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A MANUAL OF DISEASES OF THE EAR

BY
Purdey
GEORGE P. FIELD, M.R.C.S.,

*Aural Surgeon to St. Mary's Hospital and Lecturer on Aural Surgery and Dean of
the Medical School.*

FOURTH EDITION.

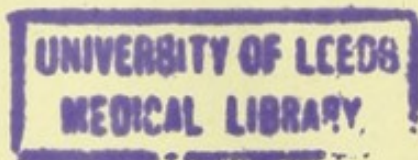
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PREFACE TO THE FOURTH EDITION.

IN the present volume the essentially important advances made in otology since the issue of the last edition have been duly noted. The author takes this opportunity of thanking Dr. William Hill, his colleague in the Aural Department at St. Mary's Hospital, for his invaluable help in the revision of the work, Dr. Cagney, for his section on the use of the constant or galvanic current, and Mr. J. J. Clarke, Pathologist at St. Mary's, for the great trouble and care with which he has executed the new drawings, most of them from specimens in the Museum of St. Mary's Hospital or from recent dissections.

The sale of the three thousand copies comprising the last edition of this work tends to show that treatises on Aural Surgery are needed by the profession, and encourages the author to believe that the labour bestowed upon this new issue will not have been in vain.

34, *Wimpole Street*,
Cavendish Square, W.,
November, 1892.



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PREFACE TO THE FIRST EDITION.

MUCH of the substance of this work has been already published in the various Medical Journals, and I hope that it may prove of service to those students and Practitioners of Medicine who may occasionally require a few hints when called upon to treat Aural Disease.

I have endeavoured to place before the reader, as concisely as possible, the result not only of my own experience, but also that of other Aural Surgeons, both British and Foreign, many of whom have considerably advanced the knowledge of Ear Diseases and greatly facilitated the relief and cure of deafness.

The Hospital to which I belong was the first in this Metropolis to appoint an Aural Surgeon upon its Medical Staff; and the good example set by the Governors of St. Mary's was followed by most of the Medical Schools in this country.

St. Mary's Hospital numbers amongst its Aural Surgeons several men who have made great strides in the pathology and treatment of Deafness, and I may mention my predecessors, Toynbee, Ernest Hart, and Peter Allen, as notable examples of conscientious workers in this field of Surgery.

To Mr. Hinton, under whose guidance I formerly studied this particular branch of Surgery, I here record my sincere gratitude.

June, 1876.

EXTRACT FROM PREFACE TO THE SECOND EDITION.

The coloured plates and woodcuts for the most part are the

work of Mr. E. Noble Smith, and the writer is much indebted to him for his faithful delineation of the different forms of disease.

It is suggested that the coloured plates of the *Membrana Tympani* should be looked at through an aural speculum, as by this means a more accurate conception is formed.

April, 1879.

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DISEASES OF THE EAR.

CHAPTER I.

ANATOMY OF THE EAR.

IN order that the practitioner may be enabled to appreciate the meaning and value of the various symptoms which spring from pathological changes in the different parts of the organ of hearing, a practical knowledge of the anatomy of the healthy ear must be premised. The relative position of adjoining and neighbouring structures must be kept constantly in view; nor should it be forgotten that areas which are apparently distant from the seat of disease may yet be in close anatomical relationship through the medium of nervous, vascular, lymphatic, or other connection.

The following brief description of the ear, whilst laying no claim to scientific merit, may yet be of value in recalling or suggesting certain anatomical details to some few of those who may not be disinclined to dip further into the pages on "Diseases of the Ear."

The organ of hearing consists of three distinct parts, named from their relative position the external, middle, and internal ear.

THE EXTERNAL EAR.

The external ear commences in the expanded pinna, which consists of yellow cartilage covered by delicate skin. By this trumpet-shaped expansion many, but by no means all, of the sound-waves are collected, to be conducted by the column of air

in the external meatus down to the parchment of the drum (middle ear), the membrana tympani.

Darwin considered that the whole of the auricle is merely vestigial in man, representing various folds and prominences which in the lower animals strengthen and support the ear. (*Descent of Man*.) The late Mr. Toynbee also, after considerable investigation, held this opinion; and in a case of rodent ulcer for which my colleague, Mr. Edmund Owen, removed the whole of the pinna, the sense of hearing did not appear to be in the least diminished by the operation.

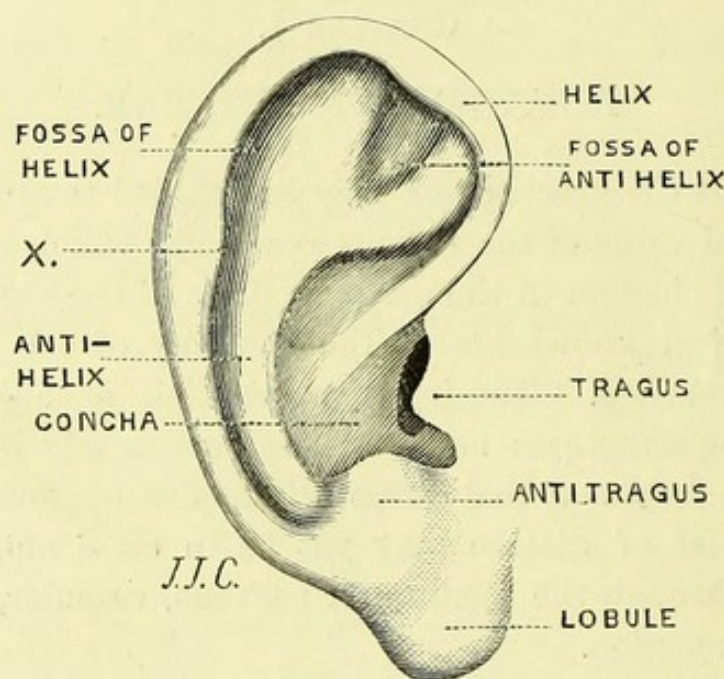


FIG. 1.—The Pinna.

The helix commences above the external auditory orifice, and, taking a spiral course round the upper and posterior margins of the auricle, is lost on the posterior upper part of the lobule. In front of the helix and parallel to it is another ridge, the antihelix. It commences by two crura which bound the (scaphoid) fossa behind the anterior end of the helix, and terminates immediately above the lobule and below the external orifice as a small mound or tubercle, the antitragus. The antihelix forms the posterior boundary of the concha, a well-marked fossa or depression which leads to the external meatus in front. The concha is in point of size and function the most important part

of the auricle. The sweat and sebaceous glands are most numerous in this part of the auricle; they increase in number as they approach the meatus, where the ceruminous (modified sweat) glands secrete a substance which, mixed with the sebaceous secretion, constitutes ear-wax or cerumen. In front of the external meatus and separated from the antitragus by a notch is a small lobe, projecting outwards—the tragus. The significance of these structures will be commented on in the chapter on Physiology.

The intrinsic and extrinsic muscular bands in connection with the human ear are, beyond all doubt, but rudimentary, though persons are occasionally found in whom the power of moving the pinna persists. It is an interesting fact that, the more nearly the shape of the ear of the quadrumana approaches that of man, the less developed do these proper muscles become.

From an error or arrest in the development of the human ear, the pointed pinna now and then, though rarely, recurs. The appearance thus presented is highly suggestive of the existence of a certain, though perhaps distant, ancestral relationship between man and the anthropoid apes.

The margin of the pinna or helix “obviously consists of the extreme margin of the ear folded inwards,” whilst the small pointed projection which is tilted forwards from it represents the apex or tip of the primitive ear of certain lower animals (Darwin). This little blunt point, marked “x” in Fig. 1, stands strangely outwards in some men, and is doubtless a reversion to the primitive type of ear; it was curled upwards and forwards in those statues in which the ancients gave us their idea of the fabulous sylvan deities.

The skin of the external ear, though thin, is so closely connected with the cartilaginous framework that abscesses beneath it are usually small and painful; and a cut through the pinna heals but slowly on account of the presence of the cartilage. The lobule, the most dependent part of the external ear, contains no cartilage: it is composed of skin and connective tissue, and is but poorly supplied with nerves and vessels, but contains much fat. The old-fashioned advice to pierce the lobule and insert an ear-ring for the cure of weak eyes (chronic ophthalmia)

probably had its origin in the fact that counter-irritation near the orbit relieves, in some derivative way, the conjunctival congestion.

Short thick hairs at the entrance of the external auditory meatus guard it somewhat against the intrusion of insects and floating foreign bodies generally, as at the anterior nares. The wax secreted by the glands of the canal-wall keeps the integument from drying and chapping.

The delicate skin between the re-entering angle of the pinna and the mastoid process is frequently the seat (especially in children) of intertrigo or eczema. The latter condition not infrequently gives rise to enlargement of the lymphatic gland over or below the mastoid process. The presence of this lymphatic gland should be borne in mind: it is often the seat of abscess from impetigo capitis. It may also take on a chronic enlargement, like the glands under the sterno-mastoid or, indeed, in any other region.

A small branch of the pneumogastric nerve (Arnold's) is here distributed. This is the twig which the alderman stimulates after dinner with the corner of his napkin dipped in rose water, so causing the stomach to hurry on the digestive process with renewed energy.

The external auditory meatus is about three-quarters of an inch long, and starting from the depths of the pinna (concha), between the condyle of the jaw and the mastoid process, passes at first a little upwards and then slightly downwards, until it reaches the tympanic membrane. The main course of the canal, like that of the petrous portion of the temporal bone itself, is inwards and slightly forwards. Like an hour glass, it is somewhat smaller at the middle than at either end; so that the surgeon may experience considerable difficulty in getting a cherry-stone or a pea at its inner end back through the straits. The cul-de-sac being considerably larger than the foreign body, this will lie loosely, and will not set up nearly so much inflammation as if it were tightly jammed at the narrower part of the meatus.

The external meatus is partly bony, partly cartilaginous. The latter is a split tubular inward prolongation of the auricle with

its upper wall shorter than the lower; it normally presents two or more small circumferential fissures (of Santorini) which require to be borne in mind from the fact that pus occasionally finds its way through one of these fissures from a suppurating parotid into the meatus. The upper and back part of the cartilaginous meatus is completed into a tube by membrane.

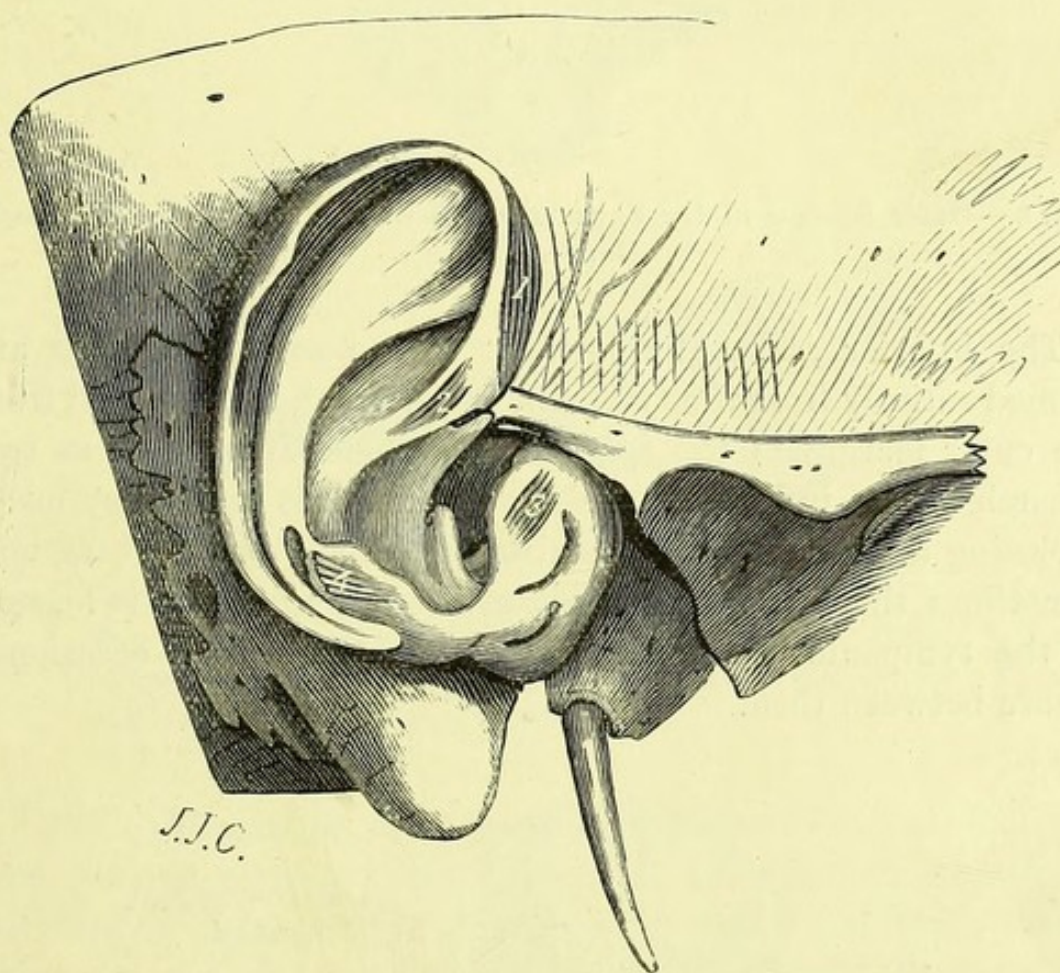


FIG. 2.—The Cartilage of the Ear, attached to the Right Temporal Bone.
1, Musc. Helicis Major; 2, Musc. Helicis Minor; 3, Musc. Tragicus;
4, Musc. Antitragicus.

The accompanying drawing shows the cartilage of the pinna and its continuation, which forms the cartilaginous meatus. The latter is deficient above, whilst below it ends in a blunt point which fits in the angle between the mastoid process and the margin of the bony meatus.

The largest portion of the bony part of the meatus is developed from a separate centre of ossification—the tympanic bone—which appears in the foetus as a delicate osseous horse-

shoe-shaped mass with the gap looking upwards. Within this incomplete ring as a frame, the tympanic membrane is stretched.

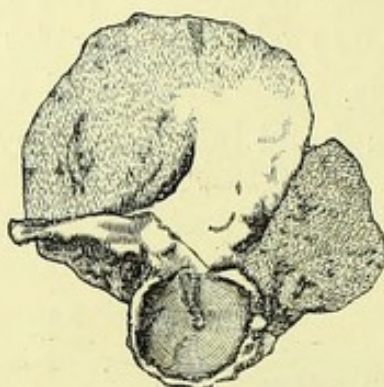


FIG. 3.—Outer Surface of the Squamo-zygomatic Portion of the Temporal Bone at birth.

The inferior and anterior walls of the osseous meatus are formed entirely from the tympanic bone, which is developed from the outer margin of the tympanic ring, starting thence as two tubercles (*a*, *p*, in Fig. 4) which grow outwards until they meet, enclosing a foramen which persists to the age of five years, and sometimes through life; the posterior wall in adults is formed by the tympanic and squamosal bones; there is an occasional fissure between them.

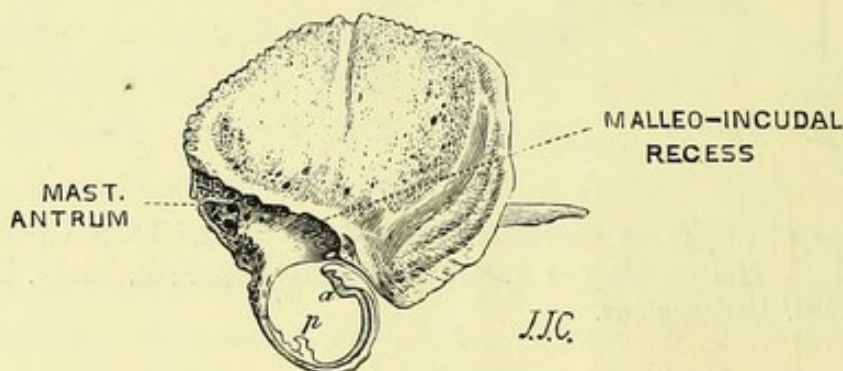


FIG. 4.—The inner surface of the left temporal bone of a nine-months foetus. The tympanic ring is well seen, and on it the groove for the insertion of the membrane, and the two tubercles (*a* and *p*), in which the outgrowth of the ring begins. In the first year the two processes unite externally, leaving up to the end of the fourth or fifth year a foramen in the bony meatus.

The meatus is lined with a layer of true skin. This is a mere invagination of the integument, which is thick and strong in

the cartilaginous portion of the meatus, thinner in the osseous. Sweat or ceruminous glands and sebaceous glands are confined almost entirely to the cartilaginous portion of the meatus, and hairs to the outer portion only of this tube.

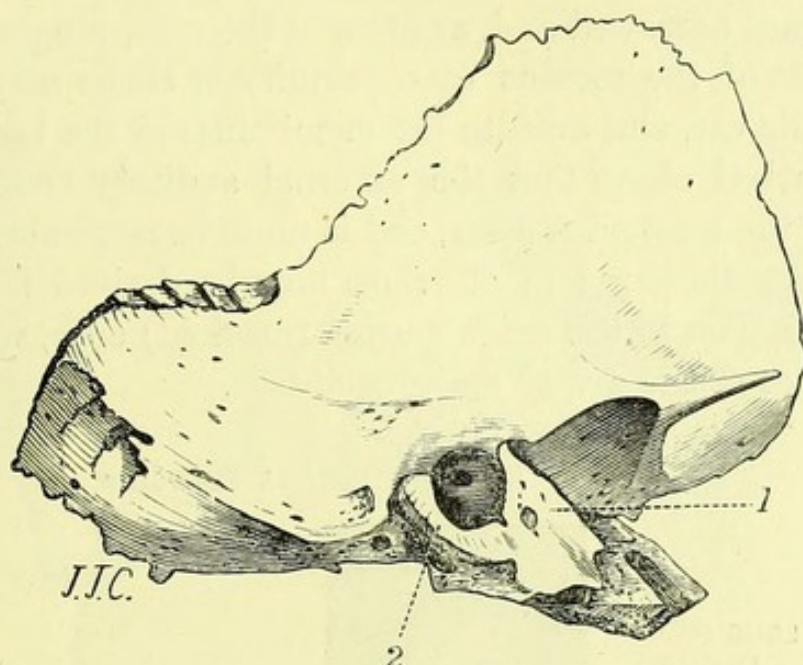


FIG. 5.—The Outer Surface of the Right Temporal Bone of a Child aged Two Years, showing a Foramen in the Tympanic Bone. 1, on the tympanic bone, refers to the part derived from the anterior; 2, to the part derived from the posterior tubercle.

The cartilaginous meatus measures about half an inch, and the osseous portion three-quarters of an inch. It is described by Sappey as an irregular narrowing canal directed forwards and inwards—inwards, backwards, and upwards—inwards, forwards, and downwards in the first and second quarters and in the second half of its course respectively. If, however, the pinna and with it the cartilaginous portion of the canal be drawn upwards and backwards, the canal will be straightened to a great extent, and will be seen to pass nearly directly forwards, inwards, and slightly downwards. It is flattened from before backwards externally, and from above downwards internally, being narrowest towards the middle. There is often a marked projection or angle at the junction of the cartilaginous and bony meatus, and in order to see round this corner in inspecting the membrane it is sometimes necessary to use the

speculum point as a lever against this angle in addition to pulling the auricle up and back.

This passage frequently suffers from a chronic inflammation which causes it to become thickened and to secrete much wax, and also to proliferate epidermal scales to excess. Thus the canal becomes narrowed and, as often is the case, plugged.

Erysipelas of the meatus by continuity of tissue may spread to the middle ear, and even to the membranes of the brain.

We remarked above that the external auditory meatus runs in front of the mastoid process, and it must be remembered that the purulent discharge in otorrhœa may be derived from sup-puration going on in the neighbouring (mastoid) cells, which, as we shall later see, is a very grave condition.

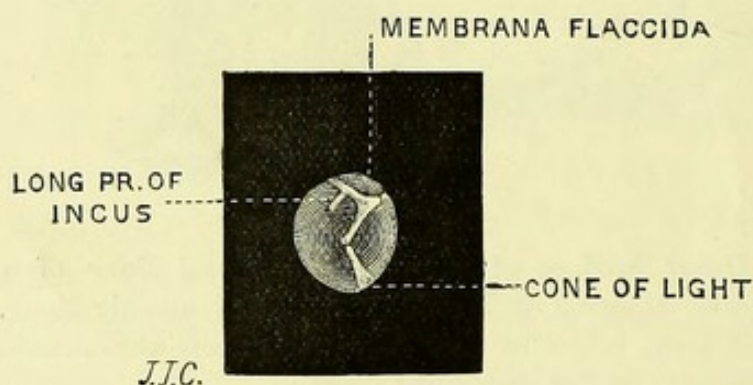


FIG. 6.—The Tympanic Membrane (nat. size).

The *tympanic membrane* slants somewhat downwards and forwards at the bottom of the external auditory meatus, and its surface looks outwards and slightly downwards and forwards. The slope will be better understood by inspection, when it will be seen that the membrane makes an angle of 140° with the upper and with the back wall of the meatus, and an angle of from 40° to 45° with the inferior and anterior wall. When healthy it is pearly white, and so translucent that the handle of the hammer (malleus) may be seen running downwards and backwards across its inner surface. Dragged inwards by the hammer, the membrane is concave on the outer surface, and convex on the tympanic side. The deepest part of the concavity is called the umbo. There are, however, present small outward bulgings at the situation of the cone of light, the short process of

the malleus, and at the anterior and posterior folds. The direction of the handle of the malleus being downwards and back-

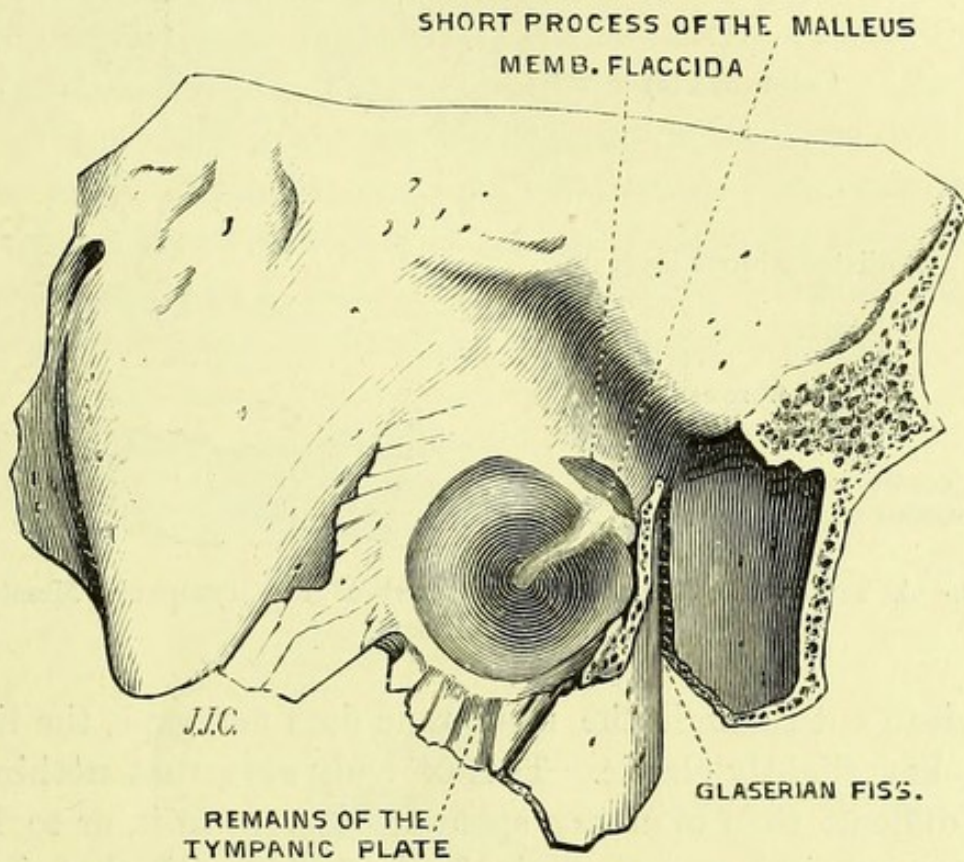


FIG. 7.—Outer Surface of the Tympanic Membrane (twice nat. size). The portion attached to the Rivinian segment above the handle of the malleus is known as Schrapnell's Membrane or the Membrana Flacida.

wards, the cone of light extends, at right angles, to it from the umbo, downwards and forwards. It is composed of three layers, of which the middle is the strongest, being made of radiating and circular fibres. The outer layer is derived from the epidermis which lines the meatus throughout. Post-mortem soaking of the ear enables the dissector to remove the epidermis of the meatus (including that from the membrane) like the finger of a glove. The other side of the membrane is covered by the delicate mucous membrane of hypoblastic origin which lines the middle ear.

The membrane derives a small arterial supply from the vessels of the meatus; also two twigs from the stylo-mastoid branch of the posterior auricular, or from some other tympanic artery, run into the inner surface along the handle of the hammer.

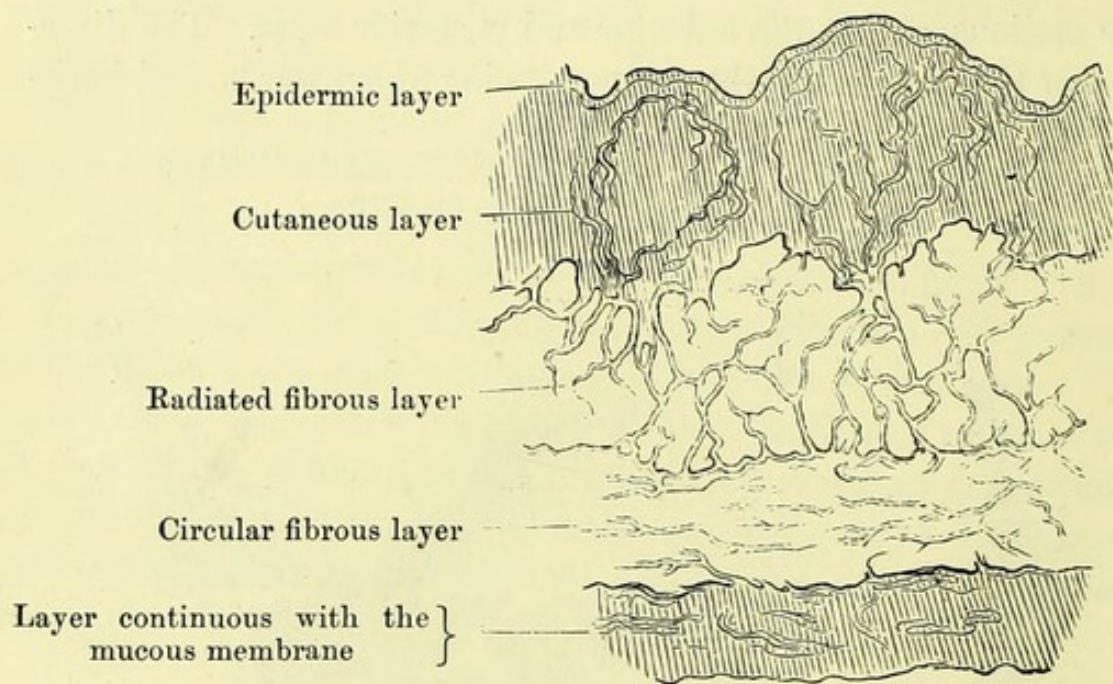


FIG. 8.—A Transverse Section through part of the Tympanic Membrane. After Politzer.

A clean cut through the membrane does not gape, the tissue being but slightly elastic. Tillaux truly says that nothing is more difficult than to close a spontaneous rent in it, or to keep patent a surgical wound made, for instance, with the view of insuring a free exit of pus.

THE MIDDLE EAR.

The tympanum, or middle ear, is a small air-chamber excavated in the substance of the petrous portion of the temporal bone, and ventilated from the pharynx by the Eustachian tube.

It is developmentally a diverticulum from the pharyngeal portion of the alimentary tract, and its columnar ciliated cell lining is hypoblastic in origin. It is situated between the membrane and the internal ear, and measures about a quarter of an inch across. It is rather larger in the antero-posterior measurement, and it communicates behind with the air-cells in the mastoid process. In front of it ascends the internal carotid artery, separated from the cavity by a thin layer of bone only. At the anterior part the Eustachian tube and the tensor tympani enter.

The roof the tympanum is formed of an extremely thin layer of bone which separates it from the cranial cavity. In young

children the bone here often presents a deficiency in the shape either of a foramen or fissure, the dura mater being continuous with the lining membrane of the tympanum, and there is a free blood communication between the latter cavity and the interior of the cranium. The importance of this point will be considered when discussing the spread of inflammation from the middle ear to the brain. From the superior wall delicate ligaments descend to suspend the two outer of the chain of ear bones (hammer and anvil). This region, seen above the chorda tympani, Fig. 9, is named the tympanic "attic" or malleo-incudal recess.

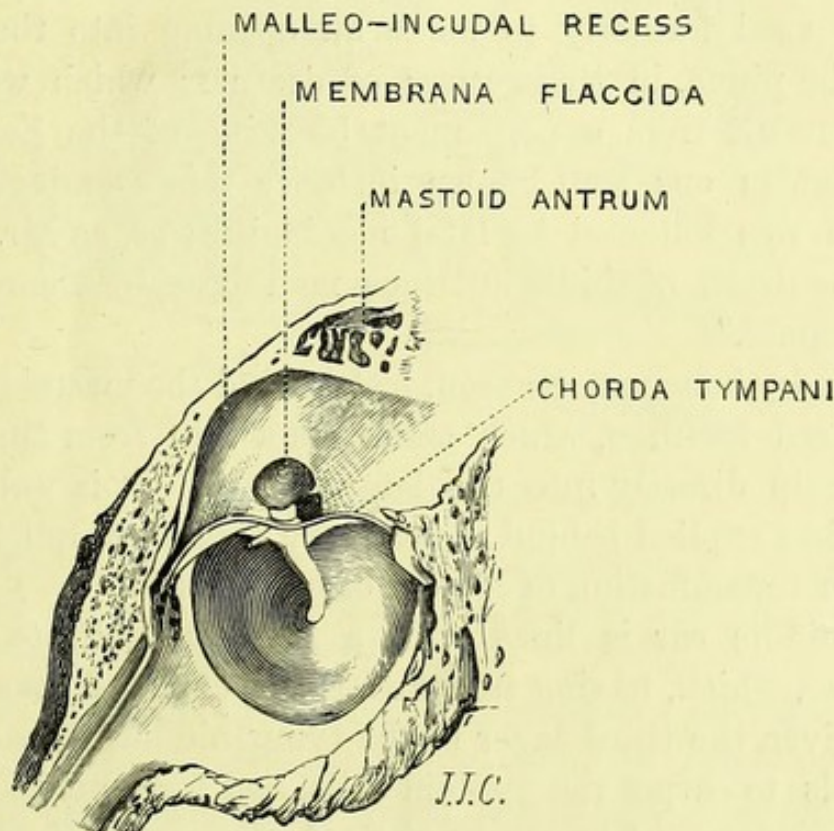


FIG. 9.—The Inner Surface of the Tympanic Membrane and Malleo-incudal Recess or "Attic" (twice nat. size). The Head of the Malleus has been cut away.

The floor of the cavity is composed of a stratum of bone which roofs in the jugular fossa.

Thus the six sides of the middle ear are found to possess relations of the greatest importance, both to the anatomist and the surgeon. Fractures of the base of the skull, extending through the tympanic cavity, may rend the internal carotid artery or the internal jugular vein, and so give rise to fatal hæmorrhage from

the external ear; or caries, the result of an inflammation, may cause the same disaster. Again, an otitis may be followed by an inflammation of the jugular vein, which may give rise to a fatal thrombosis; or the pathological condition may spread to the eighth pair of nerves (glosso-pharyngeal, pneumogastric, and spinal accessory), as they pass through the jugular foramen, and may so implicate them and the regions to which they are distributed as to produce a series of otherwise unaccountable symptoms.

Taking advantage of the superficial situation of the mastoid air-cells, and of their communication with the middle ear, surgeons used formerly to make an opening into them, from behind the pinna, in those cases of deafness which were supposed to result from a permanent blocking of the Eustachian tube. But in one well-known instance this seemingly slight operation was followed by fatal meningitis; so, as Mr. Holden says, "the death of this illustrious man brought the operation into disrepute."

On the dry bone may be seen, just behind the mastoid process, a good-sized foramen, which transmits a vein from that region of the scalp directly into the lateral sinus. It is well known that leeches applied behind the ear may give great relief in congestion or inflammation of the ear or of the brain.

The middle ear is lined with a firm but delicate mucous membrane, which, having surrounded the chain of ossicles, and having given the third layer to the tympanic membrane, passes backwards to carpet the mastoid cells, and forwards to line the Eustachian tube. The continuity of the walls of the tube, again, with the lining of the throat affords a ready explanation why otitis may follow on inflammation of the pharynx. The epithelium is squamous (Kölliker) and ciliated; but it is asserted that cilia are nowhere found on that part of the mucous lining which covers the tympanic membrane.

THE MASTOID ANTRUM.

The mastoid antrum is an air chamber situated behind and above the tympanum, with which it communicates by a cleft

which at birth usually measures $\frac{1}{4}$ inch vertically by $\frac{1}{8}$ inch transversely. It is well developed in the latter part of foetal life. See Fig. 4. The cavity is nearly always present. Thus

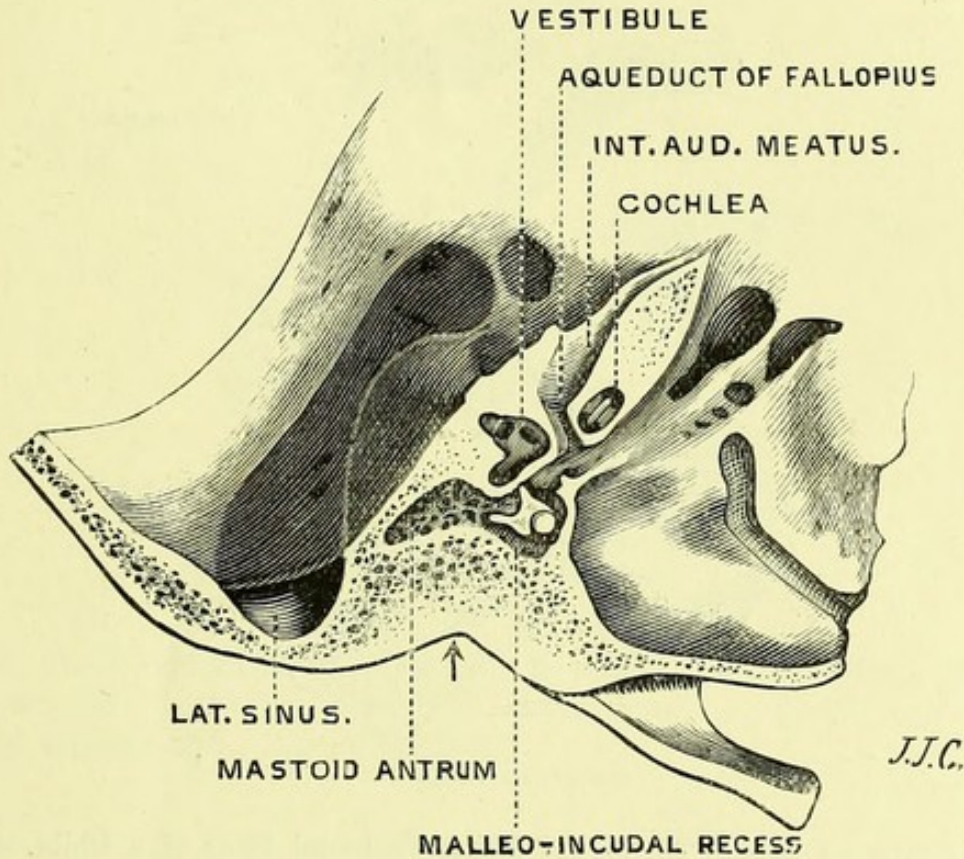


FIG. 10.—Horizontal Section of the Right Temporal Bone of a Woman, æt. 56. From a specimen in the Museum of St. Mary's Hospital. The arrow points to the external meatus.

Professor Birmingham* found it to be absent only once in one hundred bones. It varies greatly in size. It is well seen in the horizontal sections Figs. 10 and 11, which also show its relations to the lateral sinus and the cerebellar fossa. Figs. 15 and 16 show its connection with the mastoid cells. The antrum is lined with mucous membrane, and in infancy is often filled with mucus. In chronic mastoid disease the radical treatment consists in drilling an opening into the antrum. Fig. 12 shows how little space there may be between the posterior border of the bony margin of the meatus and position of the lateral sinus; hence the rule in drilling is to keep the instrument close to the posterior border of the

* "Papers on the Mastoid Region of the Temporal Bone;" *Dublin Journal of Medical Science*, 1891.

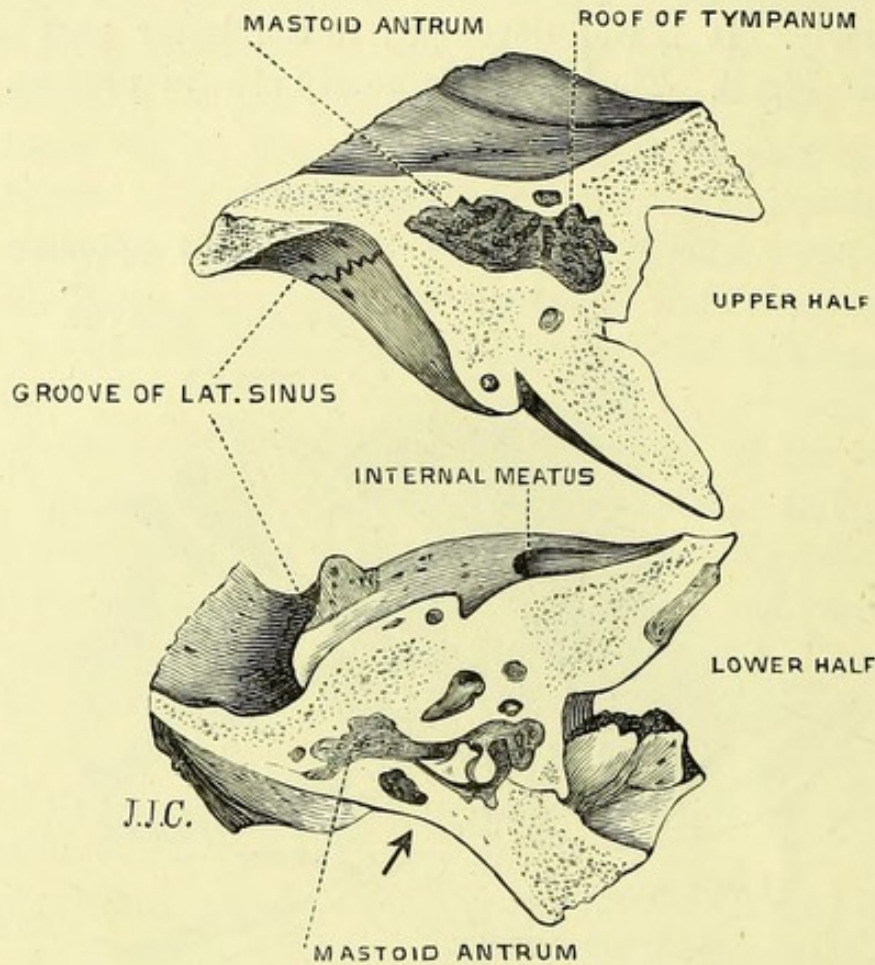


FIG. 11.—Horizontal Section of the Right Temporal Bone of a Child, æt. 3. From a specimen in the Museum of St. Mary's Hospital. The arrow points to the external meatus.

meatus and close below a horizontal line drawn along the upper margin of the same. It must be remembered that in children the antrum is as a rule (see Fig. 11), above the latter level, so that the drill must be either placed just above the horizontal line, or directed a little upwards if it is placed below. Professor Birmingham* finds that the distance of the antrum from the surface of the bone varies in adults from $\frac{9}{16}$ inch to $\frac{7}{8}$ inch. In infants the bone over it is extremely thin. As the result of disease the antrum may become greatly enlarged. See Fig. 13.

* *Loc. cit. supra.*

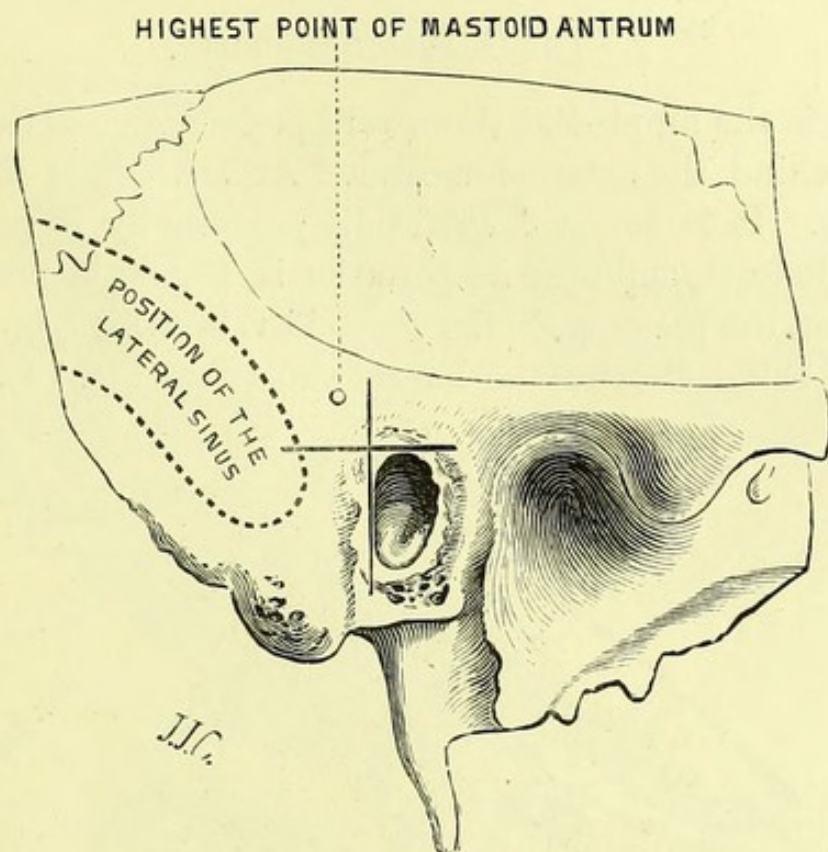


FIG. 12.—Outer Surface of the right Temporal Bone of a youth aged 15 years, showing the Position of the Lateral Sinus, &c. From a specimen in the Museum of St. Mary's Hospital.

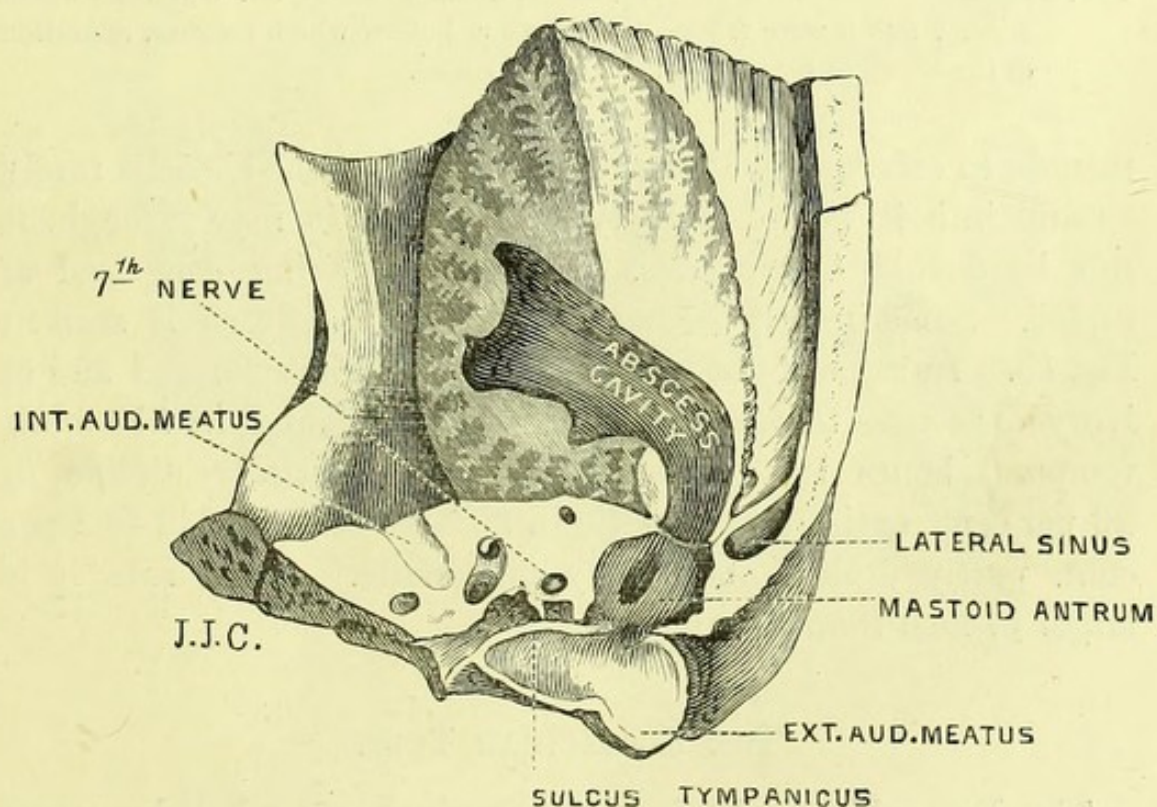


FIG. 13.—Horizontal Section showing a dilated Mastoid Antrum communicating with a Cerebellar Abscess. St. Mary's Hospital Museum, No. 746.

THE MASTOID PROCESS.

This is the nipple-like downward prolongation of the temporal bone behind the external meatus. At birth it is insignificant in size. It is rounded externally; internally it presents the digastric fossa, and near its posterior border is the mastoid foramen for the passage of the mastoid vein, which is sometimes dilated before it joins the lateral sinus (see Fig. 14). It com-

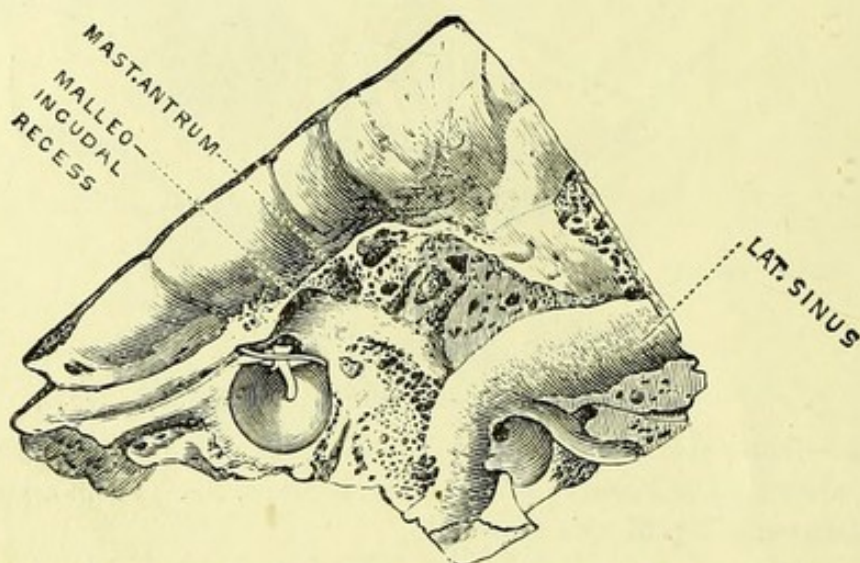


FIG. 14.—Inner Surface of a Preparation from a Child *æt.* 6; from which Figs. 7 and 9 were taken. It shows a hollow which lodges a dilatation of the Sigmoid portion of the Lateral Sinus.

mences to enlarge about the second year, but the air cells rarely extend into it before puberty, and indeed it may throughout life be devoid of air cells, its substance being composed of diploë. Sometimes it becomes highly pneumatic, as is seen in Fig. 15. In cases of chronic disease it may be sclerosed and of ivory denseness throughout. Zuckerkandl found in 250 adult temporal bones the mastoid process was entirely diploic in 20 per cent., entirely pneumatic in 36·8 per cent., and in 43·2 per cent. partly diploic and partly pneumatic. As a rule it is larger in men than in women.

THE EUSTACHIAN TUBE.

The Eustachian tube is about one inch and a half long, and runs from the junction of the squamous and petrous portions

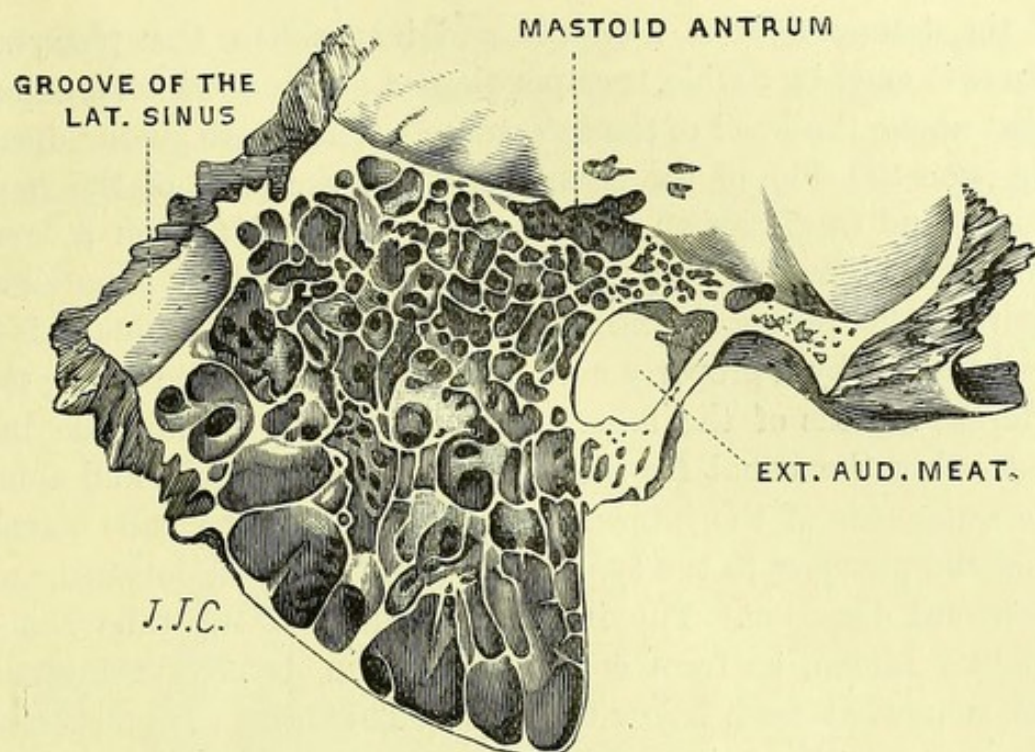


FIG. 15.—A Highly Pneumatic Mastoid Process, from a specimen in the Museum of St. Mary's Hospital.

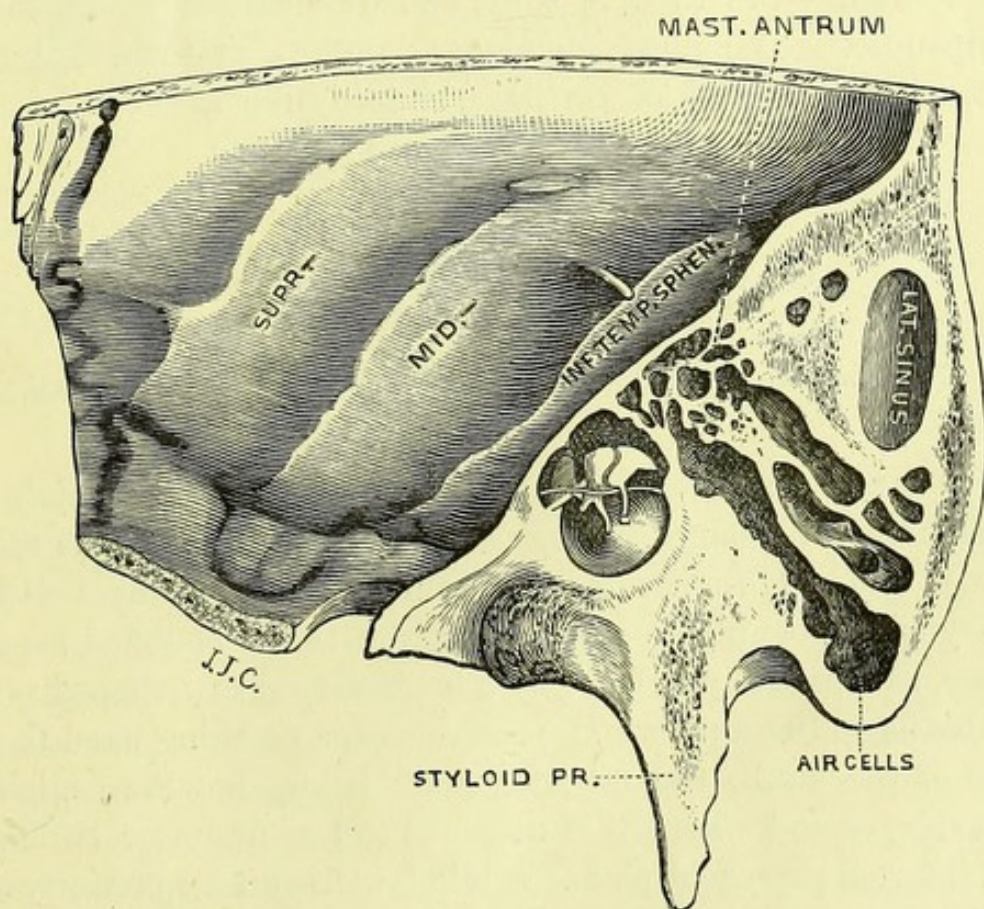


FIG. 16.—A drawing taken from a preparation in the Museum of St. Mary's Hospital. It shows the Mastoid Cells and their connection with the Mastoid Antrum. The Attic is well shown above the Chorda Tympani.

of the temporal bone forwards and inwards to the pharynx, where it ends by a wide, trumpet-shaped aperture which is somewhat above the level of the soft palate. The cartilaginous opening is on the side of the pharynx, above the level of the hard palate, and from half an inch to an inch behind, and on a level with, the inferior turbinal, though it is occasionally situated as high as the posterior extremity of the middle turbinal; it is easily found by a properly curved catheter introduced along the inferior meatus of the nose. The bony part of the tube lies just below the canal for the tensor tympani muscle, and along the outer side of the internal carotid artery. The tube passes from the pharynx to the tympanum in an upward, outward, and backward direction. The inner two-thirds of the tube has a slit-like lumen, as from compression from before backwards, and somewhat from below upwards. This lumen is greatest at the pharyngeal opening, and narrowest at about the junction of the inner two-thirds with the outer third; from this point—the isthmus—the tube is bony, and widens to expand into the tympanum. The inner and longer portion of the canal consists of a framework of cartilage, shaped like a slit tube; the

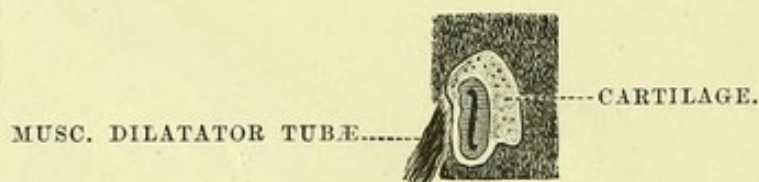


FIG. 17.—Cross Section of the Cartilaginous Portion of the Eustachian Tube (nat. size).

deficiency in the tube below and somewhat in front, which increases as the pharynx is neared, is filled in by mucous membrane and fibro-muscular structures. The trumpet-shaped pharyngeal opening is seen on section to be bounded behind, above, and partially in front by a hook-shaped or *f*-shaped scroll of cartilage, the upper and posterior aspects being fixed to the base of the skull, the anterior hook being, however, slightly movable, except where it is attached to the posterior border of the internal pterygoid plate. It is below the hook, anteriorly and inferiorly, that the tube is completed by membrane. It is only at the ostium pharyngis and at the isthmus that this membrano-

cartilaginous portion of the tube is normally patent; in the intermediate area the mucous surfaces are in contact, and in section the nearly obliterated lumen appears as an *f*-shaped slit. This arrangement is of importance in regulating the supply of air to

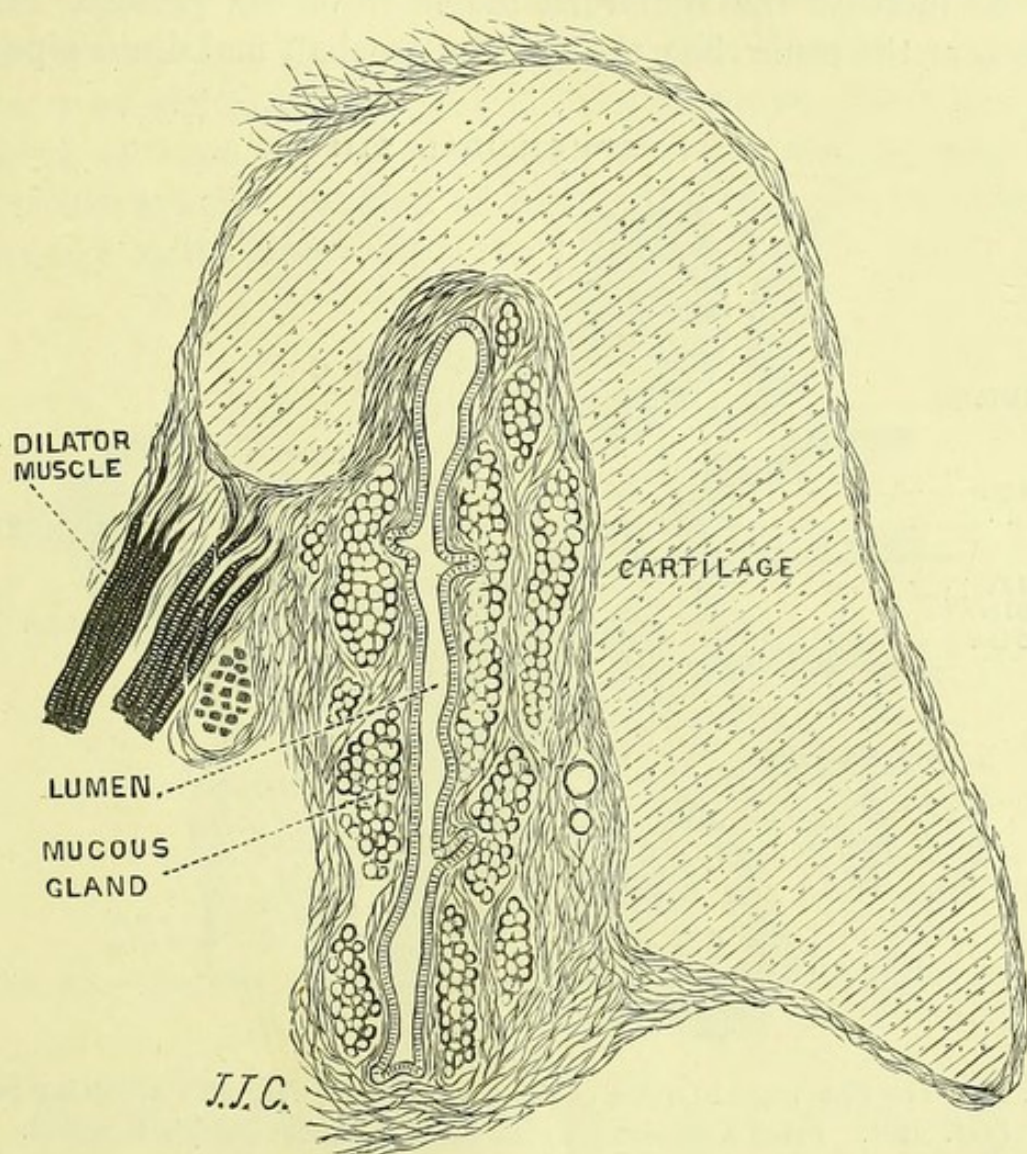


FIG. 18.—Transverse Section of the Eustachian Tube near the pharyngeal extremity, showing numerous mucous glands. Magnified 9 diameters.

the tympanum, for it is a potential valvular apparatus, which is only released by the action of part of the tensor palati (more appropriately named by Rüdinger von Tröltzsch the dilator tubæ) which is attached to the membranous wall and into the hook-like portion of the cartilage; this muscle directly pulls down the latter, and partially unrolls the hook during its contraction in ordinary swallowing, in the production of certain articulate sounds, and in other muscular procedures, such as

the Valsalva or Toynbee experiment. It is probable that the levator palati helps the tensor, for it runs parallel at its origin to the membranous part of the tube, and, when acting in conjunction with it, would appear to be able to heave up the floor and so increase the transverse diameter of the passage. The tube is at the same time the ventilating shaft and drain pipe of

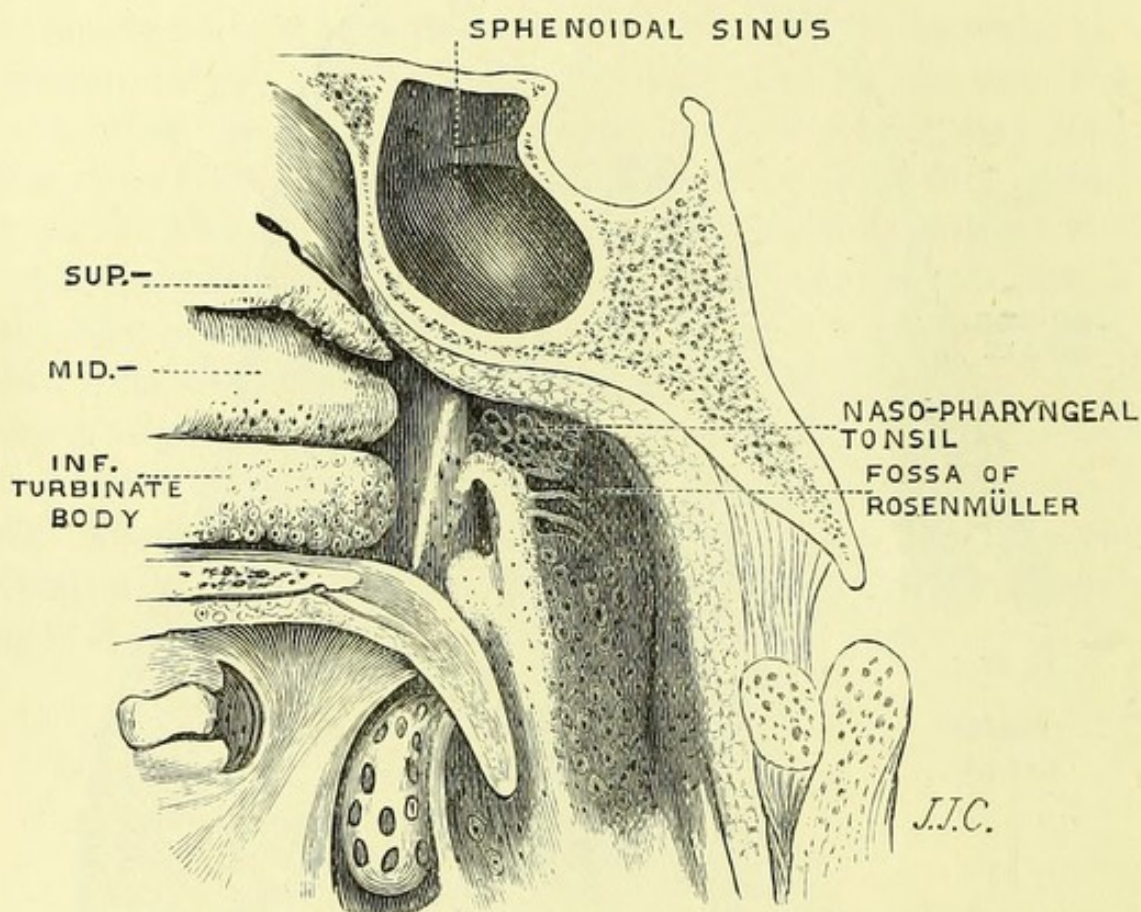


FIG. 19.—The Pharyngeal Orifice of the Eustachian Tube, with adjoining parts (nat. size). From a specimen in the Museum of St. Mary's Hospital.

the tympanic chamber, and, as will be seen, is very liable to get out of order, either from morbid swelling and other changes of the mucous lining, or from paretic conditions of its dilator muscles.

Politzer draws attention to the fact that the Eustachian canal in the child differs considerably as regards length, width, and direction from the adult. Its tympanic orifice is comparatively large, and lies somewhat lower; on the other hand, the pharyngeal orifice is indicated only by a slight depression or fissure, and the posterior cartilaginous swelling (which forms a promi-

ment tubercle or hump in the adult) forms a mere projection in the pharynx. There is a good deal of lymphoid tissue aggregated around the pharyngeal orifice, which has been named the tubal tonsil, and when this tissue is hypertrophied, as is often the case in young subjects who suffer from nasal and nasopharyngeal catarrh, adenoid growths, and hypertrophied tonsils generally, the tubal orifice may be prejudicially narrowed. This lymphoid tissue is more or less continuous with the nasopharyngeal, or Luschka's, tonsil situated at the vault of the pharynx between the two Eustachian orifices.

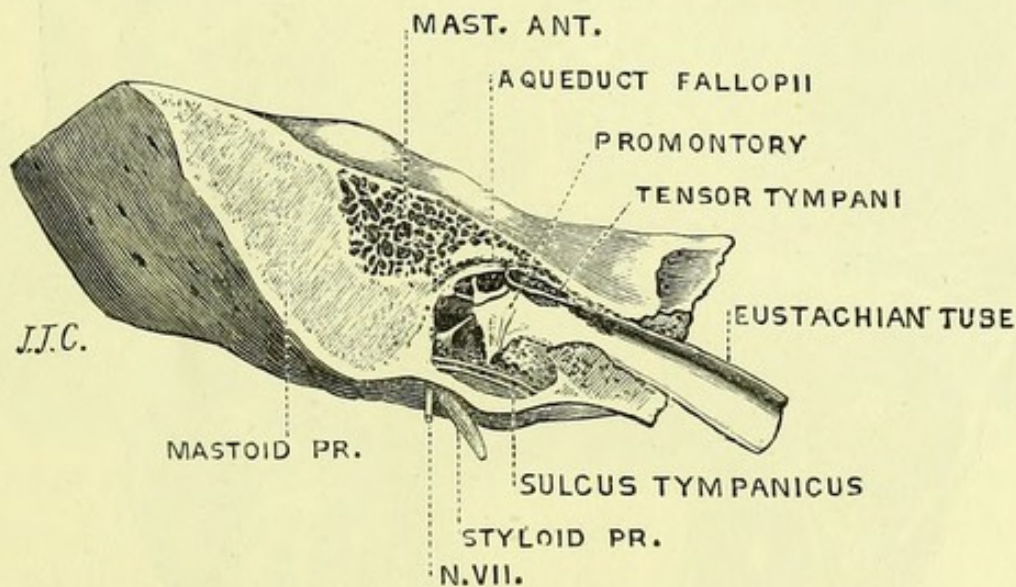


FIG. 20.—The Inner Wall of the Tympanum of a Child of one year, with Eustachian Tube, &c.

Fig. 21, showing the head in oblique section, will serve to give an idea of the relations of the ear to neighbouring structures.

Having thus shortly described the position and connections of the middle chamber of the ear, we must now proceed to examine it and its contents more in detail; and for this purpose it will be well to commence with an account of

THE TYMPANIC OSSICLES.

These three small bones are swung across the cavity as a short chain from the outer to the inner wall. They are happily named

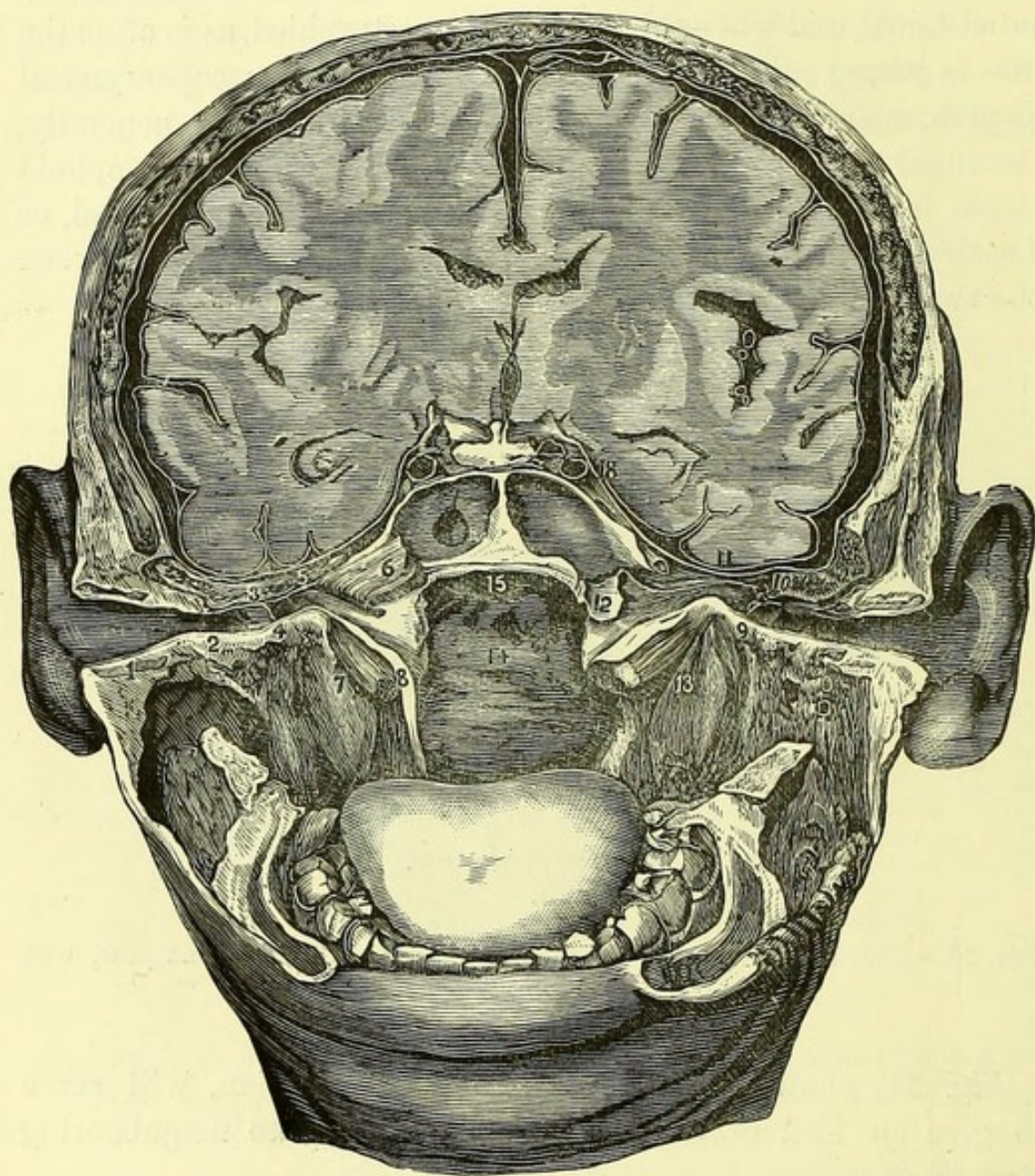


FIG. 21. — Section through the head, showing the auditory canal, drum, drum-head, and Eustachian tube of each side. 1, cartilage of the external auditory canal; 2, bony portion of external auditory canal; 3, 4, drum-membrane of the right side; 5, drum-cavity; 6, dilator muscle of the Eustachian tube; 7, 13, muscles which lift the soft palate; 8, mucous membrane of the pharyngeal orifice of the tube; 9, drum-membrane of the left side; 10, hammer bone; 11, muscle which renders the drum-membrane tense; 12, mucous membrane of the Eustachian tube; 14, 15, mucous membrane of the posterior surface of the pharynx. After Rüdinger.

from their configuration, the hammer, the anvil, and stirrup; by their oscillation they transmit the vibrations of the tympanic membrane to the fluid in the internal ear. As we have already noticed, the mucous membrane of the tympanum is wrapped around the ossicles, and it provides each with its periosteal covering and nervous and vascular supply.

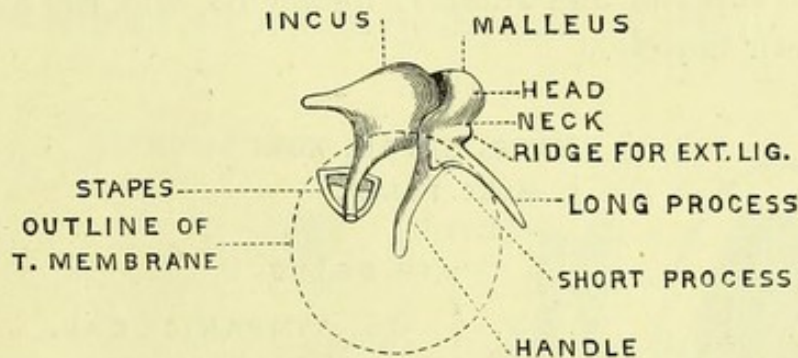


FIG. 22.—A diagram showing the Ossicles and the outline of the Tympanic Membrane seen from the outer side. After Holden.

The hammer-bone (malleus) has a head, handle, and two processes. The head is rounded, and presents a smooth depression for articulation with the crown of the anvil; the connection between these bones is secured by a delicate capsular ligament, and is lubricated by a synovial membrane. The handle is curved like an italic *f*, and lies imbedded between the inner

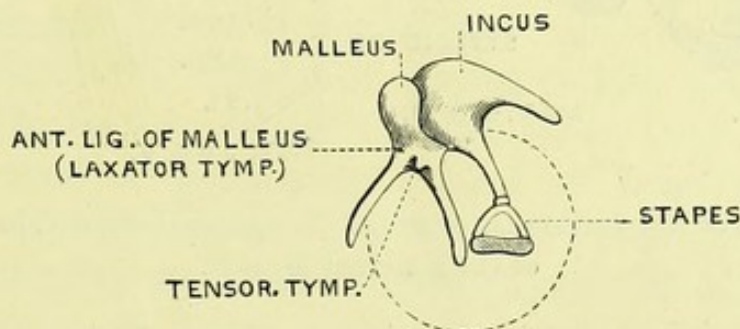


FIG. 23 —A diagram showing the Ossicles and the outline of the Tympanic Membrane seen from the inner aspect. After Holden.

and middle layers and in the upper and anterior part of the circle of the tympanic membrane. The long and slender process of the hammer runs downwards and forwards, from near where the handle joins the head, to lose itself in the Glaserian

fissure. (It is generally broken by the dissector in his attempt to remove the bone.) It receives at its base the insertion of the laxator tympani, which is often described as a small muscle, but is a ligamentous band, part of the anterior ligament of the malleus, attached to the spine of the sphenoid bone. In the drawing (Fig. 24) of a vertical section passing through the fore part of the tympanum the malleus is seen with its slender process, its superior and anterior ligaments, and the attachment of the tensor muscle.

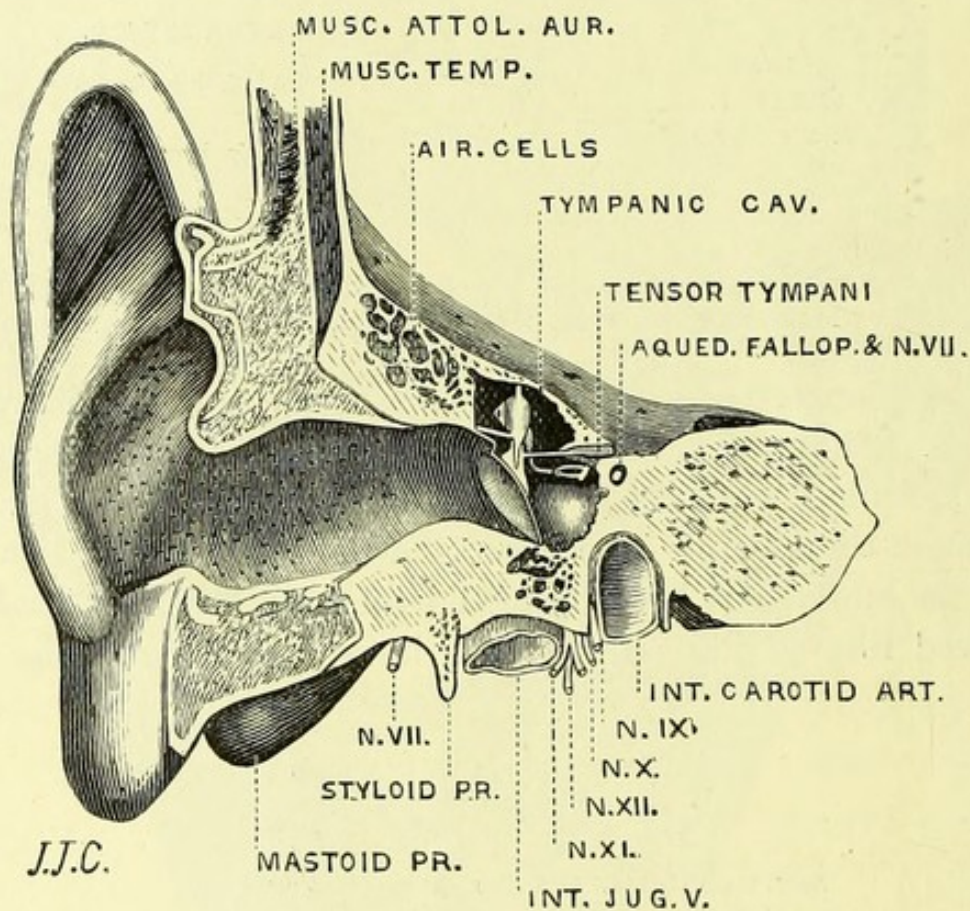


FIG. 24.—A Vertical Section through the Temporal Bone, &c., in the direction of the External Meatus.

The anvil-bone (incus) has a body, with the surface of which articulates the head of the hammer (the opposed aspects being coated with cartilage), and two processes; of these the shorter runs horizontally backwards into an aperture in the mastoid cells, and is there fixed by a ligament. The "long" process passes downwards almost in the direction of the handle of the hammer, and ends in a minute button, "os orbiculare," some-

times a separate bone, which articulates with the head of the stirrup by a capsule and synovial membrane.

The stapes is exactly like a stirrup. Its head is connected with the tip of the long process of the incus, and from it the crura, or arms, pass down to an oval plate of bone, which nearly fills up a similarly shaped aperture (fenestra ovalis) on the inner wall of the tympanum. On the other side of the foot-plate of the stirrup is the fluid (perilymph) of the internal ear,

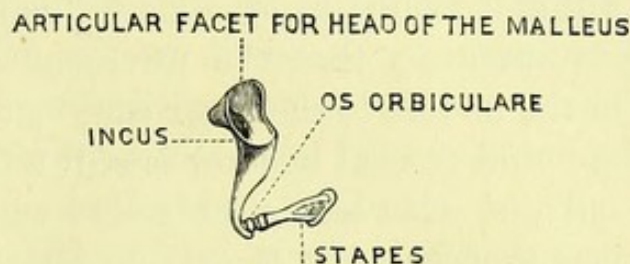


FIG. 25.—After Holden.

or labyrinth. We have thus traced the connection between the tympanic membrane and the fluid in the internal ear through the oscillating chain of bones.

Modern anatomists admit only two muscles in connection with the tympanic ossicles, both tensors—one the special tensor tympani, the other the stapedius.

The former muscle arises in the bony canal in which it is lodged, and from the exterior of the Eustachian tube, and its tendon, passing to the front of the middle ear, bends suddenly outwards around a spoon-shaped piece of bone (processus cochleariformis), to be inserted near the root of the handle of the hammer. Dragging the hammer inwards, and with it the membrane, it renders the latter more tense and indrawn. It is supplied by a branch of nerve from the otic ganglion.

The stapedius, a small muscle, arises in a hollow pyramidal process at the back of the tympanum, and passing forwards is inserted into the head of the stapes. It probably regulates the pressure of the stapes on the labyrinthine fluid. It is supplied by a branch of the facial nerve.

Now turning our attention to the bony wall which separates

the tympanum from the internal ear, we notice upon it an elevation, the promontory caused by the bulging outwards of the first turn of the cochlea, a part of the internal ear. Above it, on the dry bone, is the small oval opening—fenestra ovalis—which is blocked chiefly by the base of the stirrup. It opens into that part of the internal ear which is called the vestibule. Below and behind the promontory is another opening, the fenestra rotunda, which looks into the cochlea; as there is no process of bone from any of the ossicles to block up this round window, it is occupied by a thin “membrana secundaria” only.

It is by these apertures that the waves of sound can be transmitted from the middle to the inner ear; but whether they pass through the round or oval window is still a disputed point. If by the oval only, of what use is the round window? Probably the vibrations propagated by the stapes set the fluid of the internal ear in quivering movement, and increased pressure finds vent by pushing outwards with synchronous throbs the pliable tissue blocking up the round window.

Upon the promontory are fine grooves for the filaments of the tympanic plexus, a delicate interlacement between a branch of the glosso-pharyngeal nerve (Jacobson's) and sympathetic twigs derived from the nervi molles on the neighbouring internal carotid artery. One branch of the tympanic plexus eventually reaches the otic ganglion.

Above the oval foramen is a ridge which marks the course of the subjacent facial nerve in the aqueduct of Fallopius (see page 188). Just before the nerve leaves the lower aperture (stylo-mastoid foramen) of its bony canal it gives off a slender thread-like branch (chorda tympani), which, entering the back of the middle ear by a small foramen, passes across the tympanic membrane to an aperture near the Glaserian fissure, through which it courses on to join the gustatory nerve. As it runs through the tympanum it is situated between the handle of the hammer and the long process of the incus, and it is wrapped up in a fold of the mucous membrane of the middle ear. Leaving the gustatory nerve, the chorda tympani afterwards supplies the submaxillary ganglion, and one of the intrinsic muscles of the tongue (lingualis superior). Another nerve, the importance

of which has, apparently, been lost sight of by otologists, is a small recurrent branch of the inferior maxillary nerve which supplies the mastoid cells principally. This nerve serves to explain the association of mastoid pain and diseased teeth.

The arteries of the tympanum are small twigs derived from the internal carotid, the internal maxillary, the stylo-mastoid, and the middle meningeal. The veins terminate in the middle meningeal trunk and external jugular, and in the neighbouring intracranial sinuses. The close connection of the veins with these sinuses has to be borne in mind, for in suppurative lesions, and especially in carious disease of the tympanum, phlebitis, thrombosis, and pyæmic processes are very liable to extend to the adjacent venous channels, and fatal erosion and hæmorrhage from the internal carotid is not unknown.

This subject will receive further attention in the chapter dealing with intracranial complications in ear disease.

The internal ear is a labyrinth tunnelled out in the petrous portion of the temporal bone, and is situated at the bottom of the internal auditory meatus. It consists of three parts—the cochlea, the vestibule, and the semicircular canals, in that order from before backwards. On the outer side it communicates with the tympanic cavity (in the dry bone) through the round and oval foramina. The vestibule (situated in the middle) communicates with the cochlea in front by the *apertura scalæ vestibuli*, and with the semicircular canals behind. It is about one-fifth of an inch in each measurement. Small foramina are found on its inner wall, which transmit twigs of the auditory nerve into the vestibule from the bottom of the internal auditory meatus. These minute perforations are situated in a small round pit, which is called the *fovea hemispherica*. On the roof of the vestibule is another slight excavation, the *fovea hemielliptica*.

The semicircular canals, three in number, are hard-walled, osseous tunnels, situated in the petrous bone. They are shaped like horse-shoes, and open by each end into the back of the vestibule. They are arranged at right angles to each other, just as the floor, the end, and the adjoining side of a box are at right angles to each other.

The superior canal ascends in the antero-posterior plane to

such an extent as to cause a bulging on the upper surface of the petrous bone in the middle cranial fossa. The posterior also rises vertically, and, as it occupies the transverse plane, it runs at right angles to the superior. The external canal is situated in the depths between the others, and passing outwards lies horizontally; it is the shortest of the three. Now, as these canals all open into the vestibule, we should expect to find six small apertures; but there are only five, because the superior and posterior canals have their adjoining ends merged into a common opening.

One end of each canal is dilated into an "ampulla," the name of which is that given by the Romans to the big-bellied jug in which they kept wine.

In section the lumen of the bony portion of a semicircular canal is seen to be oval, and to be lined with periosteum. Within it is the membranous canal, having a much smaller lumen, and held *in situ* by its ligaments. Its wall consists, as Rüdinger has shown, of the following four layers: (1) connective tissue, most externally; (2) a homogeneous substance; (3) papillæ, not everywhere seen; (4) lining epithelium. McBride gives an account of an osseous semicircular canal presenting a section angular instead of oval in one part, with a reticular tissue occupying the space between its lining periosteum and the membranous canal.*

The cochlea is well named from its resemblance to a snail-shell; it is placed horizontally in front of the vestibule, its base lying against the bottom of the internal auditory meatus. Examined in detail, it is found to consist of a central axis, the modiolus, around which a tubular canal takes two turns and a half, diminishing as it ascends.† The axis is large and conical, and contains filaments of the auditory nerve, which it has received from the bottom of the internal meatus; but these do not ascend further than the level of the second turn, for there the axis becomes very slender, and, expanding like a funnel, loses itself in the tip of the cochlea. A slender spiral shelf

* See *Journ. Anat. and Physiol.*, vol. 14, 198.

† The Latin word "modiolus" signified a bucket or the stock or nave of a wheel.

(lamina spiralis) runs from the axis half-way across the tube ; and from the lower border of its peripheral margin a delicate fibrous layer, *membrana basilaris*, is continued on to the outer wall of the cochlea. Thus the spiral tube is divided into two galleries, an upper and a lower, of which the latter (in the dry bone) opens into the tympanum by the *fenestra rotunda*, whilst the former, even in the living subject, communicates with the vestibule by the *apertura scalæ vestibuli*, which we have noticed above. As the lamina spiralis does not pass into the last half-turn of the cochlear tube, the tympanic and vestibular galleries there communicate ; the space where they join is called the *helicotrema* (ἑλιξ, ἑλικος, coil ; τρήμα, perforation).

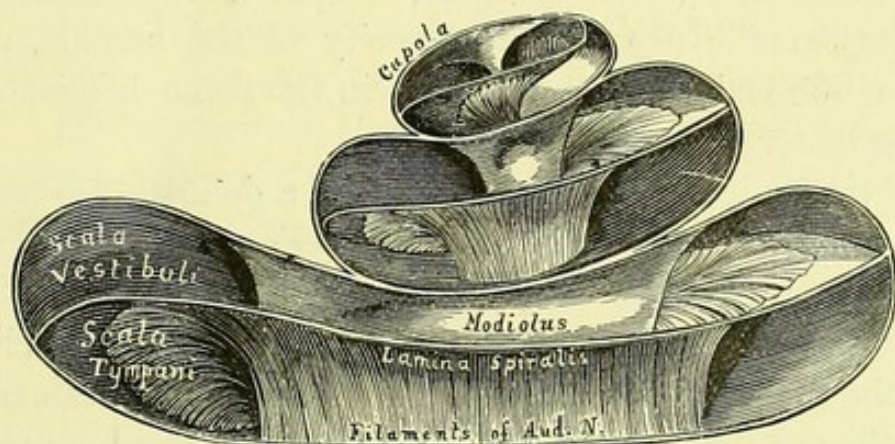


FIG. 26.—The Cochlea laid open (enlarged).
After Gray.

The bony part of the lamina spiralis consists of two thin plates, between which pass minute blood-vessels, as well as filaments of the auditory nerve : and, just as from the lower of these plates the basilar membrane passes to the outer wall of the cochlea, so from the upper plate is stretched the membrane of Corti. Between these two delicate membranes is placed the organ of Corti, which consists of strangely-shaped epithelial cells and rods in communication with the cochlear filaments of the auditory nerve. The rods of Corti, standing upon the inner and outer margins of the basilar membrane, slant towards each other above, and their heads meeting, leave an arched passage, or avenue, along the middle of the membrane.

On the outside of the avenue, resting upon the basilar membrane, are rows of cells whose heads are covered with stiff cilia.

There is one row of hair-cells on the inner side of the rods of Corti, and three or four on the outer side. Possibly the feet of the cells are prolonged deeply until they come in contact with the ending of a filament of the auditory nerve, in the same way that the olfactorial cells, described by Schultze, dipping down into the Schneiderian membrane, are supposed to join with the filaments of the olfactory nerve.

The vestibular scala is subdivided by the membrane of Reissner, which stretches from the upper layer of the lamina spiralis to the outer wall of the cochlea. This small additional gallery thus lies between the membranes of Corti and Reissner; it is called the canal of the cochlea. Ellis describes it as closed above near the tip of the cochlea, and as communicating below by a very small tube with the cavity of the saccule, a small, bladder-like body, which is lodged in the fovea hemispherica of the vestibule.

The vestibule is lined throughout by a delicate fibrous tissue, which is by one surface in firm connection with the bony wall, whilst on the other it is covered with a layer of cells of squamous epithelium. It is this membrane which closes in, with the help of the base of the stapes, the foramen ovale. From the vestibule the lining is continued throughout the semi-circular canals, whilst it enters the uppermost gallery of the cochlea (*scala vestibuli*) through the *apertura scalæ*. This gallery it lines throughout, up to the very top, and thence it passes through the gap left by the ending of the lamina spiralis (*heliocotrema*) into the lower gallery, the *scala tympani*. At the bottom of this scala it ends, blocking up the fenestra rotunda. So the osseous labyrinth is lined throughout with a fibro-serous membrane. The office of the membrane is to secrete a watery fluid, the perilymph.

The perilymph of the vestibule has floating in it a bladder which is several sizes smaller than the bony chamber itself, and tubular prolongations run backwards from this through the horse-shoe canals. The prolongations swell out in the ampullæ. From their being so like the osseous labyrinth in shape, the bladder and its semicircular processes are called the membranous labyrinth. This is covered on its inner side throughout by a

layer of squamous epithelium, which secretes more watery fluid, the endolymph. This fluid finds its way into the canal of the cochlea (the middle gallery) by a small tubular duct, named by Hensen "*canalis reuniens*."

Thus the upper and lower galleries contain perilymph, whilst the intermediate one contains endolymph.

The aqueductus cochleæ is a very slender bundle of vessels and connective tissue passing from the cochlea to the cranial cavity, and is said to be a means of communication between the perilymph and the fluid of the arachnoid cavity. In like manner, a similar structure, the aqueductus vestibuli, is said to connect the fluid of the vestibule and membranous labyrinth generally, *i.e.*, the endolymph, with the cranial cavity.

That part of the membranous labyrinth which occupies the vestibule bulges out into two cystic swellings, the utricle and saccule. The former of these is the higher and larger, and receives the openings of the semicircular canals; it is lodged in the depression known as the fovea hemielliptica. The saccule is the rounded dilatation which occupies the fovea hemispherica; it is connected with the canal of the cochlea by the ductus reuniens.

On the inner wall of the utricle and saccule, and suspended in the endolymph, are two small hard masses composed of crystals of carbonate of lime. Todd and Bowman describe similar ear-stones (otoliths) in the ampullary dilatation of the semicircular (membranous) canals, but Wharton Jones denies their presence both in man and in the lower animals.

THE AUDITORY NERVE.

The auditory nerve (*portio mollis* of seventh pair) on reaching the bottom of the internal auditory meatus divides into two branches, one for the cochlea, the other for the vestibule. The cochlear division is, of course, the anterior; its filaments enter the foramina at the base of the modiolus, and thence bend out at right angles into the bony shelf, the lamina spiralis. Here they form a plexus with ganglion cells, and thus reach the edge of the spiral lamina, and terminate in connection with the cells in the organ of Corti (Köl liker).

The vestibular portion of the nerve passes through a foramen at the bottom of the internal auditory meatus, to be distributed on the utricle and saccule, and upon the ampullary dilatations of the membranous canals. The ultimate fibres pierce the wall of the membranous labyrinth, and are probably distributed in the form of a fine network upon the internal surface. The twigs in the utricle and saccule are brought into close connection with the calcareous particles of the otoliths.

The arteries of the labyrinth are derived from the auditory branch of the basilar, from the stylo-mastoid of the posterior auricular, and occasionally from the occipital. The cochlear twigs of the auditory artery run with the nerve filaments up the axis.

The veins of the labyrinth end in some one or more of the neighbouring sinuses.

CHAPTER II.

THE PHYSIOLOGY OF HEARING.

A CLOSE analogy exists between the allied organs of sight and hearing, both as regards their structure and function.

The eye consists of a firm envelope, the sclerotic, on the interior of which are spread out the terminal filaments and ganglionic cells of the optic nerve. The essential part of the ear consists of a hard cavern, the bony labyrinth, in the interior of which are arranged the filaments and ganglionic cells of the auditory nerve. In each case the elements of the sensory nerve are so arranged as to be most perfectly exposed to that kind of irritation which is best adapted for the due liberation and the propagation to the central organ of molecular changes. Herbert Spencer remarks: "Every agent capable of altering the molecular state of a nerve causes the nerve to produce the particular change which it habitually produces."

The nerve-disturbance in the essential part of the organ of hearing is caused by the vibrations of the labyrinthine fluid acting upon the auditory cells and filaments, and these vibrations are generally brought from the external air through a chain of ossicles which communicates, by its ends, with the tympanic membrane and the internal ear. The nerve-disturbance may also be set up by the pressure of mucus or pus in the cavity of the middle ear, or by the increased supply of blood in inflammation; but the pressure so caused gives rise to the transmission of some of those meaningless molecular changes which are appreciated as "rumblings" and "singing" in the ears. The ganglionic cells in connection with the termination of the auditory nerve, being formed of unstable protein substances and fatty granules, undergo at every stimulation a certain amount of molecular decomposition; the result of this decomposition is the liberation of motion, which produces an isomeric transformation along the more stable protein substance

of the axis band of the auditory filament. The nervous stimulation and discharge are well described as consisting of waves of molecular change that chase one another rapidly through nerve-fibres, the stimulus or discharge formed of such waves arising at some place where unstable nerve-substance has been disturbed.

In the case of the auditory nerve the stimulation and discharges are specially provided for in two ways:—first, by the disturbances of the stiff processes of the fibres of Corti, and of the hair-cells of the cochlea and ampullæ; and, secondly, by the concussion of the otoliths suspended in the endolymph of the utricle and the saccule. It is by no means certain that the ultimate filaments of the auditory nerve are in immediate connection with the bases of the hair-cells.

Some of the latest observers are of opinion that they are united through the medium of a mesh of protoplasmic film. As regards the otoliths, however, there can be but little doubt that a direct nervous stimulation and discharge follow upon their coming in contact with the vestibular filaments of the nerve. Huxley, indeed, compares their effect upon the auditory filaments to that produced upon the sensory network in the skin of a bather by the pelting of the showers of little stones and sand which are raised and let fall by each wavelet which rolls upon a sandy beach. But the auditory nervous network is infinitely more complex and delicate than that of the skin, and is, therefore, more prone to disintegration, the result of which is the production of isomeric changes of the utmost complexity. Thus we are able to appreciate not only the force of sounds, but their loudness, pitch, quality, and direction. So various and subtle are the changes which the stimulation of the nerve elements produce that they are far beyond the reach of material investigation. We merely express the result of these changes when we speak of the loudness, pitch, quality, and direction of sounds. It must be borne in mind that the auditory filaments do not reach the hair-cells or the otoliths upon a firm bed; but, having traversed the perilymph, they gain these intensifying agents as they project into the endolymph of the cochlea, ampullæ, and vestibule. It may be inferred that the vibrations in the endo-

lymph are much more delicate than those of the perilymph which give rise to them, and that the vibrations of the perilymph are finer than the oscillations of the auditory ossicles; whilst simplest of all must be the movements of the tympanic membrane. By the time, then, that the air-waves have reached the ultimate distribution of the auditory nerve, the vibrations have become infinitely modified, subtle, and delicate. The functions of the meatus and auricle, in collecting, reflecting, and conducting sound towards the tympanic membrane, are so obvious as not to need detailed discussion in a clinical manual.

Stretched membranes readily vibrate to sonorous impressions. Helmholtz has, moreover, demonstrated that curved membranes are more susceptible to sound vibrations than plane ones, and that the funnel-shaped curvature of the human drum-membrane is admirably adapted to the requirements of acute hearing. The meatus is somewhat tortuous, and sound-waves in passing through it are no doubt more than once reflected, and are thus able to impinge at the most suitable angle on some one or other part of the cone-shaped membrane. Another valuable attribute of the drum-head is that it has no marked fundamental note of its own; it is thrown into vibrations equally well, within a considerable range, by impulses of widely different wave-lengths; this is a very obvious advantage, and there is some probability in the theory that the radiating fibres are comparable to a series of stretched strings of different lengths, fixed at one end to the sulcus tympanicus, and at the other to a cross-bar, the handle of the malleus. According to this view, the tympanic membrane would be more sensitive in front to high notes and posteriorly to low notes. The non-elasticity of the membrane prevents after vibrations. Altogether it is a very wonderful structure, admirably adapted to its special purpose.

The oscillations of the tympanic membrane affect the fluid in the labyrinth, and so the organ of Corti and nerve-endings, by travelling along two different routes, viz., (1) by aërial conduction across the tympanum to the membrana secundaria of the fenestra rotunda; (2) by conduction through the ossicles to the fenestra ovalis. The vibrating drum-membrane induces not only molecular movements, but also movements *en masse*

inwards and outwards. These movements are, however, much modified by the shape and articular arrangements of the ossicles, so that the excursions of the malleus are at least four times as great as those of the stapes; in fact, according to Helmholtz, the excursions of the base of the stapes do not exceed one-fourteenth to one-eighteenth of a millimetre. Taking into account the fact that the tympanic membrane is nearly twenty times greater than that of the fenestra ovalis, it will be seen that a disturbance of great amplitude and slight force exerted upon the tympanic membrane is, by the ossicular apparatus, converted into one of less amplitude and greater force. The position and tension of the tympanic conducting mechanism is influenced and regulated by two muscles, the tensor tympani and stapedius.

The tensor not only acts as its name implies, but also forces the whole ossicular chain inwards, and so increases labyrinthine tension through the pressure of the foot-plate of the stapes. The stapedius muscle has an antagonistic action, but the base of the stapes is prevented from being pulled much out from the fenestra ovalis by the "catch"-like mechanism of the malleoincudal joint.

The stapes is by far the most important of the ossicles from the surgical point of view, because, after loss of most of the membrane together with the malleus and incus, very fair hearing often remains; dislocation of the stapes, on the other hand, is always associated with marked deafness, often complete.

The Eustachian tube is the canal by which the air in the middle ear is renewed from the pharynx. When the canal becomes blocked, as through catarrhal inflammation, or from the pressure of a tumour—common causes of deafness—the equilibrium of the air on the two sides of the tympanic membrane becomes so disturbed that the vibrations of the membrane are imperfectly performed. Another use of the tube is to drain off the mucus which would otherwise block up the middle ear. Lastly, the Eustachian tube plays a part analogous to that of the mastoid cells in allowing the escape of the superfluous sonorous undulations which would not impinge upon the labyrinthine wall; and in this way the birth of an echo in the middle ear is obviated (R. B. Todd). Though the pharyngeal

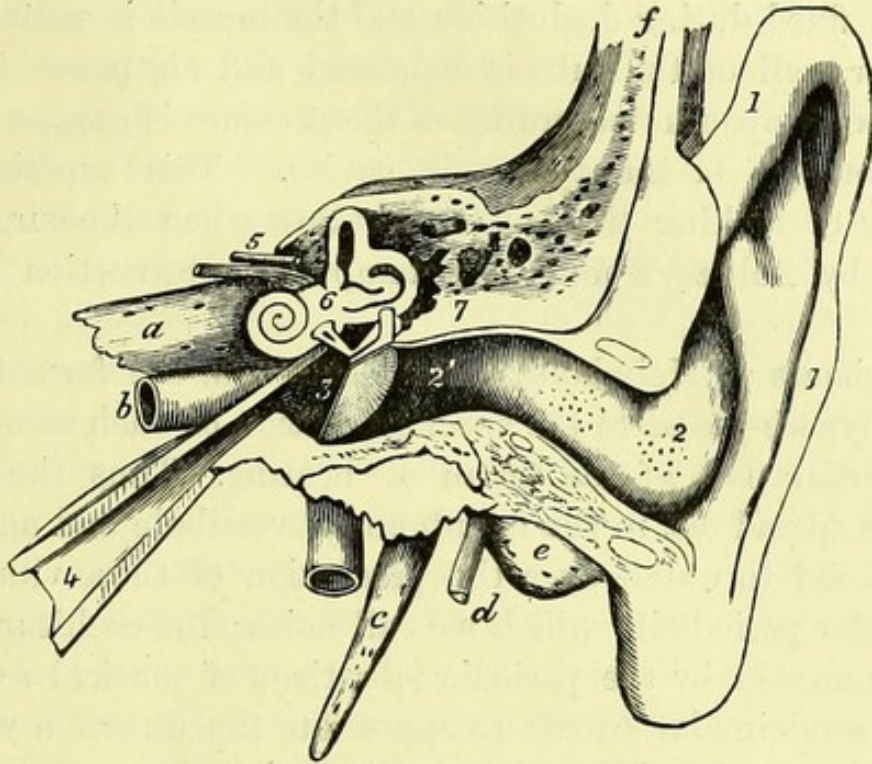


FIG. 27.—Diagrammatic view of the organ of hearing of the left side seen from before. (After Arnold.)

1, Pinna and lobule; 2, concha; 2', near tympanic membrane; 2 to 2', external meatus; 3, tympanic cavity; 4, Eustachian tube; 5, internal meatus with the facial and auditory nerves; 6, the vestibule of the bony labyrinth; 7, to the right of the mastoid antrum; *a*, apex of petrous part of temporal bone; *b*, internal carotid artery; *c*, styloid process; *d*, facial nerve; *e*, mastoid process; *f*, squamous part of temporal bone.

end of the Eustachian tube is cartilaginous, still it is not always open, and in all probability is constantly shut except during the latest stage of deglutition. We may remark, however, that Dr. Fournié, who believes that an essential function of the tube is to prevent resonance of external and internal noises, considers that he can experimentally prove that it is permanently open, and that the muscles which are usually considered dilators of it are really obturators, but the experiments of Hartmann and Politzer negative such a view.* There arises from the wall of the tube as well as from the scaphoid fossa of the sphenoid bone the tensor palati muscle, which, turning round the hamular process of the internal pterygoid plate, is inserted into the substance of the soft palate. Now, when the soft palate

* See Dr. E. Fournié's paper read at the International Medical Congress, London, 1891, in the Section of Diseases of the Ear.

is firmly fixed during deglutition and the muscle is contracting, the lower wall of the tube is depressed, and air passes into or out of the tympanum according as the pressure is greater or less on the outside of the tympanic cavity. This explains the necessity of making the patient swallow when the surgeon is treating by Politzer's method a temporary obstruction of the tube.

The labours of Helmholtz have resulted in the formation of several hypotheses as to the special function of each element of the essential part of the organ of hearing. Thus the nerve filaments spread out in the membranous vestibule and ampullæ are supposed to watch over the perception of those vibrations of irregular periodicity which we call noise; the cochlear fibres to be stimulated by the periodic vibrations of musical sounds; and the semicircular canals to appreciate the direction whence a sound proceeds. That the vestibule is the most essential part of the labyrinth may be presumed from the fact that in some of the lower animals no trace of any other auditory apparatus exists. According to Huxley, the vestibular nerve tells us that sounds are weak or loud, but gives us no further impression, whether of tone, melody, or harmony. The even and regular distribution of the multitudinous fibres of the cochlear branch of the auditory nerve, and their probable connection with the fibres and hair-cells of the lamina spiralis, which latter bodies are placed with equal regularity, has induced speculative physiologists to draw an analogy between the organ of Corti and the wires and keys of a piano, and to consider that each cell and each filament will answer to its proper note. Michael Foster gives a pretty physical illustration of this hypothesis: he says, "If a person standing before an open piano sings out any note, it will be observed that a number of the strings of the piano will be thrown into vibration, and on examination it will be found that those strings which are thus set going correspond in pitch to the fundamental tone and to the several overtones of the note sung." Further on he remarks that the arrangement of the rods of Corti "irresistibly suggest" that they may function as analysers of sounds. (*Physiol.*, p. 518, 3rd ed.).

Concerning the exact office of the semicircular canals many theories have been advanced, but as yet the nature of the impressions conveyed by those filaments of the *portio mollis* which are distributed upon their membranous ampullary enlargements is not with any certainty known. Much experimentation in the way of vivisection has been performed on the canals; and each and all have been followed by tolerably constant results, of which one of the most important and significant is that, though the canals may be destroyed, still the animal seems perfectly happy, feeding as usual, and appearing to have as keen a perception of sound as ever. Have, then, the ampullary fibres of the nerve any auditory function? Ferrier, quoting Flourens's experiments, remarks that strange disturbances of equilibrium follow section of the membranous canals in animals, division of the external (horizontal) resulting in movements of the head from side to side, that of the posterior in movements of the head backwards and forwards, with attempts to perform somersaults backwards, and that of the superior in a tendency to turn over forwards. These experiments have been confirmed by the researches of Crum Brown.

Baginsky's experiments upon the function of the semicircular canals and the consequences of increased pressure in the tympanum are as follows. He found: 1. That various fluids injected into the drum of rabbits produced in every case a definite series of symptoms, each of which differed in origin, intensity, and duration. 2. That in many cases inflammation and hæmorrhages of the brain followed the injection of these fluids, and that the cerebral changes ensued the more surely and gravely the greater the chemical difference of the fluids proved to be. From this it followed that in the injection some of the fluid must have reached the brain, and given rise to the changes there. The probability is that the fluids, injected into the tympanum, passed into the labyrinth through the round window, and thence through the aquæductus cochleæ to the brain.

He found that, whenever nystagmus appeared after the drum had been filled with fluid, the latter had passed through the round window into the labyrinth, and thence through the

aquæductus cochleæ into the subdural space. In Baginsky's opinion, the symptoms occurring after injection of fluids into the drum are due solely and entirely to cerebral lesion. The labyrinth has nothing directly to do with disturbances of equilibrium, *e.g.*, those arising solely from an attack upon the brain. If the lesion here is not severe, they soon disappear; but, if the brain has been seriously injured, the disturbance of equilibrium may last for an indefinite time. The cause of the rotation of the head is therefore always affection of the brain—either by hæmorrhages or consecutive inflammations; and it has nothing whatever to do with division of any fixed semicircular canal. The isolated injury of the semicircular canals without reaction upon the brain Baginsky considers impossible. Neither the primary nor the secondary symptoms point to the semicircular canals as peripheral organs of the sense of equilibrium.

Goltz regards the semicircular canals as the origin of impressions which regulate the equilibrium of the head, and, with it, of the whole body (Ferrier in *West Riding Reports*). Recently some vivisection experiments have been made at Naples, on sharks inhabiting the neighbouring Bay, which go to show that when the semicircular canals in these fish are injured and even completely removed no obvious effect on equilibration follows. Ménière was the first to connect a special set of symptoms with a pathological condition of the semicircular canals; but Ferrier remarked that a subject of Ménière's disease retained with more acuteness in the affected ear than in the other the power of testing notes struck on the piano. Evidence, then, is somewhat against the endowment of the ampullary fibres with any special auditory function.

The position of the canals, however, has led many physiologists to consider them as determining the direction from which a sound proceeds; but our power of determining the direction of a bell, ringing in a fog for instance, is extremely limited; and were it not for our knowledge of locality and appreciation of space being brought into requisition, our ability to make a correct estimate would probably be most imperfect. Professor Gamgee remarks that Cyon holds the semicircular canals to be the peripheral organs of the sense of space; and that the agita-

tion of the epithelial processes of the ampullæ, either by movement of the head, or by waves propagated through the endolymph, is the proximate cause of the stimulation of the ampullary nerves. The latter authority rejects the auditory function of these nerves.

Recently Professor Rutherford has propounded a brand new theory of labyrinthine function, for an account of which the reader is referred to the last edition of Stirling's or Foster's text-books of Physiology.

In conclusion, it must be admitted, in the face of such apparently contradictory data, and the absence of agreement amongst physiologists, that the whole subject requires further investigation by competent physiologists and pathologists.

CHAPTER III.

EXAMINATION OF THE PATIENT.

THE thorough examination of a patient with deafness is not quite such a simple process as it may at first sight appear—a fact which is exemplified by the frequency of errors in diagnosis, and consequent want of success in treatment, on the part of those surgeons who have not commenced the work in the right way. In taking the history of an aural case we must of course bear in mind the etiological significance of such factors as age, sex, occupation, and previous acute illnesses, especially noting predisposition to catarrh, diathetic and hereditary diseases.

We must ascertain the present symptoms complained of by the patient, attention being paid to such cardinal points as discharge, pain, tinnitus, and vertigo. The question of the mode of onset and the relative importance of these considerations will be fully discussed in the sections on etiology and symptomatology; we shall now indicate the most useful objective methods of examining the organ of hearing.

For the examination of the auricle and mastoid process nothing further than a good light is necessary. The auditory meatus also may in some instances, when wide, as in children, be inspected without the use of a speculum. It is only requisite to straighten the curve of the meatus by pulling the auricle backwards, outwards, and slightly upwards, at the same time pressing the tragus forwards. This method is particularly useful in young children, who are apt to be frightened by instruments; but on account of the curve of the meatus, the position of the tragus, and the presence of hairs, cerumen, or pus, a view of the drum in a large number of cases can only be obtained by aid of a speculum. It is hardly necessary to mention that at times the removal of cerumen, pus, hairs, &c., is requisite, as they may hinder a proper view of the membrana tympani.

The rectangular forceps and the ordinary cotton-holder are useful instruments for extracting these substances from the canal. The holders I use are silver probes, roughened sufficiently at one end to prevent cotton-wool twisted round them from falling off in the ear, though not enough to interfere with its easy removal. Silver are preferable to steel cotton-holders, for the reason that the wool is apt to cling very firmly to the latter, however, slightly roughened they may be. The syringe is a useful adjunct to the wool-holder and forceps.

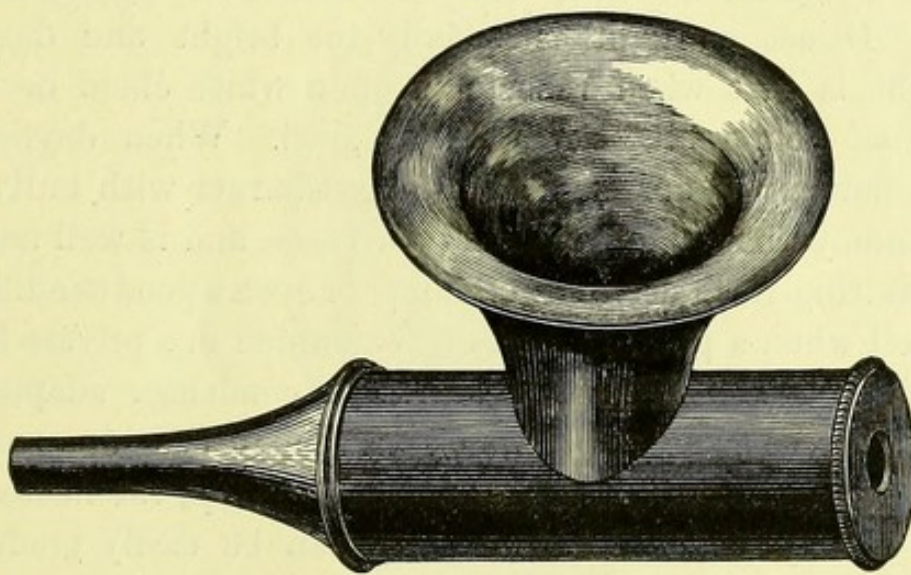


FIG. 28.—Brunton's Otoscope.

Brunton's speculum is perhaps the favourite for ordinary diagnostic purposes. It is very useful in visiting patients at their own houses, where it is often impossible to get a strong artificial light. Its advantages, as given by the inventor, are that it—

1. Is simple in construction.
2. Is easy of application, a few trials being sufficient to make the observer expert.
3. Enables the ear to be examined with precision and minuteness.
4. Can be used with either sunlight or artificial light.
5. Can be used with the magnifying power or not, at pleasure.

Recently I have used this instrument fitted with an incandescent electric lamp, illuminated by a small portable battery.

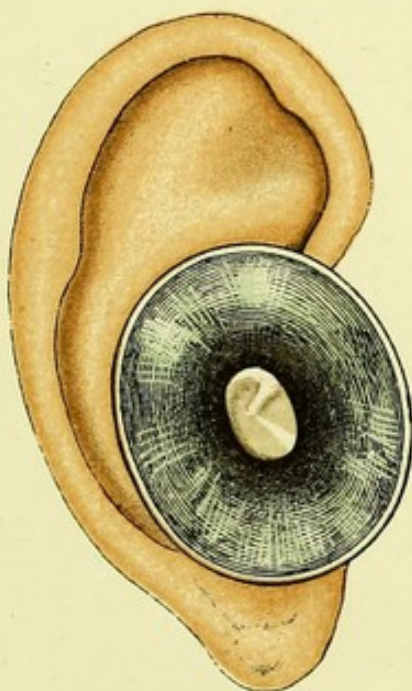
Brunton's instrument is obviously useless for purposes other than diagnostic inspection.

The ordinary silver ear speculum also answers very well when a concave mirror is used.

It is an advantage to have the inner surface blackened, to prevent the reflection of light.

In using the speculum, however, the first desideratum is a good illumination. No form of artificial light enables us to perceive the natural colouring of the tympanic membrane and meatus like good daylight from a window having a northern aspect. Direct sunlight is usually too bright and dazzling. The light is best when reflected from a white cloud or white wall; that from a blue sky is not so good. When daylight is not available, the ordinary Argand gas-burner with bull's eye and chimney answers all ordinary purposes, and is well adapted for consulting-room use. An oil lamp, or even a good candle, does very well when a patient has to be examined in a private house, and Johnson's or Mackenzie's bull's-eye condenser adapted for use with these latter is of much service in bedside examinations and operations. The lime-light is perhaps the nearest approach to daylight, and its intensity can be easily graduated. The cost of fitting and the fact that oxygen gas is necessary limit its use. Some specialists, however, habitually employ it for continuous use, as in hospital practice; it does not give out nearly as much heat as the Argand burner, and it possesses an illuminating power equal to 500 candles. The zircon light, though admirable in many ways, possesses two main drawbacks: the cones are very breakable and rather expensive, and consequently it is unsafe to move the lamp about. The electric light is available for aural purposes in many forms.

In the photophore an incandescent lamp contained in a small lantern with a bull's-eye condenser is worn on the forehead by means of a head band. The light is said to be of not more than four-candle power. Taking into account the weight on the forehead, the inconvenience of conducting wires, and the liability of even the best batteries to get out of order, it is not singular that this arrangement is little used. Quite recently an incandescent lamp has been fitted on to an ordinary spectacle-



THE MEMBRANA TYMPANI.
(As seen through the Speculum).

frame frontal mirror, by Leiter, of Vienna. It has a more complicated appearance than the photophore, but appears to give a better light; the other objections just mentioned apply to it, however.

For reflecting light down a speculum on to the drum-head, a concave mirror with a perforated centre is used. It is most conveniently fixed to the surgeon's forehead by a spectacle frame, or elastic band; the former, being the cooler arrangement,

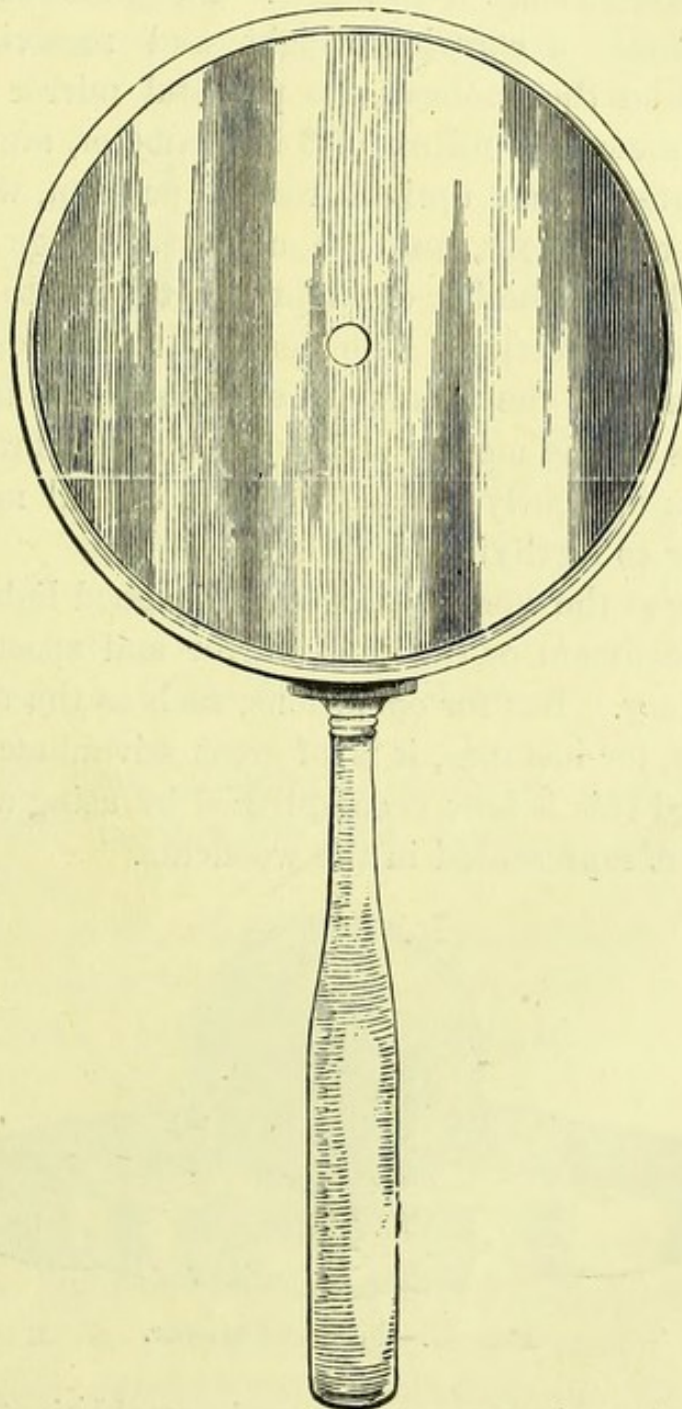


FIG. 29.—Hand Mirror.

preferable. The mirror is brought down over one eye so that the aperture occupies the line of vision. The reflecting mirror can also be held between the teeth by means of a horizontal central plate; this method is sometimes practised on the Continent, but is little in vogue in this country. Some practitioners employ a hand mirror, but its use is almost entirely limited to diagnostic purposes, as, with one hand steadying the speculum, and the other holding the mirror, operations and other manipulations are impossible. To those who object to the inconvenience of carrying weight and receiving a strong and hot light on the forehead, the pedestal mirror is available. It consists of a concave mirror of 6 in. diameter, and 18 in. focal length, supported on an upright rod, its position, which can be graduated to any height, and the universal hinge at its back enabling the light (whether daylight or artificial) to be reflected in any necessary direction. The head of the patient has to be gently adapted to the direction of the light in exploring different parts of the meatus and tympanic membrane. It does away with the unsightly spectacle of the frontal mirror, which is occasionally so terrifying to children.

For looking at the *membrana tympani* a good light and either Brunton's instrument or the hand mirror and speculum are all that is necessary. But for operations, such as the removal of a small polypus, for instance, it is of great advantage to have the hands free, and this is best accomplished by using a forehead or head mirror, as represented in the woodcuts.

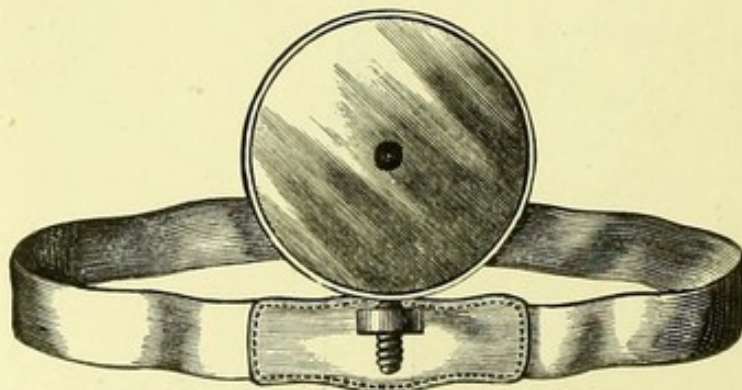


FIG. 30.—Forehead Mirror.

The head mirror is a convenient and portable instrument, and is attached to a spectacle-frame, which increases its weight but

little; and, when worn upon the head, it is certainly much cooler than any arrangement with an elastic band.*

The ear speculum for examining and dilating the meatus is said to have been the invention of Peter de la Cerlata, early in the fifteenth century. The specula used up to twenty-five years ago were cone-shaped; Wilde's speculum, a truncated cone, is a type of this variety. The pattern now almost universally adopted is shown in the wood-cut; it is of the cylindrical cone shape, resembling a funnel. The small end usually presents an oval, more rarely a round, orifice, which is made in

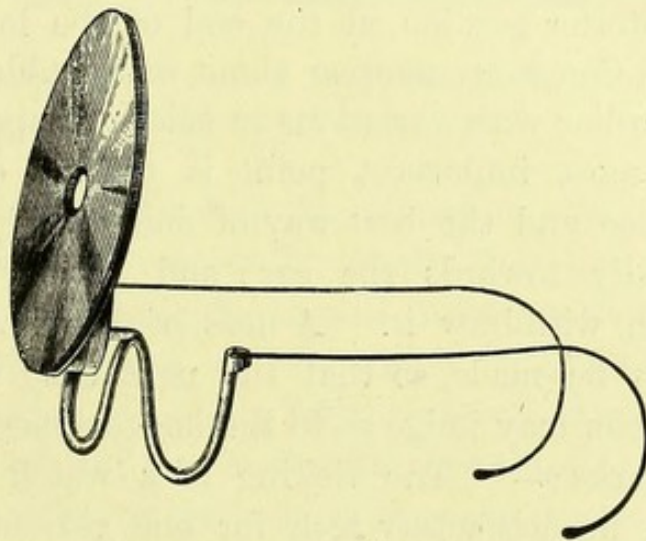


FIG. 31.—Head Mirror.

three and four sizes. The ratio of the greatest length to the greatest breadth is, however, not constant, but varies with different makers.

Speaking generally, a long but only moderately broad speculum is more suitable for operations and inspection of the drum than a short and broad one, which is, however, well adapted for operations on polypi, exostoses, and accumulations situated nearer the outer end of the meatus.

In respect of material, the silvered metal ones are more durable; those made of vulcanite, though liable to chip and break at the smaller end, are lighter and often remain in the meatus without support; they are warmer, are unacted on by corrosive substances, and, further, the black material

* Made by Caswell, Hazard, and Co., of New York.

possesses the optical advantage of "contrast" in relation to the colour of the drum-head and meatus. Vulcanite specula are more in vogue abroad than in this country.

Dr. Sexton, of New York, uses and advocates the employment of various magnifying lenses fitted to the mouths of specula, which appear to answer very well for diagnostic purposes.

These, then, are the means we command for looking at the membrana tympani; and next it is essential that it should be known what the healthy membrane is like. Suffice it here to say that it is thin and delicate in texture, of a pearly-grey colour, and presents a bright spot of triangular shape at its lower and anterior portion, at the end of the long process of the malleus. Constant practice alone will enable an observer to become familiar with variations in colour, shape, &c.

The next most important point is to find out the exact hearing-distance, and the best way of doing this is to bring a watch gradually towards the ear; and not to first place it near and then withdraw it. A note of the hearing-distance should always be made, so that the next time the patient is seen the surgeon may judge as to the improvement made. But, as Buck remarks:—* "The ticking of a watch in many instances is an unsatisfactory test, for one patient will hear it when held at a certain distance from the ear, and yet he will not be able to understand ordinary conversation. Another will hear conversation with perfect ease, and yet be unable to distinguish the ticking of a watch. Again, a patient will at one time, *e.g.*, during a subacute inflammation of the middle ear, hear the ticking of a watch at only a very short distance, and will experience considerable difficulty in understanding spoken words. As the inflammation subsides, and the fluid exudation undergoes absorption, he will experience a very decided improvement in his power to understand conversation, but little or no improvement in his power to distinguish the ticking of a watch."

There are other instruments recommended for testing the hearing-power, such as the metronome; and Professor Politzer

* *Diagnosis and Treatment of Ear Diseases*, by Albert H. Buck, M.D., New York, 1881.

has introduced his Hörmesser, which produces a sharp click or sound of uniform character.

By the use of the tuning-fork as a means of diagnosis, we are usually enabled to distinguish between diseases dependent respectively on affections of the sound-conducting and of the nervous or sound-perceiving organs of the ear. *i.e.*, between those of its external and middle divisions, which are the conducting apparatus, and those of the auditory nerve.

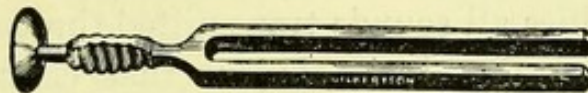


FIG. 32.—Gardiner Brown's Tuning Fork; Middle C, of 512 vibrations per second (one-third nat. size).

If a vibrating tuning-fork be placed on the forehead of a deaf person, since he naturally thinks that he ought to hear better on the less deaf side, he will often assert that its sound is more audible on the side on which he hears you speaking than on the other. Luckily for themselves this is not true for the generality of deaf people, though they think it should be so; and after trying two or three times they are generally obliged to admit that they hear the tuning-fork best with the deaf or deafer ear. Allen says:—"The common speaking-tube is a familiar example of sounds being strengthened thus, when confined in cavities of any sort. That this is the case with regard to the tympanum and its continuous tube, the osseous meatus, may be proved by closing the external passage with the fingers, when, if a tuning-fork be set vibrating on the head, or a humming sound or reading be kept up, the sounds, being conveyed through the cranial bones to the cavities of the ear, will become considerably intensified. This fact is made still more evident by placing a vibrating tuning-fork on the forehead, and stopping up one ear with the fingers; the sound will then be more audible on that side. The way, therefore, in which we distinguish affections of the sound-conducting portions of the ear from those of the nervous, or sound-perceiving, apparatus is as follows:—If the patient be deaf to the sounds of a watch, or a tuning-fork, held near (not touching) the external meatus, and

yet can hear distinctly their vibrations when conveyed through the solid structures of the head, teeth, and the like, it may be inferred that some obstruction exists to the passage of sound through the meatus, membrana tympani, or tympanic cavity, but that the functions of the acoustic nerve are unimpaired.

“The surgeon may also assume that the conducting apparatus is in fault if the vibrations of the tuning-fork and the patient’s own voice are not better heard when he closes his ears, because it has been shown by the above experiment that the closure of the meatus amplifies all sounds transmitted through the skull or interior of the mouth. It is obvious that catarrhal diseases, whether of the tympanum, its contents, or its external membrane, would hinder the escape of the intensified sounds outwards through the meatus, just as effectually as would be done by a plug of wax or the stopping fingers. Consequently, you may generally and safely conclude that you have to deal with a case of obstruction of the free entrance of sound into the internal ear, and not with a nervous affection, if the patient admits that he decidedly hears the vibrating tuning-fork on the deaf or deafer side. Lastly, ascertain also whether the patient can hear the vibrations of the tuning-fork on the head for as long a time as you yourself can. The moment he ceases to distinguish the sounds, place the fork on your own head, and you may thus determine the difference. Inversely, of course, if the fork be heard very indistinctly, or not at all, when placed on the vertex, we must infer that the auditory nerve is not so sensitive to the impression of sounds as it ought to be, and that either there exists some abnormal pressure upon the labyrinthine fluid, or that the nerve itself is implicated in disease.”* The above includes Weber’s method.

The reason why the tuning-fork is heard better on the deaf side in cases of diseased condition of the sound-conducting portions of the ear is thus stated by Hinton:—† “When any sound reaches the nerves of hearing through the cranial bones,

* *Lectures on Aural Catarrh*, by Peter Allen, M.D., p. 52. See also p. 245.

† *Supplement to Toynbee’s Diseases of the Ear*, by James Hinton, M.R.C.S., p. 425.

it is heard more intensely if the meatus be closed. If, for example, a tuning-fork be placed on the vertex, and one meatus be closed by the finger, the sound will be heard much more distinctly on that side." This "depends upon the fact that the tympanum in the natural state is easily permeable to sound in both directions—in fact, sonorous vibrations from within escape through the ear, just as vibrations from without enter by it."

A variety of other tests with the tuning-fork devised by Rinné, Gellé, Politzer, and others are used by some aurists. I shall not, however, complicate this chapter by describing them here, because, after considerable experience, I am sceptical as to their value, even at the hands of an expert.

By speech we can occasionally determine accurately the degree of deafness from which a patient may be suffering. Vowel-sounds are rich in overtones, and can therefore be heard at a much longer distance than consonants. Hence whispering, in which, as the vowel-sounds are abated, the consonants are relatively strengthened, may be better appreciated by a defective ear than are loud utterances. In order, therefore, to make a deaf person hear, a high pitch of voice is to be avoided. The greater ease with which some patients hear low sounds than shrill Burnett suggests may be due to impediment to the movement of the stapes, "either by undue pressure in the labyrinth, or by catarrhal fixation in the oval window."

Dr. Woolf, of Frankfort-on-the-Maine, has published a very able paper respecting the acoustic characters of the elements of speech. He shows that the broad A sound is heard farther than any other vowel; and that H without an added vowel is the weakest of all the consonants.

It has been shown by Dr. C. J. Blake, of Boston, U.S., that when the membrana tympani is perforated higher musical tones can be detected than when the membrane is in its normal condition. Hearing these high tones is of great value in diagnosis, and he remarks that "the limit of the perceptive power of the cochlea exceeds the limits of the sound-transmitting power of the structures of the middle ear in their normal condition; that, therefore, the structures of the middle ear in their normal condition present a barrier, as it were, to the passage of sonorous

vibrations exceeding a given rate per second ; and that, the perceptive power of the internal ear remaining the same, morbid changes in the middle ear result in a variation in the limit of their transmission of musical tones."

Dr. Blake points out* that the determination of the character, as also the localization, of the changes in the ear corresponding to decrease in the range of perception for the higher musical tones is a matter of difficulty ; and that the positive diagnostic value of the apparent appreciation of these tones is necessarily dependent on comparative experiments. He concludes that:—(1) A considerable departure from the standard limit to the capacity of hearing high musical tones evidences an abnormal condition of the sound-transmitting apparatus either of the middle ear or the labyrinth, or of the auditory nerve and ultimate organ of hearing. (2) An increase in the apparent perception of high musical tones indicates—(a) greater tension, up to a certain limit, in the sound-transmitting apparatus ; (b) removal of the obstacles that naturally exist to the transmission of short sound-waves to the labyrinth. (3) Any diminution in the apparent perception of high musical tones manifests an increase in the obstacles mentioned—the result of intra-labyrinthine pressure sufficient to annihilate the physiological function of the fenestra rotunda and ossicula, of changes in structures in the labyrinth, or of real impairment of perceptive power.

Hyperacusis, increased keenness of hearing, true hyperæsthesia, is, according to Gowers, "a rare morbid state in which sounds are heard with undue loudness, and even such as are inaudible to other persons are distinctly perceived. It occurs chiefly in hysteria, usually in association with augmented acuteness of other senses, and is probably in such cases of central origin. It has also been observed at the onset of acute cerebral and general diseases.

"Full doses of bromide of potassium have most influence in diminishing the morbid excitability."†

The phenomenon of paracusis Willisii presented by some deaf persons, or the enhancement of audition during certain loud

* *American Journal of Otology*, Oct., 1879.

† *Diseases of the Nervous System*, vol. 2, p. 244.

noises, was attributed by Willis to restoration of the tension of a usually relaxed *membrana tympani*. Löwenberg, however, found among a large number of persons presenting this affection great variations in the condition of the drum, but uniformity as regards exhibition of the following symptoms:—Each ear was deaf, but often very unequally so; the hearing was good for high tones; there was no perforation of the membrane. There was a history of acute headache and giddiness, and in some cases of apoplexy or other serious disease. He has, therefore, suggested that the power of the patients in question to take cognisance of vibrations not ordinarily heard may be due to the production by repeated noises of an increased excitability in an auditory nerve, the ordinary sensibility of which is lessened by disease, these noises being insufficient to provoke a manifestation of the specific vitality of the nerve.

According to Prof. Lucæ, the perception of low and musical tones is aided by the tensor *tympani*, and that of high unmusical sounds by the *stapedius* muscle.

Tests of hearing by means of high musical tones are most readily made with the two instruments known as the rods of König and the whistle of Galton. The former is constructed of a series of steel rods uniform in diameter, but varying in length, suspended, at measured distances from their ends, by a loop of cord or wire, and made to vibrate by the strokes of a steel hammer. The latter consists essentially of an inner tube forming the cavity of a whistle, the depth of which is diminished or increased by the screwing up or down of a plug connected with an outer tube, the pitch of the sound emitted rising or falling accordingly.

Siegle's test for estimating the mobility of the membrane and ossicles will be described later.

With these remarks on the ear speculum, the watch, and the tuning-fork, &c., without the use of which we are not in a position to arrive at any diagnosis in affections of the outer ear, I proceed to diseases of the external auditory meatus.

CHAPTER IV.

DISEASES OF THE EXTERNAL AUDITORY MEATUS.

IMPACTION OF WAX is a very common cause of deafness. To remove this obstruction, nothing more than water at a temperature of about 100° F. and a syringe is necessary. Sometimes, where the wax is very hard, it may be necessary twice or thrice to pour into the ear a warm solution of bicarbonate of soda (10 grs. to the ʒi) at bedtime before it is possible to remove the whole mass by the syringe. The patient should always stop up his ear with cotton wool after the removal of the wax, for, if this simple precaution be omitted, it not infrequently happens that painful myringitis, and even acute catarrh of the tympanum, results. The syringe should be used gently and slowly, as the employment of much force will cause giddiness, and may rupture the membrana tympani. We should be careful not to give too favourable a prognosis in such cases, for, as Von Tröltsch observes, masses of wax constantly increasing may lead to perforation of the membrane, to gradual dilatation of the osseous meatus, or to the formation of ulcers, and even worse evils. Moreover, impacted wax may cause thickening of the surface of the membrane, or even an abnormally deep position of it, with narrowing of the tympanum and over-pressure upon the contents of the labyrinth by the stapes. It must also be borne in mind that wax in the meatus often coexists with catarrhal conditions of the tympanum, Eustachian tube, and nasal passages. Earpicks should be especially avoided, for severe injuries are often caused by these instruments, in the form of sharp metal probes, hairpins, bodkins, knitting-needles, &c., used for the relief of itching in the ears, or for the removal of foreign bodies.

“The secretion of the meatus, known as cerumen, or ear-wax, is, according to Petrequin and Kessel, of a smeary consistency, on account of the soapy material made by the potash which it

contains. A part of it is soluble in water; another in water and alcohol. It also contains about 10 per cent. of water, a mixture of oil and stearin, and a dry material, not soluble in water, alcohol, or ether, in which traces of chalk and soda are found. As age advances, the parts of the cerumen which are soluble in water increase, but those soluble in alcohol diminish, so that in old persons the cerumen becomes dry and brittle. The contents of the ceruminous and sebaceous glands together are a yellowish-white, rather fluid material, which consists essentially of small and large fat globules, corpuscles of colouring matter in masses, and cells in which single globules of fat and colouring matter are embedded; hairs and scales of epidermis are also found in the canal."*

Mrs. C., who consulted me in October, 1874, had been deaf for fifteen years, and of late increasingly so. She complained of great noise in both ears, and was unable to hear a watch in contact. The cause of her deafness was very evident, for both ears were completely obstructed with hardened cerumen. When I removed a very large piece of wax from each ear, her hearing, of course, instantly improved. Her satisfaction was great at hearing the rustle of the *Times*, as she took it up to read, for she "had not heard that sound previously for fifteen years." Both tympanic membranes looked remarkably healthy, considering how long the obstruction had existed.

The Rev. A. W. came to me, August 28, 1876. He had previously consulted a well-known surgeon, who had diagnosed cerumen, and used the syringe, but had succeeded in removing only a portion of the wax. The surface of that which remained had assumed a peculiar honeycombed appearance, which had led the surgeon to consider that the patient had lost the whole tympanic membrane of the right ear, and nearly all that of the left. By carefully syringing (in the manner I have elsewhere described), I soon removed the accumulation from both ears. I found the tympanic membranes quite healthy, and hearing was completely restored. I have seen many other instances of impacted wax, as also cotton wool, assuming a great variety of appearances, calculated more or less to mislead the surgeon, so

* *Diseases of the Ear*, by Dr. St. John Roosa, p. 160.

that I am not surprised at the mistake that was made in this case.*

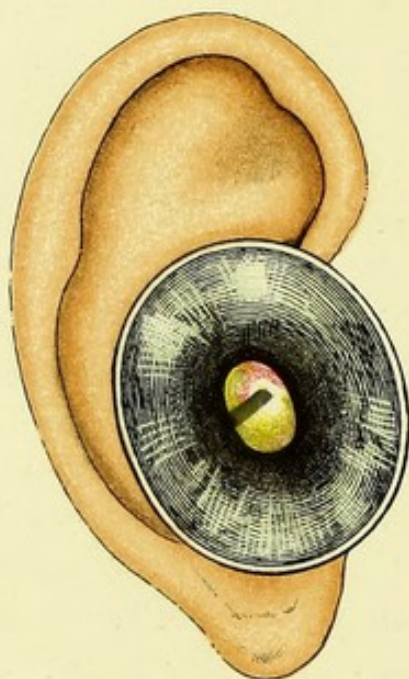
Miss Q., æt. 22, of Bury St. Edmunds, came to consult me, October, 1877, for deafness in her left ear. She had been slightly deaf for several years, but for the last two months had almost entirely lost her hearing. She stated that her mother and sister were both deaf in the left ear. I removed a large plug of cerumen, and she heard perfectly well. Her sister, aged 18, afterwards came to see me. She could not hear the watch in contact with her left ear, and remarked that she did not remember ever having heard a sound of any kind on that side. After some little difficulty I removed an immense lump of black-looking wax, and her hearing was likewise restored.

Were it not for the apparent ignorance of the bulk of the profession of the rudiments of aural surgery, I should not think of publishing such cases as the above; but, while so much and yet so easily remediable suffering exists, surely it is a duty to try thus to disseminate the simple truths necessary to relieve it.

My note-book contains many similar cases, but the three I have given are sufficient to illustrate the subject. The first is somewhat remarkable, for usually, if wax is allowed to remain for a prolonged period in the external auditory meatus, the hearing is a great deal more affected than in this instance. The cases are very numerous in which patients neglect slight deafness from an accumulation of wax, until permanent mischief is induced.

I have more than once known it happen in hospital practice that a dresser has removed cerumen and omitted to give directions to protect the ear with cotton wool for some days, with the result that painful myringitis, and even acute tympanic catarrh, has followed. Moreover, the same results sometimes follow superfluous and forcible syringing when no wax is really present. It is not always the laity, or dressers, who are at fault in this respect, for even practitioners are sometimes injudicious enough to use a powerful syringe without first ascertaining, by

* *British Medical Journal*, Oct. 6, 1877.



IMPACTED GLASSBEAD WITH ACCOMPANYING CONGESTION AND DISCHARGE.

examination, that a plug of cerumen or foreign body is really present in the meatus.

It is not uncommon to meet with patients who suffer from deafness due to a collection of epithelial laminae,* or what has been called "keratosis obturans, in contradistinction to ceruminosis obturans, the impacted plug of ear-wax. The laminae are derived from the horny elements of the external auditory canal by gradual accretion, causing great deafness, and offering great resistance to removal."† In this affection I have always found the use of warm solutions of bicarbonate of soda, which I have before recommended for obstinate cases of hardened cerumen, the best treatment.

Toynbee‡ gives an analysis of such cases. He says:—"Of 165 ears from which cerumen was removed, only 60 were cured, besides 43 cases that were much improved. Thus there were 103 cases of great amelioration, while there were 62 ears that were either but slightly or not at all improved. It is therefore important that every case should be carefully examined after a collection of this kind has been removed; because, if the hearing-power is not wholly restored, some other disease must be present which requires attention."

The wax in the ears of children is sometimes fluid and highly offensive, and, if not speedily attended to, is likely to lead to catarrhal inflammation or more serious mischief.

In adults cerumen is sometimes entirely absent, but the deficiency appears in no way to affect the hearing-power.§

And now a few words as to the best mode of removing foreign substances from the meatus. Generally speaking, the instruments introduced for their removal do great mischief, except in the hands of an expert. Instrumental interference is hardly ever necessary, and is often dangerous. Careful and

* First described by Wreden, of St. Petersburg, in the *Archives of Ophthalmology and Otology*, 1874.

† See *A Treatise on the Ear*, by C. Burnett, M.D., pp. 293, 294; also Dr. Duncanson, *Edinburgh Medical Journal*, Nov., 1878, p. 477.

‡ *Diseases of the Ear*, p. 48.

§ Although the absence of wax does not in itself seem to have any ill effect on audition, a condition of unusual dryness in the external meatus is often associated with diseases of the middle and internal ear.

persevering use of the syringe and warm water will almost always be successful, especially if the auricle be pulled upwards and backwards. Where much swelling and inflammation of the soft parts are present (and these are often very severe from irritation and pressure of the foreign body), they must, together with the acute pain, be relieved by freely applying leeches in front of the tragus; for the meatus and membrana tympani are extremely sensitive when pressed upon by hard substances. After the inflammation has been allayed by this means, and also by the use of fomentations, the syringe will easily remove the foreign body; but we should by no means attempt the removal so long as the slightest tumefaction is present. Above all, it is necessary in each case to make a careful inspection of the meatus with the speculum to see whether there actually is something to remove. Often and often have most lamentable results followed attempts to extract with instruments substances which have either never been in the ear at all, or have fallen out of it unnoticed, and not only should the body be looked for by aid of the reflector and speculum, but all instrumentation, with the exception of the aural syringe, should be performed only through the speculum. For this purpose a short and broad speculum is to be preferred. Inflammation of the brain and death have not infrequently been caused in this way; or, if life has been spared, total deafness has followed. Vomiting and coughing are sometimes met with from irritation of the auricular branch of the pneumogastric (Toynbee). These symptoms of course instantly vanish when the pressure is removed. It is often advisable to turn the patient on his side and syringe from below, or, as Hinton first pointed out, "to place him on his back, if the foreign body, as frequently happens, is jammed into the angle formed by the anterior wall of the meatus and the membrana tympani." The agglutinative method of removal is strongly recommended by some authors: it consists in fixing the impacted body by means of glue or coaguline to a piece of linen attached to a holder, and withdrawing the same when the glue has firmly set on the foreign body. Adhesive plaster attached to a piece of string may be used in the same way. Löwenberg recommends that a camel's

hair brush dipped in glue be applied to the foreign body and allowed to remain in the ear until firmly adherent to it, when the brush with the foreign body attached can be withdrawn.

The foreign substances I have most frequently met with in the meatus are beads, small stones, peas, cherry-stones, pieces of tobacco-pipe and slate pencil, shells, paper, cotton-wool, sealing-wax, and grass.

Beans, peas, and the like, are very troublesome to remove, as they often swell from moisture and cause intense pain. On one occasion, at the hospital, I removed an immense lump of tobacco from a labourer's ear, which caused him, as may well be imagined, great pain. The lower orders seem to think this an infallible remedy for every ailment connected with the ear.

But, with many substances, rather than use any force in attempting to remove them, by far the better plan is to let them remain in the ear, for a time at least.

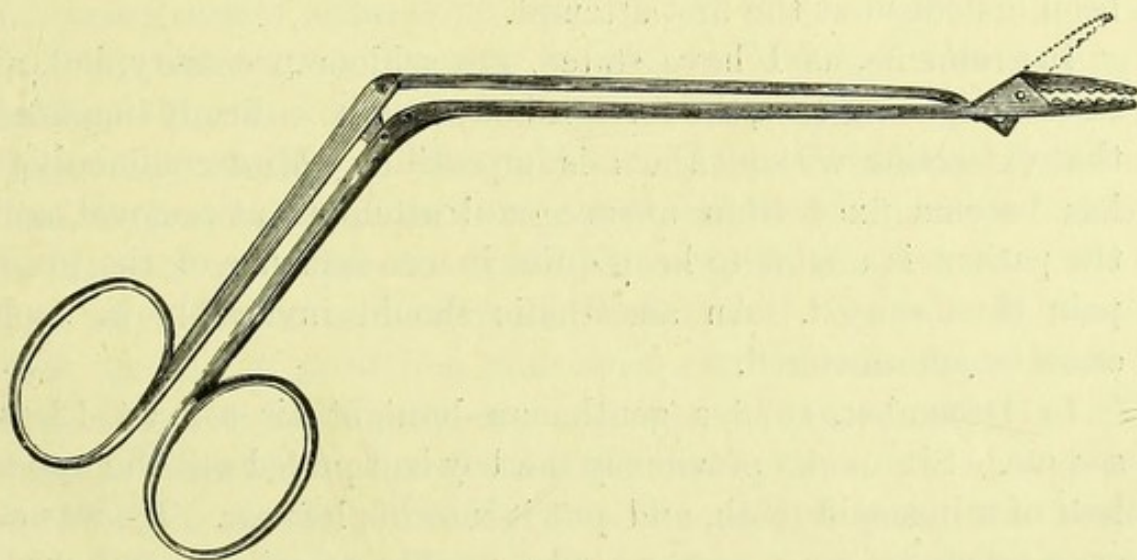


FIG. 33.—Forceps for Removal of Foreign Bodies from the Ear.*

The foregoing remarks may appear unnecessary, but I can affirm that, in nearly every case in which a patient has been brought to me with a foreign body in the ear, mischief has been caused by the constant endeavours of some anxious friend to get rid of the enemy by the use of a hair-pin, probe, or other instrument.

The following is an example of intense suffering caused by

* Made by Weiss and Son, 287, Oxford Street.

endeavouring to remove a foreign body by instrumental means. A similar case came under my observation within a week.

A. E., a girl, *æt.* 10, was brought to St. Mary's Hospital with a large glass bead in her right ear. She was in very great pain. The walls of the meatus were lacerated and swollen, and the ear was filled with coagulated blood. The mother informed me that she had herself first endeavoured to get out the bead with a hair-pin, and afterwards had taken her to three doctors, who, as she expressed it, "had all had a try." Their repeated efforts had not improved matters. The glass bead could just be seen glistening, deeply situated in the meatus. I at once used a syringe: the mother said that this had been employed very frequently already. The bead, however, came away very easily; and I have no doubt that if the nozzle of the instrument had been applied to the roof instead of to the floor of the external meatus (as commonly in using a syringe) the bead would have been dislodged at the first attempt.

Instruments, as I have stated, are seldom necessary, but, as in the following case, the foreign body may be so firmly impacted that extraction without them is impossible. Most commonly it has become fixed from unsuccessful attempts at removal, and the patient is unable to keep quiet in consequence of the great pain thus caused. An anæsthetic should invariably in such cases be administered.

In December, 1878, a gentleman brought his son, *æt.* 12, to see me. Six weeks previously the boy had pulled out the upper half of a bicuspid tooth, and put it into his left ear. He was at once taken to see a surgeon, who readily seized the tooth with a pair of forceps; but, just as it was on the point of being extracted, the lad forcibly threw up his arm against the hand of the operator, driving the tooth inwards, and so impacting it that it could not be removed. Several attempts to dislodge it were subsequently made without avail. He was then sent up to London to consult me. The tooth being deeply and firmly wedged in the external meatus, I found it impossible to expel it by syringing. Having placed the boy under chloroform, I passed a very fine bent probe along the upper portion of the meatus, and so behind the foreign body; this was then drawn

slightly forwards by the probe, and easily removed. The tooth had cut its way through the lower portion of the membrana tympani; the patient, however, made an excellent recovery.

Similar cases are very frequently met with in practice, and I am certain that, if the means I have suggested were more frequently adopted, we should very rarely have to deal with that unfortunate class of patients seen at hospitals occasionally who present injuries from foreign bodies lodged in the tympanum, such as oftentimes result in total deafness, or even in a worse fate. Voltolini says truly, "even the point of a dagger, if allowed to remain quietly in the ear, will not do so much harm as forcible attempts to remove it." He recommends the use of the galvano-cautery in some cases: employing the finest electrodes, he gradually burns a hole in the foreign body, which breaks up and is then easily removed.* Foreign bodies may, however, be allowed to remain in the ear far too long. The following case is remarkable:—

T. B., æt. 6, was brought to me in March, 1874, having suffered for nine months from deafness and from great pain (especially at night) in the right ear. His mother said that he had "suffered agony," and every now and then he put his hands to his head and cried out from the severity of the pain. She had taken him to several medical men, and was told by some that he had a gathering, and must poultice the ear, and by others that he had a polypus; but the last gentleman she took him to discovered a hard substance, and recommended him to be brought to me at St. Mary's. She said that he had been blistered and poulticed regularly for nine months without any benefit. He was unable to hear the watch in contact, and on examination I found a hard mass covered with thick yellow matter. Having carefully syringed, after a little trouble I removed a large smooth oval stone, which, remaining in his ear for nine months, had both given rise to dangerous symptoms and permanently affected hearing.

M. P., a girl, æt. 6, came to the hospital with a black glass bead of the size of a large pea in her left ear, having been sent to me by Mr. Lane. Previously, however, to her coming to the

* *Medical Times and Gazette*, Aug. 25, 1878.

hospital, several attempts had been made to extract the bead, with the unfortunate result of only pushing the bead in still deeper, and, in consequence of the inflammation thereby caused, firmly imbedding it. I syringed gently, and postponed any further attempt at removal (as there was a good deal of inflammation) until my next hospital-day. She was, however, laid up with chicken-pox for two months, and when she came to the hospital (February 16) all inflammatory signs had disappeared; but the bead could easily be distinguished with the speculum, deeply seated and firmly fixed. She was put under chloroform, and an attempt was made to remove it by means of glue attached to the end of a piece of stick. This failed altogether. She was, therefore, placed on her side, with the affected ear downwards, and the syringe used from below; and before very long the bead dropped out.

This last is a case such as one is likely to meet with almost every day. A great deal more harm than good is often done by the use of instruments; but by the procedure about to be described no injury can be caused.

How to Syringe the Ear for Removal of Foreign Body.—Place the patient under chloroform, with the affected ear downwards, and syringe from below. Pull the auricle backwards and upwards (by this means the external auditory meatus is made into a straight tube), and apply the nozzle of the syringe to the upper wall of the passage. The water is then gently forced behind the obstruction; the foreign body is loosened, and by its own weight it will fall out of the ear. I have removed all kinds of substances in this way.*

* *British Medical Journal*, March 4, 1876.

In the next number of the *British Medical Journal*, in confirmation of what I have just said, Mr. Rivington, of the London Hospital, made the following remarks:—

“Having had considerable experience in the removal of foreign bodies from the ear, I can strongly support the recommendations of Mr. Field, of St. Mary’s Hospital, contained in the *Journal* of March 4. From the time of my first connection with the Aural Department at the London Hospital I have used no other means of extraction of foreign bodies than the syringe, aided occasionally by chloroform, the dependent position of the organ, and the use of a small pair of curved forceps as soon as the

In ordinary syringing it is of great advantage to employ an ear spout, as represented in the annexed figure, to receive the injected fluid.



FIG. 34.—Ear-Spout Fitted on the Head.

Moldenhauer,* in a case where a pebble was deeply impacted in the meatus, after vainly trying ordinary methods, extracted it by displacement of the auricle. He recommends cutting through the posterior wall. Schwartze has performed the same operation for removal of exostoses, &c. By Lister's method the wound in the auricle heals, as a rule, by primary intention.

Foreign bodies in the external auditory meatus occasionally give rise to epileptiform symptoms. Cases illustrating this fact

substances appeared near the external end of the meatus; and I have never failed in procuring their ejection.

"I must not conclude these few remarks without expressing my obligation to the late lamented Mr. Hinton for the kind assistance which he rendered to me some years ago, when desirous of acquiring some little knowledge of the method of examining aural patients. I remember speaking to him about the extraction of foreign bodies, and asking him what method he recommended for their removal. He replied that 'You will not use any other method than the syringe if you are wise.' With the slight exception specified above, I have never done so; and I feel sure that those who adopt the sound advice tendered by Mr. Hinton and Mr. Field will never have occasion for disappointment or regret."

* *Archiv für Ohrenheilkunde*, vol. 18, p. 59.

have been recorded by Handfield Jones and others. The symptoms they produce somewhat resemble those of Ménière's disease.

Instances are recorded of needles and of the points of glass syringes passing through perforations in the membrana tympani into the tympanum and Eustachian tube. It is important to remember in all cases of this description that more harm than good is generally done by probing and other violent attempts at extraction. The following is the case of a pin in the Eustachian tube:—

H. W. S., a clerk, æt. 21, came to consult me at the hospital on November 7, 1880. Several years previously he had injured the drum of his right ear with a piece of slate pencil. A few days back he was picking the same ear with a small pin, when it slipped in, and he could not get it out. The pin was distinctly seen by three medical men, who in endeavouring to remove it pushed it completely through the perforation in the tympanic membrane. It was now that he came under my notice. He complained of great pain in his throat at the lower end of the Eustachian tube. Occasionally, when his neck was touched, the pain became suddenly acute. As it seemed to be impossible to remove the pin, I suggested that he should swallow a quantity of large pieces of bread, in the hope that, as the act of swallowing causes opening of the Eustachian tube (by contraction of the tensor and levator palati muscles), the pin might be released, and appear at the mouth of the tube. This treatment had the desired effect in moving the pin, for after a time he felt the pin move down his throat. He has never since suffered any inconvenience. The termination is not altogether satisfactory, for, although the dislodgment of the pin put a stop to the pain, as the patient has not to his knowledge passed it, its whereabouts is still a subject of speculation. This case shows how foreign bodies may pass through the tympanum, and down the Eustachian tube, without giving rise to such severe symptoms as one would expect.

I have seen one or two instances of cotton wool placed in the ear passing through a large perforation in the tympanic membrane into the Eustachian tube, and thence into the throat.

Very small pieces of cotton wool should not be put in the ear, especially if there is a hole in the membrana tympani.

CIRCUMSCRIBED INFLAMMATION, FURUNCLE, OR BOILS IN THE EXTERNAL AUDITORY CANAL are of frequent occurrence, and are generally met with in people of middle age. Aural boils are of two kinds—(1) traumatic, and (2) non-traumatic; the latter class are by some described as idiopathic, by others specific and epidemic. Traumatic circumscribed inflammation of the meatus may be brought about by wounding with a foreign body, by instrumentation, by chemical irritants, and such causes as usually produce diffuse external otitis. Non-traumatic furuncle is of much pathological interest.

It is certainly correct that the pathogenic organism *Staphylococcus pyogenes albus* is almost invariably present in the pus of boils of the meatus; the varieties *aureus* and *citreus* are less often found. In the present state of our knowledge we are unable to say definitely whether these organisms are casual or causal. Löwenberg believes that micro-organisms gain access to the subcutaneous tissues through the gland ducts. Their presence in the meatus is often associated with the aërial contamination of habitations from defective drainage, and their introduction is doubtless sometimes due to the use of stale lotions and instillations, some of which, if left uncorked, will in course of time undergo fermentative decomposition. Many pathologists are unable to accept the view that germs migrate from the meatus through the skin to the subcutaneous tissues even by way of the gland ducts; but, in support of the hypothesis, it is proved that furunculosis can be artificially produced by rubbing sound skin with staphylococci.

Anæmic and delicate adults are much more commonly the subjects of attack, and for this reason females are said to suffer more than males, but such is not my experience. Aural boils are seldom seen in children. Some persons are much more susceptible than others to recurrence.

Löwenberg was the first to point out the parasitic nature of the disease and its epidemic occurrence. It is not at all unusual in aural practice to see quite a number of cases within a week or two at certain seasons, notably about the spring and

fall of the year, whereas such instances in the interval are rare. In like manner, the epidemic is often limited to definite areas, and is, moreover, sometimes associated with insanitary surroundings. In more than one instance I have noted that, whilst one or more members of a family in a house defectively drained have suffered from aural furuncle, others of the household have been laid up with tonsillitis, pharyngitis, and rhinitis (of either a septic or of a rheumatic character), and in some cases accompanied by Eustachian catarrh. Exceptionally all these conditions, including the aural boil, may be present in the same individual. From a study of such cases I am inclined to believe that the same set of causes are capable of producing any of the above conditions singly or in combination. Further investigation may possibly bring out a more evident etiological connection with rheumatism and gout. All debilitating states, such as those associated with anæmia, diabetes, and the climacteric period in women, constitute predisposing factors.

The objective appearance of an aural furuncle in conjunction with the subjective symptoms renders the diagnosis certain. There is only one other condition which could easily be mistaken for boil on inspection with a good light, and that is an exostosis with an inflamed or hyperæmic cutis. Bulging of the posterior wall of the meatus in connection with mastoid inflammation is unlikely to be attributed to furunculosis. A probe gently manipulated will usually settle the question of diagnosis, but its use is rarely necessary from the fact that the symptoms are so definite. The most usual site for boils is the antero-inferior wall; they are in most cases nearer the proximal than distal end of the meatus; the lumen of the latter is sometimes quite obliterated by the inflammatory swelling, which is, however, seldom reddened to any extent. Occasionally the glands of the neck are enlarged and tender, and exceptionally I have seen a swelling situated just in front of the tragus. The subjective symptoms are severe pain, often intermittent and worse at night, sometimes radiating towards the cheek, teeth, or temporo-maxillary articulation, and increased by movements of the jaw, sleeplessness, depression, and loss of appetite, these latter varying with the amount of fever present. Tinnitus and dulness of

hearing are not infrequent symptoms, and are nearly always due to occlusion of the meatus or to concomitant hyperæmia of the labyrinth, or to catarrh of the tympanum or Eustachian tube. In the absence of treatment a boil in the meatus usually bursts in from four to eight days, when the above symptoms quickly disappear.

Treatment.—As regards surgical interference, the two main indications are the relief of tension and of the accompanying pain, such relief being most speedily and effectually brought about by an incision into the inflammatory swelling, after which the meatus should be kept clear of discharge by an antiseptic and anodyne lotion. It sometimes happens that the surgeon is unable to carry out this treatment from dislike of patients or of their friends to “the knife” in such cases, and when, as occasionally occurs, incision gives only partial relief, recourse may be had to leeches and poultices. Leeches are applied in front of the tragus; poultices of such a size as to fit into the fossa of the concha and outer end of the meatus are preferable to large ones which cover the whole auricle, as their application may cause inflammation and perichondritis of this structure. It may here be remarked that this is the only condition in my aural practice in which a poultice is considered justifiable, but the frequent application of small hot sponges is certainly to be preferred. Hot water lotions containing cocaine or morphia can be thus used in this way instead of being frequently poured into the meatus. Syringing with warm fluids may cause great pain, and even myringitis, from unskilful manipulation. When a free upward incision into the boil combined with moist warmth fail to give relief, cold applications are occasionally more successful. I have seen Leiter’s aural coil for the continuous flow of ice-cold water used with marked benefit in this and in other inflammatory conditions such as in mastoid inflammation and in quinsy.

When a free discharge of pus has been brought about by any or all of the above means, it behoves one not to be too cursory in the after treatment. Recognizing the tendency to auto-contagious recurrence which exists during the discharging period from the presence of staphylococci, and the occasional occurrence

of exuberant granulations, which, if untreated, become polypi, at the edges of the wound, Löwenberg has insisted on the importance of frequent applications of the supersaturated solution of boracic acid powder in alcohol.

This instillation, combining as it does germicidal and anti-proliferating properties, can be confidently recommended as an admirable dressing after a discharge has been established. Löwenberg claims that this solution is of great use in the abortive treatment of boils; it would not appear, however, to have been very successful in the hands of others in this respect, and it has been urged that alcohol has no marked solvent power on the fatty matter blocking the gland ducts in which the micro-organisms, the *sedes morbi*, are imbedded, and that boracic acid is not a powerful antiseptic. For these reasons some surgeons have added ether to the solution, whilst others have substituted the perchloride of mercury, as being more strongly germicidal, for the boracic acid. I must, however, observe that I have myself used cotton wool saturated with glycerine and opium with undoubted advantage, and it is the most efficient palliative I have come across.

Should a case be seen for the first time when the acute stage has passed, with granulations at the edge of the wound, which latter shows no tendency to heal, the proliferating edges can be touched with a caustic such as chromic acid or with the galvanocautery point, and the wound dressed with an ointment of iodol or sozo-iodol in vaseline; morphia, or cocaine may be added if there be pain.

Looking to the fact that boils in the ear are so often associated with debilitated states of the system, constitutional treatment should not be neglected. I have already alluded to these states. The general health of the patient should be fully inquired into and appropriately treated. This treatment not only includes the administration of drugs, but the adoption of hygienic precautions as regards the patient's diet, exercise, mode of living, and sanitary surroundings. If no cause can be discovered to account for the condition, arsenic or sulphide of calcium may be given.

The remarkable periodicity exhibited by the idiopathic form

of aural furunculosis, as in connection with the spring and fall of the year, or the menstrual and climacteric epochs, enables us to adopt prophylactic measures, which should be local, constitutional, and hygienic. On the slightest aural indication, such as dulness or pain, instillations of glycerine, of the supersaturated solutions of boracic acid powder and alcohol, or of this solution with ether, should be applied. Glycerine of belladonna or carbolic acid, or menthol in parolein, are often useful.

Boils in the meatus of a traumatic origin are best treated by simple soothing applications. When due to irritating discharges or to the application of irritating instillations and lotions, the removal of the source of irritation and the adoption of one or other of the methods of treatment previously detailed will bring about a speedy cure.

Abscesses in the meatus occasionally form a fistulous opening in front of the tragus, or tend to "an evacuation of their contents through the duct of Steno, or through the cleft found in the posterior superior part of the cartilage of the auditory canal, as described by Poorten, after the occurrence of otitis externa circumscripta." *

INSECTS often enter the meatus. Syringing with warm water is all that is necessary to effect their removal and stop the irritation which they produce. It is very common to meet with patients who imagine they have insects in their ears. The common fly has been known to deposit its eggs in the ear. The larvæ produced sometimes give rise to severe pain. Warm oil poured into the meatus will usually have the desired effect of evacuating insects, and the vapour of chloroform will kill maggots. Alcohol, pure or diluted, may also be advantageously employed. According to Dr. Barr,† maggots "may be found in great numbers, chiefly at the inner end of the canal and in the tympanum, appearing as white, worm-like creatures, moving rapidly about. These larvæ are furnished with hook-like apparatus, which fasten upon or penetrate the tissues. After they have been killed they may require to be removed with forceps."

* Burnett, *A Treatise on the Ear*, p. 315. See also paper by Sir James Paget, *Clinical Society Reports*, 1878.

† *Glasgow Med. Journ.*, Dec., 1881.

A woman once attended at the hospital who insisted that she had a black-beetle in her ear, and was deeply offended with me when she was told that nothing of the kind was visible. Simple folk from the country I have found to possess a predisposition to imagine the presence of earwigs.*

Of the vegetable FUNGI sometimes met with in the auditory passage, *Aspergillus niger* (see Figs. 35 and 36), according to Roosa, is the most common. Like inspissated cerumen, it pro-

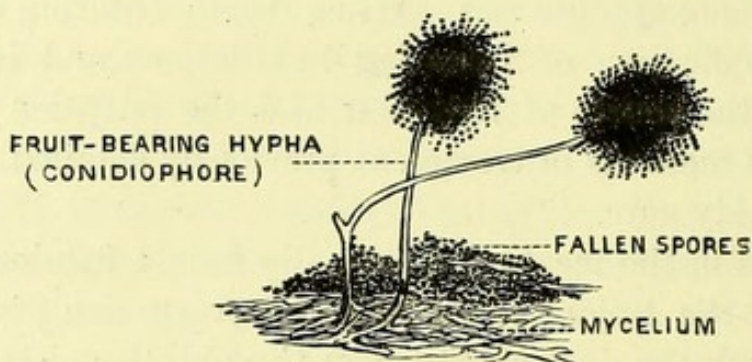


FIG. 35.—*Aspergillus niger*.

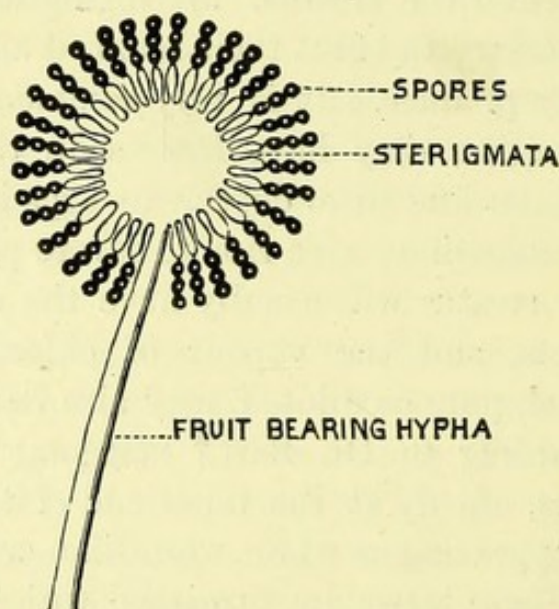


FIG. 36.—Diagram of the asexual fructification of *Aspergillus*. The sterigmata should have been drawn more peg-shaped.

* A case has been recorded of *Ascaris lumbricoides* in the ear, see *Lancet*, Oct. 23, 1880, p. 653.

duces a sensation of fulness in the ear, with tinnitus and impairment of hearing. Pain also, of a dull heavy character, which is not a common evidence of inspissated cerumen, is one of the symptoms of otitis externa parasitica. The disease is not a primary one, but a consequence of diffuse and perhaps mild otitis. Some kind of inflammation which loosens the epidermis precedes its onset, and it is very often found after eczema. The fungus is actually such a "mould" as clings to damp walls or adheres to bread not kept thoroughly dry. As might be expected, the habit of the Russians of living in badly ventilated rooms, as they are almost compelled to do during their long winter, is very favourable to the production of *Aspergillus*.

Wreden* records a case in which perforation of the membrane was caused by *Aspergillus*.

The aspergilli are species of the order of fungi named hyphomycetes. *Aspergillus flavus* and *Aspergillus fumigatus* also occur as epiphytes in the middle ear, but not so frequently as *Aspergillus niger*. The two former species have been proved to be pathogenic in rabbits.† The diagram (Fig. 36) shows the asexual mode of spore formation. Other spores (ascospores) are formed after conjugation of branches of the mycelium.

The best treatment is to syringe the meatus frequently with warm water and alcohol. The fungus most commonly appears exactly like fine coal dust blown into the ear. There is not, in the presence of *Aspergillus*, much discharge from the ear, for, as Schwartze has observed, where there is profuse suppuration the fungus does not meet with a favourable resting place.

The whitish or blackish flakes formed by the fungus on the walls of the meatus or on the membrana tympani may easily be mistaken for epidermis or hard wax, and as such they were

* *Archiv f. Augen- u. Ohrenheilk.*, vol. 3, part 2, p. 26, 1874.

† For further information on the aspergilli, Dr. Vines' translation of Sachs' *Text-Book of Botany*, Dr. D. Macalister's translation of Ziegler's *Text-Book of Pathology*, and Professor Crookshank's *Bacteriology*, may be consulted. In *Path. Soc. Trans.*, 1891, Professor Delépine has an able article based on a case of *Aspergillus niger* affecting the skin of the leg. The pathogenic properties of the aspergilli were worked out by Leber, *Archiv für Ophthalm.*, vol. 25, part 2, p. 285, and Grawitz, *Virchow's Archiv*, vol. 81, p. 355, and, later, by Koch and Gaffky.

once regarded. When the flakes are removed the tissue beneath is found to be red and tender, and in a few hours the growth is reproduced. Repeated instillations of alcohol are therefore necessary. For certainty in diagnosis the microscope must be resorted to.*

DIFFUSE INFLAMMATION OF THE EXTERNAL AUDITORY MEATUS often leads to narrowing of the passage until the introduction even of a probe is an impossibility. Diffuse external otitis is closely related to circumscribed; in fact the two conditions often run into one another. Diffuse inflammation is nearly always the sequel of traumatism or of previous suppurative disease of the middle ear. It is often found in gouty, rheumatic, and syphilitic individuals. Amongst traumatic causes may be mentioned unskilful manipulations with instruments and hairpins in attempted removal of wax or foreign bodies, the entrance of very hot or cold water, eau de cologne, or chemical irritants. When associated with previous aural disease such as furuncle or chronic suppurative catarrh, it may be due either to the irritating character of the discharge, or to the instillation applied. Granulations and polypi sometimes spring from the swollen meatal lining, especially in the severer forms of this disease, if the osseous floor is carious. When the bone is diseased, inflammation has in rare instances been known to spread to the cranial fossæ and lateral sinus. Another exceptional complication of external otitis is the formation of a diphtheritic membrane, which, however, usually only occurs in connection with an epidemic of diphtheria and in association with lesions in the throat or nose. The deposit, in some instances, is an extension up the Eustachian tube. Shedding of the epidermis in external otitis, which often occurs, must not be confounded with this rare complication. Small indolent ulcers form, which keep up a constant irritation, and give rise to a sometimes thick and offensive, but more frequently watery and inodorous, discharge. Mild astringent lotions may be prescribed, and tonics to keep up the patient's general health. Nitrate of silver, or chromic acid, should be applied to the ulcerated surface, by means of a very small probe, at least twice a week.

* *Diseases of the Ear*, Roosa, p. 135.

In a favourable case the discharge and ulceration gradually disappear, and, the passage becoming widened, hearing is restored.

A patient, Mr. G. S., who consulted me on October 1, 1878, had been suffering eight years from this disease. From the deafness caused by the contraction of each external meatus he had been obliged to give up his occupation. A small probe could scarcely be passed through the narrowed openings. Having come to me on what he described as one of his "good days," he could hear a watch one inch from the right ear, and three inches from the left; but often, if he took the least cold, a slight discharge would come on, completely blocking up his ears, and rendering him almost totally deaf.

Regularly twice a week, by means of a fine probe covered with cotton wool, I applied a solution of nitrate of silver (30 gr. to ℥j) to the ulcerated surfaces. An ointment of 1 part of the ung. hydrarg. nitratis to 8 of ung. zinci, to be used daily, and small doses of arsenic and iodide of potassium were prescribed. Under this treatment his hearing was rapidly restored. On October 4 he could hear my watch two inches from the right, and six from the left, ear, and in six weeks' time three or four yards from both ears.

Narrowing of the canal, however, may arise from a variety of other causes, *e.g.*, erysipelatous inflammation.* It has been noticed† that erysipelas frequently begins where the skin of the ear loses its dryness and other ordinary characteristics, that is, at the entrance of the external auditory meatus, just as is seen at the entrance of the nose, or at the edges of the eyelids.

The treatment to be recommended for narrowing of the ear passages, the cause of which is generally evident, depends upon and must be adapted to the special nature of each individual case.

To aid in rendering the passage patent after inflammatory stricture, nothing reduces the stenosis so rapidly and surely as the bougie treatment. The patient can be taught to pass graduated gum-elastic or metal bougies for himself.

* Itard, *Maladies des Oreilles*, p. 168.

† Reynolds, *System of Medicine*, vol. 1, p. 542, 3rd edition.

In January, 1879, I admitted into the hospital a patient with complete closure of the right external auditory meatus. Some years previously he had pricked his ear with a pin; violent inflammation and eventually closure of the passage ensued. I removed a band of hardened skin, and, keeping the meatus plugged with cotton wool soaked in a solution of carbolic acid, secured a permanent opening, and he then heard well again.

The meatus may be closed by a cutaneous band in its cartilaginous portion. A little boy, brought to me by Dr. Ray, suffered from a congenital malformation of this kind, the passage being narrow, and rendered completely imperforate by a band of skin (see Malformations, p. 108).

MOLLUSCOUS OR SEBACEOUS TUMOURS sometimes block up the meatus, and must be treated by removal of the capsule as well as its contents.

I recently saw a case of a sebaceous cyst at the mouth of the meatus apparently due to the use of a binaural stethoscope.

These tumours produce absorption of bone, without occurrence of pain, and often cause enormous dilatation of the meatus.* They sometimes make a clean-cut hole right through a portion of the petrous bone; and they, moreover, occasionally set up brain mischief, which may terminate fatally.

OTORRHAGIA, OR HÆMORRHAGE FROM THE EXTERNAL MEATUS, is a common symptom or a result of various diseases or injuries. Thus it may occur in purpura,† in malignant small-pox, in yellow fever, and in suppressed menstruation.‡ It is most generally due to injuries to the head, such as a fracture of the base of the skull, and if both petrous bones are injured it is seen in both ears. A very common cause is rupture of the membrana tympani, either from direct injury, or from air being forced with such great and sudden violence through the Eustachian tube into the tympanum as to burst the membrane, as in whooping cough, asthma, and violent sneezing; the ascent of high mountains, or a sudden descent in a diving-bell will also

* For an interesting case of molluscous tumour, see Dr. Kirk Duncan-son, *Edin. Med. Journ.*, Nov., 1877.

† Reynolds, *System of Medicine*, vol. 1, p. 230.

‡ Hinton, *Questions in Aural Surgery*, p. 97.

produce it. Occasional causes are wounds of the meatus and tympanum, bleeding polypi, and erosions of the carotid, and other vessels, in carious conditions.

The following is an interesting case of vicarious menstruation from the ear:—*

A. B., æt. 18, single, was admitted at St. Mary's Hospital, August 22, 1881. She stated that when six years old she had a blow behind the right ear; this caused a discharge of yellow matter, which had continued ever since. She had been occasionally troubled with "gathered" fingers. When about twelve years old she began to have pains in the back now and again, and became subject to sick headache. When fourteen years old she woke up one night with epistaxis, and this returned the following day, and again three days after. About a month subsequently bleeding from the right ear came on, which lasted an hour, and was very profuse. This was accompanied by "buzzing in the ear and ticking in the head." Since then she has regularly every three weeks lost blood from the right ear. The hæmorrhage lasts not more than about ten minutes, as the patient always checks it with cold water applications. She has only once menstruated from the vagina; this was in 1879, when, after she had consulted a medical man, who gave her medicine and ordered her to put her feet in mustard and water, a slight flow was produced. Bleeding from the ear was taking place at the same time, for, as she said, "it was the proper period for it."

The patient had a large perforation in the right membrana tympani. She was in the hospital for some months, during which time the hæmorrhage from the ear reappeared regularly every three weeks. Her breasts were small. No os uteri could be felt by finger. There was a copious yellow vaginal discharge.

The evidence that this hæmorrhage was vicarious menstruation appears singularly complete. To begin with, there is the fact of ear disease, with the establishment of suppuration at six years of age. When twelve years old she became subject to pain in the back and sick headaches. Here we have two factors indicated—a liability to cerebral hyperæmia at the menstrual

* See paper by author, *Med. Press and Circ.*, Feb. 8, 1882.

epoch, and a diseased surface within her tympanum ready to suffer from this periodical turgescence. In the epistaxis at fourteen years, during three days, we have another indication of the cerebral hyperæmia. This, we see, is followed, about a month afterwards, by bleeding from the right ear, since repeated regularly every three weeks. Meanwhile she has never menstruated, except on one occasion, when the flow was of a somewhat doubtful character, and artificially induced. Vicarious hæmorrhages, such as this, have been known to occur from every mucous membrane in the body. Hinton says of hæmorrhage from the ear; "It is a symptom of suppressed menstruation." Hæmorrhages from the gastro-intestinal, bronchial, vesical, buccal, and nasal mucous membranes, from the conjunctiva, the skin, old ulcers, cicatrices, and nævi have been frequently recorded. Although so many cases of vicarious hæmorrhages have been recorded, it appears of late years to have become fashionable to hold an unqualified scepticism as to their occurrence. This may be well shown by the fact that but scanty attention is paid to them by Dr. Bristowe in his standard work on medicine, in which he barely alludes to them in dealing with the causes of hæmorrhage from the gastro-intestinal mucous membrane of the air-passages, whilst, on the other hand, Sir Thomas Watson, in his early editions, mentions them at considerable length. In discussing each form of hæmorrhage the latter author speaks of their frequent occurrence, and gives several examples. That they indicate a most remarkable condition of the vascular system at the menstrual epochs—probably a local turgescence, and a general increase of vascular pressure—cannot be doubted. This has been well shown by two very remarkable cases. One was recorded by Dr. Mason* of a lady, æt. 15, who had the most extraordinary hæmorrhages from various parts of her skin. In this case the changes in the skin could be watched, "the skin appearing perfectly healthy and whole one second, melted away and bleeding the next." In this case the hæmorrhages, though coincident with an arrest of menstruation, did not occur at monthly intervals, but much

* *Edin. Med. Journ.*, Sept., 1866.

more frequently, and part of the period she was under observation they were daily ; but her menstruation also, when it first recurred, was at intervals of only one week. Another remarkable case is recorded by Dr. Puech.* In this instance the patient never had any menstrual flux, though she suffered from uterine pains every month. At seventeen years of age these were replaced by headaches, and at the same time her physiognomy underwent a marked change, owing to the appearance of varices of the facial and superficial temporal veins and their tributaries. These varices increased gradually, and at certain times attained considerable size, and one of them on the head burst, allowing the escape of a large quantity of blood. The hæmorrhage occurred very irregularly, but, instead of exhausting, it greatly relieved the patient. From time to time the conjunctiva of the left side became congested, and once a good deal of blood was lost therefrom. The hæmorrhages from the head after some time ceased, and were replaced by frequent epistaxis. Very recently, by observations made by Miss Elizabeth Jacobi, M.D., still further light has been thrown upon the vascular condition which produces vicarious hæmorrhage. This lady has demonstrated by means of the sphygmograph that there is a general rise of arterial pressure occurring during the menstrual epoch. If to this general rise of pressure we add a local turgescence at any weak spot, we have all the factors required for hæmorrhage therefrom. Hæmorrhage into the middle ear, though of an entirely different nature, and not periodical, occurs occasionally as a result of otitis, and is described by Roosa as "otitis media hæmorrhagica." His were cases of acute aural catarrh, which terminated suddenly with an abundant hæmorrhage through the drum-head. Similar discharges have been caused by Bright's disease, and are analogous to the retinal hæmorrhages due thereto.

EAR COUGH—A reflex cough, "*ear cough*" as it is termed by Dr. Fox, of Scarborough, in which a twig of the auriculo-temporal branch of the fifth cranial nerve and the floor of the fourth ventricle as a centre are involved, may be occasioned by irrita-

* *De l'Atresie des Voies Génitales de la Femme*, Paris, 1864.

tion of the external auditory canal. Dr. Fox found it could be excited in about one in five of 108 persons examined by him.

Mr. Jakins has recorded in the *Practitioner*, 1887, the case of a patient who was believed by his family doctor and friends to be suffering from consumption. Mr. Jakins found the lungs healthy, and cured the cough by removing a large plug of cerumen from one ear.

It is sometimes excited by the speculum or other diagnostic instrument, and by any foreign body, in fact.

CHAPTER V.

OSSEOUS TUMOURS OF THE MEATUS.

ENLARGEMENT OF THE OSSEOUS WALLS, causing narrowing of the meatus and consequent difficulty in hearing, is occasionally met with, especially in women. The introduction of small ivory bougies, solid or hollow, three-quarters of an inch long, is very useful in these cases of general meatal hyperostosis.

AURAL EXOSTOSES.—Exostoses of the bony meatus not infrequently occur, and like the general hypertrophy just mentioned, they diminish its calibre and impair the hearing.

(1.) Varieties, mode of occurrence, and characteristics.—Kramer has described an interesting instance of a stalactitic form of polypus, so hard that a knife could not cut it.

Professor Grüber has noted the development of osseous tissue in the walls of the Eustachian tube, occasioning the obliteration of its cavity. I have never seen an example of this kind of exostosis.

The form of aural exostosis most commonly met with, which must be distinguished from the ivory-like growth to be described below, is in the majority of cases pedunculated, and it arises usually from the middle ear, as the result of an inflammatory process. Its growth is rapid, and associated with plentiful and very offensive suppuration. It sometimes gives rise to a polypus, which precedes its appearance in the external meatus. This variety of exostosis may be removed by wire. It further differs from true ivory exostosis in containing cavities filled with medullary tissue, and hence it may be termed "a spongy osteoma," as defined by Cornil and Ranvier. In the case of Miss H., to be described later, a thin section of a soft bony growth of this nature from the ear revealed, under a power of 75 diameters, a structure similar to that of newly-formed bone. The free surface was bounded by fibrous membrane raised into small papillæ, and covered by squamous epithelium,

whilst the trabeculae of bone within formed a sort of spongy framework, in the meshes of which a vascular medullary tissue was contained. Magnified 350 diameters, the fibrous membrane showed no nerves or glands, and only a few small vessels. The layer of bone immediately beneath it was thicker and more condensed than the central portions. Its lamellae were parallel to the surface, and contained but few bone corpuscles. In the central portion of the growth the trabeculae were thinner, and limited irregular oval spaces, filled in some parts with a richly nucleated fibrous tissue containing numerous spindle and round cells. In other parts there was a small amount of fibrous tissue scattered in the midst of round cells. No giant cells were anywhere seen. The vessels consisted chiefly of very large thin-walled tubes, well filled with blood, and resembling dilated capillaries. Here and there a few arterioles were visible.

M. W., a little girl, æt. 3, brought to the hospital on July 25, 1876, had suffered from a severe attack of measles twelve months previously, and since from an offensive discharge from the left ear. I had a few months back removed a polypus. About a fortnight before she came to the hospital a hard substance was noticed in the ear, causing the child much uneasiness. This proved to be a small pedunculated osseous tumour about the size of a pea, almost filling up the meatus.

The case well illustrates the etiology of the ordinary aural exostosis, as seen by the light modern pathology has thrown upon inflammation of bone, and the resultant new growths therein.

With the above described more or less spongy growths must not be confounded certain compact exostoses, to which the majority of the multiple forms may be referred. These are usually, but incorrectly, termed "ivory exostoses. They resemble in microscopical structure the bony nodes produced on the flat bones of the cranium as a result of syphilis. They present an outer epithelial and fibrous coat, and are traversed by Haversian canals in which run blood-vessels derived primarily from those of the periosteum, round which the lamellae, with intervening bone corpuscles, are arranged con-

centrically. These canals run inwards somewhat irregularly at right angles to the surface; they are largest and most numerous in the softer and more recent specimens, while in the old and slowly growing nodules, which approximate to the ivory exostoses in density, they are very few and small, and in the superficial bony layer absent.

The true ivory exostoses (less frequently met with) partake of the nature of new growths, and are quite independent of inflammatory changes. Such bony excrescences in other parts

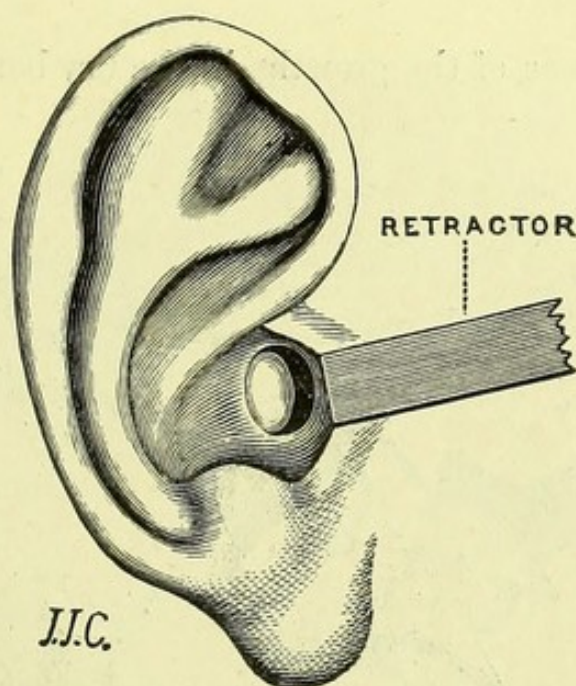


FIG. 37.—Ivory Exostosis (Hyperostosis) arising from the Posterior Wall of the Meatus.

of the body are often called hyperostoses, but it will be more convenient here to limit the term hyperostosis to inflammatory hypertrophies.

Ivory aural exostoses have been observed much more commonly in men than in women. Almost invariably they arise as a long ridge or as one or more round tumours, attached by a broad base to the posterior wall and close to the orifice of the external meatus. They are not congenital in origin. Their development is slow and insidious; they occur in apparently healthy subjects; and are unaccompanied by complications until sudden deafness and some inflammatory irritation result

from the complete occlusion of the meatus. Their very existence is not at first suspected, and, but that the patient discovers that his hearing is rapidly failing him, the absence of pain might lead him to regard the affection as trivial. In consistence they resemble ivory, whence their name; and they are usually bilateral, and covered with white smooth hairless skin. Being less vascular, they are harder even than the most compact portions of their source, the temporal bone. An attempt to saw through the hardest part of that bone gives some idea of the difficulty of an operation for the removal of a true ivory exostosis.

The appearance of the growths in the dry bone is represented

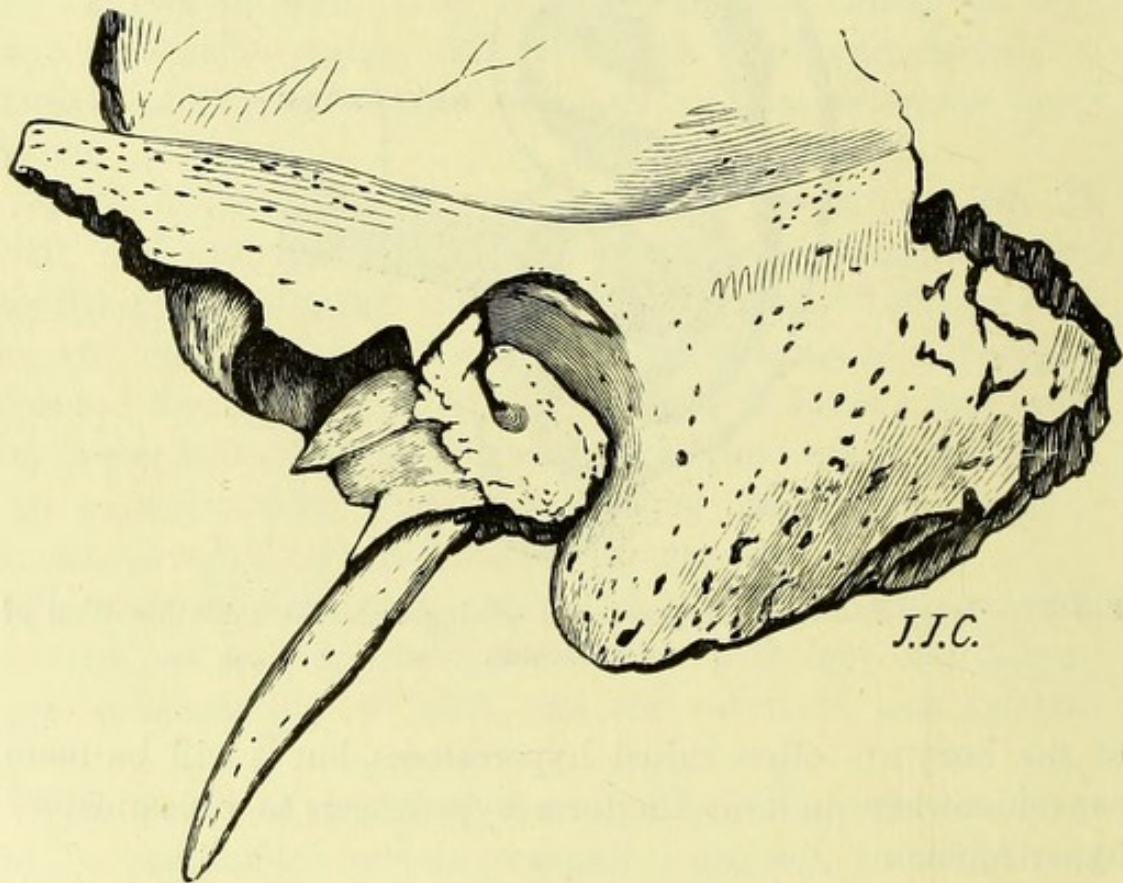
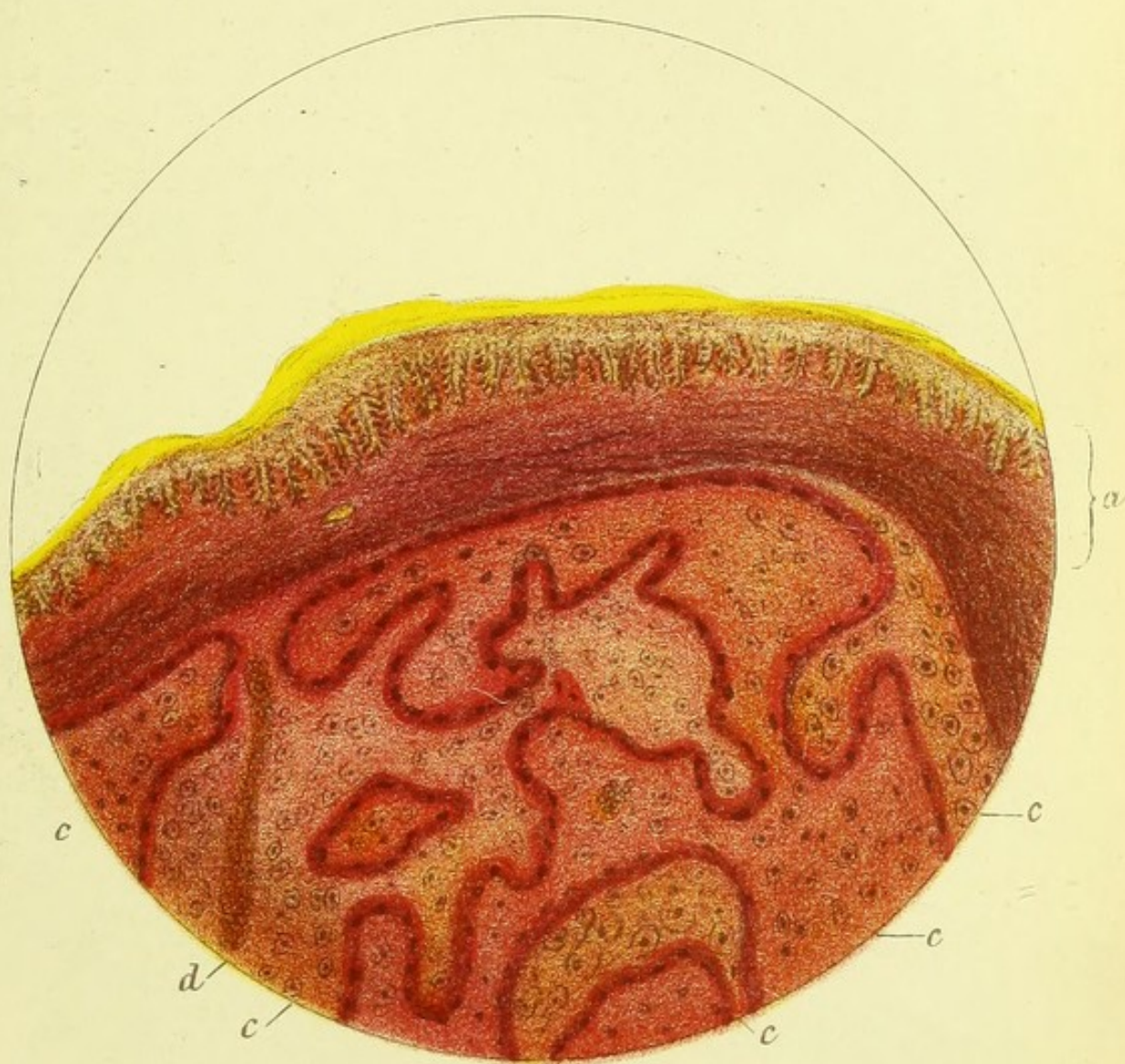


FIG. 38.—Multiple Ivory Exostoses arising on the Meatal Aspect of the Tympanic Bone, and almost occluding the passage. St. Mary's Hospital Museum, No. 802.

in Fig. 38, taken from a specimen which was presented to St. Mary's Hospital by Mr. E. W. Roughton.

In microscopical section the true ivory exostosis is seen to consist of extremely dense bone, covered by squamous epithelium

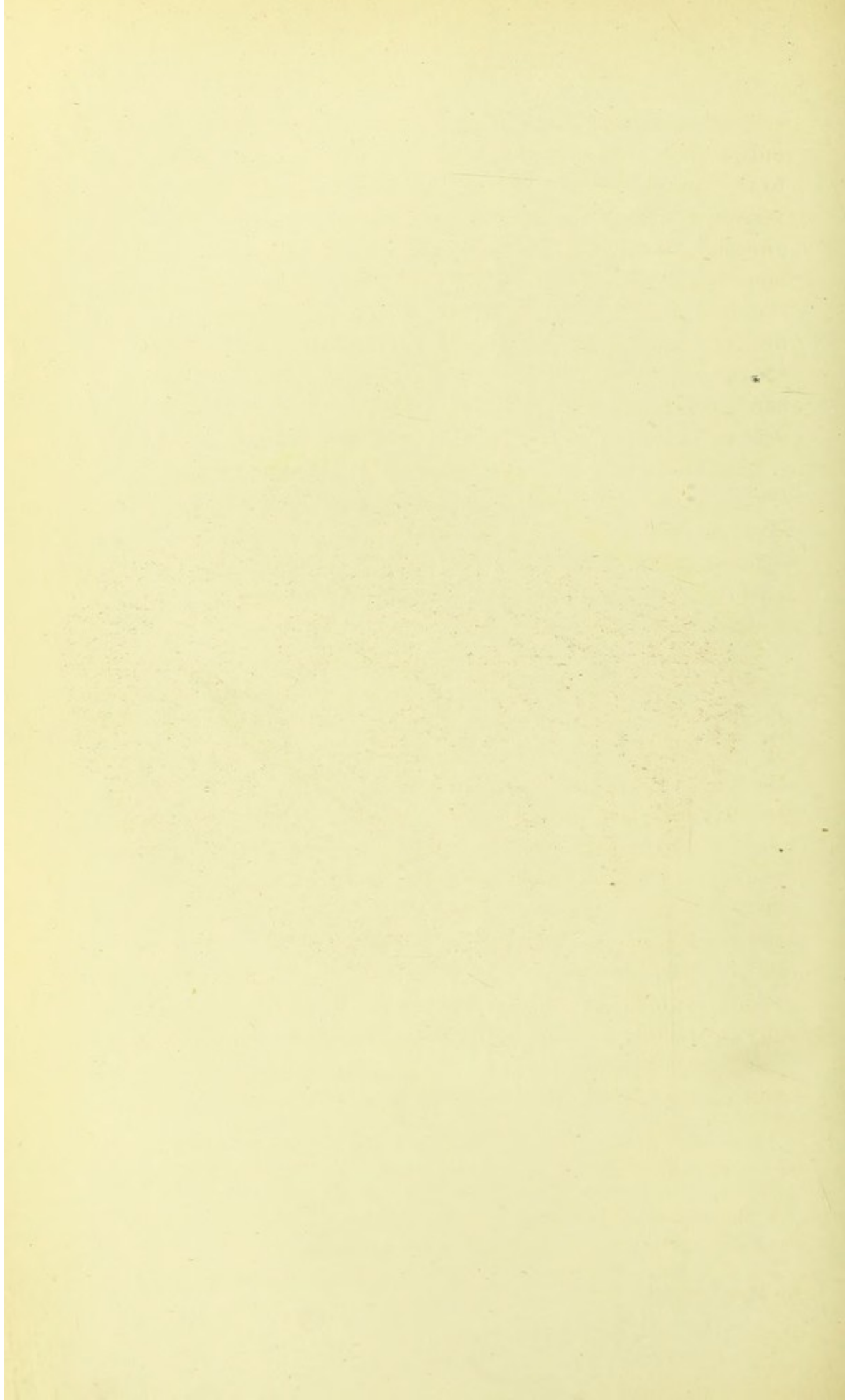


G.C.H.

× 180

Section of a Spongy Aural Exostosis stained with picro-carmin.

- | | |
|---------------------|----------------------|
| a. Epithelium. | c. Medullary tissue. |
| b. Fibrous coat. | d. Blood vessels. |
| e. Bone trabeculae. | |



resting on a thin fibrous layer devoid of papillæ, and containing only a very few small blood-vessels. The lamellæ run parallel to the surface instead of being arranged concentrically around vessels, which are usually absent from the greater part of the growth. Flattened bone corpuscles lie in lacunæ between the lamellæ, and the canaliculi run usually at right angles towards the free surface. Towards the base, the structure gradually merges into that of the temporal bone from which the growth springs, and here the vessels are more numerous. The extreme hardness of this variety of exostosis, which resembles that of dentine, is due to the density produced by the absence of vessels.

Von Tröltsch is of opinion that bony tumours of the meatus always give considerable pain when touched. In the case of Miss H. (see p. 89) there was certainly great suffering on the slightest touch of a probe. I have remarked, however, that the true ivory exostosis may be examined instrumentally without causing the slightest distress.

(2.) Etiology.—These growths, according to Toynbee and others,* occur exclusively in subjects affected with gout and rheumatism; other authors, as Triquet, hold that they are seen only as concomitants of syphilis; whilst Grüber believes all these diseases may influence their production. In no case that I have seen has there been any history of syphilis. The cause appears to be rather a chronic inflammation of the walls of the external meatus, such as might be produced by sea bathing.† The evil effect of salt water in these cases I first pointed out some years ago; I have repeatedly since had evidence of the correctness of my original conclusion. It is remarkable that most of my patients with *double* ivory exostosis were in the habit of bathing daily in the sea, and attributed their ear mischief to this cause alone. The aquatic habits of the Hawaiian islanders are well known;‡ and Dr. C. T. Blake (quoting Professor Wyman) has

* See Cumberbatch, "On two cases of Aural Exostosis," *St. Bartholomew's Hosp. Reports*, vol. 16. Cf. Cassells, *Brit. Med. Journ.*, Dec. 15, 1877.

† This view was alluded to in the presidential address on Otology at the International Medical Congress in London, 1881.

‡ "The natives here are a'most amphibious," *A Voyage in the Sunbeam*, by Mrs. Brassey.

pointed out the frequent presence in their crania of exostoses of the external auditory meatus. As has been well remarked, "A mechanical irritation continued for a long time on any part whatever of the osseous auditory meatus can give rise at that place to an osseous tumour."*

I was first induced to enunciate the opinion that these growths are most probably, in many instances, due to the irritation of the ear by salt water, introduced repeatedly during a long course of sea-baths, by the singularity of the fact that four of my patients, who for protracted periods used to bathe together on the south coast of Ireland, had each to be operated on for double ivory exostosis.

(3.) Treatment.—Tincture of iodine freely applied was formerly considered the best means of treatment for exostoses. Wilde recommends "counter-irritation, depletion, and mercurials to arrest their progress in the early stage, when there probably exists a chronic state of periostitis."† By electricity Clark, of Bristol, removed from the right ear of a girl nineteen years of age an exostosis which followed the growth of a mucous polypus. But Bonnafont, I believe, was the first surgeon who effected the removal of an ivory exostosis causing complete closure of the meatus. This was accomplished by means first of graduated styles, and subsequently of nitrate of silver. I have found his method of treatment almost impracticable, from the intense pain to which it gives rise. Pritchard formerly advocated mineral acids, but now only uses drills or trephines driven by an engine or motor. Tröltsch has successfully used laminaria to enlarge the opening between the growth and the wall of the auditory canal. Miot adopted another plan: by trephining the tumour with a very slender instrument in two or three places, he set up suppuration, and dead bone afterwards came away in sufficient quantity to allow the membrana tympani to be seen.

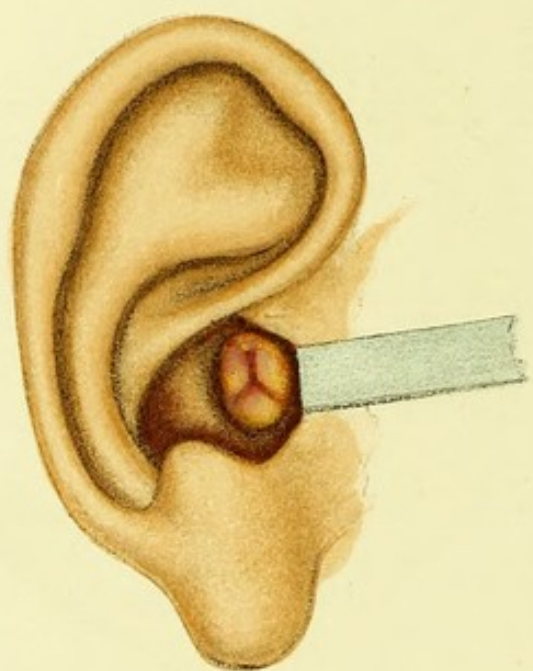
Moos, of Heidelberg, has recorded a somewhat similar case.‡ In an excellent book, published in 1881, Dr. Stephen Smith, of

* See paper by Delstanche, translated by Cassells, in *Medical Press and Circular*, July 9, 1879.

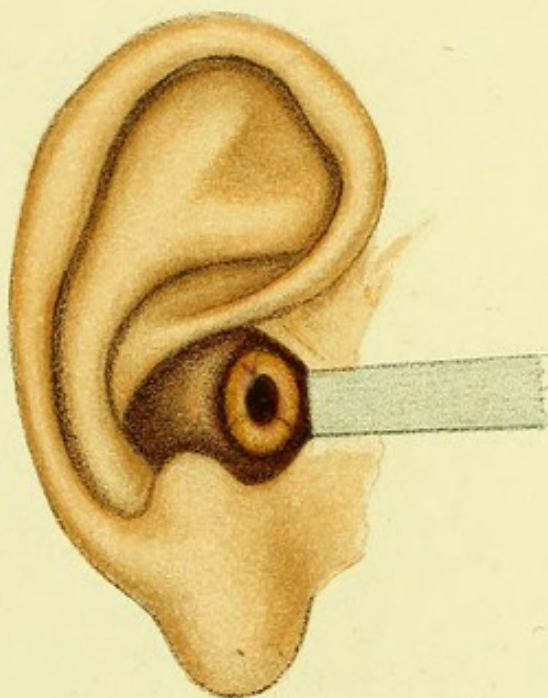
† Holmes, *System of Surgery*, vol. 3, p. 150.

‡ *Lancet*, July 20, 1878.

LEEDS & WEST RIDING
MEDICO-SURGICAL SOCIETY



MULTIPLE EXOSTOSES.
The Tragus held back.



MULTIPLE EXOSTOSES.
After drilling.

New York,* after stating with Rheinfleisch that these growths do not return when removed, goes on to say that "the ivory exostoses of the skull, owing to their hardness, are generally excised with extreme difficulty by means of saw and chisel,† and the violence involves very great danger." This, I think, is self-evident. It is to be hoped that in his next edition he will be able to bear testimony to the value of the operation by means of the drill.

The American dental engine, first suggested by Dr. Mathewson,‡ of New York, for the removal of these tremendously hard outgrowths of the tympanic bone, is perhaps the best instrument for penetrating them.

Where an exostosis is the result of suppurative inflammation, arrest of the discharge is an indispensable first requisite. In the case of multiple ivory exostoses, which have so obstructed one another's growth as to leave a narrow passage for a sound, the occasional removal of cerumen and epithelial *débris* may be all that is required for the preservation of hearing. When the tumour is of soft bone, the use of an *écraseur*, or of a dentist's forceps or elevator, preceded or not by a few minutes' drilling, may suffice. For the treatment of ivory exostosis blocking the meatus, and so preventing the escape of purulent secretions, or causing deafness, drilling with the dental engine can be safely recommended. Excision with saw and chisel has, it is true, been resorted to, but the difficulties of the operation are obvious, and constitute decided objections to its practice.

Much has been written in favour of mallet and chisel for the removal of aural exostoses. With all due admiration for those who can efficiently use them, I cannot but regard these instruments as more likely, even with the adoption of every available precaution, to cause injury to patients than the drill.

Successfully to employ the dental engine, the patient must be placed on a couch about four feet from the ground, in order to bring him within reach of the drill; his head, furthermore, must

* *The Principles and Practice of Operative Surgery.*

† Heinecke, of Erlangen, has successfully operated by gouge and mallet; but in his case there were granulations on the *membrana tympani* with suppuration.

‡ *Trans. Internat. Otological Congress*, 1876.

be placed on a pillow, with the side to be operated on well exposed to the light. To protect the internal structures of the ear, in case the drill should slip, it is highly desirable to employ a spoon-like steel guard, made after a pattern in thin copper, expressly to pass by the side of and behind the exostosis. A set of drills should also be provided, for experience shows that the gradual enlargement of a very small initial opening is the best mode of procedure. At least three assistants ought to be obtained, one to administer an anæsthetic, another to work the treadle of the dental engine, and another to keep the steel guard steadily in position. Without previously removing the skin, one may proceed at once to the perforation of the tumour, avoiding its base, keeping close to the side of the steel guard, and frequently taking out the drill to allow the sponging away of accumulated blood. The following are a series of cases of the removal of ivory aural exostoses by drilling.

CASE I.—Dr. G. M., of Waterford, æt. 32, came to me on October 4, 1877, for treatment, each auditory canal being blocked up by an exceedingly dense tumour, like a boil in shape, proceeding from its posterior wall, and reaching from about a quarter of an inch from the orifice of the meatus to close to the tympanic membrane. The patient had observed deafness in the right ear since taking a sea-bath in the previous September, and in the left ear only since October 1; and with this there had been, as usual in such cases, troublesome tinnitus and an oppressive sense of fulness in the ears. After a few days, a slight inflammatory action being produced on the anterior wall of the meatus, owing to the growth of the tumour, the deafness became absolute: so that, except on contact, the ticking of a watch was inaudible, a condition precluding the patient's continuance in medical practice, and causing, naturally enough, great depression of spirits. On October 13, the perforation of the tumour in the right ear was commenced, and, in two more operations, it was accomplished. On November 11 and December 2, the drilling of the tumour in the left ear was effected. Subsequent smart inflammation, with perforation of the membrana tympani, was checked by the use of leeches and lotions of carbolic acid; and, on January 13, it became necessary

to remove red granulations which were blocking up the passages of both ears, and to employ astringent solutions for the arrest of a somewhat persistent purulent discharge. The hearing then became normal, and it has since remained perfect in both ears.

CASE II.—My next case of double exostosis, sent to consult me by Dr. Symes Thompson, was that of a naval gentleman, Mr. A. S., æt. 31, who, like the preceding and my next two cases, had been accustomed to regular sea-bathing. He had suffered from earache from time to time, for as long as he could remember. It was in 1866 that he first found himself growing deaf, and, after some years, his hearing became so seriously affected that he found himself necessitated to retire from Her Majesty's service. On examination, December 17, 1879, I found each meatus to be closed by a large ivory exostosis arising from the posterior wall. Five operations—two for the right ear, in January and February, and three for the left, in March and April—were required for the efficient perforation of the tumours, the total time occupied being 3 hours 40 minutes. In the last operation, the absence of an assistant was, in all probability, the cause of an accident which, although its effects were soon averted, might have been serious. The guard, which I was compelled to hold as I worked with the dental engine, slipped, so as to allow a slight swerving of the drill, and the membrana tympani was injured. A little paralysis ensued, indicative, no doubt, of injury to the facial nerve. The final result in this case, as in the last, was eminently satisfactory, the patient completely recovering his hearing.

CASE III.—In April, 1881, Mr. H. was recommended by my first patient, Dr. M., to come to me, as he was suffering from traumatic deafness of the right ear, and the left was useless through complete occlusion of its meatus by a large ivory exostosis. In the earlier of two operations for the removal of the tumour, the steel guard broke in the ear, and could only with difficulty be extracted. An iron guard, which I had by me, was then substituted. It is important, I may here note, to have the guard made of metal that will bend without snapping when subjected to strain. The treatment, after the drilling of the exostosis in this case, resolved itself into the removal of granu-

lations from the opening made, and the patient then recovered his hearing.

CASE IV.—In my next case, that of Miss M., æt. 19, sent to me by Dr. McMunn, in September, 1881, there were two osseous growths in the right ear, which caused complete deafness as regarded air-conducted sounds. Both were pedunculate, and one was attached to the posterior, the other to the anterior, wall of the meatus. They were removed by means of a dentist's stump-forceps, not being of an ivory-like consistency. Cases similar to this are not infrequent in hospital-practice, in which the ivory-like growths are of comparatively rare occurrence.

CASE V.—Miss A. was first seen by me on February 17, 1882. She had, in consequence of measles at the age of 6, for twelve years been the subject of a constant purulent discharge through the right membrana tympani; and, since Christmas, 1881, she had been increasingly deaf. I discovered an ivory exostosis attached to the posterior wall of the meatus, but, as this had not attained size sufficient to impede free escape of the discharge, I deferred treatment for a while. In the following May, when I next saw my patient, the exostosis had so increased in size that only a slender probe could be passed between it and the anterior wall of the meatus, the flow of the discharge was hindered, and deafness was complete. Removal of the obstruction was now evidently requisite, as retention of pus in the meatus might have been attended with serious risk to the patient's life. The complete drilling of the growth was effected in about half an hour; and, very soon after the operation, the patient's hearing began to return, and, after the lapse of a couple of months, it was fairly restored, notwithstanding the existence of a perforation in the membrana tympani. In this case, the origin of the exostosis was evidently inflammation set up by a perpetual discharge from the middle ear.

CASE VI.—J. F., a girl, æt. 18, came to me as a hospital patient, March 20, 1882. After suffering from increasing deafness for eighteen months, she had, four weeks before I saw her, almost completely lost her hearing in the left ear. I found that there was a large, painless, and deeply seated tooth-like excres-

cence of soft bone on the posterior wall of the meatus. This I found it possible to sever from its attachments with a dentist's elevator, which, for the treatment of a true ivory exostosis, would have been of no avail.

CASE VII.—In another somewhat similar case, that of Miss H., æt. 24, sent to me by Dr. Gibson, of Hull, and treated by me in June, 1880, the growth, which was very sensitive, and was attached to the anterior wall of the meatus, was cleared away in fifteen minutes, a strong pair of dressing forceps being applied after a small hole had been drilled in the base with the dental engine.

CASE VIII.—Mr. W. G. D. G., æt. 46, from near Waterford, thus succinctly describes the origin and treatment of the exostoses for which he was sent to consult me. "I was first troubled by an abscess in my right ear in September, 1883, the effect probably of sea-bathing, and of the frequent use of an old spring-board on Kelly's Rocks. The abscess caused deafness for some three or four weeks, but was eventually cured by the application, by Dr. O'Farrell, of a solution of caustic. In October, not being satisfied with my ear, I consulted Mr. Fitzgerald, of Dublin, who said the passages in both ears were much contracted, and I might eventually have to get them operated on. He prescribed a lotion, which I used for some time, and hearing came back all right. In 1884, I was yachting from the middle of May till the end of September, and took a header or two off the main boom each morning. At the end of the season, I was again troubled with an abscess, this time in the left ear, causing deafness. At the end of November, I consulted Mr. Field, who diagnosed double ivory exostosis. After the removal of a polypus from the left ear, its hearing returned; but the exostoses had now so increased that, as soon as I could spare time, early in February, I had the worse ear, the left, drilled, the operation lasting sixty-five minutes. In consequence of leaving London before the ear was sufficiently healed, it became filled with granulations, which gave much trouble to get rid of, from the beginning till near the end of March. On the 9th of that month, the other, or right ear, was operated on, chloroform being administered for one hour and ten minutes, and in it hearing is

now, as in the other, quite restored." The final result in this case, I may add, left nothing to be desired.

CASE IX.—Mr. S. W., æt. 26, was sent to me by Mr. Swanwick, of West Hartlepool, in November, 1883, for double ivory aural exostosis, causing slight deafness. As by the following February the left meatus was much encroached upon, and the right was almost occluded, an operation was recommended for the prevention of complete deafness. Accordingly, on February 24, after operating for fifty minutes, I satisfactorily drilled through the tumour in the right ear; the left has, as yet, not been operated on. It appears possible that a tendency to nocturnal epileptiform fits, exhibited by the patient, may be due to the retention by the exostosis at some former time of secretions in the ear.

CASE X.—Dr. W. L. M., of Waterford, æt. 35, brother of Dr. G. M., my first patient with ivory exostosis, had, like him, been a great sea-bather. In August, 1884, he experienced a feeling of fulness in the ears, but without pain or deafness. Syringing the left ear with warm water on August 19 rendered it at once very deaf. On the 22nd, Dr. Storey, in Dublin, diagnosed double ivory exostosis, with irritation and inflammation of the left meatus. On the 28th the hearing of the left ear was restored, a solution of nitrate of silver (gr. x ad ʒj) having been applied daily. The patient was subsequently seen by me on September 22 and October 23, 1884, and in the following March, by which time both exostoses had increased so much that the speedy onset of complete deafness appeared probable. I accordingly operated on both ears on March 24, occupying altogether fifty-five minutes. The discharge of pus caused much deafness during the next three weeks, after which the hearing remained variable for a time, and then completely returned. He now hears perfectly well.

CASE XI.—Mr. H. C. W., of Ipswich, who first consulted me in March, 1882, gave a history of some degree of deafness in May, 1881, followed in January of the next year by gradual loss of hearing in the right ear, and eventually by much pain in that organ. The use of a lotion which I ordered him having afforded him relief both from pain and deafness, I saw nothing

more of the patient till April 13, 1885. The hearing had then been diminishing since the previous December, and acute pain had set in. On the 21st I proceeded to remove a large ivory exostosis from the right ear, employing first the drill, and then, to break up the remains of the growth, the bone-forceps. The result of the operation, which lasted sixty-five minutes, was in every way satisfactory.

CASE XII.—The facts detailed in the following history have been furnished by my patient himself, W. B., æt. 60, a country solicitor, who was sent to consult me by Mr. Oliver Maurice, of Reading. The patient was accustomed to swimming all the summer, and to plunge his head under water in a big bath every morning throughout the rest of the year. Five or six years since, the right ear began in extra hot summer weather to become stopped up for a day or two, or for more than a week at once. No pain was experienced at such times, and the hindrance to hearing used imperceptibly to depart. When, in about two years, the period of obstruction became longer, a medical man was consulted, who found a bony growth in each ear. In accordance with a warning not to let water get into his ears, the patient subsequently stopped them with cotton wool whenever he bathed; and except for times of varying duration in unusually hot weather, his hearing remained unaffected. In 1885, however, one very warm June day the patient, when at a friend's house, let a drop of water from a sponge squeezed over the head enter his right ear, in which there was no cotton wool, with the effect of causing deafness, and in a few days great pain, which, after two days, eventuated in a discharge, which gave him relief. I was consulted on June 20, and the next day removed the bony growth in each ear, chloroform being administered for about an hour and a quarter. For three or four days a slight dull pain was felt in the ears, and in a week the hearing of the left ear was pretty fair. The convalescent was then removed to new lodgings, where, after the lapse of some hours, it was discovered that the water-closets were devoid of water-supply. Evidently as a result of poisoning by sewer-gas, the patient a few days afterwards became ill with erysipelas in the head which extended from one ear to the other, and then spread over the whole body.

Subsequently, at new lodgings to which I insisted on his being removed, he had a sharp attack of double pneumonia, and Dr. Broadbent and Messrs. Oliver Maurice and Edmund Owen were called in consultation. During his illness, a discharge of matter into both ears prevented hearing; this, however, gradually disappeared on restoration to health, and his hearing is now as good as ever. I have no doubt that a timely change of residence was in this case the means of saving the patient's life. Indeed, so serious was his condition that, had he not been, although over sixty years of age, a hale and hearty man, accustomed all his life to active exercise in hunting, I think it probable he would never have recovered.

CASE XIII.—The next case I have to mention is one that shows the importance of not unnecessarily deferring operation. The patient, Mr. F. G., of Ipswich, was sent to consult me originally by the late Dr. Moore three years ago, and subsequently by Dr. Currie on account of a large aural exostosis in the right ear. I saw him occasionally, about every three months, and I told him that at no very distant date it would be necessary for him to undergo an operation for the removal of the growth; for, as he at times had a purulent discharge, it would not be safe to allow the complete occlusion of the meatus. On July 6 he came up again to see me, and when I insisted on the importance of an immediate operation, he told me he was so much occupied that this must be deferred till September; and on further pointing out to him as strongly as I could the danger he ran of losing his life, he merely replied, "That's my business; I'll take my chance." On July 17, Dr. Currie wrote to me as follows: "I have advised Mr. F. G., as he still complains of throbbing in his ear, and as the discharge is more distinctly purulent, to have the ear drilled as soon as he can. The fact is, the whole ear is blocked, and I believe all treatment but operation useless. He has no rise of temperature at present." The patient still persisted in putting off the operation, despite all advice. At the end of July I went away for my holiday, and on August 3 Dr. Currie telegraphed to me to Gloucestershire, where I was staying, to come to Ipswich at once, as Mr. G. was dangerously ill with, he feared, cerebral

abscess. I started off at once, but on my arrival in town I received another telegram to say that the patient was dead. There can, I think, be no doubt that Mr. G.'s life would have been saved by a timely operation.

CASE XIV.—Bishop B., my next case, came to consult me, September 18, 1885, with a large ivory exostosis nearly filling the external meatus of the right ear. He had at times suffered from an offensive discharge from this ear, together with much pain over the right side of the head. On September 21 he was placed under the influence of ether and operated on in the usual manner, the removal of the exostosis taking about sixty minutes. He made an excellent recovery and had no bad symptoms. In a month's time he went abroad, having recovered a very fair amount of hearing.

CASE XV.—Miss R., æt. 12, was sent to consult me by Mr. S. Robson, of Durham, October 5, 1885, having a very large exostosis completely blocking up the auditory canal. Deafness had persisted since a very severe attack of scarlet fever eight years previously. On October 6, after administration of chloroform, I employed the dental engine for sixty minutes, securing an opening which permitted of some amount of hearing; but as the child was not in good health, and the exostosis on account of its density would require protracted renewal of the drilling, I recommended that any further operative measures should be deferred till the spring, when I saw no reason to doubt that the enlargement of the opening would prove as satisfactory in its results as in the other cases just described.

CASE XVI.—The following is a case in which the drill might, no doubt, have been successfully employed, but in which the nature of the exostosis admitted the use of a readier means of extirpation. The patient was sent up from the country to the George Bird Ward, St. Mary's Hospital. I found that he had for years, on and off, suffered from discharge from the left ear, and that he had latterly complained of great pain on the left side of the head. The meatus, as examination with a probe revealed, was completely occupied by a large and apparently fixed spongy osteoma. Directly the patient was well under the influence of chloroform, I seized, and without much difficulty

Cases of Exostoses Tabulated.

No. of Case.	Name.	Sex.	Age.	Dwelling-place.	Ear affected.	Nature of Growth.	Seat in Meatus.	Assigned Cause.	Number of Operations.	Result of Treatment.
1	Dr. G. M. S.	Male	32	Waterford	Each	Ivory exostoses	Posterior wall	Sea-bathing	Two for each ear	Normal hearing, both ears.
2	"	"	31	Dartford	"	"	"	Habitual sea-bathing	Two for right, three for left ear	" " "
3	H.	"	48	Waterford	Left	"	"	"	Two	Restored hearing, both ears.
4	M.	Female	19	London	(Rt. deaf)	Two spongy pedunculate osteomata	One anterior, one posterior wall	?	One	Normal hearing.
5	A.	"	21	Ipswich	Right	Ivory exostoses	Posterior wall	Measles	"	Restored hearing.
6	J. F.	"	18	London	Left	Pedunculate soft growth	"	?	"	" "
7	H.	"	24	Hull	"	Soft growth	Anterior wall	?	"	"
8	W. G. D. G.	Male	46	Waterford	Each	Ivory exostoses	Posterior wall	Habitual sea-bathing	One for right, one for left ear	Normal hearing, both ears.
9	S. W.	"	26	West Hartlepool	"	"	"	Sea-bathing	One for right ear; left not yet operated on	Restored hearing.
10	Dr. W. M. (brother of No. 1)	"	35	Waterford	"	"	"	Habitual sea-bathing	One continuous for both ears	Normal hearing, both ears.
12	H. C. W.	"	29	Ipswich	Right	"	"	Bathing	One	Restored hearing.
11	W. B.	"	60	Reading	Each	"	"	"	One continuous for both ears	(1) Erysipelas, and (2) double pneumonia from sewer-gas. Recovery with normal hearing.
13	F. G.	"	38	Ipswich	Right	"	"	?	None permitted	Cerebral abscess and death.
14	Dr. B. R.	"	64	Hong Kong	"	"	"	Scarlet fever	One	Improved hearing.
15	"	Female	12	Durham	Left	"	Completely occluding	"	"	Improved hearing; case in progress.
16	J. L.	Male	29	London	"	Spongy osteoma	Anterior wall	Measles	"	Improved hearing.

These are my first sixteen cases. I have now operated on over 100, but it is unnecessary to tabulate further, as it would be nearly a repetition of the above.

removed, with strong forceps, a growth measuring three-quarters of an inch in length and one-third of an inch in thickness.

The above cases I have recorded as showing the possible importance, nay, in some cases, the urgent necessity, of operating for the removal of aural exostosis. But, as this may be no trifling matter, it is perhaps advisable to point out the class of cases in which (1) an operation is not requisite, and (2) is altogether unjustifiable. I have been sent numerous cases of multiple exostoses, in many of which I have been able to give the assurance that no operation is or probably will be needed, although deafness may for a time have been almost absolute. These bony excrescences, in many an instance, occur opposite to one another, and, as they grow, become wedged together, so that increase at the extremities is arrested, and a triangular central space is left. This channel, when very small, as it not infrequently is, may afford a sufficiently free passage for sound, but readily becomes blocked by cerumen or even water, causing complete deafness. Careful cleansing of the meatus must then be resorted to, and the patient should be warned never by any means to allow water to enter the ear. Practice of this precaution, and occasional repetition of the cleansing, may be all that is required for the continued preservation of the hearing.

I was, some time ago, consulted by two brothers, the one a medical man, and the other a celebrated actor, each the subject of bilateral multiple exostoses, originating in oft-repeated sea-bathing. To them, as to all others occupied in a more or less public capacity, impairment of hearing would have been a matter of most serious import. I was able to assure them of the high probability of what they have for two or three years since enjoyed, continuance of perfect audition without recourse to operation. This, however, could scarcely have been expected had each meatus contained what are sometimes to be met with, namely, four or five exostoses growing close together or behind one another. Such a condition obtained in the case of a distinguished lawyer, under my care for some few years. As he came to see me every two or three months, I was for long enabled to keep the meatus clear: but latterly its calibre became

so much reduced that, as deafness would have been incompatible with the discharge of his official functions, an operation must soon have been imperative had not his death occurred from bronchitis.

The cases in which operation is unjustifiable are those in which it would be dangerous, because of the growth being not only of extreme density, but situated at a great depth within the meatus. Cases of deeply seated soft exostoses (spongy osteomata) may, on the other hand, be treated instrumentally without risk, as in the instances of removal by forceps above recorded. The confounding of these with the harder growths has doubtless led to the accounts, occasionally to be met with, of the ready removal of ivory exostoses after a few minutes' drilling. As we have seen, the drill may be quite unnecessary for the softer class of excrescences, whereas experience proves that it alone, used for a considerable length of time, can be of any avail for the penetration of the harder growths.

These cases only go to strengthen conclusions long since arrived at by me:—(1) That aural exostoses must not be considered as at all necessarily the outcome of gout, rheumatism, or syphilis; (2) that their origin can, with strong probability, be attributed, in many, if not in all cases, to some preceding local irritation; (3) that they can be safely and most effectually treated by drilling, when a suitable guard is employed to protect adjacent structures; (4) that their speedy removal is indicated wherever they hinder the elimination of secretions and discharges from the auditory canal, cause pain by pressure, or impair or prevent audition.

It is still not uncommonly stated that, except in urgent instances, this operation should never be attempted, and for the assigned reasons that its risks are very great, and the benefit likely to be derived from it but small. Now, in publishing this second series of cases—which, be it noted, are not selected, and may therefore be regarded as representative—I wish again to emphasize the fact that, whereas the risks of the operation, when carefully performed, are practically *nil*, the benefit to be derived therefrom is lasting, and to many people of the utmost importance. That, moreover, the operation, by providing a vent

for pent-up pus, may give relief from serious and ever-present danger to life, is another fact which I have, with good cause, insisted upon in the past. It was but a few months ago that I had occasion to strongly recommend a gentleman to permit the removal from one of his ears of a large exostosis. Behind it

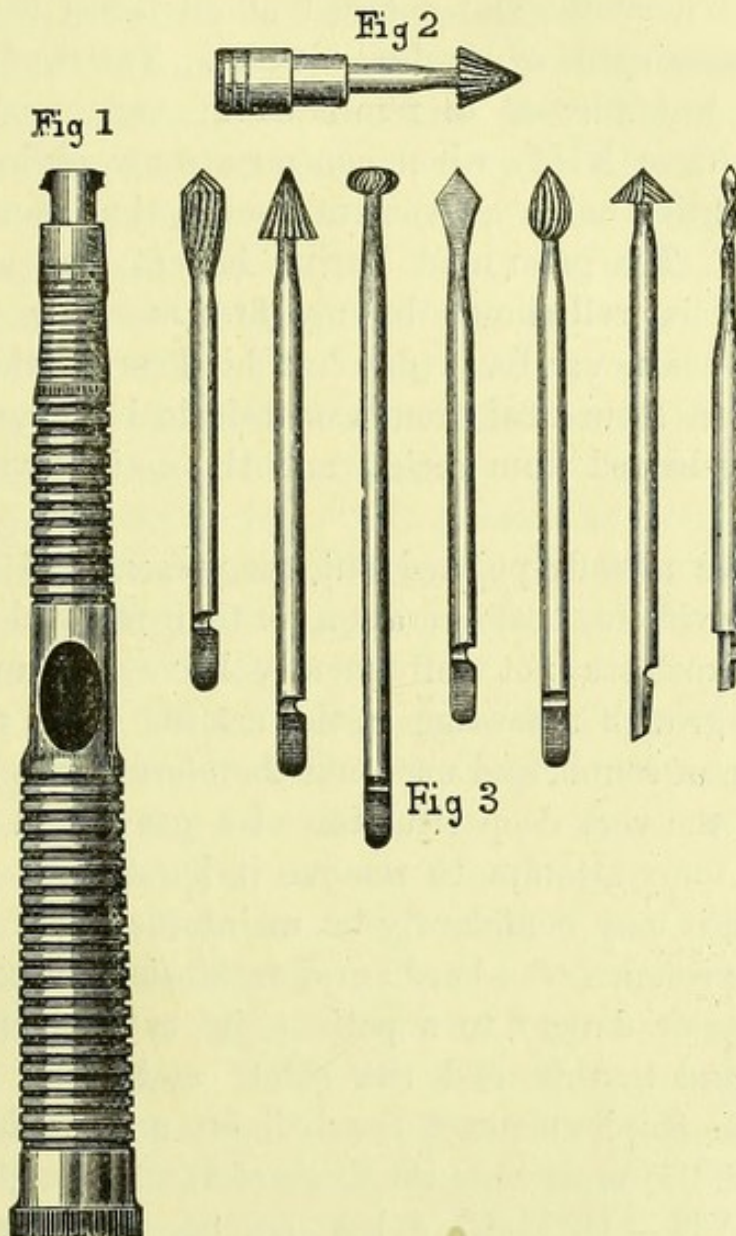


FIG. 39.—Aural Drills.

there was an accumulation of pus, for which there was no external outlet save a small aperture, the closure of which might at any time jeopardize his life. This gentleman's medical man, however, decided—on what grounds he did not demonstrate—that the risks of an operation would be too great, and accordingly nothing was done for the ear. If this patient's ear escapes

becoming completely blocked, and he has no further trouble with it, it may even be maintained that an operation could never have been desirable; for there are some persons who seem to be quite content that, if not they, certainly their neighbours, should go through life providentially afflicted with a large amount of preventable deafness, and exposed at all times to a probable chance of meningitis or cerebral abscess. The condition of the gentleman just referred to reminded me very much of that of Mr. F. G., (Case XIII), when, contrary to my advice, he put off operation until a more convenient season, thus compassing his own death. The great and lasting benefit that an operation may confer is well shown by my first case, Dr. G. M., who since 1877 has never for a day lost his hearing, though before then he was stone-deaf from exostosis in both ears, and consequently debarred from society and the active exercise of his profession.

As I have already pointed out, the presence of exostoses is no certain evidence that operation for their removal is desirable. Multiple exostoses not infrequently leave by mutual interference of growth a passage in the meatus quite adequate for conveyance of sound, and need not therefore be interfered with; and, again, the very deep situation of a growth in the meatus may render any attempt to remove it hazardous. With these limitations, it may confidently be maintained that in all cases where the presence of a hard aural exostosis is a source of inconvenience or danger to a patient, its extirpation should be effected; and to this end the safest and most satisfactory means is the employment of the drill, or aural trephine.

Fig. 3 (p. 97) represents the drills of various lengths.

CASE XVII.—D. McC., a boy, æt. $6\frac{1}{2}$, was sent to me by Mr. F. W. B. Jones, of Ross, on February 8, 1886. I found the right meatus occupied by an exostosis, seated on the anterior wall, the origin of which was doubtless attributable to abscess during an attack of measles in March and April, 1882, and remittent otorrhœa. After operating with the drill on May 3, 1886, I followed my usual course of treatment in such cases, under which the discharge gradually ceased, and hearing was much improved.

CASE XVIII.—H. G., a clerk, æt. 31, came to me at St. Mary's Hospital, April, 1886, complaining of increased deafness of the right ear. Fifteen years previously he had experienced whistling noises in the ear, and, after somewhat more than a twelvemonth, during which there was discharge from each meatus, he had noticed that his hearing was becoming impaired. He was treated awhile for the discharge and deafness, but, he says, without success. On admission at St. Mary's, the patient stated that there had been numerous abscesses in his right ear, which had always been worse than his left; also, that he had first noticed obstruction in the right ear eight months previously, when pieces of bone, like fragments of honeycomb, used to come from it. I found the right external auditory meatus to be blocked by an exostosis of soft cancellous tissue. Operating on May 12, 1886, after administration of an anæsthetic, I broke away the growth bit by bit. The subsequent treatment, which was followed by restoration of hearing, consisted in the careful maintenance of cleanliness of the meatus, and the local use of stimulant antiseptic lotions.

CASE XIX.—F. W. B., a gentleman, æt. 20, who came to me October 18, 1886, first noticed a discharge from the right meatus about 1872. For this he could assign no origin, save possibly a scald in childhood. Nothing was done for the ear, beyond the application of a blister or two behind it, until May 1, 1879, when a polypus was detected. The removal of this was deferred in consequence of an attack of scarlet fever on May 5, but was subsequently effected. At Easter, 1886, there was slight bleeding from the right ear for two or three days. As the patient's deafness—due, as I discovered, to an exostosis—continued to increase, he was brought to me by Mr. Chaldecott, of Dorking, with whose assistance, on September 21 I operated with the dental engine. The systematic cleansing of the meatus and the repeated application of a solution of carbolic acid constituted the main after-treatment, and the patient is now steadily regaining his hearing.

CASE XX.—H. C., a gentleman, æt. 61, was sent to me by Dr. Lawrence, of Chepstow. Three or four years previous to his first visit to me, in 1886, he had twice suffered from deaf-

ness of the right ear, consequent, apparently, on abscess caused by the ingress of water into the meatus. After a slight discharge for a fortnight, the deafness had on both occasions entirely ceased. In August, 1886, subsequent to bathing every other day or so during four weeks at Whitby, deafness came on in the left ear, lasting a month. The patient, who, when he came to me, was very deaf in both ears, and suffered from considerable pain in the right side of the head, presented an exostosis on the posterior wall of each external meatus. On October 20, 1886, I drilled through both by means of the dental engine. No pain or injury to the general health ensued, and hearing was restored some five weeks from that date to the left ear, and a few days later to the right. On January 6, 1887, he wrote as follows: "I am very happy to be able to tell you that I am as nearly as possible cured of my deafness. When I come to town I will certainly give you a call, that you may see how successful your operation has been."

CASE XXI.—Emma H., a hospital patient, came to me November 3, 1886, with an exostosis of the left ear, the size of a large pea, and completely closing the external auditory meatus, to the anterior wall of which it was attached by a small pedicle. The development of the growth had begun with shooting pains

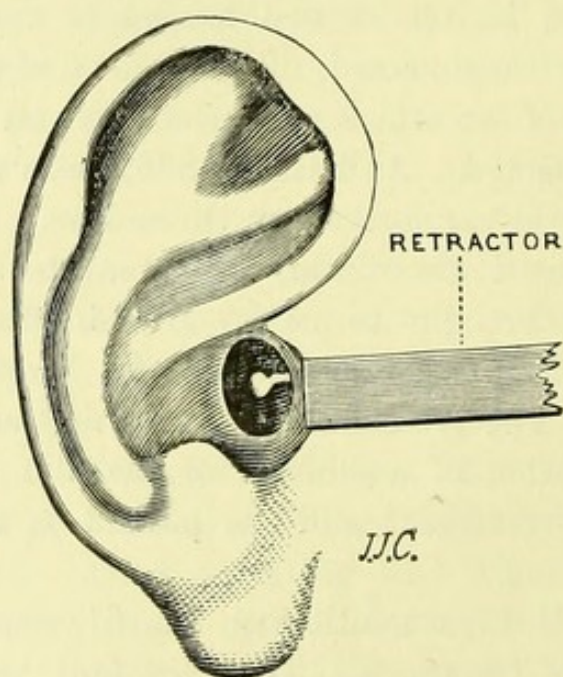


FIG. 40.—Exostosis growing from the Anterior Wall of the Meatus.

in the ear two years previously, and deafness had gradually increased, until it had now become almost absolute. In this case the use of strong forceps sufficed for the ready removal of the whole of the exostosis.

After removing granulations, dried pus, &c., from it, the bony growth presented the appearance seen in Fig. 40.

CASE XXII.—K. W., æt. 34, formerly a nurse, was admitted into the Manvers Ward, St. Mary's Hospital, November 10, 1886, on account of an ill-defined swelling below the left ear, corresponding in position with the parotid gland, together with typical facial paralysis. The patient, though unhealthy-looking, was fairly well nourished. Her family history was on the whole good, but she had lost her mother from softening of the brain, and a brother had occasional attacks of paralysis. Except for sick headache, at one time her general condition may be said to have been quite satisfactory. Ophthalmic examination showed white streaks upon the retina; by urinary tests, however, no albuminuria could be detected.

Five years previous to admission into hospital, she began to suffer pain behind the left ear; and three years later she noticed in that situation a hard, somewhat tender swelling. This slowly increased in size; and occasionally there was a slight viscid and rather offensive discharge from the ear. The facial paralysis commenced soon after the swelling became apparent. The pain behind the ear, for which opiated fomentations had been used, was described as of a stabbing character, and as running in a line from the ear to the throat.

By November 20, the patient's face had become much swollen, and she had endured several attacks of megrim, with vomiting. She was seen by me on the 25th, when I discovered in the left meatus, attached by a broad base to its posterior wall, and all but completely occluding its cavity, a large exostosis, which on percussion with a probe gave a clear ringing sound, as though it were composed of hard bone. The application of forceps proved the growth to be of loose construction, so that numerous small pieces of it, together with some granulation-tissue, were easily removed, and a passage through the meatus was secured. The following week the passage was enlarged

with the dental drill sufficiently to allow of a free discharge of pus, the pain in the head being thereby much relieved.

CASE XXIII.—The following case is one of a class in which immediate removal of an exostosis is not to be advised. E. L., a girl of 14, came to me at St. Mary's Hospital, October 24, 1886. She had from babyhood suffered from otorrhœa. On November 12, after removal, under chloroform, of a polypus in the right meatus, I found on its upper wall, and quite close to the drum-head, a large bony out-growth. As the meatus is not yet (and may never be) occluded, the position of the growth certainly for the present contra-indicates operative interference.

CASE XXIV.—Major R. B., sent by Dr. Smith, of Newport, to consult me, November 23, 1886, gives the following history of his case:—After three years' service with his regiment in Burmah, he contracted endemic fever, and was invalided home in 1867. On recovery, he discovered himself to be persistently deaf in the left ear, insomuch that a watch held to it was scarcely audible. He remarked his deafness most in a noise, and particularly in that caused by driving, railway travelling, or the conversation, as at a dinner-party, of several persons together. Near the close of 1884, he learnt from his local medical attendant that he had an unnatural growth in each ear; as, however, his deafness was not worse than usual, he attached no weight to this piece of information. In September, 1886, however, after a day's shooting, he experienced complete deafness in the right ear; this left him as suddenly as it had come on, but only to return six weeks later. By the advice of his medical man, whom he now again consulted, he saw me on November 23. Finding him to be the subject of double exostosis, I recommended operation by drilling. This I performed on December 6. The patient did well, keeping his bed for only a short time, and suffering but slightly. He returned home on December 18, twelve days after the operation, able to resume his usual occupations. The hearing of the right ear is now completely restored; that of the left, which was regained in fair measure for a few days, we may hope to be permanently restored, as in other cases, on the removal of the

granulations blocking the meatus. He says he "now hears as well as he did twenty years ago."

CASE XXV.—Mr. E. L. P., æt. 27, was sent by Dr. Thursfield to consult me, December 7, 1886. He first noticed a growth in his left ear about July, 1881, but thinks he must have been deaf for some time before then. By the advice of his medical attendant he visited an aurist, who diagnosed an exostosis, and by syringing dislodged from behind it a piece of wax about as large as a good-sized pea. Being recommended not to undergo an operation unless increase in the bulk of the tumour became perceptible, the patient, though often very deaf, troubled himself no further respecting his condition until near the end of November, 1886. He then, while washing, began to suffer from persistent pain in his ear. Dr. Thursfield, whom he consulted shortly afterwards, suggested he should see me without delay. On December 9 the drilling of the tumour was successfully effected, the operation lasting forty minutes. The patient made an excellent recovery, and on January 3, 1887, he felt perfectly well; all discharge had ceased, and a watch was audible at twelve inches from the ear.

I have operated on considerably over a hundred of such cases. During my early operations, and, in fact, until quite recently, I had only employed the ordinary motor worked by the foot. I had been so pleased with this instrument that I was unwilling to try any other form. In response, however, to the frequent suggestions of friends to use the latest scientific development of the dental engine, namely, that worked by a galvanic current, so much in vogue with the more fashionable dentists, I gave the electro-motor a fair trial. It answered very well; but I am bound to admit that, as far as aural surgery is concerned, it appeared to possess no advantage over the ordinary engine. On the other hand, on account of the battery necessitating the use of large quantities of a corrosive fluid, it is not so portable, a point of some importance in private practice, when it has to be conveyed to patients' homes or lodgings; and, moreover, it is much more liable to get out of order, and even to stop working during an operation. This latter *contretemps* happened during

one of my operations, although the machine was superintended by an electrician, and I had to finish the operation with my own instrument. I cannot, however, corroborate the experience of some aurists, who have had the misfortune to break several drills in their operation with the electro-motor. This was, no doubt, due to too high a speed. Greater speed can undoubtedly be obtained when the surgical engine is worked by electricity; but it is just because the speed obtained by the foot-motor is all that is required that I am so contented with it.*

Four years ago I tried at Mr. Dolamore's suggestion some small trephines worked by the engine in the same way as the drill. They are very expeditious, but not suitable for the hardest growths. Pritchard and Bronner report favourably of them.

Dr. Victor Bremer, of Copenhagen, has kindly sent me his notes ("Om Behandlingen af Exostoser i Oregangen") of a case of double exostosis, in which he recommends, for the after-treatment of granulations, "the application of pin-shaped pieces of *Laminaria digitata*.†

Multiple ivory exostoses do not, as a rule, cause a great amount of deafness. They are smaller and nearer to the membrana tympani than the single, and are not confined to the posterior wall of the meatus. Three of them are often found growing opposite one another, and so wedged that a triangular space is left between their apices. It is remarkable indeed, that these multiple excrescences do not entirely fill up the canal, but always leave sufficient space for the passage of sound. The

* Dr. Delstanche, of Brussels, in an able contribution to the study of the osseous tumours of the external auditory meatus (translated by Dr. Cassells, *Med. Press and Circular*, Aug. 6, 1879), says, "Since Bonnafont, Miot, and Field have shown by their successes the shallowness of the fears which were inspired by the proposed operations on the osseous tumours of the external ear, practitioners, encouraged by their results, are no longer content to make a narrow passage—they desire to do more, in order to augment the diameter of the perforation. . . . It would be, besides, impossible to trace out an immutable line of conduct in the treatment of the tumours in question, because what succeeds in one case does not succeed in another, and it is often necessary to employ a variety of means before obtaining the desired results."

† Særtryk af *Hospitals-Titande*, Nr. 2, 1879.

opening left is necessarily small, and the patients are often very deaf, for a slight obstruction caused by cerumen or even water will effectually shut out sound. To cleanse such a narrow passage is not an easy matter.

A gentleman, Mr. R., of Cambridge, who consulted me for slight deafness, had three exostoses in the right ear and two in the left. In the right ear there was a triangular aperture left.

Another patient, a clergyman, the Rev. Dr. M., consulted me for extreme deafness of long standing in both ears, caused by filling up by cerumen of the spaces left between multiple exostoses, three in each meatus. He heard very fairly when I had cleared the stricture. In September, 1880, I saw Dr. G., of Limerick, who came to show me his multiple exostoses, and who had entirely regained his hearing, after a long period of deafness, under the skilful hands of Dr. Macnaughton Jones.

Cases have been recorded of so-called ivory exostoses, in which, by drilling here and there and then using the bone forceps, the tumour has been removed, the whole operation lasting no longer than twenty minutes.

In common with other aurists, I have found the occurrence of an exostosis among hospital patients to be an almost unique phenomenon, and it is difficult to avoid the surmise that these persons owe their exemption chiefly to the rarity with which they expose their ears to the ingress of water—their ablutions, as a rule, being scanty.

In connection with the etiology of aural exostosis, it is noteworthy that among women, whose constitution and mode of life, perhaps, renders them more prone to active inflammatory disease, soft growths with discharge are much more common than among men; whereas it is almost invariably one's male patients that are the subjects of ivory exostosis.

GENERAL CONCLUSIONS.

The conclusions derivable from a consideration of the above-mentioned and similar cases, which have come under my observation, may be summarized as follows:—

1. In a very great majority of cases of aural exostosis there has been no history of gout, rheumatism, or syphilis.

2. A mechanical irritation, such as is caused by the presence of pus in the meatus, or (as pointed out in the cases cited) such as might result from the effects of frequent sea-bathing, is a frequent source of osseous tumours.

3. Where there is one tumour of the consistence of ivory occluding the canal, the only operation of any service is that of drilling through the growth by means of the dental engine.

4. It is sometimes advisable in drilling to use a metal guard which is passed behind the tumour to lessen the risk of an accident. The guard should be such as to bend, but not snap asunder, when subjected to strain.

5. In the case of multiple growths, operations of this kind are as a rule unnecessary, since a triangular channel in the meatus is usually found, which may be kept open by other means.

6. Some bony tumours in the ear, although filling up the external auditory meatus, are attached by a small pedicle, and can be easily removed (as in the case of Miss M.); such pedunculated tumours often follow the growth of a polypus.

7. In the event of purulent discharge in the tympanic cavity imprisoned by a growth of bone, filling up the auditory meatus, and producing grave symptoms, an operation is imperative.*

8. If, from the closing in of the auditory canal in both ears by bony growths, very severe deafness ensues (as in the case of Dr. M. and Mr. S)† an operation is called for. When the hearing in one ear is good, removal of an exostosis or hyperostosis for the relief of deafness in the other ear is not to be recommended, unless the existence of a pent-up purulent discharge within the tympanum be suspected. But obviously in such cases as that of Mr. H., who from an accident had completely lost his hearing in the right ear, and subsequently, in consequence of a bony tumour filling up the passage of the left, had become too deaf to follow his occupation, an operation cannot be dispensed with.

9. In skilled hands the operation is not usually of a formidable character, and the after-complications are in most instances of

* See case of Dr. Orne Green's, *Boston Med. Journ.*, April 18, 1878.

† *Lancet*, July 20, 1878.

a mild nature ; granulations are often troublesome, and may lead to stenosis by the formation of an almost complete diaphragm of scar tissue.

One curious point with regard to these operations is that in the majority of patients there is little or no pain felt afterwards ; whilst, on the other hand, in some few cases very great pain is experienced subsequently, and it may be present in one or both ears ; luckily the latter is rare, and I am unable to account for the suffering of some patients and the complete absence of it in others.

10. It is immaterial whether motive power be applied to the drill by means of the ordinary treadle engine, or by means of the electro-motor and battery now so frequently used by dentists. If the latter be employed, the number of revolutions of the drill per minute should not exceed 1,000.

Small trephines worked by the engine, especially in the softer growths, sometimes prove useful adjuncts to the drill.

CHAPTER VI.

DISEASES OF THE AURICLE.

THE malformations of the ear cannot be understood except by a study of its development. The internal ear is developed from an involution of epiblast, which takes place opposite the dorsal end of the hyoidean arch. The depression becomes a closed sac, which in the course of development assumes a complicated form, and constitutes the epithelial lining of the membranous labyrinth. The petrous bone is developed about it from the mesoblast.

The tympanum and the Eustachian tube are remains of the hyo-mandibular cleft, which is lined by hypoblast. The malleus is developed from the dorsal extremity of the mandibular cartilage, the incus from that of the hyoidean arch, whilst the stapes is the result of a cartilaginous outgrowth of the periotic capsule. The tympanic membrane is at first almost on the surface, and at an early period springs across the cleft as a diaphragm which closes the cleft. It is covered with hypoblast internally, and with epiblast externally, whilst its fibrous basis is mesoblastic. The pinna arises in the integument in a manner made clear by His.*

The accompanying figures are from woodcuts kindly lent by Mr. J. Bland Sutton, whose very lucid account of the origin of the pinna may be quoted:†

“The pinna arises from the swollen edges of the first and second branchial clefts. The germs appear very early as a series of sharply defined elevations. In embryos, at the end of the first month, six of these may be distinguished. Two belong to the mandibular, and three to the hyoid arch, the remaining one to the uniting band. In the drawings (Fig. 41) these eleva-

* *Anatom. Mensch. Embryonem.* Leipsig, 1885.

† *Dermoids.* Ballière, Tindall, and Cox, 1889.

tions are indicated by the numerals I to VI. They may for convenience be referred to as follows:—

- I is the tuberculum tragicum ;
- II, tuberculum anterius ;
- III, tuberculum intermedium ;
- IV, tuberculum antihelicis ;
- V, tuberculum antitragicum ;
- VI, lobulus.

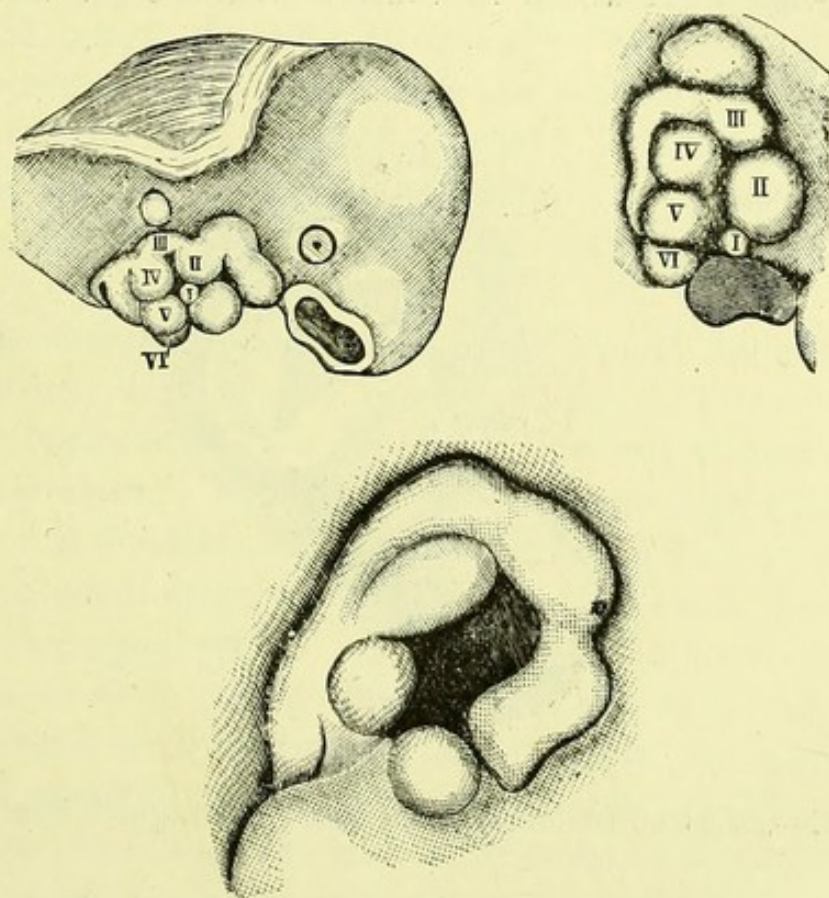


FIG. 41.—Three Drawings representing the Development of the Human Pinna.
(Modified from His.)

“The subsequent fate of the tubercles may be briefly given. The tuberculum tragicum unites, across the cleft, with the tuberculum antitragicum, the space formerly separating them being simply indicated by the fissura intertragica. The tuberculum intermedium is the source of the helix, and the tuberculum antihelicis is the source of the antihelix. The nodule VI, cut off by the fusion of tragus and antitragus, becomes the lobule.”

Malformations of the auricle will sometimes occlude the auditory canal, and often, where they exist, the external auditory meatus is entirely absent.

In the case of a girl, æt. 6, seen in consultation with Dr. Milson, the helix was doubled over and firmly attached to the tragus; the anterior and posterior edges of the lobule were also joined together; the ear, in fact, was completely doubled forwards, leaving a small opening leading down to the fossa of the anti-helix. A watch in contact with the ear was plainly heard.

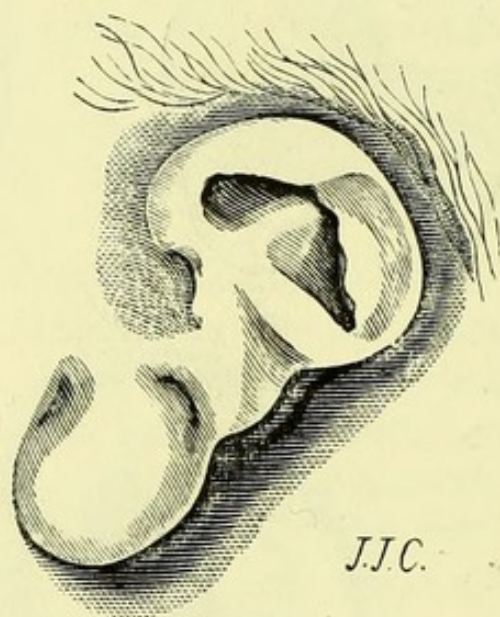


FIG. 42.—Congenital Deformity of the Ear. (Photograph from E. H.)

From this brief review of the development of the ear, it is obvious how readily malformations about the external meatus may occur. Either the cleft may close more or less completely, causing more or less complete obliteration of the external meatus of the tympanic cavity and, by extending inwards, even of the Eustachian tube. On the other hand, the cleft may not close sufficiently, but leave a fissure or slit in the external meatus, which may or may not involve the membrana tympani.

Again, deficient or excessive growth of the pinna may take place. This may be deformed or absent; or it may cause closure of the external meatus, across which it may be stretched.

Operative measures are in my experience useless; although

the following case was promising, I failed to keep the auditory canals open :—

E. H., æt. 12, was brought to consult me, February 5, 1883, suffering from a congenital malformation of both ears. His mother stated that before the child was born she suffered from a great fright, and when the infant came into the world both ears were completely closed. The boy enjoyed good health, and was able to hear if spoken to in a loud voice. I found he could hear the tuning fork perfectly, and the voice, if spoken to in a loud tone. He did not appear to hear better with his mouth open, as is not infrequently the case with these patients.

The question arose whether it would be possible for him to hear better if the obstruction was removed. I was inclined to think so, but was uncertain how the opening was to be kept open.

It was therefore suggested that he should go and see Sir James Paget, who, after a careful examination, recommended that the operation should be done. He was therefore placed under chloroform. I began by dissecting through the posterior portion of the auricle, an assistant drawing the ear forwards. I found a small aperture in the bone, into which I could just pass a good-sized probe. I carefully made an opening, and fixed in a silver speculum, which I had had made for the purpose, fastened with plaster, so that it could not move out of place. I operated in the same way on the other ear, and in three days' time the ears had completely healed, and a good opening was left on both sides, through which, when the dressings were removed, the boy could hear remarkably well: in fact sometimes when there was no pus in the aperture, he could hear a whisper. The difficulty was to keep the parts open. I thought of skin grafting, but it was impossible to cover the whole canal in this way.

At length the granulations increased, and although the openings remained for some time, they slowly closed, and I was obliged to abandon any hope of keeping the ears from closing up again.

Branchial Fistulæ.—The second post-oral cleft is the first of the permanent branchial (or gill) arches of the fish. This cleft

has therefore an hereditary tendency to remain open: it consequently does so more readily than any other, and gives rise in the sublingual region to "branchial fistulæ"—permanent congenital openings below the inferior maxilla, extending into the oral cavity—whose developmental origin it is important that we should recognize. A similar fistulous opening communicating with the pharynx is occasionally seen still lower down in the neck; this is a relic of the third post-oral cleft.

Dermoid Cysts.—There is another interesting pathological condition which has a developmental origin, the nature of which has been only recently recognized. When a branchial cleft or a cleft between two of the auricular tubercles closes at both ends, but not throughout, a closed space lined in part by epiblast is found. Thus a "sequestration dermoid is formed. It was pointed out originally by M. Verneuil,* and in this country by Mr. Wagstaffe,† that these tumours are liable to be found along the lines of closure of the clefts. Though they are most common along the line of the first pre-oral cleft, and occur notably at the fronto-malar and fronto-maxillary or lachrymal sutures, some have been recognized in connection with the first and second post-oral clefts, those, namely, with which we are especially interested. In connection with the first post-oral cleft, they form tumours about the external auditory meatus; two examples of these are to be found in Mr. Wagstaffe's tables.‡

The nature of these tumours may be recognized by their position, by their firm attachment to bone or rather to the sutures between the bones in the situations named, and by their congenital origin and subsequent slow development. After removal, they will be recognized by their epithelial lining and characteristic contents, which may include fragments of tooth, hair, and cholesterin crystals.

Mr. J. Bland Sutton's excellent work on Dermoids should be consulted for further information on the subject.

WARTS occasionally grow on the auricle, commonly at the

* *Archiv. Gén. de Méd.*, 1865, 3me sér., t. 6.

† *Trans. Path. Soc.*, vol. 29, Lond., 1878.

‡ Renoult (Cusset), *Arch. de Phys.*, 1872, p. 762. Osborn, *St. Thos. Hosp. Rep.*, vol. 6, p. 72.

entrance of the meatus. Macnaughton Jones recommends, to prevent their recurrence, ligature, and treatment with acid nitrate of mercury.* Carbolie, chromic, or glacial acetic acids are very useful.

Buck† reports a case which he terms *cornu humanum* of the auricle. The patient was in the habit of paring it down with a razor. It was removed by two converging incisions on either side of its base, and the edges of the resulting wedge-shaped wound were then brought together by suture. Union took place by granulation, three weeks afterwards the patient was well, and there was no sign of the growth.

Horns are of two kinds: either they are essentially papillomata, or they are the result of rupture of a sebaceous cyst followed by accumulation of dried sebaceous matter.

CHALK STONES may be found in the upper portion of the helix of the ear of gouty persons. They produce no inconvenience. Professor Garrod, out of thirty-seven cases of gouty diathesis examined, found them to be present in sixteen.

According to the same authority‡ the earliest appearance they present is "that of a small vesicle under the skin of the helix, as if situated between it and the fibro-cartilage; the contents of the vesicle are at first opalescent, or milky, but afterwards become white and opaque, and acquire the consistence of cream. After some months the vesicle assumes the appearance of a hard white bead closely resembling a pearl."

W. Kramer asserts§ that gout has no tendency to produce aural disease, but Sir William Wilde has described a kind of congestive redness of the auricle, which he attributes to the gouty diathesis.

INJURIES OF THE AURICLE.

Diseases and injuries of the auricle are on the whole very

* *A Treatise on Aural Surgery*, by H. Macnaughton Jones, M.D., 2nd. ed., 1881.

† *Diagnosis and Treatment of Diseases of the Ear*, by A. H. Buck, M.D., New York, 1881.

‡ Reynolds, *System of Medicine*, vol. 1, p. 854.

§ *The Aural Surgery of the Present Day*, p. 20.

infrequently met with in practice compared with other ear lesions.

Injuries include cuts, bites, tears, burns, bruises, and hæmatoma. Wounds in this region require no detailed description, and their treatment by suture is usually successful. Even when the ear is almost completely severed from the head, an attempt should be made to save the appendage. J. G., a boy, æt. 8, had the right ear almost completely torn off by a fall on gravel. I secured it with sixteen sutures, and he left St. Mary's Hospital, where he had been a patient, with hardly any trace of the injury.

The cleft lobule due to traction on an ear-ring is easily remedied by a plastic operation.

Bruises are often much more serious injuries, as they are not infrequently attended with effusion of blood and the formation of othæmatoma.

HÆMATOMA AURIS OR OTHÆMATOMA.—The blood is usually effused between the cartilage and its perichondrium. Though usually the result of traumatism, there is a widely spread belief that othæmatoma does arise spontaneously. Its frequency amongst insane persons is undoubted, and many of such tumours are unquestionably the result of violence, self-inflicted and otherwise; but even allowing for the fact that the repression of rough handling on the part of attendants has immensely reduced the number of cases of hæmatoma in asylums, there is still good evidence for believing that this condition does arise occasionally without antecedent local injury as the result of trophic changes in those the subject of brain diseases, and more rarely still in others not the subject of any obvious cerebral lesion.

Most writers deny the possibility of idiopathic hæmatoma auris in the sane; I once, however, saw an apparent example of it in the left ear of a forester at St. Mary's Hospital. This patient was certainly not insane some years afterwards, and he denied injury of any kind. It is possible that in such cases slight pressure such as sleeping on the predisposed ear may act as an exciting cause.

Dr. Savage, late of Bethlem Hospital, states that he has never



OTHÆMATOMA.

From a cast in the Museum of the Middlesex Hospital.



seen an insane person recover who has had hæmatoma auris. Strong support is given to the view that this condition in insane persons is not necessarily associated with violent bruising by the experiments of Brown-Séquard, who artificially produced othæmatomata in rabbits on irritating the restiform body of the same side. It is possible that this area is the trophic centre for the nutrition of the auricle. According to Macnaughton Jones, othæmatoma is not confined to any one form of insanity ; it is found in mania, melancholia, and dementia, but it occurs most frequently in general paralysis, and insanity associated with epilepsy.

Blood tumours, from whatever cause, appear to be more common on the left side. Those who indulge in pugilism, boxing, and football sometimes afford examples of the traumatic variety.

Othæmatoma appears as a purple swelling on the anterior surface of the auricle. It is not always fluctuating, and has been described as feeling like dough to the touch. The traumatic variety is almost invariably the larger and tenser, and nearly always painful at first.

Deafness and tinnitus only result when either the meatus is occluded by swelling, or when there is a concomitant injury of the middle or internal ear. In the latter cases the factor of traumatism is superadded.

The accompanying plate was taken, by kind permission of the authorities, from a cast in the Middlesex Hospital Museum.

Treatment.—To be of any use treatment should be prompt. Evacuation of the effused blood, whether by means of one or more aspirations, punctures, or incisions, with the subsequent application of pressure over the site of effusion, should be at once resorted to in recent cases where the contents are still in a fluid condition. Such treatment, though clearly indicated, is only occasionally resorted to in time, and hence rarely successful. When organization has commenced, the application of cold and massage are probably of small service. When treatment with a view to the relief of deformity is requested by the patient, it is possible that the cutting down and shelling out the organized contents of the most prominent part of the tumour,

as recommended by Chimani, might prove successful in some instances. In my experience the results of treatment, of whatever kind, are in the majority of cases disappointing. After spontaneous absorption, or artificial removal of the effusion, a shrunken though thickened ear often remains; the deformity due to cicatrization is, however, more marked after organization of the clot. Suppuration is exceptional and requires to be treated on general surgical principles.

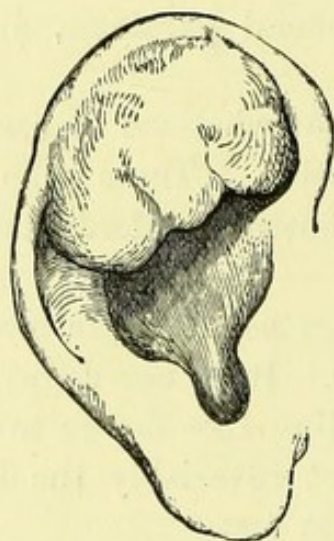


FIG 43.—Othæmatoma.

INFLAMMATORY AFFECTIONS of the auricle include frost-bite, diffuse or circumscribed cutaneous inflammation, and perichondritis. Frost-bite may be symmetrical; it results from exposure to cold, and is occasionally met with in persons of feeble circulations, whose ears have been exposed to severe cold winds whilst driving. In milder cases the tip of the auricle appears red and inflamed; in severe forms, livid nodules, vesicles, and ulcerations and gangrene are seen, and loss of substance results. Treatment consists in the application of melting snow, or ice-cold water, and gentle friction, in the first instance, cases being afterwards treated on general surgical principles.

Lesions similar to those observed after frost-bite have been recorded, in no way resulting from cold. Hartmann saw such a case of symmetrical gangrene, and Hill has mentioned a similar instance to me, which he believed to be a case of *Raynaud's disease*. Small losses of substance of the helix have

also infrequently been observed in connection with limited inflammation and ulceration, after attacks of the exanthemata.

Diffuse and circumscribed inflammation may appear as an extension of a similar condition of the meatus, or from poulticing.

Perichondritis of the auricle is very rare apart from othæmatoma; in fact, most instances are recorded as cases of idiopathic othæmatoma, from the fact that the auricle is always swollen, and presents a cystic cavity containing fluid, usually more or less sanguineous, rarely serous. The treatment is the same as for hæmatoma, but the prognosis as regards deformity is better than in that condition.

MALIGNANT DISEASE.—Epithelioma occasionally attacks the auricle. Amputation of the part is the only treatment to be recommended.

In a case related by Sir W. Dalby at the Royal Medical and Chirurgical Society, January 14, 1879, "a purely local irritation, without any predisposition in the patient towards cancer, had been productive of epithelioma; which, starting from the tympanic cavity, eroded and destroyed in its progress that portion of the temporal bone which included the mastoid process, the external auditory canal, the tympanum, and a large part of the petrous portion. In this, as in all other recorded cases of malignant disease of the mastoid bone, the lining membrane of the tympanic cavity had been a discharging surface for a considerable period. In the existence of this discharging surface might be found [according to the writer] the irritation which preceded the new growth."*

A case of primary epithelial cancer of the meatus described by Delstanche "began as a small nodule upon the inner surface of the tragus, accompanied by severe pain in the ear and over the side of the head. At the end of eight months the patient died, the disease having steadily progressed till nearly the whole of the temporal and sphenoid bones had been destroyed."†

* See *British Medical Journal*, Jan. 18, 1879.

† See *Archiv für Ohrenheilkunde*, vol. 15, and *Edin. Med. Journ.*, May, 1881.

Chimney sweep's cancer of the external ear, according to Wilde, has no special characteristic ; large quantities of pigment are usually present.

Sir James Paget and others have described a form of fibrous tumour sometimes produced in the lobule of the ear by the irritation of piercing for ear-rings. According to Erichsen "they are semi-malignant, like the warty growths of cicatrices, and after excision, their only treatment, are somewhat apt to return."*

At a meeting of the Pathological Society, May, 1881, Dr Thin showed two keloid growths excised from the lobules of the ears of a woman, taking origin from ear-ring punctures. The symmetrical character of the growths produced a peculiar effect, well seen in a photograph of the patient sent with the specimens ; Dr. Thin, on examining part of one of the tumours, found the usual keloid tissue.

The accompanying sketch represents the same condition in the lobule of the ear of a negro. The specimen was sent to the museum of St. Mary's Hospital by Mr. A. P. Boon, of St. Kitts.

SKIN DISEASES very often attack the ear, and more than general knowledge of their treatment is necessary to the aurist, on account of the deafness they frequently produce. Of these eczema is certainly the most common.

Eczema may be acute or chronic, arising either from constitutional or from local causes. In the general disorder of an acute attack, the ear is at times implicated. The eruption may show itself between the ear and head as eczema intertrigo, and is aggravated by the apposition of the parts. This form of it is common in children, especially infants prone to obesity. The disease, when affecting the ear itself, is characterized by the formation of papules and vesicles, which burst and discharge a serous fluid that stiffens linen dressings. This dries on the part, forming thin scales. If no improvement occurs, the scaly condition becomes chronic.

The most obstinate variety of eczema we meet with in practice, attacks the meatus, and the skin immediately around it,

* *The Science and Art of Surgery*, vol. 2, p. 314.

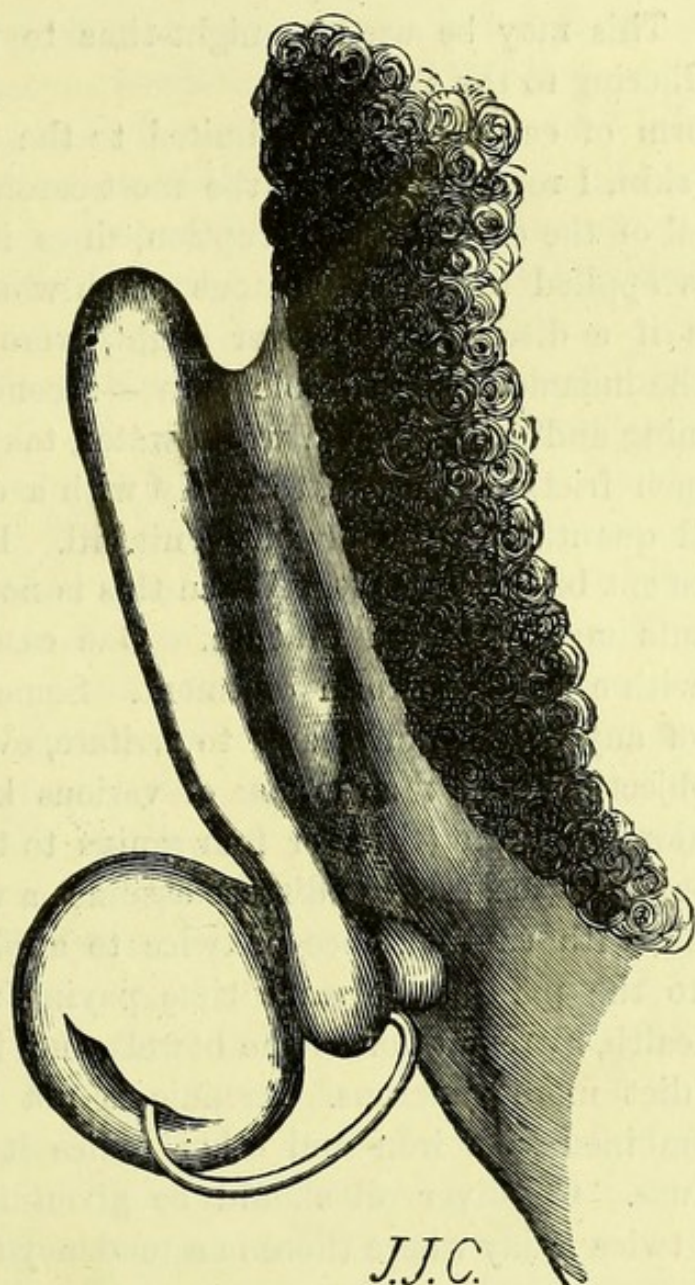


FIG. 44.—Keloid in the Lobule of the Ear of a Negro. (St. Mary's Hospital Museum, No. 499.)

and is produced originally by chronic discharge, not of necessity purulent in character. The discharge causes irritation, and leads to scratching and rubbing on the part of the patient. This is really the cause of the eczema, which often lasts for a long time in spite of remedies.

Treatment.—In the acute and early stages soothing remedies must be resorted to, such as washing with thin oatmeal water, and the application of ointment having a composition similar to the following:—Plumbi acetatis, hyd. subchloridi āā gr. x;

vaselini ℥j. This may be used at night-time to prevent the linen from adhering to the skin.

For the form of eczema that is limited to the meatus and surrounding skin, I recommend first the most careful attention to the removal of the cause of the eruption, since it is obvious that remedies applied to the eczematous patch would be absolutely useless if a discharge, however slight, were allowed to trickle over the inflamed and irritable skin;—secondly, to wash the part morning and evening with warm water, taking care not to use too much friction;—lastly, to apply with a camel's hair brush a small quantity of the ung. hyd. nit. dil. It is well to melt the ointment before using it. When this is not efficacious, other ointments must be tried in turn. One case, I treated successfully with a weak iodoform ointment. Sometimes, however, grease of any description seems to irritate, even vaseline alone being objectionable; then lotions of various kinds should be tried. Chloral hydrate (three or four grains to the ounce of water) may be of service. If the disease assumes a very chronic form, it is well, with caution, once or twice to apply nitrate of silver freely to the part, at the same time paying attention to the general health, by regulation of the bowels, and, if necessary, making the diet more generous. Arsenic is not by itself of value, but combined with iron and other tonics it may sometimes be of use. Cod-liver oil should be given in moderate doses once or twice a day where there is a tendency to glandular enlargements.

For the chronic form, the treatment consists of the removal of the scabs with oil, and the use of a tar lotion, the best being ℥ij of Wright's liquor carbonis detergens to ℥viij of water.

Before medicating an eczematous auricle, a small pledget of cotton wool should always be placed in the meatus, to prevent the lotion entering.

Bougie treatment, previously described in the section on Diffuse Inflammation of the Meatus, must often be resorted to. The bougie should be smeared with coal tar ointment.

Porriago contagiosa, or contagious impetigo, very common in children, is allied to eczema, but differs from it in some important points. It generally begins on the scalp from some

local cause, such as irritation from pediculi or the scratch of a pin. A pustule is then formed at the seat of injury, the pus from which, when it is broken, inoculates the skin adjacent, or, if carried by means of the finger when the child scratches, some distant surface. Soon, large scabs are formed, and the disease spreads rapidly, covering the whole head, blocking up the ears, and often producing deafness.

The discharge is not thin and serous as in eczema, but thick and purulent. It is caused by staphylococci, and is contagious.

The following is a typical case:—

E. G., æt. 13 months, was brought to me at the hospital, March 3, 1874. She had six months previously lost her mother, and had been constantly ailing since. The right ear and side of the head were one mass of porrigo. She was ordered a bread poultice, a carbolic acid lotion, ʒj of steel wine and of cod-liver oil three times a day, and a grey powder occasionally. By March 10 the ear looked cleaner and much more healthy. I then ordered calamine ointment instead of poultices, and continuance of the other treatment. She came to the hospital regularly, and on April 7 was discharged cured. I have found the *unguentum rubrum* of the St. Mary's Hospital pharmacopœia very useful in chronic cases.*

The treatment, it will be seen, consisted in getting off the scabs with a poultice, and destroying the action of the pus with carbolic acid and a mercurial ointment.

Erythema.—Various forms of this disease may be seen on the ear, but they are not of much importance to the aurist.

Erythema Pernio, or chilblain, is common in children. The diagnosis is rendered easy by the presence of the same affection on the fingers and toes. It is best treated by warm clothing and the constant application of a spirit lotion.

Herpes.—In the course of any of the acute inflammatory diseases it is not uncommon to see a sudden outburst of herpes

* R Hydrargyri bisulphureti (not officinal),

Hydrargyri oxidi rubri, āā gr. vj.

Creasoti ℥ ij.

Adipis ʒj

Misce.

at the margin of one of the orifices of the body, usually the mouth, but not infrequently the external auditory meatus, or indeed at any point where the mucous membrane meets the skin. By its presence in the meatus, deafness may be caused, which, however, subsides on the bursting of the vesicles, after which no treatment is required beyond the application of a simple ointment.

Herpes Zoster, or Shingles.—This disease affects some portion of a nerve trunk, with or without a cutaneous eruption corresponding to the peripheral extremity of the nerve. It is seen usually over the termination or the branches of the intercostal nerves, but occasionally in the neck, spreading upwards in the neighbourhood of the ear and on the ear itself, along the course of ascending branches of the cervical plexus.

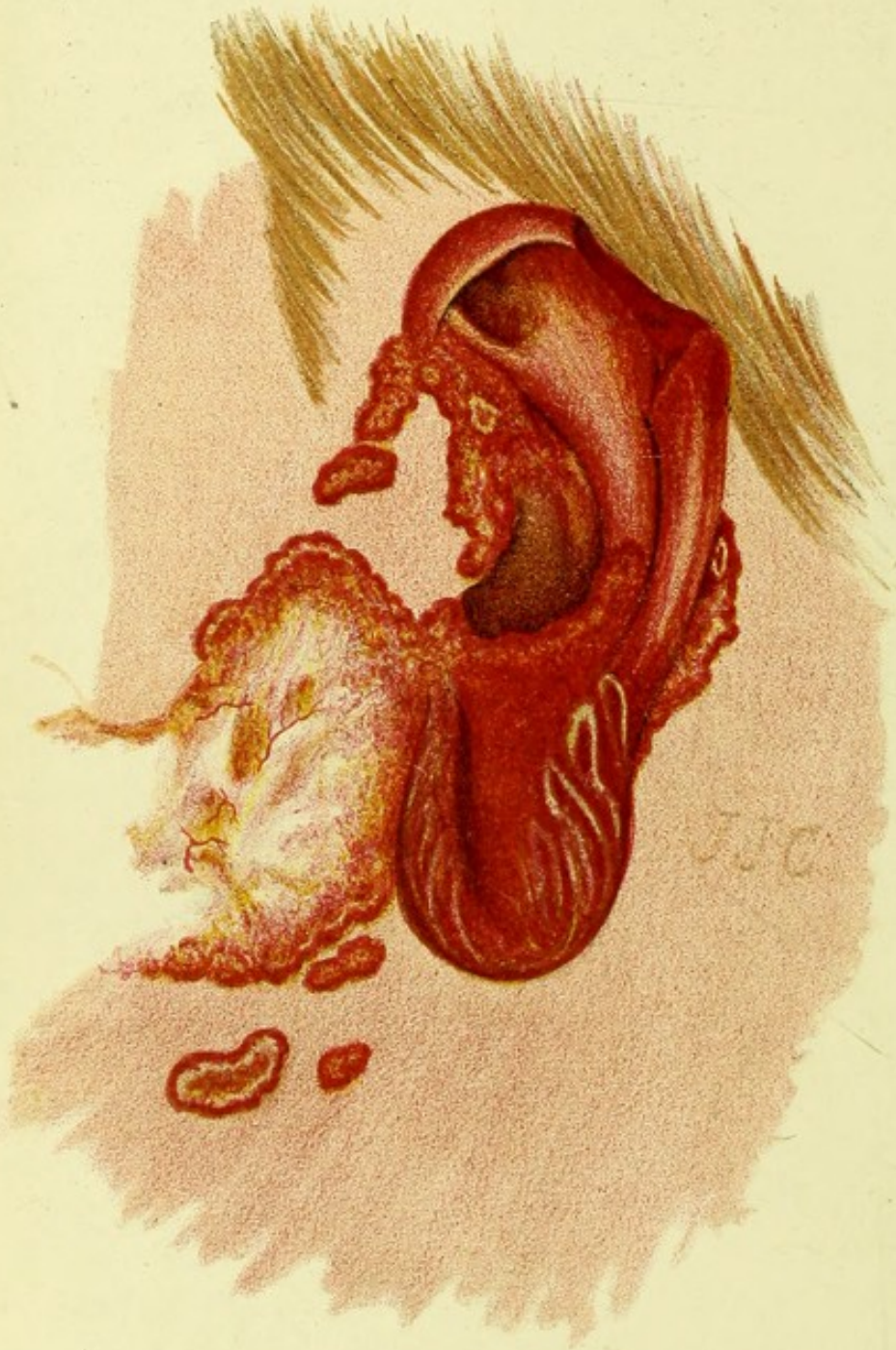
The outbreak, which is characterized by the appearance of pearly vesicles on an uninflamed base, runs a definite course of a few days only, and is often prefaced by severe neuralgic pains, which may last for weeks after all traces of the eruption have vanished. Little treatment is needed during the course of the attack, except subcutaneous injection of morphia and the internal administration of quinine to relieve neuralgia.

Pruritus, or "itching," is a troublesome ailment, concerning which the aurist will be at times consulted. It occurs chiefly in nervous middle-aged or elderly females, and persons suffering from defective circulation, and is often very difficult to cure. The cutaneous lining of the meatus is, in some instances of pruritus, dry, but in others it secretes unduly.

Scratching the part in order to relieve irritation only increases it. There is nothing to be seen on the skin outside the meatus, and the speculum reveals no alteration in the tympanic membrane.

The treatment consists in the application of soothing lotions, and of ointments containing opium, creasote, hydrocyanic acid, or small quantities of mercurial preparations. Benefit is said to be derived from strong lotions containing nitrate of silver, and arsenic internally may be efficacious in obstinate cases.

Ichthyosis.—This congenital disease consists in a malformation of the skin due to intense dryness, and abnormal development



LUPUS VULGARIS OF THE EAR AND CHEEK.

of the epidermis. It may cause alteration in the shape of the external ear, especially as regards the lobe—a fact remarked by the late Mr. Naylor.

The disease itself is incurable, but great benefit can be obtained by the prolonged application of glycerin.

Lupus erythematosus.—The principal characteristic of this disease is the early development of rough reddish patches, marked with small greenish nodules, caused by the retention of sebum in the sebaceous glands. It usually first appears on the bridge of the nose, extending down each cheek, and attaining something like the outline of a butterfly; or it may occur in detached patches on the eyelids, nostrils, and lobes of the ears. It is rare before puberty.

Treatment.—In the earlier stages the local application of cod-liver oil, afterwards scarification, assisted by such internal remedies as cod-liver oil, iron, and quinine.

LUPUS VULGARIS of the auricle is occasionally met with, and is usually associated with lupus of the face. It presents the usual characters of lupus elsewhere. The auricle, before the destructive stage commences, is always much enlarged and thickened, and sometimes stands out from the head, in the same way that a swollen ear does when mastoid inflammation is present. Serious deformity often results, including loss of substance and partial adhesions to the side of the head. The treatment differs in no respect from that of lupus occurring elsewhere, and includes patient attempts to destroy the morbid tissue by means of salicylic and other plasters, lactic and other acids, curetting, and galvano-cautery. Recently, Koch's tuberculin was tried, with but very evanescent results. When apparently all lupous tissue has been removed with the curette, sharp spoon, or even knife, lesions frequently appear at previously healthy sites. Treatment must be long continued; it is generally disappointing, and deformity is almost certain.

The accompanying plate shows the ear of a patient under the care of my colleague, Mr. Malcolm Morris. The patient was one of the first to be treated by Koch's method. At first considerable improvement was observed, but the disease relapsed, and at the time the drawing was made the hard and soft

palate and the larynx, as well as the face, were extensively affected by this disease.

Erysipelas, more commonly chronic than acute, is often met with. The following is a case:—

E. S., æt. 54, came to the hospital, November 10, 1876, with erysipelas over the whole right ear and side of the head. The meatus was nearly closed, and there was a burning sensation of the skin, with great redness and swelling. She was ordered a brisk purgative, large doses of perchloride of iron, a warm carbolic acid lotion to be very frequently syringed into the ear, and, for sleeplessness at night, morphia. Under this treatment she got rapidly well.

The head should be kept cool, and the ear lightly covered. Starch powder dusted over the affected part with a camel's hair pencil is often very useful.

SYPHILITIC DISEASE of the external ear is not uncommon. Grüber states that he has never met with a primary sore in any part of it. "Secondary eruptions are frequently seen; thus the point of insertion of the auricle and the lobule is most liable to a papular eruption, while other parts of the auricle most frequently show an exanthematous form of disease. Squamous eruptions are found on the auricle rather than in the meatus."*

The following cases of ear disease, occurring in patients with a syphilitic taint, are interesting:—

M. McM., æt. 25, came to the hospital, March 31, 1874, with a syphilitic eruption on both ears, and an offensive discharge from the external meatus, which, as well as the walls of the tympanic membranes, appeared to be ulcerated. Some time previously she had had a hard sore. This patient said that she had been quite deaf for a month, and that her life was a misery to her. I ordered iodide of potassium, gr. viij, with cinchona three times a day, a nitric acid gargle, as her throat was in an unhealthy state, and a carbolic acid lotion for the ears; the Politzer bag also was regularly used. In six weeks' time she lost all signs of the disease, and heard perfectly well.

The next case I shall mention was one of much greater severity.

* Burnett, *A Treatise on the Ear*, p. 232.

F. G., æt. 50, came to the hospital, July 28, 1873. Five years previously she had had syphilis badly. She had been deaf ever since, and was rapidly getting worse. The membranes were thickened and very white in colour. She could hear a watch in contact with her left ear, but not at all with the right. The Politzer bag was used twice a week. Some difficulty was experienced with the bag, as the nose was deformed from syphilitic disease. Large doses of iodide of potassium, gradually increased, were given. The hearing on August 4 had improved considerably (the watch being audible three inches off on the left side, and in contact on the right); and it continued slowly to gain in strength with her general health. Her throat was very troublesome for some time, but she never had any discharge from or pain in her ears.

E. N., æt. 42, a carpenter, came to me at the hospital, December, 1876. He had a hectic appearance, quick pulse, and other symptoms of severe constitutional disturbance. Two-thirds of the left auricle had sloughed away, leaving a large round hole, in which, however, the outline of the external auditory meatus could not be clearly defined. There was profuse and very offensive discharge, accompanied by severe pains. The disease had originated, he said, three months previously, in the pricking of his ear with a pin; and since that time he had been treated with different tonics, and a great variety of lotions and ointments, without any effect on the progress of the ulceration. Diagnosing a syphilitic taint, I prescribed five grains of iodide of potassium with bark three times a day. The ulceration was thoroughly cleansed with poultices, and then dressed with an ointment composed of a drachm of unguentum hydrargyri nitratis to five drachms of zinc ointment. In three weeks the sore had quite healed, leaving a not unshapely ear. When he left the hospital, although the external meatus, which had been kept open with pieces of lint, was very small, the hearing was good.

This case illustrates how a local disease may resist all ordinary treatment until, its nature being recognized, anti-syphilitic remedies are employed. This man might have been saved the loss of part of his ear, and also a dangerous illness, had the syphilitic character of his complaint been early diagnosed.

CONDYLOMATA around the orifice of the meatus are frequently found.

They appear as broad red papules near the mouth of the meatus, and they may be dry at first, but usually become moist from a sero-purulent discharge. Their increase in size is characterized by a tendency to the formation of fissures with occasional hæmorrhage.

Of the methods of local treatment, white precipitate ointment and powdered calomel are the two best. If there is much sanious discharge, corrosive sublimate lotion may be advantageously substituted as cleansing, and at the same time exerting a local action. Should the narrowing of the meatus not be relieved speedily enough by these measures, the condylomata may be cauterised with carbolic acid, chromic acid, or acid nitrate of mercury. In some instances time is saved by using the knife or scissors. Bougies and tents are rarely needed.

With respect to the employment of mercury in some severe forms of secondary syphilis, the late Mr. James Lane may be quoted* :—"There are, I think, two classes of patients in which the abstention from mercury may be advisable,—first, those who are in sound health and capable of throwing off the morbid influence without assistance, and, secondly, those in broken-down health, or in whom there is an evident strumous or consumptive tendency, which may render it desirable, if possible, to dispense with a mercurial course. In both these classes, however, should the symptoms become more severe, mercury should unhesitatingly be given, and it will often be of the most signal service."

* *Lectures on Syphilis*, delivered at the Harveian Society, 1878.

CHAPTER VII.

ACUTE CATARRHAL AND SUPPURATIVE INFLAMMATION OF THE MIDDLE EAR.

AURAL CATARRH has been divided by authors into various forms of acute and chronic inflammation of the mucous membrane of the ear passages. With these Toynbee includes similar affections of the external meatus, and in his book he mentions simple chronic and catarrhal chronic inflammation of the dermoid meatus, and catarrhal inflammation of the dermoid layer of the external meatus, with caries of the posterior wall, &c.

Von Tröltsch, with others, however, objects to the term catarrhal inflammation being applied to disease of the external meatus, on the ground that there cannot be catarrh where there is no mucous membrane. This authority makes the following division:—1. Simple acute catarrh; 2. Simple chronic catarrh, including dry and moist, &c. Mr. Hinton justly observes in a note in his translation of Von Tröltsch's treatise:* "In attempting to better demonstrate the extreme variety in which the chronic catarrhal process shows itself in the middle ear, by representing certain prominent manifestations of disease in apparently separate groups, I have not meant to establish different forms of disease; and I would lay special stress upon the fact that the three forms alluded to occur much less frequently alone than combined in various ways, and the one passing into the other." In Holmes's *System of Surgery*† Hinton himself speaks of acute and chronic inflammation of the mucous membrane of the tympanum. And lastly, my predecessor at St. Mary's Hospital, the late Dr. Peter Allen, in his work on aural catarrh, says:—‡

* *The Surgical Diseases of the Ear*, by Professor von Tröltsch, translated by James Hinton, pp. 48 and 53.

† Vol. 3, p. 166.

‡ *On Aural Catarrh*, p. 24.

Practically these divisions are useless, and we should be careful not to jump to conclusions as to diagnosis and treatment, and say, for instance, "This is a case of chronic catarrhal inflammation of the middle ear, and must therefore be treated in such and such a way." In fact, we must not only treat the inducing morbid condition, but also the symptoms which each individual case presents to us.

As regards the PATHOLOGY of acute suppurative inflammation of the middle ear, there is, firstly, hyperæmia of, and consequent hypersecretion from, the mucous lining of the Eustachian tube, tympanum, and mastoid cells. The swelling of the tube tends to lead to retention of this secretion and to strangulation of the veins and lymphatics which pass from the middle ear to the nasopharynx; the inflammation is thus increased, a far larger number of leucocytes than normal migrate from the vessels into the tympanum, and the vitiated epithelium is shed. If the secretion is able slowly to drain away by means of a partially patent Eustachian tube, the inflammation of mucous membrane does not pass beyond the sero-mucous or catarrhal stage; but if the tube fails to drain the tympanum, the cells of the retained secretion undergo fatty degeneration, and, as tension increases, ulceration of the lining membrane takes place, the tension then being, sooner or later, relieved by rupture of the drum-head. The hyperæmia often extends by continuity to the labyrinth.

The CAUSES of acute catarrh are many and various; cold is probably the commonest, and may influence the middle ear either from the direction of the external meatus, as from a draught on the side of the head in railway travelling, or from the rhinopharyngeal tract by way of the Eustachian tube. Acute, usually suppurative, catarrh of the middle ear, as a complication of the various specific febrile conditions, may arise as a separate hyperæmia of the tympanum, or it may spread directly by continuity from the nasopharynx, or it may result indirectly by blocking of the mouth of the tube as a part of an acute nasopharyngeal catarrh: this stenosis leads indirectly to tympanic suppuration through the retained secretions undergoing fatty degeneration. Acute hyperæmia of the tympanum is sometimes due to

reflex influences from morbid conditions of the teeth, turbinated bodies, and alimentary tract. Teething, and worms, in children, may be instanced. Obstruction of the tube and suppuration, is sometimes the result of adenoid growths, nasal polypi, and other tumours. Amongst traumatic influences may be mentioned (*a*) rigorous syringing for wax and subsequent exposure to cold; (*b*) syringing with cold water; (*c*) clumsy manipulation with the aural speculum; (*d*) unskilful efforts to remove foreign bodies; (*e*) irritating fluids and caustics applied to the meatus; (*f*) the use of dirty instruments in the performance of paracentesis of the membrane; (*g*) the introduction of fluid up the Eustachian tube; (*h*) unskilful operations in the nasopharynx, resulting in injury to the tube; (*i*) too extensive galvano-cauterization of the nose or pharynx; (*j*) septic inflammation after uvulotomy.

Finally, it cannot be doubted that strumous and other diathetic states and hereditary influences are predisposing factors.

The following is a summary of the SYMPTOMS, any or all of which may be present in acute catarrh:—

- (*a*.) *Pain*.—This frequently commences as an uncomfortable feeling of heat, fulness, and pressure; it rapidly increases and, when violent, tends to affect the head on the same side, occasionally shooting in the direction of the forehead and shoulder; the mastoid is more or less tender on pressure in children, and the movements of the temporo-maxillary articulation are often very painful. Pain is nearly always much worse at night, and aggravated at all times by vigorous movements, excitement, and stimulating diet. A distressing throbbing or hammering sensation is often present; it is frequently vascular in origin, and can usually be controlled by pressure on the carotid artery of the same side.
- (*b*.) The *hearing* is always more or less impaired, thus differentiating tympanic disease from myringitis.
- (*c*.) *Tinnitus* of the most varied character may be present; first of all of a ringing, hissing, or rushing character; and, as recovery takes place, there may be bubbling or

cracking sounds. Autophony is sometimes a complication.

- (d.) *Fever*.—Constitutional disturbance is usually more marked in children, who sometimes exhibit stupor, or in other instances delirium; they are generally restless, and the disease in the very young is, doubtless, often mistaken for meningitis. This latter condition may, however, be a complication, by extension of the inflammation through the unossified petro-squamosal suture; and such cases often exhibit convulsions and coma.
- (e.) *A discharge* from the tympanum often occurs after some days, being brought about by rupture of the membrane, from hypertension of the retained fluid, during an act of coughing, or as the result of suppurative ulceration. In the former case the discharge is slight and sero-mucous, and the perforation gives immediate relief, and rapidly heals; in the latter case it is purulent, and recovery is slower.

Objectively, the membrane appears red and opaque in a varying degree, according to the severity of the symptoms. When the tension is great, the postero-inferior segment exhibits a prominent bulging. Such bulges differ much in colour, from reddish or bluish-grey in acute sero-mucous catarrh, to dirty yellow and even greenish in the suppurative stage. The cutaneous lining of the meatus is often inflamed, and is nearly always tender.

In illustration of what has just been said, I purpose to record sundry cases, and my mode of treatment of the same.

ACUTE CATARRHAL INFLAMMATION.—I will begin with a malady which most of us have experienced—viz., earache with acute catarrh of the middle ear. Amongst the young this is frequently met with: the child at first gets restless and refuses food; it then cries out, and is evidently suffering intense pain. Generally, castor-oil or grey powder is administered, the gums are carefully lanced, or, may be, the stomach is well poulticed, without, it is needless to say, any good effect. In a few days, however, a discharge is noticed from the ear, and the child, in the majority of cases, gets well; but occasionally the symptoms

increase, and the little patient either becomes more or less deaf, or dies from so-called "teething!" I have seen a great many cases of the kind; in fact, the suffering of one of my own children in this way first drew my attention to the subject. The inflammation is nearly always brought on by cold. It is generally confined to one ear; and a symptom of importance, which ought at once to draw attention to the seat of malady, is that the child invariably refuses to rest its head on the affected side.

A most common symptom in acute aural catarrh, is pain on eructation, or any forcible expiration. This is doubtless due partly to muscular movements beneath an over-sensitive mucous membrane, and partly to the direct action of the current of air upon the inflamed lining of the Eustachian tube and tympanum.

The treatment I recommend, is frequently to foment the external meatus by pouring in, *not syringing with*, warm water. This, as a rule, gives speedy relief, and the child will go to sleep. Mild purgatives should also be administered. Perhaps leeches in front of the tragus will be found necessary in some cases. From the use of Politzer's bag in young children with earache I have often seen the greatest benefit. The bag can be used with effect without first asking the child to swallow; the Eustachian tube is thus rendered pervious, the pain caused by in-drawing of the membrane is relieved, and any pent-up pus is allowed to escape. Poultices, on the other hand, will lead to increased suppuration and to rupture of the drum-head.

In all forms of acute catarrh, the tympanic membrane is found to be either pink, red, or copper-coloured, according to the stage or severity of the attack. Paracentesis is indicated when there is bulging.

I will now cite a case of acute catarrh of the middle ear and Eustachian tubes after sore throat.

J. M., Esq., æt. 25, sent to consult me by Mr. Owen, August 10, 1874, had been slightly deaf for three weeks, from cold, but two days before, had got a sore throat, after which his ears began to ache. He was suffering intense agony on both sides of his head, aggravated so much by swallowing that he was afraid to

eat. The whole of the naso-pharyngeal mucous membrane was greatly congested. There was great tenderness of the right external auditory meatus, and over each mastoid process. He could not hear my watch with the left ear, though in contact it was audible with the right. The face was flushed, the pulse quick, and the skin hot. Both tympanic membranes looked bright red, but there was no sign as yet of bulging of either. The Eustachian tubes were impervious. Tinnitus aurium, affecting both ears, was very severe and distressing in the right. Six leeches in front of each tragus, a saline mixture with morphia, and a brisk purge were ordered. The next day the pain had almost gone, but the tinnitus was still present. The Politzer bag was used, and air passed easily through the Eustachian tubes. A feeling of great relief was immediately experienced, and the tinnitus aurium almost ceased. The tympanic membranes had lost some of their redness, and looked more healthy. The throat was painted with a solution of nitrate of silver, 10 grs. to the ounce. Six more leeches were applied in front of the right ear, as there was still tenderness in the external meatus and on the side of the face. These gave immediate relief. The Politzer bag was used daily with very good effect, a considerable quantity of fluid being heard bubbling, as the air passed into the tympanum on both sides. The paint to the throat was continued, and iodine liniment applied daily behind the ears. After this treatment had been continued for a fortnight, the mucous membrane of the throat and neighbouring parts became less and less congested, the fluid gradually disappeared from the ears, and health and hearing were rapidly regained.

Von Tröltsch recommends* that, during the application of leeches, the ear should be carefully stopped up with cotton wool, and that the bites should afterwards be covered with plaster, as erysipelas might otherwise occur, from the wounds being poisoned by the otorrhœa. When leeches are indicated they should be used freely; two or three are of no use whatever.

Weber-Liel has recommended, in place of leeching, the use of

* *Surgical Diseases of the Ear*, p. 23.

a cold compress, to be applied frequently over the seat of pain, and changed before it has time to get warm.*

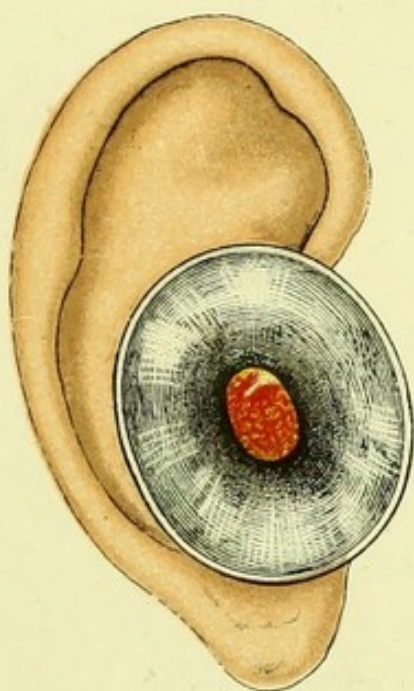
Acute non-suppurative catarrh, or, as Von Tröltsch calls it,† simple acute catarrh of the ear, is characterized by the rapid appearance of hyperæmia and swelling of the entire mucous tract of the middle ear, with considerable increase of secretion, which, however, still preserves its mucous or sero-mucous character. This state is generally associated with influenza or other specific fever, pharyngeal or bronchial catarrh, or some other catarrhal disease, or even pneumonia. Syphilitic disease of the throat is a not uncommon starting point for it. The prognosis is so far favourable, that perforation of the membrane occurs somewhat rarely, and then nearly always during violent sneezing, or blowing the nose. The hearing of the patient can be very considerably improved by early local treatment; but the attack not infrequently lays the foundation of insidious aural catarrh, since thickening of the mucous membrane of the Eustachian tube and tympanum, and abnormal bands of adhesion are very apt to remain after it. The main requisite is to prevent the development of such conditions by removing as soon as possible the mucus accumulated in the ear. Von Tröltsch recommends early incision of the membrane, and "in milder cases, air douches (catheterism or Politzer's process) to provide a mode of escape for the mucus present, and to allow the adhering surfaces of mucous membrane in the Eustachian tube and the tympanum to remain separated from one another."

Of anodyne drugs, glycerine of carbolic acid poured into the meatus, and antipyrin internally, are most useful.

MYRINGITIS.—I have purposely avoided as much as possible dividing acute aural catarrh into different forms, for practically its division is of very little importance. The drum-head itself may, however, be alone implicated (myringitis), giving rise to deep-seated tearing pain in the ear, with a feeling of throbbing and fulness, and severe tinnitus aurium. These symptoms are more or less severe. Often bleeding from the ear takes place,

* For further particulars as to the use of the cold compress, see an article by Dr. William Winternitz, in the *Practitioner*, August, 1878.

† *Diseases of the Ear*, translated by James Hinton, M.R.C.S., p. 48.



ACUTE INFLAMMATION OF MEMBRANA TYMPANI.
(*Myringitis*).

and may prove beneficial; or the case may go on to suppuration and perforation, and then is frequently followed by thickening of the membrane.

H. P., æt. 18, came to St. Mary's with acute inflammation of the right tympanic membrane, the result of a cold bath. Three days before, after slight deafness for three weeks, he had experienced "a violent beating kind of pain deep down in the right ear," and a sensation as if it were "stuffed up," with severe tinnitus aurium. He could hear my watch in contact. The drum-head was of a bright pink colour, but the external meatus was perfectly healthy. Two leeches were applied in front of the tragus, and a warm weak solution of carbolic acid was frequently poured into the ear. The leeches gave immediate relief; the membrane recovered from its highly vascular state; the slight discharge ceased; and in ten days' time he was perfectly well.

Myringitis is said to be a very rare disease, and Grüber states that as an idiopathic affection it is of scarce occurrence, as a secondary event very frequent. Burnett* says that he has assured himself that the tympanum is free from disease in all such cases as could be termed myringitis, which he is disposed to regard as usually, if not always, an inflammation of the dermoid layer of the drum-head.

Cases are occasionally described of what are called "abscesses of the membrana tympani," in which the suppuration is said to be limited in extent, and usually between the mucous and fibrous layers of the drum-head. Practically, I regard these as a useless subdivision of acute suppuration of the middle ear, with which it is identical both in symptoms and treatment: the inflammation has in every case I have seen extended beyond the drum-head—generally inwards to the tympanum, but sometimes outwards to the external meatus.

ACUTE SUPPURATIVE INFLAMMATION.—In this disease, when there is bulging of the membrane, if other methods, such as Politzer's, have failed to evacuate the pus, paracentesis should at once be resorted to, to let it out. I have already alluded to this procedure, in speaking at the beginning of this chapter of acute catarrhal inflammation in young children. In

* *A Treatise on the Ear*, p. 330.

acute inflammation following scarlet fever and measles, in which not only the cavity of the tympanum but the mastoid cells also are often filled with puriform fluid, it is especially necessary. During the operation, the head should be well supported; a good light should be thrown on the membrane through a silver or vulcanite ear speculum; and the puncture should be carefully made in the posterior and inferior portion of the membrana tympani, for here we nearly always find the bulging greatest.*

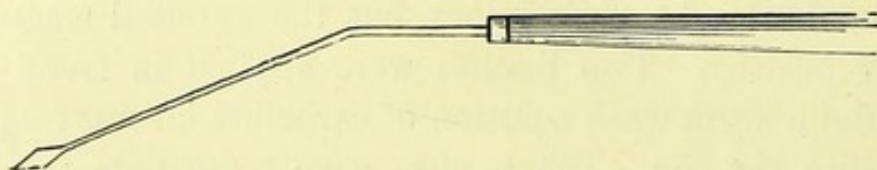


FIG. 45.—Paracentesis Knife.

Sometimes the pus makes its way spontaneously through the membrane; but, if the patient be early attended to, no bad results take place, as with care the perforation will generally heal. When an aperture remains, it does not necessarily cause deafness, even a large hole in the drum-head being compatible with good hearing-power. A child was on one occasion brought to me from the country who had lost nearly the whole of his right tympanic membrane after scarlet fever, yet his hearing was nearly perfect. However, if treatment is neglected, a very different result may ensue, as, for instance, in otorrhœa following one of the zymotic diseases. In such cases the parents frequently tell one they have been informed that “the child will grow out of it.” One might imagine that for cleanliness’ sake alone they would have endeavoured to get rid of the foul discharge, instead of allowing the morbid process to continue, and destroy the delicate structures of the ear, thus exposing the patient to the risk of very lamentable results to health and hearing, and sometimes actually adding a danger to life itself.

I shall now in the first place give some cases where, owing to early treatment, little or no mischief took place, and shall

* For further information on this subject I would refer the reader to a paper by Dr. Cassells, of Glasgow, published in the *Edin. Med. Journ.* for March, 1876, and kindly sent to me by the author.

then bring forward a few others which, in consequence of neglect, assumed a serious character.

D. S., æt. 40, came to me at the hospital with severe pain in the right ear. He stated that a week previously "he had got wet through in the rain," and since that time had suffered increasing pain in his ear. About three days back he had been "in great agony." He then for two days poulticed his ear every hour with linseed until something burst, and some thick matter came away. He was very much relieved by this, but still suffered a good deal of pain; and the discharge from his ear was very thick, extremely offensive, and continually running. He was unable to hear my watch in contact. Upon examination with the speculum I found a very large perforation in the membrana tympani, through which the abscess had burst. As there was still a good deal of tenderness, I ordered six leeches to be applied, the ear to be gently syringed every other hour with warm water, and the poultices to be discontinued. The next day the patient was much better, so I prescribed a warm weak solution of carbolic acid—gr. i. to the ounce—to be poured into the ear four times a day after syringing with warm water. Great improvement was soon manifest, and the discharge lost its offensive character. The lotion was then changed to gr. i. of acetate of lead to the ounce. He was directed also to draw up through his nose a warm solution of bicarbonate of soda (a teaspoonful to a pint of water). By this means the fluid, going up the Eustachian tube, was made to pass through the perforation, carrying the discharge into the external meatus, thus cleansing the ear from the inside. He was told also "to hold his nose and blow" when he poured the lead lotion into his ear, so that bubbles of air might pass out through the perforation in the membrane, to be replaced by drops of the lotion. The malady was thus attacked from without. The perforation now rapidly got smaller, his hearing improved, and the discharge gradually ceased; in three weeks' time the aperture had closed, and the hearing had become as good as ever it was. The naturally healthy condition of this patient was of course greatly in his favour.

If, after recent rupture, the ear is kept constantly clean, the

membrane will generally heal as satisfactorily as it did in this case.* Where, in otorrhœa, there is a discharge of thick pus, it is absolutely necessary that the syringe should be used at least three times a day, in order that the lotions may with benefit affect the diseased membrane.†

A puncture in a healthy drum-head rapidly closes up again, and is most difficult to keep open. If, therefore, the membrane is ruptured by the bursting of an abscess, the surgeon's great aim should be to get it into a healthy condition, in which it will heal up almost as rapidly as when an incision is made. This is the more readily accounted for when we remember that, in almost all cases of perforation from acute catarrh, it is a slit, and not a round opening, that first makes its appearance in the membrana tympani. But if the discharge is allowed to continue for some time, its constant passage wears the slit into a round orifice, and hence we have far greater difficulty in effecting a closure.



FIG. 46.—Slit-like Perforation in the Membrana Tympani.



FIG. 47.—Perforation in the Membrana Tympani—a round orifice.
(Both larger than normal as seen by Brunton's Speculum.)

The symptoms in different instances of acute aural catarrh vary very slightly, as I have already pointed out. In the above mentioned case the condition was such as is very commonly met with. For its most satisfactory treatment we occasionally find that one astringent is of much greater service than another; and it usually proves beneficial sooner or later to change the lotion from acetate of lead to sulphate of zinc, and so on. On

* See also the cases on page 142.

† Sir William Wilde truly says: "So long as otorrhœa is present, we never can tell how, when, or where it may end, or what it may lead to."

this subject Politzer says : " In cases of acute purulent catarrh of the membrana tympani, weak solutions of the preparations of zinc and lead are very efficacious. The preparations of lead frequently act quicker after a zinc solution has been used for a few previous days. Perchloride of iron, alumina, and nitrate of silver are not generally adapted to acute cases. In cases of purulent catarrh with a small perforation of the membrana tympani, a solution of lead dropped in is very useful. An extremely favourable result has in some cases been brought about by the use of powdered alum." Most of these preparations, he adds, lose their favourable action when applied for long uninterruptedly.

W. H., æt. 8, was sent up from Esher, March 2, 1876, to consult me for deafness during five years, accompanied by a constant offensive discharge from both ears. I found both membranes perforated, and my watch was not heard in contact with either ear. For six months he had been gradually losing his power of speech, so that, when admitted into the hospital under my care, he was almost deaf and dumb. He had never been treated in any way for his deafness. By the aid of often-changed astringent applications, the mucous surfaces regained a healthy condition, and the discharge ceased ; and after two months' constant care the patient was able to talk and hear very well.

Supposing, however, that cases of the more serious forms of inflammation are allowed to take their own course, the result is that in 99 per cent. mischief results. Thickening or perforation of the membrana tympani, chronic inflammation of the mucous membrane of the tympanum and constant otorrhœa, injury or perhaps total destruction of the ossicles, extension of the inflammatory process to the brain, &c., may supervene. After fever a sanguineous fluid may fill up the cavity of the tympanum, perhaps causing complete disorganization of its contents and total deafness. One of the most common causes of perforation is scarlet fever. The cases under consideration often do very well if the otorrhœa is at once checked by the means already suggested, for the mucous membrane is thus readily restored to a state of health ; and there is then a fair chance of healing up

the orifice in the drum-head by the application of nitrate of silver or similar remedies. If an attempt be made to effect closure before the discharge has ceased, more harm than good is done, for the pus is shut in, and a sort of artificial abscess is formed.

A lady from America one day brought her son, *æt.* 12, to consult me. He had suffered from scarlatina some four years previously, but as by that time he had learnt to speak fairly well, he, although totally deaf, had not yet forgotten how to talk. The first thing the mother did was to produce a little bottle containing the ossicles—malleus, stapes, and incus—all in a perfect state of preservation! She said they had come away with the discharge during the fever. I need hardly say that he was hopelessly deaf.

Another case, that of A. E. A., *æt.* 3, was brought to the hospital, February, 1878, totally deaf in both ears. Her mother stated that, a year before, the child had had a severe attack of scarlet fever, with great discharge from both ears, from which four or five "little bones" came away.

A most interesting case, formerly in the Victoria Ward of St. Mary's, well showing the ravages made by scarlet fever in the middle ear, was that of a girl, *æt.* 17, under the care of Dr. Broadbent, who asked me to see her. At about 2 years of age she, with her brother and sister, who both died, suffered from a very severe attack of scarlet fever, which left her deaf and dumb. One might have been led to attribute her affliction to the fact that her mother and father were first-cousins, had it not been that, before the attack of fever, she could hear perfectly, and was beginning to talk tolerably well. But she became incurably deaf, and soon lost all power of speech. Immediately behind the left concha, and hidden by it, was a round opening large enough to admit a peppercorn, leading, no doubt, into the mastoid cells. The left Eustachian tube was completely closed, so that no air could be passed through it into the unnatural opening. One was led, therefore, to infer that the permanent blocking of the tube was due to chronic inflammation caused by an abscess of the tympanum, which had discharged through the mastoid cells.

I was fortunate enough, through the kind assistance of the late Dr. Mahomed, to obtain a record of the exact condition observable in the deaf and dumb girl above mentioned, after her death in 1875 from tubercular peritonitis.

The two ears presented similar changes, of which some are shown in the annexed woodcut. The tympanic membranes were entirely destroyed. The tympanic cavities were much enlarged by caries of their walls, principally backwards and downwards, and especially towards the mastoid cells, which appeared plugged by cheesy material. The internal ear also was disorganized; in fact, all the structures within it seemed destroyed, the semicircular canals and cochlea being so plugged with inflammatory products that the outline even could not be

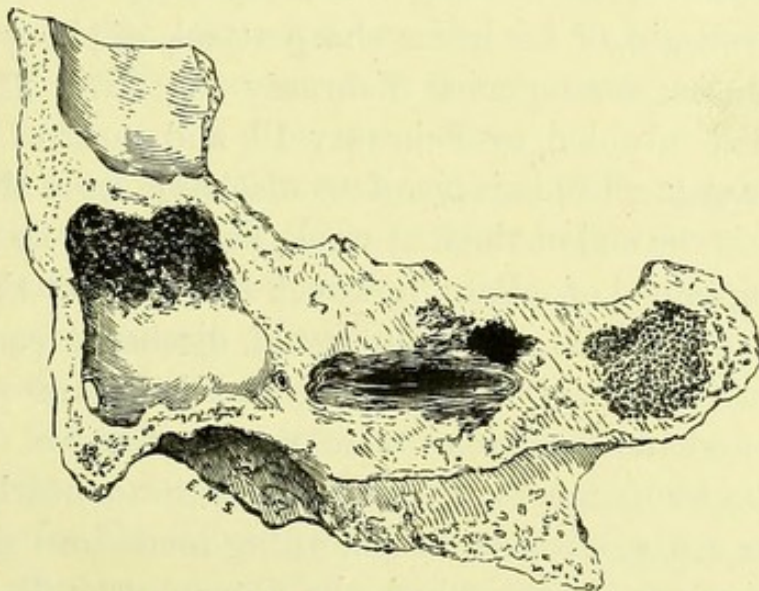


FIG. 48.—Section of Temporal Bone. From a specimen in the Museum of St. Mary's Hospital. Pathological Collection, No. 805.

traced. The Eustachian tubes, moreover, were both completely obstructed. In the right ear, the tube was seen in transverse section; in the left, in longitudinal. In the right ear, in which the opening between the mastoid and external meatus had closed some years previously to death, the tympanum was filled with cheesy pus, and was evidently in a state of quiescence. In the left ear an opening was still visible close to the mastoid process, and the tympanic cavity was divided into two parts—an anterior, plugged by cheesy material, and a posterior, lined by pyogenic membrane, from which the discharge at the time of

death originated. There was also extensive disease of the temporal bone.

The result of diphtheritic inflammation extending from the throat up the Eustachian tubes into the tympanic cavity is well illustrated by the following two cases. The first one was that of Miss M., æt. 15, to whom I was called, in consultation with Dr. Cheadle and Dr. Morton. She had undergone a very severe attack of diphtheria, and during her convalescence she had severe pain followed by discharge, first in one ear and then in the other. After this the temperature remained high for some weeks, although the patient seemed to be gaining strength. In the result, as will appear from the following notes, kindly supplied by Dr. Morton, the somewhat large perforations in the membranes healed, and hearing was completely restored.

M. M., a tall girl of 15, had a sharp attack of pharyngeal and nasal diphtheria, commencing February 2, 1887. The urgent symptoms had subsided by February 10, and most of the membrane came away. Copious purulent discharge from the left ear began towards the end of the first week, February 8, no pain having been complained of. Pain, however, set in, about February 8, in the right ear, which also suppurated, discharge commencing about February 12. Boracic lotion and iodoform wool were freely used, and the discharges were never offensive. On February 11, the temperature, which had fallen to nearly normal, began to rise again, with regular morning remissions and afternoon exacerbations, during which she seemed very ill. It crept up to 103° on the 17th, and gradually subsided again in the ensuing fortnight, preserving the same remittent character. She was very deaf, but could hear a person directly address her in a loud tone.

I was called in on February 10, and found perforation of both tympanic membranes. I ordered counter-irritation behind the ears with equal parts of tinct. iodine and blistering liquid, and syringing with a lotion of carbolic acid gr. $\frac{1}{2}$, glycerine, $\text{m}^{\text{v}}\text{ij}$, S. vini rect., $\text{m}^{\text{v}}\text{ij}$, tinct. opii, m^{iv} , to the ounce of water. This was changed, about the 23rd, for a lotion of sulphate of zinc and carbolic acid, gr. $\frac{1}{2}$ of each, gradually increased up to gr. ij. to the ounce.

Under this treatment the hearing improved, but the discharge continued about the same till March 9, when it began to diminish considerably in the left ear, and finally ceased on March 12, the perforation having closed. The right ear continued much the same till March 25, when it ceased discharging rather suddenly, without any pain, and the perforation appeared to have closed. There was a slight discharge of blood on the 18th which did not recur. Some rectified spirit was then added to the lotion.

The hearing has since been perfect.

The treatment in this case consisted in the frequent washing of the ears with a solution of sulphate of zinc, carbolic acid, glycerine, and rectified spirit, and the application of blisters over the mastoid.

It is possible that the aural trouble was in a measure due to obstruction of the Eustachian tube from post-diphtheritic paralysis of the palato-tubal dilator muscles.

The other case is one of pure diphtheritic inflammation of the ear, and occurred in the person of the daughter of the Head Master of Marlborough College, and was seen by me in April of last year, in consultation with Dr. Penny and Dr. Maurice. In this, the disease ran the same course as in the other case, but only one ear, the right, was affected. A membranous exudation, looking like tripe, was removed from the ear. I am indebted to Dr. Penny for the following report concerning the case. For a few days after my visit there was much discharge, and both ears were very deaf. At the end of a week, however, the discharge rapidly diminished, and she could hear a watch at a distance of one inch from the ear. At the end of a fortnight the discharge had entirely ceased, and the hearing distance was three feet for each ear. After her return from a visit to the seaside, her hearing was found to be as good as ever it had been. The treatment adopted was the same as in the last case.

Some attacks of acute aural catarrh come on suddenly without any apparent cause. Dr. Cassells has described* an acute inflammation of the ear which he attributes to the admixture with the air of a quantity of sewer-gas too minute to be per-

* "On Sewer-Gas and Ear Disease," *Edin. Med. Journ.*, April, 1878.

ceived by the sense of smell, and yet giving rise to a state of general *malaise*, resulting in serious disease of the ear. He says of one case: "I freely incised each *membrana tympani*, and thereby gave exit to much clear serous fluid, with marked and almost instantaneous relief to all the previous suffering. This fluid, always serous-like in appearance, continued to drain away very freely for several days, to the extent of about eight fluid ounces in all."*

In very young children, acute otitis media sometimes simulates meningitis in a remarkable manner, the retracted head being a marked symptom. Such cases are met with in children of one or two years of age who are unable to indicate that the pain is really in the temporal bone, although, occasionally, an indication is given by the infant putting its hand to the ear. If the membrane is punctured and the tubes opened by inflation, the relief is so great that the symptoms subside within an hour or two, even when only a small quantity of pus or muco-pus escapes from the tympanum; cases so immediately relieved by the removal of tension and free bleeding are probably not true instances of meningitis, although, if untreated, such a complication would be likely to ensue on account of the thinness of the roof of the tympanum, and of the intimate vascular connection of its lining with that of the meninges.

Acute otitis simulating meningitis in infants is frequently the result of the catarrhal process of pneumonia, or of one of the exanthematous fevers spreading up the Eustachian tube. Cases of this nature have lately been observed following on epidemic influenza.

Quinine in large doses may, as in the following instance, cause an acute inflammation of the mucous membrane of the tympanum and Eustachian tubes.

The Rev. T. P. came to consult me in June, 1874. A short time before, when ill in Rome with fever, he had taken large doses of sulphate of quinine. Singing in the ears and deafness ensued, which had been gradually increasing. He had a slight discharge from both ears, with inability to hear my watch in contact, and great pain. The mucous membrane of the throat

* See Chap. XIV, on "Pain as a Symptom of Ear Disease," p. 274.

was much congested; the Eustachian tubes were obstructed; and both tympanic membranes looked bright red. After a little perseverance I was able to open both Eustachian tubes by means of Politzer's bag. His hearing immediately improved so much that he could hear my watch at six inches; and the use of a weak carbolic acid lotion for the ears, an application of tinct. ferri. perch. (ʒi to water ʒi) for the throat, and the discontinuance of the quinine completed his recovery.

Roosa, in writing on this subject, says: "I am inclined to suspect the effect of quinine upon the ear is sometimes [to produce] an inflammation of the conducting portions of the ear as well as of the acoustic nerve or labyrinth. We have long known of the latter effect, but the former has not been often observed. I have been convinced by experience that it has a peculiar power of congesting the auditory apparatus." On the other hand, some authorities maintain that in therapeutic doses quinine has no ill effect upon the ear.

The truth lies in the fact that the effect of quinine varies with the dose as well as with the individual idiosyncrasy. This subject will be referred to again in discussing the aural complications sometimes associated with the exhibition of salicin, quinine, morphia, alcohol, tobacco, &c.

CHAPTER VIII.

SUB-ACUTE AND CHRONIC CATARRHAL
INFLAMMATION.

CHRONIC aural catarrh is by far the most frequent cause of deafness. Having pointed out the great variety and the difficulty of framing clear definitions of the various forms of this disease, in some of which it is hard to say when the acute merges into chronic inflammation, I shall now commence with the consideration of mucous catarrh. I shall first treat of cases of recent origin, which yield to simple measures, as Politzer's process, and shall then go on to those of longer standing, where the injection of fluids and other remedial agents through the Eustachian tube is necessary to cope with excessive secretion, swollen tissues, or hypertrophied mucous membrane. Chronic suppurative aural catarrh will be described more fully when we come to the important subject of otorrhoea.

The frequency with which children suffer from simple mucous catarrh is very remarkable, and still more so is the large number of those who, through neglect of all remedial measures, are permitted to become completely deaf.

The most successful results are those obtained by early treatment. As I have said before, it is most important to disabuse the minds of parents of the generally received notion that their children as they grow older, stronger, or less delicate, will gradually get rid of difficulty in hearing. The very slight pain experienced leads perhaps to the supposition that no evil consequences are impending, whereas usually, as a matter of fact, irreparable deafness is by degrees being established through accumulation and hardening of mucus, and thickening of the drum-head, or adherence together of the ossicles.

Another reason why a mischievous state of things is often

The following case, which occurs to me in illustration of the above remarks, is typical of a class very common in practice. J. R., a boy, æt. 9, sent to me by Dr. Broadbent, had for a considerable time suffered from delicate general health, and for two years from increasing deafness, which recently had become much worse, so that he could hardly hear my watch in contact with either ear. His throat was considerably relaxed; his tonsils were enlarged; and he was absent in manner, and could not hear ordinary conversation. He breathed heavily, snored in his sleep, and was said "to talk through his nose."

As a rule, cases of this sort in children are very easily cured, if early treated ; some, however, can be dealt with but slowly, while others are cured by a single application of the bag. It is important to remember that quite half one's success is dependent upon attention to the general health and suitable medication to the congested mucous membrane of the throat.

L 2

The following is an interesting case, and one of a kind not infrequently met with:—

M. L., æt. 14, a hospital out-patient, had been ailing and getting deaf for two years, *i.e.*, from the time that the catamenia commenced, and since their cessation, six months previously her deafness had grown rapidly worse. She was very anæmic, and suffered from loss of appetite, constipation, and relaxed throat. She could not hear my watch in contact with either ear. I prescribed the syrup of iodide of iron, and painted her throat occasionally with solution of nitrate of silver (12 grs. to the ℥i), and, as in the last case, frequently used the Politzer bag. After three months her general health was completely restored; and when last seen at the hospital she could hear perfectly.

The pathological features of middle-ear catarrh of recent origin are injection, tumidity, and shedding of the mucous membrane of the tympanum, accompanied by the secretion of a thin and clear serous or mucous fluid.

When the drum-head or tympanic membrane is drawn inwards through exhaustion of the air in the tympanic cavity, it is apt to exhibit loss of translucency, and also to assume a bluish-grey or yellowish hue. Great depression of the membrane and consequent backward and inward inclination of the handle of the malleus are especially diagnostic of long continued catarrh with impermeability of the Eustachian tube. The coincident outward projection of the short process of the malleus causes the appearance of folds running from it in the upper part of the membrane, of which the hindermost is the best marked.

So long as air is not introduced into the tympanum, the movement of the concave membrane on exhaustion or compression by Siegle's pneumatic speculum of the air in the external meatus is but slight. After vigorous inflation by Politzer's method, or by the catheter, however, the mobility is abnormally increased, the ordinary action of the atmospheric pressure being enhanced by reason of the flaccidity of the long over-stretched membrane. An "indrawn" membrane becomes a "relaxed" one.

The causes and the cure of catarrh of the middle ear more especially demand our attention, because the disease is one of

the most fertile sources of deafness. Its early arrest in the case of children is manifestly a matter of great moment. With them timely treatment is as a rule readily efficacious, whereas neglected catarrh may eventuate in any of a multitude of permanent lesions of the apparatus of hearing (*e.g.*, opacities and calcareous deposits in the membrane, purulent inflammation of the tympanum and mastoid antrum, and adhesions of the ossicles), the mischief being done long before either child or parents realize its existence, much less its terrible significance.

Of the causes of aural catarrh in Great Britain, there can be no doubt that the most potent is the variability of the climate. A common first effect of a chill is, as most persons in England are only too thoroughly aware, inflammation and swelling of the nasal and pharyngeal mucous membranes, or what is popularly known as "sore throat." Fortunately, in a large majority of cases, this passes off without implicating the Eustachian tube; when, however, that structure also becomes affected by the upward spreading of the morbid process, its passage is liable to become blocked. The patient may now complain of a feeling of fulness in the head, increasing deafness, and persistent tinnitus, for, as replacement of air absorbed from the tympanic cavity cannot be effected through the swollen and stenotic Eustachian tube, there is consequent undue atmospheric pressure upon the outer side of the drum-head, and the "indrawn" membrane previously mentioned is the result. The prolonged persistence of this pressure may of itself irremediably injure the hearing.

The progress of inflammation from the Eustachian tube is in the course of time usually evidenced by an accumulation of catarrhal products within the tympanum. So long as the tympanum does not become filled, this is generally detectable, on examination with the auriscope, by the contrast of the exudation with the air above it, the upper surface being seen as a straight, curved, or wavy line, according to the adhesiveness or tenacity of the exudation, and its amount of mobility on the shifting of the position of the head.

The diagnosis of the presence of a serous or mucous secretion in the tympanum is sometimes practicable, simply from the greater lustre of the membrane, and from its altered colour—

the normal tint being masked by the usually yellowish-green hue of the exudation, or being altered to a reddish tint when there is much hyperæmia. If the membrane retains its transparency, bubbles of air may be observed behind it after inflation with the Politzer bag in cases of serous exudation. When the diagnostic or auscultation tube is employed—that is, an india-rubber tube one end of which is placed in the patient's ear, the other in the surgeon's—the gurgling of the fluid on the introduction of a current of air, by any of the various methods of inflation through the Eustachian tube, can be distinctly heard.

Obviously, from what has been said, one of the most efficient preventatives of aural catarrh is avoidance of the causes of cold-catching, such as deficiency of clothing, dampness of the feet, undue chilling by evaporation after excessive perspiration, and exposure to draughts.

I have just indicated how a simple naso-pharyngeal catarrh leads to pathological changes in the middle ear, and the accompanying symptoms of deafness. It may be well to digress here a little, to consider the more immediate antecedents of nasal and naso-pharyngeal catarrhs, and such consequents like tonsillar hypertrophies, which indirectly affect the middle ear by impairing the efficiency of the Eustachian tube. I have already alluded to some all-important factors in the induction of nasal and pharyngeal catarrh, namely, those atmospheric influences which predispose to catching cold. Such tendency to take cold is again, however, largely determined by the mode of life and general health of the patient. Such occupations as expose individuals to sudden and frequent changes of temperature, and such as necessitate the working in a dusty or ill-ventilated atmosphere, will greatly predispose to catarrh. The same holds good generally, of insanitary homes and surroundings, and exposure to the emanations from drains and sewers. Again, those who are the subject of the strumous, rheumatic, and such-like dyscrasiæ, are not only more prone to become the subject of nasal and pharyngeal catarrh, but they suffer longer, and less easily recover from its effects, and are more liable to be the subject of such permanent hypertrophies as polypi, adenoid growths, and tonsillar enlargements. In the young, there can

be little doubt that the exanthemata and the various specific fevers, *e.g.*, influenza, which are associated with manifestations in the nasal and pharyngeal cavities, are but too often the starting point of a chronic catarrh, especially in the victims of the dyscrasie just mentioned.

In discussing the etiology of nasal catarrh it has been found convenient to speak of it as if it were a condition characterized by a more or less definite and constant lesion. I need scarcely point out, however, that the forms of rhinitis and pharyngitis met with in practice are many and varied. Broadly speaking, they may be divided into hypertrophic and atrophic. The latter, dry catarrh, as it is usually spoken of, is sometimes a primary condition, but more often, I fancy, secondary to the hypertrophic one; it is found in only a comparatively small number of cases, and is generally a very intractable disease. Hypertrophic rhinitis is characterized by thickening of the mucous covering of the nasal septum and of the turbinated bones, with marked engorgement of the cavernous vascular tissue of the inferior turbinated body. Commensurate with the hypertrophy is hypersecretion. The nasal passages, the natural avenues by which the air reaches the delicate respiratory organs, become stenotic and blocked by the swelling of the mucous membrane and by the excess of secretion, and buccal respiration results. If this condition has lasted long, a rhinoscopic examination may disclose the presence of one or more polypi or of polypoid hypertrophies of the turbinated bodies. The significance of the presence of these growths will be understood when it is remembered that finding no room in an already stenotic nose they are apt to project into the naso-pharynx, and directly obstruct the mouths of the Eustachian tubes.

I have, hitherto, briefly called attention to the more salient mechanical factors in nasal catarrh, looked at from the aural point of view, but it may be laid down almost as an axiom that hypertrophic and obstructive rhinitis does not exist for even a few days without the induction, in greater or less degree, of a catarrhal condition of the pharynx. One of the more obvious histological characteristics of the pharyngeal mucous membrane is the large amount of lymphoid tissue it

contains. In hypertrophic nasal catarrh of any standing, we almost always find the lymphoid masses much enlarged, indicating the irritating nature of the excessive nasal secretions which have been taken to the tonsils and other follicular lymphoid structures by the converging lymphatics. Luschka's tonsil, and the mass of adenoid tissue in the Eustachian tube known as the tubal tonsil, become hypertrophied in this manner and block both the mouth of the tube and its lumen. Irregular hypertrophies of the pharyngeal or Luschka's tonsil are better known as post-nasal "adenoid growths."

Prominent enlargement of the discrete and follicular lymphoid tissue of the pharynx is often called granular pharyngitis. Enlarged conditions of the faucial palatal tonsils cannot directly block the Eustachian tube, but conduce to deafness by hampering the action of the palate and muscles which open it. Nasal obstruction alone without the presence of "growths" is in itself a potent predisponent to an obstructive catarrh of the tubal mucous membrane by reason of its diminishing the natural respiratory air current, which would appear to be necessary to the maintenance of the normal healthy and patent condition of the Eustachian mucous lining.

It is important to realize *inter alia* the many varied obstructive and *mechanical* conditions which are liable to follow nasopharyngeal catarrh, and which directly or indirectly influence the integrity of the middle ear, and the essentially mechanical nature of the lesions will suggest that mechanical treatment, in addition to drugs, will be necessary. But though the nasopharyngitis is so often the prime factor in the induction of aural catarrh, it is important not to be led away by those who dogmatically teach that the latter condition is always dependent on the former, for amongst other causes may be mentioned syphilis, rheumatism, gout, and rickets, which usually bring about slow intra-tympanic changes; but, in addition to these dyscrasias, we find that the introduction of mucus and foreign matter into the tympanum during violent forms of sneezing, coughing—especially in pertussis—vomiting, and nose-blowing is often the starting point of symptoms almost identical with those of catarrhal origin. Thrush, diphtheria, tuberculosis, and the exanthemata when

actually attacking the tube and middle ear can scarcely be said to give rise to simple catarrh.

An accumulation of mucus in the tympanum appears to be, in itself, a possible origin of further and purulent discharge. In many an instance the closure of the Eustachian tube is promoted by the patient's habit of keeping his mouth open, because of the difficulty he finds in breathing with his nostrils obstructed, and by reason of the narrowing of the naso-pharynx by pushing up of the swollen palate by the enlarged tonsils even in the absence of "growths."

The general appearance of a child the subject of chronic catarrh and its sequelæ, with its perpetually patent mouth, his crowded teeth, pale and flabby cheeks, and vacant look, its nose swollen at the bridge, and constricted and pinched at the alæ, is very distinctive. No less so are the heavy, almost snoring, respiration and the nasal intonation of the voice, "talking through the nose" as it is called, meaning of course the reverse, "not talking through the nose." Even when such children do not exhibit noisy respiration during the day, they do at night, and they awake in the morning with a dry mouth and throat, sometimes even gasping for breath.

Among the occasional subjective signs of aural catarrh are various noises due to movement of mucus in the tympanum during deglutition. Sometimes a patient complains that he feels when talking a sort of echo of his own voice, as though he were speaking with his head inside a barrel. This symptom—autophony—is found to be most frequent in examples of *one-sided deafness* from slight aural catarrh.

The statement by a patient that his hearing is *variable* from day to day leads one to expect that the Eustachian tube and not as yet the tympanum has become the seat of inflammation, and one's diagnosis is accordingly favourable. The opening of the tube after prolonged deafness, and the initiation of at least temporary improvement in hearing, may be accompanied by what sounds to the patient like a loud explosive noise, owing to the sudden entry of air into the tympanum.

Hearing best in a noise is diagnostic of considerable fixation of the ossicula, which fail to perform their proper functions

without the reinforcement of the vibrations of ordinary sounds by more extensive oscillations. That is to say, that when the ossicles are, as it were, glued together, ordinary vibrations of sound are insufficient, and they require to be reinforced. This may be readily obtained by the patient getting a good shaking up in a cab over the London stones. It is a bad sign.

As regards the general treatment of aural catarrh, one primary indication is improvement in the patient's constitutional condition. Damp and cold, as we have seen, must be alike avoided; and in obstinate cases, where the ordinary methods of treatment have proved of no effect, a change to a dry, mountainous situation has repeatedly been beneficial. Open-air exercise and the use of tepid baths should be enjoined, but bathing in cold water with the ears unprotected by cotton wool must be forbidden. Laxatives in some instances, and in others, cod-liver oil, and various preparations of iron, may be of considerable assistance.

Damp, as I have already indicated, is a factor especially important to consider with respect to the origin of catarrhal deafness in children. A case came under my notice of a delicate child, living not far from London, who suffered from extreme deafness, due partly to catarrhal obstruction of the Eustachian tubes from adjacent adenoid growths in the pharynx. Her condition was bettered by the use of Politzer's bag, the usual astringent applications, and attention to the general well-being. She was not, however, restored to perfect health and hearing until she left the damp clay soil of her home, when the change for the better was immediate. On returning home she again lost her hearing for a time; but this was eventually regained after I had removed some adenoid growths.

I remember also the case of a gentleman who for ten or twelve years had suffered, on and off, from extreme deafness, in great measure dependent on atmospheric changes, cold and damp making him hopelessly hard of hearing. He said he would do anything to be free from his constantly recurring ailment. As he was a man of good private means, and without home ties, I suggested that he should live in a dry warm climate. After some years' residence in Australia, he wrote to me that he had not known a single day's deafness since his arrival there. It is

to be regretted that the remedy in this case—escape from our ever-varying and treacherous climate—is what, from circumstances, can be resorted to by but few.

Attention to the sanitary surroundings of the patient is quite an important point in treatment. It is an almost weekly occurrence to find a deaf parent with two or three children similarly affected applying at my hospital clinic. In many such cases bad drains, in association, it may be, with the strumous diathesis, will be found to be the "*fons et origo mali*." Treatment which does not include removal to a healthy abode will, in these instances, avail little.

In like manner, attention to the diathetic state by the administration of appropriate constitutional remedies, or the treatment of the rhinal and pharyngeal catarrh, with the attendant hypertrophies, if present, and the opening up of the obstructed nasal passages, will be indicated as tending to remove causes of Eustachian stenosis and tympanic catarrh. But, however assiduous we may be, and should be, in these directions, by means of douches, sprays, snares, guillotines, and caustics, it is only by appropriate treatment to the middle ear itself that we can usually hope to relieve the symptom of deafness, and it is the simpler methods of aural therapeutics which are so valuable.

First and foremost, arises the necessity of opening up the Eustachian tube and establishing equilibrium between atmospheric and intra-tympanic pressure. Air douching of the drum through its pharyngeal communication is best and most readily performed by inflation, after the method of Professor Politzer.

Politzer's bag, I may here remark, is best made of the capacity of six ounces, and provided with Allen's nasal pad for the delivery of the air, most patients, especially ladies, objecting to the insertion of the tube into their nostrils. There are certain precautions to be observed in its use. It should be compressed with only moderate force at the moment when, by the movements of deglutition, the orifice of the Eustachian tube is opened, otherwise there is danger of a rupture of the membrana tympani through the too violent ingress of air into the tympanum. This, however, is not likely to occur with a six-ounce bag.

Again, it may be used too often, so as to lose its efficacy or relax the membrane. With many persons a single application is found sufficient for the restoration of hearing, and the longer the good effects of its first employment are perceptible the more favourable is our prognosis. Usually it cannot be employed advantageously oftener than once in every two or three days for the space of about three weeks. After this an interval must be allowed of several weeks.

It is only occasionally advisable to allow patients to apply Politzer's bag upon themselves, for not only are they prone to betake themselves to it with undue frequency, producing relaxation of the membrane, but they have been known to rupture the drum-head through too forcible inflation.

I saw a case some short time ago, where the patient, who had been absolutely deaf in one ear for several years, ruptured the membrana tympani of the sound ear by using the Politzer bag on himself too forcibly. He had got in the habit of using it nearly every hour in the day. Luckily for him the membrane healed up, and his hearing was restored. And still further to emphasize this point, I may relate the case of a gentleman who ruptured his tympanic membrane from violently blowing his nose. He was seen by his own medical man, who after a time as the perforation did not heal, recommended that he should come to see me. I prescribed some mild astringent lotion, but warned him to take care and avoid cold. He went on favourably for a fortnight; he then managed to get cold in the ear, and violent pain and inflammation occurred. He was leeches freely, and everything was done to save his life. I was suddenly one afternoon telegraphed to go and see him at once, but arrived too late, as he was already past help. This is only another instance of what fatal results may arise from what appears at first sight a very slight injury.

Swallowing at the time of the injection of air by the bag is not requisite for young children, and for one's youngest patients blowing into the nostrils through a piece of india-rubber tubing is amply sufficient. Some persons are able to open the Eustachian tube merely by suddenly turning the head on one side. In place of swallowing, on the compression of Politzer's bag, some

practitioners enjoin the pronunciation of certain syllables, such as 'hic, hac, hoc,' or repeating their name.

When the bag ceases to be effectual the Eustachian catheter may in many cases be passed with good results, but children invariably resist its use, and for them, therefore, it is not to be recommended. Satisfactorily to pass the Eustachian catheter one should have the patient's head perfectly steady, and placed in a good light. The catheter, warmed by immersion in hot water, should after depression of the patient's upper lip, or raising the nose, be introduced point downwards through the inferior meatus of the nose until the posterior wall of the pharynx is reached. It must then be turned a little inwards, and withdrawn until it is felt to have hooked round the septum nasi, taking care that the catheter is at right angles with the face. It is next to be rotated outwards, with the point still downwards, until the orifice of the Eustachian tube is reached. This is an easy routine method for beginners, but after a good deal of experience it is readily enough passed directly into the tube.

For the inflation of the tympanum through the Eustachian catheter it is best to have the air-bag suspended by a loop from a button of one's coat; and the catheter after introduction should be held firmly against the patient's nose, so that it be not shifted from position on the insertion of the delivery tube. The injection of warm, and sometimes of slightly astringent and stimulating fluids, though deprecated by some persons, is, in my opinion, of high value, as also the introduction of vapour of chloride of ammonium, in those obstinate cases of deafness due to the sequelæ of catarrhal inflammation, namely, where there are considerable tissue changes in the mucous membrane, and the movements of the ossicula are hampered by adhesions and deposits. In many of such cases I have obtained strikingly good results by the injection of solution of potassium iodide, gr. x, ad ʒj, especially in cases of what is known as "dry catarrh," in which its tendency to occasion coryza is most useful. The other vapours I recommend are those of acetic ether and tincture of iodine— \mathfrak{m} xx of each to the pint of hot water, of tincture of benzoin, ʒj to the pint, and of oil of pine. Ex-

perience alone will enable one to know exactly when to apply these remedies ; but it must be evident to all that, although we do not as a rule require hot aqueous vapour for moist catarrh, such a remedy, being relaxing and softening, is indicated in abnormally dry and atrophic conditions of the ear. Again, it is self-apparent that steam applications are likely to be of benefit when, in consequence of moist catarrhal disease, a coating of inspissated mucus exists upon the drum-head.

The condition known as dry, proliferous, anchylosing catarrh, is met with mainly among adults. It is more common in hot countries than in England, and is particularly rife in America. Those troubled with it express themselves as feeling better when they have a cold in the head, and will tell one that they never require to blow the nose. In this, as in moist catarrh, early treatment is that which yields the best results. There is no clear line of demarcation to be drawn betwixt the dry, or proliferous, and the ordinary, or moist, catarrh ; and what one must invariably do when a patient presents himself is to consider how to attack the symptoms. It is as impossible as impractical, to say " This is a case of dry, proliferous catarrh, and must be dealt with in such and such a way," and " This case is one of mucous or of adenoid catarrh, and, consequently, I must apply quite another class of remedies." Dry catarrh is very often associated with an atrophic condition of the nasal mucous membrane, and with pharyngitis sicca ; of the obstinate nature of these complaints all are well aware. One may find that catarrhal deafness is the outcome of some hereditary condition, and the precise method of influencing it for good, a most difficult problem to solve. This may certainly be averred with respect to moist catarrh, that it is far more satisfactory to treat than the dry or atrophic and comparatively incurable disease. It may be found that one's case is really an example of moist catarrh, in the course of which the drum-head has become coated with inspissated mucus. The fact is, that organic changes resulting in abeyance of the secretory functions of the aural mucous membrane are not so common as was formerly supposed, and a very great number of instances of deafness ascribed to dry catarrh are illustrations merely of the effect of oft-repeated colds in hampering the

action of the drum-head by film after film of hardened mucus. There has been an excessive secretion at one time, which has been followed by an absorptive or inspissating process (not a total absence of secretions), and progressive desiccation of structures. Our treatment must have for its aim in all cases the restoration to the drum of a supply of air adequate for the conduction of sound. In the various stages of moist catarrh we generally find potassium iodide, and mercury perchloride, of value, and in the so-called dry catarrh strychnia and iron.

As a symptom, tinnitus, when it occurs, is of some importance, for it may exist before the commencement of deafness, being sometimes the only indication of approaching catarrh. It is not often met with in the cases most readily benefited by treatment.

In some instances where the repeated use of the Eustachian catheter is inconvenient, Valsalva's method of opening the tube—*namely, blowing whilst the mouth and nostrils are kept closed*—may be resorted to for the introduction of medicated vapours into the tympanum. As a means of inflating the tympanum this method is not advisable, since, though efficacious for a little while, its temporary utility diminishes in proportion to the frequency of its employment, and its oft-repetition has been found to be positively injurious to the hearing.

The following serves to show the result of treatment in an old-standing case of catarrhal deafness. Mr. S. P., æt. 50, sent to me by Mr. Critchett, May, 1885, came with his daughter into my consulting room one morning carrying a huge ear trumpet, and telling a doleful tale of how six years before he had been chairman of a bench of magistrates, and had been obliged to vacate his post through loss of hearing. He stated that he had never been to consult anyone, and that he knew, moreover, it was perfectly useless to do so; "but," said he, "my friends insist that I ought to be seen by someone, so here I am." On examination, I found both tympanic membranes thickened and drawn inwards. There was also complete obstruction of the Eustachian tubes, in no wise abated by the use of Politzer's bag. Having introduced air into the tympanum by means of the Eustachian catheter, I proceeded to recommend the patient to inhale the vapour of iodine and ether (20 drops to the pint of

hot water) three times a day, to apply a capsicum liniment over the mastoid, and to take a mixture containing strychnine and potassium iodide, the former drug, because the mischief in the middle ear had extended into the internal ear, affecting the auditory nerve, and the latter in order to promote the absorption of residual inspissated mucus in the tympanum. Just before the patient left me, I said to his daughter, "You can throw away that trumpet when he gets home." The quickness with which the late chairman caught this remark was a gratifying sign that he was already better. My outspoken heresy aroused him at once, and he warmly told me that he had not come to be laughed at, and that my treatment was "all humbug." To my rejoinder, "At least I hope you will put to the test the treatment I have suggested," he growled out that he would, and left me. I was not surprised, a fortnight later, to receive a profuse apology from him for his brusqueness, with the intimation that, having faithfully followed the instructions, he could hear ordinary conversation. Shortly afterwards he had so much improved that he was able to resume his duties as chairman. This case is a good illustration of what I have before had occasion to remark, namely, that patients with ear disease are apt to take no trouble to find out whether their condition is remediable.

When other means have been adopted without effecting decrease in the amount of secretion, or when there is a great accumulation of tenacious mucus in the tympanum, paracentesis of the membrane has to be resorted to. For this operation a sharply pointed double edged lancet fixed at an angle to its handle is employed. The incision should be made in the lower posterior or anterior portion, the patient's head being fixed in a good light; air must subsequently be injected with some force; but if after repeated inflations the mucus is not expelled, rarefaction of the air in the external meatus should be employed. This may be effected by means of a syringe attached by its nozzle to one end of an auscultation tube, the other end of which is lodged in the external meatus, but, better still, by Siegle's pneumatic arrangement. The healing of the membrane takes place, except in rare instances, after from a few hours to at most, three or four days. Paracentesis may then have to be

repeated, and it may be found that the previous operation has already exercised a favourable influence, serous fluid, instead of inspissated mucus, being present in the tympanum. To promote the emptying from the external meatus of the discharge from the tympanum it is usually sufficient to incline the head to one side; but sometimes it is necessary to use forceps to remove tenacious mucus. It is desirable to prevent any return of fluid into the tympanum by inserting into the meatus little pellets of cotton wool.

In all cases of aural catarrh it must be our aim to secure as soon as possible the automatic opening of the Eustachian tube; for, as we have seen, it is upon the permeability of the tube that the preservation of normal hearing largely depends. This, again, is to a great extent dependent, as I have already detailed, on the state of the naso-pharynx, which must consequently always be ascertained by the surgeon.

Irrigation of the naso-pharynx through the nose for the removal of the tenacious mucus may be performed by sniffing into the nostrils weak tepid solutions of sodium chloride, biborate, sulphate, or carbonate, of the strength of a drachm of the salt to a tumbler of warm water. If there is fœtor, sulphocarbolate of zinc, 20 grains to the half pint of water, or permanganate of potash, may be advantageously substituted. The following mixture is largely used as a routine collunarium in hospitals:—

R Potassæ chloratis, boracis,
Sodæ bicarbonatis, āā ʒss;
Sacchari albi, ʒj.

M. A teaspoonful to the half pint of warm water.

Collunaria are best injected with either Lynch's nasal syringe or by means of a coarse spray, which latter is the more elegant apparatus. Moreover, many patients prefer spraying to both douching and gargling; and astringent gargles of alum, chlorate of potash, &c., may be applied well to the naso-pharyngeal cavity by means of the post-nasal spray.

Weber's form of nasal douche is now seldom recommended, from the pressure occasionally resulting in fluid entering the tympanum. It is especially harmful in children suffering from

adenoid growths, and after operations for the same. In syringing the nose through the anterior (or posterior) nares, direct the patient to breathe entirely through the mouth for the time being, and to bow the head forwards. The fluid passes up one nostril and down and out of the other, the elevated velum preventing, in this position, much of it entering the lower pharynx.

Whilst collunaria, sprays, and gargles, are often of themselves sufficient to effect a cure of the catarrhal condition, it more frequently happens that the practice of applying pigments to the nose and pharynx after, but in conjunction, with the use of the spray, &c., is attended with more satisfactory results. For this purpose a paint composed of menthol dissolved in parolein (10 to 20 per cent.) is now much used by specialists on account of its possessing marked astringent, antiseptic, and anæsthetic properties. It is especially valuable as an application to the mouth of the Eustachian tube when the mucous membrane is much swollen. Among other useful pigments may be mentioned glycerine of tannin, iodine, and glycerine of carbolic acid, chloride of zinc, the perchloride of iron, and nitrate of silver. I rarely use powders and ointments in naso-pharyngeal catarrh.

Caustics are of service in those cases where the turbinated bodies of the nose and lymphoid tissues of the pharynx are actually hypertrophied and do not yield to astringent application in the form of sprays or pigments. Chromic acid and nitrate of silver are the most readily accessible for this purpose, though many surgeons employ the galvano-cautery instead.

Operative measures, which are occasionally required, include the excision of enlargements of the tonsils by the bistoury or guillotine, the abscission of a small portion of an elongated and thickened uvula by the scissors or galvano-cautery knife; the removal of "adenoid growths" by the finger-nail, curette, or post-nasal forceps; the eradication of nasal polypi and polypoid hypertrophies projecting into the naso-pharynx by the snare; finally, if the ventilation of the Eustachian tube and tympanum is prevented by nasal stenosis due to osseous or ecchondromatous outgrowths of the septum, these obstructions can be removed by a small saw. I have recently used a circular saw or

trephine worked by a surgical (dental) engine, after the manner I have been for so many years accustomed to operate for aural exostoses. Most of these operations can be performed under cocaine, but chloroform will often be required with children.

This is, I admit, a comparatively long, but by no means exhaustive, list of the nasal and pharyngeal therapeutics which we have at our command, but I advise the non-adoption of operative measures, until milder applications have failed, nor can we expect fair results from naso-pharyngeal treatment, unless it is judiciously and assiduously combined with the simple and more essentially *aural* therapeutics previously detailed. Remember also, that the levator and tensor palati are the muscles which open the Eustachian tube; it is, therefore, of prime importance that such conditions as enlarged tonsils, an elongated and thickened uvula, or hypertrophy of the salpingo-pharyngeal fold (conditions which hamper the dilator action and render parietic the palate), should be particularly attended to. In children, especially mouth breathers, do not fail to make a digital examination of the naso-pharynx in order to ascertain the presence or not of post-nasal adenoid growths.

I need scarcely insist on the value of such constitutional and other remedies as iron, cod-liver oil, arsenic, the iodides, and chloride of ammonium.

As a word of warning, I here again enjoin great caution in prescribing quinine or salicin, for patients who suffer from deafness. I not infrequently see cases of labyrinthine deafness, which I suspect to be due to the too zealous employment of these drugs during some previous illness.

EUSTACHIAN OBSTRUCTION.

Accumulation of fluid in the tympanum is frequently met with, but is less common in adults than in children. Cold and damp, by causing hyperæmia, swelling of the tissues, and increased secretion, and thereby closing the Eustachian tubes, are especially liable to produce it.

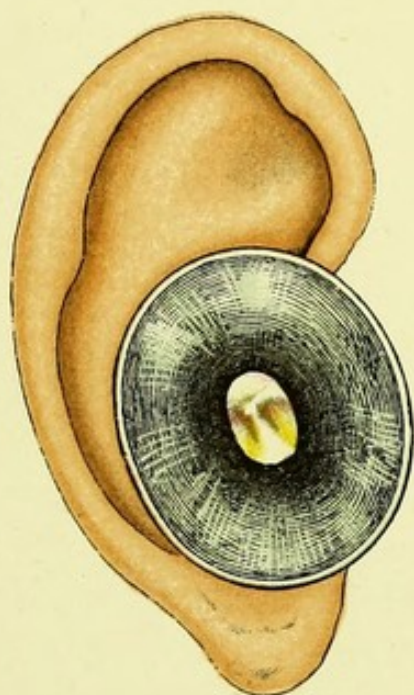
Von Tröltsch gives an excellent description of the effects of long closure of the Eustachian tubes, and the accompanying

condition of what he terms "moist catarrh." He remarks that should the closure of the tube continue long, it necessarily exerts an injurious influence on the deeper-seated structures of the ear. As the air confined in the tympanum becomes gradually absorbed, atmospheric pressure acts upon the outer surface only, of the membrane, which thus becomes unnaturally forced inwards, and with it also the chain of ossicula, and especially the foot of the stapes. In consequence of the abnormally increased pressure upon the membrana tympani, the ossicula, and the contents of the labyrinth, changes are necessarily produced in their structure and equilibrium, which may remain even if the normal communication between the ear and the pharynx is again restored. The membrana tympani appears unnaturally concave, deeply sunk in, or, more correctly, forced in. In many cases, though not altered in colour, it looks as if it were thinned or atrophied, and the long process of the incus, which may be almost in contact with the membrane, behind and parallel to the handle of the malleus, is plainly visible through it. If a marginal thickening of the mucous coat of the membrana tympani has taken place in the earlier stages, the centre and periphery differ extremely from each other in colour and curvature. Whilst a wide marginal zone of denser tissue and whitish-grey appearance remains in its normal plane, the translucent, thin, greyish-red centre, bounded externally by a sharp line, projects, funnel-like, inwards.*

Some patients with simple obstruction of the Eustachian tubes, when treated at once, recover after even one application of the bag. The following case is a good example:—

Dr. P. came up from the country to see me for deafness during three weeks in both ears. My watch was inaudible in contact with either ear. The bag caused a "tremendous explosion," after which he could hear as well as ever. An astringent application for the throat was prescribed, and the deafness did not return. He had previously consulted Toynbee and Hinton for the same affection, with a similar result.

* Dr. von Tröltsch, *Diseases of the Ear*, translated by J. Hinton, M.R.C.S., p. 51.



OBSTRUCTION OF EUSTACHIAN TUBE, MEMBRANE DRAWN INWARDS.



THE AIR DOUCHE.

I have already, in speaking of aural catarrh, sufficiently described Politzer's method of inflation, and I have also given an account of the Valsalvan and Toynbee methods.

In 1876 a valuable paper by Professor Grüber was published,* "On a New Method of making Pervious the Eustachian Tube and of Inflating the Tympanum."

The details of the method are as follows:—

The operator stands or sits at his convenience face to face with the patient. The end of the nozzle-piece of a rubber bag, which the operator grasps in one hand, is introduced for about half an inch into the inferior nasal meatus of the patient; the operator at once hermetically closes the nostrils upon it with the fore and middle finger of his other hand, and, while the patient at the word of command pronounces one of the syllables *hack, heck, hick, hock, huck, hook*, the bag is squeezed. Thereupon, air passes with distinctly perceptible noise through the tube into the cavity of the tympanum. "Hic, hac, hoc" is sometimes easier, as one knows from the pace when the last word is going to be spoken. It answers, however, better with educated patients than with those who are unaccustomed to make use of the aspirate letter "h."

When, in chronic aural catarrh, air is forced through the Eustachian tube and tympanum, and impinges on the tympanic membrane, a peculiar "thud" is to be heard, by means of the india-rubber tube known formerly as the otoscope, but now, more correctly, as the diagnostic or auscultation tube.

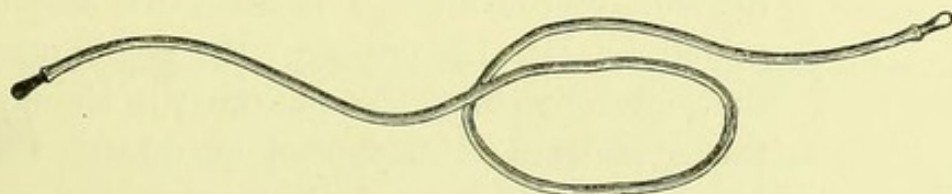


FIG. 49.—Diagnostic or Auscultation Tube.

* In the *Medical Times and Gazette*, January 1, 1876, by Professor Joseph Grüber, M.D., Aural Surgeon to the Imperial General Hospital of Vienna. See also an interesting paper on the "Vocal Method of Inflating the Tympanum," by H. H. Clutton, F.R.C.S., *St. Thomas's Hospital Reports*, 1877, vol. 8.

This instrument is usually made of black india-rubber, and about twenty-four to thirty-six inches long; for use, one end of it should rest in the surgeon's ear, the other in the ear to be examined.

If fluid is present in the tympanum, a gurgling sound is heard through the tube by the practised ear, but if the membrane is perforated a remarkable whistling noise.

I now come to the consideration of those cases, where, to overcome an obstruction in the Eustachian tubes, whether this arise from the severity of the catarrh, or other cause, the Eustachian catheter must be employed. The passing of this instrument is a very important operation, and yet the ability to perform it is a rare acquisition.

HOW TO PASS THE EUSTACHIAN CATHETER.

The patient should be placed, facing the light, in a chair with a high back, serving as a firm head-rest. For young children the use of the Eustachian catheter should be avoided, being unnecessary, very difficult, and, moreover, on account of their restlessness, dangerous. I very rarely employ it for any patient under fifteen years of age.

By far the easiest and best manner of passing this instrument is, I believe, that first suggested by Dr. Löwenberg. He recommended that, after reaching the pharynx, it should be turned inwards (instead of outwards) till it became hooked behind the vomer, and, as it could then be withdrawn no further, it should be turned completely round at right angles, its point being thus brought exactly into the mouth of the Eustachian tube.

If the instrument, after reaching the pha-



FIG. 50.—Eustachian Catheter.

rynix, is withdrawn in the ordinary position, viz., with the point turned outwards, until the orifice of the Eustachian tube is found, great difficulty is frequently experienced. The instrument is withdrawn either not far enough or too far, or perhaps its point is inserted into the fossa situated behind the Eustachian tube.

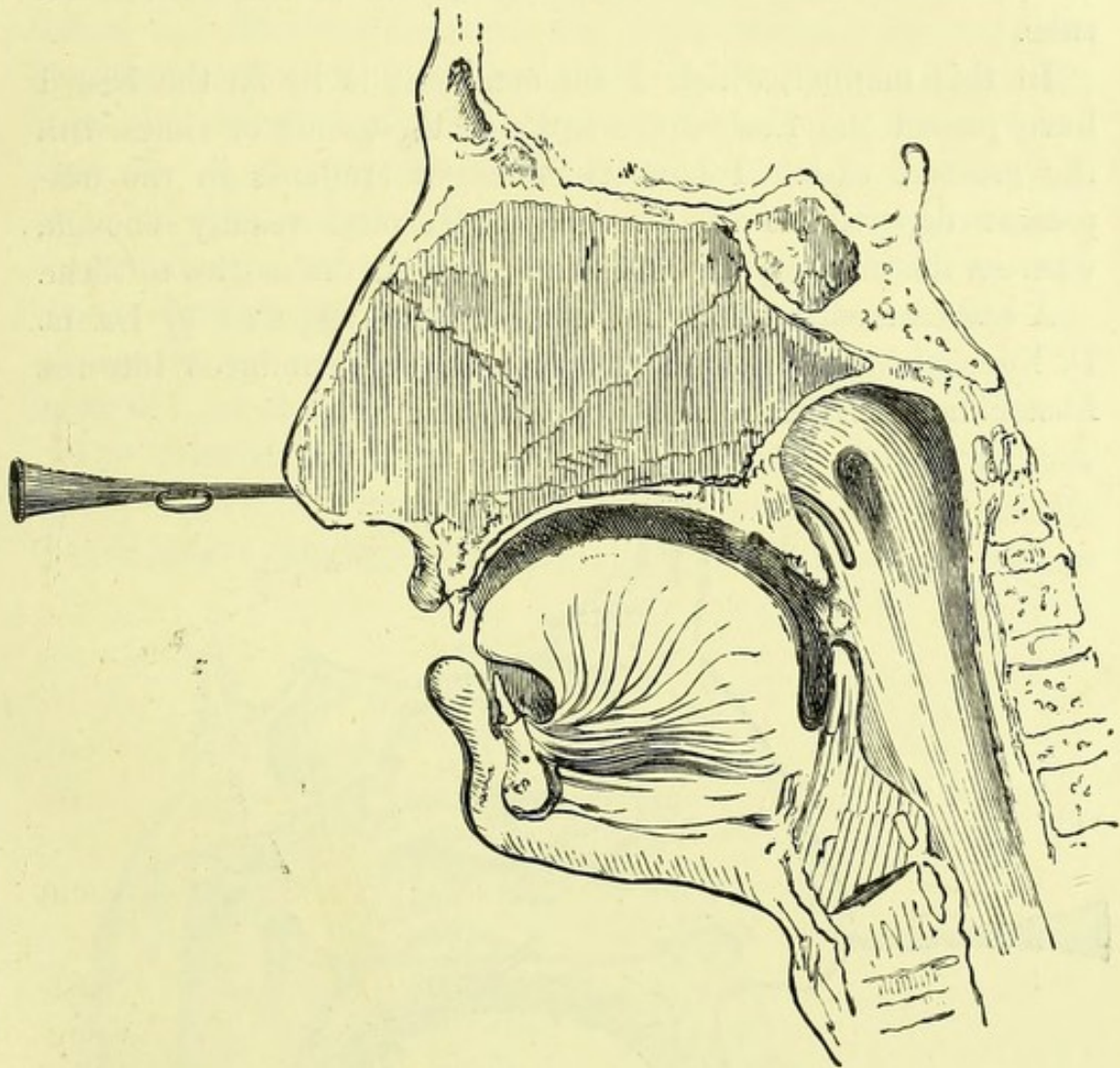


FIG. 51.—The Eustachian Catheter turned and hooked round the Vomer.

It should be remembered also that in catheter cases the mucous membrane is nearly always in a delicate state, and often highly sensitive, so that constantly moving the instrument backwards and forwards, adds considerably to the patient's discomfort, and may cause injurious effects.

Warm the catheter in hot water, depress the patient's lip, and introduce the catheter into the inferior meatus of the nose ;

pass it along the floor of the nares until it reaches the posterior wall of the pharynx, taking care to keep it at right angles with the plane of the face; withdraw it until the septum nasi is felt; then rotate it with the point downwards to the opposite side, that is, turn it outwards and a little upwards (as shown by the position of the ring at the other end of the catheter), and it will be found to have entered the mouth of the Eustachian tube.

In this manner, which I am confident is by far the best, I have passed the Eustachian catheter thousands of times with the greatest ease. I have thus taught students in the outpatient department of St. Mary's Hospital readily enough, whereas the ordinary mode always presents difficulties to them.

A catheter with a double curve, as first suggested by Dr. H. D. Noyes, is at times useful, as it can be introduced into the Eustachian tube from the opposite nostril.

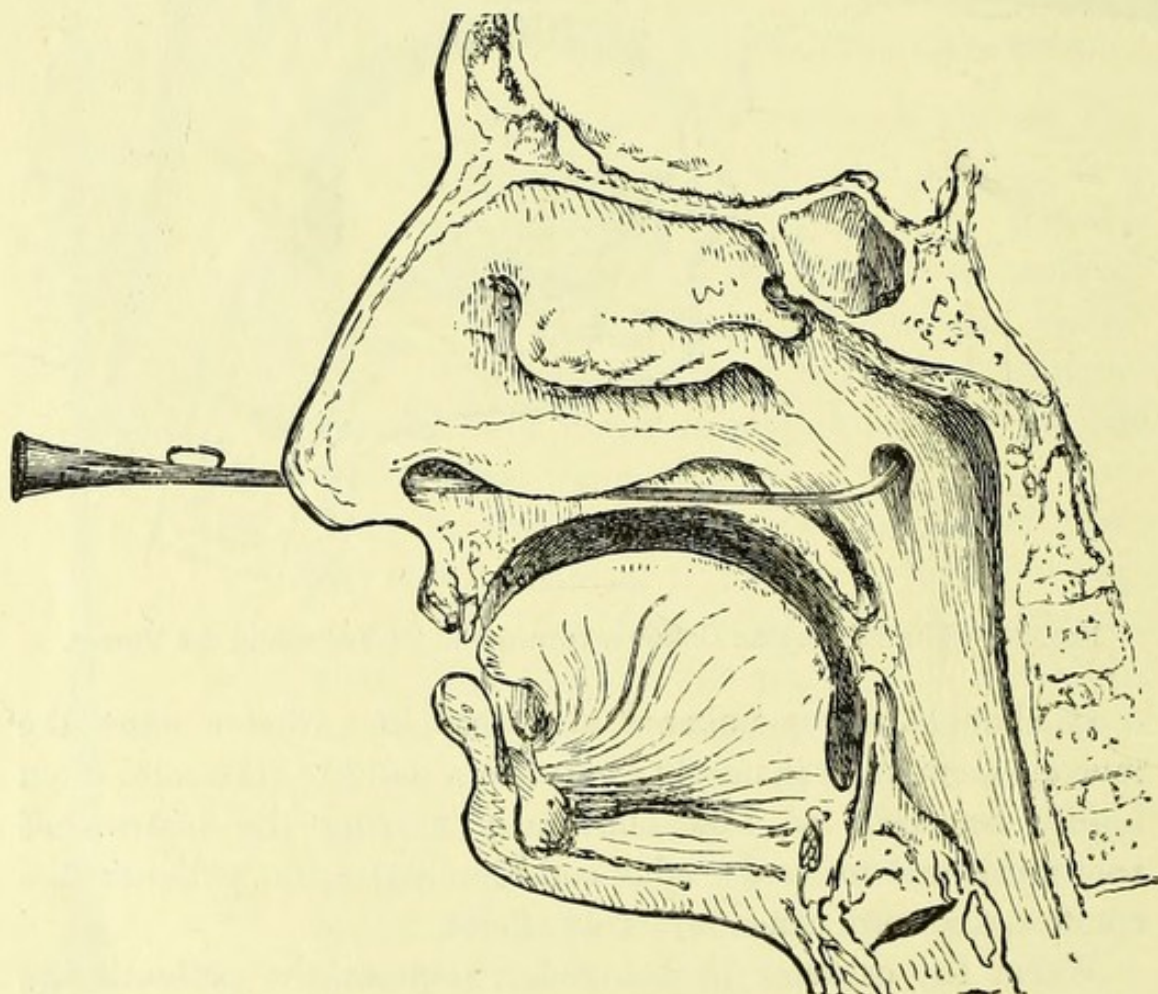


FIG. 52.—The Eustachian Catheter in position.

The employment of the Eustachian catheter is occasionally attended with disagreeable symptoms, such as pain, epistaxis, nervous cough, sneezing, and irritation of the pharynx, which, however, are generally soon relieved. If the catheter be passed skilfully, more serious results are almost impossible.

A syringe with a nozzle that fits into the larger end of the catheter is the instrument usually recommended for injection of fluids, &c., after the catheter has been passed. The surgeon, standing in front of the patient, holds the catheter with his left hand, and compresses the air-bag with his right. But as every time the bag is compressed the catheter is liable to be dislodged, its point may cause very considerable pain to the neighbouring tender mucous membrane. Again, if the left hand by any chance lets go the bag, the catheter will be forced very unpleasantly upwards. Such accidents are impossible by the method I am about to describe.

The surgeon stands on the right side of the patient, and has the air-bag (with a long india-rubber tube, the end of which fits the catheter) hanging by a loop from a button of his coat, as

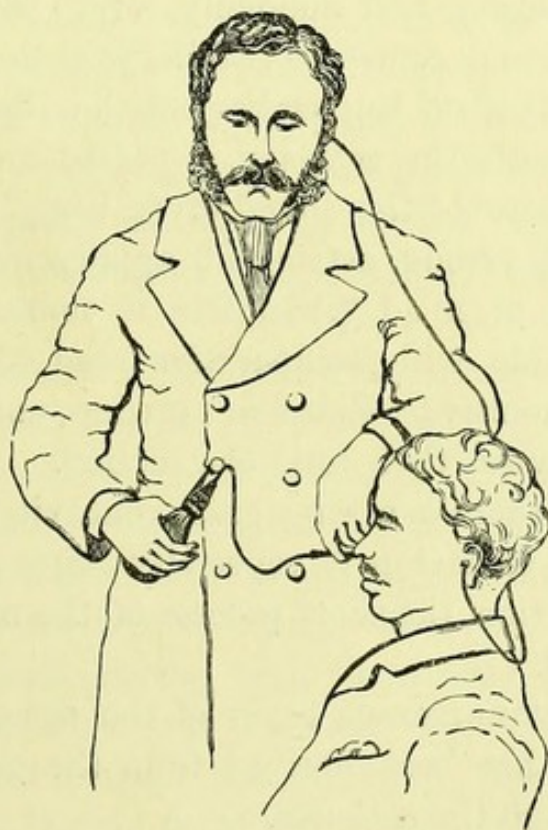


FIG. 53.—Method of passing the Eustachian Catheter.

first, I believe, suggested by the late Dr. Peter Allen. Having passed the catheter, he holds it firmly in position by the left finger and thumb against the nose. When now the end of the tube is inserted into the catheter, the latter is not liable to be tilted upwards, nor is the surgeon's hand, or the weight of the bag felt by the patient in the slightest degree.

We have thus, as it were, three hands, for the bag being constantly supported in the required position, the right hand is free to take up any fluid for injection, &c.

Having described what I consider the best means of passing the Eustachian catheter, I shall next consider the various forms of chronic aural catarrh where its employment is desirable. When we meet with patients whose hearing varies from time to time, we may be almost certain that the Eustachian tubes are in fault, and not the tympanum. The congestion of the mucous membrane of the tubes being increased (as especially in damp weather), extra secretion is poured out, and its opposed surfaces meet, excluding the air.

J. F., a painter, æt. 40, for a great many years a patient of Toynbee and Allen's at St. Mary's, and latterly under my care, has variable hearing, and suddenly, every six months or so, grows very deaf, and comes to the hospital to get relief by the catheter. The Politzer bag makes not the slightest impression on him, but directly the catheter is passed and the air-douche used, he says there is the sound of "a bang," and his hearing comes back. A strong astringent application for the throat (argenti nitratis gr. x ad ʒi) suffices to make him almost well again. He is able with comparative ease to keep the tubes open for some months by Valsalva's process, until damp or foggy weather again causes their total obstruction.

In such cases there is always great concavity of the tympanic membranes, the central part especially being sunken inwards; in the upper portion, the short process of the malleus shows out like a pin's head.

I could repeat numerous cases of the same kind, where the greatest benefit has been derived from the general use of the air-douche through the catheter.

THE EUSTACHIAN BOUGIE.

When the air-douche applied by means of the catheter fails to relieve the tubal obstruction, some real improvement is sometimes obtained by passing whalebone or gum elastic bougies up the tube for about three quarters of an inch. The catheter, loaded with a non-protruding bougie, is inserted in the usual way, and the bougie which is graduated at the butt end is then gently insinuated up the tube in a direction upwards, outwards, and backwards. The tubal end of the bougie should be olive-shaped so that it may not cause damage. The procedure is nearly always more or less painful, and in unskilled hands is positively dangerous. I, however, can recall a few cases in which persistent bougieing was well borne, and gave undoubted relief.

ELECTRICAL TREATMENT.

The application of the faradic current to the muscles of the tube by means of a catheter-shaped electrode applied to the tubal orifice has been frequently recommended and practised. Whilst excellent results sometimes follow in cases of paretic palate from catarrhal and other causes, this procedure is frequently disappointing, and in catarrhal paresis is usually unnecessary, because surgical removal of rhino-pharyngeal obstruction, together with topical applications applied vigorously with a brush, generally results in the return of tone to the tubal dilators.

M. Mercié communicated to the French Academy of Medicine (*Gaz. des Hôpitaux*, March 13, 1884, page 224) a method of applying electrolysis to constrictions of the Eustachian tube. It consists of the introduction through a vulcanite Eustachian catheter of a metallic bougie constituted of fine silver threads doubled upon themselves, to render them harmless to the soft tissues. The bougie, having been introduced into the catheter as far as the bend, is marked at its opposite extremity at a point 35 mm. from the mouth of the catheter. The sound being in place, the thread bougie is gently passed, and as soon as it is found to penetrate with difficulty, or to abut upon the stricture,

it is left *in situ*, and an olive-shaped silver electrode is inserted into the external auditory meatus and arrested in close proximity to the tympanum. A feeble current (two or three of Ehardin's elements) is then passed, by connecting the olivary electrode with the positive, and the free extremity of the thread bougie with the negative pole. The operation should not exceed two minutes. After the electrolysis, the bougie is said to slip in easily.

Recently Dr. Stevenson and Mr. Cumberbatch have made a joint communication on the same subject, and claim good results in suitable cases for this mode of relieving stricture. It is well to bear in mind the untoward results which have occasionally been observed from identical procedures in the prostatic urethra.

NASO-PHARYNGEAL ADENOID HYPERTROPHIES.

By far the most important morbid condition of the rhinopharyngeal tract which has an etiological relation to middle ear

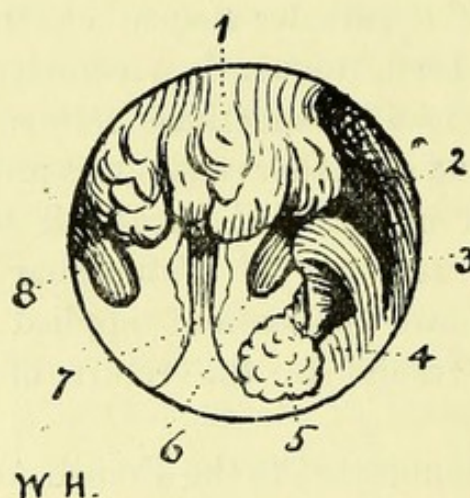


FIG. 54.—Naso-pharyngeal hypertrophies as seen with the aid of the largest size post-rhinal mirror, and White's self-retaining palate hook.

1. Adenoid overgrowth of the pharyngeal tonsil.
2. Rosenmüller's fossa.
3. Eustachian cushion with the orifice of the tube immediately below.
4. Levator fold.
5. Moriform hypertrophy of the inferior turbinated body.
6. Right middle turbinal.
7. Septum, with thickened mucosa.
8. Left middle turbinal.

(Drawn from life from an out-patient, at St. Mary's Hospital, æt. 20, by Dr. Hill.)

disease is that of hypertrophy of the "pharyngeal tonsil." This name was given by Luschka to the aggregated mass of adenoid or lymphoid tissue situated at the vault of the pharynx. The term "nasopharyngeal tonsil" is, however, a more exact, and therefore more appropriate, one. See Fig. 54.

The word "tonsil" was formerly used in a restricted sense, and applied only to the two large oval bodies exhibiting crypts and lymphoid follicles, which are situated on each side of the fauces, between the pillars. It is now known that a very large amount of lymphoid tissue, containing distinct lymphoid follicles or capsules, is scattered over the rhinopharyngeal mucous tract; in an ordinary granular pharynx, these follicles are hypertrophied, and therefore demonstrable to the naked eye. Luschka's tonsil is a very constant mammalian structure; it is usually present in all young persons, but tends to atrophy, and can only exceptionally be demonstrated after the period of full growth and development. In the sheep and ox it is normally of large size, and appears as a convoluted median body, prolonging the median partition of the nares backwards to the posterior wall of the upper pharynx. The normal pharyngeal tonsil, being a median structure, in no way approaches or interferes with the patency of the Eustachian orifices, and it is only in very marked hypertrophy, that the tonsil actually touches the tube; in spite of this, however, quite moderate enlargement of the gland often leads to marked deafness, and in these cases it is often found that the definite aggregation of lymphoid follicles situated at the mouths of the tubes—the tubal tonsils—are also enlarged.

Meyer, of Copenhagen, was the first to point out, in 1868, that lymphoid hypertrophies in the nasopharynx were associated with deafness in children. These hypertrophies were almost simultaneously described by Sir Andrew Clark, Loewenberg, Voltolini, and others; but Meyer was the first clearly to point out that these "growths" in the nasopharynx, called by him "post-nasal adenoid vegetations," were a very frequent cause of the aural troubles of children. It is remarkable that so prevalent a complaint escaped the notice of Wilde, Toynbee, and Hinton, but it must be remembered that all these aurists

recognized the connection between deafness and enlargement of the faucial tonsils, and the good effects of tonsilotomy in these cases was often remarkable; the real reason for this improvement is now evident, for it has been pointed out by Hill, that the lymphatics of the pharyngeal and tubal tonsils communicate with those of the faucial tonsils; hence a cutting operation on the latter, would greatly relieve lymphatic congestion and stasis in the former; and so lead to decrease, in size, in the amount of muco-serous secretion poured out, and in the tubal obstruction aggravated by the hampering of the tubal muscles in the palate. I have frequently seen enlargement of Luschka's tonsil diminish, after tonsilotomy of the faucial glands; and in the same way, stenotic turgescence of the nasal mucous membrane, frequently subsides in children, after removal of naso-pharyngeal growths, without any intra-nasal treatment whatever.

There has been a good deal of discussion as to how adenoid growths lead to deafness. There can be no doubt that, in some instances, portions of the hypertrophied gland actually approximate to, and block the Eustachian orifice. Such extreme cases of hypertrophy are only occasionally met with. In the more usual form, the growths only come down to the level of the upper margin of the tubes, and in these instances, the secretion from the hypertrophied gland is much increased, and the neighbouring mucous membrane becomes sodden and swollen from lymphatic obstruction; in this way, the Eustachian lining and the soft palate, become involved in the chronic catarrhal process. It is a point of common observation in my practice, that merely examining the naso-pharynx with the finger in such a way as to cause only slight injury to the enlarged tonsil will often result in marked improvement in a child's hearing power. This improvement rarely lasts more than a few weeks, and permanent benefit can only be attained by the adoption of a more radical operation to be presently described, but it indicates that slight naso-pharyngeal curetting is of service, on account of the relief the scarifying process affords to the venous and lymphatic congestion in the neighbourhood of the Eustachian orifice.

In spite of the amount which has been written about adenoid hypertrophies of this region in recent years, there is still a good

deal of uncertainty as to the etiological factors concerned in their production. Loewenberg teaches that these overgrowths are most prevalent in young individuals of a "lymphatic temperament," and others lean to the view that they are evidence of the existence of the strumous diathesis. A certain number of sufferers are certainly strumous, exhibiting, besides post-nasal growths, hypertrophied faucial tonsils, enlarged glands, &c., but children with these growths, whether the offspring of the rich or of the poor, often appear strikingly healthy in other respects. My own, now very large, experience of naso-pharyngeal hypertrophies would lead me to believe that heredity, temperament, and diathesis are only in a small number of cases, apparent factors in their causation. Atmospheric conditions and insanitary surroundings are, I think, much commoner predisponents.

It may be that the adenoid overgrowth is due to irritation caused by micro-organisms, and so falls into the same category with granular eyelids, many cutaneous warts, gonorrhoeal warts of the genitals, and various similar conditions.

Some patients exhibit a concomitant want of correlation of growth, between the various parts of the osteo-cartilaginous framework of the nose and palate; presenting a small post-nasal space, narrow choanæ, and a high arched palate, but it is difficult to decide whether the association is casual or causal.

The physiognomy of children suffering from adenoid growths is quite characteristic; the mouth is in most cases open, showing irregular, misshapen, or decayed teeth; the expression is stupid, not only on account of the open mouth, but because of the collapsed and dimpled alæ, and the enlarged, and sometimes puffy, bridge of the nose: in this region, and on the forehead, large and full veins are sometimes very conspicuous; in addition, the inner canthi are often drawn down, the lines of the cheeks obliterated, and the upper lip drawn up and everted. These children not only look stupid but in reality are very backward, and evince marked inattention at school. As Guye has pointed out, these symptoms, together with headache, are not altogether accounted for by reason of the dulness of hearing, and Guye and Hill are probably correct in insisting that adenoid growths and enlarged tonsils lead to intra-cranial lymph-

stasis and congestion; certain it is that headache, and *aprosexia*, or inability to fix the attention, often disappear immediately after removal of pharyngeal lymphoid hypertrophies. In addition to impairment of the functions of audition and cerebration, obstructions in the nose and pharynx naturally exert an important influence on voice production and respiration. The breathing is heavy and audible during the day, snoring at night, and the mouth and throat are nearly always very dry on waking in the morning. Some children wake up from sleep fighting for their breath, and in infants, spasmodic croup frequently results, either reflexly, or from drying of the laryngeal mucous lining. Whilst buccal respiration continues, it leads to increasing enlargement and hardening of the tonsils, and sooner or later respiration is so impeded, that the lungs fail to expand properly, and chest deformity, and anæmia result. On account of the parietic condition of the palate and the blocked post-nasal space, the voice loses its resonance and becomes muffled and altered in tone; this is well exemplified in the pronunciation of words spelt with the letters "m" and "n," which become perverted to sound as if spelt with the letters "b" and "d" respectively; the same often occurs in an ordinary cold in the head. Stammering and stuttering are said to be more prevalent in children with nasal and pharyngeal obstruction.

In persons, with growths, who are above puberty, the voice in singing and public speaking or reading, in addition to exhibiting want of quality and tone, rapidly succumbs to fatigue, the singing voice altogether failing in the production of head notes.

Objectively hypertrophy of the pharyngeal tonsil is met with in two forms. When overgrowth of the gland commences in very tender years, as is usually the case, the hypertrophy is irregular, and the lymphoid enlargements appear as stalactoid vegetations hanging from the roof of the pharynx; they are sometimes pyramidal, but frequently pyriform or globular, in shape, as seen by posterior rhinoscopic examination. On digital palpation, the sensation has been aptly described as feeling like touching a soft bag of worms; this is especially the case when the post-nasal space is quite filled with the vegetations. In making such an examination, the patient's head covered by a

towel should be held in the "chancery" position, and the finger should be protected by means of an india-rubber or leather guard, or by a piece of lint, in the neighbourhood of the proximal phalanx and metacarpo-phalangeal joint, as a protection from the patient's teeth; the finger is gently passed to the back of the pharynx, where its passage upwards will be barred by the contracted soft palate, but with a little gentle pressure this can be overcome. Beginners often fail to pass the finger sufficiently far down the throat to get to the lower border of the palate, and not only fail to reach the naso-pharynx, but often actually wound the velum. When the finger has passed behind the palate, it should be bent forward, and the bony and cartilaginous landmarks sought for; if this is not done, an error of diagnosis may arise from the finger not passing far enough up into the naso-pharynx when it is pressed against the posterior wall by the velum, and an impression is gained that the post-nasal space is small and entirely blocked; such a mistake cannot arise if the finger is made gently to impinge against the Eustachian cushions; Rosenmüller's fossæ lie behind them; further forward will be felt in the middle line, the nasal septum and posterior narial openings; the naso-pharyngeal vault can be explored in all directions from these landmarks, and polypi and lymphoid hypertrophies, if present, localized as regards their attachments.

It is always well at the same time to search for moriform tumours springing from the posterior extremities of the inferior turbinals. They may exist with or without "adenoids," and in the former case, if overlooked, serve to explain the occasional failure of a scraping operation. They are best removed by Jarvis' snare.

In even a most careful digital examination, the finger is often stained with blood, from wounding the soft vegetations; and this sweeping away of growths, or of mucus, from the Eustachian orifices, often temporarily relieves the deafness.

When naso-pharyngeal hypertrophy commences later in child-life, from eight or ten years of age up to puberty, or even up to the twentieth year, the overgrowth is of a more regular character; a large, firm, cushion-like mass being felt, in place of the stalactoid vegetations, which bleeds only after forcible scarification.

This form of hypertrophy is often associated with chronic post-nasal, Eustachian, and tympanic catarrh, and the resulting deafness is not nearly so curable as that associated with the softer adenoid vegetations. Moreover, whilst in young children and in cases of softer growths, the naso-pharynx is with difficulty examined by posterior rhinoscopy, even with the aid of cocaine and the palate hook, in patients above puberty it is often effected with comparative ease, and this is especially so in cases with the cushion-like hypertrophy. The information gained by the post-rhinoscopic mirror is, however, not superior to that obtained by a thorough digital examination, but the discomfort of the latter proceeding is considerable.

Children with naso-pharyngeal deafness are nearly always immediately, though temporarily, benefited by tympanic inflation, according to Politzer's method, and by antiscatarrhal and astringent treatment to the upper pharynx; menthol applied as a paint being often very successful. Such improvement under simple medication enables us to assure the friends that there is reason to anticipate greater benefit on removal of the hypertrophies by operation.

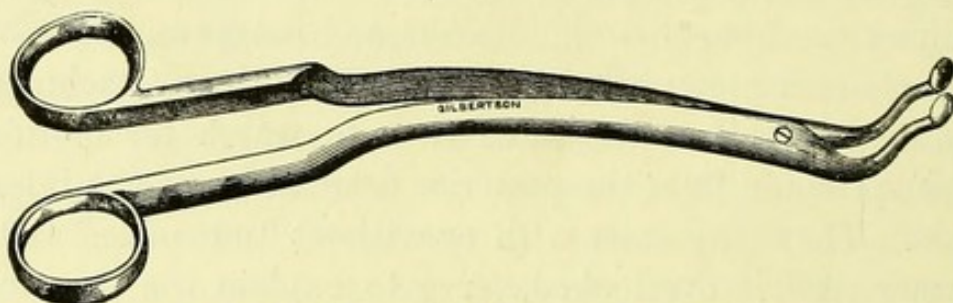


FIG. 55.—Post-nasal Forceps ($\frac{1}{3}$ nat. size).



FIG. 56.—Gottstein's Post-nasal Curette ($\frac{1}{3}$ nat. size).



FIG. 57.—Hartmann's Curette ($\frac{1}{3}$ nat. size).

Guye, of Amsterdam, was the first to point out that the post-nasal space can usually be cleared of growths by means of the finger nail. The advantages of this method over operating with forceps, curettes, or snares are, that one can feel exactly where the growths are that require removal, and that the Eustachian orifice is unlikely to be wounded, as sometimes happens when forceps or curettes are blindly and clumsily used. These latter instruments are safe enough in the hands of an expert, but it is well to remember that novices have not only wounded the Eustachian cushion causing acute otitis, but the posterior border of the septum has been seized and injured, the whole of the naso-pharyngeal mucous membrane stripped from the bone, and pieces removed from the uvula or other part of the soft palate. Even the operation of curetting with the finger nail must not be undertaken lightly under the idea that it is quite a simple matter, for I know of cases in which the Eustachian orifice and the palate have been wounded by rough manipulation coupled with ignorance of the topographical anatomy of the upper pharynx. Acute otitis rarely follows on post-nasal surgery if the operation has been carefully performed, and so-called recurrence is very frequently due to want of thoroughness of removal.

This brings me to the question of anæsthetics; there is no doubt the procedure being a painful and to bystanders even a brutal one, that it is much more likely to be hurried, and, therefore, less thorough, if no general anæsthetic be employed. Local anæsthesia from cocaine is almost useless; I, therefore, when practicable, operate with the child well under ether or chloroform. There is usually more hæmorrhage with the safer anæsthetic, ether, and therefore more likelihood of blood entering the lungs. On the ground of absolute safety, some practitioners are content with nitrous oxide anæsthesia, but this is of such short duration that the operation is necessarily hurried, and, therefore, can only be employed by those who are frequently performing naso-pharyngeal operations. Moreover, there is scarcely time to remove the faucial tonsils as well, when these are hypertrophied.

The position of the patient is a matter of some importance,

because, if the head is allowed to hang over the operating table or couch, so that the nasal choanæ are on a lower level than the pharynx, blood will run out through the nose, instead of passing in the direction of the air-passages, an element of danger in all throat operations.

I believe no good purpose would be served by endeavouring to describe the various operations for the removal of "adenoids" by the real or by the artificial nail, by curettes, or by forceps. Nothing short of a practical clinical demonstration is of the least practical use, and my teaching experience has convinced me that the *tactus cruditus* necessary for even a satisfactory digital scarification is by no means easily acquired.

When the growths have been thoroughly removed, little after-treatment is necessary. Bleeding, which may be profuse, generally ceases in a few minutes, almost certainly, if ice-cold water, or water at a temperature of about 115° F., be applied to the bleeding surface, by means of a syringe through the nose, or better still, by means of a post-nasal coarse spray apparatus; the pressure must not be great, or fluid may pass up the Eustachian tube into the tympanum and cause otitis media. Spraying through the nose with a 5 or 10 per cent. solution of cocaine or with a 4 per cent. solution of antipyrin will usually check the bleeding if it is excessive, and does not yield to hot or cold water. Swabbing the naso-pharynx with cotton wool saturated with styptic colloid, whilst the patient is under the anæsthetic, is useful. Powders of iodoform, iodol, or sozoiodol, insufflated through the anterior nares or through the mouth, are useful in the after-treatment, when the patient is resident in an insanitary dwelling. Fine sprays of antiseptic fluid are harmless, but douches and coarse sprays often lead to acute suppurative catarrh of the tympanum. Most of my cases do perfectly well without any local after-treatment whatever.

CHAPTER IX.

CHRONIC NON-SUPPURATIVE INFLAMMATION OF
THE MIDDLE EAR (*continued*).

THE more chronic form of aural catarrh, divided into ordinary catarrhal and proliferous, may be preceded by an acute attack, but more frequently comes on without any warning. It begins, as a rule, with slight deafness and with noises in the ear. The patient can generally fix with accuracy the date and cause of its origin, but in some instances it comes on so insidiously that its advent is not noted. The deafness and tinnitus aurium gradually increase, and a sense of fulness in the ears and throat is complained of. The state of the weather has a marked influence on the disease: cold and damp increase the deafness; and a sudden change in the atmosphere occasionally causes considerable pain.

I have above spoken of the use of the Politzer bag, and of the application of the air-douche through the Eustachian catheter: in the diseases of which I am about to treat more powerful remedies are necessary.

Some late writers on this subject deprecate the injection of fluids into the tympanum, ascribing any benefit resulting therefrom to stimulation of the mucous lining of the Eustachian tube; and doubtless this is often of material assistance to the patient. I am convinced, however, that the injection of appropriately selected warm fluids not only renders the Eustachian tube pervious, but frequently prevents the accumulation of inspissated mucus in the tympanum.

Again, some even contend that the fluids injected do not enter the tympanum at all. To prove this notion fallacious it is only necessary to blow air and afterwards fluid through the Eustachian catheter; the patient will then without hesitation testify how totally different is the effect produced in the ear by

the one and the other; the diagnostic tube, moreover, affords the operator satisfactory evidence on this point.

Von Tröltsch remarks:—"In moist swelling, and where increased secretion of the mucous membrane is present, vapours of chloride of ammonium are most useful, best evolved in a nascent state; whilst in a dry and thickened condition of parts, tepid or warm water vapours, alone or with iodine, introduced with a certain degree of pressure into the tympanum, most speedily promote reabsorption." Injections of astringent or slightly stimulating fluids (solutions of zinc, iodine, &c.) often produce the same effect, and are preferable in the case of a narrow Eustachian tube, or where too much irritation of the nasal mucous membrane would be produced by warm vapours.

According to Politzer, if, after repeated employment of the air-douche, there is little or no increase in the hearing distance, we may infer that the deafness is caused by the sequelæ of the catarrhal affection, viz., thickening of the mucous membrane and of the coverings of the ossicula, the mobility of which is diminished; in these cases we can expect improvement only from the use of moderately stimulating injections besides the air-douche. In a fair proportion of such cases which, during several years, have come before me, I have conferred great benefit by the often-repeated injection of a solution of iodide of potassium (gr. x ad ʒj). Two grains to the ounce is the strength usually recommended.

In recent cases the recovery under this mode of treatment is sometimes strikingly rapid, and the improvement in the hearing distance may be counted by feet instead of inches; and to very deaf people even one inch gained is a very considerable advantage.

As causes of congestion and ankylosis of the joints of the ossicula auditus, Ladreit de Lacharrière* distinguishes, independent of catarrh, three diatheses—the arthritic (evidenced in rheumatism, gout, and also migraine), the herpetic, and the syphilitic. Several times he has observed the manifestation of an affection of the ossicles to coincide with the disappearance of

* *Annales des Malad. de l'Oreille, du Larynx, &c.*, July, 1881, abstracted by Dr. E. Cresswell Baber in *Med. Record*, Dec. 15, 1881.

rheumatism of the shoulder and neck, and *vice versâ*. In syphilis he finds that the lesions are late, and not characteristic. Whatever the special treatment adopted for any given case, he recommends in addition the inflation of the middle ear with air containing iodine vapour, and the use of iodide of potassium, administered internally in quantities of half a gramme daily, also in ointment as an application for the mastoid processes, and in solution for instillation into the meatus at night-time.

In some cases of a thickened condition of parts, the injection of a weak solution of iodine, sulphate of copper, liquor potassæ, nitrate of silver, or chloral hydrate is of great service.

Of course it is of the utmost importance to select exactly the remedies indicated by the condition of the membrana tympani and by the sounds heard through the diagnostic tube.

As a rule steam-inhalation is of use only in the dry forms of chronic non-suppurative catarrh, in which the vapour of *ol. pini sylvestris*, among other remedies, has a very beneficial effect.

What, then, is the appearance of the membrana tympani? Owing to changes in its inner or mucous layer, and to the presence of inspissated mucus in the tympanum, alterations in its colour take place; it usually also loses its transparency and appears dull. There is a cartilaginous structure, appearing as a yellow spot, at the end of the manubrium of the malleus, which is regarded by Trautmann as epiphysial in character. His observations go to show that this, by thickening of the drum-head, is sooner hidden from view than the edge of the malleus; that opacities with thickening of the same, change its colour; and that its maintenance in one position during changes of atmospheric pressure in the meatus, implies either ankylosis or adhesion of the malleus to the inner wall of the tympanum. In many cases where the deafness is considerable, the membrane appears perfectly normal in colour, but on close inspection is found to sink inwards, in consequence either of adhesions within the tympanum, or, according to Weber-Liel, of contraction of the tensor tympani. To diagnose adhesion accurately, it is necessary to use Siegle's pneumatic speculum, by means of which the membrane, where adherent, is seen to be tightly fastened back, whilst the unattached portions are drawn forwards.

Dr. Woakes has introduced, for the purpose of drawing outwards the collapsed membrane, and detaching it from any adhesions, a powerful modification of Siegle's pneumatic tractor. He says: "When, as occasionally happens, the adhesion is so firm that the membrane is torn in the act of separation, when the instrument is used, the rupture takes the form of a slit-like rent, as though cut with a knife."* In several instances, he relates, improvement of hearing took place, and noises and giddiness diminished, as a result of its use.

One remarkable appearance, not infrequently met with, which I have endeavoured to represent in the coloured plate, is caused by calcareous deposits within the fibrous layer. It is said to be due to a suppurative process, which may or may not terminate in deafness. It is often present in individuals of the arthritic diathesis.

The influence of heredity is very markedly shown in the case of chronic aural catarrh.

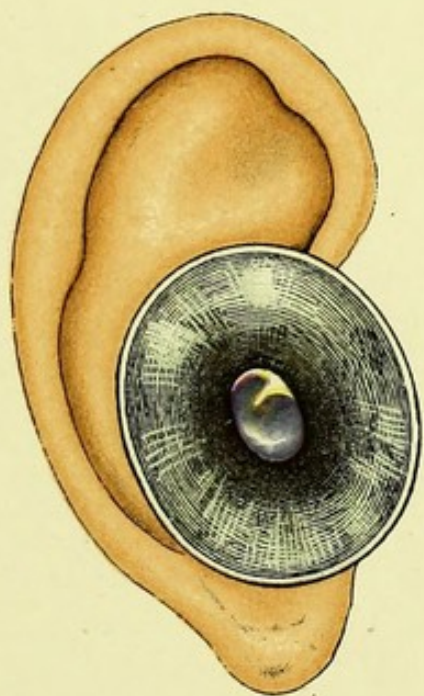
From patients who are the subjects of its later stages an odour approaching that of saliva, and probably due to some abnormal condition of the glandular structures of the buccal and naso-pharyngeal cavities, has been observed to emanate.†

It is well to bear in mind that a concavity is never produced without some accompanying loss of hearing.

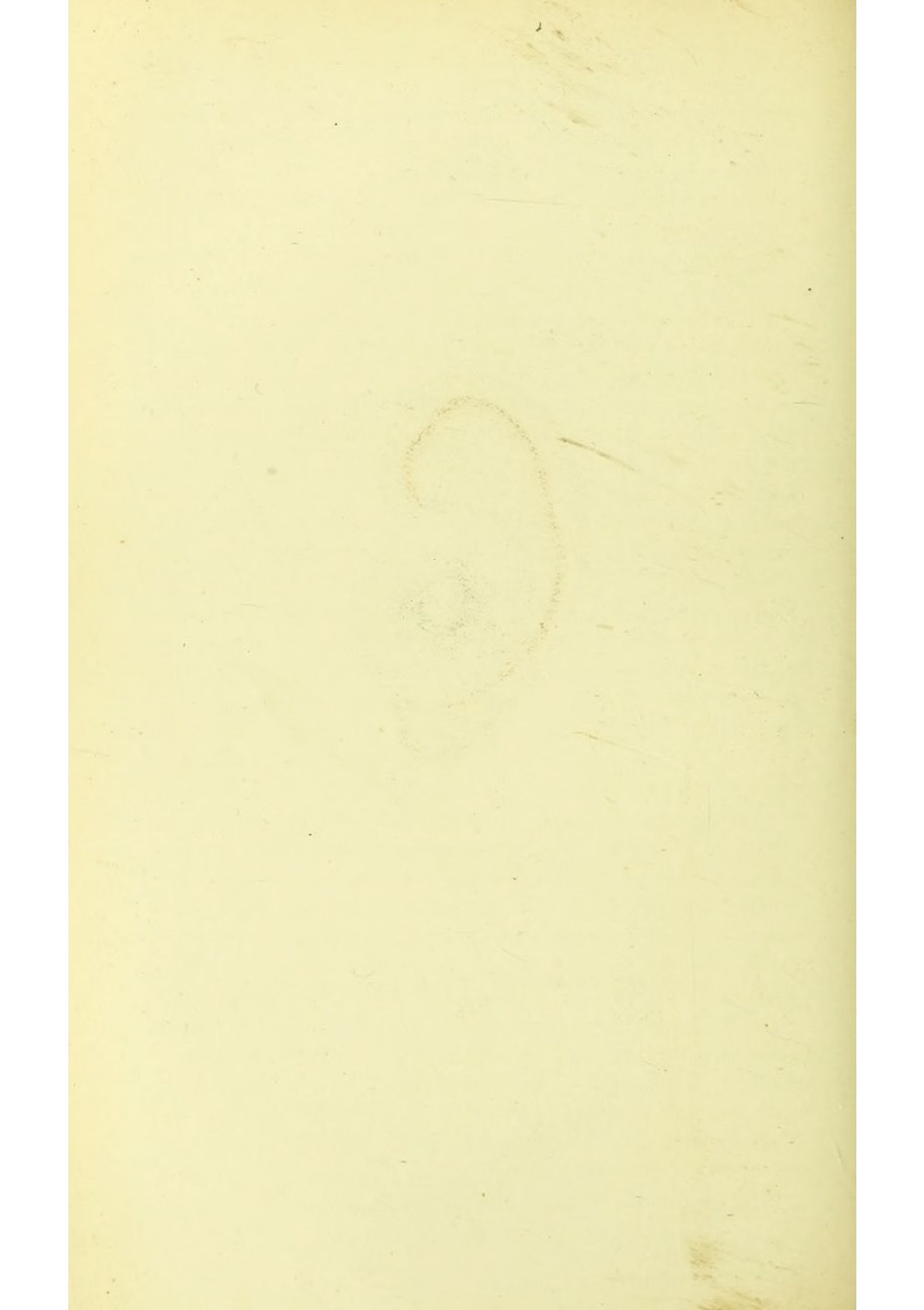
Sergeant F., æt 42, in the Army Hospital Corps, sent to me from Netley, on November 14, 1876, by Surgeon-Major Porter, when stationed at Halifax in the winter of 1868 had suffered very much from the intense cold. His hearing having become impaired, he was removed thence. He had remained more or less deaf ever since. When he came to the hospital I found he could hear the watch one inch from the right, and two inches from the left ear. The Eustachian tubes were narrowed, and the tympanic membranes considerably thickened and indrawn, and the mucous membrane was hypertrophied. I prescribed three grains of iodide of potassium three times a day, and injections of a warm solution of the same drug (ten grains to the ounce of water) every morning. On December 8th he

* See *Lancet*, September 28, 1873.

† C. H. Burnett, M.D., *A Treatise on the Ear*, p. 387.



CALCAREOUS DEPOSIT IN MEMBRANA TYMPANI.



returned to Netley, hearing fairly well again. Some days before he left the hospital he went to church, and (for the first time for seven years) heard the sermon. At the theatre also nothing escaped him, for his hearing distance for the watch had increased two feet on one side and three feet on the other. This case, a very favourable one for treatment, shows what good results are occasionally to be gained, by repeated injection of suitable fluids,* when the membrana tympani is thickened.

I have rarely failed to confer great benefit by constitutional treatment, and especially in strumous patients, to whom the use of iodide of potassium and perchloride of mercury is invaluable. In most cases, the application of menthol dissolved in oil or of nitrate of silver solution (by means of a bent brush) to the faucial orifice of the Eustachian tube is of service. It is sometimes difficult to inject fluids into the tympanum; Politzer has therefore recently introduced the tympanic tube, an elastic instrument which can be passed into it through the Eustachian catheter. Weber-Liel also recommends the passing of such an instrument in cases of chronic thickening of the mucous membrane, and where fluid secretions require to be sucked out. It is said, moreover, to be of value in chronic suppurative inflammation of the middle ear with perforation, for the removal of matter from the tympanic cavity, for which purpose the use of warm water alone is advocated.

Modifications in the structure and functions of the tympanic apparatus may arise from pathological conditions of the nasal passages and pharyngeal cavity, without any extension of inflammatory changes to the tympanum along the mucous surface of the Eustachian tube. Thus, mischief in the ear may result from mechanical interference with the lumen of the pharyngeal mouth of the tube, from the encroachment upon it of adjacent swollen, thickened, or hypertrophied tissue, or from disturbance of that muscular mechanism by which the walls of the cartilaginous part of the tube are, in turn, separated or approximated. The appropriate concomitant treatment of nasal and pharyngeal obstructions has been sufficiently discussed in the previous chapter.

* *Medical Times and Gazette*, February 16, 1878.

Disease in the ear may be caused by adenoid vegetations (alluded to at page 172) in various ways:—1. By their encroachment upon the pharyngeal mouth of the Eustachian tube, thus bringing about mechanical closure. 2. By the concomitant inflammation of the mucous membrane of the tube producing swelling or thickening with more or less secretion. 3. By the extension of that inflammation to the mucous membrane of the tympanum, or even to the mastoid cells. 4. By interference with nasal breathing. When the nasal passages are markedly obstructed, a rarefaction of the air in the tympanic cavity is produced by every act of swallowing, as is shown in an experiment of Toynbee's, and the tympanic membrane with the ossicular chain is forced inwards to an excessive extent; moreover, air suddenly and abnormally condensed by vehement expiratory acts, such as coughing, blowing the nose, or sneezing, unable to find its way through the nasal passages, may pass through the Eustachian tubes with damaging effect upon the middle ear. The treatment of naso-pharyngeal lymphoid hypertrophies—"adenoids"—has already been described.

Occasionally, when withdrawn, the Eustachian catheter is found covered with thick muco-purulent matter. As a rule, gargles avail but little to dislodge the tenacious mucus from the pharynx. The nasal douche no doubt is effective, but, its use being attended with some risk, is not to be recommended. Drawing up through the nostrils a weak tepid solution of salt, bicarbonate of soda, or permanganate of potash will often prove of great service. But perhaps the most efficacious means of cleansing the naso-pharyngeal cavity is to employ a syringe made for the purpose. Weber-Liel's syringe is, I think, the best. His method he thus describes:—"For some years I have used the syringe only for injecting the naso-pharyngeal space. My naso-pharyngeal syringe is made of glass, so that it can be seen that the fluid contained in it is pure, and free from admixture of dirt; the cylinder holds just so much fluid as the naso-pharyngeal space in the adult is capable of receiving. Both ends of the syringe are of hard india-rubber; its point is olive-shaped. The piston-rod is of metal, and ends in a ring, into which the thumb

* *Medical Record*, May 15, 1878.

is introduced. While the injection is being made, the head is held and fixed by the operator's other hand in as upright a position as possible. The olive-shaped point of the syringe is introduced firmly and in a straight direction into the nostril which has been found to be least permeable by previous experiment (such as attempts at expiration in which the mouth and sometimes one, sometimes the other, nostril are closed, or exploration by the catheter); the fluid injection then meets with no impediment to its escape through the other nostril."

Specially shaped post-nasal sprays and douches have, however, in recent years taken the place of Weber-Liel's syringe.

In those cases of long-standing disease where the Eustachian catheter is quite inoperative, puncture of the membrana tympani may be of service.

"In *relaxation* of the membrane," says Prof. Grüber,* "the sound of the tuning fork is heard less distinctly during inflation, for by outward pressure the membrane is placed in a better position for the transmission of sound-waves, and so a greater amount of sound escapes from the labyrinth. On the other hand, in cases of *overtension*, no appreciable change takes place, since the membrane cannot, by Valsalva's method, be any further stretched.

"In a case of relaxation, caused by a thin cicatrix in the membrane, I made the observation, as early as 1863, that the patient during the instant that the air-pressure in the tympanic cavity was increased by means of Valsalva's method (which consists in closing the mouth and nostrils, and forcing air through the Eustachian tubes), and the membrane thereby thrown outwards, had a marked increase in his power of hearing, which, however, he almost immediately lost as the membrane returned to its former relaxed position. On this ground I then performed myringectomy, and the removal of the relaxed portion of the membrane greatly improved his hearing."

In this country relaxation of the membrane is usually treated by painting with collodion, as first recommended by MacKeown,

* "On the Diagnosis of Anomalies in the Conducting Apparatus of the Ear," translated by J. G. Brown, M.B., *Edin. Med. Journ.*, January, 1878.

of Belfast. It is often serviceable, but, if it fails, myringectomy may be tried. Politzer practises multiple incisions.

Before we speak further of puncture of the membrane for disease of the tympanum, it will be well to turn our attention for a moment to the position and size of the middle ear.

The middle ear, or tympanum, is situated in the petrous portion of the temporal bone, immediately above the jugular fossa, and is roofed in by a thin plate of bone, which separates it from the interior of the cranium. In front of it passes the internal carotid artery, separated from the middle ear by a very thin osseous lamina, and into its anterior part the Eustachian tube and the canal of the tensor tympani muscle debouch. Above and behind, it is continued into the mastoid antrum (see Fig. 20), which is in close relation with the middle and posterior fossæ of the skull and with the lateral sinus. The outer boundary is formed chiefly by the tympanic membrane; the inner by that part of the petrous bone which separates the cavity from the cochlea and vestibule.

The distance between the tympanic membrane and the inner wall is not more than a quarter of an inch.

Tunnelled out of the substance of the inner wall is the aqueduct of Fallopius, a circuitous bony canal by which the facial nerve is conducted, in its wandering course, from the internal auditory meatus to the stylo-mastoid foramen. The canal begins at the internal auditory meatus, and passes outwards and a little forwards between the cochlea and the vestibule (see Fig. 10); then bending backwards at a right angle it courses along the inner wall of the tympanum above the fenestra ovalis, where its convex outer side is seen (Fig. 20). On reaching the posterior wall it turns downward and passes to the floor of the cavity, and is continued through the bone to the end of the stylo-mastoid foramen. At the back of the tympanum it gives off small branch canals for the nerve to the stapedius and the chorda tympani.

The position of the aqueduct and the delicacy of its covering on the tympanic side expose the facial nerve to great danger during an accidental or intentional puncture of the membrane. This membrane consists of three layers (see Fig. 8), an ex-

ternal and internal, derived from the epidermal and mucous lining of the outer and middle ears respectively, and an intervening, composed of mixed white and elastic fibres. When chronic inflammation of the middle ear has thickened this threefold membrane, it offers considerable resistance to the passage of a knife. Under the gentle pressure of the operator's hand, however, it gives way suddenly, and, with a consequent jerk, the point of the instrument may travel across the shallow cavity to impinge against, possibly to enter, the inner wall. Thus the facial nerve may perhaps be divided; but, if it escape immediate division, effusion of blood into its arachnoid sheath may cause impairment of its function.

The signs of injury to the facial nerve—immediate or delayed—are unmistakable. The muscles of the corresponding side of the face being paralysed, the orbicularis palpebrarum is unable to close the eyelids; whilst, as the orbicularis oris and the buccinator are rendered useless, the food lodges in the pouch of the cheek, or, mixed with saliva, trickles out of the mouth. (As the last-named muscle obtains additional motor filaments from the third division of the 5th nerve, its paralysis on division of the facial is only partial.) The mouth, which was kept in position by antagonistic muscular forces, is now drawn over to the unaffected side.

Impairment of taste on the affected side is a remarkable feature in injury to the facial nerve, and is in all probability to be accounted for by lesion of the chorda tympani (a branch of the facial) having checked the vermicular movements of the lingualis of that side, so that the sensitive papillæ are no longer subjected to that frictional stimulus which is necessary to render a sapid substance perceptible. This lingualis muscle also, by causing a narrowing and consequent elongation of its own side of the tongue, exerts a special influence in its protrusion. If the *right* chorda tympani is paralysed the corresponding side of the tongue will remain short, soft, and flabby, so that, on the patient endeavouring to put out his tongue (the right side being paralysed whilst the left becomes stiff and elongated), the whole organ will be *pushed over to the right* (affected) *side*.

Mr. Hinton thus describes the operation for paracentesis of

the membrana tympani :*—"Whatever instrument is used, it should be introduced into the meatus through the speculum with a good light falling on the membrane, which should be punctured in its inferior portion, either in front of or behind the termination of the handle of the malleus. A small amount of bleeding follows the incision, and, if the case be a favourable one, an immediate improvement of hearing occurs." For washing out the cavity of the tympanum he recommends a syringe fitting hermetically into the external meatus. Dried mucus which has collected behind the membrana tympani can by this means be forced out into the Eustachian tubes or the pharynx. To keep up a permanent opening, which is extremely difficult, various means are adopted, as, *e.g.*, Politzer's eyelet, puncture by galvano-cautery, the repeated passing of bougies, or use of the air-bag. The puncture, however, generally closes up so rapidly that, unless before it disappears some of the inspissated mucus can be got rid of, little or no good is effected by it.

This operation should be attempted only where other less hazardous means have been employed without avail, and in such cases of deafness as certainly cannot be relieved by the removal of the abnormal secretion which is interfering with the proper function of the membrana tympani.† Politzer says: "I perform paracentesis of the membrana tympani in those cases where, after the use of the other described methods of treatment for several days, no diminution of the exudation is observed, and where, even when exudation is not proved, the immediate improvement of hearing, which constantly follows the inflation of the tympanum, disappears in great part on the following day or the second day thereafter." The great advantage of this operation consequently consists in the shortening of the time the patient requires to be under treatment. In four only out of 1,500 cases did he find consecutive inflammation of the drum-head and the mucous membrane of the tympanum.‡

* Holmes, *System of Surgery*, vol. 3, p. 166.

† For further particulars respecting this operation, I would refer the reader to the discussion which took place at the Royal Medical and Chirurgical Society, after an interesting paper read by Dr. Laidlaw Purves. See *Lancet*, March 30, 1878.

‡ *Lehrbuch der Ohrenheilkunde für Praktische Aerzte und Studirende*, Stuttgart, 1878. *Glasgow Med. Journ.*, Dec., 1878.

As instances of injury from the operation, I may cite the following:—A gentleman came to consult me with facial paralysis on one side, together with almost total deafness, which came on after the operation had been performed by a surgeon in the north of England. Another patient told me that every week during a period of two months he had had both membranes punctured by an aurist. He said, "They always healed up the next day, and I am worse than I was before." A few deaths have taken place from inflammation of the brain resulting from this operation.

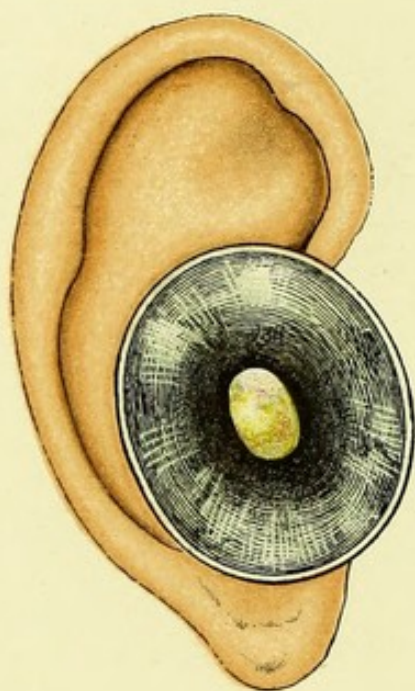
Tenotomy of the tensor tympani muscle, an operation first introduced by Weber-Liel, of Berlin, to overcome indrawing of the drum-head and ossicula, and consequent intra-labyrinthine pressure, is for some cases strongly recommended by several eminent aurists, including Grüber and Frank. The operation should be performed, according to these authorities, through the anterior segment of the drum-head, or, according to Voltolini and Orne Green, through the posterior segment. It is said to benefit most those cases which are relieved only for a short time by the use of the air bag. Schwartz and von Tröltsch have recommended the operation in a modified form. The majority of aurists, however, in Great Britain and in America are against its adoption.

At the International Medical Congress in London, in 1881, Dr. A. Paquet, of Lille, read a paper on a modification of myringectomy for sclerosis of the ear, which he stated he had found successful. In this operation he combines incision, with or without excision of a portion of the membrane, with section of the reflected tendon of the tensor tympani muscle, as practised by Weber-Liel. The blade of the knife used by him is two millimetres in breadth and four in width, and bent slightly, like a scythe.

The procedure is as follows:—A puncture is made one and a half millimetres in front of the malleus, and the membrane is divided obliquely downwards and backwards, in such a manner that the lower extremity of the incision is placed half-way between the umbo and the periphery, and at a point where a line drawn vertically downwards from the umbo would meet it.

This incision divides not only the membrane, but also the reflected tendon of the tensor muscle, or at least the tensor ligament of Toynbee. A second incision is now made in the posterior segment, two millimetres from and parallel with the manubrium, and is then carried forwards to meet the lower end of the first incision. By excising a portion of the lower end of the V-shaped curtain thus made, the perforation is, in some few instances, rendered permanent, but it is usually unsuccessful.

The fact is that simple puncture has, with a few insignificant exceptions, failed to produce a permanent opening at the hands of every operator from Sir Astley Cooper down to those of present day. Wreden's operation of resection of the handle of the malleus has been equally disappointing. Schwartzé went a step further, and excised the membrane and entire malleus. Finally, Kessel, of Prague, on the ground that even the latter operation is so rarely successful, has suggested that in order to expect even a measure of success, it is necessary to remove the annulus cartilagineus in the posterior segment of the membrane, and to resect the sulcus tympanicus with the chisel. This operation has been performed by Lucæ, Hartmann, and Schwartzé. I confess to not having contemplated this operation for non-suppurative catarrh.



OTORRHOEA.

CHAPTER X.

CHRONIC SUPPURATIVE INFLAMMATION AND THE
VARIOUS FORMS OF OTORRHŒA.

THE causes of chronic otorrhœa are many and varied, and naturally include all those previously mentioned as concerned in the production of acute non-suppurative conditions of the middle ear. They may be discussed in three groups, namely : (A) those of tubal connection ; (B) those cases which affect the tympanum through the meatus ; and (C) a small heterogeneous group which includes reflex and other more remote etiological factors.

A. Tubal causes include :—

1. Simple extension of nasal and pharyngeal catarrh, leading to marked Eustachian blocking with hypersecretion and retention.
2. Specific extension in acute febrile conditions, which is frequent in scarlet fever, measles, and other exanthemata, but occasional only in other acute septic conditions, such as pneumonia, glanders, phlegmonous erysipelas, and septic pharyngitis and tonsillitis.
3. Chronic specific involvement, as in syphilitic and tubercular states.
4. More or less accidental lesions of the Eustachian lining amongst which may be specially mentioned inflammations and injuries connected with the act of injecting air or fluids into the tympanum by means of the catheter, those incident to the forcing of mucus and other ingesta up the tube, acts of coughing, vomiting, sneezing, and a trumpeting method of blowing the nose, and injuries of the pharyngeal ostium, due to various cauterizing agents and unskilful nasal and naso-pharyngeal operations and manipulations.

5. Finally, this list is not complete without mention of the different hypertrophies and new growths which may lead to Eustachian catarrh and obstruction, such as nasal and naso-pharyngeal polypi and fibromata, mulberry, and other hypertrophies of the posterior extremities of the turbinated bodies, and adenoid vegetations and other tonsillar enlargements.

B. Causes acting by way of the meatus include:—

1. The direct action of cold air, water, and other fluids on the membrane, and even side of the head.
2. The extension inwards of acute inflammatory conditions of the meatus, such as furuncle, diffuse external otitis, otomycosis, larvæ, and other parasites.
3. Hot and corrosive fluids.
4. Inflammation excited by the presence of foreign bodies, amongst which I have reason for mentioning quack "drums."
5. Injuries to the membrane, due to percussion and explosions.
6. Traumatism in connection with meatal manipulative interference. Middle ear suppuration occasionally follows drilling for bony growths and hypertrophies; this is usually by extension backwards of inflammation, rather than from any direct injury at the time of operation from slipping of the instrument.

C. The more remote causes include:—

1. Those curious reflex factors such as irritation from teething or worms in the young.
2. Extension of disease from within the cranium, either directly, as in adults, by absorption of the tegmen or destruction of bone in that region in intracranial tumours and suppurations; or, as in children, by extension of an inflammation of the membranes in meningitis and in cerebro-spinal fever, through the direct continuity of the dura mater and lining of the tympanum at the still patent petro-squamosal suture.
3. Fractures of the base of the skull.

It may be at once stated that whilst, on the one hand, cold and the exanthemata are the commoner antecedents of cases of suppurative otitis media which become chronic, suppurations due to traumatic causes are usually of short duration.

Acute otitis very frequently (from the bursting of pent-up matter through the membrana tympani) leads to a chronic discharge, *i.e.*, otorrhœa. From this, if not attended to, serious consequences may result, such as polypus of the ear, caries of the temporal bone, inflammation of the brain, or even lobular pneumonia of a pyæmic nature, with gangrene of the lung, owing to the lateral sinus or jugular vein becoming implicated, and pus finding its way into the circulation. But a chronic discharge from the ear is by no means always preceded by acute otitis. In many cases—in strumous children, for example—we never get any history of an acute attack. The discharge comes on gradually, and without pain, and although oftentimes disgustingly offensive, is not infrequently allowed to continue unchecked for months or years. No wonder, then, that it should occasionally be followed by some of the maladies just mentioned. Suppurative catarrh of the tympanum of course, sooner or later, leads to perforation of the membrane, the permanency or otherwise of which depends largely on the duration of the discharge. Restoration of the ear to a healthy condition, and the stopping of a dangerous discharge, is to be brought about—

1st. By removal of the cause, if feasible.

2ndly. By constitutional treatment.

3rdly. By thorough cleanliness.

4thly. By astringent applications.

Constitutional treatment is of the utmost importance. Strong astringent lotions and thorough syringing will often fail to complete a cure unless the general health be attended to. As a rule, children suffering from otorrhœa require tonics: we can often heal a long-standing case if, while the ear is kept thoroughly cleansed with a syringe and warm water, we administer cod-liver oil and steel wine.

The astringent lotions prescribed should always be used warm.

The following notes, given as concisely as possible, show the length of time otorrhœa is sometimes left unchecked, and the comparative ease with which it is diminished or stopped.

Mr. C., æt. 25, eighteen years previous to coming to me, had suffered severely from scarlet fever, followed by considerable deafness of the right ear, from which there had ever since been a constant and very offensive discharge. He could hear my watch only within half an inch from the deaf ear; and purulent fluid was making its way through a large perforation in the membrana tympani, causing inflammatory action and very great pain. The pain ceased after the application of a few leeches. I then prescribed a mixture consisting of iodide of potassium and nux vomica, and the frequent use of lotions containing small quantities of carbolic acid and acetate of lead, the strength of which was gradually increased. His hearing now slowly improved, until my watch was audible at a distance of eighteen inches, and the discharge, of which he had complained bitterly on account of its offensiveness to himself and friends, entirely ceased.

Such cases are constantly being treated, and after a short trial given up as incurable—in nine cases out of ten because the parts are not thoroughly cleansed. As Dr. J. O. Tansley has observed:* “Even after carefully syringing out an ear, if we examine, there will be seen pieces of tenacious mucus remaining in the various parts of the cavity; and now if we instil the solution—argenti nitratis, for instance—there is an insoluble impervious coating of albuminates formed, which effectually covers the diseased parts, and prevents the benefit we had anticipated. Having thoroughly cleansed each ear with my cotton probe, using my forehead-mirror and aural speculum, with the cotton moistened with the solution to be applied, I touch the diseased parts, and none other.” He recommends the same treatment in the nasal cavity for ozaenic catarrh.

Bezold's powdered boracic acid treatment and the use of spiritus vini rectificatus are in some instances of marked service; but it is difficult to lay down any general line of treatment.

* “Nasal Catarrhs and their Treatment,” *New York Med. Journ.*, August, 1875.

Dr. H. N. Spencer has obtained gratifying results from the use of iodoform for the treatment of hyperplastic growths accompanying chronic suppurative inflammation in the middle ear, and also of the hypertrophied tonsils frequently associated with aural disease.* It must be remembered, however, that iodoform and its congeners iodol and sozo-iodol sometimes tend to promote granulative growth and granulomata, rather than "healing by granulation," especially if the secretions are very irritating. Powdered alum, when the virulence of the inflammation has been allayed, acts serviceably by coagulating albumen in the tissues with which it comes in contact, and forming a protective covering for the healing parts.

I have in some cases prescribed with great benefit an ointment of 20 grains of iodoform or of iodol to an ounce of vaseline, when alcohol drops have failed to benefit.

The subjoined case is typical of a class very common in aural practice.

M. J. B., a girl, æt. 10, was brought to me at the hospital in August, 1875. Her mother stated that for nine years she had had a "constant running" from both ears. The smell from the discharge was so offensive that none of her schoolmates could sit near her. Her appearance was most repulsive, for the central portion of both lobes had, as I was told, for the last four months been gradually "ulcerating away," from the irritation caused by the purulent acrid discharge. She was very deaf with both ears. The sores were dressed with calamine ointment, and the ears were six times a day syringed with warm water, and then treated with a carbolic acid and sulphate of zinc lotion (five grains of each to the ounce); also a mixture of cod-liver oil and steel wine was given three times a day. At the end of three weeks of this treatment the discharge ceased entirely. Shortly afterwards her hearing returned; and she left the hospital quite well. In certain more troublesome cases a weak solution of nitrate of silver (one grain to the ounce), applied to the external meatus by means of a probe covered with cotton wool, has often a very beneficial effect. The strength of the caustic can be gradually increased, but I do not, with some

* See *American Journ. of Otology*, October, 1879, p. 287.

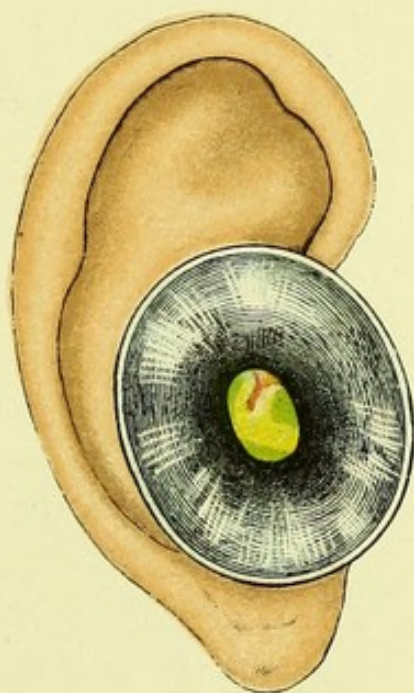
aurists, recommend the use of very strong applications of nitrate of silver for young children. For adults, however, such solutions are useful, and often necessary.

In addition to the lotions previously mentioned, the following can be used in warm solutions, in strengths of about 1 in 4,000, more or less, viz.:—Perchloride of mercury, biniodide of mercury, carbolic acid, and trichloride of iodine.

The following can be used, in strengths varying from half an ounce to one ounce to the pint of warm water, viz.:—Glycerine of carbolic acid, boracic acid, borax, chlorinated soda, lactic acid, peroxide of hydrogen, sulphate of soda, and the liquor of the permanganate of potash. Salicylic acid and sulphocarbolate of zinc can be ordered in strengths varying from a half to one drachm to the pint of warm water.

Several proprietary articles, in varying degrees of dilution, such as Sanitas Fluid, Jeyes' Purifier, Condy's Fluid, Creolin, &c., are often serviceable.

As regards *guttæ*, boracic acid, grs. xx, salicylic acid, grs. v, or carbolic acid, gr. j., to the ounce of rectified spirit respectively, may be mentioned as most useful. Morphia or cocaine may be added when necessary.



MUCO-PURULENT COLLECTION IN CAVITY OF TYMPANUM.



CHAPTER XI.

ON PERFORATION OF THE MEMBRANA
TYMPANI.

PERFORATIONS of the membrana tympani vary much in size, position, and shape, and in the effect they produce on the passage of sound. The size of a perforation in the drum-head appears to be no guide to the amount of loss of hearing we may expect to accompany it. Its position may sometimes, however, serve as a criterion ; for whenever it occurs in the upper portion (Shrapnell's membrane), an event which fortunately is uncommon, hardness of hearing results ; and necessarily the more the joints of the ossicles are interfered with, the greater is the deafness. In these instances there are nearly always adhesions and accumulations in the tympanic attic above and around the upper parts of the malleus and incus. The largest perforations met with are, as a rule, the result of scarlet fever. It may happen that two patients have precisely the same kind of perforation, arising from the same cause, and looking as alike as possible, yet their hearing may be very different.

The late Sir William Wilde was of opinion that when once the membrane had become permanently perforated, the larger the aperture, the greater was the amount of hearing, provided no further mischief had taken place, and that there was a slight ring or circle of the membrane still remaining.

In a case related by Sir A. Cooper, the left membrana tympani was entirely, and the right partially, destroyed, yet the patient, if his attention were excited, was capable, when in company, of hearing whatever was said in the usual tone of conversation.*

* *Cyclopædia of Anatomy and Physiology*, edited by R. T. Todd, M.D., F.R.S., vol. 2. p. 576.

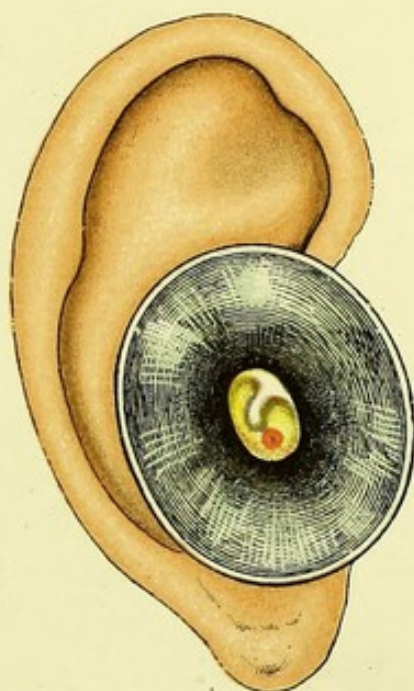
Perforation of the membrana tympani is not uncommon, and occasionally is not confined to one part of it only. Its modes of causation and its varieties and their treatment I have in this and the following chapter endeavoured to illustrate by a careful analysis of the histories of a large number of cases treated by me.

Out of 100 patients under my care at St. Mary's Hospital on March 6, 1880, 29 were cases with perforation, viz., 12 of both ears, and 17 of one ear, giving 41 perforations for 200 ears. Taking 500 consecutive cases, I found that 118 of them were instances of bilateral, or double, and 382 of unilateral, or single, perforation, *i.e.*, there were in 500 patients 618 perforations. These were divisible into two classes:—

- (A.) Perforations through disease, 106 double and 314 single, total 526.
- (B.) Perforations through injury, 12 double and 68 single, total 92.

In class A were comprised 69 single and 7 double, total 83 perforations, attributable to cold in the head; 2 single and 1 double, total 4, from acute rheumatism; 2 from bronchitis; and 8 from bathing: thus, adding together these numbers, we have, out of our aggregate of 618, 97 perforations, or nearly 1 in 6, more or less directly due to cold.

A cold in the head may give rise to acute catarrh, and this to acute purulent inflammation eventuating in perforation, the membrane nearly always giving way when pus is created. Thus it is that in the exanthemata spontaneous rupture of the drum-head takes place. The symptoms of acute purulent inflammation are important, from the tendency of this affection rapidly to destroy the tissues of the ear, and lead to suppurative meningitis, abscess of the brain, pyæmia, and death. It generally begins with a tickling sensation somewhere between the Eustachian tube and the ear, or passing from one to the other, and deep-seated pain increased by swallowing, talking, and sneezing. The pain by degrees extends over the whole of the side of the head as far as the eye, and the patient becomes almost frantic from his intense suffering; but he is immediately



PERFORATION HEALING.



relieved if spontaneous rupture of the drum-head occurs. When rupture does not take place, the pressure of the pent-up pus upon the labyrinth may cause vertigo and delirium. The drum-head in this case is intensely congested, red, and swollen, and is usually found bulging in its posterior half, and should then without hesitation be punctured by the surgeon. It is worthy of note that although mucus never, yet pus invariably, by accumulation in the tympanic cavity, causes bulging of the membrane.

Of the 618 perforations in my 500 cases, there were 147 single and 70 double, in all 287 perforations, or nearly half of the whole number, due to scarlet fever: in three of these cases death resulted from intra-cranial abscess. To measles were attributable 63 single and 79 double, in all 221 perforations, one case terminating in death from cerebral abscess.

In one instance there was severe pyæmia, originating in a fall on the head.

A fatal issue in some of these cases might, I feel sure, have been obviated by means of timely treatment; and the same may, no doubt, be said with respect to various dangerous complications, such as those about to be mentioned, directly due to chronic otitis. In 16 persons out of the 500, life was endangered by mastoid abscess and caries of the temporal bone, occasioned in 7 cases by scarlet fever and cold respectively, and in 2 by unknown causes. In 41 instances there were aural polypi, of which 29 were after scarlet fever, 2 after measles and cold respectively, and 7 after injuries.

There were 57 cases of perforation accompanied by incurable deafness, viz., from scarlet fever, 29, of which 4 were double; from injury, 14, including 1 double; from cold, 6; from measles, 3; from small-pox, 1; from unknown causes, 4.

From scarlet fever and measles combined, one patient had single, and another double, perforation. There was double perforation in a case of croup. In one of diphtheria, mischief had taken place very quickly. Pain in this disease is not severe, but the acute passes into a virulent chronic form of otitis, with rapid necrosis of bone. If, therefore, in diphtheria ear symptoms occur, the drum-head must be punctured to allow of free exit of

pus, and to obviate the impending gangrenous inflammation and consequent speedy destruction of tissue.

In a rare form of disease usually found in scrofulous subjects, there appears, coincident with an increase of pain, after a purulent discharge has lasted some time, a white diphtheritic membrane, which adheres very closely to the inflamed structure.

Perforation took place in three cases of typhoid fever, and in one of typhus. In these affections, in which early treatment is especially called for, the acute inflammation runs the same course as in the virulent exanthemata. The pain is severe at night only, and after the membrane has given way, we get at early morning a discharge of thin, serous, colourless fluid, which subsequently becomes creamy in appearance; the pain then entirely ceases.*

Ague was accountable for one single, mumps for one double, and small-pox for one double and three single perforations. The ear mischief in small-pox, as also in scarlet fever and measles, I believe originates in the throat, extending thence along the Eustachian tube.

Two of my cases were said to have arisen from syphilis. So far as I have seen, syphilitic disease of the membrana tympani presents no special appearance. In the case of J. H., æt. 22, a pawnbroker's assistant, who came to me at St. Mary's with double perforation, only antisiphilitic remedies were of any effect, and under the influence of five grains of iodide of potassium thrice a day, otorrhœa ceased, and the tympanic membranes, although remaining perforated, assumed a healthy aspect.

One case in the 500 was from phthisis, and sixteen were ascribed to "abscess." In two patients there had been convulsions. One of these last, W. F., æt. $8\frac{1}{2}$, brought to me at the hospital October 11, 1879, had twelve months previously eaten a biscuit poisoned to kill a dog. In the violent convulsions which ensued, both drum-heads gave way, and there was considerable hæmorrhage from the ears, followed ere long by a continuously flowing, thick, and most offensive discharge. He had in consequence become not only quite deaf, but dumb.

* See *A Treatise on the Ear*, by C. H. Burnett, M.D., p. 269.

After seven months' treatment the discharge entirely disappeared, and although the perforations were unclosed, the hearing was by degrees returning. These results were obtained by: (1) the use of often-changed astringent lotions and powders; (2) counter-irritation behind the ears; (3) great attention to the general health; (4) the application of Politzer's bag regularly twice a week. In such cases Politzer's process is especially beneficial, for by "mixing air and lotion within the tympanum thus, with the subsequent use of the syringe, the cavity becomes in time thoroughly cleared of its contents of viscid or purulent secretions, and old perforations, if not of very great size, will often heal. It is desirable sometimes to touch the edges of the orifice with nitrate of silver."—*Hinton*.

A similar case was that of a girl, *æt.* 12, sent to me at the hospital in 1879 by Dr. Morton. The mother had been repeatedly told that the child had become deaf and dumb from scarlet fever. By precisely the same line of treatment as that just mentioned, I was enabled to bring about a gradual restoration of both speech and hearing. Amongst several other cases of a like nature, I have had one of great promise, sent to me by Mr. Edmund Owen. Much, I am sure, may be done for some of the so-called deaf and dumb, who, however, through the habitual neglect of treatment, are hardly ever given a chance of recovery, a customary exclamation, when the patient is brought, apparently being, "Oh, deaf and dumb: take it away!" Bonnafont early in 1880 published some remarks on this subject in one of the French medical journals. It was in that year that a woman came to me at the hospital saying, "Three years ago, sir, you told me not to despair;—my child might hear; and now he can hear, and, what is more, he can talk." The result here had been achieved simply by perseverance in the above-indicated line of treatment, although I had often myself expressed grave doubts as to its being of any avail.

Another child, a boy, *æt.* 9, stated to have been rendered "dumb" in consequence of loss of hearing incident on scarlet fever five years previously, was sent to me in 1876 by Mr. Philps, of Peckham, and was similarly restored to a fair amount of power of speech and hearing.

My list contains two cases of perforation from cold after confinement, and three from myringitis, or acute inflammation of the drum-head exclusively. In the latter malady, which occurs but rarely, the process of perforation seems to begin from without. The membrane is intensely red, but hearing is not so much affected as where the tympanum is diseased. The most common cause of myringitis is a sudden chill, such as comes of taking a header into cold water.

Eight patients out of the 500 had perforation from bathing, and each with accompanying affection of the tympanum. In one of these, the lady already mentioned as having accidentally thrust a hair-pin into her ear, the injured right tympanic membrane three years later was again ruptured by a leap into the sea. Another patient, whom, like the last, I successfully treated, twice ruptured the same membrane by taking a header into the sea. Injury of the ears in bathing may always be prevented by plugging them with cotton wool.

In whooping-cough, in consequence of which two out of the 500 patients had perforation, there is generally an accumulation of mucus in the tympanum, distending the membrane, which, under the increased mechanical pressure upon it during a fit of coughing, suddenly gives way.

In the category of accidental or traumatic ruptures of the drum-head, with which some of the foregoing might almost have been classed, there were, for 80 patients out of my 500, 92 perforations, viz., 12 double and 68 single, due to accidents. From falls on the head there were 7 single, and 4 double, and from other injuries to the head 1 double and 29 single perforations. Boxing the ears was accountable for 8 cases, including 2 double, out of the 500, giving the large percentage of 1·6. The patients, all schoolboys, were the victims of the indulgence of their tutors in this most objectionable practice. Several of them were more or less permanently injured, and two were very deaf in both ears.

In this connection I may remark that it is not at all uncommon at hospital to meet with cases of ear disease due to this cause alone; indeed, it is difficult to understand how any feeling short of malice aforethought can prompt any one to

correct a child in this way. Most of us, I daresay, remember the case mentioned in Holmes' *System of Surgery*, of the boy who, suffering from the cerebral abscess that caused his death, had his ears boxed by his father for inattention. But recently a curious instance of the inadvisability of striking the ear, even by way of jest, came before me in the case of an actor, who, having to submit for over the space of two months, to a box on the ear, at the hands of a fair colleague, had developed a well-marked example of hæmatoma auris. The play was, he said, very unfairly called *Much Ado about Nothing*.

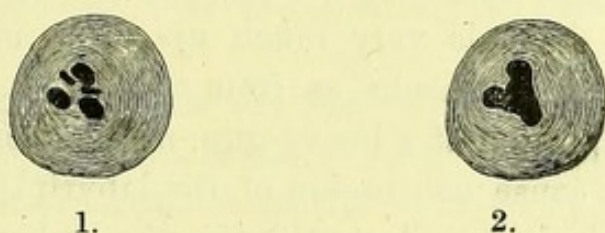


FIG. 58.—1. Exact appearance of ruptured membrana tympani the day after injury. The patient came to St. Mary's Hospital, February, 1882, and stated that her husband the evening before had given her a violent blow on the side of the head with his fist.
2. Represents the appearance of the membrane on the 3rd day. Both these illustrations were carefully drawn by Mr. Noble Smith, and well show the damage liable to occur from a "box on the ear."

My list contains further the following entries:—From other blows on the head, 16 cases, 2 double; forcing pen-holder into ear, 1; thrusting hair-pin into ear, 1; injury from foreign bodies, 4; kick from horse, 1; blows on head from cricket-ball, 2; injury at football, 1; fall of flower-pot on head, 1; violent sneezing, 2, of which 1 was double.

A hole in the drum-head may also be made:—

By dropping into the ear certain fluids, *e.g.*, urine, as in one instance, or turpentine, as in the case of a gentleman who one night applied it by mistake, or as in that of a child in hospital, whose mother resorted to it on the ground that it was a both strong and ready remedy. In the case of a country gentleman sent to me by Dr. Herbert Davies, the patient, who had some ear mischief, had been provided by a doctor with a powerful solution of nitrate of silver, and a brush, so "that he might burn it away himself." This he certainly did in the most effectual manner, for very little drum-head or anything else had he left.

For perforation after violent syringing, consult Chap. XV.

As the result of a scald, G. J., a coachbuilder, came to me at the hospital with scald of the left ear, caused by his brother spilling some boiling water upon him as he lay asleep. The inflammation, as in the last case, was very severe. Blowing the nose caused great pain and a whistling sound, due to a perforation in the drum-head. Through free use of leeches and various weak astringent lotions, as of acetate of lead and opium, the discharge gradually ceased; and the perforation in a short time closed, and hearing was regained.

Traumatic injuries of the drum-head as a class do well, being repaired with less difficulty than injuries caused by disease. The prognosis depends very much upon the mode of injury; thus, falls or violent shocks, as from a blow on the side of the head, or the explosion of a heavy gun, may not only rupture the membrane, but cause concussion of the labyrinth or permanent damage to the ossicles. A gentleman who had ruptured his left drum-head from being thrown off a dog-cart was, some time after the accident, sent to me by Mr. Woodman, of Ramsgate. I found a small perforation, which gave exit to a polypoid growth. This was destroyed, but the perforation did not disappear, and the patient remained deaf. As the history of the accident tended to show, it is probable that here there had been some concussion of the labyrinth. Diagnosis by means of the tuning-fork was not quite clear, since for many years the other ear had been deaf.

Another obscure case is that of a gentleman in the artillery, who on August 25, 1879, consulted me for deafness, of which there was no history in his family. In the right ear he was totally deaf, and in the left, the membrane of which was perforated, he could hear a watch only in contact.

Eighteen years previously, when in India, he had contracted syphilis, but with few evil effects; and he had been deaf for only a year and a half. He had marked disease of both internal ears. The question arose, was this due to syphilis, or to concussion of the labyrinth from the repeated discharge of heavy guns, at which, in the exercise of his profession, he was constantly present? Or, further, might it in any wise be the effect of sudden shock, seeing that just before the onset of his deafness,

witnessing the death under chloroform of a brother to whom he was greatly attached had caused him the utmost distress and nervous prostration?

When we remember how extremely difficult it is for the surgeon to keep open a puncture artificially made in the membrana tympani, we cease to be surprised at the success with which recent cases of perforation, whether from disease or accident, can be treated if a little care be taken with them.*

The treatment to be recommended for accidental perforation of the membrane by any sharp body (and this is often met with, especially in hospital practice) has already been given in a former section.

A clean cut or slit, from the mere fact that the edges of the wound are in apposition, heals up readily, as we often see after operations; whereas a round aperture formed by an oft-repeated discharge, unless an artificial membrane can be efficaciously employed, frequently implies partial or complete deafness.

I will illustrate what I have just said respecting clean cuts or slits in the membrana tympani by the relation of a case brought to me by Dr. Randall.

A lady, whilst dressing in a hurry for dinner, ran a hair-pin (which somehow or other had become attached to her brush) into her right ear, rupturing the right membrana tympani. She experienced intense pain at the time of the accident, and lost a considerable quantity of blood from the ear. When I saw her the next morning, a large clean-looking slit could easily be distinguished in the membrane, which was intensely congested and very painful. With the injured ear she could hear my watch only when closely pressed into contact.

From the appearance of the wound, that of a clean-looking cut, I gave a favourable opinion as to the ultimate result. Four leeches in front of the tragus immediately relieved the deep-seated and throbbing pain; and with the help of various and often-changed weak astringent lotions the wound healed. In three weeks all signs of injury had disappeared, and hearing was completely restored.

* See Schwartz, *Pathological Anatomy of the Ear*, translated by J. Orne Green, M.D., p. 80.

Oftentimes, indeed, wounds in the membrane heal up very quickly, and little subsequent treatment is required. It is astonishing, considering the anatomical relations of its parts and the close proximity of the brain, that more serious consequences do not oftener take place from accidents to the ear.

PERFORATION FROM EXPLOSION.—Several people were injured from the dynamite explosion on the Metropolitan Railway some years ago: the injury was caused from the forcible driving inward of the membrana tympani. Most of these people were terribly cut about the face and body by broken glass. They were brought to the hospital most of them totally deaf. In nearly all the cases the tympanic membranes were ruptured right across, having the appearance of a clean-looking slit, and not the round aperture we usually find after long-standing otorrhœa. Of the eight patients all recovered their hearing completely, with the exception of one man whose right ear was so completely disorganized that it was evident from the first that nothing could be done for him. The membranes were in every case intensely congested; relief was afforded by blisters applied over the mastoid, and subsequent treatment consisted in keeping the parts clean, and the application of a lotion composed of one grain each of acetate of lead and opium, and one drachm of glycerine, to the ounce of water.

G. B., æt. 54, a labourer, came to the hospital February 24, 1874. Ten days previously he had fallen eight feet from a ladder, on to the side of his head. He had lost at least half a pint of blood from his left ear, with which he could not hear a watch even in contact. With the right ear he had been slightly deaf since childhood. He said that in his left ear he constantly heard noises like water falling. Air could be distinctly heard passing through the membrane when he was told to hold his nose and blow, and the rupture in it could be seen very plainly. In this case I thought that if I could get the mucous membrane of the tympanum into a healthy state and gradually stop the discharge from it, which was constant and most offensive, the large rent in the membrane would in all probability heal up. I accordingly ordered a carbolic acid and sulphate of zinc lotion, and thorough and frequent cleansing of the ear. On February

27 the discharge still continued, but was much less, and devoid of disagreeable smell. The lotion was now increased in strength, and a mixture of iodide of potassium and cinchona was ordered. On March 12 the discharge had quite ceased, the membrane had healed up, and my watch was perfectly audible in the ordinary way.

I have now to mention a case of perforation of the membrana tympani, rendered permanent by delay in treatment.

A lady had suffered constantly for several months from discharge from the right ear, with deafness. She was sent to me by Dr. Pollock, whom she had consulted for her general health, being unaware that her ear-symptoms required any attention. I found a large perforation in the membrana tympani. By treatment with astringent lotions, such as sulphate of copper (half a grain to the ounce), and keeping the tympanum well washed out in the ordinary way, the discharge was gradually stopped, and the hearing distance improved from one inch to six, but the perforation remained. I believe that, had earlier treatment been resorted to, the opening might have been healed, and hearing perhaps perfectly restored. The following case is confirmatory of this opinion.

Mr. D., sent by Mr. Maunder to consult me in January, 1877, had seven days before, after a violent fit of sneezing, found himself deaf in the right ear. He could hear the watch only when in contact with the ear. I easily distinguished a large perforation in the membrana tympani. As the surrounding mucous membrane was unhealthy, I prescribed a lotion of sulphate of zinc and carbolic acid (five grains of each to one ounce of water), to be used four times daily. In a few days the condition of the mucous membrane had improved, so a solution of nitrate of silver (half a drachm to one ounce) was carefully applied two or three times a week to the perforation by means of a probe covered with cotton wool. In a few weeks the aperture had closed, all signs of injury had disappeared, and the hearing was quite restored. Later the patient kindly called upon me, after three months' exposure to considerable climatic changes in Egypt, to let me know that the cure was permanent.*

* *British Medical Journal*, October 6, 1877.

In perforations of long standing accompanied by deafness, I have obtained very good results by thoroughly washing out the tympanum with antiseptic fluids. The drum-head may be thickened by the mucous membrane, which covers its inner surface in common with the ossicula, being swollen from constant suppuration going on in the tympanum; or the ossicula may be glued together by hardened mucus. It is obvious that if, by any means, we can lessen or remove these defects, an immense advantage may often be gained; for in many cases the deafness is not dependent on the perforation, but on thick matter on the membrane and ossicles.

It is of the utmost importance in cases of perforation to render the mucous membrane of the tympanum healthy. This is best brought about by attacking it from within through the Eustachian tube in the way just shown, and externally by means of warm astringent applications introduced by means of an *intra-tympanic syringe* through the perforation, and followed by the Valsalva or other method of tympanic inflammation. We are able by these means, in many cases, not only to restore the mucous membrane to health, but also to wash away any abnormal discharges or inspissated secretions that may be clogging up the fenestræ, and so preventing the entrance of sound into the labyrinth, and also accumulations in the attic which interfere with the free movements of the ossicles. These cases often have the perforation in Shrapnell's membrane.

Perforations from injury do better on the whole than those occasioned by disease, because, as I believe, better treated. A blow on the head is naturally at once attended to, whereas a discharge from the ear, the sequel of a long case of scarlet fever, is generally for a time left to itself. This is evidenced by the fact that in the cases of actual recovery, *i.e.*, where the perforation has closed up and the hearing is completely restored, the patient has almost invariably been seen betimes.

Of 526 perforations from disease, I find cured 26, or nearly 1 in 21; of 92 from chance accidents, 22, or nearly 1 in 4; of 10 from box on the ears, 5, or 1 in 2. All these cases were seen early. These percentages, which at first sight may appear small, do not include cases where hearing had been almost

restored, still witho closure of the perforation; where the perforation had closed, yet the hearing had not completely returned; where the discharge had ceased, but a perforation with only slight deafness remained; or where, a perforation having been left, marked assistance had been rendered to hearing by the use of cotton-wool or other artificial means.

In many of these the hearing has been recovered, but a cure in every sense has not been effected. Those patients are not taken into consideration who, though they heard perfectly well, had lost all discharge, and considered themselves cured, yet had a perforation left, since, where there is an opening into the tympanum, a discharge is liable at any time to return, together with further trouble. Constantly one has to treat cases of perforation which are statistically of no value whatever, because a history is unobtainable: the 500 cases above discussed were, however, selected and analysed with great care, the history in all having been satisfactorily ascertained.

The degree of audition compatible with a perforation is dependent in great measure not only on the position of the latter, but also on the presence, integrity, and mobility of the ossicles. If the continuity of the chain of sound-conducting ossicles is interrupted by detachment of the incus from the stapes, the result perhaps of a perforation, the most characteristic symptom, as Hinton remarks, is an inability to hear, except during the act of listening.

"In cases of general ulceration of the mucous membrane of the tympanum," says Toynbee,* "the incus is commonly discharged, and sometimes the malleus also; but, even in these cases, if the attachments of the stapes to the circumference of the fenestra ovalis remain uninjured the power of hearing may be greatly improved; should the stapes, however, be removed, total and irremediable deafness ensues."

The incus, according to Allen, comes away most frequently because less firmly fixed than the other bones. When the ossicles are separated, it is only by supporting them and restoring their continuity by artificial pressure, such, *e.g.*, as that

* *Diseases of the Ear*, p. 166.

exerted by a moistened pellet of cotton-wool, that we can hope to obtain an improvement in the hearing. "It is important," Allen observes, "to note that this solution of continuity, especially in the articulation between the stapes and incus, may take place in the purulent inflammatory process, without necessarily any rupture of the membrana tympani; and it is in such instances as these that a most surprising improvement in hearing follows when Yearsley's artificial tympanum is applied to the membrane, the incus being thus pressed against the stapes, and the continuity of the chain restored."

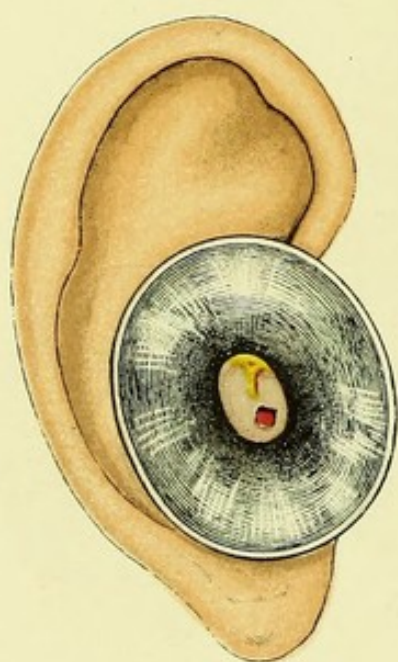
It is impossible to tell beforehand, however, whether an artificial membrana tympani will be of any service. Some patients derive the greatest benefit from wearing such a support, and others seemingly not any.

In treating cases of perforation of the membrana tympani, it always appeared remarkable to me that some patients should derive more, others less, benefit from Yearsley's pellet of moistened cotton-wool than from Toynbee's artificial membrane. It therefore occurred to me that the use of the instrument about to be described might prove advantageous, as, indeed, I have found it to be.* It is simply a combination of Toynbee's artificial membrane (viz., a thin disc of india-rubber mounted on a fine stem of silver wire) with Yearsley's cotton-wool. In my instrument, the wire is carried beyond the india-rubber, and terminates in a second disc, made of flannel. The space between the two is filled up with a small portion of Dr. von Brun's absorbent wound-dressing cotton-wool, which takes up and communicates to the flannel disc any medicated solution which it may be desirable to apply. To prevent overcharging of the cotton-wool, a pipette should be used, as one or two drops are sufficient to moisten every fibre of the wool and flannel.† A second disc of soft sponge fixed to the india-rubber perhaps answers better in some instances.

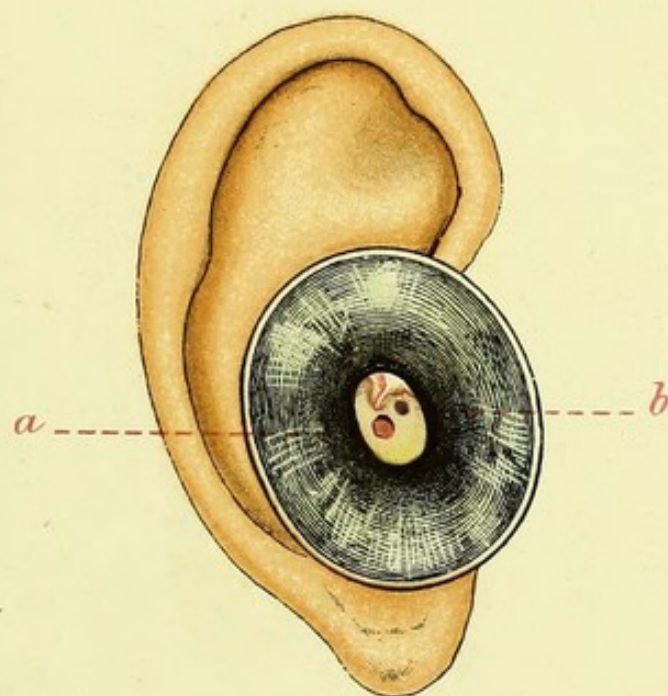
The advantages of this form of artificial drum-head are the following:—

* See *Brit. Med. Journ.*, June 18, 1875.

† It is made by Messrs. Krohne and Sesemann, of Duke Street, and by Messrs. Hawkesley, of Oxford Street.



PERFORATION OF MEMBRANA TYMPANI.



a PERFORATION OF MEMBRANA TYMPANI.
b SCAR OF OLD PERFORATION.



1. It does not irritate, and, being very soft, is unlikely to injure the membrane.

2. It contains absorbent cotton-wool, by the aid of which lotions can be constantly applied.

3. The membrane, being kept clean, becomes healthy, and the perforation heals.

4. The hearing distance is improved.

5. The india-rubber disc is not liable to become detached in the meatus.

6. It is easily used, and does not, like Yearsley's cotton-wool, require the forceps.

Dr. Peter Allen* was of opinion that "in Yearsley's contrivance (when the natural membrane is perforated or lost) the benefit is derived from support given to the ossicula, by which they are enabled to exercise that due pressure at the fenestra ovalis which keeps the membrane of the fenestra rotunda in a condition susceptible of vibrations, and capable of transmitting them to the nerve-expansion of the labyrinth." And Yearsley himself says that his object is to support the injured membrana tympani or the ossicula; that care must be taken that the entire opening be not covered, as otherwise the experiment will not succeed; and that it is also indispensable to success that the wool should be kept moist.†

Toynbee, on the other hand, says, "It seems to me that, doubtless, one of the functions of the membrana tympani is to confine the sonorous undulations to the tympanic cavity, in order that they may be concentrated on the membrana fenestræ rotundæ. Indeed, it is probable that the vibrations only partially pass through the chain of bones to the vestibule, and that the air in the tympanic cavity is one great medium of communication with the labyrinth. If the means of communication with the labyrinth be the air in the tympanic cavity, it is palpable that any aperture in the membrana tympani is likely to diminish the power of hearing, by permitting the vibrations to escape from that cavity into the meatus, and so

* *On Aural Catarrh*, p. 371.

† *The Lancet*, July 1, 1848.

preventing their concentration upon the membrana fenestræ rotundæ.”*

But, in the supplement to the last-cited work (p. 452), Hinton remarks that Mr. Toynbee modified the view he at first entertained.† This was partly in consequence of intercourse with Dr. Julius Erhard, who, without any perforation, found his hearing much improved by the use of cotton-wool, and published his experience in a paper entitled “Deafness Curable by Pressure.”

Roosa, however, says that the artificial membrane is of service only in cases of partial or complete loss of the drum-head.‡

Politzer, quoted by von Tröltsch, gives what appears to me the best explanation of its usefulness, viz., that this depends mainly on pressure on the membrana tympani and the ossicula, whether it be exercised in checking morbid relaxation in the connections of the ossicula, or act upon the fluid in the labyrinth. Professor Lucaë’s spring pressure probe was the outcome of this suggestion. It has been very favourably reported on by Bronner, of Bradford, who has also used this instrument, together with Delstanche’s pneumatic tractor, for another purpose, namely, that of carrying out *massage* of the ossicles when the joints are stiff (see p. 329).

In my artificial membrane the cotton wool exerts the necessary pressure on the membrana tympani, and, at the same time, the india-rubber disc serves as a vibrating plate.

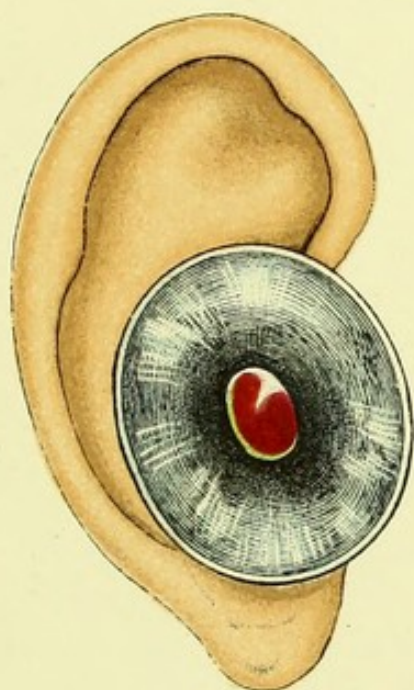
I have found the instrument of great service in many cases of perforation. It should not be worn at first for more than an hour at a time: the cotton-wool should be often changed, and the lotions occasionally altered; and, lastly, it is very essential that only a very small quantity of fluid should be applied to the cotton-wool.

Dr. C. J. Blake, of Boston, recommends as a remedy for perforation the use of small paper discs. He says: “Covering the opening of the membrana tympani with a piece of sized

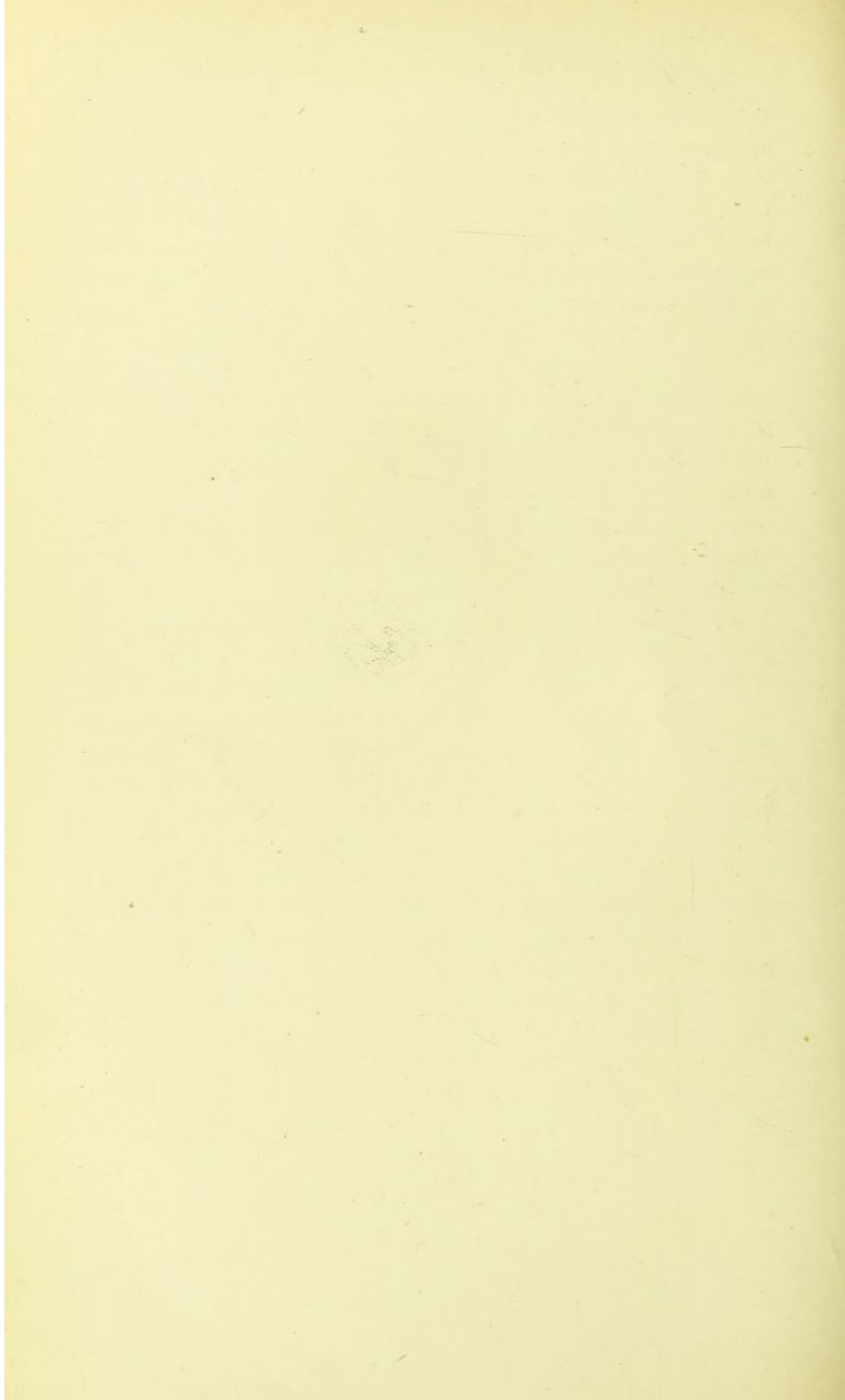
* *Diseases of the Ear*, p. 160.

† *Diseases of the Ear*, by Dr. von Tröltsch, translated by James Hinton, M.R.C.S.

‡ *Treatise on Diseases of the Ear*, p. 380.



THE MEMBRANE DESTROYED.



paper wet with water, the sizing gives sufficient adhesion. The applications generally improve the hearing immediately, and the paper stimulates new growth from the edges of the perforation, and protects it until repair is effected. The new growth, being protected by the paper, is firm and tense, and serves to assist in the vibration of the membrana tympani as a whole, as a lax cicatrix would do. The paper is then removed by a natural process of repair and growth of the dermoid coat."

The following nearly complete list of the different artificial membranes which have been from time to time invented by surgeons is taken from a paper by Dr. Ward Cousins, in which he described a hat-shaped membrane of boracic lint devised by himself:—

"Moistened cotton pellet, Mr. Yearsley. (1) Cotton ball attached to thread; (2) disc of adhesive plaster; (3) disc of sublimated gauze, Dr. Turnbull. Disc of oil silk, Dr. C. M. Thomas. Cotton pellet fixed by collodion, Dr. Barr. Disc of sized paper, Dr. C. J. Blake. Compound disc of india-rubber, cotton-wool, and flannel, Mr. Field. Solid piece of india-rubber, Dr. Burkard Merian. Solid piece of india-rubber on fine stem of silver wire, Mr. Toynbee. India-rubber tube as long as canal, Professor Politzer. India-rubber disc attached to rubber tube, Professor Lucae. Circular patch of pellicle of egg, Dr. Downie. Disc of stout linen with cotton thread soaked in vaseline, Dr. F. M. Pierce. Cylinder of gold, Dr. H. B. Richardson. Glycerine thickened with tannin, Dr. Michael. Plug of boracic acid powder, Dr. Farquhar Mattheson. Little roll of paper, author unknown."

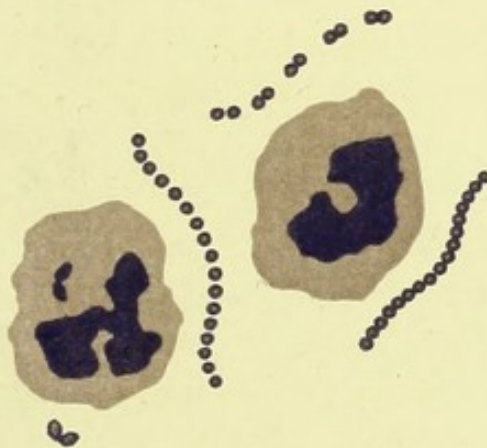
CHAPTER XII.

CHRONIC SUPPURATIVE INFLAMMATION AND ITS
RESULTS (*continued*).

As I have before pointed out, very serious results sometimes occur from allowing a chronic discharge from the ear to go unchecked.

It is an extraordinary fact that people can still be found who maintain that discharge from the ear is salutary, nay, more, almost requisite;—"as if," to quote an American writer, "the Creator would not have made the human race with such a one if it were necessary." As Wilde truly remarks, "Because it was observed that, in the supervention of cerebral disease, discharges from the auditory canal lessened, practitioners, mistaking the effect for the cause, have been led to believe that the sudden drying up produced a metastasis to the brain, a notion as crude as it is unsupported." Serious consequences must oftentimes take place if such ideas as these are commonly held, and the evidence of the out-patient practice at all hospitals tends, I believe, conclusively to prove that they are prevalent, at any rate with the lower orders. My experience is that patient after patient will present himself with running from the ear, and one and all have been told that "it is bad to meddle with the ears." They have, therefore, allowed the discharge to continue until they have become a nuisance to themselves and their neighbours, and the latter have begun to discover, not, indeed, that the discharge implies damage to health or hearing, but that its smell is past endurance.

It is my intention now to consider the graver symptoms that we may expect from an advance of purulent inflammatory disease from the tympanic cavity, a cavity respecting which it has justly been observed, that "no part of the human frame



J. J. C.

STREPTOCOCCI AND PUS CELLS.

*The drawing was made from a preparation of some muco-pus taken from the middle ear of a child who died of cerebro-spinal meningitis.
see also Plate*

Leitz $\frac{1}{90}$ in. oil-immersion.



in such a small space borders upon so many important organs, and on anatomical grounds alone we ought to watch for and dread suppurative inflammation of the soft and hard parts." *

It may be well again to call to mind the anatomical relations of the tympanic cavity. It is said† to resemble a roughly-shaped octagon. Its outer wall is formed by the membrana tympani; the inner separates it from the labyrinth; the lower, or floor, from the jugular vein; the upper, or roof, from cerebral dura mater; in the posterior wall are irregularly-bordered openings into the appendix of the tympanum, the mastoid process; and anteriorly it terminates in the Eustachian tube, which, serving for the escape of fluid as well as for ventilation, is directed somewhat downwards.

A perforation of the membrane in suppuration of the middle ear is not an unalloyed evil, since it affords the only safe outlet for pent-up pus, except the Eustachian tube, which seems, as a rule, to be the very last means it finds of exit. The following, however, is an illustrative case of suppuration in the middle ear without perforation:—

J. L., a clergyman's son, æt. 16, sent up from Weymouth to consult me in May, 1878, had been suffering three weeks from very severe head symptoms, with intense pain, attributed to bathing in the sea‡ shortly after an attack of mumps.

The whole of the left side of the head was in great pain, and no kind of sound was audible with the left ear, but there was not any discharge externally. He, however, described a "feeling of fluid running down the throat," and he had a most disagreeable taste in his mouth, and his breath was very offensive. There was no bulging and only slight congestion of the membrana tympani. I diagnosed this to be one of those rare cases in which pus forces its way through the Eustachian tube, and no perforation of the drum-head occurs. Free leeching in front of the ear and purgative medicines were ordered, which by the

* Hinton's "Tröltsch," p. 66.

† *Ib.*, p. 31.

‡ There is a most interesting account in the *New York Medical Record* for May 4, 1878, of "Diseases of the Ear from Bathing," kindly sent me by the author, Dr. Sexton.

next morning had almost removed the pain. The tympanic cavity was, by means of the Eustachian catheter, washed out with a solution of iodide of potassium once daily, and the patient, although deaf when he returned to Weymouth, a month afterwards had completely regained his hearing.

If, in consequence of caries, pus penetrate through the upper wall of the tympanum, meningitis or abscess of the brain is necessarily the result; but if through the lower wall, septic thrombosis of the jugular vein, or, as Sir William Gull first pointed out, pyæmic abscesses of the lung of the same side, accompanied perhaps by similar abscesses of the liver, ensue.

If the mastoid antrum is well developed, as it is shown in Fig. 10, thrombosis of the lateral sinus, meningitis, or cerebellar abscess is threatened.

If the carious process extends through the inner wall, fatal hæmorrhage from the carotid artery, which lies in close proximity, or facial paralysis, may occur. These accidents follow almost exclusively the chronic form of suppurative inflammation. The discharge in an acute attack of aural catarrh, as a rule, bursts through the membrana tympani, which should, if it be observed to bulge, at once be carefully incised to let out pus.

Amongst the rare remote effects of aural suppurations must be included abscesses in the lung and liver, peritonitis and pleurisy, Bright's disease, and amyloid degeneration.

ORGANISMS IN SUPPURATIVE AURAL DISCHARGES.

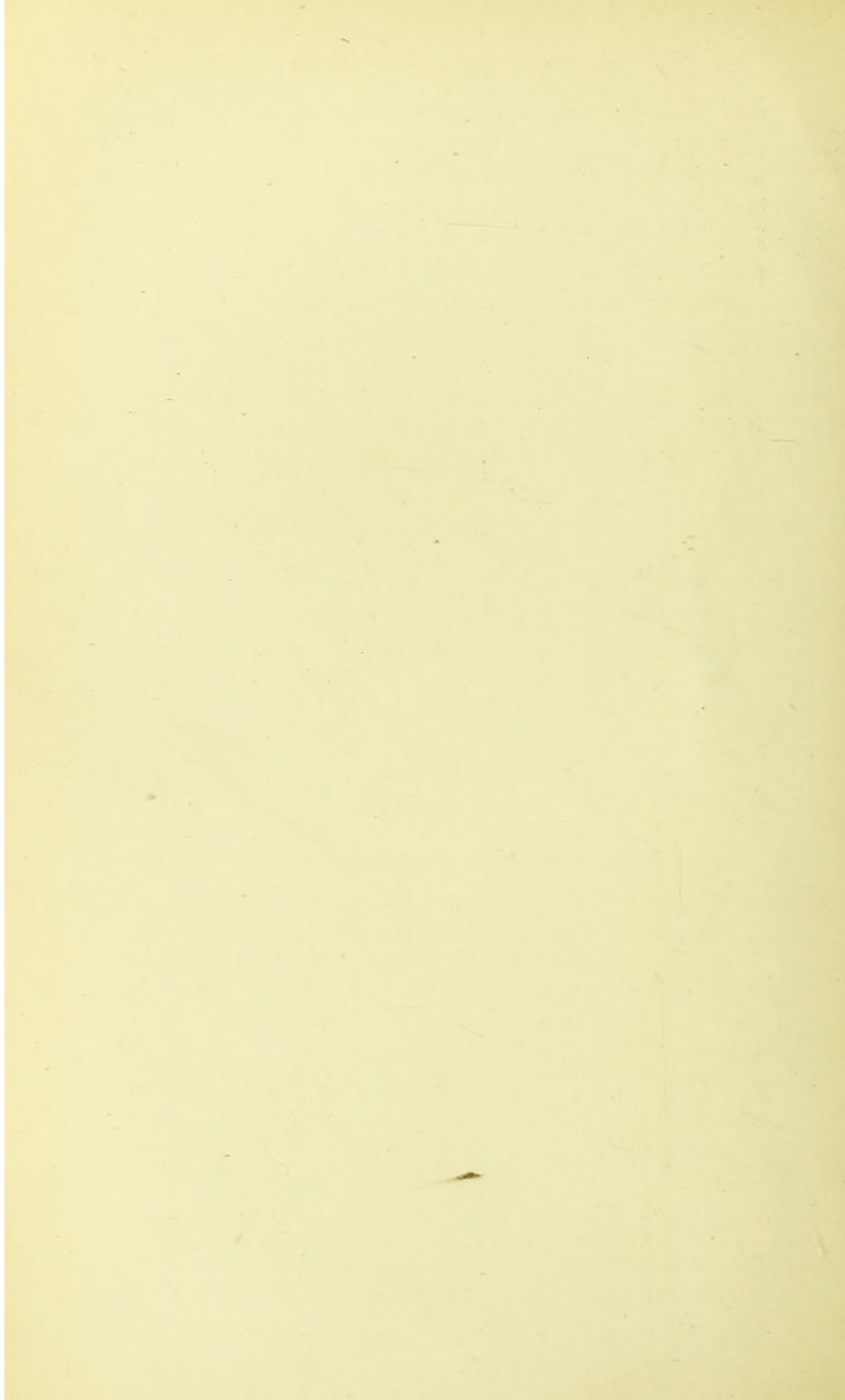
According to Zaufal, in acute otitis media, due to cold and catarrhal extension from the naso-pharynx, the *pneumo-bacillus* of Friedlander, and *diplococcus* of Fränkel, play an important part; on the other hand, this observer found that *streptococcus pyogenes* is usually present in those dangerous chronic cases which present intra-cranial complications. The two accompanying plates are drawings of preparations made by Mr. J. Jackson Clarke from a fatal case of cerebro-spinal meningitis, which supervened on suppurative otitis. Rohrer asserts, as the result of his cultivation experiments, that whereas cocci alone are usually present in non-fœtid discharges, bacilli and cocci



J. J. C.

Drawn freely under Leitz $\frac{1}{10}$ in. oil immersion.

Part of a pure culture of the strepto-coccus pyogenes, stained with gentian violet, obtained from a sub-arachnoid collection of pus in a child who died of cerebro-spinal meningitis due to middle ear disease.



are found together in fœtid cases. Inoculations, however, proved that the bacilli were of a saprophytic and innocent nature. Barker (in his Hunterian Lectures) remarks on these observations, and points out that some of the most dangerous sequelæ may be met with where the secretions from the tympanum are either nearly or quite odourless.

Allusion has already been made to the presence of *staphylococci* in external otitis; these organisms have been recognized by many observers in tympanic suppurations.*

In tubercular lesions the *bacillus tuberculosis* is readily found by the usual special methods. The *Klebs-Loeffler bacillus* of diphtheria, and the specific organisms of scarlatina and of measles are occasionally, but not invariably, to be found when these respective diseases are complicated with aural discharges.

Leptothrix is rare; and *aspergillus niger* (see Figs. 35 and 36), is only found infrequently in hospital patients, when it extends from the meatus; the subjects of it are usually foreigners of dirty habits, who have contracted the disease abroad. It and other varieties of *aspergillus* are occasionally associated with the application to the meatus of oil, which, of course, tends to become rancid.

ATTIC DISEASE.

Bone disease in the *attic* of the tympanum or malleo-incudal recess (see p. 11), is fortunately comparatively rare, for not only is the diagnosis often difficult, but the treatment requires skill and patience, and is but too frequently unsatisfactory. This cavity is divided, by the head of the malleus and its ligaments, into two communicating chambers; the outer one, bounded externally by Shrapnell's membrane, is the external attic or Prussak's space. The accompanying Fig. 59 shows the attic exposed by cutting through the neck of the malleus. The vertical section, Fig. 60, represents the parts in their natural size.

* For a very comprehensive *résumé* of the work done in the bacteriology of suppurative affections, and valuable original observations, see de Vomécourt, "Rôle des Micro-organismes dans les Otites Moyennes Purulentes, &c." Thèse de Paris, 1892.

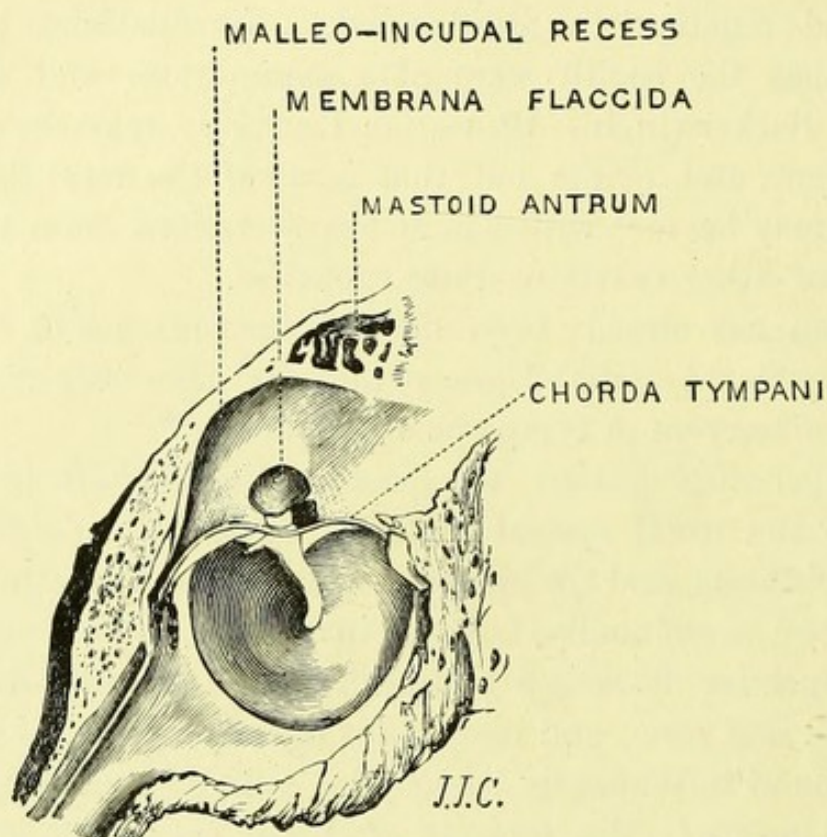


FIG. 59.—Malleo-Incudal Recess or Attic, seen above the Chorda.

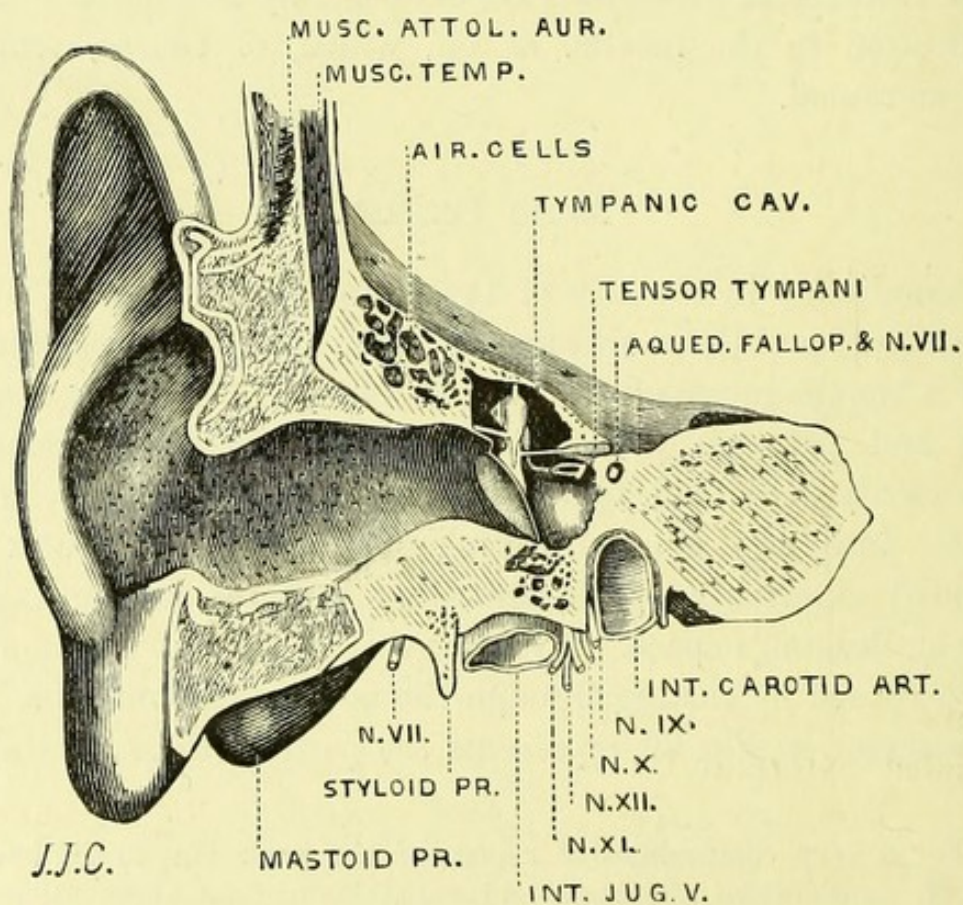
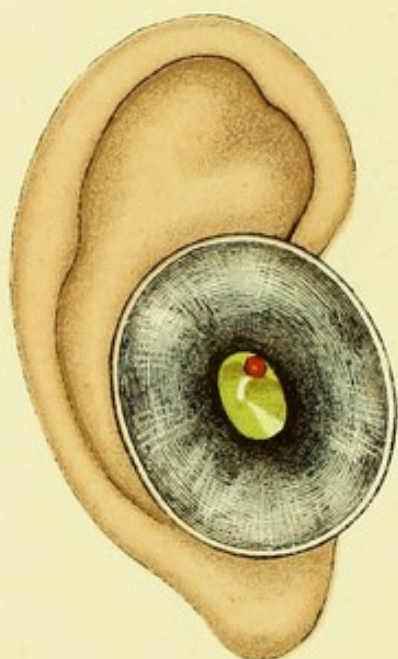


FIG. 60.



PERFORATION OF THE MEMBRANA FLACCIDA.

Attached to the malleus are the superior and external ligaments, and immediately below the latter is the membrana flaccida or Shrapnell's membrane. Fig. 61 represents a vertical section

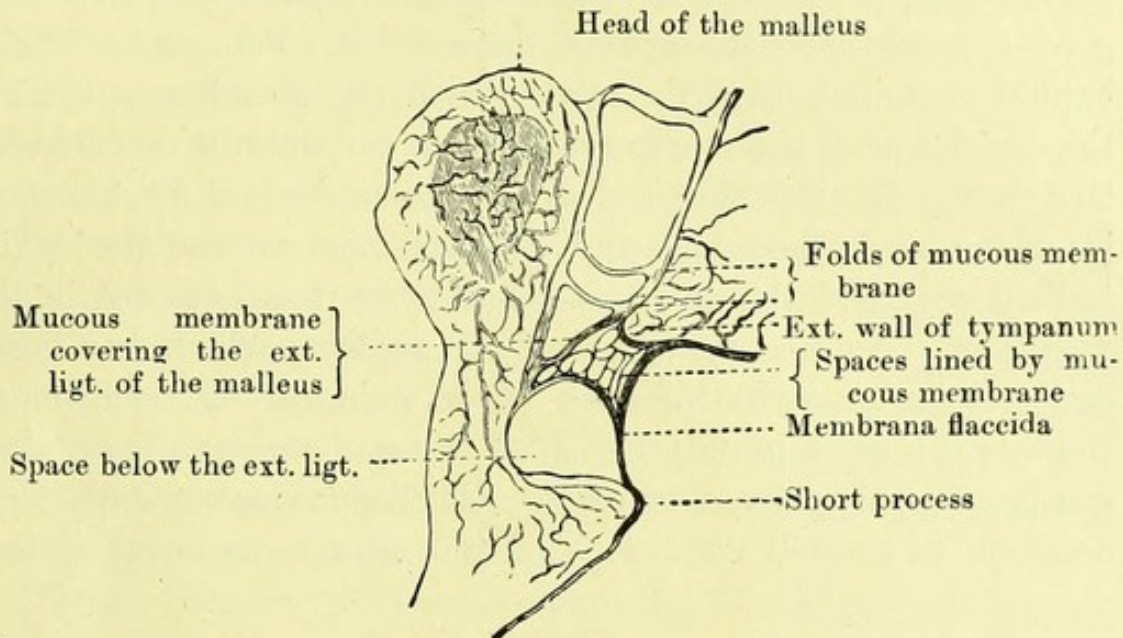


FIG. 61.—The External Attic. After Politzer.

through the upper part of the malleus, &c., of a child as seen under a low power of the microscope. According to Professor Politzer, from whose work on diseases of the ear the drawing (Fig. 60) is taken, the external ligament is formed by intersecting bands of fibrous tissue with large intervening lymph spaces. Morbid changes develop in this region, partly as primary affections and partly as the results of diffuse diseases of the tympanum. "With regard to treatment in simple perforations of Shrapnell's membrane, the septic matter in the external atticus must first be removed. Simple irrigations are insufficient, as the fluid does not penetrate into the deep parts owing to the narrowness of the opening. For these irrigations Politzer recommends Hartmann's cannula, or an instrument devised by himself, which is supplied with an elastic tube. As to the fluid for irrigation, a 3 per cent. watery solution of resorcin, or, when there is a foul-smelling discharge from the ear, a watery solution (1 in 2,000) of sublimate, is recommended. After repeated antiseptic lotions, some drops of a saturated alkaline solution of boric acid (1·05 to 20) or the alcoholic solution of iodol, occasionally also a concentrated solution of nitrate of silver (1 to 10) should be

injected into the attic through the perforated Shrapnell's membrane with an elastic tube. On some occasions the introduction of thin iodoform rods into the suppurating cavity proves highly useful. If continued, severe suppuration engenders a suspicion of caries of the ossicles. Politzer advises a careful examination of the attic with the sound, as caries of the ossicles or of the margo tympanicus can only be detected in that way. He has practised a manœuvre devised by himself, by which a soft flexible sound can be turned around its longitudinal axis, and the cavity of the attic thus explored in all directions. As to extraction of the malleus, which has been practised in modern times for other than carious conditions, Politzer thinks it is only indicated where disease of that bone can be certainly proved to exist. Hartmann recommends free drainage in morbid conditions of the attic by removal of the

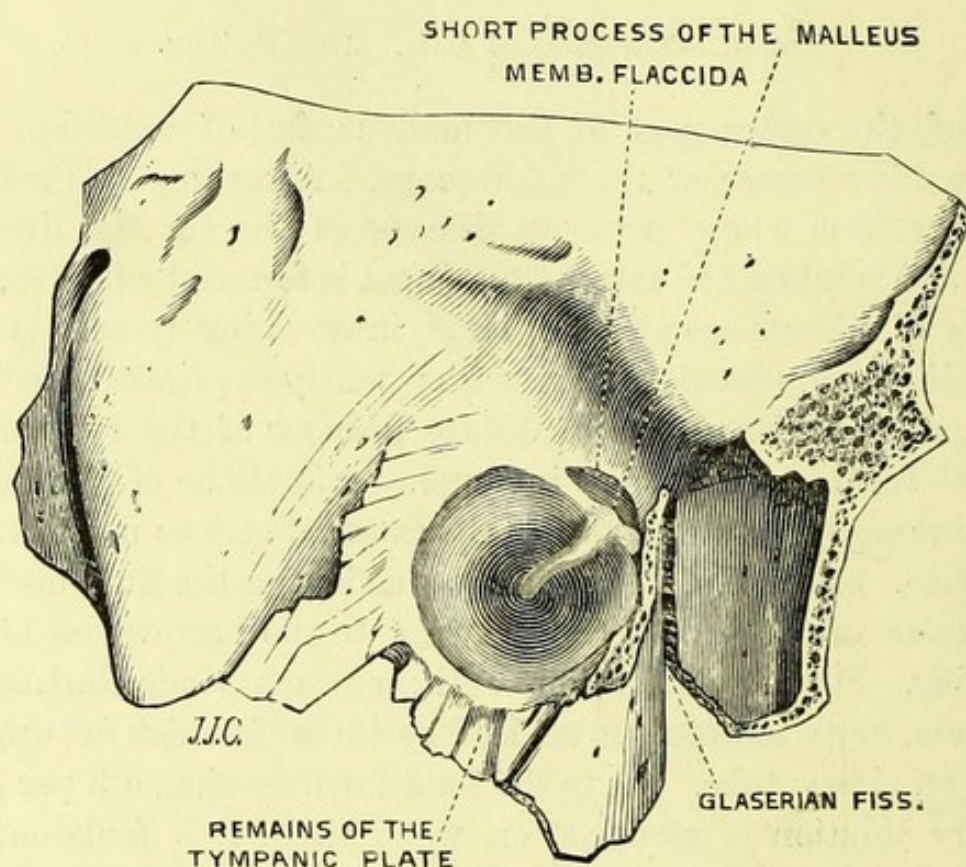


FIG. 62.—The outer surface of the Tympanic Membrane, &c., enlarged twice natural size.

pars ossea (seen in Fig. 62, above the membrana flaccida) with a special little chisel. He points out that the attic in disease

is often shut off from the rest of the tympanum, and that, as the perforation in Shrapnell's membrane is necessarily small, these cases often lead to intra-cranial mischief."* I have no doubt that in many cases of subdural abscess in the middle fossa that the destructive processes extend from this region through the *tegmen tympani*. In connection with these operations, Burnett, in recording a case, has recently pointed out that, after the necessary incisions with knife and chisel, the structures can be better removed by means of a snare than by small forceps—a very practical hint; but the danger of dislocating the stapes, and thus draining the labyrinth, if force is used, must be borne in mind, and the ossicles should not be seized with the snare until it is believed that they have been detached by the necessary incisions. The curette, or scoop, must be used with caution in the attic.

These delicate operations can only be briefly alluded to, rather than adequately described, in an elementary work; they require great manipulative skill, and should only be undertaken after fully appreciating the responsibility, even by experts. Dr. Sexton's set of delicate instruments are the best I have seen for the purpose, and the practitioner requiring details of the methods adopted for excising the ossicles is referred to that aurist's text-book.

It must here be mentioned that "cholesteatomata," pearl-like growths held by some to be epithelial accumulations, but by others considered true tumours, are sometimes found in the attic (as well as in the mastoid cells). They are usually associated with a long history of intermittent suppuration and perforation of Shrapnell's membrane; a discharge of pus, or a polypus, or a granulation is sometimes seen issuing from the perforation. It is asserted that they form a very favourable nidus for the growth of septic organisms, and serve to explain those cases where, with Shrapnell's perforation, the discharge suddenly stops, giving rise first to pain and afterwards to the development of intra-cranial symptoms. The treatment is obviously to endeavour to cleanse the attic with the intra-tympanic syringe. Recently a number of these cases have, in

* Quoted from the *Year Book of Treatment*, 1891.

Europe and America, been submitted to the operation of removal of the malleus, and sometimes of the incus also, with reported success.

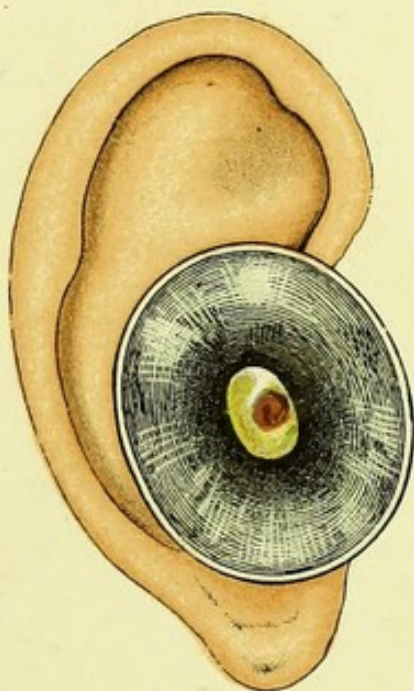
When cholesteatomata in the attic cannot be thoroughly removed by these operations through the meatus, and when they extend into the adjacent cells, some more radical procedure is necessary. The one mostly in vogue is to open the mastoid antrum by the ordinary incisions; many prefer, however, to open the mastoid cells and tympanum from the meatus after the auricle is detached and displaced forwards; this entails the chiselling away of the upper and posterior bony walls of the meatus, but it is a very thorough operation, and does not appear to introduce in practice any additional element of danger. It enables one to ascertain with more certainty the exact condition of affairs, especially as to whether any or all of the ossicles are diseased, or whether ankylosis is present.

AURAL POLYPI.

Varieties and Structure of Aural Polypi.—According to their histological characters, aural polypi may be divided into the following classes:—

(1) "Granulation" tissue (syn. Granulomata), (2) Mucous, (3) Fibrous, and (4) Hyaline myxomatous polypi.

(1.) The "*granulation*" tissue polypi are reddish, rounded, soft, and very vascular tumours, varying from the size of a pin's head to that of a pea, or somewhat larger. On microscopic examination they are seen to have a thin outer coating of epithelium, the lowest cells of which are columnar or quadrangular, while the more superficial are polyhedral, in two or three rows, and flattened towards the free surface, as in the specimen, from which the illustration (see coloured plate) was taken. The bulk of the growth is made up of round or oval cells, containing large nuclei and granular matter, imbedded in a hyaline or finely granular stroma. A few fine filaments of connective tissue are seen running through the growth, more abundant in the older parts of it, and around the vessels, which are numerous, large, and thin-walled, resembling dilated capillaries.



POLYPUS.



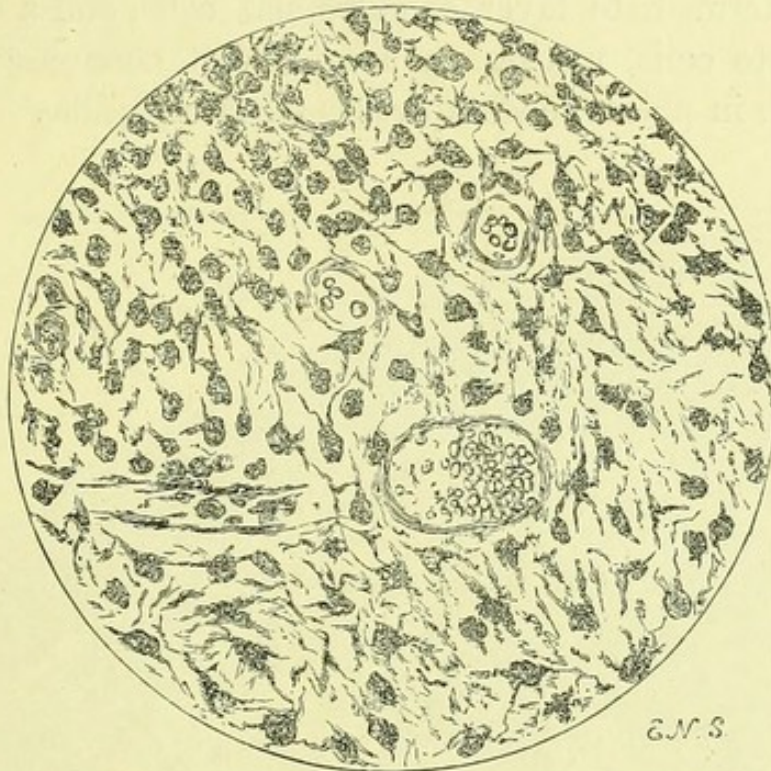


FIG. 63.—Microscopical Section of Mucous Polypus.

(2.) The *mucous polypi* manifest a rather higher stage of development, and in structure somewhat resemble the fetal skin at about the fifth month of embryonic life. They present an outer epithelial coat, the superficial cells of which are squamous, like those of mucous membrane, the intermediate layer devoid of spines, and the lowest rete cells columnar, and supported by delicate papillæ of connective tissue. Here and there the epithelial layer is prolonged into the substance of the growth in the form of gland-like recesses or crypts. The main bulk of the growth consists of a soft mucous matrix, lying in the meshes of elastic and areolar connective tissue, and enclosing cells, of which some are round or oval, with large clear nuclei, but the majority fusiform or stellate. The vessels are abundant, large, and thin-walled.

In structure, these polypi are intermediate between the true myxomata and the soft fibromata (fibroma molluscum), and represent a stage in the development of connective tissue intermediate between granulation tissue and distinct fibrous tissue.

(3.) The *fibrous polypi*, rarer than the last, have, like them, an outer epithelial coat, with well-marked superficial squamous

cells, an intermediate layer of polygonal cells, and a columnar layer of rete cells, resting on a somewhat condensed fibrous layer, which in places sends upwards minute papillæ.

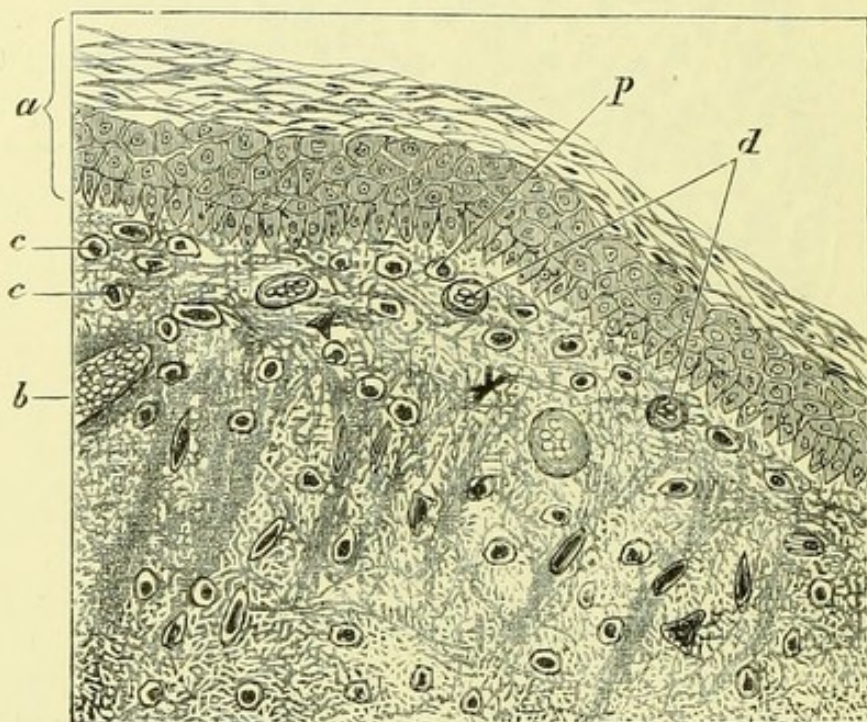


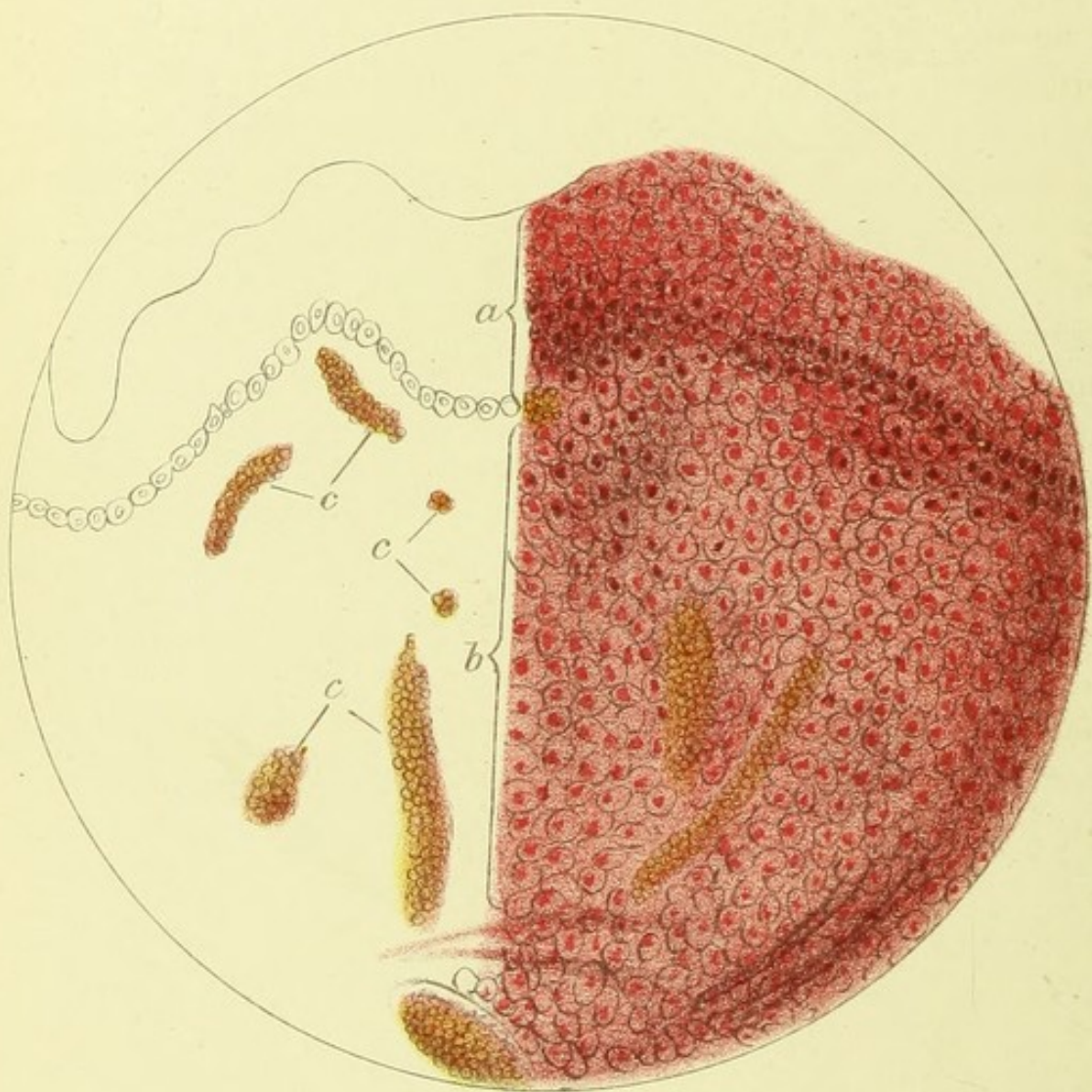
FIG. 64.—Microscopic Section of Fibrous Polypus.

- a.* Epithelial layer.
- b.* Blood-vessels of growth.
- c, c, p.* Cells of superficial sub-epithelial layer.
- d.* Capillaries.

The mass of the growth is distinctly fibrous, the stroma being made up of loosely-interlacing bundles of areolar and elastic tissue, containing in their meshes remains of the mucous intercellular substance and some small and usually fusiform or angular cells. The vessels are of less size, and have thicker walls, than those of the last-named variety of polypus; and distinct arteries, veins, and capillaries can be seen in their interior as well as at their base.

Aural polypi very often present a combination of the various structural types described above, the most recent portion of the growth being round-celled, the later mucous, and the oldest firm and fibrous.

Towards the base are found arteries and veins, with distinct endothelial, muscular, and fibrous coats; but in the tumour



G.C.H.

× 400

Aural Polypus, composed of "granulation tissue."

- a. Epithelial covering, the superficial cells of which are flattened, the lowest columnar.
- b. Small round celled tissue forming the bulk of growth.
- c. Thin walled vessels filled with red corpuscles.

itself these vessels are lined by endothelium, supported only by a delicate fibrous basement membrane. The smallest polypi have no distinct epithelial coat, and their microscopic appearances are identical with those of round-celled sarcoma.

Hyaline or gelatiniform myxomata, by far the rarest variety of aural polypi, are soft, jelly-like, semi-translucent nodules, pervaded by vessels which can be easily teased out. When cut, the surface swells up, and scrapings show red blood corpuscles mixed with round, fusiform, angular, and stellate cells, floating in a transparent viscid fluid. They consist of an outer epithelial coat surrounding a network of branched and fusiform nucleated cells, which lie in the midst of a gelatinous matrix. Small round cells are scattered here and there among the larger branched ones, and occasionally fat cells and elastic fibres occur. The blood-vessels are numerous and thin-walled.

Voltolini* remarks that aural polypi, when they excite little pain if pulled upon are benign in character, but when very sensitive afford a bad prognosis, and a deeper affection (*e.g.*, of the bone) may be diagnosed. He relates two cases in which the polypi were excessively tender to the touch: both terminated fatally, one from violent hæmorrhage from the ear, and the other from meningitis.

Etiology and Situation.—Aural polypi are, as a rule, the result of long-standing otorrhœa. They may arise from the walls of the external meatus, or even from the membrana tympani or Eustachian tube, but probably most commonly from the tympanum. They make their way out through a perforation in the membrana tympani.

Treatment.—The smaller polypi may be destroyed by the constant application of caustics. For some of the softer kinds sulphate of zinc in strong solution, or, perhaps preferably, this with carbolic acid (āā gr. v ad ʒj), answers very well.

J. B., æt. 38, a labourer, came to St. Mary's Hospital, April, 1878, suffering from intense pain on the left side of the head. He was seen by one of the physicians for out-patients, who, at once discovering ear mischief, sent him to me. He had been almost completely deaf in both ears since a fall six years pre-

* *Loc. cit. supra.*

viously, and for the past three months had been under treatment for the pain in the head, which was attributed to neuralgia. I removed a large polypus blocking up the external meatus, and immediately a large quantity of thick foetid pus escaped from the ear.

He at once obtained relief from the severe head symptoms. The hearing afterwards slightly improved. The pent-up pus would probably have led to much more serious results had it not been evacuated.

A. B., æt. 17, came up from Windsor to consult me at the hospital, March 15, 1876, with a polypus in the left ear, the largest I have seen. She had been gradually getting deaf for six years, during which time there had been a constant and



FIG. 65.—Polypus from Ear, natural size.

The pedicle shows the size of the perforation in the membrana tympani through which it passed. (St. Mary's Hospital Museum, No. 800.)

offensive aural discharge. I removed the growth in the usual way with Sir W. Wilde's snare. She was very sick after the operation. The discharge eventually ceased, and in a month's time she went home with her hearing restored.

S. B., æt. 59, came to the hospital in May, 1876.* She stated that twenty-three years previously she was placed under chloroform, and a polypus was removed from her right ear, and that subsequently the external meatus was filled with cotton-wool. She was told that she would never hear again in that ear, as "the fangs of the tumour had come away." For a few

* *British Medical Journal*, December 16, 1876.

years after the removal she had no pain or discharge, but she could still hardly hear a sound on the right side. For two or three years past there had been a very offensive discharge, and latterly she had felt pain over the right side of the head; this during a month had been so great that sleep at night had been impossible. When she came to the hospital her face was very much swollen, and she could not bear her ear to be touched. Eight leeches applied in front of the tragus gave immediate relief. When she came again, what appeared to be a large polypus was seen in the right external auditory meatus. Wilde's snare brought away a piece of this about the size of a pea. A hardened white substance, which proved to be cotton-wool placed in the passage twenty-three years previously, was then removed, and then the rest of the polypus. This had evidently forced its way along the roof of the meatus so as eventually to hang over and completely cover the cotton-wool. A weak carbolic acid and sulphate of zinc lotion and a quinine and iron tonic were ordered. In a month's time the discharge ceased; and, although she had a large perforation in the membrana tympani, the patient could hear tolerably well.

G. G., a postman, æt. 56, came to the hospital in June, 1876. His right ear had been discharging for twenty-four years, during the last ten of which it had been deaf, and at times in very great pain. For a year about a teaspoonful of discharge had come from his ear daily, and lately he had been so giddy, especially if he bent down his head to look at a letter, that he had been quite unfit for his work. A very large mucous polypus was removed. The same treatment was adopted as in the last case, with a like satisfactory result. He remarked before leaving the hospital that he should have escaped a good many years of suffering had the polypus been earlier removed; but he had acted on the advice constantly given him "not to meddle with the ears."

These cases are of interest, as showing the great length of time people will submit to pain and the constant pouring of a loathsome discharge from the ears, without seeking relief.

A great many more similar instances could be adduced; but what I want especially to point out is, that a successful ter-

mination is not to be expected without careful treatment when the polypus is removed. Thorough cleanliness is most essential.

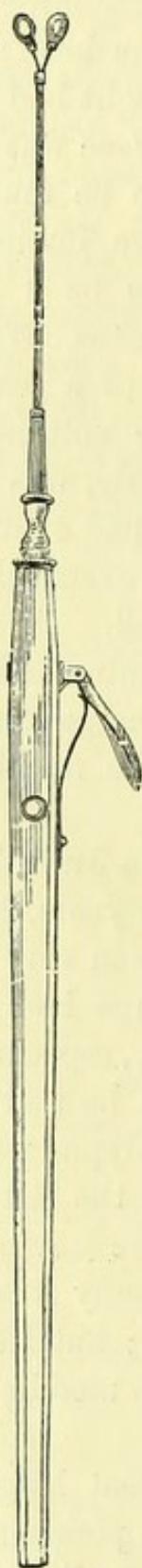


FIG. 66.—Toynbee's
Lever Ring Forceps.

If the discharge is allowed to go on unchecked after the operation, and no steps are taken to get rid of the accumulated secretion in the tympanic cavity, another polypus is likely to spring up in a short time. Hinton remarks: *—"Growths of this nature in the ear are extremely prone to recur, but the degree of obstinacy with which they resist treatment is very variable. In some rare cases they will come away spontaneously and leave a permanently healthy surface; in others they will disappear before treatment, and show no tendency to recur; in others their eradication is attended with the utmost difficulty. It has seemed to me that the accumulation of secretion behind the polypus or its root is one of the most frequent sources of difficulty in their treatment, especially in cases where the membrana tympani is perforated. The viscid matter poured out by the spongy mucous membrane of the tympanum tends to cling about its various crevices and maintain a perpetual irritation, which sets every kind of caustic or healing application at defiance. Accordingly a chief object to be aimed at in the management of polypi is the perfect cleansing of the deep-seated parts of the organ. This is not to be effected by syringing merely, however vigorous and long-continued. Water does not remove the tenacious matter, nor, probably, does the stream reach the whole secreting surface." In all cases after the polypus is removed it is necessary to apply to its seat a strong caus-

* "Supplement" to Toynbee's *Diseases of the Ear*, p. 432.

tic, *e.g.*, solution of nitrate of silver (480 gr. to ʒj) in cotton-wool on a suitable holder. Some surgeons recommend touching it with chloracetic acid by means of a camel's hair pencil every other day or so, until all signs of the growth have disappeared. Chromic acid is still more powerful, and may also be used advantageously. It is best applied on a copper probe, or better still on a probe with a small platinum loop. The deliquesced acid is the best. Dilute solutions are useless. It is well after these strong remedies have been applied, especially if any pain is experienced, to syringe the ear with warm water. After touching with chromic acid a neutralising alkaline injection is more especially indicated. Very little pain, however, will be caused if the greatest care be taken to touch only the small spot from which the polypus springs; it is therefore best to guard the meatus with a speculum, and to use a strong light. Perchloride of iron and sulphate of copper have their advocates.

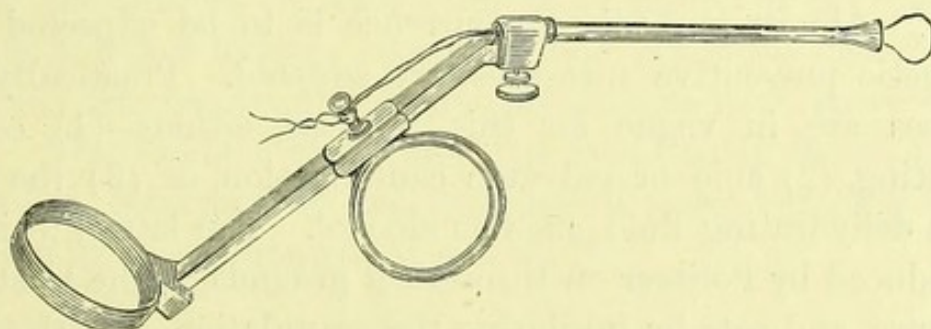


FIG. 67.—Blake's Modification of Wilde's Polypus Snare.

Numerous means have been proposed for the removal of aural polypi. Toynbee invented for that purpose the lever ring forceps, and Allen a slender three-bladed pair of forceps. An excellent instrument for cutting through them has also been introduced by Dr. Purves. I always use Wilde's snare, as modified by Blake,* and prefer it to everything else that has been suggested.

Attempts at removal of a polypus with forceps or snare are rarely successful in eradicating the whole of the growth at one

* A description of Dr. Clarence J. Blake's snare, which is adaptable to several purposes, may be found in the *Archives of Ophthalmology and Otology*, No. 2, vol. 1, published in Carlsruhe and New York, 1869.

operation. After the large mass has been removed, the meatus should first be syringed repeatedly with warm water and this should be followed by an instillation of cocaine (10 or 20 per cent. solution), not so much for the relief of pain as for its styptic properties. After a few minutes, the meatus should be thoroughly cleansed with cotton-wool and then inspected in order to ascertain the exact site and dimensions of the pedicle or base; if necessary, this should be thoroughly curetted with a small ring knife. When the growths spring from carious bone it may be necessary to scrape the bone under the granulations with a small sharp spoon (Hartmann's), but a general anæsthetic



FIG. 68.—Ring Curette ($\frac{1}{2}$ nat. size).

is to be preferred to cocaine for this procedure. These granulations require repeated and energetic treatment, and rapidly recur. Almost immediate recurrence is to be expected unless energetic preventive measures are adopted. Practically, three courses are in vogue for this purpose, either—(1) constant curetting, (2) acid or galvanic cauterization, or (3) the use of some dehydrating fluid such as alcohol. The latter, which was introduced by Politzer on theoretical grounds, is the least severe measure, and acts by inhibiting the granulation growth through the abstraction of water. Ordinary rectified spirit sometimes causes pain and irritation, and many practitioners, therefore, prescribe spirit diluted with from 10 to 25 per cent. of water, but it must be remembered that such dilution considerably modifies the dehydrating, and therefore the destructive, power of the alcohol; instead of dilution with water, the admixture of 25 per cent. of glycerine neutralizes the irritating effect of spirit, and is at the same time itself a dehydrating agent. Antiseptics such as salicylic acid can be advantageously dissolved in alcoholic instillations, and they should always be applied warm to a dry meatus. Alcohol drops undoubtedly cause shrinkage of polypi in many instances, but Voltolini has pointed out that their use for many months is undesirable, from the continuous abstraction of water from the mucous lining of

the tympanum. The drops should only remain in the ear for twenty minutes, when the tympanum should be syringed with the antiseptic solution considered appropriate for the concomitant suppurative disease.

FACIAL PARALYSIS.

With respect to facial paralysis, which not infrequently follows a chronic discharge from the ear, I cannot do better than repeat what Dr. Hughlings Jackson has so well said:—"Uncomplicated facial disease, with ear disease, is not a cerebral symptom; it is not an intra-cranial symptom; it is scarcely an ear symptom; it is rather a bone symptom. It is occasionally the precursor of facial intra-cranial mischief; but, as a matter of fact, not often, and, when so, it is independent of it. The ear disease, by distinct processes, happens to do two entirely different things at once, or in quick succession. It is erroneous to infer that because the process by which the palsy results is a gross one, recovery will not follow; complete recovery often does." My experience has been uniformly in accordance with these statements. Von Tröltsch observes, "The facial palsy does not even show much extension of the tympanic disease, but only slight extension in an unfortunate direction."*

CARIES AND NECROSIS.

Bone destruction in the neighbourhood of the middle ear is probably always the result of acute or chronic suppuration, in other words, ulceration of the bone is nearly always preceded by ulceration of the overlying muco-periosteum. Occasionally in acute fevers, as the result of the cutting off of the blood supply in certain portions of the petrous bone, a large sequestrum is formed. Bone destruction usually occurs in tubercular or in weakly individuals, and is often preceded by the formation and retention of exudation products and cholesteatomata, which cause ulceration by pressure. These destructive processes are more common in the mastoid cells than in the attic and other parts of the tympanic cavity; but, as has been mentioned pre-

* See page 189.

viously, bone disease is not infrequently rendered evident on probing the meatus and tympanum; on account of the occlusion by caseous deposits of the passage from the mastoid cells to the tympanum, the mastoid region is more frequently involved, and the carious process, fortunately, usually extends outwards; but the destruction may proceed from the antrum or tympanum superiorly to the middle fossa of the cranial cavity, or internally to the sigmoid portion of the lateral sinus and posterior fossa. Fortunately the bony tissue surrounding the labyrinth is seldom involved, though I have more than once seen the cochlea exfoliated, and also the aqueduct of Fallopius opened. It is remarkable that the membranous fenestræ are so seldom destroyed, and this accounts for caries rarely, comparatively speaking, involving the labyrinth. Cases are, however, on record of pus passing through the labyrinth to the internal auditory meatus.

Hæmorrhages and inflammation of the walls of the neighbouring arteries and veins which pass through the temporal bone are an occasional result of caries. Bleeding sometimes proves fatal in a few minutes when the carotid artery, jugular vein, or lateral sinus is ulcerated. A like result, though not so rapidly, has followed ulceration of the middle meningeal and stylo-mastoid arteries.

Of the ossicula, the stapes is least frequently affected, and its footpiece is rarely lost; the long process of the incus is more liable to disease than the rest of the bone; but, on the other hand, the head of the malleus is far more often destroyed than the handle.

The presence of a sequestrum can only be diagnosed with certainty in those cases where it is possible to make out a piece of bare movable bone by means of a straight or bent probe, but the presence of bone disease may with fair accuracy be assumed from the following series of symptoms (Hartmann):—

1. Long-continued fetid discharges unrelieved by persistent and varied treatment for otorrhœa.
2. Rapidly recurrent granulations.
3. Hyperostosis of the inner portion of the posterior wall of the meatus.

4. The previous removal of small sequestra from the meatus without diminution in discharge.
5. The present or former existence of fistulous openings behind the ear, with copious foetid discharge.
6. When, in addition to the above, there is swelling of the external ear and involvement of the lymphatic glands.

On account of the danger of intra-cranial extension, it is of importance to recognize early, the condition under consideration, and to carry out prompt and energetic surgical treatment.

A sequestrum in the meatus, or in that part of the tympanum which can be explored with instruments through the meatus, can usually be removed with a little manipulation by means of steel hooks and small forceps. It is sometimes necessary to incise the swollen meatal lining when the sequestrum is large, and if enough space is not gained by incision, it is better to avoid rough measures and at once proceed, under an anæsthetic, to perform the operation of displacing the auricle and cartilaginous meatus forward; and if this even is insufficient, the posterior wall of the bony meatus must be cautiously removed with a chisel. Sequestra in the mastoid cells are best removed by the incisions described elsewhere for reaching the mastoid antrum. In cases of extensive caries it may be necessary to combine this latter operation with the one just described for reaching the inner end of the meatus and tympanum. After sequestra, granulomata, and cholesteatomatous masses have been removed, all carious areas must be cautiously, but thoroughly curetted. The areas of danger are those elsewhere detailed in connection with mastoid operations. I have seen numerous cases in which diseased bone has been inferred from recurrence of granulations in the meatus, and absolutely diagnosed by the probe, and in which scraping the diseased area with a small Völk-mann's spoon, combined with acid applications, has effected a cure; but, unfortunately, in a large number of instances, there is disease in the remoter parts of the middle ear as well, when the mastoid cells must be opened if there is evidence, or even suspicion, of disease in that region.

CASES ILLUSTRATING DISEASE OF THE MASTOID CELLS.

K. S., æt. 19, a servant, was sent by Dr. Owen Roberts to consult me at St. Mary's, suffering from an abscess over the mastoid process, with high fever, and a pulse of 120. She had for five years complained of a constant and very offensive discharge from her right ear, and latterly of a dull heavy pain and great tension at the back of it. By means of a deep incision through the periosteum of the mastoid process, a quantity of thick pus was evacuated. After this, under a course of quinine and iron, she rapidly improved in health. An excellent plan in all such cases is each day to gently syringe out the tympanum and mastoid cells through the external meatus until the injection finds its way out through the opening over the mastoid process. The parts were thoroughly cleansed in this manner by a carbolic acid and zinc lotion.

Small pieces of necrosed bone gradually came away, and on the 11th of April she was well, and left the hospital, the wound having quite healed, and her hearing being almost restored.

M. C., æt. 25, a housemaid, was admitted into the hospital under the care of Dr. Broadbent, June 9, 1874. She had begun to look pale twelve months before, but had felt well up to Christmas, when she began to grow weak. She had for about a fortnight, whether she had taken food or not, vomited daily about three pints of yellowish-green fluid. Besides weakness, she had suffered from swimming pains in the head, everything seeming to go round; also from dimness of vision and a "running" from the left ear. She said that the beat of the heart ran up to the top of her head on the left side. Her pulse was 72, and her temperature 98.8° . She lisped, and had a slight difficulty in commencing to speak. The heart's apex-beat could scarcely be perceived.

On the 12th she had great pain in her mastoid process, and was quite deaf with the left ear. Three days later she complained of nausea, sickness, and giddiness, and of pain an inch below and to the left of the apex of the ensiform cartilage. The chest showed tenderness on percussion.

On the 18th there was still discharge from the ear: the temperature was 99.2° .

On the 19th Dr. Broadbent asked me to see her. On the whole of the left side of the head she suffered acute pains, which, when she attempted to rest it on her pillow, "darted through her brain." Her face was much flushed. The skin over the left mastoid process looked red and swollen, but the discharge from her ear, which was totally deaf, had nearly stopped. She said she felt dizzy, and the patients in the ward looked quite small. I at once cut down upon the mastoid process, with the effect of evacuating through my incision, as also through the external auditory meatus, a large quantity of yellowish, creamy-looking, and very offensive matter. I kept the wound open by means of a small piece of lint as long as the discharge lasted (about six days). The ear was very frequently syringed with warm water, and three times a day a lotion of sulphate of zinc and carbolic acid (gr. v of each to \mathfrak{z} i of water) was, after the injection, poured into the ear, the patient at the same time being directed to hold her nose and blow. By these means, and also by drawing up weak lotions through the nose, the parts were kept constantly clean, and the discharge was gradually stopped. The Eustachian tube was kept open by the occasional use of Politzer's bag. The wound closed, and by July 13 the mastoid process was quite free from pain, the perforation in the membrana tympani had closed, and the hearing of the left ear was restored.

Abscess in the brain (probably in the cerebellum) would no doubt have resulted had the opening not been made. If the lateral sinus had been implicated (and the words she made use of, viz., "the beat of my heart runs up to the top of my head on the left side," were, I think, significant), the case would probably have terminated in lobular pneumonia, with gangrene of the left lung.

A very similar case was sent to me a short time ago from the Isle of Wight, in which the wound remained open for several months, during which some small pieces of dead bone came away.

The following is one of the many cases showing the benefit

that may be derived from—first, an early incision over the mastoid process; secondly, leeching freely; thirdly, constant washing with weak astringent applications:—

L. T., a young woman, æt. 26, came to the hospital, November, 1876, suffering from abscess behind the left ear. Ten days previously she had caught a bad cold, which was followed by severe earache. After five days an abscess burst in her left ear, from which there had since been a very offensive discharge. Two days before coming to me the discharge had lessened, and she had thenceforward suffered intense pain over the left side of the head, especially behind the ear. A deep incision was made over the mastoid, and pus evacuated. She was sent up into the Manvers Ward, and six leeches were applied in front of the tragus, with the satisfactory result of taking away all pain. A weak carbolic acid lotion was prescribed, to be frequently syringed into the ear. The discharge gradually ceased, the perforation in the membrana tympani closed, and on November 28 the patient was discharged well.

The next case is one of mastoid abscess and separation of sequestrum:—

L. S., æt. 38, a German Pole, a hair-dresser, was admitted into the Grafton Ward under my care June, 29, 1878. He had pain and swelling behind the left ear, from which there had been a discharge since September, 1877. There was no paralysis of any kind, but the left ear was almost completely deaf. The origin of the mischief he ascribed to sitting in a draught whilst travelling by rail. The free application of leeches, followed by hot linseed poultices, afforded considerable relief. As the soft parts behind the ear were swollen almost as large as one's fist, causing the pinna to stand out from the head, I made a deep incision on to the mastoid and let out a large quantity of pus. The bone was found to be considerably necrosed. Much swelling and a copious discharge existed for a long time. Occasionally there was very severe pain with shivering. The temperature fluctuated much from day to day, and reached 102° F. on October 4. Openings made from time to time caused great relief, and a drainage-tube left in for some days in the beginning of November gave vent to much thick and offensive discharge.

Poultices were constantly applied, and the wound-cavity was frequently washed out with carbolic acid lotions.

On November 5 Mr. Stuart Brown, then house-surgeon, removed a piece of necrosed bone about half an inch in diameter, and subsequently other pieces of considerable size were taken away. The patient was treated with quinine and iodide of potassium three times a day. The wound behind the ear closed, the discharge ceased, and when, at the end of the year, he left the hospital, although he had a large perforation in the membrana tympani, his hearing was not entirely lost. He was on two or three occasions during his long stay in hospital in a most critical condition, and, had it not been for the free vent constantly given to the pus, a fatal termination no doubt would have taken place.

The operation of trephining the mastoid is a very old-established one, it having been advocated by Riolanus in 1649. An admirable summary of its history is given by Roosa. Though at one time it fell into great disrepute, it has been advocated by all recent writers on aural surgery. Dr. A. H. Buck, in an article on disease of the mastoid, has collected thirty-four cases in which its cells were opened, twenty-six of which resulted in recovery. It is most frequently employed where suppuration due to caries or necrosis in the cells of the mastoid, or periostitis of its external surface has occurred. It has sometimes been suggested for cases of suppurative discharge from the middle ear for which a free vent cannot be obtained through the external meatus or Eustachian tube, examples of which I have already described.

The general acceptance which the operation receives from modern surgeons was demonstrated during a discussion in 1880 at the Clinical Society of London on two cases brought before the Society by Mr. Henry Morris, in one of which trephining was performed, and in the other only incision. It is indicated by the symptoms of pains, redness, and inflammatory œdema over the mastoid bone, with the usual constitutional disturbance accompanying periostitis or necrosis, whether disease of the middle ear be evidenced or not. It has doubtless in many cases prevented or arrested destructive inflammation of the middle ear.

A form of deep suppuration in the neck due to mastoid disease—a cause generally undetected—has recently been investigated by Von Bezold.* He states that inflammation frequently finds its way from the mastoid cells into the digastric groove owing either to an inflammatory perforation or to the vascularity, thinness, or natural porosity or dehiscence of the bone at that point. Pus in the groove is prevented by the digastric muscle and broad tendon of the splenius capitis and trachelo-mastoid and by the sterno-cleido-mastoid from showing itself externally. It is there in close contact with the occipital artery. The anterior edges of the splenius and trachelo-mastoid are attached by connective tissue to the fascia parotidea-maseterica, which posteriorly is united with the tendon of the trapezius by the fan-like expansion of the tendons of the sterno-mastoid and splenius. The pus, being thus confined between the deep muscles and the fascia of the neck, burrows below them and along the sheaths of the vessels, especially along the occipital artery, and so to the sheaths of the external carotid, following which it may reach the thoracic cavity. Von Bezold has not only observed this course and distribution of pus, but has demonstrated the same experimentally by injection into the mastoid cells, thus clearing up an obscure and often unrecognised result of mastoid disease.

I have several times seen extension in this direction myself, and such a case under my care was recently successfully operated on by Mr. Pepper, and by him reported to the Harveian Society.

Toynbee long since pointed out that in children under three years of age, if the disease proceeded upwards from the mastoid cells, the dura mater and the cerebrum alone became implicated, whereas after that age the lateral sinus and cerebellum were also and most frequently affected.

There are three points, I think, absolutely necessary to attend to in all cases of mastoid abscess :—

1. Early incision over the mastoid process through the periosteum down to the bone.
2. Constant cleanliness and antiseptic treatment.

* *Deutsche Med. Wochenschrift*, Nov. 28, 1881.

3. Attention to general health.

The following case illustrates the fact that acute mastoid inflammation is sometimes relieved by leeching alone.

One summer I was called down to Kew by Dr. Cundall to see a gentleman who was in a most critical condition. There had been a discharge from the right ear for some time, but this had suddenly stopped, leaving him with such intense pain over the whole side of the head that he could not bear to be touched with the bed-clothes. His temperature was 103° , his pulse 120, and he suffered from repeated vomiting, diarrhoea, and shivering. I prescribed quinine every three hours, and eight leeches round the ear, to be repeated in twelve hours if there were still much pain. Two days afterwards I received a telegram to ask me to come down at once, as the symptoms, which had been greatly relieved by the two sets of leeches ordered, were growing serious again. Eight leeches were applied as before with the satisfactory result of removing effectually all signs of mischief from the mastoid process, and what might well be considered very grave and perhaps even pyæmic symptoms.

SCLEROSIS OF THE MASTOID PROCESS.

Cessation of discharge, immediately followed by pain, usually means that the attic and the opening from the tympanum into the mastoid cells have become altogether blocked, either by caseous accumulations, by the growth of granulations or polypi, or through hyperostosis. The two former are the commonest antecedents. We have lately had at St. Mary's Hospital two instances of a rare form of mastoid disease characterized by hyperostosis. In both instances there was present a very slight suppurative discharge of long standing which occasionally ceased; there was no obvious swelling of the mastoid processes; great pain in the temporal bone, and especially in the mastoid region was frequently complained of; it always recurred when the slight discharge ceased altogether, and the pain was only moderately increased on pressure; inability to sleep well at night when the pain was worse and occipital headache characterized both cases. The discharge was small in

quantity, thin, and not foetid; no evidence of caries in the temporal bone could be detected; no caseous deposits ever accumulated, as far as could be seen through the perforated membranes, in the tympana, and none were ever brought away by syringing. The hearing was only slightly impaired in both cases. The disease, therefore, appeared to be limited to the mastoid bone, and was evidently associated with chronic osseous changes accompanied by tension. Leeching and counter irritation in each case gave almost immediate, but temporary, relief. It was resolved to perform osteotomy by taking out a piece of bone from the mastoid, in order to relieve tension and to explore for any tuberculous spot. On trephining and chiseling over the site of the mastoid, a very solid piece of bone was removed in each case; in fact, no lesion except sclerosing osteitis was discovered. The operations relieved the pain in each case for many months; in one, however, there has been a recurrence of the pain, which has yielded to a seton. This latter mode of treatment was suggested by Dr. William Hill, who has found it useful in several instances.

Operations on the Mastoid Process.

Operative procedures in this region, as will be gathered from the foregoing remarks, are divisible into two kinds, viz.: (1) Simple incisions into the skin, subcutaneous structures, and periosteum; (2) osteotomy of the mastoid process with trephine, chisel, or other sharp instrument.

The former class of operation is suitable when with periostitis there is a bulging abscess situated over or beneath the periosteum of the mastoid process not obviously implicating the underlying bone and cells. Wilde's incision consists of a scalpel cut made right down to the bone from half an inch to an inch in length, parallel to the curved attachment of the auricle, and about three-eighths of an inch behind it. Should, however, the centre of the swelling be farther from the auricular attachment than this, a more posterior incision must be made.

If the posterior auricular artery be cut, the proximal end should be seized and twisted, or, if necessary, ligatured. It is

always well to examine the bone beneath the incision with a probe so that its condition may be ascertained; this is especially important in children, because the shell of bone between the cells and the periosteum in their case is much thinner than in adults, and can be easily perforated with a probe. I have frequently found that a good opening could be made by a strong probe in mastoid disease in young persons under the age of puberty, and it is in these cases that the gimlet is so handy. Should the symptoms not be relieved by Wilde's incision, as in those cases where the disease is situated deeply in the mastoid cells, another is often useful along Reid's "base line," crossing Wilde's incision at right angles; the triangular flaps are dissected up with the periosteum, preferably by a raspator, and the auricle pulled forward. If any carious spot is found with a probe, we may be sure that the cells are diseased beneath it, and the sinus can be enlarged with a chisel or gouge; it is not usually less than half an inch from the meatus. If no such spot be found, and it has been decided to open the mastoid antrum, certain landmarks have to be borne in mind, and much care is required in order to avoid the canal for the facial nerve and semicircular canals abreast, the cranial cavity above, and the lateral sinus behind. Hartmann has laid it down that these dangers are best avoided by performing the osteotomy at a point immediately under the attachment of the auricle on a level with the osseous part of the auditory meatus. The accompanying woodcut will serve to recall the topography of the part. Professor Birmingham found a drill-hole made at a point corresponding to the lower and posterior of the right angles in Fig. 69, always opened the antrum at its lowest part, in the temporal bones of adults. The bone should not be removed above the level of the roof of the meatus, as the cranial cavity is then in danger of being opened. The temporal ridge which is said to correspond to the floor of the middle cranial fossa is not a very reliable landmark, but it can usually be felt, and the trephine hole or chisel incision should always be kept well below it. By remembering that the groove for the lateral sinus is sometimes not more than three-eighths of an inch behind the osseous meatus, the sinus ought rarely to be

wounded even if exposed. A small red nasal bougie made of soft material, placed in the meatus and pressed against the

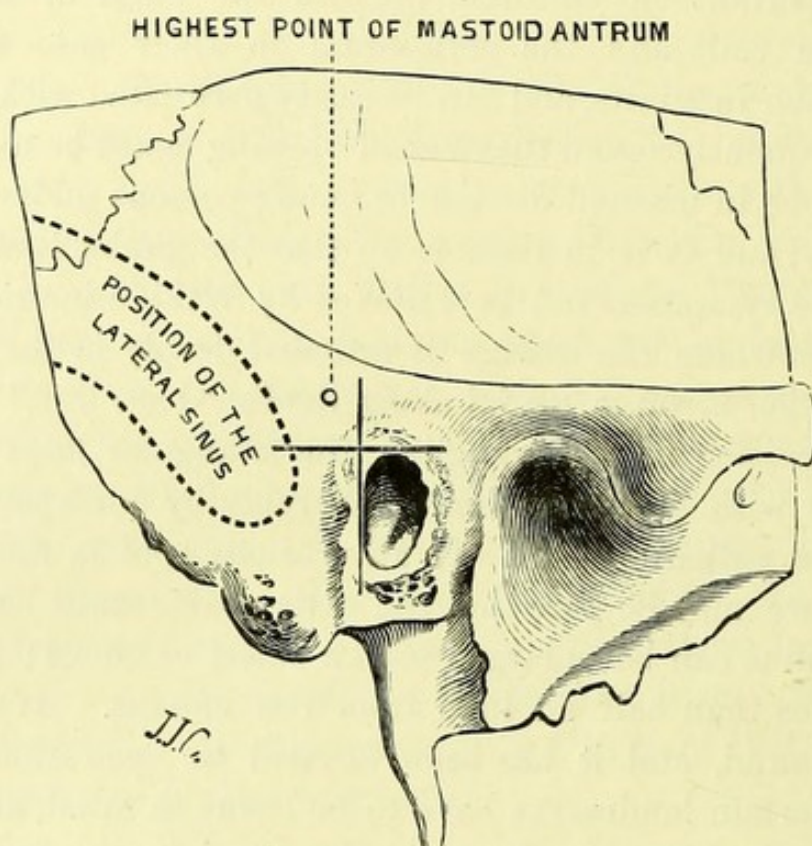


FIG. 69.—The Outer Surface of the Right Temporal Bone of a Youth, æt. 16.
(From a specimen in the Museum of St. Mary's Hospital.)

roof, forms an excellent guide as to the probable position of the mastoid antrum, and as to the direction in which the funnel-shaped excavation should be made when the chisel and mallet are used. If the depth of the incision does not exceed a half to four-eighths of an inch, the facial canal and inner ear will not be invaded. I myself now rarely use the chisel, preferring either a small hand trephine, or a trephine, or burr, worked by the surgical engine.

I have found that I can work with as great precision with this instrument on the mastoid process as I can within the meatus, and as Dr. Macewen, of Glasgow, has pointed out, the force of impact associated with the use of the mallet and chisel—so undesirable if there are intra-cranial complications—is avoided.

On reaching the cells, a stream of weak sublimate solution should be syringed into them, in order to ascertain whether

they communicate freely with the tympanum, in which case the fluid will pour out of the meatus; if the antrum contain granulations, cholesteatomata, or *débris*, these should be carefully removed, and the osseous walls thoroughly curetted. Many surgeons at the same time open the tympanum by pulling the auricle a little farther forward and detaching it, and then removing the posterior wall of the external meatus. *Débris* or growths can then be got rid of, adhesions broken down, and the ossicles examined and, if diseased, removed. A drainage tube, of perforated silver protected at its outer end with rubber tubing, should lead from the antrum to the most dependent part of the wound.

CHAPTER XIII.

THE RESULTS OF SUPPURATIVE INFLAMMATION
(continued).INTRA-CRANIAL DISEASE THE RESULT OF SUPPURATION IN THE
TEMPORAL BONE.

FROM an examination of the combined analyses of Bürkner and Bezold, we find that, out of 43,730 cases collected by the former and 11,654 by the latter, the middle ear was affected in 66·9 and 66·7 per cent. of all cases respectively ; and, further, it would appear that about 29 per cent. of all ear diseases are characterized by suppuration in the temporal bone. Moreover, statistics show that between 1 and 2 per cent. of all cases of aural suppuration die from some intra-cranial complication.

Barker records the fact that, out of 8,028 deaths from all causes in three large London hospitals during twelve years, there were only 45 cases due to disease of the temporal bone recorded, but he is careful to point out that many patients with aural suppurations attending the out-patient department of these hospitals must have died with intra-cranial complications at their own homes.

Of the 29 or 30 per cent. of all aural lesions in which suppuration is present in the temporal bone, about 5 per cent. are acute and the remaining 24 per cent. chronic. Intra-cranial complications, when present, are almost invariably the result of chronic and not of acute suppuration. In this latter class, viz., chronic cases, as has been already pointed out, there is frequently present caries of the bone, in addition to those accumulations of inspissated pus and cheesy masses in the tympanic attic and in the antrum and other mastoid cells. It is probable that antral collections are the most grave, because it is from this focus that infection usually spreads to the intra-cranial areas ; but that

quite limited caries and necrosis in the attic may occasionally extend through the tegmen tympani to the middle fossa, causing meningitis and subdural and other abscesses, has been proved by Hartmann, Politzer, and others. Hartmann says that, in cerebral abscess, the extension is *usually* through the tegmen.

Toynbee attempted to prove the thesis that affections of the external meatus and mastoid cells tend to spread towards the lateral sinus and cerebellum, while disease of the tympanum tends to produce lesions in the cerebrum, and caries of the cochlea and vestibule, abscess in the medulla.

The accompanying drawing shows a cerebellar abscess due to extension of septic inflammation from the mastoid antrum to the cerebellum. The lateral sinus narrowly escaped infection. The abscess-cavity, owing to destruction of the posterior wall of the antrum, opened directly into that cavity, which again opened into the external meatus, so that pus of the cerebellar abscess escaped from the ear. The case was that of a boy who had pain, delirium, marked retraction of the head and abdomen, irregular respiration, the "hydrocephalic" cry and

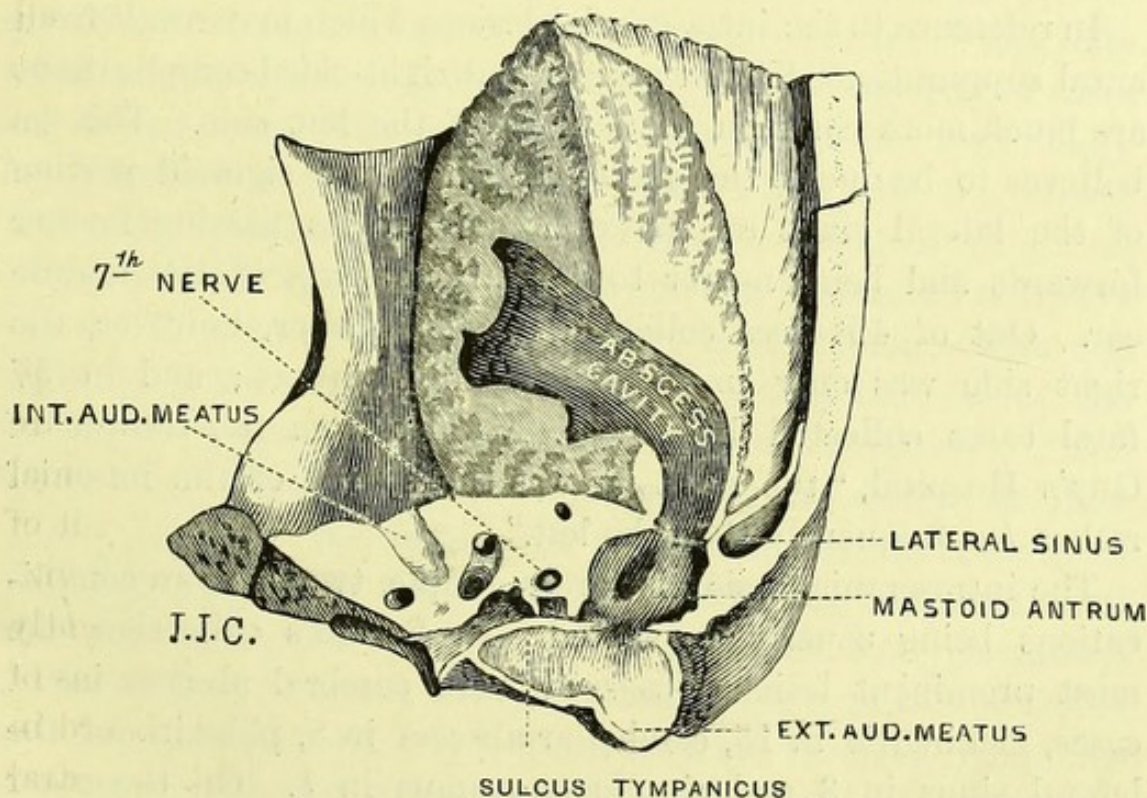


FIG. 70.—Horizontal Section showing a Dilated Mastoid Antrum in communication with a Cerebellar Abscess. (St. Mary's Hospital Museum, No. 746.)

"tâche cérébrale," and a temperature which reached 102.5° . Some relief was obtained by clearing the tympanum of granulations. After death no lesion beyond the abscess was found.

The rule has many exceptions, for the reason, it must be remembered, that the forward extension of the posterior fossa and the excavation of the sinus, especially the sigmoid portion, at the expense of the thickness of the temporal bone, is subject to great variation within anatomical limits, and varies, moreover, with the age of the individual. (See Section on Anatomy.) Exceptionally, the lesion is situated so remote from the "fons et origo mali" as the opposite half of the brain. The abscess is more or less often found an inch or so from the carious spot, apparently healthy tissue intervening. Microscopical examination, however, sometimes demonstrates thrombosed vessels along which the septic processes have travelled.

Of 76 cases of cerebral abscess collected by Sutton and Gull, 27 resulted from aural disease, and, according to Lebert, at least one-fourth of all published cases can be traced to this source. His figures were 20 out of 80 cases. The association was noticed in 9 out of 19 cases observed by R. Meyer.

In reference to the intra-cranial lesions which may result from aural suppurations, Körner asserts that right-sided complications are much more common than those of the left side. This he believes to be due to the greater depth of the sigmoid portion of the lateral sinus on the right side, to its passing farther forwards and being nearer to the various parts of the middle ear. Out of 45 cases collected by Mr. Barker, however, the right side was only implicated in 26 instances; and in 57 fatal cases collected by Dr. G. N. Pitt from the records of Guy's Hospital, "the right ear was the source of the mischief rather *less* frequently than the left."

The intra-cranial lesion is rarely simple, two or more complications being usually associated. In Barker's collection, the most prominent lesions observed were cerebral abscess in 11 cases, meningitis in 15, cerebellar abscess in 8, phlebitis of the lateral sinus in 3, and simple marasmus in 1. On the other hand, 20 of these died eventually of meningitis, 14 of pyæmia, 5 of cerebellar abscess, 4 of cerebral abscess, 1 of phlebitis, and

1 of marasmus solely. Thus, meningitis and pyæmia together were responsible for 34 deaths.

In Dr. Pitt's collection of 57 fatal cases, there were 18 of abscess, 9 on each side; 3 were in the cerebellum, 1 in the pons, 2 in the centrum ovale, and the remaining 12 in the temporo-sphenoidal lobes. In only 2 of these 12 latter abscesses was the dura mater over the anterior surface of the petrous bone healthy. Thrombosis of the lateral sinus occurred in 22 instances. Of these 57 cases, 34 were males and 23 females; 17 were under 10 years of age, 17 were between 10 and 20, 14 between 20 and 30, and only 9 over 30.

These statistics of Pitt do not bear out Barker's teaching, that of the intra-cranial complications of aural suppurations, "more than nine-tenths came under the headings of meningitis, pyæmia, and sinus phlebitis." Still it must be conceded that in many instances meningitis and pyæmia are secondary to intra-cranial abscesses not submitted to drainage by surgical interference, and are the immediate cause of death.

Fortunately, aural suppurations do not give rise to intra-cranial complications until they have lasted a considerable period; several cases have been recorded in which the otorrhœa was of only a few months' duration, but the discharge in the majority of cases has lasted more than a year. So long as the pus continually being formed at the diseased area has a ready exit, the patient may enjoy excellent health, though this is not always the case even when the drainage is good, but such an individual is always exposed to great risk from the liability to interference with free drainage from various causes, with resulting increase of the destructive processes and extension towards the interior of the skull. Interference with free drainage may be due to swelling of the lining of the meatus or tympanum, to the growth of granulation polypi in the external or middle ear, to formation of cholesteatomata and of bands of adhesions, and to hyperostoses, in the meatus, or at the isthmus between the tympanum proper and the mastoid cells. It is quite common for head symptoms to come on soon after a cessation of discharge, and when otoscopic examination gives no clue as to the cause, we must assume either that the obstruction is in the deeper parts of the middle

ear which are inaccessible to visual inspection, or, as Barker suggests, a deep septic erysipelatous attack may sometimes be the cause, though septic infection is not necessarily accompanied by partial or complete cessation of discharge. Cerebral symptoms less frequently ensue without cessation of discharge; there is, however, often diminution of the pus issuing from the meatus, and perhaps, therefore, retention in some of the cells, or in the attic, with free exit from other adjacent implicated areas.

The onset of head symptoms, with or without cessation of discharge, is sometimes consequent on exposure to cold, a blow on the ear, the introduction of foreign bodies into the meatus, and on operations, such, for instance, as for the removal of granulations or a polypus. I have seen such complications follow a too free application of chromic acid to granulations. In a majority of instances, however, there is no such history to account for the cessation of the discharge and the onset of head symptoms. I have in some cases ascertained that the otorrhœa has greatly increased with the onset of dangerous inflammation, but the possibility of retention, and, therefore, of extension of disease at some deep spot, cannot be excluded. In latent cases of cerebral abscess the insidious nature of the morbid process is often evidenced by the fact that the patient has not noticed any decrease or increase in the discharge for years, nor has he been aware of any change in his condition for the worse.

Although generally, and especially in the case of adults and older children, intra-cranial complications usually result from chronic otorrhœa, there is a small, but important, class of cases which form a notable exception to this rule. I refer to acute catarrh of the middle ear with Eustachian obstruction *in infants*. In such instances, *before* the membranes have become perforated, the inflammation often spreads to the meninges, causing retraction of the head and other characteristic symptoms, which, however, are markedly ameliorated, as I first pointed out some years ago, by paracentesis of the drum-head.

My colleague Dr. Lees* records a case of broncho-pneumonia with otitis where severe cerebral symptoms pointed to a commencing basal meningitis. I punctured both membranes by his

* *Practitioner*, vol. 37, p. 81.

request, with almost immediate relief of the symptoms, even though no pus flowed forth. Similar symptoms, which recurred, were again removed by a repetition of the operation, but on this occasion the tympanic cavities were inflated by Politzer's method, and a little undoubted pus was expelled from the left ear.

Meningitis from otitis interna in children is a cause of death frequently overlooked, and paracentesis of the membrana tympani, where retraction of the head and other cerebral symptoms are present, is an operation which, although quite harmless if skilfully conducted, is by no means sufficiently resorted to. Resumption of the normal position of the head and subsequent good recovery are the usual results, if the operation be not too long deferred. Drs. Barlow and Lees, of the Children's Hospital, have sent me several cases where by paracentesis I have at once removed the patient from an apparently moribund to a convalescent state. In this connection I may mention that McKeown* describes a method of making an opening in the membrana tympani, which will remain patent for a considerable time. He punctures the membrane either in front of or behind the top of the handle of the malleus, and cuts upwards as far as possible. Then he makes a second incision at the anterior or posterior part of the membrane, horizontally opposite the lower end of the first incision, and cuts upwards until the two incisions meet. In this way a triangular flap is formed, which falls down, and is commonly retained in position by the coagulated blood. The orifice in time closes up, but remains open sufficiently long to produce excellent results in some cases of chronic ear disease.

It would be going beyond the limits of this work to discuss in detail the various symptoms of abscess, meningitis, and pyæmia, and I must content myself with reviewing the general symptomatology of head lesions following aural inflammations.

In the first place, pain is *the* symptom by which the patient's attention is called to a change for the worse in his condition. There may not be acute pain in the ear, though a dull aching is nearly always present in the mastoid region, radiating down the neck, or towards the frontal parietal or occipital regions. In

* *Dublin Journ. of Med. Science*, 1886, vol. 1, p. 357.

addition to pain in, or radiating from, the ear, there is frequently present headache of a dull splitting character. This headache is rarely absent, and though attempts have been made to invest with diagnostic significance pains at particular spots and regions, the more cases one sees the less real value one is forced to attach to the site of even agonizing pain as a localizing factor. It is true that, occasionally, tenderness and various degrees of pain, have been present over an area which has later been found on the operating or post-mortem table to have been over an abscess or other localized inflammation; but unless the tenderness or pain is much increased on careful percussion it is well to be cautious in regarding it as evidence of a localized abscess. Abscesses in the temporo-sphenoidal and cerebellar regions have been associated with localized pain more or less acute at spots very remote from the seat of the lesion.

The temperature chart, though occasionally puzzling when several complications exist, affords, on the whole, very valuable information. Its diagnostic significance has been very clearly summarized by Barker in his Hunterian Lectures. Oscillations between subnormal and the highest ranges, together with rigors, almost invariably indicate pyæmia. Something of a similar chart is observed in sinus phlebitis, but the oscillations are not so great and the rigors less frequent. In uncomplicated meningitis there is usually a persistently high temperature with no oscillations. In simple subdural abscess there is a high and steady fever, but the chart will be modified and masked by the complications which so frequently co-exist. In cerebral abscess, on the other hand, after an initial rise there is generally an abrupt fall on the full formation of the abscess, and the temperature records are about or more often below the normal, as first pointed out by Mr. Hulke. The same rule should probably hold good in cerebellar abscess if uncomplicated with meningitis or sinus phlebitis, but this is seldom the case.

The pulse in cerebral abscess is often in striking contrast to that of meningitis, in the former being slow, even, and full; in the latter rapid, irregular, and small.

In regard to the bowels, in abscess and meningitis, there is

usually constipation, diarrhœa being associated with septic infection.

Barker remarks that vomiting may be an early symptom of any of the intra-cranial complications under discussion, but when it appears as a late symptom, it is more probably a sign of abscess, and especially of cerebellar abscess.

Rigors are of course frequent in pyæmic conditions, but are also often observed at the onset of sinus phlebitis and abscess.

Delirium is common in meningitis, coma in encephalic abscess, but either of these symptoms may be present in the later stages of intra-cranial complications.

Slow and sluggish, but perfect, cerebation is especially a symptom of brain abscess. It is a most valuable sign, the importance of which has been insisted on by Dr. Macewen, Dr. Gowers, myself, and others. It may occur in subdural abscess and in sinus phlebitis, in fact in any of the intra-cranial suppurative conditions now under discussion, but the symptom usually points, other things being equal, to abscess of some portion of the brain substance, and it speedily disappears when an exit has been given to matter by operation.

Wasting, and even rapid emaciation, is of course a sequence to be expected in connection with the high fever of meningitis and pyæmia, especially if such conditions are accompanied by vomiting and diarrhœa; but Barker has pointed out that abscess, uncomplicated by lesions leading to fever and diarrhœa, is often accompanied by great wasting.

Respiration is usually slow, shallow, and regular in abscess. Cheyne-Stokes' respiration has been observed in basal meningitis, whilst in inflammation over the convexity breathing is both accelerated and irregular.

There has been much discussion as to the value of optic neuritis as a symptom. We can, I think, however, affirm that when present (as it is in about half the cases of intra-cranial lesions from aural disease) it is a valuable positive sign of head complications, especially in doubtful cases; but it has little differential diagnostic value. Barker takes much the same view in reference to the state of the pupil.

Convulsive movements, especially if of a limited character, when present afford important localizing indications. The same may be said of paralyses, of motion and sensation, which are not very extensive. Errors of locomotor co-ordination—giddiness and reeling—are sometimes observed in cerebellar abscess and in meningitis of the posterior fossa. Careful observations as regards spasm and paralysis, together with an accurate knowledge of the anatomy and physiology of the Rolandic area, are of paramount importance in brain surgery and have led to brilliant results at the hands of Macewen and others.

Whilst twelve years ago very nearly all cases of suppurative conditions within the cranium following ear disease died without any effective treatment, it can now be affirmed that within the last decade a considerable, and an increasing, number of cases have been submitted to the operation of opening the skull, in some cases timely, but in many instances too late. I have no reliable statistics as to the percentage of cases which have been rescued from almost certain death by appropriate operative interference, but it is probably something between 30 and 50 per cent. Moreover we must bear in mind that the prophylactic measures of opening the mastoid cells and attic, which are now practised far more often than formerly, are gradually decreasing the mortality from head lesions due to ear disease.

I am here precluded from entering into further detail of the principles of diagnosis and localization of intra-cranial lesions. If, however, a diagnosis of a limited collection of pus at some area within the cranium has been made with some degree of certainty, on account of localizing, and other, indications (whether the pus be either in the cerebrum or the cerebellum, subdural, between the membranes, or in a sinus), there is now no doubt amongst surgeons as to the propriety of evacuating the matter by suitable incisions, *at the same time* not omitting to prevent the further incidence of mischief from the temporal bone, by opening up, draining, and medicating the mastoid cells and tympanum. In fact, this opening up and inspection of the aural lesion should always precede intra-cranial operations.

Moreover, when in the absence of definite localizing signs,

there is good reason for believing that matter is pent up somewhere in the skull, it is now admitted to be good surgery to open the skull over certain likely spots—the “dangerous areas” of Barker—in order that the sites most commonly implicated may be explored.

Such exploratory incisions include removing bone from an area the centre of which is at the point of junction of the horizontal and sigmoid portions of the lateral sinus—the “pars confluens.” This region may be explored for subdural abscess and for phlebitis by an extension of the almost necessary operation of opening the mastoid cells and tympanum.

Wheeler enlarges this opening in the bone upwards and forwards with the trephine in order to get at the middle fossa, and it may be enlarged downwards and backwards when cerebellar abscess is suspected. In many instances, however, in which cerebral abscess is suspected and in which sinus phlebitis may be considered to be excluded, we may at once explore the favourite seat of disease, the temporo-sphenoidal lobe, without opening the cranium below, by extending the mastoid incision. Barker has proposed as the most suitable point from which to explore the dangerous area, a circle of $1\frac{1}{4}$ inch radius, having its centre $1\frac{1}{4}$ inch behind and above the middle of the external auditory meatus. Wheeler and Birmingham, however, believe that the centre of this circle should be half an inch higher, namely $1\frac{3}{4}$ inch above, and $1\frac{1}{4}$ inch behind the centre of the meatus. Barker claims to be able to make a satisfactory exploration by means of an aspirating needle from this spot through a $\frac{1}{4}$ -inch trephine hole. Most surgeons, however, make a larger aperture. Birmingham asserts that a $\frac{3}{4}$ -inch trephine can be safely used at the higher spot mentioned above. I cannot recommend the grooved exploring needle used by many surgeons, as in a fatal case in which I failed to get indications of pus with it, it was seen, *post-mortem*, that the needle had actually passed through the abscess cavity. I intend to use an aspirating needle another time.

For exploring the cerebellar area, Birmingham asserts, that if the trephine be applied at a spot whose mid-point is 2 inches behind the centre of the meatus, and 1 inch below Reid's

base-line, there is then little danger of wounding the occipital artery and lateral sinus.

In speaking generally of operative treatment, allusion has only been made to limited meningeal lesions accompanied by the exudation of serum, or the formation of pus; it is of course obvious that diffuse and spreading meningitis is a most unfavourable condition to deal with either surgically or medically; still it seems the right thing, even when such a diagnosis appears irresistible, to give the patient a chance of relief, not only by opening the mastoid process, but also by Wheeler's method of exploratory trephining. There is always the chance that the lesion may be more limited than we suppose, with, perhaps, definite accumulations on the under, or outer, surface of the temporo-sphenoidal lobe. Barker saved such a case by operation. In doubtful cases where it is likely that, in addition to opening the mastoid cells and exposing the lateral sinus, the middle fossa and the temporo-sphenoidal region may require to be also explored; it appears to be a good plan to have a large skin flap made round the temporal crest so as to include the temporal muscle, as practised by Horsley.

The technique of the operations for opening the skull is fully described in the larger standard works on surgery, and is beyond the scope of this book, but the operation for exposing the "pars confluens" of the sigmoid and lateral sinuses, being only a backward extension of the mastoid operation, it, along with that for such conditions as phlebitis, is described later in more detail.

In illustration of the fact that, if, owing to caries, matter escape through the upper wall of the tympanum, meningitis or abscess of the brain is necessarily the result, I will now describe a case of suppurative meningitis, confined almost entirely to the under surface of the tentorium cerebelli, the membranes at the base of the brain being unimpaired.

M. A. C., æt. 19, servant, taken into hospital December 4, 1876, had suffered from a discharge from the left ear since childhood. A fortnight before her admission she had lost her senses, and would have fallen, but for a fellow-servant, who caught her. She had since fainted, and had several rigors. Talking and,

more especially, looking at a bright light gave her great pain, and she had double optic neuritis. Her head ached severely, and throbbed, and there was complaint of pain over the second cervical vertebra, as also below the left ear, and the bowels were confined. The chest sounds were normal, and the temperature was 101.4° . She moved her limbs easily. The ear was syringed with a weak carbolic acid lotion, a blister was applied behind it, and one grain of calomel with one-sixth of a grain of opium was given every two hours.

Through the night of December 5 the patient was wandering and slightly delirious. Her tongue was brown, and coated with a thick fur. At 8 A.M. she talked rationally. At 8.30 A.M. she drank some milk. Almost immediately afterwards she died.

Post-mortem Examination.—Body well-made, well-formed, and well-nourished. Slight discharge visible in left external auditory meatus. Left lateral sinus, from the point nearest the mastoid cells, where it curves round, but not further back, down to the posterior lacerated foramen, distended by *ante-mortem* clot. No clot in internal jugular vein. The bone corresponding to this portion of the sinus, on removal of its dura mater, is found discoloured and somewhat softened. Pus and cheesy-looking material occupy middle ear, extending backwards into mastoid cells, where the bone is much softened. Pus oozes out over the surface of base of brain as it is raised out of its bed; this comes from the under surface of the tentorium cerebelli, which is covered with it. A layer of lymph (with extreme superficial congestion of the tissues immediately below it) is seen on the upper surface of the lobes of the cerebellum, *i.e.*, that part in contact with the inflamed tentorium. The inflammation of brain is confined to its base, where the membranes are normal. Brain tissue normal throughout, except for a little softening about velum interpositum and septum lucidum, inflammation apparently having extended along the membranes from the adjacent diseased spot and invaded the ventricle. Other organs healthy.

In the case of an American gentleman sent by Dr. Broadbent to consult me, who suffered from intense pain in the head, and had all the symptoms of meningitis, I found, after I had cut

down over the mastoid, and evacuated a considerable quantity of pus, that the greatest relief was afforded by applying spongio-piline as hot as could be borne to the ear. Hot linseed-meal poultices do not in my experience give nearly so much relief. A small piece of the spongio-piline should be cut to the exact size of the ear, and another larger piece about six inches square placed over it; the application should be changed frequently. This patient remarked of it,—“It draws out all the pain, whereas the poultices don’t touch it.” By the advice of Sir James Paget I gave him quinine and iodide of potassium, and he made a good recovery, and eight months afterwards I heard from America that he was quite well.

The following interesting case was at St. Mary’s Hospital under the care of Dr. Handfield Jones, to whom I am indebted for the notes of it. The remarks on the *post-mortem* examination, &c., are my own :—*

C. T., æt. 20, groom, was admitted July 13, 1874. His health had been generally good, except that he had been deaf in the left ear since he was six years old. Some aural discharge occurred occasionally. On July 1 he was taken ill with severe pain in the left side of the head, extending from the mastoid region to the temple, and this with discharge from the ear had since continued. He was brought to hospital unconscious, and in a state of morose stupor, lying on the left side, refusing to move, and struggling violently when raised up to have his ear examined. The skin in the mastoid region was distinctly tender, and presented several small openings, from which pus had escaped. A free incision was made there, and a drachm of compound jalap powder was ordered, which acted well. He was ordered also four grains of iodide of potassium four times a day. On the 14th the pulse was 87, the temperature 102·2°. He was more conscious, and showed his tongue a little when asked. The urine had a specific gravity of 1030, and was found to contain a notable amount of albumen, and, after this was removed, also of sugar. On the 16th a pint-and-a-half of urine was drawn off by catheter. He was more sensible, and had no pain, but was very dull and listless in manner. His pulse was

* *British Medical Journal*, December 19, 1874.

76. There was a copious eruption of herpes round the mouth. At 2 P.M., he said he had pain in the head and felt no better. There was purulent discharge from the meatus and the wound behind the ear; no dead bone could be felt. On the 17th his temperature was 98.7° , his pulse 72; he had slept well, and could feed himself. He answered questions very slowly. When pressed to say where he had pain, he put his hand to his forehead. He had, from the 16th, a lotion of 6 grains of sulphate of zinc, 2 grains of carbolic acid, and 15 minims of liquor morphiæ, in $1\frac{1}{2}$ ounces of water, as an injection for the ear. The compound jalap powder was repeated. On the 20th he was much better: the temperature was 98.24° , and the pulse 80. He was far more conscious, and heard a watch with the right ear, but not with the left even in contact. On the 23rd, he was doing fairly well, being more lively and much less deaf: his temperature was 99° , and his pulse 86. There was free purulent discharge from the wound behind the left ear. The mastoid region was tender. The bowels were open. On the 27th he felt, he said, very much better.

A copious very offensive discharge was oozing from the sinuses behind the ear, which led for four or five inches downwards and backwards, but apparently did not communicate with any dead bone. He was ordered four grains of iodide of potassium, and a drachm of tincture and an ounce of decoction of cinchona three times a day. He took nourishment well. On the 29th he uttered a single shriek every hour or so. After this, the pain in the head became more severe; he lapsed into a stupid condition, finally becoming comatose; and on August 4 he died.

Notes of Post-mortem Examination.—Skin behind left ear dusky and infiltrated; pus escaping through an opening made some days since by the house-surgeon. Introduction of a probe shows mastoid process to be denuded of periosteum, and roughened. The skull being opened, a quantity of very offensive pus, somewhat resembling beef-tea in colour, escapes from a large abscess above dura mater in right parietal region. Dura mater red and thickened over right hemisphere, which exhibits evident signs of compression by pent-up pus. Extensive separation of

dura mater from skull between left mastoid region and chief seat of pus, probably from gravitation of pus in consequence of the patient lying on the non-affected side of the head for a few

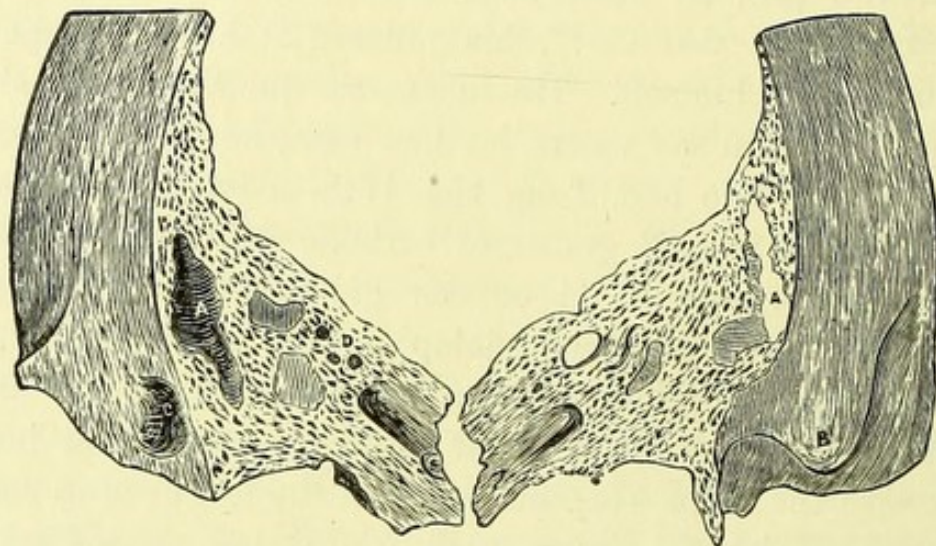


FIG. 71.

AA. Abscess cavity, seen in section through centre. B. The mastoid process. C. Meatus auditorius externus. D. Semicircular canal, through the edges of which the section runs. In the right hand figure is seen the opening by which the abscess communicated with the cranial cavity.

days before death. Left lobe of cerebellum completely disorganized, and in direct communication with primary abscess in cells of left mastoid process. Dura mater itself diffuent in that region. Section of temporal bone shows mastoid process to be the birth-place of an extensive collection of pus, which has made its way through the thin wall of the groove of the lateral sinus, without opening into the venous channel itself. Thoracic and abdominal viscera healthy.

Although the lateral sinus remained uninjured, this case clearly illustrates the ease with which inflammation extends to that sinus and to the jugular vein, as in the numerous fatal cases of lobular pneumonia with gangrene of the lung, in consequence of chronic disease of the ear of the same side.*

Another somewhat similar case is that of S. T., æt. 42, a strong, healthy-looking, and able-bodied man, who presented himself at the hospital, March 23, 1882. He stated that, under treatment there some years previously, he had been cured of a

* Sir W. Gull, "Cases of Phlebitis with Pneumonia and Pleurisy from Chronic Disease of the Ear," *Association Medical Journal*, April 13, 1855.

discharge from the left ear. This, after a long period, had returned, and had latterly become so offensive as to force him again to seek relief; it seemed to be unaccompanied by any suffering. He was ordered an aperient mixture and a weak carbolic acid lotion. In a week's time his wife came to say that he appeared to have caught cold, and had some pain behind the ear. Six leeches, to be applied over the mastoid process, and a dose of iodide of potassium three times a day were consequently prescribed. A few days afterwards the patient rather suddenly died.

Notes on Post-mortem Examination.—Dura mater moderately adherent to skull-cap; as it is cut through, much black blood oozes from the sinuses; there is some pinkish injection of its inner layer. Arachnoid exhibits general stickiness. In meshes of pia mater beneath arachnoid of sulci of hemispheres is some yellowish puro-lymph, most abundant over left temporo-sphenoidal lobe. Left lateral lobe of cerebellum adherent to dura mater of temporal bone, except where separated by an abscess-cavity the size of a walnut. The cavity has thin walls, spotted with punctiform extravasations; is filled with greyish-green very foetid pus; and extends inwards as far as middle lobe, where the surrounding tissue is greyish and softened. No other abscess is found on section of hemispheres.

Temporal bone, broken in extraction, shows considerable necrosis, with yellowish and greenish discoloration of walls of tympanum, one of the veins in roof of which is filled with blackish soft clot, and passes into midst of portion of bone united with cerebellum. Dura mater over temporal bone abnormally thick and pink, and over necrosed area, opaque and greyish. Cavity of tympanum occupied by opaque, foetid, cheesy material. Membrana absent.

As Toynbee first pointed out, "affections of the external meatus and mastoid cells produce disease in the lateral sinus and cerebellum." He most truly observes that "the insidious progress of cases in which matter in the cavities of the ear injures the petrous bone and the brain cannot be too often or too forcibly impressed upon the mind of the profession."*

* *Medical Times and Gazette*, March 16, 1861.

The above is only one of many instances of injury to the brain from neglected ear disease. The following has been selected from among several similar cases at St. Mary's during the last few years :—

*Suppurative Meningitis and Abscess of the Brain.**—S. G., æt. 18, an under-gardener at Goodwood Park, was admitted on January 24, 1880, with a purulent discharge from the right ear. On walking into the hospital, he stated that he had had a discharge from the ear for sixteen years, following scarlet fever. He had no paralysis of any kind, but complained of pain in the head. Eight leeches were applied around the right ear, with the immediate effect of relieving all pain. Iodide of potassium mixture was prescribed, and the ear was ordered to be syringed four times a day with a weak carbolic acid lotion.

Three days after admission, the patient died very suddenly, before the house-surgeon, who was called, could reach him.

The following are the notes of a careful *post-mortem* examination made by Mr. A. J. Pepper :—There was suppurative meningitis over the petrous part of the right temporal bone, and in the posterior fossa of the skull, above the tentorium cerebelli, and also to a slight extent in the cerebellar fossa. On the outer part of the petrous bone was a layer of pus between the dura mater and the bone. Its dura mater was in a sloughy condition over a surface the size of a horse-bean. The inner surface of the mastoid bone, where it enters into the formation of the lateral sinus, was of a blackish-grey colour, and the bone here was so soft as readily to allow of penetration. To the same extent the sinus itself was occupied by a very firm, partly black and partly yellowish-brown thrombus. The internal auditory meatus was healthy. There was a thick layer of puriform lymph on the under surface of the posterior half of the temporo-sphenoidal lobe of the brain, and on the inner surface of the occipital lobe. There was an abscess, the size of a large walnut, with dirty-grey, sloughy, and purulent contents, in the right hemisphere of the cerebellum, external to the corpus dentatum. The brain substance generally, and its membranes, were congested. The ventricular fluid was clear and in slight excess.

* Reported in *The Lancet*, June 5, 1880.

There was no disease of the arteries or thrombosis of the superficial or internal veins. The membrana tympani had disappeared. There was some pus in the external auditory meatus. The site of the petrous and mastoid cells was occupied by an irregular cavity, which contained blackish-grey purulent matter; around this, the bone was softened and reddened for some distance, evidently from progressive caries. The tympanum, as well as the Eustachian tube, was filled with yellow caseous matter. No trace of the incus or stapes could be discovered; the malleus was loose in the cavity, and its head was carious. The chorda tympani nerve could be traced only for a short distance after entering the tympanum. The vestibule was occupied by soft caseous matter, which under the microscope was seen to consist of fat-granules and shrunken and flattened epithelioid cells. The cochlea, semicircular canals, aqueduct of Fallopius, and carotid canal were healthy, and the facial nerve appeared uninjured.

It must be pointed out that all these fatal cases recorded were under treatment more than ten years ago; it is only within the last decade that such cases have been submitted to operative treatment, and, in a fair proportion of cases, life saved, owing to the brilliant surgery of Macewen, Barker, Caird, Horsley, Ballance, Lane, and others. Although the treatment at the present day would have been bolder in many of these cases, they have been retained in the present edition as useful examples of the terrible results of neglected ear disease.

General Remarks on Abscess of the Brain in Ear Disease.—The diagnosis of abscess of the brain is notoriously uncertain, and the above case is a good example of the sudden manner in which it is frequently revealed. It appears clinically under many aspects, and, that we may the better be able to appreciate the significance of the symptoms which it presents, it will be well to glance briefly at the pathology of the disease. Its causes are various, and the symptoms it gives rise to vary with them. The statement that abscess of the brain is never a primary affection may be taken as well established. In all cases, therefore, in which we meet with cerebral abscess after death, we should never feel content until we have obtained evidence of

past or present suppuration in some other portion of the body—and it may be in any portion. The abscess of the brain may present itself in various stages—as a patch of red-coloured acute softening, which has not yet broken down to form an abscess, or as a ragged cavity, with grey, soft, and irregular walls, containing more or less discoloured pus, or, lastly, as a well-defined cavity, with tough and fibrous walls, and occupied by a green-coloured, opaque fluid resembling pus, from which, on examination, it may be found that the pus cells have disappeared, having undergone fatty and granular degeneration. It may also contain cretaceous material.

These abscesses are usually single, and occur most commonly in the posterior part of the brain, and out of the way of the motor tract; paralysis, therefore, is but rarely associated with them; they affect the white matter rather than the grey, and most frequently that of the hinder part of the middle lobe, the posterior lobe, or the cerebellum: occasionally they occur in the corpus striatum or pons. Broadly speaking, we may say that while the more acute forms of the disease give rise to the signs usually attributed to meningitis or encephalitis, the more chronic are accompanied by no symptoms whatever until the abscess extends sufficiently near the surface of the brain to light up an inflammation of its membranes, this being the usual mode of termination. Numerous cases have been recorded in which there can be little doubt but that the disease existed for months, or even years, before death, without giving rise to a single indication of cerebral lesion. Occasionally abscesses of the brain are found after death which have never given rise to any cerebral symptoms during life, and would probably never have done so had life been prolonged for an indefinite period. Appearances have been described which suggest that such abscesses sometimes pass through a process of resolution: the pus, it has been said, undergoes fatty degeneration, and becomes quiescent; the fat is reabsorbed, and the fibroid sac shrinks, and gradually contracts upon a cretaceous residue. On the other hand, cerebral abscesses have been known to penetrate the skull and open externally, producing a hernia cerebri.

By far the commonest cause of abscess of the brain is disease

of the middle or internal ear, producing necrosis of the temporal bone; this has been said to account for about one-third of the cases.* (See Fig. 7.) The circumstances under which it occurs from this cause are various, but they vary between two chief types. In one there is extensive disease of the bone, with pus below the dura mater, and frequently thrombosis of one or more of the venous sinuses in connection with the petrous bone. The dura mater itself is thickened, and the arachnoid and pia mater are adherent over it; the brain tissue in the immediate neighbourhood is more or less inflamed and softened; and the abscess is near the surface, and is commonly found associated with a general meningitis. These cases present symptoms of meningitis or encephalitis during life; their duration is uncertain—usually not less than ten days, frequently some weeks. It is to this type that the above-mentioned case belongs; and considering the character of the lesions, the duration of severe symptoms was remarkably short. The origin of the abscess in such cases, is evidently either the extension of inflammation by contiguity of structures, or else the backward extension of venous thrombosis into the cerebral substance.

In the other type of abscess from ear disease, one finds, perhaps, very slight and not easily discoverable necrosis of the petrous bone, and no adhesion of membranes; the cerebral tissue intervening between the abscess and the surface of the brain is perfectly healthy; the veins, moreover, are not thrombosed. It is hard to say how these abscesses are produced. That they are secondary to the disease of the petrous bone it would be impossible to deny; but by what means the *materies morbi* is conveyed from one place to the other we have at present no evidence to show, although the assumption naturally is that some infective material is conveyed by lymphatics, arteries, or veins. It is difficult to trace a connection between the two diseased structures even when their distance from each other is short; and still more difficult is it to do so when the abscess is secondary to some collection of pus in other parts of the body, such as an empyema, and abscess in the ischio-rectal region or in the shaft of a long bone. It is not a little remark-

* Reynolds, *System of Medicine*, vol. 2, p. 544.

able that the brain, unlike all other organs, should be liable to the deposition of secondary abscesses, and that without any signs of a general pyæmia. These secondary abscesses, of course, cannot be strictly compared to those occurring in the liver, the peculiar blood-supply of which may afford a ready explanation of their origin. They are much more chronic in their nature than those previously described, and, as we have seen, often give no signs during life. If rather less chronic than usual, they may terminate by exciting a meningitis, always suppurative and very severe when they approach the surface. Death occurs in a very short time from the appearance of the first symptom of cerebral lesion, the abscess having existed for a long time previously.

We find abscesses of the brain, either the same as or intermediate between these two types in pathological and clinical history, which result from disease or injury of the nose, eyes, skull, scalp, or face, or from operations upon these parts. The cerebral symptoms which arise after injuries to the head may be due to abscesses connected with the dura mater, or to such abscesses of the brain as have been described: it is often impossible to distinguish between them clinically. It should be remembered that under all these circumstances cerebral symptoms may arise which would seem to indicate the existence of abscess or meningitis, but that these symptoms occasionally clear up, and the patient makes a good recovery: in all cases, therefore, our prognosis should be most guarded.

Abscesses of the brain occasionally result from a general pyæmia, and are then usually multiple and small. Finally, they may, it is said, originate in embolism of one of the cerebral arteries. In this case the disease is usually associated with sudden paralysis and other symptoms of embolism, followed by headache and sometimes more or less marked signs of encephalitis. Red softening frequently occurs with these symptoms. Occasionally the tissues have broken down and formed an abscess, or rather the softening has been so diffuent that it almost justifies the name of abscess.

PHLEBITIS AND PYÆMIC THROMBOSIS OF THE LATERAL SINUS
SECONDARY TO AURAL DISEASE.

The liability of venous trunks in and about the skull to phlebitis and thrombosis, when situated in areas of suppurative inflammation, is well known to surgeons. It is probable that in nearly all cases of otorrhœa there is *some* phlebitis of the veins passing from the tympanum and mastoid cells; as these intra-tympanic and intra-mastoid veins communicate freely with the veins of the dura mater, and in the latter case directly with the closely-adjacent lateral sinus, it is surprising that thrombosis of this sinus, by extension, and subsequent pyæmia, are not more frequently observed. When once a thrombus has formed in the lateral sinus, the phlebitic and thrombotic process may extend backwards to the torcular Herophili, and from thence to the straight or to the superior longitudinal sinus, according to the side affected, or it may pass inwards to the sinuses at the base of the skull. The extension downwards becomes evident in many cases by œdema over the lower part of the mastoid and in the neck over the course of the internal jugular vein, the blocked condition of which can often be felt by gentle digital examination. The vessel may be occluded as far as the superior cava. The thrombotic process may in some few instances be due to inflammatory extension direct from the floor of the tympanum to the bulb of the jugular.

The mere obliteration of such large venous channels as the lateral sinus and internal jugular vein is not in itself a source of immediate or paramount danger, but the gravity of the condition is due to the fact that septic processes in the tympanum and temporal bone have given rise to the phlebitis and thrombosis, and that consequently the thrombus is the nidus of various micro-organisms, whose life processes will in all probability sooner or later lead to softening and disintegration, with the setting free into the circulation of highly septic emboli and the production of general pyæmia and septicæmia.

Mr. Ballance, in an interesting paper on four cases of pyæmic thrombosis of the lateral sinus, from suppuration in the temporal bone, remarks:—

“The following are the signs that should be especially looked for in any case in which septic thrombosis of the lateral sinus is suspected. When present together they constitute a group of symptoms which are pathognomonic of this affection: 1. A history of purulent discharge from the ear for a period of more than a year. 2. The sudden onset of the illness, with headache, vomiting, rigor, and pain in the affected ear. 3. An oscillating temperature, reaching to 103° or 105° F., and then dropping, say, below 100° . 4. Vomiting, repeated day by day. 5. A second, third, or more rigors. 6. Local œdema and tenderness over the mastoid or in the course of the internal jugular vein. 7. Tenderness on deep pressure at the posterior border of the mastoid and below the external occipital protuberance. 8. Stiffness of the muscles of the back or side of the neck. 9. Optic neuritis.”

It may be laid down that the symptoms generally are those of pyæmia, together with certain super-added head symptoms and local signs. These include pain in the ear and headache, which latter, however, is not usually severe, as is often the case in meningitis and cerebral abscess. Barr remarks that “delirium is more common than in intra-cranial purulent processes, while convulsions, paralysis, or coma are less common.” Typhoid symptoms complicate some cases. Œdema in the temporal region, and especially over the mastoid process and in the neck below the parotid, is by no means invariably present, even when the internal jugular vein can be distinctly felt to be thrombosed; on the other hand, it often exists when the thrombosis is limited to the lateral sinus. Sometimes the veins of the cheeks and eyelids are distended and accompanied by œdema of those areas. I have seen the eyes quite closed. Muscular paralysis (or infrequently spasm) is only occasionally observed and is of course due to pressure on the nerves adjacent to the internal jugular, namely, the vagus glosso-pharyngeal, spinal accessory, or hypo-glossal. When thrombosis extends to the cavernous sinus, impediment to the venous circulation may lead to exophthalmos, retinal œdema, and puffy swelling of the forehead, eyelids, and nose. Pressure on the 3rd, 4th, or 6th nerve may lead to squint or to ptosis. Barr mentions epileptic and

apoplectic phenomena as due to blocking of the superior longitudinal sinus.

Optic neuritis is a non-constant symptom, and when it exists is probably one of the earliest indications of commencing implication of the meninges; also it is probably present long before retraction of the head and such-like phenomena associated with active inflammation of the meninges.

When there are no objective evidences of thrombosis of the lateral sinus, or of the internal jugular vein, present, a correct diagnosis can only be made by taking into account the rigors and other pyæmic phenomena. The more strictly tympanic symptoms aid little in a differential diagnosis; they are just as variable as those previously detailed as leading to cerebral abscess and meningitis. The character of the discharge, whether foetid or otherwise, is of little moment, and in fact there may be no pus at all in the meatus, this being especially the case in those instances where an inspissated mass has blocked the passage from the mastoid antrum to the tympanum, resulting in sudden cessation of otorrhœa with subsequent mastoid pain and inflammation, and leading to implication of the adjacent venous structures.

It is probable that some, perhaps many, cases of phlebitis and thrombosis of the lateral sinus recover with no more radical treatment than leeching over the mastoid area and appropriate aural measures, such as the removal of polypi or granulations, or the loosening of masses blocking the passage between the antrum and tympanum by intra-tympanic syringing, though such a happy issue is doubtless exceptional. When the thrombus extends into the jugular, the chances of small fragments entering the circulation and causing pulmonary and general pyæmia are enormously increased, and such cases are almost invariably fatal. It is astonishing, however, that with a foetid and thrombosed condition of the sinus, extension to the brain and meninges and pyæmic symptoms are often so long delayed. These considerations, however, though influencing prognosis, do not justify delay in operating when symptoms point to thrombosis secondary to temporal caries. The routine treatment may be conveniently arranged under five heads:—

- (1.) The removal of obstructions in the meatus and tympanum when such exist.
- (2.) Exploration of the mastoid cells, and the re-establishment of a passage between them and the tympanum when such is blocked, together with curetting or other appropriate surgical measures when caries is present.
- (3.) Exposure of the lateral sinus with a trephine, and exploration and evacuation of any subdural accumulations if the sinus be thrombosed.
- (4.) Ligature of the internal jugular vein at a point below the thrombus (if one exists in it) to prevent general infection.
- (5.) Opening of the sinus and removal of its thrombotic contents, whether foetid or otherwise.

I have already described the best methods of removing tympanic obstructions and operating on a diseased mastoid bone.

The side of the head being shaved and the skin and subcutaneous structures reflected in the usual manner, the sinus is best exposed by means of a $\frac{5}{8}$ -inch trephine incision whose centre is situated one inch behind the centre of the external auditory meatus measured along Reid's base line, and a quarter of an inch above it. Any pus between the bone and neighbouring meninges should be removed by syringing with a solution of biniodide or perchloride of mercury or other antiseptic solution, and carious bone curetted before proceeding to slit up the sinus should it be found thrombosed after inspection, digital examination, or exploration with a grooved needle or trocar. If no doubt remains on this point, the internal jugular vein should be ligatured if it is thrombosed at a point below the blocking, but if it is not, at a convenient point above the omohyoid muscle. The thrombosed sinus should be slit up with as large an incision as possible and its contents removed with curette and syringe. On opening the sinus, very foetid gas and suppurating clots frequently escape; care should therefore be taken to prevent infection of the adjacent meninges, by exercising the greatest cleanliness and the use of antiseptics.

Arbuthnot Lane, who was the first to perform this operation of washing out the sinus and tying the jugular, as suggested originally by Horsley, has ligatured the sinus near the torcular Herophili, but Ballance, S. Paget, and others have found plugging the sinus to be sufficient to stop any hæmorrhage. Silver drainage tubes, and those of silver wire known as Ellis', are usually employed. Barker strongly recommends sal-alembroth dressings, but different surgeons employ their own favourite antiseptic materials; sublimate and cyanide dressings seem now to hold the field.

VISCERAL SEQUELÆ.

A few words will now suffice to indicate how chronic discharge from the ear may lead to pyæmic conditions of the viscera and serous membranes of the trunk.

Disease of the temporal bone may produce abscesses in the viscera, by causing either embolism of a small artery in the organ affected, or else by what is known as metastasis. The embolism, when in the lung, is usually brought about as follows:—A septic thrombus, full of pyogenic micrococci, occurring, say, in the lateral sinus adjoining the diseased bone, degenerates in the centre, and becomes changed into a yellow semi-fluid material, which virtually is pus, though some decline so to designate it. The blood of some small vein entering the sinus just beyond the termination of the thrombus washes away small portions of it and carries them to the right heart, and so through the pulmonary artery to small branches of the latter, which thus become plugged. The offsets of these branches beyond the obstructions become over-distended, and exude part of their contents, owing to anastomosis with their neighbours, and the infarction, taking its character from the embolism which caused it, rapidly undergoes purulent infiltration, and forms an abscess. Around this abscess thrombi may occur in the veins of the lung, as in the lateral sinus. Fragments of these, again, may be washed off, and, passing to the left side of the heart, are distributed thence by the systemic circulation, and may produce similar infarction and abscesses

wherever they lodge, whether in the liver, spleen, kidneys, muscles, or elsewhere.

Again, it appears from the investigations of Virchow and Otto Weber that small purulent flocculi may occasionally be washed from a thrombus in the lateral sinus, and pass through the pulmonary capillaries without plugging them, though they may afterwards become lodged in the liver or some other organ, and thus produce abscesses in the viscera without any affection of the lung.

The mode of origin of the so-called metastatic abscesses does not admit of so ready an explanation as that of the pyæmic. In the case of the former, disease in one organ produces abscesses in others having apparently no anatomical connection with it. The abscesses can, however, be in certain instances accounted for by the production of passive congestion through slowing of the circulation in some parts; these are thus predisposed to inflammation, which is likely to be lit up by impurities in the blood. Abscesses so formed may occur at the base of the lungs, and must be distinguished from those which are the results of infarction of arterioles by portions of a thrombus. But why the base of one lung especially should be affected—namely, that on the same side as the disease in the skull—it is difficult to say.

Prof. W. Macewen is of opinion that in pyæmia of the lung following caries of the temporal bone, the infection is carried down the neck to the thorax by the lymphatics, and, I think, that the fact that there is often tenderness and sometimes painful enlargement of the lymphatic glands of the neck supports this view.

Sir Dyce Duckworth has recently done good service by re-directing attention to carious and suppurative conditions of the ear as occasional factors in the etiology of peritonitis and pleurisy. Moreover, in those of a tubercular diathesis, a carious temporal bone forms a suitable nidus for the germination of the tubercle bacillus, and a starting point for pulmonary or general infection. The frequency of such instances is becoming evident now that physicians are beginning to recognise the possibility of the connection and the importance of keeping the ear aseptic.

I believe there is often a causal rather than casual connection between aural suppurations and the albuminuria which some patients coincidentally suffer from. The albuminuria is not by any means always due to albuminoid degeneration of the kidneys consequent on long-continued aural discharges. The subject requires further investigation.

CHAPTER XIV.

THE VALUE OF PAIN AS A SYMPTOM OF
EAR DISEASE.

IN the present chapter I shall endeavour to indicate how important a symptom is pain in the ear in the various diseases of that organ. It is well known that earache in children may be followed by grave mischief in and around the ears. Of course, in slight cases of simple catarrhal inflammation, the ear may get well without any treatment; the inflammation subsides, and there is no discharge of pus. In other cases, even when suppuration occurs, as in teething, the little patient will as a rule quickly recover; although the common but reprehensible custom of poulticing the ears, I feel sure, often leads to extension of a simple catarrhal into an acute purulent inflammation, with perforation of the membrana tympani.

When suppuration is established, the same after-effects may be produced in children as in older people, as in the cases of adults about to be described. A leech applied in front of the tragus has often cut short all inflammatory symptoms and prevented suppuration, and has, as I have above given evidence to show, probably in many an instance saved a child's life.

In adults, ear mischief is generally but not always recognized, for I know of numerous cases of meningitis and abscess of the brain where a discharge from the ear has first been noticed in the *post-mortem* room. Unrecognized ear disease leading to fatal results must be still more common in children: Dr. Gee and Dr. Greenfield* have lately insisted upon this; and so convinced on this point is one of my own colleagues, Dr. Lees, that when he has had cases at the Children's Hospital, Great Ormond Street, presenting obscure brain symptoms, he has

* *St. Bartholomew's Hospital Reports*, vol. 8; *St. Thomas's Hospital Reports*, 1878

asked me to examine the ears to ascertain whether puncture of the membrana tympani for the evacuation of pent-up pus were requisite.

The cases here described, chosen from amongst adults, in whom we are better able to follow the course of disease than in children, illustrate the fact that pain about the ears, especially if it be acute, is usually an important symptom, and one which demands prompt attention. After having as shortly as possible dealt with the history of the cases, I shall make some remarks on the whole series.

CASE A.—Major J., æt. 50, had been suffering from intense pain over the left side of the head for ten days, when suddenly an abscess burst through the left membrana tympani. I was thereupon called in to see him, and found a perforation of considerable size in the membrane, through which an offensive discharge was making its way into the external auditory meatus. He complained of a dull heavy pain all over the left side and back of the head. He had a temperature of 108° , with a quick pulse. I ordered eight leeches, four in front of and four behind the ear. He was relieved to a very great extent by the local depletion. The symptoms having in two days returned, he was leeches again, with the same result; and, as the pain did not quite subside, he was ordered a third set of eight leeches. He took calomel and iodide of potassium, and subsequently quinine. The discharge was afterwards treated in the ordinary way with weak astringent lotions, and in a fortnight's time stopped altogether. The perforation in the membrana tympani closed, and he regained his hearing, making an excellent recovery.

CASE B.—The Rev. P. C., æt. 35, living three doors from Major J., in the same street, had a similar attack. He suffered for a fortnight from most acute pain at the top and back of his head, and was treated for meningitis by means of applications of ice to the head. One day a profuse discharge took place from both ears, with the result of freeing him of most of the pain, but leaving him intensely deaf. I was then called in to see him in consultation with Mr. Juler. He could hear my watch in contact with the left ear, but not at all with the right. I found that he had a large oval perforation in each membrana tympani,

affording passage to a very offensive and thick discharge. Eight leeches relieved all further pain. He was treated with a carbolic acid lotion applied to the ears on absorbent wool. In a week's time, when he could be moved, he was sent to another house; the discharge then ceased, but the perforation remained, and the deafness was still very marked. For a fortnight daily, and afterwards thrice a week, the edges of the perforation were touched with a 20-grain solution of nitrate of silver. In five weeks' time both perforations had closed, and hearing was restored.

CASE C.—Mrs. P., æt. 40, had for two months off and on been the subject of acute pain behind the left ear. Having been called in to see her, I diagnosed inflammation of the mastoid cells. But since this disease, as a primary affection, is very rare, I suspected that she had also mischief in the tympanum. This proved to be correct, although nothing at the time could be seen. Two days afterwards the ear began to discharge, and for ten days it continued to do so. The pain over the side and back of her head was occasionally intense, and not until fifty or sixty leeches had been at different times applied, did it entirely cease. She was treated with iodide of potassium very much as other cases here mentioned, and with small poultices the size of the ear. Her recovery was all that could be desired.

CASE D.—G. P., æt. 11, came to me at St. Mary's Hospital as an out-patient, November 13, 1880, with mastoid abscess. A fortnight previously the abscess had been opened, with the effect of relieving for a time the great pain from which he had for a long period suffered. On passing a probe, a sequestrum, apparently the size of a small bean, could be felt. There was a considerable purulent discharge both from the ear and from the sinus. He was taken into the hospital on the 18th, his temperature being a little over 100°. On December 3, the sinus closed, and the next day he left the hospital. Subsequently he caught cold, his temperature went up to 102°, and the pain and discharge returned. The pain now was intense, but it completely disappeared after the removal of a large piece of dead bone by the clinical clerk, Mr. E. O. Wight. The patient when

last seen by me heard the ticking of a watch six inches from the left ear. A scab formed over the opening into the mastoid process would occasionally fall off, giving exit to a little discharge, but the surface quickly healed again; there was no return of pain, and, considering the amount of mischief that had been going on in the ear, he was fairly well.

CASE E.—S. H., æt. 20, greengrocer, was admitted December 6, 1880, under the care of Dr. Sieveking. The right ear had been discharging for several years, and he had suffered from constant pains in the head, and was very deaf on the right side. On November 20 the pain in the right ear began to be worse, and was associated with severe headache over the right temple. On December 5 he had several fits, preceded, he thinks, by some on the 3rd. While the fits lasted he was unconscious, and bit his lips severely. He described his fits as coming on almost instantaneously, without any sickness or giddiness, and resembling the onset of sleep; whilst they were passing off, his head pained him exceedingly, and for some time he had severe cephalalgia. On the 9th a fit came on in which insensibility was accompanied by severe twitching first of the muscles of the left side of the arm, and then of the head, but not of the legs. A second fit the same afternoon was characterized by similar symptoms. The right ear was found to be blocked up by a greenish-yellow discharge of a very offensive nature. He was ordered :—

Pot. Iodidi, gr. v.

Pot. Bromidi, gr. xv.

Tinct. Hyoscyami, ℥ xxv.

Aq. Chlorof. ad ʒj. t. d. s.

He slept fairly well at night, but was very thirsty. On the 15th the pain in the right ear, which until the day previous had been much less, had greatly increased in severity, precluding any sleep. Discharge from the right ear continued, and there was swelling over the right side of the face, and pain in the right eyeball, "like a continual scratching going on at the back of it." There was, however, no pain at the top of the head. Being asked to see the patient, I ordered the application of leeches,

eight at a time, around the ear, which I caused to be frequently syringed out with a warm carbolic lotion. The leeching was repeated three or four times. The patient suffered no return of the fits during the last ten days of his stay in hospital, which he left on December 31, free from any discharge from the ear.

CASE F.—On December 27, 1880, I saw a lady, Mrs. B., æt. 33, in consultation. On the 23rd of the month previous she had got a severe chill at Ramsgate, and a few days afterwards a purulent discharge had appeared in the left ear. Subsequently, when she came to town, the lobe of the left ear became swollen, and she experienced very great pain, not only in the ear but also over the mastoid, extending on to the vertex. She had a quick pulse, and a high temperature, but no rigors. The pain became so intense that whenever the ear was touched she was seized with a kind of epileptiform attack, which lasted for about a minute. There was a very free discharge of offensive pus, and most acute and constant pain in the ear, but only slight tenderness over the mastoid process. Leeching in this case gave great relief, and after a short time the discharge (which was treated in the usual manner with weak astringent lotions) ceased—but it has since occasionally returned. The patient has, however, lost all pain, and the urgent symptoms have likewise disappeared.

CASE G.—Intense pain may be produced by syringing the ear too violently. Thus a lady, having consulted a doctor on account of deafness, was, without previous examination of the ear, subjected to syringing, until something gave way—the drum-head. She at once came up to town to consult Dr. Bryant, who called me in to see her. I found her almost mad with intense pain, and in a critical state from high fever, with the whole side of the head inflamed, and the eyes rolling. Of morphia, which in such cases is almost useless, she had taken a large quantity, without getting any relief; the application, however, of as many as eight leeches on five successive occasions freed her at length of pain, and she made an excellent recovery.

CASE H.—*Suppurative otitis.*—*Necrosis of petrous bone.*—*Sloughing of dura mater.*—*Suppurative meningitis.*—*Cerebral abscess.*—E. P., æt. 16, admitted at St. Mary's Hospital, November 15, 1880, was one of a family of sixteen children. She had

never menstruated. Seven years previously she had fallen down stairs, striking her head; and afterwards she occasionally had a discharge from the left ear. For more than half a year there had been nothing amiss with either ear, when, a month before her admission, she complained of pain in them both. There was no history of scarlet fever, and it is doubtful whether she had ever had measles. In the beginning of November, the patient said, something had "snapped" in her head. Sickness then began, which, after continuing for two days, ceased. She had been much excited, and at night unable to sleep, and had complained of pain in both ears, but mainly in the left. After November 7 she became delirious, perpetually crying out for some one to hold her head. On admission she was in much the same condition, muttering constantly, and occasionally shouting loudly, and passed excreta in bed, the bowels being freely opened. The lips and tongue were dry and coated; the pulse was 98, easily compressible, and intermittent; and the temperature 101.2° , rising in the evening to 103.5° . On November 17, the temperature was 103° , the pulse 98, and the tongue œdematous and thickly coated with creamy fur, with papillæ prominent and red. On November 18, she had passed a very noisy and restless night, until after injection of one-third gr. morphia. The pulse was 110, and the skin hot and dry, and the lips were covered with sordes. In the morning she had twitching of the muscles of the right side of the body. She was restless, repeated two or three sentences continually, and wished to kiss anyone near her. On November 20, the temperature was 99.4° (having been 101.4° in the night), the pulse 120, and the voice a hoarse whisper. There was discharge from both ears, and the mouth remained open. On November 22, the patient lay exhausted, with her head thrown backwards. Being powerless to swallow, she was fed by enemata. Muscular twitchings occurred at short intervals throughout the morning. The pupils varied in size; the temperature was 101.4° , with respirations 36, and pulse very rapid. Towards evening she became quite comatose, and at 9 o'clock she died.

Notes of post-mortem examination.—The left auditory meatus was full of thick inspissated pus. Removal of the petrous

portion of the temporal bone revealed destruction of the membrana tympani. The tympanum was occupied by pus and granulation-tissue, which extended into the mastoid cells. The head, neck, and long process of the malleus lay loose in the tympanum; and there were no remains of the incus or stapes. The Eustachian tube was choked with viscid mucus. The dura mater of the most prominent portion of the petrous bone had sloughed away over an area the size of a threepenny piece, leaving a bare surface. The convolutions of both sides of the brain were decidedly flattened, and the cerebral veins were intensely congested. There was suppurative meningitis, a thick layer of lymph and pus covering the space within the circle of Willis, and also the under surface of the left frontal lobe, pons Varolii, and cerebellum. Two abscess cavities, each about the size of a walnut, and having their walls lined with pyogenic membrane, occupied respectively the left frontal lobe and the anterior part of the left temporo-sphenoidal lobe. In the surrounding cerebral substance there were capillary hæmorrhages and general congestion. The ventricles contained an excess of turbid serum. The kidneys were congested, but all the other organs healthy.

REMARKS WITH RESPECT TO THE FOREGOING CASES.

Cases of ear disease may be conveniently divided for clinical purposes into two great groups, namely, those persons who seek advice for pain in or about the ear (as well as for discharge from the ear without pain), and persons who complain of loss of hearing, including those with tinnitus and vertigo. In the present chapter, it is with the first group that we are more particularly concerned. It is worthy of remark that, whereas the second group consists of cases in which merely more or less inconvenience and discomfort may be suffered, in the first we have to deal with cases in which life is actually endangered. Nevertheless, it happens that the members of the second group are those by whom the aural surgeon is most frequently consulted, since ordinary practitioners hold out to them no prospect of relief. The dangerous cases, on the other hand, are most

commonly treated by the family doctor, either because the disease is acute and severe, confining the sufferer to the house, or else because its nature escapes recognition ; it is therefore highly essential that a sound knowledge of their nature and characteristics should be generally diffused, in order that they may be promptly recognized and treated by the medical attendant.

Those cases having pain for their prominent symptom may be divided for practical purposes into two classes :—first, those in which the disease is in the outer ear, or external meatus, and is due to the presence of foreign bodies, as wax, or to otitis externa, either of a phlegmonous or dermoid nature ; and, secondly, those in which the disease is in the middle ear, and either of a catarrhal or of a more serious type. The first class of cases may generally be recognized with tolerable ease, either by a superficial examination, or by the use of the speculum. With an account of these I need not trouble my readers further than to say that, in all instances of pain in or about the ear, it is most necessary that a correct answer be given to the question whether the pain arises from an affection of the meatus. This answer must not be based upon a mere guess or supposition ; it can and must be established by accurate and satisfactory observation ; for upon this the life of the patient may depend. A decision having been satisfactorily arrived at, supposing the disease to be located in the middle ear, it now remains to consider its nature : and this brings me to the more especial subject of the present chapter. Speaking roughly, the second class of cases may be subdivided into three groups—first, those in which there is pain, more or less severe, but without much constitutional disturbance ; secondly, those in which the pain is associated with other and graver symptoms ; thirdly, perhaps I should add, cases in which there is no complaint of pain, but in which a discharge exists. In the first group the inflammation of the middle ear is merely catarrhal : the pain is unaccompanied by any marked rise of temperature, and is not of an intense and throbbing character ; there is neither vomiting nor convulsions, nor any external swelling about the ear or mastoid process. Such cases as these depend generally upon cold or a

disordered stomach, and sometimes upon gout or other constitutional affections. Their treatment is simple, and the prognosis good, for they very commonly do not pass on to suppuration. The second group of cases is much more serious. The constitutional symptoms are very severe: intense throbbing pain in the ear is accompanied and often disguised by the headache of inflammatory fever, hence the nature of the disease may be overlooked; there may also be vomiting, high fever, delirium, and even convulsions. The pulse may be frequent, or slow and deliberate, having the character of the "cerebral pulse;" in fact, the attack may very closely simulate meningitis, a disease in which it is not unlikely to terminate. In these cases we have to deal with an inflammation, not of the mucous membrane only, but also of the connective tissues of the periosteum, and hence often of the bone itself. An inflammation of this nature in so confined an area may, as I have above shown, terminate in meningitis or cerebral abscess, in phlebitis and pyæmia, in disease of the mastoid cells, in resolution through the Eustachian tube, in total destruction of the organ of hearing by attacking the internal ear, or in temporary or permanent interference with hearing, consequent on injury to the tympanic membrane. To combat the disease our treatment must be correspondingly active: sharp antiphlogistic remedies and leeching, as free as the cases narrated indicate, will be always necessary, while the surgeon must be ready to cut deeply down upon the mastoid process should œdema be there, or to puncture the membrane if it be found bulging. The cases I have just narrated are nearly all examples of otitis media, more or less acute. In Cases A and B we have uncomplicated examples of the disease taking its most usual course, the collection of the pus in the tympanum making its way through the tympanic membrane. Cases C, D, E, and F afford examples of a more chronic condition; in D the disease had produced necrosis of the adjacent parts of the temporal bone. In Case G we have an example of myringitis, or acute inflammation of the drum-head. Case H well illustrates the ravages wrought by suppurative otitis when allowed to be without treatment until assistance is no longer possible.

In such cases as these, we observe, there is a great liability

both to the simulation of cerebral disease where it does not really exist, and, if they are left to themselves, to its production. It is important to remember that all the symptoms of meningitis may be present in a case of otitis media, and that yet the case may recover. Similar symptoms, with a like result, arise occasionally from suppuration in the eyeball or orbital cavity. Whether in these cases meningitis really occurs and subsides, or symptoms of meningeal inflammation are produced by mere hyperæmia, it is difficult to determine; but necessarily our prognosis should be guarded when we suspect meningitis from ear disease. Such cases are, on the one hand, hopeful, because by treating the ear disease we may be able to cure the patient; but, on the other hand, they may be most grave, for intra-cranial mischief may have arisen, against which we shall be powerless. Case E is a good example of what appeared to be evidences of serious intra-cranial mischief arising from ear disease, in which the symptoms of brain affection passed off without harm. There can be no doubt, as I have already remarked, that many cases of obscure cerebral symptoms in children, some of which end in meningitis, are due to otitis media. In all those cases commonly grouped under cerebral irritation or suspected meningitis, the ear should be examined with a speculum, the use of which should be as much a matter of routine as that of the ophthalmoscope. Unfortunately a large number of medical men show a remarkable want of familiarity with the ear speculum, especially when we consider that cases of tinnitus, neuralgia, headache, vertigo, epilepsy, cerebral irritation, brain disease, and pyæmia—due to ear disease—must frequently come under their observation. For this reason it is that a large proportion of these affections pass unrecognized.

Should the membrane be found bulging it will probably require incision; but this operation, of course, must not be rashly undertaken, since it demands both experience and skill. The dangers attending it have been too frequently insisted upon to need repetition here. The other treatment necessary, should disease of the ear be detected, has already been described. It is certain that the lives of many children might be saved were the practice more generally followed; for not a few die annually

from acute otitis media and its immediate results. The treatment of the chronic discharge from the ear which follows this disease in most children who survive it would prevent those most distressing cases of suppurative meningitis, cerebral abscess, and pyæmia so common in adults—the miserable results of neglected ear disease in childhood.

To return, however, to the subject more especially under consideration, it is well that we should recognize the fact that pain which has its origin in the ear is by no means localized in that organ: it may be either in front, above, behind, or below it, indeed, anywhere on the same side of the head, and perhaps on each. The reason for this is easily discovered. The external, middle, and internal ear have all very far-reaching nerve connections. Thus, in front of and above the external ear are ramifications of the auriculo-temporal branch of the 3rd division of the 5th; behind, above, and below are the small occipital and great auricular branches of the cervical plexus; immediately behind the pinna the auricular branch of the pneumo-gastric comes to the surface, and gives rise to very important communications: all these nerves anastomose in and around the pinna. In the tympanic cavity we find an equally wide-reaching plexus. The tympanic branch (Jacobson's nerve) of the petrous ganglion of the glosso-pharyngeal communicates with the great superficial petrosal, which passes to the sphenopalatine ganglion; its small superficial petrosal twig goes to the otic ganglion; and a third filament passes to the carotid plexus of the sympathetic. Since all these nerves are united in the tympanic plexus, pain produced in the tympanum may radiate over the wide area which they supply.

Intermittent aural neuralgia occurs in patients subject to aural catarrh. I find that a liniment of $\mathfrak{z}\text{ij}$ each of tinct. aconiti, tinct. belladonnæ, and tinct. opii, to $\mathfrak{3}\text{j}$ of tinct. saponis, rubbed gently round the ears, is a most satisfactory antidote. The characteristic symptom is violent pain at night only, which may be accompanied by a discharge of pus from the middle ear. In malarial districts the disease is common, and in most cases quinine will effect a cure.

It is not my intention in the present chapter to discuss the

question of the etiology of otitis media, but there is one point of great interest I would briefly refer to. Dr. Cassells, of Glasgow, was, I believe, the first to suggest that bad sanitary conditions compelling the inhalation of sewer gas occasionally give rise to acute inflammation of the middle ear. The two first cases in this series seem to lend some support to this conjecture. Two gentlemen, living within three doors of each other, we observe, suffered almost simultaneously from the same complaint. In neither case was there any known cause, and in neither had there been any previous attack; but in the house of each the sanitary conditions were known to be bad, and there was a pervading offensive smell due to sewer gas. I have had three children in one family, and two in another, under my observation for profuse discharge from the ears; and in each instance, immediately the children were removed from houses in which the drains were in bad order, they got well, nor did they have a return of otorrhœa when they returned to their homes after the sanitary arrangements there had been improved. Granted that sewer gas possesses for the laryngeal mucous membrane the affinity which it apparently has for the tonsil, one cannot be greatly surprised if septic germs from the gas travel along the adjacent Eustachian tube, and find a suitable and undisturbed soil in the tympanic cavity.

CHAPTER XV.

DISEASES OF THE INTERNAL EAR.

ALTHOUGH many observers during the present century have done much to elucidate the coarser pathology of the labyrinth, we are still much in the dark concerning the causation of many of the symptoms of internal ear disease.

Amongst the lesions affecting the labyrinth and auditory nerve which *post-mortem* examinations have proved to exist may be mentioned :—

1. Defective development of the semicircular canals, vestibule, or cochlea.
2. Absence and disease of the ordinary channels by which sonorous vibrations pass from the middle ear to the internal, viz., the oval and round windows or fenestræ.
3. Defect or excess of the otoliths.
4. Anæmia, hyperæmia, and acute suppuration of the labyrinth.
5. Extravasations of blood and of lymph leading to organized exudations : these being probably the most frequent lesions.
6. Thickening or atrophy of the membranous labyrinth.
7. Necrosis and caries of the bony walls of the internal ear.
8. Tumours of an osseous, fibro-muscular, sarcomatous, or pigmented character ; cholesteatomatous masses.
9. Changes in the course and termination of the auditory nerve, including—

- (a.) Atrophy due to defective nourishment, either from the pressure of tumours or from cerebral and meningeal disease, especially in the cerebellum or medulla, or from a lesion of the auditory artery.
- (b.) Inflammation, hæmorrhage, lymph exudation, fatty, fibrous, calcareous, pigmentary, and other degenerative changes in the course of the nerve.

- (c.) Pathological conditions of the cerebral nervous system, involving the acoustic centre or the origins and root of the nerve, such as apoplectic clot, thrombi, softening, abscess, tubercle, cerebral and meningeal inflammation.

The internal ear is rarely the seat of primary disease. It may become secondarily affected: (1) by traumatic conditions, usually due to a blow or fall on the head, as effusion of blood or serum into the labyrinth—a fertile source of so-called nervous deafness—laceration of its structures, or direct lesion of the brain; (2) by morbid intra-cranial lesions, such as tumours, abscess, meningeal disease, atheromatous and aneurysmal conditions of the auditory basilar or vertebral arteries, vaso-motor paresis of the same, obstructions in the venous sinuses, especially the superior petrosal; (3) by more or less general constitutional conditions, as in the course of specific fevers, meningitis, syphilis, mumps, rheumatoid arthritis, and, less generally, tabes dorsalis; (4) from the exhibition of certain drugs and substances, such as salicin and quinine, opium, alcohol, and tobacco; (5) by abnormal conditions of the tympanum, such as hyperæmia, acute inflammation, bone disease, and pressure on the perilymph and endolymph through morbid lesions of the fenestræ and ossicles.

Hartmann discusses labyrinthine diseases under the under-mentioned headings, which I enumerate here because the classification brings out the chief pathological and etiological factors in morbid conditions of the internal ear:—

1. Hyperæmia.
2. Anæmia.
3. Hæmorrhage.
4. Acute Inflammation.
5. Chronic Degenerative Processes.
6. Ménière's Complex of Symptoms, including Ménière's Disease.
7. Concussion of Labyrinth.
8. Syphilis.
9. Leukæmia.
10. Mumps, Epidemic Influenza, and other Fevers.

11. Diseases of the Auditory Nerve.
12. Reflex Neuroses.
13. Hysterical and Functional Deafness.
14. Central Disease of the Nerve Roots, and of the Auditory Centre.

The symptoms of labyrinthine disease may include, in addition to (1) usually marked impairment of both aerial and bone conduction of sound; (2) subjective sounds in the ear or head; (3) giddiness or vertigo; (4) nausea or vomiting; (5) partial tone-deafness; (6) paracusis; (7) hyperæsthesia acoustica.

In many cases, upon examination with the speculum, no trace whatever of disease or injury can be discovered, the membrana tympani looking, in fact, perfectly healthy; and the Eustachian tube and ossicles being quite normal.

It may be asked, "How then do we distinguish between deafness due to mischief in the labyrinth and deafness due to disease of the middle or external portions of the auditory apparatus?" The vibrating tuning-fork is our best guide to a correct diagnosis, though, as will be hereafter seen, not an unfailing one.

At the meeting of the International Medical Congress in 1881, Mr. A. Gardiner Brown stated as his opinion that the tactile sensibility of the thumb and finger might be employed by the aurist as a ready, accurate, and simple standard whereby to measure the efficiency of the auditory nerve with respect to the sonorous vibrations of a tuning-fork held to the head.*

In treating ear disease, it is important to bear in mind that the organ of hearing is made up of two fundamentally distinct portions, the one sound-conducting, the other sound-perceiving: the former comprising those delicate structures whose function it is to carry sonorous vibrations to the complex nervous mechanism of the latter.

If, when the vibrating tuning-fork is placed on the head of a deaf person, its sound is heard louder in the deaf or deafer ear, the surgeon anticipates that there is disease and consequent

* See *Brit. Med. Journ.*, Sept. 4, 1880, p. 391

obstruction to the passage of sound in the conveying portion of the auditory apparatus; that is, in the external or middle ear. On the other hand, if the tuning-fork is more audible in the better ear, there probably exists some lesion of the labyrinth or auditory nerve, *i.e.*, of the sound-perceiving portion of the deafer ear. This is Weber's method (pages 49—51).

In this experiment the vibrations of the tuning-fork are carried by the bones of the head to the inner ear: if retained in the ear by an obstruction which makes the patient deaf to ordinary sound, they are intensified; if not, as they pass out through the external meatus without opposition, they are heard only to a very slight extent. This fact may be realized by anyone not deaf, by placing a vibrating tuning-fork upon the forehead, and with the finger closing one ear, the sound in which will now be much louder than in the other. Much care, however, is necessary in order to obtain a correct statement from a patient as to the side upon which he hears the tuning-fork best.* A deaf person, being fully persuaded that he ought to hear more plainly with his better ear, will at first, as a rule, speak accordingly. A few trials, will, however, elucidate the truth; and, as nervous deafness is comparatively rare, it is well to accept with great caution testimony as to its presence.

In testing the nerves with the tuning-fork the following routine method is useful. The surgeon should by practice learn to set the tuning-fork vibrating by a fairly uniform blow, so that it may always be heard on his own vertex or mastoid for about the same period. Having placed the vibrating fork on the patient's mastoid process, ask him or her to indicate by a sign the exact moment that the sound ceases. The fork should then be rapidly transferred to the examiner's own mastoid, when the number of seconds that the sound is still heard will be an index of the amount of the patient's nerve deafness on the side tested. Normally a vibrating fork is heard *again* when held *near* the meatus after it has ceased to be audible *on* the mastoid; in uncomplicated middle ear disease, however, aerial conduction is less than bone conduction: the converse should obtain in labyrinthine disease: when the two are equal both the middle

* See *Medical Press and Circular*, Dec. 19, 1877.

and the internal ear *may* be affected. This test (Rinné's) often proves to be fallacious.

In the vertex experiment the tuning-fork is often not heard at all; and in these cases the sound may be heard on the mastoid for only ten or fifteen seconds. Such cases are the commonest met with. If the tuning-fork is not heard on the mastoid and, therefore, not by the less sensitive route from the vertex, it is often possible to obtain appreciation of the sensation when the vibrating fork is placed on the upper incisor teeth. These points are dwelt on because the fact that a tuning-fork is normally heard best on the teeth, less well on the mastoid, and least distinctly on the vertex is of great importance in determining whether a patient is improving under treatment. In a hospital case it was found that the fork was not heard even on the teeth; he was injected with pilocarpin daily for three weeks, without any result being obvious, and the treatment would have been discontinued on account of debility and inconvenience, had it not been ascertained that the nerve had so far improved as to be sensible to vibrations conducted from the teeth. Perseverance in treatment resulted in great improvement, both in aerial and bone conduction, and in the hearing of raised general conversation; whereas on admission he could only be made to understand anything by shouting.

In a case of carcinoma not directly involving the labyrinth, and causing quantitative atrophy of the nerve-fibres in the lamina spiralis ossea of the first convolution of the cochlea, Moos and Steinbrügge observed impairment of hearing for high tones only, a condition which bears out Helmholtz's hypothesis that the nerve-fibres in the neighbourhood of the fenestra rotunda effect perception of notes of elevated pitch, but those situated further up of lower notes.* On this account it is useful to test with tuning-forks of different pitch as recommended by Politzer, and in some anomalous cases I have found Galton's whistle, in which the pitch can be varied, of much assistance.

It is commonly supposed that nervous deafness is more frequently met with in persons of nervous temperament than in others; but such in my experience is not the case.

* See *Archives of Otology*, March, 1881.

In illustration of the character of true nervous deafness, I will give the records of a case of neurotic disease accompanied by an affection of the middle ear.

G. C., æt. 5, was brought to me at St. Mary's Hospital, September 15, 1876, suffering from complete deafness in both ears. His mother stated that, eighteen months before, he had fallen downstairs, alighting on his head, and had been picked up in an insensible condition, and had remained so for nearly a week. He had since been totally deaf, but he still retained the power of speech, in which he had acquired fair facility before the injury. He could not hear the tuning-fork pressed to his forehead, or even a pistol fired off close to his ear. His mother had an idea he could hear knocking sounds. The faculty, however, in all cases of total deafness, of perceiving the concussion of a blow is due to the patients' *feeling* the vibrations without *hearing* them. Stamping on the ground or clapping the hands will often attract the attention of totally deaf persons; and in some institutions for the deaf and dumb drums have been found useful as a means of communication with the inmates.

The precise nature of the injury received in cases such as the last mentioned cannot always be determined, but in a great many instances there is effusion of serum or hæmorrhage into the semicircular canals or cochlea, or laceration of the tissues of the membranous labyrinth.

Absolute deafness is the principal symptom of disease of the auditory nerve; and with its graver forms giddiness, tinnitus aurium, paroxysms of vertigo, faintness, and vomiting may all be associated. According to Hughlings Jackson, these symptoms always depend upon affections of the auditory expansion in the labyrinth.*

At *post-mortem* examinations, Toynbee found atrophy of the auditory nerve thirteen times in persons between sixty and ninety years of age. In others there were imperfections of structure, and various diseases of both membranous and osseous semicircular canals. In some there was a deposit of black pigment in the cochlea, with blood in the vestibule, in another, blood in the cochlea. In one case in which there was a history

* *Lancet*, March 24, 1882, p. 417.

of a fall on the head some years previously, and subsequent deafness, there were dark specks on the lamina spiralis in both ears.

Professor Moos found lymphoid corpuscles on the lamina spiralis, sacculi, and ampullæ, some having undergone fatty degeneration, in the labyrinth of a soldier who had died from typhoid fever. As Burnett remarks, fatty metamorphosis of the organ of Corti may be the result of hæmorrhages into the cochlea. Amyloid degeneration of the auditory nerve is not uncommon.

If nervous deafness is the result of recent injury to the head or of other cause offering strong evidence of effusion of blood, the use of leeches, purgatives, Leiter's coil, and counter-irritants may be resorted to, for it is within the bounds of possibility that absorption may be thus facilitated;* but if the disease has become chronic, no treatment will be of use, the administration of quinine, for instance, doing more harm than good, and the application of electricity being without any beneficial result, at any rate as regards hearing, so far as I have seen. The employment of ice-bags for the head in typhoid fever I believe to be a frequent source of mischief in the labyrinth, and therefore a procedure requiring great caution. Extreme cold of any kind, as from a continuous draught of chilly air, is not uncommonly the starting point of this form of ear disease. When it originates in mumps, one side alone is usually implicated.

I had at one time under my charge a case of a young man who, three months after a sharp attack of mumps, remained quite deaf, although no lesion of the middle ear could be detected. The tuning-fork test showed that the nerve was impaired.

Deafness after Typhoid Fever.—The following case is scarcely typical of nervous deafness, but is mentioned here because it is very nearly allied to the class under consideration. It teaches us to be guarded against giving an unfavourable prognosis in all cases of apparent affection of the auditory nerve.

E. H., a girl, æt. 10, brought to me at St. Mary's Hospital, had suffered from total deafness and consequent dumbness since an

* See case of injury to head, p. 313.

attack of scarlet fever when she was two years old. Her general health had completely broken down. I prescribed cod-liver oil occasionally and

Potassii Bromidi, gr. iij.

Tinct. Nucis Vomicae, ℥ij.

Aquæ ʒss. t. d. s.

By these means a gradual though incomplete restoration of hearing and power of speech was brought about.

I concur with Burnett in thinking that, in the vast majority of cases of deafness due to typhoid fever, the affection of the labyrinth is secondary to a tympanic disorder.

During the acute stage of fever, especially typhus, it is, of course, extremely common to find more or less severe deafness; and this is always commensurate with the amount of nervous prostration induced by the fever, and the severity of the other nervous symptoms. Most commonly, with convalescence, it passes off; but it may be continued subsequently for a while, and in some cases it is permanent. It thus closely resembles a more extensive injury to the nervous system, sometimes met with, resulting in either temporary or permanent melancholia or mania. Loss of any special sense other than hearing is rare; so also is motor paralysis.

Deafness in epidemic cerebro-spinal meningitis is said to be due to inflammatory changes set up in the organ, particularly affecting the lining membrane of the vestibule and semicircular canals, and occasionally the external meatus, from which a profuse purulent discharge has flowed.* It is said to be one of the commonest causes of deaf-mutism in America, though rarely so in this country.

In typhus, of which we have had an example in the following case, deafness, according to Dr. Buchanan, generally begins at the end of the first week, may be slight or nearly complete, and persists even after the advent of convalescence, but nothing is to be seen in the ear to account for it.

E. D., æt. 19, came to St. Mary's Hospital from Walton to

* J. N. Radcliffe in Reynolds's *System of Medicine*, vol. 1, p. 505.

consult me in January, 1876. She had been deaf for ten years in consequence of typhoid fever. Neither my watch in contact with the ears nor my voice was audible, and she could hear a vibrating tuning-fork placed on the vertex of her head for a few seconds only. Her mother was the only person who could make her understand anything. The membrana tympani in both ears was concave, thickened, and of a dirty-grey colour; the Eustachian tubes were completely closed. For the last eighteen months the patient had been losing her speech, and she was now almost dumb. With a little difficulty I passed the Eustachian catheter, the use of which was continued regularly once a week for a time, and afterwards once a fortnight; I also gave her large doses of iodide of potassium. Under treatment she by degrees regained her speech, and six months after I first saw her she could talk perfectly well, and, although still very deaf, could by a little extra exertion be made by anyone to hear. I could see very little abnormality in the colour and shape of the tympanic membranes.

Of course in this case there were great difficulties to contend with; the sound-perceiving and sound-conducting apparatus were both at fault; but by improving the condition of the latter the auditory nerve was enabled to use what little power it still had, and the patient was thus prevented from becoming dumb as well as deaf.

There are several—perhaps many—instances on record of almost complete recovery from what at first appeared to be incurable deafness after typhoid and other fevers and after injuries to the head. These are cases in which it is very difficult to come at once to a certain prognosis; and I would make it a rule to treat each upon the chance of the disease not having permanently injured the nerve apparatus.

There is a close connection between the vascular structures of the tympanum and the labyrinth; consequently, in deafness following typhoid, puerperal, and other fevers, the hyperæmia of the labyrinth is often only temporary, and hence, as in cases I have mentioned, leeching and blistering freely behind the ear at once relieve the deafness. A glass of spirits will in some persons cause temporary deafness from congestion, probably

extending (as Burnett suggests) from the fauces to the Eustachian tube, middle ear, and labyrinth in succession.

Dr. S. Weir Mitchell has described a fitful kind of deafness attributable to an hysterical condition.

Intermittent attacks of functional nerve deafness and tinnitus, without apparent lesion or cause, are occasionally to be observed in the persons of neurasthenic and hypochondriac subjects. In such, a favourable prognosis and tonic treatment will effect a speedy cure. It is, however, difficult to make a positive diagnosis of neurasthenic deafness, though I have seen several undoubted cases.

LABYRINTHINE DISEASE SUPERVENING ON DISEASE OF THE MIDDLE EAR.

In cases of this affection the power of hearing is much impaired, yet not always lost, and improvement in it takes place upon amelioration of the condition of the conducting structures. Perfect audition is hardly ever regained, but by clearing and repairing the road to the inner ear we enable the patient to make use of the little that is left to him. Disease of the labyrinth may result secondarily from inflammation of the tympanum, whether acute, as in the exanthemata, or chronic, as in old catarrh of the middle ear. Dr. McBride, of Edinburgh, has described* a case of croupous inflammation of the cochlea due to a small sarcomatous intra-cranial tumour, which had penetrated the internal auditory canal to within short of its fundus. Sarcomatous infiltration of the bone around the cochlea had taken place, probably through the cochlear branch of the internal auditory artery, but the cochlear duct had suffered very little, and the membrana tectoria, crista spiralis, the "auditory teeth" of Huschke, the junction of the external and internal pillars of Corti, and the membrana reticularis could clearly be distinguished. In the semicircular canals not a trace of fibrin was detectable. The deafness noticed in this case was possibly first induced, not by direct pressure on the auditory nerve, but by inflammation of the cochlea, since facial palsy was not

* *Journ. of Anat. and Physiol.*, vol. 14, p. 195.

exhibited till long subsequently. In accordance with this supposition it is conceivable that cochleitis might be set up simply by extension of a sarcomatous tumour along the internal auditory artery.

Artillery men and boiler makers, being frequently exposed to concussive shocks, are liable to chronic inflammation of the internal ear, coming on gradually. That they seldom suffer any sudden injury may perhaps be attributed to their hardly ever being taken by surprise when a gun is fired or a blow is struck; for it is probable that by the preparatory action of the internal muscles of the ear, especially the stapedius, the parts are placed in a position suitable for the reception of shocks: aural accommodation, in fact, takes place. We all know how much less than ordinarily we feel the shock of a great noise if we are aware that it is going to take place.

If boiler makers and others exposed to continual noise would only take the precaution of wearing cotton wool in the ears, they would effectually prevent concussion and chronic inflammation of the internal ear. Ward Cousins, Macnaughton Jones, and Hawksley have each devised useful protectors, made of rubber, of celluloid, and of fibrous clay respectively.

Sometimes considerable loss of hearing comes on quite suddenly without apparent cause or warning of any kind, as in the case of a medical man, Mr. J. W., who consulted me in January, 1878, and who could not hear a watch in contact with either ear, or a vibrating tuning-fork placed on his forehead. He derived little benefit from treatment, and a year afterwards thus described his symptoms:—

“If you ask me how I now am in respect to deafness, I should say *in statu quo*, neither better nor worse. The noise varies much in the course of the day, with cold or damp, or wet or digestion. My general health is excellent. There was, if you remember, and still is, a subsidiary noise, not apparently located in the ear, but in the cerebellum. This continues the same, and just as I drop off to sleep I suffer a nervous shock or start, which, however, is not repeated so as to keep me awake.”

I once saw with Dr. Hood a case of sudden loss of hearing

and severe tinnitus aurium in a gentleman, originating in the following rather remarkable manner:—

The patient in passing through a poor neighbourhood came to a house where brokers were about to seize an old widow's furniture for a debt of some £30 or £40. After making enquiries, he paid the amount due; but he was so overcome with emotion caused by the distress he had witnessed, that he was suddenly seized with almost total deafness in one ear, due possibly to labyrinthine apoplexy or to a slight bulbar lesion, perhaps of a hæmorrhagic nature.

PILOCARPIN IN LABYRINTHINE DISEASE.

Politzer was the first to recommend this agent in the treatment of recent cases of exudative disease of the labyrinth, and in syphilis of the same, where the process had not yet become chronic. But he formerly limited its application to recent affections, and discontinued its employment in the course of a week, if no good result ensued in that time.

Kosegarten was the first to reject cases that cannot submit to daily treatment for six weeks. He injects hypodermically one centigram, and has watched the effect on the drumhead and mucosa of the tympanic cavity. A distinct redness is seen to come in thirteen minutes after the injection in some cases, and remain visible for forty minutes; then it fades away rapidly. In some cases the redness comes on more slowly. It even appears that the secretion in the middle ear is increased during the effect of the pilocarpin. It is held that this remedy acts both upon the internal and the middle ear disease. "By means of returning hyperæmia, which may even cause exudation, there ensues pliability of the sclerosed tissues, and moistening and softening of adhesions, and in this way the unyielding conducting apparatus again becomes more capable of vibrating. When exudations had become deposited, their absorption was brought about." Politzer's want of success is attributed by Kosegarten to too short a trial of the remedy, which can be efficient only when its action is long continued.

Although Kosegarten speaks of Politzer's want of success, I

can testify to that aurist's very favourable results with pilocarpin injections in patients who came under my observation in 1888. Pilocarpin, in my experience, produces marked results in suitable cases. I begin treatment with the daily *hypodermic* injection of three minims of a 4 per cent. solution of pilocarpin. The dose is gradually increased, if suitably borne, from one-tenth or less up to a quarter or even third of a grain.

Kosegarten (*Zeitschrift für Ohrenheilkunde*, xx, p. 110) records three bad cases of deafness after mumps in which hearing was completely restored by this treatment. These cases have hitherto only too often resulted in total deafness.

I recently (*Brit. Med. Journ.*, April, 1890) recorded twenty cases, mostly of labyrinthine disease, which were much benefited by pilocarpin injections, and I wrote: "One is forced to inquire how these results can be brought about, and a correct appreciation of its *rationale* would doubtless lead us to an understanding of why it is beneficial in some cases, and of little avail in others. It is advisable, in the first place, to inquire into the pathology of labyrinthine deafness. The absence of bone conduction would point to some condition which prevents the terminal fibres of the auditory nerve from being acted upon by the acoustic vibrations. With very few exceptions, such as, for instance, in some cases of Ménière's disease and in locomotor ataxy, this condition is essentially inflammatory in its origin. Primary inflammation of the labyrinth is exceedingly rare, so far as pathological observation has gone. In one case, recorded by Schwartze, suppuration of the labyrinth, independent of any affection of the middle ear, led to suppurative meningitis. Politzer, too, has recorded a case where, the middle ear being normal, inflammation of the labyrinth caused new bone-formation from the periosteum, which completely filled up the cavity. In by far the majority of cases, however, the labyrinthine disease is secondary, and although a few cases have been reported where inflammation has extended from cerebral meningitis along the sheath of the auditory nerve or through the aqueductus cochleæ to the labyrinth, yet usually the primary seat of the inflammation is the middle ear, which is so often affected in the specific fevers.

“The early stages of this affection as it attacks the labyrinth are evidenced anatomically by congestion, small cell infiltration and sometimes by suppuration and complete destruction of its membrane. The inflammation may spread along the sheath of the auditory nerve, and so reach the cranial cavity, but more commonly, and fortunately, the inflammatory process is limited to the labyrinth itself. Here at times the inflammatory material undergoes further changes. The cavity of the labyrinth becomes filled with a fatty or cheesy mass, containing a granular and sometimes calcareous matter, pigment, and crystals of cholesterine; bands of fibrous tissue may stretch from wall to wall, and the bony walls become thickened as the result of the inflammation of their periosteum. The membrane of the labyrinth may be absolutely destroyed, and with it the nerve-endings spread upon it are degenerated and atrophied. More commonly the membrane is thickened by overgrowth of fibrous tissue, and this presses on the nerve-endings and paralyses their action. The accumulation of these inflammatory products in so confined a space necessarily causes more or less disappearance of the perilymph and endolymph. The course of the inflammation, it appears then, is that which an inflammation may pursue in other parts, its results being dependent upon its severity and upon the delicacy and complexity of the organ in which it has occurred. Nor would it appear that the cause of the inflammation has much influence upon its pathological results. Syphilitic affections of the labyrinth, in which Politzer first found the pilocarpin treatment of benefit, cause practically the same pathological appearances, although it may be mentioned that Moos and Steinbrügge have described a case in which a true gumma had formed in the periosteum of the labyrinth.

“Such, then, is the condition which causes labyrinthine deafness, and it can readily be understood that it is not promising to ordinary methods of treatment. Yet it is in many of just such cases that I have found the subcutaneous injection of pilocarpin to give great relief, and in not a few instances to lead to what is for practical purposes a cure. How this is brought about is, for the present at least, incapable of proof; but the surmise I would venture to put forward—and it would appear to me to be at

least plausible—is the following:—Referring to Dr. Lauder Brunton's *Textbook of Pharmacology*, we find that pilocarpin increases all the secretions of the body, except the bile, and this it does by stimulating the secretory nerve-fibres. I notice the secretion of the outer ear, especially the wax, is increased by it; and I may mention, in passing, that in all these cases of labyrinthine deafness, wax is usually absent in the ears. It would appear not improbable, therefore, that the secretion of the inner ear should also be promoted by the injections, seeing that the action of all the mucous membranes of the body is stimulated. The softening of the inflammatory accumulations which would result therefrom would greatly facilitate their removal by the absorbents; and, even if it did not cause their absolute disappearance, would so far relieve the pressure upon the auditory nerve-endings as to allow of a resumption of their function. If the membrane of the labyrinth had been destroyed entirely, no secretion could take place. Again, no improvement could be expected from such treatment if bony hypertrophy had occurred. We know that in peripheral neuritis, as it occurs in other parts of the body, recovery of the function of the nerve may take place even after a considerable lapse of time; and where the auditory nerve-endings are functionally hindered by the pressure of surrounding exudation, it may well be that improvement may follow from the removal of the exudation. Where, however, pronounced atrophy of the nerve tissue has established itself—and this has been found in the labyrinthine deafness which is the result of locomotor ataxy, as well as in that of inflammatory origin—no treatment can be of any avail. We have no means at present by which we can judge of the presence of these unfavourable conditions; and I think it probable that to this cause may be attributed some of the abortive results of the pilocarpin injections. In a large number of instances, however, the results obtained have been most gratifying, and I venture, therefore, to record my experience of what I believe to be a valuable method of treatment."

In middle-ear disease pathological observations have shown that fibrous adhesions, cicatricial contraction of the mucous membrane, and ankylosis of the ossicles are the most frequent

results of inflammation, and these are not so likely to be benefited by the secretory action of the pilocarpin as in the accumulation of inflammatory *débris*, which is often the cause of labyrinthine deafness.

It has been urged in opposition to this view that in many cases of labyrinthine disease pilocarpin is quite useless. It is, however, obvious that it must remain so in all those cases in which there is either bony thickening or, whether from locomotor ataxy or from direct inflammatory action, there is destruction of the membrane and atrophy of its nerve endings. It would, in short, be impossible, from purely negative evidence, to come to a legitimate conclusion as to the scope of the employment of pilocarpin in labyrinthine disease. Large numbers—indeed, most of the supposed cases of this affection sent to me as unamenable to its action—have proved to be quite unsuitable for its exhibition, being examples of every other sort and condition of ear disease, including long-standing perforation of the drum-head.

I determined to thoroughly investigate this treatment during a prolonged period, both in hospital and private practice.

As the outcome of further study of the disease, its symptoms, and its modes of treatment, I would make the following observations:—

a. The case must first be carefully diagnosed as actually one suitable for treatment with the drug. Labyrinthine deafness, it must be remembered, is not a disease of common occurrence.

b. The larger number of the patients that hear better in a noise (when in a train or omnibus, for example) do not derive much, if any, benefit from pilocarpin, if used independent of other remedies.

c. The best test of hearing is to employ a large tuning-fork with a wooden handle, acting as a sounding-piece, to put on the head. Some of the small tuning-forks commonly used are worthless to the aural surgeon.

d. Cases in which the tuning-fork on the forehead is heard indifferently or scarcely at all may be suitable for treatment with pilocarpin.

e. Patients with a syphilitic history are usually much relieved,

and the possibility of hereditary syphilis in a given case must be borne in mind.

f. The very large number of patients that say they hear worse after a cold are mostly unsuitable cases.

g. Patients who say they can hear when they are spoken to very distinctly, or whose deafness began with a difficulty of discriminating sounds, or who cannot make out general conversation, and hear worse when tired, nervous, or feeling out of health, are more promising cases than the last mentioned.

h. In arriving at a diagnosis, the state of hearing as tested by the watch and the condition of the drum-head should be noted.

i. Some cases of marked aural vertigo derive benefit from pilocarpin.

j. If middle-ear disease is associated with mischief in the internal ear, the Eustachian catheter should be passed from time to time for the injection of vapours.

Finally, it must be added that epidemic influenza may affect the internal as well as the middle ear; in recent cases bone conduction is often restored and deafness markedly relieved by pilocarpin. The same remark applies to mumps and other specific fevers.

My usual method of administering pilocarpin is to inject into the back of the arms a solution of the nitrate of a strength equal to $\frac{1}{3}$ gr. to 10 minims. The dose at first, $\frac{1}{12}$ gr., is gradually increased to $\frac{1}{8}$, $\frac{1}{6}$, or, if well borne, $\frac{1}{4}$ gr. The effect is speedily manifested by diaphoresis and copious salivation. After each injection I give half a drachm of sal-volatile in a small tumblerful of water. The patient is then made to lie on a sofa, and is well covered with rugs, the head being enveloped in a shawl. When the effects are wearing off the wraps are removed, but only by degrees, in order to avoid the risk of catching cold. In the event of faintness or other discomfort from the exhibition of the drug I give brandy at once, which I keep ready at hand, and find the best restorative. Untoward symptoms need not be apprehended if the precaution of beginning with the small dose above mentioned be strictly adhered to.

Due attention to the foregoing particulars will enable one to reduce to comparatively few the number of cases amenable to

treatment with pilocarpin. The histories of the following patients have been given mostly in the patients' own words, and speak for themselves.

CASE I.—Miss A. E., æt. 39, treated by me three years ago, in answer to a letter I sent in February, 1892, writes as follows: "I am delighted to tell you that the improvement in my hearing is fully maintained. When, three years ago, I first consulted you, I required a trumpet to hear a person speaking at my side in a raised voice. I could not hear a speech or sermon in any seat in any building, even with a trumpet. I now do without a trumpet entirely, and can hear a clear voice by my side slightly raised above the ordinary pitch, and with satisfaction to myself and the speaker. I can also hear speeches and sermons if seated favourably. We think it most remarkable that my hearing could be improved after seventeen years of steadily increasing deafness. In 1889 I came to you in despair, deafness was gaining so rapidly, and then I could not hear a clock tick, and only what was said to me in a loud voice through a trumpet was audible." I may add that this lady had been treated regularly for seventeen years by means of inhalations, catheters, and the Politzer bag. Had I never relieved any other patient with pilocarpin, this case alone would have warranted me in going on with the remedy.

CASE II.—P. G., a barrister, æt. 44, sent to me by Mr. Edgcombe Venning, thus recently reported of himself to me: "Deaf in both ears for three or four years, the right ear slightly, the left very deaf, and unable to hear conversation when the right ear was stopped. Commenced treatment by injection of pilocarpin on February 22, 1891. First noticed change in hearing on March 20. Found I could hear and appreciate conversation with the left ear, which I had been unable to do for about two years previously. My wife and friends likewise noticed the change. On March 25 I heard the chirping of birds outside the house, inaudible for years; and in conducting an arbitration case I sat with the witnesses on my left, which I had always avoided doing, and could hear them very well. On March 31 could hear persons talking to each other, and could join in conversation, a thing for a long time most difficult and

trying to attempt. Later on, in April, dined with a friend, who, without suggestion on my part, remarked that I had not asked for a single observation to be repeated during the whole of dinner. I noticed during the treatment that the noises in my left ear, which had been almost incessant for four or five months, steadily decreased. They are now nearly gone, ceasing entirely at intervals."

CASE III.—Colonel W., æt. 49, sent by Sir Joseph Fayrer, August, 1890, had suffered for four years in India from deafness of both ears, with constant annoying tinnitus aurium. He had had syphilis. After six weeks' treatment the hearing of his left ear was restored, and that of the right slightly improved. In February, 1892, he called to say that his left ear was in as good condition as when he left off the treatment, and the tinnitus was far less.

CASE IV.—Mr. B., æt. 30, writes: "Before the pilocarpin I could not hear deep sounds, such as a wagon coming along the road, and sounds on the piano below the B-flat nearest the centre C on the piano were absolutely inaudible. Now, however, I can hear every note on the piano, and I am safe in the street from cabs, &c. People tell me that I am nothing like so deaf as I used to be, and that I have steadily improved." This patient was seen also by Professor Politzer.

In the three next cases aural vertigo was a prominent symptom.

CASE V.—Concerning this case Dr. Easton writes: "The patient, Miss R., you saw with me in May, 1890, was much benefited by the injection of pilocarpin you recommended. She had been suffering for nearly two years with tinnitus, accompanied every week or ten days by attacks of vertigo. I commenced injecting one-twelfth of a grain of pilocarpin on May 29, increasing the quantity gradually to a quarter of a grain. On June 6 the tinnitus was much less. On June 13 she could hear a watch tick an inch from the left ear, whereas at first it was perceptible only when in actual contact. During the whole time (six weeks) that I continued the injections, she had no return whatever of vertigo, and I hear the improvement is maintained up to the present date, February, 1892."

CASE VI.—Miss M. had suffered for several years from labyrinthine mischief with aural vertigo, aggravated to such an extent during the last twelvemonth that she was unable to venture out alone. Dr. Moore, of Maidenhead, carried out the treatment with pilocarpin for five weeks, and the patient, who came to report herself to me some time afterwards, appeared to be quite well.

CASE VII.—Captain J., æt. 53 (sent by Dr. Pollock), commander of a large steamship, was obliged to discontinue his work on account of constant giddiness, which caused him to fall down. He had been deaf for many years. After five weeks' treatment he resumed his duties, and subsequently he wrote: "I thought you would be pleased to hear that up to the present I have had no attacks of vertigo."

In further illustration of my subject, I would advert to the testimony of Dr. Bronner in the *Lancet* for September 28, 1889. He points out that improvement under treatment with pilocarpin cannot reasonably be hoped for where long-continued disease has caused much thickening and calcification of the membrana tympani, ankylosis of the ossicula, or extensive changes in the internal ear or auditory nerve; that one ought to be satisfied in chronic cases if it can merely arrest the progress of disease; and that in some acute or subacute conditions it may not only do that, but may even restore normal hearing. He, moreover, advocates the use of the Eustachian catheter in addition to injections of pilocarpin, when the deafness is not entirely due to affections of the internal ear. Dr. Bronner then proceeds to remark that he has used pilocarpin with very good results. One of his patients, a girl, æt. 12, with a history of congenital syphilis, and suffering from a subacute affection of the middle and internal ear, could not hear the watch at all, even in contact, or loud speech at 2 metres, but after twenty injections of pilocarpin, she heard the watch with the right ear at 20, and with the left at 6 inches, and could distinguish whispers at more than 5 metres with either ear. I now learn from Dr. Bronner (February, 1892) that since the publication of his paper he has treated with pilocarpin ten cases. Of five of these, having a history of congenital syphilis and exhibiting

symptoms of disease of the internal and middle ear, four did well and one did not improve. Of four others who had suffered from acquired syphilis two were much benefited. One case of subacute inflammation of the internal ear was very successful, as at first the watch was not heard on contact or a loud voice at 2 yards, and after treatment the watch was audible with the right ear at 12 and with the left at 18 inches, and a whisper at more than 4 metres with either ear.

In conclusion, I would say that, when suitable cases are chosen for treatment, pilocarpin is a most valuable remedy in labyrinthine deafness, especially that due to syphilitic taint. I do not pretend to deny that in not a few instances of indubitable labyrinthine disease the drug has proved inefficacious; but, on the other hand, I think that with enlarged experience, due regard being had to the rules for diagnosis above indicated, one's powers of distinguishing individuals of *the comparatively small class of patients* likely to gain benefit from its administration are continually receiving accessions, past failures are rendered capable of explanation, and some approach can be made to a definite prognosis.

MÉNIÈRE'S DISEASE AND MÉNIÈRE'S COMPLEX OF SYMPTOMS.

It seems difficult to draw a clear line of distinction between apparently spontaneous cases of impairment of the functions of the internal ear, such as those I have described, and auditory or labyrinthine vertigo, or Ménière's disease.

With respect to its cause there are many theories. According to Dr. Knapp, Ménière's disease is an "idiopathic serous exudative otitis interna." According to Dr. Hughlings Jackson, it presents two sets of symptoms:—

(a.) Vital, (faintness, perspiration, irregularity of pulse, &c.), from affection of the medulla oblongata by disturbance or disease in the cochlear division of the internal ear.

(b.) Locomotor, (vertigo, with or without reeling), from affection of the cerebellum, by disease or disturbance in the semi-circular canals.

Roosa,* on the other hand, says: "These cases have the usual history of what we may suppose to be effusion into the labyrinth, that is, nausea, vomiting, vertigo, and inability to walk straight, with sudden deafness. There was an autopsy in one case of Dr. Ménière's. This, however, was not a true specimen of the cases from the clinical history of which Ménière made his diagnosis. It was that of a young woman who, while menstruating, caught cold and became suddenly deaf. Her chief symptoms were vertigo and frequent vomiting. Dr. Ménière examined the ears, and found all the parts healthy except the semicircular canals, which were filled with a reddish plastic substance, replacing the labyrinthine fluid. The vestibule also exhibited traces of this exudation, but the cochlea, brain, and spinal cord were normal." Again, he says: "I prefer to say disease of the cochlea, instead of disease of the labyrinth, when the prominent symptoms are great impairment of hearing, the inability to hear certain tones, and the production of false ones. These are evidences, I think, of cochlear disease, whatever else we may have. Tinnitus is a symptom common to many forms of aural affection, while vertigo and unsteadiness of gait are chiefly to be referred to undue pressure from the base of the stapes upon the semicircular canals, and not to disease of the cochlea." He thinks too much attention has been paid to increased pressure upon the former-named part of the ear, to the neglect of disease having its origin in the tone-perceiving apparatus—the cochlea. He further observes that the term "Ménière's disease" has always seemed to him unfortunate, because indiscriminately applied, for it ought to be confined to cases of hæmorrhage into the semicircular canals, the same having very little in common with those cases in which at least the predominant symptoms are cochlear, but which are sometimes regarded as examples of Ménière's disease.

Dr. Güye, of Amsterdam, considers most cases with Ménière's complex of symptoms to be due to catarrh of the tympanum and exposure to cold, and to be usually, if not always, secondary to inflammation in the tympanum or the antrum mastoideum. In

* *Diseases of the Ear*, 4th ed., p. 494.

agreement with his conclusions, its characters may be briefly described as follows* :—

Ménière's disease is an abnormal nervous irritation in the semicircular canals, or inflammation of these or of the middle ear, producing vertigo. In typical cases there occurs with or before the vertigo the sensation of a rotatory movement about a vertical axis, which at first is always in the direction of the affected ear; there may also be a sensation of movement to and fro. Afterwards the patient feels as though he were turning forwards and backwards about a transverse axis; his vertigo becomes pronounced; and swooning, and, perhaps, vomiting ensue. The disease is usually accompanied by subjective auditory sensations, which may become permanent. In long-standing cases there is slight vertigo between the seizures, chiefly when the head is moved after awakening from sleep, or a feeling that one is falling forwards or backwards, or, again, the assumption of a stiff and forced position of the head. In children choreic conditions, and in adults clonic contractions of the face and upper extremities, sometimes with hysteria, may be developed in the course of the disease.

Féré and Demars, in describing Ménière's disease, remark that in its beginning it is manifested by attacks of brief duration, separated by more or less long periods of perfect calm. As it progresses, the transient attacks approximate, and they finally coalesce into an habitual vertiginous state, interrupted by paroxysmal exacerbations of the ordinary symptoms. When patients thus affected move from a settled position they are subject to a violent attack, and believe themselves to be overthrown. They never feel equipoised, but, on the contrary, experience a constant sort of turning in one direction or the other.†

Dr. J. A. Irwin, in an interesting and suggestive paper in the

* See paper read before the Otological Section of the International Medical Congress at Amsterdam, 1879, *Archives of Otology*, vol. 9, No. 3, Sept., 1880.

† See C. Féré et A. Demars, "Note sur la maladie de Ménière, et en particulier sur son traitement par la méthode de M. Charcot." *Rev. de Med.*, quoted in *New York Med. Journ.*, Jan., 1882.

Lancet for November 26, 1881, remarks on the extraordinary similarity between the symptoms of labyrinthine vertigo, with the exception of the deafness and tinnitus, which are of cochlear origin, and those of sea-sickness. In the ordinary form of the latter affection there is, he remarks, irritative hyperæmia of the semicircular canals, due to irregular movements of their endolymph. That sea-sickness is least felt when one is in the recumbent posture is explained by him as a result of the fact that, Nature having made small provision for the equilibration of the body in any position much behind the perpendicular, the ampullæ of all the six semicircular canals are situated on their anterior extremities, so that when the head is thrown back the endolymph and otoliths gravitate towards their least sensitive part, and disturbance of them has therefore less tendency to alter pressure or produce irritation within the ampullæ. Sea-sickness he regards as a mild semi-physiological prototype of the non-cochlear part of Ménière's disease. The latter is "a vertigo of translation" (Charcot), in which a strong subjective "sensation of a translation movement of the whole body" is induced by an abnormal condition of the semicircular canals; in the former this condition results from real objective translation movements of the whole body.

Güye maintains, as a result of his clinical observations, that the sensations of rotation to the right and to the left in Ménière's disease are felt in the right and the left horizontal semicircular canals respectively, a real rotation of the head in a direction the reverse of that of the sensation experienced, being the result of reflex action caused by the latter. He considers that Mach's experiments upon the effects of revolution, having been performed upon persons with unimpaired ears, cannot prove that any sensation of rotation whatever originates in the one ear and not in the other. In coming to the conclusion that the feeling of revolution to the right is probably due to the left canal, and *vice versâ*, Mach, he believes, has been misled by a statement made by Flourens with respect to the direction of the first movement of the head in his earliest experiment on the semicircular canals.

The forcing either of air into the tympanum, or, when perfora-

tion of the mastoid process has occurred, of water into the antrum mastoideum, may, as Güye points out, occasion a feeling of rotation such as that experienced in real Ménière's disease.

One meets in practice with instances of vertigo distinctly traceable to ear disease, where, however, the deafness is not absolute, and treatment appears to be of much value. Such I believe to be more numerous than is generally admitted, from the fact that numberless patients with ear mischief causing faintness and reeling are treated for derangements of the stomach. The following cases are typical of the kind alluded to:—

T. F., a postman, æt. 41, was admitted into the Thistlethwayte Ward at St. Mary's, November 14, 1874, with a slight discharge from the left ear. If the ear was pressed he was seized with giddiness and vomiting, and fell. When walking in the streets he was frequently attacked in this way; but, as his falls were invariably to the right, he was able in some measure to guard against accidents. Various astringent lotions for the ear, with counter-irritation behind it, and a dose of twenty grains of bromide of potassium three times a day, rendered the attacks gradually less frequent, and in a month's time he left the hospital, apparently well.

A gentleman had suffered for eight years with tinnitus aurium and occasional giddiness, and, whenever he went out, with reeling to and fro, latterly so much that he was constantly taken for drunk. He consulted a great many medical men, who all said that his trouble arose from derangements either of the liver or stomach, until he came under Dr. Broadbent's care, who directly discovered ear mischief, and sent him on to me. There had been a slight discharge from one ear once or twice. He heard the watch three yards from the right ear, two yards from the left, and the tuning-fork very indistinctly and for a very short period. The tympanic membranes looked perfectly healthy. In his attacks, during which he had not noticed that he reeled more particularly to the right or to the left, he found that the only thing that at all steadied him was stamping one foot repeatedly on the ground. He was treated as in the last case.

When subsequently I saw this patient, he told me that he was so much better that he had quite conquered his *bête noir*, viz., crossing London Bridge, which could now be accomplished without the dread of falling that he had experienced for some years past.

T. H., æt. 34, came to the hospital October 26, 1878. About seven or eight years previously he had first been seized with deafness in the left ear and fits; till then he had enjoyed fairly good health. The fits, which were sometimes twice or thrice a day, would come on gradually with a feeling of giddiness and dizziness in the eyes; these were followed by a tendency to fall to the right, against which he struggled. The fits were more liable to come on when he was by himself in the streets than at home. About the time of seizure he used to suffer from very bad headache, otherwise he was fairly well, and had not much deafness. He had been a temperate man, except in the matter of smoking. After having for a considerable time in vain sought relief, he came to St. Mary's Hospital, and was treated with bromide of potassium, in doses gradually increasing to 3ss. three times a day.

After a few weeks' treatment he was greatly benefited, and at length he was able to walk about with much confidence, and rarely had any repetition of the fits.

In other such cases I have found that very considerable relief may be given by counter-irritation behind the ears and the administration of large doses of bromide of potassium. Dr. Gowers suggests that this drug is useful in those cases where "any undue sensitiveness of the grey matter of the equilibrial centre must be lessened."

Treatment by doses of from eight to eleven grains of quinine for ten successive days, has been recommended in Ménière's disease. The symptoms, at first aggravated thereby, are at the end of that time notably diminished. After an interval of eight days quinine is again given.* The drug often wholly removes the patient's tinnitus, whilst increasing his deafness.

The following is a case of auditory vertigo where much benefit was derived from the use of quinine:—

* See Féré and Demars, *op. sup. cit.*

M. J., æt. 40, admitted into St. Mary's Hospital, October 1, 1876; had been deaf off and on since when, about twelve years previously, after much worry about business matters, she was seized with a fit, and fell prostrate. There were two more fits within the space of a few days, and then no more for a year. Afterwards they became frequent—more especially during the last two years. Before their onset the patient generally had a noise in her ears, "fluttering at the heart," and a feeling of pins and needles in the extremities; then all in a moment, whilst remaining perfectly sensible, she would fall forward to the ground. If her head were kept up she recovered the sooner. Her state of hearing varied considerably. On October 12 the ticking of a watch was audible at the distance of six inches from her right and twelve inches from her left ear. She had no difficulty in hearing the tuning-fork. Shortly before she sought advice at the hospital she had been afraid to go out of doors, having sometimes as many as four fits a week. She was ordered five grains of quinine three times a day. After taking this medicine she had no repetition of the attacks, though for a few days she occasionally had sensations as if they were coming on, and slight tinnitus aurium in her left ear.

The next is a case of double Ménière's symptoms, relieved by doses of chloride of ammonium, after all other treatment had failed.

In October, 1877, G. B., æt. 60, came to St. Mary's Hospital, having had fits, sometimes twice or thrice a day, for eight years previously. During this long period he had been treated for general nervous disorder, and had gained no relief.

He first saw Dr. Handfield Jones, who kindly sent him to me. During several years the patient had been suffering from deafness and tinnitus aurium in both ears. For a day previous to a fit, he used to feel unwell, and any little excitement sufficed to bring it on; he then had to sit down and hold fast to something, in order to keep himself from falling downwards and forwards. The fit might last from five to fifteen minutes, he being conscious during the whole time, and feeling much relief as it passed off. He was generally attacked indoors, rarely in the streets.

He was ordered:—

Ammonii Chloridi.....	gr. xij.	
Tinct. Nucis Vomicae ..	℥v.	
Aq. ad	℥j.	t. d. s.

By July, 1878, the patient had become perfectly free from his attacks, and, with the exception of temporary feelings of nervousness, was quite himself again.

There are some instances of Ménière's disease which, unlike those above mentioned, seem to defy all treatment. Güye has found local applications especially useful in recent cases.

The following case of injury to the head and probably of fracture to the base of the skull, followed by deafness, is instructive:—

H. M., æt. 20, was admitted to St. Mary's, under the care of Mr. James Lane, December 5, 1877, having fallen from a height of twelve feet, and struck his head against some steps. He was picked up insensible, and bleeding from the nose and mouth.

On admission, he was partially conscious, but in a state of extreme collapse. There was no wound, and no outward evidence of fracture, but great ecchymosis in the left eyelid, and also beneath the ocular conjunctiva. He recovered by degrees from the collapse, and then vomited a considerable quantity of blood. When he was raised from his pillow blood again flowed from the nose. During the night he was violently delirious, and tried to get out of bed: but he could understand and obeyed directions. For the next two or three days he lay in a torpid condition, with his head buried in the pillow, and his knees drawn up towards his chin, except occasionally when he had fits of restlessness and irritability, and complained of severe pain in the head. During this period he several times vomited a quantity of blood. There was no paralysis, and no elevation of temperature or other sign of inflammatory action. The pulse was never more than 70, and once was as low as 40. It was found that he had become quite deaf in the right ear, and partially so in the left.

The patient's further progress was satisfactory. The drowsiness and headache gradually passed off, so that at the end of

four weeks he was able to get up and walk about. He was, however, still completely deaf in the right ear, though the hearing in the left had much improved.

The treatment pursued was simple. It consisted of free purgation in the first instance, with cold applications to the head, perfect rest, and avoidance of excitement from the visits of friends, or otherwise. Afterwards, as a tonic, the *Mist. Ferri Co.* was given.

In some clinical remarks on this case, Mr. Lane stated that he thought that there had been fracture of the anterior fossa of the base of the skull, implicating probably the orbital plate of the frontal bone on the left side and the cribriform plate or cells of the ethmoid, and perhaps the sphenoidal sinuses. Such a fracture would account for the ecchymosis in the left orbit and eyelids, and for the bleeding from nose and mouth, as also for the vomiting of blood, since whilst the patient lay in bed, the blood passing into the pharynx would be swallowed insensibly and at intervals rejected. The continued oozing of blood through the fracture had, he thought, been of great service in preventing injurious compression and consequent paralysis, and also in warding off the tendency to intra-cranial inflammation. The head symptoms which were observed depended, he believed, rather on "cerebral irritation" than on either of the conditions just mentioned, and were probably the result of bruising, and perhaps slight laceration, of the brain substance in the immediate vicinity of the fracture. There was no bleeding from the ear to indicate fracture of the petrous portion of the temporal bone, and so account for the deafness; still, if, as was possible, such a fracture took place without rupture of the *membrana tympani*, there would be no bleeding externally, but effused blood might find an outlet through the Eustachian tube into the pharynx.

The urgent symptoms having all subsided, I was consulted in respect to the deafness. On January 2, 1878, the patient was unable to hear the ticking of a watch in contact with the right ear; and, as there were no signs of injury to the *membrana tympani*, the deafness was thought to be due probably to effusion. Blisters were applied over the mastoid process, and six

leeches in front of the tragus. Three grains of iodide of potassium were given three times a-day. His hearing now gradually improved, so that, on January 6, he could hear the watch five inches, and in ten days' time thirty-six inches, from the right ear; and at the expiration of a month the hearing was restored.

Counter-irritation behind the ear, which doubtless was of considerable value in the above case, was a procedure largely adopted by Toynbee. Doubt, however, has sometimes been expressed as to its efficacy; and at first sight it is not very evident how a blister outside the skull can affect distant and deeply-seated structures. But, although the action of counter-irritation is as yet far from being explained by physiological therapeutics, and a crowd of contradictory witnesses have been summoned by writers on the subject, who have as yet done little more than to obscure the interpretation of what at first sight appears to be a simple and very common subject of observation, nevertheless, two main facts stand out prominently for our guidance as the result of clinical experience:—(1) The experience of ages has shown that, to effect the absorption of effused serum, no remedy is so successful as counter-irritation; and (2) more modern practice has demonstrated beyond a doubt that the application of cold to a surface relieves internal congestion, and is perhaps the best means at our command of combating inflammatory action. These two facts are not in contradiction to the great physiological truth first taught by Hilton—namely, that the blood-vessels of the skin sympathize, by means of their vaso-motor nerves, with those of the organs beneath. For we learn clinically that the irritation of a blister on the skin of the thorax produces a similar irritation of the vessels of the pleura, with a change of nutrition in both parts of the same nature, though not to the same degree. So also we see the contraction of vessels on the skin of the abdomen brought about by ice-bags, applied in cases of hæmorrhage from the bowel in typhoid fever, produce a sympathetic contraction of the vessels of the intestine. In like manner a blister behind the external ear affects the nutrition of the internal ear. The reason of this is not far to seek, when we reflect that the posterior auricular branch of the external carotid supplies the internal ear by its

stylo-mastoid, and the external ear by its auricular branch, the vaso-motor nerves in each of these vessels being continuations of those on the posterior auricular itself, and therefore branches of one sympathetic plexus. By these considerations the importance of recognizing the exact pathological condition to be dealt with is made very evident: thus, while counter-irritation proves of great benefit in a condition in which the absorption of effused serum is required, the application of the ice-bag would be most prejudicial to the patient. Moreover, it is commonly observed that intense cold is a frequent cause of nervous deafness. Leeching was recommended in the above case, in the hope of relieving great turgescence of the blood-vessels of the part, should such a condition exist, and with a view to facilitating the action of the blister on the vaso-motor nerves, which otherwise might have been impeded by the over-fulness and consequent mechanical dilatation of the blood-vessels. It is important in such cases that treatment should be employed early, because, after the lapse of two months or so, the chances of a successful termination are small, in consequence of the organization of the effused products.*

The next is an extraordinary case, and bears out the remarks I have just made.

J. E., a medical man, æt. 29, had always enjoyed good health, and his parents, first cousins, were both living. When he was a child, a suspicion that he was deaf led to experiments. A pistol discharged close to him did not attract his attention, but if he were asleep awakened and appeared to startle him. When he was seven years old, whilst arrangements were being made to send him to a deaf and dumb institution, he was one day observed to scream at the banging-to of a hall door. From that time he began to hear a little. He was now brought to the late Sir William Wilde, an eminent aurist in Dublin, who said nothing could be done for him. An attempt was made to dilate the meatus with prepared sponges. These were removed at the end of about a month, and for some time afterwards a thick discharge continued to pour away from the ears, whilst the hearing gradually improved. An abscess subsequently formed in the

* *Lancet*, March 30, 1878.

left ear, causing considerable pain. The patient grew better every year till he was twenty. At the time that he consulted me, in January, 1878, he could hear ordinary conversation very well, but could hardly distinguish the vibrations of a tuning-fork placed on his head.

In some severe forms of neuralgia and tic-doloreux, the hearing is liable to become affected. Audition was impaired in four out of 128 cases of trigeminal neuralgia examined by M. Notta. It is well to bear in mind that decayed teeth, especially in the lower jaw, are often the cause of severe pain in the ear.* Loss of hearing is sometimes noticed at the time of the eruption of the wisdom teeth. Cooper holds that "in the process of dental evolution a prejudicial effect is often wrought upon the ears, the deafness being, in fact, the physiological concomitant of the tardy tooth development.†

As I have before said, some cases of deafness may occur without any very definable cause; this is especially the case in women, in whom sometimes very slight shocks caused by distressing news give rise to sudden deafness. Thus, a patient came to me at St. Mary's with almost total deafness, which ensued immediately on hearing of the death of one of her children. Another patient, a bootmaker, suddenly lost his hearing when his wife died.

Such cases are difficult of explanation. They are similar to those instances of sudden nervous attack in which, it is said, the hair turns white in the course of a few hours.

It would seem that pregnancy and suckling may occasionally take part in causing deafness. One patient always becomes deaf four months before her confinement, and gradually recovers hearing after weaning her child; and many instances are on record of women whose hearing is affected only when they are suckling.

Such cases usually improve rapidly when the child is weaned,

* Samuel Sexton, M.D., "On Affections of the Ear arising from Diseases of the Teeth." For further information respecting this subject, see *Amer. Journ. Med. Sci.*, Jan., 1880.

† R. T. Cooper, "The Wisdom Teeth and Deafness," *Dub. Journ. of Med. Sci.*, Sept., 1881.

especially if strychnine be administered; this drug is very serviceable in those cases where deafness results from suckling beyond the proper period.

The following is an instance of sudden shock affecting the offspring but not the mother:—

K. P., æt. 2, deaf and dumb, was brought to see me at the hospital, March, 1878. Her father stated that he and his wife were in good health and not closely related, and that their first child was quite free from any defect. Four or five months previously to her second confinement, his wife was severely frightened by her house taking fire. Her five children born subsequently were all incurably deaf and dumb.

In bilious attacks there may be sudden loss of hearing, due probably to a poisoned state of the blood, as when it occurs in gout, syphilis, and fever.

Nerve-deafness caused by hereditary syphilis* generally makes its appearance in patients between ten and sixteen years of age, is more common in females than in males, and is generally associated with the inflammatory affection of the eyes known as chronic interstitial keratitis. Mr. Hinton found that congenital syphilis furnished more than one-twentieth of his aural patients at Guy's Hospital. With respect to them he writes:—On examination it is found that a tuning-fork placed on the head is heard for a very short time, or not at all; the meatus is free from wax; the membrana tympani looks somewhat white and rough; it may be flat or too concave, but it generally has a dried-up look, as if its juices were deficient. The throat is by no means always unhealthy. The peculiarly harsh sound produced by passing air into the tympanum suggests the presence there of rough lymph, or the almost total deafness proves that the labyrinth has suffered." For the treatment of these cases he recommends scruple doses of chloride of ammonium.†

A large number of such cases, mostly females, have been

* See Mr. Hutchinson's admirable clinical memoir, "Certain Diseases of the Eye and Ear consequent on Inherited Syphilis," by which the attention of the profession was first drawn to the subject.

† "Supplement" to Toynbee's *Diseases of the Ear*, p. 461.

treated at St. Mary's Hospital. Of these a girl, æt. 16, admitted into the Manvers Ward in 1876, was a typical example. She heard the tuning-fork very indistinctly for a few seconds, and the watch with one ear only when in contact. Three years previously she had suffered from an inflammatory affection of the eyes, followed shortly afterwards by ear disease—in fact, her eyes and ears had alternately been more or less affected. Her teeth were much jagged, and highly suggestive of inherited syphilis. She was one of a family of eleven, of whom nine had died before they were four months old. The eldest child, however, was alive and healthy. The father was described as being “very fast and wild.”

For patients of this description various modes of treatment have been adopted without any satisfactory improvement, for hereditary syphilis is of all diseases the most rapid cause of complete deafness, and also the least amenable to remedies. Many patients that I have treated, including the girl above-mentioned, after seeming to be almost on the point of complete recovery, have rapidly sunk back again into a state of hopeless deafness. In some instances absolute loss of hearing has taken place in a very short time.

Much good, however, might be done by the early adoption of preventive measures in cases of suspected syphilitic taint. Were the endeavour more frequently made to eradicate the disease before the age of ten or twelve years, we should hear less often of interstitial keratitis and accompanying deafness. As a great authority has observed regarding the subjects of congenital syphilis,* “frequently the child is born apparently healthy, but the ordinary train of symptoms sets in a few weeks after its birth. These children under judicious treatment very frequently recover.”

In all syphilitic cases with labyrinthine symptoms of not more than a year or two's standing, I think treatment by pilocarpin injections should be tried: in spite of many failures I have witnessed some remarkable cures.

Cerebral tumour, usually either fibrous or sarcomatous, may

* *Lectures on Syphilis*, delivered at the Harveian Society, by James R. Lane, F.R.C.S.

affect the auditory nerve. The following are brief notes of a case of the latter:—*

E. J., æt. 29, admitted into St. Mary's Hospital, January 29, 1877, under Dr. Broadbent. Suffers from pain in the head and vomiting, and recently has had failing vision. Complains of throbbing of head; saw very little yesterday, and cannot see at all to-day. Has great trouble in swallowing. Is very deaf, and slow to answer. Food trickles from corner of mouth. Pulse 75, feeble; temperature 97.5° . Is sick at times. Bowels open. Ordered a drachm and a half of a solution of perchloride of mercury in an ounce of camphorated water three times a day.

February 3rd.—Rather better. Can see a little. Pain in the forehead; giddy. Marked paralysis of right side of face, and impairment of power in right limbs. Sensation about the same on the two sides. Ophthalmoscopic examination shows advanced double optic neuritis, with consecutive atrophy. It is difficult to determine whether the deafness is due to defect in the auditory apparatus or to hebetude, and impossible to say which ear is the worse.

4th.—At 5 P.M. unconscious a short time, and making a roaring noise in the throat. Right extremities generally rigid; right leg drawn up; right arm flexed and hand clenched. Frothing at mouth.

5th.—Fingers of right hand contracted. Sensation equal in both hands and on both sides of face and trunk. Facial paralysis increased. Tongue deflected to right side more than usual. Food clinging to teeth. Left eye turned further inwards. Has slept well. Complains that she cannot see at all. Pulse 76; temperature 98.2° .

When made to walk the patient does not merely drag the right leg, but shows want of control over both lower extremities, with vagueness in their movements highly suggestive of disease in the cerebellum. The cross paralysis—namely, of the sixth nerve on the left side and of the face and limbs on the right side—appears to localize the cause as affecting the left side of the pons, while the ataxy of the lower limbs shows the cerebellum

* *Lancet*, Dec. 8, 1877.

to be interfered with. The concurrence of pain in the head, vomiting, and double optic neuritis points to tumour as the probable disease; but it is difficult to understand how a tumour outside the pons should compress only the sixth nerve, and affect its nucleus without involving that of the seventh.

9th.—Rather better, but drowsy. Winks if a finger be put near the right eye, but the left eye may be almost touched without causing winking.

12th.—About 11 A.M., patient in a fit, with gurgling in the throat; unconscious some ten minutes. About 4 P.M., a second similar attack, lasting nearly the same time. About 7 P.M. a third fit. Skin cold during fits. Deafness increased. Sleeps at night. Cannot grasp with right hand.

15th.—Looks better; complains of pain in forehead, and is still more deaf; food and saliva hanging about lips and teeth. Temperature 98°.

19th.—Last night fell into a torpid state at 6 P.M., and continued so until 4 A.M. to-day. About 11 A.M., has returned to a similar condition: lies on back, with mouth open; up-and-down movement of tongue; is not roused by touching eye-balls; limbs extended; pulse 86, regular.

20th.—4 A.M. Has been from nine last night till now in a stupor, as yesterday; is still drowsy. Much more deaf; passes motions unconsciously; right hand almost powerless; articulation indistinct.

21st.—Has not been torpid again; answers slowly; urine cloudy, sp. gr. 1031; face swollen, more especially on right side, but free from pain.

March 1st.—Very deaf; pulse 61; face very red; irregular movement of fingers of left hand; temperature 79°; diarrhoea; urine contains mucus, sp. gr. 1024.

6th.—No diarrhoea; same condition as before, but rather less deaf.

8th.—Dark-red patches under both eyes; mouth rather more deflected to right side.

13th.—Not so well.

19th.—Torpid and semi-conscious; raves for her meals; breathing rather stertorous.

23rd.—Does not answer questions; passes motions in bed; left eyelids kept closed; right eye half open.

April 17th.—For the last month the condition has scarcely altered; she is quite blind and very deaf, and cries out violently for food at stated intervals; the whole fundus of both eyes is slaty in colour; the intellect seems destroyed. On April 29th she died.

At the *post-mortem* examination by Dr. Mahomed, a tumour of the size of a Maltese orange was found attached to the posterior surface of the right petrous bone,* just above the



FIG. 72.

internal meatus. It was fissured and corrugated on its surface, like the cerebellum, and was of soft sarcomatous structure, not unlike brain-tissue on section. The upper margin of the medulla formed its posterior boundary. On examination of the petrous bone, the tumour appeared to have sprung from the dura mater lining the internal auditory meatus, and ensheathing the

* The specimens from this case here figured were exhibited at the annual meeting of the British Medical Association at Manchester, and thus described in the Association Catalogue :—Fig. 72. A cerebral tumour, which took origin from the process of dura mater ensheathing the right auditory nerve. It had compressed so as to completely flatten out, and apparently destroy, the right half of the pons Varolii, and also the right crus. It also compressed the right middle peduncle of the cerebellum. It consists of round-celled sarcomatous tissue—granulation sarcoma.—Fig. 73. Petrous bone, showing origin of above tumour. It springs from the internal auditory meatus, taking origin apparently from the dura mater lining the meatus, and ensheathing the auditory nerve.

auditory nerve, but did not extend into the meatus. Microscopic examination proved it to consist of round-celled sarcomatous tissue (granulation sarcoma), showing a tendency to arrangement in whorls, mostly with blood-vessels in the centre. The contents of some of these whorls could not be distinctly made out; they much resembled "giant cells." The tumour abounded in vessels, which, however, had not thick walls. It appeared to have grown with moderate rapidity—not so quickly as most malignant growths, or so slowly as many benign ones.

The above case, though of interest from its clinical and pathological aspects, is recorded chiefly on account of its value as an example of a rare lesion in connection with the auditory nerve. When it came under observation, the symptoms were

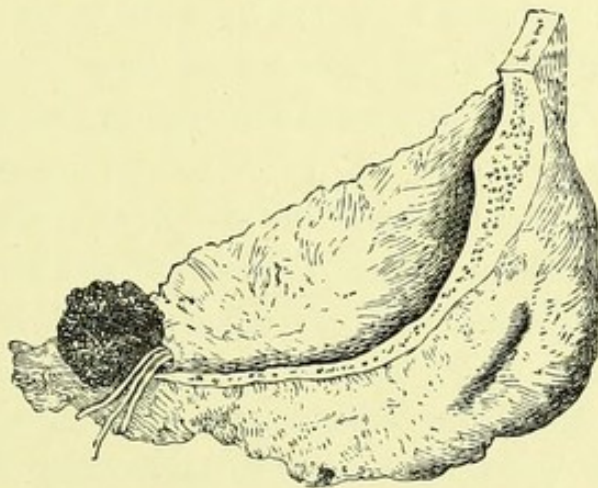


FIG. 73.

too far advanced for any conclusion as to its exact origin to be possible.

According to Niemeyer, hardness of hearing or complete deafness from destruction of the auditory nerve by a tumour of the brain is usually preceded, for a time, by troublesome noises in the ears.*

In conclusion, we have to remark that the tuning-fork generally affords sufficiently certain indications for the diagnosis of true nerve-deafness. No case should be considered irrecover-

* Niemeyer, *Text-book of Practical Medicine*, translated by Dr. G. H. Humphreys and Dr. C. E. Hockley, vol. 2, p. 240.

able until after due trial of remedies. Cases of partial-deafness superadded to disease of the middle ear may be relieved, but cannot be cured. The forms of nerve-deafness, as a class, it must be remembered, although unfavourable for remedial measures, are rare in comparison with other conditions of impaired hearing.

CHAPTER XVI.

TINNITUS AURIUM.*

SINGING IN THE EARS, a species of tinnitus aurium, is very common in nearly all ear diseases, and often very distressing.

I can imagine nothing more painful, nothing harder to bear, than a continual noise in the ears such as some unfortunate patients describe.

Roosa† mentions the case of a professor who, finding that he could get no relief after applying to him on account of severe tinnitus aurium, said, as he left his consulting room, that he should put an end to his existence, and shortly afterwards blew out his brains.

Kramer, again, says, "I have known an instance of a man, once strong and healthy, who committed suicide to escape from a persistent and loud noise in the ears, which had lasted for many years."‡

Sauvage records an instance of a musician being compelled to give up his occupation because with every note he played he heard a second inharmonious sound.§ I have had under my own care a very similar case.

Galen thought that tinnitus aurium was due in some cases to exhalations from the stomach, and in others to increased sensitiveness of the ears.

Amongst the causes of subjective tinnitus the chief is—

Abnormal *pressure* on the labyrinthine fluid, due

1. To cerumen pushing in the ossicular chain.

* Adapted from a paper read by the author before the Harveian Society, April 15, 1875.

† *Diseases of the Ear*, p. 265.

‡ *The Aural Surgery of the Present Day*, by Dr. W. Kramer, translated by H. Power, Esq., F.R.C.S., p. 19.

§ Holmes, *System of Surgery*, vol. 3, p. 165.

2. To various tympanic diseases acting in the same manner.
3. To intra-labyrinthine effusions, exudations, and thickenings.

The *reflex causes* which act on the nervous structures or on the labyrinthine circulation include *abnormal states* of—

1. The cutaneous lining of the meatus.
2. The nasal or pharyngeal mucous membrane, polypi, &c.
3. The gums or teeth.
4. The digestive tract (including intestinal worms).
5. The cutaneous surface generally (under the influence of cold).

The *entotic* sounds, that is, those resulting from sonorous vibrations originating either within the ear or its neighbourhood, are due

1. To abnormal sounds in the carotid, auditory, or other artery, or in the internal jugular vein, or in the neighbouring venous sinuses.
2. To movements of secretion in the ear.
3. To muscular contraction in or about the ear.

In reference to those sounds which we are forced to regard as hallucinations, Sir William Wilde says:—"The peculiar character of the tinnitus and the noises to which it is likened are as variable as sound itself; I think the descriptions which patients give of the noise which they experience depend, to a certain degree, upon their fancy, their graphic powers of explanation, and, not infrequently, upon their rank in life, upon the position in which they have been placed, or the sounds with which they are most familiar; thus, persons from the country draw their similitudes from the objects and noises by which they have been surrounded, as the falling and rushing of water, the singing of birds, buzzing of bees, and the waving or rustling of trees; while, on the other hand, persons living in towns, or in the vicinity of machinery or manufactures, say that they hear the rolling of carriages, hammering, and the various

noises caused by steam-engines. Servants almost invariably add to their other complaints that they suffer from the "ringing of bells" in their ears. The tidal sound, or that which we can produce by holding a shell to the ear, is, however most frequently complained of. Removing the cause and curing the deafness will often, but not always, relieve the patient of the noise: it is often caused by cerebral disease: it is sometimes an accompaniment of derangement of the circulatory, digestive, or uterine organs; of congestion of the brain, hæmorrhage, hypochondria, hysteria, chlorosis, anæmia, typhus, influenza, or simple catarrh; of closure of the external meatus, obstruction of the Eustachian tube, and impaction [blocking up] of the auditory passage with wax. A foreign body, or even a hair resting on the tympanic membrane, as well as engorgement of the lining membrane or mucous collections in the tympanic cavity, and also nervous deafness, these will all produce it. So great is the discomfort which it gives, that persons who are incurably deaf and quite conscious of the impossibility of restoring their hearing, will still apply to be relieved from this haunting and most annoying symptom. Overwork, prolonged suckling, taking quinine or iron in large quantities, a hearty meal, violent exercise, &c., &c., will often occasion it."*

The late Dr. Peter Allen wrote:†—"As chronic catarrh is the commonest form of deafness, so is tinnitus aurium the most frequent result or sign of it. It is dependent upon some abnormal pressure upon the nervous expansion in the labyrinth. The membrana tympani presses the ossicula, and therefore the base of the stapes, inwards upon the fluid where the auditory nerve is distributed; or it may be so rigid, tense, and unyielding, that the secretions within the drum press unduly upon the still more delicate membrana of the fenestra rotunda. Thickening and great tension of the lining tympanic membrane do the same thing. When, in a case of aural catarrh, tinnitus and deafness are simultaneous in their commencement, they will increase proportionately; and it is obvious that in this instance both must depend upon some alteration in the conducting

* *On Aural Surgery*, p. 84.

† *On Aural Catarrh*, p. 201.

apparatus, by which its *acoustic* properties have been interfered with. For example, a little film of mucus spread over the inner side of the membrana tympani is sufficient to alter the periodicity of its atmospheric vibrations, or even partially to quench them. Thus deafness and tinnitus will co-exist here; but as soon as the removal or dispersion of the coating from the membrana tympani occurs, both symptoms will together instantaneously vanish. We are amply warranted by facts like these in concluding that the membrana tympani is generally, in some way or another, concerned in causing tinnitus."

"Next," says Allen, "to interference with the membrana tympani, closure of the Eustachian tube is the most common cause of singing in the ears. This also, on analysis, proves to be such, not directly, but in the following manner:—A closed tube necessitates a too great curvature inwards of the membrana tympani, and consequently an abnormal pressure upon the nervous expansion within the labyrinth." This is a most important point to bear in mind.

Hinton, also, in his supplement to Toynbee's work (p. 452), makes the following remarks:—"When of a beating character and synchronous with the pulse, it [tinnitus] is obviously referable to vascular conditions as its exciting cause, and among others sometimes to aneurysm of the basilar artery.* In some cases, pressure over the course of the carotids immediately beneath the ear temporarily arrests it. In any such case, regard, of course, should be had to the condition of the heart. Some cases, when connected with headache, are said to be dependent on the weakened right side of the heart. Perhaps, however, the most frequent cause of tinnitus is pressure on the labyrinth, as illustrated by the sound heard on pressing on the membrana tympani with a probe. But, in estimating the causes of tinnitus, it appears to me that the great frequency with which enlargement and fulness of the blood-vessels of the labyrinth are found, on dissection, to accompany even slight in-

* In the *Transactions of the American Otolog. Soc.*, 1810, Dr. Spencer relates a case of supposed traumatic aneurysm of the middle meningeal artery, where the tinnitus was synchronous with the pulse, and could be plainly heard by means of the diagnostic tube inserted into the meatus.

inflammatory affections of the tympanum should not be overlooked, and that it may be held probable that any considerable amount of tinnitus seldom exists without somewhat of morbidly increased irritability of the auditory nerve."

In a great many dissections made by Toynbee, Politzer, and others, a diseased condition of the labyrinth was found.

Tinnitus aurium, it should not be forgotten, is often met with in patients suffering from chronic alcoholism, who describe it as a buzzing or rushing sound in the ears. It is frequently in them accompanied by dull diffused headache.*

Sir W. Wilde, in an article in *The Medical Times and Gazette*, says:—"In some cases rubbing over the membrana tympani gently for a short time with a camel's hair pencil moistened with any mild ointment will—for a while, at least—remove the noise." This observation doubtless led to the idea of massage of the membrane and ossicles with either the pressure probe or pneumatic tractor. Delstanche's tractor consists of a graduated syringe with a spring to the piston, so that any required positive, followed by negative, pressure can be produced on the membrane. The syringe is connected with the ear by a meatal tube.

We rarely find tinnitus present in cases of perforation from ulceration, and, if a permanent opening in the membrane can be established, relief is sometimes afforded. I have already mentioned (pp. 192 and 251) numerous expedients having this object in view.

Triquet reports cases cured in a few days by daily injections of the vapour of chloroform into the tympanum.†

Kramer, again, affirms that tinnitus is in all cases due to irritation of the chorda tympani, and not of the acoustic nerve, and that the repeated injection through the Eustachian catheter of a drop or two of an aqueous solution of strychnine (gr. j. ad ʒj.) will generally cure it.

The author of the treatise on the ear in Holmes's *System of Surgery* says, however, with respect to tinnitus: "Of all medicines, a combination of quinine and morphia in small doses,

* F. E. Anstie, M.D., in Reynolds' *System of Medicine*, vol. 2, p. 180.

† Holmes, *System of Surgery*, vol. 3, p. 185.

taken perseveringly once or twice a day, seems the most useful. Stimulating liniments around the ears, perhaps containing chloroform, if tinnitus is a prominent symptom, are at least unobjectionable; and the free use of cold water and friction may in most cases be advised. I have never known any benefit produced by strychnia.* "That drug," he observes, "may claim the position of a specific remedy for congestive labyrinthine conditions, provided always the auditory apparatus be first relieved of any well-marked morbid process which, by its presence, might tend to keep up excessive vascular action."

Reference to my cases treated by pilocarpin injection show that in many instances the procedure has relieved most distressing tinnitus. It is, however, very difficult to select cases likely to be successful. (See Chap. XV).

Dr. Woakes recommends hydrobromic acid;† and, in doses of x to xv grains three times a day, I have found it useful in those cases in which the noise in the ear is synchronous with the beat of the pulse; a dose of xx or xxx grains can be administered.

I have known of one recent case occurring in hospital practice in which nitro-glycerine afforded relief, and it, and nitrite of amyl have been reported on favourably by others.

Chloride of ammonium, and the bromides of sodium, potassium, ammonium, iron, zinc, and caffeine are severally useful in some instances. Ergot, ergotin, digitalis, convallaria, hydrastin, and sclerotic acid prove occasionally of value.

The state of the liver and digestive organs demands special attention; and any constitutional taint or dyscrasia (such as syphilis, gout, or rheumatism) must be treated on general principles.‡

* The author has sometimes considerably lessened tinnitus in certain forms of nerve-deafness by the administration of a mixture containing quinine, morphia, and strychnia.

† *Lancet*, Feb. 9, 1878.

‡ In a pamphlet on tinnitus aurium (a reprint from the *Philadelphia Medical Times*, June, 1874), kindly sent me by the author, Dr. Laurence Turnbull, of Philadelphia, there is much valuable information on the subject.

ELECTRICAL PHENOMENA.

Much light has been thrown on the nature of tinnitus aurium by the study of the electrical reactions of the auditory apparatus in health and disease. The researches of Brenner, E. Remak, Erb, and others have furnished a method of rational treatment which in many cases has afforded eminently satisfactory results.

Stimulation of the auditory apparatus in health is attended with difficulty. This is due to the fact that the nerve is placed deeply, and requires strong currents for its excitation, while these are apt to cause discomfort by their action on other parts, as the facial, gustatory, and optic nerves, the salivary glands, and the brain. But it fortunately happens that many diseases of the ear are attended with an increase of the galvanic excitability of the auditory, which then responds to currents of very moderate intensity.

METHOD OF STIMULATION OF THE AUDITORY NERVE.

For the purposes of exploration the constant or galvanic current only is used. It has been applied by an electrode passed through the Eustachian tube; but there are obvious objections to this practice, and since it is essential for purposes of comparison that the procedure should be the same in all cases, it is best to adopt a plan which is at once safe, easy, and simple. That of Erb is perhaps the best. The indifferent electrode, of large size, is placed on the back of the neck; the exciting electrode should be a sponge of about $1\frac{1}{2}$ inch diameter applied with some pressure over the aperture of the external ear. Both electrodes are moistened. The current required may vary from one which fails to deflect the needle of the galvanometer to one of 5 to 6 m.a. The weaker current, as has been said, is effective in diseased states accompanied by hyperæsthesia. In any case the current should be at first weak, and its strength slowly increased. If now, the character (polarity) of the electrodes be altered by means of the commutator, it will be found that kathodic closure (KC) with a certain current strength causes a subjective sensation of sound; and if this current be the weakest

which will produce such an effect, it will also be found that kathodic opening (KO) and anodic closure (AC) have no effect, while anodic opening (AO) is either also without effect, or causes a fainter sound than the first (KC). A slight increase in the strength of the current will not fail to give the following formula :—

KCS	....	Loud sound.
KO	....	<i>Nil.</i>
AC	....	<i>Nil.</i>
AOs	....	Weak sound.

This formula expresses the normal auditory reaction with a weak galvanic current. The character of the sound differs in different individuals, or perhaps is variously described. In disease especially such descriptions involve a great variety of epithets, as: whistling, hissing, singing, gurgling, bubbling, humming, ringing, buzzing, &c. If now more cells are brought into circuit the same sounds are produced, but louder and more sustained under KC; this sound, moreover, though diminishing in intensity, lasts the whole time during which the circuit remains closed, thus offering an analogy to kathodic duration tetanus in a motor nerve and muscle. The complete formula of the auditory reaction, as obtained with maximum currents, is therefore :—

KCS'	.....	Loud sound.
KDS >	....	Sound diminishing.
KO	....	No sound.
AC	.....	"
AD	.....	"
AOs	.....	Short weak sound (Erb).

THE AUDITORY REACTION IN DISEASE.

The auditory function may suffer either impairment or exaltation. Thus are produced, with reference to the normal stimulus, deafness and hyperæsthesia. Between those on the one hand and the states of *galvanic* torpor and hyperæsthesia on the other the analogy is not immediate and direct. In other words, galvanic excitability and the perception of sound in the ordin-

ary way are different things and often opposed. Upon this fact depends, in large measure, the usefulness of the galvanic current for the purposes of diagnosis and treatment. It is not certainly known what part of the auditory apparatus responds to the stimulus of electricity; but an abundance of observation has fixed the morbid conditions to which definite modifications of the specific sounds and noises correspond, and in this we possess an adequate guide in practice. Meanwhile, for the purposes of description, and to avoid paraphrase, the auditory *nerve* will be referred to as the part acted upon.

GALVANIC HYPERÆSTHESIA OF THE AUDITORY NERVE.

The diseased states in which this occurs are usually characterized by tinnitus, and they are for the most part also states of partial or complete deafness. Galvanic hyperæsthesia occurs especially in aural disease of long standing with organic changes such as thickening, retraction, or atrophy of the membrana tympani, catarrh of the middle ear, and suppuration following caries or injury. It is common also in central and intracranial disorders, where it is especially apt to be associated with derangement of the optic mechanism, and in traumatic and rheumatic facial paralysis. It is well known that when one of the special senses is long deprived of its appropriate stimulus it is apt to exhibit a kind of craving or exaggerated excitability. A familiar instance is the dazzling effect of light after long detention in darkness. In the same way Brenner would explain the form of hyperæsthesia under consideration when it accompanies states in which the ordinary stimulus is conveyed with difficulty, or not at all, to the organ of hearing; in short, in states of deafness. Galvanic hyperæsthesia may be simple or it may involve anomalies or even complete conversion of the formula.

In *simple galvanic hyperæsthesia* the noises produced by the current are the same for given stimuli as in health; but they are obtained with much weaker currents, and are louder and more protracted. Thus KC causes loud noises (KCN"). Moreover, the AO sensation occurs with a comparatively weak

current, as, for instance, with 4 or 6 cells instead of with 16 as in health.

In *galvanic hyperæsthesia with anomaly of the formula* certain stimuli, AC, AD, and KO, cause abnormal sounds, differing in character from those which belong to health. Such sounds are described as whistling, ringing, singing, buzzing, &c., and they may differ in each case. When these abnormal sounds have completely replaced the noises of health *conversion of the formula* is said to have taken place. This condition characterizes a more advanced perversion of function. To distinguish anomaly or conversion of the formula, a comparison with the sound ear where possible will of course be of the greatest assistance.

The galvanic reaction of the auditory nerve exhibits anomalies such as those already sketched, apart from galvanic hyperæsthesia. The actual formula may then present every conceivable variety. This is found especially in severe and inveterate ear-disease, and also where structural changes in the parts external to the auditory nerve have determined new paths for the current.

Torpor of the auditory is the condition in which the nerve fails to respond even to strong currents. Here, as before, a comparison with the healthy ear is needed to justify an inference, and it must not be forgotten that in quite healthy persons an auditory response is often very difficult to elicit. Auditory torpor belongs for the most part to severe and incurable ear disease, but not in particular to any structural changes.

Electrical Treatment of Tinnitus Aurium.—It has been shown that, alike in health and disease, definite noises can be produced by different methods of stimulation. In health it has been seen that it was the kathodic closure (KC) and anodic opening (AO) of the galvanic current which were most effective in producing sound; while anodic closure (AC), anodic duration (AD), and kathodic opening (KO) were without effect. Now it has been found that these latter stimuli have in many cases a sedative or muffling effect on the subjective noises known as tinnitus aurium. The cases in which benefit may be expected are those in which tinnitus is associated with hyperæsthesia, or qualitative galvanic changes, and especially those in which experiment

shows that the noises are aggravated by certain stimuli and subdued by others. A rational plan of treatment must be based upon the facts connected with the formulæ which have been set out above. A reference to those has suggested many modifications which space will not allow of entering upon here. The great majority of cases may be cured in the same way, and a description of this will suffice: A disc electrode of sponge, well soaked, is placed over the external meatus. This carries the anode, while the kathode is firmly grasped in the hand. By means of the Dial-collector an increasing number of cells (of a Leclanché battery) is gradually brought into circuit. The patient is asked to record his sensations. A point may be reached in which the noises are reported to have greatly faded or ceased. No further cells are then employed, and the current is allowed to pass uninterruptedly for 3—4 minutes. At the end of that time a slowly increasing resistance is interposed by means of the rheostat, and finally the circuit is broken. The use of the rheostat is indispensable, since to shut off the cells without it is to produce AO repeatedly, with the effect of producing increased excitability; and, indeed, to prevent this result requires a nicety and exactitude which can be acquired only by much practice. Finally, it should be noticed that where hyperæsthesia and reversal of the formula coexist, the method of treatment must vary, and may even be the converse of that which has just been described.

Dr. Todd draws attention to the fact that the muscular apparatus of the tympanic ossicles, in receiving its nervous supply from two sources (the facial nerve and the otic ganglion), is analogous to the iris, and observes that on this account it is extremely probable that the mode of excitation is similar in both. The stimulus of a sound conveyed to the auditory nervous centre excites by reflex action the motor power of the facial nerve, which, directly or indirectly, and with an intensity proportionate to the sound, influences the muscles of the ossicles: the more tense the membrana tympani the less will be the excursions of its vibrations, just as, the more intense the light, the less dilated is the pupil.*

* *Cyclop. of Anat. and Phys.*, vol. 2, p. 576.

FARADISATION FOR TINNITUS.

In the case of M. M., æt. 38, the membranes looked unhealthy, dusky in colour, and too concave; and the sounds heard were compared to those of a steam-engine blowing, and a kettle singing. After the repeated application of Dr. Stöhrer's double-celled apparatus, these resolved themselves into what the patient described as a faint noise, like that of a hurdy-gurdy, delightful compared with the other; and at last this was exchanged for a distant and only occasional blowing sound.

The noises described by patients are very various. In A. F., who had fluid in the tympanum, they resembled those of a steamer; in H. B., "what one hears in a stoneyard;" in E. W., "hammering on something hollow in an iron foundry;" in M. C., "the passing of a lot of trains on the underground railway;" in R. A., "the wind blowing very hard through the trees of a forest;" in J. L., "a hissing;" in E. P., "the swarming of bees;" in S. B., "the knocking of basins together;" and in J. B., "the buzzing of a fly in the ear." In these and many other patients I have found faradisation of great benefit; and not a few of them have, I believe, been cured thereby—doubtless by its stimulation of the intrinsic muscles of the ear to the performance of their functions.

In certain cases of tinnitus the stapes remains fixed within the foramen ovale, and by continued pressure upon the fluid within the internal ear cannot but tend to induce a constant formation of false sounds. The partial withdrawal of the stapes through contraction of the stapedius muscle would be followed by reduction or temporary cessation of such sounds; and it appears to me that electrical stimulation, by restoring to the relaxed muscle its lost tonicity, enables it to re-exert its proper influence on the auditory function. This theory I think affords a clue to the explanation of certain cases of so-called labyrinthine deafness attributed by Mr. Hinton to muscular spasm, in which the recovery of hearing is often perfect. The symptoms here are often vertigo and paroxysms of tinnitus; in the intervals between these the hearing improves, and, when they finally cease, it is completely restored.

Although, where noise in the ears is due to paralysis of intrinsic muscles, closely pressing the sponges of the battery into the external auditory canals, and, more particularly, the use of the probe in the manner above described, afford almost immediate relief, I am bound to admit that this result is not always lasting. In several of my patients the tinnitus has returned in a short time, to be again relieved by faradisation. For one of them the use of the battery is required every four or five days for the stoppage of a most disagreeable singing in the head.

A noise in the ear exactly like the *snapping* together of the fingers is said to be due to voluntary or involuntary contraction of the tensor tympani muscle, but Politzer believes it to be due to spasm in the palatal muscles, whereby the anterior wall of the mouth of the Eustachian tube is suddenly drawn away from the posterior, causing a sound which is conveyed through the tube to the ear. The sound is heard by an observer as if it came from the ear of the person in whom it originates. I have seen but few persons who have the power of voluntarily producing it, and only two in whom it is present as the uncontrollable result of a diseased condition. Of these latter cases, one is Miss T., æt. 50, who consulted me in July, 1877, the noise in whose ear was most distressing to her, and could be distinctly heard by any one listening close to her. The other, P. M., a medical man, says: "I have that intensely unpleasant crackling in the right ear when I yawn widely, blow the nose, shout, or clear the throat. Even a tap on the head or speaking rather louder than usual (as to a deaf person, for instance) produces a sharp crack in my ear. I suffer from it two or three hundred times a day at least. It is similar to snapping a percussion cap, only not so loud, or like suddenly tightening close to the ear a piece of wet parchment. Tinnitus I have had for years, and that is bad enough, but this snapping is unbearable."

I have pointed out that some cases of persistent tinnitus, associated with indrawn membranes and dry tympanic catarrh, are doubtless due to morbid contraction of the tensor tympani, tending to draw in the ossicles, and to impact the stapes. With a view to relieving the pressure on the perilymph, the mem-

brane can be drawn out by exhausting the meatus with Siegle's or Delstanche's form of pneumatic tractor. This procedure in some instances temporarily relieves the noises. Bronner has recently advocated massage of the membrane and ossicular joints by pushing on the short process of the malleus by means of Lucæ's pressure-probe. He claims satisfactory results.

Weber-Liel and other Continental specialists have endeavoured to give permanent relief by cutting the contracted tensor tympani. Hinton practised this operation with not very encouraging results, however, and it has fallen into disuse in this country, so far as I can learn.

On the other hand, in persistent, maddening, tinnitus, more radical measures have recently been advocated and adopted in America and on the Continent. These operations have in view the relief of ossicular impaction and labyrinthine pressure by removing the malleus, or the malleus and incus, and sometimes even the stapes as well. The removal of the stapes is necessarily attended with the occasional accident of making a hole in the oval window by tearing away of the foot plate of the stapes, and drainage of the labyrinthine fluid; but this is occasionally even aimed at in very severe cases of tinnitus, with suicidal tendencies, accompanied by great deafness. A more rational and safe, though rarely effectual, procedure, is to incise round the base and other parts of the stapes—circumcision of the stapes—with a view to relieving adhesions causing impaction. This operation is said to be easily performed in cases exhibiting a large dry perforation of the membrane and tympanic sclerosis, accompanied by adhesions and fixation of the stapes and other ossicles. I have never resorted to it.

I have lastly to say a few words as to the numerous instances that come before one of tinnitus aurium and deafness traceable not to any obvious defect in the auditory apparatus, but to *abnormal vascular conditions*.

In the first place, I must once more draw attention to the extreme importance of equilibrium of pressure between the fluids and the delicate tissues of the internal ear; for but slight variations in the pressure may give rise to severe tinnitus. Anyone desirous to demonstrate the truth of this remark may

readily do so by forcing inwards the tragus of his own ear, which, causing condensation of the air in the external meatus, pushes inwards the drum, and by its means the chain of ossicles and the fenestræ, and this immediately produces severe tinnitus by the consequent increase of the pressure upon the endolymph and nerves of the cochlea. The result obtained is exactly similar in nature and effects to the sudden setting in discordant vibration of every note of a piano by striking its key-board. The most common causes of tinnitus, viz., retained fluids, wax, or polypus in the tympanum, act in this manner; and I purpose to show that many less understood, but no less important, cases of that affection and of deafness have a similar if not so evident an origin.

M. Gellé, who has sought, by means of an india-rubber tube hermetically fixed in the meatus, and connected with an insufflating instrument, to determine the degree of mobility of the stapes in the fenestra ovalis, finds that in the case of a healthy ear the sound of a tuning-fork placed either on the tube or on the forehead is rendered fainter by compression of the air within the meatus. When, however, an ear is unhealthy, compression, owing to altered conditions of the mobility and elasticity of the apparatus for auditory accommodation, may completely extinguish or may fail to influence the sound; may be accompanied by more or less pain in the tympanic region, or by a sudden humming noise; and in rare cases is productive of a sensation of vertigo like that in Ménière's disease.*

Anæmia and hyperæmia are powerful agents in modifying pressure equilibrium. In Bright's disease, the high arterial pressure in which is evidenced by the pulse, it is the exercise of undue pressure upon the perilymph and endolymph by over-filled arteries and arterioles that gives rise to tinnitus. If we turn to other conditions by which we may test the truth of this observation we become impressed with its great importance.

Again, tinnitus is often the result of augmented blood-pressure in venous hyperæmia due to heart disease. Analogous but localized hyperæmia, observable by the otoscope, is caused by an overdose of quinine or salicin, and probably also by alcohol.

* See *Lancet*, Nov. 19, 1881, p. 884.

Tinnitus is frequently seen in cases of hemicrania due to gout or other causes in which dilatation, hyper-distension, and cord-like rigidity of the external vessels of the head are marked symptoms, and indicate a like condition of the intra-cranial blood channels.

Tinnitus frequently occurs in bilious attacks in association with increase of arterial tension, and as the forerunner of gout or of conditions of plethora liable to culminate in apoplexy. It may be the effect of decreased pressure, as in anæmia, in ordinary cases of which it is often marked, and in that due to recent and sudden hæmorrhage is especially distressing, owing to the inability of the lymphatics at once to equalize the pressures within and external to the perilymph and endolymph. One is often consulted, especially in hospital practice, by chlorotic young women, not for their pallor and suppressed catamenia, but for persistent tinnitus aurium, the result of their condition.

The production of tinnitus by anæmia may be readily demonstrated by firmly compressing one of the common carotids, and so cutting off the blood supply of the corresponding ear.

I have already, on the other hand, alluded to the circumstance that pressure on the carotids sometimes temporarily relieves tinnitus, but probably more especially when due to abnormal vascular conditions. Toynebee has pointed out the importance of bearing in mind that the middle ear is supplied by the carotids, but that the labyrinth is mainly supplied by the auditory branch of the basilar artery, which derives its blood from the vertebral, a tributary of the subclavian; so that it is evident that failure to stop tinnitus temporarily by carotid pressure by no means excludes vascular origin. Dundas Grant has therefore devised a pad for compressing the vertebral as it passes over the posterior arch of the atlas, and claims that this procedure is of diagnostic, and even of therapeutic, value.

That tinnitus is not constantly present in Bright's disease, where the tension of the blood is persistently high, appears to be due to compensatory action on the part of the lymphatics, as it results immediately on an increase of the tension through exacerbation of that disorder. The deafness met with in Bright's disease is, as Schwartze first showed, not infrequently to be

attributed to the occurrence of capillary hæmorrhages in the tympanum and other parts of the auditory apparatus, comparable to those liable to take place in the brain,* retina, and many more structures of the body, especially the softer ones, as a result of high arterial tension and consequent vascular lesion. It is evident that the deafness must be combated by remedies which reduce arterial tension, of which those are most suitable whose action is both rapid and temporary. I have known, *e.g.*, jaborandi, a few whiffs of ether, or nitrite of amyl, to prove serviceable. Several cases of relief afforded by the last named have been recorded by Michael and other German writers.

I have in a former section dwelt at some length on the excellent results obtained in this and similar conditions, by myself and others, through a course of pilocarpin injections. In some instances, however, more certain and severe means must be resorted to. Thus, in the case of a gentleman, Mr. T., æt. 65, whom I saw in consultation, who had a cord-like pulse, and was suffering from severe tinnitus, evidently dependent on a condition of extreme plethora and arterial tension—recognizing the probability of a speedy attack of cerebral hæmorrhage, I advised the abstraction of 20 ounces of blood from the arm, a procedure which was attended with immediate relief to the patient, and was probably the means of saving his life.†

Here I may mention that the sound of one's own voice in the head, double hearing, or autophony (from *αὐτός*, one's self, and *φωνή*, voice) is a common symptom in various diseases of the ear. Sexton‡ thus accounts for it:—"When the hearing motor, the drum-head, loses its tension, or when any of the ear bones become separated from each other, sound in the external auditory canal sometimes fails to cause effectual movements of the mechanism; the hearing is then variable, one moment the voice and noises in the head are all heard confusedly together, and the next moment better hearing is experienced. Autophony and tinnitus aurium are symptoms that confuse the individual very

* See Mahomed, *Brit. Med. Journ.*, July, 1877.

† See paper by the author, *Med. Times and Gaz.*, June 8, 1878.

‡ *Deafness among School Children*, Washington Government Printing Office, 1881.

much, although he may enjoy quite good hearing when the temporary interference is absent."

Sexton* maintains that false-hearing depends upon the fact that in some diseased conditions of the ear not only does the conductive mechanism permit sounds within the body which are usually inaudible to be heard, but fails to transmit in the ordinary way, sounds conveyed to it by the surrounding air; and that when the voice is heard directly through the tissues of the head it is false as regards both pitch and timbre. He points out that vocalists in whom the ear has become diseased may imagine that their voice is modified by some throat affection, whereas it is only their hearing that is at fault.

In conclusion, whether tinnitus be occasioned by cerumen, debility, chlorosis, aural catarrh, or a different cause, if the treatment be adapted to the special conditions of the case, a cure may, as a rule, be hoped for. In aural catarrh, for example, judicious treatment by Politzer's bag, the Eustachian catheter, and other appliances above suggested is notably successful.

* See paper in *New York Med. Rec.*, Jan. 22, 1881, abstracted in *Lond. Med. Rec.*, Dec. 25, 1881.

CHAPTER XVII.

A SUMMARY OF THE GENERAL PATHOLOGY OF THE EAR.

IN a work on aural surgery, it is usual to discuss in some detail the nature and treatment of the several pathological conditions of the hearing, and their effects upon adjacent structures ; but he who would become a successful and scientific practitioner must take a more comprehensive view of the subject. The structures of the ear form no exception to the rule that all the tissues of the body are under the control of certain pathological laws.* We may therefore say that there is very little if any special aural pathological anatomy.

As the morbid changes that occur in the organ of hearing and their effect on surrounding structures have already been discussed, what I now desire to do is, by pointing out the analogies that exist between diseases of the tissues of the ear and those of other and similar tissues of the body, to indicate the general pathological laws, or first principles, which should always guide us in diagnosis, prognosis, and treatment.

Let us, then, proceed briefly to trace the operation of these general laws with respect to the tissues forming the external ear. Here we find skin, subcutaneous cellular tissue, fat, a small amount of muscle, and yellow elastic fibro-cartilage, with some fibrous tissue forming ligaments. These tissues are subject to exactly the same affections in the ear as in other organs. Thus, erythema, eczema, psoriasis, pemphigus, lupus, ichthyosis, and purpura may all attack the skin of the ear, and for each some local exciting cause has to be detected. Erythema of the auricle may be due to rheumatism, or to disorder of stomach or uterus ; eczema, to gout or to local causes, as intertrigo, or vegetable or animal parasites ; psoriasis, to numerous constitutional causes, or apparently to a purely topical irritation ; syphilis

* See paper by the author, *Medical Press and Circular*, March, 1879.

may closely simulate pemphigus and lupus. The isolated position of the auricle and its exposure of a large surface for the radiation of heat render it liable to gangrene in cases where there is impoverishment of blood, enfeeblement of circulation, or disease of vessels, as in feebleness in infants, convalescence from typhus or other fevers, heart disease, general atheromatous degeneration, or frost-bite.

In the subcutaneous tissue occur fatty and sebaceous tumours, more especially where it is most abundant, namely at the back of the auricle and the lobule, also fibrous thickenings, or tumours even, the result of the irritation of earrings, which not uncommonly in negroes take on the character of keloid.

Large nævi, like those of the scalp, are occasionally found on the auricles. I have seen several cases of cirroid aneurysm.

Hæmatoma auris or othæmatoma (see p. 114) is the result of injury or inflammation of the cartilages of the ear; the auricle is much swollen, and there is effusion of blood and inflammatory products in the cellular tissue of the concavity of the auricle and below the perichondrium. As a result of the inflammation a cretaceous or bony nodule may be formed in the auricle.

Epithelioma of the auricle is not infrequent, and commences usually in the immediate neighbourhood of the meatus. Lupus, which has been proved to be a form of tuberculosis, and rodent ulcer, which may be regarded as a special form of epithelioma, may both affect the auricle, and arise most frequently at its periphery. Malformations of the auricle, which have been treated of on p. 108, can scarcely be said to be the results of disease.

The diseases of the external meatus are such as affect other parts of the body where skin is emerging into mucous membrane, especially epithelioma and condylomata. A key to the diseases of the external meatus is afforded by its anatomical structure. About the outer third is formed by cartilage, the inner portion by bone; the skin over the outer part consists of both cuticle and corium, and contains hairs, follicles, and ceruminous glands, while that over the inner portion is devoid of corium, this being replaced by periosteum.

The fact pointed out by Von Tröltsch (see p. 127), that the term "catarrh of the external meatus" has anatomically no justification whatever, is universally true, except, perhaps, as Schwartz says, with regard to those cases in which the epidermis has been destroyed, as, *e.g.*, in acute moist eczema. Pus in the external meatus nearly always proceeds from the middle ear through a perforation in the membrane. The skin of the meatus may be affected with erythema, eczema, herpes, pemphigus, and erysipelas. Its outer half is subject to phlegmonous inflammation of the corium and subcutaneous cellular tissue, but its inner to periostitis, corium and subcutaneous tissue being absent: the periostitis may eventuate in caries or necrosis.

Furuncles in the meatus are the result of inflammation commencing apparently in the follicles of the ceruminous glands, occurring in its anterior and lower wall. They, in common with chronic eczema, which induces hypertrophy of the corium, may lead to stricture of the canal.

The fact that many of these inflammatory conditions of the meatus are severally associated with the presence of certain micro-organisms has already been commented upon.

The ceruminous glands may, when obstructed, produce sebaceous tumours, or true steatomata; the cartilaginous wall of the meatus, ecchondromata; and the bony wall, the exostoses already described (see Chap. V). Sarcomata doubtless occasionally appear in the meatus, but their occurrence has not yet been recorded. It is a noteworthy fact that the external meatus is very little subject to malignant growths, notwithstanding the great and long-continued irritation to which it is often subjected, as in cases of discharge from the middle ear, chronic eczema, inflammation of ceruminous and sudoriferous glands, and concretion of wax. The production by such affections of malignant growths in other parts of the body leads me to suspect that many of the so-called polypi to which they give rise, if these show a great proneness to recur, are to be ranked among the sarcomata, some probably being examples of fibrosarcoma, other of round-celled or granulation sarcoma, myxosarcoma, osteo-sarcoma, or of osteo-chondromata.

Many cases of necrosis and caries of the middle ear and meatus, followed by death from intra-cranial complications, have, I suspect, been certified as having died from cancer. Such a case, to my knowledge, was so recorded as late as the year 1884.

The pathology of the membrana tympani, which at first sight appears complex, is elucidated by a consideration of its anatomical structure. Each of its three lamellæ has a pathology of its own, and is liable to inflammation, which, commencing in it alone, may eventually involve the others. Thus the outer epithelial lamella with its delicate and imperfect corium is liable to eczema, pemphigus, and epithelial outgrowths, and, much less commonly, to acute or chronic idiopathic or traumatic inflammation. When it is acutely inflamed its epithelium is raised up and then destroyed by the swelling of the corium from exudation of leucocytes and proliferation of connective tissue cells, and hence thickening and opacity of the membrana results. Frequently all three lamellæ become inflamed, and in rare instances they undergo ulceration and perforation. In gouty subjects the middle or fibrous lamella, or membrana propria, is especially liable to concretions of urate of soda. In some persons it becomes thickened by deposition of fat, in others by increase in its connective tissue. Calcification, when it occurs, usually affects the whole thickness of the drum-head, commencing, as a rule, in its internal lamella, and may be the effect of old inflammation or of interlamellar abscesses. Politzer and Wendt have shown that ossific change may take place in the neighbourhood of old inflammatory calcareous deposits in the drum-head. The membrana propria, having the smallest supply of blood-vessels, is the least liable of the three lamellæ to inflammatory changes. These in the internal lamella, which, like other mucous membranes, is especially subject to them, may be simply catarrhal, or more severe in character, so as to cause perforation. Minute tubercles may occasionally be seen in the submucous tissue of this membrane as a result of acute tuberculosis, and, like those in the choroid, may lend important aid in the diagnosis of that disease. Hitherto they have been so seldom sought for, that it is impos-

sible to pronounce any opinion as to their degree of frequency, or as to whether they are more particularly associated with tubercle of the meninges than with tubercle elsewhere. As the examination of the drum-head for tubercle is manifestly less painful to patients with meningitis than that of the retina, which in many cases is precluded by severe photophobia, its practice by physicians appears to me highly desirable. Inflammation of the internal layer often occasions increase in its thickness, which sometimes attains five times the normal.

Hæmorrhage may take place in either the outer or the mucous layer of the membrana tympani, or in both. It may be traumatic, or may be dependent on conditions of the blood or vessels, *e.g.*, increased venous pressure, as in heart disease, in bronchitis, and in obstruction to the superior vena cava, the innominate or internal jugular veins, or in increased arterial pressure, as in Bright's disease. The hæmorrhage may be scanty or severe, and sometimes, as Von Tröltsch has observed, exhibits a peculiar tendency to wander over the surface of the membrane. Certain abnormal appearances of the membrana tympani, described by otologists, are thus classed by Schwartze in his excellent *Pathological Anatomy of the Ear*:—1. Anomalies of colour and transparency, thickening, opacity, and calcification; 2. Anomalies of curvature; 3. Perforation of cicatricial formations; 4. Detachment of the membrane; 5. Abscesses; 6. Ulceration; 7. Anomalies of the membrana flaccida Shrapnelli. The etiology of most of these changes is sufficiently evident from the foregoing general observations. Some of them, however, depend on the condition of neighbouring parts, more especially the tympanum. The colour of the membrane varies considerably with the age of the patient: in adults the drum-head, on account of the greater thickness of its cutis and mucous layers, always appears of a duller whitish-grey than in infants. The pearl-grey colour of health may become deep-grey, whitish-grey, yellow, or yellowish-red, the last two colours often being caused by the contents of the tympanum,—the yellow by pus, and the red by hyperæmia. A yellowish or milky opacity in old age is usually due, according to Grüber, to fatty degeneration of the membrana propria. Opacity, usually the result of

inflammatory changes, may be occasioned by fatty or calcareous deposits, or by increase in the connective tissue or by other affections of the lamellæ. Flattening or increased convexity or concavity of the membrane, described elsewhere, are due to contraction or paralysis of the muscles acting on the drum, or, less commonly, to conditions of the tympanum. Atrophy of the membrane may take place, viz., partial, from chronic inflammatory changes, and total, the effect of tension from within, closure of the Eustachian tube, or external pressure by wax or tumours. What is described as hernia of the membrane is a bulging of the mucous layer through a weakened and incomplete membrana propria. Occasionally emphysema of the membrane is produced by collection of air beneath its cutis in consequence of destruction of tissue in its mucous and fibrous layers.

We have next to consider the diseases of the various anatomical structures of the tympanum. The mucous membrane which lines it is liable to inflammations usually catarrhal in character, and analogous to those of other mucous membranes. The most severe are those which extend along the Eustachian tube from the fauces and pharynx in diphtheria and scarlet fever, and, reaching the tympanum and rendering it full of pus, not only cause inflammation and over-distension and consequent perforation of the drum-head, but injure periosteum, and set up caries or necrosis in bone. I have already pointed out the dangerous nature of the complications which, on account of its immediate surroundings, may result from inflammation of the tympanum (see p. 246). The cavity sometimes becomes blocked with a mass of cheesy material, and there is the risk that this may at some time develop into an active centre of infection, and even cause general pyæmia or tuberculosis. Caseation of inflammatory products in the tympanum is most frequently met with in young children, and often occurs in both ears at once, then generally producing deaf-mutism.

In the ordinary and less severe forms of catarrhal inflammation of the mucous membrane of the tympanum, the cause may be either constitutional or local. The tympanum is liable to suffer from mucous catarrh exactly similar to that occurring in bronchitis, gastro-intestinal irritation, urethritis and vaginitis,

conjunctivitis, and, more commonly, scleritis as the result of gout and Bright's disease. Tuberculosis, another constitutional disease affecting mucous membranes, is to be met with in the human tympanum, and the bacillus tuberculosis can be found by appropriate methods in the discharges.

In early life many tympanic catarrhs are strumous, if we exclude those resulting from fevers and congenital syphilis. It is, I believe, because the disease is of a strumous or tuberculous nature that the results produced by it in the young are so severe. Many cases commonly classed as "purulent catarrh" are, I believe, of this nature, and can be effectually relieved by little else than general constitutional treatment, although local applications are of course most necessary to guard against blocking and over-distension of the Eustachian tube, adhesions of the drum-head to the walls of the tympanum, ankylosis of the ossicles, the formation of polypi, and caries or necrosis of bone.

Syphilis, so far as we know, does not attack its mucous surface, nor is it often found in the ear, except when it passes inwards from the auricle along the external meatus, or outwards along the Eustachian tube to the middle ear.

Other catarrhal affections not infrequent in young people and usual in adults, including those mentioned due to gout and Bright's disease, resemble ordinary nasal and bronchial catarrh, but are more chronic. When they are acute and severe, their first stage is characterized by arrest of secretion with considerable swelling of the mucous membrane. Subsequently secretion becomes profuse, and is often muco-purulent, and if long-continued, as it is very apt to be, may be productive of serious consequences. The auditory chamber, it must be remembered, is small: a little swelling brings its parts into contact, and the formation of adhesions and of little strings or bands of organized lymph results. The sub-epithelial connective tissue, by exudation of cells or proliferation of its corpuscles, may undergo considerable thickening, and so greatly embarrass the movements of the ossicles. The fenestræ of the labyrinth may be intruded on by the swelling. If the discharge be highly purulent, the drum-membrane may be softened and perforated; if, however,

the catarrh remain simple, it rapidly heals up again, as a rule. Most modern writers, including Schwartze, distinguish catarrhs of the tympanic mucous membrane as serous, mucous, and purulent, but their classification is not, in my opinion, satisfactory. The term "serous catarrh," being applied by them to an inflammation not akin to that occurring in serous membranes, conveys a false pathological idea, and that of "purulent catarrh," used to denote two distinct diseases, one of which is in no sense catarrhal, is not less open to objection. A catarrhal inflammation is essentially an affection producing destruction certainly of no tissue below the epithelial layer of the mucous membranes except, perhaps, superficially here and there in the tissue immediately subjacent. Deeper erosions, I believe, are generally caused by tubercular disease, and it is therefore eminently necessary to distinguish them from the results of simple catarrhs.

The discharge in catarrhal inflammation of any mucous membrane may consist of clear serous fluid, mucus, muco-pus, or pus, with which a little blood, or, in exceptionally severe cases, some highly corpuscular lymph may be intermixed. The nature of the effusion is dependent on very slight modifications of the disease. In some cases of aural catarrh, due chiefly to the glands of the mucous membrane, the discharge is, for the most part, a clear serous fluid containing but little mucin, or a viscid and tenacious mucus; in other cases it consists of pus with more or less mucus. It is accompanied, as I have said, with much swelling of the whole mucous membrane, and its effects are often severe, and may be permanent. The conditions produced are described by all the leading authors on the ear, including Morgagni, Von Tröltsch, Toynbee, Politzer, Grüber, Wendt, and Schwartze, as "adhesive inflammation" and "sclerosis," and catarrhal discharges from the tympanic mucous membrane and from serous membranes are regarded by them as both producing a tendency to the former. But surely the pathology of adhesions formed in the tympanum and that of adhesions in serous membranes is altogether distinct. Adhesions in the tympanum in many cases, I believe, result from a tubercular or strumous form of inflammation, in others from the contact of

opposite surfaces in consequence of swelling, or perhaps from organization of blood-clots. I cannot think that it is common for fibrinous lymph to be effused from a mucous surface.

As the lowest layer of the mucous membrane of the tympanum is periosteal in character, severe catarrh may induce periostitis, acute or chronic, the former leading to necrosis, the latter to irregular, local, or general hypertrophy of the bony wall. Usually the ossicles alone are affected, the mucous membrane over them being thinner than elsewhere, and requiring less inflammation to produce proliferation of cells and irritation in its osteoblastic layer. The ossicles then readily become ankylosed to one another or to adjoining structures, the stapes, *e.g.*, frequently becoming fixed to the foramen ovale. The condition resulting from general periostitis of the tympanum is called by Von Tröltsch bony sclerosis, by some others hyperostosis. When the primary catarrh affects only the sub-epithelial layer of the mucous membrane, this becomes greatly thickened and fibrillated, and presents a stiff and leathery appearance. Occasionally the deep periosteal layer undergoes similar changes known as *connective-tissue sclerosis*.

In old persons—especially those suffering from osteo-arthritis—erosion of the cartilages and thickening and ankylosis of the articulating surfaces of the ossicles are seen, just as in the joints of the limbs.

Polypi frequently occur in the middle ear, and are, perhaps, invariably the result of inflammation. Their structure varies with the severity of the inflammation and with the nature of the parts from which they spring. The most common are the ordinary mucous polypi, growths similar to which are seen in the nose and uterus. They proceed from a mucous surface, are formed of soft cellular tissue, and contain induplications of the epithelial surface, forming gland-like tubes or sacs. Their surface bears ciliated cylindrical epithelium, which at its extremity may be exchanged for mixed or pavement epithelium. More rare are the fibromatous polypi developed from the periosteal layer. Myxomata are considered by Schwartze to be extremely scarce, but I cannot say that this is quite my experience.

Cholesteatoma, sebaceous and dermoid cysts, osteo-sarcoma, and epithelial cancer occasionally occur in the tympanum.

In their diseases the mastoid cells are closely allied to the tympanic cavity, but they are more liable to caries of their bony walls, because, as their mucous membrane is not ciliated, when catarrh of the tympanum extends into them, inflammatory products are not readily discharged, and, like those effused in lobular pneumonia, tend to caseate. Masses of polypoid granulations are very frequently found, when the mastoid antrum is opened by the surgeon for suspected disease. If inflammation in the cells is very severe, as when it is of a croupous nature, it may produce rapid necrosis of the surrounding bone. Primary inflammation is rare in the mastoid cells, but not uncommon in the external periosteum, beneath which it may form abscesses. External periostitis of the mastoid is often the result of primary disease of the middle ear. In all cases of disease of the mastoid process the near proximity of the lateral sinus must be borne in mind.

The Eustachian tube forms a connecting link, both anatomically and pathologically, between the throat and the tympanum. Its diseases are chiefly limited to its mucous membrane, which may suffer from acute or chronic catarrh, and exude glairy, very viscid, or purulent mucus. It may undergo thickenings or contractions in various parts, or throughout its whole length. Its most intense inflammations are those due to scarlatina, variola, and diphtheria; less severe inflammations result from catarrh, which may be the effect of cold, gout, irritation of the alimentary canal, local hyperæmia, or immoderate smoking, or, perhaps, alcoholic excess. The ulcerations of the Eustachian tube are chiefly the same as those affecting the throat, namely, syphilitic, tubercular, follicular, diphtheritic, and variolous, which are nearly all confined to the region of its orifice in the pharynx. Ulcerations nearer the tympanum are mostly secondary to caries of the temporal bone or to epithelial cancer. Polypi have been met with in the tube.

Tumefaction of the pharyngeal orifice is sometimes the result of traumatism, or it may be due to caustics, but of the non-accidental causes must be mentioned hypertrophy of the

adenoid tissue in the sub-mucous layer—the so-called tubal tonsil. The overgrowth is occasionally so great as to be readily removed with the finger nail. Polypi, moriform and adenoid growths, springing from the region of the posterior nares, and from the vault, often occlude the mouth of the tubes, but they are rarely attached around the orifice.

The diseases of the labyrinth are more commonly functional than structural, being largely dependent, as I have already indicated, on anæmia, hyperæmia, abnormal vascular pressure, and, in some cases, on hæmorrhage. When inflammation extends into it from the tympanum, the result may be serous or purulent exudation, or even sclerosis. Suppurative inflammation may result in a blocking of the labyrinth with caseous material, or in caries or necrosis. Chronic and less severe inflammation may produce thickening, atrophy, or fatty degeneration of the membranous labyrinth, of the organ of Corti, or of the ultimate nerve-endings. It is doubtful whether the variations observed in the size of the otoliths and lime crystals are pathological or not.

The auditory nerve itself is especially liable to disease. Inflammation is occasionally set up in it by caries of the petrous bone or by meningitis. Atrophy may result from many lesions of the brain, *e.g.*, tumours in its substance or meninges, from tumours of the petrous bone, or from hæmorrhage or periostitis in its meatus, also, according to some observers, from long-continued arrest of function. Numerous new growths, including fibromata, neuromata, sarcomata, and gummata, have been found involving the sheath of the nerve. Many minor affections of the nerves and of the labyrinth have been described, and doubtless not a few remain to be discovered.

It has been my endeavour in the above chapter to give, instead of an account of the special pathology of the ear, an outline of the operation of the general laws of pathology with respect to the diseases of that organ, being convinced that a knowledge of these laws is our safest guide to correct diagnosis and prognosis, and to successful treatment.

CHAPTER XVIII.

DEAF-MUTISM.

DEAF-MUTISM, or deaf-dumbness, is an affection which, as the subjoined statistical details may serve to show, affects a by no means small number of mankind in the aggregate :—

Country.	Year.	Total number of deaf-mutes.	Males per cent.	Females per cent.	Proportion of Population.
England and Wales.	1851	..	54·67	45·33	1 in 1,738
Scotland	"	..	55·56	44·44	1 in 1,340
Great Britain and Ireland	1871	19,236	..	..	1 in 1,636
France* (86 departments)	1856	21,554	56·77	43·23	1 in 1,672
Ditto (89 departments)	1866	21,214	56·07	43·93	1 in 1,794
Ditto	1872	22,610	..	..	1 in 1,596
Prussia†	1849	11,973	56·16	43·84	1 in 1,730
Ditto	1871	23,579	54·02	45·98	1 in 1,019
North America‡ (5 countries and City of Halifax)	} Various Censuses. 1861-70-71		} ..	} ..	1 in 1,251

Loubrieu§ considers that the marked preponderance of male over female deaf-mutes is probably due to a greater frequency amongst male infants of diseases affecting audition.

The deaf and dumb, or deaf-mutes, may be divided into two great classes :—(1.) Those whose dumbness is *congenital*, i.e., due to deafness existing at birth. (2.) Those whose dumbness is

* See J. G. Loubrieu, "Étude sur les Causes de la Surdimutité," *Collection des Thèses*, 1868, tom. 8, No. 158, Paris.

† See Boudin, *Ann. d'Hygiène*, t. 49, p. 129, 1853.

‡ *Encycl. Britannica*, art. "Deaf and Dumb," 9th ed.

§ *Op. cit.*, p. 10.

acquired, i.e., due to deafness from causes arising sufficiently soon after birth, either to prevent the acquirement or bring about the loss of speech.

One obstacle to the formation of an approximate computation of the proportion of congenital to acquired deaf-mutism consists in the fact that many a parent, being loath to admit that he can have been the author of anything physically defective, is persuaded that his child's deafness is attributable to some infantile disease. Another, is the very great difficulty of accurately testing the hearing of young children.

The human infant, of whom it may be said that it comes into the world subject to "the disease of not listening, the malady of not marking," ere the third month of its existence, according to Sir W. Wilde,* takes no notice of sounds, and does not until its fourth month distinguish differences in them.

Before admitting the condition of a deaf-mute to be congenital, it behoves the practitioner carefully to examine the *membrana tympani*, since diseases of the middle and internal ear from various causes subsequent to birth, *e.g.*, *otitis media*, are common in infants of very tender age, and are accountable for a large number of so-called cases of congenital deaf-mutism.

It has been estimated† that in Great Britain, one-quarter, and in America, two-fifths, of the cases of deaf-mutism are non-congenital. According to the census of 1871, there were, out of 1,054 inmates of 12 institutions for the deaf and dumb, 63 per cent. congenitally affected. Roosa considers that deaf-mutism is acquired in fully 50 per cent. of the subjects of it. At the Michigan Asylum for the deaf and dumb at Flint in 1881, one-third of the pupils, according to the statements of their friends, were congenitally affected.‡ Hartmann§ gives a table of statistics from which it appears that 5,546 or 66 per cent. of a total of 8,404 cases of deaf-mutism were congenital.

Common causes of non-congenital deaf-mutism are typhoid

* *Pract. Obs. on Aural Surgery*, p. 461, 1853.

† *Brit. and F. Med.-Chir. Rev.*, July, 1861, vol. 28, p. 64.

‡ *Brit. Med. Journ.*, April 23, 1881, p. 654.

§ *Deaf-mutism*, Trans. by Cassells, p. 64.

and scarlet fever, measles, small-pox, cold and consequent inflammation, whooping-cough, scrofula, and falls or blows. As Hartmann* observes, experience teaches that the organ of hearing is especially liable in scrofulous individuals to suffer severely both from primary diseases and from secondary affections, *e.g.*, the sequelæ of measles and scarlatina.

For the greater number of the congenital cases of deaf-mutism marriages of consanguinity, heredity, and various constitutional defects in parents are held mainly responsible. Among the last-mentioned causes syphilis, though not universally recognized as productive of deaf-dumbness, must doubtless be included, and, seeing that it is apt to attack mouth, nose, and eyes, it could hardly be supposed always to exempt the ear. Wilhelmi regards inebriety in parents as a fertile source of deaf-mutism in their offspring.

"It is," says Dr. William Farr,† "a very singular fact, to which it is desirable attention were paid, that in those districts of Scotland, viz., the highland and insular, where the mothers suckle their infants from fourteen to eighteen months, deaf-dumbness and blindness prevail to a very much larger extent among the people than in districts where nine and ten months is the usual limit of the nursing period."

In some instances, apparently, there is no assignable origin for deaf-mutism.‡

How subtle may be the conditions productive of congenital deaf-mutism is evidenced by the fact, mentioned by Wilde,§ that a man in Waterford had two deaf and dumb illegitimate children by different females, his legitimate children being unaffected, as also by a case of one-sided congenital deafness, stated by Dr. Fosbroke|| to have been caused during intra-uterine life by similar traumatic deafness in the mother.

* *Op. cit.*, p. 10.

† *Journ. of the Statistical Soc.*, vol. 29, p. 14, 1866.

‡ See case reported in *Brit. Med. Journ.*, April 2, 1881, p. 537, of a family of 14 children, of whom 7 were born quite deaf and dumb, and 1 nearly so. Whether the parents, who were healthy and had perfect hearing, were in any wise related does not appear.

§ *Op. sup. cit.*, p. 473.

|| *Lancet*, March 5, 1831, p. 740.

Several instances are on record of the assertion of a tendency to the production of deaf-mutes only in alternate pregnancies, or in children of either sex exclusively.

Saissy's observation* that, in five related persons known to him, deafness came on at the age of 40, suggests the inference that the operation of hereditary constitutional taint in bringing about congenital deaf-mutism may, in some individuals, be but little, if at all, controlled by external conditions.

Huth† observes that "it is not a little remarkable that the greatest proportion of idiots and deaf-mutes is found precisely where are the greatest number of goitreux." In some of the Swiss cantons, says Wilde,‡ the proportion of deaf and dumb in the population is as high as 1 in 206, and in these localities mutism is generally combined with cretinism, goitre, or idiocy.

Huth, referring to the evidence of the Irish census reports, remarks that, whatever the immediate, the remote cause of congenital deaf-mutism must lie in the transmission of nervous disease, and must therefore be looked for primarily in the general causes of the same, and, secondarily, in accidental causes.

The conclusion of Loubrieu§ that pathological lesions of all kinds and, above all, nervous affections are very frequent among the children of consanguineous parents is in favour of the opinion stated by Mr. Patterson, of the Manchester School for Deaf-Mutes, that "though the result of the marriage of near relations may not be seen in the deafness of their immediate offspring, yet the result is a deterioration of the constitution of the offspring, which may show itself in deafness in a few generations." ||

It may, perhaps, be safely assumed that the misfortune of congenital deafness, whether or not from consanguinity of parents, rarely comes quite single, being a symptom of general

* See Sedgwick, *Brit. and F. Med.-Chir. Rev.*, 1861, p. 202.

† *The Marriage of Near Kin*, p. 215, 1875.

‡ *Pract. Obs. on Aural Surgery*, p. 459, 1853.

§ *Op. sup. cit.*, p. 44.

|| See G. H. Darwin, *loc. inf. cit.*

constitutional conditions as multiplex and profound, and well-nigh as capricious in their apparent operation, as those resulting in the phenomena of hybridization. Struma, rachitis, hydrocephalus, epilepsy, a proneness to disease of the scalp, to discharges from the ear, and to chilblains, as Dr. E. Symes Thompson* has remarked, are frequent in the congenitally deaf. The same author, with others, has pointed out that much of the high mortality of deaf-mutes is traceable to disorders of the circulatory and respiratory systems; but these evils are doubtless due, in a large number of cases, to lack of suitable bodily exercise, and, amongst those that are not taught to articulate, to mouth-breathing and deficient use of the lungs.† The comparative infertility of deaf-mutes has often been remarked on.

Of 341 deaf-mutes in Berlin, Dr. Liebreich examined 241 with the ophthalmoscope, and in 14 he found retinitis pigmentosa, of which in that city he did not believe there were over 20 other cases. That 8 of the 14 were Jews, he thought perhaps ascribable to the frequency of consanguineous marriages in their nation. Forty-two, or 12·31 per cent., of the 341 deaf-mutes were, moreover, Jews; there being, accordingly, one deaf-mute in every 368 Jews, and one in every 1,477 Christians. Deaf-mutism, Liebreich showed to be less frequent among the Catholics than the Protestants of Berlin, apparently because the religion of the former forbids marriages between near relatives.‡ It is necessary to remark that Hartmann and others have shown the results of the smaller statistics collected by Liebreich and Kramer to be by far too unfavourable to the Jews, although deaf-mutism is without question exceptionally frequent among them.

Where intermarriage is the rule, as at Alia, in Italy, it is common to find deaf-mutism associated with idiocy, epilepsy, suicidal tendencies, and other evidences of grave mental and bodily derangement.§

* See paper "On the Health of Deaf-Mutes," in A. Kinsey's *Speech for the Deaf*, p. 127, Lond., 1880.

† See Symes Thompson, *op. sup. cit.*, and A. Kinsey, *On the Prevention of Dumbness*, read before the International Med. Congress, 1881.

‡ *Med. Times and Gaz.*, April 6, 1861, p. 372.

§ *The Lancet*, Nov. 26, 1881, p. 922.

"It has been settled, beyond a doubt," wrote Dr. Dudley Peet,* of New York, in 1856, "that intermarriages of first-cousins, and even some of second-cousins, give rise to offspring which are generally of imperfect development, either idiotic, blind, or deaf and dumb." One cannot but conjecture that Andral, the French physiologist, must have been describing some mentally defective example of the apparent truth of this doctrine when he described the deaf-mute as "habitually in a sort of half-childishness;" for, with respect to natural intellectual constitution and capacity for learning, the deaf and dumb whose mutism is not the index of imbecility resemble other men, the limits to their possible attainments being such only as are imposed by their lack of power to perceive or analyse sound.†

The view, which has been controverted by some,‡ that congenital deaf-mutism is largely to be accounted for by consanguineous marriages, has come to be very generally accepted by the profession, and is apparently supported by results of the census in the United Kingdom in 1871. Professor Devay, of Lyons, observes§ respecting such unions that:—"La surdit   mutit   cong  nitale est sans contredit une des manifestations les plus fr  quentes de la consanguinit   dans le mariage. Chaque jour l'observation grossit le contingent des faits imputables    cette cause." He gives the following details with respect to the children of two cousins-german, taking them in the order of their birth:—(1.) Hearing became impaired. (2.) Born sound, died at five, of periencephalitis. (3.) Deafness progressing to complete loss of audition. (4.) Born deaf. (5.) Hearing defective. (6.) Born deaf. (7.) Idiot. (8.) Born deaf.

Devay mentions that Dr. Chazarain found that, of 78 pupils in L'Institut des Sourds-muets at Bordeaux, 27, *i.e.*, almost exactly one-third, were the issue of consanguineous marriages.

* *Americ. Annals of the Deaf and Dumb*, vol. 8, No. 3, p. 133.

† See Lunier, "Sur la Responsabilit   l  gale des Sourds-muets," *Ann. d'Hygi  ne*, ser. 3, t. 1, p. 448, 1879, also Hartmann, *Deaf-mutism*, p. 14.

‡ See, *e.g.*, a correspondent in *The Lancet* for 1866, p. 113, who avers that "Whenever cases have been fully published, these have always exhibited evidence of the presence of well-established causes of degeneracy irrespective of consanguinity.

§ *Gazette Hebdomadaire*, Sept., 1860, p. 598.

From statistics in 1876, Dr. Caspar Singer, of Vienna, computed that 25 per cent. of all deaf-mutes are the issue of marriages of blood-relations (Kinsey).

Loubrieu, on the other hand, found in 500 deaf-mutes 43, or only 8·6 per cent., that were the children of related parents.

In his investigations* as to the causes of deaf-mutism, Dr. Bemiss, of Louisville, Kentucky, who obtained information respecting 3,942 persons, the issue of 883 consanguineous marriages, arrived at results which may be tabulated thus :—

Relationship of parents.	Total offspring.	Born defective.	Number of deaf-mutes.	Percentage of deaf-mutes in offspring.
Uncle and niece, or aunt and nephew	53	40	1	1·88
Cousins by kindred parents...	234	126	10	4·27
Double-first cousins	154	42	2	1·29
First-cousins.....	2,778	793	117	4·21
Second-cousins.....	513	67	9	1·75
Third-cousins.....	59	16	3	5·08

It was estimated by Boudin† that 2 per cent. of the marriages in France were consanguineous, and that of the deaf and dumb 28 per cent. at Paris, 25 at Lyons, and 30 at Bordeaux were the direct issue of such marriages, which were generally between healthy persons. He gives the following figures:—

* See *Trans. Amer. Med. Assoc.*, vol. 11, 1858 abstracted in *Brit. and F. Med.-Chir. Rev.*, 1860, vol. 26, p. 151.

† See *Recueil de Mém. de Méd. Milit.*, March, abstracted in *Med. Times and Gaz.*, May 10, 1862, p. 489.

Relationship of parents.	Percentage of total marriages in France.	Percentage of deaf-mutes in offspring.
Uncle and niece.....	0·04	1·61
Aunt and nephew.....	0·614	2·04
First cousins	0·77	18·47

Mr. George H. Darwin,* however, remarks:—"It cannot be doubted that M. Boudin's estimate of 2 per cent. for consanguineous marriages within the degree of second-cousins is very much too low for France; probably 5 to 8 per cent. would be nearer the mark."

It will be observed that the mean of Boudin's first two percentages, is closely accordant with the figures given by Bemiss (*vide supra*), whereas with respect to deaf-mutism in the children of cousins-german his estimate is more than $4\frac{1}{3}$ times as great.

Mr. Buxton, of Liverpool, computed in 1859 that 10 per cent. of deaf-mutes are the offspring of first-cousins. Sir W. Wilde† gives a proportion of 231 in 3,534, *i.e.*, 1 to 15·3, or 6·19 per cent., for children of first-, second-, and third-cousins among the deaf-mutes in Ireland, but remarks that "returns of this nature must naturally be expected to be deficient."

Mr. G. H. Darwin,‡ who mentions the estimates of the last-named two authorities, adduces certain statistics to prove that "with respect to deaf-mutes . . . there is no evidence whatever of any results accruing to the offspring in consequence of the cousinship of their parents."

Investigators into the effects of the marriage of blood-relations

* "Marriages between First-Cousins," *Journ. of the Statistical Soc.*, vol. 38, p. 347, 1875. Cf. Huth, *The Marriage of Near Kin*, p. 211.

† *The Census of Ireland for the Year 1851, Part III. Report of the Status of Disease in Ireland*, p. 17, 1854.

‡ *Loc. cit.*, p. 172. Mr. A. Kinsey (*On the Prevention of Dumbness*, p. 6), speaking of this statement of Mr. Darwin's, says:—"Myself having had access to many of the sources from whence he obtained particulars, I cannot agree with the conclusion arrived at."

employ methods, Huth* maintains, that are obviously untrustworthy. "They either," says he, "inquire into the parentage of as many deaf-mutes as they can find, and then compare the result of what they suppose to be the relative numbers of consanguineous and non-consanguineous marriages, or they collect as many cases of consanguineous marriages as they are able, and then analyse the result. . . . In other words, this method of research presupposes three things to be true, all of which we have more evidence to believe untrue, to wit: that an equal proportion of deaf-mutes are born to each consanguineous marriage as to each non-consanguineous marriage; that an institution (generally charitable) is a true mirror of the state of deaf-mutism in the general population; and, thirdly, that we know the proportion of consanguineous marriages to the non-consanguineous, which I have already shown that we do not." Huth points out, moreover, that different observers have estimated the percentage of deaf-mutes in the offspring of blood-relations at from 3·9 to as high as 30·4; and it is certainly impossible to conceive that differences in the climatic or social conditions, or in the degree of family relationship of the intermarried in various localities, could suffice to account for the wide discrepancies between the results of some observers. The experience of not a few years of practice as an aural surgeon has, however, convinced me that in the majority of cases where unmistakably congenital deaf-mutism is not to be traced to defect, disease, or hereditary taint in either father or mother, the parents are nearly related, and very commonly are first-cousins.†

With respect to the relation of deaf-mutism to consanguinity in parents, the following important passage occurs in Dr. A. Hartmann's work previously quoted:—"In Prussia, where the total number of consanguineous marriages yields a percent-

* *The Marriage of Near Kin*, pp. 229, 230.

† Whilst this chapter was in preparation, the author had brought to him, on the same day, a private patient, a girl aged 5, and a hospital patient, a boy aged 6; both were deaf and dumb, and the offspring of first-cousins, who not only were perfectly healthy themselves, but could give no family history of deafness.

age of 0·8, there were among 1,210 congenital deaf-mutes (according to recent very exact statistics) 156, or 12·9 per cent., who were the offspring of consanguineous marriages; while among 1,551 individuals with acquired deafness there were only 47, or 3 per cent., who sprang from such marriages. This positively proves that consanguineous marriages are a cause of congenital deaf-mutism.

“In Prussia the deaf-mute rate in families where father and mother are blood-relations is as follows:—

Acquired deaf-mutism, 1 to each family,
Congenital deaf-mutism, 1·66 to each family,

which also proves that consanguineous marriages favour the birth of deaf-mute children.”

Wilde long since, from a careful analysis of statistics, formed the opinion that in only a small percentage of the offspring of deaf-mutes, even when the latter have intermarried, is the parents' defect reproduced. Thus, he found that to 86 deaf-mutes in Ireland, whose parents, with a single exception, could hear, there were born 203 children, of whom one only was a deaf-mute, and that out of the 13 children of 6 deaf-mute couples 12 were free from their parents' defect.*

Hartmann shows from statistics by various authors that 28 children, all with perfect hearing, resulted from 17 marriages between deaf-mutes, and 489 of such children and 11 deaf-mutes (*i.e.*, 2·2 per cent. of the total offspring) from 276 marriages where only one parent was affected.

Among the parents of the 48 inmates of a deaf and dumb school in Manchester, in 1837, Holland ascertained that there was only one deaf-mute.

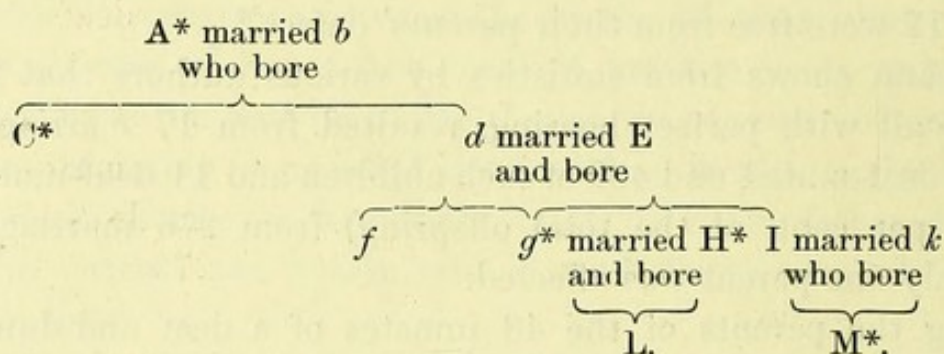
Another writer states† that, in 86 families having each a single parent congenitally deaf and dumb, 21 children, or about one-tenth of the whole number, were the subjects of deaf-mutism, and that in 24 families in which both parents were

* *Report on the Status of Disease*, p. 13, 1854. See also Wilhelmi, quoted by Hartmann in *Arch. of Otol.*, Dec., 1880.

† Turner [? Rev. W. W., of the U.S. America], quoted in *Ency. Britannica*, *loc. sup. cit.*

deaf and dumb, 17 children, or about one-third, were similarly affected.

Sedgwick calls attention to the fact that although it is rare to meet with deaf-mutes whose immediate parents are deaf and dumb, still numerous examples have been noted of the occurrence of congenital deafness in relations of theirs other than brothers and sisters. "Deaf-dumbness," he remarks,† "is not hereditary in the ordinary acceptation of the term, but only in that wider sense in which we apply it in consequence of several members of the same family, their cousins, or other collateral branches, being similarly affected." He further points out that in a large majority of cases, the disease in the offspring is the expression of some unrecognized but abnormal condition of one or both of the parents, and that to look for any existence of it in the latter would be almost useless. Dr. Arthur Mitchell, in a most interesting record of a case of deaf-mutism,‡ has shown that this defect may be even twice transmitted potentially, to appear as actual in the third generation. The family history of this case is exhibited by him in the following diagram, where capital letters denote males, small letters females, and asterisks deaf-mutes :—



The deaf-mute boy M had, therefore, neither deaf parents nor grandparents, and yet his condition was hereditary. Here A* transmitted his defect potentially through *d* to I, and I actually to M.

Dr. T. McCall Anderson has called attention to other marked examples of hereditary transmission of deaf-mutism in the case

† *Brit. and F. Med.-Chir. Rev.*, 1861, p. 202.

‡ *Med. Times and Gaz.*, Aug. 15, 1863, p. 164.

of the great-great-grandchildren, and several other relations of two brothers.*

Boudin suggests that the comparative immunity from deafness enjoyed by the offspring of intermarried deaf-mutes is due to their not being the issue of consanguineous marriages; but, as is proved by a multitude of facts, mere blood-relationship of father and mother cannot be considered alone as a cause of deaf-mutism.

It must be remembered, as statistics above given have shown that the children of even closely related parents do not by any means invariably manifest any impairment of hearing or other evidence of defective constitution. Thus the marriage of two congenital deaf-mutes, although the husband's parents were second-cousins, and the wife's also were related, and her sister was deaf and dumb, resulted in the birth of eight children all possessed of speech and hearing.† Again, Huth mentions that M. Devic found at Asprières, where many consanguineous marriages take place, only two deaf-mutes, and these not the offspring of related parents, in a population of 1,700.

System of Instructing the Deaf and Dumb.—The so-called "French" system, in accordance with the old notion that "pantomime is the appropriate language of deaf-mutes," embodies an artificial finger alphabet, and a code of signs and gestures, but does not aim at giving articulate speech.

The "Old English," or "combined" system, employs reading from the movements of the lips, and speech with signs of all kinds, natural and artificial. Unfortunately, as Mr. Kinsey has pointed out, "the sign language is perfectly unknown except to its own professors and experts. . . . Notwithstanding the universality which is claimed for signs, it is the fact that both teachers and pupils of one institution, when brought into contact with those of another, are often at fault to understand their respective signs. There is, in fact, no codified system of signs common to all institutions and countries."‡ What wonder, then, if the world of the totally uninitiated, in speaking of the

* *Med. Times and Gaz.*, Sept. 5, 1863, p. 247.

† See *Ency. Brit.*, *loc. cit.*

‡ *Speech for the Deaf*, pp. 93, 95.

deaf-mute educated by such means, can but re-echo the words of Portia: "You know, I say nothing to him, for he understands not me, nor I him. . . . He is a proper man's picture; but, alas! who can converse with a dumb show?"

It has been abundantly shown by teachers of deaf-mutes, that signs in proportion to their employment, hinder the progress of their pupils in the art of speaking.

The Milan International Congress in 1880, which met to consider the best methods of educating the deaf, came to the almost unanimous conclusion that, inasmuch as the use of signs with speech interferes with the acquirement of the latter, as also of lip-reading and precision of ideas, the pure oral method ought to be adopted.

A great disadvantage of the "combined" system is that the tone of the voice cannot, for want of practice, be sufficiently cultured, and the deaf, discovering that their voices are unmusical, select silent methods of communication, and learn to prefer the society of the mute.

The "German," or pure oral, system consists in the employment of articulate speech together with the analysis of its mechanism, or "lip-reading."

"'From the easy to the difficult,' 'From the known to the unknown,' are golden maxims of the 'German' method." (Kinsey.) The rudimentary sounds of which speech is composed are emphatically pronounced before the pupil, and the exact mode of their production is demonstrated to him both by touch and sight; he is thus by degrees led to produce an imitation of them. The alphabet having at length been taught, the pronunciation of syllables and still greater difficulties are proceeded to, and one by one overcome, whilst simultaneously the art of writing the uttered sounds is being attained. Professor A. Melville Bell's ingenious system of "visible speech" (for an able exposition of the principles of which see Dr. E. Symes Thompson, *Med. Times and Gaz.*, December 14, 1874, p. 679) was at one time regarded as a valuable auxiliary to the "German" system for the instruction of the deaf, but has been abandoned by the most accomplished and successful of their teachers. Miss Hull, of Holland Road, Kensington, for example,

says of phonetic symbols, such as those of visible speech, or any other written characters, that she finds them to be more hindrances than helps, since in their use "a process of translation from writing to speech takes place, whereas the opposite is the natural course."

For a detailed account of the many advantages both to mind and body, of the pure oral over every other system, the reader must be referred to the valuable and deeply interesting series of essays which Mr. Kinsey has collected together in his volume *Speech for the Deaf*, above mentioned, to Dr. J. P. Cassells' "Thoughts and Suggestions concerning the Education of Deaf Children," in the *Edin. Med. Journ.* for February, 1878, and to his translation, with additions, of Dr. A. Hartmann's *Taubstummheit und Taubstummenbildung*, 1880, which I have already several times had occasion to quote in the course of this chapter. With respect to deaf-mutism generally, the reader may with advantage consult Dr. David Buxton's paper, "An Inquiry into the Causes of Deaf-Dumbness, Congenital and Acquired," and its "Postscript. On the Effect of Mental Impressions during Gestation in producing the Deafness of Children," in the *Liverpool Medico-Chirurgical Journ.*, January, 1859.

CHAPTER XIX.

AIDS TO HEARING.

IN all animals the special function of the auricle and external auditory meatus appears to be the reinforcement of sound. These, as Burnett points out, form a resonator for sound-waves having a length equal to four times the various depths of the air column which they together contain. The late Mr. A. Gardiner Brown* held that the whole margin of the cartilage of a well-formed auricle, from the tragus in front to the posterior border of the helix behind, gives in answer to friction, vibrations forming a complete octave in the ascending scale of notes; and that the intrinsic muscles of the pinna are serviceable in increasing the tension, and thus raising the pitch of the resonance of different parts of the cartilage and regulating the size of the fossæ.

It is found that by putting the hand, or some other means of augmenting resonance, behind or around the ear, the auditory capacity is increased, and especially for the notes of high pitch and short wave-length which constitute the overtones of the human voice. The greater number of artificial aids for deficient hearing, have for their object the improvement of the resonance of the external ear, and the reflection of sound-waves into it as a focus, as in the case of ear-trumpets. The otophone is constructed to increase the receptivity of the auricle for sounds, by projecting it forwards. The best reflectors are hard and dense bodies, such as metals, glass, and porcelain; but the weight, fragility, and the intrinsic notes of certain materials may be objections to their employment. Ebonite, japanned iron, and silver-plated metal are commonly used. Aluminium has been recommended on account of its lightness. The simplest and

* See paper read before Otological Section of the International Medical Congress in 1881, published in *The Lancet*, Dec. 24, 1881, p. 1082.

most efficient sound-reflector is a hollow cone. Echoes are lessened by widening the open base of the cone; they may be still further diminished by obliquely truncating it, thus rendering it in outline not unlike the ears of many quadrupeds. Dr. C. J. B. Williams has shown that the confusing sounds of transverse vibrations in the air of an ear-trumpet are decreased by making eight or ten holes in its sides. He found that a cone of stiff paper, about eighteen inches in length, and ending in a short metallic ear-piece, caused very little reverberatory roar, and magnified sound twelve times. A cone of ebonite a foot in length, truncated obliquely for half that distance, he proved to have a magnifying power of ten, and to cause only a slight roar with even loud sounds.*

Politzer finds that a small horn-shaped vulcanite tube, with the smaller end inserted into the meatus, and the mouth directed backwards and fitting into the concha, is of benefit in some cases of deafness, as, like the concave posterior surface of the tragus, it serves for the reflection of sounds. It answers best for sounds originating opposite the patient.†

Koenig has invented an acoustic trumpet resembling a single-tubed stethoscope. Some patients I have found to derive much benefit from the use of small globose or conical metallic resonators.

Binaural instruments are those found most generally satisfactory in practice. Where a tube is employed for the conduction of the sound, care must be taken that its end fits accurately into the meatus.

It would be impossible profitably to dwell here at any length upon the shapes and special qualities of the multitudinous varieties of apparatus which have been contrived for the use of the deaf. Experiment alone can determine what is the best form of instrument for any particular patient. To the construction and mode of employment of artificial tympana I have already alluded.‡ Dr. Woakes has suggested, for the manufacture of the same, the use of dentists' gold-leaf.

* *The Lancet*, Nov. 2, 1873, p. 665.

† *Wiener Med. Woch.*, No. 18, 1881.

‡ See p. 212, *et seq.*

The possibility of hearing through the teeth was known in the time of Hippocrates, but was not made applicable for the purpose of conversation until Richard S. Rhodes, who was himself deaf, constructed as "audiphones," or means of conveying sound to the organ of hearing, fans of sheet vulcanite, to be placed in contact with the teeth. By transmitting to the skull vibrations received from the air, an audiphone subserves to some extent the office of a tympanic membrane.

Dr. S. Sexton* considers that autophony permitting of the successful use of the mouth-trumpet and audiphone is favoured by loss of tension, and hence of vibratory power, in the membrana tympani, whether directly through trophic changes or inflammation therein, or through dislocation of the ossicula. Sound-waves may then be transmitted through the teeth or other structures to the auditory nerve, by means of various intermediate tissues. Experiments with Rhodes' audiphone on five deaf-mutes in Paris, March, 1881, negatived the supposition that it could be made of any use in the instruction of such persons. Dr. Cassells describes it as of great value in many cases of non-suppurative catarrhal deafness, where a watch is heard only when on the teeth, or on them better than when on the temples, and not at all on the auricle. He states that his "tonomittor," a cheap form of instrument made of ash-wood, with a resonating bar attached, is equal in effect to the audiphone.

Dr. Urban Pritchard has found the audiphone of Collardon, of Geneva, viz., a large piece of hard, flexible cardboard, more serviceable than Rhodes'. The latter Dr. Pierce proved useful in not more than four or five out of 300 cases.†

For transmitting articulate sounds directly from the skull of a speaker to that of a deaf person, Dr. C. H. Thomas's "rod-osteophone" was invented. Mr. Cresswell Baber employs a modification of this, made of a number of flat pieces of wood firmly jointed together. One end of the instrument is placed against the upper teeth of the speaker, the other either similarly or between the teeth of the listener.

* "Hearing by the Aid of Tissue Conduction. The Mouth-trumpet and the Audiphone," *Americ. Journ. of Otology*, Apr., 1880.

† *Brit. Med. Journ.*, Sept. 4, 1880, p. 391.

It has not yet been shown that the microphone can be made practically available for the relief of deafness.

In conclusion, the author is bound to state as the result of many years' experience that aids to hearing, trumpets and tubes alone excepted, are useful only in a very small proportion of deaf persons, though it must be admitted that brilliant results have been obtained in a few exceptional instances.

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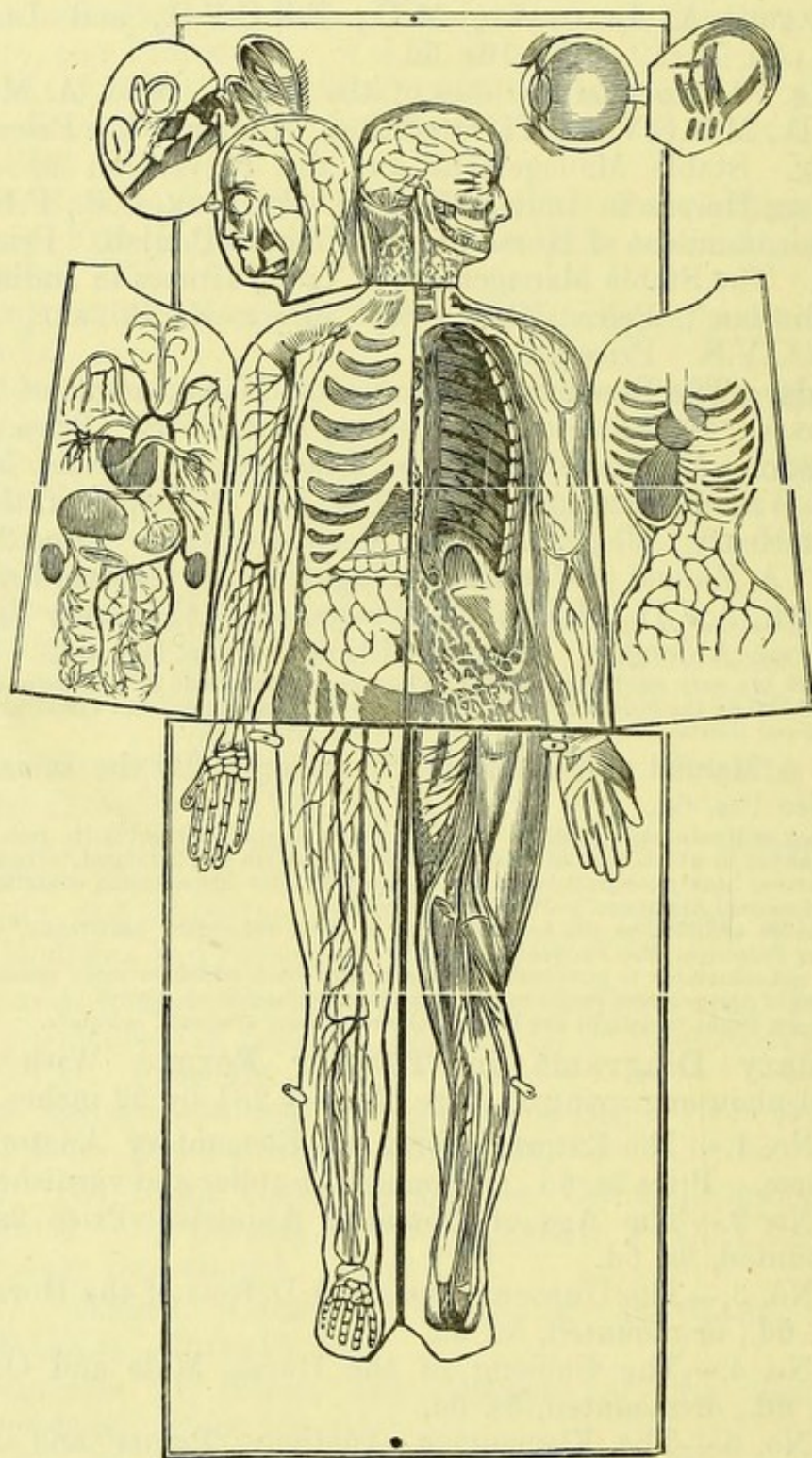
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