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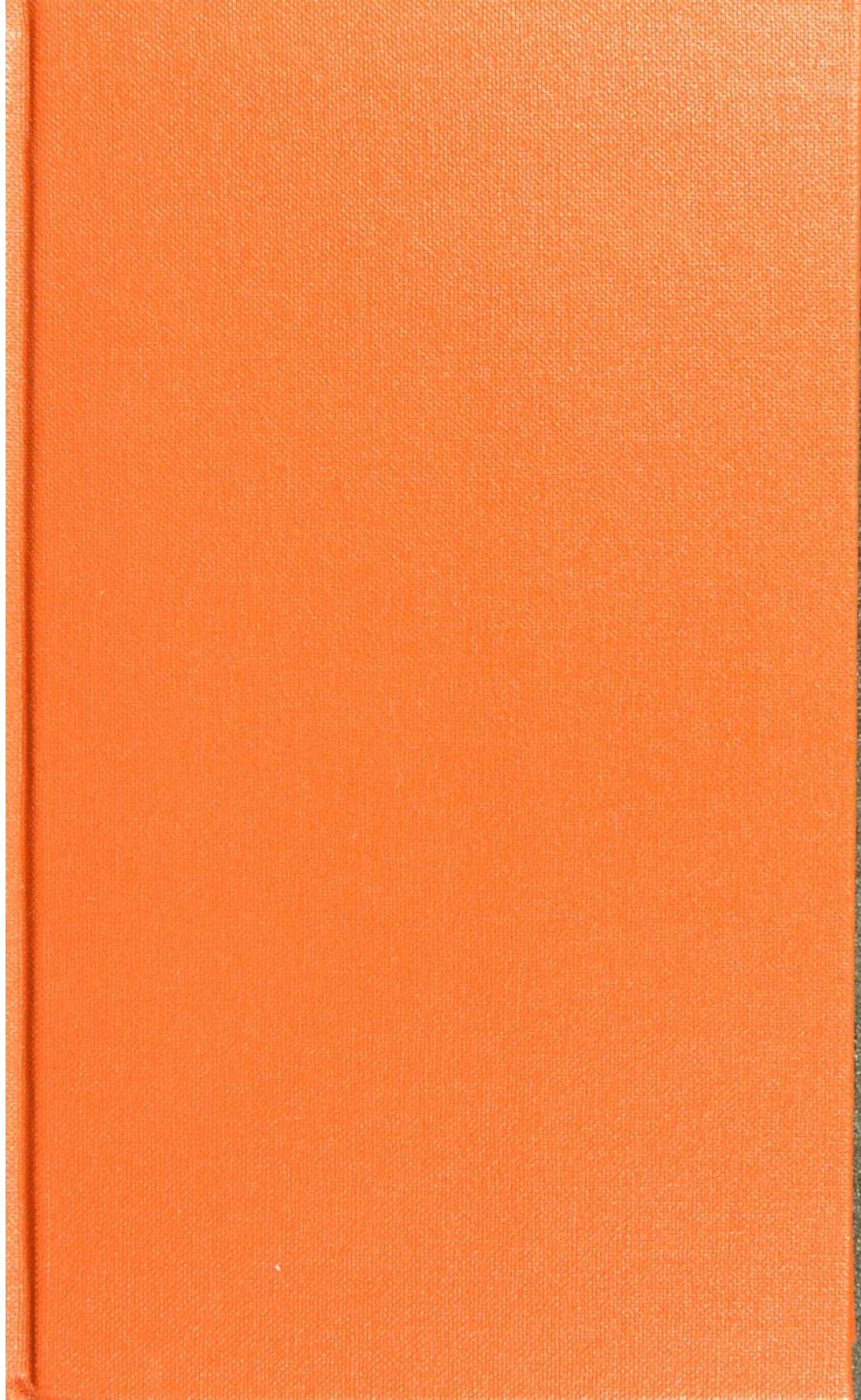
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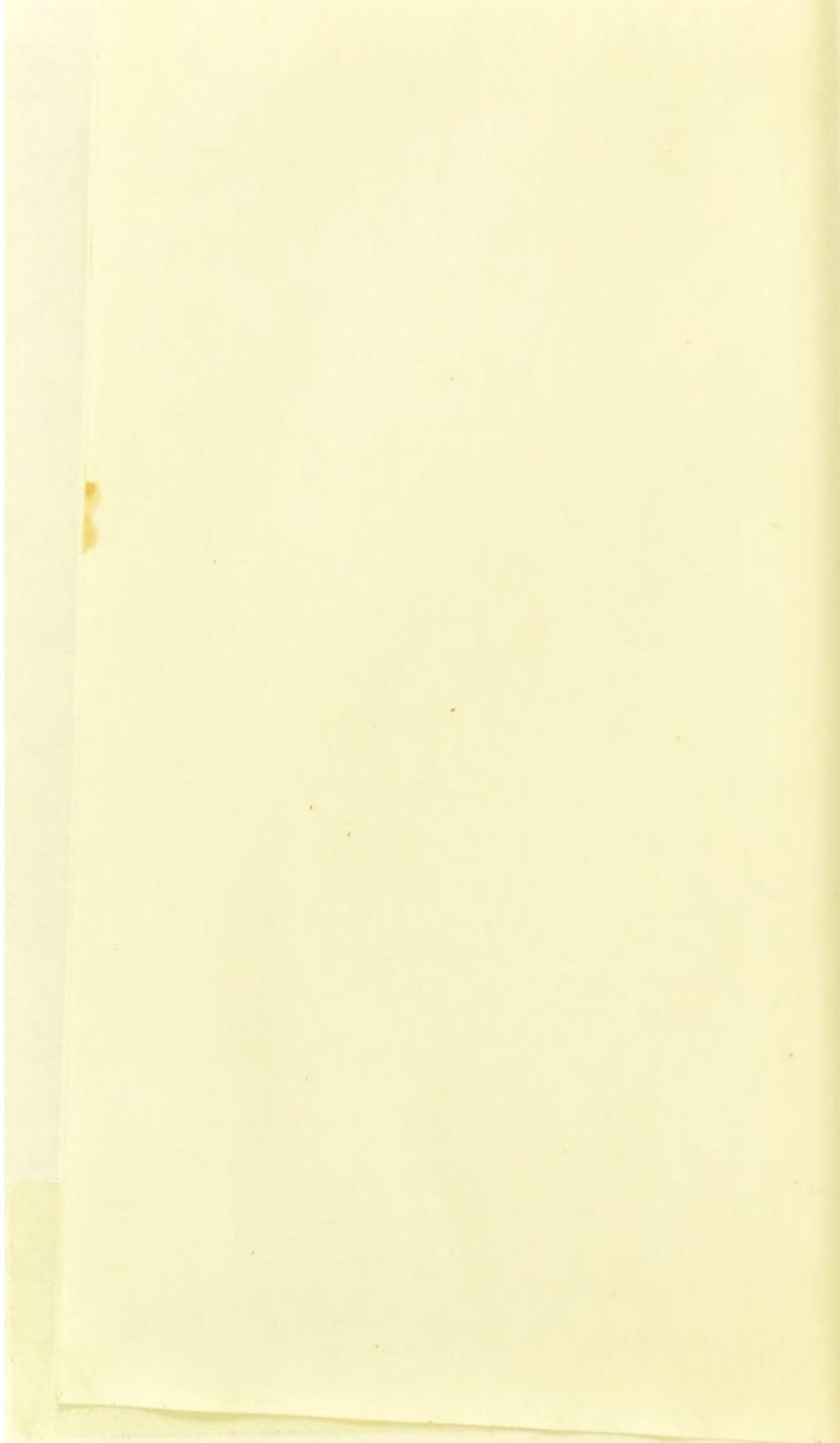




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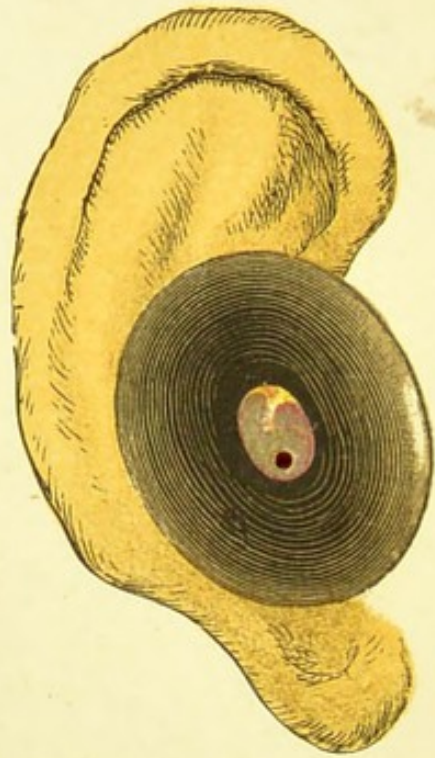


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PERFORATION OF MEMBRANA TYMPANI.

348

DISEASES OF THE EAR.

BY

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

AURAL SURGEON TO ST. MARY'S HOSPITAL AND LECTURER ON AURAL SURGERY IN THE
MEDICAL SCHOOL.

THIRD EDITION.

ILLUSTRATED WITH COLOURED PLATES AND WOODCUTS.

LONDON:
HENRY RENSHAW, 356, STRAND.

1882.

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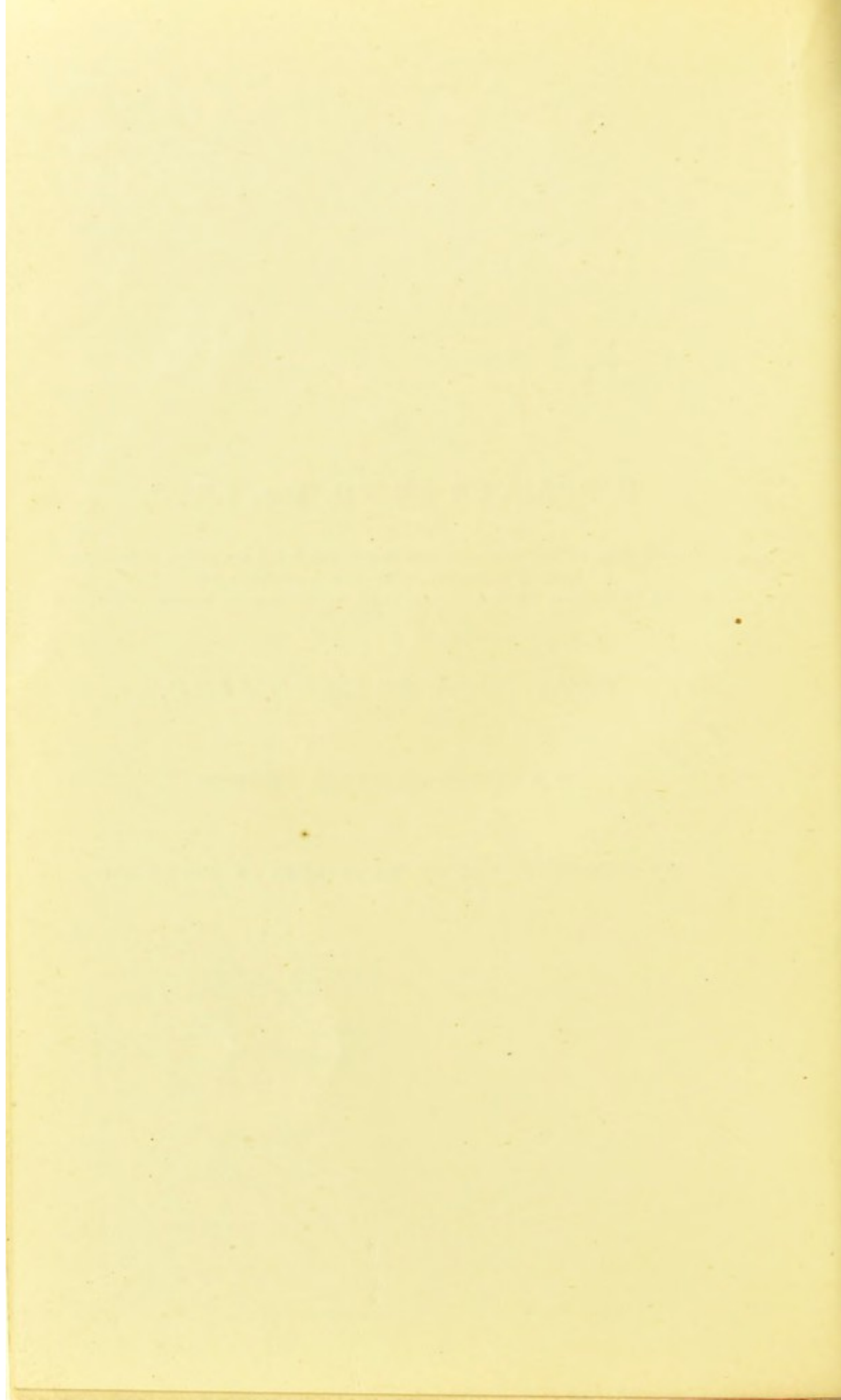
LATE MEMBER OF THE COURT OF EXAMINERS OF THE ROYAL COLLEGE OF SURGEONS,
CONSULTING SURGEON TO ST. MARY'S HOSPITAL, AND
LATE LECTURER ON CLINICAL SURGERY IN ST. MARY'S HOSPITAL MEDICAL SCHOOL,

THIS BOOK IS DEDICATED,

AS A TOKEN OF GREAT RESPECT

AND

IN REMEMBRANCE OF MANY ACTS OF KINDNESS.

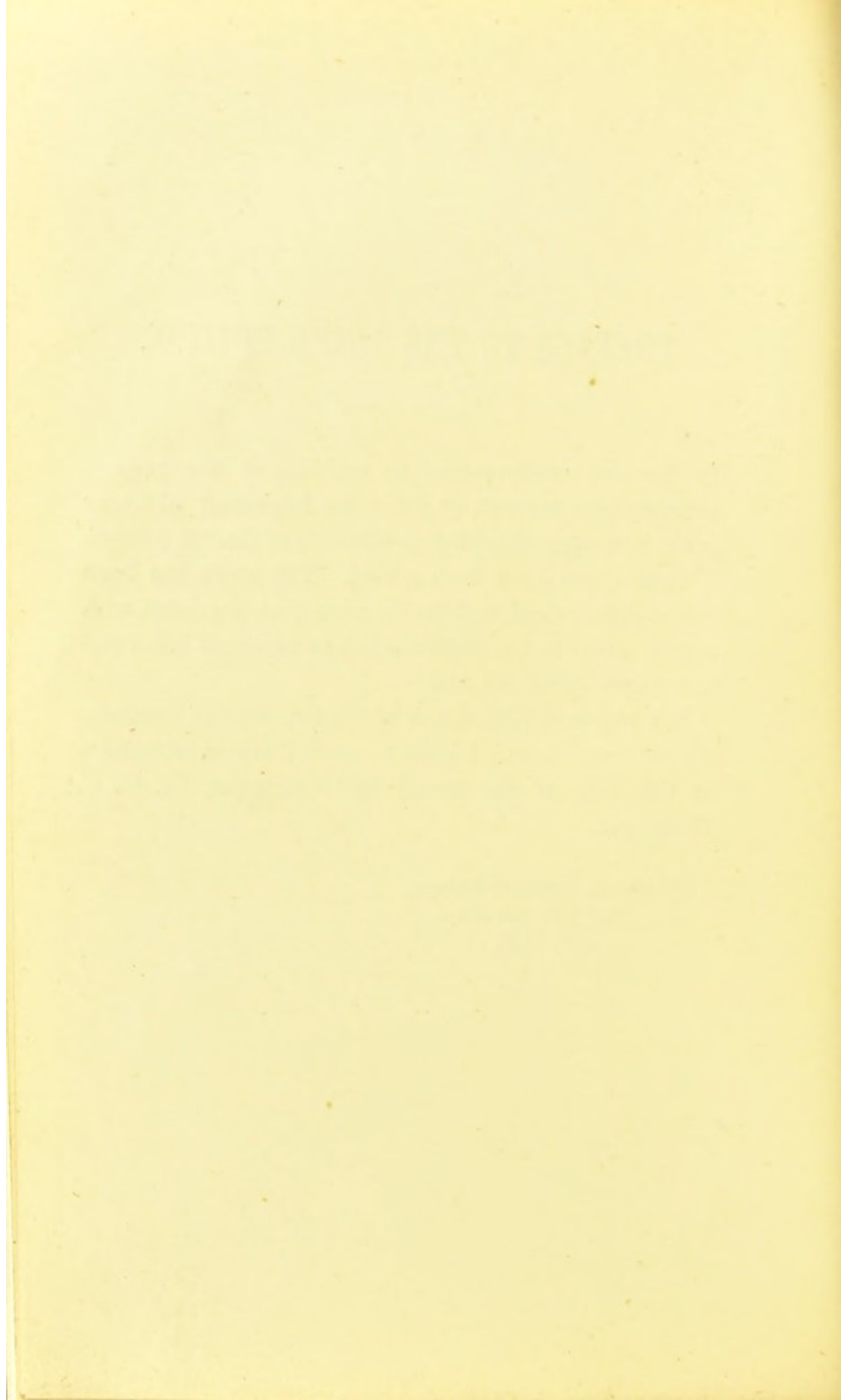


PREFACE TO THE THIRD EDITION.

IT has been endeavoured to embody in the present volume some account of the more important advances made in otology since the publication of the last edition. Five chapters have been added. The work has been thoroughly revised, and for the most part rewritten, with a view either to the condensation or to the addition and rearrangement of matter.

For plates in illustration of the structure of exostoses and of aural polypi, I have to record my indebtedness to the skill of my friend and colleague, Dr. G. C. Henderson.

31, LOWER SEYMOUR STREET,
PORTMAN SQUARE,
July 1882.



PREFACE TO THE SECOND EDITION.

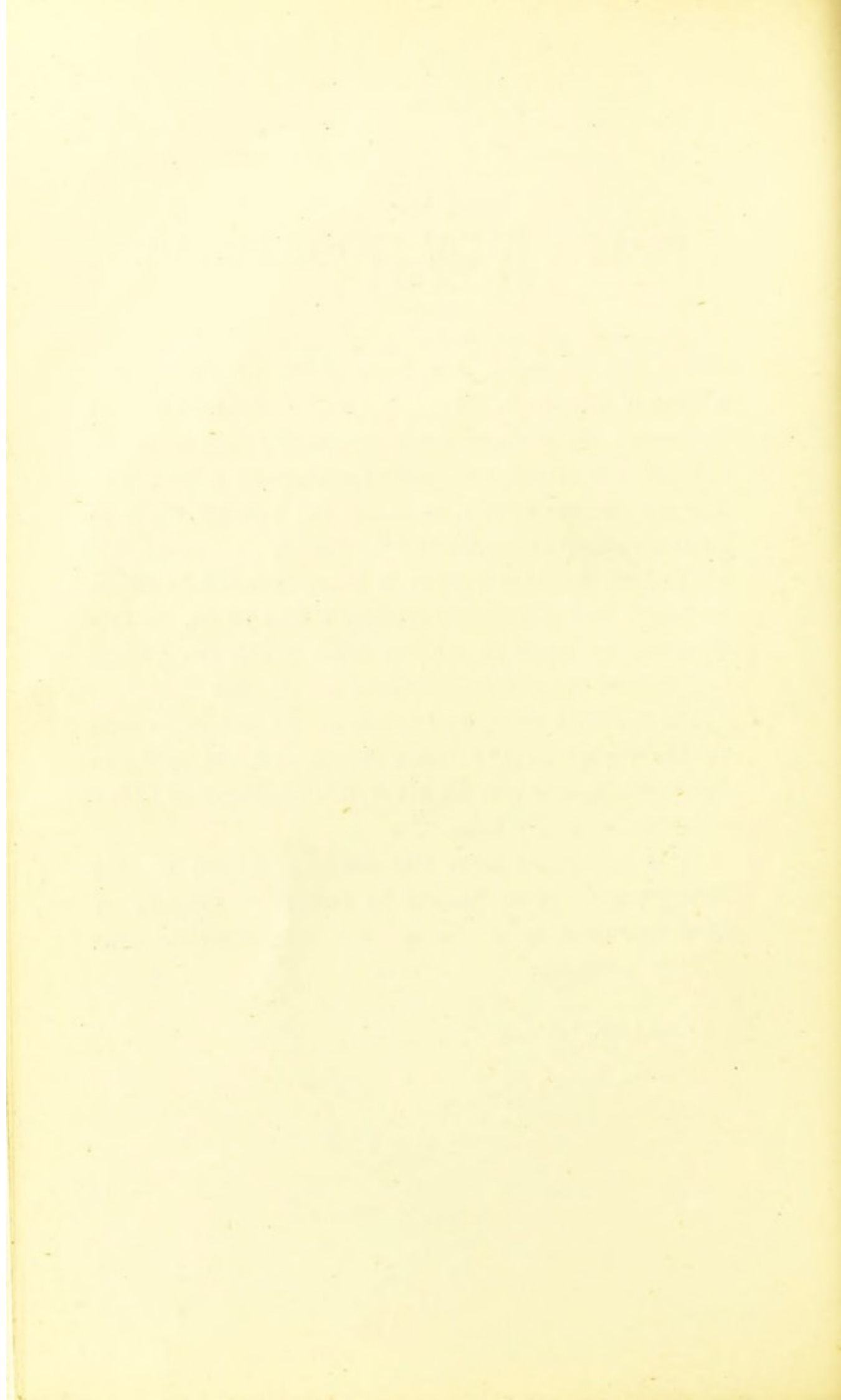
MUCH new material has been added in the second edition of this work. The rapid sale of the first edition illustrates the progress made generally in the study of, and also the demand for works on Diseases of the Ear. The writer has striven to make the present work as comprehensive as the space will permit.

His best thanks are given to the authorities to whom he refers, and also to the clinical clerks of St. Mary's Hospital for notes of various cases which are quoted to illustrate the different forms of ear disease.

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.



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. To these our best thanks are due.

Great advance has been made of late years in the knowledge of Aural Diseases, and consequently in their treatment.

We can now cure or greatly relieve cases which a few years ago were considered beyond the reach of Surgery.

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.

I have derived material assistance from several of my colleagues.

Much care has been bestowed upon the index, so as to facilitate immediate reference.

June 1876.

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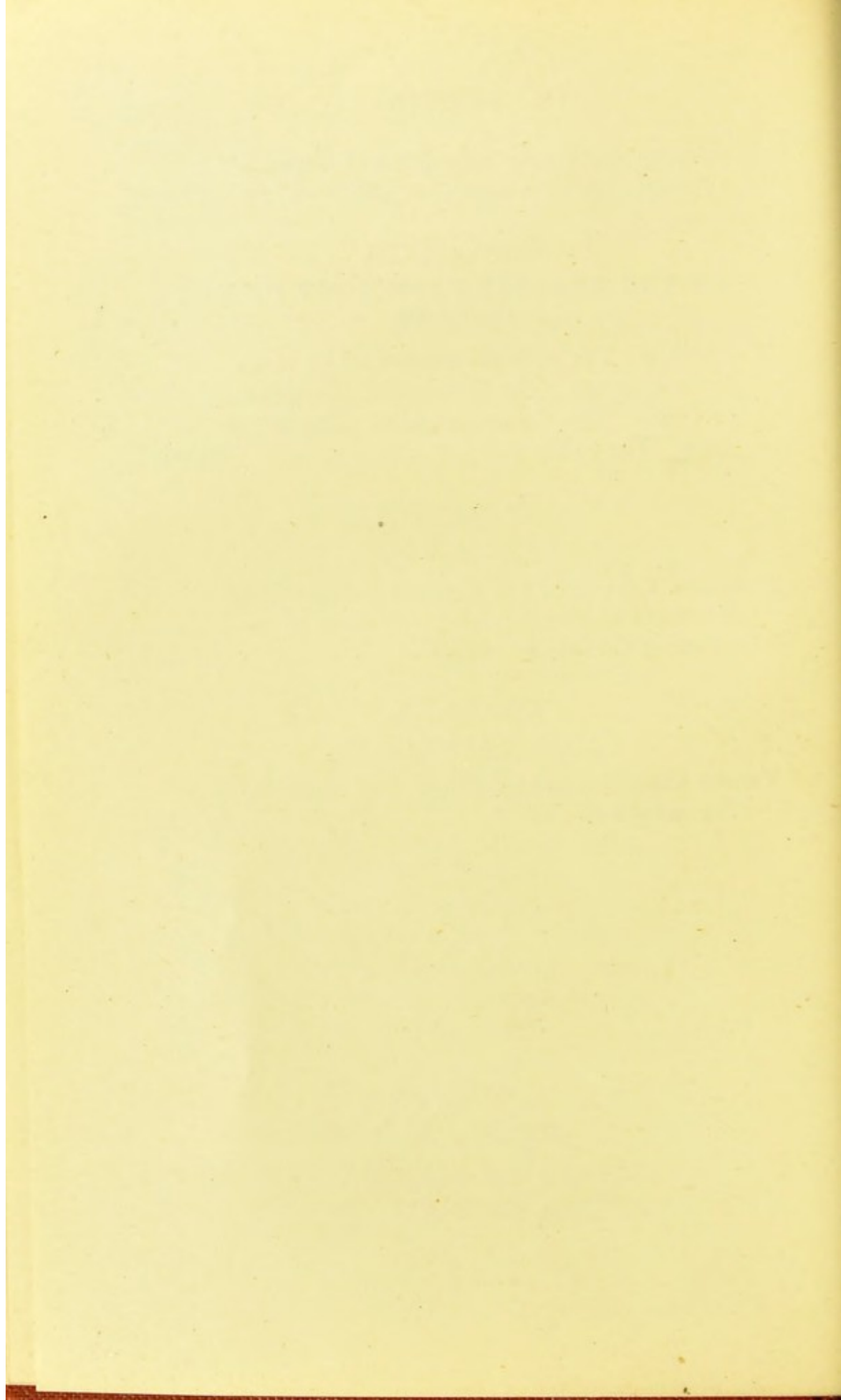
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DISEASES OF THE EAR.

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 enclosed within 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 considers that the whole of this external shell is merely rudimentary in man, as are also the 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.

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 relationship, at any rate as regards development, between man and the ape.

The margin of the pinna is called the helix; it "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 of

the ear of certain lower animals (Darwin). This little blunt point stands strangely outwards in some men, and 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 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 made of skin and connective tissue, and is but poorly supplied with nerves. 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 so near to 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. The wax secreted by the glands of the canal-wall keeps the integument from drying and chapping.

The delicate skin between 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 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 cold water, so causing the stomach to hurry on the digestive process with renewed energy.

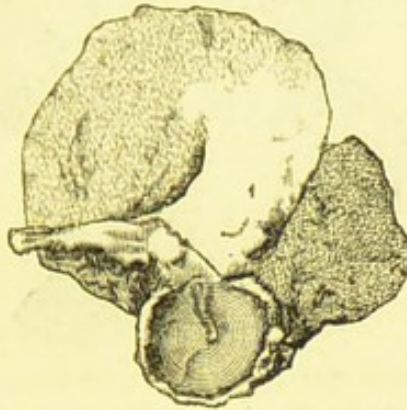
The external auditory meatus is about three-quarters of an inch long, and starting from the depths of the pinna (concha), between the condyle of the jaw and the mastoid process, passes at first a little upwards and then slightly downwards, until it reaches the tympanic membrane. The main course of the canal, like that of the petrous portion of the temporal bone itself, is forwards and inwards. 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 bottom of the meatus.

The external meatus is not made entirely of bone, for the cartilage of the pinna runs into it; and the pinna must be drawn well upwards and a little outwards, if the observer is desirous of obtaining a good view of the depths of the canal.

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.

The following figure exhibits the outer surface of the left temporal bone of an infant, showing three of the four centres of ossification, the deficiency in the upper part of the circle of the tympanic bone, and the handle

of the hammer, which is obscurely seen through the upper part of the tympanic membrane.



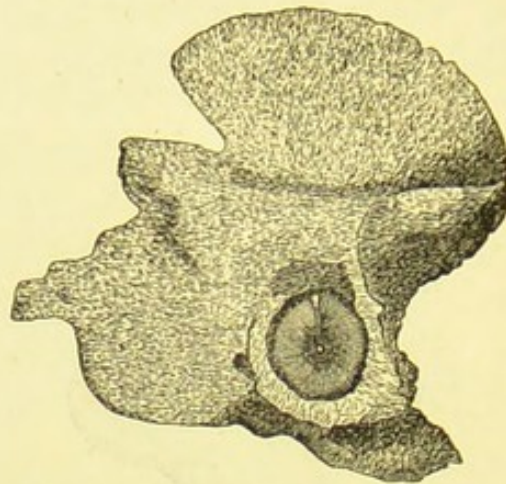
MEMBRANA TYMPANI, WITH TYMPANIC RING.

The meatus is lined with a layer of true skin. This 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 suppuration going on in the neighbouring (mastoid) cells, which, as we shall later see, is a very grave condition.

The tympanic membrane slants downwards and forwards at the bottom of the external auditory meatus. 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.



OUTER SURFACE OF RIGHT TEMPORAL BONE, FROM A STILL-BORN CHILD AT FULL TERM,
SHOWING MEMBRANA TYMPANI (NAT. SIZE).

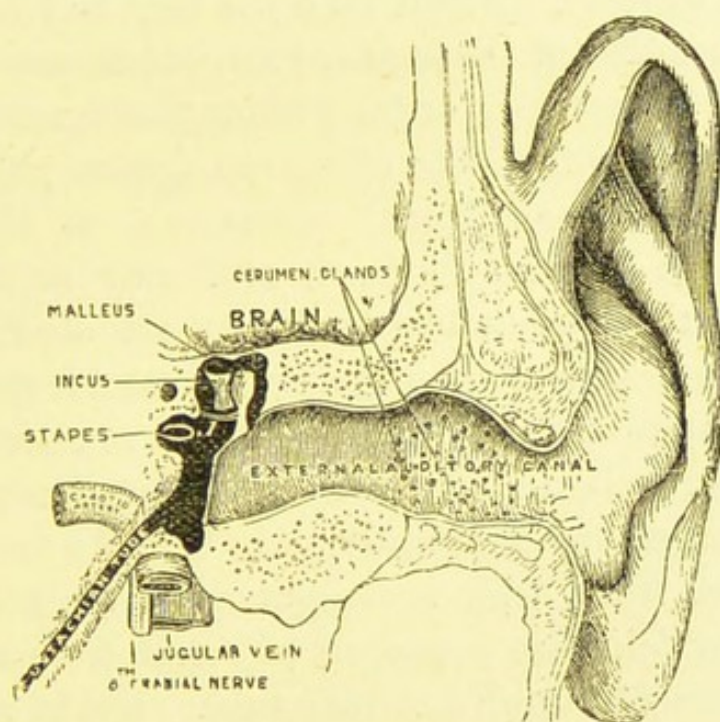
Dragged inwards by the hammer, the membrane is concave on the outer surface, and convex on the tympanic side. It is composed of three layers, of which the middle is the strongest, being made of radiating and other fibres. The outer layer is derived from the epidermis which lines the meatus throughout. Post-mortem soaking of the ear enables the dissector to remove the whole of the epidermis (including that from the membrane) like the finger of a glove. The other side of the membrane is covered by the delicate mucous membrane 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.

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 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.



TRANSVERSE SECTION OF THE EAR (LEFT SIDE).

The roof the tympanum is formed of an extremely thin layer of bone which separates it from the cranial cavity. From this descend delicate ligaments to suspend the two outer of the chain of ear bones (hammer

and anvil). So close to the tympanum are the brain and its membranes, that, as we shall have occasion to show hereafter, encephalitis not infrequently follows an abscess of the middle ear.

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

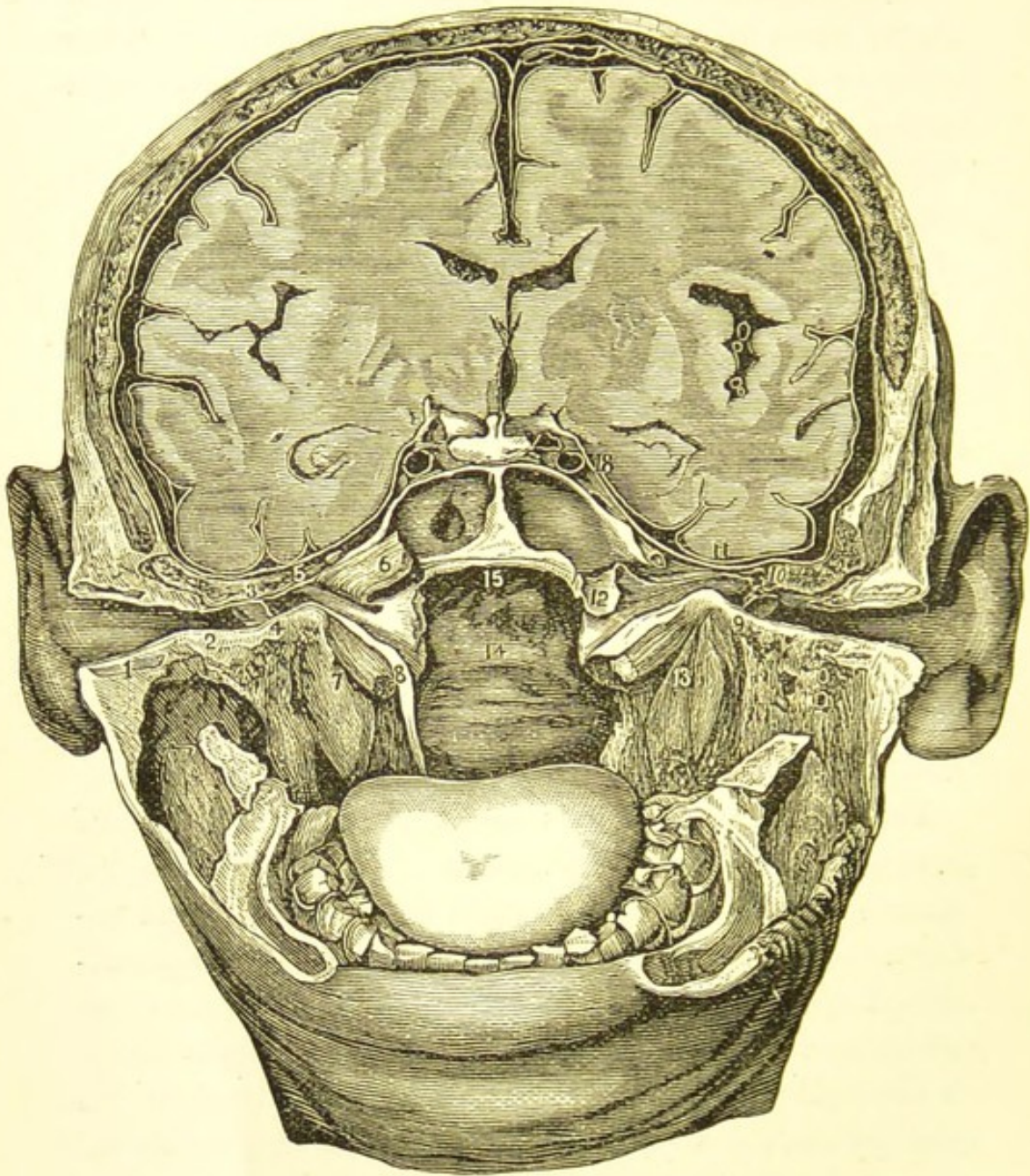
from that region of the scalp directly into the lateral sinus. It is well known that leeches applied behind the ear may give great relief in congestion or inflammation of the ear or of the brain.

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 EUSTACHIAN TUBE.

The Eustachian tube is about one inch and a half long, and runs from the junction of the squamous and petrous portions of the temporal bone forwards and inwards to the pharynx, where it ends by a wide, trumpet-shaped aperture on a level with, and just behind, the soft palate. The cartilaginous opening is easily found on the side of the pharynx, and above the level of the hard palate, 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 passes along the outer side of the internal carotid artery.

The figure on the following page, showing the head in oblique section, will serve to give an idea of the relations of the ear to neighbouring structures.



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.)

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

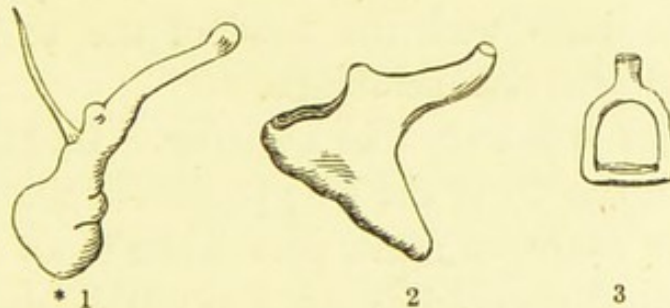
THE TYMPANIC OSSICLES.

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



MEMBRANA TYMPANI AS SEEN FROM THE INNER SIDE. (AFTER QUAIN.)

They are happily named, 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.



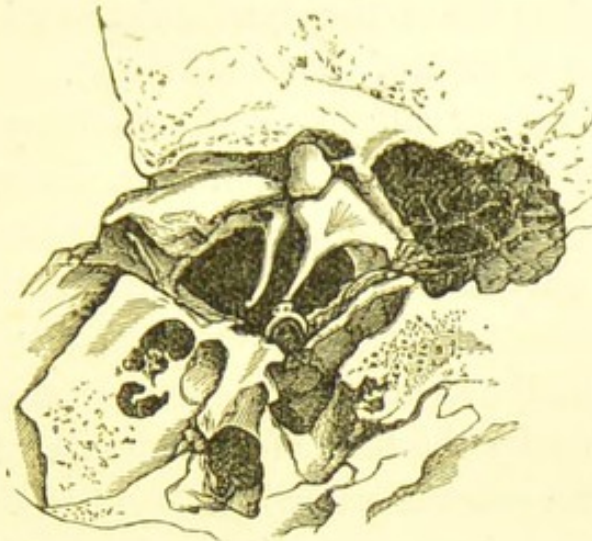
The hammer-bone (malleus) has a head, handle, and

* THE TYMPANIC OSSICLES :—(1) *Malleus*. (2) *Incus*. (3) *Stapes*. (Enlarged.)

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 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 the insertion of the laxator tympani, which is often described as a small muscle, but is probably a merely ligamentous band attached to the spine of the sphenoid bone.

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 lenticulare," 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 water of the internal ear, or labyrinth.



THE CHAIN OF OSSICLES SEEN FROM WITHIN THE TYMPANUM, FROM THE SPECIMEN FIGURED ON PAGE 6 (MAGNIFIED).

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

Wharton Jones admits only two muscles in connection with the tympanic ossicles, both tensors of the membrane,—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 last-named structure more convex. 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 compresses the fluid in the internal ear,

whilst it renders tense the tympanic membrane. 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 (secondary) membrane only.

It is by these two apertures that the waves of sound are 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 water 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 158). 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 anvil, and it is wrapped up in a fold of the mucous membrane of the middle ear. Leaving the gustatory nerve the chorda tympani afterwards ends in the submaxillary ganglion, and in one of the intrinsic muscles of the tongue (lingualis superior).

Of the blood-vessels of the tympanum but little need be said. The arteries 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 in other neighbouring vessels.

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 $\frac{1}{5}$ 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.

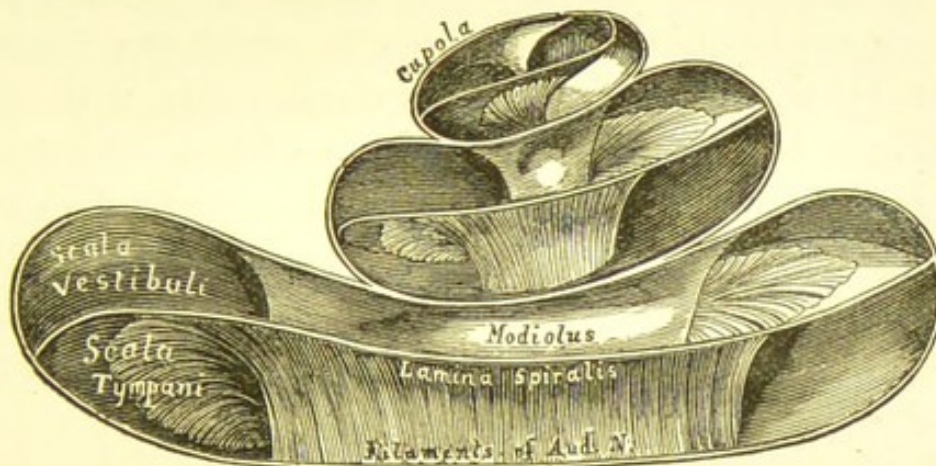
The semicircular canals, three in number, are hard-walled, osseous tubes, situated in the petrous bone. They are shaped like horse-shoes, and open by each end into the back of the vestibule. They are arranged at right angles to each other, just as the floor, the end, and the adjoining side of a box are 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 horse-shoe tubes 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. It is mostly empty, but is traversed by one or two bundles of connective tissue supporting blood-vessels. 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 LAID OPEN (ENLARGED).
(AFTER GRAY.)

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

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

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

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 (*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; *τρημα*, perforation).

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 semicircular 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 (*helicotrema*) 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 mem-

brane. 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.

A small channel leads out of the cochlea, and another out of the vestibule; but although they are called the "aqueducts" of these cavities their probable function is the transmission of slender blood-vessels.

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 sus-

pendent 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 otoliths, like those hair-cells which line the ampullæ, and enter into the formation of the organ of Corti, play almost a mechanical part in the physiology of hearing.

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, according to Ellis, 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 (Kölliker).

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 endolymph 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. It is fortunate, as Michael Foster remarks, that the membrane has not a fundamental note of its own, for this would be continually asserting itself with other sounds heard. By no means

all the vibrations which reach the auditory nerve are transmitted by the chain of bones: some pass directly across the middle ear, and reach the perilymph in the cochlea by means of the membrane blocking up the fenestra rotunda, whilst others may reach the sentient nerve twigs through the bony wall of the skull and of the labyrinth. These are probably received by the cochlea and ampullæ.

A glance at the arrangement of the tympanic ossicles shows how, when the tympanic membrane is thrown into vibration, the handle of the hammer moves with it, whilst its head, pressing upon the base of the anvil, directs the long process of the latter bone against the apex of the stirrup, the base of which rests on the membrane that assists in filling up the fenestra ovalis. So small are the bones and their joints, that pathological anatomy has not yet thrown much light upon their precise physiological office; but certain it is that the stirrup (stapes) is the most important element. The hammer (malleus) and the anvil (incus) have been torn out by the unskilled manipulator in his rough attempts to remove a foreign body from the external ear, and the sense of hearing has persisted. The purulent discharge of a tympanic abscess also may cause these two bones to be loosened and thrown out; but, if the stapes remains, hearing may still not be destroyed. If, however, the last-named bone becomes dislocated, deafness is inevitable, since the fluid of the internal ear drains away into the tympanum through the fenestra ovalis, leaving the delicate expansion of the auditory nerve as useless as a bucket in a dry well. The connection of the stapes with the margin of the fenestra ovalis is so firm, that though the malleus and incus may be loosened and even

discharged, still the oval foramen remains watertight. Chronic catarrh of the tympanum, as will be shown hereafter, may, by causing a thickening of the mucous membrane, prevent the oscillatory movement of the bones, and, the base of the stapes being fixed, permanent deafness results.

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 divided with 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.*, these 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*). 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 agitation 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.

The Eustachian tube is the canal by which the air in the middle ear is received 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

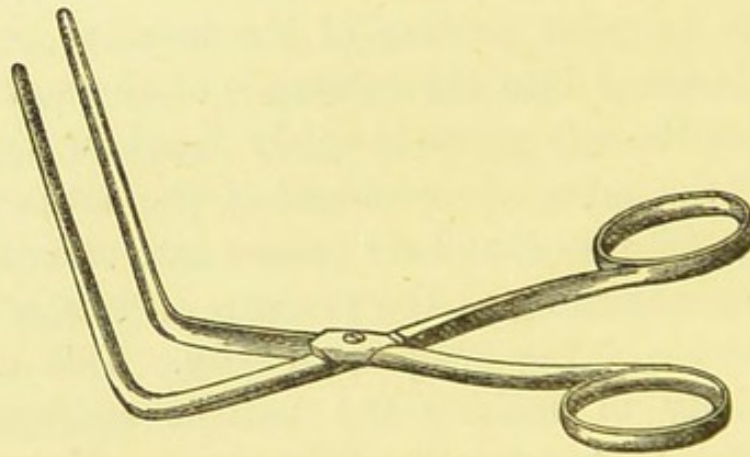
two sides of the tympanic membrane becomes so disturbed that the vibrations of the membrane are imperfectly performed. Another use for the tube is to drain off the mucus which would otherwise block up the middle ear. Lastly, the Eustachian tube plays a part analogous to that of the mastoid cells in allowing 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 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.* 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 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.

* See Dr. E. Fournié's paper read at the International Medical Congress, London, 1881, in the Section of Diseases of the Ear.

CHAPTER III.

EXAMINATION OF THE PATIENT.

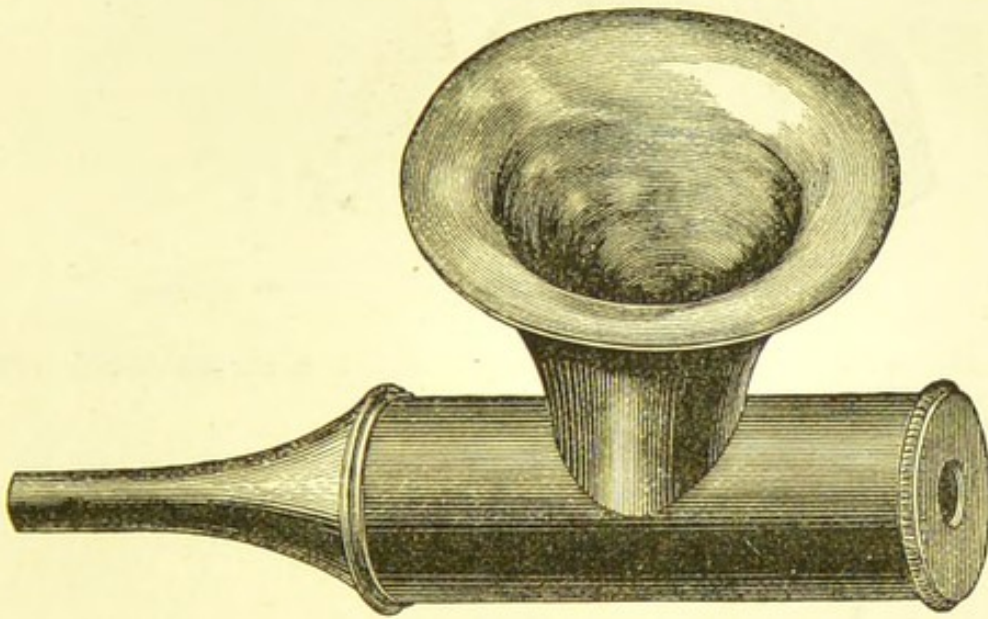
THE thorough examination of a patient with deafness is not quite such a simple process as it may at first sight appear;—a fact which is exemplified by the frequency of errors in diagnosis, and consequent want of success in treatment, on the part of those surgeons who have not commenced the work in the right way. It is well to remember that in the adult the external auditory meatus is larger in its vertical than in its horizontal diameter; whereas in children the reverse is the case. The ear speculum is an auxiliary of great value. 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.

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.



BRUNTON'S OTOSCOPE.

Brunton's instrument is perhaps the best for ordinary purposes. I have found it 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.



BRUNTON'S METHOD OF EXAMINING THE MEMBRANA TYMPANI.

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



SILVER SPECULUM, WITH SIZES OF TUBE.

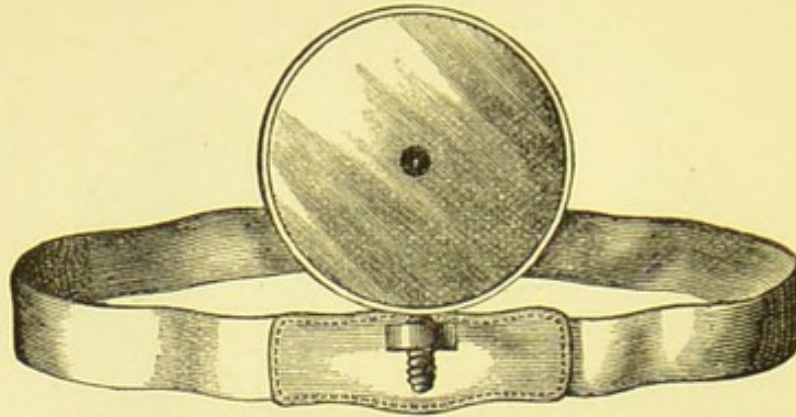
More elaborate instruments have lately been introduced, such as those suggested by Weber-Liel and Keene; and still further improvements, I think, we may anticipate from the use of the electric light.

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



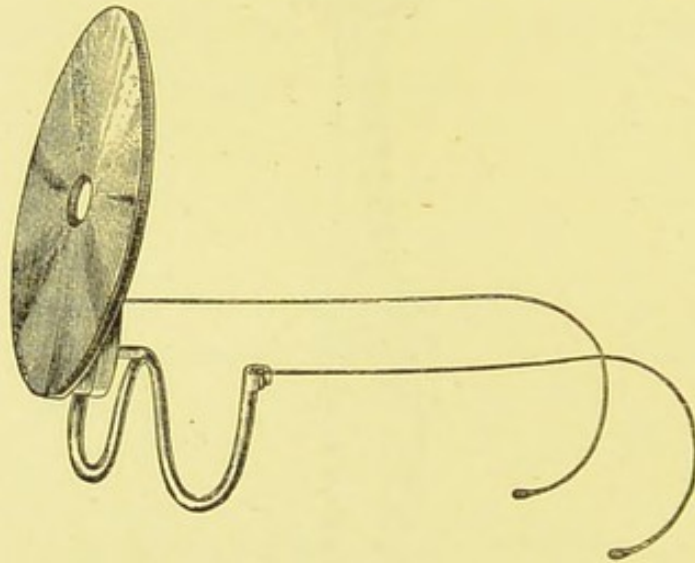
HAND MIRROR.

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.



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

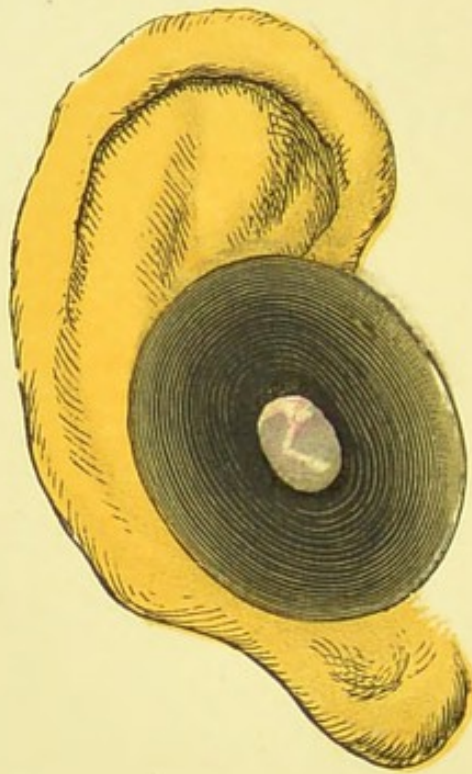


HEAD MIRROR.

head, it is certainly much cooler than any arrangement with an elastic band.*

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

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



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

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

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

By the use of the tuning-fork as a means of diagnosis we are enabled at once 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.

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. I cannot do better than quote Allen on this subject. He 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 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, 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."

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

* *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.

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

* *American Journal of Otology*, October 1879.

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 intralabyrinthine 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.

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

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 hearing, I proceed to diseases of the external auditory meatus.

* See *Brit. Med. Journ.*, Sept. 4, 1880, p. 390.

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 ℥i) 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. 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 Tröltzsch 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. Earpicks should be especially avoided, for severe injuries are often caused by these instruments, in the form of sharp metal probes, hair-pins, 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

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

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 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 the 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;

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

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.

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 ameliora-

* First described by Wrenden 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.

tion, 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. Instrumental interference is hardly ever necessary, and is often dangerous. Careful and 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

* 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 internal ear.

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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. 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.

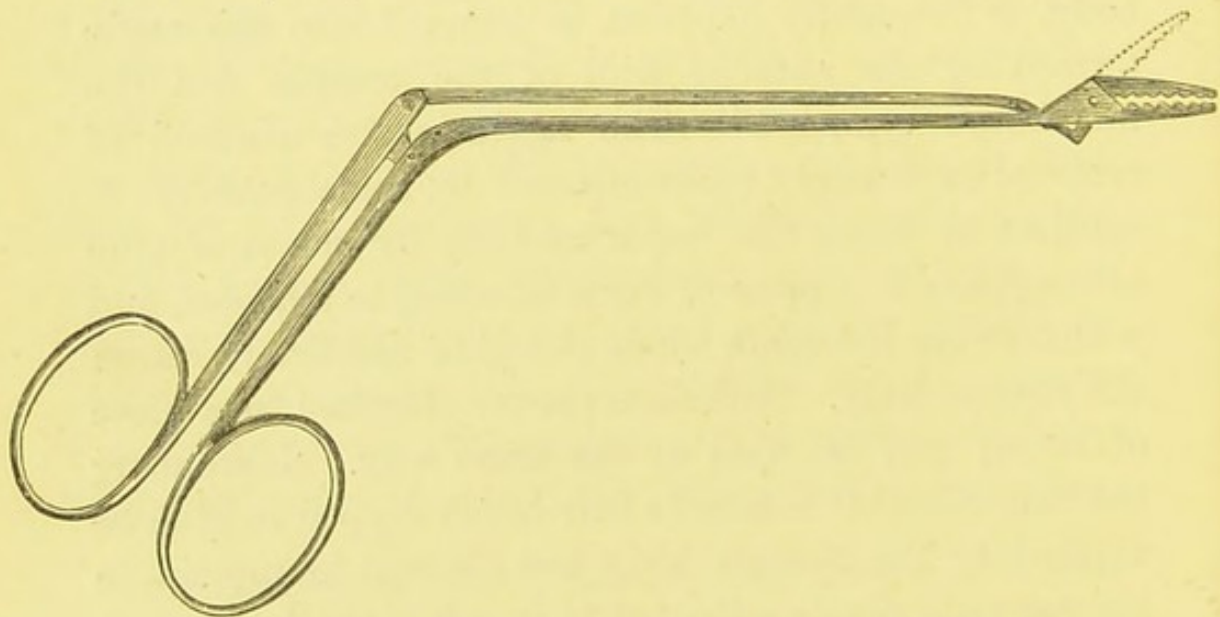
The foreign substances I have most frequently met

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 most substances, rather than use any force in attempting to remove them, by far the better plan is to let them remain in 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.



FORCEPS FOR REMOVAL OF FOREIGN BODIES FROM THE EAR.*

* Made by Weiss and Son, 62, Strand.



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:—

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

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 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 16th) 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.—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 4th. 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 substances appeared near the external end of the meatus; and I have never failed in procuring their ejection.

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



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 re-

“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.

moval 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 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 the bread assist to carry

it onwards, with comparative safety, at least, through the œsophagus. This treatment had the desired effect, 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 OR BOILS IN THE EXTERNAL AUDITORY CANAL are of frequent occurrence, and are generally met with in people of middle age. They are, as a rule, extremely painful. Some authors recommend pouring into the ear a strong solution of sulphate of zinc to induce their resolution, or the application of nitrate of silver. Poultices may be used, and are of great service if the surgeon finds intense suffering arising from a boil in the external meatus. In all other varieties of inflammation they lead only to increased suppuration, and probably to perforation of the membrana tympani. I have occasionally seen blisters behind the ear ordered; but these merely increase the irritation, and are of service only in certain cases of chronic discharge. In all acute forms of aural

disease they should be avoided. Glycerin poured into the ear will often be found useful for relieving pain in these cases.

Löwenberg considers* furuncle is due to the multiplication of a parasitic protophyte. He lances the boil, and then foment the part with an antiseptic, such as an aqueous solution of boracic acid. I have adopted his method with marked success; but I also, after lancing the boil, apply boracic acid in fine powder, on damp cotton-wool. I have found that the boracic acid may be readily reduced to fine powder by the addition to each drachm of about 10 drops of Sp. Vini Rect.

In January 1882, I was called in to see a lady suffering most intense pain from boils in the right ear. This had been poulticed for some time without any relief. I lanced the boil, and afterwards applied powdered boracic acid, with speedy and astonishing relief. The defective state in which I discovered the drains of her house was the probable cause of the patient having every now and then for some years suffered from furunculus in both ears.

Löwenberg has shown that the introduction of fungus into the auditory passages and its propagation there may be effected by the use of washes for the ear containing ingredients undergoing decomposition. Solutions of zinc salts and alum, especially if kept uncorked, are liable to be found crowded with spores, except where exposure to a high temperature, or the use of glycerin, carbolic acid, alcohol, or other antiseptic bodies has been resorted to. Löwenberg has hence suggested for the treatment of aspergillus the employment of alcohol diluted with its own volume of boiled

* *Le Progrès Médical*, August 20, 1881.

water. It is desirable, in fact, that any washes employed for aural affections should be from time to time heated, and that solutions of the alkaloids, to prevent the formation of fungi within them, should, if possible, be made with alcohol, and kept concentrated, and when used be diluted with boiled water; since the parchment-like masses of epithelium and fatty sebaceous matters met with in the ear, when mingled with the pus and various products of decomposition incident to chronic catarrhal states, afford a suitable nidus for the germination of various minute forms of cryptogamic life. Dr. Weber-Liel, Holz, and Orne Green,* with many more observers, have remarked the coincidence of aural furunculus, abscess in the meatus, and myringitis with epidemic, malarial, and other influences traceable to climatic conditions and defective drainage,† and, probably in some instances, to contagion. Thus, in May 1880, about the same time that Pasteur was pointing out proofs of the germ theory in the etiology of sundry diseases of common occurrence, Löwenberg noticed a mild epidemic of aural furunculus. Upon this subject bears the observation of M. Denucé that a local exciting cause, such as the handling of decomposing organic substances in rag manufactories and tanneries, may give rise to boils. Löwenberg insists on the great importance of distinguishing between an ordinary abscess and a furunculous gathering in the meatus. The channel in the latter disease is seldom found equally swollen throughout, but presents on its surface acutely sensitive points (Weber-Liel), to be succeeded by the distinct

* See also paper by the author, *Practitioner*, March 1881.

† For further information on this subject, see chap. xv, p. 243, "Value of Pain as a Symptom of Ear Disease."

arching of a boil. But, as it is well-nigh impossible by inspection to distinguish furuncle from abscess, Löwenberg believes that the only positive proof of the existence of the former is the reproduction by inoculation of what he holds to be a special form of microbe. Abscess, but not furuncle, he remarks, usually follows upon some abnormal condition of the meatus and drum-head or cavity.*

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 on insects, and the vapour of chloroform will kill maggots. According to Dr. Barr,‡ the latter "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

* See Dr. Macnaughton Jones, "Zymosis in Relation to Aural Therapeutics," *The Specialist*, Nov. 1881.

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

‡ *Glasgow Med. Journ.*, Dec. 1881.

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."

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 recognise the presence of earwigs.*

Of the vegetable FUNGI sometimes met with in the auditory passage, the *aspergillus*, according to Roosa, is the most common. Like inspissated cerumen, it produces 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 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*.

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

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

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 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. For certainty in diagnosis the microscope must be resorted to.*

CHRONIC INFLAMMATION OF THE EXTERNAL AUDITORY MEATUS often leads to narrowing of the passage until the introduction even of a probe is an impossibility. 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. A strong solution of nitrate of silver should be applied to the ulcerated surface by means of a very small probe and cotton-wool, at least twice a week.

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

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

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 4th 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.

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

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

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

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.

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

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 not infrequently 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 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,

* For an interesting case of molluscos tumour, see Dr. Kirk Duncanson, *Edin. Med. Journ.*, Nov. 1877.

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

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

and violent sneezing ; the ascent of high mountains, or a sudden descent in a diving-bell will also produce it. Other occasional causes are wounds of the internal carotid artery and injuries to the external meatus from polypi, abscesses, &c.

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

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

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.

Remarks.—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 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 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

* *Edin. Med. Journ.*, September 1866.

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

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.

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

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, three-quarters of an inch long, is very useful in these cases.

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

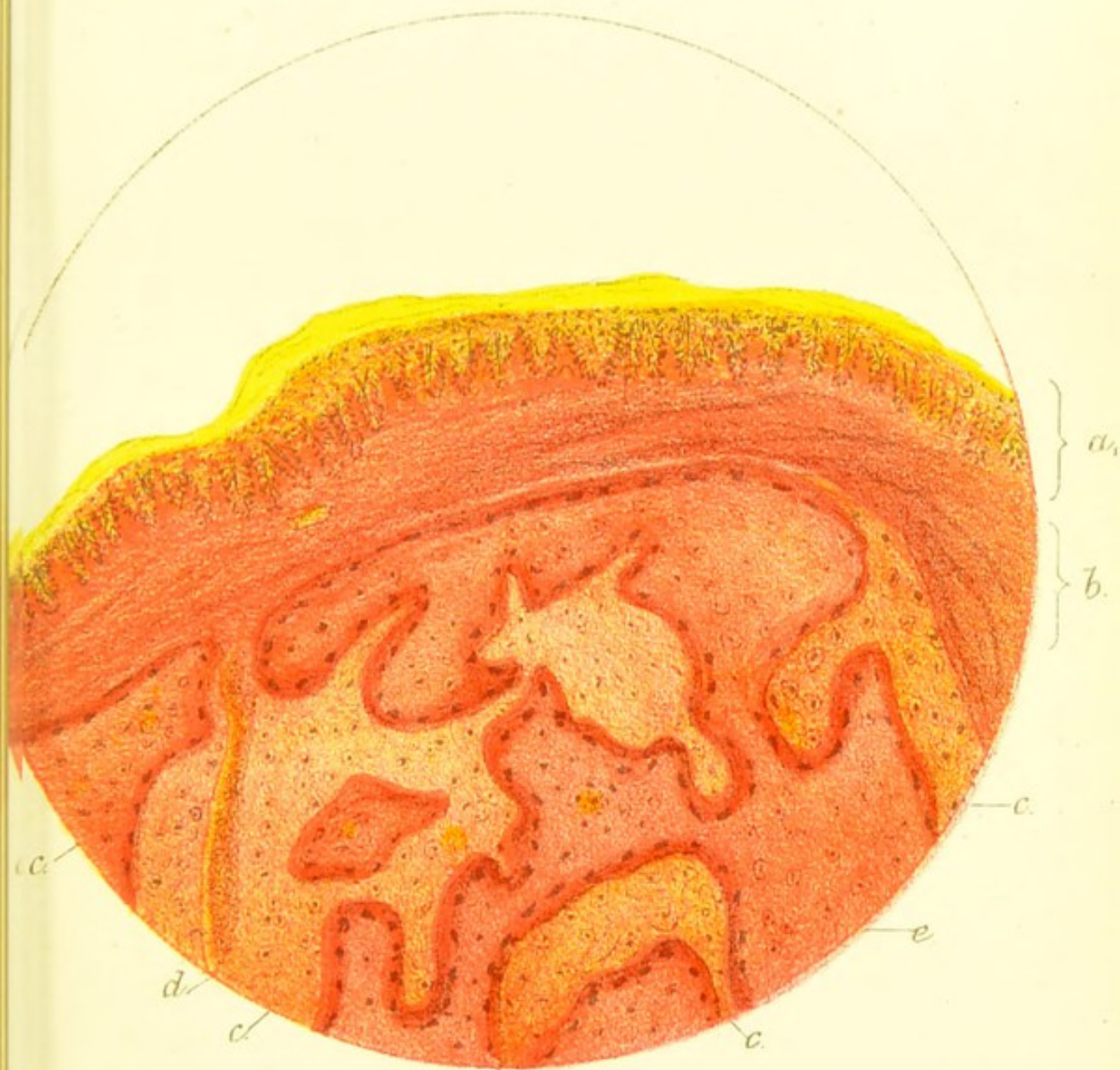
(1.) Varieties, mode of occurrence, and characteristics.—Kramer has described an interesting instance of a stalactitic form of polypus, so hard that a knife could not cut it.

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 trabeculæ 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 lamellæ were parallel to the surface, and contained but few bone corpuscles. In the central portion of the growth the trabeculæ 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



G.C.H.

× 180.

Section of a Spongy Aural Exostosis stained with picro-carmine, and nuclei tinted with aniline blue.

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

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 lamellæ, with intervening bone corpuscles, are arranged concentrically. 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 of the body would be called hyperostoses.

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.

In microscopical section the true ivory exostosis is seen to consist of extremely dense bone, covered by squamous epithelium 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. 86) 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 those 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.† It is a remarkable fact that all 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 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

* 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 almost amphibious,” *A Voyage in the Sunbeam*, by Mrs. Brassey.

osseous auditory meatus can give rise at that place to an osseous tumour.”*

(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. 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 New York,§ after stating with Rheinfleisch that these growths do not return when removed,

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

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

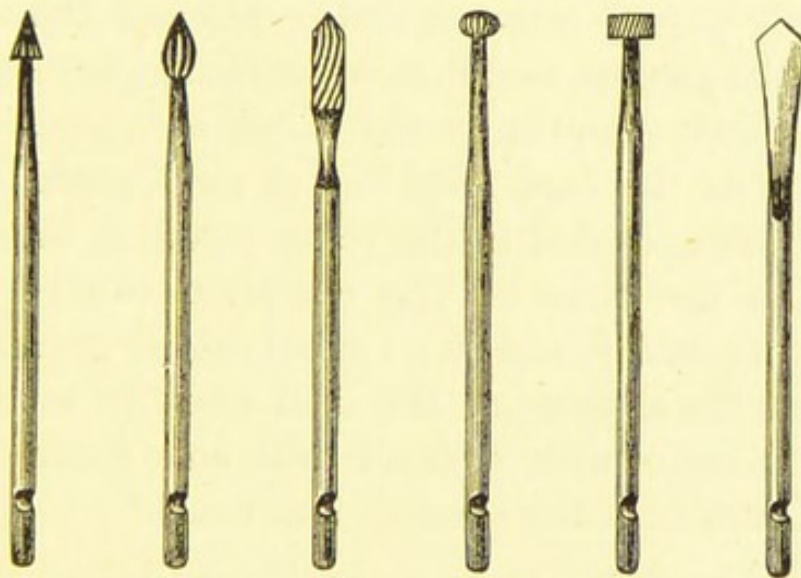
‡ *Lancet*, July 20, 1878.

§ *The Principles and Practice of Operative Surgery*.

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 petrous bone, is perhaps the only instrument capable of penetrating them.

This instrument can be used with comparative safety even on an awkwardly situated tumour, but the narrowness of the meatus and the close proximity of the brain and other important structures render the greatest



DRILLS OF VARIOUS SIZES USED FOR THE REMOVAL OF IVORY EXOSTOSES.

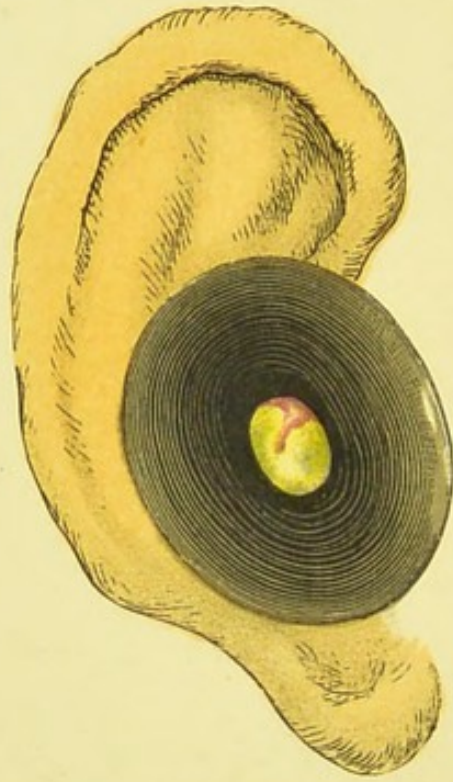
* Heinecke, of Erlangen, has successfully operated by gouge and mallet; but in his case there were granulations on the membrana tympani with suppuration.

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

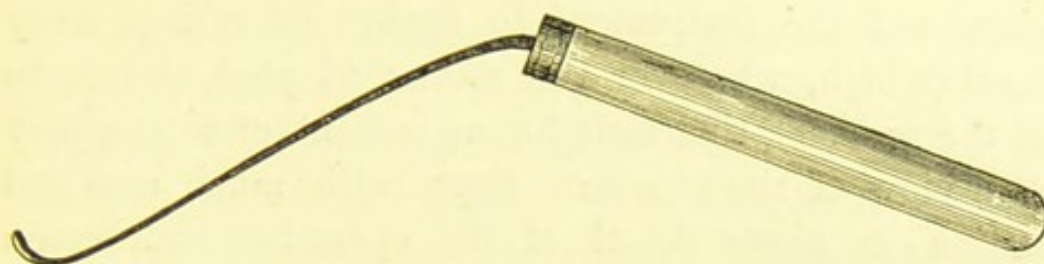
caution necessary. The operation of drilling is extremely difficult, and would require considerable time, even if the part to be pierced were less solid.

For the performance of the operation, the patient is placed on a high couch four feet from the ground, with his head so propped up on a pillow that the side to be operated on may be in a good light. The dental engine being adapted to a high chair, the drill would not reach anyone placed on an ordinary sofa. The handle of the drill or the holder might of course be made longer, to suit a low position of the patient, which, however, as it would involve constant stooping on the part of the operator, is undesirable. An anæsthetic having been administered, an assistant holds round the exostosis a steel guard constructed beforehand to fit it. The guard, as made for my first operation by Messrs. Weiss and Son, is first fashioned in very thin copper, so that it can be readily passed between the growth and the anterior wall of the meatus, and it must, of course, be bent so as to be exactly adapted to the shape of a right or left exostosis, as the case may be. A steel guard exactly corresponding to that in the softer metal is then made, which at the time of the operation can be readily placed in position, and in no small degree prevents any risk from the slipping of the drill when in motion. I generally begin with a small drill, and widen with a larger instrument the opening first made.*

* 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. 6th, 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



MUCO-PURULENT COLLECTION IN CAVITY OF TYMPANUM.



GUARD—SIDE VIEW.



FRONT VIEW.

In carrying out the operation, I have found three assistants necessary—one to give ether or chloroform, one to work the treadle of the engine, and one to hold the steel guard in the ear. Help is desirable also for sponging and syringing away with cold water the blood which with great persistency fills up the meatus.

I have not found it requisite to cut through the skin before using the drill. I proceed at once to make a small hole by the side of the steel guard, avoiding the base of the tumour, since, there being nothing to indicate the exact direction in which the drill is going, a slip might be attended with the utmost danger to the patient's life. Even if the operator succeeds in making a way through the base of the growth, he may find himself dealing with very unexpected and unenviable conditions. With the steel guard firmly fixed in place, I have found it best to work very slowly, constantly

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."

taking out the instrument to sponge or syringe away blood (which, whatever the means adopted, is sure to fill the meatus), that thus for an instant or so one may get a view of the tumour. Even with much care and caution in every detail of the operation, unforeseen *contretemps* may arise.

The following are cases of the removal of ivory exostoses by means of the drill:—

G. M., a medical man, æt. 32, strong and healthy, when a lad at school, suffered from pains in the right ear, followed by slight deafness, from which, after consulting the late Sir William Wilde, of Dublin, he in a short time recovered perfectly. In September 1877, after bathing in the sea, he again became deaf in the right ear, and as there was some swelling visible in the meatus he took iodide of potassium, while leeches were applied, together with counter-irritation, behind the ear. On September 25th leeches were again applied. On October 1st the left ear became somewhat similarly affected.

On October 4th he came to London and placed himself under my care. The swelling in both ears looked exactly like a deep-seated boil, and the hearing remained remarkably good, considering that only a very narrow passage was left for the conduction of sound. After some days an incision was made in the swelling, the knife coming in contact with an extremely hard bony growth. There had been very little redness and no pain until the tumour pressed against the opposite wall of the meatus, when slight inflammatory action ensued, followed by severe deafness. A watch was now audible only in contact. The patient suffered from great depression of spirits, due in no small degree to his

knowledge of the characteristic extreme density of aural exostoses, but chiefly to the fact that, being unable, owing to the complete closure of each meatus, to join in conversation, he felt himself shut out from all society.

I may here mention that this case presented exactly similar features in almost every respect to that which immediately follows. In each there was no history of hereditary predisposition, or of gout or syphilis. There was a most distressing feeling of fulness and pressure in the ears, together with tinnitus aurium, but no pain. The tumours filled up both ears;—arose from the posterior wall of the meatus;—were adamantine outgrowths of the petrous bone, like ivory in consistence; and extended from about a quarter of an inch from the orifice to within a short distance of the tympanic membrane.

On October 11th my colleague, Mr. A. T. Norton, saw the case, and agreed with me that operation for the removal of both exostoses should not be delayed. Accordingly, on October 13th, the patient having been placed under chloroform, I proceeded to drill through the growth in the right ear, using an American dental engine kindly lent by Mr. Sewill. The previously prepared steel guard, introduced to obviate accidents, was found to answer its purpose admirably. After an hour and three quarters of steady work, I succeeded in drilling through the greater part of the growth. The operation was rendered difficult not only by the extreme density, but by the deep situation of the tumour, and by the persistent choking up of the meatus with blood. After the operation the patient for two days suffered terribly from sickness caused by the chloroform, but otherwise went on well.

On the 28th I drilled completely through the exostosis of the right ear, so enlarging the opening in it. On the 29th there was much sickness.

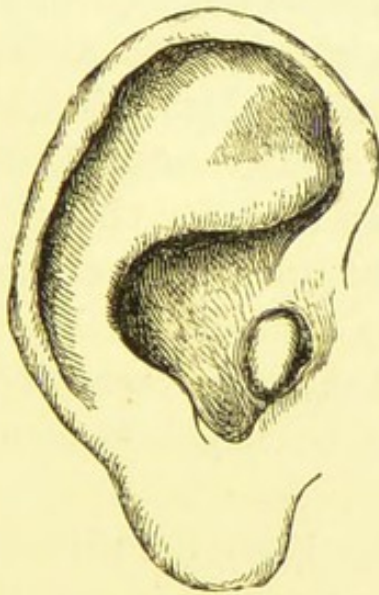
On November 11th I operated on the left ear, where the exostosis, being larger, was worse for removal than the other. As on the first occasion, the patient suffered for two days from sickness.

On December 2nd I repeated the operation in the left ear with a larger drill. During this, as in each succeeding operation, the patient took ether, and consequently, although more than an hour under its influence, he experienced not the slightest subsequent sickness.

A large opening was made, and for ten minutes or so after the operation he was able to hear perfectly well. Two or three days later violent inflammation, unfortunately, was set up in the membrana tympani, which became perforated. Six leeches were applied in front of the tragus, followed the day after by four more. The ear was constantly washed out with a weak carbolic acid solution, and the perforation after two or three days completely closed.

On January 13th the passages of both ears were blocked up by red granulations; these were removed, and afterwards red oxide of mercury was applied, and strong solution of nitrate of silver. These applications gave such intense pain that they had to be discontinued. Tannic acid was then substituted for some considerable time. There was a profuse discharge of thick pus, which completely prevented hearing. This gradually subsided, and he was soon able to hear perfectly well by day, though at night again deaf from collection of pus in the meatus. When the discharge at length ceased, his hearing

became perfectly normal, and it remained so in both ears when, four years after the operation, he was seen by me. In the treatment of this case I was favoured at different times with the valuable advice of Sir James Paget, Mr. Dalby, and Mr. Thomas Smith; and during the operations I had the advantage of assistance from my colleagues Mr. Norton and Mr. Edmund Owen, and also from Dr. W. Mackesy, of Waterford. The successful termination of the case I must ascribe chiefly to the courage with which the patient time after time (he was seven hours in all under chloroform and ether) submitted to be operated on.



IVORY EXOSTOSIS (HYPEROSTOSIS) ARISING FROM POSTERIOR WALL.

A. S., æt. 31, a gentleman in good health, came, December 14, 1879, by the advice of Dr. Symes Thompson, to consult me for severe deafness, attributable to a compact growth of bone in both ears. He ascribed his deafness to sea-bathing, and stated that occasionally in hot climates he "almost lived in the water." For as long as he could remember he had from time to time suffered from earache. In 1866, when a midshipman

in the Royal Navy, he first observed that he was becoming deaf, and began to suffer increasing pain in the ears; but he did not remember ever having any aural discharge. In 1870 he came home from China and consulted various medical men for his deafness, whose general opinion seemed to be that he would "grow out of it." Year after year his hearing gradually became worse, till at length his "ears almost closed up," and thinking nothing could be done for them, he was compelled to retire from Her Majesty's service. I found the external auditory meatus in each ear closed by a large ivory exostosis, arising, as above stated, from its posterior wall. He heard the watch only when in contact with the right ear, and about two inches from the left. My colleague, Mr. Edmund Owen, who saw the case with me on December 17th, was at one with me in thinking that the only chance of a fair recovery of hearing depended upon an operation for the removal of a portion of the bone. This Mr. S. postponed for a month, in order that, as he expressed it, "in case anything went wrong, he might have a merry Christmas first."

On January 29th, 1880, the patient was placed under chloroform, and I proceeded to drill through the growth in the right ear. After fifty minutes' steady work I succeeded in getting a fine drill through the growth. On February 11th I enlarged the opening already made, the patient being forty-five minutes under chloroform. On March 2nd I operated for fifty-five minutes on the left ear in a similar way. For this ear I found two subsequent operations necessary, one on March 24th, and one on April 17th, lasting forty minutes and half-an-hour respectively.

I have above stated that I consider the help of several assistants necessary for the proper conduct of the drilling: an accident occurred to impress this on my memory. In the last operation on the left ear one assistant was absent, and I had in consequence both to hold the guard and work the drill. Unfortunately, somehow or other, the guard slipped, and I injured the membrana tympani, and set up slight facial paralysis. This facial paralysis, what did it mean? I at first thought I had touched the chorda tympani nerve, which is a branch of the facial, and winds forwards above the tendon of the tensor tympani, and between the malleus and incus, escapes through the Glasserian fissure, and descends to unite with the gustatory nerve, and terminate in the tongue. One or two cases have been related, it is said, where irritation of the chorda tympani caused facial paralysis. It seems to me that had I touched the chorda tympani the tongue alone would have been affected, and not the muscles of the face. In my patient the mouth after the operation was drawn slightly over to the unaffected side—an almost infallible sign of injury to the facial nerve. He himself confirmed the diagnosis by saying next day, "What I complain of most, doctor, is that I can't whistle." I felt sure that when the guard slipped I must have touched the inner wall of the tympanum, and, injuring the aqueduct of Fallopius which covers the facial nerve, have wounded or slightly grazed the latter, notwithstanding that I was working with the greatest care, proceeding very slowly and holding the drill so firmly that I thought it impossible I could go wrong. The swerving of the drill by an eighth of an inch only had been sufficient to pierce the membrana tympani and

touch the opposite wall. Luckily, I had great power over the instrument, though my arms ached from the constant and strong grip required for steadily holding it.

As has frequently been remarked, accidents, however careful a surgeon may be, must occasionally take place; but he may render them not unproductive of good if, by unhesitatingly putting them on record, he warn others against their recurrence.

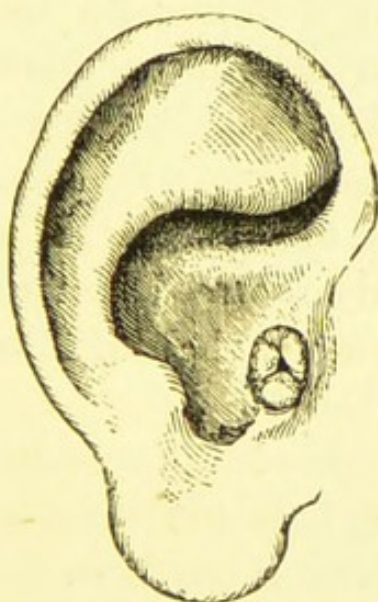
I am happy to say that, by the help of galvanism and careful treatment, the patient recovered from the effects of the paralysis, and, the perforation in the membrana tympani having closed, he did remarkably well, and regained his hearing in both ears.*

In April 1881, Mr. H., who for years had been in the habit of bathing daily in the sea, came to me with a large exostosis filling up his left external auditory meatus. The existence of this growth had been discovered by Dr. M., of Waterford (my first case), who had suggested that I should be consulted. Some time previous to its formation the patient had, in consequence of an accident, lost all use of his right ear, so that he was now very deaf. Mr. Dalby, to whom I took him, was of my opinion,—that an operation for the removal of the tumour would afford him the only chance of regaining his hearing. Accordingly, on April 27th, the patient having received ether, I operated, as in the cases above mentioned, with the dental engine, Dr.

* In a case of division of the chorda tympani together with the posterior fold of the membrana tympani, Dr. Oscar Wolf observed at the tip of the tongue complete loss of taste, with insensibility to tactile and thermal excitation over a triangular area, the hypotenuse of which was formed by the edge, and the longest side, measuring 2 centimetres, by the middle line of the tongue.—*Archives of Otol.*, Dec. 1880.

Sherfy of New York and Messrs. Dalby and M. Morris being present. For some little time the drilling was delayed by the breaking of the steel guard in the ear, where it was so firmly and deeply wedged that its extraction was a matter of considerable difficulty. Fortunately, I had with me an iron guard; and with the help of this I was able for the day to complete the operation, which was finally concluded on the 4th of May. The patient subsequently regained his hearing, though at first (as I have found in other cases) some troublesome granulations retarded recovery.

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 EXOSTOSES.

Multiple ivory exostoses do not, as a rule, cause a great amount of deafness. They are smaller and nearer

* Særtryk af *Hospitals-Titende*, Nr. 2, 1879.

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 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 in both ears of long standing, caused by a 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 of Cork.

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. The following are, I believe, instances in point.

Miss H——, æt. 24, in good health, with no history of any kind of deafness in her family, was sent to consult me on June 1st, 1880, by Dr. Gibson, of Hull.

A hard bony growth, which looked something like a small snail-shell, almost filled up the orifice of the right external auditory meatus. She could hear the watch at one inch, and the tuning-fork much better, with the deaf ear. She would not allow a thorough examination to be made, as she suffered great pain when the growth was touched. With the gradual increase of the tumour her deafness had been constantly intensified. On June 2nd, having placed the patient under chloroform, I proceeded to make an examination. With the aid of a probe I found that the tumour was of soft bone, and arose from the anterior wall (where it is said to be very rare), and near the orifice of the meatus, which it all but filled up. I then proceeded to use the dental



OSSEOUS TUMOUR ARISING FROM ANTERIOR WALL.

engine, making a small hole in the base of the tumour, close up to the anterior wall. I next seized it with a strong pair of dressing forceps, and with little difficulty took it completely away. The whole operation lasted about fifteen minutes. In ten days' time the patient returned home, hearing perfectly well.

Miss M., æt. 19, sent to me by Dr. McMunn, after deafness for a considerable time, had felt a hard substance in her ear, resembling a tooth. She was so deaf that a watch was inaudible except when pressed closely to the external meatus. On September 20th, 1881, having placed her under chloroform, I found, attached to the posterior wall of the meatus by a small pedicle, a growth which was not movable on pressure. I broke it away with a pair of dentists' upper jaw stump-forceps. A second growth, united by a slender pedicle to the anterior wall,* was then removed by the same means, and the patient regained her hearing. In this case I found the dental forceps preferable to wire, with which I had previously removed some bony excrescences.

J. F., a girl, æt. 18, who came to the hospital March 20, 1882, had four weeks previously, after gradual loss of hearing during 18 months, suddenly become very deaf in the left ear. There was no history of gout or syphilis in her family. On examination, the external auditory meatus was found occluded by a large deeply-seated outgrowth of soft bone, firmly attached by an exceedingly broad base to its posterior wall, and painless when touched by a probe. On March 27th, the patient was placed under chloroform, and, all attempts either to reach it with stump-forceps or to cut it away by *écraseur* having failed, an elevator, such as is used by dentists, was carefully applied, with the effect of

* Some authors state that exostoses are movable on pressure, even when complete ossification has taken place, and always have their point of attachment on the posterior wall of the meatus. This view is not corroborated by my experience in the above case, or in that of Miss H. (see p. 86).

severing it from its attachment. It was then seized with a pair of dressing forceps, and easily brought away. Notwithstanding its large size, it weighed only 8 grains. In shape it resembled a tooth, and one might at first sight, from its appearance, have judged it to be a hard ivory exostosis; but, as I have explained, such a growth, on account of its extreme compactness, could not have been removed satisfactorily except by the dental engine.

In section the exostosis presented the microscopical appearances described on page 71.

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 advisable in the drilling always to use, to pass behind the tumour, and thus lessen the risk of an accident, a metal guard, which should be of such a nature 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.); others are pedunculated, and 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.

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

† *Lancet*, July 20, 1878.

CHAPTER VI.

DISEASES OF THE AURICLE.

MALFORMATIONS of the auricle will sometimes occlude the auditory canal, but 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.

When dealing with malformations about the auricle, it is all-important that we should bear in mind some points about the development of the ear. The embryonic auditory follicle or "pit" is situated just behind a point from which the six branchial arches and five corresponding branchial clefts radiate. But the ear itself comes more especially into relation with two of these, namely, the third and fourth of the series, or what are known as the first and second post-oral arches. From the posterior extremity of the first post-oral or mandibular arch the *malleus* is developed, and from the same part of the second post-oral or hyoid arch come the *incus* and *stapes*. The auditory pit which forms the rudiment of the labyrinth of the ear is situated immediately behind the posterior extremity of the fissure between these two arches, this fissure being

known as the first post-oral cleft. The posterior or upper part of this cleft remains permanent during life ; it forms the external auditory meatus, the tympanic cavity, and the Eustachian tube. In the process of development a septum has grown up between the external meatus and the tympanic cavity, in the form of the tympanic bone and membrane.

The pinna becomes gradually developed from the epiblast, as a ridge of dermal tissue on the posterior margin of this first post-oral cleft.

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.

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 recognise. 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 recognised. It appears probable that, during the closure of these clefts, it occasionally happens that a small fold of dermoid tissue is nipped in: the skin and subcutaneous tissues are stretched above it, but the little included sac proceeds to develop on its own account, giving rise to one of those peculiar tumours known as dermoid cysts. 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 recognised 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 recognised 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 recognised by their epithelial lining and characteristic contents,

* *Archiv. Gén. de Méd.*, 1855, 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.

which may include fragments of tooth, hair, and cholesterol crystals.

WARTS occasionally grow on the auricle. Macnaughton Jones recommends, to prevent their recurrence, ligature, and treatment with acid nitrate of mercury.*

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, and three weeks afterwards the patient was well, and there was no sign of the growth.

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 37 cases of gouty diathesis examined, found them to be present in 16.

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 pro-

* *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.

duce aural disease, but Sir William Wilde has described a kind of congestive redness of the auricle, which he attributes to the gouty diathesis.

OTHÆMATOMATA, or blood tumours of the auricle, may be divided into two classes:—

1. Traumatic, the result of violence, as from a severe blow on the ear.

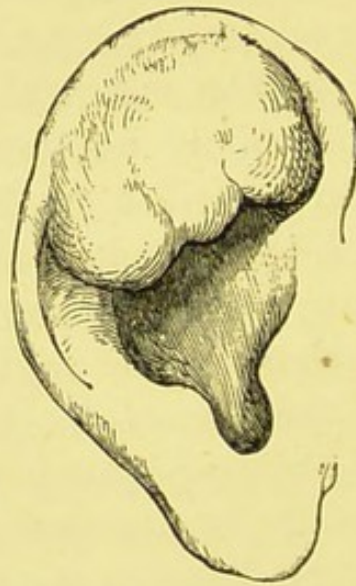
2. Idiopathic, found mostly in the insane, and arising from a diseased condition of the brain. These tumours often attain a large size, and are caused by effusion of blood between the cartilage of the ear and the perichondrium, and are situated on the anterior, or concave, portion of the auricle. Most writers deny the possibility of the existence of the idiopathic form in the sane. I once, however, saw a large example of it at St. Mary's Hospital in the left ear of a Forester, who most emphatically denied ever having met with an injury to his ear, and who was certainly not insane. Other such instances have been described by Grüber and Roosa. Dr. Savage, of Bethlem Hospital, states that he has never seen an insane person recover who has had this hæmatoma. That the mischief in these cases is the result of disease of the base of the brain is proved by the experiments of Brown-Séguard, who produced an othæmatoma artificially in a guinea-pig, by irritation applied to the restiform body on the side corresponding to that of the tumour.* The following is a typical case:—

K. E., a single woman, æt. 34, came to consult me, August 11, 1881, with a "blood tumour" on the left auricle. She stated that she first noticed the growth

* Burnett, *A Treatise on the Ear*, p. 251.

three months previously, when it felt about as big as a pea. It had gradually increased in size, until it spread over the whole of the upper portion of the ear. Her hearing was not affected. She complained of 'a loud noise, which kept time with the beat of the pulse, and never stopped.' She occasionally suffered from pain in the tumour. Two relatives on her father's side had died insane. She did not derive any benefit from treatment.

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 paresis and insanity associated with epilepsy."



OTHÆMATOMA.

Treatment.—Application of evaporating lotions, puncture of the tumour, massage, and various other kinds of treatment have been suggested, but from none have I ever seen any good results.

* *Aural Surgery*, p. 152.

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

In a case related by Mr. 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."†

Sir James Paget and others have described a form of fibrous tumours 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

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

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

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.

Chimney sweep's cancer of the external ear, according to Wilde, has no special characteristic, except that of presenting large quantities of pigment.

INJURIES TO THE AURICLE, are, as a rule, easily treated, and generally, as in the following case, do well.

J. G., a boy, æt. 8, brought to the Manvers Ward, St. Mary's Hospital, had the right ear almost torn off by a fall on some gravel. I carefully secured it with 16 sutures, and in a month's time he left the hospital with hardly any trace of the injury.

Ear-rings occasionally cause scrofulous cicatrices in the lobule. Dr. Constantine Paul teaches that all those females are scrofulous in whom the result of piercing the ear-lobe is the formation of a slit-like aperture or a linear cicatrix, instead of a round orifice.† He advises against the practice of piercing the ears in scrofulous subjects, except where it is done as a derivative for scrofulous ophthalmia, in which instance the ear-rings may be regarded as setons inserted into the lobules for therapeutic purposes.‡

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

† *L'Union Med.*, Feb. 1881, p. 337, *et seq.*

‡ See Dr. Cresswell Baber, *London Med. Record*, Dec. 15, 1881.

Prof. F. Treves states* that the, in London at least, rare examples of the peculiarities in question that he has met with were, with one exception, in scrofulous subjects; but he thinks that previous to the acceptance of the assertion of Dr. Paul, it should be shown why, if these peculiarities are due to general tissue defects, there was, in about 34 per cent. of the cases given by that author, affection of one ear alone, and why in 18 instances there was no trace of scrofula. He further suggests that there may be a connection between the lesion and the weight of the ear-rings and the metal composing them.

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 characterised 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, and is produced originally by chronic dis-

* *Scrofula and its Gland Diseases*, p. 97, Lond., 1882.

charge 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., Vaseline ʒj. 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 ℥viii. of water.

Porriigo 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, moreover, 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 porriigo. She was ordered a bread poultice, a carbolic acid lotion, ℥j. 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 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

* R Hydrargyri Bisulphureti (not official).
Hydrargyri Oxidi Rubri, āā gr. vj.
Creasoti ℥ ij.
Adipis ʒj.

Misce.

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 mucous membrane of the meatus is in some instances of pruritus dry, but in others 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 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 serum 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.

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 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 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. viii., 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.

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

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

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 4th 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, yet the hearing was good.

This case illustrates how a local disease may resist all ordinary treatment until, its nature being recognised, antisyphilitic 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.

With respect to the employment of mercury in some severe forms of secondary syphilis, my colleague, Mr. James Lane, says* :—"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., &c., &c.

Von Tröltzsch 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 Tröltzsch'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

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

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 :—†

"Aural catarrh must not therefore be considered as [the designation of] an affection in which the mucous membrane of the cavity of the tympanum and Eustachian tube is solely involved, but it is also applied to catarrhal inflammation of those structures which are lined with a continuation of the mucous membrane of the tympanum, as well as to certain forms of diffuse inflammation of the dermoid layer of the meatus. Some writers restrict the term catarrhal inflammation to mucous membrane only. There are, however, high authorities who do include it under inflammatory conditions of the external walls of the meatus. I find it convenient to designate this very frequent disorder in childhood as catarrhal, because we cannot distinguish whether the inflammation from catching cold may not have begun in the tympanic structures on the inner side of the drum-head, and then passed onwards and outwards, by continuity of surface, to the meatus. We may, therefore, I think, quite as correctly name this condition catarrhal or dermoid. If the inflammation from within or without stopped at the margin of the membrana tympani, we ought to define the affection as belonging either to one or the other structure; but, as we cannot be so acute in our diagnosis as to be able to detect the moment when it ceases to advance, either on

* Vol. 3, p. 166.

† *On Aural Catarrh*, p. 24.

the inside or the outside, any sharply restricted definitions are in practice useless."

From these different opinions it may be seen how difficult it is to define clearly any one of the forms of aural catarrh; and in practice they are constantly found combined in various ways one with another. While speaking clinically, I shall endeavour to follow as closely as possible the following classification of the phases of the disease:—

1. (a) Acute catarrhal inflammation, and (b) Acute suppurative inflammation of the middle ear.
2. Sub-acute and chronic catarrhal inflammation,
3. Chronic non-suppurative inflammation.
4. Chronic suppurative inflammation, and the various forms of otorrhœa.
5. The results of suppurative inflammation.

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 dermoid meatus, and must therefore be treated in such and such a way." In fact, we must not treat the disease, but simply the symptoms which each individual case presents to us.

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.

The treatment I recommend is by pouring, not syringing, frequently to foment the external meatus with warm water. This, as a rule, gives speedy relief, and the child will go to sleep. Mild purgatives should also be administered. Perhaps a leech 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, 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.

CONVULSIONS.—Dr. Hughlings Jackson says that "in all cases in which there is or has been discharge from the ear, especially when there is also pain in many branches of the fifth nerve; above all, if palsy of the portio dura nerve comes on, we should fear one of two

things: (1) cerebral or cerebellar abscess, or (2) meningitis. We must not decide unless there are general symptoms also, *e.g.*, increase of temperature, constipation, vomiting, and stupor, for discharge from the ear is not infrequently attended by chronic convulsions, occurring at intervals for years (epilepsy); and the fit we are consulted for may be the first of such a series."*

In all forms of acute catarrh the tympanic membrane (as one would expect from increased vascularity) is found to be either pink, red, or copper-coloured, according to the stage or severity of the attack. Children when they grow out of infancy suffer from earache arising from chronic inflammation of the external meatus. This I shall notice on another occasion.

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 Aug. 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

* Reynolds, *System of Medicine*, 2nd ed., vol. 2, p. 266.

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 Tröltzsch 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,

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

the use of 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 Tröltzsch calls it,† simple acute catarrh of the ear, is characterised 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 character. This state is generally associated with influenza, 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 Tröltzsch 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

* 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.

mucous membrane in the Eustachian tube and the tympanum to remain separated from one another."

I shall fully discuss paracentesis of the membrana tympani when I speak of chronic non-suppurative inflammation.

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.

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 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, 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

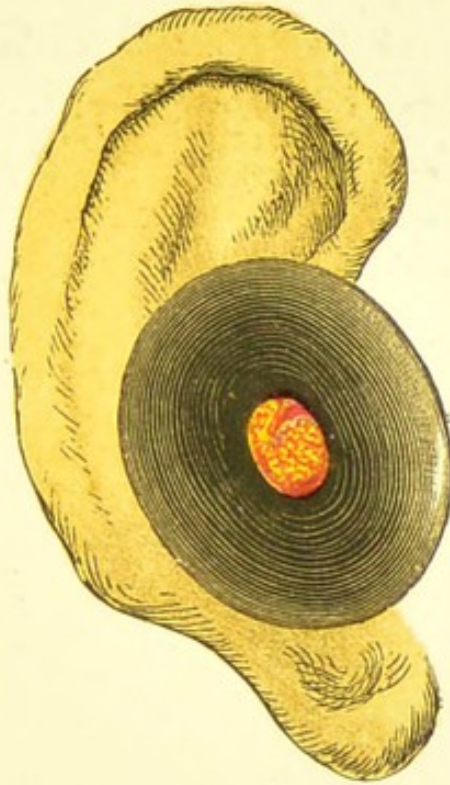
leeches gave immediate relief; the membrane recovered from its highly vascular state; the slight discharge ceased; and in ten days' time he was perfectly well.

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.

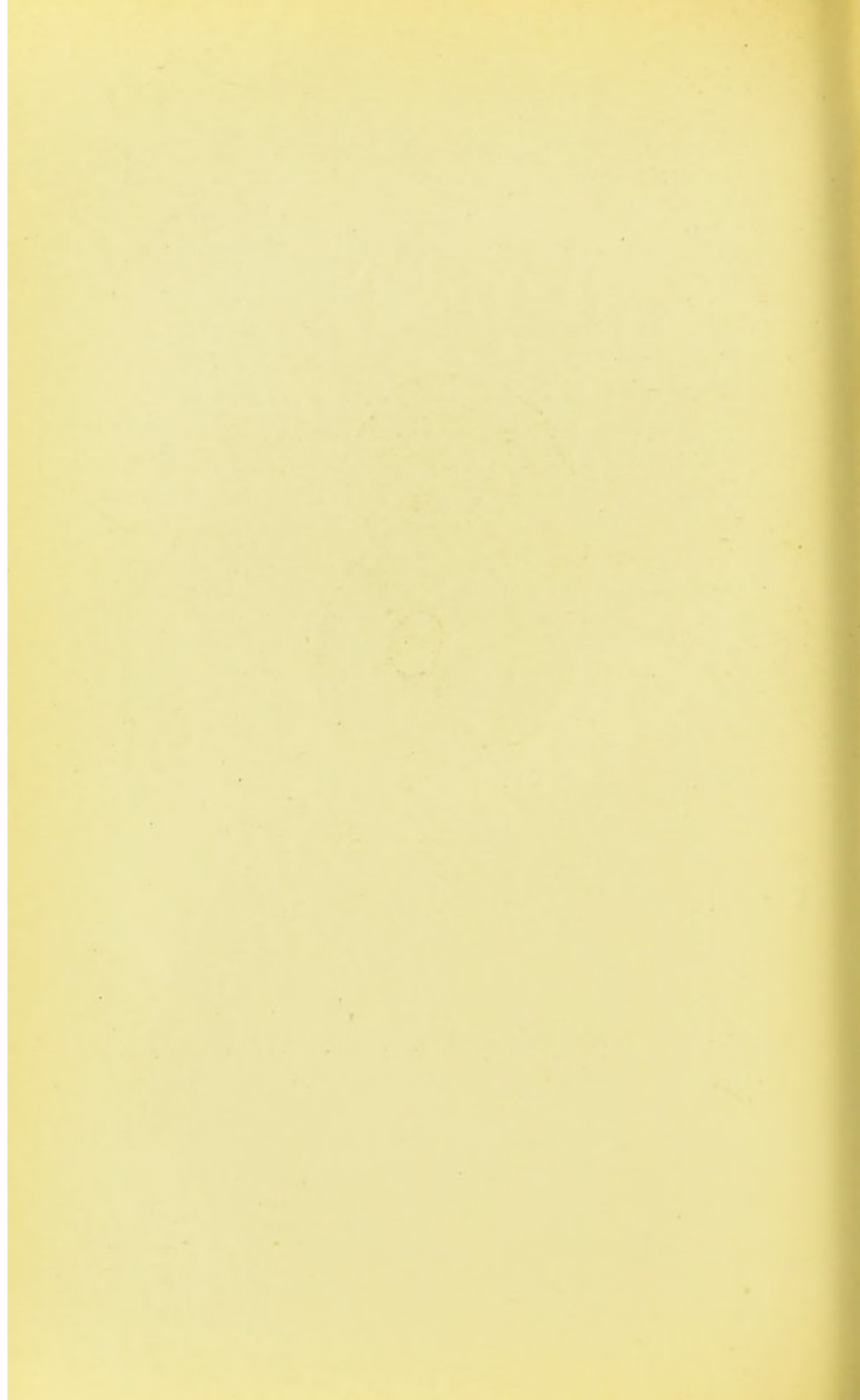
Cases are occasionally described of what are called "abscesses of the membrana tympani," in which the suppuration is said to be limited in extent, and usually between the mucous and fibrous layers of the drum-head. I regard these as a useless subdivision of acute suppuration of the middle ear, with which 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 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

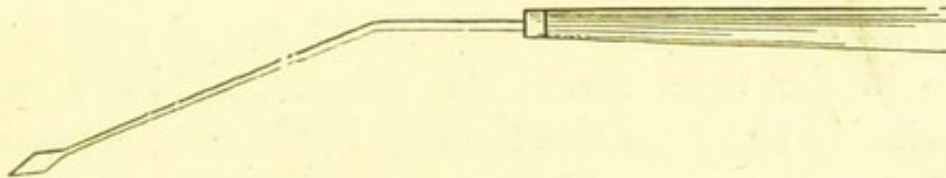
* *A Treatise on the Ear*, p. 330.



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



should be well supported; a good light should be thrown on the membrane through a silver 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.*



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 not being incompatible 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 it to feed for months or years on the delicate structures of the

* 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.

ear, thus exposing the patient to the risk of very lamentable results to health and hearing.

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



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.



SLIT-LIKE PERFORATION IN THE MEMBRANA TYMPANI.



PERFORATION IN THE MEMBRANA TYMPANI—A ROUND ORIFICE.

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 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., &c. may supervene. After fever a sanguineous fluid may fill up the cavity of the tympanum, perhaps causing complete disorganisation 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. Paracentesis of the *membrana tympani* may be most useful to some such patients.

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 kindly asked me to see her. At about two 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

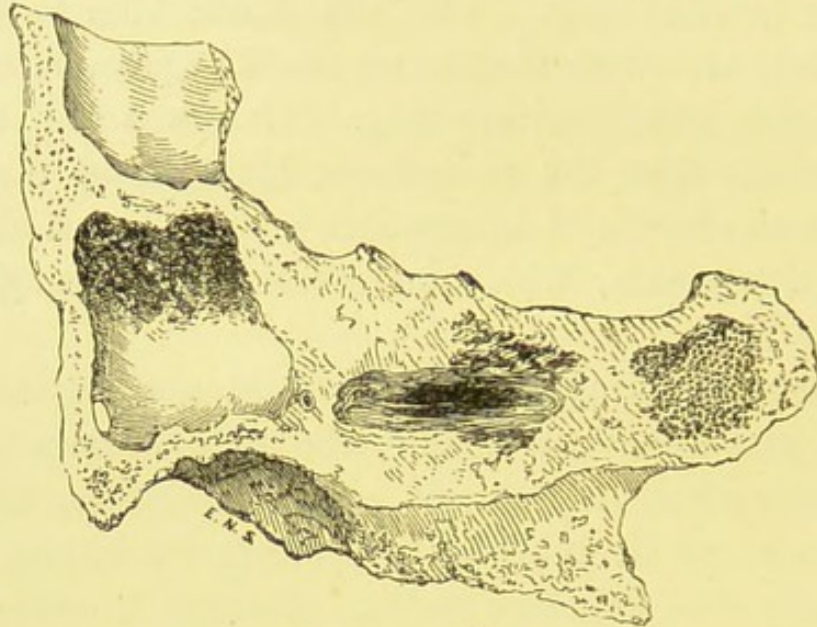
fever, she could hear perfectly, and was beginning to talk tolerably well. But she became incurably deaf, and soon lost all power of speech. Immediately behind the left concha, and hidden by it, was a round opening large enough to admit a peppercorn, leading, no doubt, into the mastoid cells. The left 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.

Whilst examining this case, I could not but think of Berger, the Danish surgeon, who died of meningitis, after having had his mastoid cells opened from the exterior to admit air into the tympanum, he having been previously deaf for some years. Nature, in effecting a permanent opening into the mastoid cells, has the advantage over the surgeon, for she works quietly and discreetly from the interior, whilst he commences from the outside, and certainly in his heroic treatment cannot always be said to act discreetly.

I was fortunate enough, through the kind assistance of 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 wood cut. 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 disorganised; in fact, all the structures within it seemed destroyed, the semicircular canals and cochlea being so plugged with inflammatory products that their



SECTION OF TEMPORAL BONE.

outline even could not be 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.

One could not fail to note, in attending to this poor girl, the disadvantages that those of the deaf and dumb are under who have been taught to converse merely by means of the finger-alphabet and signs. Although very intelligent, she had been made acquainted with no other methods of communication than these, and consequently could be thoroughly understood only by those few who chanced to have learnt the same. By the system of lip-reading, a deaf and so-called dumb child of ordinary ability can be taught, in the course of a few years, to speak with a fair degree of fluency, and with clear and not unpleasant articulation, and to follow, by watching the lips of other speakers, any conversation which may be carried on, provided the enunciation is distinct. I am convinced that this system of articulation and lip-reading has an immense advantage over the older method.* I mention it here as it is a subject which has not yet met with the attention it deserves in this country.†

Some attacks of acute aural catarrh come on suddenly without any apparent cause. Dr. Cassels 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 perceived 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

* See chapter xix on the Education of the Deaf and Dumb.

† There are already many schools where this system is thoroughly taught, but there is room for many more. An admirable institution has been started for the training of teachers.

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

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.”*

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 was much congested; the Eustachian tubes were completely closed; 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

* See chap. xv, on “Pain as a Symptom of Ear Disease,” p. 243.

congesting the auditory apparatus." On the other hand, some authorities maintain that in therapeutic doses quinine has no ill effect upon the ear.

The deafness and ringing in the ears produced by the administration of salicylate of soda appear to be quite independent of any organic change in the labyrinth.

Disease of the external meatus itself (otitis externa) is most frequently met with in children after scarlet fever, small-pox, &c., but is often brought on by bathing in cold water.

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 otorrhœa.

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 perfectly 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 diffi-

culty 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 allowed to go on is that there is a general belief on the part of parents that their child, instead of being hard of hearing, is absent or stupid. Most children, however, are said to hear more than they are wished to hear; and it is absurd to suppose them capable of systematically simulating deafness. Many cases are recorded in which serious consequences have resulted from this mistaken notion. For instance, we are told in Holmes's *System of Surgery** of a youth who died of caries of the petrous bone and abscess in the cerebrum, whose symptoms of aural disease dated from early life, but whose father had been in the habit of boxing his ears "for inattention."

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

* Vol. 3, p. 171.

heavily, snored in his sleep, and was said 'to talk through his nose.'

In this case the Politzer bag, used regularly twice a week, afforded great relief. After three weeks' treatment sounds were audible 12 inches off on both sides. Much benefit was derived from taking \mathfrak{z} i. each of cod-liver oil and steel wine three times a day. The throat was painted daily with a mixture of tinct. ferri perchlor. (\mathfrak{z} i. to \mathfrak{z} i. water). On the patient's return from a six months' stay in Germany, he came again to consult me. His hearing distance was then four inches on the left, and seven inches on the right, but by a renewal of the former treatment it was soon rendered normal, viz., five or six yards for both ears.

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 half one's success is dependent upon attention to the general health and the application of astringents to the congested mucous membrane of the throat.

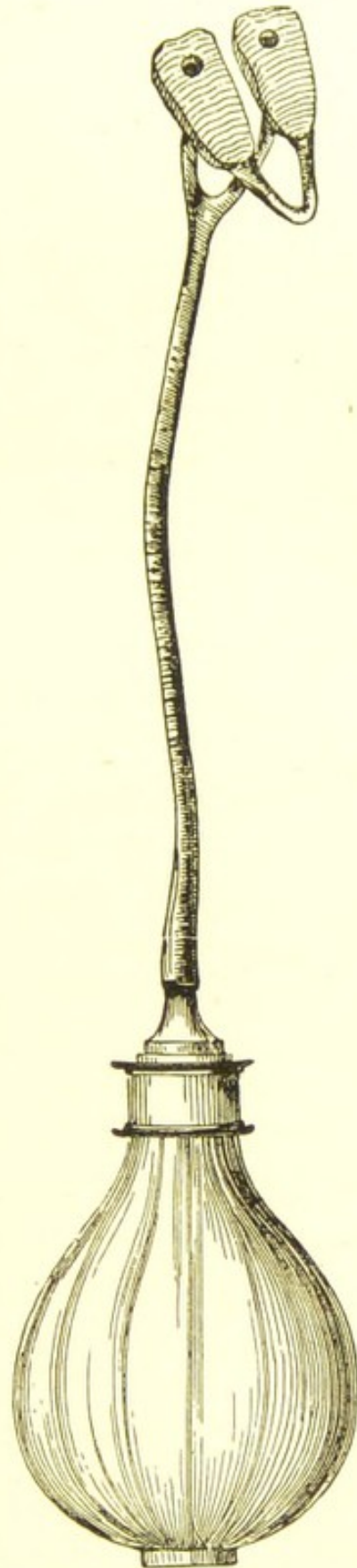
The following is an interesting case, and one of a kind not infrequently met with:—

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 \mathfrak{z} 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.

And now a few words as to the use of the Politzer bag, invented by Dr. Adam Politzer, of Vienna. This useful instrument has in a great number of cases rendered the Eustachian catheter unnecessary, and moreover is much more easily used than the latter. It is most conveniently used in conjunction with Allen's nasal pad, which causes no discomfort, and dispenses with the disagreeable necessity of holding the delivery-tube half an inch within the anterior nares, whilst digital pressure is made on both sides of the nose. By its means a double current of air is blown into the pharyngeal cavities, which forces warm air thence through the Eustachian tubes into the tympana.

When there is no great resistance to the full entry of air, the patient suddenly feels a considerable pressure in the drum, and a loud noise is heard.



POLITZER'S AIR-BAG, WITH ALLEN'S NASAL PAD.

Hundreds of cases which would formerly have escaped efficient local treatment are now relieved or cured by the help of this most excellent substitute for the catheter. For young children it is not necessary to swallow when the bag is used. With the very young it suffices for every purpose to blow air from one's lungs through a piece of india-rubber tubing (as Hinton first suggested) instead of from the bag—a proceeding quite as efficacious and not so likely to frighten.

The Politzer bag may be used with too much force, especially if the patient be allowed heedlessly to employ it on himself. It is desirable to inspect the drum-head before the use of the bag, as cases are on record of rupture by its means of small blood-vessels in the middle ear, so as to cause the cavity of the tympanum to be filled with clotted blood.*

A medical man, Dr. S., came to consult me with acute pain and almost total deafness in the left ear, from using Politzer's bag with considerable violence. He eventually quite recovered his hearing, through adopting the same treatment as recommended in the case next described.

Mr. B., a gentleman living in the country, from childhood completely deaf in the left ear, and latterly suffering from slight deafness in the right, was recommended by his medical attendant to blow air forcibly, by Valsalva's method,† into his ear. On one occasion, as the passage of the Eustachian tube seemed blocked, he went on blowing until suddenly air rushed through it with great force, causing acute pain in the right ear,

* See a case reported by Dr. A. H. Buck, *Diagnosis and Treatment of Ear Diseases*, p. 132.

† On Valsalva's method, see p. 155.

and leaving him very deaf, with at the same time a noise in the ear so loud and distressing that he talked about committing suicide. He came to London to try to get relief, and was sent by Mr. Tapson to see me. I found him to be in a highly nervous state. The tremendous roaring in the ear prevented sleep, and his deafness rendered it necessary to write down on paper what one wished to say to him. I considered that the force used had caused very considerable congestion of the blood-vessels of the membrana tympani, with perhaps slight effusion into the internal ear. When I saw him the membrane still looked red, but all pain had ceased. Free leeching, blisters behind the ear,* and purgative medicines in a short time restored the hearing, and almost completely put an end to the noise in the ear.

The vascular connections between the tympanum and labyrinth, lately traced by Professor Politzer and others, show how hyperæmia of the middle ear may easily extend to the labyrinth.

Since the above was written a valuable paper by Professor Grüber has been published† “On a New Method of making Pervious the Eustachian Tube and of Inflating the Tympanum.”

The details of the method are as follows :—

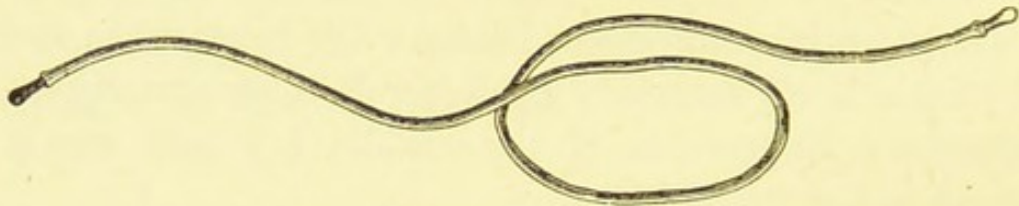
The operator stands or sits at his convenience face to face with the patient. The end of the nozzle-piece of

* With regard to the treatment by counter-irritation, &c., see page 265, in the “Remarks” on a case of injury to head.

† 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.

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.

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



DIAGNOSTIC OR AUSCULTATION TUBE.

This instrument is usually made of black india-rubber, and about 12 or 18 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.

Some children (unlike the cases I have given), who may be otherwise perfectly well, suffer from chronic catarrh. They breathe heavily, snore in their sleep, or "talk through their nose." Their throats are affected;

their tonsils are often enlarged; and, generally speaking, the naso-pharyngeal cavity is covered with red granulations. As Dr. Mayer says, the voice is singularly wanting in resonance; and, breathing through the nose being impossible, the mouth is kept continually open. Hence, exactly as in a common cold, the consonants M, N, and NG, for which "the mouth is closed in a labial, dental, or guttural fashion, and the peculiar character is given to the sound by the nasal chambers acting as a resonance cavity" (Foster), cannot be pronounced: "common," accordingly becomes "cobbod," "nose,"—"dose" or "lose," and "song,"—"sogg."

Removal of the tonsils,* if very large, the frequent

* Sir James Paget (*Medical Times and Gazette*, Feb. 6, 1858) makes the following remarks:—"There is a physiognomy by which the children and young people that have simple enlargement of the tonsils may usually be known at once. Together with a general appearance of feeble health they have a peculiar shape of the mouth and jaws. The jaws are narrow, so that the teeth are crowded and look disproportionately large. The aperture of the mouth is small, habitually slightly open; the edges of the lips thick, but not pouting, the lower lip rather inverted; the angles of the mouth a little raised; the front of the mouth is almost uniformly convex; the lower lip scarcely recedes towards the chin, but projects with a broad convexity, as if its middle part were slightly pushed forward by the tip of the tongue. The general expression is that of a gradual narrowing and a smooth uniform rounding of the lower part of the face, which make it look small and featureless.

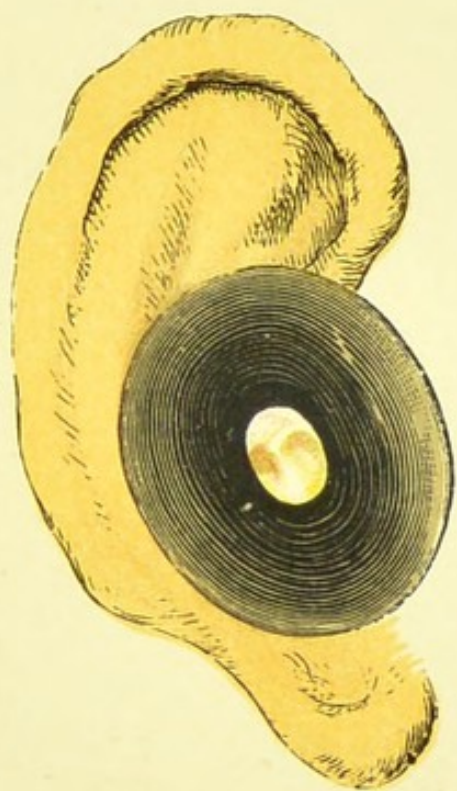
"These peculiarities of shape appear due, partly to defective growth of the jaws, and partly to the habit which the patients have of advancing the lower jaw and tongue, in the position in which these parts are yet more evidently held during acute inflammation of the tonsils.

"For chronic enlargement of the tonsils, whether through simple over-growth or in consequence of chronic inflammation, the excision of the projecting portion seems by far the best treat-

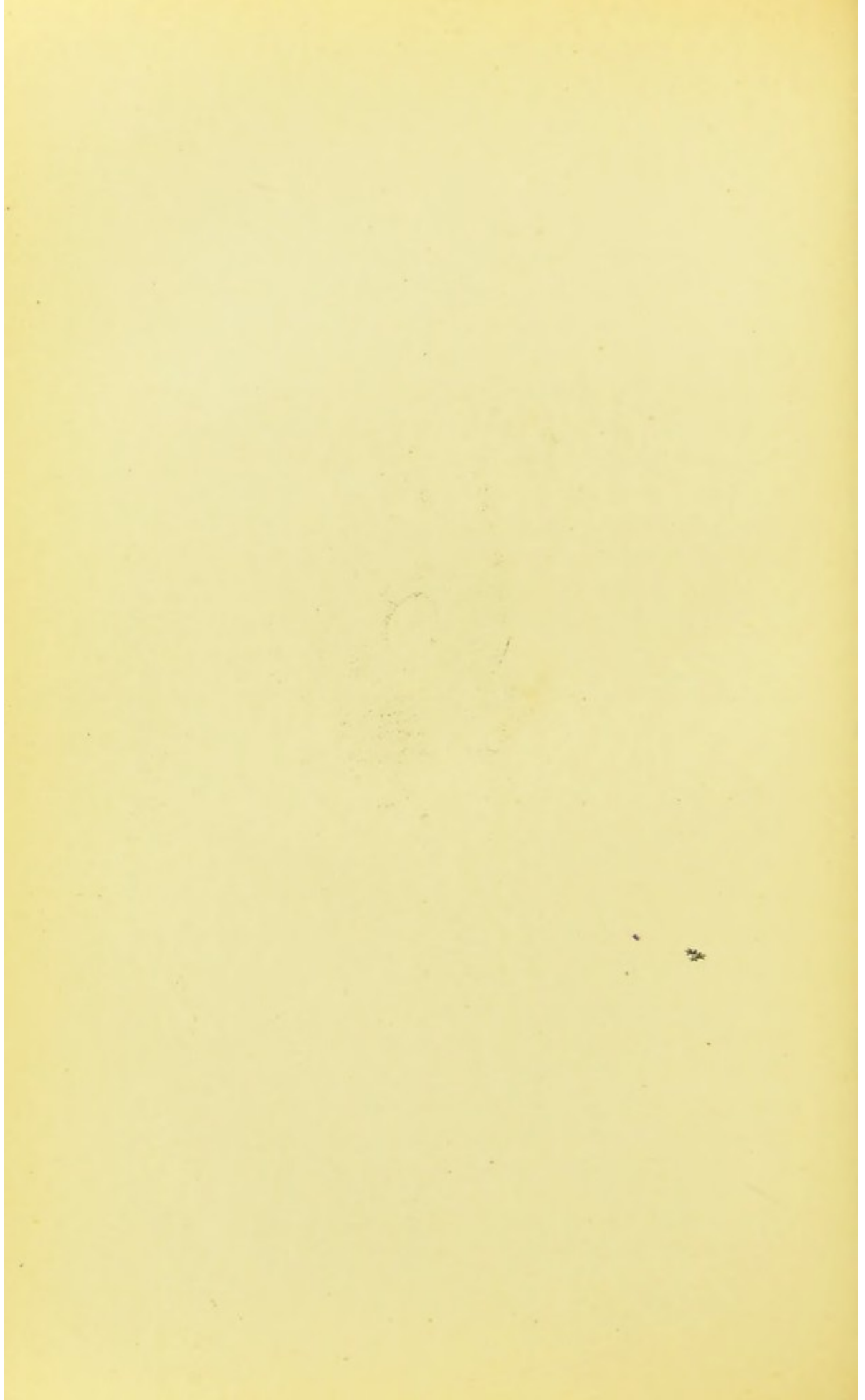
use of the Politzer bag, and astringent applications to the throat will be found all that is necessary for the cure of these cases of deafness.

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, ment. So far as I have seen, the cutting of tonsils is never followed by severe hæmorrhage or other serious inconvenience, provided they are not inflamed at the time of being cut. And I believe that if other means of reducing the size of enlarged tonsils be not quickly beneficial, the excision should be adopted both oftener and earlier than it commonly is."



OBSTRUCTION OF EUSTACHIAN TUBE, MEMBRANE DRAWN INWARDS



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.

I wish especially to direct attention to the rapid improvement here derived from the use of the Politzer bag: the symptoms and treatment are very much the same in all such cases. Some patients, by suddenly placing the head on one side, can open the Eustachian tube for a few moments and so improve the hearing considerably. This accounts for the habit of some deaf people that suffer from chronic catarrhal affec-

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

tions of constantly inclining the head to the right and left.

Colds in the head, according to Dr. Maclagan, may be most effectually cured by taking 20 grains of salicin every two hours: its full beneficial action can be got only by giving it in frequently repeated doses.*

B. R., æt. 55, stated that five months before coming to see me at the hospital she had caught a severe cold from washing her head at bedtime. Next day she began to suffer in both ears from great noise and deafness, which had since been increasing. With the left ear she could hear my watch only in contact, and with the right not at all. The same treatment was adopted as in other cases, and after seven weeks she left the hospital well.

Prof. Mosler† recommends in chronic naso-pharyngeal catarrh the use as a gargle of a weak solution of sea-salt, which is applied by first causing it to run into the pharynx by inclination of the head backwards, and then making movements of deglutition and spasmodic expirations, when, the head being held forwards, the liquid runs out of the nose and mouth.

Having pointed out the great benefit derivable, in the milder forms of chronic aural catarrh, from the use of applications to the throat, and of Politzer's air-bag, 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 ope-

* *Practitioner*, November 1877, p. 325.

† *Deutsche Medic. Woch.*, Jan. 1, 1881.

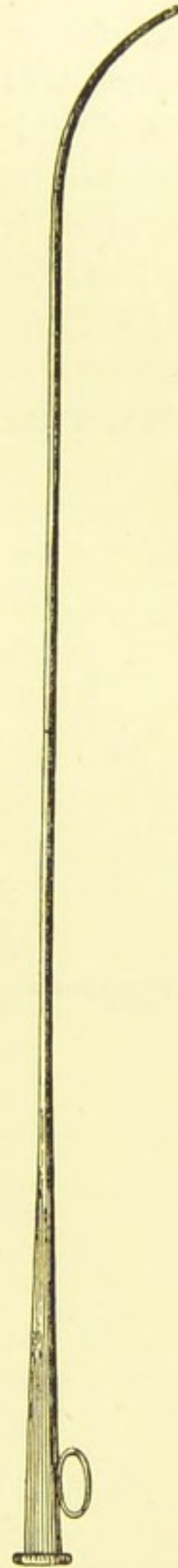
ration, and yet the ability to perform it is a rare acquisition.

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 15 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 pharynx, 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

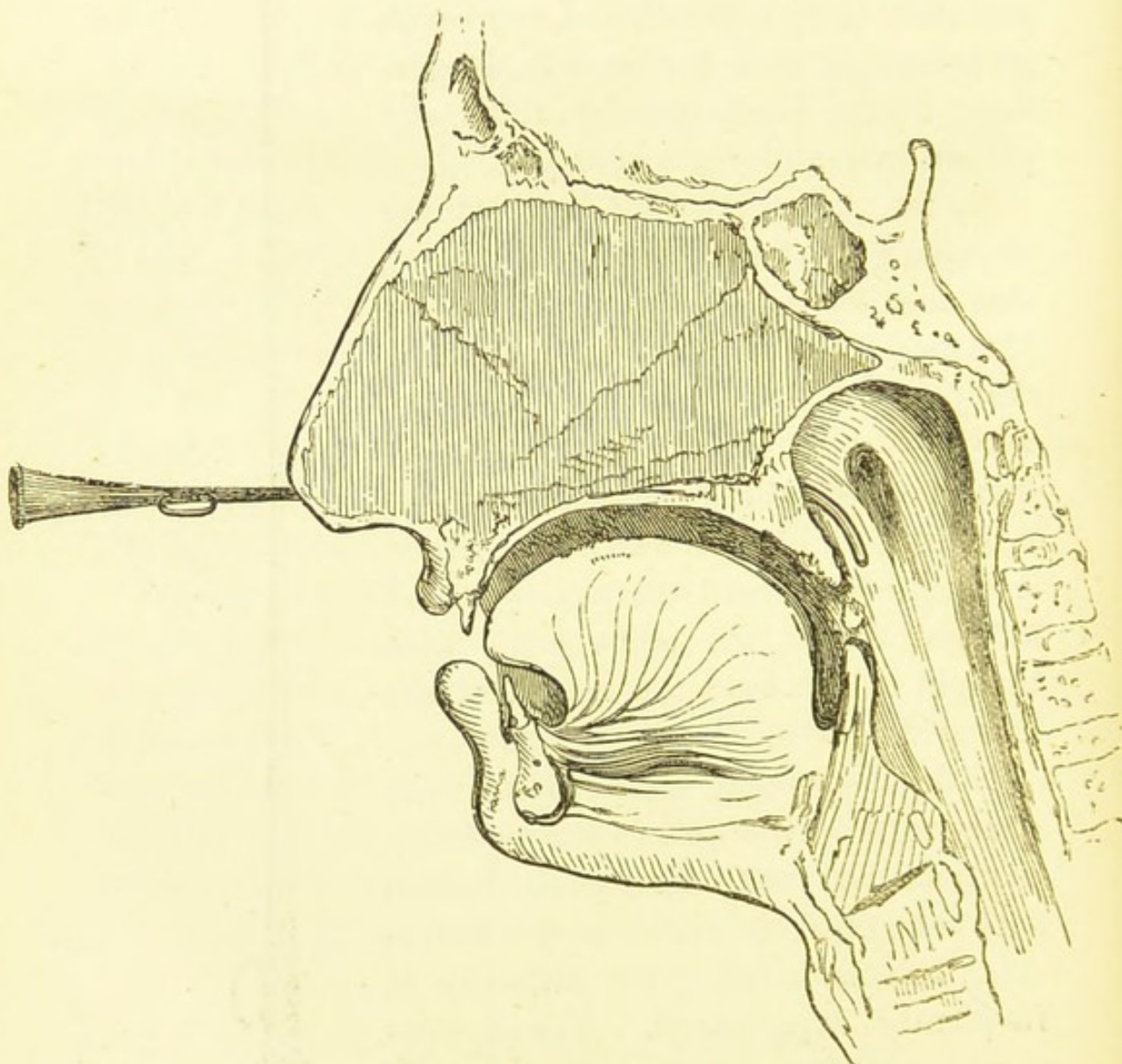


EUSTACHIAN CATHETER.

or too far, or perhaps its point is inserted into the fossa situated behind the Eustachian tube.

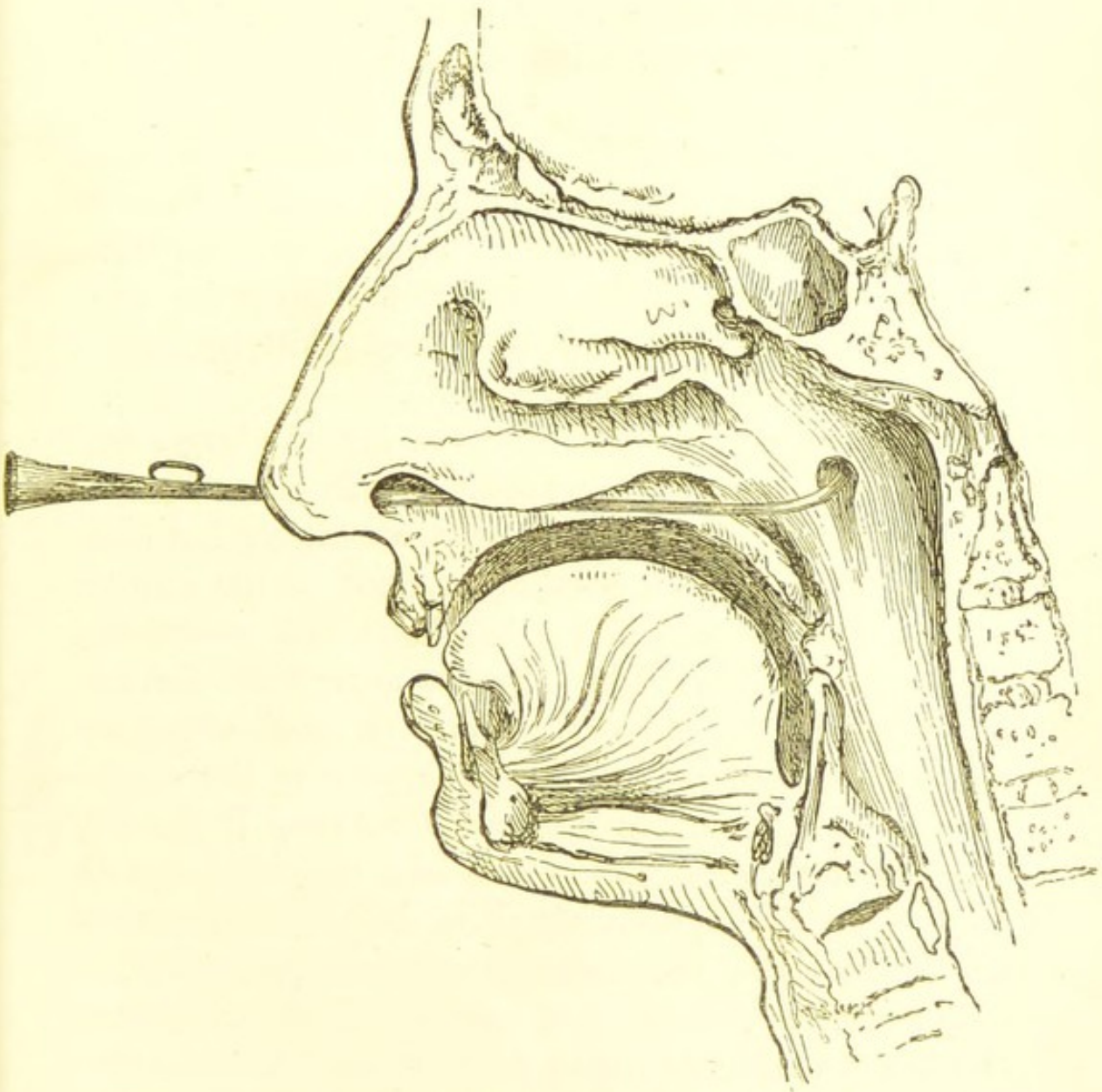
It should be remembered also that in catheter cases the mucous membrane is nearly always in a delicate state, and often highly sensitive, so that constantly moving the instrument backwards and forwards adds considerably to the patient's discomfort, and may cause injurious effects.

Warm the catheter in hot water, depress the patient's



THE EUSTACHIAN CATHETER TURNED AND HOOKED ROUND THE VOMER.

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),



THE ECSTACHIAN CATHETER IN POSITION.

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 out-patient 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.

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 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.



METHOD OF PASSING THE EUSTACHIAN CATHETER.

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 ℥i.*) 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.

With reference to digital examination of the Eustachian tube, Dr. W. H. Wynne has lately remarked as follows:—"The naso-pharynx, therapeutically, is the most important part of the ear. The method of digital examination consists in passing the index finger of the right hand, when the right tube-orifice is to be examined,

into the mouth, up and behind the soft palate to the orifice, which can easily be distinguished by its slight depression, the operator standing on the right side of the patient. In examining the left tube, the order is reversed. The time of the investigation varies from half a minute to three minutes, and disease of any of the structures that can be examined is immediately determined. This method can be used in cases where, from complications, the use of the rhinoscopic mirror is either unsatisfactory or impossible. By its use I can immediately determine the normal or pathological condition of parts within reach of the finger, namely, the pharyngeal orifice of the Eustachian tube, the posterior fossa of Rosenmüller, Luschka's tonsil, occupying a central position in the posterior wall of the pharynx, and terminating laterally in this fossa, and the posterior nares immediately in front; and here by the digital examination I am able to diagnosticate the existence of polypi and hypertrophy of the membranous covering of the inferior turbinated bones."*

* "Practical Deductions drawn from a Thousand Digital Examinations of the Pharyngeal Orifice of the Eustachian Tube," *Boston Med. and Surg. Journ.*, Nov. 17, 1881.

CHAPTER IX.

CHRONIC NON-SUPPURATIVE INFLAMMATION OF THE MIDDLE EAR.

THIS form of aural catarrh, which has been 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 per-

vious, 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 Tröltzsch 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 all the instances 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 ℥i.). 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 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

* *Annales des Malad. de l'Oreille, du Larynx, &c.*, July 1881, abstracted by Dr. E. Cresswell Baber in *Med. Record*, Dec. 15, 1881

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 it may have acquired, what he terms the 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.

It is well to bear in mind that a concavity is never produced without some accompanying loss of hearing. 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.

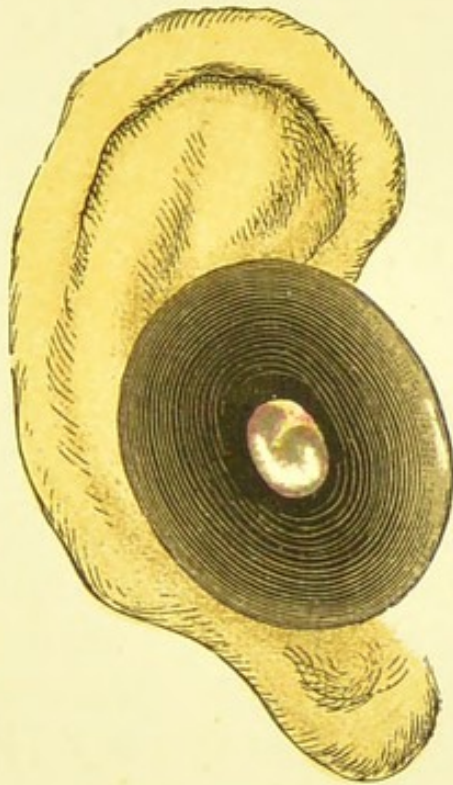
The influence of heredity is very markedly shown in the case of chronic aural catarrh.

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 mucous follicles of the buccal and naso-pharyngeal cavities, has been observed to emanate.†

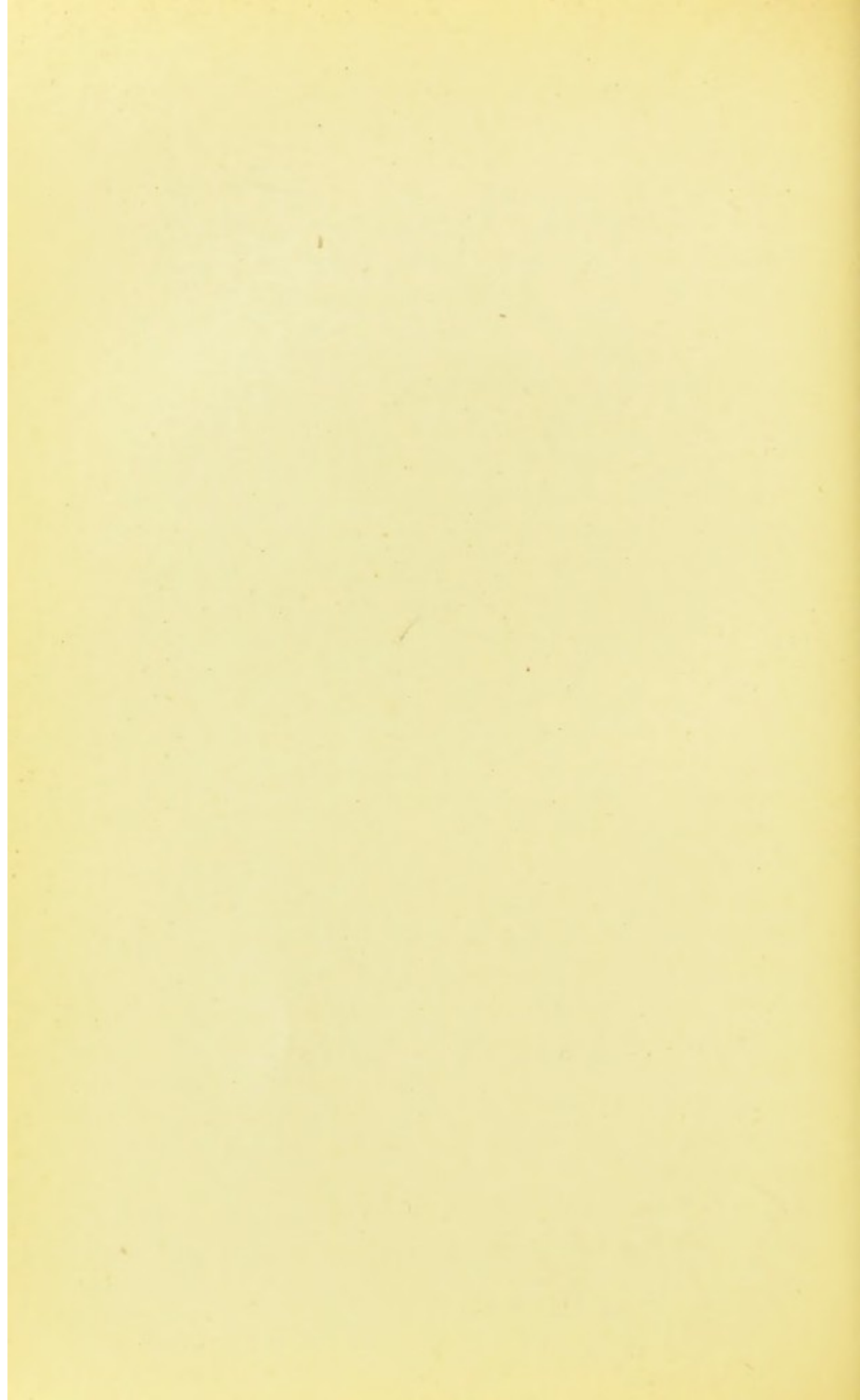
Sergeant F., æt. 42, in the Army Hospital Corps, sent to me from Netley, on November 14th, 1876, by Surgeon-Major Porter, when stationed at Halifax in the winter of 1868 had suffered very much from the intense cold. His hearing having become impaired, he was removed thence. He had remained more or less deaf ever since. When he came to the hospital I found he could hear the watch 1 inch from the right, and

* See *Lancet*, September 28, 1878.

† C. H. Burnett, M.D., *A Treatise on the Ear*, p. 387.



CALCAREOUS DEPOSIT IN MEMBRANA TYMPANI.



2 inches from the left ear. The Eustachian tubes were narrowed, and the tympanic membranes considerably thickened, and the mucous membrane generally 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 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 2 feet on one side and 3 feet on the other. This case, a very favourable one for treatment, shows what good results are occasionally to be gained, when the membrana tympani is thickened, by repeated injection of suitable fluids.*

I have never 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 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

* *Medical Times and Gazette*, February 16, 1878.

cavity, for which purpose the use of warm water alone is advocated.

Dr. Barr, in speaking of the relation of diseases of the naso-pharynx to aural affections, in the introduction to a discussion in the Subsection of Otology at the Annual Meeting of the British Medical Association in Ryde, August 1881, observed that important modifications in the structure and function 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 long-continued occlusion of the tube will inevitably lead to permanent changes of structure, and irretrievable defect of function in the organ of hearing.

Besides the numerous mucous glands of the naso-pharynx, there occurs, chiefly in the roof of the pharynx, but extending also from the roof along the posterior and lateral walls into Rosenmüller's fossa and over the mouths of the Eustachian tubes, a mass of glandular tissue, which Luschka denominates the pharyngeal tonsil. An exuberant growth or hypertrophy of this adenoid tissue constitutes the so-called adenoid vegetations of the pharynx, which appear as either tongue-shaped, globular, or flat excrescences, chiefly on the postero-superior wall, from which, how-

ever, they not infrequently extend to and narrow the posterior nares. The pharyngeal mouths of the Eustachian tubes, Dr. Barr remarked, are often completely veiled by the mass of growth. Meyer found that $7\frac{1}{2}$ per cent. of persons who consulted him with affections of the ear suffered from this morbid state of the naso-pharynx, in connection with and dependent upon which the ear is variously affected, presenting sometimes purulent disease, and sometimes simple catarrh.

Disease in the ear, according to Dr. Barr, may be caused by these vegetations 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.

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 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."

In those cases of long-standing disease where the Eustachian catheter is quite inoperative, puncture of the membrana tympani may be of service.

* *Medical Record*, May 15, 1878.

“ 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.”

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

* “ On the Diagnosis of Anomalies in the Conducting Apparatus of the Ear,” translated by J. G. Brown, M.B., *Edin. Med. Journ.*, January 1878.

† Holmes, *System of Surgery*, vol. 3, p. 166.

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

* 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.

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.* 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.

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. At the back are the mastoid cells. 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.

* *Lehrbuch der Ohrenheilkunde für Practische Aerzte und Studierende*, Stuttgart, 1878. *Glasgow Med. Journ.*, Dec. 1878.

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 bottom of the internal auditory meatus to the stylo-mastoid foramen. Thin bone is heaped up all along the track of the nerve, just as in a meadow the upturned earth defines the course taken by the burrowing mole.

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, an external 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 be readily 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*.

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. Schwartze and von Tröltzsch 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 2 millimetres in breadth and 4 in width, and bent slightly, like a scythe.

The procedure is as follows:—A puncture is made $1\frac{1}{2}$ 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 Toynebee. A second incision is now made in the posterior segment, 2 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 rendered durable.

CHAPTER X.

CHRONIC SUPPURATIVE INFLAMMATION AND
THE VARIOUS FORMS OF OTORRHŒA.

PURULENT discharge from the ear is one of the most common symptoms of aural disease. It may arise from a variety of causes. For instance, the exanthemata (especially scarlet fever) produce that worst of all forms of diseases of the ear, viz., acute otitis; which, however, may also take origin from a blow on the side of the head, from colds due to wet feet, sea-bathing, and so on. The symptoms and treatment of this malady have already been given in the chapter on acute and chronic aural catarrh, so that it will not be necessary to revert to them. 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. Restoration of the ear to a healthy condition, so as to stop the discharge betimes, is to be brought about—

1st. By constitutional treatment.

2ndly. By thorough cleanliness.

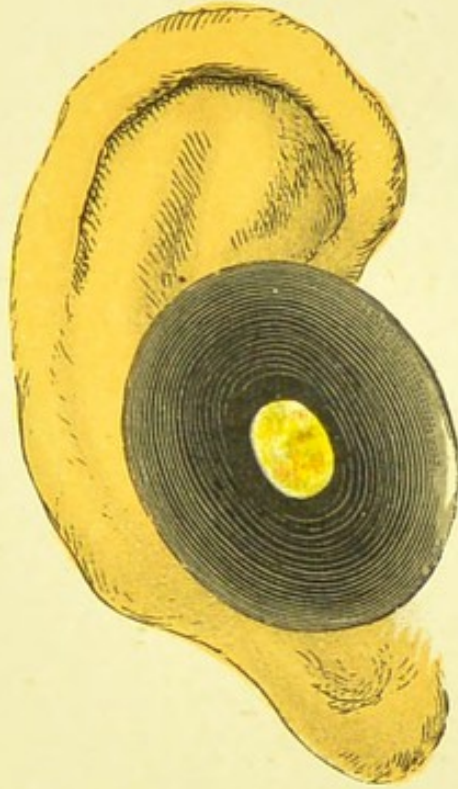
3rdly. By astringent applications.

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.

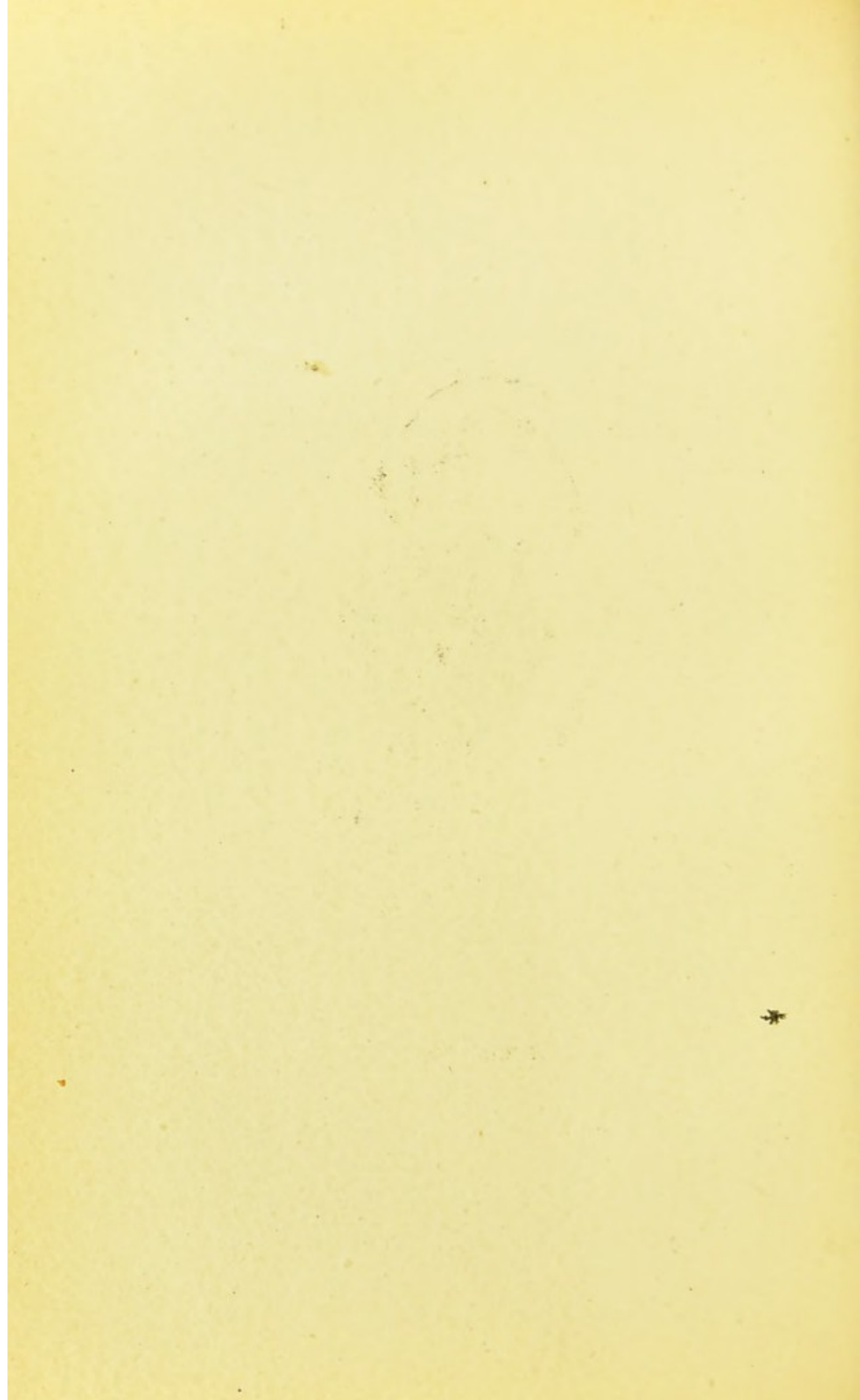
The astringent lotions prescribed should always be used warm.

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



STORRHŒA.



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 18 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 ozænic 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.

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 hyper-

* “Nasal Catarrhs and their Treatment,” *New York Med. Journ.*, August 1878.

trophied tonsils frequently associated with aural disease. Powdered alum, when the virulence of the inflammation has been allayed, he is of opinion acts serviceably by coagulating albumen in the tissues with which it comes in contact, and forming a protective covering for the healing parts. He deprecates the employment of either agent by insufflation.*

I often in such cases prescribe with great benefit an ointment of 20 grains of iodoform to an ounce of vaseline.

The subjoined case is typical of a class very common in aural practice.

M. J. B., a girl, *æ*t. 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

* See *Americ. Journ. of Otolology*, Oct. 1879, p. 287.

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 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. Grüber recommends 15 to 40 grains to the ounce, and if after four or five applications no great progress is made, he resorts to other treatment.

The treatment for perforation of the membrana tympani, frequently met with in cases of otorrhœa, I shall reserve for the next chapter.

CHAPTER XI.

ON PERFORATION OF THE MEMBRANA
TYMPANI.

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.*

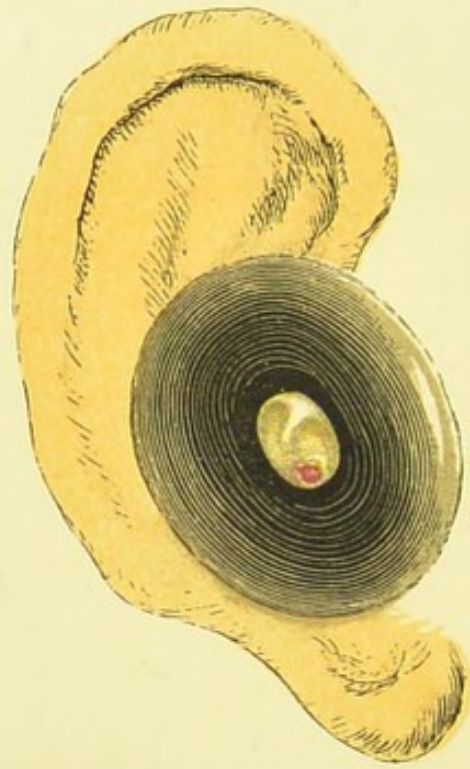
The treatment to be recommended for accidental perforation of the membrane by any sharp body (and this is often met with, especially in hospital practice) has already been given on page 119.

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, most usually 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

* See Schwartz, *Pathological Anatomy of the Ear*, translated by J. Orne Green, M.D., p. 80.



PERFORATION HEALING.

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.

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.

G. B., æt. 54, a labourer, came to the hospital February 24, 1874. Ten days previously he had fallen 8 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 27th 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 12th 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 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.*

In perforations of long standing accompanied by deafness, I have obtained very good results by thoroughly washing out the tympanum with certain 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 the thickening of the membrane.

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

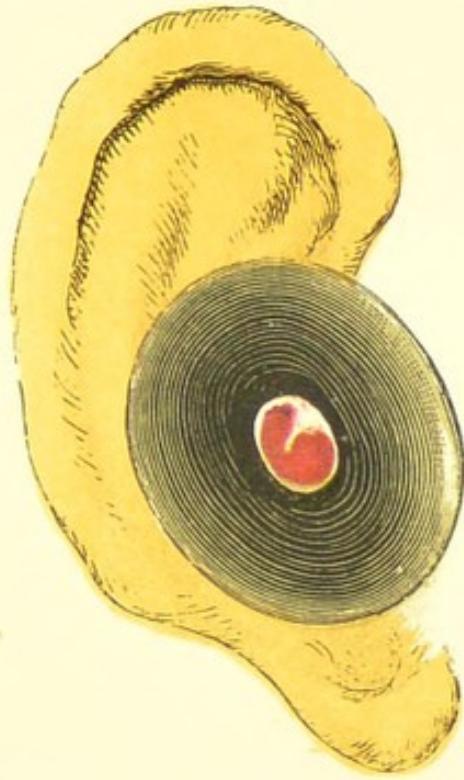
* *British Medical Journal*, October 6, 1877.

just shown, and externally through the perforation by means of warm astringent applications and the Valsalva method of inflation. We are able by these means 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 interfering with the proper functions of the ossicles.

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. 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 tympanic membrane has become permanently open, the larger the aperture, the greater is the amount of hearing, provided no further mischief has taken place, and that there is 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,



THE MEMBRANE 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.*

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 of 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

* *Cyclopædia of Anatomy and Physiology*, edited by R. T. Todd, M.D., F.R.S., vol. 2, p. 576.

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 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 intracranial 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 by 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 antisyphilitic remedies were of any effect, and, under the influence of 5 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 16 were ascribed to "abscess." In two patients there had been convulsions. One of these last, W. F., æt. 8½, brought to me at the hospital Oct. 11, 1879, had 12 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,

* See *A Treatise on the Ear*, by C. H. Burnett, M.D., p. 269.

thick, and most offensive discharge. He had in consequence become not only quite deaf, but dumb. After seven months' treatment the discharge entirely disappeared, and, although the perforations were unclosed, the hearing was by degrees returning. These results were attained 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. Philips, 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.

CHAPTER XII.

ON PERFORATION OF THE MEMBRANA
TYMPANI—(*continued*).

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 two 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.



1.



2.

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 be made :—

(1.) 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.

(2.) By violent syringing (see Chap. xv, p. 234).

(3.) 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 25th, 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?

Deafness from the sudden shock of distressing news

is, however, generally very severe, and comes on in a moment; and the patient in this case was, before his brother's death, actually under treatment for slight deafness. With reference to the production of chronic inflammation of the internal ear through concussion of the labyrinth, as in artillery practice, we may quote the remark of Burnett, that "A continual recurrence of a loud sound of an unpleasant nature causes hyperæmia of the ultimate nerve-fibres of the cochlea. The deafness comes on, as a rule, gradually. Hyperæmia of the labyrinth often follows tympanic disease, as there is a close connection between the vascular structures of the tympanum and labyrinth." After artillery practice it is the tympanum, I think, that is first involved, and subsequently the labyrinth. The temporary character of the hyperæmia of the labyrinth accounts for the immediate relief afforded, in the earliest stage of the disease, by leeching and free blistering behind the ear. Of disease of the cochlea, "the prominent symptoms are great impairment of hearing, the inability to hear certain tones, and the production of false ones, with tinnitus aurium. Artillerymen and boiler-makers are liable to this form of disease, and they may effectually protect their ears from the destructive hyperæmia caused by concussion by plugging the ears with cotton-wool." A similar preventive measure I recommend for bathers. If, in my patient's case, loud noises were the source of the evil, it was highly desirable to advise him to seek a quiet residence. His symptoms were such as are common in boiler-makers and those who, from the repeated clicking of telegraphic and other instruments, are frequently exposed to shocks of concussion. But there was the possibility that the disease might be partially

or wholly due to syphilis; and, before he came to me, the patient had undergone a long course of mercurial treatment at Aix-la-Chapelle, by the advice of Sir William Jenner. This, in the absence of all suspicion of syphilitic mischief, could only have been expected to increase the disease by occasioning loss of nervous tone: Sir William Jenner's opinion was therefore clear. My colleague, Mr. James Lane, whom I consulted, was decidedly of opinion that the deafness was due to syphilis; but, though we put him on very large doses of iodide of potassium, no improvement took place. Disease of the internal ear from syphilis, I may remark, is extremely rare. Burnett enumerates its symptoms as sudden deafness (sometimes with paralysis), vertigo, nausea, unsteadiness of gait, and tinnitus aurium.

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 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 without 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 and integrity 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

* *Diseases of the Ear*, p. 166.

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 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 artificial membrana tympani will be of any service. Some patients derive the greatest benefit from wearing them, 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

* See *Brit. Med. Journ.*, June 18, 1875.

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:—

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 mem-

* It is made by Messrs. Krohne and Sesemann, of Duke Street, and by Messrs. Hawkesley, of Oxford Street.

† *On Aural Catarrh*, p. 371.

brane 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 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."

* *The Lancet*, July 1, 1848. † *Diseases of the Ear*, p. 160.

‡ *Diseases of the Ear*, by Dr. von Tröltsch, translated by James Hinton, M.R.C.S.

Roosa 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.

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 nearly all 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 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."

* *Treatise on Diseases of the Ear*, p. 380.

CHAPTER XIII.

THE RESULTS OF SUPPURATIVE INFLAMMATION.

As I have before pointed out, very serious results sometimes occur from allowing a chronic discharge from the ear to go on 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 outwards from the tympanic cavity, a cavity respecting which it has justly been observed, that "no part of the human frame 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 here 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 is a good 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

* Hinton's "Tröltzsch," p. 66.

† *Ib.*, p. 31.

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 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, phlebitis of the jugular vein, or, as Sir William Gull first pointed out, pyæmic abscess of the lung of the same side, accompanied perhaps by similar abscess of the liver.

Again, if it finds an exit 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

* 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.

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.

DISEASE OF THE MASTOID CELLS.

In cases of this affection, as I have already pointed out, pus has been allowed to remain in the tympanic cavity, has caused caries of its bony wall, and has passed into 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 12 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 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 ℥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 4th. 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 5th Mr. Brown, the 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 wounds 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 no less than 34 cases in which its cells were opened, 26 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 pain, 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 generally undetected cause—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-masseterica, which posteriorly is united with the tendon of the trapezius by the fan-like expansion of the tendons of the sterno-

* *Deutsche Med. Wochenschrift*, Nov. 28, 1881.

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.

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 also and most frequently were 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.
3. Attention to general health.

One summer I was called down to Kew by Dr. Cundell 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.

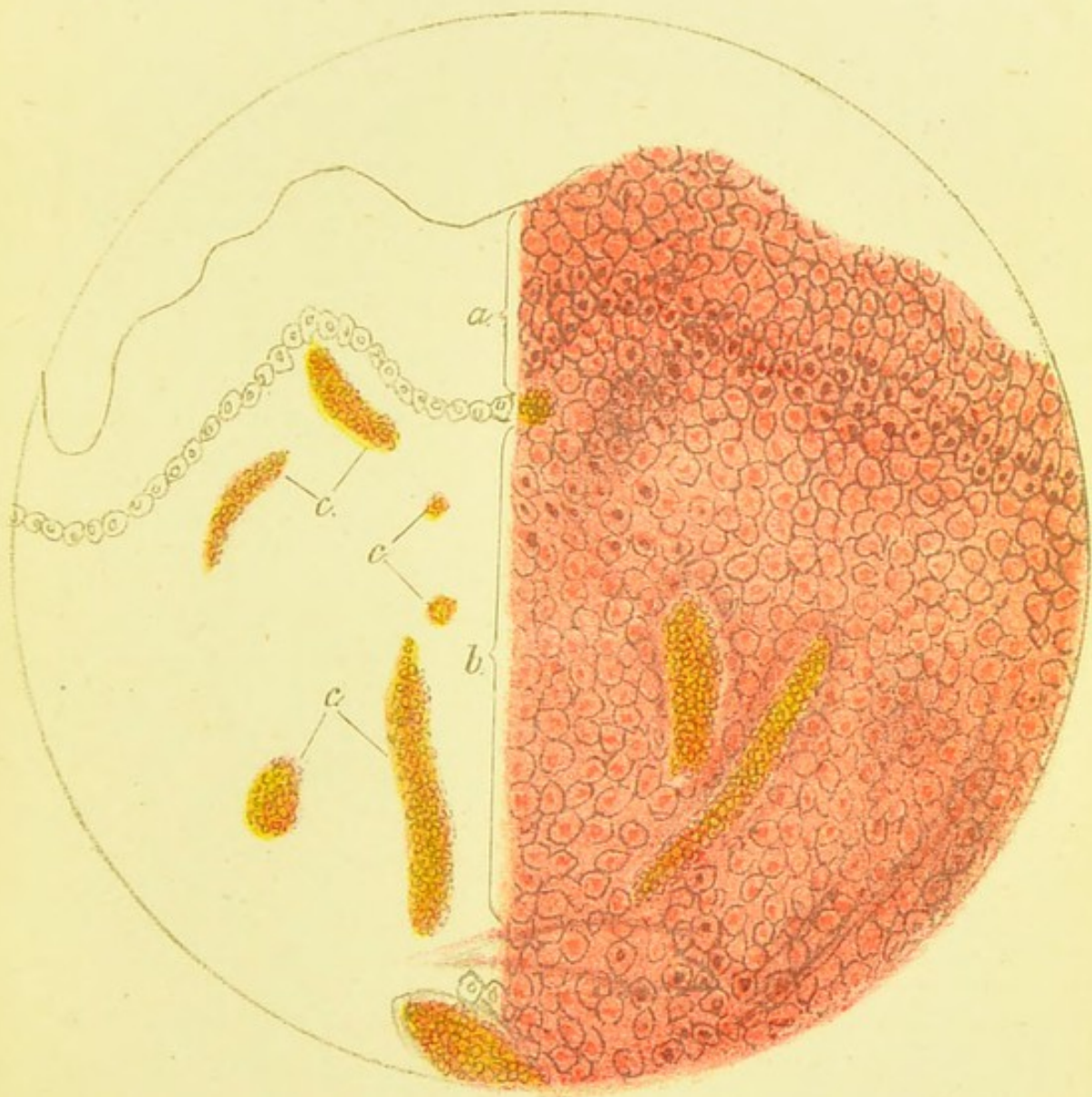
AURAL POLYPI.

Varieties and Structure of Aural Polypi.—According to their histological characters, aural polypi may be divided into the following classes:—

(1) "Granulation" tissue, (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.

Towards the base are found arteries and veins, with



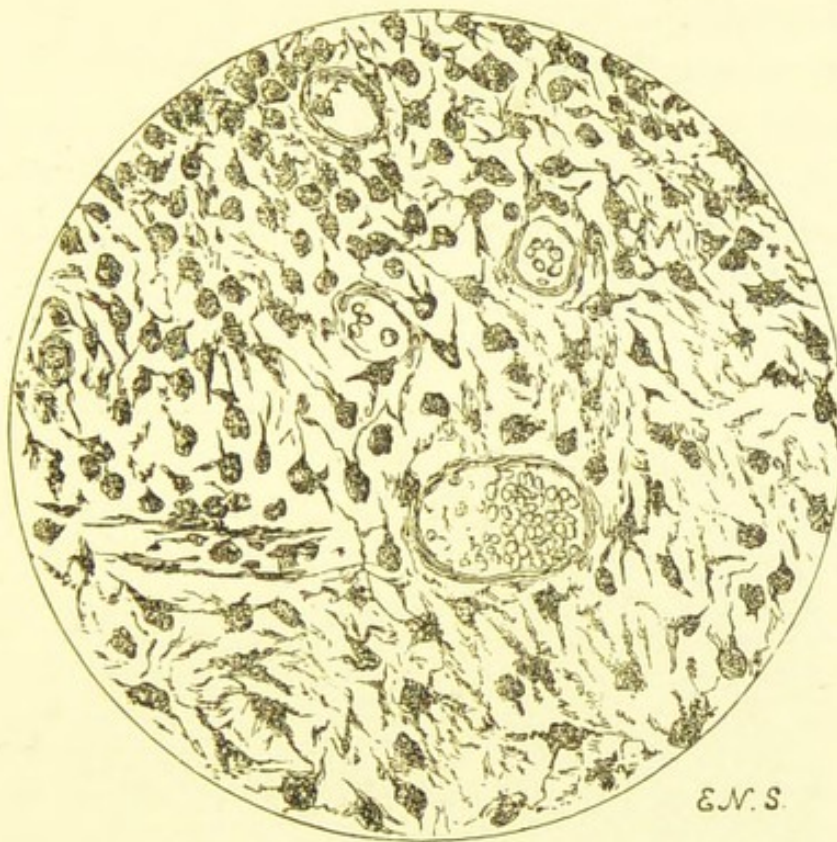
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Aural Polypus, composed of "granulation tissue."

- 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.

distinct endothelial, muscular, and fibrous coats ; but in the tumour 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-cell sarcoma.

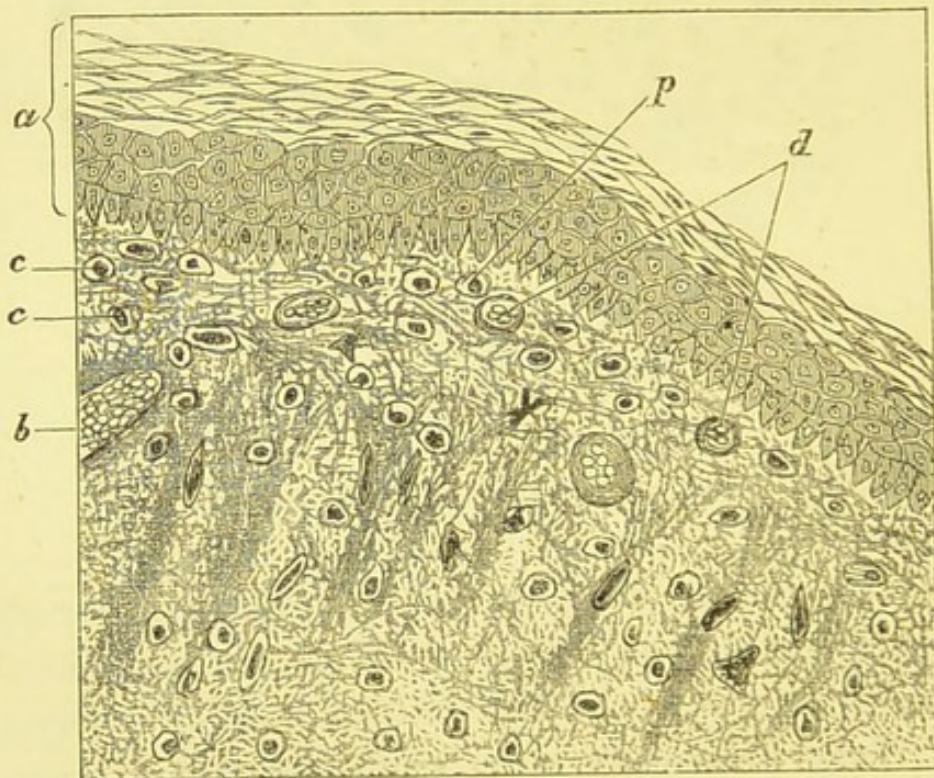


MICROSCOPICAL SECTION OF MUCOUS POLYPUS.

(2.) The *mucous polypi* manifest a rather higher stage of development, and in structure somewhat resemble the foetal 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.



MICROSCOPICAL SECTION OF FIBROUS POLYPUS.

- a.* Epithelial layer.
- b.* Blood-vessels of growth.
- c, c, p.* Cells of superficial subepithelial layer.
- d.* Capillaries.

(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.

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.

Hyaline or gelatiniform myxomata, by far the rarest variety of aural polypi, are soft, jelly-like, semi-transparent 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 occasionally arise from the walls of the external meatus, or even from the membrana tympani or Eustachian tube, but 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 previously, 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 fœtid 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



POLYPUS FROM EAR, NATURAL SIZE.

The pedicle shows the size of the perforation in the membrana tympani through which it passed.

been a constant and 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 23 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 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,

* *British Medical Journal*, December 16, 1876.

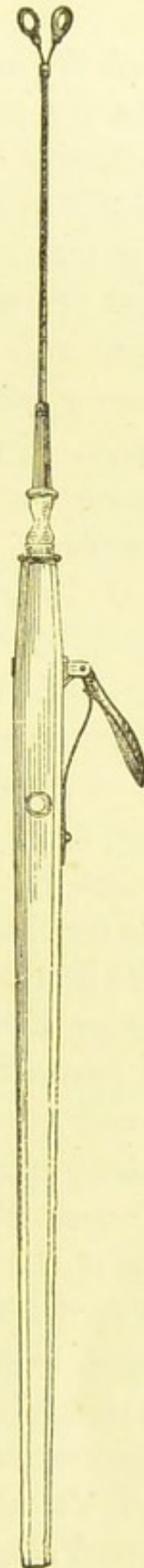
and latterly she had felt pain over the right side of the head; this during a month had been so great that sleep at night had been impossible. When she came to the hospital her face was very much swollen, and she could not bear her ear to be touched. Eight leeches applied in front of the tragus gave 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 23 years previously, was next 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 24 years, during the last 10 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 termination is not to be expected without careful treatment when the polypus is removed. Thorough cleanliness is most essential. 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

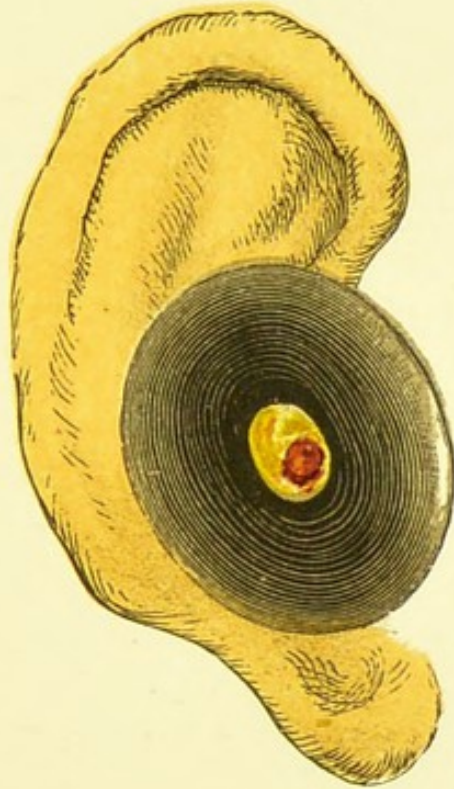
* "Supplement" to Toynbee's *Diseases of the Ear*, p. 432.



TOYNBEE'S LEVER RING
FORCEPS.

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 caustic, *e.g.*, solution of nitrate of silver (480 grs. to ℥i.) in cotton-wool on a suitable holder. Mr. Dalby recommends 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 well after these strong remedies have been applied, especially if any pain is experienced, to syringe the ear with warm water. 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. The use of alcohol for several months, as recommended by Politzer, for causing shrinkage of polypi, Voltolini thinks might be dangerous owing to its perpetual abstraction of water from the tissues.*

On the use of alcohol for polypi, see *Med. Record*, Jan. 1881.



POLYPUS.

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 Trötsch observes, "The facial palsy does not even show much extension of the tympanic disease, but only slight extension in an unfortunate direction."* Paralysis of other portions of the body, or complete hemiplegia, must necessarily result from injury to or abscesses in the brain in ear disease.

But very few cases of hæmorrhage from the carotid artery from caries of the inner wall of the tympanum have been recorded.

Albuminuria is said to follow not infrequently upon chronic suppuration of the middle ear.

* See pages 83 and 157.

CHAPTER XIV.

THE RESULTS OF SUPPURATIVE INFLAMMATION (*continued*). CEREBRAL ABSCESS, &c.

IN illustration of the remark 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 5th 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.

Dr. Ramskill calls attention to the fact that inflammation of the dura mater is apt to supervene in cases of chronic otorrhœa, an affection which frequently sets in after scarlatina, and sometimes after measles and

variola. There is first, for a long time, merely a thick muco-purulent discharge from the ear, with some tenderness about the mastoid process; then suddenly the patient becomes dull and drowsy, complains of intense pain in the head, grows delirious, and, lastly, passes into a state of coma. After death the petrous portion of the temporal bone is found carious and softened, and the superjacent dura mater detached, inflamed, and, as a rule, bathed in pus.*

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 6 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.

ABSCESS OF THE BRAIN IN EAR DISEASE.

The following interesting case was at St. Mary's Hospital under the care of Dr. Handfield Jones, to

* Reynolds, *System of Medicine*, vol. 2, p. 375.

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 1st 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 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

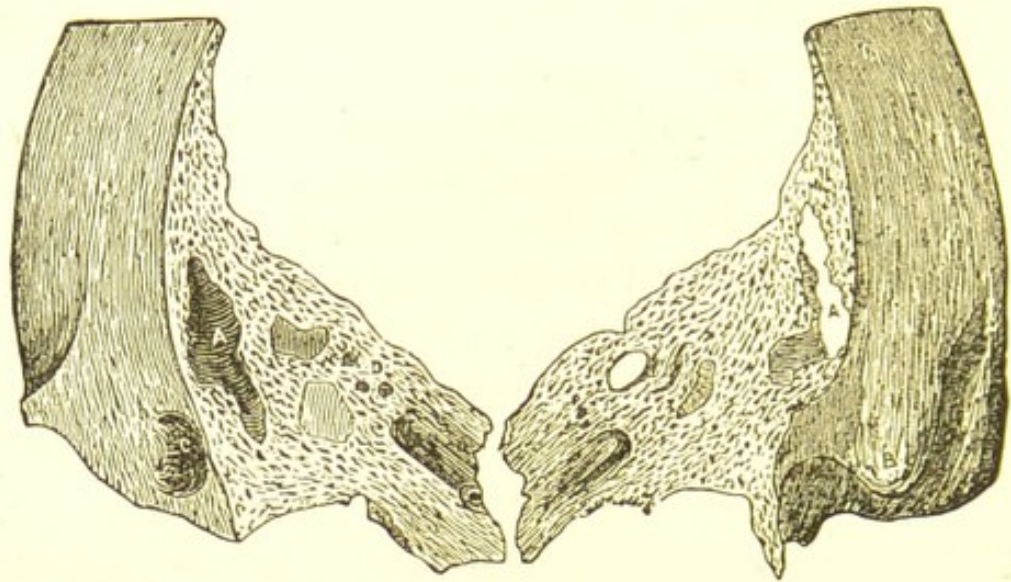
* *British Medical Journal*, Dec. 19, 1874.

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 1½ 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 4 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 4th 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,



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.

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 days before death. Left lobe of cerebellum completely disorganised, 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 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

* Sir W. Gull, "Cases of Phlebitis with Pneumonia and Pleurisy from Chronic Disease of the Ear," *Association Medical Journal*, April 13, 1855.

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."*

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 24th, 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

* *Medical Times and Gazette*, March 16, 1861.

† Reported in *The Lancet*, June 5, 1880.

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. 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.

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 till 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.* 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 con-

* Reynolds, *System of Medicine*, vol. 2, p. 544.

tiguity 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 connexion 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 remarkable 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.

PYÆMIA.—It has above been remarked that if pus finds its way through the lower portion of the drum, it

may injure the jugular vein, and lead to phlebitis and pyæmic abscesses. A remarkable example of this fact was a case admitted, October 5, 1876, into one of the isolation wards of St. Mary's Hospital, under the care of Dr. Handfield Jones.

The patient, S. L., æt. 17, a baker, had twelve years previously fallen off some pipes on to his head, causing epistaxis, and bleeding from the right ear, which had since been deaf and subject to a discharge. Four years later he again fell on to his head from a height of thirty feet, and was picked up insensible; from that time there had been deafness of the left ear also, with offensive discharge. Another fall, two years after, had occasioned compound fracture of the right arm. There was a perforation in each tympanic membrane.

Three years back he had passed through a bad attack of rheumatic fever. Before he came into the hospital, he had for three weeks suffered from frequent rigors, with high but variable temperature, profuse sweating, and all the symptoms of pyæmia. A short time afterwards a large abscess formed in his neck. For weeks he lay between life and death, but on December 9 he was able to walk about.

I think his recovery was in a great measure due to the fact that, as Dr. Jones ordered that the windows of the ward should always be kept open, he received a constant supply of fresh air.

He left the hospital on the 18th of December, when Dr. Jones kindly sent him to me. His hearing distance was then one inch on both sides; but by blowing out through the perforations, by means of Politzer's process, the thick pus which had collected in the tympanum, and by constant washing with warm astringent

lotions, his hearing was rapidly improved, until my watch was audible with each ear at a distance of about eighteen inches.

A few words now as to how chronic discharge from the ear may lead to—1. Abscess of the lung. 2. Abscess of the liver.

Disease of the petrous bone may produce abscesses in both organs, by causing either embolism of a small artery in the organ affected, or else what is known as metastasis. The embolism, when in the lung, is usually brought about as follows:—A thrombus 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—we are at present, I think, unable to say.

Various nervous symptoms frequently occur as the result of otorrhœa in cases in which no gross lesions can be discovered in the brain. Among these may be classed auditory vertigo, or Ménière's disease, and epilepsy.

EPILEPSY.—Epilepsy occasionally follows chronic suppuration of the ears. It may be divided into two forms—first, that of ordinary epilepsy, as mentioned above, in which no gross lesion can be found; secondly, cases of epileptiform convulsions, limited to one muscle or

group of muscles, often without loss of consciousness, and known as Jackson's epilepsy, occurring as a symptom of abscess of the surface of the brain, and connected with its membranes. In these latter cases, thanks to the experimental researches of Hitzig and Dr. Ferrier, to the no less valuable pathological observations of Dr. Hughlings Jackson and Professor Charcot, and the anatomical investigations of Dr. Broadbent and others, the disease may be so accurately localised that one may even venture to trephine the skull to let out pus connected with the dura mater—an operation which, indeed, Mr. James Lane, by the advice of the last-named accomplished physician, successfully performed at St. Mary's Hospital, in 1876.

As a type of very obscure nervous symptoms, I may relate the following case:—

A girl was brought into St. Mary's Hospital in an unconscious state, who had for some years suffered from a chronic discharge from the ear. Before her admission the discharge had suddenly stopped. I could discover no signs of aural disease, but, on account of the former discharge from it, I suggested the application of eight leeches round the ear. This had a somewhat beneficial result. She all at once regained consciousness, and was able to talk; but she as unexpectedly relapsed into her former condition; and shortly afterwards she died. At the *post-mortem* examination, which was most carefully made by Dr. Mahomed, not the slightest trace of disease of any kind could be found—the internal ear, the brain, spinal cord, and all the other organs were perfectly healthy in appearance.

Ear disease accompanying epilepsy is most usually otorrhœa, or chronic suppuration of the middle ear. In

a case of this kind McBride and Alexander James* found potassium bromide of marked benefit in preventing the fits and lessening vertigo. The patient's mental condition appeared to vary greatly according to the state of the ear. The vertigo, in which objects seemed to move from left to right, was such as can be produced by rotating one's self, whilst upright, from right to left, *i.e.*, with the planes of the two horizontal semicircular canals at right angles to the axis of rotation, and the ampulla of the right horizontal canal foremost. Thus, it is said, pressure in this ampulla is increased, and its auditory nerve filaments are irritated. A liability, noted by the patient, to stagger to the right or affected side, towards which also the head would often fall, was probably referable to abnormal irritability in the ampullary nerves. Similarly, in another patient with otorrhœa, a rapid turn of the head from the affected to the healthy side produced a tendency to fall.

McBride and James tabulate as follows diseases of the ear likely to produce vertigo:—

(1.) Organic lesions of the semicircular canals, and probably congestion from acute inflammations in the tympanum.

(2.) Anything causing, by movement of the stapes, increase in the tension of the intralabyrinthine fluid, as (a) a foreign body, *e.g.*, cerumen, forcing the tympanic membrane inwards, (b) catarrh, acute or chronic, of the tympanum and Eustachian tube, either through indrawing of the drum-head, or through pressure of fluid in the tympanum.

Grüber has described a case where, from the presence

* See P. McBride, M.B., and Alex. James, M.D., "Epilepsy, Vertigo, and Ear Disease," *Edin. Med. Journ.*, 1880.

of a perforation in the tympanic membrane, intense vertigo existed so long as the meatus was unclosed with a plug of cotton-wool.

A person may unawares be deaf in one ear, or partially so in both ears, as one may easily discover by testing him with a watch. Tinnitus and vertigo may accordingly be the complaints of a patient who suffers simply from a physical and easily remediable condition of the external or middle ear, and who makes no mention of affection of his hearing.

Lastly, before closing this chapter, I would just mention that insanity may occasionally result from ear disease, such as abscess of the mastoid process. A very good case in point has been described by Dr. W. Rhys Williams and Dr. Savage, of Bethlem Hospital, in which all the symptoms of acute mania disappeared after the evacuation of pus from the mastoid cells.

Some examples, latterly given, of the diseases following otorrhœa might have been reserved for a succeeding chapter; I have preferred, however, to include them in this, as they in nearly every case were the direct result of suppurative inflammation of the ear.

CHAPTER XV.

THE VALUE OF PAIN AS A SYMPTOM OF
EAR DISEASE.

IN the present chapter I have endeavoured 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 give rise to further 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 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 recognised, 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. Unrecognised 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 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

* *St. Bartholomew's Hospital Reports*, vol. 8 ; *St. Thomas's Hospital Reports*, 1878.

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 perforations 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 3rd, 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 the 5th December 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 characterised 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 ℥i. 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 22nd, 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 three-penny 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 actually life is 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 recognised 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 recognised 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 paper. 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 interna, 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 interna, 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 intracranial mischief may have arisen, against which we shall be powerless. Case E. is a good example of what appeared to be evidences of serious intracranial 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 interna. 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 unrecognised.

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 interna 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 recognise the fact that pain which has its origin in the ear is by no means localised 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 pneumogastric 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 occupy.

Intermittent aural neuralgia occurs in patients subject to aural catarrh. 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 interna, 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 XVI.

DISEASES OF THE INTERNAL EAR.

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 more or less general constitutional conditions, as in the course of fevers, meningitis, syphilis, mumps, rheumatoid arthritis, and, less generally, tabes dorsalis.

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.

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 unailing 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 at once knows that there is disease and consequent 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 ear.

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 realised 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

* See *Brit. Med. Journ.*, Sept. 4, 1880, p. 391.

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 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, 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.†

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.

In illustration of the character of true nervous deafness, I will give the records of a few cases of neurotic disease accompanied by 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,

* See *Medical Press and Circular*, Dec. 19, 1877.

† See *Archives of Otology*, March 1881.

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 of a fall on the head some years previously, and subse-

* *Lancet*, March 24th, 1882, p. 417.

quent 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 hemorrhages 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, 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 membrana tympani could be detected.

Deafness after Typhoid Fever.—The following case is

* See case of injury to head, p. 265.

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 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 Vomicæ ℥ij.

Aquæ ℥ss. 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.*

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 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, but she could hear a tuning-fork placed on the vertex of her head. 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

* J. N. Radcliffe in Reynolds's *System of Medicine*, vol. 1, p. 505.

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.

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 intracranial 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 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 per-

* *Journ. of Anat. and Physiol.*, vol. 14, p. 195.

haps 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. 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.

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.

MÉNIÈRE'S DISEASE.

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 that last 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 semicircular 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.

* *Diseases of the Ear*, 4th ed., p. 494.

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 of

Ménière's disease 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 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 hystéria, may be developed in the course of the disease.

Fére 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

* See paper read before the Otological Section of the International Medical Congress at Amsterdam, 1879, *Archives of Otology*, vol. 9, No. 3, Sept. 1880.

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 *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 "sensa-

* See C. Fère et A. Demars, "Note sur la maladie de Ménière, et en particulier sur son traitement par la méthode de M. Charcot." *Rev. de Méd.*, quoted in *New York Med. Journ.*, January 1882.

tion 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 versa*, 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 perforation 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 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 20 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 3 yards from the right ear, 2 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 con-

quered 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 ʒss. 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 60, 70, or 80 centigrammes 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:—

M. J., 40, admitted into St. Mary's Hospital, October 1, 1876, had been deaf off and on since when, about 12 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 12th the ticking of a watch was audible at the distance of 6 inches from her right, and 12 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 5 grs. 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 disease,

* See Fére and Demars, *op. sup. cit.*

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 5 to 15 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. xii.
Tinct. Nucis Vomicae ..	℥v.
Aq. ad	℥i. 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 of the base of the skull, followed by deafness, is instructive.

H. M., æt. 20, was admitted at St. Mary's under the care of Mr. James Lane, December 5, 1877, having fallen from a height of 12 feet, and struck his head against some stone 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 applica-

tions 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 intracranial 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 2nd, 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 6th he could hear the watch 5 inches, and in ten days' time 36 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 cloud 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 sympathise, 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 recognising 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 organisation 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. A futile 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 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 fairly well, but could hardly distinguish the vibrations of a tuning-fork placed on his head.

In some severe forms of neuralgia and tic-doloureux, the hearing is liable to become affected. Audition

* *Lancet*, March 30, 1878.

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 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 her 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.

* 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.

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.

Nervous 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 sug-

* 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.

gests 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 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 short time, 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

* "Supplement" to Toynbee's *Diseases of the Ear*, p. 461.

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."

Cerebral tumour, usually either fibrous or sarcomatous, may affect the auditory nerve. The following are brief notes of a case of the latter:—†

January 29, 1877, E. J., æt. 29, admitted into St. Mary's Hospital, 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 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.

* *Lectures on Syphilis*, delivered at the Harveian Society, by James R. Lane, F.R.C.S.

† *Lancet*, Dec. 8, 1877.

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 localise the cause as affecting the left side of the pons, while the ataxy of the lower limbs shows the cerebellum 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 eyeballs; 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°; diarrhœa; urine contains mucus, sp. gr. 1024.

6th.—No diarrhœa; 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

PLATE I.

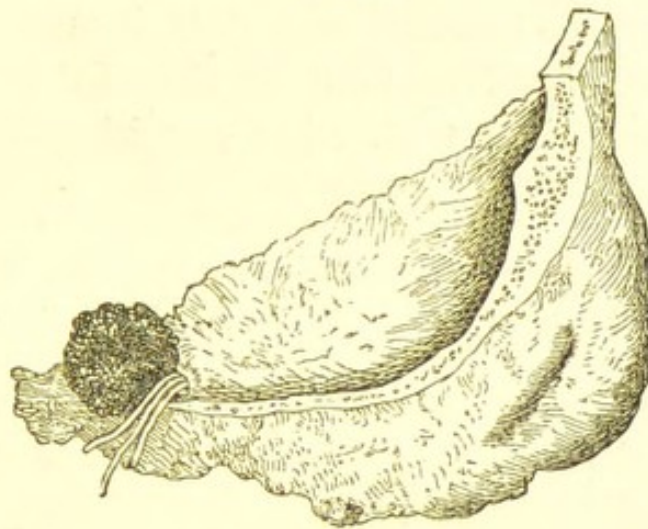


attached to the posterior surface of the right petrous bone,* just above the internal meatus. It was fissured and corrugated on its surface, like the cerebellum, and was of soft sarcomatous structure, not unlike brain-tissue on section. The upper margin of the medulla formed its posterior boundary. On examination of the petrous bone, the tumour appeared to have sprung from the dura mater lining the internal auditory

* 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's Catalogue:—Plate I. 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.—Plate II. 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.

meatus, and ensheathing the 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

PLATE II.



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 both 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 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 nervous deafness. No case should be considered irrecoverable 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 nervous deafness, as a class, it must be remembered, although unfavourable for remedial measures, are rare in comparison with other conditions of impaired hearing.

* Niemeyer, *Text-book of Practical Medicine*, translated by Dr. G. H. Humphreys and Dr. C. E. Hockley, vol. 2, p. 240.

CHAPTER XVII.

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

* 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. 185.

cases to exhalations from the stomach, and in others to increased sensitiveness of the ears.

As to the cause, 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 unfrequently, 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 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

* *On Aural Surgery*, p. 84.

† *On Aural Catarrh*, p. 201.

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." And 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 aneurism 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 a weakened right side of the heart. Perhaps, however, the most frequent cause of tinnitus is pressure on the labyrinth, as illustrated by the sound

* In the *Transactions of the American Otolog. Soc.*, 1880, Dr. Spencer relates a case of supposed traumatic aneurism 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.

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 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; but, on the other hand, Mr. Dalby relates the case of a man residing at Trieste, "who had suffered for many years from tinnitus of so distressing a character that his life was rendered perfectly wretched. All the best aural surgeons in Germany had been consulted by him without any benefit. According to a request made in his will that his ears should be examined after death, a most careful dissection was made of the temporal bones, but no abnormal appearance of any kind was detected."*

Tinnitus aurium, it should not be forgotten, is commonly 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.†

We rarely find tinnitus present in cases of perforation from ulceration, and, if a permanent opening can be

* *Lectures on Diseases and Injuries of the Ear*, by W. B. Dalby, F.R.C.S., p. 175.

† F. E. Anstie, M.D., in Reynolds's *System of Medicine*, vol. 2, p. 180.

established, incision of the membrane will doubtless afford relief. As I have already stated (p. 156), very numerous methods have been suggested to keep open the puncture.

Various other remedies besides myringotomy have been proposed for this distressing symptom of aural disease. Thus, chloride of ammonium, in doses of 20 grains three times a day, is said to be sometimes efficacious, also glycerin and laudanum applied warm to the meatus.

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." He remarks that "If there is any medicine which acts specifically on tinnitus aurium it is arnica."

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, taken perseveringly once or twice a day, seems the most useful. Stimulating liniments around the ears, perhaps containing chloro-

* Holmes, *System of Surgery*, vol. 3, p. 185.

form, 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."

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.

Ergot, digitalis, and the bromides of ammonium and potassium (which I have found useful in several cases) have all been recommended, and so have other more extraordinary remedies. A patient of mine at St. Mary's believed "a bit of dead eel put in the ear" to be "a capital thing for the buzzing noise."‡

In many long-standing cases of aural catarrh in which tinnitus is very severe from what is described as paralysis of the intrinsic muscles of the ear, and in which other measures have failed to afford the slightest relief, I have found the direct application of faradisation to the tympanic membrane most useful.

Dr. Althaus observes that all forms of electricity are

* 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.

able to arouse the vital energy of the auditory nerve, causing a sound closely corresponding to the note A.

According to Dr. Brenner, of St. Petersburg, the induced current by the rapidity of its shocks produces very unpleasant effects on the nerves of common sensation, without acting on the auditory nerve. A specific response of the latter can be obtained only by single closing or opening shocks, the opening being the more effective. Increase of the power of the current produces in some persons a regular scale of auditive sensations, proceeding from humming to hissing, rolling, whistling, and ringing; and some hear noises with low, and tones with high power.

Dr. Schwartz pronounced Brenner's statements to be altogether erroneous and devoid of value; but by Dr. Hagen, of Leipzig, they were confirmed in almost every particular; and Brenner contended that Schwartz's experiments, having been improperly conducted, were worthless.

The effect of a single shock from an induction apparatus is a noise like a scratch; that of a rapid succession of shocks resembles the buzzing of a fly on a window, or the sound of a distant trumpet. A current of high tension causes a sensation of pricking and pain. The negative pole produces more marked acoustic phenomena than the positive.

With Dr. Brenner I agree in thinking that the subjects of nerve deafness are rendered more permanent benefit by the continuous than by the induced current. The good effect of electricity appears to be entirely due to its stimulation of the intrinsic muscles of the ear. I have applied the continuous current for tinnitus aurium without any good results. I

have used Dr. Stöhrer's double-celled induction apparatus,* passing the current directly on to the membrana tympani by means of a vulcanite speculum, through which passes a piece of platinum wire attached to one of the wires of the battery. A silver probe brought into contact with the platinum carries on the current from the speculum to the tympanic membrane. It is necessary at first to apply a very weak current, which may be gradually increased in strength. The shock, if conveyed in the manner just mentioned, occasions but slight pain, and never, so far as my experience goes, either hæmorrhage or any other serious result.

The peculiar sensation of taste caused by faradisation of the drum of the ear is due to stimulation of the trunk of the chorda tympani.†

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.‡

I may here mention that in many of my patients

* Made by Messrs. Krohne and Seseman, of Duke Street, W.

† For further information, see Dr. Althaus, *Medical Electricity*.

‡ *Cyclop. of Anat. and Phys.*, vol. 2, p. 576.

suffering from severe tinnitus no abnormal condition of the drum-head has been detectible.

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 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, or, as Politzer believes, 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 anyone 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 lastly to say a few words as to the numerous instances that come before one of tinnitus aurium and deafness traceable not to any 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 but 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.

Tinnitus is frequently seen in cases of hemicrania due to gout or other causes in which dilatation, hyper-

* See *Lancet*, Nov. 19, 1881, p. 884.

distension, and cord-like rigidity of the external vessels of the head are marked symptoms and indicate a like condition of the intracranial blood channels.

Again, tinnitus is often the result of augmented blood-pressure in venous hyperæmia due to heart disease. Analogous but localised hyperæmia, observable by the otoscope, is caused by an overdose of quinine or salicin, and probably also by alcohol. 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 equalise 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.

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 not infrequently met with in Bright's disease is, as Schwartz first showed, to be attributed to the occurrence of capillary hæmorrhages in the tympanum and other parts of the auditory appa-

ratus, 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. In some instances, however, more certain and severe means must be resorted to. Thus, in the case of a gentleman, Mr. T., aged 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—recognising 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

* 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.

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 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 XVIII.

ON THE GENERAL PATHOLOGY OF EAR
DISEASE.

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

* See paper by the author, *Medical Press and Circular*, March 1879.

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; pemphigus and lupus, to syphilis. 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.

Hæmatoma auris or othæmatoma (see p. 95) is the result of 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.

The diseases of the external meatus are such as affect

other parts of the body where skin is merging into mucous membrane, especially epithelioma and condylomata. Epithelioma of the auricle is not infrequent, and commences usually in the immediate neighbourhood of the meatus. Lupus and rodent ulcer, the latter of 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. 91, can scarcely be said to be the results of disease.

A key to the diseases of the external meatus is afforded by its anatomical structure. The outer half is formed by cartilage, the inner by bone; the skin over the outer half consists of both cuticle and corium, and contains hairs, follicles, and ceruminous glands, while that over the inner is devoid of corium, this being replaced by periosteum.

The fact pointed out by Von Tröltsch (see p. 108), that the term "catarrh of the external meatus" has anatomically no justification whatever, is universally true, except, perhaps, as Schwartze 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 tympanum. 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, and occurring in the anterior lower wall of the meatus. They, in common with chronic eczema, which induces hypertrophy of the corium, may lead to stricture of the meatus.

The ceruminous glands may, when obstructed, produce sebaceous tumours, or cholesteatomata; the cartilaginous wall of the meatus, enchondroma; and the bony wall, the exostoses already described (see Chap. V.). Sarcoma doubtless occasionally appears in the meatus, but its occurrence has not yet been put on record. 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 fibro-sarcoma, others of round-celled or granulation sarcoma, myxo-sarcoma, osteo-sarcoma, or of osteo-chondromata.

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 impossible 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 Tröltzsch 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. 161). We may consider it fortunate sometimes for the cavity to become blocked with a mass of cheesy material, although there is the risk that this may at some time develop into an active centre of infection, and cause general 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, gastrointestinal irritation, urethritis and vaginitis, conjunctivitis, and, more commonly, sclerotitis as the result of gout and Bright's disease. It appears probable that tubercle, another constitutional disease affecting mucous membranes, is to be met with in the human tympanum, for Schwartz believes that he has seen it there in the living subject, and Schütz has shown its occurrence in the tympanum of the pig. 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.

In early life most 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.

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 characterised 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 passage, 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 organised 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 become 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 no 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 are 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 organisation 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 osteoarthritis—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 results 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 Schwartz to be extremely scarce, but I cannot say that this is quite my experience, though certainly the ordinary aural exostoses, which, from their nature, origin, and shape may fairly be classed among polypoid growths, are far more common.

Cholesteatoma, sebaceous and dermoid cysts, osteosarcoma, 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. If inflammation in them 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.

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, as in some cases, 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 inflamma-

tion 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 nerve 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 to successful treatment.

CHAPTER XIX.

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 & Ireland	1871	19,236	1 in 1,636
France* (86 departmts.)	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
N. 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

* See J. G. Loubrieu, "Étude sur les Causes de la Surditité," *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.

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 *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 interna*, are common in infants of very tender age, and are accountable for a large number of the so-called cases of congenital deaf-mutism.

It has been estimated† that in Great Britain one

* *Pract. Obs. on Aural Surgery*, p. 461, 1853.

† *Brit. and F. Med.-Chir. Rev.*, July 1861, vol. 28, p. 64.

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 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 recognised 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.

* *Brit. Med. Journ.*, April 23, 1881, p. 654.

† *Deafmutism*, trans. by Cassells, p. 64.

‡ See case recorded on p. 123.

§ *Op. cit.*, p. 10.

"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. 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 forty suggests the inference that the operation of hereditary constitutional taint in bringing about congenital deaf-

* *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.

|| See Sedgwick, *Brit. and F. Med. Chir. Rev.*, 1861, p. 202.

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 goîtreux." 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, goître, 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 constitutional conditions as

* *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.*

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

* 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.

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.*

“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,§

* *The Lancet*, Nov. 26, 1881, p. 922.

† *Americ. Annals of The Deaf and Dumb*, vol. 8, No. 3, p. 133.

‡ See Lunier, “Sur la Responsabilité légale des Sourds-muets,” *Ann. d'Hygiène*, 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.”

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 surdi-mutité congénitale est sans contredit une des manifestations les plus fréquentes de la consanguinité dans le mariage. Chaque jour l'observation grossit le contingent des faits imputables à 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.

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

* *Gazette Hebdomadaire*, Sept. 1860, p. 598.

† See *Trans. Amer. Med. Assoc.*, vol. 11, 1858, abstracted in *Brit. and F. Med. Chir. Rev.*, 1860, vol. 26, p. 151.

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:—

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	0·014	2·04
First Cousins	0·77	18·47

} 1·82

* See *Recueil de Mém. de Méd. Milit.*, March, abstracted in *Med. Times and Gaz.*, May 10, 1862, p. 489.

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 far 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 $4\frac{1}{2}$ 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 ill-results accruing to the offspring in consequence of the cousinship of their parents."

* "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."

Investigators into the effects of the marriage of blood-relations 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

* *The Marriage of Near Kin*, pp. 229, 230.

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 already quoted (p. 55):—"In Prussia, where the total number of consanguineous marriages yields a percentage 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 sprung 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,

* 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.

and that out of the 13 children of six 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 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

* *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.*

‡ *Brit. and F. Med.-Chir. Rev.*, 1861, p. 202.

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.

Systems 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

* See *Ency. Brit.*, *loc. cit.*

institutions and countries." * What wonder, then, if the world of the totally uninitiated, in speaking of the 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

* *Speech for the Deaf*, pp. 93, 95.

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.*, Dec. 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 Mr. Dalby's lucid pamphlet *On the Education of Incurably Deaf Children*, to Dr. J. P. Cassell's "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 Taubstummenebildung*, 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 XX.

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 free 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 behind or around the ear the hand or some other means of augmenting resonance 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 the 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

* See paper read before Otological Section of the International Medical Congress in 1881, published in *The Lancet*, Dec. 24, 1881, p. 1082.

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 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 18 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.†

* *The Lancet*, Nov. 2, 1873, p. 665.

† *Wiener Med. Woch.*, No. 18, 1881.

Kœnig 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 fit 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 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

* See p. 184.

† "Hearing by the Aid of Tissue Conduction. The Mouth-trumpet and the Audiphone," *Americ. Journ. of Otology*, Apr. 1880.

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's 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's. 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.

It has not yet been shown that the microphone can be made practically available for the relief of deafness.

* *Brit. Med. Journ.*, Sept. 4, 1880, p. 391.

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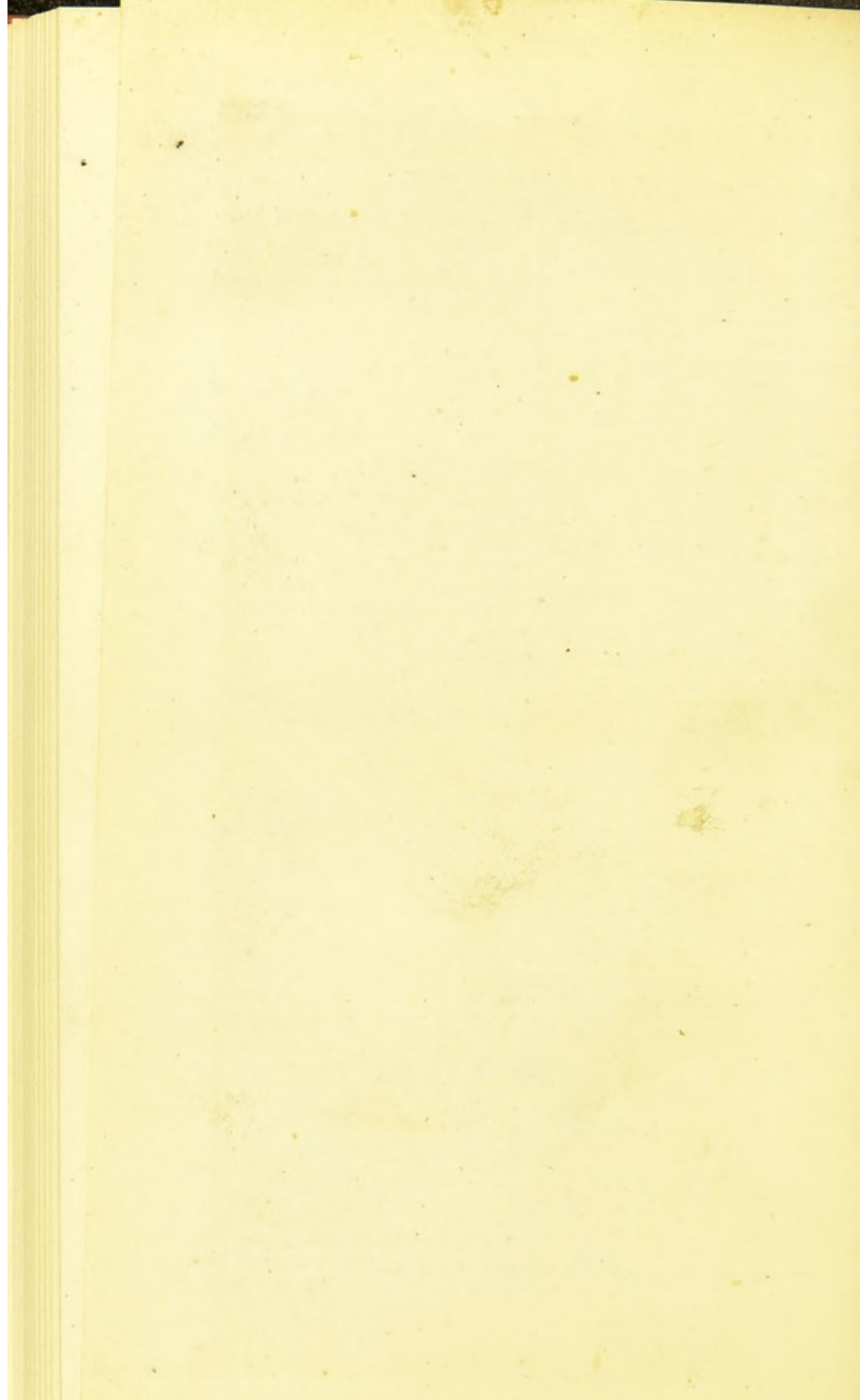
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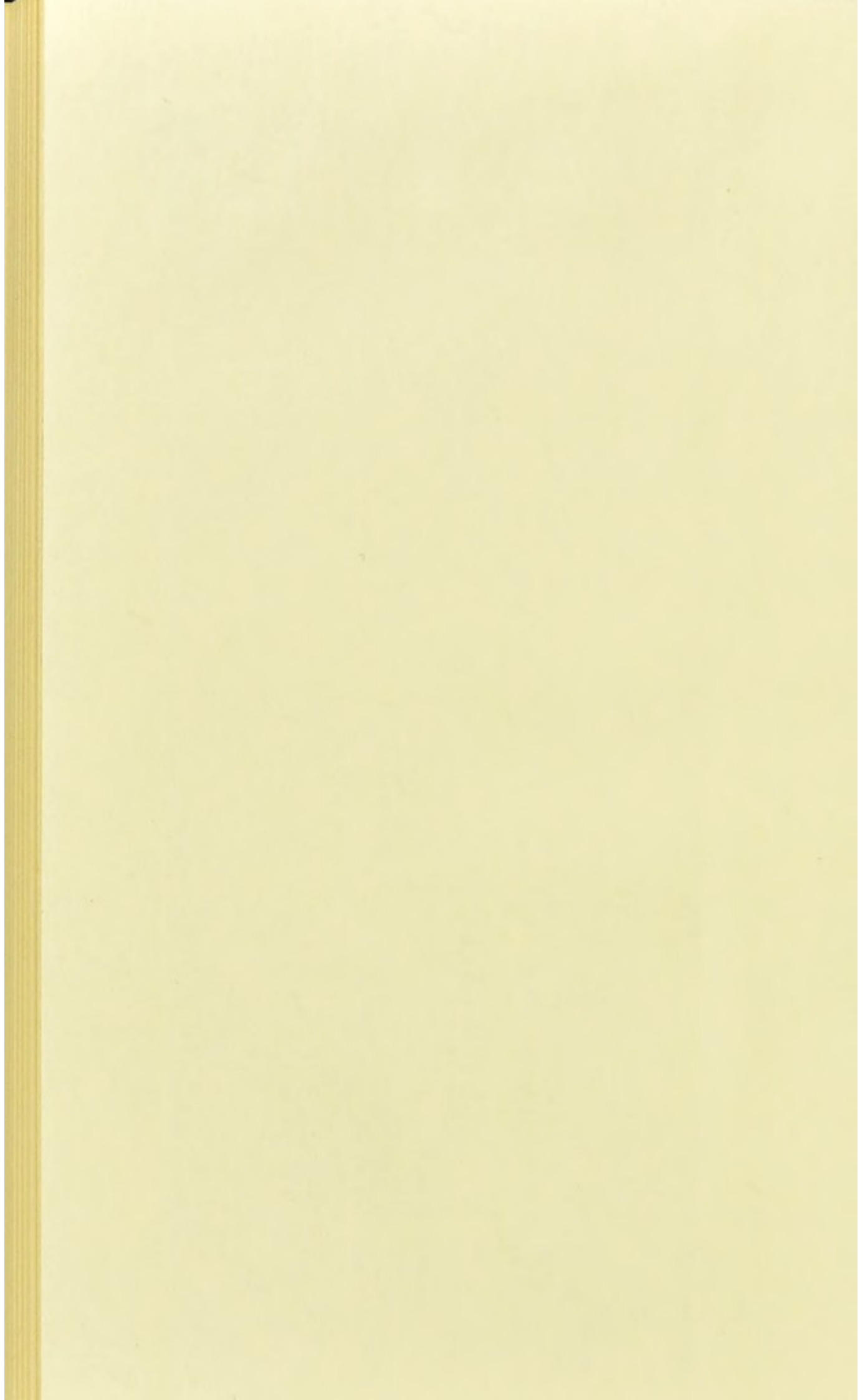
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