The practitioner's handbook of diseases of the ear : and affections of the nose and naso-pharynx relating to aural therapeutics / by H. Macnaughton-Jones and W.R.H. Stewart.

Contributors

Stewart, W. R. H. 1852-1906.
Macnaughton-Jones, H. 1844-1918.
Royal College of Physicians of Edinburgh

Publication/Creation

London : Bailliere, Tindall and Cox, 1892.

Persistent URL

https://wellcomecollection.org/works/xbp7j32n

Provider

Royal College of Physicians Edinburgh

License and attribution

PRACTITIONER'S HANDBOOK

DISEASES OF THE EAR AND NASO-PHARYNX

MACNAUGHTON JONES

W. R. H. STEWART

FOURTH EDITION

PRACTITIONER'S HANDBOOK

OF

DISEASES OF THE EAR

AND

NASO-PHARYNX.

THE

PRACTITIONER'S HANDBOOK

OF

DISEASES OF THE EAR,

AND

AFFECTIONS OF THE NOSE AND NASO-PHARYNX RELATING TO AURAL THERAPEUTICS.

BY

H. MACNAUGHTON JONES, M.D., M.Ch., M.A.O. (Hon.),

FELLOW OF THE ROYAL COLLEGES OF SURGEONS OF IRELAND AND EDINBURGH; LATE EXAMINER IN THE ROYAL UNIVERSITY; AND UNIVERSITY PROFESSOR IN THE QUEEN'S UNIVERSITY; FORMERLY SURGEON TO THE EYE, EAR, AND THROAT HOSPITAL, CORK.

AND

W. R. H. STEWART, F.R.C.S.Ed., etc.,

AURAL SURGEON TO THE GREAT NORTHERN CENTRAL HOSPITAL; SURGEON TO THE LONDON THROAT HOSPITAL; LATE SURGEON TO THE THROAT HOSPITAL, GOLDEN SQUARE; SURGEON-IN-CHARGE OF THE THROAT AND EAR DEPARTMENT, NORTH-WEST LONDON HOSPITAL.

FOURTH EDITION

LONDON:

BAILLIÈRE, TINDALL AND COX,

20 AND 21, KING WILLIAM STREET, STRAND.

1892.

LONDON:
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

DEDICATION.

To the Memory of the late

JAMES HINTON,

AURAL SURGEON TO GUY'S HOSPITAL,

THIS WORK IS INSCRIBED.

PREFACE TO THE FOURTH EDITION.

The present edition of this work has undergone most careful revision, and has been considerably enlarged. This has been necessary in order to keep the work abreast of the many advances made in aural therapeutics during the four years since the last edition (a large one) appeared. The design of the work, as expressed in the Preface to the Third Edition, has been adhered to. It is neither more nor less than what it professes to be—a practical handbook for the student and practitioner on diseases of the ear and those affections of the naso-pharynx appertaining to aural therapeutics. In dealing with the more debatable questions of practice, the authors have kept within the safe lines of proved and established treatment. At the same time they have endeavoured not to omit anything that is essential for the well-taught otological student to learn or the cultured surgeon to be familiar with in his practice. They can only express the hope that the favourable reception accorded to its predecessors, both by the Medical Press and the Profession, may be given to the present work.

H. Macnaughton Jones.
W. R. H. Stewart.

1891.

1

5

2

6

3

7

4

8

HANHART LITH.

EXPLANATION OF COLOURED PLATES.

Taken from the *Atlas of Diseases of the Membrana Tympani* (Macnaughton Jones).

PLATE I.

FIG. 1.—Polypus growing from roof of meatus (immediately in front of membrane, which was found to be entirely absent on the removal of the polypus), showing deceptive appearance of this polypus before the ear was cleared out, and a large flake of epithelium removed.

FIG. 2.—Membrane, drawn after removal of a polypus and healing of perforation.

FIG. 3.—Membrane, with cretaceous deposits at each side of malleus.

FIG. 4.—Membrane in great part absent, sebaceous tumour in the cavity of the tympanum.

FIG. 5.—Mulberry mass, protruding in front of a perforation; some pus seen above; inflamed and fleshy membrane to the side.

FIG. 6.—Perforation after scarlet fever, polypoid mass protruding from cavity of tympanum.

FIG. 7.—Old Eustachian case. Membrane very white, one large pocket blown out bladder-like on inflation.

FIG. 8.—Same ear as shown in Fig. 4, after removal of the tumour with the lever ring forceps.

PLATE II.

FIG. 9.—Idiopathic perforation, no pain during occurrence, drawn when healing.

FIG. 10.—Polypus in cavity of tympanum of insane patient, producing vertigo.

FIG. 11.—Extensive perforation of membrane—result of scarlet fever.
(*Drawings of this and Fig.* 13 *inverted in the printing by error.*)

FIG. 12.—Exostoses in meatus. This patient (a medical man) was subject to recurrent furunculus in the meatus.

FIG. 13.—Membrane with large central perforation, drawn when healing, and after treatment by absolute alcohol and glycerine applications.

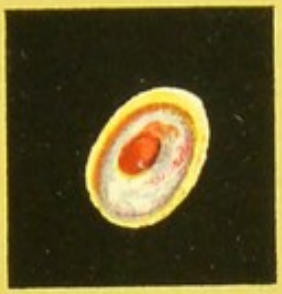
FIG. 14.—Membrane as seen altered on removal of the coating shown in Fig. 15.

FIG. 15.—Peculiar appearances presented by a membrane covered with epithelium and oily deposit. On removal of a large scale of this amalgam, the membrane presented the appearance seen in Fig. 14. The patient for some time had been in the habit of dropping oil into the ear.

FIG. 16.—Exostoses; some purulent matter blocking up the chink.—Other ear of patient, Fig. 12.

9

13



10

14

11

15

12

16

HANHART LITH.

PREFACE TO THE THIRD EDITION.

In introducing this work to the Profession, I desire in the first place to say that it is practically a new book, being entirely rewritten and rearranged. This was absolutely necessary, not alone from the unavoidably hurried compilation of the previous edition, but on account of the rapid advances made during the last few years in the science of otology. I cannot, however, place this edition before the Profession without acknowledging the too generous reception accorded to the last, and also to my *Atlas of Diseases of the Tympanum*, both in this country, in America, and on the Continent. It being well understood that this book is not so much a systematic treatise as a practical Handbook of Diagnosis and Treatment for the use of Practitioners, I am not, as I have already plainly stated in previous editions, under the necessity of devoting space to the anatomy and physiology of the organs of hearing, though I have added a short chapter, drawing attention to some of the most important points in the anatomy of the ear, bearing on aural therapeutics. A much more complete description than I could hope to give in a work of this size will be found by any student and practitioner in his standard text-books of anatomy and physiology; while, far better than plates, he will find a few careful dissections of the ear and naso-pharynx, and a careful study of the prepared sections of the petrous portion of the temporal bone—(1) the section showing the meatus,

membrani tympani, ossicles, and middle ear; (2) that showing the cavity of the tympanum and its openings, the internal ear with its semi-circular canals, the cochlea, and the various orifices. (These temporal bones may be obtained from Messrs. Matthews, of Carey Street, London, and will be found extremely useful aids in the study of the anatomy of the ear.) The beautiful models now to be had of any instrument maker will materially assist such study. The anatomical plates of Professor Adam Politzer are the best I know of, and have been generally used by me in giving clinical instruction. Those who are deficient in such practical acquaintance with the natural relations of the parts, should make good their deficiency in some other way than by plates and text-books before they attempt the treatment of middle and internal ear affections. This refers to the naso-pharynx as much as to the ear proper.

To the aurist the naso-pharynx is part of the aural apparatus. This necessitates accurate knowledge of the anatomy of the nasal fossa and pharynx, a knowledge to be gained only by an examination of the parts in the wet state. The success of the previous editions of this work has encouraged me to prepare this present more compact form. The many valuable larger treatises on the ear are, of course, replete with information on the subject of otology. It has been my experience that these larger works are not carefully or widely read by busy practitioners, and rarely by students.

Hence, through the medium of these pages some concise rules for practice, and useful hints on treatment, may be acceptable both to the practitioner and student. In order to do this I shall endeavour to make these observations as simple as possible, and deal principally with those diseases of everyday occurrence, for the treatment of which all practitioners are being constantly

consulted. It will not be necessary for this purpose to enter into vexed questions as yet unsettled, but simply to point out the leading principles which should guide the surgeon in arriving at a quick and safe diagnosis in any aural case. Nor is it necessary to distract attention by repeated reference to authorities.

To those in general practice, who may still regard the ear as an organ which is the special property of aurists, I would simply say here, that the practitioner who intelligently sets himself to discover the cause of any aural affection or deafness, and rationally applies his remedies for its cure, need not hand the ear over as the "special" property of any self-constituted authority, but may, in the great majority of ear cases which meet him in daily practice, deal with it himself. This much is certain, that by this more largely diffused and ready knowledge the public would gain infinitely more than is the case at present from the concentration of even a higher degree of skill in the hands of a comparatively few. The prevention of disease and deafness, rather than the frequently futile effort to cure conditions which might have been prevented, would be the obvious result.

The neglect of the study of aural pathology and therapeutics in the schools I refer to elsewhere in the work.[1]

The empiricism which suggests "a drop of glycerine to be put into the ear-passage night and morning," "the use of a counter-irritant behind the ear," the resort to useless and dangerous "syringing," has little excuse, if in the false notion that in aural therapeutics "if ignorance is bliss it is folly to be wise," the hearing of an ear is permanently lost. Yet these I have often known to be the remedies recommended for serious aural affections, by some who would be rightly indignant if

[1] See Chapter I.

they were not looked on as enlightened and educated physicians. It is thus that many cases of incurable ear affections seek relief in the extern department of a hospital, and in the study of the aurist, that should never find their way to either place. The greater the interest one takes in the therapeutics of aural affections himself, the more he must desire to see a wider spread of rational therapeutical knowledge in the treatment of the ear.[1] This wish grows with his every-day experience of the results of ignorance of this knowledge, and the want of cultivation of that experience which may be gained in almost any large general practice, and the study of some simple treatise on the subject.

I studiously avoid touching on dubious remedies of which I have not much personal knowledge of the effects, and that are not safe in the hands of the practitioner; nor do I embrace a reference in detail to certain operative procedures, some of which are of very doubtful efficacy, and all of which are attended, especially if undertaken by inexperienced hands, with a certain degree of risk.

The practitioner who desires fuller information on disputed points of pathology and differential diagnosis will find it in the exhaustive treatise of Politzer, translated by the late distinguished Glasgow aurist, Dr. J. Patterson-Cassells, and in the works of Burnett, St. John Roosa, Turnbull, Gruber, and others.

By the deaths, during comparatively recent years, of

[1] Only this day I was interested to learn from himself the successful efforts of Dr. J. Swift Walker, of Hanley, Staffordshire, to transplant the egg membrane to close a perforation of the membrani tympani in four patients. The antiseptic solution used to assist transplantation was a solution of 1 to 500 of perchloride of mercury in distilled water and 2 drops of glycerine to the ounce.

Hinton and Cassells, the United Kingdom has lost its most distinguished aurists. It was more especially through the disinterested kindness of Mr. Hinton that, as far back as the year 1868, I was first brought to take an interest in Aural Surgery, and to feel, in his own words, "that very few fields of practice afford subjects of greater interest to study, or give a larger reward to the exercise of skill." In his unique *Atlas of Morbid Conditions of the Tympanum*, he has bequeathed a legacy of labour and artistic skill to otology which is not likely to be rivalled.

In writing the second edition of this work, I was assisted by Drs. Löwenberg of Paris, Weber-Liel of Berlin, and Turnbull of Philadelphia; and I received valuable aid from several distinguished English authorities.

The brief observations on post-nasal catarrh and affections of the tonsils, contained in the portion of the work devoted to naso-pharynx, are, with some necessary alterations and additions, mainly those made by Dr. Morell Mackenzie in the second edition. For the remarks on othæmatoma, and the drawings of the auricle illustrating this disease, I am still indebted to Dr. Ringrose Atkins.

I have in this edition interpolated the series of notes (1885–86) on aural therapeutics which appeared recently in the pages of the *Practitioner*. While omitting matters not of practical importance to the general surgeon, I have added considerably in other directions in which I consider additions have been made to our knowledge during the last few years.

A special feature of the present book is the addition of coloured plates taken from my *Aural Atlas*, which represent some of the more commonly occurring morbid states of the tympanum.

I am under special obligation to Messrs. Baillière,

Tindall, and Cox for the use of some engravings of Professor Adam Politzer, as also to Drs. Barr (Glasgow) and Cresswell Baber (Brighton) for the same.

The instrument makers, Messrs. Mayer and Meltzer, Krohne and Sesemann, Maw, Son and Thompson, Weiss, and Matthews, can supply the various appliances mentioned in the text.

H. MACNAUGHTON JONES.

141, *Harley Street, W.*, 1878.

CONTENTS.

CHAPTER VIII.

EXAMINATION OF PATIENT.

CHAPTER IX.

GENERAL THERAPEUTICS.

CHAPTER X.

THE NOSE AND NASO-PHARYNX IN RELATION TO EAR DISEASE.

CHAPTER XI.

THE NOSE AND NASO-PHARYNX—*Continued.*

CHAPTER XII.

AFFECTIONS OF THE EXTERNAL EAR.

CHAPTER XIII.

AFFECTIONS OF THE MIDDLE EAR.

CHAPTER XIV.

AFFECTIONS OF THE MIDDLE EAR—*Continued.*

CHAPTER XV.

SOME AFFECTIONS OF THE INTERNAL EAR.

CHAPTER XVI.

TINNITUS AURIUM—ANATOMICAL.

CHAPTER XVII.

VERTIGO—DEFINITION AND CAUSATION.

CHAPTER XVIII.

DIFFERENTIAL DIAGNOSIS OF TINNITUS.

CHAPTER XIX.

CHAPTER XX.

TINNITUS AURIUM—TREATMENT.

CHAPTER XXI.

ELECTRICITY IN TINNITUS.

CHAPTER XXII.

DEAFMUTISM.

CHAPTER XXIII.

MALINGERING.

CHAPTER XXIV.

LIST OF ILLUSTRATIONS.

DISEASES OF THE EAR.

CHAPTER I.

INTRODUCTORY.

MANY years since, Sir William Wilde drew attention to the general vagueness which existed amongst medical men on the subject of aural disease, and although during the last few years medical practitioners have become more alive to the necessity of knowing something of the more common forms of ear disease, and the manner of making a diagnosis of them, that vagueness still largely exists, and the old opinion prevails that there are only two classes of ear diseases, "one that can be cured by the syringe and one that cannot." The cause of this is not far to seek. Little or no instruction is given in this "special" branch; rarely is a question asked upon it at the examinations, and the students, recognizing that many of the examiners in surgery are themselves devoid of any special learning in it, are therefore satisfied with the most superficial knowledge, or neglect the study of otology altogether. Hence a number of men are yearly obtaining qualifications to practise who are totally ignorant, not only of the advances which have been made in recent years in the diagnosis and treatment of the diseases of this most important organ, but even of the most elementary knowledge thereof.

The first edition of this work strongly commented on this want in the schools. In 1881 the committee of the

Otological Section of the British Medical Association reported as follows :—

"The committee is deeply impressed with the importance of the subject, and considers that the evident want of knowledge among practitioners in matters concerning ear diseases stands greatly in the way of their being able to deal promptly and effectually with cases of an acute character, and accounts for the very large number of neglected chronic cases which are met with in daily practice.

"After carefully considering all the suggestions received, and discussing the various means for promoting the study of aural surgery, your committee has arrived at the conclusion that all candidates for admission into the profession should have a practical knowledge of at least the essentials of otology, and that, as *compulsory* attendance on lectures and hospital practice might be deemed undesirable, the object in view can be best attained by the licensing bodies including otology among the subjects for examination."

Did the assertion of an eminent surgeon, "We may simply divide all cases of deafness into wax and no wax; wax curable, no wax incurable," come within measureable distance of the truth, the therapeutics of aural affections would indeed be simple, and, as in days gone by, a syringe with soap and water would constitute the entire armamentarium of the practising surgeon. We regret to say that there is still a belief, widely diffused, that there is something mysterious, or at the least most intricate, connected with the treatment of morbid states of the auditory apparatus, and this fear is expressed in the familiar injunctions given to sufferers "not to tamper," "to avoid meddling," "to let well alone," while these sapient precepts are perhaps carried into practice by mischievous syringing on an exposed drum-head, or the dirty and dangerous practice of dropping greasy or fungus-generating fluids into the external meatus.

The excuse for all this empiricism of our forefathers has long since been removed. The time has arrived when aural therapeutics should be completely freed from the atmosphere of charlatanism which, in the minds of many, pervades the treatment of diseases of the middle and internal ear, and the care of this most important

organ should be as intelligently and rationally carried out as that of the uterus, the male urethra, or the rectum.

It would be easy to prove that the certainty of diagnosis is as perfect, both from positive signs and symptoms and from negative evidences, in the case of aural affections as in morbid states of other organs in the body. A glance at the method by which an exhaustive examination of the ear is conducted and a final verdict given must satisfy any one on this point. We know of no organs save the eye and skin in which we can arrive at more certain and satisfactory conclusions as to the cause of aberration or loss of function than in the case of the ear. He would be a rare diagnostician who would not acknowledge that in the case of the other organs of sense, or of the internal viscera, conditions are occasionally met with which baffle his knowledge and contradict his experiences. The oculist and dermatologist have manifest advantages in the completeness of their survey of the diseased states they are called on to treat, and their powers of observation and comparison are accentuated by this facility and education.

But even in the instance of the eye and the skin, intricate questions of pathology which involve the diagnosis are constantly arising, and these baffle the localizing power of the examiner, and more or less influence his judgment on matters of therapeutical import. It is no exaggeration to say that the vast proportion of curable or remediable affections of the ear are most easily diagnosed, and require no extraordinary skill in their treatment; and these are just the conditions which come within the daily observation of the practitioner. We shall establish this assertion by a brief analysis of nearly four thousand cases taken from our hospital and private case books.

Nor are the necessary appliances for an accurate aural diagnosis in the greater number of ear diseases met with in daily practice either numerous or costly. A watch, a few aural and nasal specula, a piece of rubber tubing, a laryngeal mirror, a tuning-fork, a syringe,

an aural probe, with some cotton-wool, a tongue depressor, and, in some cases, a small Siegle's speculum, and Politzer's aural bag, are the essential tools which enable us, in a large proportion of cases, to tell the patient truthfully what is the matter and what are the chances of successful interference.

We conclude these introductory observations by a general reference to the manipulative experience and dexterity necessary in the application of local remedies to the external and middle ear. This experience is, we repeat, easily to be gained by the ordinary intelligent practitioner, and is not a whit more difficult to attain than the acquisition of the corresponding dexterity and gentleness of touch which should be exercised in various other surgical procedures, as, for example, the manipulation and treatment of the sensitive urethra. It has, certainly, to embrace the ability for careful and accurate determination of the condition, normal and abnormal, of the external ear passage, and the nature of its contents; the ready recognition of the appearance and slight anatomical deviations from the typically normal shape, colour, position of the membrane, and which anatomical peculiarities are found in a certain proportion of ears in which the hearing power is perfect. On the other hand, there must be a familiarity with the alterations presented in the shape and position of the drum-head when it has been subject to repeated catarrhal attacks, or in those cases in which there have been chronic catarrhal conditions of the middle ear, conditions which induce rigidity of the ossicles and their articulations, with corresponding alterations in the tone and degree of tension of the intrinsic muscles, and accumulation of mucus in the tympanic cavity, all of which departures favour the approach, and induce the occurrence of lesions of the internal ear and its delicate nervous apparatus.

Thorough acquaintance with the use of three appliances is essential. They are diagnostic. These are the speculum, auscultation tube (known familiarly as the otoscope), and tuning-fork. And when the physician

comes, both for purposes of diagnosis and treatment, to apply remedies to the Eustachian tube and middle ear, he has to acquire the method of passing the Eustachian catheter with facility and gentleness. Both with mirror and finger he should know how to explore the naso-pharynx, the number of naso-pharyngeal cases in which we find deafness an accompanying trouble necessitating this knowledge, not alone for the ear, but for the treatment of the attendant nasal and throat affections.

The nasal speculum, the laryngoscopic or rhinoscopic mirror, and a tongue depressor are not difficult instruments to master the use of.

CHAPTER II.

ANATOMICAL AND PHYSIOLOGICAL.

WITHOUT departing from the determination not to enter in detail into the anatomy and physiology of the ear, the practitioner may be usefully reminded of the most important anatomical and physiologial facts connected with the structure and function of the external, middle, and internal ear which affect the treatment of its various morbid conditions.

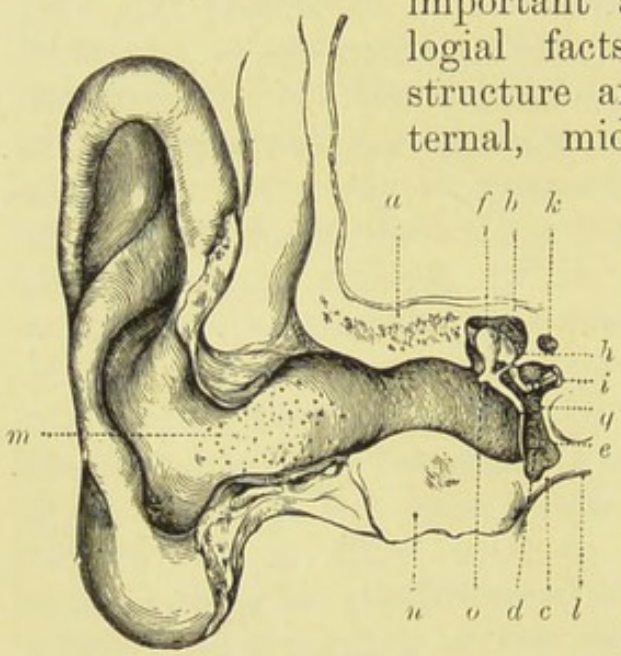


FIG. 1.—Vertical section of external meatus, membrana tympani, and tympanic cavity. *a*, Cellular spaces in the superior wall of the meatus connected with the middle ear; *b*, roof of the tympanic cavity; *c*, inferior wall; *d*, tympanic cavity; *e*, membrana tympani; *f*, head of the malleus; *g*, handle of the malleus; *h*, incus; *i*, stapes; *k*, Fallopian canal; *l*, fossa jugularis; *m*, apertures of glands in the external meatus; *n*, mastoid process. (Right ear.) (After Politzer.)

THE EXTERNAL EAR.

"Just as the eyelids," says Burnet, "prevent the entrance of injurious substances into the eye, so the external ear prevents the entrance of dust and small particles, which might easily be blown through the air into the auditory canal, and also of insects, not by a closing movement, but in the human ear by means of its peculiarly coiled form, which makes the entrance difficult to find. The latter, also, is more or less covered with minute hairs, which serve to catch any dust which penetrates, without perceptibly deadening the sound."

The auricle also collects the sound-waves and conducts them by its various elevations and depressions to the external meatus. The external auditory canal, one inch in length, the outer one-third cartilaginous and the inner two-thirds osseous, commences at the bottom of the concha and extends, first upwards and inwards and then downwards and inwards, to the tympanic membrane. It is not a straight tube of equal length and width, as, owing to the oblique insertion of the membrane, the roof is shorter than the floor, and the posterior wall than the anterior. Slightly contracted at the opening, it expands, to contract again at the junction of the cartilaginous and osseous portions. This is the narrowest part of the tube. It expands once more as it is continued to the tympanic membrane. In manipulating, cleansing, or syringing the meatus, these points must be remembered, as also in the removal of foreign bodies.

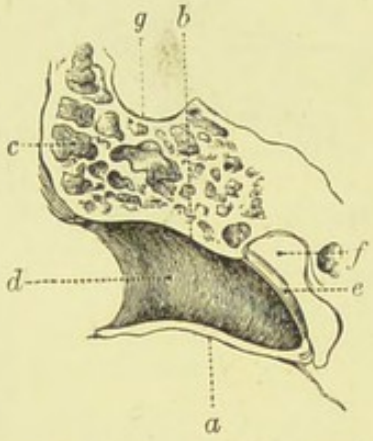


FIG. 2.—Horizontal section of the external meatus and tympanic cavity. *a*, Anterior wall of the meatus; *b*, posterior; *c*, cells of the mastoid process; *d*, meatus; *e*, membrana tympani; *f*, tympanic cavity; *g*, fossa sigmoidea. (Right ear.)

Tröltsch drew attention to the slow development of the osseous meatus in the child, stating that—

"often until the sixth year a gap is left in the ossification, which only diminishes very gradually, and, from its sharp, irregular edges, might very easily be considered morbid and the result of caries, and, at any rate, might facilitate the spread of inflammatory processes to the maxillary articulation and the parotid gland;" also, that "in very young children the inner half of the exceedingly narrow meatus has scarcely any open calibre, since the membrane, which lies horizontally, is in contact in its whole extent with the membranous floor of the meatus, this contact being due in part to the fact that the epidermis covering the membrane has at this time very considerable thickness."[1]

[1] Pollak has shown, however, that this is not so, and that there is no material difference in the inclination of the membrane in the infant and adult.

The following, among other clinical and pathological facts explained by the anatomy of the external auditory meatus, are worthy of attention (see Politzer, *op. cit.*) :—

The traversing of the cartilaginous portion by the fissures of Santorini, filled as they are by fibrous tissue, helps to straighten the meatus during examination of the membrana tympani, and through these fissures pus may force its way as the result of parotitis. In children we have seen the error made (alluded to by Politzer) of a discharge thus finding its way, after the exanthemata, into the external meatus, being regarded as coming from the tympanum. Also the ready involvement of the parotid in affections of the meatus is explained.

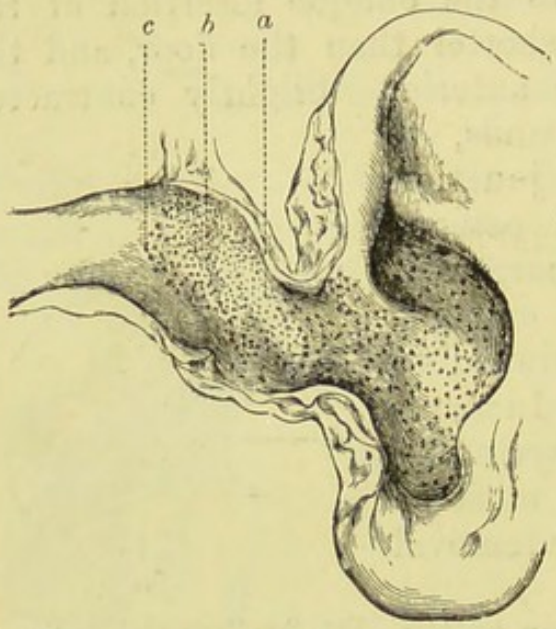


FIG. 3.—Posterior wall of the cartilaginous and osseous meatus. *a*, Orifices of glands on the cartilaginous portion; *b*, boundary between cartilaginous and osseous meatus; *c*, termination of the triangular space occupied by the orifices of the glands, which protrudes into the osseous meatus. (After Politzer.)

The superior wall of the meatus in the adult appertains to the middle cranial cavity, and is covered by dura mater. Fatal meningitis, which follows caries of this wall, is thus accounted for, and the dangers of rude efforts at extraction of foreign bodies are explained; the concavity of the inferior wall close to the tympanum permits of the lodgment of small foreign bodies. The unequal length of the superior and inferior walls, as well as of the anterior and posterior, have to be taken into consideration in the examination of the membrana tympani. The motion of the meatus felt during a movement of the jaw, when we insert the finger into it, is due to the relation of the superior portion of the anterior wall to the posterior part of the glenoid cavity, and this wall,

being separated occasionally from the cranial cavity only by a thin osseous lamella, the extension of the glenoid cavity outwards beyond the anterior wall of the osseous meatus, brings the posterior wall of the capsule of the joint into contact with both the osseous and cartilaginous meatus. The great pain occasionally complained of by aural patients in movements of the jaw in deglutition is thus explained.

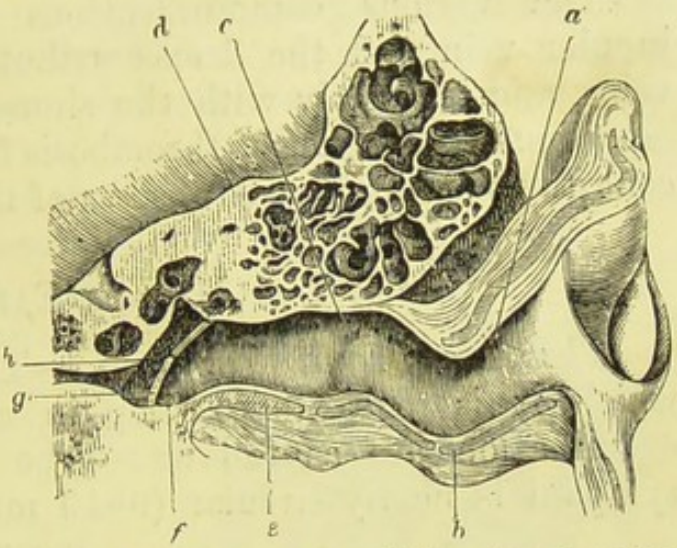


FIG. 4.—Horizontal section of the external meatus. *a*, Concha; *b*, tragus; *c*, place of attachment of the cartilaginous portion; *d*, mastoid process; *e*, anterior wall of the meatus; *f*, sinus meat. audit. extern.; *g*, membrana tympani; *h*, tympanic cavity. (After Politzer.)

The relation of the posterior wall of the meatus to the mastoid cells shows how the extension of necrosis of these to the external meatus and *vice versâ* occurs.

The fact that the glandular structure of the external meatus ceases at some distance from the membrana tympani, leaving the cutis in close union with the periosteum, explains the severe periosteal pain and thickening which ensue on inflammation of the dermoid layer of the meatus, and the occurrence of an abscess or a boil in the outer portion of the canal, while the papillæ described by Gerlack found in the cutis of the osseous portion are frequently the source of polypi. Nor must the extension of the osseous portions of the superior and posterior walls over the cartilaginous be forgotten, as it accounts for the occurrence of exostoses in these walls.

The large vascular supply of the meatus from the branches of the temporal and internal maxillary, and the free distribution of these vessels in the fibrous connective tissue, as also to the perichondrium, explain the reason for the rapid increase in congestive states of the meatus, the throbbing pain and pulsation which is here

so quickly complained of, while also the continuation of a portion of the same vascular supply to the membrana tympani and the anastomoses with the tympanic vessels teaches us the therapeutical value of early leeching.

The various communications with the external jugular vein and the deeper tributaries of the cranial veins, and indirectly with the sinuses, remind us of the occasional occurrence of thrombosis following from septic conditions arising out of abscess of the meatus.

The Middle Ear.

The Membrana Tympani.—The practical points which it is requisite to keep in mind in making an examination are as follows:—The healthy membrana tympani is nearly circular (9–10 mm., Tröltsch), translucent and concave, with a thickness between the handle and circumference of 0·10 mm. (Henle), and is fixed to the temporal bone at its circumference, and at its centre to the handle of the malleus. It varies in colour from a "pearl," or "neutral grey," to a yellowish white, or at times even an ivory white. It is placed obliquely, and forms, with the floor of the meatus, a very acute angle, with the roof a slightly rounded obtuse angle of about 140°. Its anterior-inferior part is further removed from the external opening of the auditory canal than the posterior-superior part.

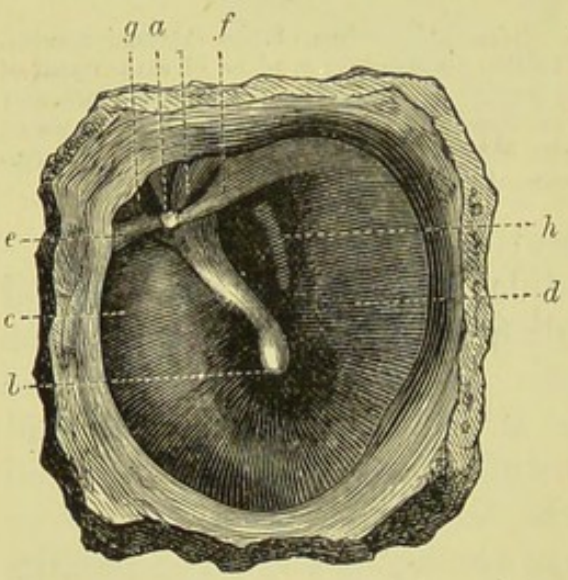


Fig. 5.—External surface of the left membrana tympani, several times enlarged. *a*, Short process of the malleus; *b*, umbo; *c*, anterior portion, and *d*, posterior portion of the membrana tympani; *e*, anterior fold; *f*, posterior fold of the membrane; *g*, Shrapnell's membrane; *h*, long process of incus seen through the membrana tympani. (After Politzer.)

The manubrium is seen dividing the membrane into two parts or segments, the anterior or smaller, the

posterior or larger. Its lower prominent end, of a yellowish colour, drawing the membrana tympani inwards, forms the depressed spot in the centre of the drum. The lower end of the manubrium itself is of diagnostic value, as changes in the colour, form, and degree of mobility will point to alteration in position of the bone, thickness and rigidity of the membrana tympani, anchylosis of the ossicles. At the point where the manubrium terminates, we see the well-known cone of light or triangular spot which gives to the membrane that beautiful and lustrous appearance when light is thrown on to it by the mirror. The lustrous epithelium of the membrana tympani, its funnel shape, and the peculiar inclination of the membrane, account both for the position and shape of the cone of light.

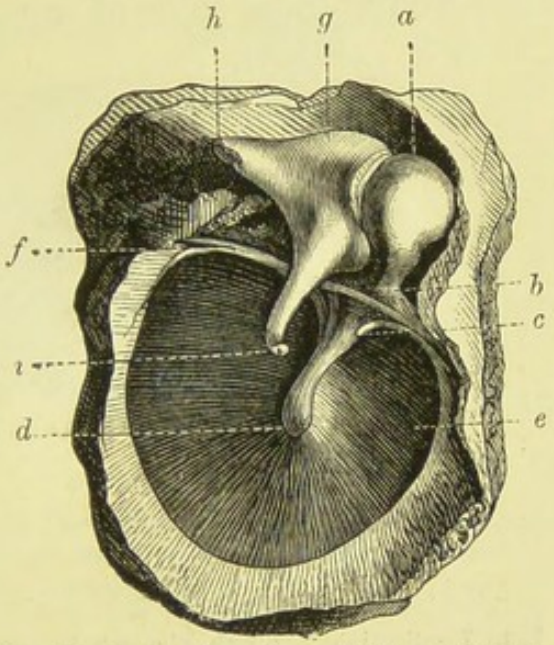


FIG. 6.—Internal surface of left membrana tympani, enlarged. *a*, Head of the malleus; *b*, neck of the malleus; *c*, tendon of the tensor tympani and anterior fold of the membrana tympani; *d*, inferior extremity of the handle of the malleus; *e*, anterior portion of the membrana tympani; *f*, posterior fold of the membrana tympani and the chorda tympani; *g*, incus; *h*, short process of the incus; *i*, long process. (After Politzer.)

The pyramid has its base directed downwards, but its position and extent are variable, and it is by no means uncommon to find its usual shape altogether lost, or perhaps no cone of light at all in an ear in which the hearing power is perfectly normal. It thus serves as a delicate indication of the degree of mobility of the membrane, as it is variously altered when the membrane is forcibly inflated by Valsalva's method. In a normal state this spot partially disappears on inflation, and the funnel-shaped depression underneath it is bulged outwards.

The short process of the malleus is also of considerable importance in a diagnostic point of view, for it

separates the anterior from the posterior pocket of the membrane, the posterior being over, the anterior under, the short process. These pockets are formed by the ligamentous fold of mucous membrane or prolongations of the ligamentum mallei anterius. They are of clinical importance, as it is in them that the secretion of mucus is retained (Hinton), and that we notice the bulgings of the membrana which we so frequently see when this retention occurs.

Above these folds of mucous membrane at either side

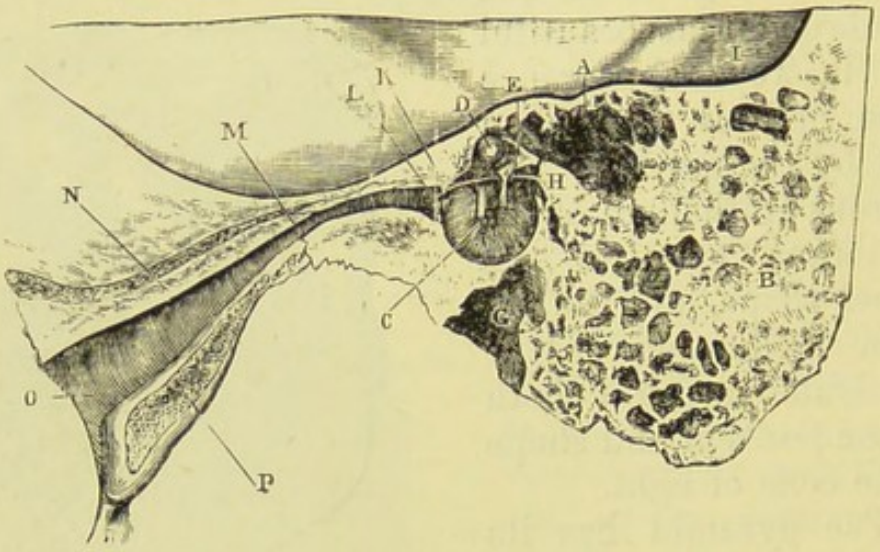


FIG. 7.—Section through the whole extent of the middle ear. A, Antrum mastoideum; B, mastoid cells; C, inner surface of tympanic membrane, at lower end of manubrium; D, head of malleus; E, body of incus; G, fossa for jugular vein; H, pyramidal partition of bone separating the cavity of the tympanum from the antrum mastoideum. Below the letter H a portion of the canal for the facial nerve is shown; I, dura mater; K, chorda tympani nerve; L, tympanic mouth of Eustachian tube; M, isthmus of the Eustachian tube; N and P, walls of cartilaginous part of Eustachian tube; O, pharyngeal mouth of Eustachian tube. (After Barr.)

of the short process is Shrapnell's membrane, the most flaccid portion of the membrana tympani, a frequent situation for collections of pus, growths of small polypi, inflammatory attacks or perforations, and behind which we often have accumulations of mucus or other secretions which push forward the membrane at this spot. The membrane is united to the auditory canal by its tendinous ring. This latter structure gives origin to the fibres of the middle layer of the membrane, which pass to be inserted into the malleus with its carti-

laginous groove. The membrane consists of three layers, an outer or dermic, a middle or fibrous, an internal or mucous, and the continuity of the dermic layer with that of the external meatus is to be remembered in the ready extension of inflammation of the meatus to the drum-head, and still further of equal moment is the direct continuation of the inner layer with the lining membrane of the tympanic cavity, and its intimate connection with the middle layer of the meatus.

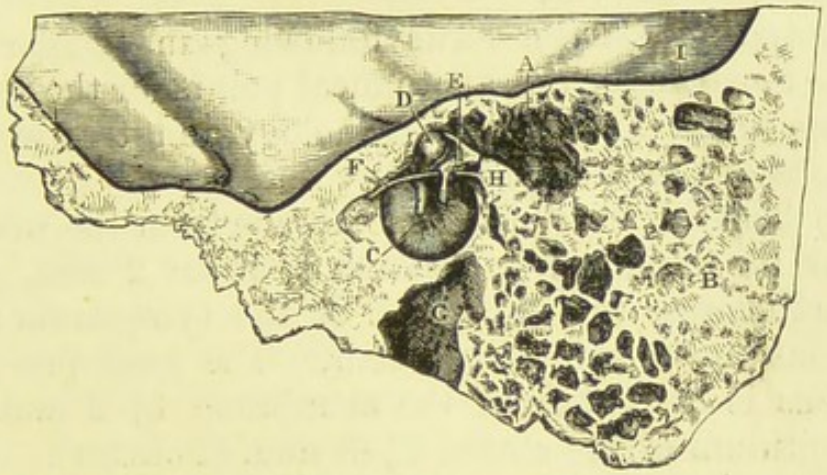


FIG. 8.—Inner aspect of the outer half of the temporal bone exposed by a vertical section made antero-posteriorly through the tympanum, antrum mastoideum, and other mastoid cells. A, Antrum mastoideum; B, mastoid cells; C, inner surface of tympanic membrane; D and E, head of malleus and body of incus, forming the osseous partition dividing the upper tympanic space into two compartments—in the drawing the outer is concealed by these two bones; F, chorda tympani nerve; G, fossa for jugular vein; H, pyramidal partition of bone separating the cavity of the tympanum from the antrum mastoideum. Below the letter H, a portion of the canal for the facial nerve is shown; I, dura mater. (After Barr.)

It is well to remember the analogy existing between the membrana tympani of the ear and the iris of the eye, in the arrangement of the radiating and circular fibres, which have a relaxing and sphincter action, preserving thus a balance of power when the drum-head is in a state of rest, and which, according to Helmholtz, explains its peculiar concavo-convex shape.

On removing the membrane from the handle of the malleus a cartilaginous structure, closely adherent to the posterior part of the handle, is seen under a strong lens; into this the delicate fibres of the middle coat are inserted. The cartilaginous structure does not adhere

so firmly to the upper portion of the handle as to the lower.[1]

The close relation of the chorda tympani nerve to the membrane should be remembered.

The highly vascular nature of the membrane and the free distribution of nerves to this delicate structure account for the rapidity of the inflammatory process in it, its ready injection with blood when irritated, and the great sensitiveness and pain that accompany all such inflammatory attacks.

Tympanic Cavity.—The following in tabular form are the most important anatomical points for the surgeon to keep before him in the pathology and treatment of affections of the tympanic cavity :—

(*a*) The distance of the membrane from the promontory at its umbilical depression is about 2 mm. It is the part nearest the inner wall of the tympanum ; here adhesions most commonly occur. The long process of the incus is distant from the membrane $1\frac{1}{2}$–2 mm., and the capitulum of the stapes $2\frac{1}{2}$–3 mm. (Politzer). If the membrane is very transparent these may be seen, and are exposed to view behind the handle of the malleus if the membrane be destroyed. This proximity of the membrane to these ossicula account for adhesions of the membrane to them, and the same fact has to be recollected in operations on this segment.

(*b*) The direct communication in the infant through the vascular supply between the tympanic cavity and the dura mater (in the vessels passing through the suture in the superior wall of the tympanum) accounts for the occurrence of meningitis in children in cases of tympanitis.

(*c*) The thinness of the osseous plate, often defective, which separates the tympanic and cranial cavities, makes the surgeon naturally apprehensive of extension of mischief to the brain in chronic suppurative conditions of the middle ear.

(*d*) The occasional occurrence of thrombosis and septicæmia in acute and chronic suppurative catarrh

[1] Grüber, *Diseases of the Ear.*

finds its explanation in the nearness of the jugular fossa to the inferior wall, and to the numerous veins, arteries, and lymphatics that surround the cavity ; while the closeness of the carotid canal to the anterior wall of the tympanic cavity accounts for the fatal hæmorrhage, fortunately of rare occurrence, which may attend on suppurative otitis media.

(*e*) The various structures in the cavity of the tympanum in their relation to each other, the position of the ossicula, their articulations, the relative positions of the fenestra, and especially the relation of the stapes to the incus and to the fenestra ovalis, the intrinsic muscles, with the arterial and nerve supplies of the tympanum, all demand a careful study in connection with the many functional and organic disturbances of hearing which result from displacement of the ossicles, adhesions, anchyloses of the articulations, contraction of the muscles, or occlusion of the fenestra. We can here merely draw attention to a few of the alterations in the normal structures of the tympanum in their anatomical positions and relations.

1. Proliferation of connective tissue, accumulation of mucus, at times inspissated or hard, thickening of the mucous lining of the cavity leading to interference with the fenestra or fixation of the stapes against the oval foramen.

2. Alteration in the topographical relations of the ossicula to each other and to the tympanic walls, with rigidity, or anchylosis, of the articulations—anchylosis of the malleus to the superior wall of the tympanum, anchylosis of the short process of the incus to the posterior wall of the tympanum, fixation of the stapes.

3. Enervation, paresis, spasm, rigidity, atrophy of the intra-tympanic muscles, the tensor tympani, and stapedius (the supply of these muscles, the former from the motor division of the fifth nerve and the latter from the facial, being remembered).

4. In the chapter on Tinnitus Aurium reference is made to the consequences following on physiological and pathological changes in the vascular supplies of the

tympanum, as also the bearing of the vascular and nerve communications between the middle ear and labyrinth on various functional and organic disturbances in the hearing (see Labyrinth), as for example in Ménière's disease and aural migraine.[1]

The Eustachian Tube.

The Eustachian tube is about one inch and a half in length ("35 mm.; 24 mm. of which belong to the cartilaginous, 11 mm. to the osseous canal," Tröltsch), the osseous portion in the temporal bone being three-quarters of an inch, and the cartilaginous portion one inch. The lumen of the osseous portion of the canal is about 2 mm. (Henlé). The width of the tympanic opening of the tube is 3 mm. In the child, while the tympanic orifice is comparatively large, the faucial orifice is small, the tube itself being shorter and wider. These facts explain the ready closure of the tube in pharyngeal congestive or adenoid states in children, and the rapid improvement we often find on inflation with the air douche.

The tube is funnel-shaped, its narrowest part being at the junction of the osseous with the cartilaginous portion. It passes from the anterior wall of the tympanum downwards, forwards, and inwards, to terminate at the pharyngeal orifice, which projects as the opening of a trumpet, close behind the internal pterygoid plate, on a level with the inferior turbinated bone, at the back part of the inferior meatus of the nose. Two lips bound this orifice, one posterior, directed downwards, the other anterior, turned upwards. It measures (Tröltsch) "9 mm. in height, 5 mm. in width." This faucial orifice (Toynbee) is nearly half an inch long. The pharyngeal end is the widest portion of the canal, and is composed both of cartilage and fibrous membrane. The mucous surfaces of the membrane which line this canal are in a state of apposition, the two patent points being the

[1] See p. 300.

faucial orifice and the commencement of the osseous portion (Tröltsch).

This arrangement converts the Eustachian tube into a form of valve, which in a state of rest is closed, and which opens and closes at each act of deglutition, in consequence of the action of the tensor and levator palati muscles, with the salpingo-pharyngeus, the former dilating the opening (Rüdinger and Tröltsch), the latter muscle drawing the inferior curved edge of the orifice of the tube into a straight line upwards. The palato-pharyngeal muscle assists in fixing the cartilaginous portion. This action we are frequently performing in the swallowing of our saliva. It is this action of the palatal muscles that we take advantage of in inflating the membrane by Politzer's method during the act of swallowing the water; the walls of the Eustachian tube are forced apart and the floor carried upwards.

The tube permits an exchange of air in the cavity of the tympanum, and prevents its rarefaction therein. It forms an outlet for abnormal secretions, and prevents their accumulation in the tympanum.

It maintains a condition of equilibrium between the air in the tympanum and the atmosphere.

It may influence the vibration of the membrane and the resulting sonorous effects on the tympanic cavity (Bernstein): clinical analysis would appear to verify the suggestion.

The valvular action of the tube has the most important bearing on our knowledge of Eustachian deafness. Closure or occlusion of the tube leads to rarefaction of the air in the tympanum. This is followed by an accumulation of mucus in the tympanum, and an increased concavity of the membrane, and finally inspissation of the secretion, contraction of the membrana tympani, and thickening and adhesion of the membrane lining the cavity, with accompanying changes in the ossicles.

The manometer of Politzer is a small glass tube which, by its india-rubber covering, can be hermetically sealed in the meatus. During the first part of the act of swallowing with the closed mouth and nostrils, the

coloured fluid contained in the tube rises slightly, while it falls considerably, owing to rarefaction of the air in the tympanum, during the second part. It maintains the level until the person again swallows with open nostrils, when it rises to its former position. The same fact is often experienced by the patient after auto-inflation of the tympanum by the air balloon on swallowing a little saliva. After the inflation, the Eustachian tube being temporarily closed, a sense of distension and slight deafness is experienced, the voice sounding rather muffled. All this disappears on the reopening of the tube during the next act of swallowing. Likewise, as Politzer has shown, the sound of the tuning-fork held before the open nostrils is increased during the act of swallowing, the vibration finding access more readily through the open Eustachian tube. The glandular elements of the mucous lining of the tube, especially in children (Gerlach), at the pharyngeal or cartilaginous end, are to be noted in connection with follicular states of the pharynx, hypertrophy of these glandular elements tending to obstruct and close the tube, especially in children.

FIG. 9.—Politzer's ear manometer.

THE MASTOID PROCESS.

To every surgeon the anatomy of the mastoid process and the mastoid cells is of the greatest interest.[1] This is exemplified elsewhere (see chapter on Inflammation and Abscess of the Mastoid Cells). The clinical conditions especially imposing on the practitioner the necessity for studying carefully the surroundings of the mastoid cells and their relation to the external meatus, tympanic cavity, middle cranial cavity, the sigmoid fossa and lateral sinus, are inflammation and suppuration occurring in the meatus and tympanum and extending to the mastoid cells.

The responsibility devolving on him under these

[1] See pp. 270–274.

circumstances of incising the mastoid, or, in certain cases where suppuration has occurred, of opening the mastoid antrum, cannot be shirked in the face of our modern knowledge of the benefits resulting from these steps, and the saving of life which follow on their successful performance.

The "landmarks" for trephining the mastoid antrum, for the more accurate definition of which we are especially indebted to Schwartze and Hartmann, are given in the description of this operation (chapter on Mastoid Inflammation and Abscess).

In a most valuable paper read before the Academy of Medicine (Ireland) in the section of anatomy and physiology (January, 1891), Dr. Ambrose Birmingham, after a series of investigations and a collection of over one hundred specimens, has come to the following conclusions as regards the anatomy of the mastoid region. He says—

"The base of the pyramidal, petrous portion of the temporal is applied to the inner surface of the conjoint mastoid and squamous portions of the bone. Below and in front, where the mastoid and squamous segments separate, is situated the external auditory meatus, which runs inwards and a little forwards towards the base of the petrous. At the bottom of the meatus is the tympanum or middle ear, separated by the membrana. From the upper and posterior portion of the tympanum (its attic) there runs backwards in the substance of the petrous the antrum mastoideum—a cavity which will usually contain a good-sized pea. Into it open the mastoid pneumatic cells, and it itself communicates freely with the upper part of the tympanum. The upper surface of the petrous forms part of the floor of the middle cranial fossa. Owing to the fact that the petrous may be applied to the squamous higher up or lower down than usual, the floor of the cranial cavity here may sometimes be a considerable distance above the upper margin of the bony meatus, while in other cases it is barely above the level of this margin. In perforating behind the meatus we must take care that we do not enter the cranial cavity in a case where the petrous lies lower than usual. Again, the lateral sinus runs downwards behind the ear in the angle between the back of the petrous and the inner surface of the mastoid; as will be shown later, the sinus comes forward in different skulls to a varying extent; sometimes it comes quite close to the meatus. Means must be found of avoiding the sinus in such cases. As to the point on the surface corresponding to the antrum internally, if the meatus runs inwards and a little forwards to the tympanum, and if the antrum runs backwards from the upper and posterior part of the tympanum, naturally a point immediately behind the meatus, and below the level of its upper border, ought to mark on the surface the position

of the antrum. Such is always the case. Most measurements have been taken either from the bony meatus—its centre or margins, or from Reid's base line—viz. a line drawn backwards from the lower margin of the bony orbit through the middle of the meatus; posteriorly this line usually lies at the occipital protuberance, or immediately under it. It may be added that when working with *portions* of skulls, the upper margin of the zygoma may be considered practically horizontal in the normal position; this has been found a useful guide.

"1. The first conclusion I have drawn is that the lateral sinus varies to an extreme degree in position and in shape. The surface markings usually given for mapping out its course are occasionally as much as an inch astray, and this at a point where there is danger of wounding the sinus in the operation of trephining for abscess, etc., of the temporo-sphenoidal lobe of the brain.

"2. The following is the average condition of the sinus:—Beginning near the occipital protuberance, it ascends gradually, running forwards and upwards in close relation to the superior curved line for a short distance; leaving the curved line, it continues to arch upwards until it reaches a height of nearly three-quarters of an inch above Reid's base line; soon after it has reached this level the sinus bends gradually or sharply and runs downwards and forwards on the mastoid portion of the temporal immediately in front of a ridge which prolongs the posterior margin of the mastoid process upwards and backwards, and in front of the posterior margin of the process itself. Here it lies about half an inch behind the meatus; having reached the level of a quarter or one-sixth of an inch below the floor of the meatus, it turns in to the base of the skull. The bend of the sinus, where it begins to arch downwards, is most commonly at a point one inch and a half behind and three-quarters of an inch above the centre of the bony meatus.

"3. As a guide for avoiding the sinus in operations upon the cerebrum or cerebellum, I would suggest the following method for mapping out the limits within which it may wander:—One line should be drawn convex upwards from a point half an inch above the occipital protuberance to a point one inch and a half behind and one inch and a quarter above the centre of the meatus, another line from half an inch below the occipital protuberance to the base line one inch and a half behind the meatus. Between these two lines the sinus will be found; above or below the space included between them trephining may be practised with safety.

"4. I have also tried to arrive at some point at which the sinus might always be sought for with success; this is required in the operation for septic thrombosis of the sinus. Although it varies so much in its course generally, at one spot it is pretty constant in its relation to the middle of the meatus. If the pin of a $\frac{3}{4}$-inch trephine be placed at a point an inch and one-eighth behind the centre of the bony meatus, and on the level of its upper border, it will expose the sinus, I believe, in every case.

"5. From an examination of my specimens I have come to the

conclusion that the safest site for trephining over the temporo-sphenoidal lobe of the brain is such that the pin of the trephine shall be at a point one and a quarter behind and one and three-quarters or, better still, two inches above the centre of the bony meatus.

"6. In trephining over the cerebellum I would recommend that the pin of the trephine should be placed an inch below Reid's base line and two inches behind the centre of the meatus.

"7. In all cases great care should be taken in boring the skull behind the ear, on account of the dangerous variations in the position of the lateral sinus; it is occasionally as little as one-twelfth of an inch from the surface; in other cases it comes within three-sixteenths—less than a quarter of an inch of the back of the meatus.

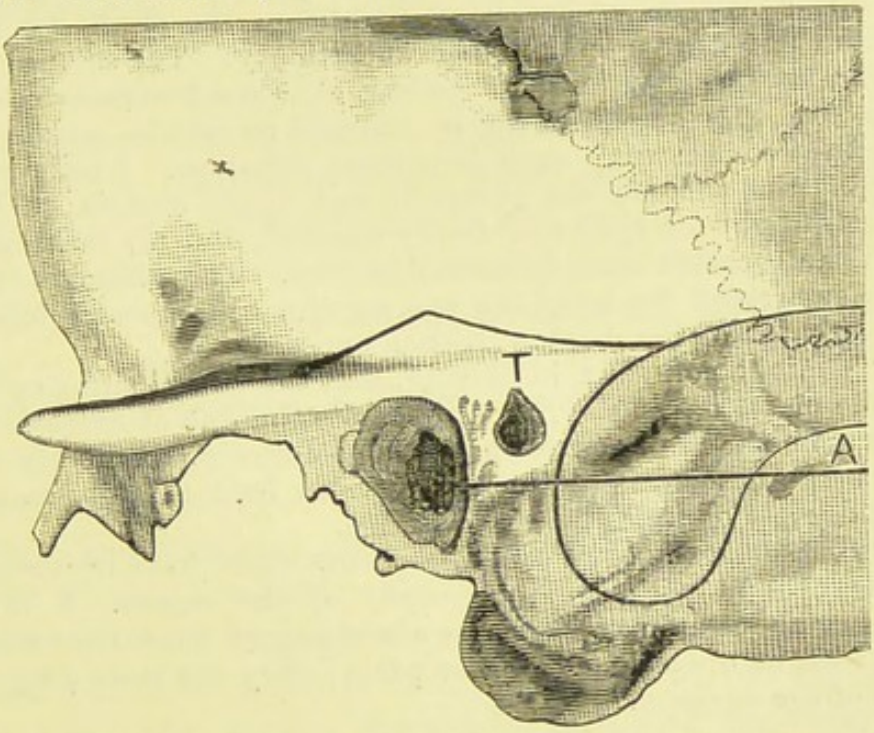


FIG. 10.—Part of skull, showing ¼-inch drill hole into mastoid antrum. T, Drill hole; A, base line. Lateral sinus is also shown. (After Birmingham.)

"8. With reference to tapping the antrum—after a careful examination of all my specimens, I have come to the conclusion that the mastoid antrum may be opened in every case, without wounding the sinus, and without opening the cranial cavity, if a ¼-inch drill be used, and sent straight inwards (without inclination backwards or forwards, upwards or downwards) at such a point that the hole it makes shall lie as near as possible to the back of the bony meatus, and its upper border not more than one-twelfth of an inch above the level of a line prolonged backwards from the superior margin of the meatus. The instrument should not be driven in further than three-quarters of an inch at the most; if it be sent further than this distance there will be a danger—indeed, in a certain proportion of cases, almost a certainty—of wounding the most external part of the labyrinth, viz. the external semicircular canal, which is in some cases not more than 17 mm. from

the surface. The antrum will usually be reached at a depth of three-fifths of an inch. In about ninety-eight per cent. of cases a $\frac{1}{3}$-inch drill might be used, and in a larger proportion even a $\frac{1}{2}$-inch instrument; but since it is impossible to tell from the exterior the dangerous cases, the $\frac{1}{4}$-inch size should be used to secure safety in every case. The aperture may be subsequently enlarged with care, if this be thought necessary.

"Finally, I would suggest a simple rule for avoiding the lateral sinus in this region—viz. that all deep perforations made here should be in front of a vertical line drawn a quarter of an inch behind the posterior margin of the meatus; and that they should be made with the greatest care. I have specially avoided giving any guides or surface marks except bony points on the skull itself, about which there can be no doubt or uncertainty. The soft parts, such as the various divisions of the ear, etc., are too movable and too variable; they should never be adopted as reliable guides in such a critical corner with such important relations. I believe that in tapping the antrum the posterior and upper margin of the bony meatus ought always to be freely exposed, and all bearings taken with the greatest care from the meatus. The directions which I have suggested for reaching the antrum can be easily followed if the margins of the meatus be thus exposed.

"I might point out, in passing, that the lateral sinus runs down on the mastoid, roughly, about opposite the line of reflection of the skin from the pinna on to the head posteriorly. I merely mention this because sometimes there is an idea held that the sinus lies a considerable distance behind this line.

"These are the chief practical points which have occurred to me in connection with the topography of the region. I have said nothing about skin incisions, or about any of the earlier structures met with in operations on these parts; they are more properly the care of the surgeon."

The mastoid cells are bounded in front by the osseous meatus and tympanum, posteriorly by the diploe of the mastoid process; above them is the plate of bone which roofs in the cells and the cavity of the tympanum, separating both from the dura mater. Below this plate of bone is the antrum mastoideum, which communicates with the upper and posterior part of the tympanum. Beneath the mastoid cells is the mastoid fossa for attachment of the sterno-mastoid muscle. Internally is the plate of bone grooved (sigmoid fossa) for the reception of the lateral sinus. Externally the cells are limited by the convex osseous plate, varying in thickness in different individuals behind the auricle. (Schwartze, Schmitt, and Wernher have reported instances of emphysema

caused by the escape of air from the tympanic cavity into the subcutaneous cellular tissue in cases of dehiscence of the mastoid process.) Politzer mentions the possibility of a dehiscence of the inner plate of bone separating the cells from the venous sinus.

The varying thickness of the osseous partition between the cells and the venous wall is of practical interest, not alone in regard to operations on the mastoid cells or threatening suppuration, and its consequences should the destruction of the bone extend, by thrombosis, embolism, and septicæmia, but also to the influence exerted by venous fulness and distension on subjective disturbances of hearing and vertiginous tinnitus aurium. The relative thickness of these outer and inner walls of the mastoid process in children and adults explains the greater frequency with which meningitis follows disease of the middle ear in the latter, as in adult life the inner table is in proportion much thinner than it is in infancy and childhood, whereas it is the reverse with the outer. Hence the greater tendency for the pus to find its way into the mastoid cells. The exit of any purulent collection from the mastoid cells is furthermore hindered by the floor of the mastoid antrum being at a lower level than that of the tympanic cavity.

That recurrent abscess and periostitis in the external meatus and otitis media should be followed occasionally by suppuration in the mastoid process is explained by the anterior wall being formed by the osseous meatus, the lining membrane of which, as we have seen, is continuous with that of the tympanic cavity.

The variations in the size and consistence of the mastoid process in different persons has to be borne in mind, the relative proportion of pneumatic space, osseous structure, diploe, or sclerotised tissue being quite different in various mastoid processes, as shown by Zuckerkandl. This variety in depth and density explains the comparative facility or difficulty met with in trephining the mastoid. The density of the bone has a still more important bearing in regard to operations and disease of the mastoid, for an advanced position of the lateral sinus

renders it specially liable to injury in such operations. The more pneumatic and well developed the mastoid, the more favourable the position of the sinus (Politzer). In some cases there is but a small space between the sinus and the posterior wall of the meatus.

Labyrinth.

There are some special facts, anatomical and physiological, bearing on the correlative functions of the middle ear and labyrinth, that must be remembered in affections of the latter.[1] They may be thus briefly summarized :—

Perilymph.—(*a*) The communication between the arachnoid space (cerebro-spinal cavity) and the fluid perilymph of the labyrinth through the aqueductus cochleæ ; (*b*) the normal mobility of the membrana tympani is essential, not alone for the transmission of the endless variety of vibrations through the ossicles to the perilymph, but this constant correlation of the yielding drum-head to the air in the tympanic cavity, and of the movable stapes to the perilymph, is the index to the degree of pressure on the endolymph.

Vascular.—(*c*) The arterial supply of the labyrinth through the basilar artery, the semicircular canals and cochleæ ; (*d*) the venous discharge of the labyrinth into the petrosal sinus and jugular vein, and the communications both arterial and venous between the vessels of the tympanum and those of the labyrinth in the osseous partitions between the middle and internal ear (Politzer) ; (*e*) the connection thus established (in disturbing conditions of the circulation more especially) between the internal carotid, external carotid, and vertebral vessels, a connection of still greater importance pathologically when we remember the large size of the tympanic capillaries, and possibly (Prussak) the direct passage of arteries into veins without any capillary intervention, while such a vascular link of communication being maintained in osseous structures must, in varying conditions of arterial or venous tension, whether local in the vessels

[1] See also pp. 281 and 288.

of the tympanum or labyrinth, or general through cardiac or other causes, peculiarly affect the blood-pressure, both in the tympanum and the labyrinth.

Professor Politzer, to whom we are more especially indebted for the knowledge of these anatomical facts, says—

"From pathological and clinical observations, there can be no doubt but that hyperæmia and congestion of the vessels of the middle ear accompanied with inflammation, owing to these anastomoses, sometimes extend to the vascular regions of the labyrinth, causing there temporary or permanent disturbances of nutrition."[1]

Nervous.—(*f*) The free distribution of vaso-motor nerves to the arteries supplying both labyrinth and tympanum;[2] (*g*) the connections of the roots and nuclei of the auditory nerve with the peduncles of the cerebellum, the floor of the fourth ventricle, the medulla oblongata, the contiguity of the auditory nuclei to those of the facial, sixth, and eighth pairs of nerves; (*h*) the decussation of the fibres of the roots which maintain a connection between the auditory nerve of one side and the nuclei of the opposite nerve, and with the corresponding side of the cerebellum; (*i*) the relation of the temporal lobe of the cerebrum (Munk and Ferrier) to the sense of hearing (hearing centre), and the experiments which point to a decussation of the auditory nerve fibres in the brain; (*j*) the nerve connections established through the spheno-palatine and otic ganglia of the fifth nerve and its superficial petrosal branches with the sympathetic, facial, and glosso-pharyngeal on the one hand (tympanic plexus), and on the other, those connecting branches of the facial, glosso-pharyngeal, and pneumogastric with the nerves supplying the Eustachian tube, tensor palati, soft palate, and naso-pharyngeal mucous membrane; while worthy of special notice is the distinct supply of the tensor tympani (fifth nerve) and of the stapedius (facial), the "activity of the former muscle being regulated by reflex action" (Forster).

[1] Politzer, *op. cit.*, p. 49.

[2] See p. 283, "Some anatomical points bearing on reflexes of the trigeminus."

Muscular.—(*k*) The action of the tensor tympani and stapedius muscles in regulating the degree of pressure on the labyrinthine fluid through the stapes and fenestræ; (*l*) the healthful action of the tubal muscles (levator and tensor palati) in opening the Eustachian tube during deglutition and in certain acts of phonation, thus securing the normal conditions of equilibration in the tympanic cavity, preventing condensation of the contained air, and in consequence maintaining free ossicular movement and the necessary and correlative response of the membrana tympani externally and the membrane of the fenestra rotunda internally, while due equilibrium is sustained in the fluid of the labyrinth.

The anatomical and physiological relations of the naso-pharynx to the ear are briefly alluded to in the chapter on the Naso-Pharynx.[1]

[1] See p. 162.

CHAPTER III.

STATISTICAL.

We have separated these 4000 and odd cases into two divisions, as 1500 of them have, for reasons stated further on, not been quite so minutely classified. The remaining 2500 odd have been divided under three heads—(*a*) affections of the external ear and meatus; (*b*) affections of the middle ear, including the membrana tympani, its muscles, the ossicles, the Eustachian tube; (*c*) the internal ear, including the labyrinth and auditory nerve.

In tabulating these affections we have placed each patient under that division which the most prominent symptoms and physical signs justified us in regarding as including the primary or principal seat of the disease and the part mainly involved. Obviously, in so large a number, where, as a rule, both ears were affected, other structures and parts were involved than those which determined the final assignment of the case. This is one of the circumstances which make an accurate classification of aural diseases difficult. The removal of cerumen may disclose a perforation of the drum-head or some old catarrhal state, with its secondary intra-tympanic consequences, and further examination may demonstrate internal-ear complications. A patient, on the other hand, may have the slowly progressive history and proofs of Eustachian deafness, resulting in both internal and middle ear mischief, but in whom all the evidence, aided by that derived from a throat examination, points to tubal collapse, enervation, or obstruction,

as the principal source, both past and present, of the affection.

The skill of the aurist mainly consists in his power of comparatively analyzing and differentiating these associated morbid conditions, and in assigning relatively to each its proportionate part in the production of the symptoms for which he is consulted. He has frequently to decide how far the removal of those abnormal states which he knows to be remediable by operative or therapeutical measures will enable him to improve his patient's hearing, or, just as important a result, to preserve it. In a certain proportion of cases he must feel, no matter how large his experience, that the chances of improvement are against him; in others he knows absolutely that no good whatever can be done. Frank admission in the case of both these classes of sufferers would save aural surgery from much of the suspicion of quackery, which at present is pretty openly hinted at, in regard to its therapeutical remedies and applications. "Don't you find aural practice very unsatisfactory in its results?" is a question which is frequently put. And the reply, "Most decidedly not," appears to astonish many interrogators.

We repeat here what has been elsewhere stated—(*a*) that the broad principles of treatment are as easily, effectually, and safely carried out in the case of morbid conditions of the ear as in those of other organs; (*b*) that the most essential of those therapeutical principles, no matter how secured, are *cleanliness* (in the widest sense of the word); free *ventilation* of the aural passages; attention to the *healthy state of the naso-pharyngeal mucous membrane;* due regard to the intimate dependence of the normal auditory conditions on a healthful relation of all the delicate structures to their supply, and hence *to the state of the blood and the arterial and nervous systems.*

The subjoined table speaks for itself, and may be looked upon as a fair index of the general run of aural affections we are called upon to treat. In the first place, it shows that about 75 per cent. of these patients had middle-ear

trouble of one kind or another. Secondly, that in over one-fourth of them the affection was limited to the external meatus. Thirdly, it demonstrates that in about one-seventh of the entire number, wax had accumulated in the meatus. And, fourthly, it shows that nasal and naso-pharyngeal affections, such as rhinitis, nasal polypi, septal deviations, outgrowths, adenoid vegetations, pharyngitis, and hypertrophied tonsils, were co-operating causes.

TABLE I.

Total number of cases, 2543.

External ear, including meatus	522
Middle ear, including the membrana tympani, the cavity of the tympanum, Eustachian tube, and the mastoid process	1809
Internal ear, including the auditory nerve and labyrinth ...	212
Total	2543
Cerumen present	338
Naso-pharynx affected	375

Table II. gives a more complete analysis of the diseased condition met with in these 2543 cases.

TABLE II.

External Ear.

Eczema of auricle	76
Erysipelas ,, ...	4
Wound ,, ...	2
Perichondritis ,, { Starvation ... 2 / Frost-bite ... 2 }	4
Lupus ,, ...	3
Tumours ,, ...	3
Congenital narrowing of external meatus	2
Diffuse inflammation ,, ,, ...	33
Furuncle and abscess ,, ,, ...	45
Caries ... ... ,, ,, ...	2
Exostoses ... ... ,, ,, ...	17
Polypi ... ... ,, ,, ...	18
Tubercular ulceration ,, ,, ...	2
Cerumen in (with collections of epidermis and fungus) ...	338
Injury to or foreign body in external meatus	41

Grass seeds, chalk, lemon pip, wool, stones, slate pencil, beads, and shells were some of the substances found in the meatus.

Middle Ear.

Wounds of the membrana tympani not causing suppuration	8
Ulceration of membrana tympani (causing tinnitus) ...	2
Cretaceous deposits in membrane	19
Myringitis ,, ,, ...	53
Acute middle-ear inflammation	26
Chronic ,, ,, ...	220
,, ,, ,, (syphilitic)	8
Collapse, closure of, or obstruction to the Eustachian tube from various causes	466
Fungi in the tympanic cavity	21
Acute and chronic middle-ear suppuration	825

Internal Ear.

Total number of patients affected with internal-ear affections	195
Ménière's symptoms	36

Other cases.

Simple otalgia	15
Ear cough	5
Deaf-mutism	2

A further analysis of 792 of these cases of middle-ear suppuration is given in Table III.

TABLE III.

Males	344
Females	448
Right ear affected only	278
Left ,, ,, ...	244
Both ears affected	270

Cause assigned.

Scarlet fever	214
Measles	148
Cold	240
Blows and injuries	56
Teething	39
Adenoids	32
Whooping-cough	18
Tubercle	12
Diphtheria	5
Syphilis	5
Bathing	4
Typhoid	4
Heart disease	2
Violent syringing	2
Smallpox	2

Bronchitis	2
Use of instruments at birth	1
No history obtainable	8

Symptoms present other than Ordinary.

Tinnitus	84
Vertigo	30
Nausea	26
Hæmorrhage	2

The following complications occurred :—

Mastoid disease	14
Cerebellar abscess	1
Cerebral	1
Thrombosis of lateral sinus	2
Facial paralysis	6
Exostoses	4
Hyperostosis of meatus	16
Granulation tissue formed	40
Polypi—right ear, 18; left, 24	42
Ulceration of auricle	52

These tables may be supplemented by reference to another of 1500. It is in no way as accurate a record as the previous ones. It is simply compiled from the register of some of the hospital patients, the special affection tabulated being noted as the most prominent morbid condition at the time relief was sought. It was impossible to make a more accurate analysis, as many of the letters of the patients were lost, mislaid, or not returned. Though only 71 cases have been tabulated as suffering from affections of the internal ear, it is clear that when so large a number as 466 had chronic catarrhal conditions and complications present in the middle ear, such as adhesions, anchyloses, etc., the internal ear must also have been, in many instances, involved. Again, patients who had polypi growing from the tympanum or membrane have not been separated from those in which it grew from the meatus. Lastly, 105 cases have been merely placed under the head of "Affections of the Middle Ear." Still we consider it sufficient of an index to the abnormal states of the ear we are called on to treat in every-day practice

to induce us to make use of it, as well as the other records.

The difference in the mode of drawing up these tables makes any just comparison impossible. But it may be well to notice that they agree in demonstrating the large number of patients of all classes who suffer from middle-ear suppuration, obstructed and collapsed conditions of the Eustachian tubes, and other catarrhal complications of the tympanum. On the other hand, it is important to observe that of these 4000 and odd patients, true exostosis in the meatus was present in only 22; that but 53 were seen in the early stage of acute inflammation of the membrane, and that only in this number was it possible to isolate, as the cause of pain, the inflammatory state of the drum-head, while about 5 per cent. had a polypoid growth either in the meatus or middle ear.

TABLE IV.

External ear	645
Middle ear, including the membrana tympani, cavity of tympanum, and Eustachian tube	716
Mastoid process	7
Polypus (either of meatus or tympanum)	61
Internal ear	71
Total	1500

Analyzing still further the causes of deafness in these patients, we find as follows:—

TABLE V.

External Ear and Meatus.

Cerumen (with epidermis and aspergillus in some instances)	present in	295
Tumour of auricle	,,	5
Injury of auricle	,,	4
Congenital abnormalities of auricle	,,	4
Absence of meatus	,,	1
Foreign bodies	,,	18
Inflammatory states of the meatus	,,	179
Furuncle and abscess	,,	88
Exostosis	,,	5
Eczema	,,	46

Middle Ear and Eustachian Tube.

Myringitis	present in	31
Catarrhal states of the tympanic cavity ...	,,	202
Collapse, closure, and obstruction of the Eustachian tube from various causes	,,	159
Unclassified affections of the middle ear ...	,,	105
Membrana tympani perforated	,,	218
Polypus of external or middle ear	,,	61
Mastoid process	,,	7

Internal Ear and Labyrinth.

Affections of (registered)[1]	,,	71

There are some broad conclusions which may be drawn from these tables.

(1) That a very large proportion of the aural affections for which we are consulted, both those of an inflammatory character and those in which there is deterioration of function, is due to essentially preventible causes, or causes over which the controlling influences within the reach of every physician and surgeon can be exerted so as either to prevent or minimize their pernicious effects.

(2) That the external ear furnishes a large proportion of the diseases we are called on to treat, and that (to take a low estimate) in some 40 per cent. of such patients cerumen (and its associated and attendant evils) is the primary cause of the trouble, and produces the symptoms for which we are consulted; and that of the remaining affections of the external ear, inflammation of the meatus, in various degrees and stages, is the condition we have most frequently to combat and limit.

(3) That chronic, dry, or moist catarrhal states of the middle ear furnish the next largest number of patients, associated with which we frequently find closed, obstructed, or collapsed Eustachian tubes. Of the 4000 and odd patients tabulated, more than one-third distinctly came under this head, and in over one-third of these closure or obstruction of the Eusta-

[1] See classification of the causes of tinnitus aurium, p. 305.

chian passage was registered. But this, as we have already shown, is to be regarded as only approximately accurate, as in the classification of a large proportion of these cases the secondary condition has not been included. We should say that at least two-thirds of these "middle-ear" cases were complicated with, or owed their intra-tympanic mischief to, Eustachian collapse or closure.

We may also draw this general conclusion, which has an important bearing on aural therapeutics, viz. that the practitioner in daily practice has principally to deal with two causes of inflammatory affections of the ear and deafness,—in the external ear, accumulation of cerumen and its accompaniments, epithelium and fungus; in the middle ear, tubal collapse, closure, and obstruction.

Analyzing a report of 1000 cases of ear disease treated in the Glasgow Western Infirmary, published by Dr. Barr, we find that the auricle and auditory canal were affected in 14 per cent., the middle ear (tympanum, Eustachian tube, and mastoid cells) in 81½ per cent., and the internal ear in 4½ per cent. Of the 1000 cases, the same disease existed in both ears in 516 persons, and a different diseased state in each ear in 88 persons. The very small proportion of internal-ear affections Dr. Barr accounts for by the exclusion of all cases save those in which the nervous apparatus was primarily affected. But he is careful to remark that "the cases in which the inner ear becomes gradually involved are generally the result of the extension to the structures of the labyrinth of disease which has begun in the middle ear." It is worthy of notice that of these 1000 patients only two suffered from exostosis of the meatus, in one of these both ears being affected. Three patients presented themselves with polypus in the external meatus, and 65 with polypi growing from the walls of the tympanum. Only three cases are recorded of acute myringitis. One is at once struck, as in our tables, with the large proportion of middle-ear diseases, and more especially of catarrhal states, acute and chronic. Also it is worthy of notice

that in twenty-three only were the mastoid process and cells affected.

It will be noticed that the proportion of internal-ear affections appears from the registered number of cases, 405 out of 4000 and odd, to be relatively small. This would be a most misleading inference to draw from any statistical table or classification of ear affections. It is an easy task to assign to the division of internal-ear disease a well-marked case of nervine deafness, labyrinthine vertigo, the combination of objective signs and subjective symptoms, which we group together under the name of Ménière's disease, or those numerous cases in which from disease or accident we can have no doubt that permanent lesions, traumatic in origin or the consequence of apoplectic, acute inflammatory, or degenerative changes in labyrinth or cochlea, exist.

But to accurately differentiate these morbid conditions, such as true paralytic states from localized nerve lesions, limited effusions of blood or serum, simple functional disturbance and paresis, from organic mischief in the nerve elements, is, we have to confess, in the present state of our knowledge and the scanty clinical and pathological data, often impossible. This is the weak side of otological science, and an unfavourable comparison can justly here be made with ophthalmological research and knowledge. Yet it is established by all past pathological evidence, that serious lesions of the middle ear—take especially suppurative catarrh with extensive perforation in the membrana tympani and old catarrhal conditions of the mucous membrane of the cavity of the tympanum—lead up to and are attended by varying degrees of internal-ear mischief, both in the labyrinth and cochlea. And, therefore, in such a classification as that which we have presented, it must have happened, and the general experience of the results of treatment proves this to be true, that the internal-ear structures were likewise, to an extent, involved though not included at the time. How far such involvement, apart from these middle-ear affections, depends on constitutional or systemic states, and morbid changes in

other organs, or to acute disease or general decay, it is our obvious duty to try to determine. At times the attempt is an impossible one; at other times the more remote source of the symptoms is immediately obvious. Under any circumstances it does not affect our duty to determine the part taken by the local lesions in the production of these symptoms, and our treatment so far of it. But over these internal-ear lesions experience proves we have little power. If present, and due to such constitutional states as general plethora, syphilis, gout, struma, and such organic conditions as cardiac disease, albuminuria, diabetes, we may do much by general and specific treatment to modify or ameliorate—we rarely cure—so that their presence does not affect the question of local treatment. It is rather one of diagnosis and prognosis.

CHAPTER IV.

ETIOLOGICAL.

We would first make some general observations on the origin of the deafness, or rather on its ascribed source, in over fifty per cent. of the 2543 patients who were able to trace either the deafness, pain, or inflammation to some definite cause. In about fifty per cent. no predisposing cause could be assigned or discovered for the ear affection. In many the deafness crept on insidiously, without pain, and not until conversational power suffered, either through the more obvious difficulty of hearing the voice when spoken to, or that more slowly perceived proof of mischief, the inability to hear general conversation at table and in society when several people are speaking at the same time, did the patient realize the fact that any impairment of hearing threatened.

Less frequently in the case of the ear than of the eye does the failure of the hitherto perfect organ awaken the person to the fact that some imperfection has already existed, which has passed unobserved until both organs begin to suffer in function. And, so long as the hearing distance is sufficiently good for the ordinary conversational business or professional necessities, the slight beginnings of deafness passed unheeded and undetected. It is with difficulty that we can at times persuade a patient that the hearing power is not as good in one or both ears as it might be. Particularly is this the case when we are consulted for tinnitus without any considerable impairment in the hearing. The persistence of the noise, of whatever kind it be, is the first warning of the future decadence which follows the early perversion of the function.

Just as we should never neglect occasional or per-

sistent pain in the ear, so should we always be mindful that tinnitus is a warning symptom, not alone of local auditory derangement, but frequently is it the danger signal of more remote mischief in the brain, heart, or general vascular system. Of the patients asked if they could ascribe any cause for the trouble for which they sought relief, we have only recorded the answers of those who appeared certain that there were good grounds for attributing it to some diathesis, illness, accident, habit, or occupation.

TABLE VI.

Scarlet fever	259
Measles	159
Fever	6
Diphtheria	7
Whooping-cough	18
Typhoid fever	7
Smallpox	2
Tubercle	14
Struma	2
Bronchitis	2
Mumps	3
Syphilis	26
Anæmia	8
Cardiac disease	10
Rheumatism	9
Gout	14
Uterine functional disorders	87
Puerperal	3
Hereditary	26
Congenital	7
Cold	374
Frost-bite	2
Starvation	2
Mental worry and shock	15
Neuralgia	13
Injuries and foreign bodies	150
Bathing	19
Teething	39
Adenoids	287
Tropical and climatic	7
Alcoholic excess	4
Gun practice	3
Ozæna	4
Nasal polypus	2
Violent syringing	2
Use of instruments at birth	1
Total	1593

We have already shown that 328 patients had cerumen in the external meatus, and that 375 suffered from various throat and naso-pharyngeal affections.

Some deductions from this table of the causation of aural diseases may be drawn.

Naso-pharyngeal Catarrh.

We find among the most frequent sources of all ear trouble, that recurrent and troublesome visitor, "a cold in the head," with its attendant coryza, and adenoid vegetations in the naso-pharynx. For out of 1593 cases, no less than 374 were ascribed to "catching cold," and 287 to adenoid growths. We will only briefly refer to naso-pharyngeal affections here, inasmuch as these conditions will be fully dealt with in discussing the various aural affections attributable to their presence.

The most commonly met with of these naso-pharnygeal affections are :—(*a*) adenoid growths in the naso-pharynx ; (*b*) naso-pharyngeal catarrh, acute and chronic ; (c) hypertrophy and parenchymatous thickening of the nasal and naso-pharyngeal mucous membrane ; (*d*) follicular hypertrophy, cytogenic states, and granular conditions of the naso-pharynx ; (*e*) enlargements and morbid growths from the inferior and middle turbinated bones ; (*f*) paretic states of the naso-pharyngeal muscles ; (*g*) deviations of and growths from the septum ; (*h*) syphilitic affections of the naso-pharynx ; (*i*) enlarged tonsils, which, though strictly speaking faucial organs, may be grouped here for convenience.

Frequent catarrhs, both of nose and throat, are common causes of the same conditions of the membrane and drum cavity.

The temporary swelling and closure of the Eustachian tube, with the consequent interruption in its valvular function, independently of the imprisonment of secretion in the tympanic cavity, is a sufficient explanation of this result. The delicate Eustachian, as well as the intrinsic tympanic muscles, are included in the inflammatory process, so that the temporary atonic state

is frequently succeeded by a prolonged, if not permanent, enervation. The recurrence of attacks increases the danger and brings on the periodical deafness or slight dulness of hearing, and the intermittent hum or buzz of tinnitus becomes in time a permanent defect. Thus each catarrhal attack is remarked by the patient to favour the symptoms of deafness and noise in the ear, but as these subside little attention is paid to them until the permanent deafness necessitates advice.

The same observations apply to attacks of tonsillitis, and so we find the ordinary "sore throat" a frequent precursor of aural mischief. Draughty places, exposure to cold air and a keen wind, rapid changes of temperature, carelessness after exercise and chill, are the occasional causes of abscess or myringitis. Nor is the relation of pharyngeal inflammation and tonsillitis to miasmatic or septic surroundings to be forgotten in the etiological consideration of external and middle-ear catarrhal inflammation. The same impure atmospheric or contagious influences operate in both instances.

And it must frequently happen that these prevalent zymotic conditions accentuate the aural as they do the throat trouble; or it may be that under the favouring conditions of confinement of organic particles in the limited space of the Eustachian tube and tympanic cavity, with the increase of temperature and the accompanying moisture, fermentative changes are here more readily induced, as we know they are from similar causes operating in the external-ear passage in the instance of furuncle.

Again, we may derive a valuable therapeutic lesson from these facts. We should attend closely to the ventilation of the aural passages and cavities during these catarrhal states. At the same time the faucial orifices of the Eustachian tubes should be kept patent. Patients should have impressed on them the danger arising from recurrences. Warmth of the extremities should be insisted on. The feet should be kept warm and free from damp. "Colds in the head" should be cut as short as possible, and the throat and nasal

passages should be seen to when the cold has passed over. Antiseptic, alkaline, and astringent agents may be combined in vapour, spray, and gargle, and the frequently existing atonic muscular state can be counteracted by change of air, local astringents, and general tonics. Most necessary is it to warn patients of the slow and imperceptible advance of this catarrhal deafness. Free inflation of the ear and attention to the nose and throat, in the manner hereafter to be described, would save the hearing of many an ear and much subsequent useless interference if resorted to early.

Scarlet Fever.

It will be noticed that scarlet fever was directly or indirectly the source of the affection in about one-fifth of the cases. A very large proportion of these patients had a perforation of the drum-head in one or both ears. Several suffered from acute suppurative inflammation during the illness; in others the perforation or catarrhal state was secondary to the exanthem. From this at least we learn the practical lesson of the paramount importance of close attention to the ear during the scarlatinous fever and the period of desquamation, seeing how frequently an affection of that organ, often producing total deafness, is one of the sequelæ. Here, if the practitioner has not the necessary skill to puncture, at the right moment, a bulging pocket of the membrane, or that he finds it difficult, from the age of the patient, to carry out this operation, close attention to the cleanliness of the external meatus and the naso-pharyngeal tract will do much to limit mischief and prevent destructive suppuration in the auditory passages. And it should be clearly understood that nothing save the lamentable ignorance of the benefit derived from this salutary step can explain the large number of terrible cases of destructive inflammation of the middle ear, with its permanent deafness, occurring during and after scarlet fever.

To permit accumulations of pus to gather in the

tympanum, the exit of which is prevented by the drum-head, when destruction of the ossicles, collections of pus in the mastoid cells, abscesses, widespread inflammation, and large ragged perforation of the membrane itself may finally result, is, in the face of our present knowledge, highly culpable. Indeed, we must acknowledge that a large percentage of the cases of post-scarlatinal deafness, with perforation of the membrana tympani and other lesions, is the result of carelessness or the want of due attention to the throat and ear complications both in the acute stages and during convalescence. Doubtless in some cases the fearful rapidity, the malignity, and the severity of the constitutional fever absorb all the attention. Yet where this is not the case, sufficient thought is not bestowed on the throat and nasal passages, the naso-pharyngeal, and palato-pharyngeal tracts.

The frequent cleansing of these parts by douches, washes, or sprays, disinfectant and astringent, applied both through the nose and mouth, as well as the occasional washing of the parts out with a brush carried well up behind the soft palate, is essential in dealing with the Eustachian complication.

But it is even more necessary to say a word of caution in regard to these patients when they are convalescent. Frequently, although no pain or discharge has drawn attention to the ear and there has been no apparent aural mischief in the acute stages, the throat complications have induced a chronic tympanic catarrh, with its accompanying swollen and obstructed Eustachian tube and imprisoned mucus, all of which troubles are apt to be exaggerated during the desquamating period, by the debility and prostration consequent upon the attack. Then it is that we frequently find the otitis resulting in perforation and discharge, often without pain, and consequently neglected by the parents until the deafness attracts attention. Or again, an acute inflammatory attack runs on with extreme rapidity to perforation, the pent-up discharge thus finding vent. It is in these cases, if seen sufficiently early and before

a perforation occurs, that the surgeon has, in incision, a safe and ready means of preventing either further aural mischief or consequent cerebral or other complications. We shall refer again to this matter when speaking of middle-ear suppuration.

Measles.

That measles is not without its risk of impairing the hearing, is amply proved by the fact that it ranks third on the list of the causes of middle-ear suppuration, and fourth in that of all ear trouble. We have also found that catarrhal states of the tympanum, with some collapse of the Eustachian tube, are conditions frequently occurring as sequelæ of measles. The coryza and nasal catarrh, with the attendant swelling of the naso-pharyngeal membrane, account for this result. The same precautions which are indicated during convalescence in the case of scarlet fever are required after measles. A little care and watching are sufficient to prevent any permanent injury.

Injuries, Blows, etc.

Rupture of the drum-head, extravasation of blood into the cavity of the tympanum or the internal ear, with some lesion of the nervous structure, and a chronic middle-ear suppuration, with all its serious and fatal sequelæ, are some of the consequences of injuries to the ear—blows, falls, explosions, etc.

Every medical man should discountenance the habit, unfortunately only too prevalent, of boxing the ears of children. More than one fatal case has occurred from the injuries thus inflicted—rupture of the drum-head, bleeding into the middle ear, otitis media, extension of the mischief to the brain have followed.

Quite recently a policeman, who in a scuffle received a blow of the fist over the ear, came for treatment;

there was some hæmorrhage at the time. When seen subsequently, there was a rent in the membrane, and this lesion was attended with complete deafness and the most distressing tinnitus. Not alone should slapping children on the ear be prohibited, but a kindred practice nearly as injurious, namely, pulling the auricle. Not long since a case was seen where severe inflammation of the auditory canal followed on "pulling of the ear." It would be well to impress these facts on all parents and school-teachers.

The following cases, recorded by W. R. H. Stewart,[1] exemplify the results that may follow these practices. In Cases I. and IV. the patients were brought for treatment soon after receiving the blow, and recovered in a few days. Case II. delayed seeking advice for a week, and was, therefore, some little while getting well, narrowly escaped a tympanic suppuration, and had some slight loss of hearing power on the affected side; while in Cases III. and V. no treatment was received for many years, with disastrous results, hearing in both cases being lost, and they were exposed to all the miseries and dangers of a fœtid suppuration. Case VI. shows how a blow may cause fatal mischief, more especially when a chronic middle-ear suppuration exists at the time.

Case I. is that of a school-boy who was brought for advice two days after his ears had been boxed by his teacher. On receiving the blow he immediately felt great pain, which still continued, preventing sleep and rest. He was quite deaf on the affected side. Examination with the speculum showed a much inflamed membrane, with a large rent across the lower part, below the handle of the malleus (Fig. 11). Four leeches were ordered in front of the tragus, and frequent fomentations of a hot boric acid lotion to the wounded drum-head. This treatment speedily relieved the pain and reduced the inflammatory condition. The rent also quickly healed, and left only a faint linear cicatrix.

FIG. 11.

Case II. is that of a woman aged thirty-three, who stated that when playing with her husband a few days previously he hit her

[1] "On Boxing the Ears and its Results," *Illustrated Medical News*, 1889.

on the side of the head with his open hand. She immediately felt a sudden and acute pain, which increased in intensity. She was completely deaf on that side. Nothing was done for a week, but the pain becoming very great, she came for treatment. There was a great deal of tenderness on pressure being applied to the tragus, and the speculum revealed an intensified condition of the previous case; there was more inflammation; the rupture, situated in the same place (Fig. 12), was wider, and through it some slight discharge was oozing. Under the influence of leeches and hot boric fomentations, the pain and inflammation subsided, and the pus disappeared, but the wound took some little while to heal. The edges had to be touched several times with nitrate of silver, and the resulting cicatrix was much thicker than in Case I.

FIG. 12.

Case III.—A man of sixty came for treatment, suffering from an offensive discharge from the ear. He stated that when a boy at school he was struck on the side of the head for inattention. He felt at the time, and for some while afterwards, great pain, and ever since he had been completely deaf on that side. Soon after recovering from the blow a running from the ear came on, which has continued off and on up to the present time. It has been more or less offensive, being frequently so bad that his fellow-workmen complained of it. He had been to his club doctor, who told him "*not to interfere with it, as if it was stopped the brain would become affected.*" Examination showed that, with the exception of a ring round, the membrane was destroyed (Fig. 13); the ossicles had disappeared, and there was a chronic suppurative inflammation of the tympanic cavity. Under the influence of great cleanliness and a lotion composed of 10 grs. of boracic acid, rectified spirit ℥j, the discharge ceased, but deafness was complete and permanent on the affected side.

FIG. 13.

Case IV.—A school-girl, aged eight, was struck on the ear by her schoolmistress. She had been caught eating sweets during school-hours, and was struck suddenly; and though the blow was very slight, according to the mistress's account, the recipient was completely unaware that it was coming. She was brought soon after the accident, when, as in Case I., pain, deafness, an inflammatory condition of the membrane, and a rupture in the posterior portion running parallel to the handle of the malleus were found (Fig. 14). The case yielded to the treatment used in Case I., and with the same happy results. It is quoted to show that mischief may be caused by a very slight blow, if administered suddenly and without any warning.

FIG. 14.

Case V. was a youth aged sixteen, employed on the railway, who came with an offensive discharge from the ear. He had

a history of pain and deafness, following a blow received some years previously. No treatment was used, and a discharge set in some little while after. It had now become so obnoxious that they would not have him in the signal-box. A largish polypus bathed in pus, which certainly was most offensive, was found. The growth was removed with a snare, and under the influence of constant care and cleanliness, with a sulphurous acid lotion (1 in 8), the discharge ceased, but the membrane, which on the removal of the polypus was found to be entirely destroyed, was, of course, not reproduced, and the ossicles being gone, permanent deafness remained on that side.

Case VI. was that of a boy, aged eleven, who was already suffering from a chronic discharge from the ear, when he was hit on the side of the head with a ruler. He complained of great pain, and a fortnight afterwards, when seen, the whole side of the head was red, swollen, and excessively tender, showing that mastoid disease had set in with a good deal of intensity. A deep incision down to the bone relieved him but slightly, and the next day the antrum was opened and a quantity of pus washed out. He did very well for a week, when suddenly symptoms of a cerebellar abscess set in, and he died in a few hours. No post-mortem was allowed.

One case of middle-ear suppuration was assigned by the mother to the use of instruments during labour, the discharge from the meatus having been noticed almost immediately after birth.

Foreign Bodies.

We consider elsewhere the question of the mode of removal of foreign bodies as worthy a special notice in this work.[1] It is just one of those practical matters that practitioners have daily to decide, and without consultation. Here, however, we may relate these curious cases of prolonged tenancy which lately came under our notice—

"A lady, aged 22, had when a child put some grains of No. 5 shot in her right ear. She never had these removed, and their existence was overlooked and the act forgotten. No pain or uneasiness followed. She was told she had wax in the ear, and in the act of syringing, a surgeon removed a grain. It was then thought all was right. Feeling the ear still uneasy, and some

[1] See p. 219.

tinnitus remaining, which did not yield to syringing, she sought further advice. On the removal of some hardened wax from the bottom of the meatus, something in the nature of a foreign body was discovered; and on persevering with the syringe, another grain of shot, surrounded by a layer of wax and epithelium, came out. This had lain snugly there all these years. A month afterwards the membrane was normal in appearance, and the hearing distance perfectly restored" (Macnaughton Jones).

The second case was that of a clerk who for many years had a more or less offensive discharge from the left ear, which had lately grown so offensive that he had lost his employment in consequence. He had been in the habit, in the earlier stages of the discharge, of inserting cotton-wool in the meatus to stop the smell when he went to work, but had not done so for the last ten years, as it did not answer the purpose; he was quite deaf on the left side, and lately had felt a good deal of pain. On examination, a large polypus was seen filling the external meatus; on attempting to remove it with Wilde's snare it was found that the instrument was obstructed at a short distance, and only a small portion of the polypus could be got away. It was then found that the obstruction was due to a hardish substance, which, on being brought away, proved to be hardened cotton-wool; the remainder of the growth was then easily removed, and after the usual treatment the hearing was fairly well restored. The case is curious from the fact that the polypus should have evidently grown over the cotton-wool, instead of pushing it before it, and also that the cotton-wool should have remained for ten years impacted in the meatus (W. R. H. Stewart).

Menstrual Disturbances.

It is well known that various ocular and auditory affections are the consequences of irregularities in the menstrual function. Amenorrhœa, on the one hand, frequently is attended by hyperæmic states of the retina and milder degrees of retinitis, or, on the other, the anæmia which is its cause produces in the overworked nervous structures both retinal irritation and early tire of the accommodative apparatus of the eye. It is not uncommon to find troublesome spasmodic states of accommodation with low degrees of refractive aberration in such patients, most difficult to rectify. The auditory nervous and vascular structures may equally suffer, and analogous defects follow in the intrinsic muscular (accommodative) apparatus of the ear. Hence at first

tinnitus, followed in time by some difficulty in differentiating sound and partial deafness.

It is more especially during the menopause that we find these auditory changes beginning. Frequent pregnancies, with the accompanying vascular and blood changes, may predispose to these. The ear suffers from the same local and intermittent congestive attacks as other organs, while the attendant cerebral disturbances so frequent at this period of life give rise to auditory subjective noises quite apart from any local changes. On many occasions we have been consulted by patients at the change of life for auditory hallucinations, such as the sound of voices, musical illusions, hearing feet approaching, etc., in whom the hearing was perfect. Sometimes the menorrhagia or metrorrhagia which complicates the menopause, as in the case of loss of blood from other causes—for example, in fibroid tumour of the uterus—induces tinnitus.[1]

It is especially during the menopause that we have to guard against the increase of "progressive deafness," and, if consulted for its premonitory signs, we should attend carefully to the general circulation, the state of the naso-pharynx, and the ventilation of the aural passages and tympanic cavities, at the same time that we, so far as we can, control or modify the uterine flux.

Puerperal causes may lead to tinnitus and deafness. We cannot be astonished at this when we reflect on the changes in the blood and vascular system present during pregnancy, as well as the cardiac hypertrophy or other lesion occasionally attendant upon these hydræmic states on the one hand, or hyperfibrinosis on the other, with or without albuminuria, and which predispose both to hæmorrhage and puerperal septicæmic affections. Here, in the toxic state of the blood, and the varying degrees of vascular tension, or, possibly, effusions or hæmorrhage, we have the source, not alone of the retinal, but the accompanying auditory affections ante- and post-partum.

[1] See p. 278.

Dentition.

Out of 792 cases of middle-ear suppuration 39 were said to be caused by "teething." Such dental sources of aural mischief may possibly have a reflex origin (see p. 341). Apart from the direct association of the inflammatory state of the gums and alveolar structures, there is the general condition of the child's health, so frequently enfeebled through the process of dentition.

Syphilis.

Inherited syphilis is a frequent source of ear mischief in children, the clear evidence of inherited taint being shown by the presence or evidence of past interstitial keratitis, the characteristic teeth, the post-nasal affection, and the nasal speech.

It is difficult to say when the morbid changes which bring about this form of deafness commence. Struma and syphilis have both their share in producing aural complications in young children; but while the symptoms which are observed in the young child and infant are frequently attributed to the former, the presence of the latter disease is overlooked.

In many obscure cases, where there is no proof of the parents being strumous, and no appearance of a strumous diathesis in the child, the search must be cautiously but carefully made for a syphilitic origin. More particularly is this necessary in those acute cases which we occasionally meet, when a child or young infant is attacked rapidly with inflammation in the middle ear, followed by profuse otorrhœa, and perhaps convulsions and death. In such a case seen lately there was general blood-poisoning and collections of pus formed in different parts of the body; the attack was ushered in with snuffles and an abscess over the antrum. The father had contracted syphilis, and the previous children had all died shortly after birth.

Suspicions must be awakened by such a history, and

it should not be overlooked, both for the sake of the patient and surgeon. These cases are most frequently met with in which the child has never heard well, there has been no history of discharge or complaint of pain. These children, particularly amongst the poorer classes, are not brought in the earlier years of childhood, and we are not often consulted until the growing deafness has become so inconvenient, at or about the age of puberty, that the parents are forced to take advice.

The symmetrical nature of these cases, as pointed out by Mr. Hutchinson, does not assist us much in the diagnosis. But the presence of the characteristic teeth, also described by him, the coincidence of syphilitic lesions of the cornea, the proofs of old skin affections, and the general characteristic appearance with which we become familiarized on seeing a number of such cases, will confirm the diagnosis. It is generally for the deafness with the post-nasal catarrh and ozænatous discharge that accompanies it that such cases are brought.

It must be remembered that we have Hinton's testimony that one-twentieth of the cases of deafness attending Guy's Hospital had as their cause hereditary syphilis. This proportion has certainly not been nearly so great in the cases under our care, as shown in the table at the commencement of this chapter, which gives only 26 cases out of 1593. The three following cases, recorded by Dr. Macnaughton Jones, are typical of the hereditary syphilitic class :—

"Mary A., orphan, aged 18. Could trace no family history; has always been deaf; barely hears the watch in contact with the left ear, altogether deaf with the right. There has never been any pain or discharge; cornea of both eyes is dull. There is a peculiar nasal voice, and a difficulty in pronouncing some words. The external meatus of either ear is healthy; the membrana tympani of both is concave and dull, with a prominent malleus. Eustachian tubes are patent. She hears a tuning-fork well in both ears when placed on the head, the sound becoming duller on closure of the ear; tonsils congested, teeth normal."

"A. M. H., female, aged 15. Her father, who is dead, was affected with deafness. She has been deaf since childhood, and the deafness has greatly increased of late. The cornea of both the eyes is dull, and there are old interstitial deposits. The hearing

is almost completely destroyed; neither loud noises nor conversation in the loudest tones are heard. The external meatus is healthy, the membranes are extremely concave and dull, with large pockets; the Eustachian tubes are closed; she has the same peculiar lisp and difficulty of pronunciation as in the last case; the teeth are partially syphilitic and discoloured."

"Miss ——, aged 15, came for advice in November, 1874, for old interstitial keratitis. She was the first child not still-born of the family; all the previous children were syphilitic. She has also now slight deafness and typical syphilitic teeth. Her eyes were healthy until she was five years old, when she had an attack of interstitial inflammation of the cornea, and a second attack supervened five years subsequently. She had the peculiar look and curious articulation which may be noticed in some of these patients."

Let us refer briefly to the teeth here alluded to, and which have been described by Mr. Hutchinson as characteristic of hereditary syphilis, and ask attention to the distinction drawn by him between the teeth of persons affected with hereditary taint, and those who have had mercury administered in infancy, and who have, as a consequence, the teeth of mercurial stomatitis.

	Mercurial Stomatitis.	Hereditary Syphilis.
Teeth primarily affected =	First molars.	Central upper incisors.
	Premolars escape.	
Character of abnormality =	Enamel deficient, transverse lines on incisors and canines, dirty, discoloured, and coated with tartar; pitted.	Peculiar notch in incisors, dirty, badly formed; often combination of effects seen in deficient enamel and dentine from mercury and syphilis.

See Hutchinson's *Illustrations of Clinical Surgery.*

Dr. Pierce, of Manchester,[1] gives the following summary of the characteristics of acquired and congenital syphilis :—

1. Extreme degree of deafness manifested early in the progress of the disease.
2. Rapidity of progress and absence of pain.

[1] International Congress, 1881.

3. Early and extreme loss of hearing for the tuning-fork over the vertex.
4. Frequent imperviousness of both Eustachian tubes.
5. Constancy of the tinnitus, of a hissing kind.
6. Frequency of simultaneous internal-ear symptoms.
7. Improvement of pre- or co-existing eye affection.
8. More decided affection of the naso-pharynx than in catarrhal ear disease.
9. Less complete recovery than in simple catarrh.

We have remarked that in many of the patients there is no abnormal appearance of the membrane that can be looked on as pathognomonic. In several others we have seen the membrane dull and thickened; it has lost its transparency, is rather of a grey colour, and inflates with a dry click. We believe, however, that it is *impossible* to define any typical appearance in this affection, in which we regret to say that treatment has with us proved of little avail. If taken in the early stages, or when the symptoms first manifest themselves, much may be done by mercurial treatment (lanolin inunction), followed by the three iodides or iodoform given internally, at the same time that the Eustachian tube is attended to and the tympanum kept free by warm iodide of potassium or chloride of ammonia injections. But when a case comes with extreme deafness (both with the watch and tuning-fork), and presents the characteristic teeth of Hutchinson, and the proofs of an attack of interstitial keratitis, either remote or recent, a good result from any treatment is not to be hoped for.

Primary syphilis of the ear must be extremely rare. We have never seen a case. Syphilis, however, occasionally attacks the ear in the form of secondary cutaneous eruptions or condylomata of the auricle. We have seen many well-marked cases of syphilitic secondary affection of the middle ear of a chronic catarrhal, non-suppurative nature. The majority of the patients, being for a time periodically under observation, ultimately yielded to constitutional and specific treatment. In some cases, occasionally, with accompanying syphilitic retinal affections, evidence has been had of internal-ear mischief, tinnitus, giddiness, cranial, or occipital pain,

with deafness. In secondary syphilitic patients, in addition to such treatment as inunction, iodoform, iodide of potassium, the greatest and most permanent benefit has been obtained from a course of baths at Aix-la-Chapelle.

In the chapter on Aural Vertigo reference is made to the use of pilocarpine in secondary syphilitic lesions of the labyrinth.

Heredity.

That deafness is one of those ailments which nature entails as an hereditary reminder of parental imperfection is well known, and in it we frequently have a good exemplification of the law of atavism ; the defect appears to skip one generation, to reappear in the next.

Occasionally, though we cannot find evidence of deafness in the parents, curiously enough two or three brothers or sisters are affected. The deafness at other times will be found at the father's or mother's side, while the parents have escaped. Such hereditary deafness is nearly always of a most unfavourable type, and treatment generally ends in a negative result. In a great many cases the physician does not see the patient until the deafness is far advanced, and there is evidence of serious middle and internal ear trouble.

The lesson, obviously, that we may gather, is to attend, in all such families, to any early indication of approaching mischief, and to lessen the chances of it by looking after the throat and tonsils and any nasal obstruction or abnormality which may exist in children. For it is the fact, and a most vital one in regard to this form of deafness, that we frequently find it first make its appearance after puberty, or even later on.

Gout and Rheumatism.

Gout also has had amongst its other universal attributes the power of causing deafness commonly attributed

to it. No doubt it is a mischievous heirloom, and we may have seen many instances of morbid changes in the ears of gouty patients, and in those members of gouty families who did not themselves suffer from it. Its influence, however, as a cause of deafness, exostosis, and other morbid changes in the auditory apparatus is somewhat exaggerated.

Gout may produce its effects at any age, and these are often most insidious, but those cases that we have seen were all over the age of thirty. We have occasionally noticed the coincidence of exostosis of the external meatus in gouty patients, and in those in whose family there has been a history of the disease. Hinton drew attention to a peculiar "irritability of the meatus, attended by slight serous or sticky discharge, with itching or pricking pain, the walls being somewhat swollen and having a tendency to purple in their redness," as a form of gouty affection. This we have many times seen, and also an eczematous condition of the meatus. Chalk-stones, too, may be deposited in the auricle, and a gradual thickening of the mucous membrane of the Eustachian tubes and cavity of the tympanum, with anchylosis of the ossicles, may occur; whilst the cretaceous deposits in the membrane, which appear after long-standing inflammatory disease, are more frequently seen in gouty or rheumatic subjects.

Take as instances the three following cases recorded by Dr. Macnaughton Jones :—

"A gentleman sought advice for deafness in the right ear, the left being hopelessly deaf for many years. He could not hear the tuning-fork louder in either ear on closure. The watch was heard at one inch with the right ear, the click of the nail at two and a half feet. He never had discharge or pain, and never heard any noises. The external meatus was narrowed and contracted from small exostoses, and the membrane was thickened and vascular. There was an occasional sense of fulness and throbbing. The sound with the auscultation tube was abnormally moist. He had consulted Mr. Hinton in 1869. Both ears were much in the same condition, the appearance before referred to, viz. a moisture and packing up with epithelium. Mr. Hinton regarded the case as of a gouty nature. The patient was always relieved by iodide of potassium and gouty remedies, the employment of the douche, and

injections of iodide of potassium into the middle ear, with careful attention to the external meatus. The last time he was seen, he was considerably and permanently benefited."

"A gentleman, aged 60, sought advice for deafness arising from a condition much the same as that described in the last case. The exostoses were perhaps larger. He had become gradually deaf, and was worse in one ear than the other. He had never suffered from gout himself; his grandfather and father both died from the effects of gout. Other members of his family are greatly afflicted by the same malady. He was convinced that his condition proceeded from the same cause, and doubtless he was correct. Nothing improved him."

"A gentleman, aged 40, came for extreme deafness in both ears. There was a gouty history, and he was of a gouty family. He always lived well, and indulged pretty freely in alcohol. The meatus of one ear was almost completely occluded with an exostosis, and there was a similar condition, though less in degree, of the other. Under treatment directed to reducing the congested condition of the meatus by frequent cleansing with astringent injections, and attention to the cavity of the tympanum, with constitutional remedies, he improved considerably."

Bathing.

Bathing, especially in sea-water, is an important and frequent cause of impairment of hearing, resulting in tympanic inflammation, the consequence of the passage of sea-water into the tympanic cavity. One is constantly consulted for deafness produced by sea-bathing; and in the cases seen, the general conditions have been thickening of the membrane, fluid in the tympanic cavity, and closure of the Eustachian tube.

We have before noticed the occurrence of exostoses within the meatus in persons fond of sea-bathing. In some there has been either a recent or remote history of inflammation in the auditory meatus, with pain; but frequently all that the patient complains of is tinnitus aurium, accompanied with deafness, which, though at first slight, goes on steadily to a most unpleasant and troublesome pitch.

"The symptoms," Turnbull says, "of water in the middle ear are, in the first stage, an uncomfortable sensation, followed by earache or pain, which after a time becomes agonizing, and is accompanied with great tenderness behind the auricle."

The accident does not so often occur with expert swimmers as with the young and inexperienced, who in diving or otherwise from the shock or cold involuntarily fill the mouth and pharynx with sea-water, a portion of which passes into the open Eustachian tube and tympanic cavity. In such cases the mischief may before long extend to the brain, and the most alarming symptoms, delirium and coma, result. Inflammation in the cavity of the tympanum, extending to the naso-pharyngeal tract, is followed by a purulent effusion, which immediately indicates incision of the membrana tympani to give exit to the pus.

We have not seen many acute cases; but we have frequently observed instances of permanent and incurable deafness, with troublesome tinnitus, in which the origin of the affection was clearly traced to bathing. In the more recent and milder cases, the best results have followed warm alkaline injections into the tympanum with the Eustachian catheter, and the use of the air douche.

Frequently we are asked our advice as to the prudence of bathing by aural patients. It is well to remember these dangers, especially when a perforation of the membrane or inflammatory and altered states of the tympanic membrane or cavities are present. Never permit an aural patient to plunge into cold water. Turnbull advises the head to be placed to one side, holding the ear well out and opening the mouth, when water is found to enter the ear. The aural protectors of Macnaughton Jones or Ward Cousins are useful when bathing; failing which, a little cotton-wool should be worn.

Whooping-Cough.

The catarrhal condition produced by this disease will very frequently cause ear trouble from the spread of the inflammatory mischief to the Eustachian tubes. It is not a rare thing to find that the membrana tympani has been ruptured by the violent paroxysms of coughing.

Mental Worry and Nervous Shock.

Mental worry, more especially when combined with night-watching and nursing, is a frequent source of a tinnitus; whilst a sudden shock, such as the reception of bad news, a fright, etc., may cause immediate, complete and permanent deafness.

Tubercle.

Suppuration in the tympanum, when it occurs in phthisical patients, as a rule causes no pain, and that there is ear trouble going on is not recognized until the discharge shows itself. Rapid destruction of tissue, however, takes place, with extension of the mischief to the surrounding bone, the petrous portion of the temporal bone being most particularly liable to be morbid. Hæmorrhage from the ear is also very frequent in this form of suppuration (Roosa).

Fevers.

The proportion of fever patients (we allude more particularly to typhus and typhoid) in whom any permanent aural lesion remains after the fever, is insignificant if we compare the number of those attacked with even severe fever with the cases of deafness arising therefrom. We only record thirteen cases out of those we have classified who attributed their deafness to any form of fever. We speak also from a large public dispensary experience, and many years of work in a fever hospital—in which were treated yearly an average of some five or six hundred cases of fever—and from a personal conduct of some 2500 cases of fever of different kinds. It is the rule for the temporary deafness which accompanies a severe fever to pass off when the attack subsides and the patient is convalescent.[1]

[1] This opinion of Dr. Macnaughton Jones is the outcome of eleven years of daily work in a large fever hospital.

This statement does not apply to the aural disturbances which follow malarial fevers. Here the remittent congestive attacks leave permanent lesions, and constantly incurable tinnitus or deafness.

The deafness of typhoid fever may arise from affections of the Eustachian tubes and middle ear, acute suppuration being at times set up from labyrinthine trouble, or from central nervous disturbance. It is common during the acute stage of the fever, varying with the amount of nervous prostration. It most commonly passes off with convalescence, but in some cases it remains permanent. The deafness of typhus may be due to affections of the Eustachian tube—acute middle-ear inflammation—mischief in the labyrinth or of the auditory nerve.

Neuralgia.

True neuralgia of the ear is very intense in character. The pain is frequently due to some reflex cause. Its source in dental irritation is fully entered into in the chapter on Tinnitus Aurium.

Cardiac Lesions.

Cardiac lesions are a frequent source of tinnitus from disturbance of tension. A tinnitus, which we cannot readily account for by the local physical signs, should always prompt us to examine the heart carefully, as in a mitral or aortic murmur we may find the solution of the mystery.

Anæmia.

Anæmic conditions of the blood, often attended by *neuralgia*, are responsible for that tinnitus which we think may truly be called anæmic tinnitus, at the same time that there is induced a general state of enervation of the tubal muscles and consequent intra-tympanic changes, with corresponding alteration in the shape and tension of the membrana tympani. These are typically the cases

which do well with change of air, a trip to St. Moritz, or some mountain health resort in the Upper Engadine, or, if this cannot be afforded, any of our elevated home sanitaria. At times a stay at the seaside will charm away these anæmic noises. It is well with this change to combine a course of arsenic and iron, with perhaps quinine and nux vomica.

It is in such persons that we occasionally find a vascular tinnitus ascribed to mental overwork and worry. It is in these mentally overworked patients that alternations in the tension of the tympanic vessels, whether it be excess or diminution, bring about tinnitus and ultimately deafness from the combined causes, vascular disturbance and irregularity of the blood supply, and enervated muscles.[1]

Leukæmia.

In a communication which was read at the International Otological Congress at Basle, in 1885, Professor Politzer dwells on the comparatively backward state of our knowledge of the pathology of the labyrinth, and hence the want which is felt of a sound pathological and anatomical basis for the therapeutics of the internal ear. This is to be attributed not alone to the difficulties in obtaining autopsies in cases in which microscopical examination might afford a clue to the clinical features, but also to the time required in making such investigations in the case of disease of the labyrinth. The principal obstacle hitherto met with in making histological examinations of the labyrinth lay in the disturbance of the topographical relations of the sacculi and ampullæ with the membrana tectoria and membrana Reissneri produced by the sections. This has been in great part overcome by the fixation of the membranous labyrinth and the organ of Corti through the forcing into the labyrinth of a solution of celoidine in diluted alcohol ; the examination can thus be made without any alteration in the original position of these parts.

[1] See p. 305.

In a case of intense leukæmia complicated with deafness, Professor Politzer was enabled to make a satisfactory examination of the internal ear after death. There was during childhood an otorrhœal discharge from the left ear. At twenty years of age the patient suffered from intermittent fever, which was attended by an œdematous state of the feet and abdomen. Three years later he contracted syphilis. In December, 1881, being then in his thirty-first year, he became suddenly deaf during the night, the deafness being complete, following on attacks of dizziness, with symptoms of ocular migraine and accompanied by tinnitus aurium. Great diuresis, increase of the anasarcous state, intense debility; dyspnœa with other lung symptoms followed, and these were attended by loss of vision.

Shortly before death these notes were made in the clinique of Bamberger (September, 1882) :—"Extreme cachexia, emaciation, anæmia, skin pale and œdematous, the extremities being covered with an impetiginous eruption, not syphilitic but consequent upon the general anasarca. The sternum and ribs were very sensitive to pressure, the liver and spleen were enormously enlarged, the cervical, axillary, and inguinal glands being also enlarged. The urine was albuminous, and microscopic examination of the blood showed evident increase of the colourless corpuscles. The membrana tympani of the right ear was dull, drawn in, and greatly contracted, that of the left was entirely destroyed with the tympanum itself, while there was complete paralysis of both auditory nerves." He died of a general increase of the leukæmic state, anasarca, and pleurisy.

The diagnosis of general leukæmic infiltration was verified by the autopsy. The liver and spleen were enormously enlarged by leukæmic deposit, the mesenteric glands being swollen into large, irregular, yellowish-white tumours, in places the size of the closed fist. All the peripheral lymph-glands likewise were enlarged. The muscular structure of the heart was in a state of fatty degeneration. The medullary substance of the sternum and ribs was of a raspberry-jelly substance and full of white blood-corpuscles, the bones themselves being softened and rarefied. The mucous membrane of the tympanum of the right ear was somewhat swollen, the membrane was drawn in, there was rigidity of the malleo-incal and stapedial joints, with increase in size and diminished movements of the latter. In the left tympanum the stapes alone remained, the malleus and incus being absent. The petrous portions of the temporal bones were found bleached.[1]

The microsopical appearances as seen in a section of the right labyrinth, made from the point of the pyramid towards the base from behind and inwards, are especially worthy of note. The scala tympani was seen penetrated by an irregularly branched

[1] The microscopic examination was made by the help of chromic acid mixed with saltpetre (Waldeyer-Goldstein method).

framework joined to the walls of the cochlea and extending from the base to near the last winding. The cochlear spaces were filled by connective tissue, in some parts ossified, so much so that the osseous spiral lamina was bulged out and pressed against the scala vestibuli. This latter was so contracted that in some places it was reduced to a quarter its normal width. In other portions of the cochlear canal, in the scala tympani and scala vestibuli and lamina spiralis, the connective tissue was less developed, and on the spiral lamina there was a circumscribed layer of coagulated lymph-cells, having the character of a recent leukæmic exudation. Exudative masses were found in the cochlear walls of the scala vestibuli. Similar exudations and tissue formations were found in the spaces between the membranous and osseous semicircular canals, the membranous canals themselves being filled in many places by the same coagulated lymph-cells. The vestibule exhibited like changes.

The left labyrinth presented kindred appearances, perhaps in a less degree, and the petrous bone had in it analogous changes to those found in the ribs and sternum. The neoplastic bony framework, the proliferating connective tissue, the exudation corpuscles, were all the result of the chronic inflammatory process going on in the endosteum of the walls of the labyrinth.

The fibres of the auditory nerve were varicosely swollen, and the nerves of the modiolus and the spiral lamina were passing through a fatty degenerative change, while the ganglion cells in the spiral ganglion were in part decayed, in part horny or infiltrated with fat. We learn a lesson, as Professor Politzer remarks, of the uselessness of any therapeutic measures in the face of such pathological changes as these. The entire case is one of extreme importance. There does not appear to have been any ophthalmoscopic examination made of the retina. But the blindness which accompanied the deafness we may assume was due to leukæmic changes in the retinal elements, probably thrombosis.

These local pathological conditions have their main interest for the otologist in their relation to the occurrence of the group of symptoms we meet with in aural vertigo.

Uræmia.

Uræmic conditions are a common cause of tinnitus. Deafness is not so frequent, and is more transitory or occasional. In the uræmia of pregnancy tinnitus may be an early indication of the presence of albuminuria. Retinal disturbances and aberrations of vision accompany the auditory symptoms.

In Bright's disease deafness is sometimes noticed. Dieulafoy has drawn attention to the deafness of nephritis. In all these cases the increase of vascular tension explains the local hyperæmia found in the small arteries both of the tympanum and retina. We have treated several patients for "noises in the head," a "sense of fulness," and "throbbing," who have been sufferers from the granular form of Bright's kidney. The urine in these cases is of very low specific gravity, and pain in the head is sometimes an attendant symptom.

The great importance of recognizing these remote evidences in the retinal and auditory circulations of hyperæmia and increase in vascular tension is evident. It may lead to the anticipation of convulsions in pregnancy, and should at all times suggest an examination of the urine and retina. The visible changes in the retinal circulation, under such conditions of the blood as those present in Bright's disease, and during the albuminuria of pregnancy, would suggest analogous alterations in the structures and vascular supply of the tympanum or labyrinth. These might be summed up as including localized hyperæmias, sclerotic changes causing thickening, contractions and adhesions, minute apoplexies, and extravasations or infarctions.

Ladreil de Lacharriere detected, in a case of nephritic deafness, hyperæmia and attendant rupture of the tympanum. Mr. Downie (*Glasgow Medical Journal*, December, 1885) draws attention to Dieulafoy's observations on this subject (*Gazette Hebdomadaire de Medicine et de Chirurgie*, January, 1878).

Climate.

Tinnitus and deafness, with catarrhal changes, are occasionally induced by a residence in India, and elsewhere in the tropics. These are not favourable cases to treat. The tinnitus is particularly distressing and intractable. Frequently there is a catarrhal state of the membrane and tympanum, or an old closure of the Eustachian tube, accompanying it. There is generally evidence of auditory nerve impairment.

Occupation.

Certain occupations, such as gunners, boiler-makers, divers, engine-drivers, those who travel much by rail, those who have prolonged night-nursing, etc., predispose to deafness. The membrane may be ruptured or the nervous apparatus put out of gear. The former is more especially the case, should a chronic middle-ear inflammation exist. So easily may the membrane become ruptured under these circumstances, that no diver or worker in caissons, etc., where the air is much compressed, who so suffers, should be allowed to go to work without first closing the meatus with cotton-wool.

Turnbull[1] has especially studied the effects of their calling on the hearing power in locomotive and other engineers, firemen, and conductors. From the shrill noises of the engines, the rapid passage on the exposed locomotive through the cold in all vicissitudes of weather, the constant exposure, and oftentimes loss of sleep and want of rest, such employees are liable to deafness. That such may be dangerous to passengers, if it prevents the engine-drivers or conductors hearing signals, the approach of other locomotives, or loud voices, is obvious. It may be more so even than colour-blindness. The watch, as Turnbull shows, is not the only test which should be tried for these persons. It is better to test them with different sounds and various tones, the voice in conversation, gongs, bells, etc. Railway travelling, especially at night, certainly predisposes to deafness.

We have noted several cases in which incessant railway journeying caused, or at least induced, a temporary tinnitus. We believe it to be associated with the vibration and noise of the train, the want of proper rest, and the imperfect sleep.

All such predisposing causes will operate in degree, according to the collateral influences present, as, for example, other abnormal conditions of the organs of

[1] *Jour. Amer. Med. Assoc.*, November 29, 1884.

hearing or general morbid states, or the existence of hereditary deafness.

That railway travelling does materially affect the auditory mechanism at the time is proved by the well-known fact that certain deaf persons hear well in a railway carriage, while others hear worse. To this we shall again refer. The vibratory movements, noise, and accompanying fatigue must imperceptibly react on those whose hearing is seemingly perfect.

Military life, especially in the British army, in which service in different parts of the world is nearly always demanded of the troops, is a not infrequent exciting cause of deafness. Residence in the various stations in India, bringing in its train intermittent fever, and rendering the person liable to a recurrence of attacks on return to England, and the effects of such campaigns as those our troops were engaged in at Abyssinia, the Zulu War, the Afghan, Egyptian, and Soudan expeditions, all necessitating prolonged exposure and fatigue under extremes of temperature, frequently cause throat and ear affections. Some of these are of a malarial, others of a simple catarrhal nature. Gunnery practice, likewise, may, through the effects of concussion, predispose to deafness.

For those in the services who are obliged to be present at gun practice, the sound deadeners of Ward

FIG. 15.—Ward Cousins' sound deadener.

FIG. 16.— Macnaughton Jones's ear protectors.

Cousins will be found of use to prevent the effects of the concussion. Macnaughton Jones has had convenient little celluloid ear-protectors made for the same purpose by Messrs. Maw, Son, and Thompson. They serve as protectors for the meatus after syringing. They are perforated so as not to encourage a vacuum in the meatus, are made of different sizes, and are not objectionable to wear. They protect from cold and draught.

Several patients have attributed the beginning of

their deafness to prolonged night-nursing. This is not so much in the case of professional nurses as in the instance of friends, when mental anxiety operates as much as the want of rest to enfeeble and enervate, the more so if grief or shock are added at the termination of a long illness. It is under such circumstances that we find enervated states of the tubal muscles, and presumably of the intrinsic muscular apparatus of the ear, producing progressive deafness; and it is here that complete relaxation, bracing air, and tonic treatment and regimen are so valuable in preventing tinnitus and deafness.

Various other occupations and trades may directly or indirectly lead to inflammatory affections of the ear, either through auto-infection, as in the case of rag-sorters, or as the result of constant exposure to vicissitudes of weather or extremes of climate, as in those instances already mentioned.

In the following chapter we shall more fully discuss malarial and zymotic influences, and the results which ensue from the want of cleanliness generally.

Syringing.

Perhaps more harm is done to the ear by useless or forcible syringing, and the continuous and mischievous dropping of oil into the meatus, than by any other practices. We may state as a general rule in aural therapeutics, that, save in the removal of foreign bodies and ceruminous plugs from the meatus, forcible syringing is injurious to the ear. We have already referred to the former of these contingencies. Cerumen is generally removable at the first visit of a patient. Sometimes those adherent casts of the external meatus which come away with imprints of its walls and of the outer surface of the drum-head do not yield without the assistance of the forceps or aural probe, though previous softening of the hardened secretion with some soda or potash solution will only delay the eviction of the mass for some twenty-four hours, if we decide not to hurry. Never to syringe on an

exposed drum-head, and always to inspect the tympanum from time to time with the speculum when we are syringing an ear for the removal of cerumen and epithelium, are essential rules to observe. We should never entrust forcible syringing to the hands of friends and unskilled persons. Douching an ear is quite a different thing, and answers for many purposes of medication ; it is easily carried out with an ordinary syphon tube (as that used for the nose) with an aural piece attached, or better still by the use of warm water squeezed out of a sponge held over the meatus, the head being inclined to the opposite side, and the water allowed to run in and out of the meatus.

In children especially, syringing must be conducted with care and gentleness. It may be taken as a fact that three-fourths of the syringing carried out by parents, friends, or nurses for children is absolutely useless, if they are not taught how to syringe the ear.

The outer portion of the meatus is washed daily, and the hollow of the passage is often filled with plugs of inspissated epithelium and pus, which collect on the tympanum, and are not reached by the stream.[1] Quite recently a mother indignantly repudiated a hint that the ear of her child was not properly cleansed, as the water came quite clear before she finished syringing. She was, however, satisfied that this was not the case when a large mass or cake of pus, with floating particles of epithelium, was detached.

We must be careful not to overlook the temperature of the water used. We have known negligent syringing with cold water cause sudden faintness to the patient and a great shock to friends. This can always be avoided by using a metal syringe, and accustoming the hand on the cylinder to act as a gauge of the temperature, before injecting the water into the meatus.

It is also as well to let the first impact of the water strike the concha, as this to a great extent mitigates the shock.

[1] See p. 217.

Ozæna and Nasal Polypi.

These do not as a rule cause deafness, unless, as in other forms of nasal affection, from the irritation conveyed to the mouths of the Eustachian tubes or by the spread of the inflammatory condition. Nasal polypi, however, may do so through the obstruction they cause in the inferior meatus of the nose.

Drugs.

Certain drugs, such as quinine and salicine, produce tinnitus and deafness. These symptoms generally pass off when the drug is discontinued, though permanent deafness may remain after a prolonged course of it. We have given as much as ten and fifteen grain doses of quinine every third hour for remittent fever, and in other conditions of hyperpyrexia, such as the fevers we have to battle with in the tropics, when we have given doses which in this country would certainly be deemed heroic, and continued its use for forty-eight hours and longer without the least permanent result following, though the symptoms of cerebral auditory disturbance, such as deafness and buzzing, were present during its administration.

That congestion of the membrana tympani (Kirchner and H. N. Spencer) occurs from the use of quinine has been proved, but the effect is temporary.

Many years since, Macnaughton Jones, in 1867, while making some experiments as to the quantity of quinine excreted by the kidneys, assisted by the late Professor Blyth, gave a healthy man, a pensioner, thirty grains of quinia (the alkaloid) for the purpose of estimating the total amount excreted by the kidneys for twenty-four hours subsequently. The man suffered for a considerable time from tinnitus and partial deafness, this continuing for nearly twelve months, and gradually becoming less. He died eventually several years later from the effects of alcohol. The tinnitus and deafness never completely deserted him.

He quotes a case in which the reeling and staggering gait produced by quinine, simulating those symptoms present in labyrinthine vertigo, has been mistaken for drunkenness, with most unpleasant consequences to the sufferer.

It is especially in cases of anæmic tinnitus that we have found quinine of service. In cases in which tinnitus follows acute diseases, and in various debilitating conditions, quinine given in small doses at frequent intervals, especially when combined with digitalis, will often afford relief. As insisted on by Burnett,[1] the cases in which any permanent physical results are found after the use of quinine have generally other causes operating, quite sufficient to account for the tinnitus or deafness independently of the medicine.

Turnbull also says, "We are prepared to state that we have never seen or known of a case of ear disease, that was developed from quinine, either in large or small doses, and all the cases that have been reported as such had, prior to the use of the quinine, some form of disease which may have been temporarily augmented by the stimulation of the quinine as an antiperiodic or tonic."

We certainly have never known it to produce myringitis or tympanitis in children. If ever trouble arose during its administration the aural complications could be more truthfully ascribed to the catarrhal or general septic condition than to the quinine.

Still both Weber-Liel and Politzer incline to regard quinine as a cause of permanent deafness—though the former is such a strong advocate for its use in all stages of malarial otitis, both as a preventative and curative agent. Politzer says—

"It is necessary only to mention the well-known effects of quinine, salicylic acid, morphine and chloroform, which exercise a temporary, but often also a lasting influence on the functions of the auditory nerve."

Even in the case above quoted, in which permanent mischief appeared to follow the large dose of the alkaloid quinia, the man was occasionally an inebriate, while there was a history of previous hardness of hearing. This undoubtedly the quinine permanently accentuated.

As Dr. Lauder Brunton remarks, the hallucinations of mania, the prodromata of the epileptic fit are produced by the irritation of the hearing centre, so the tinnitus of quinine intoxication may be due to this toxic irritation

[1] Burnett, *Diseases of the Ear*, p. 569, 2nd ed.

of the same centre, independently of any local auditory phenomena that follow its use. That the tinnitus is produced rather by hyperæmic than anæmic conditions in the tympanum and labyrinth, is rendered more probable by the action of such drugs as hydrobromic acid and ergot in relieving it.[1]

Anæsthetics and Morphia.

With regard to anæsthetics, we can call to recollection, with a rather unusually large experience of the administration of a variety of anæsthetics, not a single instance in which deafness or permanent tinnitus followed their administration. We might say the same of morphine. We happen to know at the present moment two individuals who have on their arms and on parts of their legs hardly an available spot left for the insertion of the hypodermic syringe, from the state of the skin brought about by constant injections, that have produced morphine craving—in neither instance is there tinnitus, and the hearing is normally acute.

Smallpox.

A middle-ear catarrh, with a serous exudation and pus, may be set up during the course of this disease, and Wendt says "that pustules are met with in the cartilaginous portion of the meatus, most frequently near the orifice." As a general rule, however, the ear is not affected in this disease. We speak from an individual experience of a large epidemic, and the personal care of over 1600 cases.—(Macnaughton Jones).

Diphtheria.

When diphtheria involves any portion of the ear there is usually very great pain, more especially when the false membrane is formed. Grüber says that the

[1] See p. 308.

formation of diphtheritic membrane in the external meatus is very rare, and that all diphtheritic conditions are extremely fatal. Acute inflammation of the middle ear is, however, not uncommon in this disease, and deafness may also be produced by the paralysis that so often follows.

Mumps.

This disease is at times the cause of marked deafness. Vertigo is complained of, and the labyrinth may be incurably injured. But mumps do not rank high as a cause of ear trouble.

Bright's Disease.

Through the increase of vascular tension that occurs in Bright's disease, hæmorrhage into the tympanic cavity may take place. This is either absorbed, or suppuration may be induced, with all its troubles. A hyperæmic condition of the labyrinth may also be established, with deafness, tinnitus, etc.

Bronchitis.

In a few cases the cause of middle-ear suppuration has been assigned to bronchitis. It may be presumed, however, that the general catarrhal condition was most likely the starting-point, though the excessive coughing that sometimes occurs would be liable to produce it.

Locomotor Ataxy.

Atrophy of the auditory nerve occurs in some cases of locomotor ataxy, according to Erb. Pomeroy says, "Progressive deafness is common in locomotor ataxy."

Miscellaneous Causes.

Intra-cranial tumours, alcoholic excess, obesity, and old age may all be instrumental in producing deafness—the tumours and obesity by pressure, alcoholism

by both catarrhal and nervous irritation. The deafness due to age may be caused by either middle or internal ear or cerebral changes, and occurs at various ages, in some much sooner than in others. The lumen of the external meatus may also become blocked by the throwing backwards of the lower jaw in cases where the teeth are lost.

CHAPTER V.

ETIOLOGICAL—*continued.*

UNCLEANLINESS.

COLLECTIONS of cerumen, epithelium, pus, or the fungus aspergillus, are constantly present in the external meatus, and on inquiry and by examination we find that, owing to neglect, apathy, or ignorance of the consequences which follow from their presence, these tenants have been left either undisturbed or only partially removed for weeks or months, until frequently not only is serious inflammation and suppuration the result, but putrid products have been formed which occasionally imperil life as well as hearing.

Many morbid conditions, both of the external and middle ear, may and do arise from neglect of the first of all cardinal principles in aural therapeutics, namely, cleanliness in the widest sense of the word. It may appear so obvious that neglect of cleanliness is the cause of a number of serious and commonly occurring diseases of the ear, that it seems absurd for any otologist to dwell on it.

Our experience does not prove it to be so. Again and again have we seen neglect of this simple fact and ignorance of the true consequences of uncleanliness imperil not only the organ of hearing, but in several cases life itself has been the forfeit paid for this apathy or indifference. Let us take, without entering into details, some examples of the force of this assertion. How frequently are children brought to the surgeon with

the external ear-passage full of purulent matter, which he knows to contain *débris* of pus, epithelial elements, slimy mucus, bacteria, perhaps blood, all mingled to form a combination of septic elements, which find their way into the tympanum, and through its walls to the membranes of the brain, or into the mastoid cells, and which, pouring out of the ear, we are frequently told, "wets the pillow" of the little patient at night. How often, as a consequence, do we not find mastoid abscess with necrosis of the process, polypoid excrescences in the meatus bathed in and concealed by pus, perforation of the membrane, with destruction of the tympanic ossicles, chronic suppurative and catarrhal conditions of the middle ear, cerebellar abscess, and possibly phlebitis. In adults, and especially in young persons of both sexes about the period of puberty, we frequently see the same results of neglected discharge in large perforations of the tympanum, ossicular destruction, exposed tympanic cavities, vascular polypi in the tympanum, foul and putrid accumulations in the meatus, the stench from which is found to be intolerable if the surgeon only chooses to test it by collecting a little of the matter on a piece of cotton-wool.

It is only on washing out the superficial matter, and then by passing the wool-armed aural probe deeply into the meatus or into the tympanum, that we find how foul is the discharge that lines the folds and crevices of the mucous membrane of the meatus and the cavity of the tympanum. If any one who has been in the habit of satisfying his conscience by simply syringing with water or some mild "antiseptic" lotion would convince himself of the mental delusion this imperfect idea of cleanliness has imposed, let him, when he has washed out the meatus until fluid comes "perfectly clear," the next time he gets such a case, first arm the aural probe[1] with some absorbent wool and carry it well into the tympanum, and on withdrawing it we guarantee his olfactory sense will satisfy him of his mistake.

In chronic suppurative conditions of the middle ear, the value of close personal attention on the part of the

[1] See p. 129.

surgeon cannot be too urgently insisted on. We do so the more anxiously in a work intended for the general surgeon, inasmuch as it must fall to his lot to treat many cases of chronic ear discharge accompanied by perforation and middle-ear accumulations or morbid growths. These are of everyday occurrence in general practice, and the first essential of safety for the patient, as it is for success on the part of the surgeon, is cleanliness. The mere syringing of an ear is not sufficient. The meatus should be thoroughly cleaned out, and the canal and tympanum dried with absorbent wool rolled on the aural probe.

We believe the advice given by Dr. Charles Turnbull to be most necessary when he says, "Teach the patients how to care for their ears. Show them how to syringe or cleanse the tympanum, and how to dry the parts thoroughly, and also how to inflate the ear by Valsalva's method." This knowledge on the part of patients becomes the more important when they cannot attend frequently for advice and treatment.

Those only, who go to the trouble of thoroughly cleansing an ear and exposed tympanic cavity, know how patient we have to be in securing absolute cleanliness and how troublesome the process often is.

It is no uncommon occurrence to have such patients come for relief from an incurable lesion, the result of slowly progressive and destructive processes of suppuration and putrefaction. The parents have feared "meddling" with the discharge, or they have been under the delusion that the child would "grow out of it," whatever that idea conveys. Unfortunately it is more commonly a "growing *into*" some serious lesion that is the consequence of toying with an ear with some little useless glass syringe, or one of those many forms of cheap ear douches or syringes with which people delude themselves they are cleansing an ear.

It is not an unusual result of polypus of the meatus, to find such a small growth nearly filling the lumen of the canal, at some distance from the orifice, concealed and embedded in pus, a good deal of which is always

imprisoned behind the growth. The latter may have made its appearance clandestinely (there has been no blood and little pain), and as a matter of observation these polypi have often existed for a considerable time before their discovery by the surgeon. Meantime the patient has either not been "meddled with" or some playful syringing has at various intervals of time been resorted to. On several occasions it has fallen to our lot to see in adult patients who died of cerebral symptoms old polypi filling the meatus, with accompanying discharge. Nothing had been done. On each occasion it was rather the patient's fault than the surgeon's, for they had refused to permit any interference. And this fact we are aware, from too sad an experience, is a vital matter to insist on, namely, that the risk to life from cerebral complications is great in all persons who carry about with them these foci of suppuration and putrefaction, the precursors of either cerebral inflammation or septicæmia.

We have known of several instances of persons, otherwise in perfect health, suddenly struck down with symptoms of cerebral inflammation directly due to an old-standing and neglected otitis media. Blocked-up discharge, inspissated masses of mucus with pus, may collect behind some dried and hardened wall of either epithelium, pus, or cerumen. The patient fancies the discharge has ceased. This temporary lull lasts for some time, when he is suddenly attacked with violent pain in the ear, perhaps vomiting sets in, and then all the symptoms of acute cerebral inflammation, perchance abscess, follow.

There is no safety to the patient while there exists a chronic discharge from the ear. It is the symptom of some morbid condition, and itself may be the source of diseased states, leading directly to death. Unfortunately, many treat the symptom (*i.e.* the discharge) and overlook the pathological condition which has produced it, and are satisfied if they control an "otorrhœa," unmindful of the causes on which its presence depends.

To come to simpler examples. We may take first

the dirty and harmful practice of wearing pellets of cotton-wool in the ear. It is a matter of frequent occurrence to any one in large ear practice to withdraw from the meatus one, two, or sometimes three of these foul bacterial incubators and nests for decomposing pus. Sometimes their presence is forgotten, and a small pellet slips into the bottom of the meatus to lie over and occlude the perforated tympanum, or if not perforated, to carry putrescent elements to the membrana tympani, with which it is kept in constant contact for weeks or months. Other pieces are placed in the ear, which cover the imprisoned plug; or perhaps cerumen collects, becomes hardened, and completely obliterates from view and recollection the wool, which is not thought of until the patient comes to have "wax removed." [1]

Persons who are annoyed with accumulations of cerumen have the tendency to place *wool in the meatus*, and frequently forget its presence, another layer of cerumen forms over the wool, and we have at times removed from this cause as many as three impactions of wax and two of wool from the auditory canal. In many of such cases it is very difficult, without sufficient syringing and the aid of the lever crocodile forceps, to remove these mixtures of hardened secretion and wool. Also, as in old ceruminous concretions in the meatus, the dead epithelium adheres as a coating to the wax plug, and forms a sort of cast of the canal, clinging to its walls. If portions of this dead cuticle, which has occasionally mingled with it fœtid masses of fungus (aspergillus) and mucus, are left behind after the removal of the wax, which from their adherent nature they are specially apt to be, they form the nidus for future infection and catarrhal inflammation. Such scales of epithelium are peculiarly tenacious, and, lying close against the wall of the meatus, or even on the surface of the membrane, they are liable to escape detection. Sometimes, as we have said, such epithelial linings come away in the form of perfect moulds of the meatus. It is these portions of epithelium that, mixing

[1] See p. 217.

with the other contents of the meatus, generate fungi, and in the further degeneration of these epithelial masses form purulent deposits, the decomposition of which creates septic matter and putrescent *débris* which may invade the tympanum, causing suppurative catarrh of its cavity. Frequently syringing will not get these epithelial casts or particles away. The edge of the layer has to be raised or detached with the aural probe, or with what will be found more convenient, a miniature flat vulcanite spatula or spoon, when the mass or particles can be brought away with the lever or the crocodile forceps.

Another source of epithelial accumulation in the external meatus is the common *eczema of the auricle*, which is also occasionally attended by either an accumulation of cerumen or perhaps some otorrhœal discharge from the external ear. The hairs in the meatus in other cases collect the particles of cuticle, and these clinging to its other contents are retained, carrying the disease to the deeper parts of the canal. In children especially the retained epithelial *débris* may give rise to otitis externa, and this in its turn may attack the tympanum.

Recurrent furunculus and abscess are apt to be forgotten as soon as the pain and the temporary discharge have ceased. But frequently these inflammatory swellings, due constantly in their recurrence to bacterial infection, have imprisoned masses of microbacteria and epithelial or muco-purulent *débris*, which are in contact with the membrane or lie in the meatus. Their very recurrence is due to auto-infection and fresh accumulation of infecting germs.

The lessons to be learned from the foregoing are—(1) The value of sustained douching and the use of disinfectants after we have evacuated the pus of a furuncle or when it has spontaneously opened; (2) as exostoses will imprison mucus, epithelium, pus, or cerumen, the importance of preserving the patency of the passage when these growths are present; and (3), perhaps the most important, the necessity of always

using disinfectants when clearing out choleostomata from the middle ear in order to destroy the dangerous micrococci that infest these masses, and which are let loose by the process of syringing. Cases are on record where patients, sufferers from a chronic middle-ear suppuration which has not troubled them much, have suddenly become worse, and acute mischief has been set up when non-antiseptic methods have been employed to get rid of inspissated masses in the tympanum.

Bacteria and Zymotic Influences.

As playing an important part in the etiology of all aural and naso-pharyngeal affections, we must not omit to consider the part taken by *bacteria* in the causation of acute and chronic diseases of the ear and naso-pharynx.

[1] "Acknowledgment here may be briefly made to the labours of Löwenberg, Weber-Liel, Orne Green, Bezold, and Zaufel, among many others, in advancing, if not indeed creating, modern aural bacteriology, which creation itself we owe to the genius of Pasteur, who assisted Löwenberg in working out some of his researches on aural furuncle in the inoculation of rabbits, and the cultivation and reproduction of the aural microbe or pyogenetic staphylococcus of Pasteur."

"Here, too, with benefit may be broadly reviewed the present position of otology both as regards ear ferments and bacteria. We would first, however, remark upon the suitability of the ear passages for the origin and completion of fermentative processes. Whether we look to the external meatus, the cavity of the tympanum, or the Eustachian tube, we find those essentials for fermentation, fermentation products, and ferment life which we artificially secure in advancing that process elsewhere or outside the body. We have a limited supply of air and light, with, in the case of the tympanum, only periodical or interrupted interchange. There is an elevation of temperature due to the free vascular supply in the auditory walls and structures; there is a constant condition of moisture; there is a near approach to "life without air," as Pasteur defined fermentation. Look a little further, and we find the ready elements for providing the initial ferments in the ceruminous particles, the sebaceous secretion, the epithelial *débris* of the external ear, the mucus of the tympanic cavity, and the presence in the Eustachian tube of throat mucus, or nasal and

[1] "The Etiology and Treatment of Chronic Suppurative Catarrh of the Ear," Macnaughton Jones, *Lancet*, July 27 and August 3, 1889.

pharyngeal epithelium, that may find its way thither. Also other nasal and gastric gaseous emanations enter periodically into the tube and the middle-ear cavity—for example, those of ozæna."

"This fermentative process finds occasional expression in the spreading forms of aspergillus; while in the crevices of the external meatus, the elevations and depressions of the tympanic walls (should it invade the tympanum), or in the ossicular folds, the fungus finds secure shelter and resting-places for its spores to sprout afresh. This being so in the case of fungi and ferments generally, it is not surprising to find such fungi participating in the morbid processes that lead to the chronic purulent discharges of the external or middle ear; couches of inspissated pus and dead epithelial *débris*, with hardened mucus, form comfortable beds for the troublesome tenants, who, once in possession, will not stir without forcible eviction. To Wreden, Cramer, Burnett, Orne Green, Mayer, and Schwartze, we are permanently indebted for our knowledge of the life-history of these fungi. It should be remembered that they grow somewhat like mould on an old boot, when left in a damp place, ignored and neglected."

"We turn now to the microbic side of this bacterial pathology of the ear. Though it has not yet been shown that characteristic pathogenic bacilli (that is, bacilli capable of producing some specific or contagious disease, local or general, with typical features and distinctive characters) exist in the healthy individual's ear passages, or in the secretions therein formed, the non-pathogenic varieties have been found; and, as was well remarked at the International Congress in 1887, by Professor Frothingham, in referring to Professor De Rossi's observations on the presence of benign organisms (streptococci and bacilli) in healthy Eustachian mucus, and the absence of the pathogenic varieties, "who can say under what circumstances non-pathogenic organisms may not become pathogenic?" As aerobic (twin, spherical) bacteria, the pathogenic microbes infest the outer ear in the case of furuncle and abscess, are found in the pus, and may, as suggested by Löwenberg, reinoculate the neighbouring parts. Cornil and Ranvier put forward the hypothesis that in those isolated and recurring contagious inflammations, the bacteria, as they cannot live in the blood, are arrested in the lymph vessels of the connective tissue. But in abraded states of the mucous membrane (no matter how slight), whether in the external meatus or the membrana tympani, or in the Eustachian tube, we have the door opened for the entrance of septic and miasmatic bacteria and the establishing of the septic process. Indeed, in catarrhal conditions these bacteria find access to the increased or altered mucus, and through it to the underlying tissues. The same remark applies to the pathogenic bacteria. Imperceptible abrasions are the welcoming portals for aerial and liquid microbes to enter and form purulent deposits in. Löwenberg points out how the fine hairs of the meatus may arrest the microbes, and actually direct them in their course to the congested follicle. The micrococci, both of

suppuration and putrefaction, are thus furnished from the outer air to the meatus, from the nose (Löwenberg's micrococcus of ozæna), and from the mouth. Thus we find that the putrescent processes in the external and middle ear, so often associated with disease of the mucous membrane and bone, are originated by some injury to the external ear, or by a diphtheritic or other ulceration of the mouth, nose, or palate."

"The investigations of Moos and Klebs have proved the migration of pathogenic organisms in diphtheria into all parts of the labyrinth, and also into the adjacent portions of the petrous bone. The avenues of entrance may be (according to these authorities) roughly divided thus: (1) The general circulatory current through the thoracic duct and lymphatic vessels, and thus to the Haversian canals and perilymphatic spaces; (2) in other directions by way of the ductus perilymphaticus of the aqueductus cochleæ to the scala vestibuli of the cochlea; (3) the endolymphatic spaces by the lymphatics of the nasal mucosum and the subdural spaces of the nerve roots and the lymph channels of the peripheral nerves; while others apparently find their way by the fissures (? lymphatic vessels—Schwalbe) in the fibro-periosteal tissue lining the aqueductus vestibuli."

"We will leave now these pathological and septic bacteria, and dwell for a moment on a class of micro-organisms of a different morphological, etiological, and clinical interest. We refer to malarial bacilli. We know that it is now an established fact, thanks to the researches of Klebs, Nageli, Salisbury of Cleveland, Crudeli, Cecci, Laveran, and Richard, that associated with malarial and miasmatic conditions are to be found species of schizophytes in the blood and on the mucous membrane of the intestinal canal. The association of intermittent affections with miasmatic surroundings in marshy valleys, in swamps, and wet grounds and malarial districts generally is well known. Klebs, Tommasi-Crudeli, and others have found bacilli furnished with spores in the soil of such regions. The inoculation of the culture of these bacilli into rabbits has caused intermittent fever, though it is not to be forgotten that Cornil and Ranvier criticize the views of Laveran as to the presence of such malarial bacilli, in the blood of those attacked with intermittent fever, rather regarding the mucous surfaces as the habitat of the microbes, and the chemical poisons generated through their action as the agents operating on the corpuscular elements in the blood. As far back as 1871 Weber-Liel gave the name of 'otitis intermittens' to those recurrent attacks of middle-ear inflammation which he attributed to the influence of malaria. The rhythmical nature of the onset of pain, fulness, giddiness, rigors and perspirations, tinnitus, and deafness were characteristic, ending occasionally in perforation of the drumhead. With the same recurrent obstinacy furunculi occur in the meatus. Aural neuralgia is a marked feature of the affection. General vaso-motor fulness, tendency to exudations, and chronic catarrh are constant consequences of this form of otitis. Weber-

Liel, Orne Green, Löwenberg, and others have traced the relation between these intermittent attacks of otitis media and malaria. Season of year, foul emanations from drains, defective sewerage, and rainfall have explained the epidemic nature of the disease. Miquel and Rindfleisch have shown that there is a distinct relation of the rainfall to the growth of the parasitical fungi, the development of which latter it encourages, while it is destructive to the growth of schizophytes. Miquel, at the laboratory at Montsouris, has proved the relation of season of year and rainfall to the amount both of germs and fungi in the air. On the other hand, Löwenberg has pointed out that there is a close connection between the number of micrococci found in the pus of furunculi and in chronic discharges and the duration and age of the discharge. The same observation applies with almost equal truth to the putrescent character of the discharge and its unpleasant odour."[1]

From these necessarily condensed observations it may be perceived how important a part is played in the etiology of aural suppurative discharges by vegetable micro-organisms, and the value of antiseptic treatment in the management of inflammatory diseases of the external and middle ear, so frequently and strongly insisted on elsewhere throughout this work, and not in affections of the ear alone, but also in those of the naso-pharynx and throat. Pasteur has shown the dependence of boils on the presence of a particular microbe, thus explaining the unpleasant facility of auto-inoculation with discharges from boils which we are all familiar with. He injected the liquid containing the germs found in aural furunculus under the skin of the rabbit, and obtained as a result abscesses with identical organisms. The consecutive abscesses were of a modified type, and were more readily cured. Löwenberg cultivated the microbes in beef-tea, and he looks on their presence as characteristic of furunculus, and furnishing the test as between this form of inflammation and ordinary abscess. In the latter disease he remarks with Weber-Liel that the meatus is not entirely and equally swollen; rather have we isolated sensitive spots, which are prominent, and which rapidly become globular.

The fact cannot be too strongly insisted on that

[1] *Lancet.*

linseed poultices not only cause the multiplication of micro-organisms, but may act as carriers of them, having been detected in the meal during preparation (Neprew). With the pus, epithelium, and products of inflammation they convert, as Löwenberg well remarks, the auditory meatus into a hothouse for the culture of bacteria. In fœtid otorrhœal pus, schizomycetes, spherical and rod bacteria, spores and zoöglœa, have been found. And the facilities for transmission and migration which exist in the middle ear, both with the internal ear, the petrous portion of the temporal bone, and the mastoid process, explain the presence of these organisms, in fœtid collections of pus and *débris* in these parts. Löwenberg thinks that those cases of cerebral abscess which occur without any breach of continuity in the petrous portion of the temporal bone are due to the penetration of the migrating corpuscles by the micrococci. He has demonstrated the existence of a special coccus in ozæna, and Fraenkel, prior to this, had shown their presence in this disease. The nasal passages form the most convenient hiding-places for any micro-organisms which may be in the atmosphere. Our entire clinical and pathological knowledge of affections of the external and middle ear tends to establish closely the occasional zymotic character of such diseases.

The "miasmatic influences" of Weber-Liel, defective sewage as a cause of contagious middle-ear diseases, the epidemic nature of external-ear inflammations, the relief given by quinine—are all facts which clearly point to the septic and pythogenic character of many aural affections; while in the diseases diphtheria and scarlatina we find the ear frequently suffering from the general septic conditions as well as from the extension locally of the inflammatory process to the tympanum. We shall have more to say to the application of this knowledge in the therapeutics of middle-ear diseases. Meantime we refer to it rather to show how seasons of year, temperature, atmospheric moisture, rainfall, malaria, have to be considered in the etiology of naso-pharyngeal

and ear inflammations, as also the value of the antiseptic treatment and attention to general hygienic surroundings in disorders of the ear.[1]

[1] For references to this subject, see a series of interesting papers by Dr. Löwenberg in *Le Progrès Medical*, July, August, Sept., 1881; *Knapp's Journal* and the *American Journal of Otology*, 1879; also "Uber fragmentäre, larvirti Formen des Wechselfiebers im Gebiete des Gehörorganes Malarianeuralgien im Gebiete des Tregeminus," 1878, and various papers from time to time by Weber-Liel in *Monatschrift für Ohrenkeilgunde*, No. 11, 1871; *German Clinical Studies*, No. 5, 1874; *German Practice of Medicine*, Nos. 15, 16, 1877; Cassell's paper in *Edinburgh Med. Journal*, April, 1878; *Archives of Otology*, vol. x. No. 3, September, 1881 (Löwenberg); *Transactions of the International and Otological Congress*, 1884 (Löwenberg).

CHAPTER VI.

SYMPTOMATOLOGY.

Some general observations on three of the most prominent symptoms—some or all of which are met with in every ear case, namely, pain, discharge, and deafness, may be well made before we consider the examination of a case in detail. The fourth and very general symptom, tinnitus, we shall devote a special chapter to the full consideration of. With this latter we shall consider giddiness and vertigo.

Pain.

Pain, more or less violent, is present in all acute inflammatory affections of the ear. For instance, it is, as a rule, very acute in ordinary furunculus, in abscess of the meatus, in myringitis, acute perforation of the membrana tympani, and inflammation of the mastoid cells. Under any of these conditions pain may produce a state bordering on delirium, so wild and fierce may it become, especially at night. The constant deep throbbing pain, when mischief has extended to the internal ear, is peculiarly intense and intolerable, while it is most difficult to relieve. It radiates over the side of the head, and is frequently accompanied by frontal ache and great intolerance of light.

In children especially is the occurrence of pain of importance, as it is often the only guide to the malady from which the little ones suffer; the carrying of the hand to the head and to the affected ear drawing the attention of friends and physician to the seat of the

mischief long before the occurrence of discharge. In many cases it is surprising that so abnormal a condition of things as we find present may exist without the occurrence of pain.

Constantly we see persons with evidence of long-standing disease, as exostosis of the meatus, polypus, thickening of the membrana tympani, and even perforation of the same, thickened states of the membrane of the cavity of the tympanum, or anchylosis of the ossicles, all lesions of a chronic character, in which no pain has been complained of, and in which patients deny its existence. Some of the most intractable forms of deafness, with nervine complications, are those in which there never has been from first to last any pain. The presence of pain is of value chiefly in showing the acute nature of the attack, and (excluding causes existing in the meatus) will point to inflammation of the membrane, or, if there be no appearance of such, to mischief in the cavity of the tympanum, the mastoid cells, or in the internal ear. The advent of acute pain in an old-standing case of aural disease, where there is not any manifest cause for its occurrence, should always be looked on with suspicion, the more especially if such be accompanied by any general constitutional symptoms, such as a rigor, vomiting, alterations in the pulse, constipation, or drowsiness. Pain in the ear under any circumstances should, both in old and young, receive immediate attention, and its source be carefully ascertained.

Pain of a neuralgic character is not uncommon. It resembles neuralgia occurring elsewhere in the acuteness of the suffering and the periodicity of the paroxysms. On examination we find no cause to explain its presence. At times some slight hyperæmia of the tympanic membrane is present, there may be tenderness in manipulating the auricle, but we have frequently seen violent neuralgia of the ear when no inflammatory condition was coincident with the pain. We have already referred to a form of neuralgia which is due to malarial causes (see p. 80). We constantly meet these

neuralgic states, in debilitated conditions arising in spring and autumn with frequent atmospheric changes and alternations of temperature. Nor must the possible and even probable cause of the neuralgia in a carious tooth or neglected stump be overlooked.

Earache, in patients in whom we can discover no source of the pain, should always prompt a careful examination of the teeth. As in the case of the eye and retinal affection, or other morbid states of the ocular tunics, so in the ear, the tinnitus and interference with hearing may owe their origin to irritation in the dental division of the trigeminus. The pain may be purely reflex. Dr. Lauder Brunton has drawn special attention to carious teeth and stumps as a cause of neuralgia and headache.

Discharge.

The length of time a discharge has lasted, and the conditions which have preceded its occurrence, the fact of its being coincident with pain or relieving it, its nature, whether purulent or mingled with epithelium, mucus, or blood, its quantity, any fœtor, should be particularly inquired into. One clear rule should always be observed, namely, to regard discharge from the ears as but a sign secondary to some diseased state of the auditory passages, and one which must be dealt with only after ascertaining its exact source. Nothing can be more mischievous than to regard the mere discharge as the disease, and to remain satisfied with undivided attention to it without arriving at a correct conclusion as to its cause. Frequently have we seen polypus, perforation of the membrane, destruction of the ossicles, inflammation of the mastoid process in cases treated as "otorrhœa," while these serious complications have been overlooked from neglect of the simple precaution of examining an ear carefully with a speculum when the discharge has all been removed. As a diagnostic sign, discharge is valuable in directing our attention from the external meatus to the middle ear, the constant source of its presence.

Deafness.

We have not the same means of estimating accurately and recording the normal standard of the hearing power in the healthful ear as in testing the vision of the eye. In different persons, whose hearing is for all practical purposes normal, we find a considerable difference in the perceptive power of the ear, both in estimating the degree of loudness of sound, differentiating musical notes, recognizing various tones, and in localizing the direction of sound. In making a diagnosis we have to take account not merely of the hearing of the waves of sound transferred through the air to the auditory apparatus, but also the perception of the sound waves, transmitted through the cranial bones by conduction.

In ordinary practice the watch, the tuning-fork, the finger-nail, speech, are the familiar means of testing hearing. It is necessary to refer to each of these methods before describing those appliances not so likely to be in the hands of the practitioner, and even without which he can arrive at a fair approximate estimation of the hearing distance of the ear under examination. With regard to the watch it is imperfect as a test, first, because it cannot enable us to test the hearing power for more than two, frequently not very distinct tones; secondly, it does not afford an accurate record of the standard of hearing, save with the tone of the particular watch employed, as all watches vary more or less in the loudness or sharpness of the tick; and thirdly, from the tendency there is both for adults and children to deceive themselves and us in fancying and asserting they hear the watch if they see or know that it is applied against or held any distance from the ear. It is by no means a good method of testing the conduction of sound through the osseous structures.

We may partly meet some of these objections by using a stop-watch which places the continuance of the sound under our control, and conceals from the patient the time of its commencement or cessation.

A stop-chronograph repeater which strikes the quarters

with a duplex bell sound is most useful, as it enables the examiner to test children at various distances with their backs turned to him, and in the recovery of the hearing enables us to judge correctly of the improvement.

The little patient is attracted by the strokes of the repeater and the chimes. Placing the child at various distances from us, we can direct him to turn quickly round as the watch strikes or chimes; this he readily does, and we can thus gain a pretty fair estimate of the hearing power.

By slipping a watch from one hand to the other, and keeping the patient's face turned from us when holding it to the ear, we may easily test the veracity of the child. Stupid and nervous children do not intentionally deceive, and it is a mistake on the part either of surgeon or friends to threaten or speak to them harshly while testing their hearing, or in fact at any time.

Mr. Stewart suggests a round leather pin-cushion for use with children. It can be easily slipped into the hand in the place of the watch, and the little patient cannot tell the difference in the feel of its smooth flat surface from that of the watch.

It is necessary to thoroughly occlude one ear, as the tones may not be heard with the ear we are testing, but with the other.

It is well to repeat a few times the experiment with either ear, beginning close to the ear, and approaching it from a distance. It will often be found that the patient can "follow" the sound when the watch is held at first close to the ear and then is moved gradually away, while, if we commence at some distance and gradually approach the ear, he will require to have the watch brought much closer to catch the tones.

If in a consulting-room there are two clocks in different situations which have different tones, a large proportion of patients do not hear the two of these clocks at the same time. Some hear that with the deeper tone, others that with the sharper. Often, immediately after inflation they will hear the two distinctly, and this when they have not before been made aware that there

were two in the room. If the attention is drawn to the fact that there are two clocks, some persons will then immediately recognize the two sounds. This difficulty of hearing does not appear to depend so much on the loudness as on the character of the tone, as the loudest of the two is not that generally heard. Those who cannot hear the two ticks at the same time in the first instance are generally the persons to whom table conversation is difficult if many people are talking together. If the watch is heard equally well with either ear at one hundred inches, normal hearing could be estimated at $\frac{100}{100} = 1$. The following method to note the hearing distance with the watch may be adopted :—

H.D.W. n = 1.
W. $\frac{1}{100}$ = ½ inch distance.
W. $\frac{1}{100}$ = 1 ,, ,,
W. $\frac{1}{50}$ = 2 ,, ,, and so on.
W. $\frac{0}{100}$ = 0 not heard.
W. C = heard on contact with the ear.

Or the result may be simply stated in inches, O standing for not heard, C for hearing in contact, and N for normal hearing.

The tuning-fork is so important an aid in differentiation that the reader must refer to the chapter on Diagnosis for directions for its use. With it we can test the power retained for the conduction of sound through the osseous structures, by placing it on the head, over the mastoid process, and on the teeth. We can thus try it with the normal ear and the affected one, and judge by contrast of the relative time the perception of sound lasts.

If the watch is not heard on contact, or barely on or off contact, the nail furnishes a useful test in some cases, the distance at which the click of the nail in varying degrees of sharpness is heard being noted.

In speech we have another important test of hearing. This test may be commenced when the cross-examination of the patient is begun by modulating and altering the tone of the voice when asking questions concerning his previous history and present state. We should also stand

behind the patient, to prevent lip reading, and speaking in a whisper, gradually approach him, using such soft words as "tip," "fish," "his," "bit," etc. If one ear is to be tested alone, the other should be temporarily closed while going through this performance. This method may be repeated with various modulations of the voice. The fact of his hearing better in the presence of noises (paracusis Willisiana), or in a railway train, or worse, at a dinner-table, when many persons are speaking, being then unable to follow the general conversation, should be recorded.

It is as well to ascertain what tones, both as regards *pitch* and *timbre*, are heard best. The differentiation of such sounds being regulated, it is supposed, by the vibrations of the basilar membrane of the cochlea, any defects in hearing them would probably point to some mischief in that part of the labyrinth. Double hearing, when two sounds are heard although only one stimulus is given, and exaggerated and painful hearing from the acuteness with which the sound is heard, are sometimes complained of.

There is a certain set of symptoms, some of which are almost invariably met with in every case where we have anchylosis, adhesions, or rigidity of the membrane lining the cavity of the tympanum. A lucid description of the typical symptoms which are complained of by the great majority of patients who have adhesions of the membrana tympani and anchylosis of the tympanic bones is given by Mr. Toynbee. There are no more important passages in his work on *Diseases of the Ear* than those in which he so clearly depicts those symptoms so well known to all aural surgeons, and which when described by a patient almost infallibly point to the seat and nature of the affection.

"My patients will most distinctly hear a single voice, although low, but are puzzled to hear anything distinctly when two or more persons are speaking; others hear the voice, but cannot discriminate the words; others again can hear slow conversation, but cannot follow it when rapid. These symptoms show that the *adapting power* of the ear, dependent as already shown upon the ossicles and

their muscles, is at fault. But the history of the case, showing it to be one of slow hardening of the tympanic mucous membrane, together with the absence of all those symptoms which render it liable to be confounded with other diseases, as nervous deafness, obstruction of the Eustachian tube, etc., is usually sufficient to enable an attentive observer to form a correct diagnosis.

"Thus the patient will hear perfectly a single distinct voice, but a second voice intermingling completely disables him from hearing either, he having lost the power of rapidly adjusting his ear to suit the sound of the voice of the person immediately addressing him to the exclusion of that of the other. Yet another striking symptom of the early stages of the affection is the necessity of exercising an act of distinct volition in order to catch the sound of a voice, which ceases to be perceptible as soon as the effort is relaxed. It has, indeed, happened to me to receive patients whose complaints consisted not in being dull of hearing, since they could hear everything said in a room, but in not being able to do this without a prolonged effort of attention, the fatigue of which soon became intolerable. This latter condition is, of course, perfectly explicable from the more or less rigidity of the chain of bones in this disease, and the muscular effort consequently required to move it and keep it in constant motion.

"Another symptom, and one certainly characteristic of the latter stages of this affection, but which it is not in my power to deny may not also be present in another disease of the ear, is the immense improvement of the hearing which attends the patient's travelling in a carriage over a hard road, by which considerable vibration is communicated to his body; a vibration that doubtless in a degree shakes the chain of bones, and imparts to them a kind of vibratory movement, which permits the muscles, while it lasts, so to act on those bones as to restore more or less of their proper functions in adjusting the pressure on the labyrinth."

This symptom points particularly in our experience to affections of the middle ear and anchylosis of the stapes. Tröltsch thought that in the case of persons hearing better during noises, distinct vibrations brought the stapes and incus closer together through the inward pressure of the membrana tympani, and thus prevented the interruption to the conduction of sound caused by an abnormal separation of these bones. Toynbee's view, that adhesive inflammation had produced anchyloses, and that the symptom was pathognomonic of this affection and incurable, is that taken also by Politzer.

Error in judging *of the direction* of sound (*paracusis loci*) is met with in a certain proportion of patients suffering with middle-ear affections. The cause of this

affection appears rather to be in the sound-conducting media than in the labyrinth. It exists frequently in those persons in whom we have no doubt there are anchylosed states of the articulation and ossicles. It will be observed that some patients never appear certain of the direction of the sound without turning the head to look from the clock or the place from which they think the sound issues. As it is a fact that our accurate judgment of the direction of sound is dependent on hearing with both ears, which fact can be proved experimentally in persons whose hearing is normal, and is the result of the education of the aural synchronously with the ocular sense, it happens that when the hearing is not assisted by vision, and that still further, either through interference with the transmission of sound in the external meatus or its conduction by disease in the middle ear, the binaural hearing is interfered with, this judgment of direction is either lessened or lost. This error of hearing may be of considerable moment in the case of railway officials or sportsmen, and those engaged in military service.

The researches of Oscar Wolf have proved that the pitch of the fundamental note varies in the pronunciation of the different vowels, and further that this difference exists in a greater degree between the vowels and consonants, the latter being heard much less distinctly.

Politzer has shown experimentally that:

"If words are spoken into the meatus through a speaking trumpet, the ossicula exhibit as many vibrations as there are syllables in the word, and that the greatest excussion of the vibration corresponds with the vowel of the syllable."

Taking a few of Oscar Wolf's conclusions regarding the relative distances in metres at which the sounds of certain vowels and consonants can be heard, we have these facts well exemplified:

A = 252 (pronounced as in hart), O = 245, E = 231 (as in end), I = 238 (as in ei), I = 210 (as in inch), U = 19 = 6 (as in

hunt), S = 123·5, K = 44·1, B = 12·6 (as in before), H (aspirate) = 8·4.

It must also be remembered that the pitch and volume of different persons' voices vary considerably in ordinary conversation, and in the same persons at various times and in different days, dependent on atmospheric conditions, the state of the larynx and the tension of the vocal cords, or the amount of noise present at the time they are conversing. We must recollect that in testing with the watch and by whispering much will depend on the surrounding stillness.

In the treatment of patients it will frequently be noticed that, while there is no improvement in the hearing of the watch or but very slight, the conversational power is decidedly increased, and on the other hand, that though there be marked increase in the distance at which the watch can be heard, for conversational purposes there is no gain.

The facility with which certain persons follow conversation by watching the lip movements of the speaker has to be remembered. This is especially noticeable in the case of children and young persons who have become deaf after they have learned a number of words and the alphabet. Quite recently we saw a child, aged five years, absolutely deaf to loud noises, who could understand a number of sentences when spoken to him by his mother. The ease with which he understood speech made her doubtful of the boy's loss of hearing.[1]

In trying these young patients for the possession of hearing power they must not be allowed to see the source of the noise, and it is better to blindfold them during examination. It will be found that many will hear the tuning-fork when placed on the head or over the mastoid who did not hear such sounds as the piano, a whistle, or other loud noise. In these cases the inference is that there is a certain degree of perceptive power retained in the auditory nerve.

Politzer's acoumeter, which we have for some time employed as an accessory test of the hearing, is shown

[1] See p. 356.

in the figure of its actual size. It consists of a horizontal steel cylinder tightly fitted by a screw to a perpendicular vulcanite pillar, while a lever percussion hammer is so arranged in the vulcanite pillar that by pressure on the short arm of the lever the hammer is made to fall on the steel cylinder and produce the tone. The degree of depression of the lever is limited by the rubber check-plate *d*, while the instrument is held between the fore-finger and thumb at *b* and *a*. The acoumeter is also furnished with a metal plate, which can be used to test sound conductions through the cranial bones by pressing it over such bones as the temporal or mastoid, and on the external meatus, where the tones are not heard save in contact. For this purpose the acoumeter will be found most useful. The distance at which the tone produced by the lever hammer is heard is measured by a centimetre measure, a greater distance by a metre scale previously determined and worked in the consulting-room. For the reason before stated in the case of the watch, the hearing distance is measured by gradually bringing the acoumeter nearer the ear until the tone is heard, while the eye of the same side as that of the ear tested is occluded, so that the patient cannot see the instrument or know the direction of the sound. Fifteen metres was the distance fixed by Hartmann and Politzer as the average normal distance of hearing for the acou-

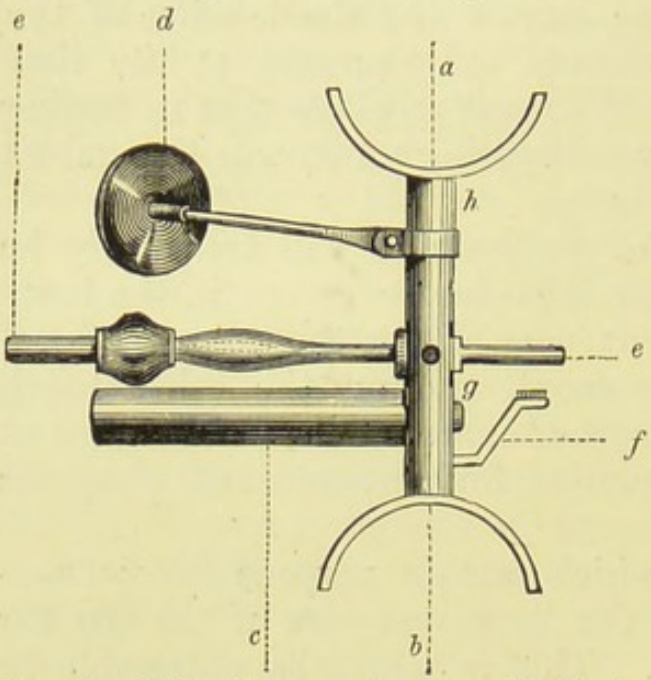


FIG. 17.—Politzer's acoumeter. *a* and *b*, Semi-circular vulcanite ends of pillar for forefinger and thumb; *h*, vulcanite pillar; *c*, steel cylinder; *e*, *e*, steel lever hammer; *f*, vulcanite check on which to press the lever hammer; *d*, brass plate at end of steel pin (which in the recent instrument, screws into the vulcanite pillar at *h*). In the improved acoumeter the vulcanite pillar and check-plate are made of one piece.

meter.[1] It has the advantages of (1) uniformity and intensity of tone; (2) a greater correspondence to the voice and whispered speech than the watch; (3) its simplicity and size.

For those who may desire other means of testing the accommodation and acuteness of the hearing power, Ogston's whistle and Galton's pipes are useful.

Dr. Turnbull has made some interesting experiments to test the power of perception of musical tones by the human ear. He used König's rods. "They were made of choice white tempered steel. These are held suspended by a silk thread, either close to the ear, or at a definite distance, say thirty-five feet, from the patient, and then tapped on the end with a little steel hammer, which causes a clear, ringing over-tone like a bell. They are two centimetres in diameter, and from two and a half to ten centimetres in length, so that they regularly increase from 20,000 to 60,000 vibrations in the second, according to their size." They were held within two inches of the ear; their temperature was about 70° Fahr. The observations were made in a room remote from noise, and during cloudy weather. With these rods he could accurately test the perception of the finest musical tones. From the table he has published, the average capacity of the normal ear for high tones between the years of twenty and thirty would appear to range from 40,000 to 60,000. It was a little lower in the advanced periods of life. In several of the cases where a marked difference was observed between the two ears, this was in favour of the left, with the single exception of the case of the gentleman who distinguished 60,000 with his right ear, and who could get no higher than 55,000 with his left.

The marked difference between the limit at twenty-two and that at fifty-seven years is believed not to be due simply to senile thickening of the membrana tympani, but also to a gradual narrowing and change of shape in the auditory meatus, together with alterations in the middle ear, diminution of conducting power of the bones, and diminished susceptibility of the auditory nerve, incident upon advancing years.[2]

---

[1] The acoumeter can be had of Messrs. Krone and Seseman, and Mayer and Meltzer, or Maw, London.

[2] Professor Hughes devised an audiometer to measure accurately the power of hearing in a deaf person, and to afford a means of exactly testing the hearing at intervals when a patient is under treatment. It consists mainly of an appliance in which the telephone is adapted by means of the inventor's microphone key to convey the most delicate gradation of sound (up to absolute silence) to the ear. It is worked by two Léclanche's cells, and the intensity of the sound is regulated by a moving coil placed on a graduated bar between the two primary coils.

Past Treatment.

Before concluding the cross-examination of any case, it is well to ascertain the nature of the treatment, if any, which has been previously adopted. This is particularly necessary in dealing with aural patients. In many instances it may be a guide to the prognosis that we give. It will also prevent the repetition of the employment of useless remedies, and save the patient from interference, which cannot do good, and which may do harm. In a large number of cases various empirical means have been already used to combat the pain or deafness, and it is advisable, both for the confidence of the patient and as a guide to the surgeon, that all information on these matters should be elicited before the treatment of a case is commenced. It should not be necessary to give any caution as to the judicious care which must be shown in asking information on such points. The reputation, the welfare, at times the character of a brother practitioner are in our hands; the man who forgets the duty he owes that brother, through a base desire to advance his own interests, is unworthy of the position he holds as member of our profession.

Touch Deafness.

Dr. Alexander Ogston, in the Cavendish lecture, delivered before the West London Medico-Chirurgical Society (*Med. Press and Circular*, June 18th, 1890), on "Unrecognized Lesions in the Labyrinth," draws attention to "touch deafness" as well as deafness to sounds in cases of effusion into the labyrinth, unattended by any catarrhal processes in the middle ear, in which there are varying degrees and kinds of tinnitus. This tinnitus, Dr. Ogston says, is aggravated at night on going to bed, and diminishes in the morning. Noise and movement aggravate the tinnitus, so does stooping or blowing the nose. Giddiness, loss of balancing power, and sense of tension in the ear are accompanying symptoms. Recurrence of the attack and gradual diminution of hearing frequently attend the course of the affection, and the loss of high notes is never regained. This latter symptom Dr. Ogston regards as a most characteristic one. The hearing is impaired, as if the ear were closed by wax or a plug of cotton-wool. When the range of hear-

ing is tested it is found that a watch, heard by the good ear at twenty-five feet, is now audible on the affected side at a distance of only two feet, or perhaps even six inches or less, a loss of from eleven-twelfths to forty-nine fiftieths of the power of hearing. The voice, as is usual in deafness, is better heard, and is not so accurate a means of testing the diminished sensation.

"This deafness gives rise to a singular phenomenon in the region of the external auditory meatus. When, in a normal ear, the finger is brought into contact with the skin around the meatus, the individual both feels and hears the contact. If the deafness described is present the contact of the finger is *felt* as usual, but is not so distinctly *heard*, and hence for three-quarters of an inch in front of and below the meatus, and over nearly the whole pinna, when the finger is rubbed gently so as to stir the fine hairs and the skin, the patient feels as if the part touched were benumbed (Fig. 18, where the benumbed area is shown), in marked contrast to the sound ear, where the usual familiar sensation is perceived.

FIG. 18.—Area of touch deafness in effusion into the labyrinth.

"The numbness described is not a symptom peculiar to disease of the labyrinth, as anything that interferes with the conduction of sound to the internal ear will equally produce it. It can be caused by plugging the external auditory meatus pretty firmly with cotton-wool, and it may also exist where unusually large collections of cerumen block it up. It will not be well made out, however, in any condition unless the interference with hearing be considerable, and hence it is slightly marked or absent during the milder attacks of effusion into the labyrinth, and also in the severer attacks when the great degree of deafness accompanying their earlier stages is passing away."

TESTING THE ACUTENESS OF HEARING.

In the same lecture, Dr. Ogston says:—"I do not think a better illustration could be given of the imperfection of our methods than the fact that it is not generally known that the field of hearing of a normal ear has its limits in lateral directions, and that points of

greater and less acuteness exist in it. If a person be seated with his ear horizontally directed towards a watch or other source of sound, and at such a distance from it that he can just distinctly perceive it, it will be found that as he inclines his head in various directions, the sound becomes more or less distinct, and at certain limits of inclination inaudible. As an instance of this I may give the measurements taken in the left ear of one of my patients, who suffered on his right side from the labyrinth disturbances I have described, but in whom the left ear was normal. When the imaginary line joining his two external auditory meatus, which I may call the meatus line, was directed horizontally, and a watch was placed in the prolongation of this line at a distance of 10 feet from his good ear, at which point he could just distinctly hear it, it was found that when he rotated his head for 15 degrees towards his back, that is, in a horizontal plane backwards, the watch was heard at a distance of 14 feet, or, which is the same thing, if his head remained stationary while the watch was moved forwards to a situation 15 degrees in front of the meatus line, it was there heard at a distance of 14 feet. It was of course immaterial to the result whether the patient or the watch was moved. In testing further it was found that if the watch were moved forwards to an angle of 40 degrees in front of the meatus line it was there heard only at 6 feet, and at 55 degrees only at 3 feet. The back part of the field showed a slow decrease of the range of hearing, the watch at 25 degrees backward being heard only at 6 feet, and at 40 degrees backward at 5 feet, beyond which the range fell to 3 feet and less. So that the patient's field of hearing embraced only 95 degrees of a circle, its point of greatest acuteness being 15 degrees in front of the meatus line.

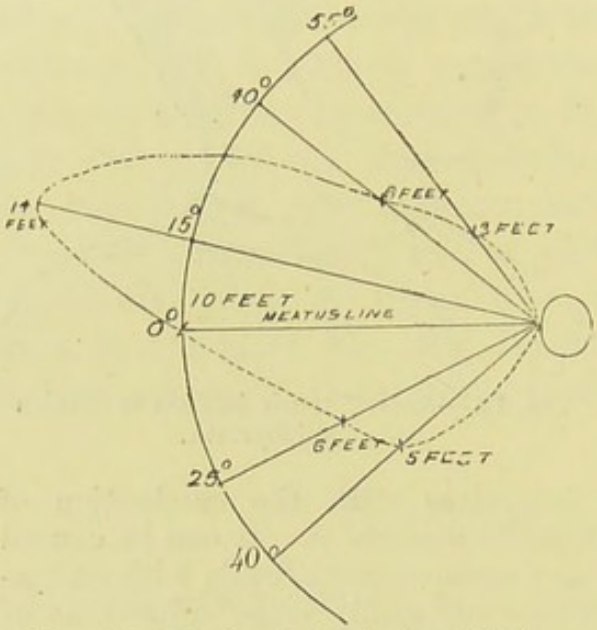


FIG. 19.—Hearing in the horizontal plane.

"The diagram (Fig. 19) will render this more intelligible. It corresponds to several other measurements I have taken of normal ears, and is, I think, a tolerably accurate representation of what is usually found in health; although the conditions under which I had to work when examining all these cases, particularly as regards noise and currents of air, were unfavourable to perfect accuracy.

"When the hearing in the vertical plane was next examined, it was found that here also the sound was not best heard when opposite the meatus. It was there audible at 10 feet, while at 15

degrees above the range diminished to 8 feet, 40 degrees above to 6 feet, and 60 degrees above to 3 feet and less; but below it slowly increased for 35 degrees, at which point it reached 12 feet, diminish-

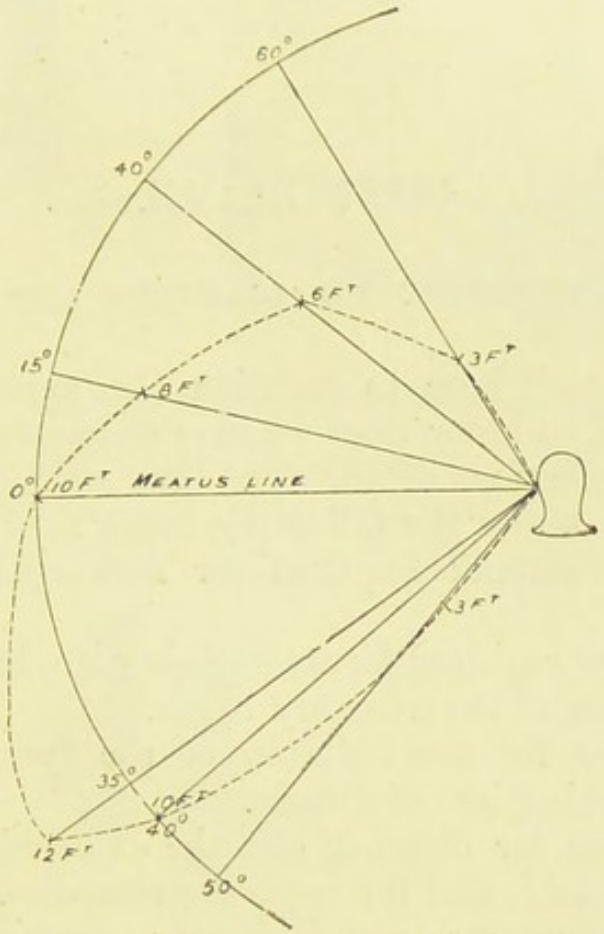


FIG. 20.—Hearing in the vertical plane.

ing then to 10 feet at 40 degrees, and to 3 feet and less at 50 degrees as shown in the diagram (Fig. 20). The point of most distinct hearing is therefore below the ear."

CHAPTER VII.

APPLIANCES NECESSARY FOR DIAGNOSIS AND TREATMENT.

It may be well here to mention the apparatus which are essential, in order that we may successfully diagnose and treat affections of the ear. For simplicity we may divide them under the following heads :—

(*a*) Instruments required for making a direct examination.

(*b*) Those required for ascertaining the hearing power and condition of the auditory nerve.

(*c*) Those for the inflation of the tympanic cavity and ascertaining its conditions.

(*d*) Those for clearing out the external meatus and tympanic cavity, and for applying remedies.

(*a*) *Instruments required for making a direct examination.*

1. A *bright steady light.* Sunlight is undoubtedly the best when obtainable, for a beautiful view of the membrane can be had by its means ; but the light should be thrown rather on the wall of the meatus than directly on the membrane, as by its intensity it may dazzle and prevent us seeing distinctly. Unfortunately, as sunlight is too frequently conspicuous by its absence, and therefore not to be depended upon, artificial light must be used. We may employ ordinary coal-gas, a mixture of oxygen and hydrogen, electricity, or oil.

The most convenient way of utilizing gas is to employ the ordinary bull's-eye with an argand burner in a lever bracket, to be obtained of any instrument maker. To overcome the heat, which is sometimes very much complained of by patients, an outer chimney is made to fit

into the inner one; it is lined with asbestos, and an air space is left between the two.

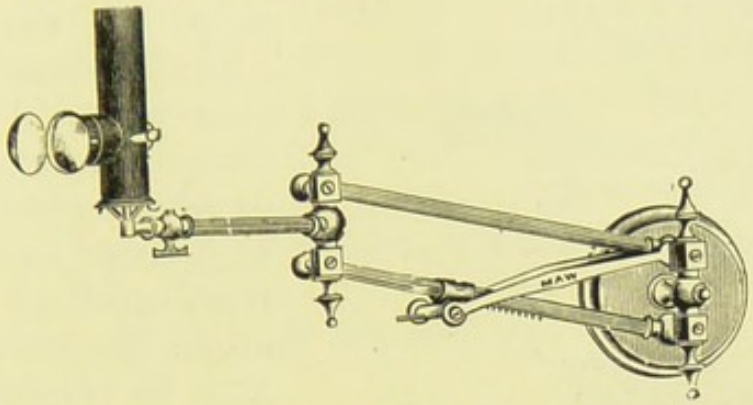


FIG. 21.—Gas-lamp bracket and chimney for Argand burner.

Fig. 22 shows a movable standard lamp for gas, and Fig. 23 a very good oil lamp, both made by Maw.

Fig. 24 is a very useful portable lamp for bedside

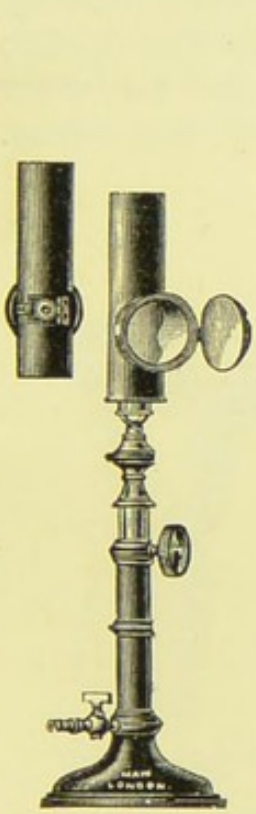


FIG. 22.—Argand gas-lamp.

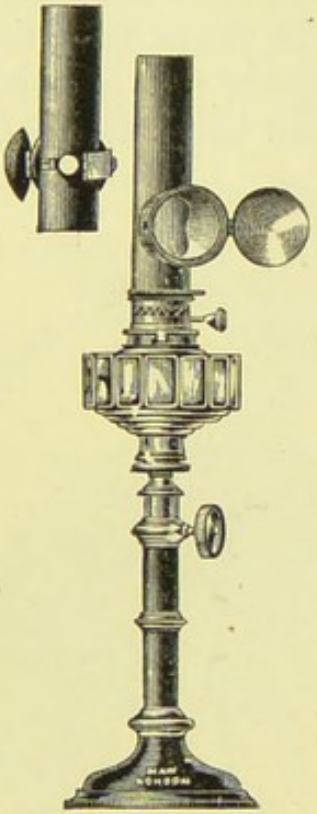


FIG. 23.—Oil lamp.

FIG. 24.—Portable oil lamp.

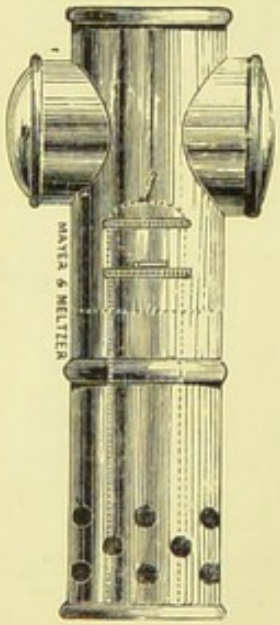


FIG. 25.—Candle lamp.

purposes. It can either be used standing or held in the hand by an assistant.

Fig. 25 shows a very convenient candle-lamp of Mayer and Meltzer, which gives a good light and can be carried about without fear of upsetting the oil.

In cases of emergency any ordinary lamp, candle, or even a good wax taper may be employed. Should, however, a more powerful light be deemed necessary, the oxy-hydrogen limelight of Messrs. Coxeter gives most excellent illumination. The lever bracket may be employed, the oxygen being kept in a bottle at the side, standing on a tripod, or the lens and burner may be fixed directly over the oxygen bottle. In these days, too, when electric light wires are being rapidly put into houses no better light can be employed than that supplied by this means.

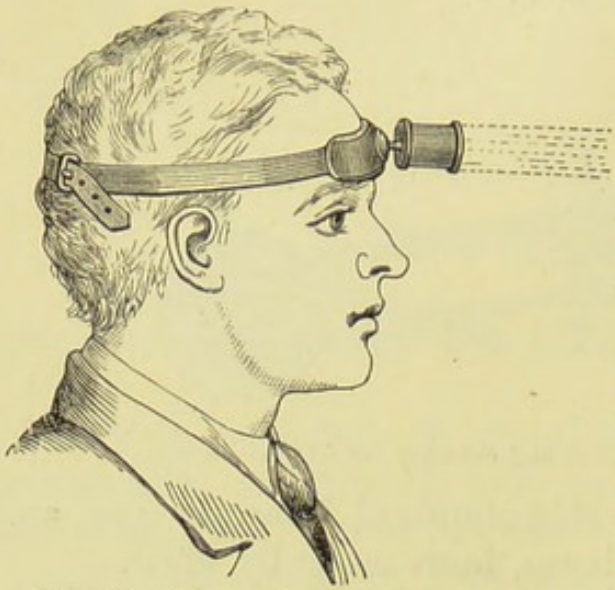


Fig. 26.—Electric photophore on forehead.

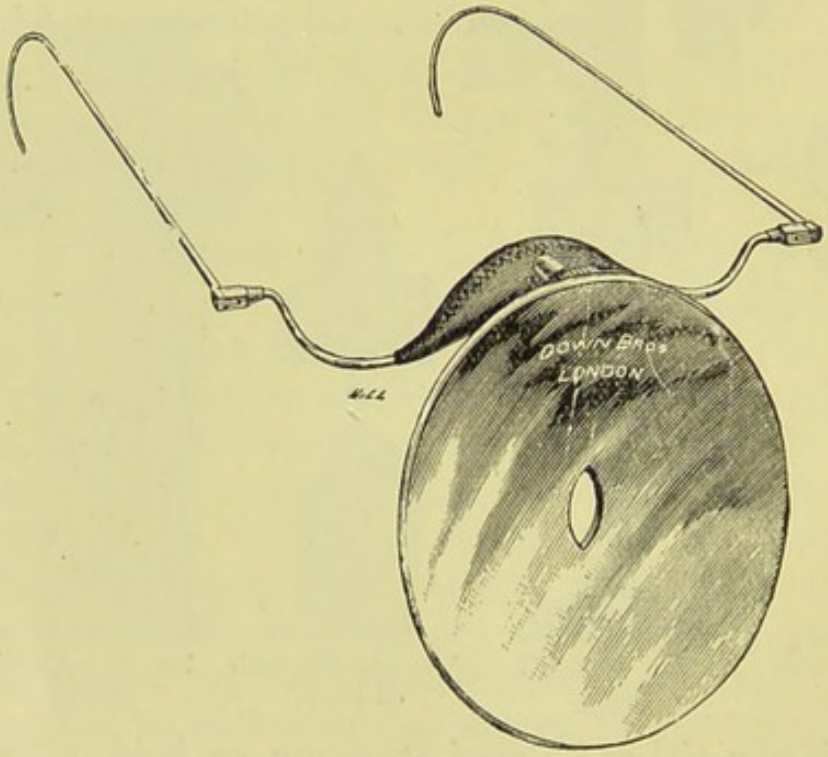


Fig. 27.—Reflecting mirror.

2. A *reflecting mirror.* The mirror with the spectacular frame ordinarily used in laryngoscopy, with the ball-and-socket joint (Fig. 27), will be found the most

useful, as with it we can either examine with the hand, or with the mirror on the face. With a little practice full view can be had from the face mirror, and if there is any manipulation necessary, it is the best method of using the mirror, as we have then both hands free to operate with.

3. Various sizes of *aural specula.* Different varieties of specula have been brought into notice since the time when Grüber and Wilde first introduced theirs to the notice of the profession.

FIG. 28.—Grüber's speculum.

For practical purposes, either that known as Toynbee's, or that of Grüber, will be found quite sufficient, but some aurists prefer the more complicated one of Brunton; here the frontal mirror is not wanted, the light being admitted through a funnel in the side. A small electric lamp is sometimes placed in this funnel, and gives a very good light. But the utility of a speculum does not

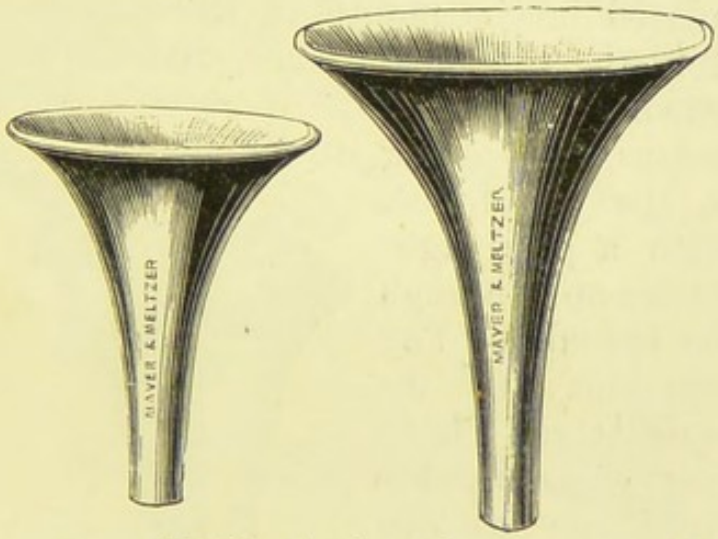


FIG. 29.—Aural specula.

FIG. 30.—Kramer's speculum.

so much depend on its form as on the hand that guides it, and each must choose the one he likes best. With children it is necessary either to have a speculum with a very small end, or else to use a Krämer (Fig. 30). This is also a very useful instrument when operating, as the sides open, and in hospital work, for you have at hand

one speculum that can be made to fit the varying calibres of the meatus that have to be rapidly examined.

4. *Siegle's pneumatic speculum.* For determining the presence of adhesions of the membrane and the mobility of the malleus, the pneumatic speculum first introduced by Siegle is very valuable. It consists (*vide* Fig. 31) of an ordinary vulcanite speculum, *a*, which screws into a vulcanite box, *c*, covered with a glass lens, *b*, which is also screwed on. By placing a little piece of india-rubber tubing on the tubular part, it fits air-tight into the meatus. The box has an india-rubber tube and a mouth-piece, *d*, connected with it, which is placed in the mouth of the surgeon; suction is applied to the end of the tube, and the air drawn from the meatus, thus acting on the membrane. With a good light thrown on it through the speculum, any adhesions and inequalities which may exist in the membrane are disclosed.

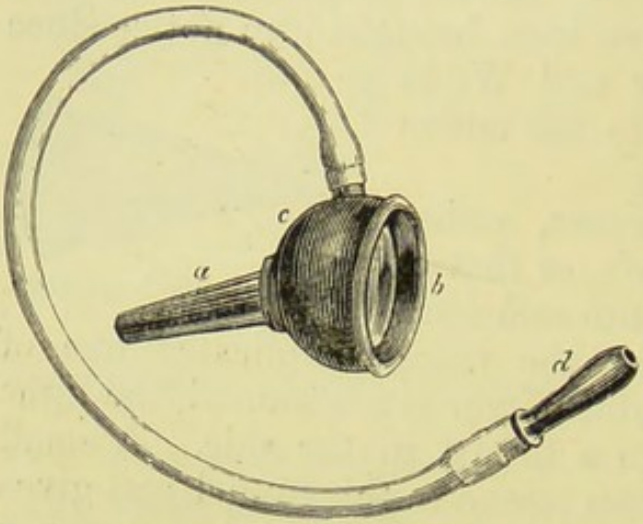


Fig. 31.—Siegle's speculum.

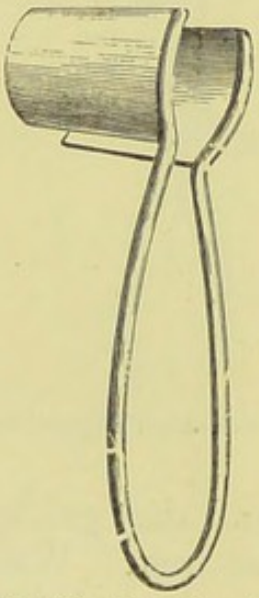


Fig. 32.—Thudichum's nasal speculum.

5. *A nasal speculum* must be at hand in order to thoroughly examine the anterior nares.

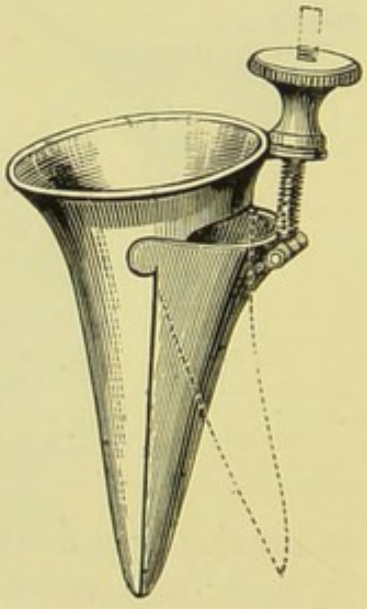


Fig. 33.—Nasal speculum (Duplay).

The varieties, like the aural specula, are very great, but the three we have found most useful are Thudichum's

small (Fig. 32), Duplay's (Fig. 33), or Fraenkel's (Fig. 34). Baber's nasal retractor (Fig. 35), too, is very convenient when operating on the nose.

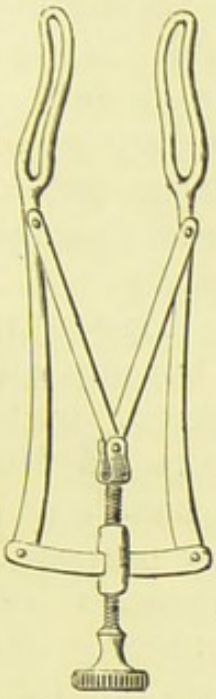


FIG. 34.—Fraenkel's nasal speculum.

6. *Posterior rhinoscopic mirror.* The rhinoscopic mirror should resemble the laryngeal in shape, but the reflecting surface should not be more than five-eighths of an inch in diameter, and the shaft should be bent at a convenient angle. Zaufal's mirror (Fig. 36) works on a hinge, and is very convenient, as the different angles can be obtained by simply pressing on the spring after it has been passed straight. Whistler has made a slight

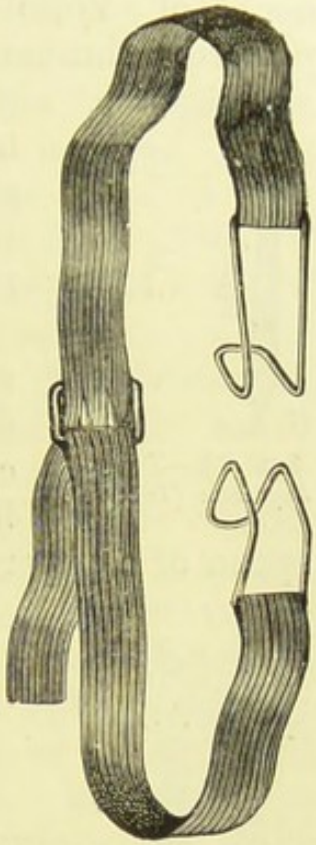


FIG. 35.—Cresswell Baber's nasal retractor.

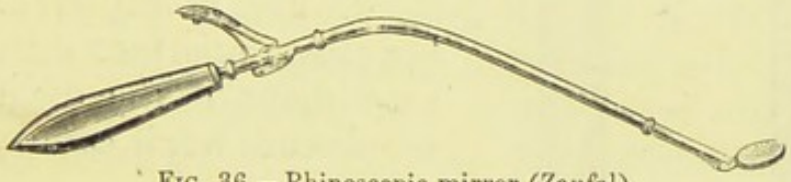


FIG. 36.—Rhinoscopic mirror (Zaufal).

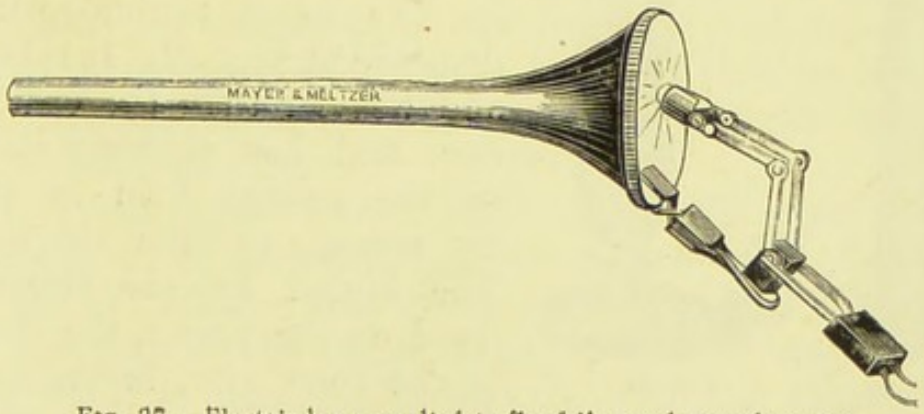


FIG. 37.—Electric lamp applied to Zaufal's nasal speculum for examination of the nasal fossa.

modification of this, by having the reflecting portion made in the shape of a small parallelogram.

7. An *uvula hook*, the *uvula twitch*, or the *uvula noose* of Voltolini are sometimes used in performing posterior rhinoscopy. But they may as a rule be dispensed with, and if anything is wanted to draw forward the soft palate, a piece of string stiffened with mucilage, passed through the nostrils and drawn through the mouth, is all that is necessary.

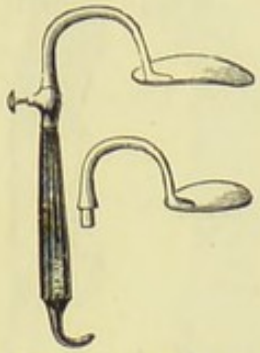


Fig. 38.—Tongue depressor (Türck's).

8. *Tongue depressor.* These are numerous and vary in shape, but any will do, the simplest being preferred, or, in cases of emergency, the unprotected first finger of the left hand, the handle of a spoon or a paper-knife, etc., will answer every purpose.[1]

(*b*) *The instruments required for ascertaining the hearing power and condition of the auditory nerve.*

1. *The watch.* The method of ascertaining the hearing power by the watch has been already explained, as also Politzer's acoumeter (*vide* p. 95).

2. The *tuning-fork.* This is a most important instrument, as without it the diagnosis of an obscure aural case is incomplete.

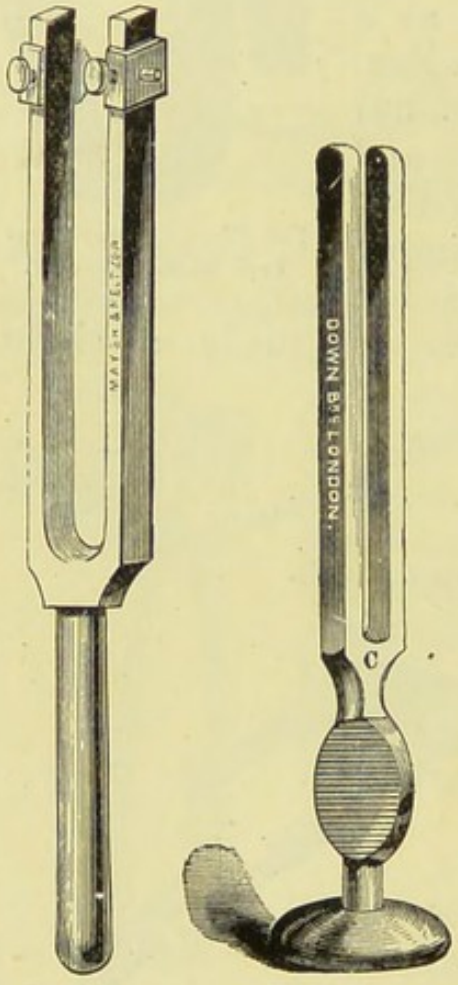


Fig. 39. Fig. 40.
Tuning-forks.

The aural tuning-fork is depicted at Fig. 39. It is larger and heavier than the ordinary one, and has shifting clamps on the prongs, held in place by screws, to alter the tones. The higher up the clamp is fixed on the prong, the deeper is the tone, and, according to Kiesselbach, the weight of the

[1] An ordinary tonsillotome without the cutting blade makes a very useful and effective tongue depressor.

clamp alone deepens the tones. But an ordinary "C" tuning-fork with a wooden button on the end to place on the forehead (Fig. 40), and pieces of india-rubber drainage tubing slipped over the prong to alter the tones, as recommended by Bing, will answer every purpose.

If possible, it is as well to have at hand a few tuning-forks of various sizes and different keys.

It is not in keeping with the design of this work to enter into the various physiological and acoustic reasons which have been assigned for the fact that vibrations passing through the solid media (the bones of the head) in the normal state, are, as a rule, intensified and the reflections increased when the external meatus is closed, and those vibrations prevented from escaping. Whether this obstruction is in the meatus or in the cavity of the tympanum, the effect is identical. Cerumen, a foreign body, polypus, obstruction from epithelium and hardened mucus in the external passage, or accumulated mucus in the cavity of the tympanum, will produce a similar effect. This is not an absolute rule. There are persons whose hearing is very acute, and in whom there are no symptoms of any abnormal conditions, who do not hear the tuning-fork louder on closure. Some time since, in trying the tuning-fork on the heads of some bystanders, and explaining the reasons for the use of the instrument in diagnosis, the accuracy of the theory received rather a blow, when the first person, a student, on whose head it was placed for experiment, and one who had remarkably good hearing, and had never had anything wrong with his ears, declared that he did not hear the tuning-fork louder on closure of the meatus, but, of the two, less so.

He was tried several times with the same result. There was no cerumen, the membranes were healthy; all the bystanders were, however, influenced differently.

Nothing in the examination of the ear requires the exercise of so much patience as the trial with the tuning-fork. Each experiment should be repeated a few times, and the patient kept in ignorance of the result expected. Deaf patients, especially the poorer ones, are often

intensely stupid. To arrive at a truthful conclusion, we must try their accuracy several times. It is a good plan to return to a previous step in the examination, and to repeat the question as to the intensity of the sound. Constantly, patients will at the same examination contradict assertions which a minute before they have made with the greatest confidence.

It is often at the hospital a great trial of patience to elicit the truth, which they quite unintentionally obscure. The following method of testing whether the deafness be unilateral or bilateral may be adopted :—

1. Ascertain if the sound is heard louder in either ear, the meatus of each remaining open.

2. If the sound is heard louder in either ear, or the contrary, the meatus of each having been closed alternately with the finger.

3. If the sound, as heard with the meatus of each ear closed, is louder as contrasted with its intensity when both ears are open. This may be done by making the patient, with his thumbs, quickly close the ears on placing the tuning-fork on his head, and by testing him alternately with both the ears open and closed.

Let us take a few uncomplicated examples. Having by the speculum excluded any cause which can exist in the external meatus, such as cerumen, polypus, epidermis, or foreign body, we wish to arrive at a conclusion as to whether the deafness and tinnitus are due to tympanic obstruction, or to disease in the labyrinth and of the auditory nerve.

First, a patient hears *badly in the right ear*, and well in the left. With the tuning-fork on the head in the first step of the examination, he hears it *loudest in the right ear*. The presumption is—*mucus in the cavity of the tympanum on that side*. On closing the left ear the sound is intensified in it, equalling, if not exceeding, that heard in the right. On closing the right ear the sound is not as a rule increased. The diagnosis, that it is one of obstruction in the cavity of the tympanum, is thus confirmed in a majority of cases.

Secondly, a patient is *deaf in both ears;* the tuning-

fork placed on the head is *heard loudly and equally in both*, and there is *no difference, or very slight, on closure of either meatus.* We may presume *mucus in the tympanum of each ear.*

Thirdly, a patient is *deaf in the right ear;* the tuning-fork placed on his head is *heard louder in the left ear. We assume nerve deafness of the right ear. On closing the left ear, the sound is intensified in it; on closing the right, there is no difference.* In our experience in the majority of cases it is, of the two, *less.* We confirm the assumption of nerve deafness in the right ear.

Fourthly, a patient comes to us *deaf in both ears,* with or without tinnitus. The tuning-fork placed on the head, *he hears perhaps badly, and the sound dies rapidly away.* This can be ascertained by testing him as usual, and transferring the fork quickly to the observer's head or teeth, on the patient's making a signal that the sound has disappeared. It is possible *he may not hear the tuning-fork at all* when placed on the head, and we must transfer it to the teeth before the vibrations are conveyed. Closure of either ear produces little difference, and, although according to Hinton the sound is slightly increased, we are inclined to think it is more frequently lessened. We diagnose *labyrinthine deafness of both ears.*

Such is, up to the present, the result of our experience in the majority of cases. On the disputed point of the patient hearing the sound less distinctly on closing the deaf ear (Roosa) in a case of uncomplicated nervine deafness, or its being slightly intensified (Hinton), after examining many hundreds of cases, we believe that the result is variable. Complications may exist which escape observation, and may be outside our power of diagnosis. Such complications existing in the tympanum, and which involve its membrane and ossicles, would influence the result. That they coexist frequently with nervine deafness is, of course, true, and hence it may be the case that much of the difficulty lies in this source of error.

Though the above rules as regard the diagnostic value of the tuning-fork are generally found to lead to a correct conclusion, still anomalous cases are constantly occurring in a large aural practice, and in the instance of very intelligent persons, which we do not pretend to account for, and which are more or less at variance with them.

In these cases we are inclined to believe the mischief is not confined to the cavity of the tympanum and the ossicles, but, probably from the effects of long-retained secretion, chronic inflammatory states of the lining membranes, adhesion, and partial anchylosis of the bones have been produced, implicating the labyrinth and nerve. In such patients we find the membrane unyielding on inflation, no improvement in suction with the pneumatic speculum, and its concave and thickened appearance verifies the diagnosis. It must also be remembered that the conductive power of the bones in some people is very much impaired. This is more especially the case in old persons.

There are a variety of other methods for testing the hearing power with the tuning-fork, but in a work of this description it will be only necessary to simply mention them.

Weber's Method consists in placing a vibrating tuning-fork upon the forehead, and observing whether the sound appears more or less loud in the ear under examination when it is stopped by the finger or any other way.

Gruber's Method.—After the tuning-fork held before the ear has ceased to be heard, the end of the finger should be inserted into the ear, and the vibrating fork placed on the finger, when the sound again becomes audible and is heard for some time.

Rinne's Method consists in ascertaining how long the vibrating tuning-fork is heard when held in the air close to the ear, after it has ceased to be heard when placed on the teeth. If it is heard in this way, the fact is denoted as "Rinne's method positive" (+ R); if no longer perceived, "Rinne's method negative" (− R).

Gelle's Method consists in ascertaining the perception of the tone of a vibrating tuning-fork while the air is condensed in the auditory canal.

These are a few of the various methods, for further

details of which the reader must refer to some larger work.

(c) *The instruments required for inflating the tympanic cavity, and for ascertaining the condition of that cavity and the Eustachian tube.*

1. The *auscultation tube* or otophone (frequently though inaccurately called the otoscope). This instrument (Fig. 41) consists of a simple india-rubber tube, from two

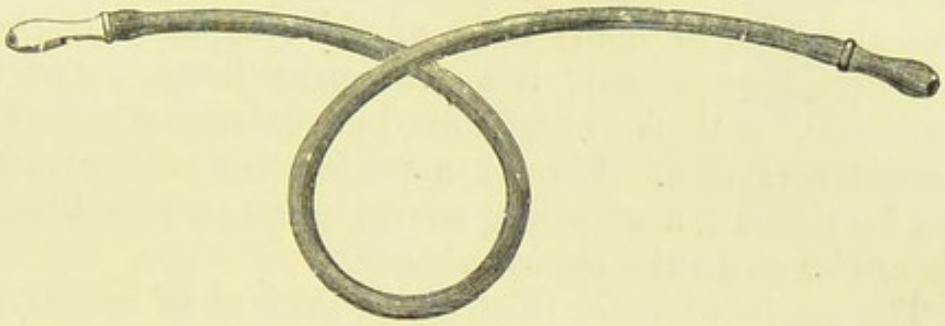


FIG. 41.—Auscultation tube.

to three feet long, having a bone ear-piece at the end and a vulcanite one at the other. It is necessary to have the two ends differently coloured, as you can then keep one expressly for yourself and one for your patients. Three tubes may be had connected to a central hollow vulcanite ball (Fig. 42). This form is useful for teaching purposes, as a student can examine the ear with it at the same time as the surgeon. If the surgeon place a tube in either ear, the intensity with which the sound is conveyed is increased, and the least inflation perceived. Double German otoscopes, on the principle of the double stethoscope of Scott Alison, have been contrived.

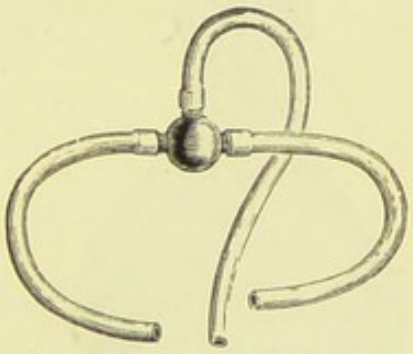


FIG. 42.—Double auscultation tube.

The auscultation tube is necessary for ascertaining the results of inflation, either by the Valsalvan method, by Politzer's bottle, or by the Eustachian catheter. On inflation by either of these methods, with the auscultation tube in position, that is to say, one end in the

patient's ear and the other in the operator's, various sounds are heard. If the passage is normal and free from obstruction, a full clear note is heard as the air strikes the drum-head. Again, if there is a certain amount of obstruction, a more or less feeble and distant sound is heard. A peculiar moist gurgling sound, varying in intensity, is heard if there is a moist condition of the Eustachian tube, or an accumulation of mucus or fluid in the tympanic cavity. On the other hand, there is, in many cases of old tympanic mischief, a dry crackling sound; it accompanies flaccidity of the membrane, and is heard in long-standing cases of retained secretion. Should a perforation of the drum-head be present, a whistling sound, more or less distinct, is heard close in the operator's ear.

The mode of using *Valsalva's method* of inflation is simple. The patient is desired to shut his mouth, and at the same time to hold his nose firmly, and then to blow (not too forcibly), when the air is at once heard impinging against the membrane. By reversing this method, that is to say, going through the process of swallowing whilst the nose and mouth are closed, the tympanum may be emptied.

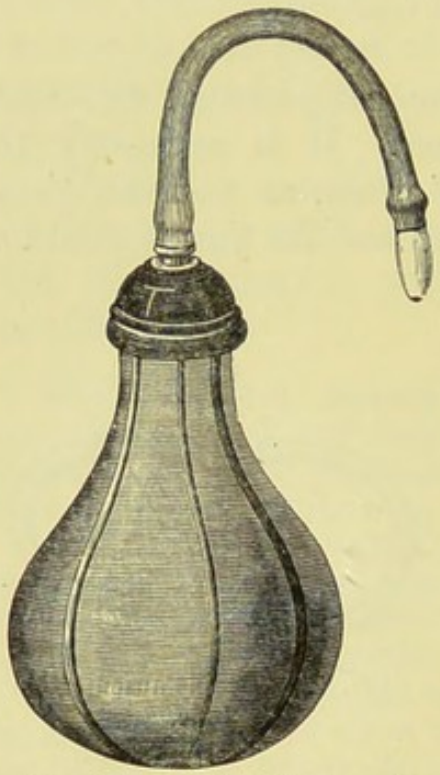


FIG. 43.—Politzer's balloon for insufflation.

3. *Politzer's balloon.* We employ two forms of Politzer's bag. One is the original bag of Politzer (Messrs. Matthews, London), and which is an ordinary 6-oz. india-rubber bottle (Fig. 43); the other is Macnaughton Jones's modification of one suggested by Löwenberg, for auto-inflation. The nozzle of the bag should be covered with a piece of rubber tubing, but it may be had with the longer tube and olive-shaped nose-piece of Weber-Liel. Another most convenient nozzle

is made of hard rubber, and is conical in shape. This is useful to the novice, as from its shape it cannot possibly be forced into the nostril and do damage to the nasal mucous membrane (Fig. 44). These bags should have an inlet valve. The following is the method of using it :—The patient is given a little water to hold in the mouth, and he is made to incline his head slightly to one side. In the floor of the nostril corresponding to the ear it may be our wish more forcibly to inflate, we introduce the tube or nozzle in a horizontal direction. The head is inclined from the same side, the nostril being upturned. If both ears are equally affected, it is better alternately to inflate through either nostril. The surgeon now firmly closes the nostrils with the thumb and index finger of the disengaged hand, at the same time that he retains in position the nozzle or tube. The patient is now desired to swallow (the process having been previously explained to him, if an adult), and immediately, as the larynx commences to rise with the hyoid bone, and the fluid is passing into the pharynx, the bag is forcibly compressed, and the air rushes into the tympanum.

FIG. 44.—Conical rubber nozzle.

FIG. 45.—Politzer's bag applied.

There is no difficulty whatever in carrying out this simple manœuvre, and even children get quite accustomed to the inflation if in the first attempts they are taken gently and gradually taught.

Lucae has found that we may blow air into the middle ear by employing a movement which will cause the velum palati to hermetically close the naso-pharyngeal space.

"Such a process may be effected by a prolonged phonation of the vowel *a*, best pronounced in a nasal tone, which will cause the velum to rise, cut off the upper from the lower pharynx, and during this act air may be blown into the nares, and thence into the middle ear, by a powerful inflation with the hand-balloon."

It will be found in many persons that the ear is easily inflated during this act, and if so, in a much simpler manner than by the process of swallowing water. In some, however, this plan of Lucae fails. It is well to try both methods in those cases in which there appears to be a difficulty of inflating the tympanum. Nor in some cases where we suspect liquid accumulation in the tympanum should Politzer's suggestion be forgotten, as it will be found more effectual, and may remove the serous collection. This is to give the patient a little water to keep in the mouth, and direct him to hold the head forwards and slightly to one side, and then, after the head has been held in this position for a minute, to inflate during the swallowing of the water. The tubal orifice thus opened permits the fluid secretion to pass out, and the position in which the head is held favours the passage of it in the direction of the Eustachian tube.

Grüber, seeing that the tongue is pushed further back during the pronunciation of the consonants *h* and *k*, suggested that inflation should be practised while the patient pronounces the syllables "hick," "hock." The operator "sits in front of the patient, and the end of the nozzle of the syringe (the ball of which is held in one of the operator's hands) is passed to the depth of one-third of an inch into the nasal opening. The operator then, with the thumb and first finger of the other hand, closes the opening around the syringe nozzle most carefully, and while the patient utters one of the prescribed syllables ('hack,' 'heck,' 'hick,' 'hock,' 'huck,' 'hck'), the ball is compressed, and the air flows with a clearly perceptible noise through the tubes into the tympanic cavity."

He claims for this plan these advantages—(1) Sim-

plicity; (2) the avoidance of swallowing water in the act of deglutition; (3) a more prolonged inflation; (4) it is better adapted for self-treatment.

There is another plan, which sometimes answers better, namely, to direct the patient to close the lips and make a forcible effort at expiration. If the bag is then gently squeezed the air readily enters the tympanic cavity.

Macnaughton Jones's auto-insufflator is a modification of Politzer's bag, and of one devised by Löwenberg, to permit of the inflation either of respired air or of any vapour into the tympanum (Figs. 46 and 48). It is also the best bag for auto-inflation we know of. By compress-

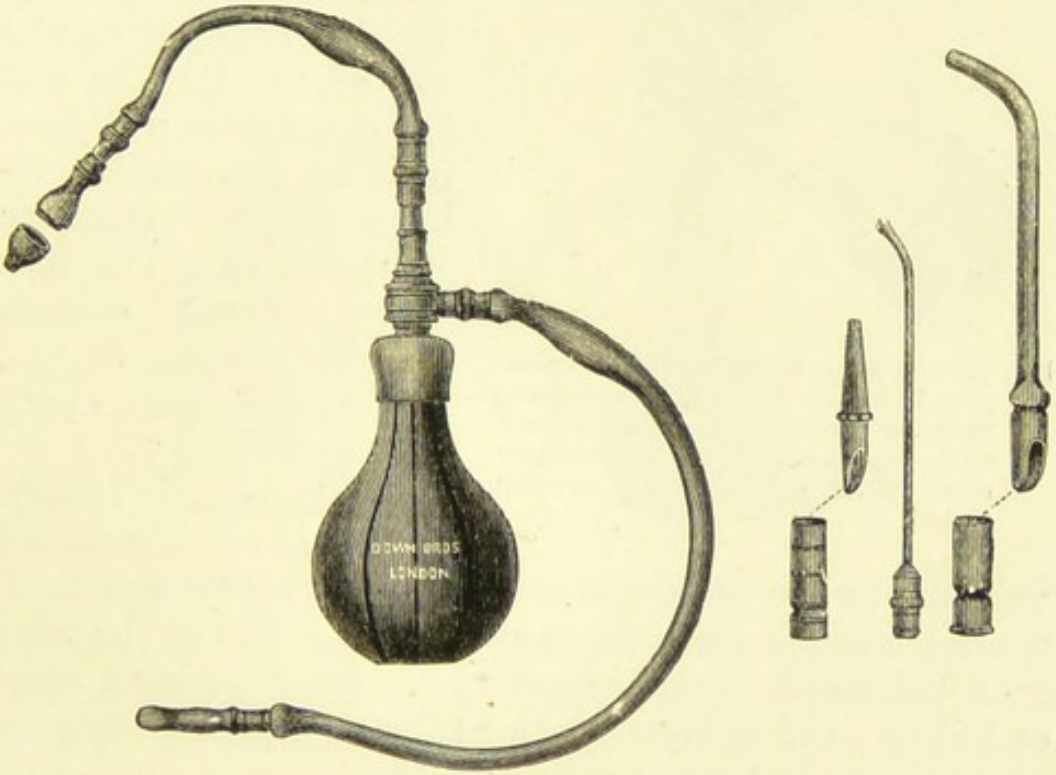


FIG. 46.—Macnaughton Jones's universal auto-insufflator, with mounts for nose, mouth, larynx, and Eustachian catheter.

ing the bag and blowing into the side tube, it is filled with warmer and heavier air than the ordinary atmospheric air (Löwenberg). Besides, as Löwenberg has pointed out, a greater interchange of gases is likely to take place when such air reaches the tympanum, than in the case of the ordinary atmospheric air. By a few alternate inflations (through the side tube into the bag) and acts of com-

pression, the bag is filled with air at the temperature of that in the lungs. The person wishing to inflate places with the thumb and middle finger of the left hand the vulcanite nose-piece in either nostril, closing the other with the forefinger of the same hand. By a sharp act of compression made with the right hand he drives the air into the open or partly open Eustachian tube just at the commencement of the second act of deglutition. Any surgeon trying this bag in the manner described on himself, will find how effectual it is, and that the simple attempt to swallow a little saliva is quite sufficient without taking any water into the mouth. We do not think, for the use of the surgeon and for diagnostic purposes, it is as powerful an inflator as the ordinary Politzer's bag, but it is quite powerful enough for any patient to use, and is more easily managed.

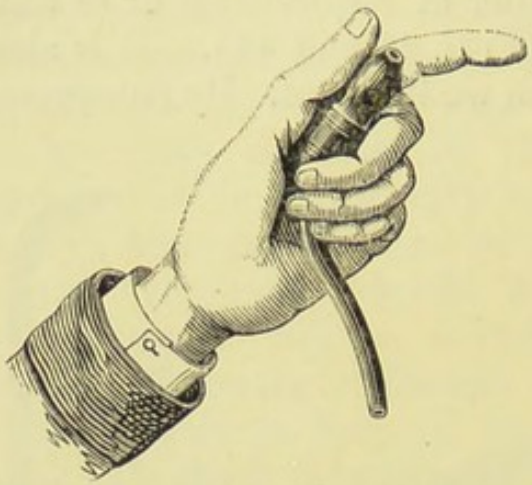


FIG. 47.—Showing method of holding nasal piece in introducing it into the nostril; the thumb secures it in and closes on it in the right nostril, while the forefinger is ready for closure of the opposite nostril.

Quite recently Messrs. Down have introduced valves into the nasal (or oral) and side tubes, and have made the appliance still more perfect. It can be used for aural, nasal, or oral insufflation. By attaching a nasal or laryngeal insufflator to the tube any powder may be blown into the nose or throat.

It is better that the surgeon for a few occasions should freely Politzerize a patient. He will often be surprised at the marvellous improvement in the hearing, and the decrease in the intensity of the tinnitus, which follow from this simple step. He should remember the position and direction of the Eustachian orifice. The nozzle of the ordinary bag when inserted in the nostril should be directed horizontally; the patient is placed sitting; the act of compression should occur just as the

hyoid bone is rising in preparation for the second act of deglutition. The patient can most effectually sustain the good effect by using the auto-inflation bag at home. This he can do once daily at first, and at less frequent intervals subsequently. He will find that much of the "magic" of the aurist's art rests in this simple but successful trick of inflation, the suggestion of which we owe to Politzer.

It is as well to remember that too much force might rupture a vessel or even the membrane itself, more especially in the portion called the membrana flaccida. Another argument against using force is that the barrier

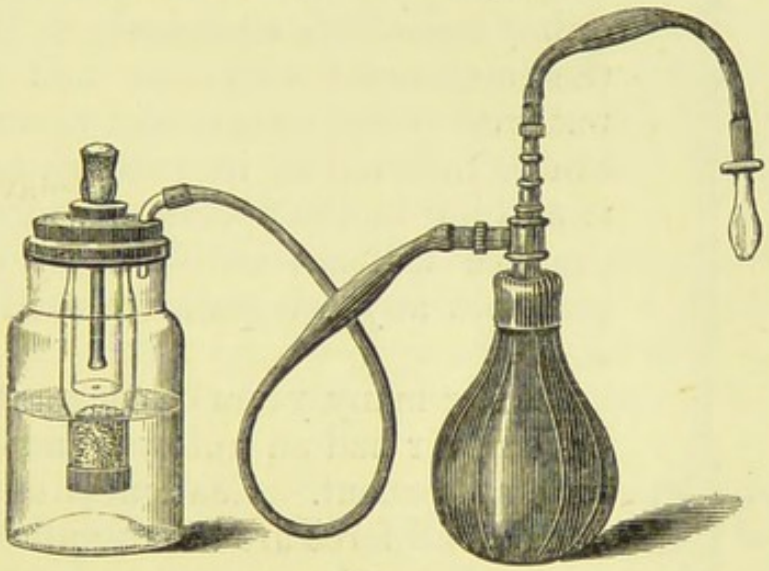


FIG. 48.—Basdon's chloride of ammonium inhaler, with the auto-insufflator attached.

formed by the soft palate and naso-pharynx may be driven down, thus causing unpleasant sensations to the patient, and non-inflation of the tympanum. It sometimes occurs that air will enter freely on the one side but not on the other, and if in a case of this description for any reason the employment of the catheter is not to be desired, then, by directing the patient to incline the head to the opposite side, the air will more readily pass into the tympanum that is uppermost, leaving the other unaffected.

4. *Eustachian catheters.* It is essential that all who would treat aural cases successfully should become dexterous in the use of the catheter. Cathe-

terization is necessary in therapeutical application to the middle ear, in overcoming Eustachian obstruction to inflation. In the diagnosis and prognosis of middle-ear affections, students should not neglect to learn the method of using the instrument any more than they do that of the urethral one. Awkwardness is as hurtful, and gentleness combined with delicacy of touch as indispensable, in the one as in the other. It is a matter for surprise that so many surgeons still fear to practise catheterization of the Eustachian tube. It is true that it requires some little experience to introduce the instrument with ease and celerity; but with ordinary care and tact no harm can be inflicted in its passage, and there is nothing in the operation which a little practice will not enable every one who possesses any manipulative skill to overcome.

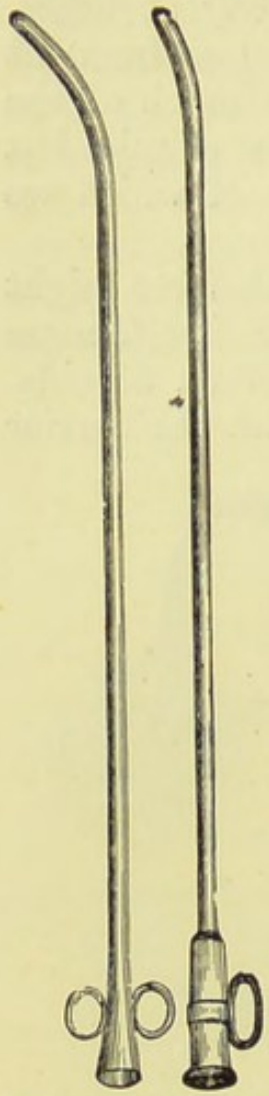


FIG. 49.—Eustachian catheters.

After many years of constant use, we have never had an untoward result follow its employment. Gentleness and avoidance of all force are the essentials to success. With these precautions we cannot conceive the catheter doing any harm. Taking these, any surgeon should be able to pass it with facility. The errors which we have seen generally committed by beginners are these:—The catheter is taken hold of in too clumsy a manner, and held too firmly during its introduction; it is introduced too slowly, and carried into the middle meatus instead of the inferior; it is not passed far enough back, or is turned towards the ear, anterior to the orifice of the tube; on the other hand, when passed back to the pharynx and turned into the fossa of Rosenmüller behind the faucial orifice of the tube, it has not been drawn sufficiently forward.

The essentials to success are—a thorough knowledge

of the situation of the opening; a light hold of the instrument, which we introduce with the forefinger and thumb of *either* hand; the beak of the catheter should be directed well downwards, and glided along the floor of the nares, avoiding the turbinated bone.

It is of importance to be able to pass the catheter with either hand with facility. Frequently a patient, just as he finds the sensitive anterior part of the nose touched by the catheter, raises his hand to catch the operator's. It is well to have the left hand in readiness, so that while we restrain the patient with the right, we continue quickly the passage of the catheter with the left hand, which we transfer to it.

It will be found useful to have catheters of various sizes and curves ready at hand. Both vulcanite and silver instruments are made (we prefer the latter), and can be curved to suit each case, the former being first placed in a little hot water to soften them.

The short catheters, about four and a half inches long, now made, are much preferable to the old-fashioned longer ones, as they do not protrude so far after passing and are not so likely to have the beak knocked out of the tubal orifice.

The following is the best method of introducing the Eustachian catheter. The plan is that which is generally adopted, and is a combination of the methods recommended by Krämer, Tröltsch, Politzer, Löwenberg, and Hinton.

The catheter, held lightly between the forefinger and thumb of the right hand, the left being in readiness to transfer to it, has its curved point directed downwards, introduced into the nostril; the hand being then raised, the catheter is carried lightly and quickly *horizontally* along the floor of the nares, all force being avoided, until the pharynx is touched posteriorly. The instrument is then rotated upwards and outwards until the ring on the outer end points in the direction of the outer canthus of the eye; it is then drawn gently forward about half an inch, and will be felt in the Eustachian tube, after having ridden over the posterior lip, and we

verify the success of the operation by inflation with the Eustachian bellows. Löwenberg and Politzer recommend a plan which it is well sometimes to adopt if we miss the orifice, namely, to turn the catheter in, withdrawing it from the pharynx with its point in a

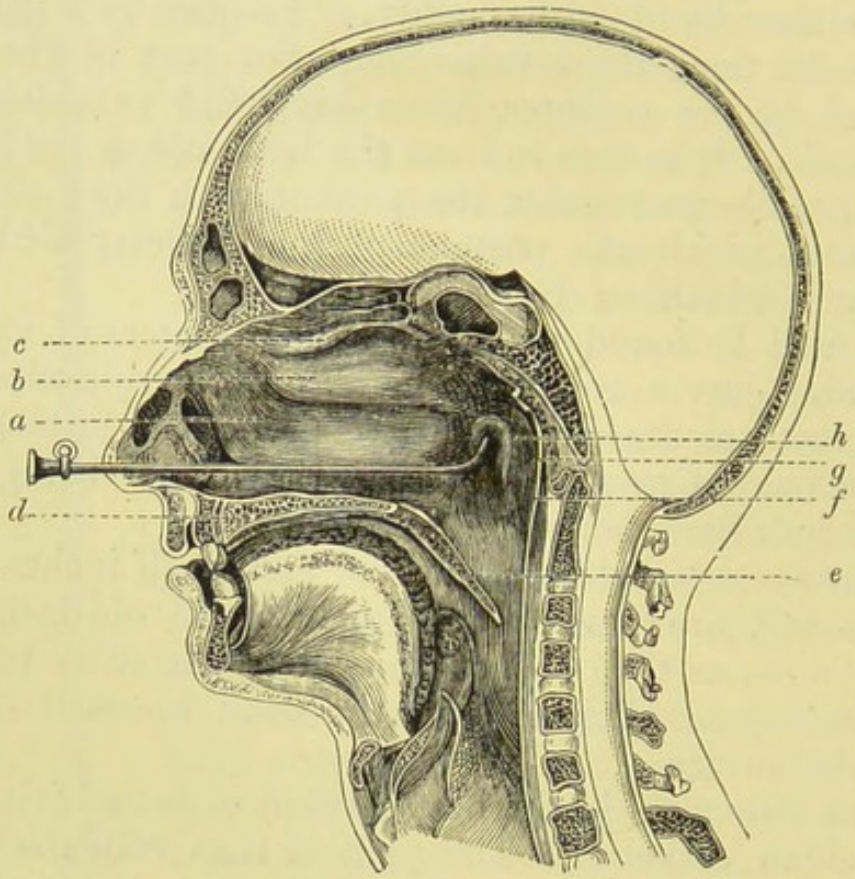


Fig. 50.—Eustachian catheter in position (Politzer). *a*, Inferior spongy bone; *b*, middle spongy bone; *c*, superior spongy bone; *d*, hard palate; *e*, velum palati; *f*, pharyngeal wall; *g*, Rosenmüller's fossa; *h*, posterior lip of Eustachian tube.

direction inwards, until we feel it against the septum, and then, by rotating the catheter outwards and upwards, to turn it towards the Eustachian tube.

The surgeon may fall into error from two causes with regard to air entering the tympanic cavity when he listens to inflation with the auscultation tube. He may think the catheter is in the Eustachian tube when its beak is only in the neighbourhood of the tubal orifice, and hence that air is entering the tympanum on inflation when it is not; or, a more likely error, he may insert the catheter correctly, yet air may not

pass beyond the wide part of the tube. The false sound produced in the first instance may be learned by any one with the Eustachian bellows and catheter. The sound reaching the surgeon's ear in the second case is far more distant, and altogether distinct from the characteristic rush of air heard when it directly enters into the tympanic cavity.

The careless or rough passage of the catheter, followed by too powerful an inflation, may lead to laceration of the mucous membrane and emphysema of the cellular tissue of the pharynx, and parts about the larynx, or, as proved by Voltolini, to pneumothorax and consequent collapse of the lung. Such an accident we should say can only result from the employment of unjustifiable force or the reckless use of the hand-bag in inflation.

Should emphysema, however, have occurred an incision should at once be made into the swelling, and for want of a better instrument the roughened finger-nail will answer the purpose. Our experience generally is that free Politzerization in the great majority of cases is the most effectual method of inflating the tympanic cavity, and that it is rare for inflation by the catheter to do much good where it fails. This remark does not apply to cases of stricture or closure of the tubal wall from tumefaction of the mucous membrane, in which cases we may have to force the walls apart by warm injections through the catheter both after and previous to Politzer's inflation. Here the greatest benefit is derived from the use of the catheter. In these cases also it is that, by passing a fine bougie through the catheter into the Eustachian tube, we succeed in opening the tube, and the subsequent inflation is more effectually secured. The bougie should be marked to indicate the degree of its protrusion from the catheter; the end of the bougie may be medicated by dipping it in any solution and allowing it to dry on it, as nitrate of silver, sulphate of zinc, chloride of zinc.

The double-curved catheters, first devised by Noyes,

and passed from the opposite nostril in a case where there is an abnormality in the vomer or turbinated bone, or an obstruction in the nasal passage of the side corresponding to the affected ear, are occasionally very useful.

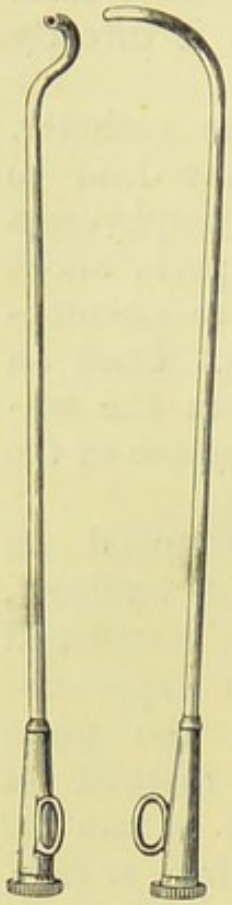


FIG. 51.—Noyes' Eustachian catheter.

It is a catheter with a double curve for the right and left Eustachian tube (Fig. 51), and enables us as a rule to disregard those obstacles of the septum and vomer, which prevent the passage of the instrument. The catheter is held in the right hand for the right nostril, and *vice versâ*, at a right angle with the nose, on a line with the floor of the meatus, the back of the hand being turned upwards, the beak of the catheter is introduced at the inner side of the corresponding nostril. The catheter, kept close by the septum, is carried for a short distance backwards, when the hand is brought down, the direction of the catheter being gradually changed to that of the horizontal one maintained in passing the ordinary catheter. With a sweep it is carried round the septum posteriorly, and then rotated inwards, the point readily entering the Eustachian tube of the opposite ear.[1]

We have been using these instruments of Dr. Noyes for a considerable time, and are constantly enabled with them to catheterize cases which would prove very troublesome, if not impossible, to manage without their assistance. We have been in the habit of employing the instrument depicted in Fig. 52, originally sent to us by Dr. Turnbull, of Philadelphia. It is a forceps which he finds extremely useful for wiping the faucial orifice of the tube, and clearing away any collections of mucus, etc., which may obstruct the orifice. We now make it a practice in those cases where we find a difficulty in

[1] An ordinary silver Eustachian catheter is easily curved in the same manner for the right or left side.

passing the catheter, to mop out well with the forceps the part about the opening of the Eustachian tube with a small portion of cotton-wool, wet with some soda solution and glycerine, previous to introducing the instrument.

FIG. 52.—Turnbull's Eustachian forceps. *a*, Sliding clip.

In some persons, where the nostril is sensitive, tender, or obstructed, it is useful either to pass a soft bulbous bougie, well oiled, once or twice before introducing the catheter, or to mop out the inferior meatus with a twenty per cent. solution of cocaine. A patient on whom the catheter has been a few times passed can tell immediately when the tube is entered and the membrane inflated. Such persons, who are accustomed to the instrument, are the best for beginners to examine, as they are less sensitive, bear the operation well, and can at once tell when it is successfully performed.

Before passing water through the ear and Eustachian tube, in cases of perforation, when we wish to wash out the tympanum, it is of importance to place the patient in a

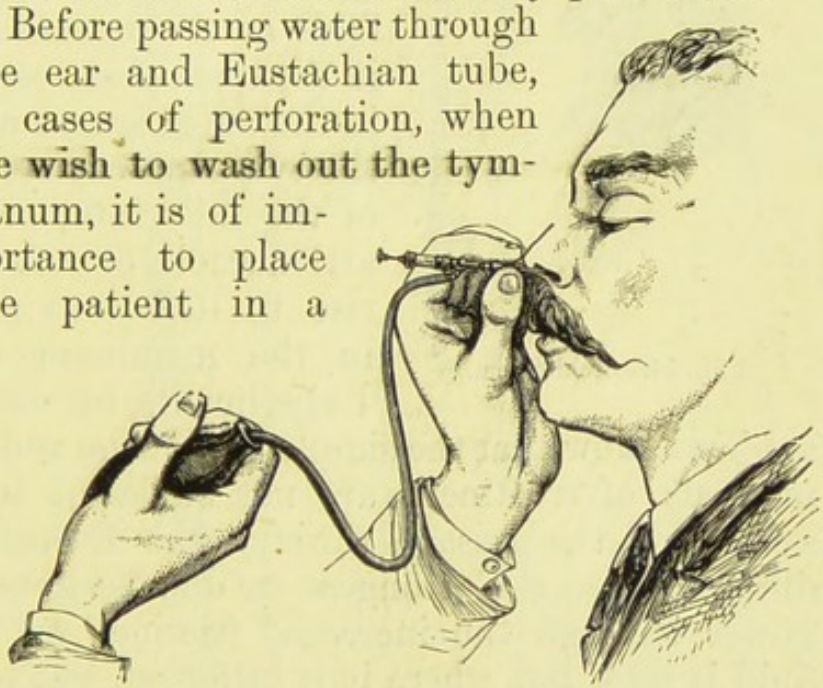


FIG. 53.—Koniontron, with the hand-balloon applied to the Pravaz syringe and catheter.

sitting posture, for here also we are likely to produce a sense of reeling and giddiness. The imprudence of using any instruments, throat or ear, which have been used promiscuously with several patients, or at any time after any suspicious case, or where there has been discharge, without first thoroughly cleansing such by dipping

them into boiling water, absolute alcohol, or some disinfectant solution, is obvious. It is unfair to the patient, and lays the medical man open to the charge of being the cause of transmitting a disease.

Dr. Weber-Liel first introduced, in certain cases of obstinate chronic ear catarrh, a special tympanic catheter. As it is included in his Koniontron for direct inflation and injection of the tympanic cavity, the description of the latter appliance is appropriately given here. Dr. Weber-Liel thus indicates the class of case in which the use of this catheter is required: in cases of long-continued chronic catarrh, where old inspissated and viscid accumulations are present in the folds of the membrana tympani, in the spaces between the malleus, in the anterior and upper walls of the tympanic cavity, in the niches of the labyrinth, or around the articulations of the ossicles, giving rise to decreased mobility both in the membrane and ossicles. Experiments on dead and living subjects show that the simple air douche and the ordinary methods of treatment are not sufficient to wash them away. If the passage through the Eustachian tube is difficult, even the strongest air douche loses much of its power through the increased friction, and the injected fluid is sent, not where it is intended, but to the bottom of the tympanic cavity or into the cells.

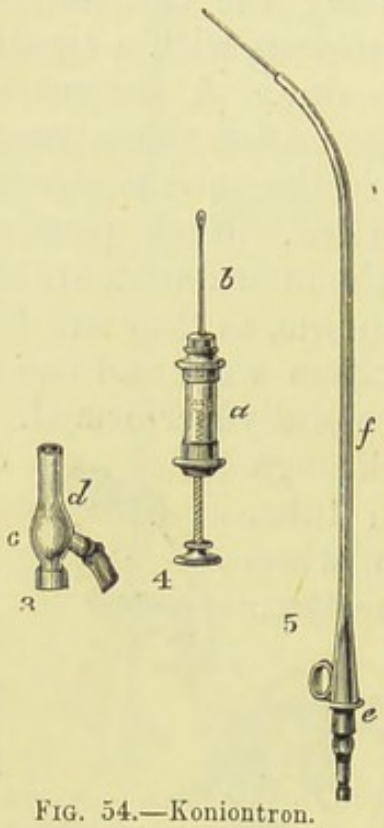


FIG. 54.—Koniontron.

The best fluid to employ is a solution of carbonate of soda, 10 grs. to the ounce. Our experience quite corresponds with that of Weber-Liel. We have never found pain or inconvenience arise from this solution.

The Koniontron (Figs. 53 and 54) consists of three parts—

1. The tympanic catheter, *f*, is a thin flexible catheter

spun of strong silk and covered with india-rubber (length, 16–18 cm. ; thickness, $1\frac{1}{4}$–$1\frac{3}{4}$ mm.). Some are made with the aperture in the side of the catheter quite close to the end.

2. The *Pravaz* syringe, *a*, *b*, made from hard caoutchouc.

3. The middle piece, *c*, *d*, is screwed on the syringe, and

Fig. 55.—Tympanic catheter.

Fig. 56.—Tympanic catheter passed through the ordinary Eustachian catheter.

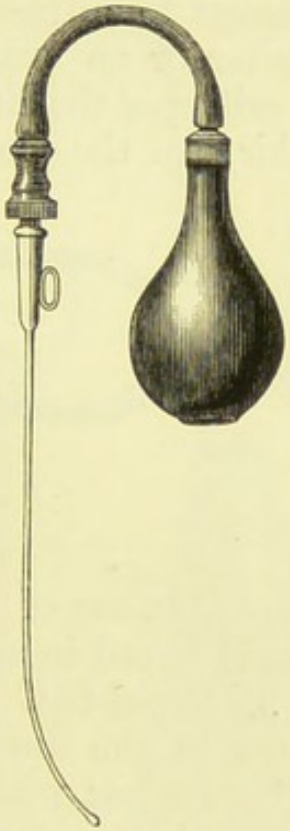


Fig. 57.—Small bag attached to the catheter for douching the Eustachian tube.

joined with a tube and balloon ; a bone top is inserted into the upper part to join it to the tympanic catheter.

After washing out the naso-pharyngeal cavity, a silver catheter is inserted into the mouth of the Eustachian tube, and the flexible tympanic catheter is

[1] The tube of a small hand-bellows may be attached to the soft catheter, and the tympanum be thus inflated.

pushed through it by a rotatory movement. Graduated markings show how far the catheter is to be introduced.

This flexible catheter is indispensable in many cases for diagnosis. It is also of service in applying suction to the tube and tympanum.

The tympanic catheter being *in situ*, and the silver catheter fixed, either by the surgeon or by the patient, who must press it with his thumb against the septum narium, the syringe with the middle piece must be joined to the tympanic catheter by the top *e*.

The Pravaz syringe is necessary when we require to resort to intra-tympanic injection. The fine flexible catheter or an ordinary catheter being introduced into the orifice of the Eustachian tube, the syringe is applied to this, and the quantity (10 to 20 minims) injected. By

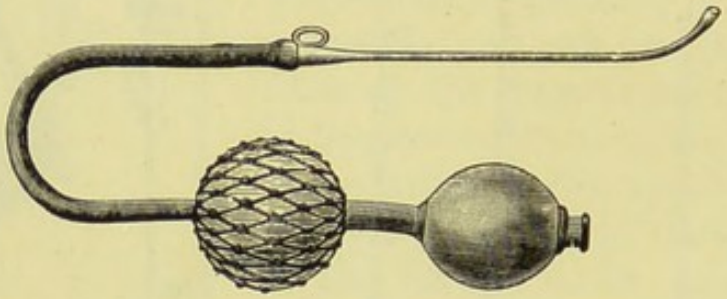


Fig. 58.

subsequent use of the bellows or small balloon bag, the fluid is forced in as spray in the tympanic cavity.

5. *Hand-ball bellows.* By such a bellows as that shown in the drawing, or by attaching the nozzle of Politzer's bag with a piece of tubing to the catheter, we can inflate the tympanum and ascertain that the catheter has entered the tube.

The bellows should have a loop close to the ball, to fix on a button of the operator's coat, thus leaving both hands free ; the other end should have a nozzle to fit the catheter. After the latter has been passed, the nozzle should be placed in the end and a few squeezes given to the ball, when, if the catheter is in its place, the response will be heard through the auscultation tube. Should it be necessary to blow fluid into the tympanum the end of the bellows should be removed,

the fluid taken up in a pipette and dropped into the catheter; the nozzle is then replaced, and the ball again squeezed two or three times.

A larger bag, having a valve and a tube furnished with a nozzle which accurately fits the catheter, is necessary for more forcible inflation through the catheter. The use of the larger balloon or of Politzer's bag for this purpose we do not recommend in ordinary practice. Any forcible inflation with this more powerful bag may do harm, and if the catheter be not accurately passed into the Eustachian canal air may be driven into the cellular tissue, and serious results follow.

FIG. 59.—Ear syringe.

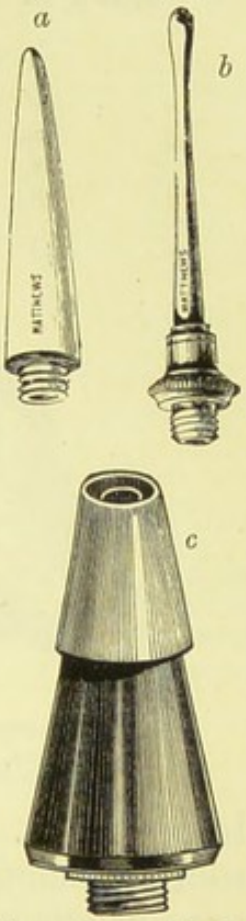


FIG. 60.—Nozzle for passing stream through the middle ear.

(*c*) *Instruments required for examination and exploration of the meatus and tympanic cavity, and for therapeutical purposes.*

1. The *syringe.* It is of course necessary to possess a good syringe —we generally employ the one here figured. The screw nozzle is an advantage, as it does not get out of order so readily as the one that merely fits on. This latter frequently becomes loose after it has been in use for some time. The narrow metal nozzle, *b*, shown in the drawing is also very useful for removing cerumen, and will be found much more efficacious than the one with the larger bore ; also the vulcanite nozzle, *c*, with the india-rubber cap can be screwed on to the syringe easily. This nozzle is useful for the treatment of cases of perforation of the

membrane. The conical india-rubber end fits well into the meatus. The patient is directed to hold the head forwards over a vessel, and the stream is passed through the ear, and flows from the Eustachian tube through the nostril. We are thus enabled to wash out the cavity of the tympanum, remove secretions, and clear the Eustachian tube with disinfecting solutions.[1]

The interior of the syringe should be kept scrupulously clean. The piston should be regularly washed in such disinfectant solutions as those of permanganate of potash or bichloride of mercury, and vaseline used to

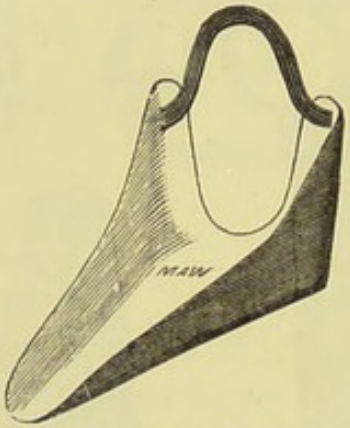


FIG. 61.—Aural spout for the ear.

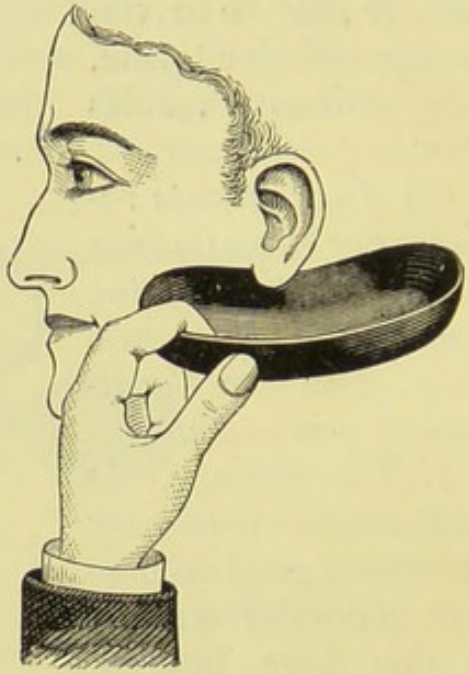


FIG. 62.—Vulcanite slice for the ear (Maw).

lubricate it. Every day after use some disinfectant solution should be passed through the syringe. Such precautions are absolutely essential, otherwise fungi and impure solutions mingled with organic particles, carried from the interior of the syringe, are apt to be introduced into the patient's ear.

2. An ear-shoot (Fig. 61) is necessary when using the syringe to catch the return fluid. The vulcanite ear-slice (Fig. 62) or a small hand-basin will answer the purpose. Stewart's ear-shoot (Fig. 63) is extremely useful, for with a little care you cannot possibly wet

[1] See pp. 66, 144.

the patient, as it is well padded at the sides and back with india-rubber to make it fit closely round the auricle. The band that goes over the ear can be altered in length by the button on the side of the shoot.

3. An *aural probe* or *cotton-wool holder* should be used for the purpose of thoroughly cleaning and drying the meatus and membrane after using the syringe.

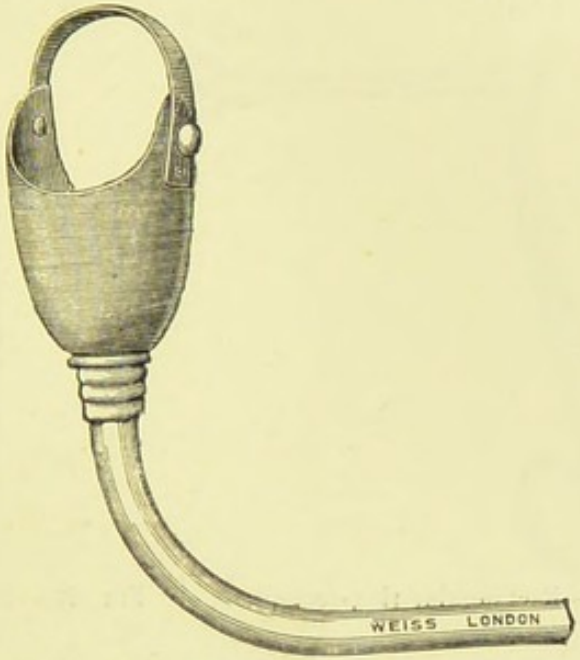


FIG. 63.—Stewart's ear-shoot.
The tube at the bottom can be as long as desired, and is run into a jar to catch the fluid. It is better to pass it under the patient's arm, and this with a touch of the little finger keeps the shoot close to the side of the head. Those now made have a larger receptacle, and can be had in tin or vulcanite.

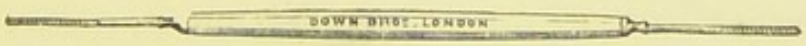


FIG. 64.—Aural probe of Macnaughton Jones.[1]

FIG. 65.—Aural probe, armed at both ends with wool. *a*, For application of chloro-acetic or chromic acid; *b*, for cleansing purposes.[1]

4. *Forceps.* Wilde's forceps, or the rectangular one devised by Hinton (Fig. 66), or the small alligator

[1] The aural wool-holder and probe, with screw ends, was first devised by Macnaughton Jones (*Med. Press and Circular*, 1869); the original probe was made by Messrs. Weiss.

forceps (Fig. 67), may be required to detach adhesive epidermis, cotton-wool, portions of hard wax, or foreign bodies. The rectangular forceps will be found, perhaps, the most useful; it is lighter, and the teeth being so perfectly adapted, the smallest particle may be grasped

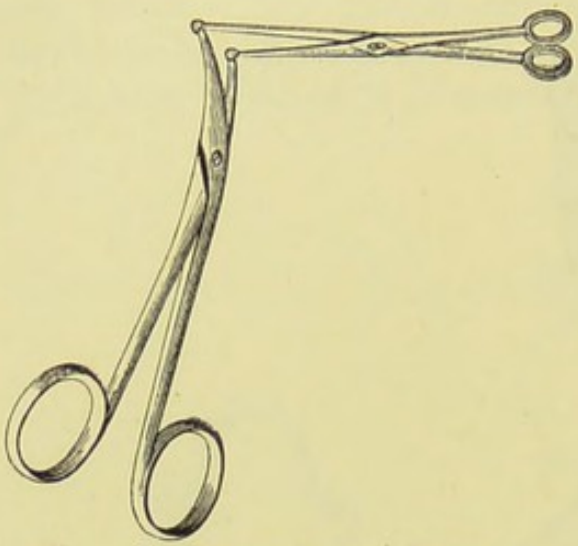


Fig. 66.—Rectangular ring-forceps.

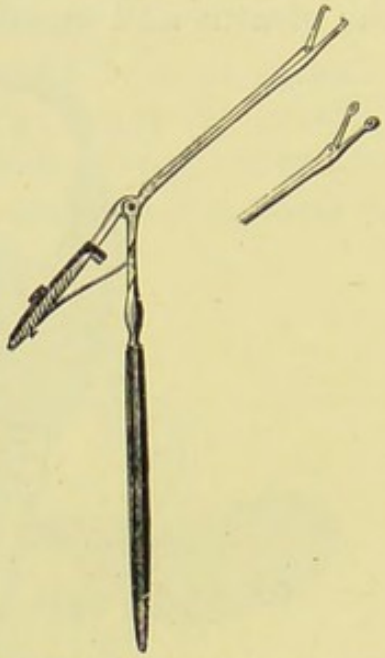


Fig. 67.—Small alligator forceps.

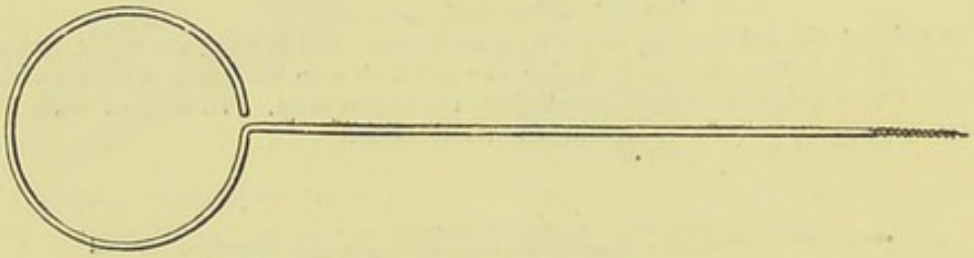


Fig. 68.—Stewart's cotton-wool holder.[1]

Fig. 69.—Small platinum crucible.

with it and withdrawn. It does not in the least interfere with the view of the meatus, and may be used through a wide speculum.

[1] These are made of ordinary wire, roughened at the end; are therefore cheap, and answer every purpose.

5. A *platinum crucible* is very necessary for fusing nitrate of silver. The silver should be melted over a lamp, and a probe lightly dipped in, when a thin coating of the silver is left on the end of it.

6. A *cautery battery*, various *snares*, a *chromic acid carrier*, and small *ring-knife* are necessary, and will be explained later on.[1]

[1] See p. 151.

CHAPTER VIII.

EXAMINATION OF PATIENT.

Steps of Examination, History, Symptoms, etc.

The following method of examination will be found adequate in general practice :—

History of case, including residence, occupation, duration of deafness—Mode of onset.
Causes.
Hereditary influences.
General health.
Past treatment.
Present symptoms, including—
- Tinnitus.
- Giddiness.
- Pain.
- Discharge.
- Evidence of constitutional taint.
- Hearing distance with watch, click of finger-nail, speech, acoumeter.
- External meatus (condition of).
- Auscultation tube and Politzer's inflation.
- Membrana tympani (condition of), with cavity of tympanum.

Tuning-fork.
Eustachian tube (state of).
Throat (state of).
Nasal cavities and naso-pharynx (state of).

This can be briefly entered in the surgeon's case-book (space being left for the above particulars), in tabular form, thus :—

No. of Case—Name—Age—Occupation—History, etc.
Symptoms.

	Right ear.	Left ear.
H. D., E. M., M. T., T. C., T. F., E. T.,	*Before and after inflation by Politzer's method.*	

Nose and naso-pharynx.
Throat.
G.H. (General Health).

Examination.—Having noted the general state of the patient's health, the first step is to inquire the length of time the deafness has lasted, if both ears are affected, and if so, how each has been attacked; next to note carefully the manner in which the deafness has progressed, if this progress has been rapid or insidious, with or without pain or discharge. A careful examination and comparison of the hearing power of the *two* ears is requisite in every instance. Patients constantly affirm that the hearing of one ear is perfect, yet on coming to test it accurately we may find it more or less impaired, the reason of this being that, while the conversational power is not interfered with, the hearing distance as measured by the watch is considerably so. We should now seek closely for some cause, making inquiries into the habits, occupation, state of health at the time of or preceding the invasion of the symptoms. The connection of deafness with the exanthemata is a point which should not here be overlooked, these and the various fevers being frequent causes of deafness. Cold, rheumatism, gout, and syphilis should not be forgotten, the last both as a direct and hereditary source of mischief.

It is surprising how minute may be the portion of cerumen which, if it rests on the membrane, will cause tinnitus.

External Meatus and Membrana Tympani.

Having ascertained the characteristic symptoms from which our patient suffers, the mode of their occurrence, and the nature of their progress, with such personal or family history as may be of importance, we next proceed to examine the present condition of the auditory passages. We shall here merely detail the steps which it is necessary to take, as it will be requisite to refer to each part specially in considering the various morbid conditions requiring treatment.

We have now to place our patient in a good position for examination. He should be seated in a chair, with the light used on either the right or left hand side. The surgeon should then sit facing him, and reflect the light by the frontal mirror well on the point to be examined. With a little practice a full view can be easily obtained, and any one can soon familiarize himself with the steps necessary to make a complete examination.

A child is best examined sitting on the lap of the mother or standing or kneeling on a chair, the head, if the child is restive, being fixed by the mother or some assistant.

(1) Examination of the Mouth, Nose, and Naso-Pharynx.

In arriving at a diagnosis, an examination of the throat, nose, and, if necessary, the posterior nasal passages, is essential in most affections of the middle ear. It is quite outside the object of this handbook to enter into any detailed descriptions of affections of the throat and nose. It is absolutely necessary, however, to consider briefly those affections of the naso-pharynx in so far as they involve our diagnosis and treatment of the ear, and especially the middle ear.[1]

As it must be necessary occasionally to practise

[1] Practitioners will find Dr. Cresswell Baber's *Guide to the Examination of the Throat and Nose* (Lewis, London) most valuable.

rhinoscopy in the treatment of deafness, and as the manipulation of the laryngoscope is a less difficult one than that required for rhinoscopic examination, while the same reflector and illumination can be employed for both purposes, it follows that any practical aurist should first familiarize himself with the use of the laryngoscope. In every case we should place our patient opposite a good light, and, with a depressor getting the tongue well down, examine the state of the mucous membrane covering the soft palate, uvula, tonsils, and pharynx. Frequently we may have only a congested condition of the pharyngeal membrane, and an ordinary catarrhal state, popularly called relaxed. This turgidity leads to temporary closure of the Eustachian tube, and is a frequent accompaniment of "cold in the head."

Fig. 70.—Ordinary laryngoscopic mirror.

Mouth and Pharynx.

In this first examination we note the state of the tongue as indicative of the general health of the patient, or evidence it gives in any white patches or fissures of the presence of a syphilitic taint.

The colour of the mucous membrane covering the hard and soft palate, whether it affords proof of a general anæmic condition, should be noted, or any scarring or ulceration. We may, at the same time, observe the relative size, position, and appearance of the tonsils, if enlarged, and the seat of follicular inflammation, the size of the uvula, and the depth of the space between the velum and the pharyngeal wall and its tonsils. Any discharge covering the pharynx, as, for example, the well-known slimy dark-brown or greenish-black tenacious discharge, which is the most characteristic feature in old catarrhal conditions of the nose and naso-pharynx, accompanied in ozænatous states of the nares by a most unpleasant odour. An error in regard to this odour might readily be fallen into

in some cases. A lady consulted Dr. Macnaughton Jones for what she thought was an unpleasant smell coming from her nose, and for which she had been locally treated. Examination showed that though the mucous membrane of the pharyngeal wall was somewhat dry and glazed, there was no evidence of retained secretion, or any post-nasal discharge. Still a most offensive odour was present with the breath. By making her breathe lightly through the nostrils, with the mouth closed, no smell was perceived; on her breathing entirely through the mouth, it was present as before. A course of papaine, with permanganate of potash and peptones, and careful regulation of the diet, in a short time cured this most offensive symptom of gastric derangement and dyspepsia. During the general survey, we may be directed to a paretic source of the deafness by alteration in the natural position of the uvula, or the palatal arches, the former of which, in consequence of one-sided paresis of the palate muscles, is drawn to the side, the latter drooping and occupying a lower level than in the normal state. Having, then, thoroughly examined these facts, we next proceed to—

(2) The Examination of the Anterior Nares.

To do so the light should be thrown well into the nostrils. A nasal speculum should then be inserted, and the patient directed to breathe gently through the nose. For the examination of the anterior part of the turbinated region, the patient's head should be inclined slightly backwards and slightly forwards when the posterior part is to be looked at.

A careful examination should be made of the turbinated bones, the septum, and the passages. The appearance of the mucous membrane of the inferior and middle turbinated bones and the bones themselves, and whether there is any atrophic or hypertrophic ulcerative or carious condition, ascertained by means of the probe, should be noted. Any growths on either side, or deflections or outgrowths from the septum, whether

congenital or the results of injuries, must be looked after. And the perviousness of the meatus may be ascertained by the nasal probe or bougies.

FIG. 71.—Macnaughton Jones's portable flat and screw end nasal probe.

FIG. 72.—Nasal bougies (Stoker's modification).[1]

A little practice will enable the surgeon readily to recognize hypertrophic conditions and abnormalities of the turbinated bones from polypus and other growths, while the concavity, on one side corresponding to the convexity in the obstructed nostril, when we examine both surfaces of the septum with a probe, will decide any doubt between deviation and growth of the septum.

(3) Posterior Rhinoscopic Examination.

The patient being directed to sit with the head erect, and to open his mouth widely, the tongue is pressed forward and downward with the shank of the mirror, a tongue depressor, or the forefinger of the left hand, and the mirror is introduced to the back of the throat, so that the plane of the reflecting surface forms with the horizon an angle of about 135°. If the uvula is drawn upwards and backwards, the patient must be directed to expire gently, and continue to produce some nasal sound. Straining and forced inspiration must be especially avoided. The practitioner will find it a good plan to introduce the small mirror between the anterior pillar and the uvula on one side first, and then to withdraw it and introduce it again in the same manner on the opposite side. In this way the posterior nares will be seen, and by slanting the mirror first to the one side and then to the other, the

[1] These will be found admirable bougies for the surgeon's or patient's use. They can be rendered soft by heat.

orifices of the Eustachian tubes will become visible. It is seldom that the whole of the posterior nares can be viewed with the mirror, as the soft palate generally eclipses the lower third.

In examination of the posterior nares the principal difficulty we have to contend with is the length and breadth of the uvula, and the shortness of the distance between the anterior pillars of the fauces and the posterior wall of the pharynx. The former obstacle may be in some measure overcome by attention to the hints given above as to breathing, or, in those cases in which these plans are not successful, by trying the stiffened piece of string (Wales) referred to on p. 106, in the last chapter. But all these methods at times fail, either from the unwillingness of the patient to submit to examination, or from the closeness of the soft palate to the pharyngeal wall. At best we can get, at any one moment, only a partial view of the posterior nares, and must reintroduce and shift the mirror in different directions, and from side to side, to ascertain what is the condition of all the parts seen by the post-rhinal method. In the case of patients in whom the soft palate lies quite close to the pharyngeal wall, posterior rhinoscopy may be quite impracticable. The facility of examination in sensitive persons may be increased by brushing the pharynx with cocaine before the introduction of the mirror.[1]

Palpation.—But in young children frequently we cannot use the rhinoscopic mirror. This is of more consequence since we have come to recognize, thanks to Löwenberg and Meyer, the relation which adenoid tumours of the naso-pharynx hold to deafness and imperfect nasal respiration. In such cases we may gain all the information we require by palpation.

The method of palpation is as follows:—First paint the pharynx and fauces with a twenty per cent. solution of cocaine; stand behind the patient, and having first placed a towel over the head—and the reason for this in hospital practice is very frequently too sufficiently

[1] Page 106.

obvious—pass the left arm round the neck, and place the left thumb on the front teeth of the lower jaw, taking the precaution to cover the thumb with the end of the towel if the teeth are sharp; you will thus have immense power over the patient, and be able not only to prevent him from closing his teeth on your fingers, but, having got his head in chancery, prevent him from moving it.

Pass the forefinger of the right hand quickly and gently to the pharynx, and hooking it round the soft

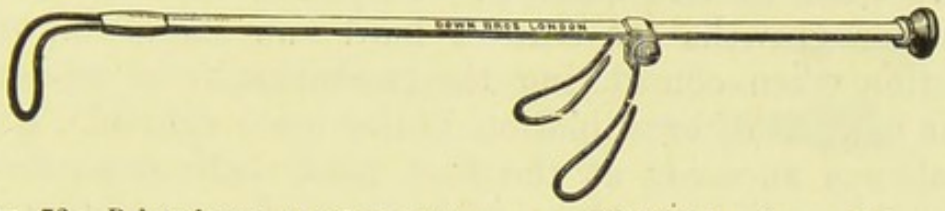


Fig. 73.—Palate lever, American pattern, as modified by Mr. Cresswell Baber.

palate, carefully search the regions of the Eustachian orifices, the posterior nares, the vault and wall of the naso-pharynx, and the pharyngeal tonsil. If growths are found, it is as well to take the opportunity of giving the softer ones a scraping with the finger-nail, for in this way many may be removed, and in some cases, where the growths are few and soft, nothing else is necessary.[1]

Löwenberg remarks that the direction to bend the head forwards, intended to facilitate rhinoscopic examination, has been tried by him for digital exploration also, but he finds that it does not attain the object proposed, and for this reason—that the head, when bent forwards, is brought nearer to the anterior surface of the vertebral column, and that thus the dimensions of the naso-pharynx are considerably diminished from before backwards in the antero-posterior diameter. He thinks it better to direct the patient to incline the thorax forwards and the head backwards; by these means we get the widest space between the soft palate and the back of the throat; at the same time we secure

[1] Paper on adenoid growths by W. R. H. Stewart, *Lancet*, September, 1890.

the greatest distance from the surfaces of the cervical vertebræ, thus gaining as much space as the anatomical relations of these latter with the cranium will allow.

Digital examination thus enables us to judge of the condition of the posterior and superior walls and the lateral regions of the pharynx—a result which it is more difficult to obtain by the rhinoscope. The finger gives us the parts in their relative position, as they really are, while, when reflected in the mirror, they necessarily appear foreshortened, and not, as they are normally, in relation to one another. Palpation also shows us whether growths are soft or hard—an important distinction when considering the treatment to be adopted. This method of examination is the more valuable, since it always succeeds at the first trial, and consequently gives immediate results, which we might not obtain for a long time with the rhinoscope, enabling us to ascertain the presence or absence of growths, their site, their dimensions, their shape, and often their insertion, while the rhinoscopic mirror, if we can also use it, shows the condition of the mucous membrane, its colour, and the nature of its secretions, and with its assistance we can examine deeply into the nasal fossa, learning with greater certainty than by palpation the existence of small tumours. We should then, so far as it is possible, when we suspect the presence of adenoid growth and post-nasal obstruction, employ both methods; the patience exercised will be more than recompensed by the accuracy of the diagnosis, and the possibility thus acquired of radically curing the affection.

The laryngeal brushes depicted in Fig. 74 are indispensable in the treatment of the throat and naso-pharynx. They can be curved to apply behind the soft palate, and to the posterior nares.[1]

4. We now turn our attention to the ear itself, and we should first thoroughly overhaul the auricle for any obstruction to the meatus arising from deformity or

[1] The modern plan of making the handles and shanks of aural and nasal appliances of metal has the advantage of greater cleanliness. They can then be washed with boiling water after use.

disease, such as eczema or erysipelas. And then having turned a good light on, the speculum should be introduced, and in doing so, remember the direction of the meatus, and endeavour to straighten it as much as possible by drawing the auricle a little upwards, outwards, and backwards, otherwise there is a tendency for the light to fall on the wall of the meatus. Opening the mouth too will sometimes slightly enlarge the lumen of the canal.

In introducing the speculum we must remember the great timidity that many patients exhibit on being examined, and also that violent fits of coughing and even syncope may follow rough usage. Hence it is that a gentle yet firm hand is required to conduct all aural manipulations. In many affections of the auricle and meatus there is superadded to the natural sensitiveness an inflammatory state which makes the handling of the ear a thing to be avoided as much as possible. In any case of aural affection all force or roughness in manipulation is to be deprecated. Those who cannot manipulate with gentleness had better not manipulate at all. A man's entire success with a patient will depend much on the confidence and ease with which he introduces the speculum or the Eustachian catheter; the infliction under any circumstances of unnecessary pain should be avoided. This preliminary encouragement of the patient can only be secured by keeping constantly in mind and strictly adhering to the resolution to *avoid all force.* No rough or awkward surgeon can ever be an aurist.

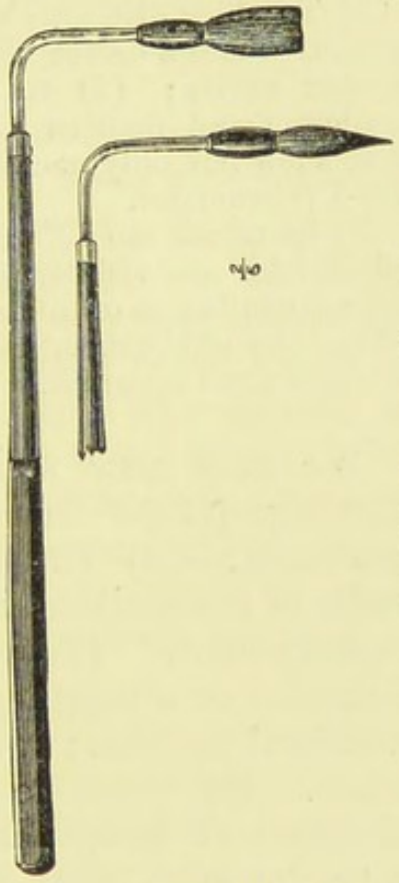


Fig. 74.—Laryngeal brushes.

Having introduced the speculum well into the

meatus, we note its shape and size, if narrowed and painful; if the dermis is congested or inflamed; if there is any discharge, and if so, its colour, nature, or smell; if there is a collection of cerumen which interferes with our view of the membrana tympani. If there is any pus or epithelium blocking up the meatus it must be carefully removed with the syringe, and the passage cleaned with a little cotton-wool rolled on the aural probe. The canal can then be examined thoroughly for foreign bodies, polypi, molluscous or sebaceous tumours, aspergillus, exostoses, etc.

Weber-Liel has devised an ear microscope,[1] with these objects:—(1) To show distinctly the magnified membrana tympani, and, in cases where a defect of the membrane exists, the part of the exposed cavity; (2) to demonstrate the oscillations of the membrane and malleus under normal and abnormal conditions, *i.e.* to show not only morphological, but also functional alterations with a micrometer.

By its means the different excursions of the membrana tympani and ossicles are visible, and the power of motion in the former under the influence of different sounds or musical tones. Adhesions and rigidity of the membrane and anchylosed states of the ossicles are made more apparent.

We may now seek to satisfy ourselves on the following points in connection with the tympanic membrane:—(*a*) The appearance and position of the handle of the malleus, if drawn inwards and "shortened in perspective" (Tröltsch); if it appear unusually prominent or altogether displaced and dislocated from its natural position; if it is vascular and injected on the surface. (*b*) The cone of light, if present, its direction and degree of lustre; if it has lost its shape, or if there are two or more spots of light. (*c*) The general colour and appearance of the membrane itself; the degree of curvature, opacity, and thickening; the prominence of the anterior and posterior folds; the appearance of the manubrium, the umbo, and short process; their relative prominence, vascularity, and colour; the degree of

[1] A full description of the ear microscope appeared in the second edition of this work.

mobility or flaccidity on inflation; the signs of any deposits, calcareous or otherwise; the presence of polypus; if there be pulsation, rupture, or perforation.

Often, with the speculum, it is not easy to diagnose a pin-hole perforation or a slight rent or slit in the membrane. The presence of a minute particle of cerumen, a tiny blood-clot on the membrane, a small foreign body, an old scar, or the cicatrix of a healed perforation, may each be taken for a small perforation. We should on all occasions, when in doubt about perforation, confirm the diagnosis by inflating the ear.

Sometimes the hole is covered by a bright bubble of air, the movement of which distinctly marks the vascular pulsation, and the glisten of which at once shows the seat of the perforation.

All deceptive appearances are discovered by the adoption of these two methods: first, by careful examination with the speculum and watching the suspicious spot on inflation; secondly, by the use of, especially in recent cases of perforation, the auscultation tube and Politzer's bag. To examine a patient for a perforation we must first carefully cleanse the meatus, and get a full and distinct view of the membrane. If the perforation is large there will be no difficulty in recognizing its presence, the clean-cut edges marking its size and position. In many instances the membrane is almost entirely absent, and then we get a view of the cavity of the tympanum.

Not alone may we see with the pneumatic speculum the smallest perforation, but we can recognize any adhesions that may have formed, binding the membrane to the inner wall of the cavity or to the stapes and promontory. The membrane may be thick and cartilaginous-looking, a condition frequently accompanying anchylosis of the bones.

CHAPTER IX.

GENERAL THERAPEUTICS.

The Artificial Membrane.

In applying an artificial membrane for the improvement of hearing in the case of a perforation of the membrana tympani, there are some facts that must be remembered, both as regards the manner in which the false membrane acts and its mode of application. It does not improve the hearing by merely closing the opening; on the contrary, closure frequently acts the reverse way. The pressure on either the malleus or incus is distributed through the stapes to the labyrinth, or it may be directly to the stapes. This direction of the applied pressure must vary in different positions or conditions of the ossicles dependent on the amount of destruction or displacement which has occurred. But the artificial disc may improve the hearing by changing the leverage action of the ossicular chain, and then altering the pressure on the fluid of the labyrinth. Knapp points out how diminution of tension may follow from the pressure of the artificial membrane on the short process of the malleus, which, if pressed inwards, would release the lower arm, and move the stapes outwards. Thus it comes to pass that in some cases where no aperture in the membrane exists, the pressure of the artificial disc improves the hearing by acting on the equilibration of the fluid in the labyrinth. Thus, also, we see why it is that the results which follow from its use are so variable, and how necessary it is to try patiently and perseveringly

to ascertain whether it improves the hearing or not by altering the direction of the pressure. This experiment may have to be repeated a few times. It follows equally that we must seek for other causes of disturbance of equilibration than the ossicular in the application of an artificial membrane, and, if possible, remove these ; as, for example, any obstruction in the Eustachian tube. The improvement in hearing is sometimes extremely marked, and the delight of the patient who suddenly hears conversation is in proportion. Other possible consequences than the improvement in hearing must, however, be remembered in connection with the use of the membrane, be it made of rubber or wool.

It may be said that these only follow from the careless or improper application or use of the membrane ; yet, as they do so follow, it is well to bear them in mind. The disc may cause pain and irritation in the ear, if it be too long or too forcibly applied. It may also produce giddiness. It may bring about septic states of the meatus and middle ear if worn too constantly, if it be not removed at night, or if the ear is not systematically cleansed during its use, and attention paid to the periodical disinfection of the ear passage. If these precautions be taken to obviate such consequences, and patients are given precise instructions, no harm is likely to follow the use of the membrane.

Of late years, for hospital practice, we have seldom resorted to any membrane save when there was marked improvement, but we must say that in our experience, in a large percentage of perforation cases, that improvement is not sufficient to compensate for the inconvenience and risk that attends the use of the artificial membrane in the poorer classes of society, where neglect of it is often found to be followed by bad results. It is better in such persons to get the drum cavity and perforation into as healthy a state as possible, enforcing on the patients a periodical visit, and unless they are very intelligent we do not trust them with an artificial membrane.

The figures represent some different forms of tympanum. In practice it will be found that the best

results are to be obtained from the ball of absorbent wool or the plain rubber disc. We generally find that where metal is used irritation ensues. In one case, too, in which an india-rubber disc was employed, the patient came the next day with the disc stuck to the remains of the drum-head, and some little difficulty was experienced in removing it, but warm water and the application of Politzer's bag at last effected it. In applying either, the ear must be cleansed and the membrane applied with a small membrane forceps or by its stem, the disc or wool having been first moistened with carbolized glycerine, or solution of bichloride of mercury in glycerine, strength $\frac{1}{3000}$.

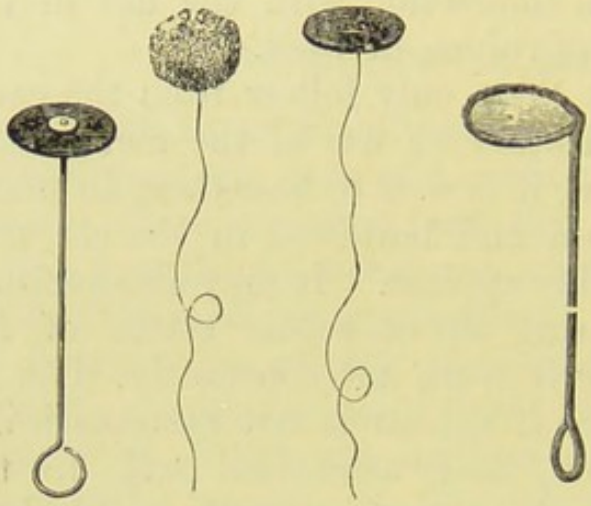


FIG. 75.—A, Toynbee's; B, Yearsley's cotton-wool; C, Grüber's; D, Turnbull's membrane.

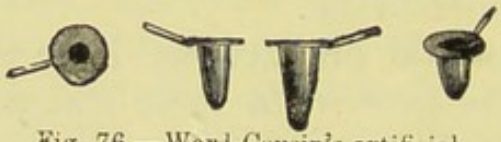


Fig. 76.—Ward-Cousin's artificial membrane.[1]

FIG. 77.—Forceps for applying Yearsley's wool, with tube for carrying Toynbee's membrane.

It is best to remove all artificial membranes at night. Toynbee's tympanum can be had either with a stem or piece of thread attached, the latter being applied with a small tube. Yearsley's is a simple egg of cotton-wool. Field's is a combination of Toynbee's artificial membrane

[1] These membranes are of three sizes, and instructions for use are printed on each box.

with Yearsley's cotton-wool. The wire is carried beyond the india-rubber for about a quarter of an inch, and terminates in a second disc made of flannel. The space between the two is filled with a small portion of absorbent cotton-wool, which takes up and communicates to the flannel disc any medicated solution which it may be desirable to apply. Turnbull's tympanum has a steel stem at the side. Ward-Cousin's is composed of compressed cotton and is shaped like an inverted cone.

Artificial Aids to Hearing.

Artificial Aids, Ear Trumpets, etc.—There must ever remain a number of patients who consult us for deafness, and for whom we can only advise some artificial aid to assist the hearing. The present state of our knowledge in differentiating the conditions benefited by the various kinds of trumpets, ear-tubes, auricles, audiphones, dentaphones, etc., is anything but satisfactory. Cases where there are extensive changes in the ossicles, or the nerve itself is diseased, and the ear can only hear certain tones, of high or low pitch, which cannot be conveyed through a trumpet, are but little improved by any form of apparatus. Still, in a large number the patient is made fairly comfortable by some such means of hearing and carrying on conversation. Also in public buildings such aids are indispensable.

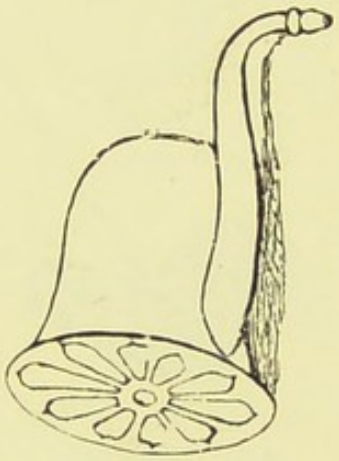


Fig. 78.—Ear trumpet (Krohne and Co.).

It is not possible to speak positively of any particular form of ear trumpet, inasmuch as it is purely a matter of experiment with each individual case which one is found to give the best results. We figure here a few of those we have found most useful in practice. The light conical-folding trumpet, made of japanned tin, is one of the best, and most convenient for the pocket. The small bell-shaped trumpet is also handy and portable.

The folding audiphone of Rhodes is simply a fan, made of thin vulcanite, which folds up, one end of which is applied to the teeth, while, with the handle held by the listener, the convex surface is presented to the speaker.

The dentaphone consists of a small vulcanite clip connected with a small circular vulcanite box by a string, somewhat like the ordinary toy telephone. The proportion of cases in which such aids improve hearing

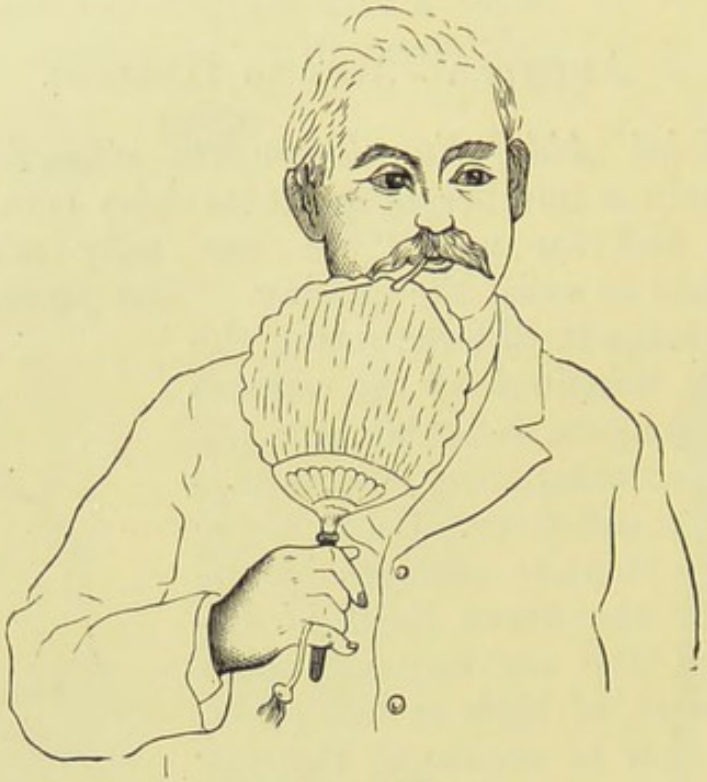


FIG. 79.—Audiphone.

in our experience is very small. Most patients object to the conspicuous nature of the audiphone, and the majority hear best with a trumpet of some kind. It is a matter of experiment in all cases, and perhaps we may expect to find about five per cent. of deaf people benefited by either appliance. Any one can make an audiphone for himself from a piece of very thin ash wood, which is the best for the purpose. This is steamed, and when warm given the suitable curve. The teeth must be separately tried to test the conduction. The instrument must touch a natural tooth. The patient must then be spoken to in different tones. He may be

tried with the piano or singing. A portion of a book, and the same extract, may be read aloud from day to day, so as to test the improvement. A common Japanese fan makes a very good audiphone. The advantage derived from small instruments worn in the meatus is generally very slight. Politzer devised a small trumpet to diminish as much as possible the loss of the sound-waves during their reflection, and to conduct them into the auditory meatus. We have had in many patients a satisfactory result with this little trumpet. It must fit the meatus well. The instrument is here represented. It is made of flesh-coloured vulcanite, and is not conspicuous. The narrow part fits into the ordinary meatus, and the wide portion is turned towards the concha. There are three different sizes, the larger measuring in length $2\frac{1}{2}$ cm.; at its outer opening it has a diameter of 12 mm., and at the inner aperture it has a diameter of 5 mm.

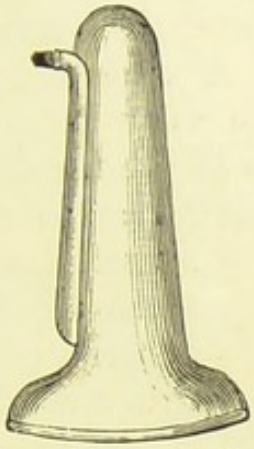


Fig. 80.—Small vulcanite trumpet.

Fig. 81.—Folding ear trumpet.

Fig. 82.—Politzer's ear tube (actual size).

The materials most commonly used for "aids" are silver-plated metals, aluminium, japanned iron, ebonite.

Aural Forceps, etc.

For removing small particles of dead cuticle and loose foreign bodies, which can be readily caught, such as cotton-wool, sponge, etc., either the rectangular forceps or the alligator forceps, already alluded to in p. 130, are simple and handy appliances. But for the removal of granulations, small polypi, or minute sebaceous

tumours, and in fact in all cases in which we require an instrument adapted to grasp expeditiously a minute growth or small particle of any kind in the meatus or on the membrane, the lever forceps shown (Fig. 67) is most useful. A movement of the thumb closes the blades, and the view is not obscured in consequence of the direction of the handle.

The lever-ring forceps of Toynbee (Fig. 83) is also a useful and delicate instrument for the removal of small vascular polypi, but has the objection of the handle being in a straight line with the blades.

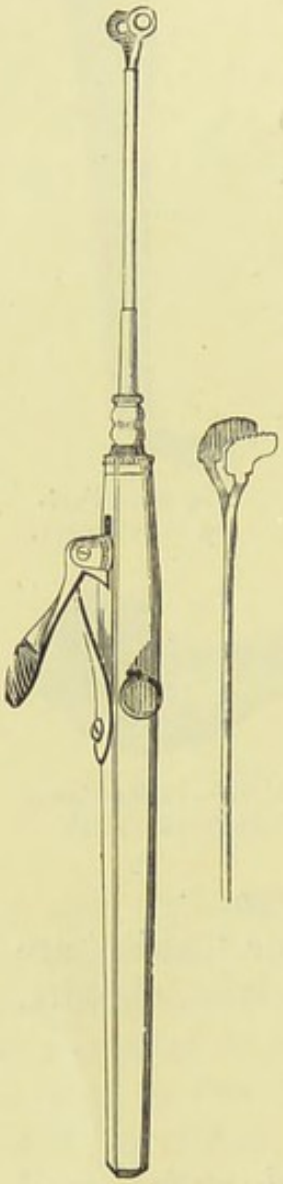


FIG. 83.—Toynbee's lever-ring forceps.

In using either of these forceps the patient is made to sit with the head inclined a little to one side; a large-sized speculum, a Krämer or a Stewart (the latter consists of Krämer's blades, cut much shorter, and mounted on a spring-like Thudichum's nasal speculum), is introduced into the meatus, and the light thrown into it with the spectacle mirror. A twenty per cent. solution of cocaine having been previously applied, an assistant supports the head of the patient, and when a good view of the polypus is obtained, the forceps is carried steadily down to it; the rings being now opened, the polypus is grasped by pressure on the lever, and removed. The forceps, in the case of two or three polypi growing from the membrane or meatus, may have to be introduced some few times in order to remove all the growths. If bleeding obscures the view, it is well to wash out the meatus with hot water, and then dry the surface of the membrane or the bleeding part before reintroducing the instrument.

For the removal of the smaller polypi, a ring-knife

(Fig. 84) set at an angle is most useful. The ring being slipped over the growth, the knife is drawn out with some slight pressure towards the root, and the growth will as a rule come away easily. The aural snare originally devised by Wilde (Fig. 85), or a small Jarvis (Fig. 86), is necessary for the removal of the larger polypi. The latter has the advantage of having screw power as well as the slide—greater force can thus

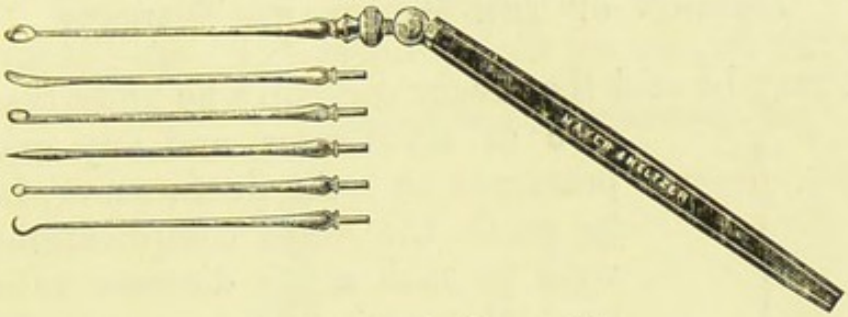


Fig. 84.—Ring-knife at angle.[1]

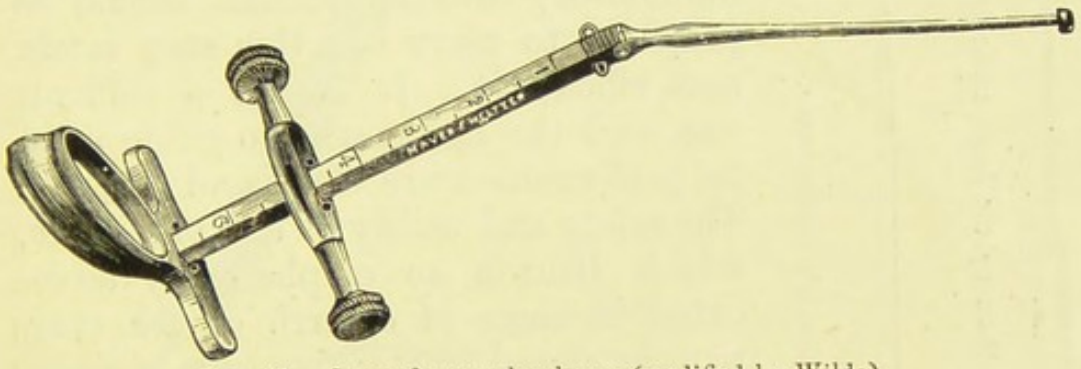


Fig. 85.—Snare for aural polypus (modified by Wilde).

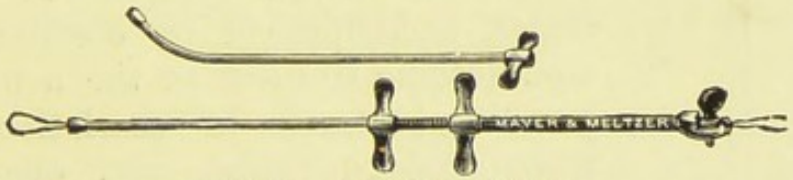


Fig. 86.—Jarvis's small snare.

be applied if necessary, and in removing very vascular growths there is not so much hæmorrhage.

In all cases it is necessary to ascertain the size and attachment of the polypus with a probe. Having done this, the patient's head must be steadied, the wire loop of the snare applied, and the growth removed. It may be well to use cocaine to the meatus beforehand, but if

[1] This is a very handy set of instruments, all fitting into one handle.

the instrument be properly applied to the pedicle there is little pain caused by the removal, and syringing with hot water quickly restrains any hæmorrhage. When this has ceased, then the application of cocaine subdues the slight pain which may subsequently be present for a short time. With children it is often necessary to give an anæsthetic.

Incision of the Membrana Tympani.

It may be said that every surgeon who undertakes the care of aural cases, and any one who presumes to treat deafness, or, indeed, to guide the aural complications met with in such acute diseases as scarlatina, the various fevers, or acute inflammatory throat affections, should be prepared to carry out this step safely and efficiently. It is not a difficult one, and the landmarks to guide us in its performance are clear and distinct. The safety and utility of this procedure, which Hinton so emphatically advocated in cases of catarrh of the tympanum, closed Eustachian tube, rigidity of the membrana tympani in various states, accompanied by obstinate and troublesome tinnitus in the acute suppurative catarrh of scarlatina, is a recognized operation, and one which can alone relieve certain morbid states causing or accompanying deafness. In many cases of catarrh of the tympanum, accumulation of mucus with incurved membrane, incision is followed by results far exceeding our most sanguine expectations. At the same time we must be prepared for many negative trials and disappointments. Hinton may have been too enthusiastic as to the ultimate place that this operation would take in aural surgery, yet undoubtedly this enthusiasm

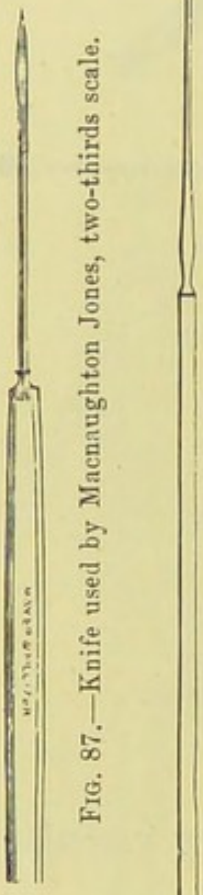


Fig. 87.—Knife used by Macnaughton Jones, two-thirds scale.

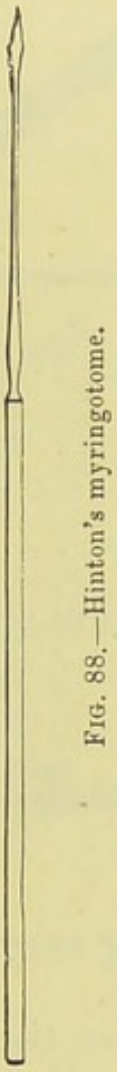


Fig. 88.—Hinton's myringotome.

was warranted by the brilliant success which attended his treatment of a large number of otherwise hopeless cases.

The operation may be performed thus :—The patient is placed sitting opposite a good light with the head fixed, the mirror throwing the light well down on the membrane through a wide speculum. A small lance-headed knife, shaped like a very fine cataract knife (a sheathed instrument is preferred by some), is carried steadily down to the membrane with the edge of the blade turned up. The membrane is punctured generally

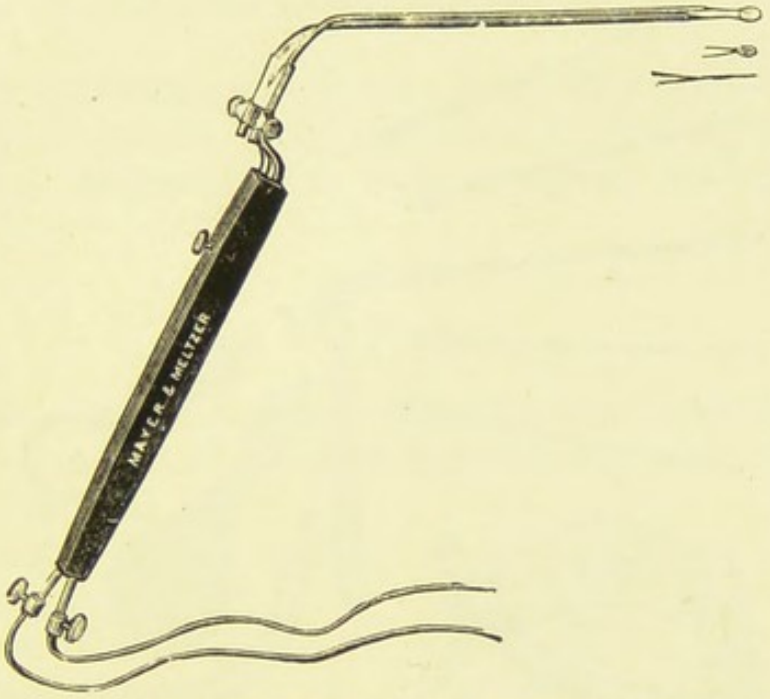


FIG. 89.—Galvano-cautery knife and needle for use in the case of growths and in paracentesis of the membrane.

behind the handle of the malleus, the blade is carried up to any extent the operator sees fit. There is no bleeding, and but very little pain. A knife with a long handle set at an angle with the shank of the blade, and shaped like a small cataract knife, with but one cutting edge, is preferable. In chronic cases, for some days before performing the operation, it is a precautionary measure to thoroughly Politzerize the tympanum, and to use a warm carbonate of soda douche with the Eustachian catheter. Inflation with Politzer's bag should be practised after the puncture, and the patient may resort to Valsalva's method, so as to blow any fluid serous secretions or

mucus through the aperture, care being taken not to use too much force from fear of producing an inflammatory condition of the drum-head. The patient should also exercise caution after the operation—avoiding cold or stimulating diet. Mechanical means to keep the perforation open, such as the eyelet of Politzer or the ring of Voltolini, are not to be recommended.

M'Keown of Belfast suggests a method of making an artificial perforation which would remain open for a period varying from

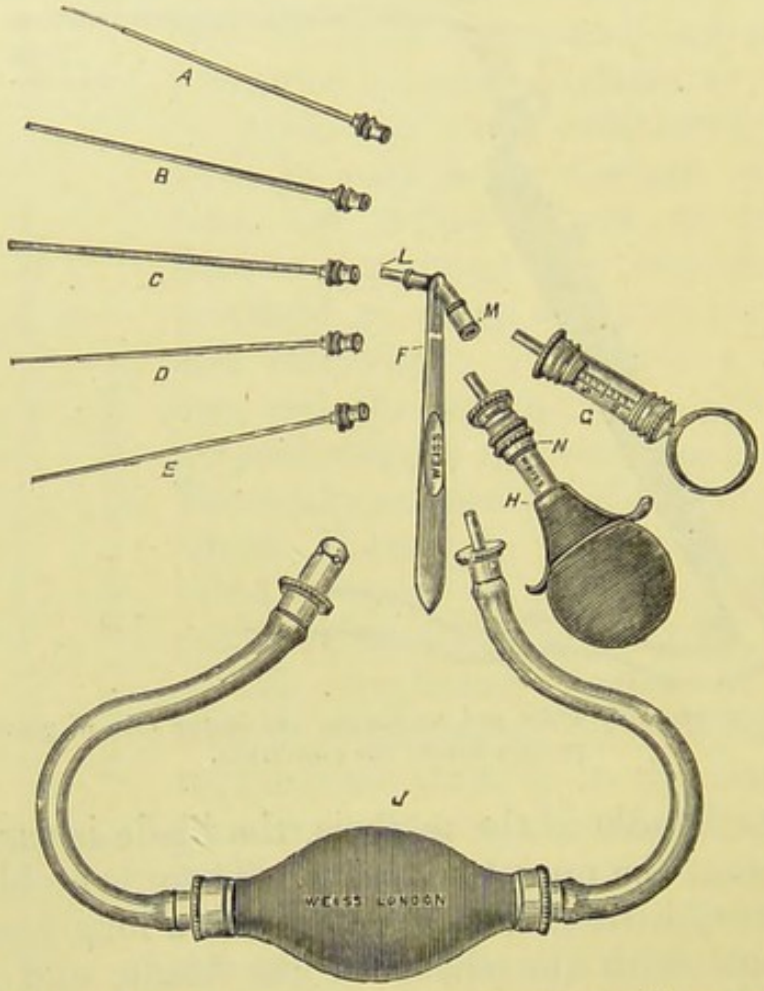


FIG. 90.—Stewart's intra-tympanic syringe, aspirator, insufflator, and douche.[1]

[1] It consists of a series of tubes, A to E, which fit into the end of a handle F, into the other end of which can be inserted the syringe G, which when reversed acts as an aspirator, the insufflator H, or the douche J, a small Higginson's syringe, which will also, if necessary, act as a stronger aspirator when reversed. The tubes are of various calibres to pass different-sized perforations, and one is always kept separate for the use of powders. The haft of the handle is hollowed on either side to take the fingers and give more firmness to the grip. This instrument is of the greatest assistance in the treatment of middle-ear suppuration, as will be shown in a subsequent chapter.

two weeks to two months. He makes a triangular flap of the membrane, commonly selecting either that part in front of or that behind the handle of the malleus. He uses a speculum, and illuminates the membrane by the frontal mirror. He then introduces the knife—a very fine straight knife with a thin handle—punctures the membrane in front of or behind top of the handle of the malleus, cuts upwards as far as he can; then he makes a second incision, beginning below, either at the anterior or posterior part of the membrane as the case may be, and in a horizontal line with the lower end of the first incision, and cuts upward until the two incisions join. The flap thus formed, unless in case of a very thickened membrane, falls down, or may be turned down with a fine probe, and commonly remains in position, adhering to the membrane below by blood exuding from the cut surface.

After perforating it is very frequently useful to aspirate the tympanic cavity, and then to thoroughly wash it out by means of the intra-tympanic syringe, etc. (Fig. 90).

Massage.

Massage is a method of treatment which has been found of service in certain cases of nervous deafness, attended by tinnitus, and in "progressive deafness" due to chronic middle-ear changes, and also in neuralgia of the tympanum. It has in some cases decidedly a beneficial effect. Massage over the mastoid regions is directed to be carried out thus:—The patient is seated opposite the masseur or masseuse, who stands in front, with the hands laid on each side of the occiput. Pressure is then made by rotating the hand in an upward direction.

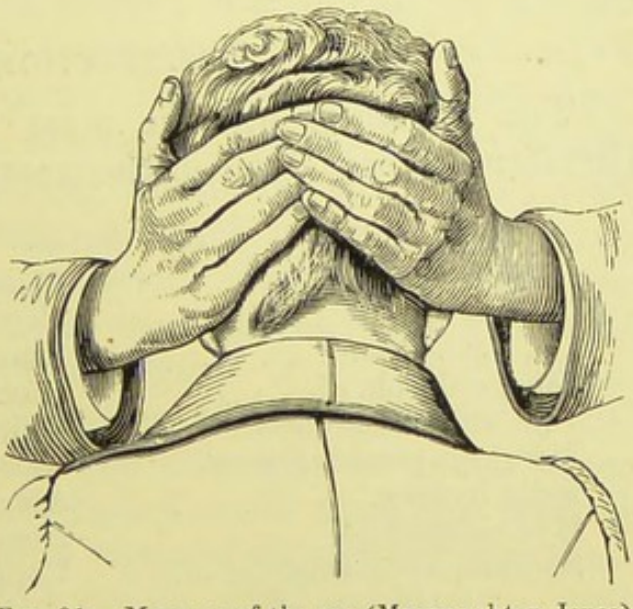


Fig. 91.—Massage of the ear (Macnaughton Jones).

This movement may be alternated with *tapotement*

(Fig. 92). The lobe of the ear is drawn back with the fingers of one hand, while the strokes on the mastoid are rapidly made with the fore and middle fingers of the other (Fig. 92). Also, massage can be practised by friction with the fingers, the head being in the same position as in Fig. 91. This should be carried out twice daily, for some ten to fifteen minutes at a sitting. It should be wet; that is, the mastoid is smeared over with a solution of menthol (one part in seven), or the fingers of the operator are moistened with the same solution.

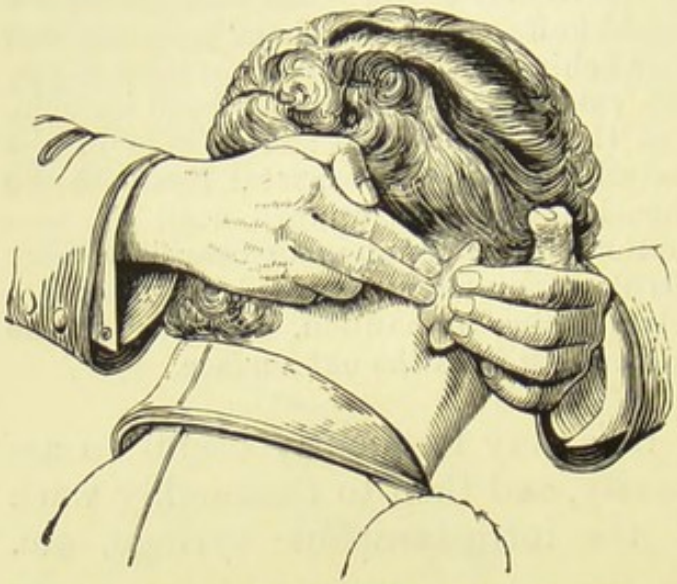


FIG. 92.—Tapotement (percussion) (Macnaughton Jones).

DISINFECTION.

The following are the most useful antiseptics and disinfectants employed in the treatment of ear disease :—

In Solution.

Acid, carbolic.
„ boric.
„ salicylic.
Zinc, chloride of.
„ sulpho-carbolate of.
Mercury, perchloride of.
Iodic hydrag.
Hydronaphthol.
Sodium, hypo-sulphate of.
„ biborate of.
Listerine.
Potash, permanganate of.
Arsenic.
Saccharine.
Quinine, sulphate of.
Alcohol.
Aldehyd.
Iron, perchloride of.
Copper, sulphate of.

In Powder.

Acid, boric.
„ salicylic.
„ tannic.
„ iodol.
Iodoform.
Chinoline, salicylate of.
Phenacetine.
Salol.

In Vapour.

Iodine.	Eucalyptol.	Oil of turpentine.
Bromine.	Menthol.	Iodoform.

Exceptional.

Lime, hypo-chlorate of. Resorcin.

We may place somewhat in their relative order of utility amongst aural antiseptic agents in common, the following:—Perchloride of mercury, iodic hydrag., iodine (especially on spores), hydronaphthol, iodoform, salicylic acid, boric acid, eucalyptol, alcohol, carbolic acid, chloroform.

As washes, we prefer those of perchloride of mercury (1 to 1000), the iodic hydrarg.[1] of the same strength, or boric acid and salicylic acid, and chloride of zinc in combination with carbolic acid solutions. Perhaps the most effectual supplement to the use of these is an absorbent salicylic acid wool plug covered with some iodol or iodoform, which is inserted by the patient and worn at night. The iodol, though its antiseptic properties as compared with iodoform are doubtful, has the advantage of absence of odour; but if this be not at hand, vanilla, menthol, coumarine, or coffee will serve to deodorize the iodoform. But it is a question how far washes of any kind are safely entrusted to patients' friends to use. Löwenberg insists on the necessity of using solutions, the water of which has been boiled, so as to deprive them of organisms. And certain it is that ordinary astringent lotions kept for any time contain quantities of fungi and bacteria. It is best to order concentrated alcoholic solutions of the ordinary astringents, a given quantity to be added to so much water (which has been recently boiled) each time the wash is used. But the cleanliness ensured by the surgeon himself *from day to day* is by far the most important. And this can only be attained *by careful and repeated drying of the external passage and tympanum*, if it be exposed, with absorbent wool, *after the meatus has been cleansed* by an antiseptic lotion in the first instance. This must

[1] Iodic hydrarg. is made by Messrs. Burroughs and Wellcome.

at first be done by the surgeon himself with the aural probe, but an intelligent parent or friend can be taught, after a little time, to cleanse the canal. When the parts are thus cleansed with the wool the more powerful antiseptic solutions can be applied with the probe.

Macnaughton Jones recommends a mixture of absolute alcohol (2 parts), carbolic acid (1 part), and glycerine (3 parts).[1] To this may be added one per cent. of hydronaphthol or five per cent. of boric acid. We generally prefer concentrated solutions to the use of insufflations of such powders as boracic acid, boracic acid and salicylic acid, and iodoform or iodol. If granulations remain and require restraint, chloroacetic acid and chromic acid are our favourite agents.[2] Both of these should be applied carefully, and only to the spot affected. But they never, if thus used, have any bad results.

The Middle Ear.—In patients suffering from perforation of the membrane we require to wash out with some antiseptic the tympanic cavity. This may be done either with the conical nozzle which fits on the ordinary syringe and fills the meatus (see p. 127), or by the intratympanic douche (see p. 154).

We must avoid washing remains of pus and mucus that may lie in the external meatus with force into and through the tympanum. Chloride of zinc or carbolic acid solutions, an acid perchloride of mercury solution (1 in 1000, with grs. iii. of tartaric acid to the ounce)—the acidulation prevents the formation of a solid deposit of a combination of the mercurial with the pus—hydronaphthol (1 in 2000), or the iodic hydrag., are perhaps the best to employ. After the fluid has passed from the nose the tympanum should be inflated a few times and the expelled fluid and mucus dried carefully off by the aural probe from the external meatus. Finally, the parts are touched with whatever antiseptic application is chosen.

Of late years the conviction has grown on us that the

[1] Also a solution of iodoform (5 per cent.) in eucalyptol.

[2] See treatment of polypus, p. 264.

fewer the washes we use in aural practice the better.[1] Daily, or every other day, attendance and dressing on the part of the surgeon, and, if necessary, the direct application of more concentrated solutions to the discharging surfaces, or insufflation of such a powder as boracic acid or salicylic acid, or deodorized iodoform, in all cases of chronic otorrhœal discharge, will be found the most successful treatment, and give the best permanent results.

Alcohol in different strengths, according to tolerance, as recommended by Burnett, is the most efficacious remedy in those cases of aspergillus, both of the meatus and tympanum, that we have treated. We believe it to be the best remedy also for healing or contracting a perforation. In granular conditions of the tympanum and post-polypoid states, chromic acid carefully used (1 in 8 solution) is an admirable application.

By close personal attention to the cleanliness of the ear passages and the adoption of antiseptic measures at an early stage of the affection, such as those indicated, we believe surgeons generally would save the hearing of many ears now lost from the results of otitis, externa and media.

Depletion and Counter-Irritation.

Leeching, more particularly the periodical leech or the artificial leech of Heurteloup, is not as often used as it might be in acute inflammatory conditions of the external ear and in chronic congestive states of the internal ear. In follicular abscess of the meatus, in myringitis, and in acute catarrhal attacks of the tympanum, experience has taught that we have, in a few leeches applied behind the concha or in front of the tragus, a most useful remedy, while the distress of a loud congestive tinnitus with a throbbing sensation in the ear is often relieved by a periodical leech or two applied

[1] *Vide* paper on "Some Points in the Treatment of Middle-Ear Suppuration," read at the Birmingham meeting of the Brit. Med. Ass., 1890, by W. R. H. Stewart.

to the mastoid process at night. For the relief of pain caused by acute inflammatory conditions of the external and middle ear, leeching has no equal. (For relief from tinnitus by leeching, see p. 343.)

Though *counter-irritation* over the mastoid is regarded as another old-fashioned remedy, still its derivative effects frequently arrest threatening inflammation in the meatus and tympanum, and in hyperæmic conditions of the internal ear the tinnitus may now and then abate under its influence. The liquor epispasticus and the charta epispastica are the cleanest and quickest vesicants. A capital embrocation to apply with the finger over the mastoid is the combination of spt. armoraciæ comp. ʒii., chloroformi ʒii., tinct. aconiti ʒii., tinct. capsici ʒii., spt. camphoræ ʒiv. This is useful in neuralgic pain of the meatus and tympanum.[1] A small portion of a mustard leaf is also a most useful and cleanly application in this region, when mild counter-irritation is required. (For relief from tinnitus by counter-irritation, see p. 343.)

Sedatives.—In neuralgic attacks of the tympanum the bromide of ethyl (hydrobromic ether) as recommended by Turnbull, in the proportion of equal parts of water, glycerine, and hydrobromic ether, may be placed within the outer ear, on cotton-wool, and renewed occasionally. A 10 to 20 per cent. solution of cocaine in similar conditions will give relief, and, indeed, as a local anæsthetic in all painful states of the external and middle ear cocaine has no equal. For pain in the meatus and tympanum the syphon douche of warm laudanum water, and the steam of same, are soothing adjuncts to other treatment, such as the subcutaneous injection of morphine. But perhaps the most efficacious remedy in neuralgic pain of the tympanic nerves, often associated with similar pain in the trigeminus or facial, is the application of the constant current over the mastoid and auricle, and on the course of the fifth nerve. It is not

[1] Messrs. Corbyn have made, at our suggestion, a linimentum sinapis co. (containing belladonna and aconite), which is excellent as a rubefacient for the mastoid.

to be forgotten that such pain is occasionally reflected and associated with various systemic states (hysteria and anæmia), and at times may have its source in dental caries. In some such patients massage of the face and neck muscles will afford relief. In assuaging pain and in the treatment of inflammatory attacks, the application of heat and cold may be resorted to. Generally warm anodyne fomentations are the most effectual and the safest.

But in the incipient stages of otitis externa, periostitis of the mastoid, and myringitis, cold, the degree of which is regulated by Leiter's refrigerating aural tube applied both to the auricle and around it, may assuage pain and abort the inflammation. By means of this regulator, special forms of which can be obtained for the ear, warm or tepid applications at any temperature can be maintained. They will be found useful in relieving the pain of inflammation either in the auditory meatus or the tympanic cavity.

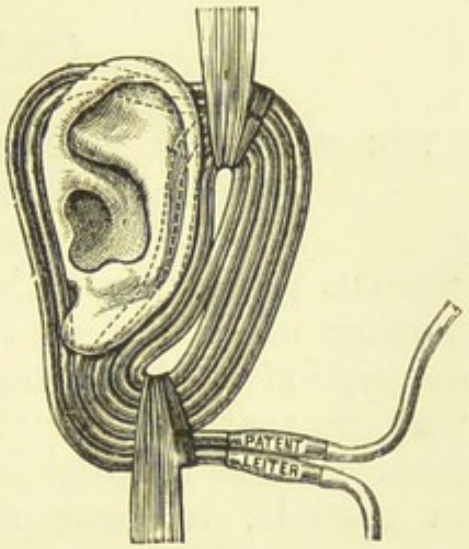


FIG. 93.—Leiter's irrigator.

CHAPTER X.

THE NOSE AND NASO-PHARYNX IN RELATION TO EAR DISEASE.

Before proceeding with the diseases of the different portions of the ear, we think it advisable to give a brief description of those conditions of the nose and naso-pharynx that are associated with ear trouble. We will preface these remarks by drawing attention, as briefly as possible, to some anatomical points necessary to remember.

1. The *outer wall of the nasal fossa.* In this wall are three processes—the superior, middle, and inferior turbinate bones; the first two being processes of the ethmoid, the third a distinct bone. Under each of these are three passages—the superior, middle, and inferior meatus. These processes and passages are covered by a mucous membrane, which is intimately connected with the bone. The superior turbinate bone is small and invisible by anterior rhinoscopy; the middle is larger than the superior, and the inferior the largest of the three. There is a large amount of erectile tissue covering the inferior turbinate bone, and less markedly so on the fore edge of the middle and the posterior extremities of the middle and superior bones (Zuckerkandl).

Of the three passages the inferior is the most important from a clinical point of view, some authorities looking upon it as a continuation of the Eustachian tube. It is a good deal longer and straighter than either of the others, and in its fore part is the opening of the nasal

duct, a not unimportant fact to remember in cauterization of the turbinate mucous membrane.

2. The *internal wall* or *septum*, partly osseous and partly cartilaginous, is formed principally by the central plate of the ethmoid bone, the vomer, and the septal cartilages; it is covered by mucous membrane.

3. The *posterior nares* will be better understood from the accompanying diagram (Fig. 94). The chief

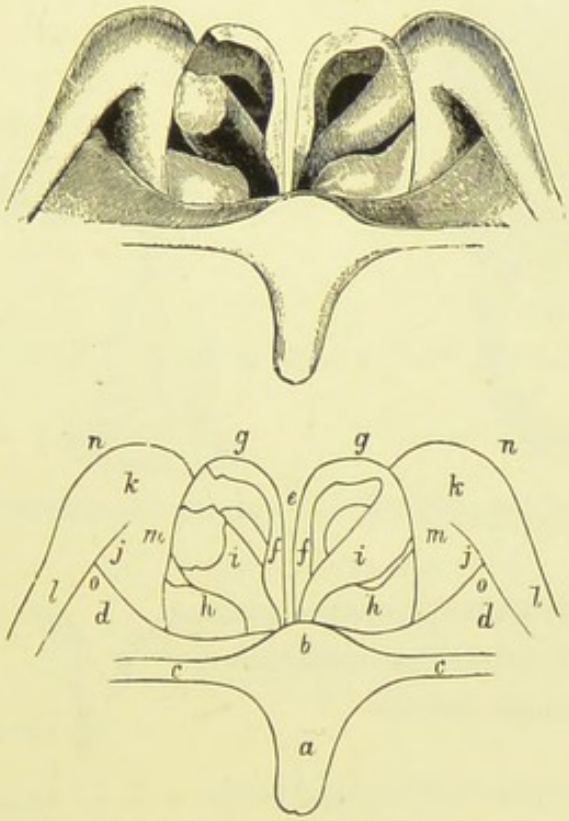


FIG. 94.—Posterior rhinoscopic view, as seen with the mirror in the ordinary position and without the use of any instrument to draw forward the palate. (The posterior nares and Eustachian openings were carefully sketched under illumination with electric light, from a male adult in whom there was paresis of the soft palate. The Eustachian cushions and folds have been semi-diagrammatically drawn, as they were not very closely marked, but the upper margins of these cushions appeared distinctly above the level of the summits of the choanæ.) *a*, Posterior surface of uvula; *b*, uvula cushion; *c*, *c*, posterior margin of palate (across palato-pharyngei); *d*, *d*, levator cushions; *e*, septum nasi; *f*, *f*, swellings on the sides of septum; *g*, *g*, choanæ or posterior nares; *h*, *h*, inferior turbinated bodies; *i*, *i*, middle turbinated bodies; *j*, *j*, Eustachian openings, more strictly the depressions leading to them; *k*, *k*, Eustachian cushions; *l*, *l*, salpingo-pharyngeal folds; *m*, *m*, salpingo-palatine folds; *n*, *n*, position of upper part of Rosenmüller's fossæ; *o*, *o*, posterior tubal sulci. (Creswell Baber).

points of interest to us are the posterior extremities of the turbinate bones, and the pharyngeal tonsil, a mass of adenoid tissue situated above the posterior nares.

The Naso-Pharynx—Therapeutics.

Before discussing those morbid states in which audition is affected, we propose here to offer a few general observations on the therapeutics of the naso-pharynx.

For ordinary practice the following appliances will

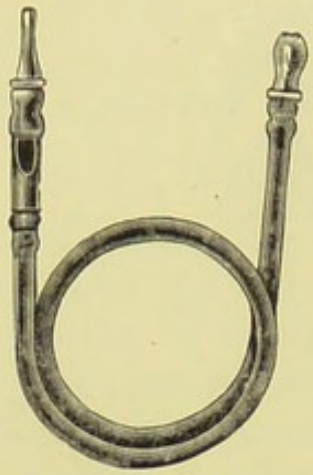


Fig. 95.—Auto-insufflator.

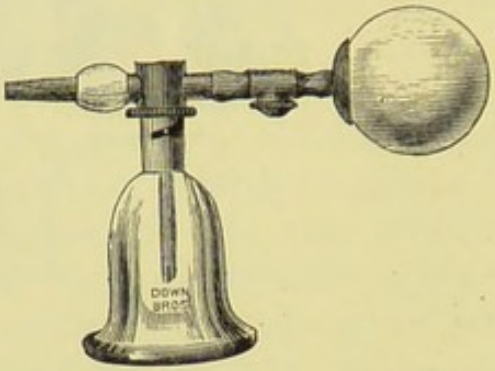


Fig. 96.—Kabierske's insufflator.

Fig. 97.—Nasal and laryngeal mounts to fix on the insufflator.

be found to answer most purposes of medication:—A post-nasal syringe, a nasal insufflator (for the surgeon's use by far the best insufflator is that of Kabierske, Fig. 96); a nasal spray (Figs. 100 and 101); a galvano-cautery; some laryngeal brushes which can be easily bent to the naso-pharynx; and an ordinary syringe, with a piece of rubber tubing a few inches long, which can be passed along the floor of the nostril to wash out the nares and naso-pharynx.

The substitute for the auto-nasal insufflator we have used for many years is a piece of rubber tubing about one foot long, a portion of thick glass tubing

being inserted at one end and a quill at the other, which may be covered or not with rubber. In treating persons who cannot afford costly appliances such a simple and inexpensive one is acceptable.

FIG. 98.—The hand nasal douche (Macnaughton Jones).

The Gargle.—To thoroughly wash the pharynx with a gargle in cases of follicular pharyngitis, tonsillar hypertrophy, and general pharyngeal relaxation, is frequently a most essential adjunct to more direct applications to the nose and naso-pharynx. To get a patient to do this properly he should be made to lie down on his back, and keep the head low when gargling the throat. With a little education and practice he can learn to force the fluid up behind the soft palate, or eject it from the nostrils.

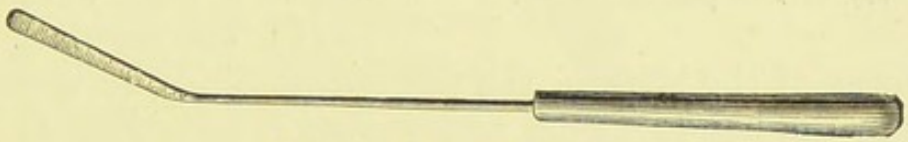


FIG. 99.—Bosworth's probe.

The Nasal Douche.—The nasal douche of Weber consists of a tube from three to four feet in length, a weighted end for insertion in the liquid, and a nasal piece (better olive-shaped) for fitting into the nostril. By raising the vessel in which the weighted end is suspended we can graduate the force of the flow.

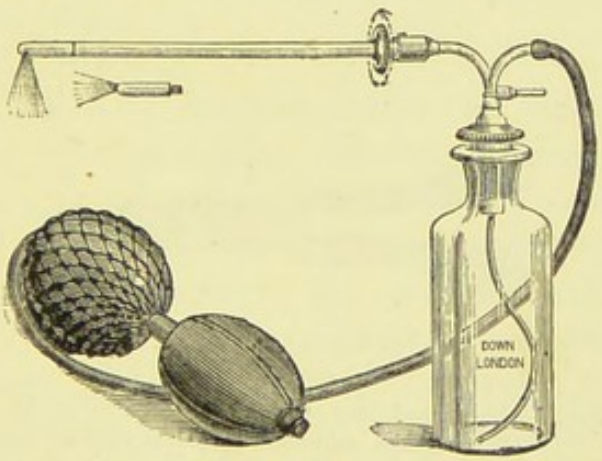


FIG. 100.—Reversible nose-spray.

We have never found any serious effects follow the

use of the syphon nasal douche. We have occasionally had to abandon it in consequence of headache, frontal ache, giddiness, and earache resulting. This occurred only when permitting the stream to pass through from one nostril to the other by the usual method of holding the head forwards. But we have found that such symptoms were more frequently due to neglect of the instructions given to patients for the use of the douche, for they have disappeared when the following precautions were adopted: —(1) The regulation of the force of the stream, the patient holding the vessel of fluid in the hand, raising or lowering it according as it is wished to increase or lessen the strength of the douche; (2) the maintenance of a proper temperature of the fluid (about 100°)—the colder the douche the greater the risk of

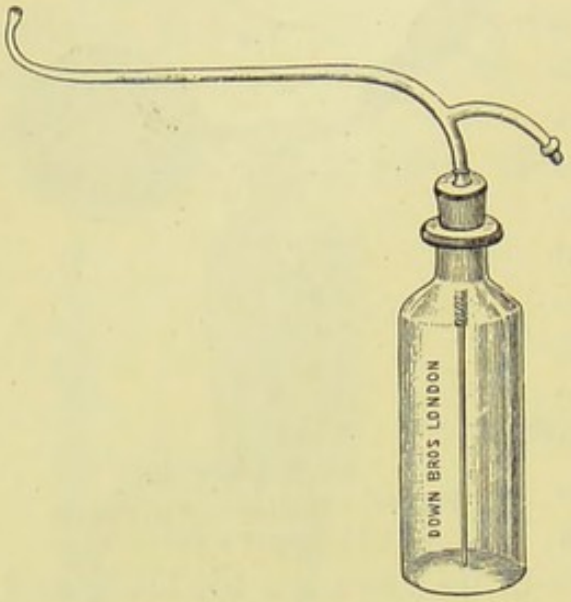
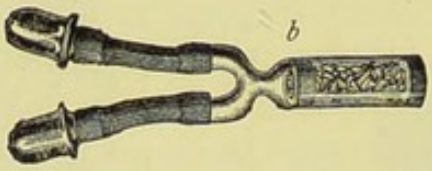


FIG. 101.—A post-nasal spray.



For nasal use.

Case containing menthol, an oral and nasal inhaler.

FIG. 102.—Nasal pocket menthol inhaler of Macnaughton Jones, to be had in small case with the menthol solution and an oral piece (Burroughs and Wellcome). The menthol solution is dropped through the gauze covering (*a*) into the pine wood filling glass cylinder (*b*).

unpleasant results; (3) the avoidance of strong saline solutions—such concentrated fluids entering the Eustachian orifice may cause intra-tympanic inflammatory troubles.

The mouth should be kept slightly open during the act of douching, and for the moment or two it is better to direct the patient to suspend his breathing. After douching it is advisable to use an inflating-bag, and a few times inflate the tympanum. The thumb and forefinger may be used to check the flow, and transfer

FIG. 103.—Nasal ointment atomizer (Burroughs and Wellcome).

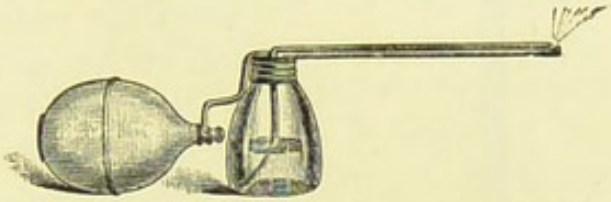


FIG. 104.—Post-nasal ointment atomizer (Burroughs and Wellcome).

the nose-piece to either nostril. Frequently it is not necessary to do more than allow the stream to pass from a height a little above the head into either nostril. If the douche cannot be borne, or if we find it is not tolerated when the stream is permitted to run from one nostril through to the other, this latter plan may be followed.

FIG. 105.—Nasal irrigator (Woakes).

Both for the surgeon's and patient's use the post-nasal sprays, as represented in the cuts (Figs. 100 and 101), are most useful. In catarrhal and ozænic states we may wash the nares, anterior and posterior, thoroughly out with them. The patient is placed with the head inclined to one side and forwards, the tube is gently passed back to the pharynx through the nostril, and the stream runs from the opposite. The post-nasal syringe (Solis Cohen) has its beak carried behind the soft palate either by the patient himself or the surgeon, and the head being held forwards, the fluid is injected through the nostrils. The nares should be wiped clean with absorbent wool before any solutions are used. Should severe smarting follow the application and last any little time, a warm alkaline stream should be passed

through the nostrils. The powders for insufflation we find of most service in catarrhal conditions are those of iodoform (deodorized with fresh coffee, coumarine, or vaniline), tannic acid, catechu, oxychloride of bismuth, and in tonsillar and throat congestions guaiacum. A small quantity of any of these powders may be used for each insufflation, powdered starch or lycopodium making an admirable basis. Fatty preparations serve in ulcerative states. We do not much care for greasy applications to the nasal membrane, but we can well apply in this manner iodoform or iodol, bismuth, belladonna, morphia, bichloride of mercury, the oxides of mercury, iodide of potassium, oxide of zinc, cocaine, the best

Fig. 106.—Ball insufflator for pharynx and larynx.

Fig. 107.—Insufflator, glass (Maw's).

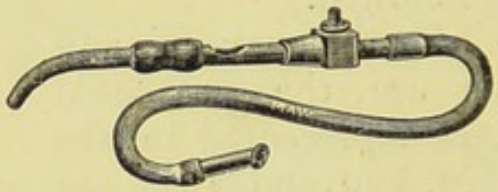


Fig. 108.—Insufflator, portable (Maw's).

medium for suspension being one part of vaseline and two parts of lard to four parts of lanolin. There can be no doubt that lanolin (diluted with lard, geoline, or vaseline) makes a capital absorbent basis for ointments. The paroleine of Messrs. Burroughs and Wellcome, already mentioned, and the adepsin oil of Corbyn are valuable bases for ointments or atomizing. Iodol is the best substitute for iodoform, being quite devoid of its unpleasant odour, and possessing all its properties without any of its toxic effects.

The small portable menthol inhaler (Fig. 102) is very useful and handy.

Finally, with reference to operative proceedings generally, from the perusal of other chapters in this work it cannot be thought that we do not attach due importance in the treatment of tinnitus, deafness, and giddiness, to securing patency of the nasal passages and a healthy condition both of the pituitary membrane and the other structures in the nasal fossa and naso-pharynx. But in operative procedures, we submit, we are bound to go cautiously. In those aural cases which come under our observation that demand operative interference in the naso-pharynx, we are influenced by (1) the presence of hypertrophied tonsils; all such we

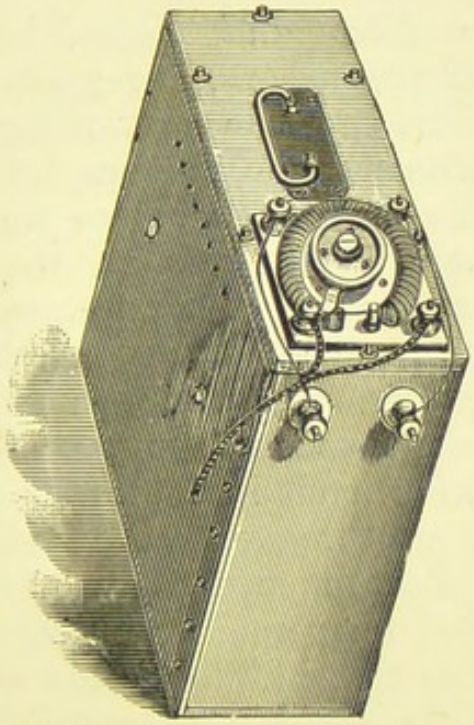


FIG. 109.—Portable accumulator battery for cautery (Coxeter).

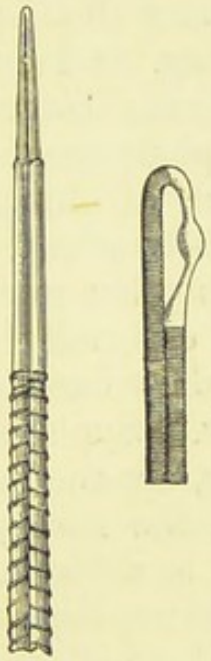


FIG. 110.—Platinum points for nose.

believe should be reduced or removed in cases of tinnitus and deafness; (2) the presence of adenoid growths,—these should be removed; (3) hypertrophied portions of turbinated bones and morbid growths, polypi,—these should be excised or reduced; (4) displacements and enchondromatous enlargements, with consequent deviation of the septum, require interference to free the obstructed nasal passage.

In cases of chronic coryza, and in hypertrophic

states of mucous membrane covering the turbinate bones, the *galvano-cautery* will be found a simple and efficient means of reducing the hypertrophy and restoring the calibre of the nasal fossa. A thin-bladed speculum is inserted into the nostril, and the interior well exposed with a good light. The cautery, various shapes of which can be had, either with loop or blade, needle, or button ends, is then introduced cold and applied to the hypertrophied part. The septum should not be touched with the platinum unless spores exist which require destroying. The best battery is a modified Trouve's. The current is completed by raising the cover of the box in which are the cells.

The Hygiene of the Nose and Naso-Pharynx embraces all those hygienic precautions, as regards diet, clothing, and exercise, which assist in preventing and modifying catarrhal inflammatory conditions of the naso-pharyngeal tract. We may include also the influence of climate. Without giving reasons, we may generally admit, what everyday experience proves, that heredity has much to say to nasal and throat affections, more especially catarrhal states, moist and dry, and the secondary congestions of the mucous membrane which follow. Syphilis in the earlier, gout in the latter years of life, are the maladies we most frequently see evidences of in the naso-pharynx. But independently of these, there is a common catarrhal temperament in which we find a predisposition to "catch cold," to "colds in the head," to "sore throat," to attacks of tonsillitis, to follicular congestions of the soft and hard palate, to elongation of the uvula, to occasional attacks of hoarseness and hyperæmia of the vocal cords. How much the syphilitic or gouty taints may have to say to this it is generally hard to discover. We believe the former influence is present oftener than we are aware. The rhinitis, with characteristic post-nasal secretion, which we frequently find in young persons who have, both in the eye, skin, or teeth, evidences of hereditary syphilis, shows that here we have a region early manifesting the evidences of constitutional taint. Indeed the "snuffles"

of infancy and the purulent rhinitis which are present in the syphilitic infant are still earlier proofs of this. On the other hand, it has to be remembered that rhinitis may arise from various exciting causes, such as adenoid growths, enlargement of Luschka's tonsil, occupations in which irritating substances enter the nose and naso-pharynx, the temperature and mode of heating of dwelling-houses and business offices. Nor is there any doubt that in debilitated states of the system generally these nose and pharyngeal troubles are more liable to occur and pass gradually into more extensive and inveterate affections, with permanent changes in the mucous membrane and subjacent structures.

The deafness which increases periodically with each cold caught, the patient will often tell us, has been preceded by an "out of sorts" feeling, a loss of appetite, and indigestion. Indiscretion of diet and the consequent dyspepsia are the constant attendants upon what is termed "an uncomfortable sensation in the throat, and a stuffy feeling in the head." We do not enter into this question of diet further than to remark that the simpler and the less complex the food, the less liable the mucous membrane appears to be to catarrhal attacks. But the one "accessory" of diet which unquestionably promotes this tendency and excites congestive changes is alcohol in any form. *Alcohol* and *tobacco* are very frequently associated, while the conditions under which both are generally indulged in increase whatever hurtful effects they have in themselves. After-dinner libations, in hot rooms surcharged with tobacco vapour, taken before issuing into a cold atmosphere, smoking and drinking in heated restaurants, and in warm billiard-rooms, are some common examples of such attendant conditions. They are the most favourable to excite an acute, and to maintain a chronic rhinitis. It is much after the ostrich principle of protection that delicate persons come from heated theatres, over-crowded ball-rooms, and warm churches into the colder atmosphere outside, imagining that some small oral respirator protects them from cold. It is a question if, by tending to

increase the number of nasal respirations, it does not rather encourage a tendency to rhinitis. Naso-oral respirators are the only true protectors. Dr. Whistler's is a most ingenious respirator of this class. But on emerging from warm buildings at night, a small portion of absorbent wool placed lightly inside the nostrils in no way impedes nasal respiration, but arrests and filters the cold air, which is thus partially warmed before it reaches the nasal passages. The wool can be rolled into an egg shape, and as Gottstein has recommended, can by a little screw shank be inserted in the nostril, the screw being readily freed by reversing it (or with the nasal probe). But the most convenient, and, what will recommend itself to most young people, the least disfiguring, is a light knitted silk or woollen scarf thrown across both mouth and nose. It answers every purpose. In our variable climate, with its easterly winds, the common error of "changing clothes" is the most frequent source of "colds caught." In the instance of women, from the nature of their dress and the exposure of the extremities, this is still more the case than with men. It is essential always to insist, to aural patients, on the necessity for a warm skin. Cold and damp feet are much more frequently than is imagined a cause of deafness.

"Keep the skin and feet warm" is, in the prophylaxis of deafness and tinnitus, from every sense in which we give this injunction, a maxim only of second importance to "Don't neglect the naso-pharynx." The skin and naso-pharynx are, both in childhood and youth, the vulnerable avenues through which noises and deafness approach in adult life. In cold bedrooms we have another frequent source of chill. The girl with sluggish cutaneous circulation retires from a warm sitting-room, removes warm skin clothing, undresses with a certain degree of exposure and consequent chill, and substitutes a cold linen or calico night-dress. This she does often when the temperature is lowest (midnight), and the power of vital reaction the least.

That room of which the temperature is frequently

most neglected in a house is the bedroom, the one of all others whose heat should be properly and uniformly maintained. In winter, while strongly objecting to the enervating habit of hot-water tins and bottles for the feet, we see no objection to previously securing the heat of the bedclothes by a contrivance which can be removed on the person getting into bed. And further, the effects of the nightly change of clothing can be averted by substituting a light and loose flannel vest, which, covering the trunk, prevents the chance of chill. Not less foolish habits prevail on rising from bed, such as standing with naked feet, or only in stockings, protracted exposure of the body while washing or bathing, prolonged toilet with the chest and arms uncovered. The other hygienic sin is one rather of omission than commission; the neglect of the use of a proper sponge bath in the morning, tepid where indicated, with suitable friction of the skin. True, the cold bath is an admirable preventive of catarrh, but, as all know, it has its dangers, is absolutely contra-indicated for some constitutions, and in these is liable to produce and prolong the very condition which it is intended to prevent.

The Turkish bath with its shampooing process is one of our most valuable modes of treating acute rhinitis, and the resort to a few Turkish baths will occasionally relieve a chronic one; but we are no advocate for the too constant use of the Turkish bath, and certainly consider such dangerous in those predisposed to congestive states of the naso-pharynx and tympanum. Some people can go on taking Turkish baths daily to a good old age without any bad effects. Others, again, will break the ice on a winter's morning for their dip. But such facts, though we are frequently confronted with them, establish nothing. They are parallel to the instances of inebriates, inveterate tobacco-smokers, vegetarians, and "one meal a day" eaters, who are quoted as living charmed lives. Of the ill effects of sea-bathing in patients suffering from aural complaints we have already spoken. Exercise, active, but moderate, taken with due attention to the risk attached to over-

heating of the body, is the next best preventive of rhinitis.

In climate we have one of the most valuable of all the hygienic means of arresting chronic rhinitic states. Of places on the Continent, the greatest good is found to follow the use of the nasal douches and the waters of Aix-les-Bains, Cauterets, and Allevard-les-Bains. There are at these baths the most perfect means of treating the nose and naso-pharynx. At Aix-la-Chapelle, also, we have known chronic rhinitis and post-nasal catarrh disappear. For gouty and debilitated patients, for whom an arsenical course is indicated, Royat and La Bourboule in the Mont Dore district are to be preferred. Such climates as those of Cannes, Nice, Algiers, the Grand Canary, or Tangiers, may also immediately cure these conditions; while there are many who in winter lose the stuffy feeling in the nose and head in the clear and more bracing air of Davos or St. Moritz. A few sea voyages have frequently a good effect. Perhaps the best is a Mediterranean trip, with a short stay at Suez before the return journey. As foreign seacoast residences, Corfu and Biarritz may be recommended. If sulphur waters are indicated we have our choice in those of Barèges, Bonnes, Eaux-Chaudes, or Schinznach. Very much the same good result can be had at home by patients, at the proper seasons, availing themselves of such health resorts as Bath, Harrogate, Strathpeffer, Buxton, Malvern, Tunbridge, Torquay, and the south coast watering-places.

Lastly, the physiological connection between the sexual and naso-pharyngeal centres already alluded to must be remembered. This throws some light on the ill effects which follow excessive sexual indulgence, and which are manifested in the swollen and thickened condition of the pituitary membrane.

CHAPTER XI.

THE NOSE AND NASO-PHARYNX (*continued*).

THOSE affections of the naso-pharynx which most concern the aural surgeon are—

Acute rhinitis.
Chronic rhinitis.
Hypertrophic rhinitis.
Atrophic rhinitis.
Stenosis of the nasal fossæ from growths or other causes.
Deviations and dislocations of the septum.
Naso-pharyngeal catarrh.
Foreign bodies, rhinoliths, etc.
Adenoid growths in the naso-pharynx.
Hypertrophied tonsils.

ACUTE RHINITIS.

Causation.—Amongst the principal causes may be placed—exposure to cold and wet, sudden vicissitudes of temperature, season of the year, nervous and rheumatic temperaments, cold extremities, change of clothing, bodily fatigue, inhaling irritating gases, vapours, dust, fog, etc., or in some people the internal administration of iodide of potassium. It occurs in certain diseases, such as measles, influenza, etc., and, from its tendency to spread in households, might be called contagious. This, however, is denied by some authorities. Both sides of the nose are generally affected, and the inflammatory condition may spread to the naso-pharynx, to the adjacent sinuses, and the Eustachian tubes.

Symptoms.—During the first stage there is general

malaise, slight rigors, with rise of temperature ; a feeling of dryness and irritation in the nose, causing fits of sneezing, followed by a stuffy feeling from a swelling of the mucous membrane, and a sense of fulness in the head, with frontal headache ; an altered voice, and blunted taste and smell. This soon gives place to a watery discharge, containing lymph corpuscles and epithelium cells, which will produce, if long continued, an irritation of the nostrils. The eyes participate in the general coryzal state, the lids are swollen and red, and there is an increased secretion of tears. During the second stage those symptoms gradually subside, the nose becomes stopped by accumulation of muco-purulent or purulent secretion, the Schneiderian membrane is swollen. In the third stage the swelling and discharge slowly disappear, and the patient gradually regains health. At various times during the progress of the cold there may be a feeling of fulness in the ear, slight singing tinnitus, and partial deafness. These auditory symptoms are more marked in those who are subject to Eustachian deafness and catarrhal states of the middle ear.

Treatment.—To arrest a "cold in the head" is not an easy matter. It is rather in the prevention of acute rhinitis, by laying down rules for clothing, exercise, and diet, that the surgeon can do more service than in its cure.[1] The following are some of the more simple means of arresting and treating a cold :—The administration at night of the powder—℞. Nitratis potassæ grs. x., P. Jacobi Ver grs. iii., pulv. Doveri, grs. ii.–iv., the powder to be taken at bed-time after a hot foot-bath, followed by a warm drink immediately on or before going to bed (whey or gruel). The patient, if the cold is threatening, and during the first stage, will find the inhalation of the vapours of ammonia or carbolic acid, or of camphor, a most soothing remedy. This may either be done with the naso-oral inhaler of the late Dr. Spencer Thompson, the powdered camphor being added to the hot water, or (what we find equally

[1] See p. 170.

efficacious) the camphor heated over the fire and some of the warm oil rubbed in the hands, which are held so as to make a tight naso-oral cup, while the vapour of the camphor is drawn in through the nose and mouth. A cone of stiff brown paper can be so narrowed to cover tightly the nose and mouth, the narrow end being fitted to a small circular-topped jug, and thus the steam of the hot camphor water may be inhaled. A dessert-spoonful of the following mixture taken in a little water three or four times in the day has an admirable effect on a cold :—℞. Spt. æth. nitrosi ʒiii., liq. am. acet. ʒiii., liq. antimonialis ʒii., Tr. opi. ʒi., syrupi simp. ʒiii. (For Dobell's snuff see Formulæ.) A Turkish bath will frequently prevent and cure a cold.

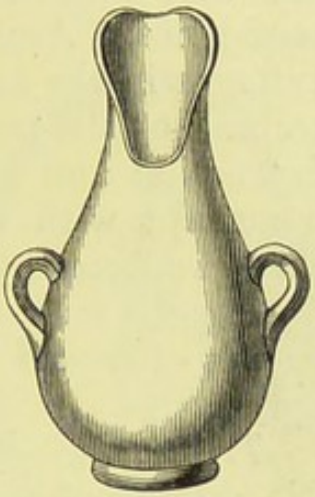


Fig. 111.—Spencer Thompson's naso-oral inhaler.

Anti-febrile remedies, such as quinine, aconite (in one-minim doses of the tincture), iodide of potassium (gr. i. doses every hour), the muriate of pilocarpine ($\frac{1}{16}$ to $\frac{1}{8}$ of a grain with a few drops of tincture of belladonna), and saline aperients are useful.

Ferrier's snuff is still used, but we cannot say that we have seen any great benefit from it. Now and then it lessens the severity of the flux and the symptoms of rhinitis (see Formulæ). A mixture of bromide of potassium and tincture of belladonna is also of considerable service in acute catarrh.

Another good powder is one recommended by Moore (see Formulæ). A spray of a 4 per cent. solution of cocaine gives great relief for a time, but great care should be taken in prescribing it, as it at times engenders a cocaine habit.

Chronic Rhinitis.

Causation.—Recurrent acute attacks, or it may develop from the same causes as the acute, without any pronounced previous acute attack—this is more

especially the case with those who work amongst irritating fumes and dust—nasal and post-nasal growths (see Adenoid Tumours)—irregularities of the nasal fossæ—snuff-taking, spirit-drinking, temperament, syphilis.

Symptoms.—The most marked feature is a persistent and obstinate discharge (rhinorrhœa) of varying consistence. Accompanying this is generally a sense of stuffiness in the nose and frontal headache, a redness and swelling of the mucous membrane, which leads to nasal obstruction and nasal speech. This obstruction varies in amount with the turgescence of the erectile tissue, which is affected by any slight irritation. Occasionally the discharge is muco-purulent, and there are sore spots and patches of eroded mucous membrane on the cartilaginous septum.

Treatment.—We may often exhaust every conceivable astringent and alkaline powder and spray in these cases without any apparent benefit. In some persons the discharge rather increases with almost any local treatment.

Bismuth, tannic acid, alum, salicylic acid, singly or in combination; bougies of iodol, bismuth, acetate of lead, and a variety of solutions, as sprays or douches, such as common salt, bicarbonate of soda, chlorate of potash, chlorinated soda, tannic acid, sulphate of zinc, or hazeline, either by means of the hand spray, nasal irrigator, or syphon douche; menthol or iodine inhalations, can be tried. The liquid extract of hydrastis in combination with iodine and carbolic acid in glycerine is another valuable application in old cases of rhinitis.

Ext. hydrastis liq.	min. xxx.
Acid carbolici	min. v.
Tinct. iodi	min. xxx.
Glycerine	ad ℥i. M.

To apply with the cotton-wool holder daily.

A spray of warm vaseline is at times useful,[1] to which a

[1] (Rumbold, St. Louis.) This spray, or that of adepsin or paroleine, is conveniently administered with Burroughs and Wellcome's ointment atomizer.

few drops of eucalyptol may be added as a disinfectant. In severe cases resisting ordinary means, the application of the galvano-cautery knife will be found of great service, and is generally followed by a decrease in the discharge and permanent reduction of the swelling. Cocaine we have used with marked benefit (20 per cent. volume) in congested and catarrhal states of the mucous membrane, applied with a brush or cotton-wool. This mode of using the cocaine is, we think, the best, as fatal results have followed the use of the spray. A very good plan when operating on the nose is to place a piece of cotton-wool that has been dipped in the cocaine solution over the spot selected and leave it there for a few minutes. Cocaine wonderfully facilitates operations on, and explorations of, the nares.

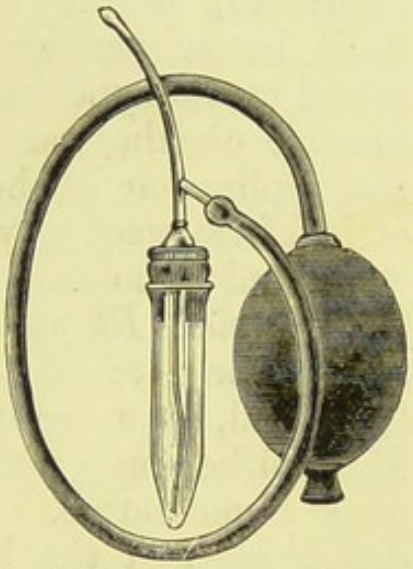


FIG. 112.—Cocaine spray for nose or ear.

OBSTRUCTION OF THE NASAL FOSSÆ.

Hypertrophic rhinitis[1] may be called a sequel to the simple chronic rhinitis. There is a general increase of redness of the mucous membrane, which appears swollen and injected, more especially the anterior and posterior ends of the inferior turbinate bone, though the middle bone is also frequently affected. The globular or curved surface of the turbinated bone appears to be part of the septum, at times touching it; the soft protrusion can be compressed with the probe on to the osseous structure, and its continuity with the bone easily ascertained. There often is attendant enlargement of the bone accompanying this hypertrophy. Audition is occasionally affected, as also the smell and taste to a more or less degree, and the nasal duct is at times ob-

[1] For the proportions for volatile oils in paroleine, see Formulæ.

structed. A sensation of weight and pain across the bridge of the nose is often complained of, and also redness of the tip.

Treatment.—The application of chromic, lactic, or glacial acetic acid will, if persevered with long enough, reduce the swelling; but this takes a long time, and it is better perhaps to employ scarification, the removal of the hypertrophied portion by the snare, cutting forceps, or the galvano-cautery (see p. 169). After the application of the cauterizing agent, a small plug of iodoform wool may be inserted, and an alkaline nose-wash used at home.

Atrophic Rhinitis is characterized by a wasting and dryness of the mucous membrane of the nasal fossæ and, to a certain extent, of the underlying bone. The epithelium of the glandular structure undergoes fatty degeneration. The glands and blood-vessels are destroyed, and the bones atrophy in consequence of the destruction of the blood-vessels. The secretions are so altered that rapid crust-formation and decomposition takes place, giving forth a most fœtid odour (ozena). According to Bosworth, it is preceded by purulent rhinitis. The condition is more common in females than males, and commences as a rule in childhood or early life. The subjects are generally strumous or anæmic.

Symptoms.—A feeling of obstruction in the nose, while greenish-grey lumps, smelling offensively, are discharged into the handkerchief or down the naso-pharynx. These sometimes accumulate and cause nasal obstruction. Dry throat and nose and frontal headache are complained of. Smell is often quite lost. Audition is impaired and tinnitus frequently present. The breath is remarkably offensive, yet the patient himself seldom knows this until informed by a friend. The nose is often flattened across the bridge and the anterior nares are large. It is generally associated with a dry, glazed, atrophic appearance of the naso-pharynx. The pharynx, too, may be affected, and dry crusts are visible with the laryngoscope about the vocal cords, producing hoarseness and troublesome cough.

Treatment.—The crusts should be removed daily by an alkaline douche. If they adhere firmly a brush or fine forceps may be used to assist their removal. The surface should then be well rubbed with a strong solution of chromic or lactic acid,[1] or the liquid vaseline should be well sprayed into the cavity. The patient should be ordered some powdered iodoform, with directions to well insufflate the parts after washing away the crusts with the alkaline wash. Gottstein recommends a tampon of cotton-wool, about three inches in length, should be inserted and changed twice in twenty-four hours; Fraenkel and others, the galvano-cautery.

Nasal Polypus is generally found in the middle meatus, is pedunculated, globular, and smooth, single or multiple; it is painless, soft, and can be isolated by the probe; it has a distinct history of growth, and produces a stuffiness and inability to breathe through one or both nostrils.

Treatment.—The growth must be removed by the snare or galvano-cautery (see p. 184).

Exostoses.—These tumours frequently proceed from the inferior turbinated bone, more rarely from the septum; they are generally associated with other congestive or hypertrophic states of the mucous membrane—the probe at once strikes on a hard resistant surface directly continuous with the outer wall of the fossa; they impede the insertion of the speculum, and can often be readily felt with the finger; they prevent nasal respiration, and affect pronunciation. Audition is commonly affected. Treatment consists of removal with the nasal shears (see p. 186), the septal spurs being cut off with the fine nasal saw, or ground away with the dental drill.

Enchondromata spring from the septal cartilage, and are seen quite close to the aperture of the nostril or

[1] Stewart has used strong solutions of lactic acid for some time with markedly good results, commencing with a 40 per cent. solution and increasing up to the pure acid. It sometimes greatly assists the action of the acid to well scarify the parts before the application is made.

occluding it; they sometimes push the ala aside, are comparatively soft, can distinctly be seen as part of the septum, and traced continuous with it; there is a concavity at one side of the septum corresponding to the convexity at the other; they cause nasal deformity and obstruct nasal respiration. Rarely affect audition.

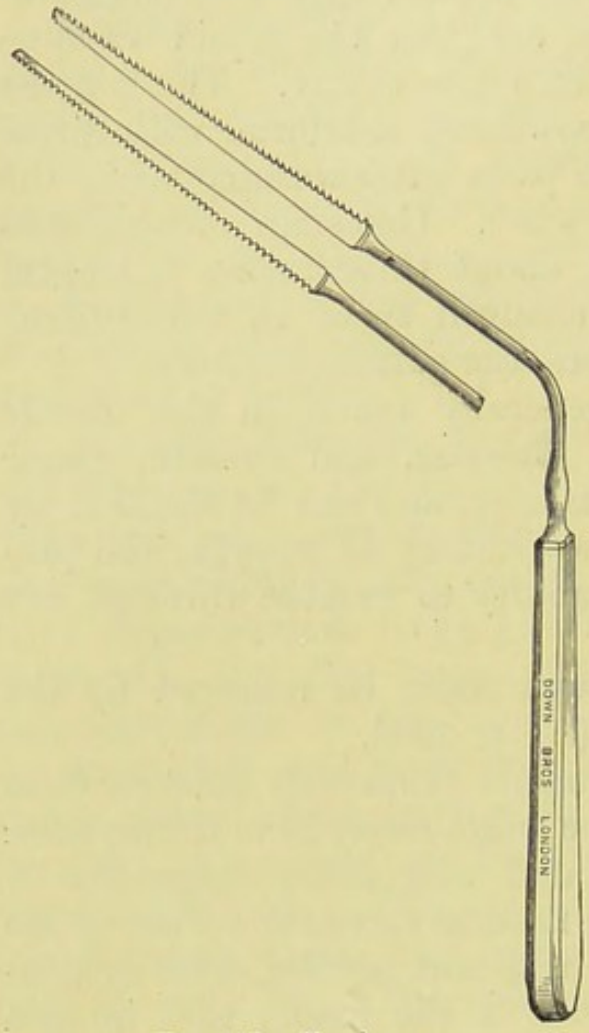


Fig. 113.—Nasal saws.

Treatment. — Destroy the growths by galvano-cautery or removal with shears, gouge, or saw.

Deviation of the Septum.—This cause of obstruction is frequently associated with other abnormal conditions of the nose, as deformity and lateral displacement the result of injury, tumours growing from the turbinated bones, enchondromata of the septum itself. A lofty vault to the palate is generally accompanied with septal deviations, or with hypertrophic rhinitus. There should be no difficulty in diagnosing displacement in any part of the septum by means of the aural probe and rhinoscopy. Sometimes affects audition.

Treatment.—If any treatment is necessary, the septum should be forcibly straightened with Adam's septum forceps. After the operation it is generally necessary to wear the septum clamp (Fig. 114) for some time.

If there be complete stenosis from displacement of the septum, it may be necessary to punch an aperture in the septum, from the side of the open nasal passage; but this is rarely necessary.

Other Tumours and Morbid States.—Other diseased states of the nasal fossa, such for example as necrosis, syphilitic ulceration, malignant growths, have clinical

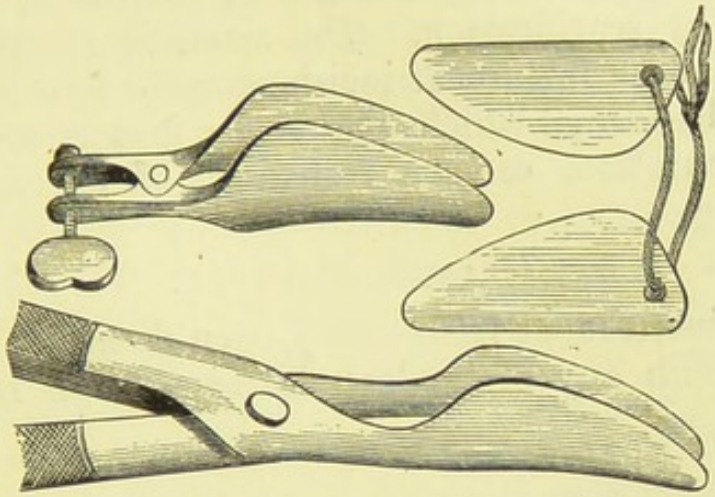


FIG. 114.—Mr. Adams' septum forceps and clamp.

features so characteristic, apart from the fact that they do not generally affect the hearing, that we need not here consider them.

Operative Treatment.—We have sufficiently dwelt on the general therapeutical treatment of rhinitis and simple hypertrophic states of the mucous membrane to limit any remaining remarks to the necessary operative measures to be adopted in those cases in which the nasal obstruction is of such a degree as to demand and justify them.

Abnormal Conditions of the Turbinated Bones and Septum Nasi.—Operative procedures of a more severe nature are called for in cases of deafness in which we find permanent nasal obstruction coincident with the aural affection. It may be impossible to pass the Eustachian catheter, and the ventilation of the middle ear may be completely interrupted.

Diagnosis.—In the diagnosis of the sources of obstruction we must be careful not to mistake hypertrophic conditions or other enlargements of the turbinated bones for polypi. With careful examination of the nasal fossa by a good light and the nasal probe, no one on his guard against such an error is likely to fall into it.

Operative Measures.

Scarification.—If the swelling that results from acute congestion of the mucous membrane is excessive, and does not yield to douches or irrigation, it may be relieved by scarification. The swelling should be well exposed, and a few linear incisions made into it.

The bleeding, which should be first encouraged by hot fomentation, can be restrained, if excessive, by a nasal plug.

Galvano-Cautery.

This instrument has already been described (pp. 169, 170). With any of its loop blades we can reduce the

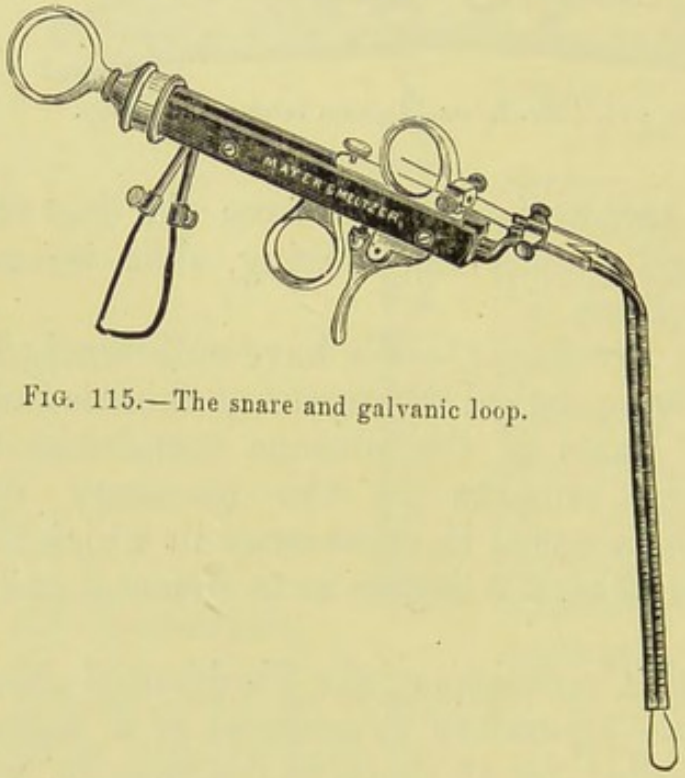


Fig. 115.—The snare and galvanic loop.

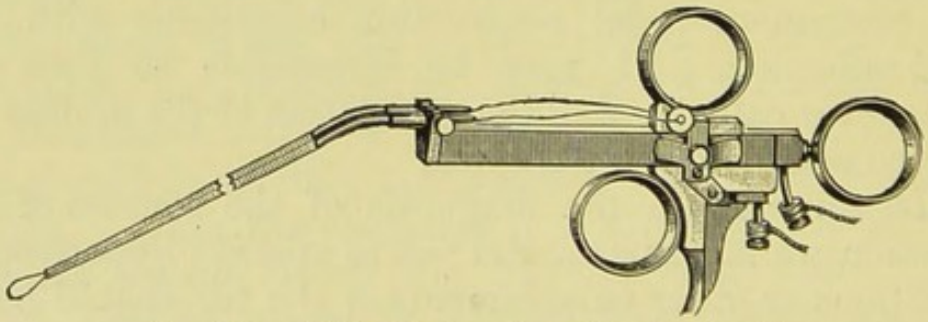


Fig. 116.—Sattler-Nieden universal cautery handle.

more permanent hypertrophic conditions of the turbinated bones. The blade should be drawn two or three

times along the length of the thickened tissue, making linear incisions down to the bone.

The Snare and Galvanic Loop.—These are useful in the removal of polypi. The semi-barbaric practice of simply tearing away the growths with polypus forceps, and then abandoning the patient to his fate, until a re-growth necessitates a renewal of the process, should, in the light of our modern appliances, be avoided.

If the snare, nasal écraseur, or the cutting instrument (polypus guillotine) of Mr. Marshall is used, the polypus should be thoroughly exposed by a good light, and the attachment of the growth having been ascertained, the thin piano wire is carried well down to it.

A miniature wire prong, similar to that used for carrying the wire to the neck of a uterine polypus, will assist in effecting this step. When the polypus is removed the site must be touched with the galvano-cautery point.

Failing this, the best application will be found to be either perchloride of iron or chromic acid (saturated solution or the crystals). These may be applied the day after removal with the nasal probe. This dressing should be repeated from time to time. Bismuth (oxychloride) powder may be insufflated nightly by the patient.

Any small re-growths should be attacked by the galvano-cautery, which is certainly the best and cleanest method of removing polypi.[1]

Shears, Gouge, and Saw.

In operating on growths from the turbinate bone, osseous or other, we require strong, curved, blunt-pointed scissors, or rather shears, with a spring separating the handles; a gouge (the "nasal plough" of Woakes will be found the best), and a director or guide.[2]

A fine nasal saw, when it can be used, affords the

[1] The severer operations for the removal of larger nasal polypi and the turbinate bones are not here considered.

[2] Woakes uses a catch forceps, which acts both as guide and forceps. The bone is grasped by the blades of the forceps at the line of section; the catch secures the blades firmly, which serve as a guide for the plough or gouge.

best means of removing osseous growths from the turbinated bone. In using any of these instruments for the removal of morbid growths or unhealthy osseous structures from the nasal fossa, in cases of deafness, we may accept the following rules for our guidance :—

1. Never to resort to any operative interference un-

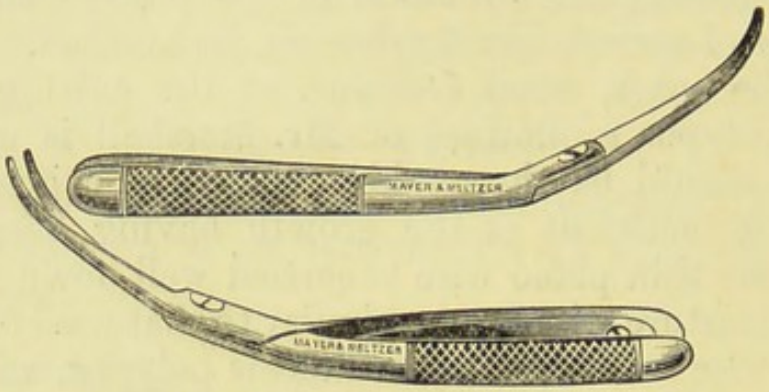


Fig. 117.—Macnaughton Jones's nasal shears.

Fig. 118.—Woakes' nasal plough.

less fully satisfied that the degree of obstruction and the nature of the growth demand such.

2. Before operating be clear as to (*a*) the nature of the growth, (*b*) its position and size, (*c*) the quantity of healthy structure that may have to be sacrificed and the line of section. After none of these operations, if carefully performed, need we fear hæmorrhage of a dangerous nature.

Naso-Pharyngeal Catarrh.

This affection occurs in two forms, the one *moist*, the other *dry*. The *moist* occasions but little inconvenience. The mucous membrane of the posterior wall and vault of the pharynx is slightly swollen, and more or less covered with thick tenacious mucus of grey or yellow colour, if not blackened by city air. The patient is troubled by a constant pouring down his throat. The affection often passes away spontaneously, but sometimes proves rather obstinate, getting better or worse from

time to time, almost disappearing in warm dry weather, and again becoming troublesome in wet or cold weather. In such cases, a stimulating application of chloride of zinc (grs. xx. ad ʒi.), perchloride of iron (ʒi. ad ʒij.), nitrate of silver (grs. x. ad ʒi.) will prove beneficial. Stimulating inhalations of pine or juniper (eucalyptol or turpinol) inspired through the nose also greatly assist in effecting a rapid cure. Macnaughton Jones's eucalyptus cigarettes, or those of iodoform and eucalyptus, and cigarettes of cubebs, will be found useful in both this and the dry type of the disease.[1]

The *dry* form of post-nasal catarrh gives rise to much more disagreeable symptoms, and more frequently occasions deafness. On examining the throat, the back wall and vault of the pharynx, and more rarely the superior turbinate bones, are seen to be dry and shining, or covered with a thin yellowish-brown adherent crust of mucus. Rosenmüller's fossa appears deepened, and the Eustachian orifices stand out sharply. When the membrane is merely dry, it is of a bright-red colour, and in those cases in which there is an adherent secretion, the mucous membrane will be seen to be red if the discharge be removed. The mucous membrane for some distance round is generally much inflamed, and its veins and capillaries are in a turgid condition.

Treatment.—For the cure of this form of the disease, it is of the utmost importance that the adherent secretion should be entirely removed. This can be most effectually done by spraying the part with an alkaline solution, to which a small quantity of carbolic acid has been added. The following formula will be found serviceable:—

℞ Acid carbol	...	...	...	...	♏xv.
Sodæ carb.	...	...	...	...	ʒij.
Aq. ad	...	...	...	...	℥viii.

After the crusts have been got rid of, the parts should be freely touched with chromic acid (saturated solution) or lactic acid, or swabbed with a solution of nitrate of silver. After the nitrate of silver solution

[1] These cigarettes are made by Messrs. Corbyn, New Bond Street.

is applied the patient should lie on the back and gargle with a warm solution of common salt; this neutralizes the unpleasant effects of the nitrate of silver. If after a fair period of time no benefit results from this treatment, perchloride of iron (℥i. ad ℥i.) or chloride of zinc (grs. xx.–xl. ad ℥i.) should be substituted as a local application. If the catarrh extend low in the pharynx, the effervescing chlorate of potash and the compound eucalyptus lozenges or pastilles often give great relief, and assist in effecting a cure. Great advantage is also derived from injecting an alkaline wash through the patient's nostrils, or directing him to suck it up through the nose.

In these cases of post-nasal catarrh, the naso-pharyngeal douche or the curved douche for use through the mouth will be found most efficacious. We are in the habit of using mild chlorinated soda washes, combined with salicylic acid and sulpho-carbolate of zinc. Permanganate of potash is the most useful as a douche for disguising odour, or the cigarettes before referred to may be smoked for the same purpose. We find great benefit from the thorough swabbing of the naso-pharyngeal cavity with carbolic acid and glycerine, and chloride of zinc or perchloride of iron applications. These patients must be all taught to use the nasal douche. We have found great service follow from wearing nightly a plug of wool in the nostril smeared over with vaseline and iodoform (15 grs. ad ℥i.), or the iodoform deodorized or iodol are diluted with bismuth and starch and blown with an insufflator on the pharynx and up the nose.

In treating all such cases it should never be forgotten that constitutional treatment must accompany the local applications, as, for instance, attention to diet, exercise, change of air, the ventilation of sleeping apartments. Frequently in syphilitic cases a course of the bichloride of mercury with preparations of bark, or the bicyanide of mercury (gr. $\frac{1}{12}$) with quinine (gr. ij.), and arsenious acid (gr. $\frac{1}{40}$), will be of service. This should be alternated with a course of iodide of potassium

and bark. So in anæmic cases much may be effected by the combination of iron and arsenic (see Formulæ), or, better still, the syrup of the iodide of iron. With children, cod-liver oil and iron, the syrups of the hypophosphites, and preparations of lime, will be found useful.

Adenoid Growths in the Naso-Pharynx.

Adenoid growths are very commonly met with in childhood and youth, causing a train of symptoms which soon attracts the attention of the parents.[1] The large bed of adenoid tissue, forming the pharyngeal tonsil, a kind of "secreting sponge" (Lacauchie), the vault and the upper part of the naso-pharynx, are the favourite seats of these adenoid collections; in the latter situation they appear as ridges in the posterior wall. They are covered with epithelium, of which the superficial cellules are cylindrical and generally vibratile; the substance is composed of adenoid tissue, of which the trabecules only become visible after we have removed with the forceps the numerous lymphatic cellules which fill the network.

Löwenberg believes that the difference between adenoid growths and the granulations so frequently met with in the pharynx lower down than the level of the soft palate consists in this, that the former involve the entire group of elements of the mucous membrane of the naso-pharynx, whereas it is simply the follicles that are hypertrophied in the latter (follicular pharyngitis). There is a strict histological similarity, however, between the two, the difference depending rather on the anatomical site of the adenoid formations.

Etiology.—In the etiology of adenoid growths, it would appear that heredity plays an important part, an entire family being at times affected, and the characteristic symptoms, with the accompanying physical characteristics, being found in the parents, males seeming to be more often affected than females. As we

[1] "Dr. Löwenberg on Adenoid Tumours of the Naso-Pharynx; their Influence on Hearing, Respiration, and Phonation," translated by Macnaughton Jones (*Medical Press and Circular*, April to June, 1879); "Adenoid Growths in the Naso-Pharynx," by W. R. H. Stewart (*Lancet*, 1890).

might expect from the presence of growths that obstruct the nasal cavities and the Eustachian tubes, the symptoms are due to the interference with the functions both of respiration and hearing. Naso-pharyngeal catarrh, nasal speech, interference with nasal respiration, breathing with the mouth open, snoring at night and restlessness, alteration in the form of the chest-wall, and peculiar physiognomy, and perhaps gait, are the characteristic symptoms. The occlusion of the nasal cavities, and consequent interruption with their function, produces in time serious changes in the pituitary membrane, which becomes thickened or dropsical (Störk); the sense of smell is blunted or obliterated, and to a degree that of taste; the nose ceases to act as our natural respirator and air filterer, the air reaches the lung more directly impregnated with impure matters, and colder.

A characteristic deformity of the chest has been observed in connection with adenoid growths, consisting in a circular depression of its walls at the junction of the lower and middle thirds, with an appearance of abnormal bulging at the upper part of the thorax. Löwenberg thus accounts for the peculiar prominence of the chondrosternal cartilages—

"A time must of necessity arise when the obstruction of the posterior nares, which is habitually incomplete, becomes still more impeded during certain attacks of greater swelling, or of more copious secretion, which are peculiar to the affection. At those times nasal respiration is insufficient, but, as the patient has not yet exclusively breathed by the mouth, from time to time he involuntarily closes it, and attempts to breathe by the nose; this latter being closed, the thoracic cavity cannot be enlarged. In consequence of this there is lowering of the diaphragm and contraction of the intercostal muscles, particular the external, which tend to enlarge the thorax during the air passage through the glottis; for the same reason there is also flattening of it. This flattening proceeds from the predominance of the atmospheric pressure on the one hand, and on the other the elasticity of the pulmonary tissue, which tends to diminish the volume of the lung in proportion as the intra-pulmonary pressure diminishes."

Thus the intercostal spaces are deepened and the cartilages are deformed.

To the peculiar defect in speech Löwenberg applies the French term "*nasonnement.*" The letters *m* and *n* are converted respectively into *b* and *d*. There is in addition an absence of resonance in the vocal sounds. This is the direct consequence of nasal obstruction at the posterior nasal apertures. It is especially perceptible in the pronunciation of the German nasal sounds. This is not to be confounded with "nasal twang," or the sound conveyed when a person speaks too much through the nose—nasal speech increased; on the contrary, "*nasonnement*" expresses speech in which there is no nasal resonance.

FIG. 119.—Appearance of patient suffering from adenoid growths in the naso-pharynx. From a photograph (Cresswell Baber).

Now that we are so familiar with the effects of adenoid enlargement on the hearing, it is not necessary to dwell here for any length on the influence the adenoid encroachment must exert, through swollen or closed Eustachian tubes, on the middle ear, producing chronic catarrh, with accompanying tinnitus, deafness, perforation, and suppurative discharge.

The teeth, exposed to the drying influence of the air, especially at night, when the mouth is wide open for hours, without being even temporarily closed, become the resting-place of various organisms; and these, not being washed away by the action of the saliva, produce caries, whilst a contracted dental arch and a lofty palate are frequently seen accompanying this disease.

Diagnosis.—The serious mistake may be made of overlooking the presence of adenoid enlargement of the pharyngeal tonsil or the presence of adenoid tumours. Chronic coryza and hypertrophy of the tonsil may be considered to be the sole cause of the symptoms. Nasal

or naso-pharyngeal polypi are much less frequently confounded with adenoid tumours.

The safe rule to avoid any error of diagnosis is, in all cases in which we are consulted for these nasal troubles, whether deafness be a symptom or not, to explore by palpation, if posterior rhinoscopy be impracticable, the naso-pharynx and posterior nares.

With regard to the part taken by *enlarged tonsils* in the production of the naso-pharyngeal symptoms and oral respiration, apart from the presence of adenoid growths, we must be guided by the size and position of the hypertrophied tonsil. That they may in themselves cause snoring at night, and closely simulate in their effects on respiration those produced by the adenoid growths, we have often proved to our satisfaction.

Löwenberg says that he has seen cases of enormous hypertrophy of the tonsils, which were free from all appreciable trouble, especially nasal respiration, and the important consequences which result from its suppression. On the other hand, in some cases of hypertrophy of the tonsils, in which these troubles also existed, he found adenoid growths hidden behind the enlarged tonsils.

In the case of naso-pharyngeal polypus, the symptoms will depend upon its size. The following facts will distinguish it:—Its origin from the periosteum of the inferior surface of the basilar process;[1] the age of the patient; it is met with after puberty generally; it frequently causes a peculiar wheezing respiration, with symptoms, if the polypus be any size, of dyspnœa; it causes nausea and difficulty in deglutition; the patient is liable to nasal hæmorrhage.

Prognosis.—It is certain that as hypertrophy of the tonsil may disappear spontaneously in adult life, so do the adenoid enlargement of the pharyngeal tonsil of childhood and adenoid growths. They usually disappear about the age of twenty, though we know of a case requiring operation at the age of thirty-three. Yet, in waiting for this spontaneous cure, we may permit the complications and functional disturbances to become per-

[1] Lorrain, *Bull. de la Soc. de Chir.*, p. 260, 1860.

manent. They always are a source of irritation, which involves the Eustachian tube, while, if of large size, they must mechanically press on the tube and obstruct it. They thus interfere with the ventilation and equilibration of the air in the tympanic cavity, and may imprison mucus and inflammatory secretions in it. Such consequences are most deleterious to the hearing, and, if permitted to operate for any time, must lead to some permanent change in the auditory passages.

Independently of this deleterious action on the ear, the oral respiration necessitated by the nasal obstruction may predispose to deafness.

Catlin[1] laid special stress on the habit of breathing by the mouth, which he designates *malo inferno*, or "the most destructive of habits." Amongst two millions of Indians whom Catlin examined, he did not find one individual who breathed by the mouth, nor a single deaf one, with the exception of three or four deaf-mutes.

Not one, among 150 chiefs with whom he conversed, could remember, during the last ten years, a single comrade deaf, or even with defective hearing. Catlin attributes this to a practice of the Indian mothers, who close their children's mouths each time that they breathe through them.

In no class of cases may we speak more hopefully of the restoration of hearing than in the instance of children whose deafness is due to adenoid enlargement and tonsillar hypertrophy, if radical means be adopted to cure those states. After removal of the growths they do not recur, and the deafness disappears, its relief being aided by other means for restoring equilibration in the tympanum, though, of course, the length of time the symptoms have lasted before treatment is applied for, and the condition of the middle ear, must make a considerable difference in the prognosis.

Treatment.—With regard to treatment, the growths must be at once destroyed or removed, and a variety of instruments have been devised to these ends. For their destruction by cautery, Lincoln has devised a special electrode, which is safe and simple. The platinum end is completely surrounded by bone. This is guided to

[1] Catlin, *History of the North American Indians.*

the growth by the forefinger of the left hand; the point is then exposed and the current turned on.

We may cauterize the sessile growths or use astringents to moderate or prevent their development. Both nitrate of silver and chromic acid (ʒi. ad ʒi.) can be employed for this purpose. With both these solutions care must be taken to press out the superfluous liquid

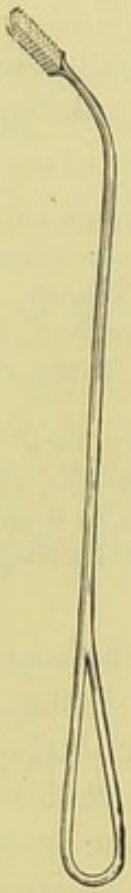


FIG. 120.—Post-nasal applicator of Politzer.

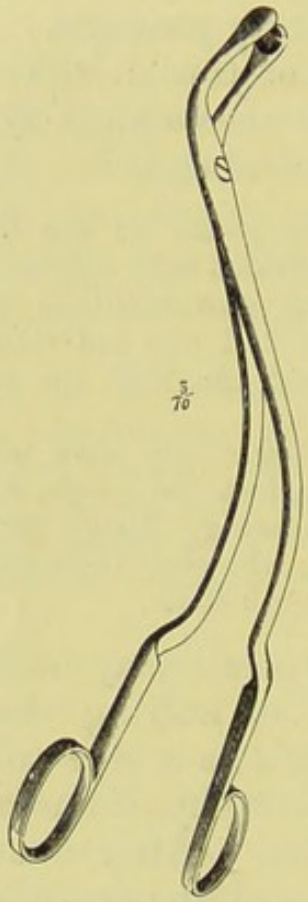


FIG. 121.—Löwenberg's forceps (post-nasal).

FIG. 122.—Post-nasal curette.

from the absorbent wool before its application, so that none may drop into the larynx. A probe, roughened at the end, can be curved to the proper shape to pass behind the palate, and then dipped into nitrate of silver, which has been fused in the platinum crucible. Guided and protected by the index finger, the caustic may be applied to the part. When solutions are used the same form of probe, with a screw-end to which cotton-wool is firmly attached, may be employed. The curved end is dipped in the solution and then carried to the naso-

pharynx. For mopping out the posterior nares, either through the nose or by the mouth, the uterine probe or cotton-wool holder will be found most efficient.

We have no great faith in either of these methods, and only use them in cases of pronounced bleeders, where other ways are impracticable. To remove the growths various forceps, ring-knives, and curettes are used, and all are more or less useful; such as Meyer's oval cutting ring-knife, Mackenzie's sliding forceps, Löwenberg's forceps and

Fig. 123.—Gottstein's ring-knife.

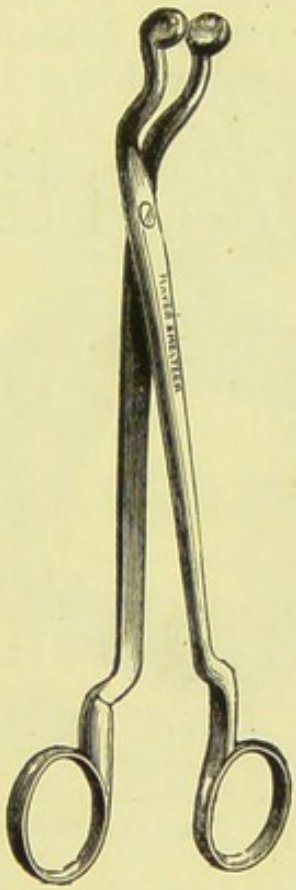


Fig. 124.—Woakes' modification of Löwenberg's forceps.

post-nasal curette, the armed finger-sheath with its cutting edge, and a variety of others; but the instruments most to be relied on are Gottstein's newest pattern ring-knife, the unprotected finger-nail, and Woakes' modification of Löwenberg's forceps—the modifi-

cation consisting in the prolongation backwards of the cutting edges, and an extra twist in the blades. The knife is shaped to fit the vault of the pharynx, and has the very great advantage of being quick in its action and safe. When operating we always have the patient under chloroform. Nitrous oxide gas is almost sufficient when the knife is used; if not, a little chloroform blown over with a Junker, or a few whiffs of ether, will be all that is necessary.

The ring-knife is passed behind the soft palate, and pushed to the vault, then one sweep down the centre and one on each side will be found sufficient to clear the naso-pharynx in most cases, but should any small portions remain behind they will easily come away when scraped with the finger-nail.

If the forceps are employed, they should be introduced closed, and guided to the growth by the index finger of the left hand. The blades are then opened

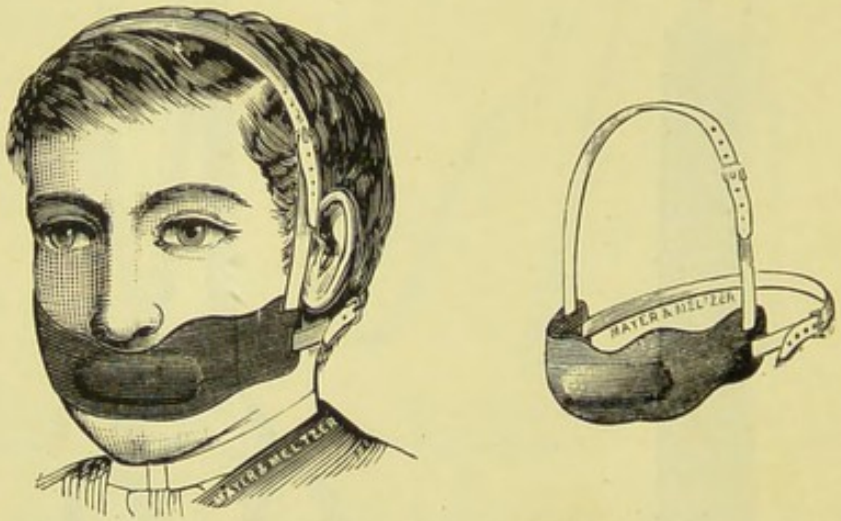


Fig. 125.—Macnaughton Jones's oral protector.

and the growths *cut* off as closely as possible to their base. A gag must be employed if either the ring-knife or forceps are used.

Bleeding, of which there seems a considerable quantity, stops, as a rule, as soon as the gag is removed. It adds greatly to the comfort of the patient if some warm water is syringed through the nostrils, previous to his return to consciousness, to wash away all clots and

débris ; and, in doing this, it is well to have the patient's head hanging over the end of the table.

Treatment, after the first forty-eight hours, should consist of an alkaline wash used as a douche, and continued for a week or ten days, and an occasional Politzerization may be necessary to complete the cure.

We also must not overlook the accompanying temperament and state of the child's health generally. Löwenberg rigidly insists on the value of hygienic and constitutional treatment combined with and apart from the operative. The lymphatic diathesis should indicate

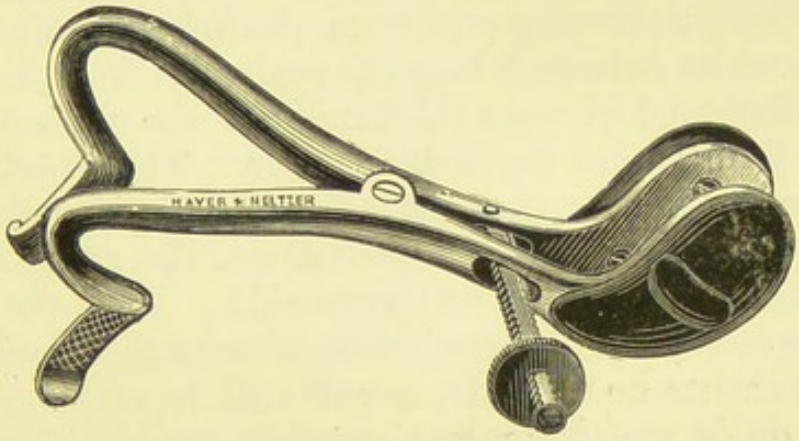


Fig. 126.—Gag.

the use of such remedies as iodide of iron with cod-liver oil, and such preparations of iron and the hypophosphites as those of Fellows and Dusart. Malt preparations and peptonized foods are indicated in cases of weak digestion and assimilation. Milk should be the principal article of diet, given in various ways. Attention to the several matters alluded to in the chapter on Hygiene, as clothing, bathing, exercise, is of great importance.

The child's habit of breathing with the mouth open should be attended to. Much may be done to correct this habit by friends and nurses reminding the child to close the mouth. Macnaughton Jones has devised an instrument for keeping the mouth shut (Fig. 125). Any parent or nurse can be taught to make from a piece of ordinary roller the four-tailed chin bandage,

and to apply it in the same manner as we do in fractures of the inferior maxilla ; or a simple cotton-wool respirator, with tapes at the side to fix to the head, may be prepared in any home. These contrivances are applied at night, and will in a short time encourage the independent habit of breathing through the nose.

Hypertrophy of the Tonsils.

This is mainly a disease of early life, being sometimes congenital, and in the great majority of cases becoming developed at or before the age of puberty.

Defective hearing, or even deafness, is often associated with enlarged tonsils, probably from irritative congestion, and chronic thickening of the mucous membrane lining the Eustachian tube. The chief cause, however, of interference with the hearing is supposed to be due to pressure. Derangements of the senses of taste and smell are also frequently present.

Diagnosis.—The recognition of enlarged tonsils generally presents no difficulty ; but still it is necessary to be on one's guard against possible error. The glands may appear to be very much hypertrophied through being rotated forwards and towards the middle line, so as to present their inner surfaces anteriorly and appear near to each other, thus simulating great enlargement. To avoid error from this source it is well, in examining a patient's tonsils, to make him open his mouth widely, and take a deep breath, when the natural relations of the parts will be retained. A correct estimate of the volume of the organ can be obtained by palpation, the first finger of one hand being applied to the internal surface of the tonsil, and that of the other to the outside of the throat, close behind the angle of the jaw.

The treatment of tonsillar hypertrophy may be divided into *local*, *constitutional*, and *operative*.

Local treatment, which consists in applying astringent remedies directly to the enlarged gland, is seldom of much efficacy in reducing its bulk, but such agents have a very beneficial effect upon the *honeycomb* tonsil.

A solution of perchloride of iron (3i. ad 3i.) may be applied once or twice daily with a brush, or finely powdered alum or tannin may be blown on to the tonsil with an insufflator, and then rubbed well into the surface. Tincture of iodine painted over the enlarged structure has little or no effect, nor does solid nitrate of silver answer better, though both are often recommended.

We have found great benefit from insufflation on the tonsils of guaiacum (see Formulæ), combined with the local application of perchloride of iron in solution.

In real hypertrophy of the part, escharotics sometimes give good results. The London paste (Throat Hospital Pharmacopœia) is efficient in diminishing the size of enlarged tonsils so as to preclude the necessity for a cutting operation. The powder should be mixed with a little water, and rubbed up to the consistence of thick cream, and applied to separate points of the diseased structure by means of the pharyngeal spatula. Immediately after the application, the patient should freely gargle his throat with cold water. This should be repeated at intervals of two or three days, and care should be taken not to apply the paste too freely. Its effects should be closely watched, lest extensive inflammation be set up by its use.

The best method of reducing the hypertrophied tissue, if the knife is objected to, is the galvano-cautery. A fair-sized point should be dug into the tonsil in several places, care being taken not to do much at each sitting or severe inflammation may result. It will be found, however, that the plan of treatment in all cases in which it is permitted should be amputation of the enlarged portion of the tonsil. Any other method is apt to end in failure, and involves a long-continued course of troublesome and unnecessary treatment.

With any of these local measures should be combined constitutional treatment according to the particular indications of each case. For this purpose, fresh air, nutritious diet, with general tonics, or special remedies, such as iodide of potassium, cod-liver oil, and phosphate of iron, should be employed. The sulphurous springs of

Bagnères de Luchon are said to be very beneficial in such cases.

Operative treatment consists in the amputation of the hypertrophied portion by means of the tonsillotome. The operation is attended with but a trifling degree of pain, and general anæsthetics are as a rule unnecessary, but the parts should be painted with a 20 per cent. cocaine solution. In most cases the bleeding is slight, and soon ceases on the patient gargling his throat with cold water

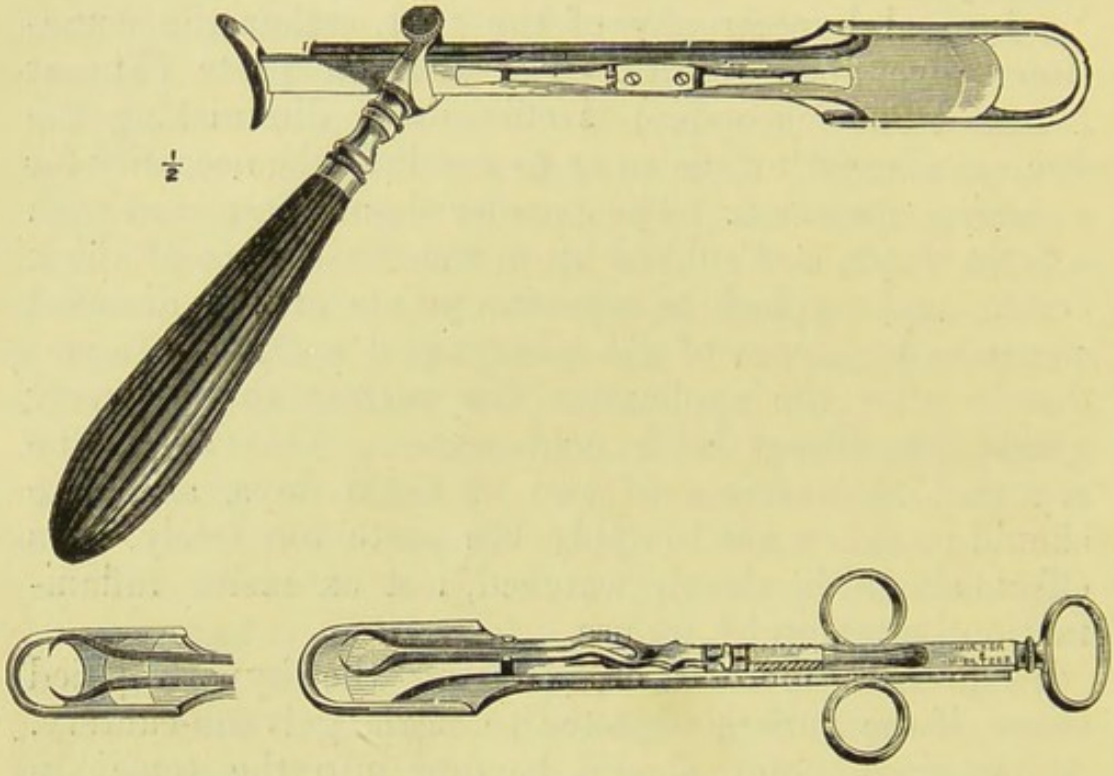


Fig. 127.—Tonsil guillotines.

or sucking ice. If the hæmorrhage be severe, the patient should be directed to swallow slowly a small quantity of tannin held in suspension in water. The tannin is not intended to be dissolved, and a little gallic acid added to the water prevents solution taking place. The following formula will be found almost invariably successful:—

Tannic acid	360 grains.
Gallic acid	120 grains.
Water	1 ounce.

Rub the acids to a fine powder and mix with the water.

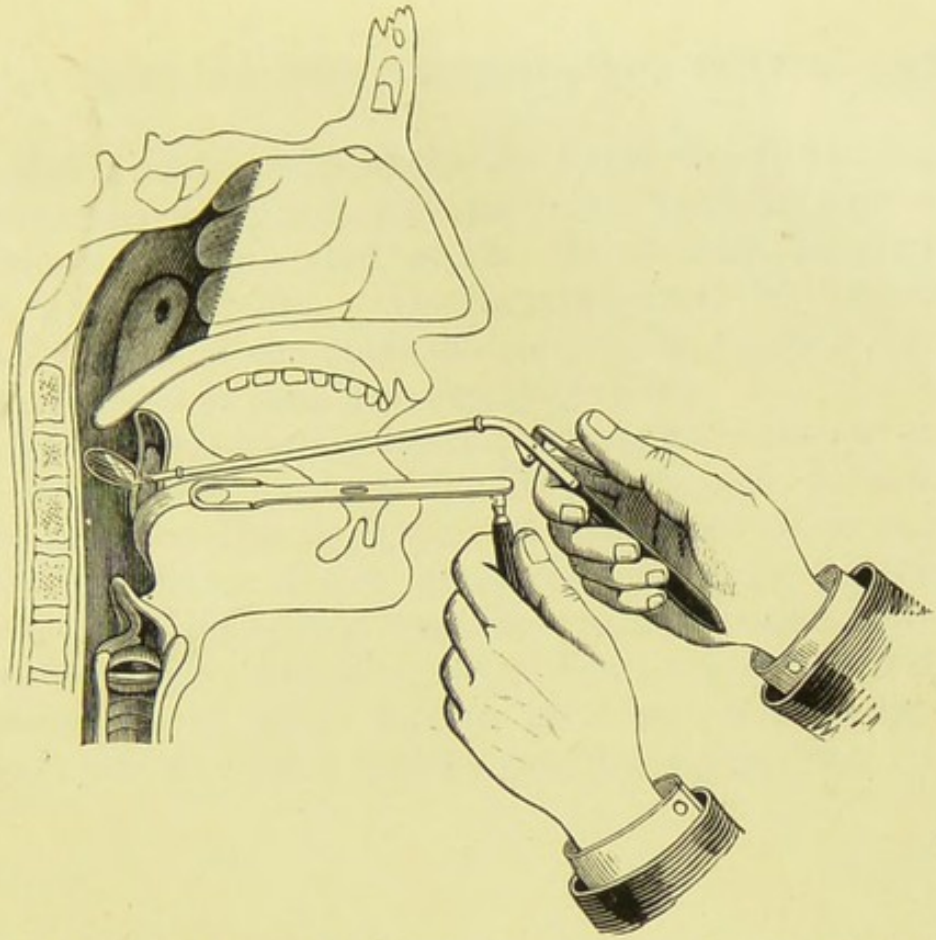


FIG. 1.—Application of the rhinoscope—unarmed tonsillotome used as a tongue depressor.

FIG. 2.—Adenoid masses as seen in the rhinoscopic mirror.

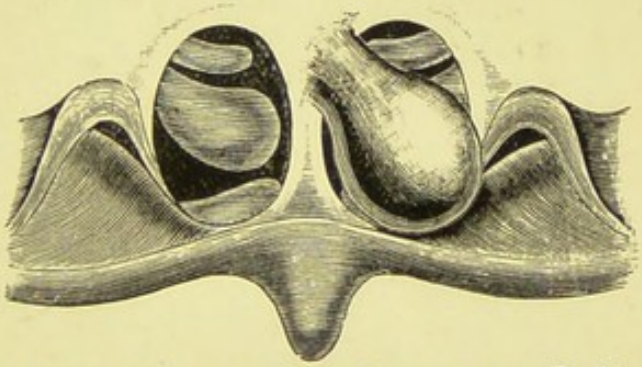


FIG. 3.—Naso-pharyngeal fibro-myxoma (Bark).

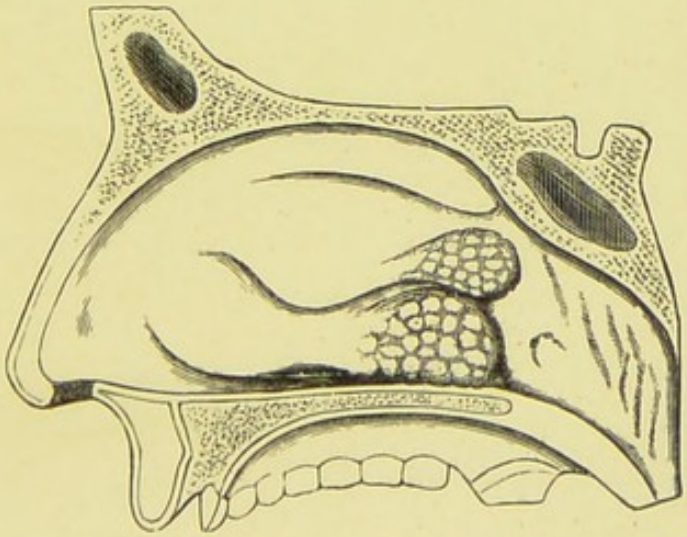


FIG. 4.—Posterior turbinate hypertrophies.

To face p. 200.

Half a teaspoonful of this fluid very slowly swallowed is generally sufficient, and no more than is necessary should be administered, or the throat may be gargled with a little hazeline. The patient should be instructed to have some of the medicament by him, so that he can at once use it in case the bleeding recurs.

The wound usually heals spontaneously in a week or ten days. The patient should be enjoined to remain indoors for a few days, and to avoid hot or irritating articles of diet. If, as sometimes happens, especially when the bleeding has been severe, the wound becomes covered with an unhealthy exudation, two or three light applications of solid nitrate of silver will suffice to change the ulcer to a healthy granulating surface.

CHAPTER XII.

AFFECTIONS OF THE EXTERNAL EAR.

Affections of the external ear include diseases and injuries of the auricle, and of the external auditory meatus. There are, however, some diseases which implicate both these portions of the external ear at the same time, such, for instance, as eczema and erysipelas; and these, to avoid repetition, will be spoken of together.

Diseases and Injuries of the Auricle.

1. *Malformations.* May be unilateral or bilateral. Are due either to an excessive growth, or to an arrest of development. Excessive growth may involve the entire auricle, or only individual parts. Or again, every now and then a child is brought for treatment with one or more supernumerary auricles. These may be situated in any abnormal position, such as the neck or cheek. In these cases surgical interference, according to requirement, at an early age will do much good.

In a hospital case recently under our care, in which the upper portion of the ear was largely developed and perfectly flat, with no helix, by the removal of two triangular portions of the cartilage, with an equal portion of the skin, a very presentable ear was formed (Stewart).

Arrest of development may, like the preceding, be unilateral or bilateral, partial or complete. This state of things is unfortunately, as a rule, accompanied by a

corresponding want of development of the middle and internal ear.

A gentleman came for advice a little while ago with the whole of the upper part of both auricles deficient, and the skin formed a complete septum over the opening into the meatus. The cartilaginous lining of the opening into the meatus could, however, be distinctly felt, and the watch was plainly heard in contact. This is one of the few cases in which good can be expected from surgical interference (Stewart).

Fig. 128 (Macnaughton Jones) shows the auricle of a child five years of age. In this case there was no meatus to be felt. The hearing was *nil;* that of the other ear normal.

One case which came under our notice is extremely rare. A child a few months old was brought to the hospital with an entire absence of the auricle, and no sign of a meatus could be felt (Stewart).

Injuries, burns, scalds, tears, frost-bite, warts, cysts, tumours, malignant or otherwise, occur in the auricle as in other parts of the body, and their treatment is the same.

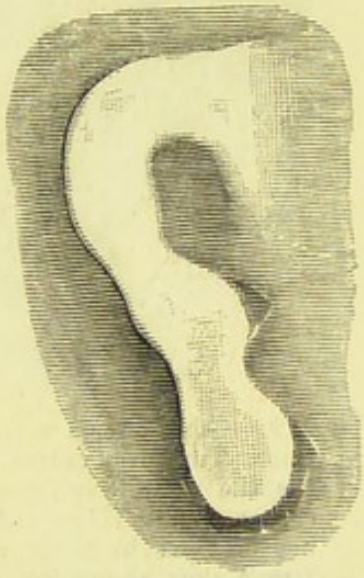


FIG. 128.—Auricle in case of congenital absence of meatus (Macnaughton Jones).

OTHÆMATOMA, OR BLOOD TUMOUR IN THE AURICLE.

Othæmatoma, or sanguineous tumour of the external ear, may be either idiopathic or traumatic. In the former variety it is, with very rare exceptions, solely met with amongst those affected with mental disease; in the latter, it frequently results from a direct blow, and is occasionally met with in the football field.

Nature and Appearance.—Othæmatoma consists of an effusion of blood from the perichondrium investing

the cartilage of the auricle, appearing as a tense and shining tumour of a reddish-blue or livid colour, varying in size, and occupying some portion of the concavity of the organ, rarely forming on the posterior convex surface. When it commences in the concha, the tumour is generally localized above, and externally by the ridge of the antihelix, and extends inwards towards the meatus externus, which it may occlude, causing deafness according to the degree of occlusion. In this situation the tumour presents itself as a smooth, and usually even swelling, about as large as a pigeon's egg; when the fossa of the helix is the site of the effusion, it is confined below by the ridge of the antihelix, and the swelling then assumes a somewhat kidney-shaped outline.

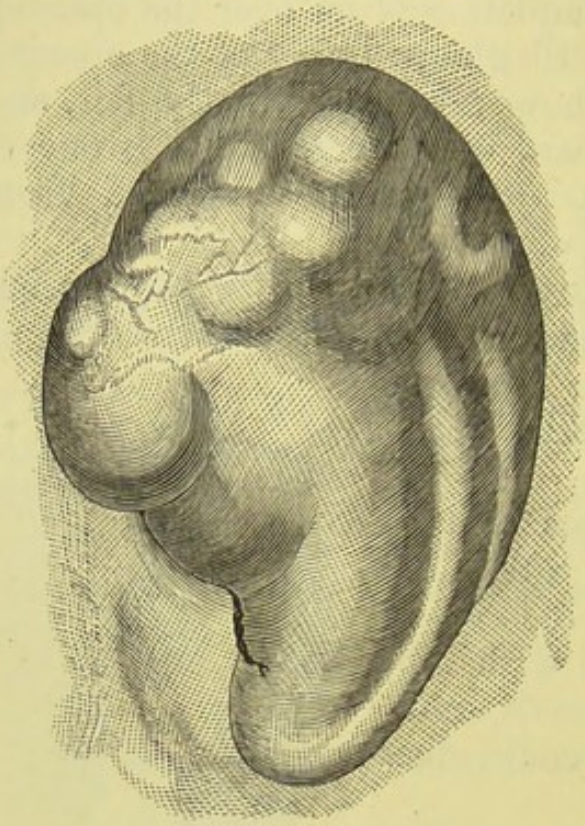


FIG. 129.—Othæmatoma in the acute or *primary* stage. Tumour of extraordinary size occupying the entire cavity of the auricle, and obliterating its ridges and hollows. Surface uneven, and in parts of a plum colour. *Result*, slow absorption, with extreme contraction, and finally the almost complete distortion of the auricle, and obliteration of its several component parts. Case of E. H., affected with active melancholia, taken from life (Ringrose Atkins).[1]

In exceptional cases the tumour becomes extended over the entire surface of the auricle, and when this is the case, the various ridges and cavities become wholly obliterated, the hollow of the ear being filled by an egg-shaped swelling, fuller above, and losing itself inferiorly in the lobule, which is never implicated.

In a female suffering from active melancholia a hæmatoma appeared in the left ear, and in *three* days

[1] These drawings of othæmatoma are taken from Macnaughton Jones's *Atlas of Diseases of the Ear*.

it had developed to a large globular tumour, filling the entire cavity, of a livid red colour, and completely obliterating the meatus. In two months it had commenced to shrink, and after six months the ear was quite shapeless and shrivelled. In the case of a male patient suffering from subacute mania, the entire cavity of the auricle was occupied by a large ovoid sanguineous swelling, without any known cause, in less than twenty-four hours. The ear in this case is now also shrunken, the upper part of the concha being thrown into several sinuous folds, the organ still, however, retaining its normal shape and gross outline.

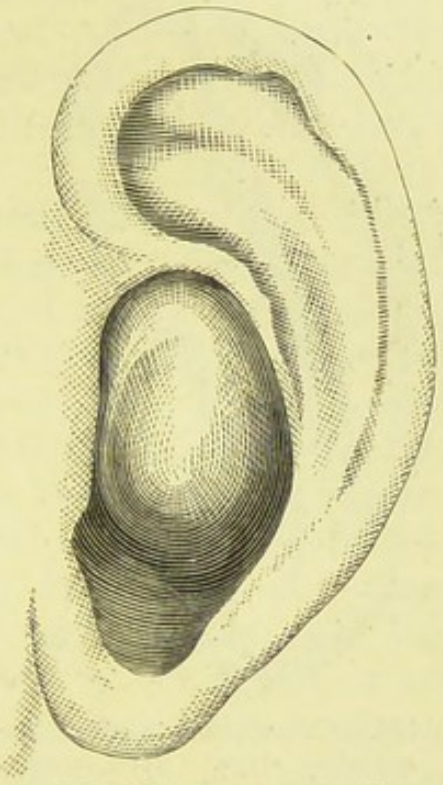


FIG. 130.—Othæmatoma in the acute or *primary* stage. Tumour of moderate size filling up the cavity of the concha; full and rounded above where it is bounded by the ridge of the antihelix, being lost below in the lobule. *Result*, disappearance with but little subsequent deformity. Case of C. H., affected with recurrent paroxysmal mania, taken from life (Ringrose Atkins).[1]

Othæmatomata are accompanied by scarcely any subjective symptoms, but little pain or increased heat being experienced, any deafness that may exist being due to the mechanical closure of the external meatus by the tumour. They frequently form very rapidly, instances of which have just been mentioned, but generally from a fortnight to three weeks elapse before they become fully developed. The contents are usually found to be purely sanguineous, though a yellowish serous fluid has been observed to escape on puncture; the contained blood remains fluid for a longer period than when extravasated elsewhere, but when evacuated shows a tendency towards normal coagulability. Suppuration sometimes occurs in the contents of the tumour, accompanied with the usual symptoms of heat, pain, etc.,

followed perhaps by rupture of the sac, if the latter be not surgically interfered with. In one such case lately under observation free incision afforded vent to a large quantity of sero-purulent fluid, but the tumour rapidly filled again, death taking place before further interference could be had recourse to, the case being one of far advanced paralytic dementia.

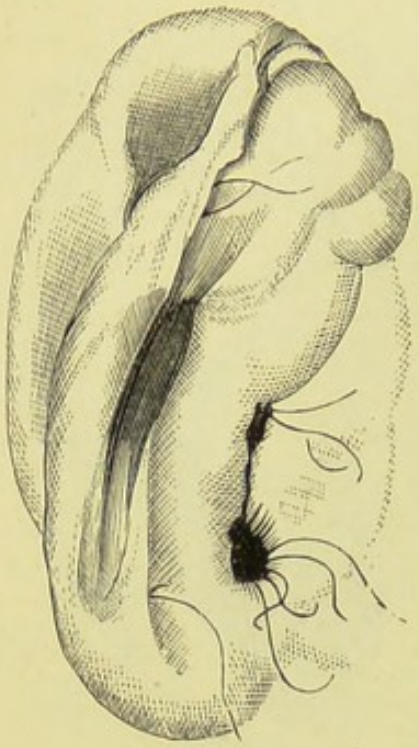


FIG. 131.—Othæmatoma in advanced *secondary* stage. Helix folded over antihelix, fossa of latter completely obliterated. The upper portion of the auricle was transformed into an irregularly tuberculated misshapen mass. On section a triangular portion of bone had become developed in the centre, surrounded with cartilage and connective tissue. Affection of very long standing. Case of J. M., affected with chronic dementia, taken after death (Ringrose Atkins).[1]

The course of othæmatomata in many respects closely resembles that of blood extravasations occurring in other parts of the body. The tumour, in its ordinary condition, rarely bursts, though the skin may crack, and some sanguineous oozing follow, usually at about the end of three weeks, or from that to a month. When the tumour has become fully developed, the effused blood slowly coagulates, and gradually solidifies, and then what may be termed the secondary stage, or that of *shrivelling*, commences. As the watery portion of the blood is reabsorbed and the fibrin precipitated, the skin and cartilage become irregularly adherent to the cyst walls, and the latter contract unequally upon themselves; new fibrous tissue is then formed, which in time may become cartilaginous, or even osseous; and as the result of these changes, the affected surface of the auricle is distorted, and assumes the most bizarre and fantastic forms, which are henceforth permanent.

The hollow of the ear may be thrown into irregular folds or sinuosities; the helix folded over the concha,

which may be greatly thickened, and frequently the entire organ becomes so crumpled and shapeless as to be barely recognizable.

Regarding the frequency with which either ear is affected, observers state that in three cases out of four the left is either solely, or, in cases where the effusion is bilateral, primarily attacked. In the majority of cases we have met with, the affection has been bilateral, but in those unilaterally attacked the left side has the preponderance.

Etiology and Pathology.—The occurrence of othæmatoma was first noticed in Germany, but as an accompaniment of mental disturbance it was first studied in France by Ferrus in 1838. The result of his researches directed attention to the subject, and many important papers relating to it subsequently appeared from time to time, the most important being the *Memoirs of M. Achille Foville*, published in 1859, and those of MM. Delassiauve and Motet, inserted in the *Gazette Hebdomodaire* in the same year. In the year 1850, Franz Fischer directed attention to two forms of affection occurring in the ears of the insane. The one appeared as a "serous œdema," the other as a "sanguineous tumour." The first condition was frequently bilateral, colourless, and painless, rapidly forming, and as rapidly disappearing. The second was unilateral, of a special colour, painful, and of longer duration; the contents were easily reproduced after an accidental puncture, and subsequent deformity of the ear ensued. Following these authors, M. Maury published a thesis on the subject, in which he gave a *résumé* of the various views which had been advanced as to the nature and origin of the tumours up to that time.

As to the etiology of the affection, various theories have been put forward from time to time to account for their peculiar occurrence. Yung and Senbuscher attributed them to passive hyperæmia of the neck and ear, with paralysis of the vascular nerves. According to Neumann the hæmatoma is an erysipelas of a particular kind. Schmaltz considers the affection to be the

result of inflammation of the cartilage of the ear, and Fischer coincides in this view, attributing it to a chronic inflammation of the auricular cartilage and its envelope, to which is added a dyscrasia of a particular kind. The sanguineous tumours are looked upon by Renaudin as a serous œdema, a passive hæmorrhage, an active effusion, or the product of inflammatory action, according to the state of the affected individual, the nature of the malady, and the conditions which have preceded their appearance. "They are produced," says Dr. Merlan, "most frequently in a spontaneous manner, sometimes under the influence of atmospheric variations, and sometimes as the result of traumatic causes." Marcé, who has published a case of double hæmatoma of the ear, in which the eyelids were also the seat of sanguineous effusion, believes that, under the influence of congestion, the vessels of the ear dilate, and that this condition determines or favours the production of hæmatoma.

M. Delassiauve, sharing the views of Renaudin, is of opinion that the hæmatoma must be in great part attributed to the textural peculiarity and special sensibility of the ear. Its proneness to become flushed under the least emotional disturbances, or under the least physical injury, and its sudden pallor under other circumstances, combine to prove, says this author, that the ear participates more than one imagines in the conditions of general life. M. Foville, in the conclusions arrived at in the memoir already alluded to, thus expresses himself: "The formation of sanguineous tumours of the auricle is most often preceded and accompanied by a general disturbance of the cephalic circulation." Morel is also in favour of the theory of congestion with hæmorrhage. M. Ducros, in a memoir presented to the Faculty of Medicine at Montpellier, concludes "that the causes of hæmatoma are multiple, but that traumaticisms alone never suffice to explain its occurrence; it appears that a local affection of the cartilage, depending on a disturbance of the nervous system, always pre-exists."

M. Castelain, who has examined the question closely, thus expresses himself:—"Under the influence of this profound disturbance of the economy, there occurs a *ramolissement* which plays a considerable part as a predisposing cause in the production of sanguineous tumours." M. Bonnet is of opinion that the sanguineous tumours of the ears are veritable congestive apoplexies due to degeneration of the sympathetic, which results in turgescence of the vessels of the ear, and, as a sequel, the apoplexy is produced. Griesinger leant to the hypothesis that traumatic causes were the most fruitful source of their origin, alleging that the tumours were not met with in asylums carefully looked after, and in which the attendants were active in their surveillance. In this country Dr. Wilks is of the same opinion, considering the tumours to be the result of violence inflicted either by the patient himself or by others, the constitution being predisposed to sanguineous effusions. This view is, however, negatived by the experience derived from the modern treatment of the insane, which is now free from any such violence, and yet the occurrence of hæmatoma is no less frequent at the present time than formerly before the humane system was introduced. Moreover, if injury were the cause, we should expect to find ecchymosis or abrasion of the skin with damage to the auditory apparatus, which, so far as we are aware, never appears, nor do we meet with any similar result from blows on the ear of sane persons.

Dr. Nicol has suggested that the sanguineous effusion is produced by the pressure of the delicate structure of the external ear against the mastoid process of the temporal bone during sleep, by the pillow beneath—especially when the latter is hard—in a patient weakened by some "blood dyscrasia." Were this the cause, many more cases of othæmatoma must occur, as the great majority of patients who are likely to be its subjects lie on one or the other side, bear the same pressure, and suffer from the same blood dyscrasia, and yet hæmatoma occurs in but a small minority. Moreover, there is no reason to suppose that the pinna is delicate and peculiar

in structure. Robertson considers that othæmatoma is more probably due to functional disorder of the cervical sympathetic, associated with, or perhaps resulting from, the existing cerebral or cerebro-spinal disturbance, on the following data :—(1) The tumour not unfrequently appears on both ears simultaneously, without any indication of either being injured; (2) an effusion under the conjunctiva occurred in a case of dementia at the same time, and on the same side as the tumour of the ear; (3) some of its complications, such as Graves' disease, indicate disorder of the vaso-motor system. Whether such vaso-motor disturbance is the cause or not, there can be no doubt that mental excitement, resulting from derangement of the vascular system, is a very constant factor, its occurrence being most frequent in those forms of insanity (*vide* appended tables) in which such excitement runs high.

Pathological Appearances.—The morbid appearances presented by the shrivelled ear differ according to the age of the formation. Dr. Barlow, as mentioned by Dr. Alexander Robertson (*Glasgow Medical Journal*, July, 1875), states that at the end of two months he has found a section to be dark and fleshy in aspect, firm and slightly elastic in structure, and adhering closely to the cartilage of the auricle, and less firmly, though with considerable tenacity, to the perichondrium. The tumour was one-fourth of an inch in its thickest part; a transverse section, under a power of three hundred diameters, showed it to be composed almost entirely of white fibrous tissue, with here and there collections of shrivelled blood corpuscles—the fibres being stained at these points with blood pigment. The fibrous tissue was denser at the point of junction of the cartilage with the tumour than at any other point. One of the shrivelled ears we last mentioned, which we have examined, measured on section an inch and an eighth in greatest thickness, and was dense and solid throughout. A fine section under the microscope showed it to consist of somewhat loose fibrous tissue with deposits of fine hyaline cartilage, and a little within

the centre a triangular-shaped mass of bone containing wide channels with lacunæ and canaliculi. The condition of the ears here, as we have mentioned, was of very long standing, and between this and the organized clot of the earlier stages we noticed fibrous tissue and cartilage in varying degrees of development.

Forms of Mental Disorder in which Othæmatoma occurs.—Othæmatoma is not confined to any one form of insanity; it has been found in mania, melancholia, and dementia, but it occurs most frequently in general paresis and insanity associated with epilepsy. The two following tables gives the form of mental derangement, and the relative frequency with which one or both ears were affected in fifteen cases which have come under our observation.

TABLE I.—*Males.*

One or both Ears.	Form of Mental Derangement.	Result.
Both	Acute mania	Died.
Right	Subacute mania	Recovered and discharged.
Both	Relapsing mania	,, ,, ,,
Both	Chronic dementia ...	Died at an advanced age.
Right	Acute mania	Recovered and discharged.
Both	Imbecile	In asylum still.
Both	Acute mania	Died.
Left	Subacute mania	Recovered and discharged.
Left	Acute mania	In asylum still.
Both	Subacute mania	,, ,,

TABLE II.—*Females.*

One or both Ears.	Form of Mental Derangement.	Result.
Both	Acute melancholia ...	Recovered and discharged.
Both	Epileptic dementia ...	In asylum still.
Left	Epileptic idiocy	Died.
Left	Dementia	In asylum still.
Left	Active melancholia ...	,, ,,

Dr. Savage, formerly of the Bethlem Royal Hospital, says that in that institution he has never seen a case in which it occurred recover. We are inclined to think, however, that its importance in this respect has been too highly estimated. Referring again to the cases above tabulated, it will be seen that five out of the fifteen have been discharged recovered, and there is a prospect of the recovery of a sixth; hence, though an unfavourable prognostic, the development of a hæmatoma should not, we think, be looked upon as one of the physical characteristics of a hopeless lunatic.

Treatment.—Grüber suggests surgical treatment, and recommends evacuation of the contents of the tumour and subsequent compression. The difficulty, however, of dealing with the class of patients in which such tumours occur, must in the great majority of cases prevent any such interference. It is to be feared also that such pressure as could be applied to the ear would be powerless to prevent the refilling of the tumour, the contents of which might then, from the admission of air, undergo suppuration, and greater mischief follow than if the tumour had not originally been interfered with.

In some few cases, indeed, where, on other grounds, a hope of final recovery from the mental disorder exists, and when it may be important to prevent the possibility of the after deformity which will in all probability result if the swelling be allowed to run its course undisturbed, the aspiration of the sanguineous effusion may perhaps be attempted, and an endeavour be then made to induce rapid and equal adhesion between the cyst walls. Painting the surface of the tumour with vesicating fluid has been also suggested, and we believe tried successfully in several cases, though as far as we are aware it has not come into extended use.

Eczema.

We are constantly consulted for eczematous states of the auricle. In practice these may be divided under two heads. There is the eczematous eruption in children,

especially present in connection with the exanthemata and whooping-cough, and which, in strumous subjects, so frequently attends various catarrhal states of the meatus and tympanum. A child with phlyctens on the conjunctiva, or some form of catarrhal affection of the eye, comes with an eczematous state of the ear and face or scalp. The child is characteristic of its class; there is a general anæmic and debilitated appearance, with the peevishness and irritability of temper which are usually present; parents try to soothe with sweets, cakes, and all sorts of trash; the result is, that at hospital we generally see children of this type of constitution with the accompaniment of sweets, cakes, or fruit. Hygienic defects and all the attendant evils help out these eczematous states. This form of eczema differs in no way from the similar disease which attacks other parts of the body. It is easily recognized by the discharge and the crust which forms. The cleft between the auricle and the mastoid process is often the seat of an irritating discharge, the surrounding skin is excoriated, and with difficulty can we examine the raw mucous surfaces. The disease may attack the meatus; the auditory canal is filled with a collection of epidermic scales, muco-purulent discharge; the glands about the mastoid process in the neck are enlarged.

In persons advanced in life we find the meatus occasionally the seat of a dry, eczematous desquamation. There is itching and irritation of the canal, rarely discharge; the auricle is sometimes swollen and sensitive, and the ear passage is filled with masses of dry epidermis and some epithelium. These collections, added to the swollen condition of the skin, cause deafness. If the meatus is neglected the membrane sooner or later becomes affected, appearing dull and thickened, while there may be considerable difficulty in removing the tenacious and adherent layers of dead cuticle which cover its surface. Such persons frequently come and affirm they have "gout in the ear," and have resigned themselves to the intractable nature of the affection.

In nearly all these cases there is some constitutional

cause for this local affection that should be looked to. In adults there may be a gouty temperament, free living, disorder of digestion; in children worms, dirt, or general impoverishment of the blood in a leukæmic temperament.

Treatment.—The crusts should be softened and separated, first by oil packing at night (a few pieces of soft linen rag soaked in oil, and covered with oiled silk or gutta-percha tissue), and, after a few days, the exposed surface may be treated with some mild stimulating astringent ointment, such as lanolated benzoate of zinc with carbolic oil and vaseline, or liq. carbonis detergens and liq. plumbi diacet. and vaseline, or a little of the ordinary calomel wash. If there be much discharge, particularly if the skin between the attachment of the auricle and the mastoid be raw and moist, a lotion of calamine and oxide of zinc in rose water applied during the day, the powder being allowed temporarily to dry on the part, will be found useful (see Formulæ).

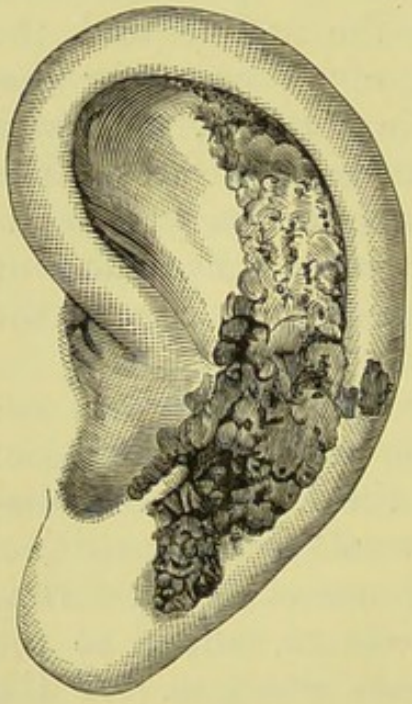


FIG. 132.—Auricle of patient suffering from inveterate eczema (Macnaughton Jones).

At the same time the internal administration of mild alteratives, with such tonics as cod-liver oil and iron, or mineral acids, is indicated. The internal administration of a few drops of liq. arsenicalis with the meals has often the best effects. But the essential element in the treatment consists in the attention paid to the diet and general surroundings of the patient. Simple and plain food, plenty of milk, and a little oatmeal in the mornings, with the avoidance of all trashy stuffs, attention to the cleanliness of the child's person, with sufficient outdoor exercise, should be the directions to parents.

By far the most troublesome variety of ulceration of the auricle is that which results from a chronic form of

eczema, in which a thick and hard scab forms over a most inveterate and highly ichorous discharge. This crust clings with great tenacity to the part, and is with difficulty removed. When it is removed, the fluid which lies concealed by the scab is nearly transparent and straw-coloured. The entire helix is involved, and the ulceration extends so deeply that there is a loss of substance, and perhaps permanent disfiguration of the lobe. In one case that was under our care, there remains considerable deformity, from a long-continued and oft-recurring attack of the kind above described. The auricle is marked with permanent scars, or (as in the case represented in Fig. 133) is destroyed in parts. Various remedies had been used, but with no ultimate benefit. We were consulted when the deformity was considerable. The treatment we have pursued in these cases is much as follows:—Complete removal of the scab by scraping, and thorough cleansing of the raw surface, which is then lightly touched with either chromic acid or carbolic acid. This removal of the scab is repeated as it forms, and the acid is very gently reapplied. The patient may himself use a lotion of calomel and lime water after a few days, and smear a carbolized zinc and vaseline ointment on the part at night. A few applications of the acid are generally sufficient, and then the chloride of zinc (grs. xxx. ad ℥i.), applied after the removal of the scab, acts admirably. The crust should be removed daily, and the raw surface dressed.

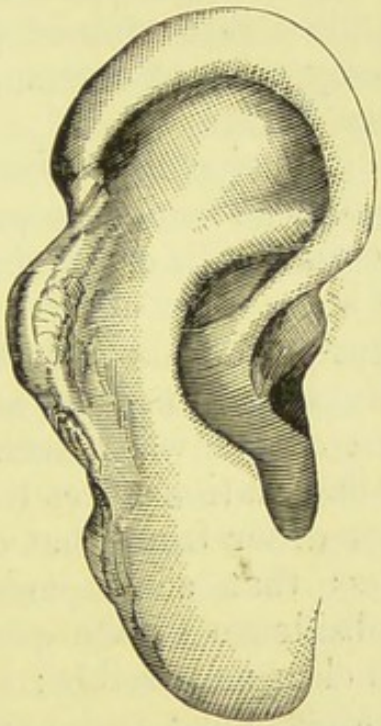


FIG. 133.—Auricle of patient who had suffered for years from recurrent attacks of same affection; drawn after complete healing of the ear, showing the existing deformity (Macnaughton Jones).

The general health, at the same time, has to be attended to, and the internal use of arsenic and iodide of

potassium may with benefit be prescribed. Often in eczema and psoriasis of the scalp the meatus is filled with cakes of loose epithelium, which block up the passage, impair the hearing, and produce in time alterations in the membrane. These should be constantly and carefully removed by syringing and forceps ; the passage must be well cleaned out with cotton-wool, and chloride of zinc with glycerine, or better the saturated boracic acid and alcohol solution. Nitrate of silver solution (grs. xx. ad ℥i.) acts well when applied to the cleansed wall of the meatus. Of late we have used the chaulmoogra oil, combined with almond oil, in a pack, or applied it combined with lanolin and oleate of zinc in many cases of eczema, in the latter stages of the disease (see Formulæ).

Erysipelas of the Auricle.—Sometimes this affection assumes formidable proportions, occurring either in connection with erysipelas of the scalp, or as a complication of some other aural trouble. We have just had a case of erysipelas of both auricles occurring in connection with a slight ecthymatous attack of the head and face. First one auricle was attacked, and then the other ; finally the inflammation spread to the scalp. The treatment does not differ from that of erysipelas elsewhere. The deafness that accompanies the disease disappears on the subsidence of the swelling. The meatus must be kept as clear as possible ; some fine powder of equal parts of starch flour and oxide of zinc kept to the part, with gauze over the skin, or fine muslin ; or, if it be preferred, an application of equal parts of mild mercurial ointment and vaseline. The general health should be well sustained, and tincture of iron administered.

Absence or Excess of Cerumen.

The healthy secretion from the follicles of the meatus varies greatly in different individuals, both in quantity and character. In some it is very soft and oleaginous, in others it is dry and has a tendency to crumble. The colour also is different, varying from a pale yellow to

black. It may be mixed with hairs, or portions of epidermis. With the dry forms of secretion we often find eczematous conditions present.

Absence of Cerumen.—There is no doubt that the popular notion that a "dry ear" is indicative of deafness is, generally speaking, true. We find this dryness of the meatus and absence of secretion frequently present in those who suffer both from middle-ear catarrh and accompanying affections of the labyrinth. It is more commonly observed in old persons. It may be indicative of some morbid condition of the trophic nerves of the ear (Politzer). Certainly it is a frequent accompaniment of catarrhal appearances of the membrane and ossicles, and is often present in obstinate cases of tinnitus. Its appearance, and secretion of wax, is occasionally noticed, not necessarily with an improvement of hearing. Some emollient application, as glycerine, white vaseline, or an alkaline lotion, may relieve the sense of dryness or itching.

Excess of Cerumen.—Excess of wax deserves special attention on the part of the surgeon, as it is so common a cause of deafness, and is so frequently found complicating other pathological changes in the ear.

Causes.—It may be attendant on a narrow external orifice which favours its collection. The use of towel ends and various "picks" for the ear favours the collection and impaction of wax. Imperfect cleansing of the ear after the free use of soap in washing is another cause of the collection of wax. This inflammatory state of the meatus is often seen with cerumen, so much so that we may look on a chronic form of dermatitis as both a possible cause and sequence of excess of cerumen.

Diagnosis and Symptoms.—The symptoms complained of by patients suffering from "wax in the ear" are that of deafness, with a stupid feel and some form of tinnitus, usually singing. It is well to insufflate a patient with the aural bag a few times after the removal of wax. Most ridiculous errors are often committed from overlooking this simple cause of deafness.

Nothing can be more exasperating than for a patient

to return a long distance to a surgeon, and find that the source of all his blistering and leeching, and perhaps physicking, lay in a mass of easily removable wax; yet this occurs. The characteristic black shining surface of the wax can hardly be mistaken, with any degree of care. The surface of an old and hard mass of wax sometimes has a peculiar lustre, and may give to the inexperienced eye the idea that it is the membrane, but it is only necessary to mention this, in order to prevent any surgeon from falling into so unfortunate an error. Two imprudent practices patients should be cautioned against;—the habit of inserting picks, rolls of towels, etc., into the ear, to cleanse the meatus, which can only do harm and ensure the consolidation of any cerumen in the canal, and its impaction on the drum, and the fashion of placing cotton-wool in the ears.

The presence of wool is frequently overlooked. Remaining in the meatus it collects secretion, and may be hidden by wax, or if there be any discharge it may become imbedded in it. The necessity for the wool after syringing or on going out into the cold air is obviated by placing an aural protector in the meatus. It will be sufficient to mention that not long since we removed three layers of wax and two of cotton wool from the ear of a gentleman who was completely oblivious of the presence of the wool.

Treatment.—Free syringing is generally all that is required for the removal of this common and troublesome cause of deafness. The mass may not come away until a considerable time has been spent in syringing. This more frequently occurs when there has been some inflammatory action in the meatus, or when the shed epidermis which envelops the cerumen is adherent to the wall of the passage.

The removal of a plug of impacted wax is often expedited, after syringing a little time, by carefully grasping the mass with the rectangular or lever forceps, and thus withdrawing or loosening it. A little liquor potassæ and glycerine, or a solution of carbonate of soda (grs. xv. ad ʒi.), dropped into the ear for a few

nights will help to soften hard masses of wax and epithelium.

After a portion has been removed, and while the grub of cerumen or waxy cast of the meatus is being washed out, the canal should be from time to time examined with a speculum; much harm may be done if this step be not attended to, as the healthy membrane may be forcibly syringed on and injured. On the removal of cerumen, the membrane has generally a dull appearance, with an absence of transparency, and the surface of the malleus has an injected look; the collection being removed, an interval of a few days will generally set things to rights, and if this be the sole cause of the symptoms, nothing further is necessary. If any tinnitus or pain persists, or if the deafness is not relieved, we must suspect other mischief, and proceed to examine the ear closely.

Insects in the Meatus.—Should an insect find its way into the meatus, the best thing to do is to pour in a little warm oil or glycerine, with some alkali, as potash or soda, so as to suffocate it, and then it can be washed out with a syringe.

Maggots from the larvæ of flies are sometimes found in the ear, and are seen like little white moving bodies. The best treatment is to kill them with chloroform vapour, and then to pick them out with forceps.

Foreign Bodies in the Meatus.

Persons are yet to be found who can be rash enough to employ clumsy force and ill-contrived instruments in the removal from the external meatus of what often is, even after a prolonged residence, a comparatively harmless tenant.[1] Common sense and surgical instinct, guided by even a minimum of anatomical knowledge, might suggest how imprudent are such attempts to any one who pauses to reflect on these simple considerations of the anatomy of the external passage of the human ear.

[1] See p. 46

From this it is evident that the direction of any extracting or expelling force must depend on the portion of the canal in which it is applied, and also that, having in view secondary consequences, and the effect of inflammation in frustrating our efforts to remove a foreign body from the passage, we should employ no force that is in the least calculated to excite this inflammation. The greater the swelling of the epidermis with subcutaneous cellular effusion, and it may be periostitis, the greater the jamming of the foreign body, whatever be its nature. If it be hard and angular, this is more likely to occur than if it be smooth and round.[1]

If it be pushed into the pouch in front of the membrane, and the latter be contused in attempts to catch it, the more likely are we to have inflammation of the membrane and resulting perforation, with tympanic mischief. If the canal becomes so swollen that the foreign body cannot be seen, and its removal be still attempted, then the effects of this "groping in the dark" are more disastrous; further inflammatory mischief and tighter jamming.

It may be conceded that, in the large proportion of cases, foreign bodies are fixed in the ear by attempts at removal. If the body does not occupy the calibre of the canal, it lies in it, and there is a space for the expelling force to be directed from behind on to it.

If it be so large as to fill the entire calibre of the passage, which is rarely the case, it will, previously to being interfered with, in all probability lie loosely in the passage, its further entrance being arrested by the contraction of the wall.

In our experience, the most frequent seat of the arrest of a foreign body is at the junction of the cartilaginous and osseous portions of the meatus. It becomes *arrested* here, or is driven against the membrane by extractive efforts. Every touch of an instrument, no matter how gentle, sends it further in; each forcible effort tends to further *impaction*. Of course, there are some bodies so small and so shaped that it is a

[1] See p. 8.

matter of no difficulty to catch them with a forceps and withdraw them. It may be laid down as an axiom in aural surgery that, in the case of any arrested body in the meatus, where any space exists between the foreign substance and the wall of the meatus, the only agent which should be employed is water.

Many pages have been devoted to the consideration of this subject, and many opinions have been expressed as to the superiority of this or that method of removal, and the advantage of this or that instrument over others, whether scoop or forceps. Our belief is, from several years' experience, that syringing is the one safe and certain method of removing foreign bodies from the ear. This is *the rule;* there may be some few and rare exceptions. We have, by careful, repeated, well-directed syringing, removed foreign bodies of all descriptions and shapes from the meatus by syringing alone. Amongst some of the substances we have thus removed, were glass beads of all shapes, shells, stones, pieces of chalk, berries, ears of corn, pieces of slate pencil, etc. If the body be impacted, or if it completely occlude the canal, much will depend on the nature of the body, its shape, the material of which it is composed, the length of time it has lodged, the presence or absence of inflammation, the kind of instrument at hand. It is our conviction that, in all recent cases, those quickly brought to the surgeon, syringing is the best means to adopt; in all cases where inflammation is not present, no matter how long the body lies lodged, syringing is also the best means; and, in cases where inflammation is present, we prefer, as a rule, to wait, using means to subdue it, with gentle syringing daily; and, if patience only be exercised, success in the end is almost certain. The instrument suited for one occupant of the canal will be found valueless for another. The nature, shape, and position of the foreign body must be taken into consideration in the selection of any extracting instrument. To avoid all force is the rule, never to be violated, let the circumstances of the case be ever so tempting.

Sponge, dried peas or beans, in the meatus offer

examples of exception to the rule we have laid down as to syringing.

Finally, on this much-debated question of the extraction of foreign bodies from the ear, we venture to give it as our opinion that *all* instruments are in a degree dangerous, to be employed with caution, and on no account should their use be continued until proper syringing has first been given a long trial. To syringe the ear, the lobe should be held well back, the head sideways, the face slightly up, and the stream directed with sufficient force to pass between the foreign body and the wall of the meatus. We fill the ear with glycerine after each syringing, and repeat the process daily. We have known a piece of cobbler's wax used with success to draw a foreign body out.

Glue applied with a camel's-hair pencil and allowed to harden on the body has been employed (Löwenberg). Dentist's cement may be applied with the same object. Quietness and firmness with friends, patience in using the syringe, extreme caution with all forms of mechanical helps, are the essentials for dealing successfully with foreign bodies in the ear.

Any form of extractor, no matter how ingeniously devised, should be taken in the hand only when the nature of the substance justifies the belief that we can lay hold of it or that by its position we can gently raise it from its bed.

We will here quote some remarks of Hinton and Tröltsch on this subject. The former says—

"I must be pardoned for speaking earnestly on this point. Even to this day it remains the fact that ears are thus destroyed without shadow of reason or excuse, and not by careless or incompetent persons alone. I believe it may be laid down as a rule that, whenever an instrument will succeed, syringing would also succeed; and that, when proper syringing will not succeed, all instruments are full of danger; if had recourse to before violence has been used, would probably, in all cases, remove the offending body in ample time to prevent mischief."

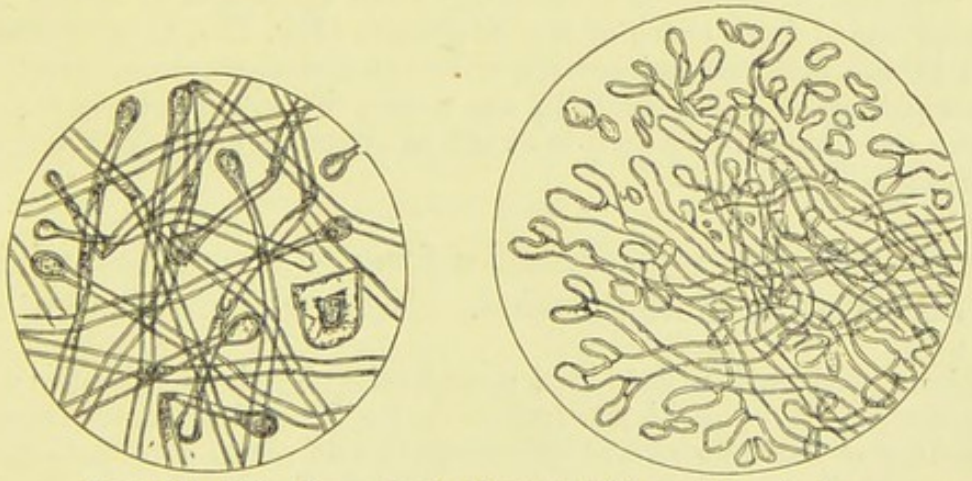
"Injuries," says Tröltsch, "are frequently inflicted on the soft parts of the meatus by patients with itching in the ear by means of knitting-needles or sharp metal ear-pricks; graver and more serious frequently prove those contused and lacerated wounds of

the meatus inflicted by a professional hand, in attempting the removal of foreign bodies, even in those cases in which most harmless intruders, as morsels of bread and paper, are concerned. . . . On such occasions, the instrumental foreign bodies are generally the chief part of the evil."

Aspergillus—Otomycosis.

Microscopic Appearances.—To Burnett of Philadelphia we are specially indebted for a clear description of the microscopic features of this fungus. On the Continent many otologists, following Wreden and Mayer, have described the etiology of otomycosis, more especially of late years Pacini, Schwartze, Grüber, Politzer, Weber-Liel, Löwenberg. In America, Orne Green and Rosa, and in England Cassells, have also added to our knowledge of these vegetable organisms. Burnett regards the *Aspergillus nigricans* as the commonest variety met with, having himself never met with a case in which the *A. glaucus* was present, though the polymorphism of the fungus is asserted, and the varieties of the fungus are by some regarded as but different stages of development of the same species.

Burnett thus describes the microscopic features of the *Aspergillus nigricans*, the figures in the text being from his original drawings :—



Figs. 134, 135.—Stages in development of Aspergillus nigricans.

If a small piece of a colony, in the earliest stages of its development, be examined under the microscope with a power varying from 250 to 300 diameters, a field similar to that in Fig. 134 will be observed. It is, in fact, the first formation of rootlets or the

mycelial web, from which, at a later period, the fruit-stalks or fructiferous hyphens spring. It will also be seen that some of the filaments composing the web tend to become bulbous at one end, and that the latter, as the stem grows, becomes larger and dotted (Fig. 135), until finally there is standing out from the dense web of mycelial filaments a perfect fruit-stalk and a fructiferous head —the latter studded with short peg-like limbs, the sterigmata, on the free ends of which are the spores (Fig. 135).

"All of these stages of growth I have traced in specimens of the fungus removed from the human ear. In the fluid parts of the specimen, epithelium may usually be seen in small quantities, as the parasite develops, as in the upper part of Fig. 135.

"Very rapidly, in the course of a day or two at most, the perfect fruit-stalk is formed in large numbers and in all stages of development, and the mycelial filaments can be seen to be coarser and septate. On one hand may be seen a well-formed though unripe fruit-stalk and head (Fig. 136, B), while in the centre of the field there may be seen the ripe aerial fruit, from which the fully-grown spores drop literally in myriads (Fig. 136, C).

FIG. 136.—Aspergillus nigricans.

"The characteristic difference between the two varieties of aspergillus, the so-called *yellow* and *black*, is seen in the shape and size of the *receptaculum*, and the arrangement of the *sterigmata* upon it, these two parts forming the so-called 'head' or *sporangium*.

"In the *A. nigricans* (Fig. 136, B) the sporangia or heads are distinguished from those of the *A. glaucus* (Fig. 136, A) by the fact that in the first the sterigmata cover the receptaculum, which is spherical, on all sides, while in the latter, the lower fifth or fourth of the receptaculum, which is ovoid in shape, is entirely free from sporangia."

Dr. Löwenberg described a form of aspergillus, which he observed in some patients. In each there was an

"oblong and rather flat bag, completely closed on all sides; it measured from $1\frac{1}{3}$ to $1\frac{1}{2}$ centimetre on its longest diameter (corresponding to the long axis of the meatus), and about one centimetre in one of the transverse diameters, and half a centimetre in the other. These measurements varied slightly in different cases. One of the flat faces was obliquely truncated at the end, and showed an exact cast of the membrana tympani. The colour was yellowish-white in one case, light brown in the second, and whitish-grey, turning to a dirty brown, in the third. These bags were

composed of mycelium, sporangia, free spores, and epidermic cellules. On examining such cases the otoscopic aspect is very puzzling, the growth entirely filling the fungus of the meatus, and hiding the membrana tympani. After removal of the bag, which is followed by great relief, the drum-head is found injected, and marked with white specks on a red ground."

These curious cystic formations were also observed by Mayer, Pacini, and others.

In the etiology of otomycosis the favourable character of the external meatus for the growth of fungi and schizomycetes has to be remembered. The further tendency to otomycosis and the development of parasitical fungi, Löwenberg has shown, is increased by the nature of the substances introduced into the meatus. It is chiefly, he says, with the object of proving the possibilities of engrafting this, a very painful disease, upon the one for which the patient demands our care, that we write these remarks. In a great number of cases the affection is provoked by the introduction of an oily substance into the external ear, such as olive oil, oil of almonds, etc., at times lard, balsam, or pomade. In employing these oily substances, it is not sufficiently remembered that they all undergo rapid decomposition once they remain exposed to the atmosphere, even at an ordinary temperature; how much more so at the more elevated one of the auditory meatus. Oils contain in solution azotic substances which, under the influence of the oxygen of the air, provoke special fermentation, becoming rancid. This raises the temperature rapidly; the neutral fatty matters contained in the oil are changed into glycerine and fatty acids. Thus the spores of the musty fungi, which are abundant, are provided with all that is necessary for their germination, viz. oxygen, watery vapour (in the air), sufficient heat, organic decomposition, and the acidity which favours their development. The filaments of the mycelium grow rapidly. The acid products of the decomposition on the one hand, and the vegetable foreign body on the other, irritate the ear and set up this inflammatory process, causing the watery secretion, and exciting the formation of the organic

azotic substances that are so easily assimilated by these cryptogams.

Also Löwenberg noticed that certain astringent solutions in common use as lotions appeared to induce this fungus growth. On investigating the cause of this, he found an explanation in the presence of cloudy collections of mycelia and spores that formed after those solutions were kept for a few days. Macnaughton Jones examined a large number of these solutions himself, and in addition such solutions as are in common use in eye affections, and those containing the various alkaloids. He kept these solutions in corked and open bottles. He found at intervals of from one week to a fortnight in all, whether opened or closed, quantities of spores, but far more in the open bottles. The carbolized and the chloride of zinc solutions were, in some of the bottles, quite free of spores; it was not so in others.

Here we have a fruitful source of fungoid and other germs of infection. More especially in catarrhal conditions of the meatus and tympanum attended by perforation of the membrane.

Bottles that have been laid by for some time, perhaps not carefully corked, are used again in cases of discharge when they may be teeming with fungus spores.

Löwenberg advised as a preventative that the solutions thus employed should be filtered from time to time, and that they should at the same time be subjected to a few minutes' boiling; and that the bottles in which they are replaced should be carefully rinsed out with freshly boiled water.

We see from the above how dangerous are these "oil drops" that are occasionally and aimlessly prescribed. The second danger may be obviated by prescribing concentrated aseptic solutions in absolute alcohol and recently boiled water, and ordering the patient to make his lotion by adding a certain amount of these to the proper quantity of recently boiled water.

Symptoms.—A patient comes to us for advice for deafness, discharge, perhaps tinnitus, with, it may be, an old perforation of the membrane, with recurrent

attacks of earache and subsequent irritation, which have lasted for some time. On examining the ear with the speculum we may find the meatus narrowed by the intermittent inflammatory attacks, and experience some difficulty in inspecting the membrane. This difficulty is further increased by a mass which blocks up the passage and obscures the view. On examining closely we see that this is not of the nature of wax. It has a lardaceous appearance, like wet paper, of a greyish-white colour; the plug is mixed with epithelium, or it appears as a round mass, and we may, on removing this with syringe or forceps, see distinctly the fungus either on the wall of the meatus, on the tympanum, in its crevices, or in the tympanic cavity if there be a perforation of the membrane. The discharge also is not of the character of ordinary catarrhal inflammation; it is thin and watery. There is with each attack of inflammation a renewal of the pain and a change in the character of the discharge. These flakes of membrane which adhere to the meatus and membrane can be peeled off, leaving an injected surface underneath, or sometimes the pellicle removed is dotted with brown spots of the aspergillus, or a perfect coat of the meatus may be detached.

Dr. Burnett notes a fact that we have often observed, namely, that we seldom find cerumen and aspergillus. He points out that its occurrence has been noticed frequently where the patient had pursued the imprudent practice of constantly picking at the ear to keep it "clean." We have frequently seen particles of wool mingled with the fungus. We have several times removed from the ear of a patient a mass of wool, the presence of which he was innocent of, when this had formed, with fatty matter, epithelium, and fungus, a complete plug in the meatus, concealing a perforation while the fungus flourished in the tympanic cavity. We have seen this disease occasionally in the better classes, but it is not a matter for surprise that it was frequently met with in the poverty-stricken patients in Ireland, more especially the younger ones who attend in such

numbers the hospital clinique. In these, neglect of the ear, want of cleanliness, general delicacy, combined to produce it.

These facts, connected with the growth of the fungus, teach some important lessons in regard to the prophylaxis of this affection, viz. the importance of perfect cleanliness in catarrhal states of the ear attended with discharge, the avoidance of fatty and oleaginous remedies in such cases, the necessity for the daily use of antiseptic and astringent lotions where we dread the formation or development of the aspergillus.

Treatment.—In treating the fungus we place reliance principally on alcohol and glycerine—equal parts of absolute alcohol and glycerine. This we apply after thorough cleansing of the part, whether meatus or tympanic cavities, with cotton-wool on the aural probe. We also use carbolic acid and glycerine (1 part to 2) and chromic acid (grs. xx. ad ℥i.); boric acid with absolute alcohol and water (saturated solution). The meatus and tympanum may be washed out daily with a bichloride of mercury lotion (1 in 1000). Dr. Burnett speaks highly of solution of hyposulphite of soda (grs. iij. ad ℥i.). We make a rule to wash out the tympanum thoroughly, in cases of perforation of the membrane, with a disinfectant solution by passing the stream through the nose in the manner already described, or with the intra-tympanic douche. Dr. Laurence Turnbull speaks highly of Fowler's solution as a parasiticide, and Wreden recommends chloride of lime (grs. ij. ad ℥i.). We must insist on seeing the patient occasionally and for some time, as by this means alone can he be certain of a permanent cure.

Otitis Externa, Acute and Chronic.

Diffuse inflammation of the external ear of the acute type is induced by the same causes that contribute to produce the more circumscribed attack of furuncle or abscess. In addition to these we may especially

mention sea-bathing, the exanthemata, the presence of foreign bodies, and imprudent attempts to extract them; the strumous diathesis, gout, syphilis, injuries, diabetes, otomycosis, and aspergillus. Diphtheritic inflammation is extremely rare, but when it does occur it is very fatal.

Course and Symptoms.—The inflammation once excited spreads rapidly, and may extend from the dermal layer of the meatus to the periosteum of the osseous portion. We have already considered the continuity of these structures with the tympanic membrane and cavity. This continuity of structure explains how in very severe cases the osseous canal may become involved in the inflammation, and necrosis or caries result, and how still more frequently the tympanic membrane and middle ear are attacked.

Thus the site of the inflammation, or its extent and limitation, influence its character and course. If the osseous canal be specially involved, there is greater pain, often complete occlusion, the subjective symptoms of deafness and tinnitus are intenser, the course of the disease is more tedious, the middle ear is more likely to be affected, and the hearing permanently influenced.

The local signs of diffuse inflammation are characteristic of it, and can hardly with care be mistaken for any other affection, save the more circumscribed form of abscess or boil. There are present, from the first, pain, sense of heat, throbbing, tinnitus, some deafness. On examination of the ear there is perhaps some redness of the auricle, with general sensitiveness of the whole external ear; the patient shrinks from the touch of the speculum; the ear passage is swollen, the walls of the meatus are red, and appear to touch each other, preventing any view of the membrane. For some days there may be no discharge, or only some sticky secretion closing the small aperture between the swollen walls. Then follows some discharge of serous, sero-sanguineous, or purulent secretion, generally mingled with *debris* of shed epidermis. Still the pain continues, recurring with fresh severity on each accession of the inflammation, and is particularly bad

at night. There are generally some constitutional symptoms attendant on the attack. The pulse increases in frequency, the tongue becomes coated, there is loss of appetite, the disinclination for food being further increased by the pain experienced from the movement of the jaw in eating.

The progress of the disease and its subsequent course will in great measure depend on the local treatment the patient receives, and the severity of the attack. Too frequently it is tedious, and runs into the chronic type of the affection, some swelling and erosion of the canal walls continuing, with purulent discharge, and more or less involvement of the tympanic cavity, and possibly perforation of the membrane. In severe cases occurring in delicate ill-nourished children, extensive gangrenous sloughs may be formed, and these may even encroach upon the adjacent soft structures of the cheek, head, and neck.

Recurrences of the inflammation also are apt to take place, causing a renewal of all the symptoms (see Recurrent Abscess in the Meatus). When the disease has pursued its course unchecked there remains very often a granular state of the mucous lining of the meatus and tympanum, and possibly small vascular polypi. Still further the mastoid cells may be attacked, and inflammation spreading to these, mastoid abscesses, caries, or necrosis may ensue, or in the worst cases meningitis, inflammation of the brain, and pyæmia.

Chronic Otitis Externa.

This is commonly the consequence of the acute disease. It is from the concurrence of chronic otitis media and suppurative discharge from the middle ear, with otitis externa, that we have the latter trouble so often confounded with the former in practice, and both jumbled up under the terms of otitis and otorrhœa.

In the chronic affection various conditions of the external meatus and middle ear are met with. There are collections of pus and epidermis in the canal, which

is more or less contracted, sensitive, irritable, and denuded of its epidermis in parts. The tympanic membrane participates in the chronic inflammation, loses its lustre, is thickened and often perforated. Other appearances are similar to those found in otitis media.

Prognosis.—The prognosis will be in great measure dependent upon the means of treatment adopted in the early stage of the disease, and on the subsidence of the acute symptoms. Also, it will depend on the degree to which the disease has extended both in the external meatus and middle ear. If perforation occurs so that the ossicles are implicated the hearing must permanently be affected.

If the inflammation extends to the mastoid cells, or destroys the roof of the tympanum, then the case is of a most grave character. On the other hand, with early and judicious treatment and continued care of the ear, in the great majority of cases the patient recovers, if not perfectly, with but slight permanent results.

Treatment.—Much that is said of the treatment of furunculous inflammation and recurrent abscess of the meatus applies equally to otitis externa (see chapter on General Therapeutics, also Treatment of Furuncle and Abscess). Depletion by leeches, the artificial leech, the use of Leiter's irrigator to the ear, frequent anodyne fomentations, mild, astringent, and antiseptic warm douches, the internal administration of salines, and some alterative, with careful attention to diet, including the avoidance of alcohol, are the principal means of combating the inflammation. The patient should be seen daily and the external meatus examined. An incision may have to be freely made into the swollen tissue, and this is the more necessary if we have reason to believe that pus is concealed. The same remark applies with additional force to inflammation of the osseous portion of the canal.

For the remaining management of the case the reader can turn to the directions for the treatment of furuncle of the meatus, abscess, stenosis, and chronic suppuration of the middle ear.

Furunculus and Abscess in the External Meatus.

Both ordinary furunculus and more severe abscess may occur in persons of all types of constitution, and often in those who enjoy robust health, and at all ages, though various degrees of circumscribed inflammation are more commonly observed in those who from any cause are debilitated and enfeebled in general health.

Causation.—We find among the most common causes of abscess, exposure to cold, injuries, irritation of the meatus from foreign bodies, "picking at" the ear with pins or other pointed bodies, collection of wax, with attendant inflammation of the cutis.

The association between the occurrence of furunculus and abscess and the season of the year, malaria, and the presence of bacteria is referred to fully in the chapters on Etiology and Hygiene.

Symptoms.—The symptoms are characteristic—severe pain in the ear, of a shooting nature, increased at night, with some slight attendant fever and constitutional disturbance. Accompanying these symptoms there may be some deafness and tinnitus. This pain is of a radiating character, extending to the side of the head, and aggravated by movement of the jaw in eating. The entire ear becomes sensitive to the touch, the patient shrinks from examination. The abscess may occupy any portion of the canal, and vary in size from a minute boil situated on some part of its wall, to a considerable swelling which may block up the entire meatus. The intensity of the pain and the symptoms vary according to the situation and extent of the inflammation: whether it be restrained by the bony boundary of the canal and in proximity to the membrane, or seated more externally in the cartilaginous portion.

Diagnosis.—The presence of the abscess is easily recognized. It is not often necessary to use any speculum, and this should be avoided, if possible, as its employment causes unnecessary pain. The meatus

may be entirely closed by the swelling. This gives rise to a possible source of error, yet one which with any degree of care should never be committed.

We have known instances where attempts have been made to snare an abscess in mistake for a polypus. It is needless to say that with a little care, and if any doubt exists, on examination with a probe, such a mistake could not result. The complete continuity of the abscess with the wall of the meatus immediately distinguishes it. It is rare for resolution to occur, and

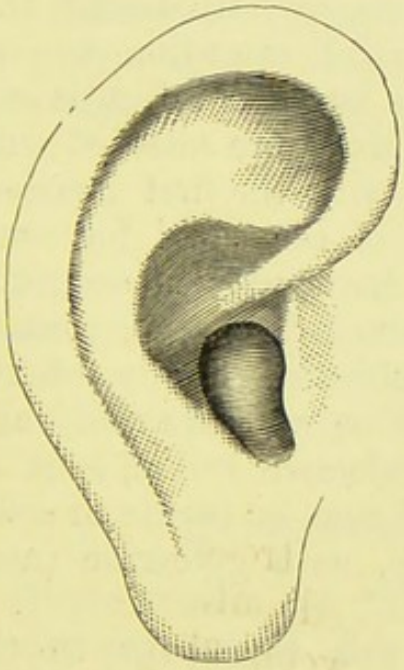


FIG. 137.—Abscess in external meatus.

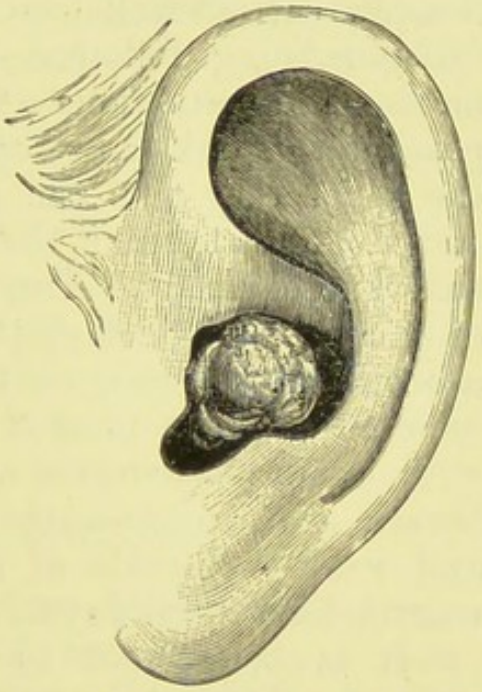


FIG. 138.—Polypus protruding from meatus.

generally, in periods varying from two to six or eight days, pus forms and is discharged.

Treatment.—The treatment consists in depletion with leeches (two or four) applied over the tragus or in the meatus, and in the early stage of the disease warm fomentations, such as a decoction of camomile and poppies and hot laudanum water, or the ear may be periodically steamed. The syphon douche can be used, Maw's aural douche and one of Savory and Moore's answering the purpose admirably. Hinton and Roosa caution against the use of external poultices, the latter

recommending a small conical linseed poultice introduced into the ear. It is well to emphasize this caution. We have seen great harm done by the continued use of large poultices. Sometimes benefit may be had from an application of the liquor epispasticus over the mastoid process in the early stages. Often vesication is of great use in allaying the pain, also subcutaneous injections of morphia. If the meatus be not blocked up, warm injections of carefully strained poppy water, frequently repeated, will be found grateful. When the abscess has formed, the early evacuation of pus, by an incision carried well into it, is the only treatment, this incision being followed by careful attention to the meatus and membrane. On this latter point it is not possible to speak too strongly. Many are satisfied with the relief they give the patient with the first incision, and do not continue their care of the canal for some time subsequently. The result frequently is occlusion of the passage, with epithelium and discharge, perhaps a recurrent abscess, or the implication finally of the membrane. The meatus should be well cleansed daily with a mild astringent and disinfectant lotion, such as boracic acid, sulpho-carbonate of zinc, or borate of soda, and weak bichloride of mercury, with glycerine (used warm), for several days.

It is better not to trust this treatment to the patient. After the meatus is washed out, it should be gently dried with the absorbent wool, and then the walls lightly wiped with a saturated solution of boracic acid in water and alcohol.

As abscesses are particularly likely to recur, it is well to warn the patient of this tendency, and so avoid the unpleasantness which sometimes arises from impatience at the prolonged nature of the inflammation. It is in these recurrent cases that the continuance of poulticing does such mischief, relaxing the parts and maintaining a chronic state of congestion of the vessels.

Weber-Liel rightly insists, in the case of abscess of the meatus, on early and free incision. Thus the morbid process is shortened. He recommended a spirit bath of

alcohol and weak solution of bichloride of mercury in the commencement of the inflammation; the patient lies on the side and the ear is filled with the alcohol. This has a hygrometric and anæsthetic effect. A five per cent. solution of carbolic acid (two to four drops) is injected subcutaneously into the furunculus. This lessens the tension and pain. The alcohol bath is then used for one hour. The injection is repeated if necessary, only a fresh and pure solution of carbolic acid should be used. Pain is thereby arrested; the inflammatory process is cut short and recurrence anticipated.

At times abscess in the meatus assumes very formidable proportions. This is particularly so in those cases where there is frequent recurrence of the abscess.

Polypi.

These may be found growing from the walls of the meatus, but as they more frequently arise from the middle ear, we will treat of them in the chapter on Middle-Ear Disease (p. 263).

Hyperostosis and Exostosis.[1]

Hyperostosis, an inflammatory thickening of the osseous portion of the meatus, or exostosis, a new growth, may occlude the auditory meatus, producing deafness and tinnitus, or cause retention of secretions in the auditory canal or tympanum. Hyperostosis is diffused (Tröltsch), and never seen until the osseous meatus is completely ossified.

Cause and Symptoms.—It is caused by the spread of an inflammatory condition to the bone, and may be produced by disease, such as syphilis or gout, by the irritation of an acid discharge, a polypus, or caries of adjacent bone, or by injuries. If any symptoms exist they are those caused by a narrowing of the lumen of the meatus, deafness and tinnitus, or those produced by the penning up of pus, etc., in the cavity of the tympanum.

[1] See Plate II. Figs. 12–16.

Treatment.—In treating a case of hyperostosis, the attention must be directed to the cause and all sources of irritation removed. It is remarkable sometimes how soon this bone thickening will disappear on the removal of a polypus, or from simply keeping the meatus clean and free. If after the removal of the sources of inflammation the thickening does not subside, the insertion of small ivory bougies, laminaria tents, or the painting with iodine or nitrate of silver should be tried, and great good may be effected in this way. Should, however, these means fail, and it is necessary to do something to relieve the patient from imminent danger, then, and *then only*, should either the dental drill or the mallet and chisel be used, for interference with these instruments, unless absolutely necessary, is wholly unjustifiable. Should, however, the occasion arise, the dental drill is the best instrument in our opinion. The operation should be performed with the greatest care and caution, a steel guard (Field), previously adapted, being used if the obstruction is near the tympanum. Plenty of assistance, too, should be at hand, so that the surgeon may keep his attention entirely fixed on guiding the bur. Some surgeons prefer to turn forward the auricle, and, dissecting the mucous membrane from the wall of the meatus, remove the growths with mallet and chisel; but we prefer to do so by the natural channel.

Exostoses differ little from osteomatous growths in other parts of the body, and are commonly divided into spongy, ivory, and an intermediate variety, according to their degree of density. They are usually found growing at the junction of the cartilaginous and osseous portions of the canal. They may be caused by constitutional disturbances, such as gout or syphilis, by sea-bathing and much diving, or as one of the results of a neglected chronic middle-ear suppuration.

The *spongy* is a softish tumour, usually single, pedunculated, and of rapid growth. This variety may be produced by the conversion of a polypus into the osseous condition. It is easily removed with the snare.

The *ivory* is so named from its hard consistence. It

grows slowly from a broad base; it may be single or multiple, is covered with a smooth white skin, and is usually seen on the posterior wall of the meatus. This condition seldom yields to any simple treatment, and when necessary the dental drill must be used.

The *intermediate* variety is harder than the spongy, but less dense than the ivory; is generally multiple, broad of base, and covered with a white skin. This is the variety that yields such good results to Bonnafont's ivory dilators or laminaria tents.

CHAPTER XIII.

AFFECTIONS OF THE MIDDLE EAR.

Myringitis.

Inflammation of the Membrane—Myringitis.—There can be no doubt that the dermoid layer of the membrane may be attacked with acute inflammation and yet the tympanic cavity itself escape. We are not inclined to look on acute inflammation limited to the membrane as of such extreme rarity as many authors suppose. If this be not strictly true in an anatomical sense, it is undoubtedly a matter of common clinical experience that inflammation of the external meatus spreads to the membrane, as it is that catarrhal conditions of the middle ear expend their force on it. Yet, independently of any previous external or middle ear inflammation, we have several times had patients in whom inflammation—beginning in an injected state of the drum-head, running on to a general redness, these vascular changes being accompanied by severe intermittent shooting pain—has culminated in perforation, and has slowly subsided under treatment, without any permanent effect on the hearing. We have seen such inflammation result from an injury, as a blow of the fist on the ear. Burnett looks on myringitis as always "an inflammation of the dermoid layer of the drum-head."

We have not the least doubt, from the observation of a large number of cases, that this strictly localized inflammation does frequently occur. More frequently, however, do we find the membrane inflamed after the occurrence of a small abscess in the external meatus, or

inflammation attacking it in consequence of exposure to cold, or after catarrhal conditions of the throat and naso-pharynx, in which the Eustachian tube and tympanum are involved.

Symptoms.—The delicate membrane may be the first part to attract attention to the mischief by reason of the pain, tinnitus, and throbbing which usher in an attack. Very often such a case as this presents itself. A patient has become slightly deaf in one or both ears, there is a dull, periodical pain, the external passage is sensitive if we stretch the auricle or insert the speculum. On examining the ear we find an injected state of the meatus near the membrane, and the membrane itself, with the manubrium, unusually vascular; or perhaps things have gone a stage further—the pain is more severe and constant, especially at night; there is marked tinnitus, the patient frets, is generally unwell and weak; the movement of the jaw in masticating gives pain, as also does pressure on the tragus. On examining the membrane there is a full and bulged or flattened look. Perhaps the normal concave appearance is lost, and the whole membrane presents rather a convex surface, giving us the idea of concealed fluid in the drum cavity. The prognosis is generally good, the inflammatory condition clearing up, and the hearing power being completely restored.

We have often seen a slight myringitis accompany that severe neuralgic pain for which we are so frequently consulted.

Treatment.—In the treatment the main object is to arrest and limit the inflammatory process while we relieve the pain. Frequently, notwithstanding any means that we employ, acute perforation will occur, or at least some superficial ulceration of the drum-head. We often find that patients who suffer from myringitis are out of sorts. There is some cause for worry, and a general debilitated and relaxed state of the entire system. Under these circumstances we are in the habit of giving quinine, in five-grain doses, by itself, or combined with iron. Bromide of potassium, in twenty-grain doses, combined with

hydrate of chloral, taken at regular intervals, is a good combination to assuage the pain. The local application of ethylic ether, or cocaine in the meatus, we have found of service. Warm laudanum fomentations and the instillation of warm laudanum solutions or warm laudanum and lead are soothing. The first step, however, is depletion of the ear (*vide* General Therapeutics), followed by warm sedative fomentations, while great relief will often be obtained from vesication over the mastoid (application of iodine pigment or liq. epispasticus). The throat should be carefully attended to, the ear inflated, and the Eustachian tube kept free, while its pharyngeal orifice, if there is any congestion, may be daily touched with a nitrate of silver solution. Dr. Blake, in the acute stages, scarifies the membrane, making a few cuts in the prominently congested parts. Should there be fulness and bulging of the membrane, and we fear any accumulation in the tympanic cavity, it is far better to perform paracentesis.

As regards local douches, we prefer weak soda, common salt, or muriate of ammonium (two to five grains to the ounce), to which is generally added a little glycerine, the basis being carefully strained poppy water. Change of air will be imperatively required should the attack become intermittent; and it is well, if it can be done, to send the patient for a time from home.

Cretaceous Deposits on the Membrane.[1]

Often associated with catarrhal conditions of the tympanum we find these deposits (composed of phosphate of lime), which are easily recognized. They appear as white layers of a chalky substance, arranged crescentically near the periphery, or irregularly radiating towards the handle of the malleus. They may exist without much disturbance of hearing, and frequently are to be found in one ear only.

They are very troublesome at times, causing severe and persistent tinnitus. *Non-interference is the best*

[1] See Plate I. Fig. 3.

treatment; but should the tinnitus be excessive, then an attempt may be made to scrape away the substance with a small sharp spoon. If this is unsuccessful, which it most frequently is, the part must be excised.

Inflammation of the Middle Ear.

Tröltsch divided middle-ear inflammation into simple acute and simple chronic, subdivided into dry and moist; acute suppurative and chronic suppurative.

The following views of Weber-Liel on the etiology of simple aural catarrh of the tympanum are those we would urge on the attention of practitioners:—(1) There arises from the paralysis of the tensor veli collapse of the walls of the Eustachian tube, and therefore hindrance of the proper ventilation of the tympanic cavity; (2) allowing that the tensor veli acts as an antagonistic to the tensor tympani, when the elastic strain and contractility of the tensor veli is entirely or partially paralyzed, not only collapse of the tube occurs, but an antagonistic contraction of the tensor tympani also; and so, the want of air in the tympanic cavity being added to the effect of the anomalous straining of the powerful system of active factors in the mechanism of the tympanic cavity, a high degree of nutritive and functional anomaly in the cavity and labyrinth must in time be occasioned.

Weber-Liel thus classified the causes of aural catarrh:—(1) Extension of a simple catarrh from the Eustachian tube and the pharynx-nasal cavity; then the latter only must be the object of treatment; (2) collapse of the walls of the Eustachian canal, dependent on insufficient or paralyzed action of the Eustachian-tube muscles; (3) alterations of the vaso-motor and trophic nerves supplying the tympanic cavity.[1]

Thus arise many cases of catarrh of the middle ear, from the hyperæmia *ex vacuo,* caused by the rarefaction

[1] *Proceedings of the Medical Congress, Amsterdam,* 1879, "On Intra-tympanic Injections."

of the intra-tympanic air, and the retardation of the tympanic and the intra-tympanic circulation by the increased amount of strain and limited motion of the structures from the abnormally contracted tensor tympani. This double effect of air in the cavity and contraction of the tensor tympanic cause (1) an abnormally strong tension of the tympanic membrane, (2) an abnormally tight fixation of the chain of ossicles, and (3) an increase of the intra-labyrinthic pressure, since the stapes is pressed into the labyrinth by the ossicular chain. Thus the reception and conduction of the vibrations and the vibrating capability of the implicated portions are much prejudiced. As the functional expressions of these disturbances, arise subjective auditory sensations, and frequently sensations of faintness.

At the beginning of the affection disturbances of hearing may seldom be present, or they are not then noticed as deafness, but rather as acoustic hyperæsthesia for certain noises; and gradually defects in the capability of hearing, especially during mixed conversation, make their appearance, and again are followed by symptoms which are spoken of as "accommodative disturbances;" and now, when the other ear begins to suffer, the tinnitus gradually arises and increases. For a long time there is nothing save singing noises in one ear, one ear being always first affected; the other one following after some time.

The collapse of the tube and the abnormal contraction of the tensor tympani continuing, there develop in time secondary changes in the sound-conveying apparatus. The hyperæmia of the tympanic cavity already present often increases through the passage of catarrhal conditions from the pharynx to the now easily affected parts, and intra-tympanic exudations are easily produced by slight attacks of cold. The structures in the tympanic cavity being, on account of the defect of air in the cavity, approximated to each other, give these exudations points for adhesive attachments. A not necessary but very frequent consequence of the continual impressing and fast fixing of the stapes in the

fenestra ovalis is a synostosis of the stapes, and other anomalies in the joints of the ossicles; the local hyperæmia, which is especially marked in individuals of the gouty, rheumatic, and syphilitic diathesis, playing an important part in the production of such changes. In time the hyperæmia of the tympanic cavity lessens, the "*stanungs-hyperæmie*" leads to interstitial connective-tissue growth, and wasting of the vessels and trophic changes of different kinds are seen, atrophy of the tympanic membrane being common. It is comprehensible that in time, changes in the circulation and nutrition of the labyrinth must also occur, not only on account of the continual and increasing pressure from the cavity, but on account of the difficulties under which the conducting apparatus must act.

It is a matter of observation that such patients at the beginning of a conversation often hear moderately well, but when the affected ear has been strained for an hour or so they complain of giddiness and increased tinnitus (spasmodic contraction of the tensor tympani), which symptoms can only be referred to an increased flow of blood to the labyrinth. Pulmonic and hepatic congestion increase (through the connection of the labyrinth with the arachnoidal space through the ductus cochlea) this trouble.

The snapping noises heard, even by bystanders, in certain catarrhal states, is accounted for by the separation of the moist walls of the Eustachian tube in swallowing.

Weber-Liel still adheres strongly to these views on the subject of aural catarrh. He does not regard pharyngeal catarrh as such a direct cause of aural mischief as some would insist. In most of those cases of aural catarrh, he is of opinion that the accompanying difficulties in singing, swallowing, or in insufflating by Politzer's method are due rather to a collapse of the tube walls "through the abolition of the counter-straining force of the antagonistic muscles"—it is not a catarrhal state, it is rather paretic—"we can pass a bougie when the air douche will not act."

Eustachian Collapse, Obstruction, and Closure.

Most frequently the origin of both acute and chronic (non-suppurative) catarrh may be traced to some abnormal state of the Eustachian tube. The study of the various diseases of the ear which follow abnormal conditions of the Eustachian tube, shows that the healthy or unhealthy state of this canal offers to us a clue to the causes of by far the largest proportion of aural complaints.

Causes.—The exciting causes of Eustachian closure may be simply cold "caught" in any way; exposure to draughts, damp, rheumatism, sea-bathing, exanthemata, mental shocks, diphtheritic paralysis, etc., are some of the most frequently assigned. During a cold every one is familiar with the sense of stuffing in the ears, and the muffling of sounds or the tinnitus which occasionally accompanies it. On examining the throat, we may find the mucous membrane swollen or turgid, there may be a granular state of the pharyngeal membrane, the follicles are enlarged, perhaps the uvula is relaxed, or the tonsils are hypertrophied. The faucial orifice of the Eustachian tube is likewise swollen; and in consequence there is temporary closure of the passage, and secretions are imprisoned in it. When this condition persists for a time we see the characteristic dull membrane of Eustachian closure. Little air enters the tube, and the air in the tympanum is rarefied; this results in an increased concavity of the membrane. Hinton described this form of membrane as characteristic of Eustachian deafness.

> "The malleus appears foreshortened, and the membrane has a tense stretched look, like a drawn curtain, often falling into similar folds. The colour varies, is generally white and dull, but sometimes, especially in the earlier stages, the congested mucous membrane of the tympanum shines through it."

When inflation is resorted to, we hear the sound with the auscultation tube either not at all, or with great difficulty. This simple swelling of the Eustachian tube, beginning with a slight deafness, and perhaps a little

earache, which at first may be periodical and remittent, finally becomes chronic and permanent. It may or may not be a considerable time, dependent to a certain extent on the mischief attacking only one or both ears, before troublesome deafness, accompanied by tinnitus, occurs.

Nothing in the whole range of medical practice is more astonishing than the extent to which persons permit aural mischief to proceed before they seek relief, the more so if only one ear be affected. Often it is the incessant tinnitus that forces them to apply for relief, and not the deafness. If the closure and obstruction lead to other results, say acute suppurative inflammation of the tympanum and perforation of the membrane, as it frequently does, then they apply for relief from the symptoms which accompany these lesions.

We may thus summarize the ordinary effects of Eustachian collapse and closure:—Slight catarrhal inflammation, which is the consequence of the primary affection, leads to an accumulation of mucus. This mucus increases in quantity and is imprisoned. It may become hardened and form hard masses both in the tube and the cavity of the tympanum, about the chain of ossicles, and on the membrane. A chronically collapsed and closed Eustachian tube, leading to imprisonment of mucus and alterations in the position and structure of the membrana tympani, followed later on by permanent change in the shape and appearance of the latter, with adhesions, anchylosis of the ossicles, and hardening of the mucus, are the usual effects which ensue on a common cause, viz. a catarrhal state of the naso-pharyngeal mucous tract.

Dr. Weber-Liel[1] thus summarizes the causes which contribute to relaxation, insufficient action, and paralysis of the tubal muscles and velum palati:—General weakly conditions from disease, parturition, excessive exertion, unhealthy conditions of life (nervous exhaustion, masturbation), will have disturbing influences on muscles already weak, and this is often the case with the mus-

[1] *Op cit.*, p. 124.

cular apparatus of the tube. The muscles of the tube of the left side participate in the general more feeble development of that side, and he thinks that the affection nearly always begins on the left side. Chronic catarrh of the mucous membrane covering the muscles appears to have often been the starting-point of defective functional ability of this group of muscles. In nervous individuals, in those much affected by grief or care, with different nervous lesions (*e.g.* of the trigeminus), the innervation of this portion is very easily disturbed under disposing influences. Rheumatism, tubercle, typhus, diphtheritis, progressive muscular atrophy, chlorosis, and anæmia are amongst the predisposing causes.

Treatment consists in inflations by Politzer's bottle, passing the Eustachian catheter, and washing out the tympanic cavity with an iodide of potassium, alkaline, or chloride of ammonium wash; the regular use of an alkaline nose wash, with astringent applications to the pharynx and fauces; galvanism to the tubal muscles (see p. 326). Constitutional treatment must not be forgotten, and tonics must be administered. If there is narrowing of the Eustachian tube, due to chronic catarrh, the passing of Eustachian bougies will occasionally do much good.

Simple Acute Catarrh.

Course and Features.—We find that the various forms of catarrh above enumerated are the result of different degrees of inflammatory action occurring in the tympanic cavity or the passages. The inflammation occurs most frequently in children. Both ears are at times equally affected; but, as a rule, the inflammation is more active in one side than the other.

Cause and Symptoms.—Simple catarrhal inflammation, when acute, may be caused by cold; acute diseases, such as the exanthemata, fevers, pneumonia; sea-bathing; and any irritation in the tympanic cavity, such as a collection of fluid. Blows, injuries to the

membrane, sewer-gas, irritating fumes, excessive smoking and alcoholic drinking, are all causes that may set up an irritation in the naso-pharynx. The too free application of the galvano-cautery to the nasal passages may cause Eustachian contraction or obstruction. Simple acute inflammation seldom causes a perforation of the drum-head.

In the milder form there is the advent of the slight deafness (which is not rapid); the pain is trifling, rather in many cases described as an "uncomfortable feeling" about the ear, possibly some tinnitus; both accompanying a sore throat, or a slight attack of tonsillitis; there may be nasal catarrh, perhaps some headache or accompanying neuralgia, and pain in the ear in coughing, sneezing, or swallowing, and at times in talking.

But in the more severe form all these symptoms are much intensified, and the constitutional disturbance may be very great. On examining the drum-head, we may perceive little alteration from its normal condition, it being but slightly injected. On the other hand, there may be great redness and injection of the vessels. The prominent full and red appearance of the membrane is characteristic. If secretion rapidly occurs the pockets may be bulged out by the imprisoned mucus.

Treatment.—In simple acute catarrh of the tympanum the indications for treatment are much the same as in inflammation of the membrane (see Myringitis). Added to these, we must pay special attention to the naso-pharynx and the condition of the Eustachian tubes. Alcohol and tobacco, too, must be strictly avoided.[1]

Simple Chronic Catarrh.

Symptoms.—Frequently a patient presents himself with a history of a recent cold, or it may have been a

[1] For directions for the relief of pain, depletion, fomentation, and other general treatment, the reader can refer to the chapters on General Therapeutics and the Management of the Naso-Pharynx.

throat attack, and this has been succeeded by a slight deafness and tinnitus generally of one ear. On testing the hearing with the tuning-fork, we find that it is heard loudest in the affected ear, and that there is no marked difference on closing the meatus of this ear; that is, the tuning-fork is not then heard louder. There may be conveyed a moist or gurgling sound with the auscultation tube. The membrane has perhaps lost its transparent look; it is either concave and of a dull or greyish-white colour, or it is rather convex. We may at once suspect a recent acute catarrhal attack, passing into a chronic stage, with an accumulation of mucus in the tympanum. We more frequently, perhaps, meet chronic cases in which no treatment has been pursued, or, if any, some useless empirical course of blistering and leeching, which has been energetically pushed, with a pleasing variation in the administration of remedies internally, while the tympanum has been all the time gradually filling with dry mucus, hardening and producing, it may be, irremediable changes. In such patients we frequently find a dry external meatus—the wax is not secreted. As to the appearance of the membrane in cases of accumulated mucus, we must confess that in our experience there is no one form characteristic of this condition. It may bulge forwards in any part, or appear as if the entire membrane was pushed outwards; or, on the other hand, it may appear abnormally concave, and this bulging or concavity may be accompanied by every variety of change in the position and shape of the membrane, and irregularity in the position of the malleus.

These alterations in the form of the membrane do not frequently bear any definite relationship to the degree of deafness or the tinnitus. The membrane may appear but slightly changed, and yet the deafness and tinnitus be extreme.

It is, indeed, often very difficult to diagnose positively the presence of mucus in the tympanum, especially in old chronic cases complicated with other lesions, whether of the nerve, ossicles, or membrane. In such

cases, for instance, the operation of paracentesis must be purely experimental, and may be, and often is, followed by negative results. In many patients where we do not succeed in obtaining any proof of the accumulation by evacuating the mucus, we have the satisfaction of seeing them benefited by the treatment, and the hearing decidedly improved.

There can be no doubt that nerve impairment frequently attends on the presence of mucus in the tympanum. Thus we have on many occasions noticed that severe mental shock, the occurrence of a fever with brain complications, have produced the nervous derangement, while an accompanying relaxed state of the throat has left imprisoned secretions in the tympanum. So, in other cases, a gouty or syphilitic taint has often been the source both of the nervous derangement and of the accumulated mucus.

Treatment.—The treatment of simple chronic catarrh of the tympanum involves so much that has been said on the therapeutics of the ear generally, that the reader must refer to the chapters on General Etiology and Therapeutics for the necessary information as regards the prophylactic and other treatment of this common affection. We propose in this chapter merely to make some observations on some special forms of treatment, several of which are elsewhere fully dealt with.

Weber-Liel lays special stress on the methodical practice of gymnastic exercises with the muscles of deglutition and respiration and of the Eustachian tube, while we combat the general debility by such means as a sea voyage, a tonic regimen, and the internal administration of the salts of iron, strychnine, quinine, etc.

In the treatment of all conditions supervening on a closed or obstinate state of the Eustachian tube, the first matter is to secure its patency. The method of doing this we have already dwelt on—catheterization, assisted if necessary by ordinary or laminaria bougies (very fine), about half a line in diameter for the narrowest part of the Eustachian tube, and if a laminaria bougie is used

in addition to the catheter, it must not be left in longer than twenty minutes. The bougie is passed through the catheter, and the catheter is withdrawn before the bougie.

Suction of the meatus will be found of service in collapsed conditions of the Eustachian tube. This is best effected with the pneumatic speculum, through which we can at the same time see the extent of the adhesion. It is a good plan to give a patient a piece of tubing with an ear-piece covered with india-rubber to fit the meatus air-tight, and instruct him to apply suction with the mouth through the other end. This plan of suction and inflation practised by the patient himself may be followed up by the incision of the membrane, tenotomy, or, in rare instances (Hinton), an attempt may be made to restore the malleus to a normal position, as by doing so we free the stapes. It is, however, a step not to be lightly undertaken, as it requires the most delicate manipulation to cut round the adherent malleus or stapes, and raise them by the gentlest of pressure into a better position. Politzer's plan of "air-tight closure" of the meatus when the membrane has been well inflated, may be found useful in these cases of collapsed membrane.

The treatment of accumulated mucus must to a great extent depend on the duration of the affection. If recent, and the accumulation is not great, we can do much by warm alkaline injections (two to five grains to the ounce) of carbonate of soda, iodide of potassium, common salt, chloride of ammonium, etc., into the tympanum; also by injection of sulphate of zinc (two to five grains to the ounce), or the passage of iodine vapour. Such means, combined with the free use of the air douche and the nasal syphon douche, often afford complete relief (see chapter on General Therapeutics and the Therapeutics of the Naso-Pharynx). For the systemic states accompanying the tympanic trouble, perchloride of iron in combination with strychnia, where there is general debility, is a most valuable combination. At times, in hysterical patients and delicate

women, bromide of potassium, or bromide of ammonium with iron, or the salts of zinc, bromide, and phosphide, will be found most useful.

For the tinnitus, the internal use of bromide of potassium and hydrobromic acid, hydrobromic ether, and the nitrite of amyl may be tried (see, more fully, Treatment of Tinnitus). Iodide of potassium in gouty and syphilitic systems, and bichloride of mercury in the latter, are of service. Thorough cleaning out of the Eustachian tube and tympanum, combined with such internal remedies as give tone to the system, at the same time that we keep the secretions regular (with such waters as Rubinat, Friedrichshall, Victoria, and Hunyadi Janos), is a summary of the treatment of such accumulations in the tympanum.

We have elsewhere alluded to the question of artificial perforation of the membrane and the mode of performing the operation. Whatever doubt may remain as to the propriety of this step as an experimental effort in obscure cases of deafness, especially when complicated with troublesome tinnitus, combined at times with division of the tensor tympani, none can exist as to its utility, where accumulated and imprisoned secretion is ascertained to be the cause of the trouble, or in those acute cases, before referred to, which are so ambiguously grouped under the heading of "acute aural catarrh," and in which the pent-up secretion is prone to assume the suppurative character. For example, a patient came for treatment extremely deaf, not hearing the watch when pressed to the ear, and whose conversational hearing power was very bad. There was an old syphilitic history. The tuning-fork was well heard, but closure of the meatus produced no difference ; the membrane had a bulged appearance, and the sound with the ausculation tube was of a gurgling character. Incision was determined on, and accordingly, after some previous syringing with warm iodide of potassium, both membranes were punctured and the apertures kept free. A quantity of semi-transparent mucus of a brownish colour came away through both openings. This man, with his face averted,

subsequently heard conversation in a low tone across the study.

In most cases of Eustachian closure we rely mainly on warm carbonate of soda or chloride of ammonium injection, and the frequent use of Politzer's bag (see General Therapeutics—Eustachian Tube). The nasal douche of salt water is of great benefit, and also gargling with cold alum water while lying in the horizontal position. Constantly we meet patients who cannot use the syphon douche. The simple sniffing up of a warm solution of salt is a capital substitute for the use of the nasal hand spray. About an egg-spoonful of common salt may be added to two wine-glasses of tepid water used once daily. If suppurative catarrh leading to perforation occurs from closure of the Eustachian tube, we must be satisfied with the gentle washing out of the tympanum daily, with a warm solution of chloride of ammonium or carbonate of soda, while we attend to the inflammatory condition of the membrane by warm fomentations, gentle syringing with anodyne and alkaline washes, leeches, or vesication.

In rheumatic otitis media, turpentine and salicylate of soda are indicated, Weber-Liel speaking very highly of the former remedy.

Acute Suppurative Catarrh.

Course and Terminations.—Very different is this affection from the non-suppurative variety; we have it typically represented in the attack which accompanies or follows scarlatina or an infectious fever. We have generally severe constitutional symptoms, violent pain, tinnitus, deafness, attended at times by vertigo and discharge of pus from the meatus. Perforation of the membrane occurs in periods varying according to the severity of the attack. It is in the neglect of the warning afforded by the aural mischief, the attention of the medical man being diverted by complications, such for example as convulsions in young children, that the surgeon is so apt to commit an error. Irreparable deaf-

ness—perhaps deaf-mutism—is the consequence. The acute stage may end in a chronic inflammatory state of the tympanic cavity, with retention of pus in it; or it may terminate in a spontaneous perforation, the membrane rupturing and giving vent to the imprisoned secretion. The pus may find its way into the mastoid cells, producing disease in these regions, or perchance the mischief may extend and give rise to intra-cranial complications. But these complications more usually follow an attack of acute inflammation which supervenes in a case of chronic middle-ear discharge.

Symptoms.—If we examine the membrana tympani before such perforation takes place we find it either deep red or generally of a bright pink colour; it has a swollen appearance from the gradual obliteration of the pockets and malleus, which goes on till the membrane has lost completely its normal character. After perforation has occurred, pain may totally or partially abate, or may continue intense with a pulsating perforation.

Causes.—There can be no doubt that the exanthemata furnish most frequently the starting-point of the disease. Cold, exposure to draughts, blows on the ear, the vile habit of boxing the ear—the causes enumerated as operating in myringitis and simple acute catarrh (see chapter on Etiology)—may give rise to the mischief. We have referred to the effects of cold bathing in producing inflammatory catarrh of the tympanum. Burnett draws attention to the close relation of the molar teeth to the tympanum, and the possibility of an error in diagnosis being made through mistaking the pain of decayed teeth for earache.

"Whenever," he says, "we find earache without sufficient objective symptoms to account for its cause, it is never amiss to inquire after the teeth."

Treatment.—The treatment consists in warm anodyne fomentations, applied externally, or by gently washing out the meatus, subcutaneous injections of morphia, the free application of leeches, vesication over the mastoid, and incision of the membrane if we suspect pent-up secretion, and incision over the mastoid process, or the

use of the trephine if there be swelling and other signs pointing to the presence of purulent matter in the mastoid cells (see Remarks on Inflammation of the Mastoid Process). At the same time the constitutional symptoms should be attended to, the bowels carefully relieved, and a saline given internally, while a combination of bromide of potassium and hydrate of chloral, with the local application of the vapour of bromide of ethyl, cocaine, laudanum, may relieve the pain.

Chronic Suppurative Catarrh of the Middle Ear.

Course.—This affection may follow as a result of the acute form. Suppurative catarrh, acute or chronic, is often shamefully neglected, more especially in children; the younger the child, and therefore the less competent to make its complaint known, the greater the probability of neglect. Aural mischief is, in a very young child, often masked by symptoms that direct attention to the other parts, the brain, stomach, or the teeth. Discharge from the ear is long neglected, and the ignorance of its cause or the results of its continuance induce many to fancy that to arrest it is a mistake. Therefore it is that in children, where there are obscure head-symptoms with feverishness and restlessness, the surgeon should always examine the ear. The carrying of the hand to the ear is often the only indication of any local mischief. Otorrhœa continues often for a long time in children with but little effect on the hearing, and no pain. When the ear is seen for the first time there is frequently perforation of the membrane, a granular state of it, or polypus. Too often it unfortunately happens that the surgeon is asked for advice only when irremediable and fatal brain complications have arisen. If this be culpable on the part of friends, how much more so is it in the case of the medical adviser, who, through carelessness, has permitted these warnings to pass unheeded, which might, if noticed in time, have saved life.

The absurd popular prejudice regarding discharges from the ear often leads to neglect. Thus when the

child is seen the otorrhœal discharge fills the meatus, blocks up the canal, and obscures the tympanum. The ossicles may have been destroyed and long since escaped through the perforated membrane, and yet the patient is not brought for relief until the unpleasant odour renders it inconvenient for teacher or parent. Too frequently has the disease made inroads into the labyrinth or attacked the nerve. The tympanic cavity has cakes of old hardened masses of epithelium and pus, with aspergillus that have developed in the decaying *débris*. These are of all cases the most insidiously dangerous. Perhaps the discharge has ceased to flow from the meatus in consequence of the complete blocking up of the tympanum, or the closure of a perforation or the collection of cerumen in the external auditory canal. Meanwhile mischief has been advancing in the petrous portion of the temporal and the adjacent surfaces of the brain membranes. Any form of brain trouble may be the consequence.

Turnbull and Cassells have both discussed the influence of a chronic discharge of the ear on the question of life insurance. There cannot be the least doubt that the existence of such a discharge may invalidate a life insurance, and that the concealment of such a condition, or any chronic disease of the ear, might cause the question to be raised of the *bonâ fide* nature of an insurance contract.

The following is a classification of the causes of a chronic suppuration of the middle ear :—[1]

Diathesis	Gout. (Rare.) Struma (tubercle). (Frequent.)
General diseases ...	Primary syphilis. (Rare.) Inherited syphilis. (Occasional.) Fevers. (Exceptional.) Phthisis. (Occasional.) Exanthemata. (Frequent.) Diphtheria. (Occasional.) Mumps. (Occasional.) Angina Ludovici. (Rare.) Whooping-cough. (Not infrequent.)

[1] *Lancet*, July 27—August 3, 1889—"The Etiology and Treatment of Chronic Suppuration, Catarrh of the Ear," by Macnaughton Jones.

Parotitis.
Tonsillitis.
Naso-pharyngeal adenoids.
Naso-pharyngeal catarrh (acute and chronic).
Ozæna.
Catarrhal inflammation of the Eustachian tube.
Other unhealthy throat states.

New growths
- Generally associated with external-ear discharges.
- Polypi.
- Papillomatous growths.
- Sebaceous tumours.
- Cystic tumours.

Traumatic ...
- Injuries inflicted from the direction of the external meatus.
- Injuries inflicted from the direction of the Eustachian tube.
- Puncture or rupture of the membrana tympani.
- Direct injury to the tympanic cavity.
- Injuries inflicted with the Eustachian catheter.
- Foreign bodies: (1) approaching from the Eustachian tube; (2) approaching from the external meatus.
- Injections through the Eustachian tube.

Climate and hygienic ... ...
- Residence in the tropics.
- Temperature, dust, sand.
- Rainfall and moisture.
- Miasmatic influences.
- Sewer-gas.
- Defective drainage.
- Gas leakage.
- Epidemic influences.

Symptoms.—The symptoms vary considerably. A discharge more or less constant and profuse, ranging from a pale and watery consistence, which may be stained with blood—to a thick and creamy one; it may be inodorous, but more frequently, and especially in long-standing cases, there is a smell varying from a slight unpleasantness to a most abominable stench. Pain is sometimes severe; in other cases, especially those occurring in strumous or phthisical children, there is none. Deafness from impaired aerial conduction; tinnitus and vertigo, due either to irritation or pressure; tenderness over the mastoid region; loss of taste from the chorda tympani being involved, and facial paralysis from the portio dura being implicated. The membrane ranges in colour

from a pale pink to a deep red, the polish has usually gone, and the cone of light has disappeared or been displaced. Signs of old cicatrices and deposits of cretaceous matter may be visible. A perforation varying in size from a pin's point to complete destruction of the membrane is seen; in the latter case, the objects on the internal wall of the tympanum may be observed. The tympanic mucous membrane may, however, be so swollen and œdematous as to mask them and resemble a polypus. Caries or necrosed bone is easily demonstrated if within reach of a probe, but if it cannot be reached, the character and odour of the discharge may give some indication of its presence; but this test is not infallible, as a collection of putrid caseous pus and *débris* in the mastoid antrum will give a most fœtid smell.

Prognosis.—The prognosis must be very guarded. We may, and frequently do, get the very best results, the perforation healing, and the hearing power being almost entirely restored. But the hearing may be permanently impaired if the perforation does not heal, and even if it does, the suppurative process may have so damaged the tympanic contents that complete and permanent deafness remains.

Treatment.—It is essential in treating these cases that extreme cleanliness and antiseptic precautions be employed to remove the discharge and inspissated pus, and to destroy any pathogenic microbes that may be present (see chapters on General Therapeutics, Cleanliness, and Bacteriology). The tympanum should be either thoroughly washed out through the perforation in the manner already described — this is easily done, and cleanses the Eustachian tube also of any secretion that may have passed and accumulated there—or it may be washed out with the intra-tympanic syringe. A good plan of treatment is to thoroughly wash out the tympanic cavity with the acid perchloride solution daily, using the douche (Fig. 90, J); then, after careful drying with absorbent wool, to stuff the meatus with iodoform wool, carefully putting it in piece by piece.[1] In syringing

[1] W. R. H. Stewart, paper *On Some Points in the Treatment of Middle-Ear Suppuration*, Birmingham, 1891.

through the Eustachian tube, a solution of chloride of zinc, chloride of ammonium or sulpho-carbolate of zinc (grs. ii.—grs. iv. ad ʒi.), with a little glycerine or carbolic acid (1 per cent.), is generally selected, a stream of warm water being always passed through the nose first, and then the disinfectant or astringent solution. Astringent solutions and powders, such as boric acid, talc powder, tannic acid, salicylic acid, nitrate of silver, chloride of zinc, sulphate of zinc, absolute alcohol and glycerine, carbolic acid and glycerine, aldehyde, with carbolic acid, sulphurous acid (1 in 8) if there is carious bone, are some of those most frequently used with success. The saturated solution of boracic acid, with equal parts of absolute alcohol and glycerine, as a final application after the perforation has been carefully dried, is very useful. Having cleansed out the meatus and perforation well, the latter should be thoroughly dried with cotton-wool rolled on the aural probe, and then with this same probe nitrate of silver should be carried well down to the perforation, and its margin touched. We always use the air douche of Politzer after the employment of any of these agents. If powder be used it must be very gently blown with a fine tube,[1] and quite on to the surface of the membrane, and care must be taken that it is washed out every third day before it is again applied.

There is a strong objection to give patients powders to use themselves in cases of discharge from the ear. They cannot sufficiently cleanse the meatus when using them, and the powder is apt to cake both on the membrane and in the tympanum if there be a large perforation.

Iodoform,[2] its odour being disguised by powdered

[1] Fig. 90, H, the intra-tympanic insufflator.

[2] To Dr. Robert Sinclair of Dundee, in this country, the credit is due of drawing special attention to the value of iodoform in aural practice; and to Drs. Lizarda and Rossett abroad. Macnaughton Jones suggested the use of iodol instead of iodoform in these cases. It has no unpleasant odour. It answers well, but he doubts its equivalent antiseptic strength. A solution of iodoform in eucalyptol (5 per cent.) he specially recommends.

coffee, vaniline, or coumarine, is the most invaluable remedy in otorrhœal discharges. It should be prescribed in all cases (see Formulæ). We now commonly use iodoform for cleansing the meatus in this manner. The iodoform salve is applied with a camel's-hair pencil, or a little of it is smeared on a piece of cotton-wool and inserted into the meatus after it has been cleansed at night with a sulpho-carbolate of zinc and chloride of ammonium wash. This is repeated in the morning, and the iodoform salve again used. We know no better lotion for the patient's own use than that of sulpho-carbolate of zinc and glycerine with carbolic or boracic acid. However, these remedies, and others such as alum and chloride of ammonium, must be alternated and varied; the secret of successful treatment being constant attention and cleanliness on the part of the patient, combined with the application, almost daily by the surgeon himself, of the more powerful remedies.

Grüber[1] says, in connection with a perforation and purulent discharge through Shrapnell's membrane—

"We now come to the important point of how these purulent inflammations should be treated. It is evident from the diagnosis that no single line of conduct can be laid down as the correct method. As a general rule surgical interference has to be resorted to. The perforation of the tympanum may not lie in the proper direction, nor is it large enough to carry off the inflammatory products, and hence a second incision or an enlargement of the primary one may have to be performed. Where greater destruction has taken place, a more heroic operation may be required, as when caries is present, the small bones and part of the temporal bones may have to be removed. In the first stages of the pathological change we have an inflammatory process to combat which is sometimes very difficult owing to the inflammatory product not escaping through the small perforation, or from additional irritating germs entering by the small opening and further exciting the abnormal change. In chronic inflammatory conditions the polypoid growths of retained matter may assume a variety of forms, but must be carefully diagnosed before treatment.

"After carefully satisfying myself in these common cases that the more heroic operation is unnecessary, I commonly commence treatment by carefully disinfecting the whole ear by a solution of common salt, and after all foreign matter has been removed,

[1] *Med. Press and Circular*, 1891.

rinsing the whole with a sublimate solution (1 in 1000). When all has been thoroughly cleaned, I apply Siegle's trocar and balloon, compressed before introduction, which draws out by suction the tympanum and any other remaining part of *débris* that may not yet have been removed, as large pieces of mucous membrane or granulation matter may become impacted in the aperture during injections, thus closing all communication. By this means I am better able to judge whether the perforation is unsuitable for the discharge or too small, and requiring incision. I prefer, however, to enlarge the opening by the galvano-caustic 'myringectomie,' which is more suitable for the proper therapeutical treatment of the chronic condition and destroying the infectious germs in the morbid process. The principal success attending the treatment will depend on the free opening and cleaning out of all retained matter and granulation from the upper part of the tympanic cavity. This I advise to be done with a sharp scoop, of which I always carry a few of different forms and sizes in my operating case.

"Having thus removed all injurious substances and checked hæmorrhage, I now introduce iodoform or sublimate gauze tampons into the inflammatory area in the middle ear, as well as closing the outer ear with the same substance. These tampons for the middle ear have a special arrangement with a long thread attached, which lies in the external ear, and is a guide for the forceps removing the tampon from the middle ear through the aperture. To facilitate this operation I have had a special pair of forceps made. The tampon ought not to be removed for a few days unless untoward symptoms appear, such as pain, fever, etc., or where the discharge or secretions are still abundant. If the case proceed favourably, with very little secretion, five or eight days should elapse before any removal of the dressing, after which it should easily be removed; but if any difficulty should arise, a small quantity of antiseptic fluid should be injected to loosen the tampon. As soon as the inflammatory secretion has ceased tamponing should also cease, but a tampon should be laid outside as a protection. Should the secretion recommence fresh tamponnading should again be resorted to."

Perforations of the Membrane.[1]

Before proceeding with the complications that may arise in chronic middle-ear suppuration, we will say a few words with regard to perforations of the drum-head generally. This may be brought about by a variety of causes, among which the following are the most common:—By an acute or chronic middle-ear suppuration, or by an incision to relieve a distended tympanum; by

[1] See Plate I. Figs. 4 and 8; Plate II. Figs. 9, 11, 13.

irritating applications ; by violent sneezing or coughing, as in whooping-cough ; by atmospheric pressure, as the concussion from an explosion, boxing the ears, or diving ; by direct violence, such as wounds caused by foreign bodies and the unskilled endeavours to remove them ; the use of ear-picks, hairpins, etc. ; by forcible syringing, and from pulling the auricle.

The diagnosis is readily made, as a perforation, unless it presents the form of a mere rent or a minute pin-hole in the membrane, is easily seen, and if not, can be discovered by means of the auscultation tube. A source of error to beginners is the bright bubble of air and liquid which sometimes obscures the orifice. On throwing a good light on the membrane, and desiring the patient to close the nose and blow, the air will often be seen to bubble out through the aperture. Sometimes these acute perforations pulsate ; this is due to the arterial throb. This pulsation may puzzle a beginner not accustomed to examine such perforations. As to the character of the perforation, this may vary in size from a small pin-hole or chink to a large ragged opening. One or all the bones may be destroyed or attached by adhesions to the tympanic walls. A mere rim of membrane may be all that is left, or even this may be absent.

Treatment.—In the plates taken from the *Aural Atlas* (see Plates I. and II.) are some representations of the various forms of perforation. It is remarkable the large number of patients who have extensive perforations yet retain remarkably good hearing power. The greater the number of cases we treat, the more are we astonished at the percentage of patients, whose hearing varies, say, from $\frac{5}{100}$ to $\frac{10}{100}$ with the watch test, and whose conversational power is excellent. As noticed by Politzer, Wilde, and others, this hearing power does not appear to depend so much on the size of the perforation as the part implicated. It, of course, is more particularly influenced by any abnormality of the stapes if the bone be fixed by adhesions, anchylosis, etc., or indirectly affected through the direction of the perfora-

tion (Politzer), and the transmission of the sound-waves to this bone. This has to be remembered in the application of artificial membranes, the good effected being not so much attributable to closure of the opening by the disc or wool, as to properly applied pressure through the stapes.[1]

After the cause of the perforation has been cured and the hole shows no sign of closing, the edges should be lightly touched with nitrate of silver or a fine galvano-cautery point, and if the perforation is round a slight incision at either end will sometimes start the healing process.

[1] See p. 144.

CHAPTER XIV.

AFFECTIONS OF THE MIDDLE EAR—*continued.*

Of the complications that follow a chronic middle-ear suppuration, some are liable in a more or less degree to destroy the hearing power, and are not, unless neglected, especially dangerous to life; others are most serious, and may threaten the life of the patient. Two very common consequences are an *ulcerative condition* of the auricle and the formation of adhesions and cicatricial bands, by which the remains of the membrane are bound down to the tympanic walls. The former is easily cured by cleanliness, by soaking away all crusts with carbolized oil, and then dusting the surface with iodoform, the points of deeper ulceration being touched by the solid nitrate of silver, if necessary. The latter, if too firm to be divided by Politzerization or by suction through a Siegle's speculum, may be divided by section of a portion of the band; but as this is a very delicate operation, and one the results of which are by no means certain, it is not to be lightly undertaken.

Polypi.[1]

Polypi are found growing from the tympanum, more especially its posterior wall, from the meatus, and from the tympanic membrane. This order of growth corresponds with the relative frequency of the seat of the polypus.

Pathology.—They are either mucous, fibrous, or

[1] See Plate I. Figs. 1, 2, 5, 6; Plate II. Fig. 10.

myxomatous. The first named is composed mainly of a homogeneous stroma, in which are round cells enclosed in a fibrous framework (Politzer). In their interior may be found cystic spaces lined with epithelium. They are rich in vessels. The density of the growth depends on its gradual conversion of the round cells into fibrous elements. The fibrillar nature of the fibrous polypus distinguishes it, and it is not so vascular as the mucous. True myxomatous polypi are exceedingly rare.

Those polypi which grow from the membrane and tympanic cavities are very vascular. They occur as the result of otitis media and chronic suppurative states of the middle ear. They vary in size from that of a large mass which completely fills the meatus, and protrudes from it, to a small growth, which it is difficult to seize with the forceps.

Polypi may be multiple, several existing in one ear, and we may find them in both ears. There is often a considerable discharge of pus, obscuring the growth, which requires removal by a syringe before the polypus comes into view. There is not necessarily pain during their formation, and the characteristic symptoms are deafness with a discharge, which is occasionally mingled with blood. Those springing from the deeper portion of the meatus, or just in front of the membrane, frequently conceal a perforation of the latter (see chapter on Cleanliness). The dangers arising from the neglect of aural polypus are elsewhere referred to.

Treatment.—It is well to determine as carefully as possible before operating, the size, mobility, and seat of attachment of the polypus. This, as a rule, can be readily done with a probe. Most of the globular polypi which fill up the meatus are easily removed with the ordinary small curved polypus forceps, but the best instrument is the polypus snare of Wilde or a small Jarvis; the only difficulty which we meet with is the careful noosing of the polypus close to its attachment.[1] This, however, is seldom much trouble, and will be found less so if wire strong enough for the removal of

[1] See pp. 130–151.

the polypus, at the same time that it can be easily moulded so as to encircle the mass, is used.

Fine copper or iron wire, if the growth is large and hard, is preferable. Thin wire or fishing gimp can be used in ordinary cases.

For operating on small vascular growths, either the rectangular ring forceps, the lever ring forceps, or the ring-knife is the best to use. The latter instrument is admirably adapted for this purpose.[1]

Free syringing will bring away any loose portions of polypus not removed by the forceps. We have never had any hæmorrhage to speak of after removal of any kind of polypus. We generally use a little very hot water if the bleeding is severe, and this is, as a rule, sufficient to control it. Occasionally it is not possible to remove the whole of one of these vascular polypi at one time, and we have to operate three or four times before the growth is cleanly extirpated. But the mere removal of these troublesome growths is only the first step in the process of cure. It requires often considerable forbearance on the part both of the patient and surgeon to follow up the treatment. Periodical touching of the exposed surface with some caustic is required, as well as the thorough cleansing out of the canal. Having wiped the raw surface with cotton-wool, used with the armed aural probe, the site of the polypus must be lightly touched with a fine pencil of wool rolled on the point of the probe, and moistened with chloro-acetic acid. The crystallized acid is readily converted into a fluid state by the addition of a little water. We may also use nitrate of silver, carbolic acid, chromic acid, alcohol with glycerine, or perchloride of iron. One rule should be adopted in every case: no one should be satisfied as to the cure of the disease until all discharge has ceased, and the surface from which the polypus has sprung presents a healthy appearance.

The neglect of polypi may lead to the most serious consequences. The fatal results that have followed

[1] For description of these instruments and the method of operating, see pp. 130–151.

should act as a warning to practitioners not to simply pull away a polypus with a forceps or snare, and then send the patient home with the idea that he is cured, only giving him some simple lotion to keep the ear clean with. The polypus re-grows, perhaps the patient has the growth again torn away, or partially torn, as happens in many cases, and he now thinks it useless to apply for relief for that which is certain to return. And so he is satisfied to let things remain as they are until some formidable symptoms are induced by the growth and the discharge. All this is the result of want of subsequent attention to the remains of the pedicle of the polypus or the granulations that remain after its removal.

Whenever a polypus is removed the patient should have impressed on him the necessity of a prolonged attendance or an occasional inspection of the ear subsequently, in order to prevent its re-growth, and also to get the meatus or other seat of the disease into a healthy condition.

The osseous growths that follow a chronic middle-ear suppuration have already been discussed.[1]

Mastoid Inflammation and Abscess.

Causes.—In acute and chronic otitis externa, and in catarrhal states of the tympanum, the inflammation may spread to the mastoid cells, or the petrous portion of the temporal bone.

Symptoms.—Mastoid periostitis is marked by characteristic symptoms. There are frequently severe constitutional accompaniments, such as rigors, rapid coating of the tongue, quick pulse, increase of temperature, with severe pain. The post-auricular and supra-auricular regions become red and swollen. The rapidity with which the swelling occurs is often alarming. In a case under our care of severe furunculous inflammation in the meatus, the entire side of the face and neck became swollen in forty-eight hours. The swelling has then

[1] Page 235.

an erysipelatous look. We have never seen a case of mastoid periostitis or abscess in which the meatus and tympanum have not been involved. The sterno-mastoid has only been implicated in one case. Turnbull notices that implication of the sterno-mastoid is not probable when the inflammation is intense; we are more likely to have caries and post-aural opening. If the inflammation runs its course, suppuration may occur, and the pus will escape either by the external meatus or through the mastoid process. Remembering the anatomy of the bony parts (see Mastoid Process in chapter on General Anatomy), it must be a matter for surprise that the mastoid cells escape as frequently as they do when the tympanum is affected. Still there can be little doubt that the spreading of the inflammation does frequently happen, and is not suspected. Purulent or hyperplastic formations may occur in the mastoid cells, especially in children, and no external evidence exists of this. It is surprising how often in children, especially of the poorer classes, extensive bone changes may go on in the mastoid, leading to softening, necrosis, and caries, with but little indication of the danger, and consequently a degree of excusable neglect on the part of the parents.

Dr. Orne Green (*Proceedings of the Otological Society of New York*, 1877) divided the results of periostitis in the interior of the mastoid cells, thus:—(1) *Formation of pus and resulting abscess;* (2) *Extension of the inflammation by the minute vessels in the osseous foramina to the external surface of the mastoid;* (3) *Ostitis*—this latter being purulent or hyperplastic—purulent leading to perforation, with consequent absorption of the entire osseous structure or of the calcareous particles alone, or, it may be, to complete necrosis or caries; hyperplastic causing new periosteal bony formation, and resulting hyperostosis, and perhaps finally obliteration of the entire mastoid cavities by new bone.

Course and Termination.—Properly directed treatment will generally arrest ordinary inflammation of the periosteum of the mastoid, the swelling, redness, and pain subsiding after some days.

Treatment of Mastoid Inflammation and Abscess.—In the instance of mastoid periostitis the earlier symptoms may be met by free leeching over the mastoid process, the application of the artificial leech, of Leiter's refrigerating irrigator, or, failing it, a small ice bag suspended on the affected bone, its effects being carefully watched, or iced compresses. The meatus and tympanum must be well attended to, both being kept pervious. If we fear accumulation in the tympanic cavity, warm douches should be used with the Eustachian catheter. If fomentations are more agreeable to the patient and relieve the pain, they should be resorted to. Poultices, it should be borne in mind, when constantly applied tend to increase the general hyperæmia and congestion.

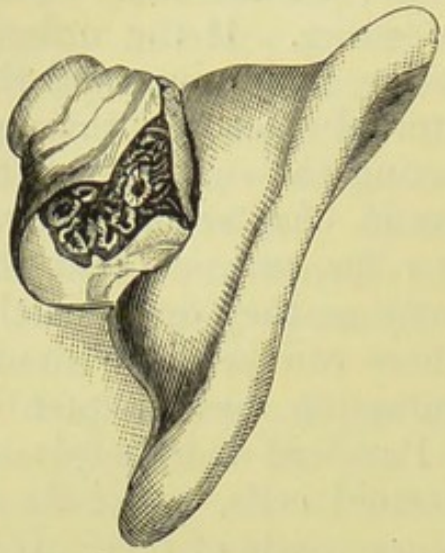


FIG. 139.—Necrosis resulting from mastoid periostitis (Macnaughton Jones).

Salines should be administered and the pain at night relieved by hypnotics. Our experience, however, is altogether in favour of incision in those cases in which after a few hours the symptoms continue, notwithstanding this treatment. When the swelling does not subside and encroaches on the auricle, whether there be pus present or not, the incision of Wilde gives great relief. The best position for the incision is immediately (1 centimetre) behind the auricle, this line answering subsequently for the application of the trephine if it be necessary to use it. The knife should be inserted on a level with the lower part of the external meatus, and the cut made from below upwards, a free incision, from two to three inches long and down to the bone, to divide the periosteum, being made. After incision, the probe should be used and the bone examined. Its state will afford an indication of deeper mischief in the cells or the probability of purulent collections, and also of the

presence of any necrosis. This is usually followed by the happiest results—complete subsidence of the pain and inflammation, and in one case in which the most alarming symptoms—delirium, high fever, vomiting, etc.—were present, this step gave almost immediate relief.

After incision and the removal of all dead bone, the surface should be well syringed with a warm antiseptic lotion and a poultice applied to the wound, taking care it does not cover the meatus, for twenty-four hours, replacing it then with an antiseptic gauze dressing.

Opening of the Mastoid Process.

It is necessary to emphasize the vital importance of this step in certain cases of ear disease, and the responsibility resting on the surgeon who omits to carry it out, in the event of a fatal issue following when the operation is not performed.

Politzer (*op. cit.*, p. 564) classifies under five heads the indications for the operation :—(*a*) Purulent inflammation, with persistent pain unsubdued by other means ; (*b*) accumulation of pus in the mastoid process when there is no means of escape by the external meatus, even when the parts over the mastoid are not swollen or infiltrated ; (*c*) when symptoms indicate retention of pus in the mastoid process though the posterior wall of the meatus has been incised ; (*d*) in cases in which we have reason to fear the existence of a circumscribed osseous abscess ; (*e*) "as a vital indication in any suppuration, combined with inflammation of the mastoid process in which vertigo and headache are developed during the course of the affection . . . in such cases the indication for the operation is vital."

To this test we would add (*f*) those cases of otorrhœa which obstinately resist all treatment, seem to go from bad to worse, or at any rate show no inclination to improve, and where the discharge is not great, but offensive.

To perform the operation the surgeon requires a good light ;[1] an anæsthetic ; sponges ; carbolized water ; torsion forceps ; a few small retractors, or hooks ; a strong blunt-pointed knife ; a trephine ($\frac{1}{4}$-inch), gouge, or perforator, like that of Hinton ; a few small-sized and differently shaped Volkman's spoons. A curved incision is made perpendicularly down to the bone in the situation before described, and about an inch and a half in length. A small flap incision may be

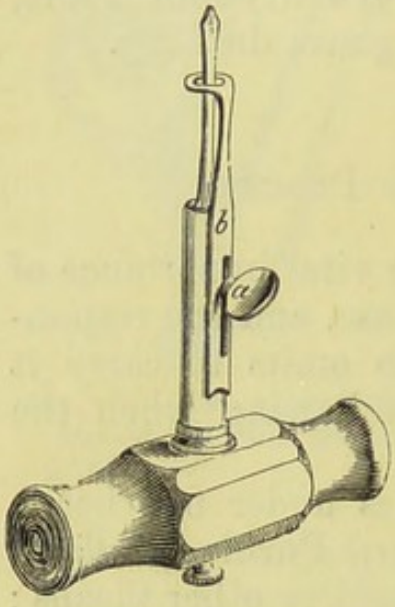


FIG. 140.—Hinton's perforator for opening the mastoid process.

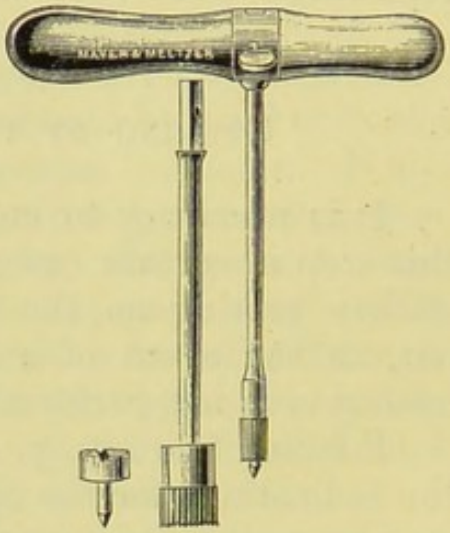


FIG. 141.—Trephine for mastoid, antrum, and lateral sinus.

made if the operator prefers, so as to expose a greater surface of periosteum. Vessels are twisted and a little time is taken to control the hæmorrhage, for which purpose very hot water and a sponge may be used. The periosteum, if remaining, is peeled off, and the bone is now cautiously operated on in the method the operator elects, whether with chisel and mallet, the trephine, or Volkman's spoon, the opening into the bone being made as close to the meatus as possible. In those cases under heading (*f*), if the destruction of membrane be great, the antrum may be opened through the posterior wall of the meatus, having first turned forward the auricle and soft parts, but this should not be done unless the hole in the meatus is big enough

[1] See p. 274.

for the inspissated pus to come through. The extent of the aperture in the bone, its depth, and other features of the operation, will depend in great measure on the amount and character of the disease, and on the formation of the mastoid process itself. There should be no haste, and from first to last excessive care should be taken.

"In my operations," says Hartmann, "I have followed the maxim of confining myself in the removal of the morbid parts to what was most needed, *i.e.* chiefly the removal of the granulations and the extraction of such sequestra as were fully loosened and could easily be reached. It seems, then, necessary in the after-treatment to keep the wound open by a thick drainage-tube, so that in the subsequent days we may have a full view into the depths of the wound, from which now the sequestra, gradually loosening themselves, may be detached with the probe and removed. It seems also desirable in the latter stage (as has been emphasized especially by Schwartze and Von Tröltsch) to keep the aperture open as long as possible by means of a leaden nail or a short leaden tube, until we are sure that the mastoid process is in a sound condition. The important point in the after-treatment is the regular removal of the accumulated secretion, for which purpose we prefer syringing at first with antiseptic, later with neutral, and lastly with astringent fluids." In all cases the formidable and serious nature of the operation and its risks should be plainly placed before the patient and relatives.

Intra-cranial Complications.

Of these serious complications it will be sufficient for us to indicate the more prominent symptoms, in order that danger may be recognized early, and such steps taken as may be necessary to save life, if it be threatened, as it always is in such cases.

If in a case of chronic suppuration a feeling of malaise, with nausea, vomiting, pains in the back, a high temperature and frequent pulse, with or without rigors, aching pains in the side of the head and neck, occur, it is right to

assume that some septic trouble has set in. These brain complications may come on suddenly, when the original trouble is subsiding, sitting in a draught or a blow on the head being the exciting cause. The symptoms are at times very obscure and insidious, increased pain being rapidly followed by paralysis, coma, and death.

Cerebral abscess more frequently follows middle-ear disease than any other, more especially disease of the tympanic walls (Toynbee). It may be acute or chronic, a well-defined abscess or a diffused softening, and is usually located in the temporal lobe, behind a vertical line drawn through a spot just anterior to the tragus, extending backwards, but seldom forwards (Barker). The pus may be in direct communication with the diseased bone, or separated from it by a layer of healthy brain substance. Pain is dull and localized, with a tendency to become diffused. The temperature, at first high, steadily falls to below normal, not to rise again until the pus has been evacuated. The pulse becomes slow, regular, and full; the respiration is slow and shallow; there is constipation, and a sluggish and slow cerebration and drowsiness. If this condition rapidly passes into coma fatal results quickly follow, but normal conditions are established if the abscess is thoroughly emptied.

Treatment.—The presence of an abscess being suspected, the trephine should at once be employed. A large semi-circular flap of all the tissues should be turned down, and the instrument applied at a spot situated an inch and a quarter and an inch and three-quarters to two inches above the centre of the bony meatus (Ambrose Birmingham), and a crown of bone removed. A fine trochar should then be thrust into the brain in different directions until pus is found. The abscess cavity should be freely opened and thoroughly irrigated with a boric acid solution, a drainage-tube inserted, and the wound dressed with a light antiseptic gauze. The irrigation should be continued daily until the cavity has healed.

A cerebellar abscess has the same characteristics as the cerebral. The usual seat is one of the lateral hemispheres, where it lies in contact with the petrous bone,

and is most frequently produced by disease of the mastoid or petrous bone (Toynbee). The symptoms are the same as the foregoing when uncomplicated, but this is rare, as there is usually some thrombosis or phlebitis of the lateral sinus at the same time.

Treatment.—This should be the same as with cerebral abscess, with the exception that the trephine must be placed at a different spot, viz. two inches behind the centre of the meatus and one inch below the base line [1] (Birmingham).

Meningitis is, perhaps, the most fatal of the intra-cranial complications. It may be either secondary to some other, such as cerebral abscess, thrombosis of the lateral sinus, etc., or it may be simple and occur within a few days of the commencement of the otorrhœa. Should any intra-cranial complication occur early in the course of ear disease, it may be safely ascribed to meningitis. It may be limited or diffuse. The former is generally found over the roof of the tympanum, or by the lateral sulcus. The latter spreads rapidly, preferring the base of the brain to the vertex. The disease commences suddenly, and runs a rapid course, with sharp pain all over the head, high temperature, small, irregular, and rapid pulse. There are listlessness, drowsiness, and coma, or rigors, delirium, and extreme restlessness; optic neuritis has not generally time to develop. Treatment is not of much, if any, avail.

Thrombosis of the lateral sinus may occur directly from necrosis of the posterior part of the petrous bone, to the mastoid cells, or posterior wall of the tympanum. The thrombosis will spread backwards to the trocular herophyte, and downwards into the jugular vein. The clot may be tough, with a tendency to organize and obliterate the vessels, or soft and friable, being liable to break and be washed into distant parts of the body, causing local abscesses or general sepsis. The onset of the disease, in a long-standing case of chronic middle-ear suppuration, is very sudden. Pain is very acute and lasting, and when situated in the posterior triangle,

[1] Reid's base line is an imaginary line drawn from the occiput through the centre of the meatus to the lower angle of the orbit.

running downwards in the line of the jugular, it is a very valuable diagnostic sign (MacEwen). Tenderness is generally felt on firm pressure being applied over the posterior border of the mastoid and below the occiput. There is vomiting, diarrhœa, high temperature, with frequent pulse and respiration. Rigors take place, and the skin has a peculiar goose-skin appearance (Barker).

Treatment.—The only one of any avail is that advocated by Ballance.[1] It is to cut down upon, tie, and divide the jugular vein in the neck below the level of clot, then trephine over the lateral sinus, the trephine being placed one inch behind the centre of the external meatus, and one inch and a quarter above the base line. When the groove has been opened, the bone should be chipped away with bone forceps. The sinus should then be incised, and the clot and any pus washed away. After this has been cleared out the upper portion of the vein should be opened and similarly treated. All dead bone must be removed, and the wound stuffed with antiseptic gauze. The vein in the neck is sometimes difficult to find, owing to its attenuated condition. This operation, if done sufficiently early, may rescue the patient from certain death.

Pyæmia may follow a neglected chronic middle-ear suppuration. It has no special characteristic from that occurring from any other causes, and the only special treatment required is that the middle ear must be frequently irrigated with some antiseptic solution.

[1] *Lancet*, 1890.

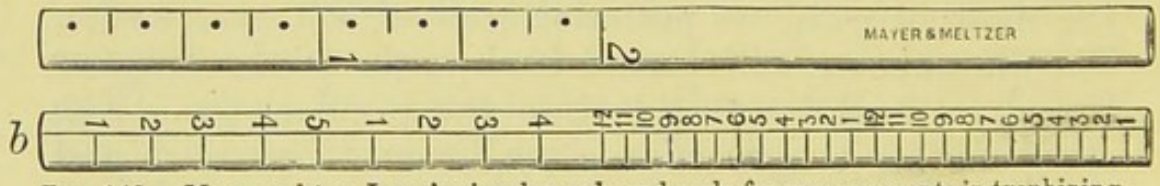


FIG. 142.—Macnaughton Jones's circular rule and scale for measurements in trephining the skull: Birmingham's guides; *b*, reverse side of rule.

EXPLANATION OF MARKING.

L.S. Lateral Sinus.	M. Centre of Bony Meatus.
T.S.L. Temp. Sphen. Lobe.	M.A. Mastoid Antrum.
C. Cerebellum.	R.B.L. Reid's Base Line.
m. Superior Margin of Bony Meatus.	

GUIDES TO TREPHINING THE SKULL (*Birmingham*).

L.S. = 1½ in. behind M. × level with upper border.
T.S.L. = 1¼ in. behind M. × 2 in. above it.
M.A. = $\frac{1}{12}$ in. above level of and behind m.; depth ⅜ in. to ¾ in.
C. = 2 in. behind M. × 1 in. below R.B.L.

CHAPTER XV.

SOME AFFECTIONS OF THE INTERNAL EAR.

Tinnitus Aurium—Etiology.[1]

We will first consider the causation of tinnitus and a few of the anatomical and physiological problems connected with its origin, with a view to arriving at a more scientifically concise and accurate differentiation of the causes of tinnitus.

Macnaughton Jones says (*Brit. Med. Journal*, 1890)—

"Perchance as a personal sufferer in the past from two distinct varieties of tinnitus, I have taken special interest in this most troublesome symptom of affections of the ear and other organs.

"In the winter of 1878 and the spring and summer of 1879 I had excessively hard work. The meeting of the British Medical Association occurred in the latter year in Ireland (at which, by the way, at my instigation an Otological Section was first instituted) and the secretarial work of that meeting placed great additional labour on my shoulders. Up to the end of 1879 I suffered from a vascular pulsating tinnitus in my left ear, which accompanied the cardiac systole; the noise was exactly like an aortic regurgitant murmur; it was present only on retiring to rest and on awaking in the morning, often prevented sleep, and was partially relieved by deep and firm pressure on the mastoid and behind the condyle of the jaw."

"In mentioning this fact to Dr. Dundas Grant, he has reminded me of his observation, how much tinnitus was interrupted by pressure in the suboccipital triangle on the vertebral artery, this pressure affecting the circulation through the auditory artery. He suggests this as a diagnostic test of a labyrinthine tinnitus. In

[1] These chapters on the internal ear are, in great part, abbreviated from Dr. Macnaughton Jones's work on *Subjective Noises in the Head and Ears.* Baillière, Tindall, and Cox, 1891.

my case I believe the pressure was exerted on the external carotid, posterior auricular and stylo-mastoid vessels.

"During this time I had a slight functional cardiac irregularity, and my arterial tone was below par. My hearing was and is above the normal standard of acuteness, which fact I have often proved with a Galton's whistle. I parted with my annoying companion at the end of 1879. Switzerland I think cured me. Again in the summer of 1882 I had a great deal of night work. I happened to be staying in the country for a short time, and first discovered my tinnitus by getting out of bed in the morning to ascertain if the wind was high, as I knew the night had been unusually fine. I found the rustling sound of waving trees existed in my ears. This latter tinnitus remained with me until the end of 1883. It troubled me very little in the day time and was aggravated when the meatus was closed or when the head lay on the pillow. During the time of its existence I had, on and off, a very slight naso-pharyngeal catarrh, and I believe my right Eustachian tube was occasionally in a state of partial collapse. My hearing was never in the least affected. Wilde took a very gloomy view of such cases of tinnitus, and prophesied a dismal end for those who suffered from noise in the ears while the hearing was acute. I hope and believe, from rather a selfish view, that the distinguished Irish aurist was not correct."

We propose first to briefly summarize the most important facts deducible from an analysis of 260 cases of different forms of tinnitus, drawing attention to some interesting features of a few cases.[1]

The following cases exemplify some affections of the eye which were accompanied by symptoms of tinnitus:—

"A gentleman, aged fifty-three, consulted me for migraine and tinnitus; for twelve days previous to his visit he had suffered from diplopia. The noises he described as like a 'steam engine, and a singing in both ears;' the left ear and hearing distance were normal; the right ear had been deaf for fourteen years, the watch not being heard on contact; there was pain in the head, more particularly across the forehead; the globe of the left eye was tender to the touch, and the tension was increased to + 2. The papillæ of both eyes were hyperæmic to the point of neuritis; the membranes of both ears were normal, and no local changes were discernible in the ears; he had been a great smoker. Under treat-

[1] Dr. Macnaughton Jones presented to the Otological Section of the British Medical Association tables containing the statistics of 260 cases arranged under the headings of *sex*, *age*, *ear affected*, *clinical conditions of ear found on examination*, *ascribed and recognized causes*, *symptoms* (*British Medical Association*, *Annual Meeting*, 1890).

ment and local attention to the eyes, he lost the diplopic symptoms, but the noises continued.

"A young gentleman, aged twenty, consulted me for cloudiness of vision. He was subject to facial neuralgia, and there was constant tinnitus in the right ear. The left ear was normal. The membrana tympani of the right ear was healthy; there was a collapsed state of the Eustachian tube; the watch was heard at about a foot. The right eye had been affected on and off for nearly ten years. The tuning-fork was heard somewhat louder in the right ear when open, but much less so on closure of the meatus. There was advancing optic atrophy of the papilla of the right eye, and general hyperæmia of the left retina, with small blood extravasations at the margin of the papilla.

"A lady, aged thirty, whose eyes had been what she termed weak, was attacked in the month of August with a loud tinnitus in the left ear. This was followed by dimness in the corresponding eye. When she consulted me in December of the same year, the vision of that eye was reduced to the bare perception of the shadow of objects, and the vision of the right eye to perceiving 70 Snellen at 18 inches. The tension of both eyes was then + 3, and there was a glaucomatous papilla. Both ears were normal, and the hearing was in no way affected."

Under the head of catarrh are included those evidences of middle-ear changes which result from chronic catarrhal states of the tympanum, including alterations in the shape, position, consistency, and mobility of the membrane, with or without adhesions; various ossicular changes, such as adhesions, rigidity, displacements; collections of mucus in the tympanum.

The cases in which the symptoms as regards extreme deafness, inability to hear the tuning-fork, vertigo, or other evidences, pointed with certainty to an affection of the labyrinth, are included under the clinical head of labyrinthine deafness. The features of each case are thus subdivided: Sex; age; ear affected, if only one or both; cause ascribed by the patient for the noise and deafness; the clinical condition and clinical symptoms.

The following were the noises recorded as complained of by patients:—The sound resembling buzzing; sea roaring; trees agitated; singing of kettle; bellows; bee humming; noise of shell; horse out of breath, puffing; thumping noise; continual beating; crackling sounds in the head; train; vibration of a metal; whistle of an engine; steam engine puffing; furnace blowing; con-

stant hammering; rushing water; sea waves; drumming; rain falling; booming; railway whistling; distant thunder; chirping of birds; kettle boiling; waterfall; mill wheel; music; bells.

We may place the proportion of aural patients who suffer from tinnitus as about one in three.

Analysis of Table.

Sex.

Males	127
Females	133

Ages.

Under ten	3
Ten to twenty	36
Twenty to thirty	43
Thirty to forty	41
Forty to fifty	39
Fifty to sixty	35
Sixty to seventy	21
Seventy to eighty	8
Not recorded	34

The youngest patient under ten was three years old; the next, four; the other, seven.

The causes ascribed in these cases were respectively, three years, nasal turbinal obstruction; four years, fever (possibly meningeal complications); seven years, tonsillar hypertrophy. The ears were normal in the child affected with tonsillar hypertrophy. There was absolute deafness in the patient attacked after fever.

Right or left ear, or both: right ear, 36; left ear, 53; both, 171.

Ascribed Causes.

Cerumen[1] (present on examination)	30
Naso-pharyngeal catarrh	28
Nasal turbinate congestion and obstruction	19
Mental worry and overstrain	14
Sea-bathing	12
Scarlatina	9
Heredity	8
Tropical effects	8
The menopause	8

[1] Cerumen in these cases was the sole cause of the tinnitus, and it disappeared on its removal, or did so after some slight additional treatment.

Injuries	7
Hypertrophied tonsils and tonsillitis	7
Abscess or inflammation of meatus	7
Cardiac disease	7
Gout	5
Uterine disorders	5
Measles	4
Syphilis	4
Alcohol	4
Rheumatic fever and rheumatism	3
Pregnancy	2
Morbus Brightii	2
Ozæna	2
Decayed teeth	2
Facial paralysis	1
Puerperal septicæmia	1
Quinine	1
Adenoid growths	1
From gun concussion	1
Pneumonia	1
Parotitis	1

In the remaining cases no cause was ascribed. In a few of the above there was a double causation ascribed; where this appears to have been of importance it has been included.

Clinical Conditions of Ear found on Examination.

Cerumen (those cases of cerumen in which this condition was of secondary consequence, and evidently not the cause of the tinnitus, are not included)	30
Inflammation or abscess of the meatus	7
Exostosis of the meatus	7
Catarrhal changes in the tympanum	102
The same, with closed Eustachian tube	20
Collapse and obstruction of Eustachian tube	38
Perforation of the membrana tympani	17
Polypus in the tympanum	4
Disease in the labyrinth	47
Nasal obstruction from enlarged turbinate bones, deviation of septum, congestion of the Schneiderian membrane, etc.	19
Tonsillar hypertrophy	7
Cretaceous membrane	1
Both ears normal	26
One ear normal	7

Ascribed and Recognized Causes of Tinnitus in an Ear in which the Hearing was normal.—Recent sea-bathing; fever; alcoholic excess; tropical causes;

cardiac weakness; nasal obstruction; puerperal septicæmia; irregular catamenia; mental strain; overstudy; menorrhagia; Bright's disease; the menopause; albuminuria; quinine; retroflexion of uterus with neurosis; pharyngeal catarrh; neurotic temperament; tobacco.

The hearing distance was normal in *both ears* in 18 cases. In the cases in which this occurred the tinnitus was ascribed to overwork, alcohol, puerperal septicæmia, the menopause, residence in India, nervous temperament, overwork on the stage, hypertrophied tonsils, exostosis, albuminuria. No cause was ascribed for the tinnitus in three of these cases of normal hearing.

Symptoms.—The main symptoms complained of in 187 of the cases were tinnitus and deafness alone; in 22 vertigo was present, and in 9 of these the typical symptoms of Ménière's affection occurred—nausea, vertigo, syncope, tinnitus, and deafness. There were accompanying ocular symptoms with associated retinal changes in 7; hyperæsthesia acoustica or hyperalgesia (Ross) in 1; paracusis loci in 2; and reduplication of sounds in 2. What the patients described as "crackling sounds in the head" occurred in 9; confusion of ideas was present in 2; insanity followed in 1 (there was a previous history of insanity in the family in this case). One patient complained that "every step she took she heard it in the left ear" (this symptom commenced after recovery from puerperal septicæmia); in one there was typical laryngeal vertigo, accompanied by a sense of choking on attempting to swallow. In one, in whom the deafness was only occasional, but the noise in the left ear and the side of the head was constant, facial paralysis of the left nerve was present. In another, tinnitus aurium was the first symptom (with slight accompanying deafness, which foreshadowed the future involvement, successively, of the nuclei of the auditory, facial, sixth, sensory of fifth and motor of fifth, and glosso-pharyngeal nerves). In one the deafness and tinnitus began after a railway injury. In the case of hyperæsthesia acoustica the patient said that "church

bells set her wild," "the organ made her quite giddy," "the clock in the room was disagreeable," and "the sound of her brother's voice was peculiarly distressing." It is worth remarking, that of the 17 cases of perforation of the membrana tympani, of those cases in which both ears were chronically affected, no noise was heard in the perforated ear in 5 instances. In several of the others the perforation was either acute or complicated with other conditions. In 11 cases the tinnitus was only heard at night or became so aggravated as only to give great distress to the patient at night.

In the 13 cases of *simple vertigo* noted, the following were the clinical conditions :—

(1) Adenoid growths in pharynx.
(2) Perforation of right membrana tympani, catarrhal changes in left.
(3) Obstruction of the Eustachian tube.
(4) Labyrinthine deafness right ear, left ear normal (double optic neuritis present, migraine, diplopia, mydriasis).
(5) Polypus in tympanic cavity.
(6) Ears normal, hearing normal.
(7) Slight catarrhal effects in tympanum.
(8) Catarrh of tympanum and labyrinthine deafness.
(9) Hearing normal, inefficiency of cardiac syncope.
(10) Ears normal, hearing normal, deafness only occasional, facial paralysis present.
(11) Catarrh of tympanum and labyrinthine deafness, laryngeal migraine present.
(12) Polypus in the tympanic cavity.
(13) Chronic catarrh of tympanum (after sea-bathing and syringing on the membrane with cold water); tinnitus in the left ear, and tendency to fall to the right side.

In the 9 cases in which the more characteristic symptoms of *Ménière's vertigo* were noted, the following were the clinical conditions :—

(1) Ears normal, gouty diathesis and systolic inefficiency; in this case the tinnitus was described in the right ear "as maddening."
(2) Labyrinthine deafness.
(3) Labyrinthine deafness with neuralgic headache.
(4) Labyrinthine deafness left ear, right ear normal; patient of rheumatic and gouty diathesis.
(5) Labyrinthine deafness; the patient fell without warning to the ground with the first attack of vertigo, now constantly "rolls about as if drunk."

(6) Catarrhal changes in tympanum.
(7) Collapsed state of membrana tympani, tinnitus and deafness only found in the left ear; right ear normal and its hearing normal.
(8) Chronic changes in tympanum (ascribed cause syphilis).
(9) Labyrinthine deafness; the first attack came on after recovery from an operation for hæmorrhoids; is liable to attacks in bed.

CHAPTER XVI.

TINNITUS AURIUM—ANATOMICAL.

We may thus summarize the more important *points of anatomical interest that bear on the etiology of tinnitus.*

First, there are the connections now shown to exist between the auditory nuclei in the medulla and pons, and the cortical auditory centres of either side of the brain. We may now look on it as absolutely certain, after the recent exhaustive Croonian Lectures by Dr. Ferrier, that "the sense of hearing is in greater part situated in the temporal lobe, and more especially in the superior temporal gyrus of this lobe." As Dr. Ferrier remarks, in a letter to me on the subject, "tinnitus may occur in both ears as the result of unilateral irritation, the effect of the intimate connection of the auditory nerves and centres." The cases of sensory cortical discharges[1] reported by Hughes Bennett may be advanced, Dr. Ferrier thinks, to establish this view. Ferrier states[2] that Baginsky says that the auditory nerve is in relation with the auditory centre of the cortex through the lower fillet of the opposite side, and thence by means of the posterior tubercle of the corpora quadrigemina and internal geniculate body to the medullary fibres of the cortex.

It is probable that lesions of the adjoining parietal and occipital lobes may encroach upon, invade, or inhibit the hearing centre and cause both deafness and tinnitus. The auditory nucleus in the fourth ventricle

[1] *Lancet*, 1890. [2] Croonian Lectures, 1890.

is connected with that of the facial and the trigeminus, and in close proximity to those of the vagus and hypoglossal. Some fibres of the nerve also arise from the superior vermiform process and pass out through the inferior cerebellar peduncle. It is important to remember that the anterior nucleus of the auditory nerve is supplied with vaso-motor fibres. We may thus classify the principal sources of reflex irritation or inhibition of the auditory nerve : (*a*) Through communications at the nuclei of origin ; more especially might this occur through the sensory fifth and tenth nerves. (*b*) Through the communications with the facial in the internal auditory meatus, the reflections from this connection being transmitted along the petrosal nerves from the otic and Meckel's ganglions, and the parts supplied by them. (*c*) Through communications between the nerves supplying the tympanic structures, and Meckel's ganglion and the otic and geniculate ganglions. According to Foster, the activity of the tensor tympanic muscle is regulated by reflex action. (*d*) Irritations may be reflected to the cerebellum or the auditory centre and referred to the ear or different parts of the head. Most important are the researches of Gaskell as to the presence and course of vaso-constrictor and vaso-dilator fibres (which control the blood supply by constriction or dilatation of the small vessels) arising, the former from the upper part, and the latter throughout the whole length of the spinal cord, and which pass to the cervical ganglions of the sympathetic, and thence (in this instance) to the special arteries, furnishing the supply of blood to the ear, more especially the internal auditory from the basilar. Also of importance is the fact that certain nerves, such as the trigeminus and cervical sympathetic, appear to be supplied with special "pressor" fibres (McKendrick), which have the power of constricting the vessels ; this may occur either from a direct or reflected irritation of these fibres, which irritation, as in the case of the cervical sympathetic nerve, must have an important effect on the circulation in the ear. Of the various

other nerve communications and distributions in the ear, which bear on reflex irritation, we have to recollect the connections between the glosso-pharyngeal, fifth, and sympathetic nerves, as, for example, the supply of the tensor tympani and stapedius from the otic ganglion and the facial nerves respectively; the communications in the tympanic mucous membrane, between Jacobson's nerve, the sympathetic, and the geniculate ganglion of the facial nerve, and the other communications between the carotid plexus of the sympathetic, Jacobson's nerve, and the otic and Meckel's ganglions, thus bringing all these nerve communications into direct relation with the superior cervical ganglion. The supply of the anterior wall of the external auditory meatus and the tympanic membrane from the auriculo-temporal is an important point bearing on reflex irritation from affections of the external meatus, which cause tinnitus, when the middle ear is healthy. This sensory supply, be it remembered, is connected with the facial and pneumogastric nerves.

Some Anatomical Points bearing on Reflexes of the Trigeminus.

There are some anatomical points in regard to the connections and communications of the fifth nerve which are of interest to remember in discussing any of those reflexes which irritation of the dental branches may produce. It may be well in the first place briefly to tabulate these.

1. Nuclei of origin of fifth.	The connection of the motor nucleus with the cortical motor centre of the opposite side, and its connection with the descending root. The anastomosis of the sensory root with all the motor nuclei of the nerves arising from the medulla, save the sixth (Landois and Stirling).[1]
2. Distribution to dura mater and arachnoid	The supply of the dura mater from the fifth nerve through the recurrent branch from the Gasserian ganglion, superior maxillary, ophthalmic division of fifth; the communications between the branches of the carotid plexus of the sympathetic going to the

[1] Landois and Stirling, *Text Book on Physiology*, 1889.

from fifth nerve.

dura mater, with the Gasserian ganglion and Meckel's ganglion, through the vidian. Besides the facial and spinal accessory, the motor division of the inferior maxillary of fifth sends a branch to the arachnoid; while the fifth also participates in the supply of the pia mater.

Supra-trochlear, infra-orbital, from ophthalmic; temporal of orbital, from superior maxillary; auriculo-temporal, from inferior maxillary. "*All the cutaneous offsets of the fifth nerve form communications with the adjacent ramifications of the seventh nerve*" (Quain).

3. Distribution to scalp and communication, of fifth.

The intercommunications between the great auricular small and great occipital (from the second and third cervical nerves), and the posterior auricular of the facial, form a connecting link between the cutaneous branches of the second and third cervical, and the fifth nerves. This anatomical connection has an important bearing on the concurrence of cervical with dental neuralia.

Important communications of fifth with other cranial nerves.

With the facial. Through the chorda tympani; temporo-facial and temporal; malar; infra-orbital; buccal; supra-maxillary.

With the auditory. The upper division of the auditory nerve communicates with the geniculate ganglion or facial, and so, by means of the large and small superficial petrosal nerves, with Meckel's and the otic ganglion, respectively.

With the glosso-pharyngeal. Jacobson's "tympanic branch" with the small superficial petrosal and otic ganglion-section of the fifth nerve is followed by inflammatory changes in the tympanum of the rabbit (Berthold and Grunhagen). Also in relation to *ocular*, *auditory*, and *nasal* reflex irritation, these distributions of the fifth nerve have to be remembered.

Other Distributions.

Eye. The origin of the long ciliary branches through the sensory root of the lenticular ganglion; the infra- and supra-trochlear branches to the eye and lachrymal apparatus, the supra-orbital cutaneous twigs to the scalp and frontal pericranium. Communications with the third, fourth, and sixth nerves through the ophthalmic of fifth.

Ear. The communication through the otic ganglion with the tympanic plexus. The muscular supply from the otic ganglion to the tensor tympani and the tensor palati.

Nose. The supply through the branches of Meckel's ganglion, and the naso-palatine nerve, to the hard palate and the middle and inferior meati, soft palate, tonsils, septum nasi, and ethmoidal cells.

These connections and distributions of the branches of the fifth nerve are in themselves sufficient to explain some of the occasional reflex symptoms that may be traced to an irritation of dental twigs. The connections of the fifth nerve with the sympathetic are of primary importance in so far as they bear on the vaso-motor effects of irritation of the dental twigs. These effects are manifested in allied conditions of blood pressure; increase or diminution, in the ciliary circulation in the eye, in the vessels of the tympanum and labyrinth in the ear, and those of the septum and turbinate bones in the nose. The same observation applies to the scalp, frontal pericranium, and dura mater. Though the auditory nerve in common with the optic and olfactory has no connection directly with the sympathetic, yet there are the communications from the carotid plexus with Meckel's ganglion through the deep and great superficial petrosal (forming the vidian), and the filaments that proceed from the sympathetic around the middle meningeal to the otic ganglion. There are indirect connections also through the tympanic branch of the glosso-pharyngeal and the communications with the facial nerve through its geniculate ganglion and its branch to the stylo-hyoid muscle. There are also the vaso-constrictor fibres (contracting blood-vessels) which pass from the anterior roots of the upper dorsal through the sympathetic cervical ganglia (Gaskell) to the carotid artery, and thence to the special arteries supplying the parts before named. The vaso-dilators arising from the entire spinal cord find their way in the same manner to the smaller vessels. The knowledge of the existence of these distinctly opposed vaso-motor nerves, one raising the blood pressure, the other lowering it, helps to explain some of the seemingly paradoxical effects following on stimulation of the fifth nerve, as, for instance, an increase or diminution of the intra-ocular vascular tension from decayed teeth and supra- or infra-orbital nerve excitation. Still more seriously touching on this question is the knowledge that "pressor" nerve fibres exist in the trigeminus which

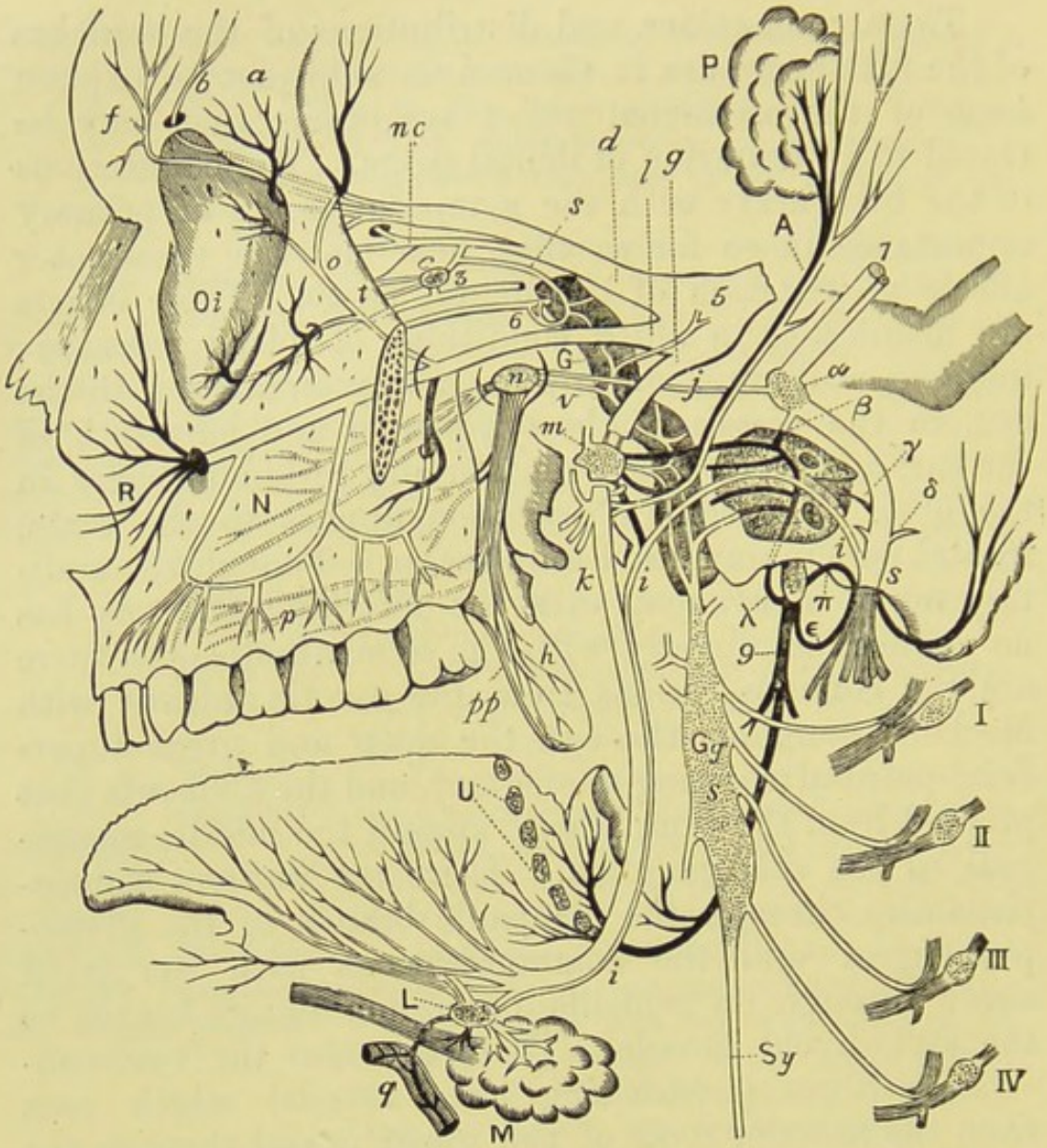


FIG. 143.—Ocular nasal and aural reflexes. Semi-diagramatic representation (after Landois and Stirling) of the nerves of the eyeball, the connections of the trigeminus and its ganglia, together with the facial and glosso-pharyngeal nerves. 3, Branch to the inferior oblique muscle from the oculo-motorius, with the thick short root to the ciliary ganglion, *c*; *t*, ciliary nerves; long root to the ganglion from the naso-ciliary, *nc*; *s*, sympathetic root from the sympathetic plexus surrounding the internal carotid, G; *d*, first or ophthalmic division of the trigeminus (5) with the naso-ciliary (*nc*) and the terminal branches of the lachrymal (*a*), supra-orbital (*b*), and frontal (*f*); *l*, second or superior maxillary division of the trigeminus (R) infra-orbital; *n*, spheno-palatine (Meckel's) ganglion with its roots; *j*, from the facial, and *v*, from the sympathetic; N, the nasal branches, and *pp*, the palatine branches of the ganglion; *g*, third or inferior maxillary division of the trigeminus; *k*, lingual; *i*, *i*, chorda tympani; *m*, otic ganglion, with the roots from the tympanic plexus, the carotid plexus, and from the third branch and with its branches to the auriculo-temporal, *a*, and to the chorda, *i i*; L, sub-maxillary ganglion with its roots from the tympanico-lingual, and the sympathetic plexus on the external artery, *q*. 7, Facial nerve; *j*, its great superficial petrosal branch; α, gang., geniculatum; β, branch to the tympanic plexus; γ, branch to the stapedius; δ, anastomatic twig to the auricular branch of the vagus; *i i*, chorda tympani; S, stylo-mastoid foramen. 9, Glosso-pharyngeal; λ, its tympanic branch; π and ϵ, connections with the facial; U, terminations of the gustatory fibres of 9 in the circumvallate papillæ; *Sy*, sympathetic with *Gg*, *s*, the superior cervical ganglion; I., II., III., IV., the four upper cervical nerves; P, parotid; *m*, sub-maxillary gland.

excite the vaso-motor centre in the medulla and cause a rise[1] of blood pressure.

Physiological.—We now group the *abnormal physiological conditions* which are likely to cause tinnitus.

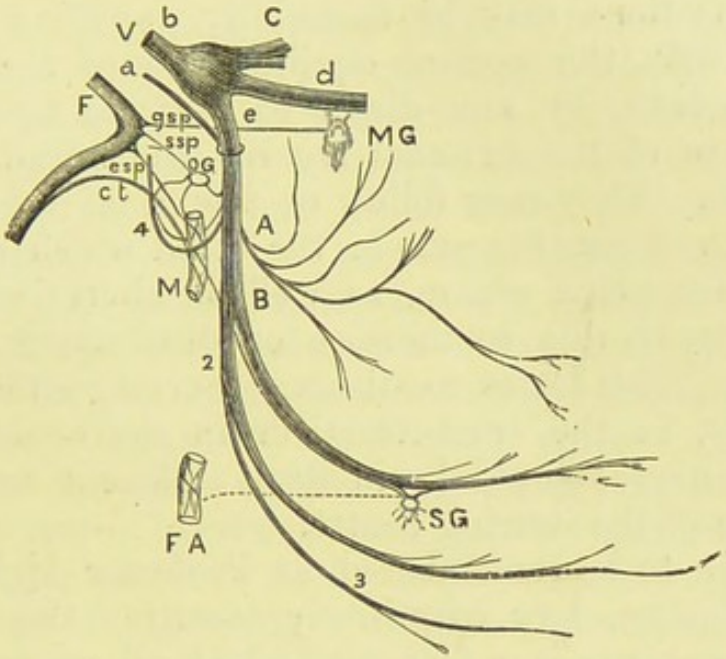


FIG. 144.—Diagram of the third division of the fifth nerve, its connection and branches. V. Fifth nerve. b, large sensory root with the Gasserian ganglion; a, smaller motor root joining inferior maxillary nerve. A, anterior division of the inferior maxillary nerve with its branches to the muscles of mastication and buccal branch (mainly motor); B, posterior division; 1, its lingual branch; 2, the inferior dental branch, with the twigs to the teeth, and the mental branch; 3, the mylo-hyoid branch; F, the facial nerve with its (ct) chorda tympani branch going to (SG) sub-maxillary ganglion as its motor root. OG, otic ganglion; gsp, great superficial petrosal, connecting the facial nerve with (MG) Meckel's ganglion; ssp, small superficial petrosal, connecting the facial nerve with the otic ganglion; esp, external superficial petrosal, connecting the middle meningeal (M) plexus with the facial nerve. FA, facial artery, communication with sub-maxillary ganglion.—From *Hermann's Physiology*.

With regard to the physiology of hearing, it does not appear that there are any proofs that separate centres exist for the perception of different kinds of sounds. A sensation arising from any irritation in the auditory centre may be referred to the periphery, that is, to the origin of the nerve filaments in the labyrinth (McKendrick). The receptive auditory centre is possibly in part situated in the cerebellum. An irritation occurring either in the labyrinth, the auditory nerve, or

[1] *Textbook on Physiology*, by J. McKendrick, M.D., F.R.C.S., vol. ii. p. 294, 1889.

receptive centre, will, Professor McKendrick considers (in a communication which he has kindly written to us on this subject), "produce a stimulus in the hearing centre which will cause a sensation or a series of sensations which will always be referred to the labyrinth." Such irritations may be caused by anything that interferes with the normal equilibration of the fluid in the labyrinth, by any direct or reflected irritation of the nerves of the external meatus, the middle ear, or labyrinth. They may follow or attend on the presence of abnormal constituents in the blood which circulates in the receptive centre, as well as alterations in the blood supply due to increase or diminution of blood pressure. This latter condition, occurring either at the periphery, in the cerebellum, or in the course of the auditory nerve, would be in itself sufficient to start an irritation of the hearing centre.

It has to be remembered, as Professor McKendrick rightly insists, how exquisitely sensitive the auditory nerve apparatus is, a fact with which all are acquainted who have studied the physiology of the ear in its perceptive powers, and its faculty of differentiating, analyzing, and synthetically arranging sound-waves. Hence, how extremely feeble and imperceptible to the finest resources of the aurist, which he employs in diagnosis, may those causes of stimulation be which are yet sufficient to produce tinnitus. In one case a loud tinnitus was complained of, which the patient said occurred quite suddenly while in the open air during harvesting. Resting on a perfectly normal membrane was found, on examination, the fine membranous husk of a hay seed, the removal of which completely relieved him.

There is nothing to show that we can strictly apply the hypotheses as to the *probable routes by which mere noises, as distinguished from tones or other regular series of vibrations, are transmitted to the brain,* through the vestibular or cochlear nerves respectively, to those varieties of sound, musical and other, which are heard in the case of persons suffering from tinnitus.

It may be that some explanation can be offered by assuming that the nerve filaments of different portions of the basilar membrane were affected at the same and at different times in the same and in different individuals, so that the impulses arising from irritations of the nerve fibres supplying narrow or broad portions of the basilar membrane, and the superimposed elements of Corti (devoted to the transmission of certain waves of sound to the auditory centre) having different qualities of intensity, timbre, and pitch, would probably convey such sensations of sound as were ordinarily transmitted to them by normal stimulations of these same fibres due to the passage of sound-waves through the air. Thus, the pitch of the sound heard and the character of the vibration referred by the hearing centre will depend upon the intensity of the irritation of the part of the cochlear nerve involved from base to summit, and we can further conceive such complex irritations as would be capable of producing the same impressions as result from compound waves of sound that make up or combine to produce musical tones and notes. Further, if it is, as it appears to be true, that the transmission of noise occurs through the ampullæ through the coarser elements of the crista acoustica, we may assume, when loud and harsh noises are referred from the hearing centre, that it has been through the terminations of the ampullar nerve that the irritations have been conveyed. McKendrick says—

> "The ultimate analysis of auditory sensations must take place in the auditory centre of the brain; each fibre of the auditory nerves that comes from the cochlea will be stimulated by the vibrations of its own hair cells, or set of hair cells, and each filament will conduct impressions proportional in number to these hair cells."[1]

Then, as suggested by Rutherford, different cells in the brain will receive varying numbers of nervous impulses, and the sensations of sounds of different pitch will be produced. We might reverse this order of things, and

[1] J. G. McKendrick, M.D., F.R.C.S., *Textbook of Physiology*, vol. ii., 1890.

assume the irritation of certain groups of cells in the cortex as productive of associated impulses referred to the nerve filaments distributed to different portions of the labyrinth.

Or it may be that in the storage of memory of impressions in the sensory centre another explanation can be offered. In referring to molecular movements in the cells of the cortex arising out of impressions and the resulting reflex phenomena, Professor McKendrick says in his work—

> "They may be called into action by a stimulus from another part of the brain, as when irritation of the corpora quadrigemina by Indian hemp awakens in the cells of the visual centres of the cortex those changes which are associated in the mind with long-forgotten visual impressions, and the person sees passing before him the phantasmagoria of brilliantly coloured images."

It is conceivable that a stimulus of the receptive auditory centre may in like manner awaken old impressions and give rise to reflex phenomena of sound.

CHAPTER XVII.

VERTIGO—DEFINITION AND CAUSATION.

It would be out of place in this work to introduce any lengthy observations on the physiology and etiology of vertigo generally, and the differentiation of aural vertigo from those other forms which have been associated with mental, epileptic, ocular, laryngeal, pharyngeal, gouty, and gastric miasmatic causes of giddiness. The names of Trousseau, Charcot, Lasègue, Duchenne, Gueneau de Mussy, Abadie, Krishaber, Guye, and Weber-Liel abroad, and those of Ferrier, Gowers, Hughlings Jackson, McBride, and Woakes in England, are those we are most familiar with in relation to this differentiation.

Definition and Causation of Vertigo.—We must simply limit these few observations to the aural vertigo which is associated with tinnitus aurium. The cases recorded demonstrate some important facts, which those who have previously written on this subject have noticed: (1) the origin of pharyngeal vertigo and tinnitus from adenoid growths in the naso-pharynx (Guye); (2) vertigo due to disturbance of equilibration from tubal obstruction; (3) cerebral vertigo associated with optic neuritis; (4) vertigo and tinnitus in which the ears were normal, and the hearing distance normal, of a purely reflex or neurotic character; (5) vertigo and tinnitus due to inefficient cardiac systole; (6) vertigo with tinnitus due to facial paralysis—the hearing being normal—a reflected irritation probably from the geniculate ganglion; (7) labyrinthine deafness associated

with laryngeal vertigo; (8) sea-bathing associated with the origin of vertigo and tinnitus; (9) rheumatism and gout as causes of a vertigo due to labyrinthine affection; (10) the association of vertigo with naso-pharyngeal morbid states (this fact is not shown in the tabular statement bearing on vertigo, as we have not here included the causes in those cases in which vertigo occurred); (11) the occurrence of vertiginous attacks when lying down in bed (the tinnitus in this case was not of the nature of an aural hallucination).

It is necessary to define more accurately our meaning when we speak of aural vertigo, the frequent companion of tinnitus, and of that accompanying train of symptoms which are so often equivocally grouped under the head of "Ménière's disease."

Attacks of vertigo proceeding from such causes as pressure on the external meatus, the effect of cold in syringing on the membrana tympani, and of inflammation in the external ear, though strictly considered forms of aural vertigo, are not correctly included in the definition and view of this affection which we are more familiar with. The vertigo produced by syringing through the middle ear into the nose in cases of perforation of the membrana tympani finds its explanation in Weber-Liel's experiment of pressing on the exposed stapes, when the degree of pressure exercised produced in succession all the phenomena of vertigo, including faintness and sickness of the stomach.

True aural vertigo is an affection characterized by attacks of giddiness, in varying degrees of severity from transient dizziness to actual vertigo, this reeling being accompanied or succeeded by nausea, if not by actual vomiting, and being preceded or attended by deafness and tinnitus. As we well know, a patient may suffer from aural vertigo and we may not be able to detect any defect in the auditory apparatus, and when the attack ceases the hearing may be perfect and the tinnitus disappear. As McBride has pointed out, we might speak of an aural, ophthalmic, and stomachic vertigo, to which we may add laryngeal.

In connection with the subject of aural vertigo, Charcot's laryngeal vertigo must be mentioned. Charcot described such vertiginous attacks complicating cases of gouty bronchitis and asthma, in which there was an accompanying laryngeal irritation. Some only of these vertiginous paroxysms were attended by convulsive movements and unconsciousness. Krishaber (*Annales des Maladies Coreilli*, March, 1882) records a case associated with syphilis in which the starting-point of similar attacks was the larynx; Gray and Lefferts (*American Journal of Neurology and Psychiatry*, November, 1882; *Archives of Laryngology*, July, 1883) have recorded similar cases of "laryngeal epilepsy." Gottstein, who with Krishaber believes that these attacks are due to spasm of the glottis, and that the syncope attendant on them is brought about by the effect on the blood pressure immediately at the close of a full inspiration, supports this conclusion by the observations of Weber (Müller's *Archives*, 1851), who proved that forced expiration with closed glottis had a similar effect both in his own person and with others. Dr. McBride, of Edinburgh, has carefully detailed the particulars of a case agreeing with the above view. Macnaughton Jones had under his care a lady who was threatened with syncope, and some vertiginous symptoms occurred during the act of defœcation. She is rather of a neurotic temperament, and has a feeble cardiac syncope. Curiously enough, there is a chronic throat and laryngeal trouble in this case, which has been present for years, and for which she has tried the effects of various climates.[1]

The aural vertigo we meet with *in debilitated persons*, and in atonic states, oftentimes attending irregularity of meals, over-press and worry of business, general anæmia with dyspepsia, is strictly analogous to its twin sister ocular vertigo. It may have its origin in some peripheral irritation, pneumo-gastric or sympathetic, or it may be a depraved blood-current which produces the central irritation in the hearing centre, more easily excited by perverted stimuli in these adynamic states, and the consequence is, as in the case of the retina, the subjective auditory phenomena. More frequently perhaps in the instance of the ear than of the eye, are there any local physical accompaniments or consequences, and a tinnitus rather objective than subjective is the result.

Aural vertigo we find caused also by such *middle-ear affections* as growths in the tympanum, collections of mucus and pus in it, exudations, ossicular and other

[1] *Vide Practitioner*, 1886, vol. xxxvi., "Ocular and Aural Therapeutics." Macnaughton Jones.

intra-tympanic changes which produce intra-labyrinthine disturbance through stapedial immobility and pressure, mastoid and petrosal disease, and venous congestion in the sinuses. And in the internal ear we find associated with aural vertigo all those abnormal states which have been already enumerated as sources of tinnitus, and which may be subdivided under the seven headings—increase of labyrinthine pressure, vascular changes, nerve changes, rheumatism, gout, syphilitic reflex disturbances, cerebral and cerebro-spinal affections, medicaments as quinine, salicine, etc.

Though we think all *naso-pharyngeal affections* causing deafness should be looked on as so correlated to the accompanying or consecutive middle-ear morbid states that they must, strictly speaking, be included in the consideration of these, still we feel it is preferable distinctly to refer to them as a separate exciting cause of vertigo, if for no other reason than to impress on all the fact of the importance of the patency of the nasal passages in preserving the equilibration of the labyrinth. The mere mechanical obstacle which obstruction or closure of the nasal passages presents to the ventilation of the tympanum is by no means the most serious of the considerations bearing on the presence of vertigo arising out of an affection of the nasal mucous membrane, be it catarrhal, hypertrophic, ulcerative, or an enlargement of the turbinated bones from any cause, more especially of the inferior. Vertigo which results from the secondary tympanic changes consequent merely upon such obstruction is not of frequent occurrence. We have the best proof possible of this in the instance of nasal polypi, accompanying which it is comparatively rare to find deafness or tinnitus, and rarer still vertigo.

Patients come with congenital enlargement of the pharyngeal wall, with hypertrophy of the pharyngeal tonsil, with large naso-pharyngeal polypi, in whom all these vertiginous symptoms are absent. We often see patients with such a deviation of the septum nasi that the mucous surfaces of the outer wall of the nostril and the septum were in apposition. There has been a deaf-

ness of the corresponding ear, but no vertigo and frequently no tinnitus.

Children with post-nasal obstruction from adenoid growths of the naso-pharynx—whose respiration is so affected that the chest presents the peculiar "pigeon-breast" deformity seen in such cases, even where these growths are attended by contraction of the nasal passages and swollen nasal mucous membrane, do not suffer from giddiness. It would appear, therefore, from these clinical facts of everyday experience that the coincidence of vertigo and tinnitus, in a given proportion of disordered states of the naso-pharynx with accompanying impediment to nasal breathing, is difficult accurately to explain if we do not include interference, primary or secondary, with the equilibration of the labyrinthine fluid as the cause. It may in many cases be idiosyncratic. There may be required some special inherited susceptibilities and abnormal excitability of the hearing and vertiginous centres to account for the slight disturbance in the physiological balance producing the symptom in some individuals and not in others.

The extensive nerve connections in the naso-pharynx, motor and sympathetic, through the cerebro-spinal nerves and sympathetic ganglia, and the distribution of these nerves to the several vessels supplying the large vascular area which includes the entire auditory tract and naso-pharynx, are sufficient anatomical grounds on which to explain the healthful physiological relations maintained between the nasal respiratory function and the circulation in the naso-pharynx, tympanum, and labyrinth. The equilibration of the labyrinthine fluid and the inhibiting function of the hearing centre and cerebellum, including the efficient control by these of any perverted impulses which may be excited in these parts through morbid processes involving the peripheral nerves, have a correlation which these anatomical considerations explain.

Dr. Woakes considers that the cervical ganglia of the sympathetic, through their widely distributed afferent and efferent connections with the correlated vascular areas over which their branches preside, play

the most important part in the production of aural vertigo. The primary deviation may occur in the afferent ganglionic nerves, leading to local changes in the tissues, nasal and pharyngeal, producing ganglionic neurosis, which, through the efferent nerves, results in dilatation of the vessels in the correlated vascular areas and consequent congestion. He regards the inferior cervical ganglion especially as the one whose normal correlating function in its widely-distributed branches of distribution is more especially essential for the maintenance of healthful nutrition in the correlated areas. And vertigo he looks on as one result of functional disturbance in any of the correlated areas presided over by this ganglion. The phenomenon may be reflex, or, as in the case of goitre, be due to primary lesion of the ganglion itself (the middle and superior ganglia, it may be, being also involved, as in Dr. Shingleton Smith's case), the direct effect of the ganglionic lesion being vaso-motor paralysis of the inferior thyroid artery, and hence the goitre.[1]

It appears that in the anatomical relations already epitomized, and more especially those of the roots and nuclei of the auditory nerve with the restiform bodies, the peduncles of the cerebellum, the floor of the fourth ventricle, the contiguity of the auditory nuclei to those of the facial sixth and eighth pairs of nerves, and in the relation of the ampullar and vestibular nerves to the cerebellum, we have a most important explanation of reflex aural vertigo. The second and equally important anatomical connection to be remembered is the numerous links which connect the different cerebro-spinal ganglia with the cervical sympathetic and the vaso-motor centre in the medulla.

A chain of continuity is thus maintained between the pneumo-gastric nerve and its branches and the nerves supplying the naso-oral and naso-pharyngeal regions, with the sympathetic supply of these parts, which explains the various vaso-motor effects on the blood-vessels of the labyrinth, tympanum, and naso-pharynx, effects

[1] Woakes on *Post-Nasal Catarrh, Deafness, Giddiness, Noises in the Head*, 3rd edition.

which are immediately made manifest through the semicircular canals in the disturbance of equilibration in the fluid of the labyrinth. We have no difficulty, from our physiological knowledge of the allied functions of the semicircular canals and cerebellum, in understanding how such nerve communications produce vertiginous sensations; and if we agree with McBride,[1] that there is a cerebellar vertiginous centre, the numerous reflex causes of, and the varied phenomena which attend upon vertigo, find a still more ready explanation.

The vertiginous troubles which all otologists are familiar with in patients suffering from tumour of the brain are little different from those met with when the tympanum is filled with a morbid growth. Thus Macnaughton Jones once had two patients (as far back as 1879) attending hospital at the same time, the one with a large mass of granulations in the tympanic cavity, the other with evidence of a central cerebral irritation (probably syphilitic gummata) in the neighbourhood presumably of the fourth ventricle. Both had periodical attacks of severe vertigo, when they would fall to the ground if not supported, and swoon off. The most noticeable difference in the symptoms was, that in the case of the man with the intra-tympanic growth, during the intervals between the attacks the vertigo did not entirely leave, as there was uncertain and staggering gait, with a tendency to reel. The patient with the cerebral affection had optic neuritis of the right eye, which was blind; the neuritis finally became double. He came into hospital for some time. There was tinnitus in both ears, but not loss of hearing. He always reeled towards the right side in the vertiginous attacks, turning rapidly towards this side before falling. There was violent occipital pain. Injections of pilocarpine and a seton in the neck relieved the occipital pain.[2]

[1] *Medical Times and Gazette*, vol. i., 1881.

[2] Quite recently, a patient was sent by Dr. Bredin, of Norton-Folgate, to Dr. Macnaughton Jones, for severe vertigo, who had been operated on by Mr. Hinton twenty years before for a "growth" in the meatus. The lumen was occluded by an osseous growth,

Ménière's Disease.—Much confusion has resulted from the adoption of this name for a group of symptoms which it is certain includes widely dissimilar pathological conditions. It is a mode of classifying or identifying a disease or group of symptoms which has always the most disastrous results in point of accuracy of association of pathological causes, and the symptoms, especially when we name the disease after an authority whose sources of observation of the pathological conditions connected with it were limited, as in the instance of Ménière's affection.

This "authority" method of nomenclature we believe to be a disastrous one for students, as indeed it is for us all. Acquaintance with the name of the investigator is too frequently made to stand either for a knowledge of the disease, or it justifies a very muddled conception of it. We must take much that has been said with regard to the occurrence of tinnitis and aural vertigo into consideration when we are making a diagnosis as to the presence of Ménière's affection, nor can we well separately study these affections apart.

Guye of Amsterdam, grouping all those cases in which a sensation of vertigo is caused by abnormal irritation of the nervous terminal apparatus of the semi-circular canals under the head of Ménière's disease, notices that the first sensation is one of rotation around a vertical axis and *toward* the *affected side*, followed, before the vertigo is complete, by a sensation of rotation about a transverse axis, forward and backward, the vertigo then becoming complete, and the patient swoons, with or without loss of consciousness and vomiting. Guye also calls attention to the tremulous character of the handwriting in the early stages of Ménière's disease.

Pathology.—In many cases of Ménière's disease the middle-ear appearances and the pathological changes in

behind a fungus-like mass of granulations. Both were removed under ether with a Volkman's spoon. Concealed behind, and filling the tympanum, were fœtid felted masses of old *débris*. These were all cleared out, and the patient made an excellent recovery.

the middle ear are those we are familiar with in various forms of aural vertigo. In those cases in which we have negative evidence of any brain lesion the pathological causes of the vertigo and deafness are likely to be present in the form of secondary degenerations of blood or lymph effusion, with consequent connective-tissue formations in the cochlea and semicircular canals. Such conditions, even in a minor degree, with the accompanying nerve degeneration, are little, if at all, amenable to therapeutical remedies. They teach us that in every treatment, while effusions are still recent, we have the greatest reason to hope for results from local and constitutional remedies.

Lorenz Eckert, reviewing all that has been written on Ménière's disease, and the particulars of all recorded cases, arrives at these conclusions :—(1) The semicircular canals, with their ampullæ, are the organs of the sense of co-ordinate motion, directly for the head, indirectly for the entire body. (2) The localization of sound is determined by binaural power of hearing. The semicircular canals take no part in this, but possibly exert acoustic functions in other respects. (3) The appearance of the various symptoms of Ménière's disease is in most cases attributable to a diseased state of the terminal apparatus of the acoustic nerve in the labyrinth. It is only in rare instances that these are called forth by pathological changes in the adjoining nerve-centres. (4) Pathological changes of conditions in the middle ear and in surrounding structures, producing a change in the intra-labyrinthine pressure, may call forth a similar train of symptoms. (5) The symptoms are induced by an irritation of the labyrinthine organs or their nervous centres. Complete destruction of the same seldom calls forth a loss of function. (6) Disturbances of co-ordinate motion may be absent in pronounced chronic or acute affections of the labyrinth. (7) Constitutional diseases, such as syphilis, leukæmia, epidemic parotitis, and tabes, are recognized factors predisposing to the development of Ménière's disease.[1]

[1] *Archives of Otology*, June to September, 1885.

Causation.—Amongst the more frequent of the assigned causes of Ménière's affection we find injuries, catarrhal conditions of the middle ear following cold or sea-bathing, nasal obstructions, syphilitic exudations in the middle ear and labyrinth. Guye states that the symptoms may follow fissures of the skull during cicatrization (see the preceding chapter on the Causes of Tinnitus and the remarks on the Causation of Aural Vertigo).

It would appear far better, following Politzer, to limit the term Ménière's affection to those sudden apoplectiform attacks of deafness in which the typical train of symptoms of aural vertigo are present.

In all the cases we have seen, during the chronic stages blindfolding the eyes at once accentuated the giddiness. Though the phenomena which mark the onset of the affection may be the first indication to the physician of the occurrence of the lesion in the labyrinth, obscure auditory symptoms may for some time precede this, such as sensation of fulness, pulsating tinnitus, and slight deafness.

Certain disturbances in the equilibration of the labyrinthic fluid, or reflex irritations of any part of the nervous apparatus of the labyrinth, or irritation of the auditory nerve nuclei, may cause the symptom of vertigo to accompany that of tinnitus. Stimulation of the cerebellum or cortical auditory centres may have the same effect; such stimulations may be reflected; deafness is not necessarily an accompaniment of the vertigo under these conditions, nor is it absolutely necessary that there must be local aural changes discernible in those suffering from the symptoms portrayed by Ménière. The augmentation, however, of tinnitus, or its aggravated occurrence at the moment of the vertiginous attack, has been looked on as pathognomic by Charcot. The latter authority speaks of a vertiginous state in which the paroxysms are more or less constant, occurring by night, alike in the dorsal decubitus as in the vertical position. A patient is at present under treatment who is subject to very severe attacks at long intervals, some

of these occasionally occurring in bed. He has an old and large perforation of the membrane in the left ear, and catarrhal changes in the right, the hearing of which is still fair; he does not suffer from tinnitus constantly, and associates the first attack of aural vertigo with his recovery from an operation for internal hæmorrhoids. Severe sickness attends on the paroxysms. In simple aural vertigo "the giddiness, the noises, and deafness go hand in hand, and disappear at the same time, when the original cause of the trouble is removed; but in Ménière's affection the deafness increases when the vertigo becomes more rare." This accords with our experience, and is the opinion of Leroux.[1]

Ladreit de Lacharrière[2] would limit true Ménière's trouble to those cases in which there is labyrinthine hæmorrhage, and Leo says it is the severity of the deafness which differentiates the vertigo of Ménière from simple aural vertigo.

We have not here referred to those *objective* noises occasionally present, and which are heard by others as well as the sufferer. We have dealt solely with subjective noises. Such objective sounds are usually associated with chronic middle-ear changes. But even without the presence of these changes, as is well known (in the instance of Johannes Müller and the cases quoted by Mayer, Schwartze, Politzer, and others), such objective sounds can be voluntarily produced by some individuals by contraction of the tensor-tympani muscle. Politzer and Luschka both attribute the voluntary production of such a snapping noise to separation of the walls of the Eustachian tube through spasm of the palatal muscles. All audible noises we have at any time heard, apparently in the ears of patients, were associated with movements of the palatal muscles. Such an audible cracking or snapping noise can be produced by certain gymnastic movements of the tongue against the hard palate during the first part of the first act of deglutition. Burnett, who writes the most complete and interesting summary of these objective noises,

[1] *Dict. Encyclo. des Sci. Med.* [2] *Dict. Enclo.*, art. "Oreille."

relates the particulars of a case in which he proved that they occurred in consequence of spasmodic movements in the velum palati at one side, and in another the "clicking" was associated with phonation, the only clinical feature of importance being hypertrophic turbinated bones. Such muscular spasms Burnett considers are produced by catarrhal irritations of the palatal or pharyngeal muscles, which in the effort to get rid of the irritant, are thrown into a state of chronic spasm, the sounds being caused by the vibrations in the muscular structure and are conveyed through the Eustachian tube to the middle and external ear.[1]

We cannot omit a reference to the valuable work done by Weber-Liel, Hartmann, and others bearing on the part played by the tensor tympani muscle in the production of tinnitus, and the results which they have recorded, familiar to all, which follow section of the tendon of that muscle. The absence of tinnitus in the majority of cases of perforation of the drum of the ear, often even with absence of the ossicles, is a fact which bears on the justification of the operation now performed for removal of the auditory ossicula in cases of tinnitus, and certainly may be advanced as an argument in favour of this step (Sexton, New York).

[1] Burnett, *Diseases of the Ear.* Churchill, London, 1890.

CHAPTER XVIII.

DIFFERENTIAL DIAGNOSIS OF TINNITUS.

THE following classification may be taken as a basis for a classification of the different causes and varieties of tinnitus aurium :—

Class I. *Impulses originating in the temporal lobe, or superior temporal gyrus, the cerebellum, or the auditory nuclei (in the medulla or pons), and referred as impressions to various situations, as the labyrinth or certain parts of the head.*—Such acoustic impressions may or may not be attended by deafness. These impulses may be associated with lesions in these areas—as tumours, apoplexies, effusions, thrombi, or possibly lesions in the adjacent portions of the occipital or parietal lobes. Such impulses may result also from reflected irritations of any of these parts.

Class 2. *Impulses due to irritation, direct or reflected, in any portion of the auditory nerve.*—This latter would include hyperæsthesia, atrophy, sclerosis, traumatism, vaso-motor (dilator or constrictor) effects, morbid blood supply to the nerve, as in uræmia, anæmia, or the circulatory changes which occur during pregnancy. These latter causes may also operate under Class 1.

Class 3. *Impulses originating in the peripheral ends of the auditory nerve,* due to (*a*) Increase or diminution of labyrinthine pressure ; increase or diminution of, or encroachment upon, the perilymph or endolymph, from abnormal pressure on either of the fenestræ ; this latter cause would include rigidity of the membrane of the round opening, and fixation of the stapes against the

oval opening. (*b*) Vascular changes—increase or diminution of blood pressure, frequently associated with cardiac disease—hyperæmic, anæmic, or toxæmic states of the blood circulating in the labyrinth ; apoplexy, and extravasations. (*c*) Morbid nerve conditions—hyperæsthesia, paresis (organic or functional), atrophy, sclerosis, traumatisms. (*d*) Rheumatic, gouty, or syphilitic states of the walls and vessels of the labyrinth. (*e*) Reflected disturbances through the spinal cord or cerebro-spinal nerves, as occurs in uterine disorders, pregnancy, gastric derangements, disorders of the liver, flatulence, spinal neuroses, dental, nasal, and ocular irritations involving the fifth and facial nerves.

Class 4. *Irritations arising from interferences with the intra-tympanic muscles—tensor tympani and stapedius.*—Such interferences would include any spasms of these muscles—abnormal changes in the membrana tympani or the mucous membrane of tympanum—reflex irritation transmitted from the facial or trigeminal nerves.

Class 5. *Irritations transmitted by altered conditions of equilibration of the air in the tympanic cavity.*—This would include enervation of the tubal muscles of the Eustachian tube, and altered relations between the air in the tympanic cavity and the blood in its vessels or those of its membrane ; also pathological states of the membrane.

Class 6. *Irritations due to disease in the middle ear and labyrinth.*—This would embrace atheromatous changes in the arteries, aneurysmal dilatations, blood extravasations, venous congestion within the lateral sinuses, disease of the mastoid cells, and disease of the petrous portion of the temporal bone, exudations and tumours.

Class 7. *Irritations arising in the external ear*—including inflammation and abscess, ceruminous collections, eczematous inflammation, exostosis and hyperostosis, othæmatoma, foreign bodies.—Some of these causes act by direct irritation of the nerves supplying the external auditory meatus or tympanic membrane,

as in inflammatory attacks and exostosis; others, as cerumen or foreign bodies, by the influence they exert on the sound-waves, or by the pressure due to their presence on the membrana tympani, and thus conveyed to the ossicles and labyrinth.

Class 8. *True aural hallucinations*—subjective impressions arising in the psycho-sensorial brain centres, and having no objective cerebral or aural source of origin.—Such hallucinations may become insane hallucinations. The latter may be divided into two distinct forms:—(*a*) Hallucinations which arise subjectively in the brain when the aural apparatus and auditory nerves are healthy. (*b*) Hallucinations which are secondary to objective changes in the aural apparatus, and in which a tinnitus is developed that leads up gradually to a fixed illusion. It is essential always to keep such hallucinations or aural illusions apart, as phenomena quite distinct from tinnitus. They are analogous to ocular illusions or spectra. We refer to "heavenly voices" or "music"—a symptom associated with epilepsy and hysteria. The same observation applies to "alcoholic psychoses." The entire auditory apparatus is healthy, and the hallucination is quite independent of any acoustic trouble. That able psychologist, Dr. Ringrose Atkins, Resident Medical Superintendent of the Waterford Lunatic Asylum, says, in regard to the relation of tinnitus to insanity, "Instances do occur where what was originally a tinnitus, depending on some morbid state of the aural apparatus, may eventuate in a condition of hallucination. That is, the individual so affected may, from a lowered state of the nervous system, or as the result of long-continued irritation, come to consider the subjective noises as real, and depending on external causes, and they may act thereon." This would constitute an insane hallucination, though it might not depend on any morbid condition in the psycho-sensorial brain areas. This, we believe, is exactly what occurred in the case included in the tables. After marriage the lady fell into ill health; she became despondent about her ear, and the noises

which were present; gradually she developed delusions with regard to the ear, screaming violently and being with difficulty controlled; this state gradually merging into one of ordinary dementia, but in which the prominent idea was that the ear was the source of all her trouble. "I have known," says Dr. Ringrose Atkins, "a woman in no way insane who, as the result of tinnitus, firmly believed that an insect had entered into her ear and penetrated her brain, and that it was constantly biting the latter, as she heard it within. The morbid belief raised the purely somatic subjective sensations to the level of an 'insane hallucination.'" He also cites a case of "a man who was in a condition of deep depression from tinnitus, which took the form of 'crackling' all over his head, and which was well-nigh unbearable.' Here another suffered from athetosis. In another, in whom the ear and brain were normal, there was complete blocking up of both nostrils, through turbinal enlargement.

Class 9. *Therapeutical causes of tinnitus aurium.*—The action of such drugs as ergot, nitro-glycerine, alcohol, ether, quinine, salicine, caffeine, apomorphine, nitrite of amyl, tobacco, iodine, iodoform, chloride of barium, digitalis, convallaria, atropine, veratrin, duboisin, gelsimin, jaborandi, pilocarpine, monobromide of camphor, hydrobromic acid. Some of these drugs may act by direct stimulation of the auditory nuclei in the medulla, as caffeine, gelsimin, iodoform, salicine, and quinine; others, as digitalis, jaborandi, nitrite of amyl, chloral hydrate, by their action on the vaso-motor centre. Others, as quinine, digitalis, and convallaria, by their secondary effects on the auditory circulation through their action on the heart. Quinine, we believe, occasionally causes such vascular conditions in the labyrinth as to bring about symptoms of Ménière's affection. Elsewhere we have given examples of this. The tinnitus of fever is almost invariably transitory. That is our experience.[1]

[1] Dr. Buzzard, in an interesting paper, which he read before the Harveian Society (*Lancet*, January 25, 1890), draws attention

Light thrown on the Case by Preliminary Examination.—A careful preliminary examination of the patient will show the bearing which the occupation and habits or general health of the patient have on the occurrence or the persistence of the tinnitus. It will indicate the probable source of the tinnitus in a local (aural) abnormal condition, or in some constitutional or systemic affection. The examination of the ear should decide the character of any local condition which is most likely to cause the tinnitus, whether in the external, middle, or internal ear, or possibly in two or all of these portions of the organ of hearing. The occurrence of vertigo and its relation to the hearing of the patient, when taken into consideration with other features of the case, and the response given to the tuning-fork (applied in the proper manner) will help, if we can exclude both external and middle ear affections, to locate the source of the tinnitus in the labyrinth or in the course of the auditory nerve. The fact that there is normal hearing, though tinnitus be present, points to some extra-aural source of the symptom, not infrequently to be found either in an increase or diminution of vascular tension or abnormal state of the turbinate bodies.

The associated symptoms—tinnitus, deafness, vertigo and nausea—may pretty surely, though not certainly, be taken as evidence of Ménière's affection. It must be remembered that this same group of symptoms may

to the occurrence of vertigo without deafness or tinnitus as a consequence of central irritation. In the cases in which there is no deafness or noise in the ears (such as those instanced by him), he attributes the faintness and giddiness to irritation of the nucleus of the vagus, the auditory nucleus, and the vaso-motor centre in the bulb. He instances those cases of paroxysmal deafness with tinnitus in which there is vertigo, as cases not of organic affection of the auditory nerve, but of functional central disturbances. Such disturbance may depend upon the presence in the blood of some such irritating ingredient as uric acid or urate of soda. There can be no doubt that we do meet with such cases, and not unfrequently, in which we have no evidence of any organic lesion in the auditory nerve, yet in which the characteristic features of Ménière's affection are present. Dr. Buzzard quotes some interesting cases confirmatory of this view.

be due to an intra-tympanic growth, or may be attendant on a cerebral apoplexy or tumour, though in the latter case we should most likely have confirmatory evidence in correlative affections of the parts supplied by other cranial nerves, or some peripheral nervous lesion which would assist us in localizing the central one. A tinnitus in a case in which the hearing is not affected will at once indicate the necessity for a cardiac examination. It may, for instance, be associated with general anæmia, and the attendant hæmic murmurs will help to explain the cause of the tinnitus as being located in the vessels of the labyrinth. An inefficient systole and the frequent attendant irregularities of rhythm are not uncommonly found in these cases of overworked and worried men and women. Here a "pulsating" tinnitus is occasionally complained of, always worse on first lying down at night or on awaking in the morning, and frequently disappearing during the daytime. Such a tinnitus may be materially modified or altered by pressure made under the ear, behind the condyle of the jaw, or over the vertebral artery in the sub-occipital space. Again, both aortic and mitral insufficiency are attended at times by tinnitus. Also, a tinnitus with unimpaired hearing is often present (generally the sound being of a low hissing or rustling character) in slight catarrhal conditions of the naso-pharynx in which the respiration through the nose is obstructed, especially at night, when the patient has a tendency to sleep with the mouth open. The same may be said of cases in which we find slight congestion and hypertrophic enlargement of the turbinate bodies.

The exploration of the nose is absolutely necessary in every case of tinnitus, save those in which the cause is obvious, as in the case of a foreign body in the meatus. And even in gross middle-ear changes we may find the key to their causation in abnormalities of the nasal septum or the turbinate bodies. In a similar manner our diagnosis will be assisted or verified by a careful examination of the naso-pharyngeal and palato-pharyngeal regions. The presence of adenoid growths,

thickening of the pharyngeal tonsil, generally relaxed states of the mucous membrane, hypertrophied tonsils, follicular engorgements and hypertrophies, paretic conditions of the palate muscles—all will help to throw light on the cause of the tinnitus.

Heart and Vascular System.—In all cases of migraine, syncope, or any vertiginous affection accompanied by tinnitus, the heart, the great vessels, and the conditions of the radial pulse should be examined.

The Nervous System.—Roughly speaking, this first survey will include examination of the knee and ankle reflexes; the condition of the retina; oculo-motor symptoms; signs of paresis or motor disorders, hyperæsthesia or anæsthesia; affections of the nerves of special sense; contractions, contractures or spasms, atrophic muscular changes; localized neuralgia; hallucinations; reflex neuroses; vaso-motor disturbances; pain (its seat and character).

Having thus carefully examined the organs of hearing, and having searched for any extra-aural causes of tinnitus, we are in a position to approximately determine the class or classes under which we include the particular case before us. It is difficult in many cases to do this accurately and with confidence, but in a very large number of patients we can come sufficiently near the reference of the individual case before us to a special class, or it may be the border-land of two distinct classes of tinnitus, to enable us to give a correct prognosis of the chances for or against recovery, and to indicate the correct line of treatment to be pursued. To return to the etiological classification we have tentatively laid down, we may recapitulate the grounds on which, by such an examination, we include this or that case under any of these heads.

Class 1. Most of those who would come under Class 1 are likely to have some evidence of the implication of the other nerves of sense in reflex disturbances, in muscular paresis, cutaneous anæsthesia or hyperæsthesia, or in oculo-motor symptoms and pupillary changes. Such causes as apoplexies, effusions, thrombi,

or cerebral lesions, acting by inhibition, are most likely to reveal themselves in objective signs in the parts in correspondence or associated with these cerebral centres. It is probable that in such reflected excitations we have an explanation of a tinnitus without deafness, as in cases of dental caries, dental periostitis with neuralgia, spinal tabes, uterine disorders, as versions and flexions, and in the functional sexual disorders of the menopause or pregnancy (though in the latter it is more often to be attributed to arterial tension and hæmic changes).

Class 2. We may expect to find similar symptoms to those referred to in Class 1, with more direct evidence of a lesion or excitation in the auditory nerve itself. In hyperæsthesia, the hyper-sensitiveness and pain attendant upon certain sounds, as pointed out in the peculiar case we have already referred to, though there may be normal acuteness of hearing; in traumatism, the history of some injury, as a blow on the ear, a railway collision, a nasal fracture; in sclerosis and atrophy, the absolute deafness and the negative response to the watch or tuning-fork, even by conduction, added to the history of pre-existing aural symptoms and progressive deafness or possibly vertigo; in irritation of the vaso-motor centre, vaso-motor disturbances of the labyrinth due to reflected excitations arising in the spinal cord or in the nuclei or branches of the fifth nerve, with all their evidences; in spinal neurosis, spinal and ganglionic irritation, oculo-motor symptoms, visual disturbances, gastric crises, headache, possibly thyroid changes, flushings of the face, eruption of the wisdom teeth, dental neuralgia and associated dental affections, ocular and laryngeal migraine.

Urine of low specific gravity, with a radial pulse of high tension, albuminous urine or that charged with excess of uric acid, the characteristic uræmic complications with the associated altered blood of pregnancy, require only to be remembered as coming under this class to secure their detection on examination.

In Class 3 we confront more clearly local causes of

the tinnitus. Such peripheral auditory nerve excitations are usually associated with some abnormal states of the middle ear or the membrana tympani. These, in a case of diminution of labyrinthine pressure from changes in the perilymph or endolymph with accompanying rigidity of the round membrane or fixation of the stapes, have most frequently as their consequences, tinnitus, deafness with vertigo, and often nausea. The ossicula frequently are involved, the joints are anchylosed, the membrane is fixed, its pockets are altered in shape; the malleus is sharply defined, or if the case be an old one its head alone is visible, the normal division of the membrane into pockets is absent, the pyramid of light is either blurred or imperceptible, and the membrane may have lost its translucent look. But at other times this is not so, and with clear evidence from the tuning-fork and acoumeter that the auditory nerve is affected, the membrane preserves its translucency, and there is but little deviation from the natural appearances. Then there are the cases in which a fair degree of hearing is preserved, and still we have tinnitus and possibly vertigo superadded. There may or may not be local evidences of gross middle-ear changes. Here we at once suspect vascular tension, increase or diminution of blood pressure, and we search for evidence of organic cardiac changes or altered states of the circulatory fluid in anæmic or hyperæmic conditions. The urine requires to be carefully tested, and such toxic states as are likely to influence vascular tension may be detected. Such toxic or hæmic sources of tinnitus are frequently the forerunners of deafness and the occurrence of Ménière's symptoms following on extravasations and apoplexies. Aural vertigo rarely occurs without the associated "noise in the ears." The first attack may occur suddenly and without previous warning, but generally there has been some pre-existing tinnitus with impairment of hearing.

Class 3. Peripheral lesions in the labyrinth are often attended with loud noises, and not unfrequently the patient will describe two or three different kinds of

noise, one of which is a musical tone or note. But we look in vain in these cases, as distinguished from those in Classes 1 and 2, for any evidence of serious cerebral complications or such causes as uræmia, anæmia, or pregnancy. Gout and rheumatism occasionally may cause tinnitus, but this symptom is associated with evidence of gouty changes in the meatus or on the membrane, and the uric-acid diathesis is manifested by the evidences of gout elsewhere in the body, and the presence of free uric acid in the urine. A pasty meatus, shedding of epithelium, and possibly a slight discharge are often seen in such gouty cases. Also we may find on inspection that some cretaceous deposits have occurred, which are seen as irregular white coatings on the membrane. Such cretaceous masses we have occasionally observed in gouty patients. We must say that in our experience we have rarely found tinnitus and deafness (arising from changes in the middle ear) as a result of syphilis. This is not so true in the case of the labyrinth. If they are caused by specific disease there are other signs of syphilis present, most probably in the skin or palate, and pharynx, or the nose, and there is the history of a past syphilitic attack. Mere reflected disturbances of the labyrinth which arise in uterine disorders, during pregnancy, in various forms of dyspepsia, hepatic congestion, flatulent distension of the bowel, or in various visceral neuroses, obviously form but one of the groups of symptoms which are met with in such conditions. More particularly has it to be remembered that tinnitus has its possible origin in dental irritation, in astigmatism and associated asthenopia, in nasal turbinate abnormalities, since such starting-points of excitation are specially apt to be overlooked. This remark applies more particularly to the nose. In every case of tinnitus the septum and turbinate bones have to be carefully explored. In many instances it will furnish an explanation of the aural condition.

Class 4. Here we realize a source of tinnitus which has its direct origin rather in a muscle than in a nerve.

Obviously, any abnormal action of the tensor tympane or stapedius, causing increase or diminution of pressure; and alteration in the equilibration of the labyrinthine fluid may start a tinnitus. Remembering this, we must not omit to seek for the starting-point of the mischief in some direct or reflected irritation in the facial or fifth nerve. It is not necessary in such cases that we should find any indication of an affection of the middle ear or the labyrinth. Thus the hearing may be but slightly affected, or, on the other hand, the influence on the muscles may be caused by gradual changes in the mucous membrane of the tympanic cavity and the ossicular ligaments, with accompanying changes in the mobility, position, shape, and consistency of the membrane. If these latter are present they will be visible with the speculum.

Under Class 5 we find the commonest causes of tinnitus, both with and without deafness. Both in this and in the last group we may have, in the tympanic membrane in its displacement and obliteration of its segments, rigidity and immobility, or in varying degrees of collapse, the consequences of chronic catarrhal attacks, evidence of gross changes in the middle ear, which are associated with anchylosis of the ossicles and fixation of the stapes. The patient will often complain of inability to join in general conversation in society, may hear better in a railway train or omnibus (paracusis Willisii), and cannot synchronously distinguish two distinct tones, as, for instance, the ticking of two clocks in the same room. On watching the membrane when Valsalva's method is practised, it may not in the least, or but very slightly, yield on inflation. The cone of light is but little altered, or we may detect but the slightest movement of either pocket with Siegle's speculum. On the other hand, the membrane may appear thinner than normal, the malleus may be altogether displaced, so as to give the appearance of one large pocket which is blown bladder-like out on inflation. But it by no means follows that such pathological signs must be present, even though there be considerable impediment in the

Eustachian tube from imprisoned secretion, collapsed walls, stenosis, or obstruction from other cause. Slight deviation from the normal position and translucency of the membrane may be detected, but it is only on listening with the otoscope to the inflation of the tympanum, and by careful observation of the membrane through Siegle's speculum, that we are enabled to discover obstruction or collapse of the Eustachian tube. Examination of the nose and throat may give the clue to the interference with the tympanic ventilation. In the nose, spurs or deviation of the septum, enlarged turbinates, hypertrophic mucous membrane, polypus, rhinolith (both the latter rarely); in the throat relaxed and feeble palatal muscles, congestion of the palato-pharyngeal mucous membrane, generally with elongated uvula, tonsillar hypertrophy, adenoid growths, are among the more frequently occurring and accompanying conditions which explain the Eustachian interferences, and account for the altered relations of the air in the tympanum to the blood in its vessels, as well as the pathological conditions of the vessels themselves.

In Class 6 we have included those more serious middle-ear complications which follow upon disease of the arterial tissues—local apoplexies, extravasations of blood, lymph exudations, congestion of the venous sinuses, arising from pressure or from cardiac diseases.

To it also we refer those noises arising from obstructed pulmonic circulation and deficient oxygenation. There are those more serious inflammations of the mastoid and petrous portions of the temporal bone, which lead to both exudations and suppuration. The recognition of such states is not generally difficult. A careful examination of the tympanum with the speculum, showing possibly intra-tympanic growths, granulations, or polypi, and the presence of a fetid discharge will at once arouse suspicion of a deeper-seated cause for the pain, giddiness, or tinnitus, than that recognizable with the speculum.

Pain, tenderness and fulness over the mastoid, with projection of the auricle, will generally be present when

there is threatening of mastoid abscess; pain more violent and diffused over the head, possibly pupillary changes, optic neuritis, tendency to delirium and secondary lung complications, if the disease has extended deeper and has involved the petrous portion of the temporal bone, or has possibly implicated the lateral sinus.

The causes of tinnitus, included in Class 7, are easily discovered, and hence the greater need for their being the first sought for and not overlooked. It may not be amiss to say a few words on each of these outer-ear sources of tinnitus. Inflammation and abscess are easily recognized by the local symptoms of pain, severe heat, throbbing, swelling, and occlusion of the meatus, tinnitus, and deafness. Such inflammation and abscess may lead to inflammation of the membrana tympani and perforation of it. These acute perforations are frequently attended by severe pain and loud tinnitus. They may be seen, if viewed through the speculum, to pulsate. Recurrent furunculi occur frequently in the meatus, associated with otomycosis. Such inflammatory conditions frequently have a miasmatic origin.

It has to be urgently insisted on that all such abscesses and furuncles demand as careful attention in their departure as during their more acute and active stages. Dead *débris* of purulent collections, epithelium, or cerumen, are apt to be left behind and cause chronic irritation in the ear-passage, and may possibly lead to the occurrence of aspergillus or perforation of the membrane. This caution is the more necessary if the attack is attended by middle-ear inflammation and perforation of the drum-head. A persistent tinnitus may be the consequence, which a little local attention will remove. Take such a case as the following:—A lady, aged sixty, came suffering from these symptoms. A most distressing tinnitus, "like a steam engine," was heard almost entirely in the left ear, through which, she complained, "shooting pains occasionally darted." There had been deafness of the right ear since childhood. She suffered occasionally from attacks of giddiness. The acoumeter

was heard at less than two inches, and the watch, not on contact. The meatus contained a plug of cerumen, the removal of which caused but a little difference in the hearing. On exposure of the membrane, an old perforation was seen in Shrapnell's membrane, and there were evidences (with Siegle's speculum) of long-standing contractions and adhesions. In the left ear the hearing was better than in the right, the watch being heard well on contact. In the meatus was a plug of cerumen and dead cuticle which was very difficult to remove. This was pressed down on the drum-head, the walls of the passage being in an inflamed and irritable condition. When the meatus was cleared and the tympanum inflated, she heard the watch at four inches well, and the acoumeter at fifteen feet. Her tinnitus was gone. The case shows that it is possible to overlook such simple causes of deafness, giddiness, and tinnitus.

Eczema of the meatus, especially of the gouty type, which is started by irritation of its walls, may be the sole cause of the tinnitus, and is frequently incurred by the entanglement of the desquamated particles of cuticle in cerumen and discharge which clog the lumen of the meatus and impinge on the membrane. Both exostosis and hyperostosis may set up a tinnitus by the irritation they cause. But it is rare to find these as a sole cause of tinnitus, and they are frequently present without it.

More often we can trace the occurrence of the noise to associated middle-ear catarrhal conditions, a gouty diathesis or some Eustachian obstruction. In gouty patients there is at times a distinct neurotic exaggeration of symptoms which includes a dwelling on, and morbid apprehension of any tinnitus that may be present. Over-indulgence in alcoholic drink, and, possibly, excess of tobacco-smoking, contribute to increase the loudness and intensification of such noises. It must suffice to refer to othæmatoma as a cause of tinnitus. The nature of this affection we have fully discussed and illustrated elsewhere.

Of the therapeutical sources of tinnitus, the only one we propose to delay over is quinine. That a temporary

tinnitus, deafness, and giddiness follows on the prolonged use of large doses of quinine is well known. At times this amounts to that condition known as quinine intoxication. In one instance an officer, appearing on parade shortly after some large doses of quinine, so nearly approached the condition of a drunken man that he was placed under arrest on a charge of inebriety. Burnet insists, and with this view we quite agree, that in most of the cases in which any permanent effects have been noticed as following the use of quinine there have been other causes present quite sufficient to account for the tinnitus or deafness independent of the quinine. Still the fact that quinine can produce aural disturbances of function, and that many of those who have taken quinine in large quantities complain of tinnitus and deafness, added to the possibility of its producing a congestive state of the vessels of the labyrinth, independently of its irritating effect on the hearing centre, is sufficient to point to quinine as a probable and predisposing cause of tinnitus.

CHAPTER XIX.

TINNITUS AURIUM—PROGNOSIS.

It has to be confessed that, in the present state of our knowledge, it is difficult, in defining the grounds on which we arrive at a prognosis in cases of tinnitus aurium, to follow the lines of the classification that have been suggested. Yet that attempt at a differentiation of the causes of tinnitus may be of use in confining the proposed therapeutical steps to certain clinical and pathological conditions which may justify us in hoping for relief, if not cure, following on their application.

(1) We may, in the first place, fairly exclude from the category of curable cases those noises which attend on cerebral tumours, lesions, apoplexies, and degenerations which are secondary to the occurrence of thrombi. It is, however, conceivable that certain cerebral effusions may yield to time and such special remedies as, for instance, iodide of potassium and mercury.

(2) Atrophy, sclerosis, and traumatic lesions of the auditory nerves.

(3) Rigidity of the membrane of the round opening, and fixation of the stapes against the oval opening.

(4) Extravasations in the labyrinth.

(5) Organized effusions in the labyrinth.

(6) Traumatism of the labyrinth.

(7) Rheumatic, gouty, and syphilitic degeneration of the walls and vessels of the labyrinth.

(8) Organic changes in the periphery of the auditory nerve.

(9) Certain chronic and irremediable conditions of the intra-tympanic muscles, leading to atrophy, rigidity, or spastic contractions.

(10) Many cases of chronic catarrhal inflammation, with corresponding and evident changes in the tympanum, in which a considerable degree of deafness attends on the tinnitus, and in which there is a history of progressive deafness extending over a considerable time, with possibly hereditary deafness in the patient's family; permanent closure, or occlusion of the Eustachian tube, may be included under this head.

(11) Many cases of chronic Ménière's affection (true labyrinthine vertigo) in which, after the more acute symptoms have subsided, there still persists deafness, occasional attacks of migraine, and tinnitus.

(12) Tinnitus consequent upon aneurismal conditions of the auditory arteries or atheromatous changes in their tissues.

(13) Exudations and tumours of the mastoid cells, say of a syphilitic and gummatous nature, or disease of the petrous portion of the temporal bone consequent upon chronic suppurative catarrh of the tympanum.

(14) Distinct aural hallucinations attendant upon or following gross changes in the middle ear and labyrinth.

Turning now to those cases in which we may hope for amelioration, if not complete cure of the tinnitus, we may thus classify them:—

(1) Tinnitus arising out of any reflected local or systemic irritations of the auditory centre or auditory nerve, which are due to deficient morbid blood supply or vaso-motor disturbances in the auditory areas.

(2) Tinnitus arising out of simple primary hyper-

æmia of the labyrinth or a hyperæmia which is secondary to certain fevers as intermittent fever, puerperal sepsis, so-called "cerebral" fever, and the continued fevers.

(3) Tinnitus consequent upon temporary alterations of the labyrinthine equilibration, whether due to altered conditions of tension of the fenestræ or increase or diminution of blood pressure, and frequently associated with cardiac functional disorders; simple hyperæsthesia acoustica.

(4) Tinnitus which has its origin in rheumatic, gouty, and syphilitic conditions, whether in the labyrinth or middle ear; in the uræmia of pregnancy or Bright's disease.

(5) Tinnitus due to abnormal states of the intra-tympanic muscles, as enervation, spasms, altered muscular tension (from defective middle-ear ventilation and equilibration), producing conditions and positions of the membrana tympani and accompanying deviations in the normal relations of the ossicles, which have their consequent effects on the labyrinth through the fenestræ.

(6) Tinnitus arising out of enervation of the tubal muscles of the Eustachian tube, collapse and closure of the walls of the tubes, temporary obstruction of the tubes from catarrhal conditions of the mucous membrane, or accumulation of mucus in the tube.

(7) Tinnitus arising from irritations in the external ear.

(8) Tinnitus arising from therapeutical causes.

(9) Aural hallucinations which occur independently of any acoustic or cerebral trouble, and which may be associated with visceral or pelvic neuroses. Such hallucinations, if they become insane hallucinations, disappear with the mental alienation.

CHAPTER XX.

TINNITUS AURIUM—TREATMENT.

Having thus attempted briefly to indicate the grounds, clinical and pathological, on which we may hope to come to a decision as to the prospects of relief of the noises complained of in any individual case, we may summarize the therapeutical means at our disposal for treating such subjective sounds. We may, for practical purposes, consider the therapeutics of tinnitus under two principal heads :—

(1) Therapeutical measures directed to correct any local defects in the organ of hearing itself.

(2) Therapeutical measures adopted for the relief of such systematic derangements as may cause tinnitus.

Under the first head we include—

(*a*) Attention to the entire naso-pharyngeal tract, including the state of the nares, the naso-pharynx, the soft palate and palatal muscles, the pharynx including the tonsils.

(*b*) Attention to the external, middle, and internal ear.

Under the second head we embrace :—

(*a*) A consideration of the temperament and diathesis of the patient, the other evidences of hereditary disease, occupations, habits, vices, influences of climate and residence.

(*b*) Attention to those evidences of visceral disorders which are shown in maldigestion, bilious states, flatulent distension ; symptoms of functional and organic cardiac affection.

(*c*) Inquiry into the general health of the nervous system may elicit proof of organic or reflex

nerve irritations and neuroses. The health of the cranial nerves particularly should be tested. Headaches, insomnia, ocular migraine and vertigo, aberrations in smell or taste, require investigation. Early signs of mental alienation and any hallucination must not be overlooked.

The Naso-Pharynx.

It cannot be disputed, as we have already remarked, that every form of nasal obstruction is repeatedly found, and tinnitus has not followed as a consequence. The same observation applies to deafness.

Nasal vertigo is frequently found without aural symptoms being present. This is due to reflected irritation, and not to obstruction. If tinnitus and vertigo, or tinnitus alone, be present, we may be pretty certain that there is either an associated disturbance of equilibration of the labyrinthine fluid, which disturbance may be secondary to an interference with normal ventilation of the tympanum, or they are caused by a reflected irritation which produces vaso-motor changes in the correlated areas presided over by the nerves, communicating with those suffering in the irritated or congested nasal membrane. Referring to the anatomical connections (see pp. 288, 289), we can have no difficulty in realizing how such irritations starting in the nasal areas may cause reflex aural tinnitus or vertigo through the relation of the ampullar and vestibular nerves to the cerebellum. Besides, as we have elsewhere said, there may be in certain individuals special inherited susceptibilities or abnormal excitability of the hearing and vertiginous centres (McBride), to account for the slight disturbance of physiological balance, which may account for these symptoms in some persons and not in others.

It is worthy of note that Urbantschitsch and others have found that those "after perceptions" produced by certain noises in persons under thirty, and lasting a given time after the objective source of sound, and to

which he gave the name "positive after-images," have what he has called "subjective fields of hearing," and while some of these are situated in the forehead or back of the head, the seat of the "subjective field" has also been found in the naso-pharynx (Politzer).

The pathological relation between congested and hypertrophic conditions of the Schneiderian membrane and excessive sexual indulgence is of interest in connection with this physiological fact. Patients have often expressed to me the fact that the tinnitus was aggravated by frequency of the sexual act, or by seminal emissions.

What, then, are the nasal affections which most frequently demand treatment for the cure or relief of tinnitus?

They are in our experience—

(1) Deviation of the septum nasi;
(2) Acute and chronic rhinitis;
(3) Hypertrophic rhinitis.

Tinnitus may occur coincidently with such affections as hypertrophy of the posterior extremities of the superior turbinate bone, polypus, adenoid growths, post-nasal catarrh. If so, we must remove the two first mentioned of these causes by operative interference, and the latter by suitable treatment, before we can determine the correlation existing between these conditions and the tinnitus. But we do not think that there is any doubt that the three affections specified are those generally demanding active attention both for the deafness and tinnitus. (See chapter on the Naso-Pharynx for treatment.)

The Middle Ear.

The main therapeutic indications to be fulfilled in any case in which the tinnitus may depend on an affection of the tympanum are primarily—

(1) Attention to, and prophylactic measures against, acute and recurrent attacks of catarrh of the middle ear (otitis media).

(2) The ventilation of the middle ear.
(3) The patency of the Eustachian tubes.
(4) Release of imprisoned secretions in the tympanum or Eustachian tube.
(5) Improvement in the condition and position of the membrana tympani.
(6) Restoration of tone and function to the intrinsic muscles of the middle ear and Eustachian tube.

We have already fully dealt with the details of treatment in *affections of the middle ear*, to the chapter on which the reader may refer for directions as to the different therapeutical steps indicated in such affections.

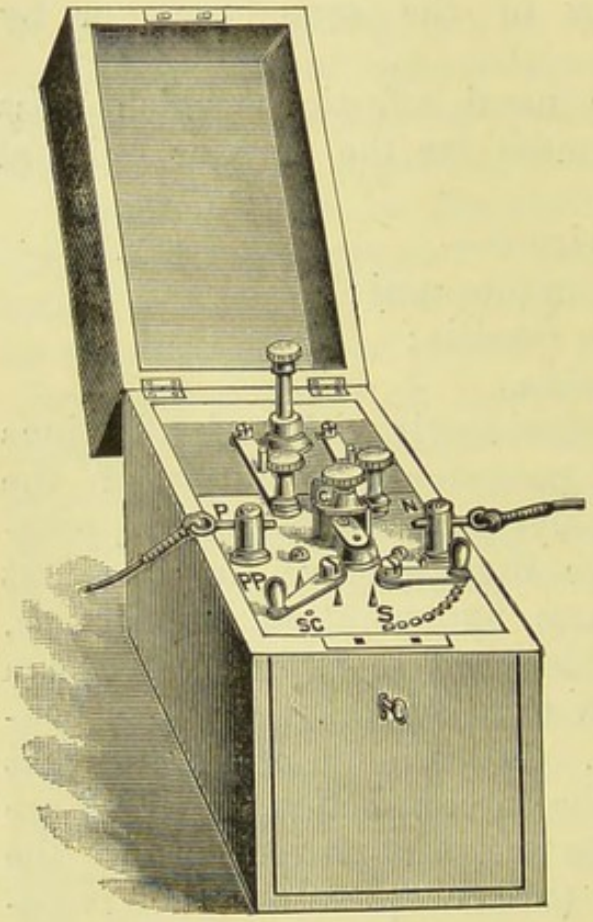


Fig. 145.—Faradic battery.

Restoration of Tone and Function to the Muscles of the Eustachian Tube.—This end will be accomplished partly by some of the measures already recommended for treating the naso-pharynx, both local and constitutional. Mild faradization of the tubal muscles should be tried. The best battery to employ is the one here figured (Fig. 145), and the small reophore of the author will be found convenient for conveying the primary current. It is readily passed in the same manner as a Eustachian catheter, the small piece of sponge at its end having been first dipped in a solution of common salt. The current may be completed by an elastic band, holding a brass disc similar to that used for faradizing the larynx, or with a second ordinary laryngeal electrode. The

brass disc can be placed over the mastoid or on the neck, or the knob of the electrode can be carried against the soft palate, over the mastoid, or beneath the ear. Contact is made and broken by the levers, or the clip devised by me (Fig. 146) can be adjusted, and thus can be used both for the faradic and galvanic currents. We judge of the strength of the current by its effect on our own and the patient's lip. The strength should never be more than what is easily borne, and no shock should be felt. With the second electrode we can complete the current in any part of the external auditory passage we choose, being careful to have the current weak. We may here say that this is the only form of electricity used for the specific objects of influencing paretic states of the tubal muscles, and in some cases of the intrinsic

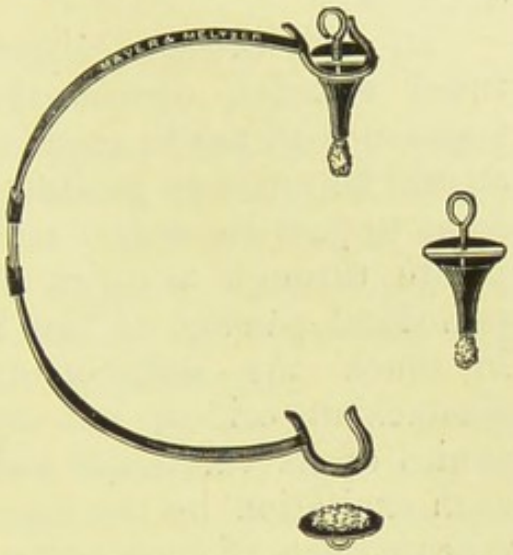


FIG. 146.—Macnaughton Jones's clip for mastoid electrode and galvanic speculum.

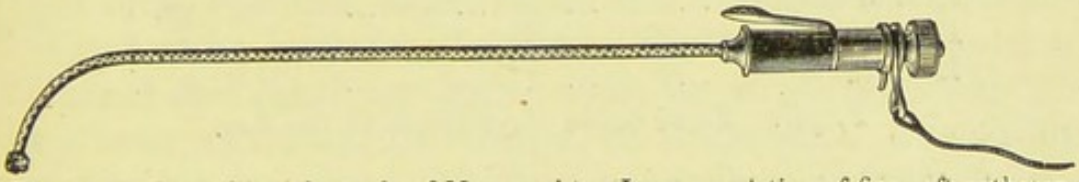


FIG. 147.—Eustachian electrode of Macnaughton Jones, consisting of fine soft catheter containing wire tipped with sponge. The battery-wire is fixed by the brass screw-handle, and contact is made or broken at will by the little lever. The india-rubber band used to carry round the neck in galvanizing the vocal cords, with a piece of sponge in the centre which is connected with the battery, is placed round the head, bringing the sponge over the mastoid process, hooking the band either round the head and over the mastoid or underneath the chin.

muscles, that we have any confidence, or, indeed, much experience in the utility of. We believe in it as an occasional means of correcting such conditions, and with other remedies at our command of alleviating thus indirectly the tinnitus. It has as often disappointed me. On the other hand, from the good it has, we might say unexpectedly, done in those cases in which tubal and

middle-ear troubles have been at the source of tinnitus, we always give the patient the benefit of the doubt, and try faradism for some sittings, when if we find there is no result we abandon it (the galvanic current we shall refer to in speaking of its application in cases of labyrinthine deafness).

In such cases, weakened states of the palatal and tubal muscles, occasional gargling in the horizontal position is of use in exercising the muscles. The patient should be made to swallow rapidly several sips of water, so as to pass the entire muscular mechanism of the soft palate through a series of gymnastic exercises. The periodical passage of the Eustachian bougie does good in much the same manner, not alone freeing the Eustachian orifice, but by stimulating the muscular tunics of its valve-like walls, especially if we follow up such excitation by the muscular actions associated with repeated acts of deglutition.

Such patients are frequently anæmic, and iron in some form must be administered cautiously. In the case of female patients we prefer the combination—

℞	Acid arseniosi	gr. $\frac{1}{36}$—$\frac{1}{40}$
	Ferri sulph. exsic.	gr. $\frac{3}{4}$
	Quinæ sulph.	gr. 1
	Ext. nucis vom.	gr. $\frac{1}{4}$
	Ext. gent.	q. s.

F. pil. To be taken three times in the day.

A little St. Raphael wine given with meals a few times daily, where wine can be borne, will be of service for such anæmic patients. Strychnine is of special use in these paretic cases. An admirable mixture is that of—

℞	Liq. strychniæ	℥i.
	Liq. acid phos. (Horsford)	℥j.
	Syrupi aurantii	℥i.
	Aquam ad	℥x.

Half an ounce to be taken three times in the twenty-four hours.

Another valuable combination is a teaspoonful of Horsford's acid phosphates and one of Fellows' compound syrup of the hypophosphites, taken before meals

a few times daily. In other nervous or hysterical cases the salts of zinc appear to act beneficially, more especially the valerianate and sulphate; for example, such a pill as—

Acid arseniosi	gr. $\frac{1}{30}$
Zinci valerianatis	gr. $\frac{1}{2}$
Ext. nucis vom.	gr. $\frac{1}{2}$

which may be given with benefit with other tonics. The patient, when possible, should be advised change of air and scene, avoidance of overwork, night-work, late hours, much railway travelling, night nursing, and those prejudicial influences alluded to in dealing with catarrhal states of the nose and middle ear.

Climate has much to say to the liability of such attacks. A dry and sheltered locality is the best for these sufferers. Too great exposure to what is popularly called a "bracing" air is not to be recommended. Bath, Ilkley, Malvern, Tunbridge Wells, Torquay, Brighton, Hastings, Bournemouth, Eastbourne, Cornwall, the Isle of Wight, and Southsea are among the best of our home resorts. Abroad we prefer Aix-les-Bains, Royat, Bourboule, Cauterets, Algiers, and the Canary Islands. In the early summer, Schwalbach and Kreuznach, Ems and Wiesbaden; later on, the Swiss Riviera. In the winter, Cannes and Nice; or better still, for those who will go, a winter at Davos, St. Moritz, or Pontresina. If sulphur waters are indicated in gouty conditions, Harrogate and Strathpeffer are our two best home waters, while on the Continent Aix-la-Chapelle (Aachen), Barèges, Bonnes, and Eaux-Chaudes give us ample choice. But to the worn-out city worker who suffers from tinnitus and a tendency to catarrhal states of the throat, Eustachian tube, and middle ear, and who wants to combine rest of mind and relaxation with benefit to his local affection, we advise, at the proper season and before any other place, Switzerland, with its glorious air and sky, its marvellous change of scenery, at little cost of travel, and its mountain climbs. After this, perhaps, the Mediterranean trip to Suez and back in a P. and O.

vessel is to be recommended. But we must not overlook the fact that to many, continental travel is an impossibility, and for these the Scottish Highlands, a trip through the Caledonian Canal to Strathpeffer and Pitlochry, or a stay in the lovely Teviotdale may be recommended. Matlock and Malvern or Ilkley have each their advantages in individual cases.

In cases of tinnitus in which there are abnormal conditions of the membrana tympani, either in the form of thickening, adhesions, displacements, atrophies, collapse, in my experience but little can be done for the subjective noises. Various plans may be tried when, in consequence of Eustachian closure or collapse, there is inward displacement of the membrana tympani with increase of tension. In addition to the use of Eustachian injections and bougies, with free inflation, we may try systematic suction on the tympanum through the meatus. Such suction we may first test the effect of with the pneumatic speculum, and then instruct the patient to apply suction himself, through a piece of tubing with an ear-piece at one end which is covered with india-rubber, so as to fit the meatus air-tight. On the other hand, we can adopt the plan advocated first by Dr. McKeown, in cases of considerable concavity of the membrane, of applying a little collodion to it, and making gentle traction by means of an artificial cotton-wool membrane, or armed probe, on the drum-head. When the membrane bulges, or there is any doubt, after the careful use of the auscultation tube and speculum, that some secretion may not be imprisoned within the tympanum, the best step to decide to take is paracentesis of the tympanum. Whether for this purpose, or for relief of tension, there can be no question that paracentesis often gives great relief to tinnitus. Unfortunately with the difficulty of keeping the opening patent, this troublesome symptom recurs. But this is not always. Elsewhere we have fully entered into the results of our experience, and the advantages of and various methods of performing this operation. Here we are at once brought face to face with such opera-

tions as myringectomy (Grüber), separation of adhesions (Wreden), division of the tensor tympani, or division of the tendon of the stapedius muscle with separation of the incus from the stapes (Weber-Liel), removal of the ossicles (Sexton). These serious operations, which are undertaken with very variable results, we do not stay to discuss here. All are outside the province of those who have not had very exceptional operative experience, both on the living and dead body. None of them are in very special favour in this country. All will be found fully discussed in the larger treatises on otology. The morbid conditions for which these steps are undertaken are atresia of the Eustachian tube, considerable increase of tension of the membrana tympani, great thickening of the membrane, adhesions of the membrane and the ossicles, fixation of the stapes from rigidity of the stapedius muscle.

The Internal Ear.

We turn now to the internal ear. We have to remember how seriously disturbances of equilibration of the air in the middle ear, altered relations of tension of the membrane of the tympanum, and perverted action of the ossicles, either through rigidity, displacement, or clogging of any or all of them, must affect the acoustic conditions of the labyrinthine fluid. It is, therefore, obvious that in treating the abnormal states of the tympanum, its membrane, its valvular outlets, and its intrinsic muscular apparatus, we are indirectly dealing with the labyrinth, and may possibly remove the primary cause of the labyrinthine disturbance. We have here to consider rather how far we can influence such abnormal states of the auditory nerve itself, or of the circulation in the labyrinth, as are likely to cause tinnitus. This is most difficult in the outset from the obscurity that surrounds both the physiological and pathological causes of the noises we are anxious to relieve. Some of these conditions we have already regarded as beyond the reach of any thera-

peutical act or agent. We may, however, determine certain sources of excitation of the nervous structures. And we may further endeavour to differentiate those sources of irritation which have their starting-point in the labyrinth from those which are reflected from the centre or from some intervening parts of the auditory nerve. But this effort to clear the ground for a rational therapeutics, in the present state of our knowledge, only enables us at best to generalize in grouping means or remedies likely to relieve. We may make such a grouping with this object as the following :—

1. Nervous Excitation. — The treatment of central irritations that affect the labyrinth in a reflex manner ; of peripheral irritations that may affect the labyrinth by reflex action. Of irritations due to the local excitations occurring in some portion of the auditory nerve :—

2. Vascular Excitations. — (*a*) Those consequent upon general diminution of tension of the vascular system. (*b*) Those consequent upon general increase of tension of the vascular system. (*c*) Those due to toxic ingredients in the blood.

3. Collateral Excitations. — The treatment of such collateral sources of irritation as may arise from temperament, habits, vices, occupations, hereditary tendencies and taints.

We may briefly summarize the lines on which we can hope to attack such predisposing causes of a tinnitus which has its origin in direct or reflected irritations of the nervous structure of the labyrinth.

Central and Peripheral Excitations as a Cause of the Noises.—We may have to treat the uric-acid diathesis and latent gouty conditions, or that state of the blood brought about by quickly recurring and numerous pregnancies. Independently of general treatment, which we can pursue at home, such gouty patients who suffer from noises in the ears derive benefit from Homburg, Ems, Wiesbaden, Kissengen, Vichy, Bourboule, Harro-

gate, Strathpeffer, Bath, Buxton, Leamington. It is in these cases that the combination of the iodides of potassium, sodium, and ammonium, or the iodide of potassium alone or combined with the bromide salt, do much service.

If there be attendant upon this gouty disposition (or otherwise) a torpid or enlarged liver and general biliary congestion, the exhibition of salines, an occasional mercurial, and the more commonly administered vegetable cholagogues may mitigate, if they do not remove, the tinnitus. The bitter purgative waters of Rubinat, Æsculap, Hunyadi, Friedrichshall, and Carlsbad are indicated. And if there be, as there often is in such persons, a degree of cardiac irregularity and an associated palpitation, such vascular tonics as digitalis, convallaria, or strophanthus should be given. Bourboule, Aix, Wiesbaden, Homburg, Ems, Marienbad, and Carlsbad are among the most important of the waters to which such patients should be sent. It is not necessary to insist on the importance of diet, the strict limitation or total abandonment of alcohol, and great moderation in the use of tobacco. It is always worth the temporary trial in any case of tinnitus to abandon tobacco for a time, and the enforcement of the well-understood dietetic observances imposed on all large nitrogenous eaters as to the habit of smoking. Tobacco has also a tendency in many persons to increase the tinnitus, if not primarily to cause it. Remembering the influence of tobacco on the heart (Handfield-Jones), we should say that complete abandonment of the habit in the class of case we have just described is imperative. The lesson learnt by the action of toabcco in the retina in producing atrophy of the papilla and ambylopia should not be forgotten in the instance of the auditory nerve. Though we have not the same direct evidence of its effects, the possibility of tobacco deafness and tinnitus should be remembered. As with the eye so with the ear, the total relinquishment of the practice of smoking gives the patient the best chance of recovery. Another attendant upon these disorders of digestion and mal-assimilation of food that

requires to be carefully attended to when noise in the head or ears is complained of is flatulence. It is noteworthy the number of reflex symptoms to which flatus will give rise. We have known it to cause not alone tinnitus, but sudden sharp pain in the ears. Diet here, again, is of importance. Raw vegetables should be for a time interdicted, and all others calculated to cause this digestive complication. Abdominal massage is of great value for such torpid livers and bowels. Administered properly and with care it is a splendid remedy. This applies more to sufferers from constipation. With it we may combine the galvanic ten cells of Léclanche elements in the course of the great bowel.

Uterine Disorders.—The frequency with which disorders of the female sexual organs are found attendant upon tinnitus is more than a mere coincidence. This is proved by the occasional disappearance of the noises when the sexual disturbance, or the condition it has given rise to, is cured. Pregnancy, large fibroids of the uterus, severe displacements, menorrhagia, the menorrhagia of the menopause, and other female diseases, which by pain cause exhaustion and general debility, may give rise to tinnitus. The time of life when women are most subject to reflex disturbances is that of the menopause. Then also it is that we frequently find that they suffer from exhaustive discharges. So we might expect that noises "in the head" and ears would be most likely to occur, and experience verifies the supposition. At the climacteric period we find those sudden changes in blood pressure which are so often fatal to the integrity of vessels elsewhere than in the uterus—as, for example, in the nose, the retina, the lung, and the kidney. We might then expect to meet with these subjective aural phenomena at this time, or those graver objective consequences, apoplexies of the labyrinth, with the train of symptoms which are grouped together under the name of Ménière's —attacks of vertigo, nausea, deafness, and tinnitus. Such graver results or lesions are more apt to follow in the instance of a woman whose blood has been subject to

frequent drains, and all the physiological changes of many pregnancies. Treatment in such cases must be directed to the vascular supply of the viscera, the prevention of congestion in such organs as the liver and kidney, maintaining the portal circulation, watching for waves of depression or exaltation in the vascular system generally, and, more especially, the strength and regularity of the heart's rhythm. We do this in a threefold manner:—First, by the judicious use of such cholagogues and aperients as are calculated to promote the flow of bile and prevent portal congestion; secondly, the administration of such medicines as are proved to act as fingers to the central vaso-motor stopcock in controlling either excess or diminution of blood pressure; thirdly, the periodical, but timely, resort to vascular tonics, more especially those calculated to act directly on the heart itself, in steadying and controlling its action.

In the eclectic remedies, iridin and euonymin, combined with mild aloetic aperients, and followed by salines, we have examples of the first; in the bromides of potassium and sodium, hydrobromic acid, pilocarpine, nitrite of amyl, hydrobromic ether, hydrastia, of the second; and in digitalis, convallaria, strophanthus, of the third. There is another group of remedies that act more especially on the small vessels, and have a constringent effect on the arterioles which can frequently with this object be availed of in tinnitus with benefit, viz. that containing belladonna, digitalis, ergot.[1] But independently of any general treatment the local conditions will require attention, displacements must be rectified, congested states reduced, menorrhagic discharges should be controlled, ovarian excitations subdued, sexual excesses moderated. We may here repeat what we have elsewhere said bearing on the subject of vascular pressure in relation to tinnitus.

We find two clearly distinct classes of patients in whom the symptom of tinnitus is present, the distinction

[1] Grüber speaks well of arnica in nervous tinnitus, five to fifteen drops on sugar three times in the day.

being generally so evident as to broadly indicate the lines of therapeutic action. *In one group* there is slow and feeble action of the heart, perhaps attended by occasional intermittence; the pulse at the wrist varies in force and character—it may be full but compressible, or feeble and easily obliterated; the temporal arteries are dilated; the veins on the backs of the hands are unduly prominent; auscultation reveals an imperfect cardiac systole or diastole; the digestive powers are weak; there is a tendency to general nervous depression, and the occasional attacks of giddiness or faintness are evidences of cerebral anæmia.

It is in these cases we find benefit derived from such drugs as iron and its combinations, digitalis, convallaria, arsenic, quinine, strychnine, caffeine, ergot. The bromides have to be administered with caution, and it is a question if any temporary relief due to diminished irritability of the reflex and cardiac nerve centres compensates for the depression which is attendant on their prolonged employment. The bromide salts of caffeine, zinc, and iron will, however, often be found most valuable given in combination with other vascular and nerve tonics. We have constantly found hydrobromic acid with quinine and pyrophosphate of iron useful. The use of alcohol in such cases in any quantity we have little doubt is most injurious; the secondary dilatation of the arterioles which follows the use of alcohol, especially in the intervals between its administration, increasing the tinnitus, while the cardiac irregularity and gastric disturbance which it frequently causes still further adds to the mischief. A small and defined quantity of alcohol taken with food in cases of weak appetite, and such wines as St. Raphael, Burgundy, claret, and the red Australian wines, are of service in anæmic states; though even this amount of alcohol we find in many persons aggravates the noises.

In the second group of cases there are the general evidences of increased arterial tension in the incompressible radial pulse, throbbing carotids, rigid vessels, ocular phenomena, sleeplessness, headache, and sense of

fulness in the head. We frequently find that organic changes in the vascular system or the kidneys accompany this increased arterial tension.

Aortic stenosis and mitral insufficiency, aneurismal tumours, atheromatous degeneration, Bright's disease, contracted kidney, are perhaps the most frequently met with of these organic sources of tinnitus. In gout, rheumatism, chronic alcoholism, diabetes, and transitory glycosuria the same condition exists. It is present in females who suffer from erratic or suppressed menstruation, and is not uncommon at the menopause and during pregnancy. Excessive indulgence in tea may produce it. We have drawn attention to the frequent occurrence of tinnitus in the case of cerebral tumours and other degenerative changes both of the brain and spinal cord.

It is especially in this increased tension tinnitus that bromide of potassium gives such relief. We do not think it is of equal value to hydrobromic acid, which is the most reliable medicine we know of for the relief of hyperæmic tinnitus. It should be given in thirty-drop doses, and may well be combined with such medicines as digitalis, convallaria, or quinine, when these are indicated. The hydrobromate of cocaine is likely to prove a useful agent for tinnitus in doses of a quarter to one grain. We have given, as first advocated by Turnbull, hydrobromic ether, held in suspension by a little powdered acacia and glycerine in three to five minim doses with advantage. It may also be blown into the middle ear through the Eustachian catheter. Nitrite of amyl and nitroglycerine will often afford temporary relief from the noise and throbbing in the ears. We have known inhalation of nitrite of amyl give great relief in several cases of tinnitus attendant on granular kidney, and in other forms of hydræmia in which the urine was of low specific gravity. Ergotin and sclerotic acid are valuable remedies in cerebral hyperæmic conditions attendant on cardiac irritability, and, alone or in combination with digitalis, often mitigate distressing tinnitus. Hamamelis may be given for the same object in combination with ergot.

It is in this class of patients that the morning ad-

ministration of some saline aperient waters following on such vegetable cholagogues as iridin, euonymin, podophyllin, or occasional small doses of mercurial powder or pill, will have a beneficial effect on the tinnitus.

Pilocarpine.—Here we come to allude to a remedy with which Macnaughton Jones's name has a kind of historic interest (*vide* leading article in the *Lancet* of September 25, 1880). He says, "I believe I was one of the first in the United Kingdom who gave pilocarpine hypodermically as a vascular depressant and rapid diaphoretic. For nearly a year before the meeting of the British Medical Association in Cork in 1879, I had been using pilocarpine in ocular affections both locally and hypodermically, for the relief of glaucomatous states of the ocular vessels. As far back as that year I used it in a case of Ménière's affection due to syphilitic disease of the labyrinth.[1] And this experience and knowledge of its action it was that led me to its use in the famous case, well known at the time as 'The Pilocarpine Case,' in which I employed it for suppressed scarlatina. The records of the case and the professional verdict on it can be found in the medical periodicals of the years 1880 and 1881. Suffice it to say that my use of the drug in that case cost me a hospital inquiry that lasted the greater part of a week, at which I fully vindicated my action; and, what I have always regretted more, the *British Medical Journal*, for its vigorous defence of my treatment, was subjected to the annoyance of a costly action at law for libel."

It is a question if we avail ourselves of the action of pilocarpine as frequently as we should. It is probably the most certain and powerful of all our drugs in cases suitable for its administration, where the reduction of vascular tension is our object, and in which we desire to check effusion and control the tendency to extravasation. These are exactly the conditions in the earlier stages of Ménière's disease and other forms of vertigo in which labyrinthine effusions are threatening or occurring. At the Milan Congress (1880) Professor Politzer drew atten-

[1] *Practitioner*, vol. xxxvi. p. 193.

tion to the use of subcutaneous injections of pilocarpine in syphilitic exudations of the labyrinth, and then inferred that it might prove of service in other than specific affections of the internal ear. The strength of the solution he is in the habit of using, and which is nearly the same as that I have myself employed, is a two per cent. solution, injecting three to six drops into the arm for each dose. The treatment may be abandoned if, after fourteen days, no result is apparent; otherwise it may be continued daily until a decided improvement is manifest. This is attained in periods of time varying from six to forty days. It is not uncommon to find the progress vacillating. But as a rule the greatest advance is made during the first fortnight of the treatment. During the administration there should be no other local or internal treatment pursued. A few out of the several remarkable and typical cases instanced by Professor Politzer are well worthy of notice.

"In July, 1871, a Russian gendarme contracted primary syphilis, which was followed by secondary symptoms, and was treated by mercury and iodine. In January, 1881, he was attacked by deafness of both ears, tinnitus, giddiness, sickness, and violent pain in the occipital region. The right ear was first affected, uncertainty of gait followed, especially if he was in the dark. The acoumeter (or Hörmesser) was not heard on contact with the right ear, or on the corresponding temple, while loud speaking conveyed only the idea of sound. With the left ear the acoumeter was heard at the distance of a metre and a half, and whispering at five metres. The tuning-fork placed on the head was heard only with the left ear. Inflation made no difference. After the first injection of pilocarpine speech was heard at sixteen centimetres by the right ear, after the fourth at half a metre, after the eighth at four and a half metres; at the end of the fourth week the hearing distance of the left ear was normal, and loud speech was heard at five and a half metres.

"Another instance was that of a lawyer, aged thirty-two, who had been very deaf in the left ear from sclerosis and middle-ear catarrh. In September, 1884, he contracted primary syphilis, which was followed by secondary symptoms and an ulcerative pharyngitis. He was benefited by special treatment. A deafness supervened in the right ear, accompanied by tinnitus, giddiness, and headache. There were no changes apparently in the membrane, middle ear, or Eustachian tube. The acoumeter was not heard with the left ear, nor with this ear could he hear a loud voice. With the right ear the acoumeter was heard at a distance of four

centimetres, and loud conversation at one-third of a metre; no sound was heard through the cranial bones. The tuning-fork was heard with the left ear longer when the fork was placed on the mastoid process than when it was held to the ear. It was the reverse with the right ear. The deafness in the left ear was doubtless due to stapedial fixation and loss of sound conduction; in the right ear to syphilitic effusion into the labyrinth.

"Without going into daily progressive improvement under pilocarpine injections, it will be sufficient to state that after the thirty-second injection the hearing of the right ear was normal, and the subjective noises had disappeared, and the interference with the musical perception was completely removed."

We may thus summarize the conclusion of Professor Politzer with regard to the use of pilocarpine injection in affections of the labyrinth:—(*a*) It is in syphilitic affections of the labyrinth that it is of most service; (*b*) in those syphilitic cases which may be regarded as hereditary it is of less use; (*c*) in cases in which there has been middle-ear disease, arising out of diphtheria or scarlatina, pilocarpine is useless; (*d*) it is useless in old cases following on meningitis, or cerebro-spinal fever, though in recent cases (Jacobson) it may be tried with success; (*e*) there is a large percentage of failures in advanced cases, but the success of the treatment is sufficient to warrant its employment in recent and more desperate cases of so-called "nervine deafness;" (*f*) it should be administered early in the deafness, and persevered in for some time; it is harmless in its operation given in the doses before recommended.

While we thus appraise at its true value this agent both for lowering vascular tension in the labyrinth and promoting the absorption of effused products, we have to protest against its indiscriminate employment in all cases of tinnitus and deafness, attended or not by vertigo, as the purest charlatanism. If we can exclude gross middle-ear changes and irremediable labyrinthine lesions, and if we are able to trace the aural subjective phenomena to vascular pressure in the labyrinth, let it arise how it may, or to recent effusions of serum or lymph into the labyrinth, then pilocarpine may rationally be expected to do good, and not otherwise. To use it without such discriminate precautions is to bring the drug

itself into contempt, and otology into disrepute. Used in the manner indicated by Politzer, and with proper precautions, to encourage perspiration and prevent chill, we have not had any bad effects from pilocarpine. It is best to begin with the smaller doses and gradually increase in strength and frequency, according as the patient bears the effects of the injections.

Dental Reflexes.—In referring to reflected peripheral excitations, we must not omit a reference to those arising from the teeth. In a paper on "Dental Reflexes,"[1] recently published, Macnaughton Jones alluded to tinnitus and deafness as possible reflex symptoms arising out of disorders of the teeth. This cannot surprise us when we remember the numerous communications of the trigeminus with the other cranial nerves and their nuclei. Such aural reflexes are not of frequent occurrence. We might expect to find them more frequently with eruption of the wisdom teeth. But indirectly through loss of sleep caused by facial neuralgia, headache, and the nervous prostration which we frequently find present with painful carious stumps, tinnitus may be induced by dental periostitis and caries. At least the teeth, in any persistent case of tinnitus in an enfeebled person, should not be above suspicion and inspection. Indeed it is well to seek for any collateral source of excitation in the other cranial nerves, as well as the auditory itself. It is conceivable that the prolonged irritation caused by astigmatism and its secondary consequences, in persistent headache, vertigo, and nausea, might start in the ear such a subjective phenomenon as tinnitus. As a fact, we have known, whether as a coincidence or otherwise, on several occasions in an astigmatic sufferer, tinnitus to be present. As it has a bearing on this subject we reproduce that portion of the communication on "Dental Reflexes" more especially touching on tinnitus aurium.

"In the record of neuralgia of the fifth and facial nerves associated with tinnitus aurium, I found that out of two hundred and sixty cases of tinnitus, seven were

[1] *Dental Record*, September, 1890.

suffering from neuralgia of these nerves, and seven more complained of severe headache. Though I have no record of the condition of the teeth in these cases, still I am aware that in many the teeth were affected, and it is only reasonable, on physiological grounds, to infer that the decayed teeth may have had a share in causing the tinnitus, or in starting the morbid condition of the tympanum which accompanied it. Rarely, however, in aural cases is *deafness* attributed to the teeth. This is my experience. This may arise from the patient and surgeon overlooking the teeth as a probable source of the ear mischief. Neuralgic and radiating *pain* in the ear associated with dental pain is common. In the eruption of the wisdom teeth such pain is not unusual. Still, occasionally, the origin of deafness is ascribed to toothache. A lady, aged thirty-four, consulted me in 1888 for deafness and tinnitus. She was positive the deafness at first appeared when she was suffering from severe toothache. There were carious teeth of the upper and lower jaw. She was quite healthy in every other respect. The membrana tympani of either ear was rigid; there was collapse of the Eustachian tube—she had the teeth attended to, but the deafness and tinnitus continued.

"I have this day seen a patient with white and gold stoppings in the upper and lower left molar teeth, and overcrowded incisors; she suffers from periodical tinnitus aurium of the left ear, the hearing is nearly normal, there is nothing discernible save some slight catarrhal changes in the membrana tympani, yet there is violent neuralgic pain apparently starting in the ear and radiating in the course of the facial branches. This lady has been wearing a pessary for some time for retroversion of the womb, to which she ascribes all her ills. And many times I have known neuralgia of the ear, occurring without any inflammation or other abnormal conditions of the ear, unquestionably due to a carious tooth, and the pain has been immediately relieved by its removal. Such neuralgic attacks are, as I shall show, accompanied occasionally by tinnitus. Such a local symptom generally points either

to an interference with the equilibration of the air in the tympanum or the fluid in the labyrinth, or at least to sufficient irritation in the auditory nerve tract, from nucleus to cortex, to start this symptom. The communications of the fifth with the auditory nerves through the otic and spheno-palatine ganglia, the distinct supply of the tensor tympani by the fifth nerve and of the stapedius by the facial—the two muscles which are most important in regulating the equilibration of the fluid in the labyrinth—offer the anatomical explanation of such a reflex aural irritation springing from a dental cause in the superior or inferior dental branches of the fifth nerve. This possible reflex disturbance of the fluid equilibrium in the labyrinth, through an irritation existing in the teeth, demands additional attention in face of the fact stated by Foster that the 'activity of the tensor tympani is regulated by reflex action.' Nor in estimating the various reflex relationships of fifth nerve must the fact be overlooked that at its origin the sensory root of the fifth anastomoses with all the motor nuclei of the nerves arising from the medulla, with the exception of the abducens (sixth) (Landois and Stirling)."

Massage.—This method of treatment, which will be found of use in some cases of "nervous deafness" and in "progressive deafness" due to chronic middle-ear changes, and also in neuralgia of the tympanum, has been already described at p. 155.

Depletion and Counter-irritation.—We have several times known a throbbing tinnitus relieved by the application of one or two leeches, applied inside or under the concha. One patient, a medical friend, was in the habit, whenever the tinnitus became distressingly loud, of applying a few leeches in this manner. This always gave him relief for some time from the "thumping noise" he complained of, and the sense of fulness.

In the same manner we have known gentle counter-irritation with the charta epispastica, or a small portion of D'Albespeyres' dressing laid over the mastoid, mitigate the noise. A good counter-irritant embrocation for this purpose is the following :—

℞ Tinct. capsici,
Tinct. aconiti,
Spt. armoracia co.,
Chloroform, āā ʒi. M.

Or—

Sol. menthol (1 in 7), ʒii.
Ol. sinapis, ʒii.

This latter solution is to be applied gently to the mastoid a few times in the day. Such remedies are at best but palliative; still, anything that affords even temporary relief from the distressing noise will be welcomed by the sufferer.

CHAPTER XXI.

ELECTRICITY IN TINNITUS.

The satisfactory application of electricity to the ear is in practice attended with many difficulties. Patients are so differently constituted that some cannot bear even weak currents, others refusing altogether to submit to internal galvanism; they are impatient of a treatment which is unpleasant if they do not experience speedy results in the diminution of the noises or the deafness; nor can the practitioner truthfully deny that there is much that is experimental in the treatment.

As regards galvanism and its effects in tinnitus, we may say at once that personally it is a remedy we cannot strongly recommend and are not much in favour of, for the following reasons:—

It is uncertain in its effects, frequently causing grave aggravation of the subjective noises. The fact that the galvanic current is more powerful in originating subjective sensations in the morbid than in the healthy auditory nerve (Benedikt) is not to be forgotten.

The dosage of it is difficult to measure. In the hands of those not accustomed to electrical manipulation it is a most haphazard treatment in that form of nerve disturbance that requires technical skill in manipulation and fineness of adjustment in appliance.

Some expressions of opinion on the part of such experienced authorities we venture to quote, as we feel that it completely accords with our own experience of galvanism. In cases in which it has done good we have always been in doubt if the benefit was not as much

derived from other treatment accompanying its use as from the galvanism alone. We cannot rationally expect much benefit from any physiological or therapeutical effects of electricity in those cases in which an examination affords clear proof of serious organic changes in the middle ear or labyrinth. It is rather in those patients in which the examination by the speculum, auscultation tube, and tuning-fork points to tubal collapse as the principal cause of the tinnitus, and that other correlative evidence leads to a belief that there is a condition of enervation not alone of the tubal but also of the tympanic muscles, producing by pressure or otherwise disturbance of equilibration in the labyrinth, that electricity is likely to be of service.

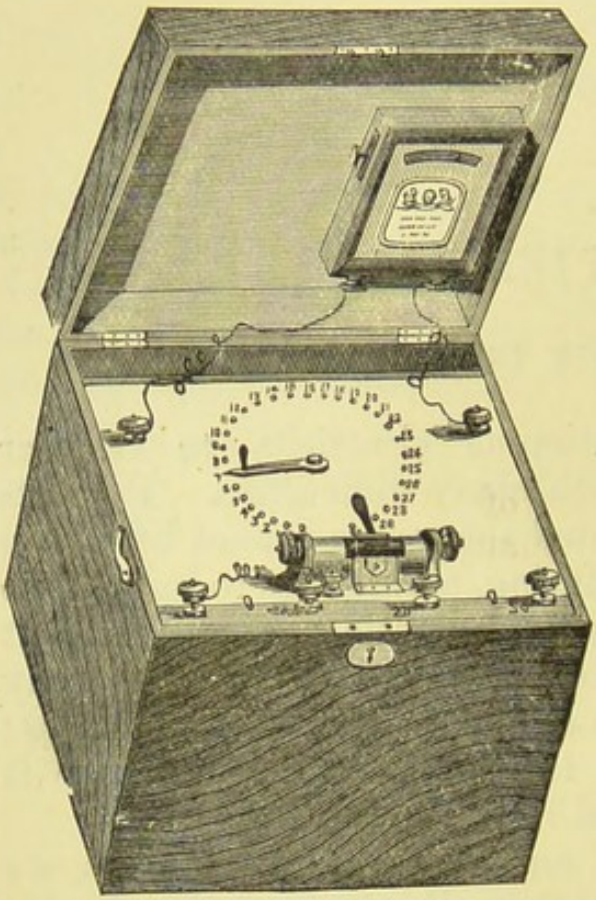


FIG. 148.—Portable Voltaic battery for general application, 40 Leclanche cells, accessories, collector, interruption, current reversion and galvanometer (Coxeter).

"My accumulated experience," says Politzer, "indicates that galvanic treatment effects a lasting improvement in the function of hearing only in a few cases, and complete removal of the subjective noises extremely rarely; but that very often, after longer or shorter treatment, the intensity of the subjective noises and their annoyance are lessened for a long time, and that, besides, the head symptoms accompanying ear diseases are either quite removed or greatly improved. On the other hand, he notices that aggravation of the symptoms sometimes follows the galvanic treatment, the noises becoming more intense, and general excitement attending even a few sittings."

If we now take Grüber's opinion and compare it with that of Politzer we find it is as follows :—

"As regards the employment of electricity from his own experience, he entirely agrees with Schwartze, who disputes altogether the accuracy of Brenner's conclusions as expressed in his well-known formula in reference to Brenner's statements about 'electro-diagnosis.' Neither, unfortunately, can he say much as to the effects of electricity in aural diseases from a therapeutical point of view. The induced current appears most serviceable in cases in which there is a paretic condition of the internal muscles (Weber-Liel). Perhaps, too, the electrolytic action of the galvanic current may have an influence, as Schwartze has suggested, upon plastic processes in the middle ear; though the results hitherto obtained are not of a very favourable kind. With respect to particular symptoms, it is certainly true that galvanism is frequently capable of temporarily relieving or removing the subjective auditory sensations. It is nevertheless well ascertained that a permanent cure of these is an extremely rare occurrence, and that in the majority of instances the noises return after a few hours, sometimes in a much more intense degree."

"In such cases, or in those in which other morbid symptoms are increased by the application of electricity, its further employment should be undertaken with much circumspection, as thereby the condition may be considerably aggravated. Electricity may tend to improve the hearing power when general nervous affections are present which are benefited by this mode of treatment. The author has, however, not been able to convince himself of its efficacy in primary disease of the auditory nerve. If he were to draw a conclusion from his own experience of its action, he should in general agree with Bettelheim, who says that though it may be proper to employ it in cases of nervous aural affections after long-continued treatment conducted on ordinary principles has proved fruitless, yet it would not be good practice to do so before everything else had been tried."

Having thus expressed our views as to the advantage of electricity in the treatment of tinnitus, we consider the subject sufficiently *sub judice* and of that importance to place this brief review of the whole question before our readers.

[1] Excitation of the auditory nerve has been carried out in various ways by different observers, but in the author's opinion the best method is that of Brenner, which was adopted also by Erb. The indifferent electrode—a plate of large size—is placed over the back of the neck, and the circuit is completed by pressing a

[1] We are indebted for this summary of the subject to Dr. James Cagney, St. Mary's Hospital, who has devoted special attention to the subject of electro-therapeutics.

sponge electrode of medium size over the external ear so as completely to occlude the external meatus. Both electrodes should be thoroughly soaked in water or a solution of common salt. Since the results depend upon the subjective sensations of the patient, he should be told what to expect and made to disregard concomitant sensations. In some healthy persons the auditory reaction cannot be obtained, because the auditory nerve, being situated deeply and in the neighbourhood of very sensitive organs, a current sufficiently strong for its stimulation is apt to cause intolerable discomfort. In disease, on the other hand, a galvanic hyperæsthesia of the auditory nerve commonly exists, and on this fact depends in large measure the practical utility of the procedure to be described.

With the electrodes disposed in the manner indicated, a weak current is passed and repeated kathodic closures are made. If the current be slowly increased, a point will be reached at which kathodic closure is always attended by a definite sound, and with the same strength of current anodic opening causes a similar but feebler sound. In this way is obtained the normal auditory formula—

KC.S′	... ...	Loud sound.
KO	... ...	*Nil.*
AC	... ...	*Nil.*
AO	... ...	Weak sound.

—Erb.

Or with strong currents, the complete formula—

KC.S′	... ...	Loud sound.
KD.S>	... ...	Sound diminishing and disappearing.
KO	... ...	*Nil.*
AC	... ...	*Nil.*
AD	... ...	*Nil.*
AO.s	... .	Short weak sound.

—Erb.

The Auditory Reaction in Disease.

The auditory nerve reacts to galvanic currents in a very characteristic manner in disease. The affections to which this statement applies are especially apt to be attended with obstinate tinnitus. They are, moreover, of all others the most likely to be benefited by electrical treatment, and since the form which the latter should assume will be directly suggested in any given case by the results of investigation, it is important to possess some knowledge of the method in which this may be conducted.

There is another fact which renders this class of cases especially suited to the purpose. It has been mentioned that excitation of the auditory nerve in health is often difficult, sometimes impossible, because strong currents are needed to effect it, and these cause discomfort by their action on other parts, such as the visual apparatus, the trigeminus facial and gustatory nerves, and the brain itself. In disease, on the other hand, galvanic hyperæsthesia of the auditory, in which the nerve responds to very feeble currents, is constantly present. This has been explained in a very satisfactory manner by Brenner. The special senses, when deprived for long of the appropriate stimulus, are apt to exhibit a condition of craving or excessive excitability for such as may yet reach them. A familiar instance is the dazzling effect of light after prolonged detention in the dark, and doubtless many cases of tinnitus in those who are wholly or partially deaf, may be accounted for in the same way. The electrical examination of the auditory is conducted in the same manner as in health, but generally weaker currents will suffice.

Simple Galvanic Hyperæsthesia.—In this condition the auditory nerve is more readily excitable than in health, but there is no change in the normal formula. It is apt to occur with moderate disturbance of hearing, associated with thickening, retraction, or slight atrophy of the membrani tympani ; it is common in long-stand-

ing ear disease, with tinnitus as the usual accompaniment, perforated tympanum, suppuration, otitis media, caries, fractures, traumatic, and especially rheumatic facial paralysis. The degree of hyperæsthesia should be estimated where this is possible by a comparison with the sound ear ; but the number of cells (4–8 instead of 12–16 in health) or of milliampères of current employed should always be recorded.

Simple galvanic hyperæsthesia is constantly observed in connection with subjective noises in the ear, apart from organic disease, and such are particularly amenable to electrical treatment. It is usually found that the sound ceases at once and entirely with the passage of AC. and AD., while it is aggravated by other stimuli.

Galvanic Hyperæsthesia, with Anomaly of the Formula.—The sounds in this case, besides being more readily evoked, are altogether different from those of health. They are variously described as whistling, buzzing, singing, humming, ringing, hissing, etc. They are loud and persistent. Though the sounds differ in different cases, and with the different phases of excitation, they are the same in the same case for each of these phases (KC., RD., AO′., etc.). Further, there are superadded morbid sensations—usually at first an AC. and AD. sensation ; later, one with KO. The following illustration is from one of Erb's cases :—

A man of fifty-four, with partial deafness, old-standing tinnitus, thickening and retraction of tympanum.

10 cells	KC. Wh′	Loud shrill whistling.
	KD. Wh	Prolonged whistling.
	KO′. h	Short humming.
	AC′. H′	Loud buzzing and humming.
	AD. H>	Same, fading.
	AO. Wh>	Whistling as in KC.

Sometimes the normal sensations are entirely lost, and the morbid ones only remain. There is then said to be *Conversion of the Formula.* The conditions in which anomaly and conversion of the formula occur are

old aural disease, extensive destruction of the middle ear, and labyrinthine trouble.

Qualitative Anomalies of the Galvanic Reaction of the Auditory without Hyperæsthesia.—The anomalies in question are those that have just been described. They are of every conceivable variety. They appear to depend upon nutritive errors, and they may be due also to the action of vertical replacing the actual poles in cases where structural changes have determined new paths for the current. They are met with in severe and inveterate ear disease, in rheumatic facial paralysis, and in central disorders.

Torpor of the Auditory Nerve.—This is a condition of diminished excitability (Donne) in severe and incurable disease, in which for the most part the precise connection with structural changes is not apparent.

Electrical Treatment of Tinnitus Aurium.—From what has been said in the preceding paragraphs, it will appear that the behaviour of the auditory nerve to galvanic currents is apt to vary very greatly, and it is unnecessary to insist that the appropriate treatment must depend upon the result of a previous investigation in each case. It is impossible to lay down rules for all. It is obvious that where the purpose is to allay subjective noises this may best be done by repeated application of the stimuli which are found by experiment to exercise a soothing effect, and where unusual difficulties are encountered treatment should be left to those whose experience has provided them with special skill. In this place will be described the method of treatment which is most useful in the greatest number of curable cases—the typical condition being that in which subjective noises of nervous origin accompany a simple galvanic hyperæsthesia without a change of formula. In respect of prognosis there is no difficulty. Those cases will be benefited in which it is found that the noises disappear or diminish under treatment. Others will not be benefited, with the exception, perhaps, of certain cases of rheumatic facial paralysis in which electrical treatment may affect the primary disease.

In the typical case which we have taken it is from the application of anodic closure and anodic duration that benefit is to be expected. To secure these, without the subsequent influence of anodic opening, the use of a rheostat is indispensable. The electrodes already described are used. The indifferent electrode may be held in the hand instead of being placed upon the neck, and that over the ear is connected throughout with the positive pole of the battery. The current is allowed to flow, being at first very weak, and gradually more cells are added. The patient is questioned as to his sensations, and no further increase of current is made when the subjective noise has ceased or become muffled to the utmost. At this point the current is allowed to flow for about thirty seconds. Resistances are then slowly interposed by means of the rheostat until there is no reflection on the galvanometer. Repeated anodic closures are then made, each followed by anodic duration as before, and the current always removed by means of the rheostat. The current strength should always be determined in this way, by its effect, and the sitting should not last most than three minutes. It may be repeated daily, or on alternate days, and may have to be continued for many weeks before a complete cure is reached.

Treatment of Paralysis of the Tympanic Muscles.— The tensor tympani is supplied by a branch from the otic ganglion, and paralysis of this muscle may be assumed to be a part of paralysis of the motor portion of the trigeminus. This last condition, however, is one of great rarity, and belongs almost exclusively to intracranial disease involving the basal ganglia. It is, of course, impossible to recognize paralysis of the tensor tympani as a distinct affection, but there are certain indications, to be presently described, which will form a useful guide to electrical treatment of the muscle.

The stapedius is innervated by a branch of the facial nerve, which is given off in the aqueductus Fallopii. The muscle must therefore suffer in lesions of the nerve or in those of a central origin. It does so also in those

due to injury or caries involving the nerve in the first part of its course through the petrous bone. In accordance with the more ordinary views it would be expected that the stapedius would escape in cases of rheumatic facial paralysis, which constitute by far the most frequent and at the same time the most tractable forms of the affection in question. However this may be, and whatever the underlying anatomical conditions, disturbances of hearing are very common in rheumatic facial paralysis, persisting often after the grosser evidences of disease have disappeared, and manifesting especially a tendency to cause troublesome tinnitus. Under these circumstances the electrical treatment of the facial nerve within the bone, and of the stapedius which must at the same time be stimulated, is rationally suggested, and it has been approved by experience. If in a case of facial paralysis from otitis media or from injury or caries involving the aqueductus Fallopii, it be decided to resort to electrical treatment, the best method is galvanization as described for tinnitus with auditory hyperæsthesia, which in most cases coexists. Or with the same electrodes and points of application the faradic current may be substituted for, or used alternately with the galvanic. It is on the whole less apt to give rise to unpleasant sensations. In cases, on the other hand, of a distinctly rheumatic character, where deafness or tinnitus accompanies or persists after paralysis of the facial, the best treatment is that usually employed for the primary lesion. Two electrodes of convenient size are connected with the poles of a galvanic battery. They may be of sponge or of metal, or carbon covered with wash-leather, and should be thoroughly soaked with water holding common salt in solution. These are pressed firmly into the auriculo-mastoid fossæ, and a current of three to eight milliampères is passed for from one to three minutes. At the same sitting, or on alternate sittings, labile galvanization of the entire facial area is practised. A medium anode is applied behind the ear, and the nerve twigs and facial muscles are individually submitted to the kathode (small electrode), which is passed

along their course; 5–6 m.a. current strength will suffice, and the application should not exceed five minutes. This treatment is of undoubted utility, and its efficacy probably depends upon the intimate connection between the nuclei of the fifth and seventh nerves. It is perhaps impossible to stimulate the nucleus of the facial directly, since currents of sufficient strength cannot be borne; but this may be done vigorously, and a current of moderate strength passed through the whole course of the nerve in the manner described above.

Electrical stimulation of the tensor tympani can be very readily and certainly effected. We have seen that paralysis of this muscle is probably of rare occurrence, and that it cannot be certainly diagnosed, but paresis of the tensor tympani is a constant factor in facial paralysis from disease of the facial and trigeminus at the base of the skull, bulbar paralysis, and diphtheria; and in stenosis and occlusion of the Eustachian tube from local causes. In these latter states electrical treatment is of great importance. It is carried out in various ways. It may be stated here that it is seldom necessary or advisable to pass an electrode within the Eustachian tube, and when this has to be done the operation should be confided to a skilled manipulator. In the great majority of cases it is sufficient to place a small conical or sponge electrode from the mouth over the orifice of the Eustachian tube, where it can be easily felt above and behind the soft palate, while the circuit is completed by means of a disc electrode of convenient size held or strapped against the auriculo-mastoid fossa. If the galvanic current be employed the internal electrode should be connected with the negative pole. A current of moderate strength is then passed (5–8 m.a.), and in chronic disease repeated reversals may be tried. Much annoyance may be caused in the process from excessive salivation. This may be checked by applying a small sponge or a pad of lint over the orifice of the parotid duct. The sensibility of the mucous membrane may be allayed by the previous use of the cocaine spray, but

some persons are remarkably tolerant of interference in this situation.

In one syphilitic case of old standing, Dr. Cagney repeatedly passed very strong currents (15–18 m.a.) with benefit, and though salivation was profuse the patient complained of no discomfort. So energetic a measure, however, is not to be recommended. The faradic current may be applied in the same manner as the galvanic, and may be usefully alternated with it. For its strength the sensations of the patient are the best guide.

CHAPTER XXII.

DEAF-MUTISM.

Importance of Attention to the Subject.—Any physician who has had a child brought to him for his opinion as to the probabilities for or against the little one's hearing or speaking, and who has seen the look of agony and despair on a mother's face as she hears her worst fears confirmed, must feel the great importance of the subject of the education of deaf children. In a professional point of view, it is of vital importance that all who are consulted in such cases, where the hearing is either in great part or entirely lost, and the power of speech absent, should be in a position to advise parents as to the best course to pursue in the training of the child; and it is also of vast moment, from a social aspect, that deaf-mutes should be so taught as that they may become fairly useful members of society, and be fitted to fill certain positions and earn a livelihood. The few remarks that we make on this subject are intended merely to draw the attention of practitioners generally to the means which can be adopted to remove in some measure the deplorable consequences of this melancholy affliction.

Time to commence Treatment.—There can be no doubt that the earlier this is begun the better. If with the mutism there are some objective signs of aural disease, these should be attended to while the child is instructed and taught to speak. We have known ourselves a few instances of children who were over four years of age who were gradually taught to speak, while

the hearing was improved by local treatment. Hartmann,[1] Scmaldz,[2] Alt,[3] and others have reported cases of restoration of speech both in cases of acquired mutism and in those of children who could only utter a few words before some local affection such as scarlatinous inflammation attacked the hearing. Alt's case is a remarkable one, as the boy was seven years old and had lost his speech after scarlatina, for a period of four years. He "became very talkative and attended an ordinary school." Hartmann says that, "as a rule, it may be assumed that deafness occurring up to seven years of age will have dumbness as its consequence, while speech is retained if the child be older than that. Still there are cases on record in which children of fourteen and even fifteen years of age have lost their speech by becoming deaf. In such cases it must, however, always remain doubtful whether deafness alone was the cause of the deaf-mutism."

"We will assume," says Tröltsch, "that among the 38,489 deaf-mutes in Germany, only 15,000 were not born with the defect, but acquired it subsequently, and we will surely not be far out if we assert that a fifth of those, viz. 3000, if they had received timely and energetic treatment, would not have become deaf-mute, but at the worst hard of hearing to a high degree, so that they might have made use of ordinary private tuition, or could even have attended the public schools, and would at any rate have retained intelligible speech."

Causes of Deaf-Mutism.

As the principal causes of deaf-mutism, we have consanguineous marriages, heredity, naso-pharyngeal troubles, throat and nose affection, catarrh of the middle ear, suppurative otitis media from scarlatina, exanthemata, cerebral affections (convulsions), injuries. Typhus is regarded by Hartmann as a potent cause. Macnaughton Jones says—

[1] *Hartmann on Deaf-Mutism*, translation by J. P. Cassels, M.D. (Bailliere, Tindall, and Co.).

[2] *Archiv für Augen- und Ohrenheilk.*, vol. vii. p. 211

[3] *Ueber die Taubst.*, p. 105 *a*.

"In the Fever Hospital in Cork (where I treated over six hundred cases of severe typhus fever in patients of all ages) I have never known a case of deaf-mutism arise from this disease while I was attached to the hospital, a period of over eleven years.

"Deafness during the fever, and permanent partial deafness of one or both ears, was the worst result I have seen. I can only call to recollection a few cases of complete deafness after typhus fever, but their speech was not affected."

Elsewhere we have dwelt on the importance of treating naso-pharyngeal troubles in children; this is evident, so far as their effect in causing deafness and resulting loss of speech, from the following statement by Hartmann (*op. cit.*):—

"It has been ascertained by *post-mortem* examinations that inflammations of the middle ear are frequently accompanied by inflammation of the labyrinth. While Moos particularly has shown that the membranous labyrinth is infiltrated with small cells, even in cases of slight inflammation, a number of other observers have proved the existence of an accumulation of pus in the labyrinth in cases of severe inflammation of the middle ear.

"In cases of chronic inflammation of the labyrinth, developed in primary diseases of the ear, or occurring as a consequence of general diseases, hyperæmic swelling, fatty or connective-tissue degeneration, atrophy of the membranous labyrinth, changes in the labyrinthian fluid, and deposits in the same take place. It has already been pointed out, when speaking of congenital deafness, that naso-pharyngeal catarrhs may be the cause of deafness, and that catarrhs, occurring unnoticed in early childhood, may lead to a deafness which is then mistaken for congenital deafness."

As those congenital and acquired conditions of the naso-pharynx and ear, so frequently associated with adenoid growths in the latter situation, are specially prone to produce otitis media, the importance of attention to these tumours in children is manifest.

Pathology.—From Hartmann's table of the results of *post-mortem* examination of deaf-mutes, we select a few examples of the changes found in congenital and acquired deafness in the middle and internal ear:—

(Bochdalek, *vide* Lincke, p. 594.)—Congenital malformation. On both sides the three semicircular canals ending as culs-de-sac, without opening into the vestibule, and the auditory nerves much atrophied. In addition, changes in the tympanic cavity, which had probably taken place after birth.

(Moos, vol. vii. p. 448.)—Congenital, middle ear. Anchylosis of the ossicula with each other; osseous closure of both fenestræ rotundæ; great abundance of otoliths and numerous colloid globules in the labyrinth.

(Cock, *vide* Toynbee's list.)—Not stated if congenital. All the ossicula absent; membranæ tympanorum partially destroyed; in addition, two of the semicircular canals imperfect.

(Schwartz, *Archiv für Ohrenheilkunde*, vol. v. p. 296.)—Acquired. Complete absence of the labyrinth; in the left ear a solid osseous mass in its place, in the right ear a mass of fibrous tissue. Tough mucus in both tympanic cavities. It was stated that deafness had set in in consequence of an inflammation of the brain.

(Politzer, communicated to the second Otological Congress, held at Milan in 1880.)—Acquired. The cavity of the cochlea and the semicircular canals completely filled with a newly formed osseous mass.

The Management of the Deaf-Mute.

We may divide the training of the deaf-mute under two heads :—(1) moral; (2) scholastic.

If the child lives at a distance from a training school, he should be sent to one where he will be treated by teachers of established reputation with kindness and forbearance. This moral training of deaf-mutes is of special importance. While considerable kindness is shown them, they must be made to know the difference between right and wrong; their habits of order and discipline should be carefully attended to. Foolish indulgence is as bad as excess of severity. The general deportment and carriage of the child should be attended to, to prevent the awkwardness in gait and manner so often accompanying deaf-mutism. So should the special senses of sight and touch be cultivated. Companionship is indispensable; it enlivens the spirits, prevents moroseness, helps the cultivation of ideas, brings the child into constant contact with those who hear. Any words uttered before a child has become deaf must be taken note of, and the faculty of speech encouraged in every possible manner. We believe that, for a time at least, every deaf-mute is better away from home influences, and under the care of skilled teachers.

It may be said that in no occupation in life is greater exercise of patience, of gentleness combined with firmness, the happy combination of a pleasant and hopeful manner without any relaxation of discipline, more demanded, than in the teacher of the deaf-mute.

Scholastic Training.—As it happens that a large proportion of mutes do hear sounds, the voice, certain notes, etc., it is evident that an endeavour should be made at all times in children to increase this power. Much may be done at home in this way to train the child.

In every instance, especially when the child is sufficiently intelligent, the parents and friends should be cautioned to persevere in coaxing the child to articulate and copy sounds. The hereditary and congenital aspects of mutism are not to be forgotten, and the intermarrying of near relatives of deaf or mute persons should be discountenanced. But decidedly in all cases where such a step can be taken, the child should be early removed to an institution where the teachers are accustomed to take real trouble, and to give the mute the benefit of a skilled training. As Dr. Turnbull remarks on this matter—

"Congenital deaf-mutes, attending an ordinary school, may learn to write, or rather to copy, and may perhaps get some idea of numbers; but the teachers of such schools do not know how to train their pupils' minds, even if they have the time to teach them. As a rule, such children might as well be at play, except that school occupies their time and their thoughts. Another advantage, however, which is gained for the deaf-mute children is in their mingling as much as possible with those who hear.

"If a child cannot profit by the instruction given in an ordinary school, let him if possible have a private teacher, but not necessarily in his own house, as he is not always subject to the best government there. If he needs stimulating, it may be well to place him in a class with four or five others of a suitable degree of advancement; and if this cannot be done, he may be placed in a school or institution where the instruction is especially adapted to the deaf.

"If children are too deaf to profit by the common school, and yet have sufficient hearing to have acquired speech through the ear, instructors of the deaf are nearly or quite unanimous in the opinion that they should be taught by articulation and lip-reading. The experience of the teachers would lead them to say, 'Let the attempt be made, if possible, to teach *every* deaf child in this way.'"

There can be no doubt that the lip method is the one to adopt in the education of the deaf-mute. In France as much progress has not been made as in Germany, where the results achieved have been wonderful. Taught thus, and if well instructed, he is, as Dr. Hartmann says—

"not at all inferior to his perfect fellow-men; he is able to understand all kinds of writing, and to instruct himself by reading them, he can learn foreign languages, and choose any calling he likes."

In the United States, Turnbull tells us (1880)—

"it has been received and adopted in seven of our forty-eight institutions, and with the most gratifying results. The United States have a 'National College' at Washington, where more advanced studies can be pursued, and where young deaf-mutes are graduated with a standing and scholarship not inferior to that achieved by the graduates of ordinary colleges. This institution bears to others for the deaf and dumb the same relation that colleges bear to schools and academies. Many of the graduates of this college have received appointments as teachers, while others are editors, authors, and writers, or are found in the various government offices, in the exercise of duties which they are quite capable of performing in an entirely satisfactory manner. In the Centennial Exhibition were some admirable pictures executed by deaf-mutes, as well as other products of their pencils and pens. They are also capable handicraftsmen, and are to be found in our shops and factories, as well as in the Industrial Homes founded for their special benefit."

In this country the school for the training of the deaf-mute, under M. von Praagh, has achieved a wide and deserved notoriety, and we speak from personal observation of the results of the admirable system of training in this establishment at Fitzroy Square.[1]

We add, for the information of those who are not acquainted with the method of teaching by the lip, a few illustrations from the method of Bell, which may serve as a guide to the manner in which, even before a child can be removed to a training school, he should be taught.

[1] There is a school for the education of mute children of the upper classes, under the management of Mr. Harry White (from whom full information may be had), at 13, Sinclair Road, Kensington.

We avail ourselves of Turnbull's description of Bell's articulate method :—The foundation of the system rests upon the fact that articulation is simply a *mechanical* process, the result of certain well-defined positions and movements of the vocal organs, together with a more or less forcible expulsion of air from the lungs. Of the former, the sense of vision renders the deaf-mute cognizant; of the latter, his sense of feeling. All mute children are imitative, and it is upon the possession of this faculty, *imitation*, that our success in teaching depends. We proceed, then, at the onset by making simple gestures with the arms, the easier gymnastics, in short; then we walk, look in various directions, sit, stand, etc.

"Having thus engaged the attention, place the child directly in front of you, press your upper teeth in a marked manner upon the lower lip, hold a bit of paper in your hand and blow. He sees the paper fly away, is amused, imitates the process, and has given his first letter, *f*. Again, swell your lips out with air, open them quickly, the paper flutters away; this is *p*. Should it be too forcible or not sufficiently so in forming this letter, then imitate a person smoking a pipe; the *puff*, *puff* conveys the idea of *p*.

"*T*. Place the tongue between the teeth, force the air out so that it will come in one volume, which is best felt on the back of the pupil's hand, and *t* is produced.

"*H* is simply the expiration of breath with slightly increased force, the mouth opened naturally.

"*M*. With closed lips the force of the letter *m* is felt by the pupil, who must apply his finger to the side of his nose; the vibration indicates the rapid expulsion of air from the lungs.

"*N*. In the same manner the mute learns the nasal *n*, but is shown the mouth opened slightly, and the tongue pressing against the back of the upper teeth. The six consonants are the ones perhaps most easily learned.

"*B* is formed like *p*, but is accompanied with sound; the throat is both seen and felt to dilate, and the

expulsion of breath is also less forcible, the puff is gentler.

"*D* resembles *t*, although it is better in the beginning to teach the pupil to place the point of the tongue back of the upper teeth; the vocalization is made apparent as in the case of *b*, also the less decided emission of breath.

"*V* is simply a vocalized *f*, and, as in the case of *z* and the sub-vocal *th*, the vibration is most sensibly perceived by pressing the palm of the pupil's hand upon the crown of your head.

"*O*. The vowel *o* is attended with no difficulty. Place the child's hand firmly on your breast that he may feel the vibration, while he sees your mouth assume the shape of the letter produced.

"*E*. Place the pupil's fist under the angle of the jaw; the peculiar and forcible vibration there felt he readily produces.

"*A*. Press the palm of the pupil's hand against the chest, and show him your tongue firmly set against the lower teeth, and somewhat arched; with this position the letter *a* as in *fate* is produced.

"*I*. To form *i* open the mouth very wide, and, as you produce sound, close it quickly.

"*U* is made like *o*, except that the lips are nearly closed.

"As soon as the pupil has learned the sounds of the vowels, require him to join a consonant with each in succession, making easy syllables, as *fa*, *fe*, *fi*, *fo*, *fu*, and reversing the letters, *af*, *ef*, etc. Next teach him simple words, the names of objects which he can see, or pictures of them which can be shown him, as map, mat, cap, cat, dog, horse, cow, top, etc. The next step is to embody these in the form of a sentence, as 'What is that?' 'That is a cat.' 'What are those?' 'Those are maps.' The point cannot be too strongly insisted upon that the child should write, as well as speak, everything he learns. This constant practice strengthens the memory and insures steady and permanent progress."

Professor Bell recommends "articulating rapidly

combinations containing *and*, *but*, *the*, with a, an, at, etc. He had found that senseless exercises also gave great pleasure to deaf children when the syllables were arranged rhythmically.

"He would therefore recommend teachers of very young deaf children to study such a book as 'Mother Goose,' and to set their articulation exercises to the rhythm of the most favourite rhymes."

We would conclude these observations on deaf-mutism by laying down these axioms for the practitioner's guidance :—

1. In all cases of deaf-mutism exhaust every means of ascertaining the smallest retention of hearing in both ears—try this by various noises, musical tones, the tuning-fork, etc.

2. Critically examine the ear and throat for local causes of deafness, and under any circumstances heal these if present.

3. Begin as early as possible the training of the child, and guide the parents by judicious advice, both as to the moral and mental management.

4. Urge the child being sent to a skilled teacher to learn, or reputed training school.

CHAPTER XXIII.

MALINGERING.

To detect Malingering in Cases of Feigned Deafness.

1. Examine carefully the ear and naso-pharynx for objective evidences of any aural affection.

2. *In Unilateral Deafness.*—The eyes being blindfolded, test with the watch and acoumeter the hearing distance of both ears repeatedly, the person's head being turned in different directions.

3. Place a tuning-fork (Chimani) on the middle of the vertex of the head; ask the person which ear he hears loudest in—the malingerer will, as a rule, affirm that he hears the sound loudest in the healthy ear, or that he can detect little difference, or that he does not hear it at all in the deaf ear; close now the healthy ear, and the malingerer will assert that he does not hear the sound, or only indistinctly.

4. Take a binaural stethoscope (David Coggin), plug one of the soft tubes, so that the sound is prevented from passing through this tube; place now both the ear-pieces in the person's ear, taking care that the plugged tube communicates with the hearing ear; speak to the person through the cup-end of the stethoscope—the malingerer will say he hears; next remove the tube from the hearing ear, and again speak through the stethoscope—the malingerer now says that he does not hear, as the tube has been removed from the sound ear.

5. *In Bilateral Deafness—*

(1) Inquire carefully into the history of the case, mode of onset, and duration of deafness.

(2) Examine both ears carefully, and apply in different methods the various hearing tests.

(3) Find if a loud noise or call will awake the person from sleep (Politzer).

(4) Propose certain operative procedures in the deaf person's presence—such as electricity, puncturing the drum with the cautery ; speak of the painful nature of these steps, watch the expression of the countenance.

(5) Try in every way to take the suspected person unawares.

CHAPTER XXIV.

FORMULÆ.

The following formulæ are inserted here for more easy reference. Further particulars and directions as to their use, with the special indications for each, will be found in the various chapters of the book.

EXTERNAL EAR.

Drops to soften cerumen in meatus previous to syringing.

Bicarbonate of soda, grs. xx.
Glycerine, ʒiv.
Water to ℥i.

Liquor Potassæ, ʒi.
Glycerine, ʒx.

To apply to a dry meatus, with absence of cerumen.

White vaseline,
Lanolin,
Benzoated lard,
Glycerine (equal parts).

Add 1 part in 10 of the red oxide of mercury or white precipitate ointment.

In Eczema of the Auricle.

Ointments.

Lanolated ointment of oxide of zinc.
Lanolin, 2 parts.
Benzoated lard, 1 part.
Almond oil, 1 part.
Rose water, 1 part.
Oxide of zinc, 1 part to 7.

Lanolated ointment of diacetate of lead.

Lanolated ointment of oleate of lead.

Lanolated ointment of oleate of zinc.

Lanolated ointment of ichthyol (5 per cent.).

These are made in the same proportions as the ointment of oxide of zinc.

Ointment of oxide of mercury.

Ointment of nitrate of mercury, 1 part.
Ointment of red oxide of mercury, 1 part.
Ointment of spermaceti, 5 parts.
Almond oil, 1 part.

Ointment of caulmoogra oil.

Caulmoogra oil, 2 parts.
Lanolated zinc ointment, 6 parts.

Carbolized ointment.

Carbolic oil ($\frac{1}{20}$), 1 part.
Lanolated ointment of zinc, or
Caulmoogra oil ointment, 7 parts.

Ointment of iodoform.

Iodoform, 1 part.
Glycerine, 2 parts.
Almond oil, 2 parts.
White vaseline, 10 parts.

with vaniline, 5 grs.; coumarine, grs. v.; or fresh coffee, 1 part, added as deodorizers.

Iodol may be substituted for the iodoform in the above, in which case the deodorants must be omitted.

Ointment of lead and calomel.

Calomel,
Acetate of lead, āā grs. x.
Lanolin, ℥i.

The stimulant or astringent ointments mentioned above may be applied to the meatus with a brush.

Lotions.

Lime water with diacetate of lead.

Solution of diacetate of lead, ʒi.
Lime water, ℥viii.

Calamine lotion (Wilson).

Oxide of zinc, ʒii.
Calamine, ʒiv.
Glycerine, ʒii.
Rose water, ℥viii.

Some of this is used to the raw or moist surface in the daytime, lightly sponged off at night, and the lanolated, simple zinc, or other ointments applied.

Sulpho-carbolate of zinc lotion (grs. iv. ad ℥i).

Liq. carbonis detergens (ʒss.–ʒi. ad ℥i.).

Acetate of lead (gr. i. ad ℥i.).

Carbolic acid, 1 in 500–1000.

Boric acid (grs. x. ad ℥i.).

Calomel (lotio nigra, B. P.).

APPLICATIONS.

Nitrate of silver. Apply lightly after removal of the scab and drying the surface.

Nitrate of silver solution, various strengths, to be applied with a brush.

Chromic acid solution (grs. x.–grs. xx. ad ℥i.).

Carbolic acid with glycerine (℥i. ad ℥i.), to be applied with a cotton-wool holder.

Chloride of zinc solution (grs. xx.–grs. xxx. ad ℥i.).

Iodoform or iodol. To be applied either in powder or in a solution of eucalyptol or ether.

Ointment of iodide of starch.

Iodide of starch, 1 part.
Oxychloride of bismuth, 1 part.
Powdered starch, 6 parts.

To dust a foul surface.

Iodoform and iodide of starch are indicated in syphilitic cases.

In Chronic Eczematous Conditions of the External Meatus.

APPLICATIONS.

Saturated solution of boric acid, 2 parts.
Absolute alcohol, 1 part.
Glycerine, 1 part.

To be applied with the aural probe or cotton-wool holder, or with a stiff camel's-hair brush after cleansing and drying the meatus.

Salicylic acid may be used in the same manner.

Carbolic acid, 1 part.
Absolute alcohol, 1 part.
Glycerine, 4 to 10 parts.

Chromic acid solution (grs. x.–grs. xx. ad ℥i.).

Iodoform or iodol solution (℥i. ad ℥i.).

Ichthyol solution, 10 per cent.

In Purulent Discharges from the Ear.

WASHES OF

Sulpho-carbolate of zinc (grs. iv. ad ℥i.).

Sulphate of zinc (grs. iv. ad ℥i.).

Boric acid (grs. x. ad ℥i.).

Salicylic acid (grs. ii. ad ℥i.).

Chloride of zinc (grs. xx. ad ℥i.).

Carbolic acid, 1 in 500 to 1000.

Permanganate of potash (grs. ii. ad ℥viii.)

Acid perchloride of mercury solution (1 in 5000), acidulated with tartaric acid (grs. iii. ad ℥i.).

Iodic hydrag., 1 in 2000.

Hydronaphthol, 1 in 2000.

Lead and opium (acetate of lead, gr. i.; tinct. opii, ♏xv. ad ℥i.).

Sulphurous acid, 1 in 8.

Hazeline.

These are best ordered in the concentrated form, to be added to a given quantity of *recently boiled water*, and used thus diluted, for example :—Boric acid ʒii., biborate of soda ʒiv., absolute alcohol ℥i., glycerine ℥i., distilled water ℥ii. ʒii.–ʒiv. to be added to the ℥iv. of warm water, and used to wash the ear out with.

Sulpho-carbolate of zinc ʒii., chloride of zinc ʒii., carbolic acid ʒi., absolute alcohol ℥ii., distilled water ℥ii.
To be used in the same manner as the last.

To relieve Pain in the Ear in Otitis externa, Myringitis, or Neuralgia.

Instillations.

Cocaine solution, 10 per cent.

Hydrobromic ether with glycerine, 1 in 7.

Applications.

Chloroform, 9 parts.
Liniment of aconite, 1 part.
Applied to mastoid.

Laudanum, 1 part.
Liniment of belladonna, 1 part.
Applied to mastoid.

Various.

Leeches (2 to 4). Applied to front of tragus.

Fomentation of decoction of poppy-heads and camomile flowers.

The same of laudanum water.

Post-aural vesication or counter-irritation.

Leiter's temperature tube.

Ointment of veratrin. Applied over mastoid.

Hypodermic injection of morphia.

In Aspergillus.

APPLICATIONS.

After disinfectant cleansing of meatus, applications of boric acid in solution with absolute alcohol.

Absolute alcohol and glycerine.

Solution of hypochlorite of lime (grs. ii. ad ℥i.).

Hydronaphthol, 1 in 2000.

INSUFFLATION.

Chinoline salicylate, 1 part.
Boric acid, 15 parts. (Bennett.)

Exostosis in the Meatus.

Application with aural probe of chromic acid (grs. xxx. ad ℥i.).

Nitrate of silver (grs. xx. ad ℥i.).

Chloride of zinc (grs. xxx. ad ℥i.).

Tincture of iodine.

MIDDLE EAR.

Suppurative Conditions of the Tympanum.

LOTIONS.

Warm anodyne and weak and antiseptic lotions :—

Laudanum and decoction of poppy-heads.
Bicarbonate of soda (grs. v. ad ℥i.).
Chloride of ammonium (grs. v. ad ℥i.).
Boric acid (grs. iv. ad ℥i.).
Bichloride of mercury, 1 in 5000.
Permanganate of potash (grs. ii. ad ℥viii.).
Sulpho-carbolate of zinc (grs. ii. ad ℥i.).
Salicylic acid (grs. ii. ad ℥i.).

To be used separately or in combination.

POWDERS FOR INSUFFLATION.

Boric acid.

Salicylic acid, 1 part ; boric acid, 3 parts.

Resorcin, 1 part ; boric acid, 8 parts.

Iodol.

Iodoform.

Washes.

(*See Purulent Discharges*).

Applications to Granulations, etc.

Chromic acid (ʒi. ad ℥i.).

Chloro-acetic acid.

Carbolic acid.

Nitrate of silver (grs. xxx. ad ℥i.).

Absolute alcohol, 1 part; carbolic acid, 1 part; glycerine, 1 part.

Iodoform (5 per cent. in eucalyptol).

To be applied with absorbent wool on the aural probe or cotton-wool holder.

Intra-tympanic Medication in Catarrhal Conditions.

Vapours.

Iodine.
Chloride of ammonium.
Iodoform.
Guaiacol.
Guaiacum.

Some Solutions to be used with the Eustachian Catheter.

Bicarbonate of soda (grs. v. ad ℥i.).

Chloride of ammonium (grs. ii.–grs. v. ad ℥i.).

Iodide of potassium (grs. ii.–grs. iv. ad ℥i.).

Chloride of sodium (grs. v. ad ℥i.).

Embrocations and Counter-Irritants.

To be applied over the mastoid process.

Chloroform, 2 parts.
Spirit of horseradish, 1 part.
Tincture of capsicum, 1 part.
Tincture of aconite, 1 part.

Oil of mustard, 1 part.
Spirit of horseradish, 1 part.
Liniment of chloroform, 2 parts.

Belladonna liniment, 1 part.
Aconite liniment, 1 part.
Camphor liniment, 2 parts.
Chloroform, 1 part.

Iodine, 1 part.
Mastich, 1 part.
Rectified spirit, 8 parts.

An iodine pigment, to apply to the mastoid process; it may be mixed with equal parts of flexile collodion.

Liquor epispasticus (Smith's). To apply to the mastoid with a brush.

Charta epispastica. A small portion cut to shape and applied to the mastoid.

INTERNAL EAR.

Tinnitus Aurium.

Internal Remedies.

FOR RELIEF OF VASCULAR TENSION.

Hydrobromic acid, dil.

Caffeine.

Bromides of potassium and ammonium.

Bromide of zinc.

Bromide of caffeine.

Hydrobromate of cocaine.

Hydrobromic ether, ♏v.
Powder of acacia, grs. xx.
Glycerine, ♏xx.
Water, ℥ss. (Turnbull).

Nitrite of amyl (in capsule).

Nitro-glycerine (in tablet).

Ergotin.

Hydrastin.

Sclerotic acid.

Muriate of pilocarpine, 2 drops of a 2 per cent. solution injected subcutaneously and repeated at intervals, care being taken to promote the action of the skin and prevent any subsequent chill.

Tonics.

Bromide of iron.
Phosphide of zinc.
Quinine.
Strychnine.
Arsenic.

Vascular Tonics.

Digitalis.
Convallaria.

Cholagogues.

Iridin. Euonymim. Hydrarg. cum creta. Podophyllin.	with	Ext. Colocynth Co. Pil. Colocynth Co. or Pil. Rhei Co.

Vegetable Aperient.

Extract of cascara sagrada (liq.), ℥i.
Glycerine, ℥i.
Water, ℥viii.

℥ss. as a dose early in the morning, and a warm drink after.

Tabloids of cascara sagrada (Burroughs and Wellcome).

In Syphilitic Cases.

Mercurial (lanolin) inunction.

Bicyanide or bichloride of mercury (gr. $\frac{1}{12}$).

Tannate of mercury (gr. i.–grs. ii.).

Aix-la-Chapelle, course at.

Pilocarpine injections.

Electricity.

Iodide of potassium or the mixture of the three iodides — potassium, sodium, and ammonium.

In Anæmic Cases.

Salts of iron.

Pyrophosphate of iron (syrup of).

Fellows' and Easton's syrups.

The syrup of the iodide of iron.

Arsenious acid, gr. $\frac{1}{40}$.
Quinine, gr. i.
Sulphate of iron (dry), gr. i.
Extract of gentian, grs. ii. Fiat Pil.

One pill after food three times in the day.

Blaud's pills.

NASO-PHARYNX.

Nasal and Post-Nasal Insufflations

(alone or combined).

Oxychloride of bismuth, gr. ss.–gr. i.
Starch (maize), grs. ii.–grs. iii.

Iodol, gr. ss.
Starch (maize), grs. ii.–grs. iii.

Iodoform, gr. ss.
Starch (maize), grs. ii.–grs. iii.

Tannic acid, gr. ss.–gr. i.
Starch (maize), grs. ii.–grs. iii.

Alum (dry), gr. ss.–gr. i.
Starch (maize), grs. ii.–grs. iii.

Hydrochlorate of morphia, grs. ii.
Acacia powder, ʒii.
Subnitrate of bismuth, ℈i. } (Ferrier's snuff.)

Hydrochlorate of cocaine, grs. x.
Hydrochlorate of morphia, gr. i.
Camphor powder, grs. xx.
Subnitrate of bismuth, ℈i. } (Moore's snuff.)

Camphor.
Tannic acid.
White sugar.
High-dried Welsh snuff (equal parts). } (Dobell's snuff.)

Bismuth, grs. ii.
Morphia, gr. $\frac{1}{12}$.
Starch, grs. iii.

Pharyngeal Insufflations.

Iodol, gr. $\frac{1}{4}$ to gr. ss.
Iodoform, gr. $\frac{1}{4}$ to gr. ss.
Tannic acid, gr. ss.
Oxychloride of bismuth, gr. ss.
Trisnitrate of bismuth, gr. ss.
Catechu, gr. ss.
Kino, gr. ss.
Alum, gr. ss. } Diluted with starch, lycopodium, or both.

Nasal Sprays.

For use with atomizer.

Solutions.

Bicarbonate of soda (grs. x.–grs. xx. ad ℥i.).
Biborate of soda (grs. x. ad ℥i.).
Chloride of sodium (grs. xx.–grs. xxx. ad ℥i.).
Chloride of ammonium (grs. x. ad ℥i.).
Chloride of zinc (grs. ii.–grs. v. ad ℥i.).
Chlorinated soda, liq. sod. chlor. (℥i. in ℥iv.).
Carbolic acid (grs. iii. ad ℥i.).
Alum (grs. ii.–grs. v. ad ℥i.).
Tannic acid (grs. iii.–grs. v. ad ℥i).
Ferro-alumini (gr. i.–grs. ii. ad ℥i.).
Sulpho-carbolate of zinc (grs. ii. ad ℥i.).
Quinine (grs. vi. ad ℥i.).
Boric acid (grs. v. ad ℥i.).
Salicylic acid (grs. ii. ad ℥i.).
Sulphurous acid, 2 per cent.
Cocaine, 4 to 10 per cent.
Permanganate of potash (gr. i. ad ℥i.).
Iodoform in ether (grs. xx. ad ℥i.).
Thymol, 1 in 2000.

The best solvent for volatile oils used in the treatment of nasal disorders is "paroleine"[1] (the fatty paraffin oil), which does not turn rancid by keeping. The proportions for some of these oils are:—

Pinol, 1 in 9 of paroleine.
Thymol, 1 in 9.
Eucalyptol, 1 in 9.
Menthol, 1 in 7 (*vide* pocket menthol inhaler of Macnaughton Jones—text). Burroughs, Wellcome, and Co.
Iodoform, 1 in 60.
Carbolic acid, 1 in 19.
Camphor, 1 in 4.

Adepsin[2] is a useful solvent for menthol.

[1] Burroughs and Wellcome. The ointment atomizer of this firm is referred to and figured in the text.
[2] Corbyn, Stacey, and Co.

An Alkaline Nose-Wash.

Bicarbonate of soda,
Borax, each grs. x.
Carbolic acid, grs. ii.
Water, ℥i.

Watson Williams' Nose-Wash for Rhinitis.

Sod. bicarb.,
Sod. bibor., each ℥i.
Sod. salicyl., gr. i.
Thymol, gr. i.
Menthol, gr. ss.
Glycerine, ℥i.
Water, ℥iii.

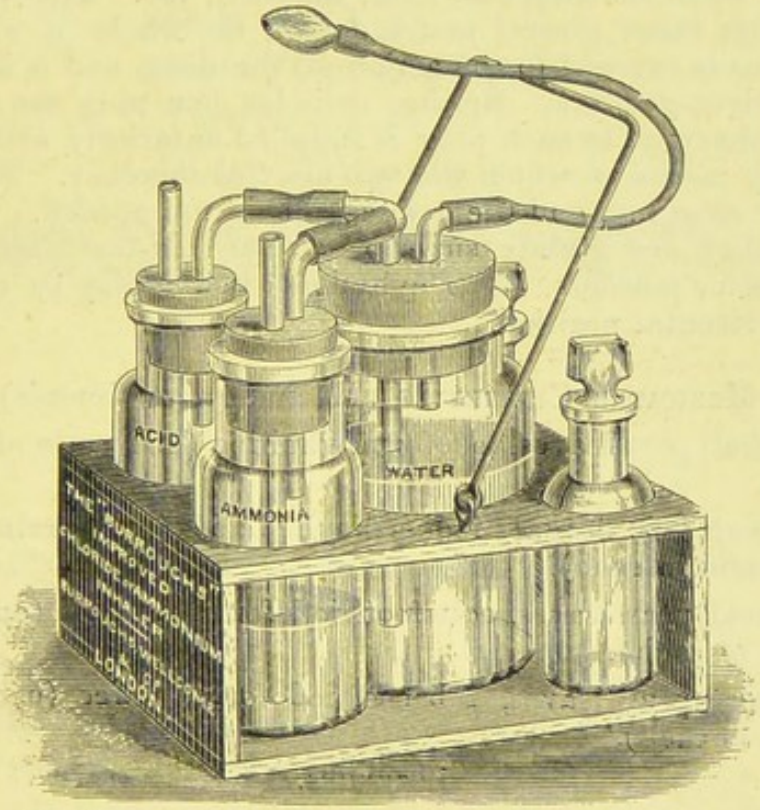


Fig. 149.—Continuous chloride of ammonium inhaler. It is always ready for use, and does not require recharging with the ammonia and acid on each occasion that it is used. Other useful chloride of ammonium inhalers (referred to in text) are Basdon's, Godfrey and Cook's, and Kerr's.

Stronger Topical Remedies for the Nares and Naso-Pharynx.

Chromic acid (grs. x.–grs. xx. ad ℥i.).
Tannic acid (grs. x.–grs. xx. ad ℥i.), with glycerine.
Nitrate of silver (grs. x.–grs. xxx. ad ℥i.).
Chloride of zinc (grs. xx.–grs. xl. ad ℥i.), with glycerine.
Iodoform, in ether (grs. xx.–grs. xxx. ad ℥i.).

Sulphate of copper (grs. xxx. ad ʒi.).

Compound tincture of benzoin and glycerine, equal parts.

Carbolic acid with glycerine, various strengths.

Perchloride of iron (grs. xxx.–ʒi. ad ʒi.).

Boric acid, saturated solution.

Aldehyde and glycerine, equal parts.

Glacial acetic acid.

Lactic acid, 40 per cent. to pure.

Medicated Nasal Cylinders.

These are small hollow glyco-gelatine cylinders, which are inserted into the nasal passages in hollow vulcanite plugs. They are variously medicated with different quantities of such drugs as bismuth, cocaine, iodoform, lead, menthol, etc. The process of liquefaction takes several hours, during the whole of which time the surface is exposed to the action of the drug, and is kept moist by the glyco-gelatine. Neither cylinder nor plug can slip back into the pharynx, as each plug is supplied anteriorly with a small thread, by means of which the two are tied together. There is no caking or clogging, and the respiration is unimpeded. For these reasons they are greatly superior to the old-fashioned bougies, ointments, or powders. The cylinders should only be used while in the horizontal position.

Medicated Cigarettes (Macnaughton Jones's).

1. Eucalyptus leaves, iodoform, vaniline (one grain of iodoform in each).

2. Eucalyptus leaves, iodo-salicylic acid (one grain of iodo-salicylic acid in each).

3. Eucalyptus leaves, coltsfoot, iodoform, vaniline (one grain of iodoform in each).

4. Eucalyptus leaves, tobacco, iodoform, coffee (one grain of iodoform in each).[1]

Lozenges.

The most useful are:—

Compound eucalyptus.

Chlorate of potash.

Kino.

Guaiacum.

Benzoic acid.

Bismuth.

Compressed tablets (Burroughs and Wellcome) of the above can be substituted.

[1] Corbyn, Stacey, and Co.

Pastiles.

Each of the above agents may be had of any chemist in the form of soft jujube or pastile (made with glyco-gelatine); they are softer than the lozenges, and are at times to be preferred.

Pastiles of cocaine are useful in some cases of painful throat affection.

Messrs. Burroughs and Wellcome have made, at Macnaughton Jones's suggestion, *soluble* tabloids, each containing—

Cocaine mur., $\frac{1}{6}$ gr.
Borax, $2\frac{1}{2}$ grs.
Menthol, $\frac{1}{50}$ gr.
Sodium chloride, 7 grs.
Boric acid, $\frac{3}{4}$ gr.
Sodium benzoate, $\frac{1}{2}$ gr.
Thymol, $\frac{1}{100}$ gr.
Ol. gaultheriæ, min. $\frac{1}{20}$.

These tabloids are most useful in catarrhal states of the nose and pharynx or larynx—one dissolved in an ounce of water as a spray.

GARGLES.

Pharynx and Naso-Pharynx.

To use with Steam Atomizers in water at a temperature of 140°–150°.

Thymol, 1 in 2000.

Terpinol (min. xv. ad ℥x.).

Eucalyptol (min. xv. ad ℥x.).

Ol. pin. sylvestris (min. xv.–min. xx. ad ℥x.).

Tincture of iodine (min. xx. ad ℥x.).

Compound tincture of benzoin (min. xxx. ad ℥x.).

Camphorated spirit (min. xxx. ad ℥x.).

Aqua camph. concent. (Corbyn) mixes well with water, and may be used as a basis for other inhalants (℥ii. ad ℥x.).

Carbolic acid (min. xv.–min. xx. ad ℥x.).

Creosote (min. x. ad ℥x.).

[1] We can recommend Wallich's inhaler (Fig. 152), in which the handle is perforated so as to permit the passage of air through the inhalant. It is not necessary to retain the sponge which is placed in the cap.

Light carbonate of magnesia may be added to suspend the oils in water thus :—

R. Ol. eucalypti,
Ol. pin. syl. (vel terpinol), āā 3i.
Magnes. carb. lev., 3i.
Aq. camph. concent., ℥i.
Aquam, ad ℥iv.

3ss. added to the half-pint of water at 150° for steam atomizing or inhalation in Spencer Thompson's naso-oral jug inhaler (see text).

Vaporoles for Inhalation, Fumigation, and Aural Use.

Messrs. Burroughs, Wellcome, and Co. have manufactured small capsules, containing each the necessary quantity of medicament to be employed in inhalation. This is of great service in prescribing for private patients. In using the vaporoles for inhalation, the capsule is first crushed, and then dropped into the inhaler. Each capsule is protected by a thin layer of cotton wool, and enclosed in a silk cover. This is a very elegant means of prescribing inhalations. The list of those prepared by Messrs. Burroughs, Wellcome, and Co. is as follows :—

Fig. 150.—Nasal vaporole.

1. Vaporole carbolic acid, 20 minims.
2. Vaporole ether, 30 minims.
3. Vaporole amyl nitrite, 5 minims.
4. Vaporole tinct. benzoin co., 30 minims.
5. Vaporole chloroform, 30 minims.
6. Vaporole creosote, 10 minims.
7. Vaporole cubebs and lemon, 5 minims.
8. Vaporole iodine tinct., 10 minims.
9. Vaporole juniper, $2\frac{1}{2}$ minims.
10. Vaporole terebene, 10 minims.
11. Vaporole pinol, 10 minims.
12. Vaporole eucalyptol, 10 minims.
13. Vaporole pini sylvestris, 5 minims.
14. Vaporole ol. calamini, 1 minim.
15. Vaporole iodoform c̄ Pinol (aural).
16. Vaporole iodoform c̄ eucalyptol (aural).
17. Vaporole tinct. iodi, 10 minims (aural).

At Macnaughton Jones's suggestion, Messrs. Burroughs and Wellcome made aural and nasal vaporoles, containing tincture of iodine, solution of iodoform in eucalyptol, and of iodoform in pinol. These, for aural purposes, should be gently crushed, squeezed into the required shape, and inserted into the external meatus, where they may remain all night.

Fig. 151.—Aural vaporole.

The gelatine ovoids of Grüber are made by Bullock and Co., and are very useful.

Fig. 152.—Wallich's inhaler (Burroughs, Wellcome, and Co.).

INDEX.

INDEX OF AUTHORS.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.