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CAUSES & TREATMENT OF DEAFNESS.

JAMES KEENE.

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A MANUAL OF

AURAL SURGERY,

FOR THE

USE OF STUDENTS AND PRACTITIONERS
OF MEDICINE.

With Illustrations.

BY

JAMES KEENE, F.R.C.S.,

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PREFACE.

WRITING for the use of the student and busy practitioner, rather than for the specialist, I propose in this manual not to enter into the scientific minutiæ of the larger treatises on Aural Surgery, but to limit myself, as far as possible, to the consideration of matters of practical detail. I must refer those who desire more information to many valuable works and contributions to journals which have been published in this country and abroad. I shall endeavour, as concisely as possible, to describe the affections of the auditory apparatus, and point out how these may be recognised and rationally treated. The great importance of the subject, and the fact that some years have elapsed since any complete separate treatise on ear disease has appeared in this country, must be my excuse for endeavouring to facilitate the study of a department of surgery very little understood by the general profession.

When the late Joseph Toynbee first wrote on this subject, England not only took the lead, but was the only country in which really scientific work in aural surgery was cultivated. Now, however, a great change has taken place, and German surgeons occupy that honourable position which we formerly held, while we have gradually but surely fallen into the rear. I am not vain enough to imagine that this small manual will take a place beside those elaborate treatises of Tröltsch, of Gruber, of Politzer, or of Toynbee, which will ever remain monuments of the industry and research of their authors; yet I hope it will be found a trustworthy *resumé* of the more important points to be remembered in every-day practice.

I have divided my subject into two parts. In the first are described the different methods and apparatus employed for the purposes of diagnosis and treatment, together with the various normal and pathological conditions of the auditory apparatus; the second is devoted to the consideration of special diseases. Under this head the arrangement I have adopted in dealing with affections of the middle ear differs somewhat from that of

previous writers. I have ventured to describe catarrh as distinct from inflammation of the tympanum, and to treat of suppuration and plastic depositions as consequences of inflammation rather than as primary diseases. The reasons which have induced me to follow this course are described in page 111, and the fact that my views have been arrived at from the pathological observations of others will tend more to their confirmation than if they had been derived from original research made, perhaps, with preconceived ideas on the subject.

My best thanks are due to several friends who have kindly afforded me assistance while these pages were passing through the press. Among them I will specially mention the names of Dr. Goddard Rogers, Mr. Bird, Mr. Reeves, and Mr. Cuddeford. I have also largely consulted the works of Tröltsch, Gruber, Politzer, Toynbee, Hinton, and Allen, as well as various contributions in the *Archiv für Ohrenheilkunde*, the *Journal of Ophthalmology and Otology*, the *Lancet*, &c.

Having explained the principal objects of this

book and performed the pleasing task of expressing my gratitude to those to whom I am indebted for help and information, it only now remains for me to crave the indulgence of my readers for the imperfections of which no one can be more conscious than myself.

33, Maddox Street, Hanover Square, W.,
March, 1873.

THE CAUSES AND TREATMENT OF DEAFNESS.

PART I.

THE METHODS AND APPARATUS EMPLOYED IN THE PRACTICE OF AURAL SURGERY.

Of the many specialities into which the practice of medicine and surgery has drifted, perhaps none is more thoroughly in the hands of the specialist than the department of aural surgery; and I think I may say without fear of contradiction that none of the specialities receives so little attention from the student and practitioner of medicine. This neglect of an important branch of medical knowledge is due partly to the natural difficulties of a subject in which little assistance is given in the schools, whilst at the same time none of the examining boards require proficiency in aural pathology for their diplomas. But the principal cause, in my opinion, is to be attributed to a very prevalent belief in the incurable nature of deafness. Even at the present time we are not

unfrequently told, and that too by persons of good general information, that deafness seems to be of two kinds, the one which is due to wax in the ears and is curable; the other, which depends upon other causes, and is incurable. This want of confidence in the curative power of aural surgery is, I regret to say, shared by the medical profession, many of whom still believe that nothing more can be done for a case of deafness than to syringe the ears, and if that fail to apply blisters over the mastoid process. At the present moment many ardent workers have devoted their energies to the study of aural pathology, and though in this, as in every other department of medical science, much remains to be done, each year brings important additions to our knowledge; and I hope to be able to show that the advance made by aural pathology, and the success attained in practice, will bear favourable comparison with any other department.

Much has been written concerning the comparative importance of the senses of vision and hearing. Some maintain that loss of sight is of more consequence than loss of hearing, whilst others hold just the opposite view. So long as these senses alone are considered much may be said in support of either opinion, but when we turn to congenital blindness and compare it with congenital deafness, or deafness occurring in very early life, there can be no doubt that hearing is the more important sense, as its loss is necessarily accompanied by dumbness, and few would venture to assert that a

deaf-mute is not more seriously afflicted than one who is deprived of sight only, though that deprivation is immeasurably great. Whatever the comparative value of these senses, their intrinsic worth can hardly be over estimated, and those who have always enjoyed good vision and hearing can with difficulty comprehend the sacrifice which the loss of either entails.

As suming then that the sense of hearing is second to none, every means by which it may be preserved—or, if lost, be restored—is deserving of the serious and attentive study of the profession. A few years ago many of the most important aids to diagnosis and treatment, now in constant use, were unknown, consequently the aural surgeon labored under considerable disadvantages which the modern student escapes, and it may be confidently asserted that aural diseases can now be recognised with the same accuracy as most other affections to which our bodies are liable. In the matter of treatment, too, we are not so far behind: we may congratulate ourselves upon having made vast progress within the last few years, and if the cure of deafness is not as frequent a result of treatment as we can desire, much of the blame is due to the patients themselves, who think too lightly of the earlier stages of the affection, and neglect to apply for relief until the disease is firmly rooted and permanent mischief established. Were the same system adopted with other affections, I fear our boasted success in treatment would dwindle into comparative insignificance.

The study of aural diseases which cause deafness and tinnitus, though considered such a bug-bear to the medical student and practitioner, is by no means difficult, the affections are not numerous, and they bear a striking resemblance to those of the eye, to which it may not be unprofitable to compare them. The organ of hearing, like that of vision, consists of two parts—the conducting and perceptive, and upon the integrity of both these depends perfection of function. In like manner deafness and blindness may be considered as of two kinds, according as they result from disease affecting the conducting or perceptive apparatus. To examine the parts *seriatim*, we find that the eye is provided with certain protective organs, which serve to guard it from the effects of injury and to lubricate its surface. Such are the eyelids, the lachrymal and the Meibomian glands. In the ear, the auricle, meatus externus and ceruminous glands serve the same purpose. We next come to the globe of the eye. The cornea will be represented by the membrana tympani, and the anterior part of the eye, which contains the apparatus for the concentration of light as well as for the regulation of its quantity and focus, corresponds with the tympanum in the ear; the chain of ossicles representing the lens, and the tensor tympani and stapedius the iris and ciliary muscles. The posterior portion of the globe is covered by the expansion of the optic nerve or retina, which receives the luminous rays prepared for its reception in the anterior part of the eye. So in the internal ear or labyrinth

is the auditory nerve spread out to receive sonorous vibrations which have been concentrated or brought to a focus in the middle ear.

In a pathological point of view the affections of the eye and ear are very similar. The auricle, like the eyelid, is liable to various inflammatory and eruptive diseases, and the secretion of the glands in both organs may be altered in quality and quantity. The membrana tympani, like the cornea, may suffer from different forms of inflammation as well as from ulceration, and opacity. Adhesions and fixation of the ossicles, like opacity of the lens and its capsule, offer an impediment to the transmission of sound in the one case and of light in the other. Defects in the accommodating powers of the muscular structure are found in the ear as in the eye, and finally the nervous structure of both organs may be damaged or destroyed. Thus increased pressure on the auditory nerve through the medium of the ossicles, like augmented ocular tension in glaucoma, gradually diminishes and ultimately destroys the activity of the nerve of special sense in both cases, and though the nature of the disease in the nerve structures of the ear can not be so clearly made out during life as in the eye there can be doubt of its existence.

Before the introduction of the opthalmoscope, which has thrown such light on the nature of eye disease, a very large number of cases of blindness was attributed to amaurosis, but as our knowledge of ophthalmology increased, this term gradually disappeared from among diseases of the eye, and they are

now called by other names indicating the nature of the affection. Much the same thing has taken place with ear disease, in which "nervous deafness," so commonly spoken of a few years ago, is now rarely seen by aural surgeons, amongst whom it is almost considered as a synonym for want of knowledge or imperfect observation. I do not mean to say that we have yet attained to so perfect an acquaintance with the morbid anatomy of the internal ear as to be able to ascertain the nature of each lesion of the nervous structure during life, but I do say that we have arrived at that point when we ought, with the aid of modern appliances, to be able to distinguish between affections of the middle ear and those of the nerve structures, and that by so doing we shall very rarely see cases of primary nervous deafness.

In the investigation and treatment of aural disease certain methods and apparatus are employed, and as these come before us at every step it will be well to describe them in the first place. We shall thus avoid much unnecessary repetition in subsequent portions of the work where we shall be enabled to confine our attention to the diagnosis and treatment of each disease, referring to this section for details of the method to be employed. With this apology I pass on at once to the main object of the chapter, and suppose a patient suffering from an affection of the auditory apparatus to present himself for advice—What must we do in order, first, to ascertain what is wrong; and secondly, but chiefly, to set that right?

Having ascertained the name—age—occupation —residence—general health and family history of our patient, which circumstances have the same bearing in ear disease as in other affections of the body, we direct our attention to the special organs of hearing. Dismissing for the moment cutaneous eruptions and malformations of the auricle and its surroundings, which occasionally come before us, we shall find that our patient generally applies to us complaining of one or more of four symptoms, viz.: 1, deafness; 2, noises in the head; 3, pain in the ear; 4, discharge from the ear. He may be suffering from any one or more of these. Thus deafness may occur alone, or it may be associated with tinnitus, pain, and discharge. Tinnitus, or as it is popularly called "noises in the head," is always accompanied by more or less impairment of hearing; sometimes also by pain and discharge. Pain in the ear is generally connected with some degree of deafness, frequently also with discharge and tinnitus. And otorrhœa, or discharge from the ear, is rarely present without some amount of deafness, and not unfrequently also pain and tinnitus. Sonorous vibrations are conveyed to the sensorium by certain conducting apparatus, the integrity of which is essential to perfect hearing. Deafness may therefore depend upon functional or organic disturbance of these parts, or of the nervous centre itself. Tinnitus is an effect of irritation of the nerve of hearing, which may be induced through the medium of the conducting organs, and also, though less

frequently, by direct affection of the nerve itself. Whatever produces irritation of, or pressure on, the membrana tympani will give rise to this symptom, which is sometimes accompanied by giddiness. Pain is generally seated in the external or middle ear, these parts being the ones most abundantly supplied by nerves of common sensation, but it may result from a variety of diseases. The internal ear, in which is placed the nerve of special sense, is not sensitive to any extent to the existence of this symptom. Otorrhœa may depend upon disease of the meatus externus, of the membrana tympani, or of the parts situated internal to the membrane, which in this case must be perforated to give passage to the discharge. Otorrhœa is therefore said to be external or internal, according as the discharge proceeds from the external or middle ear.

Part affected.—We should now enquire if the disease is seated in one or both ears, and which ear is affected or principally affected. It frequently happens, however, that patients believe one ear to be sound when it is in reality diseased, and sometimes also they will state that that ear is worse which will prove on examination the better organ.

Origin of the Disease.—We should next ascertain as nearly as possible the date of commencement of the present and of former attacks on each side. Here again the statement of patients must be received with much caution, as when deafness is the symptom.

complained of, and particularly when it commences in one ear, it may not be noticed until the hardness of hearing has increased to such an extent as to interfere with the duties of every-day life.

Our next question should have reference to the mode of origin of the affection, having specially in view its occurrence in the course of or following some other general or local disease. In reply to this question we may learn that discharge, deafness, or both, have followed one of the exanthemata or fevers. This will probably indicate that the affection depends upon inflammation and suppuration of the middle ear, which may be complicated or not with caries of the bones or polypus. It may, however, though more rarely, be due to diffuse inflammation of the meatus. We may elicit that the symptoms are consequent upon inflamed sore throat, rheumatism, or gout, or that they have come on gradually and imperceptibly without apparent cause. This will be suggestive of inflammation of the membranous lining of the tympanum, which in the absence of otorrhœa will probably be plastic in character, with, possibly, bands of adhesion or anchylosis of the ossicles. In some cases we may discover that the patient has suffered from a granular affection of the naso-pharynx, or that he has been subject to repeated attacks of catarrh, each successive one causing increased deafness and tinnitus. Such cases will most likely prove to be catarrhal, with perhaps accumulation of mucus in the tympanum.

In other instances the symptoms come on after ex-

posure to cold draught or after bathing, and commence with more or less pain. This mode of origin is very little suggestive of the nature of the disease, as it may depend upon inflammation of the external meatus, membrana tympani or tympanum itself, even when accompanied by discharge. The presence of tinnitus however will indicate probable implication of the tympanum in some of its parts, but the character of the attack will not be pointed out. We may be informed that deafness, with probably tinnitus, and perhaps giddiness came on suddenly and without pain, or after bathing or washing the ear or inserting something to clean or scratch the meatus. Or we may learn that a certain degree of deafness and tinnitus, with a sensation of fulness in the ear, has for some time been present, but that after washing or moving the cartilaginous meatus, it has often suddenly disappeared or been greatly alleviated, and perhaps as suddenly recurred. Such causes will naturally suggest to our minds a plug of cerumen in the ear. These are some of the indications afforded by the mode of origin of the attack, but I wish it to be understood that they will not enable us to form our diagnosis, but are merely suggestive, and should serve to direct the line of enquiry to be adopted for the purpose of further elucidation.

Previous treatment.—We shall not unfrequently derive important information by enquiring the nature and result of any former treatment the case may have received before coming under our care,

and as the patient will probably fail to distinguish between the manipulations employed for diagnostic purposes and those used in treatment, his answers will usually convey information on both these points simultaneously. Thus we shall learn whether his case has been investigated and treated in accordance with the rules of modern science, or upon the routine principle of syringe and blisters, and by the knowledge thus acquired we shall be materially assisted in forming a correct diagnosis and prognosis as well as in prescribing a proper form of treament to be pursued.

Taking Notes.—Before proceeding further let me impress upon my readers the importance of taking notes, however brief they may be, of all the cases of aural disease which present themselves. Without keeping some such record we shall have the needless trouble of repeatedly going over the same ground, and being unable to judge what improvement or otherwise has followed our treatment the case will not be satisfactory to the surgeon or to the patient.

The account given by the patient of his symptoms will generally convey some idea of the disease from which he is suffering, and we must now proceed to investigate the objective symptoms, in order that we may arrive at a correct diagnosisa, by which alone we shall be enabled to apply an appropriate line of treatment.

Hearing.—We may commence by testing the hearing power. This we do roughly while ques-

tioning our patient, noticing at what distance he can hear our conversation, raising or lowering the voice until it is distinctly heard. We should record in our note-book *ordinary*, *loud*, or *shouting* conversation, heard at so many feet or inches from the ear. Deaf persons, from constant habit, acquire the power of understanding conversation by watching the movements of the lips, without really hearing. We should therefore be careful to avoid this source of error by placing ourselves in such a position that the patient cannot see our lips. It not unfrequently happens that a patient who understands conversation so well when sitting in front that his defect of hearing is scarcely perceptible, fails to hear our remarks, though in a much louder voice, when we stand behind him or at his side. We may then shout in his ears at a distance of a few inches before he will comprehend. Persons accustomed to deaf patients will also succeed in making themselves heard much better than others, probably from an acquired habit of speaking distinctly and not mumbling the words. We should notice, while conversing, whether the patient seems to listen with a marked effort, as this symptom would probably indicate interference with the muscles of accommodation, generally due to fixation of the ossicles.

In some cases patients will inform us that they hear better in a noise. This symptom is so frequently complained of that we can hardly explain it, as Tröltsch does, by supposing that, under the circumstances mentioned, the speaker naturally raises his

voice. Instances are on record in which deaf persons could only hear conversation in the midst of the noise of a mill, while leather was being pounded on the lapstone, or while travelling over a rough road, which we must endeavour to explain in a more physiological manner. Wilde states that this symptom occurs in cases of relaxation of the membrana tympani; and there is no doubt it does so, but we sometimes meet with the same symptom when the membrana tympani is deficient, and we must therefore seek an explanation which will meet both these circumstances; the one given by Dr. Allen is perhaps the best. The muscles which are connected with the function of hearing are two in number; the tensor tympani, supplied with innervation from the otic ganglion, is an involuntary muscle, whilst the stapedius, deriving its supply from the facial, is a voluntary one. We have already seen that some patients can only hear when they listen attentively, and that they are almost deaf to conversation unless they do so; these exert their hearing power by a voluntary effort, which can only be made by the stapedius muscle, but in cases where its movements are impeded from any cause, or where its action alone is insufficient to produce the effect desired, further assistance is called for which must be obtained from the tensor tympani. Now we have seen that this muscle is not influenced by the will, and can only be brought into action by some other stimulus which is afforded by noise, in the same manner that light will contract the iris quite

uncontrolled by any voluntary effort. The improvement of hearing in the midst of noise is only therefore a manifestation of aggravated lesions of the same nature as those which call for voluntary effort of attention, and, like it, depends upon reduced conducting power of sound through the medium of the stapes to the fluid of the labyrinth and thence to the auditory nerve. This symptom is most frequently observed when the mobility of the ossicles is diminished by thickening and rigidity of the lining of the middle ear by bony anchylosis of the stapes to the fenestra ovalis, or by the existence of bands of adhesion between the ossicles, or between them and the walls of the tympanum. It may also be caused by adhesions or paralysis affecting the stapedius, and so rendering it necessary for the voluntary action of this muscle to be supplied by its involuntary coadjutor—the tensor tympani.

If I am correct in interpreting these phenomena, their existence will afford considerable aid to diagnosis in some of the more obscure cases of deafness. We should therefore be careful to note when this symptom is complained of, and not to set it down as the result of "careless observation," as suggested by Von Tröltsch.

The manner in which patients hear conversation, though affording us some information, is at best but a rough method of estimating the hearing power. For the purpose of more accurate observation it is therefore customary to employ a watch. Having ascertained on persons of normal hearing the distance

at which the tick can be heard, this constitutes a standard by which we can judge the amount of diminution of hearing in disease. Watches, however, differ so much in tone, and consequently in the distance at which they can be heard, that to describe a watch as being heard at so many inches from the ear really means nothing except as regards the particular watch employed. I would therefore recommend keeping record in a manner very similar to that used in testing vision. Thus the watch may be represented by the letter W, and supposing the distance at which it can be heard by the healthy ear be five feet, *i.e.* sixty inches, W $\frac{60}{60}$ would express the normal hearing distance corresponding with the emmetropic condition of the eye. If in the case under observation the watch can only be heard at one foot, *i.e.* twelve inches, $\frac{12}{60}$ would represent the condition of hearing. In each case the denominator of the fraction indicates the number of inches at which the watch can be heard in health; the numerator, the actual distance in the case under examination. When the distance is less than an inch, the addition of a cypher to the denominator would express the quantity in tenths; thus $\frac{5}{600}$ would represent half an inch, and so forth. Contact may be expressed $\frac{C}{60}$; pressure, $\frac{P}{60}$; and if not audible at all, $\frac{0}{60}$. This method possesses the advantage of showing at a glance the distance at which the watch should be heard as well as that at which it is heard. Thus, supposing that a watch, which under normal conditions can be heard at five feet, is only audible at one inch, we may conclude

that there is considerable diminution of hearing; but this will be the case in a far smaller degree should the watch employed be one normally audible at one foot only. As the surgeon usually employs his own watch, precision may seem of very little importance, but in reporting cases and in hospital practice, where other persons may examine the patients, it seems to me of some consequence, and as it is attended with no additional trouble, it can be recommended. Indeed, the more we assimilate our observations to the very accurate methods employed in opthalmology, the more we shall advance the science and art of otology.

The letters R and L may be employed to represent right and left respectively, just as we do in testing vision. When the watch cannot be heard at any distance from the ear some surgeons produce a click by moving backwards and forwards and rubbing together the edge of the nails of the middle finger and thumb.

The common *tuning-fork* is a very useful instrument for diagnosing derangements of the power of hearing, more particularly for distinguishing those caused by disease of the conducting media from those of the nervous structure. Thus, when the hearing is normal the tuning-fork should be audible outside the meatus externus for a longer time than when pressed on the bridge of the nose, vertex of the head, mastoid process, or teeth, and when applied to these parts the sound should be intensified, and also return after it has ceased to be heard, by stopping the meatus. In the application of the fork we

strike and apply it to the bridge of the nose or vertex, telling the patient to inform us the moment he ceases to hear the note; we then quickly remove and hold the tuning-fork close to but *not touching* the meatus; should he then hear it, the disease, if any, is most probably not in the conducting media. We may apply the instrument to the mastoid process and incisor teeth with the same object, though on the teeth I am satisfied that common sensation is quite as much concerned as hearing, and that the patient not unfrequently assures us that he has heard the sound when in reality he has only *felt* the vibration. When shouting conversation is inaudible, and the fork gives no sound to whatever part applied, we may, in most cases, conclude that the nervous structures are affected either primarily or secondarily, or that fixation of the ossicles has taken place. It must, however, be remembered, that in the aged the tuning-fork is often inaudible through the medium of the cranial bones, and also that in all cases, except when applied on the bridge of the nose, it is necessary to use some pressure with the fork, in order that the sound may penetrate the soft coverings of the head, else we are liable to pronounce too hastily an unfavourable opinion, which more careful observation will not warrant. When deafness is caused by obstruction in the conducting apparatus, such as occurs if the meatus externus be filled with cerumen or if the tympanum contain mucus, the tuning-fork placed on the vertex will be better heard in the affected ear, and the sound will be distinguished by

the patient for a longer time than we ourselves can hear it if applied on a corresponding part, and also after it is quite inaudible, close to the patient's ear. The sound, moreover, will not be further intensified by closing the meatus, because this is already closed by the existing obstruction. When a plug of wax has been discovered filling the meatus, which is believed to be the cause of existing deafness, if the tuning-fork pressed on the head be not distinctly heard in the obstructed organ, our prognosis should be very guarded, as a primary or secondary affection of the nervous structures may also be present, which, I need hardly remark, will not be cured by removal of the wax. This will be rendered more probable by the fact that, in the absence of such lesion, the cerumen would cause increased intensity of sound to be conducted to the sensorium through the medium of the cranial bones.

We next proceed to examine the auricles and surrounding parts both visually and by palpation. We look carefully in front of and behind the ears, as well as at the mastoid process. By this examination we shall be enabled to discover the existence of malformations, deformities, injuries, and diseases of the external parts, should any exist. Careful pressure around the ear, more particularly on the mastoid process, should be made in search of tenderness or fluctuation, and we may then pass on to the ocular inspection of the membrana tympani and adjacent portion of the meatus. This affords a very important aid to diagnosis, and for its performance requires in most cases

the use of the speculum. I say in most cases, because it occasionally happens, more particularly in children and those who have a large meatus, that by drawing back the helix whilst the tragus is drawn forward, we may succeed with a good light in obtaining a view of the tympanic membrane, though it is rarely more than partial, owing to the curvature of the auditory canal.

The Aural Speculum consists of a funnel-shaped tube, the narrow end of which should terminate in a cylinder of uniform diameter for about half an inch in extent. Three or four such specula are necessary, varying in size, and may be made of silver vulcanite or porcelain. The first material has the advantage of being more durable, and as it can be made much thinner than either of the other two, it admits of a fuller view, but on the other hand, being heavier, it is not retained so easily without holding. This fault is, however, reduced to a minimum by the form I have recommended, namely, that having the terminal cylindrical part of uniform diameter. When the instrument is conical or nearly conical throughout, it has a natural tendency to spring out of the meatus as soon as the hand is removed from holding it, but in my opinion the most serious objection to the metal tubes as usually manufactured—longer than I have mentioned, and bright—is that they produce deceptive appearances, owing to the oblique rays which are thrown upon the membrane of the drum. These may be readily observed by examining the flat surface of a

piece of paper through the speculum, when we may see a great variety of light and shadow changing in form when we turn the instrument or alter the position of the light. I have thus succeeded in producing an illumination bearing a strong resemblance to the cone of light, which is one of the most important points to be looked for in an examination of the membrana tympani. Sometimes we may observe concentric circles of light, sometimes fantastic figures, all of which are liable to give a very deceptive idea of the surface under observation. These phenomena may be readily explained: the pencils of luminous rays passing from our concave reflector enter the wide end of the speculum, the central ones pass direct to the surface of the membrana tympani, but the exterior rays impinging on the bright surface of the interior of the tube are reflected to the opposite side, and thence strike obliquely the surface of the drum-head, where they produce distortion of the image, and may induce various errors, more particularly when the observer is unaccustomed to making these examinations, and when an oval speculum is employed.

The form of aural speculum I have recommended above (Fig. 1) possesses several advantages, some of which I will enumerate. By the shortness of the parallel portion of the tube it does not penetrate so far into the meatus; there will therefore be no danger of injuring the membrana tympani when a speculum of sufficient size is employed. The instrument extends deeply enough to straighten the meatus without covering the portions adjacent to the tympanum,

which will be illuminated by the oblique rays and can be examined; and these oblique rays not being reflected by the walls of the meatus, we shall avoid the deceptive appearance which they would otherwise produce on the membrana tympani. The shortness of the tube, moreover, possesses the advantage of being less in the way when we require to use instruments in the meatus. The vulcanite and porcelain specula are free from many of the sources of error I have described, particularly when the interior is not too highly polished. A black dull speculum is undoubtedly the best for correctness, although the membrane will not be so brilliantly illuminated.

In the choice of a speculum, one should be selected as large as the meatus will accommodate without distending it so as to cause pain. We shall thus admit the greatest amount of light, and consequently have the advantage of the best illumination of the parts to be examined, whilst at the same time we avoid the danger of pushing the instrument too deeply, which might injure the membrane of the drum.

Siegle's Pneumatic Speculum.—Fig. 8 is an instrument intended to enable us to observe the membrana tympani in vacuo. It consists of a tube, made to fit the meatus externus hermetically. To this tube is attached an air-tight chamber, glazed externally, and into the side of which is fitted a second tube, through which the air may be exhausted by suction. The portion inserted into the meatus being opposite the transparent part of the chamber, we are enabled

to observe the changes taking place in the tympanic membrane while the air is gradually exhausted. This speculum is useful when abnormal concavity of the membrana tympani is present, and will not yield to Valsalvian or Politzer inflation, thus leading us to suspect the existence of adhesion between the promontory and ossicula. In such cases we shall observe the membrane distend unevenly, showing depressions wherever it is bound down to any of the parts within the drum. By employing this speculum we occasionally succeed in relieving deafness and tinnitus more effectually than by inflation, though the benefit will probably be of short duration. We may then instruct the patient to fit one end of a flexible tube into his ear, and to suck at the other end. This will answer the same purpose, without the necessity of any more complicated apparatus; it is, of course, a *sine quâ non* that the tube fit the meatus hermetically, or a vacuum cannot be produced.

The illumination best suited for the interior of meatus auditorius is obtained by directing into it a pencil of converging rays from a concave reflector (Fig. 2), worn in front of the eye of the surgeon. This arrangement is, in my opinion, preferable to the one in ordinary use, in which a hand mirror is employed resembling the ophthalmoscope, but larger. Our reflector should be perforated in the centre, and mounted on a frontal band or spectacle frame, precisely the same as the laryngoscopic reflector, if we employ the lamp and condenser, but should we

prefer to illuminate by ordinary daylight, the focus of our mirror must be shorter—about eight instead of eighteen inches. By using the frontal mirror we shall have both hands free, a matter of considerable importance; as the patient must turn the ear under examination away from the source of light, whilst we require to draw upon the helix with one hand and to introduce the speculum with the other. Under these circumstances it will be impossible to illuminate the parts by means of the hand-mirror, consequently we shall be working in the dark, with every probability of occasionally causing unnecessary pain. Though this difficulty will be overcome by constant practice, it is nevertheless desirable that we should be enabled to observe the condition of the walls of the meatus during the gradual passage of the instrument. When we employ daylight for our examination, it is well to remember that direct sunlight is not so good as diffuse light from a white cloud or reflected from a white wall, and that sunlight is, moreover, liable to burn the patient at the point of focus. When, as not unfrequently occurs, particularly in this treacherous climate, the light is insufficient for our purpose, an Argand gas-burner, with the condenser, as used in laryngoscopy (Fig. 6), is an admirable substitute. In this case, as I have said, the ordinary throat reflector of eighteen inches focus or even a plain mirror will serve, as the rays, concentrated by the lens affixed to the burner, continue in their converging course, the point of the focus being regulated by the distance of the bull's-eye from the frontal mirror.

Artificial light, it must be remembered, always imparts a yellow tint to the object; so that we should mention the illumination employed when we make drawings in colour of the appearance presented. Indeed, it becomes a matter for consideration to the aural surgeon, whether, having due regard to the uncertainty of light, it is not better always to examine the ear by artificial illumination, which will yield uniform results at all times and seasons; as he requires frequently to inspect the throat and to use the rhinoscope, one set of apparatus will serve for all these purposes. I confess to a bias in favour of this method, due, perhaps, to the fact of having worked for some time with my friend Dr. Morell-Mackenzie at the hospital, in Golden Square, where many of my readers have no doubt witnessed his beautiful demonstrations on the throat. The objection to artificial light on the ground of color will soon be overcome by practice, and we shall readily accustom ourselves to disregard the yellowness which it imparts.

In order to make an examination of the ear, if we intend to employ daylight for the purpose of illumination, the patient should be seated close to a window, with the side under inspection turned away from, but not quite parallel to it, so that the shadow cast by his head may not impinge on our reflector. When the lamp is used this should be placed towards the opposite side of the patient and somewhat behind him. We now direct the light from our frontal mirror on to the ear, and as far as possible into the meatus, using the thumb and forefinger of one hand to draw

the helix upwards and backwards, while with the other hand we draw the tragus forward, in order to straighten as much as possible the external portion of the auditory canal. This we should carefully examine in all its parts before proceeding to insert the speculum, which should be introduced with great care and gentleness, and a slightly rotatory movement. It is important to remember that the direction of the meatus is at first somewhat backwards and upwards to about its middle, it is then more forwards and downwards. This results from the projection of the anterior-inferior wall at the junction of the cartilaginous and osseous portions. The position of the surgeon and patient, during an examination with the aural speculum and frontal reflector, is represented in Fig. 10.

Let us now consider the normal appearance of the meatus auditorius and of the membrana tympani which separates it from the cavity of the drum. The external auditory canal varies in length in the adult from an inch to an inch and a quarter or a little more, but it is much shorter in the child. Its calibre is liable to considerable variation, sometimes it will admit a tube of nearly half an inch in diameter, at other times it will only be possible to introduce one the size of a crow quill. In form the meatus is oval, the long diameter being almost vertical in the first part of its course, and more horizontal as we approach the membrana tympani. The upper wall is nearly straight and horizontal; the anterior-inferior wall is curved, the convexity being directed

backwards and upwards, and causing a narrowing of the meatus about its middle. The outer portion, to the extent of about half an inch, is provided with ceruminous glands; these secrete a thin lining of ear wax, which covers this portion of the tube and should be of sufficient consistence to adhere to the walls of the meatus without crumbling, yet without being too thin. The entrance of the meatus is generally studded with hairs, which increase with the age of the patient, and are more abundant usually in men than in women. The inner half should be clean and shining.

The membrana tympani which presents itself to view at the bottom of the speculum (Fig. 14), is concave in the middle, three-fifths of its extent semi-transparent and shining. In color it may be described as neutral grey, with more or less admixture of a yellow brown or purple tint. This varies in different individuals, and in different parts of the same membrane; and is, moreover, influenced according as we employ natural or artifical light in our examination, and according as the membrane is nearer or further from the inner wall of the tympanum. The darkest portion will generally be found in front of the malleus handle, and above the triangular light-spot. I am conscious that even the lengthiest description can convey very little idea of the color which the membrane presents; and I therefore strongly recommend my readers to make frequent examinations with the aural speculum in healthy *living* subjects. The position of the membrana tympani in

the auditory canal varies from an almost horizontal one in the child, to an angle of 140° in the adult, measured from the upper and posterior wall. It is important to bear in mind this peculiarity in children in order to know where to look for the membrane as well as to avoid injuring it by inserting the speculum to an improper depth. In the lower three-fifths of its extent the border of the membrane is sharp, well defined, and whiter in color where it joins the walls of the meatus. At the upper fifth, where, as we know, the sulcus tympanicus is deficient, the boundary line is less regular and impinges upon the superior wall of the auditory canal; at this point, too, its attachment is less firm. Proceeding from the anterior superior margin obliquely downwards and backwards will be observed a yellowish white line, which terminates at the most depressed portion of the membrane situated a little below the centre; this is the manubrium, or handle of the malleus. An imaginary line drawn along the posterior superior border of this bone to the inferior margin of the drum-head would divide the membrane into two unequal segments, the anterior being the smaller. Another imaginary line at right angles to this one, at the inferior point of termination of the malleus handle, would subdivide the circle into quadrants, called antero-superior, antero-inferior, postero-superior, and postero-inferior. It may, perhaps, seem superfluous thus to subdivide a surface whose entire extent is little more than a quarter of an inch, but when we wish to describe the position of a lesion I know of no

better method than to speak of it as being situated in one of these quadrants. Let us now proceed to study the characteristic peculiarities of each, and the topographical anatomy of the parts which it contains; for this purpose I will direct the reader's attention to Plate IV. In Fig. 12 is depicted the annulus tympanicus as seen from without; to this is attached the membrana tympani, through which may be observed the anterior and posterior pockets of Tröltsch as well as the handle and short process of the malleus. Fig. 13 represents the same, examined from within, and shows the malleus and incus *in situ*, with the chorda tympani nerve running between them. Figs. 14 and 15 are drawings of the healthy membrana tympani as it appears through the speculum. In the first of these the membrane is in its normal position, and the principal points to be noted are the pockets of Tröltsch, the short process and handle of the malleus, and the triangular light-spot. In the second the membrana tympani is represented as it appears when drawn inwards by exhausting the air from the middle ear. In this drawing the artist has endeavoured to show the increased concavity thus produced, and also the outline of the long process of the incus which is brought into view. These figures, as well as the four which follow, have been copied from Dr. Joseph Gruber's beautiful work, the *Lehrbuch für Ohrenheilkunde.*

In the anterior superior quadrant is contained the whole of the malleus. Its head projects into the concavity in the superior wall of the meatus, and there

articulates with the incus. This portion is hidden from view by a semi-lunar fold corresponding with the anterior pocket of the membrana tympani. At the posterior part of the semi-lunar line may be distinguished a rounded prominence, not unlike the round head of a small pin, over which is stretched the transparent membrane. This is the short process of the malleus, and must be looked for close to the anterior superior margin. At the lowest point of the manubrium is the umbo, or most depressed portion of the membrane. Along the posterior superior border of this bone run the vessels and nerves of the membrana tympani, very minute and almost invisible in health; but when enlarged by disease, appearing as a red line of varying thickness.

In the anterior inferior quadrant there is nothing to observe but the triangular light-spot; but this is a very important point, as it serves to indicate the amount of curvature of the membrane of the drum, increasing as the concavity diminishes, and *vice versâ*. Its form is that of an isosceles triangle, with the apex at the umbo, a little below and in front of the end of the manubrium, and the base extending close to the inferior margin of the membrana tympani. The effect produced upon the light spot by expiration and inspiration, with the mouth and nose closed, is enlargement of the triangle in the former case and diminution in the latter.

In the posterior superior quadrant, at the upper part, is also a semi-lunar fold, resembling that situated anterior to the malleus, but larger; this

corresponds to the posterior pocket of the membrana tympani. Along the inferior curved edge of this runs the chorda tympani nerve, which may sometimes be seen proceeding upwards and forwards. Parallel with the manubrium, but posterior to it, is the long leg of the incus. It does not extend so far downwards, and it is on a plane further removed from the observer. At the lower extremity of this may occasionally but much more rarely be seen, extending obliquely upwards and backwards, a finer line; this is the posterior crus of the stapes. In order to observe these parts, the membrane must be very transparent, and also drawn in, either by disease obstructing the Eustachian tube, or artificially, by swallowing or making an inspiration with nose and mouth closed.

The posterior inferior quadrant presents nothing for our special attention. In the internal or vestibular wall is the fenestra rotunda, which cannot be seen through the tympanic membrane; but when this is destroyed we may sometimes observe the margin of the depression or fossa which leads to the foramen.

Occupying the central portion of the tympanum opposite the angles of junction of the four quadrants, is the most depressed portion of the membrane, called the umbo, behind which, on the inner or vestibular wall, is situated the promontory. Rays of light piercing the membrana tympani are reflected from the promontory, and passing back again through the semi-transparent membrane are visible to the eye of the observer, modified in color according to that pre-

sented by the inner wall of the tympanum. Normally this structure is yellowish, and imparts the same tint to the membrana tympani, but when congested or inflamed it becomes red and reflects rays of more or less redness, thus giving a coppery hue to the drum-head.

When we have examined a sufficient number of healthy ears to enable us to recognise the normal appearances visible through the speculum, we may enter the field of pathological enquiry. But it is necessary to become well acquainted with these healthy conditions before we can appreciate the very slight deviations which serve to indicate disease.

In passing the speculum we should not omit to notice any pain or tenderness complained of during its introduction, and also the appearance of the walls of the meatus in those parts not already seen. When the previous examination has showed the meatus filled with wax, epidermis, or polypus, it will be evident that no further information can be afforded by the speculum, and, moreover, that its application is likely to be painful and injurious by pressing the foreign body against the membrana tympani, we must therefore defer its employment until the passage has been cleared. It may, however, be remarked that syringing generally causes some hyperæmia, particularly of the vessels of the malleus handle. In order to avoid this it is best, where small portions of cerumen or epidermis impede our view, to remove them through the speculum with a small pair of forceps (Fig. 3). We may find the auditory canal unnaturally dry, or bedewed with secre

tion, or it may be red, hyperæmic, or inflamed. It may contain an increased or diminished quantity of cerumen, which may be abnormally soft or dry in character. We may discover the existence on some portion of the canal of a furuncle or minute boil or of a sebaceous or molluscous tumor. Having made our inspection of the walls of the auditory canal as the speculum gradually enters, we should observe what presents itself at the bottom of the tube. It may be wax lying against the membrana, but insufficient in quantity to be visible without the speculum. This will be of a dark yellowish brown colour, with uneven surface, often glistening with cholesterin or epidemic scales. It may be blood which appears of a black color, or it may be portions of separated epidermis, varying in color from white to yellowish brown. It may be parasitic fungus, white or mouldy green, with a soft woolly appearance. It may be a polypus of a pink or whitish hue, too small to appear externally. It may be a foreign body introduced from without, such as a bead, a button, a stone, a piece of gravel, a grain of corn, a pin, or, in fact, almost anything which children are in the habit of playing with. It may be a fragment of hair, an insect in its mature or larval state; the most insignificant object resting on the membrana tympani often giving rise to very unpleasant symptoms of tinnitus.

These are some of the appearances which may be observed through the aural speculum, but what we should see at the opening at the bottom of the tube

is the membrana tympani, as described page 26, plates 14, 15, which may present a great variety of appearances in proportion to its deviation from a healthy state. The curvature of the membrane may be altered, the most frequent form being increase of the natural concavity. This may be recognized by alteration in the form of the cone of light, which becomes larger and more diffuse. The handle of the malleus appears shortened from being drawn in towards the promontory, whilst the short process looks more prominent than natural. Extending backwards and also forwards from this point may be observed two folds of membrane, the former much more marked than the latter, which may not unfrequently be scarcely, if at all, visible. When the membrane retains its natural transparency we may sometimes be able to see the long leg of the incus as well as the pockets of Tröltsch, the chorda tympani nerve, and occasionally, though faintly, the ramus of the stapes. When the color and transparency of the membrane are unchanged abnormal concavity depends upon obstruction of the Eustachian tube, without implication of the cavity of the drum, or upon contraction of the tensor tympani muscle—the result, probably, of some former disease; but when the membrane presents a purplish, dusky, or peculiar dark gray appearance, in addition to the concavity, there will also be implication of the middle ear; circumscribed concavities of the tympanic membrane may also be observed, due to indrawing of a portion which has become unnaturally thin, or to adhesion existing between it and some part within

the tympanum. The membrana tympani may also be abnormally convex, but convexity of the whole membrane, without alteration of its color and consistence, is never observed, though it may be induced by forcing air into the middle ear. When produced by this cause it is usually less marked in the situation of the malleus handle than around it. Circumscribed points of convexity may be seen in the form of small pustules, or the membrane may be prominent in places from interstitial exudation, from accumulated secretion or from the presence of polypus within the tympanum, with local thinning of the membrane. Inflation of the drum will sometimes produce small circumscribed bleb-like hernial protusions in parts where the membrana tympani is reduced in thickness by ulceration, or protrusions may be caused by air getting between the laminæ of the membrane, which necessarily presupposes a breach of continuity in some part of the internal layers. The color may be whiter than natural, with a more or less dull appearance, resembling that of ground glass. The part of the membrane affected by opacity may be judged by the appearance of the handle of the malleus and the form assumed by the opacity; thus we know, when the opaque film extends over the manubrium, that it must be in the dermoid or epidermoid layer; radiating or triangular patches depend upon the thickening of the external layer, and crescentic or circular ones are due to affection of the internal fibrous lamina. A pink or red appearance of the membrana tympani may be localized in a similar manner, when it is found to

extend over the malleus handle which it conceals wholly or partially, we may conclude that the inflammation or hyperæmia has its seat in the dermoid layer, whilst a pink, coppery, or red appearance, which leaves the manubrium quite clear and white, can only be dependent upon disease of the inner layers of the tympanic membrane, or upon reflection from the reddened internal wall of the tympanic cavity seen through the transparent drum-head. We may sometimes observe an abnormally yellow, greyish-yellow, or mottled appearance of the membrane, either partial or extending over the whole surface, with or without alteration of curvature, by diminution of the natural concavity, which occasionally becomes convex, in parts; this indicates the presence of mucus or pus, or an admixture of the two, with perhaps the addition of serum. When the secretion contained in the middle ear is thin, it will be affected by the laws of gravitation, and accumulate at the lower part, indicating its presence by a dark line corresponding to its upper border. This dark line generally assumes a curve upwards and alters its position with every movement of the head. When the secretion is thick and tenacious in character, it usually adheres to the ossicles, most commonly around the articulation of the malleus and incus, where it will be recognised by the grayish yellow appearance which it imparts. The tympanic membrane will sometimes appear red, uneven, and granular, like the surface of a raspberry, with purulent secretion between its small prominences. This indi-

cates separation of the dermoid layer or the formation of polypus, which affections can only in some cases be distinguished from each other, particularly if the surface be convex, by employment of the probe; this will pass under the edge of a polypus, which it can not do when the appearance depends upon ulceration. We shall also find polypous growths more moveable. The condition here described may be confounded with a soft granular state of the promontory, occasionally seen after destruction of the membrana tympani, from which it is sometimes impossible to distinguish it, even with the combined use of a probe and inflation of the drum. After the red granulations have disappeared in a case of ulceration of the external surface of the tympanic membrane we may sometimes observe radiating lines with more or less injection remaining, as represented in Fig. 16; this appearance is due to thickening of the outer fibrous lamina exposed by separation of the dermoid layer. Sometimes we may detect one or more perforations in the drumhead, which assume a great variety of form and size (Fig. 18, 19). When small they appear black, but when large enough to permit illumination of the interior of the tympanum, the color of its walls will be seen through the opening.

Inflation of the Tympanum—Valsalvian method.—After having completed our observations with the speculum, we direct the patient to hold his nose and mouth closed and to blow. This, in the normally patent condition of the Eustachian tubes, inflates

the drum on each side, and is called the *Valsalvian method.* As we shall constantly have occasion to speak of this mode of inflation, it is important to remember how it is effected. It should be performed before removing the aural speculum from the ear, and, as I have said, after the examination with it is complete. These directions should be strictly carried out; because if we direct our patient to inflate before we have noted the condition of the membrana tympani, we shall be apt to find, in addition to abnormal convexity, congestion of the vessels which run along the posterior border of the malleus handle, and even in some cases a reddened appearance of the whole membrane from congestion of the internal wall of the tympanic cavity showing through. It is well also that the Valsalvian experiment should be performed, in the first instance, while the speculum is in the ear, because we shall be enabled to note several important conditions under its influence. The entrance of air into the drum will be indicated by the membrane becoming more convex; this is known by an alteration occurring in the form and size of the triangular spot of light. When this is observed no doubt remains of the perviousness of the Eustachian tube, though the converse does not equally hold good, as it not unfrequently happens that the alteration of the membrana tympani under inflation is not observed, although it may occur. This may depend upon movements on the part of the patient or some other cause during the act of blowing; it is therefore always well to enquire of the patient whether he has

felt or heard anything in the ear, as he may often be conscious of the entrance of air, though the surgeon may fail to see its effects through the speculum, or even hear them with the otoscope.

A *manometer* has also been devised for the purpose of indicating whether or not air penetrates the tympanum during inflation. The instrument consists of a U-shaped tube of small bore, one end of which terminates in a short horizontal portion, made to fit the meatus hermetically. In the bent part of the tube is placed a small quantity of colored spirit, which will move upwards in the arm further removed from the ear, when the membrana tympani is forced outwards. If the manometer be graduated, the extent to which inflation occurs may also be measured, but it will not afford so much information as the otoscope when this can be efficiently employed.

In affections of the tympanum certain deviations may be observed through the speculum during inflation; if the tympanum contain fluid, which by the laws of gravitation occupies the lower part of the drum, and shows a curved line across the membrana tympani, Valsalvian inflation may change it into a spotted appearance, from bubbles resting against the internal surface of the drum-head. When the contents of the tympanum are of greater consistence and flakes of mucus can be seen through the membrane, these may sometimes be displaced, and thus their nature will be disclosed. Again, when thin spots exist in the membrane, these parts yield and appear like vesicles on the surface, or when perforation has taken

place, we see air bubbles rising from the opening if within the range of observation, or from the discharge which is generally present in the meatus in such cases.

Politzer method or Air Douche.—Fig. 11.—As I have already observed, we may sometimes fail to satisfy ourselves of the permeability of the Eustachian tube by the Valsalvian method, either on account of the inability of the patient to perform the operation properly, or our being unable to see or hear the effects of inflation; the *Politzer method* then affords increased facility for the entrance of air. It has been demonstrated that the pharyngeal orifice of the Eustachian tube is opened during the act of swallowing, and the circumstance is turned to account in this method, which consists in causing the patient to take into his mouth a small quantity of water, which he is directed to swallow at a given signal. A tube attached to an india-rubber bag containing air, called Politzer's bag (Fig. 4), is introduced into the nose, which the surgeon closes round the tube by compressing both nostrils between his finger and thumb.* The patient then receives the signal to swallow, and at the same moment the surgeon compresses the bag. This forces a stream of air into the nares, which ought to penetrate into both tympanic cavities with a distinct sensation to the patient. In order to avoid hurting the delicate mucous membrane of the nose with the point of the nasal tube, it is

* This is not shown in Figure 11.

advisable to cover this with a small piece of india-rubber tubing, which should extend a little beyond its extremity. In the absence of this precaution, a few drops of blood will occasionally follow the operation. It is important in using the Politzer bag to withdraw it from the nostril before allowing it to expand, or it will charge itself with nasal mucus, which would not be conducive to the cleanliness of the apparatus. To obviate this, certain modifications have been introduced by adapting a single or double valve to the bag, and also by substituting air-pads to be pressed against the notrils in the place of the tube to be introduced within. The single valve at the bottom of the bag is, perhaps, an improvement; the second valve, however, being required at the neck of the instrument, has been found to increase the noise of blowing, and consequently to place further difficulties in the way of auscultation. The air-pads do not constitute an efficient substitute for the tube, and cannot be recommended.

Though it is very usual to employ the otoscope during the Politzer method, the rush of air into the posterior nares, and the gurgle it produces in the water which the patient is swallowing, in most cases precludes the surgeon from deriving much information. It should be mentioned that in children the orifices of the Eustachian tubes are naturally much more patent than in adults, and that, in consequence, it will be unnecessary for them to take any liquid into their mouths, or to swallow during the administration of the air-douche. This fact is of consider-

able importance in practice, as it would be difficult or impossible to teach a child, already somewhat alarmed by the necessary preliminaries, to perform its part satisfactorily. Some aurists object to the employment of the Politzer bag, on the ground that cold air is driven into the tympana. They prefer forcing warm air from their own lungs through a flexible tube, one end of which is placed in their mouths, while the other is placed in the patient's nose. I confess the objection appears to me very trivial, compared to that of forcing the patient to inhale the breath of another person. Whatever method we employ for producing a blast of air, the other steps of the operation remain the same. When we fail in the first attempt to inflate both drums, either from narrowing of the tubes or from the fact of the patient not having swallowed at the right moment, we may repeat the operation two or three times. This method will often succeed, even where the Valsalvian has failed, and deafness, depending upon obstruction of the tube, may sometimes be instantly removed, much to the surprise and delight of the patient. Where, however, the cause depends upon closure of the tube from thickening of its walls, the deafness will return after a time sufficient to permit the air within the drum to become again rarified, but a repetition of the inflation will be attended with equally beneficial results. In cases such as these the principle so universal in our art, "Sublatâ causâ tollitur effectus" applies, and we must direct our

attention to the cause, before we can hope permanently to benefit our patient. But of this more hereafter, when we come to the treatment of these affections.

Eustachian Catheter.—Whilst on the subject of inflating the tympanum it will be well to describe the Eustachian catheter, although it is rarely employed, and I think never needed for the purpose of diagnosis, though it is of the greatest service in treatment. Some surgeons, particularly on the continent, are of a different opinion; but since the introduction of Politzer's method, their number is gradually diminishing. The Eustachian catheter is a tube of six inches in length, slightly curved at its extremity for the last inch and a half, the curve forming a segment of a circle of about one and a half inches. The instrument may be of metal or ebonite, and should be slightly bulbous at the Eustachian extremity, thereby avoiding sharp edges. Near the handle of the catheter, on the side corresponding to the concavity of its curve, should be placed a ring parallel with the length of the tube, This serves to indicate the direction of the point of the instrument and also to enable it to be turned with greater facility. Three catheters of different sizes will suffice in practice, the opening in the handles of each being of equal calibre, so as to fit a nozzle of the same size for the purpose of inflation or medication when required. The metal instrument should be made of thick soft silver,

so as to admit of being bent without flattening or breaking. Before using the catheter we must never omit to ascertain that it is pervious, for the mucus of the nasal passages is very liable to cause rather obstinate plugging when it is allowed to remain and dry in the tube. This would, of course, give rise to erroneous impressions regarding the perviousness of the Eustachian tube, and might also be the means of introducing an obstruction instead of removing one. The readiest method of cleaning the instrument when stopped up is to soak it in an alkaline solution, which will soften the contained mucus and enable it to be blown out.

The introduction of the Eustachian catheter, though at first sight it may appear to be a difficult operation, can, after a little practice, be performed with the greatest ease in most cases by adopting the following rules :—

The patient being seated opposite the light with his head bent slightly backwards, the operator should take a catheter of proper size in the right hand, with the point directed downwards, and, standing facing the patient, he should introduce the instrument into the nostril of the same side as the Eustachian tube to be operated upon, resting the point on the floor of the nasal cavity, which will serve as a guide until the upper part of the soft palate is reached. The point of the catheter will then be felt to descend, producing a corresponding elevation of its handle, which the surgeon should continue to glide onwards until the further progress of the in-

strument is stopped by impinging on the posterior wall of the pharynx, the resistance of which will be distinctly perceived. The catheter should now be turned so that the ring in the handle may be directed outwards; it should then be withdrawn to the extent of half an inch, when a slight turn of the ring upwards will cause the point to enter the mouth of the Eustachian tube, where it should be grasped so that the handle can no longer be turned either upwards or downwards without withdrawing it.

Surgeons differ in opinion as to the best and easiest method of introducing the Eustachian catheter. Some recommend the point of the instrument to be turned upwards and outwards on reaching the soft palate without touching the wall of the pharynx, when it will be found to enter the tube on passing it a little further onwards. Others, again, introduce the instrument with the point directed outwards instead of downwards. These plans are not so easy as the one I have recommended, and are much more liable to be attended by failure.

In some cases it will be found impracticable, from obstruction in the nostril, to introduce the catheter on the same side as the Eustachian tube we wish to penetrate. This most frequently occurs on the left side, owing to a common congenital deviation of the septum of the nose towards this side. It may also occur on either side from enlargement of the inferior turbinated bone, from tumor of the antrum, polypus of the nose, &c. In such cases we shall have to resort to catheterism through the opposite nostril.

For this purpose we must employ an instrument of greater curvature, which should be passed in the same manner as described above, until it reaches the posterior pharyngeal wall, when after withdrawing it half an inch as before, its handle should be turned inwards instead of outwards.

The catheter will be known to be in its proper position in the Eustachian orifice by the following circumstances :—

1. It will form an almost right angle with the plane of the face.

2. It will remain immoveable during speaking and swallowing.

3. It will be felt firmly held, so that it cannot be turned without first withdrawing it.

4. When air is blown through the instrument by the surgeon, it will be felt by the patient in or towards the *ear* and *not in the throat.*

5. When the Eustachian tube is not impervious, we may inflate the tympanum and hear the air penetrate with the otoscope.

The principal causes of failure in catheterism of the Eustachian tube in the manner I have described arise from (1) allowing the instrument to escape from the inferior into the middle meatus of the nose, and (2) from not withdrawing the instrument sufficiently after touching the posterior wall of the pharynx, thus placing its point into Rosenmüller's fossa, situated behind the orifice of the Eustachian tube. In both cases if the catheter is introduced to a sufficient extent, it will be in the pharynx, and will

consequently be influenced by the pharyngeal muscles which will cause it to move during swallowing. In the former case, moreover, the angle formed by the catheter with the plane of the face will be obtuse above, and acute below, and the point of the catheter not being in the Eustachian tube, air will not enter the ear of the patient, and consequently will not be heard by the surgeon through the otoscope.

Besides the difficulties I have mentioned, other causes of failure may occur depending on disease, such as closure of the tube by the cicatrix of an ulcer, or the presence of a polypus in the naso-pharynx obstructing the entrance of the tube. The point of the catheter may also penetrate the mucous membrane, either through an ulcerated part, or through an opening made by using too much violence with too sharp an instrument, air may then be forced into the areolar tissue. Fatal cases have been recorded from this cause, which must, I fear, be attributed to a want of proper skill and caution. Nervous patients and children will not unfrequently give much trouble by resisting the passage of the catheter, owing to the dread they entertain of the operation; should we, however, succeed in passing the instrument once or twice with proper gentleness, this repugnance will often be overcome. In order to acquire gentleness and delicacy of touch, I know no better plan than for the surgeon to pass the Eustachian catheter on himself, after having practised the operation a few times on the dead subject. Nothing speaks more feelingly to our

senses than experimenting on ourselves; we thus acquire correct knowledge of the peculiar feeling of the parts; we learn where they are most sensitive, and we discover the best method to avoid inflicting unnecessary suffering on our patients.

The catheter is employed for the purpose of in-inflating the tympanum, and of applying to it and the Eustachian tube medicated liquids and vapors in the manner described further on. It serves, moreover, as a guide through which bougies of whalebone, catgut, or laminaria may be passed, so as to dilate the Eustachian tube in cases where this is constricted by plastic deposition in its walls. The bougies should be blunt and conical at the point, and should have marked upon them the length of the catheter through which they are introduced. Above this, towards the handle, they should be graduated, so as to enable us to know the distance they pass beyond. In their passage these instruments not unfrequently cause pain, usually at the point of junction of the cartilaginous and osseous portions of the tube. In order to facilitate the introduction of the bougie, it will sometimes be found advantageous to withdraw it a little, or to rotate, and glide it onwards with a sort of screw movement, as in urethral catheterism. We shall often succeed in making the bougie enter the cavity of the tympanum, where it may be seen with the aid of the speculum, at the lower part of the anterior superior quadrant. The passage of bougies, though occasionally very useful, is not frequently required, and has been known to give

rise to emphysema of the neck, even where every precaution appeared to have been taken.

Having dwelt at some length on the various methods employed for inflating, I will say a few words about exhausting the air in the middle ear, which may be effected by swallowing, or making a forced inspiratory effort, while the nose and mouth are closed. This increases the concavity of the normal tympanic membrane, and not unfrequently induces temporary tinnitus, which, however, disappears again on swallowing with open nostrils. By the operation we obtain a better view of the deeper structures of the tympanum, and may sometimes succeed in dislodging secretion which it contains, more particularly when there exists perforation of the tympanic membrane, in which case we may also cause liquid placed in the meatus to pass through the tympanum into the throat.

The Otoscope or Diagnostic Tube.—I have somewhat digressed from the regular order in which the examination of our patient should be conducted, to return to which we will suppose our inspection with the speculum completed and that we are about to resume our investigation by the employment of the otoscope, or as some prefer calling it, the diagnostic tube. This instrument requires very little description—it consists of a simple india-rubber tube of about eighteen inches or two feet in length, provided with a nozzle at each end of suitable size for introduction into the auditory meatus. These nozzles

should be made of india-rubber or ivory, or if it is desired to distinguish one end from the other, so that one should be used for the surgeon's ear, whilst the other is reserved for the patient's, one may be of white ivory, the other of black-rubber, or they may be of different shapes. Some surgeons employ a simple india-rubber tube without nozzles. This serves equally well as a conveyor of sound, and being soft may be introduced into the ear without causing pain or distension even when the meatus is tender. The otoscope like the stethoscope serves for the purpose of auscultation, and like it requires considerable practice to enable us to appreciate the knowledge which it imparts. It affords us information of the permeability of the Eustachian tube, of the consistency of its contents, as well as that of the tympanic cavity. We may also learn from its use the condition, with respect to flexibility, or rigidity of the tympanic membrane.

For the employment of the otoscope it suffices that one end be inserted into the ear of the observer, whilst the other is placed in that of the patient taking care that in no part of its length the tube is in contact with a portion of the dress or any other substance, which may cause friction. Having by this precaution guarded against the production of extraneous sounds, the patient is directed to hold close his mouth and nose and to blow, or what is perhaps better, the surgeon compresses the alæ of his patient's nose for him, and directs him to blow. When the Eustachian tube and cavity of the tympanum are in a healthy state, the

air will be heard to enter the middle ear with a peculiar sound which has been variously described by different observers as a sound like rain falling on the leaves of trees—a vesicular murmur—a faint crackling sound, and so forth; but with these, as with respiratory and cardiac murmurs, all comparisons and likenings are at best approximative only, and more may be learned in a few minutes concerning them by using the instrument, than by any amount of likening and comparing. No difficulty will be experienced in finding plenty of opportunities for practising auscultation of healthy ears, and every student of aural surgery should avail himself of them. After having thoroughly learned to recognise the normal sounds, he will be able to appreciate those which occur in disease.

Instead of the natural healthy sound of air penetrating the tympanum, we may hear through the otoscope coarser crepitation or gurgling, which tell us that the secretion in the tympanum or Eustachian tube is present in abnormal quantity. If the sound appear far from the ear we infer that it is situated in the Eustachian tube, whilst nearer approach indicates that it is in the tympanic cavity. The nature of the crepitation or gurgling, moreover, serves to point out the consistence of the secretion, but these are refinements which can only be appreciated by the expert otoscopist. We may sometimes find that inflation is accompanied by a sound resembling somewhat the crackling of parchment, this is indicative of rigidity of the membrana tympani, and also suggests

the possibility of the co-existence of the same affection of the fenestral membranes with or without thickening or schlerosis of the coverings of the middle ear.

Examination of the throat and fauces.—The great frequency with which the middle ear is affected by extension of disease from the throat, renders it imperative that the part be carefully examined. This may be most easily and effectually performed by sitting opposite the patient, who must be so placed that the lamp, Fig. 6, is at one side of and somewhat behind him. With the frontal reflector, of eighteen inches focus, the surgeon should direct the light into the patient's mouth, which ought to be kept open as widely as possible, and the tongue within the hollow of the lower jaw. This the surgeon depresses near its root with a spatula, or what is perhaps better, because less liable to induce spasm, with the index finger of the left hand, and thus a view will be obtained of the pillars of the fauces, the tonsils, and uvula, as well as the portion of the posterior wall of the pharynx, which lies behind the faucial arch. Some surgeons recommend that the patient be directed to take a deep inspiration, or to phonate "A" or "Ah," while the throat is being examined; in my opinion, however, nothing is better than easy respiration without straining.

Rhinoscopy.—The directions above enumerated apply equally when we desire to examine the parts situated above the soft palate; but, in addition, we

must place a well-warmed laryngeal mirror under the velum palati, with the bright surface directed upwards and forwards. Care must be taken not to touch the posterior wall of the pharynx, as this is very liable to induce spasm. When the space is sufficiently capacious, we shall see the upper surface of the soft palate and uvula, the posterior nares with their fossæ, and, by inclining the mirror slightly to either side, the orifices of the Eustachian tubes will be brought into view. With some patients it is advisable that they be requested to phonate "Ah" during rhinoscopy, this will occasionally assist in opening the space for the mirror, but in most cases easy respiration is preferable. Some surgeons recommend the patient to breathe as much as possible through the nose with the mouth open, which usually raises the root of the tongue to such an extent as to close the faucial opening, a movement quite unfavorable to rhinoscopy. Of this anyone will be satisfied by making the experiment on himself before a looking-glass. The advantage of the finger over every kind of tongue depressor is very manifest in rhinoscopy; by it we avoid spasmodic actions on the part of the patient, and also depress the centre of the tongue near its root where it is most needed, in order to make way for the mirror.

Let us now glance briefly at the affections to which the throat is liable, and which to a greater or less extent contribute to the causation of disease of the ear and deafness. Amongst these must be enumerated almost every disease having its seat in the parts

bounded in front by the palatine arch, at the sides and behind by the pharyngeal walls, above by the base of the skull, and ending below on a level with the glottis. These parts may be red and congested or inflamed, or they may be pale and relaxed, with purple or blueish vessels coursing over them; or they may be abnormally dry, with or without adhering patches of thick mucus of a dirty color. The posterior pharyngeal wall should be carefully examined, as I have there known ulcers of large size escape detection on account of the yellow glistening appearance they present. Granular pharyngitis, a disease which affects the mucous follicles, causing them to swell in the form of pale granulations, which vary in size from a coarse grain of sand to that of a millet seed or even larger, not unfrequently occupies the surface of the soft palate as well as the posterior wall of the pharynx. The uvula may hang down in the form of a transparent sac, pale in color or bright red. The eruptive fevers, more particularly scarlatina, frequently attack the throat whence the inflammation spreads to the tympanum, carrying with it, unperceived—suppuration and destruction. Syphilis, too, not uncommonly affects the throat, and occasionally causes disease within the tympanum. Sometimes also it produces ulceration at the opening of the Eustachian tubes, which may be closed by cicatrization of the ulcer.

Diagnosis of Aural Disease.—Having placed before my readers the principal methods at our

command for the purposes of diagnosis, I will now endeavour to point out how their employment enables the surgeon to arrive at correct conclusions concerning the nature of aural disease. Let us suppose that we have before us a case of deafness; we should first note its amount in each ear as tested by the watch. Our next care should be to localize the defect of hearing in the external, middle, or internal ear, and with this object we apply the tuning-fork over the nasal or some other cranial bone. Should the power of hearing it be diminished or gone (the patient not having passed middle age) we may infer either that the nervous structure is affected or that there exists some fixation of the ossicles. But should the tuning-fork be heard as perfectly or more so than under normal conditions, we may at once exclude from our calculations disease of the internal ear. A careful ocular inspection of the meatus should next be made, assisted, if necessary, by the use of the speculum. By this we shall discover the presence of cerumen or other foreign bodies, of tumors, or of swelling of the walls of the meatus, which obstructs the passage of sound, if any exist. Should the meatus be clear and free from disease the affection cannot be in the external ear, and must consequently be sought in the tympanum. If the case be accompanied by severe pain or febrile symptoms it will be either acute inflammation or it may possibly be an early stage of herpes zoster in the course of the auricular nerve of an ear already affected by chronic diseases. The former, however, may be excluded, if

there be no tenderness of the meatus, and if there be decided intermission in the symptoms. Should the deafness come on rapidly in connection with a catarrhal affection of the nasal or pharyngeal mucous membrane, accompanied by obstruction more or less firm of the Eustachian tube, with perhaps moist sounds on inflation, but without pain, it will probably be due to acute catarrh of some portion of the tympanum. Should these symptoms continue for a considerable time, or should the affection come on more slowly but in a very similar manner, the sounds audible through the otoscope being a gurgling of a coarse character, which gradually merges into a sort of squeaking sound, chronic catarrh, or its consequence, —obstruction of the middle ear by retained mucus— may be suspected. If, as a result of acute inflammation and pain, or without much pain, we find gradually increasing deafness, both for external sounds and for the tuning-fork applied to the head, but without discharge from the ear or yellowness of the tympanic membrane, if the patient require an effort of attention to hear, or if he hear better in the midst of noise, it will indicate plastic depositions, with perhaps condensation, schlerosis, or anchylosis within the middle ear. Should we, however, detect perforation and discharge, suppuration, with possibly necrosis or caries, may be diagnosed. Such is a brief and somewhat imperfect outline of the deductions to be drawn from the application of the various methods which we employ in the investigation of aural diseases, but which I hope will be sufficient to direct the student

to that portion of the work wherein he will find a more detailed account of each affection.

The Treatment of Aural Disease.—Having already described, in connection with diagnosis, several methods which I stated were likewise employed for the purpose of treatment, it will be unnecessary to return to them here: we will now therefore direct our attention to those plans which have not yet been considered.

Aural Syringe.—In treating diseases of the ear we shall constantly require to use a syringe, and the best form of instrument for our purpose will be found to be one of brass, made to contain three or four ounces of fluid, and provided with rings at the sides through which to pass the fore and middle fingers, whilst the thumb is inserted in another ring at the end of the piston-rod. We should have two nozzles to our syringe made to fit on without screwing, either by a tightly-fitting conical joint or by a bayonet joint, thus enabling us to remove them quickly for the purpose of filling. The nozzle for cleansing or removing cerumen and foreign bodies from the external meatus should be moderately thin and probe-shaped, so as to give a fine stream, the strength of which can be regulated by the pressure of the thumb on the piston. The second nozzle should be round-pointed, conical, and of sufficient size to fill the meatus externus. This serves to force liquid through the middle ear and Eustachian tube into the throat,

in cases where perforations of the membrana tympani exist.

The ear syringe, as already suggested, is employed for two purposes, namely, to wash out the external meatus, and the middle ear. When using it for the former object (Fig. 9), the patient should be seated with head erect, a towel placed round his neck, and a shoot fixed under his ear, by means of a spring passing over the head to the opposite side, so as to avoid wetting him or his clothes. I have had the shoot modified, by adapting to it a funnel extremity; to which is fitted a flexible tube, to conduct the fluid flowing from the ear into a basin placed on the table; a grating in the interior prevents the possibility of it becoming blocked with particles which escape. By this appliance the surgeon will obviate the necessity of having assistance to hold a basin or tray for the purpose of catching the liquid as it flows from the meatus, while both his hands are occupied; the one in manipulating the syringe, and the other in drawing the helix upwards and outwards to straighten the auditory canal. If it be our object to remove a plug of cerumen, a powerful stream from the syringe should first be directed into the meatus and made to play upon the margins of the obstruction. When, by this means, we have loosened its adhesion to the walls of the canal, or when the purpose of using the syringe is to extract some foreign body, we may direct the jet principally to the upper part, where usually the liquid will penetrate behind the plug and thus drive it out-

ward, until it will escape into the shoot. We should carefully watch for this result during the operation, and introduce the speculum from time to time; as it is hurtful to prolong the syringing after the foreign body has been removed. All fluids injected into the ear must be warm, or they will be liable to cause pain and giddiness. It is advisable, moreover, that the syringing be not prolonged, even though we fail to remove the object of our search, as it is better to return to the task at a future time, than to run the risk of setting up irritation by injecting for too long a time at once. In the interval between the sittings, should the obstruction be caused by hardened cerumen, we may endeavour to soften it by directing the patient to place warm water and glycerine in the ear with a small pellet of cotton wool; we should recollect that putting drops into an ear which is plugged with wax is very liable to increase the deafness, it is desirable therefore to state this to the patient, or he may think we have damaged instead of improving his hearing. Inflammation of the middle ear occasionally follows the removal of cerumen, from the increased admission of cold air, which should be guarded against by applying cotton wool for a few days after the syringing. Though clearing the auditory meatus by the means I have described may seem a trivial operation, it requires for its effective performance some skill, and much patience and perseverance; we should never, therefore, conclude that the meatus is clear, because a patient tells us that he has frequently had recourse to syringing, even though

that may have been done by the ordinary attendant. We must bear in mind, too, that injecting not unfrequently causes hyperæmia of the auditory canal and tympanic membrane, and for this reason it is always preferable, when it can be done without irritation, to remove small obstructions to our view, if we intend to make an examination afterwards, with the forceps, delineated in Fig. 3. When we require to syringe, for the purpose of removing discharge from the meatus, prior to making the inspection with the speculum, a very gentle stream should be employed. Before leaving this subject, I will add that syringing the ear *should never be performed unless this contains something to be removed*, and that although so commonly employed under the impression that it can do no harm, this operation is very frequently the cause of injury to the organ of hearing.

In cases where patients suffer from otorrhœa, it is necessary that the meatus should be frequently washed out; for this purpose it is preferable to recommend them to employ a douche, by which a very gentle stream is guaranteed. With this view a small reservoir perforated at or near the bottom, and provided with a flexible tube serves the purpose best. By raising this slightly above the level of the ear, a mild current may be made to flow into the meatus, which will thus be purified. This is necessary, not only for the purpose of cleanliness, but also to remove the secretion before applying ear drops. We must not omit to inform our patients that all fluids for the ear require preliminary warming.

For the purpose of passing a stream of liquid through the middle ear our patient should be seated with the head bent forwards over a basin, and he should breathe through the mouth only, which must be kept wide open for the purpose. The syringe having been filled with the liquid to be injected properly warmed, the nozzle is to be inserted firmly into the meatus externus, and the piston gradually pushed down. The fluid will thus pass through the Eustachian tube and escape by the nostrils. In this manner we shall frequently remove masses of tenacious dark-colored mucous of large size, which have probably been lodged in the mastoid cells. When this results from the operation, we not unfrequently find great improvement of the hearing to follow. Alkaline solution of bi-carbonate of soda or potash, 5-20 grains to the ounce, is a better solvent in these cases than simple water. Syringing through the tympanum is of use in the treatment of cases of perforation of the membrana tympani which often prove obstinate to cure, and also after puncturing the membrane in cases of retained mucus in the middle ear. Of course it requires the Eustachian tube to be permeable, and where it is not so, we must be satisfied with syringing in the manner recommended for the removal of foreign bodies from the meatus.

In addition to the method already described for injecting the middle ear through the meatus externus, certain other plans are employed by which fluids and vapors may be applied through the Eustachian tube

either with or without the catheter. A syringe may be fitted to the catheter, a plan I do not regard with great favor, because, by the rigid and inflexible nature of the apparatus, the patient is liable to be put to unnecessary pain. What I consider a preferable method, and one now in general use, is to place a few drops of the fluid, intended for injection, into the catheter. This may be done before inserting it; when a small cork applied to the external opening will prevent the liquid escaping, or we may drop the fluid into the catheter while *in situ* by means of a small syringe or drop-bottle. A puff from the air-bag will then drive the injection into the middle ear in the form of spray. The operation may also be performed by means of a bottle (Fig. 7), through the cork of which pass two bent glass tubes, the shorter of which terminates immediately inside the cork, whilst the other dips to within an eighth of an inch from the bottom of the bottle; to the former of these should be attached the flexible tube of the inflator of a Richardson's spray apparatus, and to the other also a rubber tube connected to the catheter by means of a nozzle inserted into its handle. The tympanum may thus be injected by pressing the air-bag without causing any motion or jarring of the catheter. By changing the direction of the current through the bottle in this apparatus we may also employ it for injecting medicated vapor. For this purpose any volatile liquid we wish to use should be placed in the bottle; the current of air from the inflator should then be driven through the longer

tube into the liquid, through which it will pass out, charged with volatile principle, by the shorter tube into the catheter. Acetic ether—tincture of iodine—iodic ether—or other volatile liquids may be thus employed, always bearing in mind that the bottle should never be more than one third full. When we wish to employ two gasses in combination, such as is done in the production of chloride of ammonium vapor, a bottle containing hydrochloric acid should be connected by means of two tubes, which dip below the liquid, with two jars, in which are contained liquor ammoniæ and hydrochloric acid respectively. These should, by means of a double tube, be attached to the inflating apparatus. Hydrochloric acid and ammoniacal vapors thus enter separately into the bottle under the surface of hydrochloric acid, where they unite to form chloride of ammonium vapor, which is thus applied in a nascent condition to the interior of the tympanum. Instead of Richardson's inflating apparatus of india-rubber some prefer to use a forcing-pump, but the principle is the same whatever apparatus we may employ.

Another very ready method of injecting vapour into the tympanum consists in passing a current of air from an inflator through a receptacle open at each end, and containing sponge impregnated with the volatile liquid we wish to use. We may also employ an india-rubber bag with a valved opening at each end, to each of which is affixed a flexible tube, the one inserted into the liquid or vapour we wish to inject, whilst the other is connected with the Eustachian

catheter. Fluids may likewise be forced into the middle ear without the aid of any apparatus by causing the patient to hold the head horizontally on the side to which we wish to apply our medication, a drachm or two of the liquid should then be injected through the nostril into the naso-pharynx, where it will rest on the open end of the Eustachian tube; the Valsalvian or Politzer inflation will then drive some of it into the tympanic cavity; or again, if the tympanic membrane be perforated, drops placed in the external meatus may be caused to flow into the tympanum by an inspiration with nose and mouth closed. By a forced expiration under similar circumstances, bubbles of air will pass through the fluid, which will subsequently obtain admission into the cavity of the drum. In a variety of ways, therefore, we may succeed in applying remedies to this part, and whichever one we adopt a very beneficial result may be obtained in seme cases of disease.

Blistering has been considered a remedy of such universal application in aural disease, that we rarely see a patient who does not inform us that vescication has formed a part, at least, of any previous treatment he may have undergone. I fear, therefore, that it will be deemed unorthodox to raise my voice against a system so popular, yet I must say, that though blisters cause considerable pain, produce an unpleasant and unseemly discharge and are often followed by eczematous eruptions, they are productive of little, if any benefit in a vast majority of

cases. This opinion, now universal in Germany, is gradually gaining ground in this country, and I doubt not, with careful observations, will soon become general. We must not be led away by the *post hôc ergo propter hôc* doctrine and conclude—because a case of deafness presents itself to us in which we apply blisters, and the patient gets well—that therefore the blisters have cured him; but we must ascertain whether the same result will not follow, and with equal rapidity, without this treatment. If we carefully observe on this principle, I am sure that our faith in vescication for the cure of ear disease will be considerably shaken, if not altogether dispelled.

Fomentations and Poultices.—It is certain that no form of treatment tends more to relieve pain in acute inflammatory affections of the various portions of the ear than fomentations and poultices, yet there can be no doubt that these remedies are in many instances productive of severe injury. Thus it happens that having at our command most powerful agents for the relief of suffering we are often compelled to withhold them on account of the consequences to which they give rise. Experience has repeatedly shown that the application, of which I am writing, induce such relaxation of the tissues that profuse and wearying discharges frequently follow: therefore, without counselling the total abandonment of these remedies in severe inflammation, when it is quite superficial, I feel called upon to urge the necessity for great caution in their employment.

As substitutes which, it must be admitted, are not of equal efficacy in lulling pain, I recommend hot water, with or without the addition of opium or morphia, to be poured into the meatus where it may be retained for ten minutes at a time, by inclining the head to the opposite side. The steam of hot water, to which we may add hyoscyamus or conium, the active principles of which are volatile, may also be directed into the meatus by means of an inflator attached to the *longer* tube of the bottle depicted in figure 7. These methods may be employed in all cases of acute inflammation of the external or middle ear, fomentations and poultices being only admissible in furuncle and diffuse inflammation of the meatus when quite superficial, but, for the reasons I have stated, it is always better to dispense with these remedies if possible.

Local abstraction of Blood.—In the treatment of aural disease it is not unfrequently necessary to have recourse to local depletion, and, in order that the best locality may be selected for the purpose, I will say a few words about the circulation in the ear. The chief vessels of the external meatus and membrana tympani are the deep auricular artery and vein situated in front of the meatus, between it and the articulation of the lower jaw; when we wish therefore, to take blood in affections of the meatus or tympanic membrane, the proper place to apply our leeches will be immediately in front of the tragus. Practically, it is found that when so applied the

effect is much more decided. The middle ear is supplied by the tympanic artery which enters by the glasserian fissure and the stylo-mastoid artery, which enters by the foramen of the same name. The nearest point, therefore, to these vessels will be below the lobule in the furrow which separates the lower jaw from the mastoid process. The mastoid process and adjacent portions of the petrous bone derive their blood supply from the arteries of the dura-mater and pericranium, whilst numerous veins penetrate the bone and establish a communication between the veins and sinuses within the skull, the veins of the diploë, and those outside. When, therefore, the deep structures of the internal ear—the membranes of the brain or the bone substance—are affected in a case of aural disease, we ought to draw blood from the surface of the mastoid process behind the ear. Occasionally it will happen particularly in children in whom this circumstance will be attended with most danger, that considerable difficulty occurs in stopping the bleeding from leech bites. Should we meet with such a case, it is important to know how to arrest the hæmorrhage, and, indeed, whenever we prescribe leeches we ought to instruct the patient or his friends what to do should bleeding persist, as. life has sometimes been lost through ignorance on this point. The most simple hæmostatic is free exposure to the air; should this not answer, a little shredded lint or cotton wool pressed on the part will often succeed; failing this, firm digital pressure above the lint will generally

effect the desired object, or the bite may be touched with perchloride of iron or a fine point of nitrate of silver. Should all these fail, a fine sewing needle must be passed through the lips of the wound and silk twisted around it. The quantity of blood drawn by a leech is calculated at about two drachms, which may be doubled by subsequent hot fomentations or poultices. Leeches bite better if they have been kept out of water for an hour previous to their application, and they should be dried in a towel before putting them on the part, which may be moistened with a little milk. The surgeon ought to place a dot of ink on the spot where each is to be placed. *Heurteloupe's artificial leech*, applied over the mastoid process, will be found a very useful mode of depletion in some cases of deep-seated inflammation in the middle or internal ear, or when the parts within the skull have become affected.

Myringotomy.—When purulent or mucous secretion is confined in the middle ear, it will sometimes be necessary to make an opening through the membrana tympani. For the performance of this operation the *Myringotome* represented in Fig. 20 will be found useful. It should be somewhat narrower in the blade than shown in the drawing, and also double-edged at the point. The part of the membrane selected for incision should be posterior to the handle of the malleus, between it and the incus, unless the bulging be very marked at some other spot, in which case the most prominent point

must be chosen. The frontal reflector, and the largest speculum which the meatus will accommodate, must be used, and having thus obtained a good illumination, we may make our incision parallel with the manubrium, and extending from the lower border of the posterior pocket of Tröltsch nearly to the inferior margin of the membrane. It is important to bear in mind the position of the chorda tympani nerve, as it has been occasionally divided during the operation. Should this accident occur, the patient will probably complain at the time of a pricking sensation along one side of the tongue, followed by more or less numbness and loss of taste; these symptoms will, however, subside in a few days. The anatomical relation of the parts concerned in paracentesis of the membrana tympani may be seen in Figs. 12 and 13. As the drum-head is a most sensitive structure, we may expect the patient to flinch at the moment of making the puncture, but we ought not on this account to rest his head against any immovable substance, as, by so doing, we might cause him to start against the point of the knife, with the likelihood of doing some damage to the delicate structures within the ear.

In children an anæsthetic should always be administered prior to the operation, and this will also not unfrequently be advisable in adults. After paracentesis, the middle ear should be syringed in order to remove the secretions which it contains. This may be done according to one of the methods already described, and should be repeated daily until

the opening closes, which it will generally do in four or five days. The only unpleasant consequence which has been observed to follow this operation is the occasional occurrence of acute inflammation of the meatus. Although this accident causes severe suffering it will generally subside in two or three days by the employment of hot sedative lotions poured into the meatus, and by incisions through the inflamed structures, down to the bone.

Extraction of Polypi.—In Fig. 21 is represented what I believe to be the best form of forceps for the extraction of polypi. The points are fenestrated and obtuse, though they should not be quite so broad as in the drawing. When the meatus has been well illuminated with the aid of the frontal mirror we may insert one blade of the forceps on each side of the polypus, which may then be easily removed with a slight rotatory movement. Wylde's snare, constructed on the *ecraseur principle*, is also a very safe and useful instrument for the same purpose. The wire loop should be passed over the polypus, which may then be drawn out or strangled off by tightening the wire. For the removal of small polypi situated close to the membrana tympani, Hinton's rectangular forceps, which are triple-jointed, will sometimes prove useful. By the peculiar arrangement of the joints, this instrument possesses the advantage of a firm hold, without being so thick in the blades as to fill the speculum and obstruct our view. Toynbee's tubular ring forceps

may be used in similar cases; but, being straight, the hand of the operator can hardly avoid getting in the way. They might, however, be manufactured with a curve, like Dr. Mackenzie's laryngeal forceps, and would then be free from the objection I have named. All these instruments are sometimes of service for the removal of foreign bodies from the meatus.

Instruments intended for use in the meatus auditorius should be curved or bent at an angle of about 150°, so that the hand of the operator may not obstruct his view. We shall require to have a few knives, pairs of forceps, probes, brushes, and a Wylde's snare constructed on this principle. These, as well as the other instruments mentioned in this manual, may be procured from Mayer and Meltzer, of Great Portland Street.

For the purpose of making incisions into the walls of the meatus I am in the habit of using an instrument of the form depicted in Fig. 20, but shorter and stronger in the blade. I prefer this to the sickle-shaped knife generally employed, the point of which is very liable to be bent or broken in cutting through the dense structure of these parts.

The forceps represented in Fig. 3 will be found very useful for removing from the meatus small pieces of cerumen epidermis or other foreign bodies, which obstruct our view through the speculum. It is always preferable to extract these obstructions without having recourse to the syringe, as we thus avoid causing hyperæmia of the parts to be examined.

A couple of probes and a curette mounted in handles similar to those used for ophthalmic instruments will also be found very serviceable. One of these terminating in a button extremity can be employed for the same purposes as the forceps shown in Fig. 3, and will readily remove small obstacles through the speculum. The ordinary probe is sometimes called for to enable us to distinguish between minute vascular polypi and granulations on the surface of the membrana tympani and also to detect circumscribed tender spots on the walls of the meatus in furuncular inflammation. The curette is useful for clearing out the contents of sebaceous or molluscous cysts and for the removal of foreign bodies from the auditory canal. My reason for recommending these instruments to be mounted in handles is that ordinary probes and curettes, when curved for insertion in the meatus, are too liable to twist between the fingers, and that, in consequence, they will be deprived of the delicacy of touch which is of the greatest importance in using them. Careless probing has been known to cause perforation of the membrana tympani; it is important to bear this in mind when using any instrument inside the auditory canal.

A few camel-hair pencils of the sizes called by artists "crow" and "minature" should be kept on hand, and may be fixed on small stems of wire fitted into wooden handles. The brush may thus be bent to any angle we may desire, and will be found useful for making various applications to the walls of the meatus and membrana tympani.

In the treatment of affections of the nose and throat, so commonly the causes of disease of the middle ear, it will be necessary to have some additional instrument and apparatus which I will briefly describe.

The Nasal Douche.—It is well known that a liquid directed into one nostril will flow out of the other, without entering the mouth, if this is kept open for respiration while the head is bent forwards. The fluid in its passage washes all the parts situated above the soft palate as well as the interior of both nostrils. The stream for our nose-douche may be obtained in a variety of ways, the simplest of which consists in raising the reservoir to a sufficient height and letting the liquid flow spontaneously either through a tube fitted into the bottom of the receptacle or through a syphon passed in from above. The latter possesses the advantage of enabling us to use an ordinary utensil, such as is found in every household, whilst the former requires one specially adapted for the purpose. Simple water used in this manner will cause considerable irritation in the nose, but if we employ a solution of common salt or of carbonate of soda no pain or irritation will ensue. These salts dissolved in water, in the proportion of a teaspoonful to a pint, are very useful applications in cases where the parts are affected with increased secretion of tenacious mucus so common in chronic catarrh and granular pharyngitis. Without sharing his opinion, I think it right to mention that Dr. St.

John Roosa of New York, has expressed himself somewhat strongly against the employment of the nasal douche, and has recorded some seventeen cases wherein inflammation of the tympanum followed its use. Though I am in the habit of prescribing this remedy and have found the greatest benefit from it, no case of accident has come under my observation. In order to avoid opening the Eustachian tubes during the operation, the patient ought not to swallow, and the fluid should be used cold.

Tonsillotomy. Though the tonsils do not press directly upon the Eustachian tubes, their enlargement gives rise to disease in the naso-pharynx, which will cause deafness, and may be cured by removing these glands. If they are so much enlarged as to cause the patient to talk thickly and to snore at night, excision is called for, as well for his general health and welfare as to benefit his hearing. Some patients suffer from repeated attacks of quinsey, on subsidence of which the tonsil returns to its normal size. The attacks cause a considerable amount of suffering, and are not unfrequently attended with deafness. In such cases tonsillotomy is often called for, to guard against the recurrence of this troublesome disease as well as to relieve the acute symptoms. The operation should be performed as soon as enlargement of the gland has taken place, even if suppuration have occurred. By this means we shall effectually remove the cause of evil, and at the same time give exit to the pus, if any be present, without

the dangers which attend puncture in the ordinary way. In order to perform the operation quickly and effectively, the best instrument, in my opinion, is a simple guillotine without barbed forks, hooks, or other complications of any kind. It consists of a flat metal plate of about six inches in length, provided with a rim at each edge. At one end it is fastened, at an angle of about 45 degrees, to a roughened handle. The other end is semicircular and is pierced by a rounded opening through which to pass the tonsil. The blade is made to slide on the metal plate where it is retained by the lips, which are continued round the end forming with the extremity of the plate a double ring. The edge of the blade is placed at its extremity, and is convex, so as to fit into the fissure in the concave border of the double ring. At the opposite end of the blade is a crescentic piece of steel made to receive the end of the thumb, by which the blade may be pushed onwards, whilst the handle is grasped in the palm of the hand. Two or three guillotines of different sizes will be desirable; and, when operating, all that is necessary is to draw back the blade, pass the ring over the tonsil, and push the blade onward with the thumb. The gland may be removed to a greater extent if an assistant press with his finger below the angle of the lower jaw. When both tonsils require removal this may be done most readily by using two guillotines, so that directly one gland is abscised the second instrument may be taken, to remove the other. The operation is attended with

little pain, so that even in children both tonsils may be removed without closing the mouth.

Elongation of the uvula, like enlargement of the tonsils, not unfrequently sets up and maintains disease of the fauces, which spreads to the tympanum and causes deafness. When this occurs the uvula may require removal by operation, which can be performed by taking hold of it with a pair of long forceps, and cutting it off with scissors. As the organ retracts considerably it must be drawn down, and in order to avoid wounding the posterior wall of the pharynx, one blade of the scissors should terminate in a blunt beak at a right angle to the edge. A very ingenious contrivance, now generally employed at the Throat Hospital, is a *uvulotome*, the invention of Dr. Elsberg, of New York. It is a species of guillotine, to the under surface of which is attached a pair of toothed forceps, to seize the uvula and prevent the possibility of its falling into the glottis.

For the treatment of disease of the naso-pharynx it will also be necessary to have a few camel-hair brushes, mounted on stems at right angles, so that they may be made to pass under the velum palati to reach the posterior nares and orifices of the Eustachian tubes. The brushes should be thick, about an inch and a-half long, and screwed on a stem of aluminum wire, fitted into a wooden handle. Some stems similar to these, but without the brush, may be covered with fused nitrate of silver, and will be found very useful. They may be charged by dipping into a small crucible containing the nitrate in a state

of fusion, or by heating the metal end in the flame of a spirit lamp, whilst at the same time the stick of nitrate of silver, also heated, is rubbed upon it. This will cause the salt to adhere firmly, and will form it into a rounded head at the end of the stem.

In the preceding pages I have endeavoured to describe the various methods and apparatus employed for the purpose of diagnosing and treating affections of the ear. Before bringing this chapter to a conclusion let me remind my readers that aural diseases, like all other affections of the body, are liable to occasional complications. We must not therefore expect every case to be clearly and sharply defined; but, on the contrary, diseases not unfrequently present themselves associated with others, by which they are more or less disguised. If, however, the student acquire a habit of careful and precise observation, he will readily overcome all difficulties, though they may at first appear considerable, and he will, after a little practice, obtain an amount of knowledge amply sufficient for enabling him to treat any case that may come before him.

PART II.

SPECIAL DISEASES.

AFFECTIONS OF THE EXTERNAL EAR.

Considered from a physiological point of view, the organ of hearing consists, as we have seen, of two parts—the conducting and perceptive. The former is constituted by that portion of the auditory apparatus which lies between the surface and the nerve of hearing, to which it conveys sonorous vibrations. Anatomically, the parts are divided into three, namely—the external, the middle, and the internal ear; the first two of these are separated from each other by the membrana tympani, and together with it belong to the conducting portion; the internal ear appertains to the perceptive. In the study of aural disease we will follow the anatomical division, and commence with the external ear, which includes the auricle, the meatus auditorius externus, and the external surface of the membrana tympani.

THE AURICLE.

Wounds.—The auricle must be acknowledged to have very little influence on the hearing power, as it may be wounded or entirely removed without

perceptibly affecting audition. Wounds of the auricle, though by no means uncommon in some of the university towns of Germany, where the habit of duelling prevails, are comparatively rarely seen in this country. Sometimes the part may be bitten in a drunken brawl, or partially torn off by a brutal schoolmaster, but on the whole I think the auricle is very little liable to be wounded. When Lynch law prevailed in California it was the custom to lop off the right ear of a thief—a form of punishment which served to mark the individual for the rest of his days. We can, therefore, imagine that any person deprived of this ear would be regarded with considerable distrust in places where the custom I have mentioned was known to have existed, and that he would be naturally anxious to have the part restored. Nothing can be done, however, by surgical means to effect this object unless the part have been removed within a very short time and be brought to us. Under these circumstances it should be cleansed, if necessary, and replaced, retaining it *in situ* by means of stiches, and endeavouring to maintain the temperature by the aid of cotton wool. Sutures will mostly be needed even in slight wounds of the auricle on account of the unevenness of surface.

Malformations are of unfrequent occurrence, but when present usually indicate concurrent deformity in other portions of the skull as well as of the auditory apparatus. Partial or entire closure of the meatus auditorius is, perhaps, the most common malformation

met with in practice, and where this depends upon pressure inwards of the tragus mechanical means may be employed to keep the parts patent. Sometimes it may be advisable to remove a portion of the tragus. The cartilage of the auricle is occasionally deficient, the ear being represented by certain folds or prolongations of skin. In these cases the meatus auditorius is generally absent, and we may be consulted as to the probability of a child so affected obtaining useful hearing, or as to the possibility of performing an operation for the relief of the deformity. Judging from a few cases in which a careful dissection of the parts has been made, the principal malformation consist in absence of the membrana tympani and tympanic bone, besides defects in the ossicles and muscles of the middle ear. The deformity, though considerable, appears to be confined to the conducting apparatus, the nervous portions remaining almost or quite normal. The hearing power is diminished, but it does not appear to have been lost in any of these cases. Indeed, it is surprising to find, with such considerable defects, how good the hearing may be. We shall, therefore, be justified in predicting that the child will not be deaf, though we can hardly expect the hearing to be perfect. Operative surgery can do little or nothing to benefit these patients, and though attempts have been made to open the meatus by the knife, the results have not proved encouraging. Adhesions occurring after birth may contract or close the external meatus. In a case recently under the care of my friend Mr. Reeves, at the London Hospital,

the concha was drawn forwards by adhesion of its posterior edge to the tragus, leaving a very small opening which would only admit a probe. This was enlarged by operation, when the meatus was found distended by a plug of cerumen. Some difficulty was experienced after the operation in preventing closure of the wound. Ears are sometimes of such diminutive proportions as to amount to deformities even though they are perfectly formed. *Supernumerary auricles* are of very rare occurrence, but have been occasionally observed. In one case mentioned by Cassebohm a child had four ears, two of which were in the usual position and two below. Each temporal bone had two petrous portions. In an other instance, however, reported by Birkett, the supernumerary organs were uncomplicated by malformation of the deeper structures and were removed.

Blood Tumor, or, as it has been called, othatoma—hæmatoma auris—hæmatocele of the external ear, is formed by effusion of blood between the cartilage and integument of the auricle. At one time these were considered to be peculiar to the insane, but now they are known to result from contusion of the part, and may occasionally be met with in the ears of infants after instrumental delivery as well as in those of prize-fighters, whilst they are becoming less common in lunatic asylums on account of the improved care and attention bestowed on the inmates. When a blow has been received on the ear, the integument covering the concave part of the auricle

will often swell so as to fill up its depressions which appear as a rounded swelling. This will be of a livid red or purplish appearance, with a doughy feel and increased temperature. It is usually situated at the upper portion of the fossa below the helix, which is itself often involved. A certain predisposition must exist for these tumors to form, as the ear is often subjected to great violence without blood tumors occurring. When left to themselves, hæmatomata are very liable to result in permanent disfigurement of the auricle. Respecting the *treatment* of these growths considerable difference of opinion exists; some advise free incision, some recommend a small puncture, whilst others counsel evaporating lotions for a week or two, and then passing a seton through the long axis of the tumor. The last method is perhaps the best, as, after incision or puncture, the tumor has been found to refill very rapidly.

Nævus occasionally has its seat on the auricle; it differs in no respect from the same affection in other parts, and should be treated in the same manner. I may mention a plan which, though not generally known, will prove very effective. It consists in applying a small plaister containing one part of tartarised antimony and four parts of dyachylum. A thin layer of the compound spread on linen should be applied over the nævus, extending a little beyond its edges, and the whole covered with collodion. Suppuration will take place in five days, followed by

a crust, which on falling off leaves a perfectly soft cicatrix. This treatment is usually attended with no pain, and results in perfect cure.

Tumor of the Lobule, though comparatively a rare affection in England, is not unfrequently met with among the colored population in the West Indies and elsewhere. Dr. Roosa, of New York, considers that these growths are caused by wearing *brass* ear-rings. The tumor, which is hard and fibrous in structure, has its seat in the situation pierced for the ear-ring. The *treatment* of the growths consists in removing them by a V-shaped incision, and approximating the edges of the wound by suture; this will leave no perceptible deformity.

Cancer, occurring as a primary affection of the auricle, is of very rare occurrence, but cases of schirrus, as well as epithelioma, have been observed. Toynbee never saw the disease except as an accompaniment of carcinoma in the petrous bone, and most authors make no mention of it. Should a case of cancer, limited to this part, present itself, there can be no doubt as to the propriety of removing it or the ear itself.

Gouty deposits are very frequently seated in the auricle, and, according to Dr. Garrod, this part is often the one in which the disease first makes its appearance, even before any of the joints are involved. The deposit, which presents a white chalky

appearance, usually occurs at the upper part of the helix, and varies in size from a pin's head to that of a pea. These formations are attended usually with no local symptom, but sometimes the part is the seat of pricking sensations. Tröltsch says that he has seen appearances on the auricle, not distinguishable from those here described, in young persons not subject to gout. The only importance of these gouty manifestations to the aural surgeon is that occasionally they will serve to indicate the diathesis in other ear affections.

Erysipelas sometimes attacks the auricle, both in the acute and chronic forms. The *acute* form, which is less common, differs in no respect from the same affection occurring in other parts. The skin becomes rose-red, swollen, tense, and shining. The redness will disappear on pressure, which causes pain, and the part conveys to the finger a sensation of increased heat. Sometimes vescicles or bullæ will form, these burst and yield a straw-coloured secretion, which may become semi-purulent. There is usually pain of a tingling or burning character, as well as itching.

Treatment may, in most cases, be advantageously commenced by a cholagogue purgative of calomel or podophyllin. Should the case be of a very mild form, salines, with sulphate of magnesia in small doses, may suffice. When the digestive system has been regulated, tincture of perchloride of iron, bark, and stimulants, will be called for, together with

easily digestible nutritious diet. Locally, the application of sulphate of iron, twenty grains to an ounce of lard or cerate; solution of nitrate of silver, twenty grains to a drachm of distilled water, or simple collodion will be the most useful remedies; in addition to these, the part should be kept uppermost in bed, and may be covered with cotton wool. Warm poultices will sometimes afford great relief, but their applications must not be continued for more than a day or two.

Chronic Erysipelas is most frequently seen in women over forty years of age. It sometimes follows the acute form, and it is generally tedious to cure, occasionally lasting with exacerbations and remissions for many years. The auricle becomes greatly thickened and disfigured, it is hard, tender to the touch, dry, red, and often scaly. The meatus is not unfrequently narrowed or closed by the disease, which then causes more or less deafness. The itching of the part is sometimes intolerable, but there is usually no actual pain.

Treatment. The disease always attacks those whose general health is much impaired. This must be attended to on general principles, as recommended for the acute form. The local treatment consists, when there is considerable heat and tenderness, in the application of poultices for a few days, after which, or when the symptoms mentioned are mild, the part may be painted with collodion or collodium flexile of the pharmacopœia, or with glycerine. Lotions

of subacetate of lead, or of nitrate of silver, as used in the acute form, or much weaker ones of about two grains to the ounce, may be employed. When the disease subsides, permament thickening of the meatus sometimes remains, this must be combatted by wearing in the canal a small tightly-fitting tube, which will gradually promote absorption of the thickened tissue, and should then be followed by larger sizes, until the calibre of the meatus is restored.

Herpes Zoster may affect the parts supplied by the auricular branch of the trigeminus nerve. Dr. Anstie, who was enabled to watch this affection in his own person, describes the symptoms as commencing by acute pain in front of the tragus, coming and going several times a day, darting into the meatus, the maxillary articulation and up the side of the head. The pain in his case recurred four times in twenty-four hours, the parts being quite free during the intervals. There was no tenderness on pressure, or on passing the aural speculum, neither was there any abnormal appearance in the meatus or membrana tympani, although the pain was of extreme severity. A *point douloureux of Valeix* existed in front of the tragus. Manifest improvement occurred on the ninth day, and on the thirteenth herpetic vescicles were discovered on the pinna; these got rubbed, then ulcerated, and finally became very susceptible to the influence of cold, which would set up all the old neuralgic pain. Vescicles subsequently formed at the angle of the mouth

and over the region of the sterno-mastoid muscle. All symptoms had disappeared on the twentieth day.

The treatment advised by Dr. Anstie is as follows: Morphia should be used hypodermically to the region of the trunk of the auriculo-temporal nerve (*i.e.*, immediately in front of the tragus), in doses of one sixth of a grain twice daily. All the painful parts should be hermetically closed from the air, the external ones by means of collodium flexile, and those within the meatus by a thick coating of simple ointment or purified tallow, made warm and applied with a brush. These should be constantly re-applied, and the meatus closed by cotton wool. Moderate counter-irritation by mustard, or cantharides to the occipital triangle, may also prove beneficial by reflex or distal stimulation. This affection had not been noticed by authors until Dr. Anstie drew attention to his own case in "*The Practitioner*," and he himself failed to recognise the disease until the vescicles appeared. He suggests that many of the cases of ear-ache, believed to depend upon suppurative inflammation within the tympanum, may arise from this form of herpes. The perfect intermittence of the paroxysms of pain—the absence of tenderness in and around the meatus, and of any abnormal appearances of it or the tympanic membrane—the hearing being unimpaired—as well as the subsequent appearance of the characteristic eruption, should serve to distinguish the disease from inflammatory affections of the tympanum.

Eczema, both in the acute and chronic form, constitutes a not unfrequent affection of the auricle. The *acute* disease is very much more uncommon than the chronic, it commences with great heat, redness and swelling of the skin, on the surface of which numerous vescicles appear. These burst and throw out an abundance of thin serous fluid of a pinkish color.

The treatment consists in the administration of saline and aperient medicines, with the local employment of warm lotion of subacetate of lead.

Chronic Eczema is much more frequently met with, and constitutes in fact the most common form of cutaneous disease of the auricle.

Symptoms. The affection generally occurs in children and in women about the climacteric periods. The part usually presents a swollen dull red appearance more or less covered by scales or crusts of a yellowish or brownish color. Often there will be found deep fissures or rhagades, from which exudes a serous discharge. It is very commonly found associated with a similar eruption of the scalp, from which it appears to spread to the ear. This disease is not only very obstinate and difficult to cure, but is also liable to recur again and again, producing considerable thickening and deformity of the auricle. Deafness sometimes results from narrowing of the meatus.

The treatment should be chiefly directed to the constitutional causes which produce the affection, for this purpose the diet must be carefully regulated,

and stimulants restricted in quantity or altogether abstained from. Should the urine contain crystals of oxalate of lime nito-hydochloric acid may be administered, combined with a bitter tonic; and in very obstinate cases liquor arsenicalis in three minum doses three times a day, gradually increased, will sometimes do good when other means have failed. Local applications of collodium flexile, of benzoated zinc, or ammonio-chloride of mercury ointment will prove advantageous. The principal object seems to be to protect the parts from the action of air. Before employing any local remedies the ear should be carefully dried. Accumulation of discharge is very apt to take place in the meatus, to prevent which we should recommend a frequent use of the ear douche.

THE MEATUS EXTERNUS.

As I have already mentioned, the external meatus is liable to suffer from extension of certain diseases from the auricle, it may also be affected by diseases and injuries peculiar to itself.

Foreign Bodies are generally placed in the ear by children in sport, and the objects thus introduced present an endless variety, which it will be needless to enumerate. When a patient comes before us with the history of a foreign body in the meatus, it may be deemed superfluous to say that, the first thing we ought to do should be to ascertain that it is really present. Cases have occurred, however, where surgeons, relying upon the statement of patients or

their friends, have introduced instruments or a strong jet of water for the purpose of extracting something that was *not* there; and, moreover, it is a prevalent idea, against which I cannot too strongly protest, that *syringing can do no harm.* Even where an examination has failed to detect any thing in the ear many have recourse to injection only to satisfy the patients. Our first step, therefore, should be to illuminate the ear thoroughly, using the frontal reflector, fig. 3, and drawing the helix upwards and backwards with one hand, and the tragus forwards with the other. By these means we shall generally succeed in detecting a foreign body unless the walls of the meatus have become tumefied through rough handling or unless the intruding substance be of small size and close to the tympanic membrane. In the latter case we must introduce the speculum, making a very careful examination, and bearing in mind that even a fragment of hair or a small insect will cause intolerable irritation, and tinnitus. *Treatment.* When the foreign body is of such size as to be in contact, or almost in contact, with the walls of the canal all round, and presents no process by which it can be seized with certainty and removed, or when it has penetrated beyond the prominent anterior-inferior wall of the meatus, syringing is the best treatment, the jet being directed along the upper wall of the meatus where there will usually be found a passage for the liquid, which will get beyond the foreign body and gradually cause it to slip out. If the object we seek to remove be smaller, and an interval exist between

it and the walls of the canal, we may be enabled to slip an instrument behind, and so extract it. The wire of a Wilde's snare will sometimes do this, with less danger of doing harm than a more rigid instrument. Forceps, if employed to remove smooth hard substances, such as a bead or a cherry-stone, will be almost certain to slip when they are closed for the purpose of grasping the foreign body, which would probably be driven against the membrana tympani. In every attempt of this kind we should never forget that the hand must be directed by the eye, and that unless we can so illuminate the meatus that every movement of the instrument and foreign body may be clearly seen, we are not justified in hunting at random, and endeavouring to seize a substance within the ear. Careful syringing will be found the best and safest treatment, and will generally succeed when the ear has not been already tampered with; should we fail, however, after having made a sufficiently prolonged attempt, we must desist, for the foreign body will do no harm if allowed to remain, even for months; and by injecting from time to time, it will ultimately drop out. On the other hand, attempts to remove substances from the meatus have frequently been known to cause rupture of the membrana tympani, and sometimes even the ossicles have been dragged out. These accidents are usually followed by suppuration in the middle ear, and occasionally also by meningitis, cerebral abcess, and death. Cases not unfrequently present themselves to our notice where considerable injury has been done to the meatus, which we find so

swollen that the foreign body is firmly grasped by its tumid walls. Here it will be quite useless to make any attempt at extraction, and where there is much pain in the parts, a few leeches may be applied, followed by hot fomentations or poultices. The same method should be adopted where, in clumsy and violent attempts to remove the foreign body, rupture of the tympanic membrane or inflammation of the middle ear has supervened. I have already stated that foreign bodies are most frequently found in the ears of children; and as little patients cannot be persuaded to keep quite quiet, even though we cause them no pain, it will generally be necessary to administer an anæsthetic when we intend to employ instruments.

Abnormal Secretion.—The cerumen within the meatus is liable to considerable variations in quantity and quality. It is generally more abundant in those who have a greasy perspiring skin, whilst those who possess a dry harsh cuticle usually have very little. Some authors have stated that the absence of ear-wax is a frequent cause of deafness, but as we find great sympathy of function to exist between the middle ear and the meatus, and as dryness constantly follows tympanic disease, we may conclude that it is rather an effect than a cause of the tympanic affection. It is certain that the value of this symptom has been very much exaggerated, and that it is unnecessary to apply remedies for its cure.

Accumulations of Cerumen not unfrequently

become hardened, and thus form a firm plug in the meatus. This may depend upon an increase in the secreting power of the ceruminous glands, or what is more usual upon mere retention of the wax within the canal.

Symptoms. A plug of ear-wax often occupies years in formation, and remains unnoticed until suddenly deafness appears. This may come on during the morning ablutions, or on moving the cartilaginous portions of the ear; or the same causes may improve the hearing. The deafness is usually less in the morning, and is characterised by the rapidity with which it comes and goes several times, perhaps, in a day. A cold which causes tumefaction of the walls of the canal will frequently render a patient completely deaf, the hearing returning with a cracking sound in the ear. Sometimes, however—either after several attacks such as I have mentioned or without—the deafness will persist, often accompanied by tinnitus, a feeling of stopping up of the ear, and perhaps giddiness. Patients under such circumstances fancy that they are about to have a fit, and medical men not unfrequently adopt the same view, the patient being in consequence subjected to strict antiphlogistic regimen, or even venesection. When cerumen has accumulated in the auditory canal, anything which tends to push it inwards will be liable to produce these symptoms by causing pressure on the fluid in the labyrinth through the medium of the chain of ossicles. So long as the passage is not completely occluded patients will sometimes continue to hear moderately well,

although tinnitus or giddiness may exist. Besides the symptoms caused by wax in the ear, which may be got rid of by removal of the cause, some permanent injury to the organ of hearing not unfrequently occurs; Toynbee found that in 60 only out of 165 cases did removal of the cerumen restore normal hearing; thus in nearly two-thirds was some lesion left behind. Sometimes the gradual accumulation produces absorption of the bony walls of the meatus, as is well shown in several preparations in the Museum of the Royal College of Surgeons. In other cases it produces ulceration of the membrana tympani, or, by continued pressure, the muscles of the tympanum are rendered powerless, and fail to act when the plug is removed. In addition to this, there is often found a state of inflammation of the walls of the meatus as well as a thick sodden condition of the epidermis. Should we in a case of deafness discover the ear plugged with hardened cerumen, it is well to avoid promising a restoration of hearing by the use of the syringe, particularly if the tuning-fork be not very distinctly heard through the cranial bones in the affected ear. The only substance likely to be mistaken for cerumen is hardened blood in the meatus, which presents a dark black color somewhat resembling it, but the surface is generally smoother, whilst that of cerumen is usually uneven and more or less glistening with epidermic scales and cholesterine.

The treatment of impacted cerumen consists in removing it with the syringe in the manner described

page 56. It is advisable that the patient wear a little cotton wool in the meatus for two or three days, and also that he be recommended to perform Valsalvian inflation once or twice daily during the same period.

Vegetable Parasitic Growths.—The aspergillus glaucus has occasionally been met with in the meatus auditorius, but it seems to be a rare affection in this country. It generally occurs associated with diffuse inflammation, though it is probably rather the effect than the cause of it.

Furuncle or Follicular Abscess occurs in the meatus auditorius, as elsewhere. The disease depends usually upon some constitutional cause, and therefore when one boil appears there is every probability that it will be followed by others. The inflammation generally originates in a hair follicle, which, together with some of the connective tissue around it, dies, giving rise to a slough or core.

The symptoms commence with pain in the ear, which sometimes continues slight throughout, amounting only to a troublesome sensation of distension and pressure, but most frequently it becomes very acute, spreads to the side of the head, and renders every movement of the jaw painful. There is throbbing, heat, and distension in the ear, and the suffering becomes so unbearable, that sleep is almost entirely prevented. In fact, the symptoms are so out of proportion to the severity of the disease, that we are

often led to suspect suppuration in the middle ear, until an examination makes matters clear. The walls of the meatus will generally be found red, swollen, and so tender to the touch that to introduce the speculum would cause acute pain, and should therefore not be attempted. The tumefaction is often sufficient to prevent us obtaining a view of the interior of the meatus, but when we can see, we shall generally observe a small circumscribed red spot, which will be found excessively tender, and may be detected by the probe when vision cannot help us. If left to itself, this spot will generally be surmounted by a small pustule, which bursts in from three to six days from the commencement of the attack, and is generally followed by speedy relief to the symptoms. Sometimes, however, resolution will occur without any discharge of matter. The amount of deafness will depend upon the extent of swelling and closure of the auditory canal. Formidable as the symptoms may appear, we can always give a favourable prognosis as to their speedy and complete subsidence—that is to say, as regards the present attack; but we ought to mention the probable occurrences of fresh abscesses with renewal of the symptoms.

The treatment of this troublesome affection, if we should be consulted sufficiently early—that is to say, before swelling of the meatus or suppuration has occurred—is to endeavour to stop the attack by the use of abortive applications, the best of which will be the solid nitrate of silver fused on a probe. Solution

of sulphate of zinc, 30-60 grains to the ounce o water, is said to produce the same results. When, however, the pain and throbbing have reached a high degree of severity, leeches applied in front of the tragus, followed by hot fomentations or poultices, will often afford relief. Steaming with hot water by means of the bottle (Fig. 7)—connected with the inflator of Richardson's spray apparatus by the longer tube—will also be found very grateful. The greatest benefit will, however, be afforded in severe cases by an early incision, which should be made as soon as the situation of the furuncle can be discovered by circumscribed redness, swelling, or tenderness. I usually employ the knife described at page 70, and cut through the inflamed part, which, being hard and resisting, generally requires some pressure. Immediately after the incision, warm water should be injected into the meatus in a gentle stream to encourage the bleeding and soothe the pain. By this treatment patients will be relieved from all suffering, and on a recurrence of the affection, will generally beg for the incision. The increased flow of blood to the meatus in this disease, particularly when there have been several abcesses in succession, naturally induces augmented secretion of cerumen, as well as separation of cuticle; it is advisable, therefore, to make an examination of the ear a few days after complete recovery, to ascertain that no obstruction has occurred from this cause. It is very important, as far as possible, to prevent the repeated occurrence of this painful disease, and for this

purpose the general health of the patient should be attended to. It is well to administer an aperient in the first place, and then give a tonic with nitro-hydrochloric acid or some preparation of iron. I think I have seen benefit from the local application of calomel ointment, which seems to prevent the occurrence of fresh boils. It should be applied once a day with a camel-hair brush.

Diffuse inflammation of the meatus externus may be acute or chronic, or it may, and generally does, assume a form between the two, which can hardly be said to belong entirely to either. It often commences in one form, and passes insensibly into the other, so that we may well call the disease, as Tröltsch does, a polymorphous affection.

The symptoms, though usually less severe than those attending follicular abscess, should not induce us to regard the disease as of less importance, for it will be found not only more obstinate to cure, but also more liable to produce disease, which may endanger hearing and life itself. Sometimes the attack commences quite unperceived, and runs its course without any symptoms, except, perhaps, slight itching of the meatus. At other times, the affection begins with symptoms of such severity, as to resemble those of circumscribed inflammation. Both these extremes, however, are rare compared with the intermediate grades, which will be met with in every degree. Usually the symptoms commence with itching, heat and dryness of the meatus, which

soon becomes red and swollen. To relieve the irritation patients almost invariably introduce pins, penholders, ear spoons, and the like to scratch the canal, which, under the influence of this further irritation becomes more painful and inflamed. The pain is generally increased at night, and seems to penetrate to the deeper parts. More or less febrile symptoms, with occasionally mild delirium, occur in the severer cases. The inflammatory stage usually lasts two or three days, when exudation takes place, followed by immediate alleviation of all the symptoms. At first the discharge is thin and watery, sometimes very profuse; subsequently it assumes the appearance of mucus, and ultimately becomes quite purulent. In some cases the disease appears without the occurrence of discharge, whilst in others the discharge makes its appearance, continues for a short time, and spontaneously subsides. In all cases desquamation takes place, the epithelial debris being thrown off either in the form of a whitish thick secretion or in that of large white lamellæ, the cuticular lining of the whole meatus and membrana tympani may be shed in one piece, and come out like the finger of a glove. The auditory canal will be found more or less contracted from inflammatory swelling of its walls, which, after removing epidermic flakes and secretions, will appear redder than natural, and resemble the surface of a granulating sore. The tympanic membrane participates in the disease, and deafness will be in proportion to the extent to which it is affected.

The diagnosis of diffused from circumscribed in-

flammation of the meatus, is not always easy when the symptoms are severe and the swelling considerable. We are then unable to obtain a view of the interior of the meatus, and are compelled to ascertain by means of the probe the existence or otherwise of the tender swollen spot of furuncle. We must remember that inflammation of the meatus is not unfrequently present as a result of inflammation of the tympanum. It will, therefore, be necessary to find out if the middle ear be healthy before we can decide that a case is one of uncomplicated diffuse inflammation.

The causes of this affection are very numerous; the eruptive fevers, which, as we shall see, are common causes of suppuration in the middle ear, also give rise, though much less frequently, to the disease we are considering. Eczema, erysipelas, and pemphigus may spread from the auricle to the meatus and give rise to inflammation. Various forms of irritation and injury of the parts—such as a hunt after foreign bodies, the introduction of irritating liquids or solids—such as eau de Cologne, laudanum, tobacco, cold water, or even a draught of cold air blowing through a small opening into the ear, will occasionally produce it. Besides these local causes, constitutional ones have a great deal perhaps more to do with the causation and maintenance of the affection. It is very much more frequent and obstinate in the poor, half-starved, sickly children who attend our hospitals than in private practice, though persons of all ages and

of both sexes are liable to be attacked. Diffuse inflammation of the meatus is very commonly observed among the scrofulous, gouty, and syphilitic, in whom it constitutes a frequent cause of obstinate external otorrhœa.

Prognosis.—When the disease occurs in a healthy subject, and is properly treated in an early stage, it will generally speedily subside; but when the patient is of an unhealthy constitution, and particularly if subjected to defective hygienic influences, we shall not unfrequently have a chronic ottorhœa established, which may last for months or even years. The fœtid discharge flowing from the meatus excoriates the parts around, and unless great care and cleanliness are observed the patient will constantly have a loathsome and offensive smell. Ulceration and perforation of the tympanic membrane not uncommonly occur in connection with chronic inflammation and give rise to suppuration of the middle ear, polypoid growths, and internal otorrhœa. From the intimate connection existing between the cutaneous lining of the meatus and the subjacent periosteum, inflammation may spread from the former to the latter and induce caries of the bone, meningitis, cerebral abcess, and death. Several cases of this kind are on record, where, without perforation of the membrana tympani, a fatal result has occurred. When we call to mind the anatomy of the parts in close relation to the meatus and middle ear, and consider the tenuity of the bony plates which separate them from many vital parts, we shall see the importance of

sparing no pains to arrest the progress of inflammation and otorrhœa.

Treatment. When seen in its early stage and in the acute or sub-acute form, the treatment should consist in the application of two or more leeches in front of the tragus, hot fomentation and steaming, placing hot water into the meatus, and retaining it there by lying on the opposite side for ten minutes at a time. I have already mentioned that there is a growing feeling against poultices and fomentations in diseases of the ear, as their employment seems to have a tendency to produce relaxation of the parts and to cause profuse and wearying discharges. Schwartze altogether eschews poultices even in furuncle, and we know how very frequently minute boils will appear under a poultice. Tröltsch has to a great extent abandoned these applications, he acknowledges the relief they give in inflammatory cases, but only employs them in furuncle and in diffuse inflammation when quite superficial. As these are remedies universally employed, it should be remembered that they have disadvantages, and that the application of hot water or steam are the best substitutes. After the discharge is established, the ear should be injected with warm water three or four times a day, taking care that the stream is very soft and gentle. This will be best secured by directing the patient to employ the douche described at page 59, which will in most cases prove very soothing, and should be continued, for the purpose of cleanliness, in the chronic stage so long as there is any discharge.

It may be followed by astringent drops of sulphate of zinc, 1-4 grain, or of alum, 2-4 grain to the ounce. Ointments of dilute nitrate of mercury or of red precipitate, or a solution of nitrate of silver, 5-10 grains to the ounce, may be applied with a brush after carefully drying the parts. The blowing in of an inert powder, such as talc (French chalk), magnesia, or oxide of zinc, will sometimes effect a cure after the more potent local remedies have failed. On account of the constitutional defects present in most of the chronic cases, general treatment will be of the first importance. Among cachectic and scrofulous children, iron and cod liver oil will often prove the best remedies with regulation of the diet. In patients of a syphilitic or gouty diathesis, the constitutional peculiarity should not be neglected.

Sebaceous or Molluscous Tumors sometimes form in the meatus. They seem to commence from enlarged sebaceous follicles, and contain epithelial scales. This kind of growth was first observed by Toynbee, who speaks of it under the head of molluscous tumor. He collected several interesting pathological specimens, now in the Museum of the Royal College of Surgeons, in which the gradual increase of such growths caused absorption of bone. In some they penetrated the skull, causing death; in others, the inferior wall of the meatus was alone affected. This disease may occur at all ages; it is more common, however, in the old, and is very frequently overlooked.

The treatment consists in laying open the cyst, removing the accumulated sebaceous matter with a small curette, and after syringing with abundance of warm water, removing the thick membranous sac with forceps, if possible. It must not be forgotten, however, that these tumors have been known to penetrate the skull, consequently great care must be taken to avoid unnecessary irritation.

Exostoses and Hyperostoses.—The meatus auditorius is subject to bony deposits, either in the form of distinct nodules or of more diffuse deposition. In the former case they occur generally without any sign of inflammation; there are often two or three which meet in the centre and gradually obstruct the auditory canal. The diffuse affection seems more frequently the result of chronic periostitis. It may occur at any time of life and at different portions of the meatus. The new bony deposit is very hard and ivory-like in structure.

Symptoms. The gradual encroachment of these tumors will cause, after a time, considerable deafness, even before they completely close the canal. This depends upon the accumulation of secretion behind them. They are sometimes tender to the touch, at other times they are quite free from tenderness.

Treatment. When the disease seems to depend upon inflammatory action in the periosteum, a few leeches outside the meatus, with the use of preparations of iodine, externally and internally, will be followed by diminution of the swelling. But I

cannot imagine the possibility of removing, or even reducing an ivory exostosis in the meatus any more than elsewhere by the application of iodine, as stated by some authors.

THE MEMBRANA TYMPANI.

The membrana tympani, which separates the external from the middle ear, is covered by the epithelial lining of both these parts, whilst its fibrous lamina is continuous with the periosteum of the tympanic ring. From the nature of its component parts this membrane not unfrequently participates in their diseases. Thus, when the dermoid layer of the meatus is affected, the external layer of the tympanic membrane will often be found to sympathise. When the periosteal tissue is inflamed the disease may extend to the fibrous lamina of the drum-head. So also when catarrh attacks the middle ear the mucous lining of the membrana tympani will not uncommonly suffer. Although affections of the tympanic membrane are among the commonest met with in aural practice, as they rarely occur alone, I propose considering them in connection with the diseases of which they form a part, and as this chapter is devoted to the study of affections of the external ear, we will only now direct our attention to those diseases and injuries of the membrana tympani which affect the external or dermoid layer.

Acute inflammation of the dermoid layer may occur independently, though it most frequently

results from extension to the membrana tympani of diffuse inflammation of the meatus. *The symptoms* show themselves by slight pain, with more or less deafness, and perhaps also tinnitus. The membrane appears swollen and red with a network of vessels on its surface; not unfrequently it is bedewed with thick viscous secretion, and small pustules have occasionally been seen upon it. This affection usually attacks persons of weak and debilitated constitutions.

The treatment is the same as that recommended for diffuse inflammation of the meatus, namely, a leech or two to the tragus near the margin of the auditory canal, and warm sedative lotions poured into the ear. When the more acute symptoms have subsided astringent lotions may be employed. Under this treatment, with attention to the general health, the disease will commonly subside without leaving any permanent damage to the hearing power. In some cases, however, it will pass into the chronic form, or it may proceed to ulceration.

Chronic inflammation may, as I have just mentioned, originate in the acute form, or it may commence as a chronic disease from the first. It is generally met with in those whose constitution is debilitated by disease or want of proper nourishment, and on this account is more frequently met with in hospital than in private practice. It is not usually seen except as a part of general inflammation of the meatus.

Symptoms. This disease generally produces more

or less deafness, but it is seldom attended with pain. There is commonly discharge, which varies in consistence according to the quantity. When this is small, the epidermoid products are in excess, and give to the secretion a sort of fine granular appearance which sometimes accumulates on the membrana tympani causing a considerable degree of deafness.

Treatment. By attention to the general health and the administration of such remedies as tend to correct the constitutional derangement, this disease will often disappear with the injection of warm water two or three times a day. Should this prove insufficient, astringent lotions may be dropped into the meatus, or the membrane may be painted with solution of nitrate of silver, 10-20 grains to the ounce. On subsidence of inflammatory affections of the tympanic membrane, it not unfrequently remains opaque and dull, with a milky-white appearance, resembling the rough surface of ground or opal glass. The brilliancy of the surface is much diminished, so that the light spot can scarcely, if at all, be seen, and the outline of the manubrium is obscured; but in spite of these abnormal characters the hearing will often be found normal or nearly so.

Ulceration of the membrana tympani sometimes occurs by which the dermoid layer is destroyed exposing a red uneven granular surface, more or less bedewed with purulent secretion. The malleus handle is altogether concealed and when the surface is convex it will often be doubtful whether we have

to deal with ulceration or with a polypus. Under these circumstances it will be necessary to use a probe in order to ascertain if it will pass under the edges. This it will not do if the case be one of ulceration only, though it will raise the border of the polypus. Sometimes after total destruction of the membrana tympani granulations arise from the inner wall of the middle ear. These are soft and elastic to the touch, and so nearly resemble the disease we are studying that they cannot be distinguished either by the eye or with the probe. Inflation of the drum by the Valsalvian or Politzer method may enable us to form our diagnosis, but it will not unfrequently fail. As the granulations gradually disappear in a case of ulceration, we sometimes observe converging radial lines on the surface of the membrane, which are obviously due to thickening of the external fibrous lamina. A red swollen appearance not unfrequently lingers in the situation of the malleus, which is still concealed. This condition is depicted in Fig. 16, taken from Gruber's work. Occasionally ulceration penetrates more deeply than the dermoid layer and perforates the tympanic membrane, though this rarely occurs as compared with perforations proceeding from within, as the result of suppuration. For this reason, and also because the disease is not confined to the dermoid layer, it will be considered in another place. Ulceration is by no means a common affection, and is usually found associated with inflammation of the meatus, or results from the pressure of cerumen or some other foreign body. This

disease is not unfrequently attended with pain, and there is often a discharge of blood from the ear.

The treatment consists in applying powdered talc through the speculum ; this, with constitutional treatment, will often suffice. Sometimes the use of astringent application will be necessary, or it may be advisable to paint the part with a solution of nitrate of silver. The ear will require washing out from time to time with the douche, or by a gentle stream from the syringe.

Rupture of the membrana tympani sometimes takes place as the result of violence, from the concussion of an explosion, from a blow on the ear, or from some hard body being driven into the meatus. This accident is accompanied by effusion of blood, which may be sufficient to appear externally, or it may remain within the ear. The rent usually occurs behind, and parallel to, the handle of the malleus. On inspection with the speculum the edges of the wound will generally be found covered with dark coagulated blood. Some pain and deafness, though the amount is very variable, usually follow the injury, but last only a short time. On inflation of the tympanum by the Valsalvian or Politzer methods the air will pass through the opening with a hissing sound, audible at some distance from the patient. Fissures in the membrane of the drum usually heal spontaneously in the course of three or four days, with little or no diminution of the hearing power; the place of the rupture will however, be marked for a

considerable time, perhaps for life, by a white cicatrix. Fracture of the handle of the malleus has been observed, though only three or four cases have been recorded. The same kind of violence which I have mentioned, as producing rupture of the membrana tympani, will sometimes cause severe and even irreparable injury to the nerve structures. The case will then be one of true nervous deafness, and will be described under that head.

Treatment, in most cases of simple rupture, is altogether superfluous; the opening generally heals in a few days with perfect restoration of function. Sometimes, however, the injury sets up inflammatory action in the middle ear, and the suppuration resulting must be treated in the manner described further on.

Polypi, although they most frequently spring from the walls of the tympanum, sometimes grow from the membrani tympani or from adjoining portions of the meatus auditorius. These growths assume various forms and appearances in different cases. Sometimes they are red, granular, and bleeding very readily on being touched. Sometimes they are of a pale pink color, smooth, and rounded on the surface, but they are mostly accompanied by purulent or muco-purulent secretion, often of very offensive odour. Occasionally, but rarely, polypi appear as white, semi-transparent, shining tumors, without secretion being apparent. They may be so small as to be with difficulty distinguishable from granulations

on the surface of an ulcerated membrana tympani, or they may attain such dimensions as to fill the meatus or protrude beyond it.

Polypi are always soft to the touch, and proceed from the bottom of the auditory canal; consequently a probe will always pass around them. Whenever a patient has suffered from protracted ottorhœa we should be on the watch for polypi, as no more frequent cause than this is met with. In such cases the meatus should be carefully cleansed with the syringe, and an examination should be made with the speculum and reflector from time to time. Polypous growths are more or less fibrous in structure, and are sometimes covered with ciliated or columnar epithelium, sometimes with the squamous variety.

The treatment of polypi, though sometimes tedious, is very simple. They should be removed in one of the manners described, page 69, after which chloro-acetic acid should be applied with a small camel-hair brush daily for three or four days, then less frequently according to the requirements of the case. If we neglect this after treatment the polypus will be almost sure to return. Nitrate of silver is not a sufficiently powerful caustic, and must not be relied upon as a substitute for the above. Toynbee recommended sticks of potassa cum calce; but this preparation is very deliquescent, and therefore liable to injure other parts than those intended. The soda cum calce, or "London paste," made into sticks, will be found much safer. The application of caustic to polypi is sometimes very painful; the pain will,

however, readily cease on syringing with warm water.

AFFECTIONS OF THE MIDDLE EAR.

Under the appellation of middle ear will be included the tympanum proper and its prolongation in the Eustachian tube and mastoid cells, as well as the ossicles, ligaments, membranes, and muscles, which it contains. Of all the cases of deafness which occur in practice, affections of the tympanum constitute fully seventy-five per cent.; and, in addition, many of the nerve affections are but secondary manifestations induced by disease in these parts.

The affections of the middle ear, from which all others may be considered to originate, are catarrh and inflammation, each of which may be acute or chronic. Catarrh is simply hypersecretion resulting from an augmented supply of blood to the lining membrane of the tympanum. This may terminate in resolution by subsidence of the hyperæmia the parts resuming their normal condition, or in mucous accumulation from the secreted products being retained. If exudation take place from the blood-vessels the case becomes one of inflammation. This also may terminate in resolution by absorption of the inflammatory products and return of the tissues to a healthy state. It may proceed to suppuration by extra-proliferation of cells, which become pus, or it may result in plastic deposition if the exuded products remain in the tissues and become organized. Suppuration and plastic depositions, which are con-

sequences of inflammation, may themselves terminate in further sequelæ. Thus the purulent formations of suppuration may escape by the Eustachian tube; they may cause perforation of the membrana tympani, or the destructive action may extend to the periosteum and bones, giving rise to caries or necrosis, which may even extend to the cranial cavity and cause death. When the exudation is plastic, this may produce adhesion among the parts within the tympanum, or thickening and hypertrophy of the lining membrane, which may become the seat of osseous or calcareous deposits. Thus, perforation of the membrana tympani and caries or necrosis of the bones may be considered as consequences of suppuration; schlerosis, anchylosis, calcareous degeneration, and polypus as results of plastic depositions. This arrangement certainly possesses the advantage of simplicity, and is the one which will be adopted in the following pages. It must be admitted that perforation of the membrana tympani occasionally occurs without being preceded by suppuration in the middle ear, either for the purpose of giving exit to mucus secreted in simple catarrh or as a result of ulceration from without. Polypus, moreover, is much more frequently preceded by suppuration than by that form of inflammation the products of which are plastic. In such cases, however, I believe that plastic action becomes superadded to the suppurative, and that the two forms co-exist. It may be further objected that catarrh is always present in non-suppurative inflammation, and that the catarrh is

itself the inflammation; but on the same ground suppuration is also a catarrhal inflammation, because it is always attended with increased mucous secretion. Under both these conditions I contend that catarrh is but a secondary subordinate manifestation, due to the augmented supply of blood which takes place in inflammation. Let us now proceed to study acute and chronic catarrh, with its termination in resolution and mucous accumulation, and then consider inflammation, with its termination in resolution, suppuration, and plastic deposition, and the consequences which result from each.

CATARRH OF THE TYMPANUM.

Acute Catarrh.—The cavity of the tympanum is lined by a prolongation of the mucous investment of the body, which extends to it through the Eustachian tube, and naturally suffers from the same diseases to which the mucous membranes are liable in other parts, influenced only by those circumstances which are peculiar to the situation, functions, and conformation of the cavity. Thus catarrh is common to all mucous membranes, and in the ear-drum, as elsewhere, it commences with contraction of the blood-vessels indicated by the occurrence of abnormal dryness; then follows hyperæmia with increased secretion of thin mucus, the result of augmented activity of the parts, and finally exfoliation of the mucous cells, which have been prematurely worn out during the [exaggerated activity of the secreting surface, indicated by the presence of thick

tenacious secretion. Thus simple catarrh occurs in three stages, alike in all mucous membranes, and its progress may be followed in the simple and common affection, a "*cold in the head.*" Indeed, this affection is most frequently the parent of the one we are about to study, spreads from the continuous surface of the throat to that of the Eustachina tube, and so to the rest of the tympanic cavity. No dweller on this planet, or, at any rate, on this island, has been fortunate enough to escape nasal catarrh; and few, indeed, do not feel the troublesome affection more than once every year. I will therefore presume that its symptoms are familiar to all. Many, however, do not recognise when, during such attacks, they suffer from deafness, stuffiness, or uneasiness in the ears, even in a very mild degree, that the affection has spread to the tympanum, and that they are actually the subjects of catarrh in some part, at least—of that cavity. This is, nevertheless, the case, and the most frequent way, moreover, in which the disease occurs. It is true that sometimes the attack commences from the other side, cold water or a draught of cold air gains admission to the membrana tympani by the meatus externus and sets up irritation, which spreads to the mucous lining; but *simple catarrh* occurring in this way is rare when compared with the one I have just mentioned.

Symptoms.—We will suppose a patient suffering from an attack of nasal or pharyngeal catarrh: in the first stage as we know the mucous membrane will be congested and dry, we shall therefore expect to

find in the Eustachian tube, when it becomes affected, symptoms which indicate an abnormally patent condition. The patient's voice vibrates in his ears with unwonted and disagreeable resonance. The act of swallowing, sneezing, belching, or coughing seems to penetrate into the drum, blowing out the membrane each time the act is repeated. Inflation is readily performed by the *Valsalvian method* giving through the otoscope a *dry sound*, and showing with the aural speculum movements of the membrana tympani at each puff from the lungs. The membrana tympani will present a perfectly normal appearance, both as regards itself and the contents of the tympanum, which can be seen through it. Sometimes the catarrh spreads no further than the Eustachian tube; and the affection may pass through all its stages without any alteration occurring in the membrana tympani, through which we may observe the changes taking place within. The first stage may be of brief duration and may pass over quite unheeded.

Still assuming the case to have commenced in the throat, upon the stage we have been considering follows that of tumefaction, in which we find obstruction of the Eustachian tube by congestive swelling of its mucous lining membrane. The Valsalvian and even the Politzer method now frequently fail to produce inflation of the middle ear, and should we succeed in the effort, the air will penetrate with difficulty and be accompanied by a hissing sound. Examination of the membrana tympani through the speculum generally gives evidence

of nothing abnormal except concavity, which is the necessary consequence of stopping the inter-communication between the air within and that without the drum. This of itself, without further reason, causes diminution of hearing, often accompanied by tinnitus, which may be relieved by forcing air into the tympanum. When concavity occurs in the membrana tympani it will be recognised, as already described, by alteration of the bright spot of light, which will become indistinct at its borders, and as it were dwindling away towards the periphery; sometimes it is reduced to a small point or line, or it may be entirely absent. When the transparency and smoothness of the membrane is unaffected these appearances mark a state of altered curvature, which is further shown by undue prominence of the handle of the malleus, and more particularly of its short process. The membrane seems as if stretched tightly over a small bony prominence at the upper part of the anterior superior quadrant, and the manubrium is drawn inwards and foreshortened. The transparency of the membrane enables us, when it is thus drawn in, to see with unwonted clearness the contents of the tympanum, the long process of the incus, and sometimes the anterior crus of the stapes. Uncomplicated cases of this kind are often seen in practice; frequently also the hyperæmia extends to the inner wall of the tympanum, around the opening of the tube, and gradually pervades the whole cavity, causing a reddish reflection from its surface. The membrane of the drum may become gradually dulled; or some

previous attack may have caused a cloudiness or opacity which prevents us obtaining an unintercepted view. When the membrana tympani is implicated it becomes more opaque and visibly congested, and the vessels which run down the handle of the malleus become enlarged and swollen. The increased secretion of thin mucus within the drum being unable to escape by the obstructed Eustachian tube, accumulates at the lower part of the cavity, and may, when the quantity is large enough, present at the upper border a dark curved line with its concavity upwards, altering in position with the movements of the head. Should we succeed in producing inflation of the drum, this line may change into a number of round bead-like circles, which rest against the membrane. This indicates that the tympanum contains fluid, and that the fluid is thin in character. Though I have described this appearance, it must not be expected in every case; on the contrary, it is very rarely observed, and I have only mentioned it as an exaggerated effect which we may meet with. However, it is well to remember that such an appearance may indicate nothing more formidable than the second stage of catarrh of the middle ear. When the hyperæmia extends to the membrana tympani and there is tenderness, increased on movement of the jaw, or on inflation of the drum, the disease may be deemed to have extended from the mucous lining to some of the proper structures of the membrane, as pain does not occur when the disease is limited to the mucous surface.

In the third or desquamative stage we find a thick mucus, loaded with cells, blocking up, and glueing together the mucous surfaces. The Eustachian tubes are obstructed, but yield with greater or less difficulty to inflation by the Valsalvian or Politzer method, and convey to the ear of the surgeon, through the otoscope, a gurgling sound, or sometimes a decided crack from sudden yielding of the obstruction. When the cavity of the tympanum has been affected, we may observe with the speculum that the parts which formerly appeared red and congested have now become paler in color, leaving little to be seen beyond some opacity of the drum membrane where that part had been attacked, with, of course, concavity if the Eustachian tubes do not permit interchange of air between the tympanum and throat. Sometimes, also, we may perceive a yellow appearance in the situation of the head of the malleus. When the attack proceeds towards resolution the mucous secretion within the tympanum gradually decreases by escape into the throat, where it may not unfrequently be felt by the patient and occasionally observed by the surgeon. The deafness diminishes, and the patient is gradually restored usually with a sound as of something cracking in the ear. Such is the most usual and favorable termination of acute catarrh of the tympanum—by resolution. It may, however, assume the chronic form, or it may light up inflammation in the tissues which line the middle ear, complications which will be considered in separate sections, or it may leave behind it an accumulation of

thickened mucus with the consequence to which this gives rise.

Chronic Catarrh of the Tympanum.—I have endeavoured to describe the symptoms of an attack of acute catarrh of the tympanum, as it usually accompanies a common cold. In the ordinary course of things this spontaneously gets well with the disease which produced it, and leaves little or no mischief behind, particularly if it be the first attack. Thus it happens that we are very rarely consulted on account of simple acute catarrh of the tympanum, which, presuming the case to be one of no undue severity uncomplicated both as regards present and past mischief, and not extending beyond the Eustachian tube is looked upon as a natural consequence of a cold in the head, to which all human kind is subject. Occasionally, however, the third stage persists with more or less severity, according to the extent of the affection and the constitution of the patient. Thus it enters into the chronic form, in which the symptom may increase in severity or remain stationary, with occasional exacerbations and remissions for an almost indefinite period. Chronic catarrh may occur without being preceded by the acute form and is very apt to spread from the tubal to the tympanal portion of the middle ear. As this is a very frequent cause of deafness, great attention ought to be paid to every case which presents itself.

It will be observed that acute catarrh, as I have described it, is a disease of no severity, and is quite

different from the aural catarrh of most authors. The only danger of detriment to hearing results in the chronic form, which leaves the mucous membrane in an altered condition, in which it secretes a thick tenacious mucous. From the glutinous character of this product, and probably also from a certain amount of narrowing of the Eustachian tube, the mucus accumulates in the tympanum, where it clogs the delicate mechanism within. In these cases we find that authors acknowledge the existence of catarrh as distinct from the form of inflammation producing plastic deposits. Von Tröltsch, writing of acute catarrh, says—"Every inflammation of the mucous membrane lining the cavity of the tympanum and mastoid process is also an inflammation of the periosteum, every catarrh of this membrane is a periostitis." Yet, when he treats of chronic catarrh, he acknowledges the existence of two forms, though confessing his inability to distinguish between them during life. He says: "Like all inflammations, chronic catarrh of the mucous membrane of the ear sometimes affects the interior of tissue, that is, it is interstitial, and thus chiefly produces a thickening and loss of elasticity of tissue. Again, it is characterised by hyperæmic swelling, and abnormally increased secretion." It cannot be denied that great difficulties exist in distinguishing chronic catarrh from chronic inflammation, because as I have said, the latter disease is always complicated by the former through the converse does not hold good. It seems to me, however, a matter of no small importance

to endeavour, though perhaps in the present state of our knowledge it will often prove impracticable, to discriminate as early as possible between these diseases, because they lead to different consequences and require different treatment.

Morbid Anatomy. The disease I wish to describe is a chronic one affecting the secreting structure of the middle ear, the activity of which is thereby excited, but without the occurrence of interstitial exudation, which only takes place in inflammation. The same distinction exists between catarrh and inflammation in the middle ear as between catarrh of the pharynx and pharyngitis, and in most cases it will be found that catarrh of the nose and pharynx will cause the same affection in the tympanum, whilst pharyngitis will generally be accompanied by inflammation of the lining membrane of the middle ear. Chronic catarrh of the tympanum is not unfrequently met with in adults; it is, however, much more common among children, particularly in those of a strumuous diathesis, in whom the general soft and spongy condition of mucous membrane may be presumed to extend through the Eustachian tube into the middle ear. The tonsils and other glandular structures of the nasal and pharyngeal surfaces are generally enlarged and their secretion abnormally augmented.

Symptoms. When the disease occurs in children they have usually a peculiarly characteristic appearance. They generally present themselves with a vacant stupid stare, with mouth open, and thick snorting respiration. Their general appearance

denotes laxity of fibre, and they are usually very deaf. With the speculum the membrana tympani will be found abnormally concave, but its transparency little if at all interfered with. Not unfrequently we may observe a yellow appearance at the upper part of the antero-superior quadrant due to adherent mucus around the articulation of the malleus and incus. Owing to the tenacious character of the secretion, it can seldom be moved by inflation of the tympanum: sometimes perforation takes place. Should we succeed in hearing anything with the otoscope it will be of a more or less gurgling nature, or a decided *crackling* sound. The tuning-fork on the vertex will be well heard, but most frequently, tinnitus will not be complained of. The tonsils will generally be enlarged, sometimes considerably so, meeting or almost meeting in the median line.

In adults the symptoms are very similar, but in addition there will usually be tinnitus, sometimes in an aggravated degree. The tonsils may be enlarged, but the most frequent condition of the throat is found to be that of chronic catarrh or granular pharyngitis. The general appearance is not so characteristic, but we shall generally obtain a history of nasal or naso-pharyngeal catarrh, which, instead of disappearing as usual has left deafness, and perhaps tinnitus, behind.

Mucous Accumulations in the Tympanum.—For a case of chronic catarrh to become one of accumu-

tation of mucus in the tympanic cavity no further pathological changes are required. The mucous secretion becomes thicker and more tenacious by gradual absorption of its aqueous portion; and, being unable to escape by the Eustachian tube, it is retained, with consequent clogging of the movements of the ossicles. Even after the catarrhal process, which produced it, has ceased the secretion remains, extending probably into the mastoid cells. Sometimes the gradual pressure from within will cause perforation of the membrana tympani, with partial escape of the mucus. This will, however, rarely be complete without surgical aid.

Symptoms.—If, in a case which has been attended with catarrhal symptoms, the deafness persists or has increased, with, perhaps, a sensation of something occasionally moving within the ear, if the hearing power be improved by a shake of the head, we shall be led to suspect that an accumulation of mucus is retained in the tympanum. The suspicion will be confirmed if the tympanic membrane have a dull white appearance, presenting in certain parts a yellowish or brownish hue, which can be moved on inflation, or if a white or reddish color be perceived at the posterior superior quadrant. Often we shall discover transparent depressed spots, which can be converted into bulgings on inflation by the Valsalvian or Politzer method. In the earlier stages a yellow appearance of the membrane will sometimes be found, with enlargement of the radiating vessels. If the amount of secretion be small and tenacious,

concavity is not unfrequently present. All these appearances will be considerably masked in cases where the membrana tympani is opaque, rendering it necessary to rely upon the sounds discovered on auscultation with the otoscope. Perhaps the most characteristic of these is a sort of squeaking, into which the moist gurgle of chronic catarrh gradually merges. When thin fluid is present, in addition to inspissated mucus, it will greatly obscure the evidence to be derived from the otoscope; so that it not unfrequently happens that we cannot positively state that mucous accumulation exists.

Treatment. Acute catarrh merges insensibly into the chronic form, and this passes almost imperceptibly into the disease which I have described as mucous accumulations; it will therefore be most advantageous to consider the treatment of these affections together.

In an uncomplicated attack of simple acute catarrh, whether it be confined to the Eustachian portion or extend further into the cavity of tympanum, the disease, if left to itself, will generally get well without medical or surgical aid. When, however, a patient is known to be subject to repeated attacks, it is of great importance to nip the disease in the bud, and so soon as the first symptoms of nasal catarrh present themselves, we should endeavour to stop them by every means in our power. This will be best effected by stimulating the schneiderian membrane by a few pinches of snuff, or by smelling strong ammonia, iodine, or ether. The first of these I have often known to stop a coming cold; the others, also,

will sometimes prove effective. If this plan fail, or if we are not consulted until the catarrh is well established, all hope of arresting the disease will be at an end; we should therefore, immediately the third stage has commenced, recommend the nasal douche to be employed two or three times daily, using a cold solution of table salt, one teaspoonful to a pint of water. In addition to this, occasionally practising the Valsalvian or Politzer method of inflation will prove advantageous. Should the third stage persist, in spite of this treatment, we must conclude that the disease has become chronic.

Here, also, I have found the greatest advantage from persevering with the nasal douche. A mixture containing two grains each of iodine, iodide of potassium, and carbolic acid dissolved in three drachms of glycerine, may be applied with a brush to the upper part of the pharynx and around the orifices of the Eustachian tubes. This will prove of great service more particularly when we find the dry condition of the pharynx so common in chronic catarrh. The air douche must be regularly employed, and, in addition, it will often be necessary to force into the tympanum carbonate of soda solution, five grains to the ounce, by means of the catheter, or one of the other methods described, page 61. This will soften the mucus and promote its evacuation. In order to check further secretion, an astringent lotion of sulphate of zinc, in the proportion of four grains to the ounce of water, should be injected about twice weekly during some time. It is not desirable to do

this, however, while the tympanum contains thick mucus, as it would be toughened by the application. The entrance of lotions into the middle ear may be heard through the otoscope, and can also be felt by the patient, thus enabling us to determine if the operation be successful. The results of inflation, though often attended with surprising benefit at the moment, are generally of short duration, and will require to be repeated as often as the deafness and tinnitus return.

The treatment of children affected in the manner I have described should clearly be directed quite as much to the constitutional as to the local disease. The organs of digestion should be first attended by the administration of an occasional alterative. The diet should be carefully regulated, both as to quantity, quality, and the times of administration. It will often be elicited that the appetite is very captious, sometimes the patient will eat almost ravenously, then perhaps scarcely take any food for days together. Often we shall find that the little patient will devour pastry or bread and butter between meals but refuse its regular food. These matters should be enquired into and full directions given. Some preparation of iron will generally be indicated, and exercise in the open air with daily cold sponging the body, if it can be borne, should be enjoined. Local applications to the throat are most useful in this complaint. I most frequently employ the one described above, omitting the carbolic acid. Various astringents are also useful, such as

pechloride of iron or chloride of zinc from forty to sixty grains to the ounce of water. It will often be advisable to remove the tonsils in these cases, not, as some have stated, because they press upon the Eustachian tubes, but because their presence keeps up that condition of mucous membrane which it is important to remedy in order to cure the affection of the tympanum. It is also very important to inflate the drum from time to time; at first this will often be required daily, but after a time two or three times a week will suffice. Children can rarely be made to inflate by the Valsalvian method; we should therefore employ the Politzer. On account of the more patent condition of the tubes young patients will not be required to swallow at the moment of squeezing the bag, and therefore the difficulty will be considerably less. It is extraordinary, even after prolonged obstruction, how a single inflation will often benefit the hearing.

In all these catarrhal diseases of the tympanum the throat will generally be found more or less affected, we shall therefore derive great benefit from the use of various gargles and lozenges. Among the former may be mentioned, a solution of common salt, of the same strength as that recommended for the nasal douche. We may likewise prescribe gargles, containing any of the following astringents, either alone or in combination, namely:—simple alum, or iron-alum, 80 grains, or tannic acid, 120 grains dissolved in 10 fluid ounces of water. The most useful lozenges are those of Rhatany, Kino and Tannic acid, prepared according to the formulæ adopted at

the Hospital for Diseases of the Throat. The first is the most generally used, as it is less liable to disagree with the stomach or to cause constipation. After removal of the tonsils or uvula the trochisci altheæ will prove very soothing to the parts.

When the tympanum is distended by excessive secretion within, so as to cause thinning and threatened rupture of the membrane, or when we fail to remove the inspissated mucus by the means I have enumerated, we must have recourse to paracentesis of the membrana tympani in the manner described at page 67. After the operation the middle ear must be washed out daily, until the opening closes, with an alkaline solution of carbonate of soda or potash. This may be done through the catheter or by the meatus externus.

INFLAMMATION OF THE TYMPANUM.

Acute inflammation is one of the most painful, whilst it is one of the most formidable diseases of the auditory apparatus. It not only causes an obstinate form of deafness, but in some instances threatens life itself by spreading to the membranes of the brain.

Morbid Anatomy. When acute inflammation attacks the lining membrane of the tympanum, this becomes thickened and spongy, and the vessels so enlarged and numerous that the surface appears as if covered by a layer of dark-colored blood. This may extend to all the parts of the tympanic cavity as well as to the mastoid cells and Eustachian tube, or it may

be limited to one or more of them. The ossicles and their articulations often participate, sometimes also the labyrinth itself. Abundance of cells are exuded during the inflammatory process, which give rise to thickening of the parts to such an extent as almost to obliterate the tympanic cavity. The inflammation may proceed to suppuration, which may be followed by ulceration, necrosis, or caries; or the exudation may become organised, giving rise to adhesions among the ossicles, thickening of the lining of the middle ear, with calcareous or osseous deposits or polypus. The last most frequently follows suppuration from the supervention of plastic action.

The Causes are sometimes cold, applied to the membrana tympani either in the form of draught or of cold water during bathing; but the affection most frequently extends to the Eustachian tube from pharyngitis. We shall generally find that the patient caught a severe cold which affected the throat, and that the ear affection was the consequence.

The Symptoms commence with uneasiness in the ear, which becomes actual suffering on swallowing or blowing the nose. The pain soon becomes continuous, and, in severe cases, intolerable, extending over the side of the face, down the neck and throat, and is increased by pressing the cartilaginous meatus or moving the jaw. Not unfrequently also there will be found more or less tenderness over the mastoid process. There is generally considerable tinnitus, which is of a throbbing, pounding character. Sounds as of hissing, roaring, or ringing are com-

plained of, and these may occur simultaneously, producing a confused and most distressing meddly. Fever, with quickened pulse, hot skin, headache, and general malaise accompany the disease; the patient is disinclined to speak or in fact do anything. He has confusion of ideas, is low-spirited, and despondding; has no appetite, and feels thoroughly prostrated by his sufferings. Delirium sometimes supervenes, and even death may ensue from extension of the inflammation to the membranes of the brain. In milder cases—for matters do not usually go to such lengths—the symptoms are of course much less formidable, and many of them may be altogether absent. Occasionally some distortion of the features takes plaec, from the facial nerve becoming affected in its canal. When the attack is very severe, the disease will usually proceed to suppuration, the symptoms rapidly subsiding as soon as the pus finds an escape, or they may abate more gradually by resolution or by merging into the chronic form.

When a child is attacked with acute inflammation within the tympanum, and it is much more frequent among children, it will often utter piercing and most pitiful cries, it will be unable to rest in any position, and the suffering will be increased by the habit so prevalent of shaking and jolting it about. If at the breast the pain will be aggravated by sucking, so that it will reject and push away the food after one or two attempts to suck. When it falls asleep from exhaustion and suffering, it will wake with a start and cry with agonizing pain, which will be

increased if it lies on the affected side. The inability to explain its sufferings will often lead the medical attendant to attribute them to teething, and consequently recourse will be had to the gum lancet, but without benefit. Although the symptoms as I have described them are exceedingly formidable they are not always so. Usually the disease occurs in its mildest form among children, in whom it constitutes a frequent cause of earache. In them the tissues are more lax and extensible, hence the severity of the symptoms are somewhat less and there is usually less constitutional disturbance. Sometimes when the affection occurs in the course of one of the exanthemata, although from its very rapid course it must be deemed acute, the local symptoms are so masked by the constitutional ones that the first indication of aural disease may be an escape of pus from the external meatus. In these cases it is very necessary to make a careful examination of the ears from time to time, and to be constantly on the watch for this complication, because if neglected until purulent discharge has taken place our best endeavours will often prove unavailing in preventing permanent deafness and dumbness also if the child be very young.

The hearing power is generally considerably diminished, so much so that in many cases the watch cannot be heard in contact with the meatus; in some, however, the impairment is comparatively slight. The power of hearing the tuning-fork through the medium of the cranial bones is often greatly lessened,

though it is rarely altogether deficient. The walls of the meatus sometimes become swollen and tender, but usually the auditory canal presents a perfectly healthy appearance, with the exception of slight redness close to the membrana tympani. The introduction of the speculum is generally attended with pain, and the examination does not reveal much of the changes taking place within the middle ear except in the earlier stages. After these have passed, the membrana tympani generally becomes too opaque to be seen through; but where this is not the case, and before effusions have occurred in the drum, the color of the hyperæmia within is reflected through the membrane, which appears very brilliant, and has been compared by Politzer to a polished surface of copper. When the membrana tympani itself is inflamed it presents a pink appearance, the depth of which depends upon the activity of the inflammation. The handle of the malleus continues distinct so long as the external layer of the membrane is unaffected. After a time, however, this becomes infiltrated, the membrane becomes dull and opaque, reflects light unevenly, and the triangular light-spot almost or entirely disappears. The manubrium is now no longer visible, but in its place may be observed an enlarged bundle of vessels forming a red line from above, downwards and backwards; other minute vessels sometimes appear around the margin of the membrane which presents a blueish grey appearance. There will generally be found more or less bulging of the membrana tympani, or of some portions of it, which may vary in color.

The surface often has a moist appearance and dull leaden hue, with an occasional mottling of yellow. Slight discharge from the meatus sometimes takes place without perforation, from sympathy of its dermoid layer and of that of the membrana tympani. When the disease terminates in resolution much of the brilliancy of the membrane returns; the bright spot again becomes visible, though generally small in size, sometimes as a mere point. The malleus handle again comes into view, beginning at the upper part, and is often drawn inwards.

The presence of mucus in the middle ear which always accompanies this disease, will cause the same sounds as those described in catarrh. Sometimes the walls of the Eustachian tubes are so swollen that air will not penetrate the drum by the Valsalvian or Politzer method. The otoscope affords us very little information, and as inflation of the tympanum is usually difficult and painful it may be abstained from.

On examining the throat of a patient suffering from acute inflammation of the tympanum it will usually be found of a bright red color, swollen, sometimes streaked by transparent glary exudation, and contracting spasmodically with acute pain and crackling in the ear, on attempting to depress the tongue. We have, in fact, the condition known as acute pharyngitis or inflamed sore throat. Occasionally the disease is complicated with tonsillitis.

Diagnosis.—When acute inflammation occurs in its severe form the pain will serve to establish the dis-

tinction between it and all other diseases, except furuncle, diffuse inflammation of the meatus and herpes zoster affecting the auricular branch of the trigeminus nerve. From the first and second of these it will be readily distinguished if the meatus be unaffected; but we must not forget that inflammation sometimes spreads from the tympanum to the meatus, and *vice versa*, its presence will not therefore contra-indicate tympanic disease. In herpes the hearing power is generally unaltered both for the watch and for the tuning-fork; there is no tenderness of the meatus or pain on inflation of the tympanum, and the symptoms usually intermit. Should this painful form of eruption occur in an ear already more or less deaf from other causes, the diagnosis may be rendered very difficult, until the vescicles make their appearance. It occasionally happens, particularly in children, that the symptoms of meningitis accompany acute inflammation of the tympanum. An inspection of the ear should always be made in such cases, and will enable us to detect the aural affection if any be present.

Prognosis. The disease may terminate by resolution, the thickening gradually diminishing or it may assume the chronic form, in which the new material deposited may increase in quantity and density, and in the course of time become the seat of bony or calcareous deposits or of polypous growths. Sometimes lymph is thrown out, and forms organised bands of adhesion between the different parts within the tympanum. Not unfrequently suppuration

occurs which may pass away through the Eustachian tube, or through a perforation in the membrana tympani, or ulceration, caries, necrosis, and even death, from extension of the inflammation to the brain or its membranes and sinuses, may take place. If properly treated, the prognosis of this formidable affection will be favourable, and there will be very little impairment of hearing. Some lesion, however, generally remains behind and becomes manifest should the attack be renewed. In children, although the disease is milder, it is more likely to be followed by unfavourable consequences.

The treatment consists in the application of leeches below and in front of the meatus, the number varying with the severity of the attack and the age of the patient. One or two will suffice for a child or for a mild attack, whilst from four to half-a-dozen will be required for an adult when the inflammation is severe. The bleeding from the bites should be encouraged by hot fomentations or poultices, and if the symptoms seem to call for it, more leeches may be applied. The effect of this treatment is sometimes very marked, the pain almost disappearing before the leeches drop off. Although the application of poultices and fomentations is most grateful to the patient, the use of these remedies must not be continued, as they are very liable to induce suppurative action, which it is our object to avoid. The interior of the meatus and throat should be well steamed, and hot water may be employed to gargle or it may be used with or without the admixture of morphia or

liquor opii to place in the ear while the patient lies on the opposite side. The intensity of the pain will generally call for the administration of opium or chloral hydrate in order to procure sleep. When the acute symptoms have subsided, and there is no more pain in the ear, inflation of the tympanum should be performed once or twice daily. If from thickening of the walls of the Eustachian tube air will not penetrate, Siegle's pneumatic speculum should be employed from time to time until hearing is quite restored. Counter-irritation behind the ear over the mastoid process by means of iodine paint or blistering fluid is generally recommended, though it will rarely prove of any advantage. A Guaiacum lozenge every two or three hours seems to exert a specific effect on the throat, more particularly when tonsillitis is present. In some cases where a frequent recurrence of quinsy occurs the tonsils should be removed, as recommended in page 73.

Chronic inflammation, as already stated, is often a result of the acute form which not unfrequently merges into it; but this disease much more commonly occurs as a primary affection.

Morbid Anatomy. The lining of the tympanum is in health so thin and delicate and so sparingly supplied with blood, that it presents an appearance more resembling that of a serous surface; indeed, so fine is this covering, that its existence can only be recognised on the bony parts by the touch, and the shining polished appearance which it gives.

These characters are entirely altered in inflammation. The parts become vascular and opaque, soft and elastic to the touch, exudation takes place from the blood-vessels, and produces thickening of the tympanic walls, which now fill up, or nearly fill up, the whole cavity of the middle ear. The augmented supply of blood necessarily induces hyper-secretion from the mucous membrane, so that any space remaining between the tumid walls becomes choked up with mucus; this, if it cannot escape by the normal channel —the Eustachian tube—may lead to pressure on and absorption of the membrana tympani, which at last ulcerates, producing perforation and internal otorrhœa. When the thickening process continues a polypus may form, and project through the opening into the meatus, where it may continue to grow until it appears externally. Again, as a result of this disease as well as of the acute form, membranous bands may form between the ossicles, binding them together, or to the promontary, or the inflammatory exudation may assume plastic characters, with shrinkage and condensation, producing rigidity of all the parts, with a tendency to bony or calcareous deposits. This affection is more common in persons who have passed middle age, whilst chronic catarrh is more usually met with in children and young people.

Symptoms. Chronic inflammation of the tympanum is seldom attended with much pain, except of a dull gnawing character, which comes on chiefly after exposure to cold. A heavy stuffy feeling, accom-

panied by more or less dullness of the functions of the brain, is, however, not unfrequently complained of. The hearing power is often greatly reduced, but the extent of this depends upon the parts which are affected. Thus, a considerable amount of thickening and opacity of the tympanic membrane may be discovered, though the hearing continues good or moderately so. On the other hand, inflammatory swelling of the membranes of the fenestræ or impaction of the base of the stapes, even in a slight degree, will cause at times a great amount of deafness. Tinnitus is a very common symptom in this disease, and is a source of considerable annoyance to the patient. Until this occurs, particularly when only one ear is affected, the patient may be quite unaware of his gradually increasing deafness, so much so that any statement he may make concerning the duration of the disease, must be received with great caution. Deafness is generally worse in the morning, whilst the noises and heaviness in the ear increase after dinner, after prolonged stooping, or after partaking of stimulants, such as alcohol, tea, coffee, or quinine, and also when the head is placed on the pillow at night. It will be found that variations of temperature or humidity affect this disease considerably, as well as the catarrhal form. Irritability and depression of spirits are very commonly present.

When the tubal portion of the tympanum is alone affected its obstruction will give rise to concavity of the membrana tympani without interfering with its transparency or lustre. We shall observe fore-

shortening of the malleus handle with increased prominence, more particularly of its short process. The light spot will appear more or less rounded, indistinct at the margin, and often reduced in size. In addition to these appearances if the inflammation extend to the membrana tympani its transparency will be diminished, and circular or radiating markings may be observed, due to thickening of the fibrous laminæ. The concentric lines will often be visible only when the drum is inflated. The outline of the manubrium will generally be distinct, with little or no enlargement of its vessels; but, if the disease be of old standing or have recently been acute, thickening of the dermoid layer of the drum-head may be present, rendering the malleus handle more obscure. Enlarged vessels then appear at the edge of the bone, and perhaps also round the margin of the membrane.

The otoscope generally reveals moist crackling sounds due to the presence of catarrhal secretion usually present in this disease. Sometimes, however, the tympanic cavity is dry, even abnormally so, and the sounds will then be of a dry character. When this is observed condensation and shrinkage of the inflammatory exudation has probably commenced. Inflation of the tympanum is generally more difficult than in health from narrowing of the Eustachian tube.

Diagnosis. It must be acknowledged that the diagnosis of this affection is by no means easy and in view of the difficulties which present themselves, many authors do not admit its existence as distinct

from chronic catarrh, with which it is certainly very frequently associated. It cannot be denied, however, that catarrh and inflammation produce different effects, which are found on dissection, which are acknowledged to exist, and the treatment of which is certainly different. It should therefore, it seems to me, be our object to endeavour, even though the task may be a difficult one, to discriminate between these two diseases, which we shall be unable to do, so long as we continue to look upon them as one and the same affection. If it were usual to find this disease uncomplicated, there would be little difficulty in arriving at a correct diagnosis; but, in addition to the complication caused by the association with catarrh, the symptoms of chronic inflammation and those of plastic depositions merge so imperceptibly into each other that it is often impossible to decide when one terminates and the other begins. I know no means by which inflammation confined to the Eustachian tube can be distinguished from catarrh of the same part. In both there will be obstruction to the passage of air, more difficult to overcome, perhaps, in the former than in the latter case; in both also moist gurgling sounds will be heard through the otoscope; and in both, if inflation of the tympanum can be effected, deafness dependent upon closure of the tube will be relieved. When the inner wall of the tympanic cavity is implicated, the tuning-fork will afford some information. In simple catarrh it will be heard as well as or better than in health; but when

inflammation attacks the lining membrane of the middle ear, around the fenestral openings, it will be heard less than under normal conditions. A successful inflation of the drum by the Politzer or Valsalvian method greatly improves the hearing and tinnitus in catarrh, but not to the same extent where inflammatory exudation has caused fixation of the ossicles or thickening of the fenestral membranes. When the membrana tympani is implicated in the inflammation it will present certain appearances different from those of catarrh. It will be less transparent, more evenly thickened, and on inflation we may often observe radiating lines; in catarrh the opacity is uneven and as it were mottled. It is probable that in most cases of long-standing chronic inflammation of the tympanum some organisation of the exuded material takes place, and that therefore plastic depositions co-exist with the inflammation. The only means by which we can recognise these changes during life is in the gradual diminution of the accommodative power, with steady increase of the deafness, both for the watch and the tuning-fork. Sometimes the sounds audible on auscultation will be of a dry character, with perhaps a crackling like parchment. When bands of adhesion fasten down portions of the tympanic membrane they may not unfrequently be seen by employing Siegle's speculum. Trustworthy signs by which catarrh, chronic inflammation, and plastic depositions can be distinguished from each other are still much to be desired.

Treatment. The indications to be fulfilled in the

treatment of this disease are to arrest the progress of the thickening, and as far as possible to promote absorption of the material already effused. For this purpose alterative doses of mercury are often required. When we consider the great importance of the function involved we must not hesitate any more than we should if iritis threatened by effusion of lymph to obstruct the pupil and to form adhesions between the iris and the capsule of the lens. As however the disease we are considering is not acute smaller doses will suffice than for iritis, we may prescribe half a grain of sub-chloride, one grain of grey powder, or what I usually prefer, a sixteenth of a grain of bichloride or biniodide three times a day, combined with tonics. Iodide of potassium will also prove most useful, either alone or with the bichloride. When the disease is seen in its earlier stages or in the sub-acute form, the application of a leech below the meatus every other day or twice weekly for three or four times will be of advantage. If the Eustachian tube be obstructed we must endeavour to render it pervious by the employment of iodine vapor to the naso-pharynx; iodine and glycerine paint to the faucial orifices of the tubes and adjacent mucous membrane and the use, inside the catheter, of bougies of whalebone, catgut, or laminaria digitata. When no obstruction exists, or after it has been removed by treatment, the middle ear should be injected with the vapor of iodine, acetic ether, or chloride of ammonium, or with a solution of iodide of potassium or of nitrate of silver.

Forcible inflation of the tympanum must also be performed by means of the Politzer bag, with or without the catheter, twice or thrice weekly, in order to prevent or loosen adhesions. Suction by the meatus externus with Siegle's pneumatic speculum, or with a simple tube as described in page 21, may be practised with the same object. If the disease be complicated by mucous accumulations in the tympanum, this should be evacuated by incision of the membrane. We should not forget that this is a disease of slow progress, and will also, at the best, be slow to abate, particularly if it have lasted for a considerable time.

Suppuration within the tympanum is the most common mode of termination of acute inflammation, particularly among children; it also not unfrequently follows the chronic form.

When suppuration occurs in the tympanic cavity the lining membrane will be found red, thick, and velvety in appearance, and bedewed with purulent or, more correctly speaking, muco-purulent secretion. This condition not unfrequently extends into the Eustachian tube and mastoid cells. If the Eustachian tube be pervious the secretion may escape into the throat, but perforation of the tympanic membrane almost always occurs to a greater or smaller extent, producing otorrhœa and sometimes polypus. The pus may find an exit by some other route, generally over the mastoid process, sometimes into the cranial cavity by perforation of the thin plate

—tegmen tympani—which separates the drum cavity from the dura mater. We should always bear in mind that this portion of the skull is exceedingly thin, and that sometimes the bony partition is absent, so that the outer surface of the dura mater is in contact with the lining membrane of the tympanum. Besides this, in the infant the dura mater sends a vascular prolongation to the tympanum through the petro-squamosal suture, and in the adult branches of the middle meningeal artery pass from the dura mater at this part. Hence the not unfrequent occurrence of cerebral abscess as a consequence of caries and necrosis. Most frequently the ossicles only are affected, sometimes the handle of the malleus or the entire bone, sometimes the incus, occasionally the rami of the stapes, but rarely the entire bone will exfoliate or be destroyed by caries. Usually even after all the other parts of the ossicula have disappeared, the base of the stapes will remain fixed in the oval fenestra. In some cases upon record the whole osseous labyrinth exfoliated during life, but from its contiguity to many vital parts death most frequently occurs before so great a destruction and separation of tissue can take place. Sometimes suppuration occurs in the mastoid cells, forming an independent abscess, which does not communicate with the cavity of the tympanum. Occasionally this penetrates the posterior fossa of the skull, but more frequently it points externally behind the ear.

Inflammation of the membranes of the brain and abscess in the cerebral substance occurring in children,

more particularly when in the region of the temporal bone, depend upon suppurative disease in the tympanum much more frequently than is generally supposed. Von Tröltsch made a careful examination of the auditory apparatus, in 48 instances, occurring in 25 children who had died of various diseases. Omitting one case which was found affected with caries of the temporal bones on each side, he discovered suppuration within the tympana is 33 out of 46. In most of these the mucous membrane was hyperæmic and swollen to such an extent that the ossicles were imbedded in it and could with difficulty be made out. Occasionally there was a network of delicate vessels. In 8 of these cases where the mucous membrane was found of gelatinous consistency, peculiar red bodies varying in size from a pin's head to a hemp seed, and hard to the touch, were found firmly attached to the membrane. The children were of different ages from 17 hours to 11 months and were taken indiscriminately from the Lying-in Institution and Anatomical Department of the Medical School of Würtzburg during a period of three years and a half and were not suspected to have disease of the ear. Wreden of St. Petersburg examined the auditory apparatus of 80 foundlings, the youngest of whom was 12 hours, the eldest 14 months, the greatest number being between 3 and 14 days old, of these the tympanum could only be considered healthy in 14 cases or 17·5 per cent. All those whose ears displayed considerable disease died of some severe affection. In one only of the cases was the ear primarily

affected, and led to fatal constitutional disease. The conclusions arrived at by Dr. Wreden are that none of the children who had normal ears died of pneumonia or meningitis, and that where the aural disease was slight the congestion of brain or lungs was also slight. Of the eighty children, 16·25 per cent. were affected with *acute* suppurative otitis. Purulent inflammation occurred in 45 per cent., simple mucous catarrh in 21·25. More than half the cases of suppurative inflammation were accompanied by consecutive affections which were often the direct cause of death. In one only was perforation discovered in the membrana tympani.

Causes.—It is well known that children are much more liable to this affection than adults, and that those of a scrofulous or weakly constitution, as well as those who are debilitated by disease or want of proper food and hygienic conditions, are more especially subject to this disease. Perhaps the most common exciting cause is scarlatina, and among those not unfrequently met with must be mentioned measles, typhus, and phthisis. Suppuration always originates in inflammation of the middle ear, more particularly if this have been neglected.

Symptoms. When this disease occurs as a consequence of acute inflammation of the middle ear the symptoms continue to increase until relief occurs by escape of the purulent secretion. The pain is usually exceedingly severe, accompanied by a deep-seated burning and throbbing sensation. The febrile symptoms are very intense, and delirium or stupor,

particularly at night, are often present. From the proximity of the tympanum to the dura mater this membrane is often congested or inflamed, giving rise to more or less cerebral symptoms, which are most severe and dangerous when the membrana tympani offers considerable resistance to the escape of the matter. In some cases, after enduring the most frightful suffering, the patient may die from inflammation of the brain. Sometimes the auditory canal participates in the disease, becomes red, swollen, and acutely painful, and frequently suppuration of the meatus takes place. The mastoid process also is often the seat of pain and tenderness, followed by swelling, with a doughy feeling, and ultimately fluctuation. This occasionally indicates the formation of abscess in the part, which does not communicate with the tympanum. Generally we shall find in these cases a circumscribed spot of redness on the posterior wall of the auditory canal. A yellow or greenish-yellow color of the tympanic membrane, with diminution of its normal concavity, will be observed on examination with the speculum; the membrane soon becomes convex, presents a sodden appearance, and finally perforation occurs, unless the matter finds some other means of exit. The disease may thus pass through all its stages in forty-eight hours; or if less severe, it may occupy three or four days. Rupture of the membrana tympani may occur from the pressure of accumulated secretion within the drum, but it more frequently takes place during the act of sneezing, coughing, or blowing the nose. On subsidence

of the acute symptoms with perforation of the membrana tympani, we generally find discharge continuing more or less profusely, and for a longer or shorter time, according to the constitution of the patient. In the weakly, half-starved and scrofulous, it may last for months or years, sometimes assuming acute or sub-acute inflammatory symptoms again. When these occur we usually find that the discharge, which had previously been abundant, ceases, and at the same time pain and cerebral symptoms arise. We should always look with considerable suspicion upon the sudden suppression of internal otorrhœa and be prepared for aggravation of the symptoms. The only legitimate means by which discharge from the middle ear ceases is by gradual improvement of the general health and of the local condition of the lining membrane.

Diagnosis. When inflammation attacks the tympanic cavity, it will often be impossible to predict whether or not it will proceed to suppuration. If the symptoms be very severe, if they occur in the course of one of the eruptive fevers, or if the patient be weak and debilitated, it will very frequently take this course. Yellowness and bulging of the membrana tympani following acute symptoms such as I have described will leave no doubt as to the occurrence of suppuration. Occasionally, however, when the inflammation has been chronic and unattended by pain, the accumulated secretion within the drum may be either mucous or purulent. After suppuration has been for some time established

it is always accompanied by otorrhœa, and can only be confounded with one of the forms of inflammation of the meatus until an examination has been made with the aid of the speculum. It very frequently happens, however, that suppurative discharge proceeds from the external and middle ear at the same time, when, should we fail to see the opening in the membrana tympani or to obtain evidence of its existence, we may overlook the tympanal disease. Whenever we have cause to suspect the formation of pus within the tympanum, we should never omit to use the speculum. In children it will often be necessary to administer an anæsthetic for the purpose, if there be much pain and tenderness of the meatus, or if the child cannot be kept quiet during the examination: we should, under these circumstances, be prepared to evacuate the matter if its presence be detected.

The treatment of acute and chronic inflammation of the tympanum, until we have evidence of the formation of pus, has already been fully described. When, however, suppuration has occurred, the rule must be to evacuate the matter as early as possible and wherever it may be found. With this object the membrana tympani should be punctured in the manner described at page 67, and after this the meatus should be syringed with warm water to wash away the secretion. If tenderness be discovered over the mastoid process, particularly when there exists a doughy feeling, we ought not to wait for decided fluctuation, but at once

proceed to make an incision through the periosteum down to the bone, which latter must be perforated if the symptoms indicate suppuration within the mastoid cells. For the purpose of making this opening in the bone, a drill mounted in a handle resembling that of a trephine is generally employed, but the osseous structure will often be found softened to such a degree that a strong scalpel will suffice. Immediate relief of the symptoms usually follows successful evacuation of the matter with the subsequent application of a poultice, and the patient enjoys a refreshing sleep, which he had probably not obtained for several days, owing to the acuteness of his suffering. The administration of calomel and opium has been universally recommended in this acute affection, and to such an extent has the practice prevailed that no trial appears to have been given to any other treatment. It must be admitted, however, that at the present day calomel is abandoned in the treatment of suppurative diseases, in which it has been proved to promote rather than check the formation of pus. The results obtained in suppuration of the tympanum by treatment on this principle certainly give no encouragement for persisting in its use, and under the circumstances no reason can be found for excepting ear disease from the rules which direct our practice in similar affections in other parts of the body. The severity of the symptoms will generally indicate the employment of narcotics or sedatives to lull the pain and cause sleep.

When suppuration of the tympanum occurs in

the course of scarlatina, or of one of the exanthemata or fevers, the attack is often so rapid in its course, whilst at the same time the mind of the medical attendant is so much absorbed in the treatment of the constitutional disease, that the ear affection escapes notice until matter flows from the meatus. If the case have reached this stage without treatment much valuable time has been lost, and it will frequently happen that our best directed efforts will be in vain. Though cases such as these very rarely come under the notice of aural surgeons during the acute stage, no more fruitful source of deafness occurs in early life. These are just the instances in which every medical practitioner is called upon to display a knowledge of ear disease, and to ward off by appropriate treatment the formidable consequences that so frequently follow. The debilitating influence of the constitutional affection will generally contra-indicate the employment of even local depletion; but if there be nothing to prevent, one or two leeches should be applied below the ear. Warm applications used in the manner already described will be found very useful, and will at the same time prove grateful to the patient. Convulsions occurring during scarlatina are, I believe, due to accumulation of purulent secretion in the tympanum much more frequently than is generally thought; it is therefore of great importance to puncture the membrana tympani as soon as suppuration takes place. When an escape has been provided for the pus, whether by incision or by an effort of nature, the meatus auditorius should

be washed out two or times daily with a gentle stream of warm water either by means of the douche or the syringe.

Perforation most frequently takes place at that part of the membrana tympani which is situated in front of the manubrium in the anterior-inferior quadrant, but it may occur at any other part. Perforations do not usually implicate either the centre or the external border of the membrane, but are generally situated between these two portions. They may be round, oval, or kidney-shaped; in the latter case, the extremity of the malleus handle, with a small portion of the membrane adhering on each side, will be observed to project into the portion representing the hilus, which will therefore be directed upwards and forwards. In size, perforations may vary from that of a pin's point, not discoverable except on inflation, to that of nearly the entire surface of the drum-head. Even the largest are usually surrounded by a narrow border of membrane which has escaped destruction. It is most common to find one perforation only; there may, however, be two or more, separated from each other by a bridge of membrane. When the aperture is of small size it presents the appearance of a minute black spot, but when large enough to permit of illumination the color of the lining membrane of the tympanum appears through the opening, the edges of which are usually red and tumid. When perforation is situated in the central portion the manubrium is detached from the mem-

brana tympani, and is usually drawn inwards in contact with or adhering to the promontory. The bone, being thus invisible, will often lead us to believe that it has been thrown off by necrosis when it is still in the tympanic cavity. If the perforation be extensive the portion of the middle ear exposed to view will usually be found reddened and swollen with fine bloodvessels running across the promontory. We may sometimes in these cases recognize the anterior border of the fossa leading to the fenestra rotunda in the situation of the posterior-inferior quadrant. We cannot, however, obtain a view of the membrane which closes the fenestra, owing to the obliquity of the fossa. In the posterior-superior quadrant, close to its outer margin, we may occasionally perceive the neck of the stapes, with a portion of its rami imbedded in the swollen tissues which line the tympanum and which quite conceal the base of the bone. Under these circumstances the stapes will often be found separated from the long process of the incus, which may be altogether absent. A sound knowledge of the anatomy of the parts within the tympanum will teach us where to look for them, and will enable us to recognize them when they are seen. Sometimes perforations are situated in the anterior-inferior quadrant, so near the lower wall of the meatus as to escape detection. We shall then only become aware of their presence by observing bubbles to arise on forcing air into the drum, and also by the whistling sound, audible at some distance from the patient, which the inflation produces. A pulsating appearance

may sometimes be observed in cases of perforation, as pointed out by Sir William Wilde, but this is by no means constant. Occasionally the border of a perforation adheres to the inner wall of the tympanum and thus shuts off communication between the throat and the external meatus (Fig. 19). In these cases the ring of tympanic membrane which remains may often be distended by inflation through the Eustachian tube. Perforation of the membrana tympani usually causes a certain amount of deafness, but this is sometimes so slight as to be scarcely perceptible.

Treatment. If otorrhœa persist after perforation, treatment directed to the cure of the affection of the middle ear will be the one best suited to remedy the perforation and otorrhœa which are dependent upon it. Carefully washing away the purulent secretion several times a day is probably the most important point to be attended to. Should the discharge be very offensive, a small quantity of chloride of soda, permanganate of potash, or some other disinfectant may be added to the warm water. After the parts have been dried by lying for a few moments on a folded towel an astringent lotion of alum 2-4 grains, of sulphate or chloride of zinc 1-2 grains, or of nitrate of silver 1-10 grains to the ounce of water, may be used, or we may employ an absorbent powder such as talc, magnesia, or oxide of zinc, which should be blown into the ear or inserted through the speculum. In some cases the addition of a little morphia to these powders may prove advanta-

geous. The general health of the patient must be carefully attended to, or in spite of all local remedies the otorrhœa may persist for months or even years. In these cases we shall be commonly called upon to ring the changes between cod-liver oil and different preparations of iron until the constitution becomes more healthy; the discharge will then not unfrequently cease almost of itself.

Great improvement, not only to the hearing but also to the discharge, will sometimes follow the employment of the artificial membrana tympani. This result is in no way dependent upon restoration of the tympanum to the condition of a closed chamber, but seems to depend rather upon exerting pressure on a suitable point of the ossicular chain, and thus affecting the tension in the labyrinth. With this explanation we may comprehend how the different methods advocated by Toynbee and Yearsley may produce similar results. The cases which will derive benefit from either of these forms of artificial membrane do not seem to be ascertainable beforehand, and can only be determined on trial. Yearsley's method, which certainly possesses the advantage of simplicity, consists in placing in the meatus a small piece of cotton wool, moistened in water or glycerine, and adapting it with a pair of forceps to the spot, where it is found to produce the greatest improvement of hearing. Toynbee's artificial membrane consists of a disc of flat india-rubber; to the centre of this is fixed a fine metal wire, which terminates in a small ring, for the purpose of adjusting or removing the apparatus.

Either of these plans will sometimes succeed in restoring the hearing to such an extent that the patient may be enabled to join in conversation, even though he had been unable to do so for years previously. In some cases of relaxation of the membrana tympani, where the pressure on the chain of ossicles is insufficient, the cotton wool may prove equally serviceable if properly applied, although no perforation be present.

Caries and Necrosis affecting the ossicles of the middle ear are not unfrequent consequences of suppuration. These diseases may also attack the temporal bone itself and extend thence to the brain, its membranes, or sinuses. When caries penetrates the cancellous structure of the bone the diploë becomes soaked in purulent secretion, which is thus brought into contact with the venous system and may induce pyæmia and metastatic abcesses in the lungs and elsewhere. The most common result of disease of the petrous portion of the temporal bone, extending inwards from the tympanum, is inflammation of that portion of dura mater which lies over it. Sometimes caries spreads in the direction of the large vessels which surround the tympanum, and severe or fatal hæmorrhage results. The formidable consequences which may follow extension of suppuration from the middle ear to the bone render it very desirable that the earliest signs of this extension should be recognised. It is very unsafe, however, to employ the probe when there is reason to suspect

the existence of caries in parts which are situated deeply within the ear and out of sight. We can only determine the existence of the disease by finding detritus of bony tissue mixed with the discharge. In proportion to the duration of otorrhœa will there be greater cause for apprehension, and therefore it cannot be too strongly impressed upon the minds of all who practice medicine that *discharge from the ear ought never to be made light of.*

Meningitis and Cerebral Abscess.—According to Lebert, about 25 per cent. of the cases of cerebral abscess originate in caries of the petrous portion of the temporal bone. Tröltsch estimates the number at nearly 50 per cent. When the middle ear is affected with inflammation this often spreads to the dura mater, lying on the petrous portion of the temporal bone. This is most frequently the case when the attack is acute, and when, through resistance of the membrana tympani, the pus cannot find an escape by the meatus. In these cases, or when discharge from the ear suddenly ceases, we not unfrequently find violent tinnitus and throbbing, accompanied by severe head-ache which occasionally extends along the spine. Nausea, vomiting, chilliness and rigors succeed, followed by stupor and death. It is a curious fact that the symptoms often intermit, sometimes for a day or more at a time, the patient being almost free from pain in the interval.

Treatment. Inflammation of the dura mater sometimes ends in recovery, but abscess in the brain is

almost always fatal, whatever treatment we may adopt. Many surgeons give mercury in these cases; but, for the same reasons which induce us to withhold this drug in suppuration of the middle ear, we should not employ it here. Antiphlogistic treatment and general depletion are injurious. We may, however, apply cold to the head, leeches on the mastoid process, and blisters to the nape of the neck. Nutritious spoon diet should also be administered at regular intervals. It is always of the greatest importance that the discharge should have a free exit, whether it proceed from the tympanum or from the mastoid cells.

Plastic Depositions may be said to have occurred within the tympanum when inflammatory exudation is retained in the tissues and becomes organized. The new material assumes the form of connective tissue, which gradually becomes more and more fibrous, and may ultimately be the seat of osseous or calcareous formations. If we remember how small the tympanum is in health, we can readily understand that any hypertrophy of its walls will materially reduce the capacity of its chamber. The thickening and rigidity may be limited to the bony walls of the middle ear, or they may spread to the tympanic and fenestral membranes or to the ossicles and their ligaments. As the tissue which lines the tympanum is also its periosteum, we not unfrequently find the dense fibrous deposits becoming osseous or calcareous. Hypersecretion of mucus,

resulting from increased activity of the lining membrane during the inflammatory stage, almost of necessity accompanies this disease, which may thus be complicated with mucous accumulations within the drum.

Morbid Anatomy. The lining of the tympanum assumes a whitish or bluish grey appearance, the niches or fossæ leading to the fenestra ovalis and rotunda become narrowed and increased in depth, whilst in the former the base of the stapes becomes impacted and grasped in the rigid tissue, or united to the opening by bony anchylosis. Sometimes the membranes which close the fenestræ become thickened, and in a more advanced stage calcareous deposits take place in them. In the membrana tympani radiating or crescentic white patches not unfrequently occur, and the ligaments which bind the ossicles together, more particularly the articulation of the malleus and incus, become thickened and rigid. Sometimes true bony anchylosis takes place. After prolonged obstruction of the Eustachian tube, with consequent indrawing of the membrana tympani and malleus handle, the tensor tympani becomes contracted, just as the flexor muscles of a limb will do if it has been long retained in a state of flexion. The same effect may also depend upon adhesions or membranous bands holding the bone in an abnormal position.

Causes. It is an undoubted fact that this affection is hereditary, as we frequently find that members of our patient's family, perhaps for several generations,

have suffered from deafness of apparently the same character. Persons of a gouty or rheumatic diathesis are most liable to this form of disease, and debilitating influences seem to predispose to it. Old age, too, by inducing a general degeneration of tissue may likewise be mentioned as a cause of the rigid and calcareous deposits which frequently occur.

The symptoms of plastic formations are always preceded by those of inflammation, even though these may have been so slight as to have escaped detection. As the disease gradually produces more and more condensation and rigidity of the tissues, we find considerable diminution of the power of accommodation, which shows itself by an inability to hear conversation if more than one person is speaking at a time. The sound of the voice may be heard, though the patient may find himself unable to distinguish accurately what is said, even though he appears to strain every nerve to listen, the effort being attended with fatigue. This symptom, gradually but surely increasing, generally indicates fixation of the ossicles, more especially impaction or anchylosis of the stapes in the oval fenestra. Patients, under these circumstances, not unfrequently complain of fulness, pressure in the ears, and a buzzing when the head is laid on the pillow. Yawning, pulling the outer ear, pressing the tragus, or loud sounds, sometimes cause momentary improvement. Amelioration of the hearing power in a noise, or when travelling over rough roads, will also be occasionally noticed. This I have endeavoured to explain at page 13.

We are rarely consulted until the affection has lasted for a considerable time, and we therefore usually find the hearing power for the watch greatly diminished or altogether gone. Occasionally, however, when the patient is only aware of being deaf with one ear, for which he applies to us, we may discover disease in an early stage in the other ear, with which the watch may be heard moderately well. When schlerosis or anchylosis exist, the tuning-fork, placed on any part of the head will generally be heard less distinctly in the affected ear than in the sound one, and also less than by the surgeon. The meatus is commonly dry from defective secretion of cerumen. As regards the membrana tympani, it may appear quite healthy when the disease is limited to other parts of the drum cavity, or we may find the concentric or circular fibres thickened in various degrees, and showing white radiating or crescentic patches (Fig. 17), which indicate the results of inflammatory action. The former appearance becomes more evident during Valsalvian or Politzer inflation. The latter is more frequently found in the posterior quadrants behind the handle of the malleus. When plastic formations assume the form of membranous bands which bind together the parts within the tympanum, we not unfrequently derive important information from the employment of Siegle's pneumatic speculum. The membrana tympani, when examined with this instrument, will sometimes show portions which do not expand with the rest, and thus the points where adhesions have taken place will

be indicated. In advanced cases of schlerosis the membrana tympani sometimes presents a very transparent and shining appearance, looking tense and glistening. Abnormal concavity will likewise be found if the Eustachian tube be closed.

The sounds heard with the otoscope, like the other symptoms, vary considerably; when the disease occurs in its uncomplicated form, air may enter the tympanum with a dry sound, accompanied by harsh clacking of the membrane; but when, as we not unfrequently find, the disease is complicated with mucus within the drum, the sounds produced by inflation are modified in consequence, and we hear the moist crackling of catarrh or the squeaking caused by inspissated mucus. Sometimes the air-douche will fail to elicit any sound.

Diagnosis. I have already stated that the symptoms of chronic inflammation merge gradually and almost imperceptibly into those of plastic depositions within the tympanum. When the inner walls of the cavity are affected the symptoms resemble each other most closely, because the effects produced by inflammatory swelling are the same as those caused by more permanent organisation of the exuded products. In either case the ossicula become more fixed from tumefaction of the parts which surround them, and thus their sound-conducting properties are impaired. The intractible nature of the affection, in spite of treatment directed to the cure of inflammation, will lead us, in conjunction with the appearances of the membrana tympani, in forming a correct

diagnosis. The characteristic symptoms of this disease are steadily progressive deafness, wherein the patient requires a marked effort of attention to understand conversation, with little or no pain, but constant tinnitus and depression of spirits. In many cases there is no obstruction of the Eustachian tube or concavity of the membrana tympani, though this membrane frequently indicates thickening of its fibrous layers or glassy dryness of its surface; sometimes, too, there is evidence of secretion within the cavity. These symptoms would lead to a strong conviction that we have to deal with plastic depositions, and the opinion will be further strengthened if the patient be of a rheumatic, gouty, or syphilitic diathesis. If, however, the thickening affect the Eustachian tube, causing its occlusion, the diagnosis becomes much more difficult, and often impossible, until the obstruction can be overcome. When mucous accumulation is present, this should be first evacuated in the manner described at page 67; if little improvement follows we shall have evidence of the existence of some further lesion which will probably be no other than the one we are now considering. The tendency of the disease is, as we have seen, to cause fixation and rigidity of the tissues, chiefly by impaction or anchylosis of the stapes, by thickening and calcareous deposits in the fenestræ, or by membranous bands. The absence of these lesions may be pretty correctly inferred by the use of the tuning-fork, which can never be heard better; but, on the contrary, very much worse when they

exist. If therefore improvement or no deterioration of the hearing power for the tuning-fork placed on the head exist, we may conclude that plastic formations are not present, and, consequently, that the symptoms depend upon some other cause.

Prognosis. When a patient presents himself in the earlier stages of the affection, before the plastic exudation has become firm fibrous tissue, we may entertain some hope that by judicious treatment relief will be afforded, or that the disease may be prevented making further progress; but when after many years' duration the newly formed tissues are thoroughly organized, or when bony and calcareous deposits have taken place, the chances of success will be considerably diminished. The accidental occurrence of acute inflammation will sometimes result in considerable benefit to the hearing, just as purulent ophthalmia will often cure granular lids. Unfortunately, however, the simularity ends here; for when artificially produced, inflammation of the tympanum has not proved successful in curing plastic formations: such at least is the experience of Von Tröltsch.

The treatment recommended for chronic inflammation of the tympanum must be continued when plastic depositions have taken place. The vapor of iodine combined with steam, and injected through the catheter in the manner described at page 61, will perhaps be the most useful. This will often cause some pain as well as congestion of the tympanum, and the hearing will not unfrequently be

made worse for a few days after the application. We should not fail to mention this to the patient, or he may think that we have done him harm. When the Eustachian tube is closed by plastic deposition in any part of its walls we should insert bougies through the catheter until the part is rendered pervious. Forcible inflation of the middle ear by Politzer's method, with or without the catheter, and suction employed through the meatus, should be performed from time to time to loosen adhesions or rupture membranous bands, if they be present. By these means we may not unfrequently succeed in producing very beneficial results, especially if the disease be of recent date. When, however, it has lasted a long time and calcareous deposits or anchylosis are present to a considerable extent, we shall often fail to produce more than slight amelioration, even by most assiduous and prolonged treatment.

Polypus of the ear in most cases springs from the walls of the tympanum, and on this account ought, perhaps, to be considered in this place. I have, however, for reasons already stated, described the affection among the diseases of the external ear at page 109, to which I must refer the reader.

Affections of the Eustachian Tube have throughout this Manual been treated with those of the middle ear, of which they form a part. I will now direct attention to some diseases which specially affect this portion of the tympanum. We occasionally

discover, either with the rhinoscope or on *post-mortem* examination, ulceration of the faucial extremity of the tube. On cicatrization this sometimes produces contraction or absolute closure of the orifice. This condition most frequently occurs in scrofulous and syphilitic patients, and would be much more commonly observed during life if the rhinoscope were more generally employed. In many cases, however, from the narrowness of the space between the soft palate and the posterior wall of the pharynx, or from irritability of the parts, we cannot obtain a satisfactory view. Abnormal patency of the Eustachian tube is a rare affection, but may be occasionally met with. Dr. Jago describes this condition as observed in his own person. The principal symptoms are a buzzing noise of the patient's voice in his ears, unnatural audibility of the respiratory murmurs, and abnormal sounds on blowing the nose and swallowing. This is probably a congenital malformation of the parts. Sometimes the tympanal extremity of the Eustachian tube becomes dilated in cases of long-standing catarrh of the middle ear, from continued pressure exerted by the secretion contained in the tympanum.

Pathological Observations.—Before concluding the study of affections of the middle ear, which, as I have said, constitute so large a proportion of diseases of the auditory apparatus, it will not prove unprofitable to examine the statistics of the various morbid appearances of this part observed on dissection. For

this purpose I will refer to the observations of the late Mr. Toynbee. In 1,013 diseased ears examined after death by that painstaking and accurate pathologist, the tympanum contained mucus in 65; blood in 6; blood and mucus, 1; blood, mucus, and lymph, 1; serum, 10; serum and mucus, 3; serum and lymph, 1; lymph, 6; epithelium, 2; epithelium and oil, 1; scrofulous matter, 20; calcareous matter, 8; cerumen, 1; cholesterine, 1; cholesterine and mucus, 5; cellular tissue, 2; oily matter, 1; pus, 17.

The mucous membrane was more vascular than natural in 75; thickened, 211; thick and very vascular, 16; so thick as to conceal the stapes, 27; so thick as to fill the tympanic cavity, 6; ulcerated, 24; pulpy, 5; containing black pigment cells, 2; having serum beneath it, 1. Membranous bands were present between—the malleus and promontory in 6; malleus, incus, and promontory, 1; malleus and stapes, 1; malleus, stapes, and promontory, 6; incus and promontory, 5; incus, stapes, and promontory, 3; incus, and malleus, 1; stapes and promontory, the mucous membrane being healthy, 79; stapes and promontory, the mucous membrane being thick, 48; stapes and promontory, the mucous membrane being vascular, 6; stapes, promontory and pyramid, 1; all the ossicles, 30; all the ossicles and promontory, 9; tensor tympani muscle (the tendon) and the stapes, 3; chorda tympani nerve, incus, stapes, and promontory, 2; chorda tympani nerve and upper wall of tympanum, 1.

The malleus was adherent to the promontory in 1; absent, apparently from caries or ulceration, 4; partly

removed by caries, 1; malleus and incus lying in the mastoid cells, 1; fixed by ligamentous anchylosis to the upper wall of the tympanum, 3; fixed by osseous anchylosis to the upper wall of the tympanum, 2; the body anchylosed to the incus, 3; the handle detached from the membrana tympani, 3; the handle fractured, 1; the handle in contact with the promontory, 3; the handle adherent to the incus, 1; the handle detached from the body, 1; the handle absent, 2; the handle carious, 3; the handle exostosed, 1.

The incus was absent in 4; long process absent, 2; partially removed by caries, 8; disconnected from stapes, 14; disconnected from stapes and malleus, 1; fixed by membranous anchylosis to the orifice of the mastoid cells, 2.

The base of the stapes was anchylosed by bone to the fenestra ovalis in 49; expanded and anchylosed by bone to the fenestra ovalis, 6; anchylosed by membrane to the margin of the fenestra ovalis, 36; expanded and anchylosed to the margin of the fenestra ovalis, 6; anchylosed by membrane to the margin of the fenestra ovalis, an exostosis surrounding the fenestra, 2; attached to the fenestra ovalis more rigidly than natural, 66; projecting into the cavity of the vestibule, 5; expanded and more fixed than natural, 7; expanded and projecting into the vestibule, 2. The bone was detached from the incus and attached to the membrana tympani in 1; anchylosed to the incus, 2; detached from the fenestra ovalis and incus, 2; disconnected from the fenestra

ovalis, 1; partially absorbed, 1; atrophied, 1; absent apparently from ulceration, 2.

All the ossicles were less movable in 4; absent apparently from ulceration, 2; disconnected from each other, 1; carious, 2.

The osseous walls of the tympanum were thickened in 1; carious, 6; upper wall partly deficient, 54; lower wall partly deficient, 25; osseous lamina between mastoid cells and lateral sinus incomplete, 2; osseous lamina between mastoid cells and cavitas cerebelli incomplete, 1; canal for portio dura nerve incomplete, 2; carotid canal contracted, 7.

The membrani tympani was opaque in 15; vascular, 7; vascular and thick, 3; relaxed, 4; tense, 10; tense and atrophied, 2; inner surface connected to the promontory by bands of membrane, 32; inner surface adherent to the incus, 9; to the stapes, 4; to the stapes by membranous bands, 11; to the incus, 1; to all the ossicles, 2; to all the ossicles and promontory by bands, 6; outer surface more concave than natural, 34; concave and thick, 4; concave and opaque, 2; concave, thick, and opaque, 1; concave and soft, 2; concave and tense, 2; very concave, inner surface in contact with the promontory, 10; very concave, inner surface connected with promontory by bands, 13; very concave, the whole inner surface in contact with the inner wall of the tympanum, obliterating the cavity, 7; very concave, thick, and adherent to the promontory, 3; thickened, 66; thick and unyielding, 5; thick and white, 12; thick and soft, 2; thick and tense, 5; thick and attached to the

incus by bands, 1; thick and vascular and adherent to the incus by bands, 1; thick and opaque, 4; thick, tense, and congested, 2; containing calcareous deposits, 14; containing spots of cartilage, 2; flat externally, 6; flat, thick, and white, 4; epidermoid lamina thick, 8; epidermoid lamina absent, 5; dermoid lamina very vascular, 1; dermoid lamina thick, 4; dermoid lamina very thick and vascular, 3; dermoid lamina detached from the fibrous laminæ, 1; radiate lamina absent, entirely destroyed by ulceration, 3; absent in parts, 2; dermoid and fibrous laminæ absent in parts, apparently from ulceration, 3; radiate and circular laminæ destroyed by ulceration in parts, 6; radiate and circular laminæ entirely destroyed by ulceration, 4; radiate and circular laminæ entirely destroyed by ulceration, the mucous lamina attached to the promontory, 2; radiate and circular laminæ containing pigment cells, 3; mucous lamina thick, 2; all the laminæ destroyed by ulceration except the epidermoid, 3; all the laminæ destroyed except the mucous, 2; all the laminæ perforated 47; all the laminæ absent, apparently from ulceration, 21; all the laminæ perforated, the remaining portion of the membrane adherent to the promontory, 9; all the laminæ perforated and very thick, 1; all the laminæ perforated, very thick, and concave, adhering internally to the promontory, 2; all the laminæ perforated by molluscous tumors, 2; upper part of all the laminæ detached from the bone, 2; circular cartilage exposed, 2.

In 1,523 dissections the Eustachian tube was found

containing mucus in 10; containing mucus, the lining membrane being congested, 2; containing mucus, the lining membrane being thick, 2. The lining membrane congested, 5; faucial portion, mucous membrane red and soft, 2; bands of adhesion connecting the walls, 3; stricture in osseous part, 1; stricture in cartilaginous part, 2; very large, 2.

AFFECTIONS OF THE INTERNAL EAR.

I purpose in the following pages giving a brief outline of what is known concerning diseases and injuries of the internal ear. Under this head will be included affections of the nervous or perceptive portion of the auditory apparatus, as well as tinnitus, which, though it often depends upon extraneous causes, can only be regarded as a nervous symptom. The information which it is in my power to impart on the subject before us is, I regret to say, exceedingly meagre and unsatisfactory both in a pathological and therapeutical point of view; it is therefore fortunate for the credit of aural surgery that disease of the labyrinth is of very rare occurrence in practice. Indeed, it may be fairly concluded that in proportion to the advance of our knowledge we meet with a steady decrease in the cases which we are obliged to set down as "nervous," so that the number so considered will form a test by which to estimate the amount of knowledge we possess. This is well illustrated by the personal experience of Kramer, who states that in the earlier part of his career he believed nervous deafness to constitute about fifty

per cent. of all cases of ear disease, but as his knowledge increased in later years he only met with about four in a thousand. The improved methods of diagnosis which we have at our command, and which have been explained in the first part, will in most instances enable us to discriminate between affections of the internal and middle ear; but we are still to a great extent in the dark concerning the nature of each particular lesion of the nerve structures. Opportunities for accurate pathological observation are, of rare occurrence, and thus much time and patience are needed to enable us to form accurate conclusions on many important points; but we may hope, however, that the well-directed efforts which are now being made in search of information will ultimately be crowned with success, and that before many years we shall be able to identify the symptoms of nervous disease of the ear with the same accuracy that we can do those of the eye.

As the result of *post-mortem* investigation, hyperæmia, effusions of lymph of serum and of blood, diminution of otoconia, increase of the labyrinthine fluid, exostosis, necrosis, and fracture of the bone, hypertrophy of the cochlearis muscle, sarcoma, amyloid degeneration, and atrophy of the nerve structures are described as the morbid appearances occasionally met with in the internal ear. Unfortunately for practical purposes, the subjects of the pathological changes I have mentioned were not observed during life, and therefore the symptoms dependent upon them have not been ascertained. In a great number of cases, too, which

presented well-marked evidence of nervous disease during life, no morbid appearances were discovered after death, and we must acknowledge that we have still much to learn on this subject.

Injuries are sometimes inflicted on the nervous apparatus either as the result of loud noises or of fracture of the base of the skull. The former are most commonly observed among artillery-men, boiler-makers, or those who from accidental or other circumstances have been exposed to concussion of the auditory nerve. The nature of the lesion resulting from such causes is at present unknown; it may possibly be due to separation of the nervous expansion in the labyrinth, or to paralysis, induced by exaggerated impressions on the nerve of special sense, as occurs in the eye. Certain it is that in some cases deafness comes on either suddenly or more slowly, according as the impression producing it was sudden or gradual, and that the patients thus affected do not seem to be benefitted by any treatment which has been tried for their relief.

In fractures of the base of the skull, the middle zone is the part most commonly injured, and in the majority of these cases the fissure implicates the petrous portion of the temporal bone. Fractures in this situation are frequently accompanied by a watery or bloody discharge from the ear—a symptom which is of great importance in assisting us to form a correct diagnosis of the locality of the injury. When the patient does not die from the immediate effects of the accident, permanent, and often total, deafness

very commonly results, due probably to laceration of the auditory nerve in some part of its course. Blows or falls on the head without fracture will sometimes be followed by similar consequences.

Shortly before his death, Menière described some very interesting cases of nervous deafness which occurred in his practice. The symptoms came on suddenly, accompanied by tinnitus, giddiness, and nausea. Two of these terminated in death; one in five days, the other after two months. In the former of these—a girl exposed to cold during the catamenial period—the semi-circular canals were found full of red plastic lymph, a sort of bloody exudation, of which there were scarcely any indications in the vestibule. The brain and spinal cord were healthy. The second case was very similar, but the patient lived for a longer time, and in it the exudation was yellow in color, with grey spots not unlike tubercles. Menière believed the affection to be inflammatory; but Hinton suggests that it was more probably due to apoplexy of the labyrinth. This view is supported by analogy; for in cases where blindness occurs under similar circumstances we may sometimes detect, on examination with the ophthalmoscope, a retinal vessel terminating in a large blood-clot. Since Menière wrote, few opportunities have occurred for studying the disease *post-mortem*, although the symptoms as described by him have occasionally been met with. These bear such a strong resemblance to those which result from impacted cerumen pressing against the membrana tympani that there can be

little doubt that they, too, are dependent upon undue pressure on the nervous expansion in the labyrinth. Deafness following convulsions in children is not improbably to be attributed to the same cause. In cases of death from typhus and typhoid, effusions of blood or of bloody serum have been found in the labyrinth. These exudations are likely to be of a similar character to those which produce petechiæ in other parts of the body. I am not aware, however, if the same morbid appearances have been met with in the internal ear after death from purpura or scurvy, or that these diseases produce deafness. The impairment of hearing consequent upon continued fever usually disappears when convalescence is fully established.

Some years ago Mr. Hutchinson directed attention to a form of deafness which occurs in patients affected with congenital and hereditary syphilis. It generally becomes apparent about the period of puberty, sometimes earlier, and, from the nature of the symptoms, is manifestly due to an affection of the nerve structures, though the pathological changes present in these cases do not appear to have been studied. Patients suffering from this affection will commonly be found to have opacity of the cornea from previous attacks of interstitial keratitis, and it not unfrequently happens that these diseases alternate with each other, the symptoms of one abating while those of the other are aggravated. Disease of the internal ear is sometimes caused by acquired syphilis, and the deafness resulting is often very considerable. It generally

co-exists with secondary symptoms in other parts of the body, and will frequently disappear with them under treatment.

Functional disturbance of the hearing power is occasionally met with, and is generally accompanied by tinnitus. Thus deafness occurs in anæmia, chlorosis, hysteria, and after the administration of quinine in large doses. Neuralgia of the trigeminus will also at times cause impairment of hearing. Anæmic deafness is most frequently met with after considerable losses of blood, prolonged lactation, or great mental anxiety or shock. Peripheral irritation from worms has been known to induce deafness; but in all these instances some predisposing cause was probably located in the nervous structures.

Deafness to certain tones, like color blindness, has been occasionally observed, but the morbid condition of the organ which produces these symptoms is not understood. In addition to the diseases of the internal ear which cause deafness, function may be impared or lost from causes which affect the auditory nerve previous to its entrance into the meatus auditorius internus. Thus the brain may be affected at the point of origin of the auditory nerve, or this may be subjected to morbid influences during its transit from the fourth ventricle to the labyrinth. In hydrocephalus, apoplexy, and inflammation of the brain or its membranes, as well as in cases of aneurism and of tumors, deafness is not unfrequently present. It will also be found as a common accompaniment of cerebro-spinal meningitis.

The treatment of disease of the internal ear must be conducted on general principles, directed to the constitutional causes which produce the affection. Local applications seem to have little or no effect, whether applied to the external or middle ear. Perhaps the most tractable form of nervous disease is the syphilitic, which, with the secondary symptoms accompanying it, will often yield to iodide of potassium, with or without mercury. When deafness depends upon rheumatism, gout, anæmia, or chlorosis, these should be treated according to the rules laid down for the management of the constitutional affection. In Menière's disease, as well as in injuries of the head, little can be done. Galvanism seems to benefit some cases of nervous deafness; but as this treatment is much more successful among women than men, we are led to the belief that hysteria has something to do with the cases.

Concerning tinnitus little remains to be said; it is a frequent accompaniment of most of the diseases of the ear, and indicates irritation of the nerve of special sense in some part of its course. Sometimes the cause will be located at the point of origin of the nerve in the fourth ventricle of the brain; sometimes in its transit to the internal auditory meatus, most frequently, however, in the petrous portion of the temporal bone, as the result of disease of the middle or internal ear. Tinnitus may be considered to be of two kinds—one which is of an intermitting character, throbbing with the beats of the pulse, and depends upon irritation conveyed through the

vascular system. The transit of blood through the vessels becomes audible, which it is not under normal conditions. This form is met with in congestive and inflammatory affections of the head or ear—in aneurism within the skull, more particularly of the basilar artery—in venous obstruction—in certain constitutional diseases, such as chlorosis and anæmia, as well as after the administration of quinine in large doses.

The second form in which tinnitus occurs, is more continuous and constant in character, and depends upon compression of the auditory nerve through the medium of the labyrinthine fluid, and may be induced in various ways. It is met with in cases where the membrana tympani is driven inwards from any cause, such as cerumen or a foreign body in the meatus, or by atmospheric pressure when the air within the drum becomes rarefied as a consequence of closure of the Eustachian tube. It also occurs when the malleus handle is drawn against the promontory either by adhesion or by muscular contraction. Abnormal pressure may likewise be induced by causes seated within the labyrinth, such as effusions of serum, or blood. Noises in the head may be considered as an auditory delusion attendant upon loss of nervous power, just as visual illusions and mental halucinations accompany many diseases of the eye and brain in which the nervous power is impaired.

The noises which patients hear are of the most varied character, and are frequently likened to some sound which they are in the habit of hearing. Generally

they are of an unpleasant nature, and sometimes so wearying that persons have been driven to commit suicide through this symptom alone. Occasionally, though rarely, the tinnitus is described as of an agreeable character; but even the most pleasing sounds will generally become annoying if constantly present. In one case, recorded by Tröltsch, a composer constantly heard a certain hymn in his ear, the one which had rendered his name famous. Some patients will tell us that the tinnitus resembles the singing of birds or some other pleasant sound, but very few are met with who would not gladly get rid of the noise.

The treatment of tinnitus is, perhaps, the most difficult matter which comes before us. When the cause of this disagreeable symptom can be detected, its removal should be our principal object. Not unfrequently, however, even after this has been apparently effected, and after the hearing power is restored or considerably improved, the "noises in the head" continue without amelioration. In these cases, and in some where tinnitus is the chief and or only symptom complained of, we may at times afford considerable relief by the internal administration of chloride or bromide of ammonium or of bromide of potassium in twenty-grain doses three times a day. Sometimes tincture of ergot, of digitalis, or of opium will act beneficially. When anæmia, chlorosis, or debility are present, preparations of iron, zinc, or strychnia will prove advantageous. Locally, we may employ the vapor of chloroform or of camphor, or the liquor atropiæ, diluted with an equal quantity of

warm water, injected through the Eustachian catheter. The mastoid process may be blistered or rubbed with chloroform liniment with advantage in some instances. Sometimes the vesication gives relief at first, but after a short time the noises return with increased violence. Inflation of the tympanum or the use of Siegle's speculum often produce a marked improvement, but the effect is rarely more than temporary. Puncture of the membrana tympani will frequently cure tinnitus, the relief lasting as long as the opening can be maintained; but this usually closes in a few days, and then the noises return with the same severity as before. To obviate this difficulty a variety of expedients have been adopted. It has been recommended to remove a small piece of the membrane; to make a minute flap; to puncture by the galvanic cautery; or to insert a small ring of hard rubber into the opening; but in spite of these and other methods the aperture will generally close and the tinnitus return. In some cases we may try all the likely remedies of the pharmacopœia in vain, and the patient will be in no way benefitted.

This brings to a conclusion what I have to say concerning disease of the internal ear, and with it of ear disease generally. In giving to the profession this brief, and I fear imperfect epitome of aural pathology, I trust that it will prove useful. If I have succeeded in throwing some light on a much neglected department of surgery, the object I have had in view in writing this manual will be in a great measure attained.

Plate I.

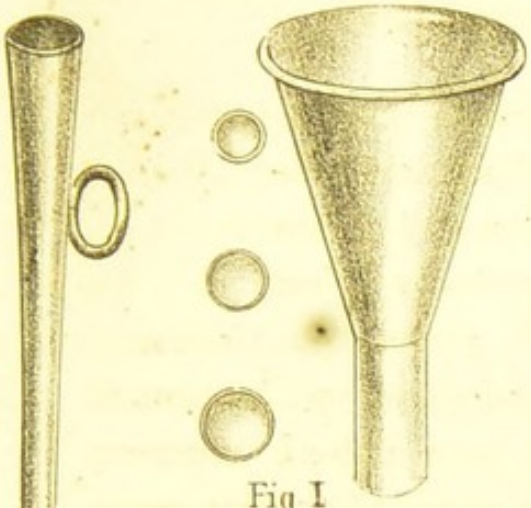


Fig I

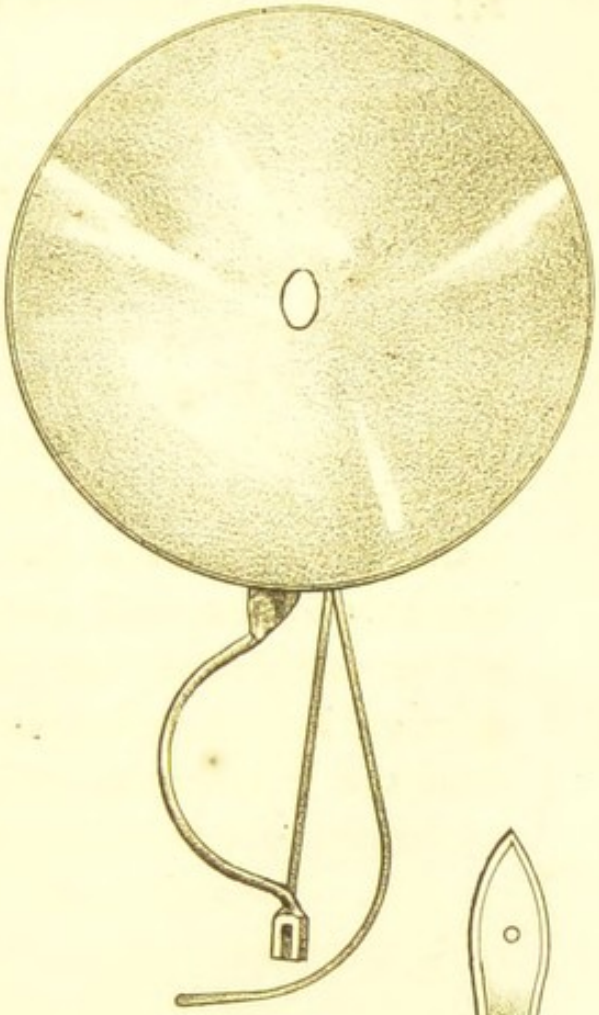


Fig. 2

Fig 5.

Fig 4.

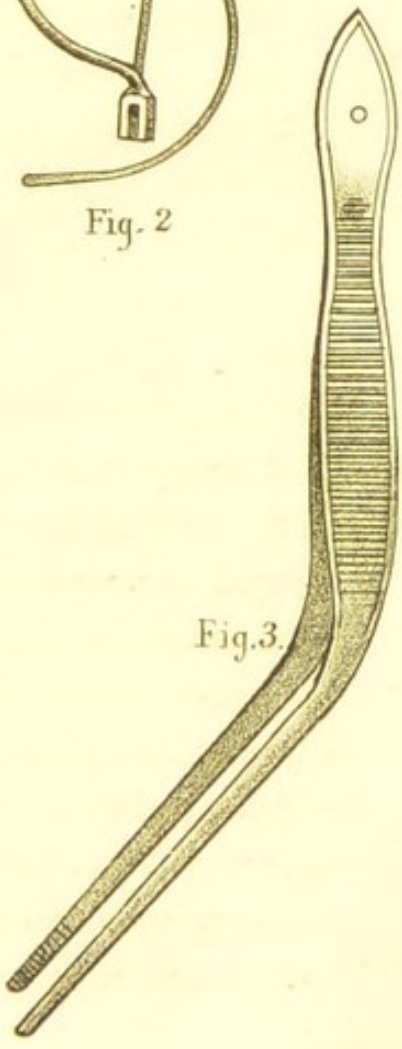
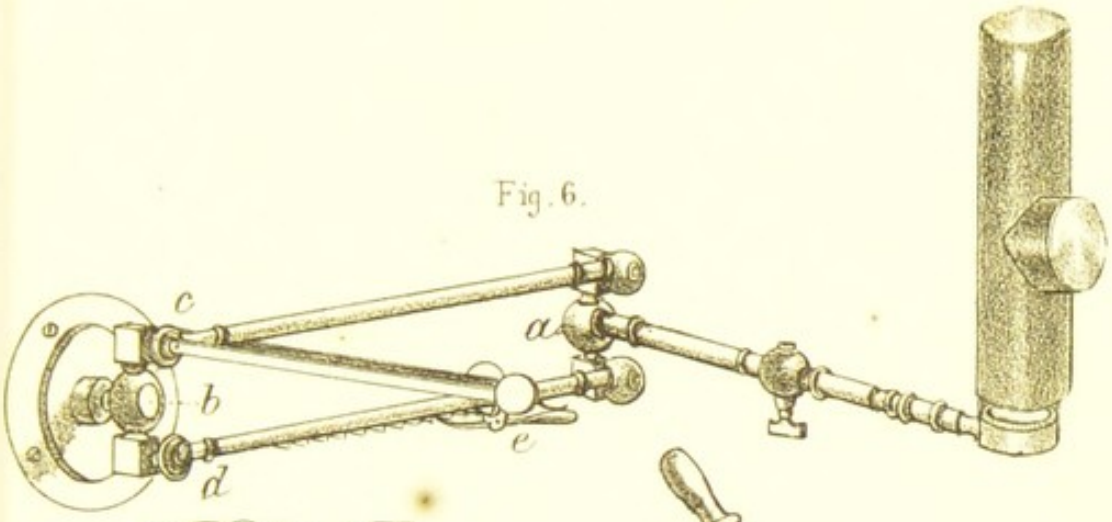


Fig. 3.

Plate II.

Fig. 6.



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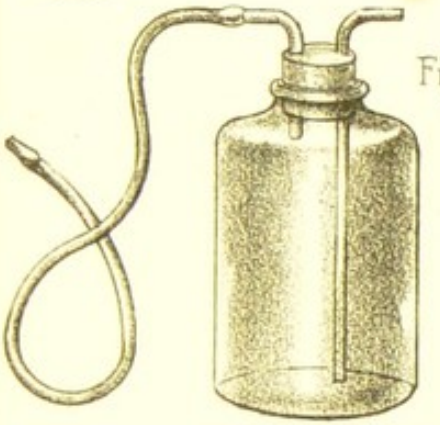

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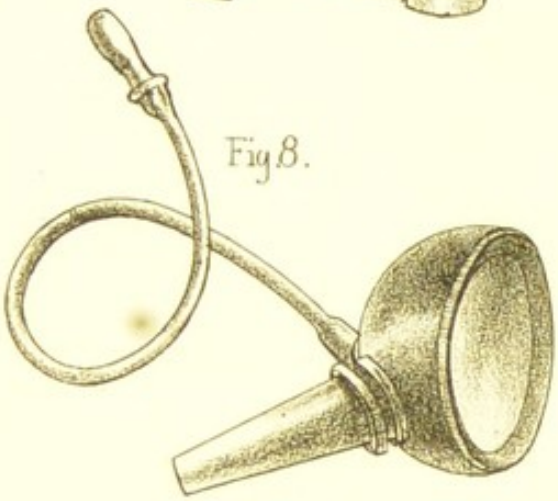

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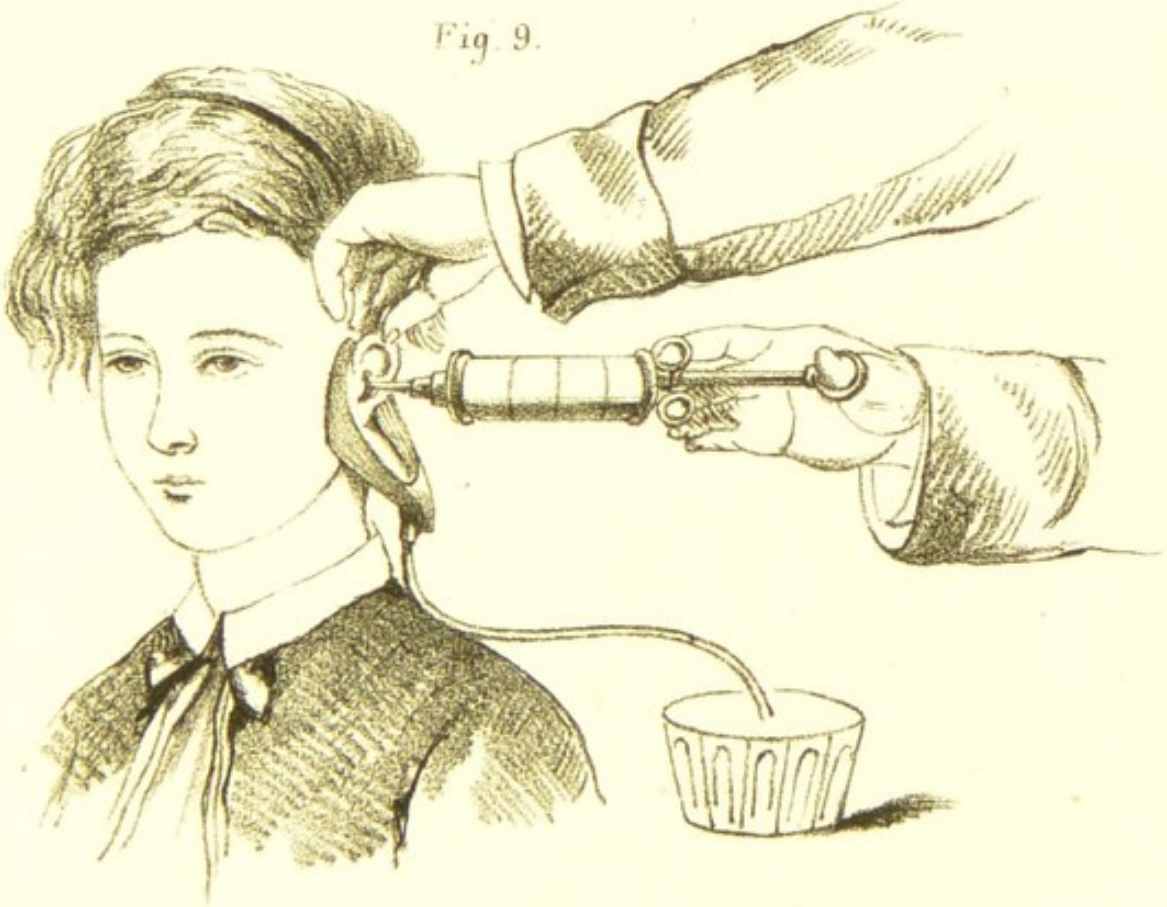

Fig 10.

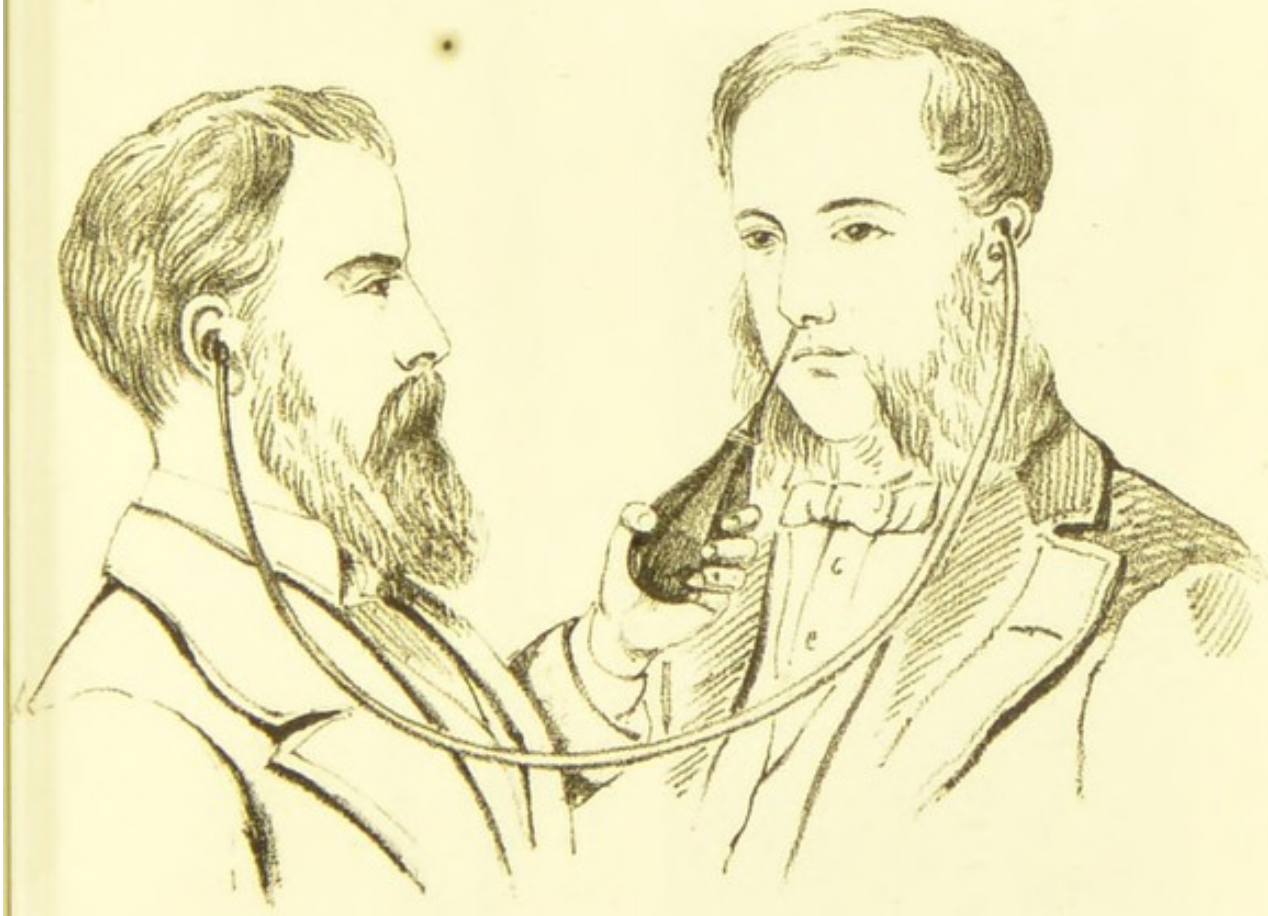

Fig. II.

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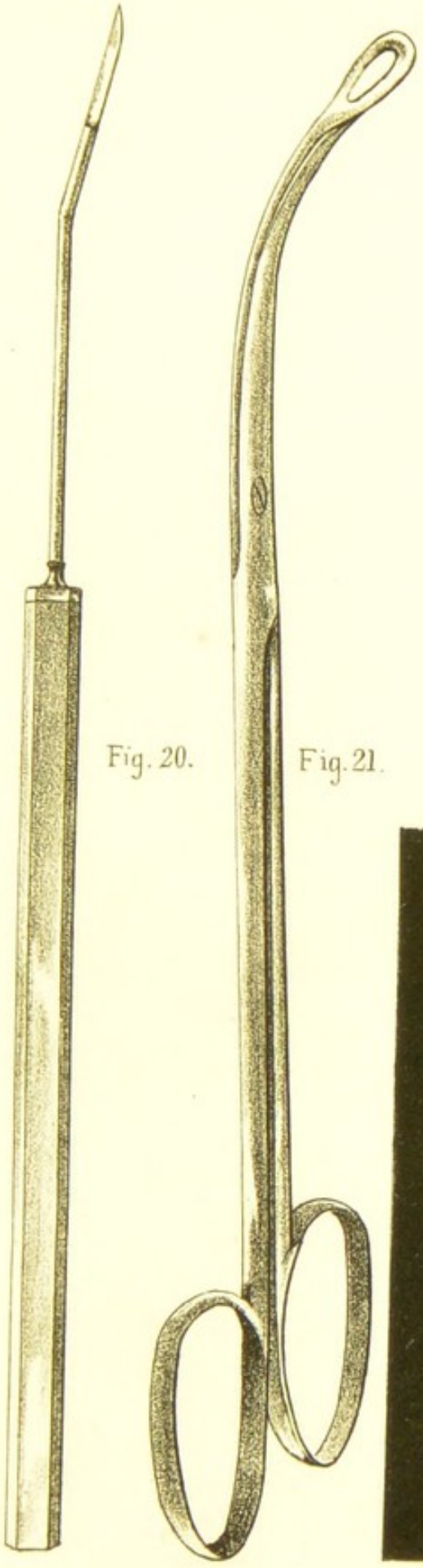
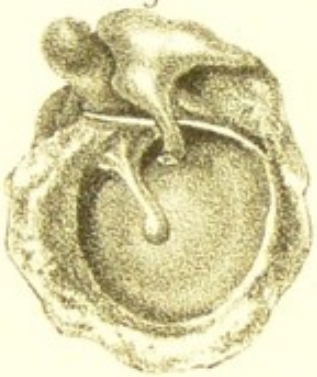


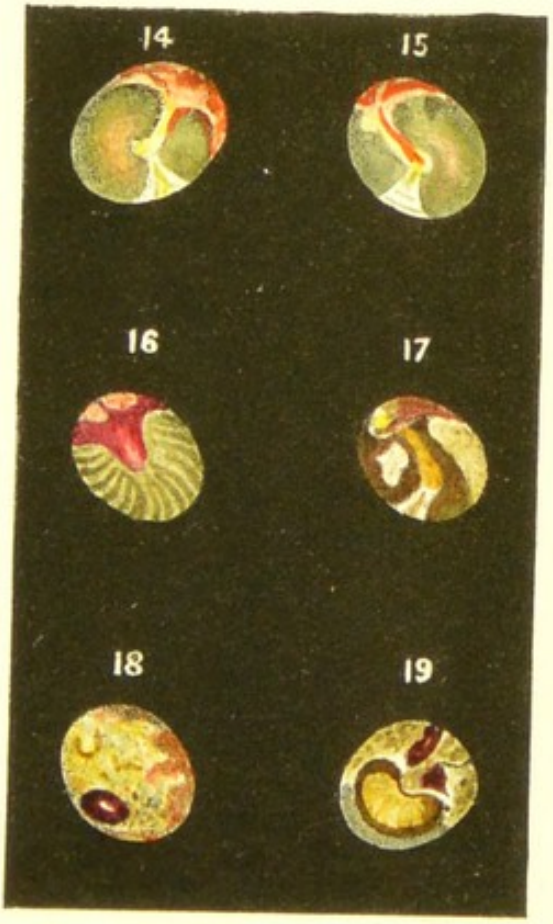
Fig. 20.

Fig. 21.

Fig. 12.

Fig. 13.





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