane to drain it, irrespective of openings in the tense membrane below. The objection often raised, that high-placed openings (Figs. 1733 and 1736) are ill suited for drainage, is usually specious. Whoever raised this objection ignores the fact that most persons are recumbent at least one-third of the time, and, furthermore, that capillary attraction counts for more than gravitation in this matter of draining the tympanum. As stated above, I believe that the majority of perforations are located in the upper quadrant and are so efficient that they permit of prompt cure with little or no recognizable scar. Perforations occur high up because in this region there is retention of fluid which is not drained away by the normal channel of the Eustachian tube. Yet the occurrence of multiple perforations in the tense membrane should always raise a question as to the existence of a tuberculous process; and when we come to investigate these cases we shall often find that there is a prolonged expiratory sound, if not more marked trouble, at one or both lung-apices, or that the family history shows a tendency to consumption. At times the perforations almost merit the term "sieve-like," as in the cases figured (Figs. 1739 and 1740); and if the process is notably

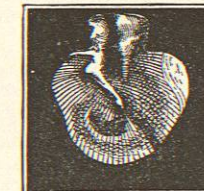


FIG. 1734.—Large Loss of Bone at the Inner End of the Upper Wall of the Meatus. A very delicate membrane which closes the opening and applies itself closely to the ossicles, bellies out on inflation. Hearing, 0.5 metre for acoumeter, 5 metres for loud whisper. (Poltzer.)



FIG. 1735.—Purse-like Distention of the Upper Posterior Quadrant of the Left Membrana Tympani. (Schwartz.)

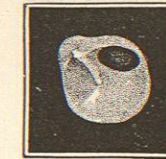


FIG. 1736.—Perforation of Upper Posterior Quadrant, such as sometimes remains after rupture of the distended portion shown in the previous illustration.



FIG. 1737.—Right Ear of a Boy, Eight Years of Age, with Long-standing Suppurative Otitis after Scarlatina. The membrane is extensively destroyed, leaving but a narrow margin all around, except where a triangular portion remains along the retracted manubrium. The tip of the long process of the incus is just visible posteriorly, the niche of the round window appears behind, and the irregular depressions of the floor of the tympanum may be seen below. Anteriorly, we look into the Eustachian tube, as far as to the isthmus.

At times the perforations almost merit the term "sieve-like," as in the cases figured (Figs. 1739 and 1740); and if the process is notably



FIG. 1738.—Left Membrana Tympani of a Woman Thirty Years of Age, with Long-standing Purulent Otitis Media. A reniform perforation involves much of the lower half of the drumhead, and a polypus arises by a narrow peduncle in front of the short process. Upon its removal, no perforation was recognized at its point of origin.



The usual tendency of a perforation, of whatever size and however produced, is toward closure. Even the most thorough excision of the entire drumhead has been followed by complete regeneration; and Kessel urged that the tympanic margin should be chiselled away in such cases if a permanent opening was desired. The healing takes place more promptly in youth than in later life and in acute than in chronic cases; yet it is sometimes a far slower process in the case of small than in that of large openings,—the reason being that the "skinning over" of the margins by ingrowth of the drumhead epithelium suppresses the growth of reparative granulations. The further great importance of this process in the production of cholesteatoma and the renewal or maintenance of suppuration will be dealt with later.

Drumhead healing in its simplest form is seen in many of the acute cases, in which the perforation has been a mere pressing apart of the tissues, especially the fibres of the membrana propria, with little or no loss of substance. The tissues come together and unite as if by serous agglutination, the epidermal and the mucous epithelium are promptly renewed, and in a short time every vestige of the opening has disappeared. Where there has been loss of substance this must be replaced by new tissue, and in the traumatic ruptures, even when promptly healed without suppuration, there is apt to be enough new tissue to make a permanent scar, often more visible than the inconspicuous rent. Such cicatrices involve only the fibrous layer, as a rule; for the epithelial and mucous surfaces soon lose any altered appearance if the supporting tissue approximates the normal. This it often does, and it is at times easy to overlook large cicatrices or, in recognizing their thinness, to be in doubt as to whether the condition is one of atrophy or of a healed perforation. Most perforations present a thickened margin, which may be recognizable after they have healed and which furnish the characteristic which distinguishes them from mere atrophic areas. This thickening contains most of the peculiar substantia propria fibres which spanned the site of the opening, and in the healing process these may be drawn back into place; but regeneration of these fibres probably does not occur, although it has been reported. Some new tissue will be present to unite the separated fibre ends, but this may be hardly discernible under microscopic study. Most commonly, in openings of any size, granulations form on the margins; they arise from any or all of the layers, and are clinically recognized as a pink or red

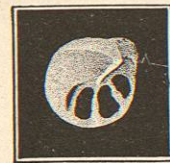


Fig. 1739.—Right Membrana Tympani of a Man, about Fifty Years of Age, Showing Four Perforations in the Lower Portion. The narrow, most posterior opening closed under observation. (Patient had laryngeal tuberculosis.)

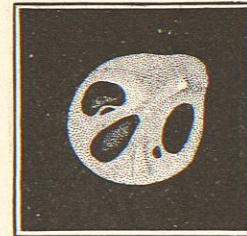


Fig. 1740.—Right Membrana Tympani of a Man, forty years of age, who died about a year later of Tuberculosis. An oval perforation occupies the anterior portion of the membrane, a more pear-shaped one is down and back from the umbo, and a third, of kidney shape, is up and back. Two small and elongated openings are close to the first and the third. The membrane shows plications below the umbo.



Fig. 1741.—The Same Drum Membrane immediately after the use of the Air Douche, which raises his hearing nearly to the normal. (Poltzer.)

edging. They grow inward, cicatrizing as they do so, and drawing inward, like a sphincter, any of the old tissues which may be present. Finally, they meet and coalesce. Vascularization or other factors may make this process unsymmetrical, and the new tissue may be even a tongue-like growth which proceeds from one side and closes all but a cleft at the opposite margin. I have observed this especially in perforations healing under the stimulation of a paper patch. This new tissue is soon converted into a fibrous scar, but it rarely has much of the rigidity of the original membrane and almost always shows a flaccidity and undue mobility which are apt to increase. Hence such scars are generally more or less depressed and may even collapse into contact with the



Fig. 1742.—Right Membrana Tympani in a Boy Seventeen Years of Age, who has Suffered with Chronic Middle-Ear Catarrh for Eight Years. Naso-pharyngeal catarrh with great swelling of the mucous membrane of the tube. The depressed area rests upon the inner wall and shows the incudo-stapedial joint. (Poltzer.)

inner structures of the drum cavity (Figs. 1741 and 1743). They may not only fail to serve as parts of the vibrating membrane but may even hamper its movements or those of the deeper structures, blanketing the stapes if in its region and seriously interfering with hearing. On inflation they often bag out into the canal in single or multiple bosses and may furnish strikingly variable pictures as shown in Figs. 1742 and 1744. So complete may be the depression of a scar that it may be practically unseen, its peripheral portions hiding beneath the perforation margins, while its centre, instead of being concave and giving back the usual reflection, may apply itself to the convex promontory and seem but a glossy coating of its surface (Fig. 1745 and 1746). The perforation may therefore seem still open; but inflation will usually distend its cicatrix conspicuously in front of the drumhead. Such flaccid scars often interfere with the hearing. Multiple incisions have therefore been made in the hope of effecting a firmer cicatrization; but I have generally found that better results may be obtained from McKeown's plan of painting the distended drumhead with contractile collodion. The temporary splinting is accompanied by enough irritant effect to thicken up the flaccid tissue, and even though there is little visible difference, there is often much gain in hearing after a few repetitions.

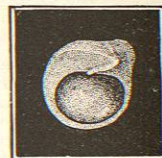


Fig. 1743.—A large rounded loss of substance of the membrana tympani below reaches up to the tip of the manubrium, which projects slightly into the upper margin. It is closed by a delicate cicatrix applied to the promontory and moulded upon its inequalities. The edges of the depression are sharp-cut and overhang, so that the area seems an un-closed perforation.



Fig. 1744.—Inflation of the middle ear forces the delicate cicatrix out like a bubble into the meatus, where it seems larger than the opening and hides its edges and the handle of the malleus. In a few minutes the distended sac loses its tension, and becomes plicated as it collapses, soon to resume its old position in contact with the inner tympanic wall.

Small scars, however much they may collapse, and provided they are not located directly over the stapes, rarely disturb the hearing so long as they remain free; but adhesion to the underlying structures, especially those of the inner wall (Fig. 1747), is usually very disabling to the conducting apparatus. Such attachment may be primary, in that the remains of the drumhead are united thus to the tympanic walls by granulations that should have built up a cicatricial closure of the perforation; but it may also

be secondary to the collapse of a full-formed scar. Not very rarely vigorous inflation or pneumatic massage is seen to be followed by extravasations in a scar lifted from a contact that has given rise to inoculation of its vessels with those of the underlying tissues. Where the margins of the open perforation are bound down to inner structures, very puzzling pictures are sometimes presented; for we generally recognize a hole by its sharp-cut margins, and with the melting of these into other parts landmarks may be wholly effaced. In very rare instances a free cicatrix may form in advance of parts thus bound down and such a condition of "detachment of the manubrium" results as is shown in Figs. 1748 and 1749.

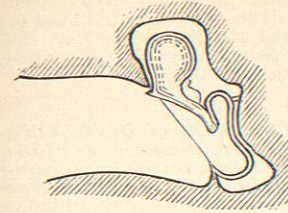


Fig. 1745.—Diagrammatic Section of a Large Free Cicatrix Depressed into Contact with the Inner Tympanic Wall and Stretched in all Directions, so that the Margins of the Perforation overhang it.

Occasionally a complete new membrane may form external to the annulus, arising apparently from the union of granulations which spring from the canal walls. Those which I have met were located in the inner third of the canal, at the upper part, very close to the drumhead; but they were placed almost at a right angle to the axis of the canal, with none of the obliquity of the real drumhead. The usual landmarks of the drumhead were also lacking. As they probably impede hearing very little if at all and are excellent protective partitions for the drum tissues, interference for their removal is rarely advisable.



Fig. 1746.—A large reniform perforation of the left membrana tympani, in a man twenty-one years of age, is closed by a delicate, almost invisible cicatrix closely applied to the underlying structures. The niche of the round window posteriorly, and the incudo-stapedial joint above, are seen as clearly as though not covered. The tube was but slightly permeable, and little functional improvement or change of the picture was afforded by inflation.

Where healing of a perforation is long delayed and it seems advisable to secure the protective effect of an intact drumhead, this result may often be promoted by the surgeon, either through freshening the edges by rubbing or by stimulants such as silver or trichloroacetic acid (25 per cent.), or—more safely—by Blake's method of covering it with a patch of thin writing or tissue paper. This may be moistened so that it shall adhere by its own sizing, or it may be coated with a little glycerin or boroglyceride of tannin and carried by a probe or forceps into snug contact with the margins. In a week or two it may be washed away and replaced if the healing is incomplete; but a dry non-vitalized opening that has been rather widening than narrowing for weeks or months, will sometimes be found perfectly healed at the end of a week or ten days. The lining membrane of the egg-shell has also been used, but with doubtful advantage. In this delicate procedure full recognition of the obliquity of the drumhead is essential if precise placing of the patch is to be secured. It is also very important to warn the patient that a decided loss of hearing

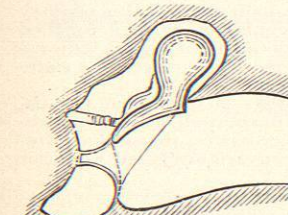


Fig. 1747.—Diagrammatic Section of a Small Depressed Cicatrix attached to the Promontory.

may be the primary result of such interference; for otherwise he may be greatly disturbed by this temporary change for the worse.

Perforations in the flaccid membrane show a much less marked tendency to close, and this is especially true of those cases in which there has been any caries of the adjacent margin of the scute. Some of this is ascribable to the ingrowth of epithelium and the formation of cholesteatoma within the attic and antrum. The rapidly proliferating epithelium (Blake has shown that the growth is most rapid above) transplanted to the succulent mucous surface grows with unprecedented activity. Desquamation takes place promptly and finds the region unprepared to rid itself of the debris. These cavities are naturally lined with cells which break down into mucus and are supplied with cilia to sweep the fluid down the Eustachian tube; but the cilia, if not already destroyed, are incompetent to move the flakes of epidermis, and these remain to excite further the proliferating tendency. Onion-like masses are formed as layer is added to layer, and under pressure of the collection the bony walls may undergo absorption, the soft tissues stretch or yield, or, with the help of any infective material that may be present, a suppuration may be set up. This is likely only to swell the collection and painfully increase the destructive pressure. Fortunately, the outward direction often offers the least resistance, and through the old perforation or one newly formed the pearly mass may escape into the canal; too frequently, however, it is only by absorption or carious destruction of the bony walls that an exit can be secured. The ossicles, if uninjured by the earlier suppuration, are apt to suffer displacement or caries, granulations form as the natural protest of the parts, and, as a result of their endeavor to rid themselves of the really foreign material, all the malign elements of chronic suppuration are called into activity. Strictly, the cholesteatoma should be called a *product*, not a neoplasm, although its analogy to the pearly nodule of epithelioma is very close; yet it acts at times almost as destructively as does a vascular growth and has a similar tendency to renew itself after removal. Absorption or carious destruction of the scute, or so much of it as forms the outer wall of the affected region, may afford adequate exit for the material so often as it forms, although the soft parts are apt to grow more or less over the gap and a partition in miniature has to be suffered each time that a mass finds exit. In some cases, even without such opening up of the affected area, the proliferative tendency seems to wear itself out; but more often there is at best recurrent suppura-

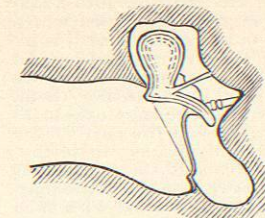


Fig. 1748.—Diagrammatic Section of the Same Case, Showing the Knee Below and the Manubrium Drawn in Behind the Middle of the Membrane.

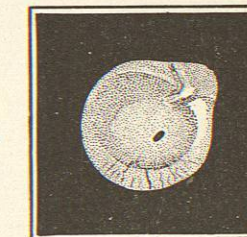


Fig. 1749.—Right Membrana Tympani of a Woman, aged forty-five, with Long-standing Intermittent Suppuration of the Tympanum Recently Recurring. Small central perforation in a free cicatrix stretched across in front of the lower half of the manubrium. Periphery of membrane thickened and opaque, calcified anteriorly; the central portion depressed and presenting a sharp "kneeing" below. Closure of the perforation by drying of the scanty discharge leads to further depression of the cicatrix, and brings it into contact with the lower portion of the manubrium, which is then seen to be entire and perhaps bound down to the promontory. Before rupture the thin scar was visibly pulsating and gave way spontaneously under observation.



tion,—“repeated gatherings” as the sufferer naturally calls them,—if not a persistent discharge with exacerbations, until some serious accident occurs or the surgeon forestalls it by operation. No branch of surgery has made greater advance within the past active decade than has otology in dealing with these cholesteatomatous conditions and their results. It is a subject for most earnest congratulation that we are growing into a better comprehension of the pathological principles which underlie these cases, and while our diagnostic skill is increasingly efficient in bringing them to recognition and clearing the mystery which often enshrouded them, we are also more prompt and rational in combating them. For a long time to come, however, we may expect to see cases in which, owing to neglect (on the part of the patient rather than on that of the physicians), these cholesteatomatous masses continue to exert their injurious effects unchecked. I have repeatedly seen the entire mastoid hollowed out into one huge cavity filled with such a laminated mass, with absorption or caries of the inner table and serious pressure on the dura and brain. Knuckle-like portions may invade the cranial cavity and give all the pressure symptoms of brain tumor, or the whole mass, with the pus which it has induced, may enter the cranial fossa as an extra-dural abscess and make its way outward through the squama. In this, or in one of many other ways, which will be set forth in detail in other articles of this group, cholesteatomatous masses may involve extensive portions of the temporal bone and set up a variety of pathological processes of the most serious character.

Caries of the ossicles is to be expected in many of these cases; in some of them, indeed, it may have already led to their dislocation or exfoliation before the patient is first seen. If the disease has not advanced as far as this it may often be stayed and the ossicular chain restored to usefulness or at least to innocuousness. It is often most surprising how perfect the hearing may be with the attic full of pus and the ossicles bare or clearly carious. The most vulnerable because least vascularized portion is the shank or descending process of the incus, and its destruction sets the stapes free of hindrance, as well as of help, from the rest of the ossicular chain. The neck of the malleus, where Prussak's pouch holds infective material in contact with it, is next in the frequency of its involvement; yet it may be eaten through and the head loosened or lost without great impairment of function. These and



Fig. 1750.—Extensive Destruction of Membrana Tympani, Partially Replaced by a Retracted and Pleated Cicatrix. The malleus handle greatly thickened and apparently truncated, with its short process covered with granulations. The incus seems to be lost and the stapes is exposed to view, covered by an almost invisible membrane through which its dimpled head shows perfectly. The promontory is rough, and there is a red streak posteriorly of uncertain nature.

many other carious portions are after all almost microscopic in size, and operative interference on a very minute scale may prove adequate for securing resolution. Thus, for example, rubbing the bare surfaces with a bare or cotton-tipped probe may not only reveal but at the same time sufficiently curette the caries, and a speedy and lasting cure has frequently rewarded this procedure in my experience. Persistent polyps or granulations justify suspicion of the integrity of some portion of the bony structure, even when it wholly eludes careful probing; but painstaking, and if need be painstaking, search and minutely thorough use of the measures elsewhere detailed will bring most of these cases to an apparent cure. This, however, should be regarded as a mere truce, and minute crusts should be searched for at intervals; and when found they are often best removed dry, so that we may see if the under surface is wet with recent discharge.

When the ossicular chain is broken, as by loss of the incus or its shank, any remains of the damaged larger ossicles are of interest only as possible maintainers of suppuration, and if not soon brought to healing should

be removed; but when the chain is unbroken, more can generally be accomplished for the improvement of the hearing by judicious mobilization and massage than by excision. Adhesions, after being cut, often unite more firmly than before; but the blunt probe may stretch them so as to afford lasting relief. When the dimpled head of the stapes comes to view (Fig. 1750) we know that the incus is disarticulated, if not lost, and we should confine our intervention to freeing the oval and round windows.

B. Alexander Randall.

**EAR DISEASES: ARTIFICIAL AIDS TO DEFECTIVE HEARING.**—When, in the course of disease, either of the sound-conducting or of the sound-perceiving apparatus, pathological changes have become so pronounced as to render ordinary conversation, or even that of a higher pitch, unintelligible to the unfortunate individual, and when all of the well-recognized methods of treatment have proven unavailing, then it may become necessary, for his comfort and convenience, and that of his friends as well, to resort to the adaptation of one of the mechanical devices which experience has shown to be useful in such conditions.

For convenience of description these appliances may be divided into three classes:

1st. Those for use within the auditory canal and tympanic cavity and which are concealed from view, or nearly so.

2d. Those in which the bulk of the instrument is exposed to view and the sound waves are transmitted by means of a conveniently shaped tip introduced into the meatus.

3d. Instruments which are brought into use by simply placing the proximal end against the auricle and the distal end in the direction from which the sound waves emanate.

The ideal instrument in all respects, did it but sufficiently contribute to the augmentation of the sound waves, would be one of the first class, for they are of necessity very small, being limited in size to the diameter of the meatus and auditory canal, and hence could be worn unobservedly. But, unfortunately, they can aid only by affording support to the remnant of drum membrane which may be present or to the ossicles, and by directing or concentrating upon the sound-perceiving apparatus such aerial vibrations as are collected by the auricle for transmission into the meatus. Could a small instrument be devised that would render the same service as one of the larger kind later to be described, the ideal would be reached. The problem has not yet been solved and will not be easily.

Marcus Banzer (1640) suggested the introduction into the auditory canal of an ivory tube, over the end of which was stretched a portion of pig's bladder. Leischevin (1763), Antereith (1815), and Lincke (1840) used similar devices in cases of perforation of the drumhead, but seemingly with the only object in view of protecting the exposed delicate structure of the tympanic cavity, as we have no account of any attempt on their part to improve the hearing. It is well known to those familiar with otological literature that the first account of a device worn within the ear, for the purpose of improving the hearing, was recorded by Dr. Yearsley, of London, in 1848. He was informed by a patient from this country who consulted him that he could, by placing a rolled strip of paper in the auditory canal, markedly improve his hearing. Tests made at the time proved the statement to be true beyond question.

Dr. Yearsley was quick to take advantage of the discovery, and subsequent experimentation led him to substitute pellets of cotton for the twisted paper, since frequent trials of the latter had invariably failed on other patients.

Toynbee in 1853 introduced his artificial tympanic membrane (Fig. 1751), which consists of a disc of vulcanized rubber of the size and thickness of the normal membrane, and to the centre of which is attached a wire about an inch in length, terminating in a little ring to

enable the thumb and finger more readily to grasp it for the purpose of introduction and removal. Modifications of the original membrane of Toynbee are numerous, and, as sold in the shops of to-day, it consists of a thin circular disc of india-rubber tissue, to the centre of which is attached a gold wire. Politzer invented for use among the poor an artificial membrana tympani, the manufacture of which is, as he states, very simple. A piece is cut from the side of an india-rubber tube 2 to 3 mm. thick, and to the lower end of this is fixed a strong piece of wire as indicated in Fig. 1752.

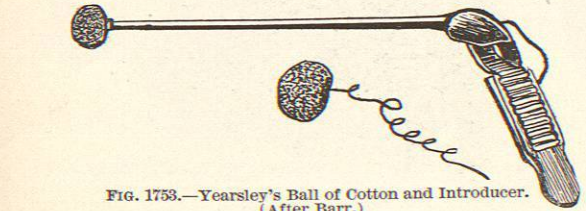
Gruber, on account of the liability of the Toynbee disc to become detached from the wire, the conspicuousness of the latter when in position in the canal, and the liability of the deeper parts to be injured if a blow should fall upon the ear, substituted for the wire a thread passed through the centre of the disc, and then provided for its introduction by specially devising for the purpose an instrument which is nothing more than a wire with a small ring at its end and bent at right angles to the shaft. The thread is passed through the ring, and then, after the disc has been introduced, the wire is thread is left lying in the canal with one end protruding from the meatus—an arrangement which renders it easy for either the surgeon or the patient to remove the disc. A small piece of soft lint has been used instead of the india-rubber. Again, an india-rubber tube, cemented at the end to the disc, has been employed instead of the wire.

It matters not whether the original Toynbee drum or one of its modifications be used, it will be found advantageous to moisten it before introduction, either with warm water, an antiseptic solution, or vaseline, to cut and trim it until the desired size is secured, and, finally, to change its position until the right spot has been found, and the improvement in hearing—if in any way attainable—has been obtained. Frequent changes are often found to be necessary before the contrivance can be worn comfortably by the patient, while at the same time rendering efficient service. If the use of this device improves the hearing, the patient can readily be taught to introduce and remove it, and soon he becomes so expert as to be better able to judge when it is in the proper position than the surgeon.

The Yearsley pellet of cotton (Fig. 1753), is probably more often used at the present day than any other intraural device, and, as stated by Dr. Thomas Barr, it has the following advantages over Toynbee's artificial membrane: “(1st) It is softer and excites less irritation; (2d) it is a convenient medium for applying medicaments to the interior of the ear; (3) it does not cause disagreeable

devices when the drum membrane is intact, but it is only in those cases in which continuity of the ossicular chain has been broken, or in those in which extreme relaxation of the parts exists, that we can hope, by making pressure against the manubrium mallei or against the stapes, appreciably to improve the hearing.

When there is acute inflammation in the ear, or when there is profuse suppuration, or when the wearing of the



noises when the wearer is chewing, as does the wire of Toynbee's membrane; (4) it has the advantage of being entirely concealed.” Its cheapness and convenience cer-

tainly recommend it in clinical practice, and it is doubtful if the disc would be useful where the cotton pellet fails.

While the cotton pellet may be used dry, better results will be obtained by moistening with glycerin, or with a suitable antiseptic, if suppuration still exists. The cotton is easily introduced with a delicate forceps or by an instrument such as is shown in Fig. 1754, or by one made for the patient's use, like that shown in Fig. 1755.

The method which should be followed by the patient in introducing the cotton pellet is so well shown in Fig. 1755 that no further explanation is needed. The piece of thread which is attached to the ball of cotton and which lies in the canal, enables the patient to remove it at his pleasure.

Hassenstein's device consists of a small hard-rubber stem (split throughout a part of its length and provided with a sliding metal ring) which holds the cotton plug firmly and is intended to remain with the plug in the canal. Hartmann recommends a substitute for an artificial membrane a small thin rod of whalebone enveloped by cotton wool. Leichtenberg suggested the application of flexible collodion to cover over the perforation in the membrane. Blake has had marked success in some cases by the application of sized paper to the perforation in the membrana tympani. This not only enables the patient to hear better, but contributes as well to the permanent healing of the opening. Gruber states that he has tried various materials for use as an artificial membrane and that those made from linen or silk, as suggested by Czarda, sometimes accomplish more than the others.

In all of these devices, it matters not which may be used, success depends upon so placing the appliance as to induce pressure on the stapes or the long process of the incus, and as a rule the proper location can be found only by repeated trials. In rare instances it is possible to improve defective hearing by means of one of these

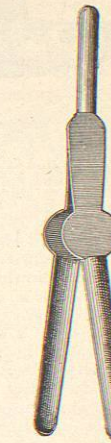


Fig. 1754.—Forceps for Patients to Use in Introducing Cotton Pellets into the Ear. (After Barr.)

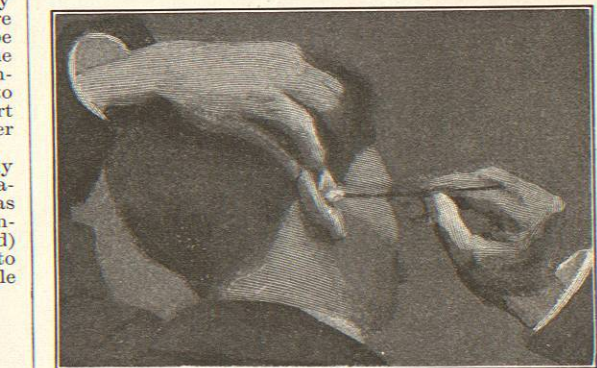


Fig. 1755.—Patient Introducing Disc of Cotton into his Own Ear. (From Barr.)

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