



THE PRACTITIONER'S OTOLOGY

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To
WILLIAM A. PEARSON, Ph.C., Ph.D., M.D.
*Dean of the Hahnemann Medical College
of Philadelphia, Pa.*

this work is dedicated in
appreciation of his tireless endeavors
in behalf of our College

PREFACE

During many years of teaching and consultant work, we have come frequently in contact with beginners in otology and practitioners who have suggested the value of a brief work covering the more common aural conditions, their diagnosis and treatment. Their claim for this has been that, from their standpoint, the average excellent work on otology is too advanced for their use and that, in order to acquire the limited knowledge required for their practical purposes, they were forced to read much that is of interest to the advanced student but more or less confusing to the beginner and general practitioner.

With a desire to meet the above requirements this book is presented, in which we shall attempt to set forth, in as clear and concise a manner as possible, the knowledge which the beginner and general practitioner wish to acquire for their general work. For this reason many aural conditions, advanced treatment, surgical measures and finer methods of diagnosis are not mentioned, as these come within the scope of the specialist.

After many years of teaching, we feel that the reading of these pages should give a good understanding of the basic principles of otology, enable the reader to diagnose and treat the more common aural affections and answer at the same time the question so often asked, "When shall I refer my case to the specialist?"

PREFACE TO SECOND EDITION

The reception accorded the first edition of the Practitioner's Otology together with the constant requests from various sources for further copies have encouraged the authors to publish a second edition. No attempt has been made to make radical changes in the arrangement of the work. Additions have been made especially in the chapter upon functional testing. The general acceptance of the former edition and personal observations of its utility to those for whom it is intended have been most encouraging and justify the continuation of the work.

The authors are indebted to Messrs. Boericke and Tafel for publication and in particular to Mr. A. L. Tafel for his personal interest.

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The drawings from which the cuts in this book have been made were the work of Gertrude Schwartz and the late Margretta Washington.

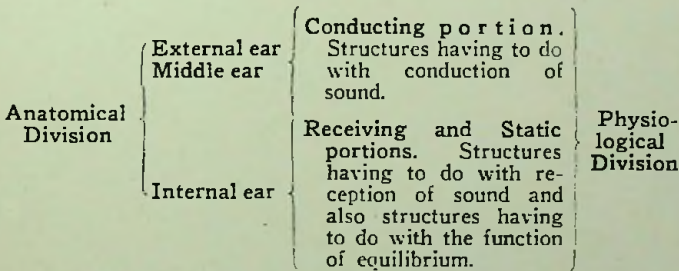


CHAPTER I

ANATOMY AND PHYSIOLOGY OF THE EAR

It is impossible to work understandingly without a clear idea of the anatomy of the ear and the functions performed by it. For this reason we shall consider the anatomy and physiology from a purely practical standpoint, directing attention especially to those points which are essential for an understanding of the more common ear affections.

The following outline, if studied, will give briefly the main points of the anatomy. In the text, following the outline, we will direct attention to those portions which we consider of greatest importance from a practical standpoint.



External Ear	Auricle	Attached to the head by integument, muscular and fibrous tissue.
	External auditory canal	<p>Cartilaginous portion: Shorter than the bony; is a continuation inward of the auricular cartilage.</p> <p>Bony portion: Longer portion. At birth only an imperfect ring, later forms with the mastoid the bony canal.</p> <p>Length of canal, $1\frac{1}{8}$ in.</p> <p>Direction: Upward and backward, then forward and downward.</p> <p>Diameter: Varies; smallest at junction of cartilaginous and bony portions.</p> <p>Walls: Anterior and inferior the longest; this is due to the oblique position of membrana tympani at the end of the canal.</p>
Middle Ear	Membrana tympani	Three layers: dermal, fibrous and mucous. Placed obliquely at the end of the canal.
	Ossicles	Malleus, incus and stapes. Drum attached to malleus along the manubrium and short process.
	Tympanic cavity	<p>Contains the ossicles.</p> <p>Anterior wall: Eustachian tube opening and internal carotid artery.</p> <p>Floor: Jugular bulb.</p> <p>Roof: Middle cerebral fossa.</p> <p>Posterior wall: Aditus ad antrum.</p> <p>Inner wall: Round and oval windows and facial nerve.</p> <p>Outer wall: Drum and outer plate of squamous portion.</p> <p>The chorda tympani nerve crosses the cavity.</p>
	Eustachian tube	<p>Extends from the nasopharynx, just posterior to the posterior end of the inferior turbinate, to the anterior wall of the tympanic cavity. The first portion is cartilaginous, the second bony.</p> <p>Function:</p> <p>(a) Drainage.</p> <p>(b) Allows passage of air to the tympanic cavity, thereby equalizing the pressure of air of the external auditory canal.</p>

Middle Ear	Aditus ad antrum	Connecting middle ear cavity with the mastoid.
	Mastoid antrum	Large bone cell in the mastoid process.
Internal Ear.....		Bony labyrinth. Membranous labyrinth. Auditory nerve. Brain centers.

The *external ear* consists of the auricle and external auditory canal. The entire auricle, with the exception of the lobule, consists of cartilage with a covering of perichondrium and integument. It is attached to the head by the integument and is more or less movable, an anatomical fact of considerable value, as we shall see later in our consideration of the objective examination.

The *external auditory canal* consists of a bony and a cartilaginous portion, the entire canal being lined with integument, which is an extension inward of that covering the auricle. The cartilaginous portion of the canal is the more external and is a continuation of the cartilaginous framework of the auricle, while the bony portion is formed by the mastoid portion of the temporal bone and the vaginal process.

The cartilaginous and bony portions are joined by fibrous tissue which permits of free motion as before mentioned. The canal, from its orifice to its inner end is approximately $1\frac{1}{8}$ inches in length, being closed at its inner end by the *membrana tympani* or ear drum. In the average case it is a curved canal, having in its first portion, a direction backward, upward and inward; in its second portion downward, forward and

inward, so that it is impossible, in the average case, without instrumental aid, to see the ear drum at the end of the canal. The integument, lining the canal, is intimately attached to the perichondrium and periosteum, a fact well worth remembering as explaining the early and intense pain produced by extravasation of fluid beneath it. In the first portion of the canal, we find many glands and hair follicles, while these are sparsely found in the second portion. (This histological fact explains why so many acute and sub-acute inflammatory conditions are found at, or near, the orifice of the canal.)

The anterior and inferior walls are longer than the superior and posterior walls, due to the oblique position of the membrana tympani at the end of the canal. (This anatomical fact is of value to remember in the removal of small foreign bodies which are resting against the drum.) Throughout the canal are found glands which secrete cerumen, this acting as a lubricant for the integument of the canal. By a peculiar method of growth of the epithelium of the canal, this growing from the drum outward, the cerumen, under normal conditions, is kept from collecting in the canal. At the orifice of the canal are found, in many cases, a varying number of hairs. In some individuals these are numerous and strongly developed. In such cases very frequently they make difficult our examination, often acting as an obstruction and bringing about the retention of cerumen in the canal. The general course of the canal will be found to vary in different individuals and these variations tend either to make more difficult or to simplify the objective examination. An

abnormally formed canal may act as a factor in the excessive collection of cerumen.

The narrowest portion of the canal is at the junction of the cartilaginous and bony portions, the canal being constricted at this point and narrower than at either end. It is here that small foreign bodies, such as peas, beans, and shoe buttons tend to lodge and it is well to remember this anatomical narrowing, for if, through unskilled instrumentation, foreign bodies are pushed beyond it, it becomes a difficult matter to remove them.

On the anterior wall of the bony canal we have a close relation with the condyle of the lower jaw, this explaining why, in acute inflammatory conditions of the canal, the symptoms are aggravated by chewing. The canal has also a close relation with the parotid gland and it is possible to have a suppurative process of this gland break through into the external canal.

On account of the lack of development of the bony canal in the child, we find the direction of the canal varying somewhat from that of the adult, and we also find it shorter, the ear drum lying closer to the orifice of the canal.

The *membrana tympani* or ear drum is placed at the end of the external auditory canal in such a way that it has a double obliquity, being oblique from above downward and inward, while at the same time having an obliquity from behind, forward and inward. This peculiar placement of the drum accounts, as before mentioned, for the difference in length of the walls of the external canal.

Histologically, the drum consists of three distinct

layers, an outer layer, which is a continuation of the dermal layer of the external canal; a central fibrous layer consisting of two sets of fibers, one arranged concentrically, while the other radiates from the center of the drum to the periphery. These fibers give strength and resistance to the drum and undoubtedly play an important part in the ability of the drum to conduct sound. (In atrophic conditions these fibers are absent and the membrane will be found to be intensely lax and flaccid.) A third, or inner layer, consists of mucous membrane, a continuation of the mucous lining of the middle ear cavity. While in the larger portion of the membrane the central or fibrous layer is found, there is a small upper anterior portion in which this fibrous structure is lacking. This portion of the drum is known as the *membrane of Shrapnell*, or the *membrana flaccida*, in contrast to the remaining portion, which, because of its fibrous contents, is called the *membrana tensa*.

The drum is placed in a small horse-shoe shaped bony ring, known as the annulus tympanicus, and in many ears this can be seen around the edge of the membrane, except in the region of the membrane of Shrapnell where the annulus is lacking. Attached to the *membrana tensa*, in its fibrous layer, we have certain processes of one of the ossicles, hereafter to be described, and these processes form, as you shall see later, valuable "landmarks" in the examination of the drum.

Within the middle ear cavity are found three *ossicles*, the *malleus*, *incus*, and *stapes*, so called because of their similarity in form to a hammer, an

anvil and a stirrup. These ossicles are so joined, by a system of articulations, that they form, as it were, a system of cogs, across the middle ear cavity from the ear drum to the oval window; the malleus being attached intimately to the drum, the incus being placed between the malleus and stapes, while the footplate of the stapes is lodged in the oval window. It is through this chain of ossicles that the sound waves, received by the ear drum, are carried to the internal ear. As certain processes of the malleus are important, forming as they do, "landmarks" for examination of the ear drum, we describe this ossicle somewhat in detail. It consists of a rounded head, neck, short process, manubrium (or handle) and a long process, known as the *processus gracilis*. It is so placed in the middle ear cavity that its head lies above the level of the external auditory canal, while the neck and short process and manubrium extend in a direction downward and backward to about the center of the ear-drum, being attached to the fibrous layer as before stated, so that the short process and manubrium are distinctly seen in the objective examination. Attached to the neck of the malleus and extending inward to the inner wall of the middle ear cavity is the tendon of the *tensor tympani muscle*, this acting, as its name implies, to regulate the tension of the ear drum while at the same time drawing it inward so that the drum is, under normal conditions, depressed at its center.

The *middle ear cavity*, or *tympanic cavity*, is small and irregularly shaped, lying, in its greater portion internal to the ear-drum. On its anterior wall we find

the opening of the Eustachian tube. On its posterior wall a small opening, extending back into the mastoid cells, the *aditus ad antrum*. Above its roof lies the

The Malleus

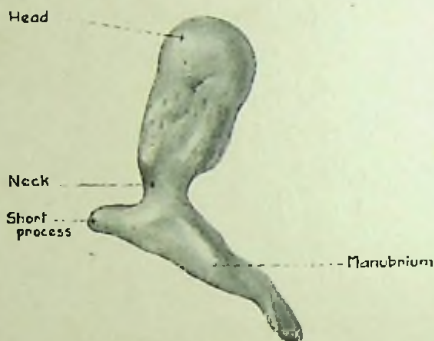


PLATE I

Cross section of external canal, membrana tympani and tympanic cavity.

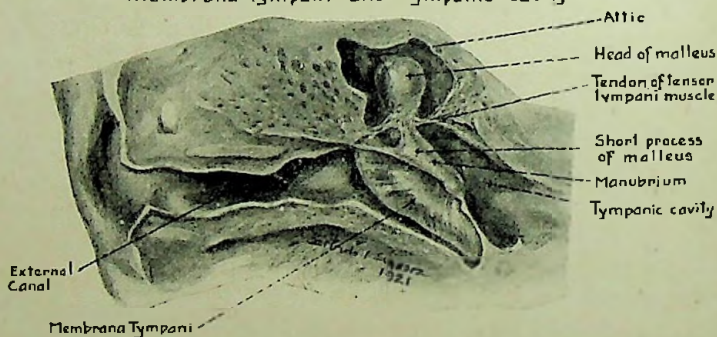


PLATE II

middle cerebral fossa; below its floor the bulb of the jugular vein. Its inner wall is formed by a portion of the outer wall of the internal ear and presents two

openings, the *oval window* and the *round window*, the former being closed, in the natural state, by the foot-plate of the stapes, while the round window is closed by a membrane, resembling in structure that of the ear-drum, the outer layer composed of mucous membrane, the middle layer fibrous, and the inner layer endothelial. Along the inner wall also runs the facial nerve enclosed in a small bony canal known as the *Fallopian canal*. We thus see that the tympanic cavity has important relations with

(a) the middle cerebral fossa above,

(b) the nasopharynx anteriorly by means of the Eustachian tube,

(c) the mastoid cells posteriorly by means of the aditus ad antrum,

(d) the facial nerve on the inner wall; also here a close relationship, through the round and oval windows, with the internal ear.

The outer wall of the middle ear cavity is formed largely by the *membrana tympani*. The entire cavity is lined with mucous membrane, which is an extension inward, through the Eustachian tube from the nasopharynx and this membrane acts as a nourishing membrane for the underlying structures. In its greatest diameter the middle ear cavity will measure less than an inch. The upper portion of the middle ear cavity, which lies above the level of the roof of the external canal, is known as the *attic*.

The *Eustachian tube* extends from the nasopharynx, on its lateral wall, just posterior to the posterior end of the inferior turbinate, in a direction upward, backward and outward, entering the middle ear cavity on its

anterior wall. As with the external auditory canal, we find here also a cartilaginous and a bony portion, the cartilaginous portion being the pharyngeal end of the tube, while the bony portion is formed by the temporal bone. It is lined throughout by mucous membrane, an extension upward from the nasopharynx. Under normal conditions the walls of the Eustachian tube lie closely together just as the walls of the urethra, but by the action of the tensor and levator palati muscles during the act of swallowing the walls are forced apart and air passes into the middle ear cavity, thereby equalizing the pressure of the column of air in the external auditory canal, so that the ear drum, under normal conditions, has the same air pressure on either side. This condition allows free movement of the ear drum. As we shall see later, disturbances of this function produce certain subjective symptoms as well as pathological conditions. In addition to this important function of the Eustachian tube, it also acts as a channel for drainage of the middle ear cavity. Cessation of this function also produces its chain of subjective symptoms and pathological conditions.

As in the external auditory canal, we find the narrowest point or isthmus of the Eustachian tube at the junction of the cartilaginous and bony portions. It is important, in treatment of tubal conditions, to remember the relations of the Eustachian tube to the internal carotid artery, as rough manipulations may produce injury to this vessel.

Passing backward, from the middle ear cavity, we enter through a small passage known as the *aditus ad antrum*, or way to the *antrum* and *mastoid cells*.

In order to understand these cells we give a brief description of the mastoid process.

This process, called *mastoid* because of its similarity in form to the breast, consists of a bony capsule with an outer and an inner plate, the distance between these two plates depending upon the character of the contained structures. In the typical mastoid these structures consist of a large number of irregularly shaped bony cells, lined with modified mucous membrane which is an extension from the middle ear cavity. This type of mastoid is known as the pneumatic mastoid. In a certain percentage of mastoids the outer and inner plates lie close together, the contained structure being of a *sclerotic* nature or *diploic* in character and so-called *sclerotic* or *diploic mastoid*. In every mastoid, however, there is found in the upper anterior portion a large cell, known as the *antrum*, this communicating directly with the middle ear cavity through the aditus ad antrum and directly, or indirectly, with the mastoid cells. On account of the variation in structure of the mastoid we find wide variation in its size. At the same time, in consideration of its plates, we find wide variation in their density, the one specimen showing the outer plate more dense, another the inner plate.

The mastoid has very important anatomical relations, with (*a*) the middle cerebral fossa above, (*b*) the lateral sinus and posterior cerebral fossa posteriorly, (*c*) the facial nerve and labyrinth internally, (*d*) the structures of the neck inferiorly through the inner surface of the mastoid tip. (Because of the wide variation in the cell formation of the mastoid and the density of its plates, we find, in a series of cases of mas-

toiditis, varying clinical pictures.) The mastoid is covered, upon its upper two-thirds, by the integument and periosteum, while the lower one-third, or tip of the mastoid, is roughened, and here are attached the tendons of the splenius capitis and sternomastoid muscles. If we will hold this anatomical fact in mind, we shall understand why, in a case of perforation through the outer plate, there will be a fluctuating swelling behind the auricle when the perforation is in the upper two-thirds, while there will be no fluctuation if it occurs in the lower one-third, because, in this case, the pus is thrown out underneath the attached muscles and is forced into the neck.

The mastoid antrum is in very close relation with the posterior wall of the external auditory canal and it is due to this anatomical relation that, in cases of acute mastoiditis, we frequently find a sagging or sinking of the posterior canal wall due to a periostitis in this region.

The *internal ear* consists of a *bony and membranous labyrinth* together with the *auditory nerve* and *brain centers*. The bony labyrinth is lodged within the petrous portion of the temporal bone and consists of three main anatomical divisions, the *vestibule*, *cochlea*, and *three semicircular canals*. Within the bony labyrinth is placed the membranous labyrinth, this being surrounded by a fluid known as the perilymph. The membranous labyrinth contains the endolymph. Within the membranous labyrinth also we find the endings of the auditory nerve which have to do with the essential functions of the labyrinth. As a detailed descrip-

tion of this would prove most confusing and not of practical value, we omit it. Suffice it to say that the auditory nerve consists of two portions, a cochlear and a vestibular portion. The cochlear portion, which has to do with hearing, is lodged within the cochlea, while the terminations of the vestibular branch, which have to do with equilibrium, are found within the vestibule and semi-circular canals.

An anatomical fact, worthy of note, is the association of the auditory and facial nerves in their course through the base of the skull, this association existing to the end of the internal auditory canal where the auditory nerve divides into its cochlear and vestibular branches. The facial nerve then passes out through the end of the internal auditory canal to the inner wall of the middle ear, where it turns sharply backward along the wall of the cavity through the Fallopian canal above the oval window. It then passes backward beneath the horizontal semicircular canal where it turns sharply downward, passing deeply through the anterior portion of the mastoid process, and appears at the stylomastoid foramen. In its course downward through the mastoid, it gives off the stapedius and chorda tympani nerves, the first going to the stapedius muscle, which is attached to the stapes, while the latter passes back across the middle ear cavity finally reaching the anterior two-thirds of the tongue and supplying taste to this region. We mention the facial nerve as it may be involved in suppurative conditions of the temporal bone.

Physiology of the Ear

The ear has two functions, hearing and equilibrium. The function of hearing or the acoustic function is dependent upon the cochlear branch of the auditory nerve, the terminations of which are found within the cochlea, while that of equilibrium is dependent upon the vestibular branch, the terminations of which are found within the vestibule and semi-circular canals. It is evident therefore that diseased conditions of the ear can produce either lessening of hearing or disturbances of equilibrium.

Sound can reach the cochlear branch of the auditory nerve by means of air or by bone conduction. In the first instance the sound waves pass through the external auditory canal, the drum and ossicles, to the footplate of the stapes in the oval window where the vibrations are transmitted by means of the perilymph and endolymph to the terminations of the cochlear nerve in the cochlea. From that point they are transmitted through the cochlear nerve to the brain centers. In the second instance the sound is conducted through the bones of the cranium to the internal ear and then reaches the brain centers through the cochlear nerve.

Due to pathological conditions, air conduction is often interfered with and we have therefore deafness produced as a result of interference with conduction, while the receiving portion of the apparatus, the cochlear nerve, may be intact, as will be evidenced by the fact that sound is still perceived by bone conduction. Conversely, we may have an intact conducting apparatus but the receiving portion, the cochlear nerve, being dis-

eased we have again deafness produced, in which case sound will not be heard by bone conduction. As we shall see later, many of the functional tests are based upon the fact of bone and aerial conduction.

Disturbances within the vestibule and semicircular canals will produce disturbances of equilibrium and other symptoms to be mentioned later under diseases of the labyrinth.

CHAPTER II

SYSTEM OF EXAMINATION

If a definite system of examination is followed in every aural case, it will, in the first place, facilitate the work and, in the second place, you will acquire very definite knowledge concerning the patient. We would suggest as a basis the following: *Family history, personal history, age and vocation.*

Great care should be exercised in getting the history of the patient, as this will prove of invaluable aid from the standpoint of diagnosis and prognosis. Indeed from the history alone the diagnosis can often be made, as also the prognosis be given.

Family History.—This is of extreme importance as pointing to a possible hereditary basis for the present condition. As in diseased conditions elsewhere, hereditary tuberculosis, syphilis, etc., play an important part; also a family history of deafness is of value in a prognostic way. Such cases are not usually so amenable to treatment as are cases where heredity does not play an important part. If, for instance, syphilis is suspected as a possible cause of the condition, we should determine whether the mother had had miscarriages, as in this way we can often gain a hereditary history of syphilis where we could not get it by direct inquiry.

Past Personal History.—In obtaining the past history we should know whether our patient has had any previous aural condition and from what general

diseases he has suffered. To the diseases of childhood, although remote, can often be traced the existing aural condition, as also to typhoid, pneumonia and other general diseases of later life. Syphilis, rheumatism, diabetes, Brights' and similar disorders are often causal factors in aural conditions.

Present Personal History.—Inquire carefully as to the onset of the present condition, whether it developed gradually or rapidly, whether accompanied by pain, deafness or any of the usual aural symptoms, whether the attack came on with influenza, exposure, traumatism, etc. The causal factor is a guide as to the severity and prognosis. Cases of chronic otorrhœa which have their origin in an attack of scarlet fever or measles, do not offer so favorable prognosis as do cases arising from simple exposure or colds. Cases of chronic otorrhœa having their onset without pain are suggestive of tuberculosis.

Age.—The age of the patient is of prognostic value in otology as in other branches of medicine, the resistance of the patient lessening with advanced years.

Vocation.—The occupation very often plays an important part as a causal factor in ear disease. Perception lesions are common in those who work in noisy places, such as boiler factories, machine shops, etc., while the catarrhal affections of the ear are more commonly observed in those who are exposed to the elements or who live in poorly ventilated surroundings.

Subjective Examination

Many of the more common ear conditions can be diagnosed by careful study of the subjective symp-

toms and, indeed, in some cases, because of inability to make an objective examination, it becomes necessary to depend upon the subjective symptoms for the diagnosis. In any case, the subjective examination should be of special interest to one who is not skilled in the objective examination.

Certain symptoms are common to ear disease, one or more of these being found in every case. These symptoms are: (a) *pain*, (b) *dull hearing*, (c) *stuffy, full feeling in the ear with numbness about the ear*, (d) *sensation of something moving in the ear*, (e) *tinnitus* (head noises), (f) *vertigo, nausea and vomiting*. A careful study of these symptoms, as obtained from the patient, will prove of great value both from the standpoint of diagnosis and from that of prognosis. We should study these symptoms as to their amelioration and aggravation and their occurrence with other symptoms.

(a) *Pain*.—This occurs in all acute inflammatory conditions of the ear with acute exacerbations of chronic suppurative conditions and, reflexly, from such conditions as carious teeth, ulceration of the pharynx, tonsils or larynx.

The pain of acute external otitis is aggravated by motions of the jaw, as in chewing, and by traction or manipulation of the auricle. It is usually constant, and in the majority of cases is referred anteriorly to the auricle. Such a patient is very sensitive to examination because of the aggravations given, and if lying down will be found with the diseased ear upward as he cannot comfortably lie upon the auricle.

The pain of a middle ear condition is aggravated

by swallowing, belching, talking or any act which causes movement of the tissues of the Eustachian tube. It lacks the aggravation of the pain of external otitis. The patient, if an adult, is not sensitive to examination, and if lying down will usually lie upon the diseased ear. The pain is due largely to the tension produced by the secretion contained within the middle ear cavity and is relieved with the perforation of the drum. In children, especially, there will be found periods of intermission of the pain, due to the fact that the Eustachian tube is shorter and wider than in the adult and drainage occurs easily into the nasopharynx, thereby relieving tension. It is therefore not uncommon in children to have them go through the day without pain, the paroxysms of pain recurring at night.

The pain of a typical mastoid condition always follows a middle ear condition. It is of a deep, boring character, referred usually to the region of the mastoid, and is constant.

Reflex pain in the ear occurs from carious teeth, etc. It lacks the aggravations of the other named aural conditions and is diagnosed by the elimination of these.

(b) *Dull hearing* occurs with a variety of aural conditions. It is caused by mechanical obstruction of sound conduction in the external auditory canal, such as impacted cerumen or epithelial plug or foreign bodies in the external auditory canal; by closure of the Eustachian tube as in tubal conditions; by collections of fluid within the middle ear cavity and by lesions of the internal ear. Lesions of the conducting

apparatus will produce marked dull hearing but do not produce absolute deafness, this occurring only with diseased conditions of the internal ear. We should study this symptom as to its onset, whether rapid or insidious: as to its amelioration and aggravations and its occurrence with other symptoms.

Dull hearing which comes on rapidly, accompanied by a stuffy, full feeling in the ear or numbness about the ear, is due either to obstruction in the external auditory canal (cerumen, epithelial plug or foreign body) or to closure of the Eustachian tube and the cessation of its function. In conditions of the external canal, the dull hearing is due to the mechanical obstruction to the sound waves, the full feeling being due to pressure of the material in the canal. In Eustachian lesions it is due to the cessation of the function of the tube, a vacuum being produced in the middle ear cavity so that the column of air in the external auditory canal presses the drum inward, thereby limiting the motion of the ossicles and at the same time producing a full feeling.

Deafness occurring rapidly, associated with nausea, vomiting and disturbances of equilibrium, is suggestive of a lesion in the labyrinth.

Dull hearing which develops gradually, extending perhaps over a period of weeks or months, usually indicates a condition of the conducting apparatus.

If the *hearing is worse in a noise* it indicates a possible labyrinthine lesion, while *hearing better in a noise* is indicative of a conducting lesion.

Hearing better in certain positions of the head indicates the presence of fluid within the middle ear

cavity or granulations of polypi which, in certain positions of the head, by pressure, limit the sound conduction, while in other positions the pressure is relieved.

Hearing worse in temperature changes indicates a vasomotor disturbance in the Eustachian tube and middle ear.

Deafness occurring during parotitis is usually total and permanent; *that occurring during meningitis* usually permanent.

The prognosis in cases of dull hearing resulting from drug ingestion is usually good unless this has been carried to excess.

(c) *Stuffy, full feeling in the ears.*—This is often associated with a *sensation of numbness about the ear*. These symptoms indicate a condition either of the external auditory canal (impacted cerumen, epithelial plug), or of the Eustachian tube. Very frequently the patient attempts to relieve this symptom by placing the hand over the ear or a finger in the ear, making rapid suction movements. This symptom is very often observed during la grippe, or severe colds, due to involvement of the Eustachian tube, or in the summer time especially following bathing, the symptom then being due to swelling of the cerumen or epithelial plug within the external auditory canal or to direct entrance of water into the Eustachian tube.

(d) *A sensation of something moving in the ear* is usually due to fluid in the middle ear cavity which changes its position with the changed position of the head. Such patients will often insist they have an insect in the ear but upon examination none can be

found. Careful examination of the middle ear cavity will prove the presence of secretion.

(e) *Tinnitus* (head noises) occurs with almost every type of aural condition. It is described variously by the patient, such as buzzing, roaring, hissing or a sound like bells. The only type of head noise, which is especially suggestive of a possible cause, is the pulsating type which occurs synchronous with the pulse. Such a tinnitus suggests an obstructive condition of the tympanic vessels or a possible lesion somewhere in the circulation.

Tinnitus is, at times, a forerunner of mental disease. Such cases have also often auditory hallucinations and usually have good hearing. There is no aural symptom so stubborn to treatment or so tiring to the physician and patient as tinnitus.

(f) *Vertigo, nausea and vomiting*, together with nystagmus of the aural type and disturbances of equilibrium, occur from lesions of the labyrinth. In the light of present-day knowledge, it seems likely that all types of vertigo arise from irritation of the vestibular branch of the auditory nerve.

CHAPTER III

FUNCTIONAL EXAMINATION OF THE EARS

The functional testing of the ear must include the examination of the condition of the *acoustic* and *static* functions.

In testing the acoustic function, *quantitative* and *qualitative tests* are made; in other words the degree to which the function is diminished must be determined and also the location of the lesion.

The degree of loss of function is measured by means of the *watch* and the *human voice*, the latter being the more important.

In applying all *quantitative tests* there are certain rules which should be observed:

1. The ear to be examined should be toward the examiner, the opposite ear being closed tightly with the moistened finger. The room must be quiet.

2. The eyes of the patient should be closed.

3. Both ears should be tested, even though only one be complained of.

4. Subsequent tests should be made under similar conditions as to position in room, etc. (It is well known that the acoustics of rooms vary in different positions.)

5. Tests should be made before and after treatment. In this way the result of the treatment can be noted.

The Watch Test.—Owing to the difference in intensity and pitch of the ticks of different watches, it is important to determine the distance your watch should be heard by previously testing it upon a number of normal individuals. Having determined this, test the patient first by holding the watch close to his ear, then recede slowly from him, instructing him to indicate the moment he ceases to hear the watch tick. Note at once the distance from the patient, then test again by going outside the distance at which he has heard the watch, asking him to indicate when he first hears it. It will usually be found that this distance is less than the first. By repeating these tests three or four times, a good estimate of the average distance at which the patient hears the watch can be determined. Assuming, now, that the watch should be heard at ten feet, and that the patient examined hears it at five feet, we should note—hearing right or left ear $5/10$ of the normal, the normal distance being used as the denominator, the distance at which it is heard as the numerator of the fraction.

The watch test, as stated, is not the most reliable quantitative test. There are many individuals who can hear the watch tick at a normal distance whose hearing for the human voice is much lessened, and *vice versa*; and as in practical life the patient's hearing is used mostly for the human voice, the use of this is of prime importance.

The Voice Test.—Dependent upon the degree of deafness, make use of the whisper, conversational tone or loud voice. The greatest difficulty in using the voice test is in obtaining the same intensity and

pitch of the voice at various tests. A fairly constant intensity can be obtained with the whispered voice by using the residual air after forced expiration. With the voice test it is especially important that the patient's eyes are closed, so that he cannot see the examiner's lips, as many persons are expert lip readers and, if the eyes are open, their hearing is helped materially by watching the motion of the lips. It is important that a series of words covering different vowels and consonant sounds be used, because certain sounds, such as "S" and "T," are heard more readily than are sounds such as "A," "O," "U." Words containing the same vowel with different consonants, such as "cat," "pat," "rat," or words such as "Manchester," "Winchester," "Chester," "Rochester," are of value. Very often a patient will repeat vowel or consonant sounds, but he does not repeat the entire word correctly. Be careful not to repeat these words in the same order at each testing, but vary the order now and then, using words which have not been used before. Unless this is observed, the patient will apparently hear the words and repeat them, as from previous testing he will have learned the sequence. Here again it is highly important that the opposite ear is tightly closed.

Tests of the conversational or loud voice are of questionable value unless some form of noise-producer is used in the opposite ear, as it is very difficult to determine that the patient is not hearing with the sound ear. Numbers will be heard better than words containing many syllables. Note carefully, at each examination, the distance at which given words are

heard, so that it will be apparent whether there is improvement from treatment.

By means of the *qualitative* tests we determine, as before stated, the location of the lesion, whether it is one of the conducting apparatus (*i. e.*, external canal, or middle ear tract), or one of the receiving apparatus (*i. e.*, internal ear).

In the finer qualitative tests, long series of tuning forks and various other devices are used, but for the practitioner's purposes one fork, preferably the Vienna Model A, will suffice.

The fork tests used are based upon the fact that sound is heard by air or bone conduction. *In diseases of the conducting apparatus there will be a shortening of the aerial conduction and an increase in bone conduction, while in diseases of the receiving apparatus there will be a shortening of the bone and air conduction.*

The tests of *Weber*, *Schwabach* and *Rinne* will suffice for general purposes.

Weber's Test.—A vibrating tuning fork being held by the handle is placed upon the median line of the skull and the patient asked to indicate in which ear he hears the tone.

In normally hearing individuals the tone will be heard all over the head or the tone will not be lateralized.

In lesions of the *conducting apparatus* the tone will be referred to the diseased ear.

In lesions of the *perceiving apparatus* the tone will be heard in the unaffected ear.

In bilateral conducting lesions, that is, where both ears are involved due to lesions in the conducting ap-

paratus, the tone will be heard in the poorer hearing ear.

Where both ears are involved due to perception lesions in both ears the tone will be heard in the better hearing ear.

If there be a lesion of the conducting apparatus on one side and a lesion in the perception apparatus on the other side the tone will be heard in the ear presenting the conducting lesion.

In cases where there is a bilateral mixed deafness, that is where the deafness is due to a mixture of conducting and perception deafness, the tone in Weber's test will be heard in the ear presenting the greater amount of conducting lesion.

Schwabach Test.—This test consists of testing the bone conduction of the person examined with that of a normal. It is necessary to remember in making any bone conduction test that when a vibrating fork is applied to the mastoid process of one side the tone is heard not only in the ear of that side but also in the opposite ear. The major part of the sound goes to the side upon which the fork is applied. Bone conduction may be lessened on one side when normal air conduction exists because some of the bone conduction has been borrowed by the opposite ear by reason of a lesion in the perceiving apparatus which has lessened the bone conduction. The bone conduction may be found to be lengthened and air conduction normal because of a lesion of the conduction apparatus of the opposite ear. These facts must be kept in mind when observing the results of bone conduction tests.

In performing *Schwabach's test* a vibrating fork

is placed in the depression in the mastoid process just behind the auricle, and the time it is heard by the patient is noted by means of a stop watch. This is compared with a normal. Allowances should be made for age, children usually having better bone conduction than old persons. The fork must be placed in corresponding positions over the mastoids and the amount of pressure exerted must be uniform. Fatigue should be minimized by not applying the fork to the mastoid immediately after it is set in vibration but by allowing about thirty seconds to elapse. The fork handle should be removed from contact with the bone every few seconds and reapplied. This interruption of application allows for a period of rest and is repeated until the tone is no longer heard. The time is observed with a stop watch.

When bone conduction is *longer* than normal it is suggestive of a lesion in the *conducting apparatus*.

If the bone conduction is *shorter* than normal it is suggestive of a lesion in the *perceiving apparatus*.

Rinné Test.—The tuning fork is set in vibration and placed in the depression back of the ear as in performing the Schwabach test, and the patient instructed to indicate as soon as the tone is no longer heard. The fork is then removed from the mastoid and the tines brought as close to the external meatus as possible without coming in contact with the auricle and again the patient instructed to indicate as soon as the tone is no longer heard. Fatigue by air conduction may occur just as it does in bone conduction so that it is proper to remove the fork from in front of the meatus for a few seconds then replacing it, repeating until the

tone is no longer heard. The time the tone is heard by bone conduction is compared with the time it is heard by air conduction.

Normally air conduction is longer than bone. This is known as a *normally positive Rinne*. The degree of positiveness will depend upon the tuning fork used in making the test.

A fork that is heard 70 seconds by bone conduction and 110 seconds by air conduction is the best fork for performing the Rinne test. Such a fork is neither too long or too short for accurate testing.

The Rinne test is designated *positive* when the air conduction is longer than bone conduction. It is termed *negative* when the bone conduction is longer than air and *neutral* when air and bone conduction are of equal duration. Hence we may have as results of the Rinne test:

Positive normal:—air conduction longer than bone and both normal.

Positive pathological:—air conduction is shorter than normal and bone longer than normal but air longer than bone. This is seen in early *conducting lesions*.

Positive pathological:—air conduction is longer than bone but both air and bone are shorter than normal. This is observed in *perception deafness*.

Negative:—bone is longer than air and the increase in bone conduction is about equal to the loss in air conduction. This result is seen in *conducting lesions*.

Negative:—the bone conduction is longer than air conduction but both air and bone are shorter than normal. This type of Rinne reaction is observed in mixed

types of deafness where both the conducting and the perceiving apparatus are involved.

Neutral:—the bone and air conduction are equal, the bone being lengthened and the air shortened. This Rinné reaction is seen in conduction lesions.

Neutral:—the bone and air conduction are equal but both shorter than normal. This type of Rinné is seen in perception deafness.

In order to understand these tests more thoroughly let us assume two simple cases :

Case 1: Patient complains of dull hearing in the right ear. By Weber's test the fork is heard in the right ear, Schwabach's test shows lengthened bone conduction, and with Rinné test there is shortening of air conduction and a lengthening of bone conduction. This suggests a lesion in the conducting apparatus.

Case 2: Patient has deafness in the right ear. Weber's test is referred to the sound (left) ear; Schwabach's test shows shortened bone conduction; the Rinné test shows shortening of air and bone conduction and both shorter than normal. The lesion is in the receiving apparatus.

In using the tuning fork it is essential that it be struck upon some soft substance so that only the true or fundamental tone is heard. If the fork is struck upon a hard substance the overtones are produced.

Static Tests.—In testing the static function of the labyrinth we make use of three tests, the *rotation* (or so-called *afterturning nystagmus test*), the *caloric test*, and the *galvanic test*.

The reactions produced by these tests are (1) *nystagmus* of the rhythmic type and (2) *vertigo*.

The *nystagmus*, if carefully observed, will be found to consist of two components: a quick movement in one direction and a slower movement in the opposite direction. This type of nystagmus is known as the rhythmic or aural type and is found, upon further examination, to be increased if the patient looks in the direction of the quick movement, and to be lessened or stopped as he looks in the direction of the slower movement. Nystagmus may be horizontal, rotary or vertical.

The *vertigo* is a subjective sensation of disturbed relationship, the result of impulses carried from the internal ear to the cerebral cortex. This vertigo may be recorded objectively by the *pastpointing test*. Normally an individual is able to find the finger of the examiner which he has previously located. This he is able to do as readily with the eyes shut as when open. The patient is seated in a chair, the examiner stands in front of the patient. The examiner holds one arm toward the patient with the index finger extended and supported by the other hand. The patient is instructed to extend his arm, touching the finger of the examiner with his own index finger, then to raise the arm from the shoulder and bring the arm down, touching the examiner's finger. This is repeated with the eyes shut, when it will be found, in normal individuals, the examiner's finger is again readily located. If the ear be stimulated by turning or douching and the above test made, it will be found that, if vertigo is present, the patient will be unable to touch the examiner's finger because of the vertigo produced. If the patient feels that he is turning to

the left, he will pastpoint to the right; if he feels that he is moving to the right, he will pastpoint to the left.

The Rotation Test.—If a normal individual, seated in a revolving chair, with the head forward thirty degrees, and with the eyes shut, is turned to the right ten times at the rate of two seconds for each turn, and is then stopped and told to look directly in front of him at a distance of not less than twenty feet, it will be observed that he has a jerky movement of the eyeballs (horizontal rhythmic nystagmus) to the left or opposite side from which he was turned. This movement lasts in the average normal case about twenty-four seconds. If now, in the same position, he is turned to the left ten times and stopped, it will then be found that he has the same jerky movement of the eyeballs, but this time to the right (horizontal rhythmic nystagmus), or again in the direction opposite to the turning. This movement lasts also twenty-four seconds. This is the normal nystagmus reaction.

In order to test the vertigo, the patient is turned in the position as above stated, the head forward thirty degrees. In this instance the rate of turning is one turn per second. The patient is turned first to the right and upon stopping, and with the patient's eyes remaining closed, he is given the examiner's finger with the right hand, instructed to raise the arm from the shoulder, and lowering it attempts to find the examiner's finger. This is repeated in prompt order with the left hand. In a normally reacting individual it will be found that, after turning the patient to the right, he will pastpoint to the right with both arms, because he has the subjective sensation that he is

revolving to the left. This pointing is repeated with each arm in succession until the patient no longer past-points but touches the examiner's finger. Normally it will be observed that the pastpointing will occur about twelve to eighteen inches with the arm corresponding to the side to which the patient is turned, from six to eight inches with the opposite arm, and returning to the first arm the pastpointing will be about six or eight inches, and with the opposite arm two to four inches, and so on until the examiner's finger is touched. The pastpointing may be timed with a watch, when it will be found that, in duration of time, it corresponds very closely to the duration of the nystagmus.

The Caloric Test.—If a normal individual is seated with the head forward thirty degrees and the ear is syringed with cold water (68°), there will result after douching, in from fifty-five seconds to a minute and a half, a rotary nystagmus to the opposite side. If the ear is syringed with warm water (110°) there will result nystagmus to the same side. If, for instance, we syringe the right ear with water at the temperature of 68° there will result, under normal conditions, within a minute and a half, a rotary nystagmus, of the rhythmic type, to the left, and if we syringe the left ear with cold water there should result in the same length of time a rotary nystagmus to the right side. The reason for the result obtained from these tests is that, through turning, and also by using the cold or hot water, currents are created in the static labyrinth which produce irritation of the terminal filaments of the vestibular nerve.

Observation of the vertigo produced by the caloric

test is made in the same method as that produced by the afterturning or rotation test.

The Galvanic Test.—If the negative (kathodal) pole is applied just in front of the tragus and the positive (anodal) pole is held in the hand and the current allowed to flow it will be found that from four to six milliamperes will produce nystagmus and vertigo. The nystagmus will be rotary in type and directed to the same side as the kathode is applied. If the polarity be reversed it will be found that the nystagmus will be reversed, that is the anodal pole applied in front of the tragus and the kathodal in the hand the nystagmus will be to the same side. The kathodal reaction is balanced by the anodal of the opposite side. If two or less milliamperes of current will produce a reaction it is indicative of an irritated labyrinth. If more than six milliamperes of current are required to produce a reaction it is indicative of a destructive lesion.

In irritative lesions of the labyrinth there will be with the afterturning test, markedly lengthened nystagmus and pastpointing to one or the other side depending upon the ear influenced. With the caloric test in irritative lesions the nystagmus will come on earlier than normal and will be more intense. The pastpointing will be wider. The galvanic response will occur with less than normal amount of amperage.

In destructive lesions of the labyrinth, the afterturning nystagmus will be of shortened duration and less amplitude and the pastpointing will be less marked. With the caloric test there will be no reaction or markedly diminished reaction from syringing and the pastpointing will be absent or markedly diminished. With

the galvanic test the amount of current required to produce a reaction will be increased more than six or eight milliamperes, or there may be total absence of reaction.

The presence of nystagmus of normal duration is an indication of a reacting labyrinth. The presence of a well-defined vertigo, with or without nystagmus, is also evidence of a reactive labyrinth. Nystagmus and vertigo may both be absent, but the presence of marked nausea and vomiting is evidence of the activity of the static end organ in the labyrinth. Lesions in the brain stem may interfere with the impulses from an active labyrinth reaching the eye muscle nuclei to produce nystagmus, or impulses reaching the cerebral cortex, to produce vertigo. It is important to observe carefully the presence of nystagmus and vertigo in all instances, as change in the relationship of one to the other may indicate serious intracranial involvement, the end organ being normal.

In order to clarify the foregoing we cite the following hypothetical cases:

Case 1. Normal Case.—After turning to the right (technique as above outlined), horizontal nystagmus to the left lasting twenty-four seconds. After turning to the left, horizontal nystagmus to the right lasting twenty-four seconds. Turning patient to the right, pastpointing with both arms to right lasting twenty-four seconds. Turning patient to the left, pastpointing to the left with both arms lasting about twenty-four seconds. This proves the horizontal canals to be normal.

Douching the right ear with water at 68° produces

a rotary nystagmus to the left and pastpointing with both arms to the right, in from fifty-five seconds to a minute and a half.

Douching the left ear with water at 68° produces a rotary nystagmus to the right and pastpointing with both arms to the left in from fifty-five seconds to a minute and a half.

With the kathode to the right ear rotary nystagmus to the right with four milliamperes of current. With the kathode to the left ear nystagmus to the left with the same amount of current.

Case 2. Irritative Lesion of the Right Labyrinth.—Turning to the right produces a horizontal nystagmus to the left lasting more than twenty-four seconds. Turning to the left produces nystagmus to the right longer than normal and increased over the right. Turning patient to the right produces a wider pastpointing and of longer duration. Turning patient to the left produces pastpointing beyond normal.

Douching the right ear with water at 68° produces a rotary nystagmus in a shorter space of time than normal and wider pastpointing. Douching the left ear with water at 68° produces a rotary nystagmus to the right in normal period of time and normal pastpointing.

With the kathode applied to the right ear less than four milliamperes of current produces nystagmus to the right. Kathode to the left ear produces nystagmus to left with four to six milliamperes of current.

Case 3. Destructive Lesion of the Right Labyrinth.—Turning the patient to the right produces a horizontal nystagmus to the left of shorter duration than normal. Turning the patient to the left, produces a

nystagmus to the right of shorter duration than the nystagmus to the left. Turning the patient to the right produces short or no pastpointing. Turning the patient to the left produces shorter pastpointing.

Douching the right ear with water at 68° produces no nystagmus and no pastpointing. Douching the left ear with water at 68° produces nystagmus to the right and normal pastpointing.

With the kathode to the right ear no reaction will be obtained with eight to ten milliamperes. With the kathode to the left ear, nystagmus will be produced with the usual amount of current. If the destructive lesion is of recent date the side of the destructive lesion will react to the kathodal current because the stimulation is taken up by the eighth nerve.

CHAPTER IV

INSTRUMENTS USED IN AURAL CASES

Objective Examination of the Ears

Before proceeding to the objective examination it is important to mention briefly the instruments which are necessary for the more common examinations and treatment of aural cases.

This list includes: (1) head mirror, (2) aural speculas, (3) Siegle's otoscope, (4) cotton carriers, (5) aural forceps, (6) metal syringe, (7) Politzer bag, (8) auscultation tube, (9) Eustachian catheters, (10) Vienna Model A tuning fork, (11) myringotome, (12) nasal speculum, (13) tongue depressor, and (14) a post-rhinoscopic mirror.

Among the essentials for a successful objective examination is a good head mirror and a thorough knowledge of its use. As head mirrors are concave, each mirror will have a definite focus, this focus depending upon the curvature of the mirror. The best illumination is exactly at the focus; hence, in choosing one, a mirror which has a focus of approximately ten inches will be found best adapted for the average examination. The focal distance of a mirror can readily be determined by reflecting the image of a window (which should be at least twenty feet distant) upon the hand or piece of paper. It will be found that, when the focus is reached, there will be a clear image of the window. If the mirror is with-

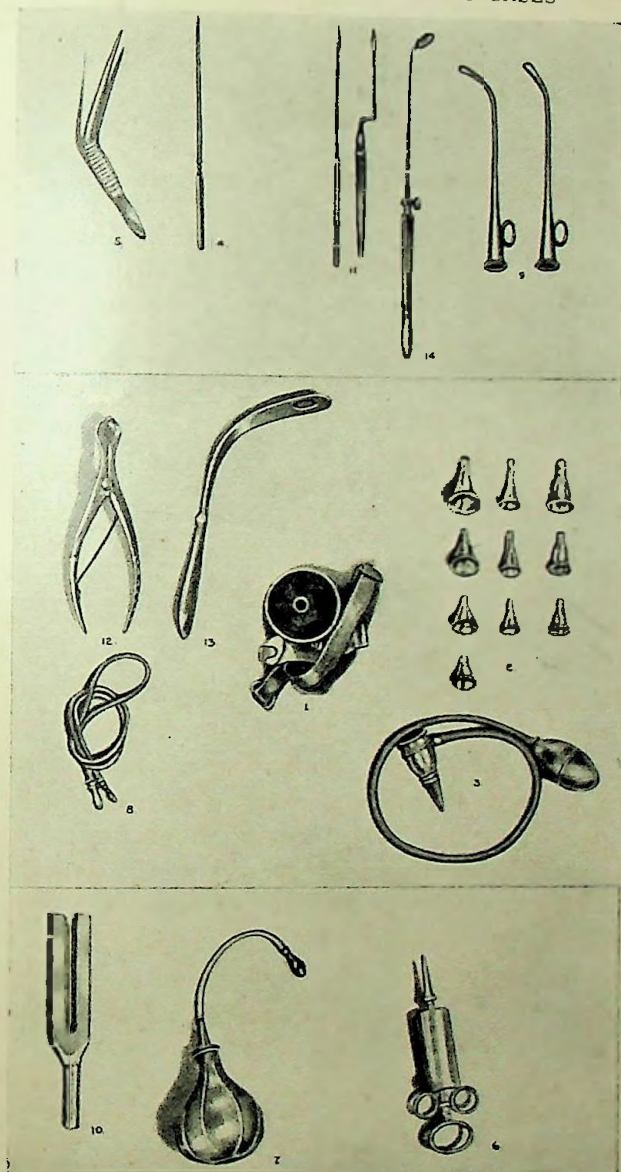


PLATE III. Instruments used in aural cases

drawn or moved closer to the hand or piece of paper, it will be seen that the illumination is lessened.

Use of Head Mirror.—In order to get the best view obtainable through the head mirror, it should be so placed upon the head that the sight hole of the mirror is directly in front of, and as close as possible to, the examining eye. The portion of the ear under examination should be exactly in the focus of the mirror. In order to obtain this result it will be necessary to be closer to the patient when examining the ear drum than when examining the orifice of the external auditory canal, for, as stated in the description of the anatomy, the distance from the orifice of the canal to the ear drum is approximately $1\frac{1}{8}$ inches. One of the greatest difficulties encountered, when working with the head mirror, is to quickly and properly throw the light upon the portion which you wish to illuminate. This can be learned more quickly by sitting in front of the light which is used in examination and then attempting to quickly focus the light upon your hand, held in different positions in front of you. There is nothing which will shake the patient's confidence quicker than unskilled efforts to illuminate the ear with the head mirror.

Objective Examination

As with the general examination of the patient, here also a system in examination will facilitate the work.

We would divide the examination into (1) external, (2) the external auditory canal, (3) the ear drum and

middle ear tract, (4) the Eustachian region in the nasopharynx :

1. The external examination includes inspection, palpation of the auricle, and, in some cases, percussion of the region anterior and posterior to the auricle. By inspection, swelling or any change from the normal appearance will be noted; by palpation and percussion, sensitive areas around the auricle and in the mastoid region will be discovered. You should get into the habit of palpating the mastoid of both sides, as in this way you will become familiar with the variations in the normal contour of the mastoid, so that slight pathological changes will be readily noted. By palpation of the auricle also the small shot-like tophi may be felt over the cartilage and may prove a valuable guide as to the possible cause of an aural condition, these being indicative of a rheumatic or gouty cause. Always inspect the mastoid region from behind so that a comparison can be made of the two sides. In this way you will become familiar with the normal position of the auricle, this enabling you later to recognize displacement of the auricle and beginning œdematous conditions over the mastoid, as occur in mastoid and acute external auditory canal conditions.

2. In examination of the external auditory canal you should note the color of its lining membrane, the presence or absence of hairs and the general course of the canal.

Before examining the deeper portions of the canal, under good illumination from your head mirror, examine carefully the orifice of the canal, both by

inspection and by palpation, as it is at this point that furuncular conditions are apt to be found. If this is not done before you insert your speculum for examination of the deeper portions of the canal, you are apt to overlook lesions occurring in the region of the orifice. In cases complaining of pain of the external type, inspection alone may not give you the diagnosis, as the origin of many acute inflammatory conditions is deep and the point is only discovered by careful palpation with an aural probe.

Having assured yourself concerning the condition of the orifice, you should then pass to the inspection of the rest of the canal. At this juncture let us point out some of the difficulties met with in normal cases.

As brought out in the consideration of the anatomy, the external auditory canal is curved in its first, or cartilaginous portion and then extends downward and forward in the bony portion, so that, in the average case, it is impossible to see the deeper portion of the canal and the ear drum at the end of the canal, without first straightening it and using an aural speculum. Now and then you will have a case in which the canal is practically a straight one and in which you can inspect the ear drum directly without instrumental aid. In the majority of cases, however, in order to straighten the canal, grasp the auricle between the index and second fingers (for the right ear use the left hand, for the left ear the right hand), gently pulling it upward and backward (in the child directly backward). This straightens the average canal and you are now ready to insert the speculum with the fingers of the other hand. At this

point of the examination certain difficulties may have to be overcome: (a) There may be a large number of hairs in the canal which obstruct your view through the end of the speculum. These are usually overcome by rotating the speculum in the canal, thereby pressing the hairs against the canal wall, while at the same time pressing the speculum gently inward. (b) Very frequently there is a narrowing of the canal, due to a prominence of the anterior wall, upon which the end of your speculum catches. In such a case, under good illumination, insert the speculum in a direction somewhat upward and backward, until you see through the end of your speculum, that you have passed the obstruction, and it can then be, together with the auricle, drawn upward and backward.

The speculum being now in proper position for examination of the canal, it can then be held in position and moved, as may prove necessary, during the course of the examination by the thumb so that the other hand can be used for instrumentation.

Color, Width and Contour.—Examine the canal with some system as to color, width and contour. Starting at the end of your speculum, examine minutely first the roof and then the various walls of the canal and thus familiarize yourself with the normal color and normal variations in the width and contour of the canal. These vary considerably but you will learn to differentiate the normal from the abnormal. Always bear in mind that the color differences are quite marked, depending upon whether day light, gas light or electric light is used.

You will note the difference in the length of the canal walls, as pointed out in the section on anatomy, and will see that these differences are due to the position of the ear drum at the end of the canal. You will also note, as you look directly at the end of the canal, that the direction of the straightened canal is one somewhat toward the opposite eye. The average, unskilled examiner has a tendency to look into the canal as if its direction were toward the opposite ear, thereby seeing only the posterior wall of the canal. You will thus see that when the patient is in the proper position for examination, his face will be turned toward the opposite side. Under normal conditions a certain amount of cerumen will be found upon the walls of the canal. This can readily be removed with a cotton applicator and when examined will be found to be of a consistency similar to vaseline, and of a somewhat sticky, saponaceous character. At times this cerumen may appear as small light or dark brown spots upon the walls of the canal or ear drum. These may also be readily removed with a cotton applicator.

Never rely entirely upon the eye in your objective examination, but, if anything unusual is found, confirm your ocular findings by palpation with the aural probe or by attempted removal of any foreign substance with a cotton applicator. We mention this because the presence of a foreign substance, especially aural discharge, very frequently gives ocular pictures which are very deceptive, the entire picture changing when, on using the cotton applicator, the presence of a discharge is determined and the discharge removed.

Very often a bubble, in an aural discharge, will give the picture of a perforation of the drum and we have seen many who have been deceived by it. When in the slightest doubt, therefore, as to the presence of a deviation from the normal, *always confirm your ocular findings by other methods of examination.*

Having completed your examination of the external auditory canal you are now ready to examine the ear drum at the end of the canal. In our experience the average student passes to the examination of the ear drum immediately after inserting the aural speculum, thereby often overlooking many things in the external auditory canal which are of extreme value from the standpoint of diagnosis. *Get into the habit, therefore, of careful examination of the external auditory canal before passing to the examination of the ear drum.*

3. *Examination of the Ear Drum and Middle Ear Tract.*—Because of its histological structure, which makes it a semi-transparent membrane, and because of its anatomical relations to the Eustachian tube, the middle ear cavity and the mastoid, the appearance of the ear drum is of greatest importance in forming an opinion as to the conditions of the structures of the middle ear tract above named.

Because of the semi-transparency of the drum, the light reflected from your head mirror passes through it, reaching the structures within the middle ear cavity, and is again reflected back through the drum, so that the condition of underlying structures is thrown upon this screen. Again, the loss of this transparent character of the drum, either through the entire membrane

or only in spots, gives us further aid in diagnosis of the existing conditions.

The anterior upper portion of the drum is in close relation to the opening of the Eustachian tube, while its upper posterior portion is in close relation to the aditus ad antrum and to the antrum of the mastoid process, so that changes in these portions of the middle ear tract will be frequently noted on the corresponding portions of the drum. As the drum forms a large portion of the outer wall of the middle

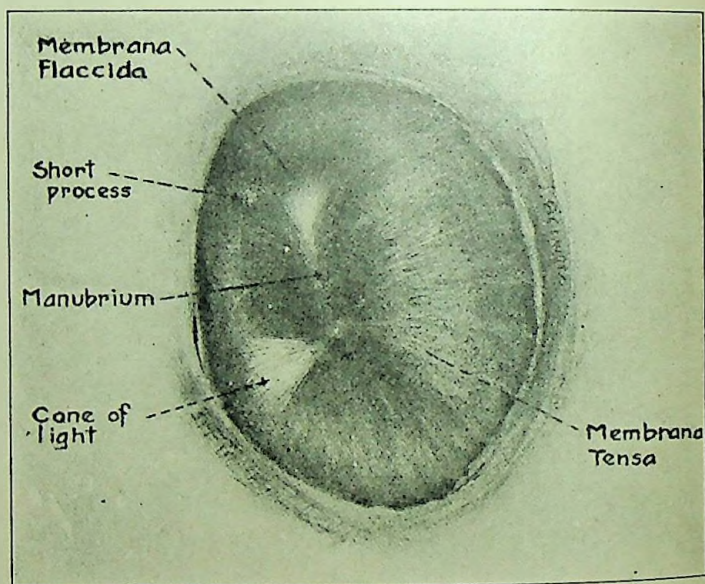


PLATE IV. Left Membrana Tympani

ear cavity, its inner layer being a continuation of the mucous membrane lining of that cavity, changes occurring in the middle ear cavity will also affect the mucous membrane covering the drum. These

changes very often stand out prominently by transmitted light and alter materially the normal picture.

Having mentioned these general facts concerning the value of the ear drum from the standpoint of diagnosis, we will now consider in detail its normal objective appearance, and in doing so we must consider it from the standpoint of its (*a*) form, (*b*) position, (*c*) color and (*d*) gloss. By learning the appearance of the normal drum thoroughly, you will take a great step forward in your understanding and diagnosis of ear diseases. In fact, *unless you can recognize the normal drum, you cannot hope to diagnose the deviations from the normal or, in other words, the pathological conditions.*

(*a*) In form the drum is slightly oval (see plate membrana tympani), its long axis tilting slightly



PLATE V. Right Membrana Tympani
as seen through the aural speculum

forward from the vertical position of the head. The membrane is attached by its fibrous layer to the annulus tympanicus, this forming a ring around the periphery of the drum, except in its upper portion where there exists a defect in the annulus. The annulus can readily be seen, in the average normal drum, as a whitish ring surrounding the periphery. The drum is placed in the annulus as is the crystal in a watch. The upper portion of the drum bridges over the defect in the annulus and this portion of the membrane is known as the *membrana flaccida* or Shrapnell's membrane.

(b) *Position*.—As the annulus is placed obliquely, in its relation to the end of the external auditory canal, the drum has therefore the same oblique position, this obliquity, as before pointed out, accounting for the fact that the anterior and inferior walls of the external auditory canal are longer than are the posterior and superior. If you will hold your watch in your hand, you will find that it is possible so to hold it that its face, while having an oblique position from behind, forward and inward, at the same time can have an oblique position from above, downward and inward. Such then is the position of the ear drum in its relation to the external auditory canal. If you will fasten in your mind this oblique position of the drum, you will then realize that the upper and posterior portions of the drum lie closer to your eye than do the anterior and inferior portions.

(c) The *color* of the ear drum varies with the kind of illumination used in the examination. While with day light the color is of a pearly gray, with gas light

or with electric light a pinkish color will be noted. These color changes are due to the blending of the color of the light used in the examination with that of the mucous membrane.

(d) *Gloss*.—The outer surface of the drum has a high polish or gloss very similar to patent leather. This is apparent in the anterior inferior portion of the drum, as will be mentioned shortly.

In addition to the points mentioned, there are certain important structures seen through the drum which, because they occupy a fairly constant position in the normal drum, we speak of as the "landmarks." A change in the position of these landmarks, the absence of these, or any one of them, is significant to us of definite pathological conditions; again we refer changes noted in the ear drum as anterior or posterior or inferior to these landmarks.

In order to understand the position of the "landmarks," let us imagine the ear drum divided into four quadrants by a vertical and a horizontal line crossing each other at the center of the drum. We will find in the upper anterior of these quadrants, at a short distance from the periphery of the drum, a small whitish spot. Extending downward and backward, from this spot to the center of the drum, is a whitish or yellowish line, this varying somewhat in width in different cases. Extending downward and forward from the end of this line, in the center of the anterior quadrant, is a fan-shaped bright area, with its broad end reaching almost to the periphery of the drum. The small spot spoken of is the *processus brevis of the malleus*. The line extending downward

and backward from this is the *manubrium* while the bright area is known as the cone of light, this latter being due to the light from the head mirror reflected from a portion of the membrane which is placed at right angles to the examining eye. This reflection is made possible by the polished surface of the drum.

The entire drum is drawn inward at its center by the tensor tympani muscle, which is attached to the neck of the malleus, so that the outer surface is concave, the inner surface having a corresponding convexity.

Movability of the Drum.—Under normal conditions the ear drum is to a certain extent movable, as can be demonstrated by inflation of the ear or by means of the pneumatic otoscope. (See Under Diagnostic Methods.)

Summarizing, therefore, the examination of the ear drum, it is important in addition to studying the position, color, gloss, to note carefully:

(a) The absence of any or all of the landmarks.

(b) Changes in position of the landmarks.

(c) Changes in relation of the landmarks to each other.

(a) *Absence of Landmarks.*—Should examination reveal the absence of any or all of the landmarks, it is important to determine that there is nothing lying in the external canal, between the examining eye and the drum, which is obstructing the view (such as cerumen, epithelium, secretion, polypi or foreign bodies). This can be determined by using a cotton applicator or an aural probe.

(b) *Change in Position and Relation of the Land-*

marks.—Under normal conditions the cone of light is at right angles to the manubrium. Any change in the position of the drum will alter this relation. In retraction of the drum, this angle becomes more obtuse. Again in retraction of the drum, the manubrium is apparently shortened and the short process becomes more prominent. (See Plate X.)

The objective examination of the middle ear tract presupposes also skill in the examination of the nasopharynx and of some of the objective methods used in diagnosis. You must, to a considerable extent, form your opinions as to existing normal or abnormal conditions of this tract by the results obtained from these objective methods. By inspection of the nasopharynx with the post-rhinoscopic mirror, or by means of the nasopharyngoscope, you are able to recognize normal or changed conditions of the nasopharynx. You can also inspect the orifices of the Eustachian tubes, which lie upon the lateral walls of the nasopharynx just posterior to the posterior end of the inferior turbinate bone, presenting here as marked prominences upon either lateral wall.

In order to determine the normal function of the Eustachian tube, you make use of the methods of inflation. (See Diagnostic Methods.) If, while you carefully inspect the eardrum through the speculum, the patient inflates his ear by means of Valsalva's method, or if you inflate the ear by means of Politzer's method, it will be noted that, as the air enters the middle ear cavity, the drum will move outward as evidenced by a change in the position of the cone of light. In this way you can prove that the tube

is patulous and can also judge, by the ease with which the inflation took place, whether the lumen of the tube is normal. By means of the Eustachian catheter, together with the auscultation tube, you are able to diagnose normal or abnormal conditions of the Eustachian tube and middle ear cavity, by the character of the sound produced. In advanced work, by the use of Eustachian bougies, further information as to the permeability of the tube can be determined.

Discharge from the Ear:—This may be serous, sanguinous, mucous, pus, blood or combinations of these.

Serous discharge is observed in the early stage of acute otitis media.

Sero-sanguinous discharge occurs in the severe influenzal or streptococcal types of acute otitis media.

Serous, offensive, scanty discharge associated with itching in the ear is characteristic of external otitis usually of the eczematous type. A serous, offensive discharge is also observed in old chronic suppurative disease of the middle ear.

Mucous discharge from the ear tells at once of the existence of a perforated membrana tympani. It denotes a secretory pathology of the middle ear mucosa.

Sero-mucous discharge is seen in the second stage of acute otitis media.

Inoffensive, muco-purulent discharge occurs in the later stage of acute otitis media of the suppurative type.

Offensive, muco-purulent discharge is present in chronic suppurative middle ear disease.

Purulent discharge from the ear may occur in suppurative conditions of the external auditory canal or in suppurative disease of the parotid gland.

Bloody discharge from the ear occurs in traumatism to the head and in intense inflammatory conditions as seen in influenza.

Microscopic Examination of the Discharge.—In cases with aural discharge a careful microscopic examination is of great importance, and much of value, from the standpoint of diagnosis, prognosis and treatment, can be learned with but a simple technique. You can determine by this means (a) the type of infecting bacteria and, through a knowledge of the characteristics of these, form an opinion of the virulence of the condition. (b) The discharge collected in a receptacle, after syringing the ear, can be centrifuged and this examined for the presence of cholesterine crystals, these being an evidence of cholesteatomata.

In order to determine, with accuracy, the type of infecting bacteria, it is essential that a careful technique is used in the collection of the specimen to be examined. Specimens taken from the external auditory canal are always contaminated with the various forms of staphylococci and many unidentified types of bacteria. These may so far exceed the numbers of real infecting bacteria, that a wrong deduction is made of the germ producing the condition.

The specimen should be obtained as near the source from which the discharge arises as possible. The external auditory canal should be syringed out with sterile water, then dried by means of sterile

cotton tampons. A cotton cone is then placed in the external auditory meatus. After a few minutes the cotton cone is removed and a sterile speculum inserted into the canal and, under good illumination, the specimen collected with a sterilized platinum loop from the point at which the discharge is appearing. In removing the platinum loop, great care must be exercised that it does not come in contact with the walls of the external canal. In the absence of the platinum loop, a cotton applicator can be used, after sterilizing it in the flame of the alcohol lamp. The material so obtained can be placed upon properly prepared microscopic slides, carefully stained and examined. Or this material can be placed on culture media and incubated.

Slide preparations are advantageously made at one end of the slide. It is well to make two or three smears. After fixing in the flame, one slide may be stained with a simple dye such as Löffler's methylene blue, in the cold for five minutes. The other preparation may be stained by the Gram method, counterstaining with safranin. The use of Coplin jars for the stains is economical as well as convenient. The smears, after rinsing and thorough drying in the flame, are examined without cover glass under the oil immersion lens. Exceptionally, the slide specimen may be stained for tubercle bacilli, though this is done more readily when the smear is made upon a cover glass.

Direct bacteriological examination, by means of the spread, is inferior to cultures made after the careful technique outlined before. The primary cultures, made

either upon blood agar or plain agar, should be immediately diluted through two or three subcultures of blood agar. This procedure may enable you to obtain a streptococcus or other causative organism within twenty-four hours.

Culture material can be obtained from all the large manufacturing firms, agar or blood agar being, for all practical purposes, sufficient. In the absence of an incubator, the test tube containing the culture media can be placed in a thermos bottle containing air heated to the temperature of about 99°. It is often possible to get a good growth upon the media by placing the cultures near a stove, hot-air register or radiator. After a certain amount of experience one can soon learn to recognize fairly well the colonies of the more common types as they appear upon the media.

CHAPTER V

DIAGNOSTIC METHODS IN OTOLOGY

In addition to the methods of examination, which have been described under functional tests, there are certain other valuable aids in diagnosis and treatment: (a) inflation of the middle ear; (b) use of the pneumatic otoscope.

(a) There are three methods of inflation, *Valsalva's method*, *Politzer's method* and that by means of the *Eustachian catheter*.

Valsalva's Method.—The nose is so held between the thumb and index finger of the patient that his nostrils are tightly closed anteriorly. He is then instructed to make a forced effort as if he were blowing the nose. The nostrils being tightly closed and it being impossible for the air to escape anteriorly, there results increased pressure in the nasopharynx, this forcing open the Eustachian tubes, as these are the points of least resistance. As a result of the opening of the tube, air enters the middle ear cavity. Subjectively, the patient will then state that he feels the air passing to the ears and that a sense of fulness in the ears is produced. Objectively, if the drum is watched during the inflation, it will be seen to move outward as evidenced by a change in the position of the cone of light, this change being due to the fact that the ear drum has been pushed outward by the column of air entering the middle ear cavity.

Inflation frequently occurs in this way during head colds when the nose is violently blown. Also the ears are frequently inflated in this way by those suffering from nasal catarrh, who practice frequent forcible blowing of the nose. As we shall see later, this frequent blowing of the nose, with resultant inflation of the ear, as occurs in chronic nasal conditions, is very often the cause of certain pathological conditions of the middle ear tract and ear drum.

(b) *Politzer's Method*.—In applying this method of inflation it is necessary that we have, as aids, a Politzer bag with properly attached rubber tubing and a tip to be applied in the nostril. The rubber Politzer bag being held in the right hand, the tip of the bag is placed within one nostril, the nose then being grasped between the index finger and thumb of the operator in such a way that both nostrils are tightly closed anteriorly, so that it is impossible for air to escape at this point. Having reached this stage, the inflation can now be brought about in different ways.

First, instruct the patient to forcibly say "Ah!" The result of this is that the soft palate is drawn upward tightly against the posterior pharyngeal wall, thereby closing the nasopharynx from below. The nostrils having been closed tightly anteriorly by the operator's fingers, there exists *at the moment of phonation*, a closed space extending from the upper surface of the soft palate to the anterior portion of the nostril. The moment the patient says "Ah!" forcibly, pressure is made upon the Politzer bag with the right hand. The air thrown from the Politzer bag increases the pressure within the closed cavity above

mentioned, there resulting a bulging, at the point of least resistance—the Eustachian tubes, so that the air escapes through these to the middle ear cavity.

Second, instead of phonating, the patient may forcibly puff out the cheeks or forcibly blow through the lips as if he were blowing out a candle. While the patient is performing either of these acts, pressure is made upon the Politzer bag and inflation of the middle ear occurs. The counter pressure exerted by the patient prevents the air from the Politzer bag from going below into the pharynx.



PLATE VI. Politzer's method of inflation of the middle ear.

Third, while the tip of the Politzer bag is held within the nostril, as before stated, the patient takes a small sip of water in the mouth and holds it until instructed to swallow. The act of deglutition throws the soft palate forcibly against the posterior pharyngeal wall, there resulting again a closed cavity, just

as occurs when the patient phonates, the closure, however, in this case being more forcible. It is important that the pressure be made upon the Politzer bag *at the moment* when this closure occurs. If applied too early, the water not yet having left the mouth, it will be driven out forcibly through the patient's lips. If applied too late, after the soft palate has again relaxed, the air will follow the water downward into the stomach and there will result inflation of the stomach. In order to know just when the Politzer bag should be pressed, you should watch the thyroid cartilage of the patient; it will be noted, as he swallows, that the cartilage rises. At the moment that it reaches the highest point, the bulb should be pressed, as it is at this time that the nasopharynx is closed from below by the soft palate. In applying *Politzer's* method, you will find that you will meet with better success by using one of the two first-mentioned ways, as the technique is simpler and does not demand the same amount of experience in applying, as is demanded in the application of the third way. It is, however, well for you to master the latter technique, as you will find, in certain conditions, it is possible to force an opening of the Eustachian tube in this way when it is not possible by either of the other two ways.

Lack of attention to the details of technique is responsible for failure of inflation in the majority of cases. Especially is it important that the two nostrils are tightly closed anteriorly, so that the air cannot escape from these points. Next it is of importance that the Politzer bag is pressed at the proper moment.

(c) *Method of inflation by means of the Eustachian Catheter.*—In applying this method you make use of a Politzer bag, an auscultation tube and a Eustachian catheter. Before attempting to pass a Eustachian catheter you should first examine the nasal passage under good illumination in order to determine the formation of this. In this way you can determine the size of the catheter you will use or whether there are obstructions present, such as a deviated septum or septal spurs, which will forbid the passage of the catheter. It is frequently possible to pass the catheter above or below a septal spur although, upon first inspection, it might seem to forbid its passage.

The patient should be seated in front of you, with his knees close together so that he is within easy reach. It is an added advantage also if the patient's head is resting against a head rest or, in the absence of this, against the wall, so that he cannot, by throwing the head backward, as will be his tendency, make the passage of the catheter more difficult.

With the patient in this position you place one end of the auscultation tube in the ear which is to be examined, the other end being placed in either one of your ears. Be sure that the tips of the auscultation tube fits snugly in the patient's ear, as well as in your own, so that they will not have to be held by the hand; also you must see that the tubing does not rub against the patient's or your own clothing during the inflation, as sounds may be produced by this which may be not only distracting but misleading. Having made sure that the auscultation tube is in proper position, you



PLATE VII. Fig. 1.—Catheter Inflation. Elevation of the tip of the nose with the thumb of left hand, the fingers resting upon the patient's forehead.



PLATE VII. Fig. 2.—Introduction of the catheter in the vestibule of the nose.

then place the Politzer bag in the patient's hand so that you can easily reach it when needed. You now place the tips of the four fingers of the left hand upon the patient's head, just above the frontal eminences, while with the thumb of this hand you raise the tip of the nose. By doing this the anterior naris is so exposed that the catheter can be properly inserted. Now with the catheter held in the fingers as you would hold a pen, introduce the beak just within the naris. In doing this it is necessary to hold the catheter in a somewhat vertical position until the beak has passed over the nasal crest of the superior maxillary bone and lies upon the floor of the naris. Now raise the catheter to a horizontal position, making sure that the patient's head is held erect, by pressing with the fingers of your left hand upon the forehead, thereby overcoming the tendency which the patient will exhibit to lean the head backward. Now, with the beak of the catheter resting upon the floor of the nasal cavity, push it gently backwards along the floor, being careful to hold it lightly between the fingers, so that, if any obstruction is met with, the fingers will slide along the catheter. If the catheter is held too tightly, too much pressure may be made if an obstruction is met with and some damage done. Under normal conditions the catheter will glide backward along the floor of the nasal cavity, enter the nasopharynx and eventually rest against the posterior wall of the pharynx. The resistance offered by the posterior pharyngeal wall is readily recognized after a certain amount of experience and is also recognized by the depth to which the catheter has entered. The catheter being



PLATE VII. Fig. 3.—Passing the catheter along the floor of the nose into the nasopharynx.



PLATE VII. Fig. 4.—Rotation of the catheter toward the septum.

now held by the right hand, in its position along the floor of the nasal cavity with its beak resting against the posterior pharyngeal wall, the fingers of the left hand are brought down from the forehead and the catheter held firmly in this position between the thumb and index finger of the left hand, the other three fingers resting upon the nose. The thumb and index finger, while holding the catheter in position, at the same time hold it so that the catheter can be rotated between them.

Now, with the right hand, rotate the catheter through an arc of 90° inward, so that the beak points toward the opposite side. (The ring upon the proxi-



PLATE VII. Fig. 5.—Engaging the beak of the catheter on the posterior curvature of the nasal septum.

mal end of the catheter indicates the position of the beak in the nasopharynx.)

Now draw the catheter gently forward through the thumb and index finger of the left hand, until it meets with an obstruction. The beak is now hooked around the posterior end of the nasal septum.

Holding the catheter carefully in this position, with the thumb and index finger of the left hand rotate it downward and outward through an arc of 180° . (Do not attempt to rotate it upward as the beak of the catheter will come in contact with the roof of the nasopharynx.) The catheter should now be in proper position with its beak in the Eustachian



PLATE VII. Fig. 6.—The beak of the catheter has been rotated downward and outward through an arc of 180 degrees and engaged in the orifice of the Eustachian tube.

orifice, the ring of the catheter pointing slightly upward and outward.

Should the patient gag or retch at any stage of your manipulation, stop for a moment, allowing the catheter to rest quietly until satisfied that you can proceed. Any distress, which the patient may have, will disappear as soon as the beak of the catheter is in its proper position in the orifice of the Eustachian tube.

Now you take, from the patient, the Politzer bag, inserting the hard rubber end directly into the end of the catheter and make pressure upon the bag. If the inflation is successful, you will then hear, through the auscultation tube, the column of air entering the middle ear cavity producing a clear, soft, blowing, tubular sound.



PLATE VII. Fig. 7.—Inserting the tip of the Politzer bag into the catheter.

To withdraw the catheter, grasp it lightly between the thumb and index finger of the right hand and remove it gently; as soon as it is removed from the

Eustachian orifice, the beak will drop down into a vertical position and the catheter can be withdrawn along the floor of the nasal cavity. During this procedure the proximal end of the instrument is gradually dropped so that as the beak emerges from the vestibule of the naris, the instrument will be in the same vertical position which it occupied when you started to introduce it.

It is necessary, during inflation, that you hold the catheter firmly in position, with the thumb and index finger of the left hand, so that there will be no movement of the catheter forward or backward when the tip of the Politzer bag is inserted in the catheter. Also it is necessary when inserting the Politzer bag to insert it directly into the expanded proximal end of the catheter.

It will often be found necessary, when using the catheter upon a patient for the first time, to cocainize the floor of the nasal cavity. Later, as the patient becomes used to the passage of the catheter, this will not be necessary.

While in the average case, by following the technique above described, you will find, upon inflation, that the catheter has entered the Eustachian tube, in a certain percentage of cases you will find, upon attempting to inflate, that the normal blowing sound is not produced. In such a case rotate the catheter upward or downward slightly, attempting again to inflate, or move it backward or forward a little. You will usually find that, after such slight manipulations the inflation will succeed.

After the air is expressed from the Politzer bag,

remove it from the catheter before releasing your pressure upon it, as otherwise suction will be produced through the catheter, as the bag refills with air, this drawing into the catheter any secretion which may be in the Eustachian orifice, so that, when we attempt again to inflate, this secretion will be forced into the Eustachian tube. The number of times that an ear should be inflated and the amount of force to be used, will depend upon the purpose for which you are using the method. If used for purely diagnostic purposes, to determine the permeability of the tube, the presence of secretion within the tube, or middle ear cavity, one inflation will frequently be sufficient and, under normal conditions, a very moderate amount of force will be found necessary. Where this method is used for treatment, and in cases where the tube is considerably narrowed by diseased conditions, it may be necessary to inflate a number of times, while at the same time increased force is used to overcome the obstruction. You will do well to start with moderate force and you will soon learn to recognize, by carefully observing the sounds produced through the auscultation tube, the degree of pressure you must exert upon the Politzer bag in order to bring about an inflation.

Valsalva's method of inflation should only be used for diagnostic purposes. By closely examining the ear drum, under good illumination, while the patient inflates by this method, you can determine the permeability of the tube, as evidenced by the movement of the drum produced as the increased pressure of the air in the middle ear cavity drives it outward:

also you can determine the movability of the drum, which is of advantage in cases where adhesive conditions of the middle ear are suspected. Again, the presence of a perforation in the drum is evidenced by the whistling sound produced as the air passes through the perforation. It is not well to advise your patient to make use of this method of inflation in order to relieve him of certain symptoms occurring during middle ear conditions. While it is true that the patient can often, for a time, gain relief by practicing this method, it usually happens that he gets into the habit of inflating his ear many times a day and there results ultimately, through this oft-repeated, increased pressure, a markedly relaxed condition of the drum, this acting as a factor in the production of deafness. *You should never, therefore, make use of Valsalva's method in the treatment of aural conditions.*

As with Valsalva's method, there occurs also with Politzer's method, usually, an inflation of both ears. On this account in unilateral lesions of the ear the method should seldom be used.

The method by means of the Eustachian catheter is always to be preferred for finer diagnostic and therapeutic purposes. By this method each ear can be treated separately, the finer changes, such as strictures or fluid in the Eustachian tube and middle ear, can be more accurately studied and, as a scientific means of treatment, it can be more accurately applied.

(b) *Use of the Pneumatic Otoscope.*—When the metal tip of the otoscope is adjusted snugly in the orifice of the external auditory canal, so that no air can

escape around it, and pressure is made upon the bulb of the instrument, the pressure of the column of air (extending from the bulb to the ear drum) will be increased. This will be noted as you look through the lens, in that you will see the walls of the external canal pressed outward, so that the canal lumen is somewhat widened and also, as you look at the drum, you will note that this is pushed inward, as evidenced by the change in the position of the cone of light and also by the direct movement of the drum. When the pressure on the bulb is released, the walls of the external canal resume their normal position, the drum moving again outward. You thus see that, by means of the pneumatic otoscope, you can produce increased pressure or suction. These manifestations are valuable as diagnostic and therapeutic measures. In some instances the instrument will be used for suction alone, while for still other purposes alternate suction and pressure will be used. For example, by suction, fluid, contained within the middle ear cavity, can be brought out, through a perforation of the drum, into the external auditory canal, thus clearing the middle ear, while at the same time allowing you to see, through the lens of the otoscope, the point from which the secretion emerges. By alternate pressure and suction, the drum can be moved backward and forward. If, then, any portion of the drum is adherent to the wall of the middle ear cavity, this will readily be noted, as it will be seen that the adherent portion is immovable.

When the otoscope is used for the purpose of suction, the bulb should be compressed before the metal

tip of the instrument is inserted in the orifice of the external auditory canal.

In addition to the advantages already mentioned, the magnifying lens in this instrument gives an enlarged picture of the structures at the end of the external auditory canal. This enlargement is of considerable value in studying these structures.

Now and then you will find that the pressure or suction, exerted by the otoscope, will cause dizziness of mild degree. If you encounter a case in which, through suppurative process, a fistula exists in the bony wall of the labyrinth, very intense vertigo may be produced. This fistula symptom is made use of in the diagnosis of certain labyrinthine conditions.

You will find that, by placing a small piece of soft rubber tubing over the metal end of the otoscope, it can be better adjusted in the orifice of the external auditory canal, while the softness of the tubing will add to the comfort of the patient.

CHAPTER VI

ETIOLOGY OF AURAL DISEASE

If the beginner in otology will firmly fasten in his mind the fact that the majority of aural diseases are due to some underlying general condition, he will at once understand that, in many aural conditions, he cannot hope for a cure or an improvement, unless, while treating the local condition, he at the same time carefully considers and treats the underlying general condition.

The successful specialist is the one who recognizes the general cause of aural conditions and who insists upon a thorough general examination of his patient, before arriving at any definite conclusions as to the line of treatment to be instituted. There is necessity, therefore, for the hearty co-operation of the internist, the otologist, the pathologist, the roentgenologist, the dentist and others, if results are to be obtained in many aural diseases.

Many cases of deafness are due to toxic conditions arising from different sources. Formerly such cases were considered hopeless but, in the light of present-day knowledge, it is often quite possible to locate the source of toxæmia, by determination of the character of the gastroenteric tract or through blood and urinary examinations. Deficient kidney action, anæmia, acidosis or syphilis, or some such foci of infection as dental pathology, diseased tonsils, empyemia of the

nasal accessory cavities, prostatic infection, uterine or ovarian infections, are frequently the cause of aural disease. It can readily be seen, from these statements, that considerable skill is demanded in order to determine the cause of any given condition and that, therefore, very frequently, the co-operation of experts in various lines will be demanded.

On account of the general cause for many aural affections, it is important that you should have a good knowledge of the general etiology of aural diseases. If you do not have this you cannot know along what lines your investigations should be extended.

Recent co-operative work by specialists, in different lines of medicines, have fully proven the necessity for such thorough investigation and the skilled aurist of today, on account of such co-operation, is obtaining very flattering results in the treatment of many aural conditions, which a decade ago were looked upon as hopeless.

If you will hold in mind the anatomical and histological structures of the ear, you will see that there are three main channels through which the ear can become diseased: (1) the external auditory canal, (2) the Eustachian tube, by continuity of structure, and (3) from systemic disease by means of the blood and lymph.

1. Through the external auditory canal there may occur traumatic conditions of the drum and middle ear cavity, from the introduction of toothpicks or other means used by patients for removing cerumen from the canal, or through the introduction of various types of foreign bodies within the canal. Insects

occasionally find their way into the canal, setting up irritation which in addition to the local trouble in the canal, may extend to the ear drum or the middle ear cavity. Through the sudden rarification or compression of the air within the canal, considerable damage may result to the ear drum or middle ear cavity. Through infection, arising from trauma, there may subsequently result serious middle ear involvement or even intracranial conditions.

2. Through the Eustachian tube by continuity of structure, the various inflammatory conditions of the nasopharynx can invade the middle ear tract, producing a variety of affections, both acute and chronic. Obstructive conditions within the nose and nasopharynx (such as deflected septa, hypertrophied turbinates, adenoids and enlarged tonsils) by lessening the aeration of the middle ear cavity, produce marked aural changes. During bathing, or nasal douching, water can pass through the Eustachian tube to the middle ear and act as a cause of acute middle ear disease. Chronic catarrhal conditions of the nose, which necessitate repeated blowing of the nose, can cause chronic middle ear disease by too-frequent inflation of the middle ear resulting from such violent blowing.

3. Through the blood and lymph channels the ear will become affected during a variety of diseased conditions such as the acute exanthemata, influenza, mumps, syphilis, tuberculosis, Bright's disease, diabetes, rheumatism, pneumonia, typhoid fever, meningitis and toxæmias arising from foci of infection.

Certain drugs have a marked influence upon the

ears, especially quinine, the salicylates, lead, arsenic, mercury, phosphorus, tobacco and alcohol.

Occupation is an important causal factor in disease of the ears, as, for example, those exposed to the weather, dust, or smoke; those who work in trades where certain drugs are used; and those who work in noisy places, such as boiler factories, machine shops and caisson workers.

Age and heredity are important factors to be considered in the etiology.

CHAPTER VII

PREVENTION OF AURAL DISEASE

The prevention of ear disease is largely in the hands of the family physician. In the early stage of all aural affections, the patient consults the general physician and in the majority of cases is treated by him. It is essential, therefore, that in order to prevent many of the acute and chronic aural diseases you should recognize the significance of the early symptoms and, by a proper course of treatment, prevent the occurrence of many of the chronic conditions. Also, through your knowledge of the possible occurrence of acute aural conditions, during the course of such diseases as scarlet fever and measles, through proper treatment of the nose and throat during the course of these diseases you should prevent the establishment of acute conditions. You should recognize the fact that patients, suffering from a variety of nasal conditions, are liable to a subsequent involvement of the ear, and therefore see that such nasal conditions are corrected. The presence of adenoids, diseased tonsils, nasal obstructive conditions should be recognized and corrected. You should know that tubal catarrh is the prodromal stage of middle ear catarrh and should prevent the deafness which would arise from this, by insisting upon a proper care of the tubal condition. By such a thorough care of the patients whom you treat, you

will prevent and help materially to stamp out many of the acute and chronic aural conditions. Unfortunately the symptoms and conditions, which foretell aural involvement, are frequently not recognized and the patient is allowed to pass carelessly through these early stages, when the condition could be cured, and to reach the chronic stage in which hope of cure, or even of improvement, is passed.

The physician, who, while recognizing the importance of these early stages, does not feel himself able to properly treat the condition, should, in justice to the patient, see that the case is referred to someone who has the required skill. It is our experience that the average intelligent patient respects the family physician who is honest enough to acknowledge his limitations, while, at the same time, appreciating his unselfish interest.

The above statements are made after a long experience in the treatment of aural conditions and a careful study of the histories of such aural cases. The average case is referred to the aurist only when, after long years of a more or less routine treatment, the condition has not improved, so that the majority of cases, especially of the chronic type, have passed beyond the stage of probable improvement and it is only possible, by dint of most careful attention, to prevent a further advance of the condition. It is not to be expected that the family physician should have an intimate knowledge of the care of these special conditions.

CHAPTER VIII

DISEASES OF THE EXTERNAL EAR

Aside from the occurrence of such mechanical conditions as foreign bodies and cerumen within the external auditory canal, the external ear is subject to inflammatory conditions both of the acute and of the chronic type.

The acute conditions are characterized by *pain aggravated by motions of the jaw, as in chewing, and by traction or manipulation of the auricle*. The pain is also usually constant and throbbing in character and in many cases referred anterior to the auricle. You will do well to remember the characteristics of this type of pain.

The chronic types of inflammation of the external ear are characterized mainly by *itching* of either mild or severe degree. This itching frequently drives the patient to use some means to allay the symptom, such as scratching with a match stick or finger, and there often results from this an infection, so that the acute type of the disease will frequently be found with the chronic type. Chronic conditions of the external ear are very frequently symptoms of, or part of, a general condition. Usually it will be found that there exists faulty elimination. The integument, lining the external auditory canal, is subject to the same types of disease as is the integument elsewhere, but, as the structure of the canal favors warmth and moisture, making of

the canal practically an incubating chamber, diseased conditions of the integument, within the canal, are therefore markedly favored in their progress, their severity and chronicity. Remembering this fact you will see that moisture should be avoided as far as possible in the treatment of conditions of the external canal.

Diseases of the Auricle

Malformations of the auricle, supernumerary auricles, deformities due to trauma or diseased conditions, being of a surgical nature, will not be considered here.

Perichondritis of the Auricle

Causes.—Traumatism and frost bite, complications of diseases of the external auditory canal.

Pathology.—Inflammation of the perichondrium resulting in exudation which undermines the perichondrium. As this is the nourishing membrane of the cartilage of the auricle there results ultimately, unless the condition is arrested, death of the cartilage with subsequent marked deformity of the auricle.

Symptoms.—The condition starts with heat, this followed rapidly by pain, which, within a few hours, becomes intense.

Objectively.—The entire auricle, with the exception of the lobule, is at first reddened. As exudation occurs, the contour of the auricle is gradually lost, this showing especially upon the anterior surface. When fairly well developed, the auricle appears very much swollen, pits readily over its entire surface, and is extremely sensitive to touch. If the condition advances beyond this point, rupture occurs

through the auricle, the fluid secreted being at first of a serous character, later becoming purulent, as sloughing of the cartilage takes place. In the average case this stage is reached within a very few days.

Diagnosis.—This condition must be differentiated from hematoma of the auricle. (See under that subject.)

Prognosis.—In the majority of cases, if seen early and promptly treated, the prognosis is good. In some cases of trauma and severe frost bite, the condition, progressing in spite of treatment, results in ultimate deformity of the auricle.

Treatment.—In the early stage, before exudation occurs, the application of cold by means of the ice-bag. When exudation occurs, aspiration of the fluid followed by compression with dressings, so as to keep the perichondrium in contact with the cartilage. If this does not stop the progress, then drainage secured by free incision through the integument and perichondrium.

Remedies.—Apis and belladonna.

Hæmatoma of the Auricle

Causes.—Traumatism.

Pathology.—There occurs as a result of trauma, an extravasation of blood between the cartilage and perichondrium. This may occur as one large single hæmorrhage or as multiple hæmorrhages, appearing as single or multiple swellings upon the auricle. The blood either absorbs, or suppurates, or it may become organized with a resulting permanent thickening and deformity.

Symptoms.—Sudden appearance of a doughy swelling, usually upon the anterior surface of the auricle. This may involve only a small area or several areas, or may cover the entire auricle. With the occurrence of swelling, pain develops. Unless the condition is relieved there results a breaking down of tissue or an organization of the clot, in either case there resulting a deformity of the auricle.

Objectively.—There will be seen upon the surface of the auricle one or more areas of swelling which are bluish in color and doughy upon palpation.

Diagnosis.—The condition must be differentiated from perichondritis of the auricle. In *hematoma* the swelling occurs more rapidly than in perichondritis; there is less redness and heat; the swollen areas are more doughy to the touch. By transillumination the swollen area appears dark, while in *perichondritis* the swollen area transmits light readily.

Prognosis.—Usually good.

Treatment.—Incise over lower portion of the swelling, remove the blood clot and apply pressure bandage. If suppuration occurs, free drainage and treat surgically.

Remedies.—Hamamelis and arnica.

Epithelioma, Sebaceous Cysts and Eczema of the Auricle

Epithelioma is the most common malignant condition of the auricle and should receive the same treatment as this condition occurring elsewhere.

Small *sebaceous cysts* are frequently found upon the posterior surface of the lobule. These should

be removed by dissection, the skin surfaces being closed by sutures.

Eczema of the auricle will be considered with eczema of the external auditory canal.

Diseases of the External Auditory Canal: Foreign Bodies

Animate and inanimate bodies are found in the external auditory canal.

Animate objects include the various types of insects.

Inanimate objects include shoe buttons, peas, broken match sticks, grains of corn, newspaper, cotton and a vast variety of substances introduced usually by the patient.

Symptoms.—*These will depend upon the character of the object, its size and position in the external canal.* Insects will produce a sensation of something crawling in the ear, buzzing, or, in cases of insects having tentacles, pain may be produced, especially if the insects attach themselves to the ear drum.

Inanimate objects, if small, may cause no symptoms, or, by change of position of the head, may produce very annoying sensations by movement in the canal and contact with the drum. Larger objects, completely occluding the canal, may cause dull hearing and fullness in the ear, or, by pressure, produce pain. It is possible for foreign bodies to be retained in the external canal for many years without producing any symptoms.

Diagnosis.—This is made from the history of the case, together with the finding of the foreign body by

objective examination. (We would especially caution you against accepting the statement of the patient without making an objective examination.) Not infrequently, foreign bodies become covered by cerumen or epithelium; the diagnosis can then only be made by gentle palpation with an aural probe or, upon removal of the supposed cerumen, the foreign body will be found imbedded in the mass which has been removed.

Prognosis.—If the case is properly treated the prognosis is good. Much damage can be done through unskilled manipulations in efforts to remove foreign bodies.

Treatment.—The removal of a foreign body from the external auditory canal, will very frequently test the ingenuity and patience of the physician. The average case is brought by an excited mother and you must not allow the excitement of the mother or the family to affect you in the least, but should assure them that the condition is not a serious one. Too often the physician himself becomes excited and, in his haste, does not use good judgment, is not sufficiently prepared for his work, and either fails to remove the foreign body or produces traumatic conditions of a more or less serious nature. You should first, by careful examination, determine the character, size of the object and its location in the canal. Having determined this, you should then consider carefully how best the object can be removed. This will depend, as above stated, to a large extent, upon its character, its size and location in the canal. At this point it is well to remember the formation of the

external auditory canal; the fact that the canal is narrowest at the junction of the cartilaginous and bony portions; and that the anterior and inferior walls of the canal are longer than the posterior and superior walls. Not infrequently foreign bodies, such as peas, beans, and shoe buttons, lodge at the narrowest portion of the canal. If, through unskilled manipulation, they are pushed beyond this point, their removal becomes extremely difficult. Also, where the foreign body is resting against the drum, especially round bodies, such as beads and shoe buttons, it will be seen that there is room to introduce a small hook, or some other such instrument, back of the object on the anterior or inferior wall. If introduced along the posterior or superior walls, injury to the drum may be produced as the foreign body, at this point, will be in direct contact with the drum. Before attempting to remove any foreign body, you should have at hand a good equipment, as the instrument first thought of may not prove the proper one for removal. The usual instruments necessary are aural forceps, aural hook, aural ring or sharp curette. In case of a shoe button in the ear, it may be possible, by very careful and gentle manipulation, so to rotate this that the eye of the button is exposed and this can be grasped and the button readily removed. When the foreign body is round and hard it is better to attempt to insert an instrument back of the body and pull it outward. If you grasp such an object with an aural forceps it may be pushed ahead in the canal, just as you would expel a watermelon seed from your fingers.

Softer objects, such as newspaper or cotton, may be grasped with a forceps and removed.

As the objects found in the canal are so varied, it is impossible to outline the treatment of every case so that, as stated above, your ingenuity and patience will be tried to the utmost.

In many cases, especially in children, an anæsthetic should be administered so that you will have ample time to remove the object and can work carefully. In some cases it will be found impossible to remove the foreign body through the external auditory canal, it becoming necessary to expose the membranous canal posteriorly, through a mastoid incision, and remove the foreign body through an incision made through the membranous canal. Insects should first be killed by dropping alcohol or bichloride solution into the external canal. Very frequently the insect will be removed by the fluid so instilled. If this does not occur it can then be removed by syringing. If the insect has attached itself, by its tentacles, to the ear drum or walls of the canal, it can first be killed and then removed with the aural forceps.

We cannot too strongly advise caution in the treatment of foreign bodies in the external auditory canal. We have so frequently seen cases in which the foreign body has been pushed deeply into the canal, either by instrumentation or by syringing, this making the removal of the foreign body much more difficult. Also, we have seen marked trauma of the external auditory canal or ear drum produced, either through excitement or lack of proper understanding of the

anatomy of the external auditory canal. Suppurative conditions of the middle ear frequently follow such trauma, and such suppuration may materially damage the hearing or may even cause involvement of the mastoid from which serious ultimate intracranial complications may result.

Because of its importance, we do not therefore hesitate to repeat: (1) be sure there is a foreign body present; (2) be well equipped; (3) keep in mind the anatomy of the external auditory canal; (4) be gentle in your manipulations; (5) if necessary use an anæsthetic.

Excessive or Impacted Cerumen

Under normal conditions, there is secreted from the ceruminous glands, in the external auditory canal, an amount of cerumen sufficient to cover the integument with a thin layer, so that in the normal canal this can be readily seen upon its walls. (See Anatomy of the External Auditory Canal.)

Frequently the cerumen is found in abnormal amounts and it is then spoken of as excessive cerumen, or in case it causes a complete occlusion of the canal, it is designated as impacted cerumen.

Causes.—(1) Excessive secretion; (2) abnormal secretion; (3) presence of hairs in the canal, which prevent the normal removal; (4) abnormal formation of the canal which acts as an obstruction; (5) a foreign body acting as a nucleus for the collecting of cerumen.

Symptoms.—These will depend upon whether the canal is completely occluded or not; whether the ceru-

men is pressing against the ear drum; and whether it is fixed or movable in the canal.

If the canal is occluded, there will be dull hearing. If the foreign body is pressing upon the drum, there will result a stuffy, full feeling in the ear from pressure and often, also, some form of tinnitus. If it is movable, it may produce a sensation of something moving in the ear, or, by bumping against the drum, produce unpleasant sensations. The average case of impacted cerumen will complain of dull hearing; stuffy, full feeling in the ear; and some degree of tinnitus. A plug of cerumen may lie in the canal for months and produce no symptoms and then, after the patient has been swimming or, during the warm weather, when he perspires freely, the plug may, by contact with water, become swollen and produce, suddenly, the symptoms above enumerated.

Diagnosis.—Upon objective examination of the external canal of a patient complaining of the above symptoms, there will be found a light or dark brown mass filling the external canal. This color will vary, depending upon whether it is a fresh deposit or has been in the canal for some time. The fresh deposit will be lighter in color and glistening on its surface, while the older deposit will be darker, due to the presence of dust which has become mixed with the secretion. At times, the deposit is covered with a thin layer of epithelium and may then appear whitish or yellowish-white in color.

Prognosis.—Frequent recurrences of the condition may, by pressure upon the drum, cause changes in the middle ear and some degree of dull hearing.

The condition is liable to frequent recurrences. As tinnitus and dull hearing sometimes remain after the removal of a ceruminous plug, the physician should be guarded in his statements to the patient.

Treatment.—Small amounts of cerumen, which do not completely occlude the canal, can readily be removed under good illumination, by either the aural curette or the aural forceps. The removal of excessive masses will depend, to some extent, upon the consistency of the plug. If this is old and dry and not adherent to the walls of the canal, it may be possible to remove it with aural forceps. If, however, it is found to be adherent to the canal walls, or, upon grasping it with forceps, only small portions are removed at a time, it is then better to carefully separate the plug from the canal walls with an aural probe and then attempt the removal by means of the aural syringe. If the plug is of soft consistency, the aural syringe is the proper instrument to use for removal. Only in extreme cases should we make use of the aural curette in the removal of ceruminous plugs and especially should the one who is not skilled in this work avoid the use of this instrument, as he can very readily produce traumatic conditions of the external canal or ear drum.

Method of Using an Aural Syringe.—As the result of using an aural syringe, for the removal of impacted or excessive cerumen, depends largely upon a proper technique, we go somewhat into detail upon this subject.

The patient should be seated in a chair having a back. This is extremely important, for it occa-

sionally happens that syncope occurs during syringing, and if the patient is sitting upon a stool he may fall suddenly upon the floor. Place a towel and rubber sheeting about the patient's neck and a kidney pan beneath the lobule. Illuminate the orifice of the external canal with the light from your head mirror, or by having the patient's ear turned toward the window. Grasp the auricle with the thumb and two first fingers of the left hand, pulling it upward and backward in order to straighten the cartilaginous portion of the canal, the right hand being free to manipulate properly the aural syringe. Now insert the end of the syringe into the orifice of the external auditory canal so that it has the same direction as the canal. This is very important to

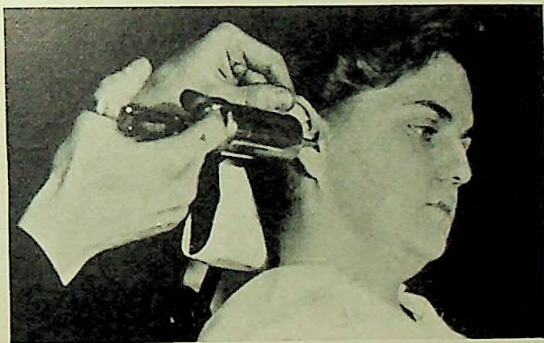


PLATE VIII. Showing the proper method of elevation and retraction of the auricle and proper position of the syringe in irrigating the ear.

observe for, in order to remove the cerumen, the column of water from the syringe must be thrown

directly against the cerumen. If you do not observe this, the column of water will be thrown against the posterior wall of the canal. Being sure that your syringe is properly inserted, you are ready to start your syringing. At first only gentle pressure should be made upon the plunger of the syringe and you should note whether the patient shows any sign of dizziness, as some are very sensitive to syringing. If this does not occur, then the force can be increased. If, after one or two syringefuls, of warm, sterile water have been injected into the canal, the plug is not dislodged, then, with the aural speculum, examine the plug. It may be found necessary to loosen it somewhat from the walls of the canal. After doing this, again use the syringe. Usually after three or four syringefuls have been injected, the ceruminal mass will be washed out into the kidney pan, or will be seen presenting at the orifice of the external canal from which it can be readily removed by forceps. Now examine the external canal to see that all the cerumen is removed and, with a small cotton mop upon the cotton applicator, gently remove the remaining water from the canal. *Always inspect the canal and ear drum after removal of a ceruminal plug.* Occasionally a case is encountered in which the apparent ceruminal plug, when removed, uncovers an old suppurative condition of the middle ear with a perforation of the drum, which the patient had considered cured or had forgotten existed. If a careful examination of the plug is then made, it will often be found to consist of a mixture of cerumen and middle ear secretion. The patient's attention

should then be called to this condition, for, after the removal of the plug, there being now no obstruction to drainage, the ear may discharge and the patient place the blame upon you.

Very often it is impossible to remove the cerumen at the first visit because the wax adheres to the canal walls. In such cases it becomes necessary to instill certain solutions into the ear for the purpose of softening the wax. The best solutions for this purpose are peroxide of hydrogen or bicarbonate of soda. The first can be used pure, the latter in the strength of a teaspoonful to 4 oz. of warm water. The patient should be instructed to lie down with the ear to be treated up, then to fill the canal with the solution, allowing it to remain for five or ten minutes. He should repeat this three or four times at intervals of a half-hour before reporting at the office. In the average case it will then be found that the cerumen is sufficiently softened so that it can be removed by syringing. Occasionally a case presents in which it is necessary to repeat this procedure several times before the plug is sufficiently softened. As the instillation of drops in the ear by absorption produces an increase in the volume of the ceruminous plug, there is often produced increased pressure and deafness and you should inform your patient of this, as otherwise he may think your treatment is making him worse and may not return to you. Also, on account of the temporary increase in his symptoms and the attending discomfort, it is usually advisable to instruct him to use the drops the day upon which

he is to report to your office as, otherwise, he may spend a very uncomfortable night.

On account of the liability to recurrences of this condition and the possible damage to hearing from repeated impacted masses, you should inform your patient of these possibilities and advise him to present himself from time to time for examination. In this way, any accumulating cerumen may be removed before it has had an opportunity to exert much pressure, and also, as in certain cases it is determined that an underlying dermatitis is the cause of ceruminous accumulations, treatment of this condition will frequently prevent recurrences.

Laminated Epithelial Plug

Causes.—This condition usually occurs in elderly people as a result of a senile seborrhœa or from a dermatitis; occasionally also it accompanies a gouty diathesis.

Pathology.—As a result of an underlying dermatitis, the epithelium exfoliates, usually throughout the entire lumen of the canal, and, through repeated exfoliations of the epithelium of the canal, there results a closure of the canal by a plug which, upon examination, is found to consist of concentrically arranged laminae, the more recent exfoliations being external.

Symptoms.—Subjectively there is produced a feeling of stuffiness or fullness associated with numbness. If complete occlusion of the canal has occurred, some degree of deafness will be noted, together with tinnitus of varying character. Pain is usually absent.

Objectively.—The canal is found filled with a straw-colored or yellowish-white mass, the consistency of which will vary with the amount of moisture present.

Prognosis.—The condition is apt to recur. Frequent recurrences, by pressure upon the ear drum, may produce changes in the middle ear.

Treatment.—Remove the plug by grasping with aural forceps. Usually the plug is, in this way, successfully removed from the canal, the patient having instant relief from symptoms. If the plug is moist, several efforts must be made, the plug being removed in portions. If it is not readily removed, it may be necessary first to separate it from the canal walls by gentle manipulations with the aural probe, before attempting to remove it. Failing to remove it by means of the aural forceps, the aural syringe may be used. Occasionally these plugs are difficult to dislodge and it may be necessary to use some such solution as enzymol, which, through its digestive action, will gradually disintegrate the plug so that, after repeated syringing, it can be removed. Owing to the tendency to recurrence of this condition, the patients should be advised to present themselves for examination from time to time, so that the epithelium present can be removed before it has reached the stage of complete occlusion of the canal.

Exostoses of the External Auditory Canal

These are bony growths occurring in the bony canal, protruding into the canal and producing a narrowing of its lumen. They may be single or multiple, spongy or eburnated, pedunculated or with a broad base.

They often occur in both ears and are frequently symmetrical in location.

Causes.—There is no known cause. Sometimes they are hereditary.

Symptoms.—There are no subjective symptoms.

Objectively.—They appear as hard nodules projecting from the canal walls, the skin covering them being thinner and lighter in color than the surrounding integument. When multiple, they occupy opposing positions, but usually do not touch each other, there being some space between them. Occasionally they ulcerate and may become adherent, causing an occlusion of the canal.

Diagnosis.—They must be differentiated from furuncles and polyps. A furuncle pits on pressure and is remarkably sensitive. A polyp is movable, bleeds easily and is not sensitive.

Treatment.—Unless they are necrosing, or are acting as a dam to drainage from the middle ear, no treatment is necessary. Otherwise the treatment is surgical.

Atresia of the External Auditory Canal

These are congenital or acquired narrowings, or closures, of the external auditory canal. The congenital atresias usually occur at the orifice of the canal, the acquired atresias are consequent upon primary inflammation of the external canal, or some secondary inflammatory condition of the canal due to suppurative disease of the middle ear. They may occur in any part of the canal.

Treatment.—Usually surgical, although in some cases the canal can be dilated by pressure plugs.

Parasitic External Otitis: Otomycosis

Causes.—This condition is due to the growth of fungi in the external canal. The usual fungus found is the aspergillus, either the aspergillus niger, rubrum or flavus. Under favorable conditions these fungi grow very readily in the canal and, by throwing off spores, a continued growth may be kept up indefinitely.

Symptoms.—A feeling of fullness in the canal, with the occurrence of a thin watery discharge, are the symptoms which bring the patient for examination. Where complete occlusion of the canal occurs, dull hearing may be present. When the condition is of long standing with inflammation of the canal walls and ear drum, there may also be pain.

Objectively, a thin watery discharge is found in the canal, or is seen issuing from the canal, the end of the canal being filled with a whitish substance having the appearance of wet paper. Depending upon the type of the aspergillus present, there is often added a blackish, yellowish, or reddish color to the material in the canal. This material is very readily removed by syringing when it will be found to have a gelatinous appearance and to be of the consistency of wet paper, upon which will be seen the small black, yellow or red colonies of aspergilli. Under the microscope the separate aspergilli have a toadstool appearance. After removal and upon drying the canal, it will be found that the walls close to the drum, and frequently

also the outer surface of the drum, exhibit a varying degree of redness, due to the diseased condition of the canal caused by the fungi.

Prognosis.—The condition responds very readily to treatment and does not recur. It can be very easily carried to the other ear by the patient.

Treatment.—Remove all the material in the canal by syringing. Dry the canal by means of cotton upon the applicator and then instil absolute alcohol. This should be left in the canal for some minutes. Usually after a few applications the condition will disappear. In stubborn cases it may be necessary to continue this treatment over several days until all the spores, which have been deposited in the canal, have been destroyed.

Acute Circumscribed External Otitis (Furunculosis)

Causes.—From infection produced by the patient in his efforts to relieve the itching, which occurs during certain diseased conditions of the external auditory canal, or through infection caused by an acute or chronic otorrhœa. During convalescence from various febrile conditions, especially typhoid fever, during the course of diabetes or Bright's disease, during menstrual disturbances, or as a part of a general furunculosis.

Pathology.—A staphylococcic infection of the sebaceous glands and hair follicles resulting in a circumscribed inflammation which eventually suppurates. Deeper structures may be involved forming a perichondritis or a periostitis of the areas attacked.

Symptoms.—The condition is usually preceded by itching, followed by a longer or shorter period of warmth, this rapidly followed by pain, constant in character, which is usually referred anterior to the auricle. *The pain is aggravated by motions of the jaw and any movement of the auricle.* On account of the pain produced by motions of the jaw, these patients are apt to avoid solid food, preferring liquids, as the effort of swallowing does not aggravate the pain. They avoid lying on the affected ear, as this increases the pain.

Dull hearing occurs in these cases only when the swelling is sufficient to produce occlusion of the canal; also, after the furuncle has ruptured, the discharge may so fill the canal that dull hearing will occur.

These subjective symptoms rapidly disappear as soon as suppuration occurs and the furuncle opens.

Objectively, a furuncle is recognized either by direct inspection or, where the condition is deep, by palpation of the external canal and the finding of an especially sensitive area. The usual position for a furuncle is near the orifice of the canal in its cartilaginous portion. If superficial and well developed, a red elevation will be found on one of the walls of the canal, usually the anterior, this area being extremely sensitive to touch. If pus has already formed, a small, yellowish spot will be seen at some point on the surface. In the very early stage, the condition may only be recognized by finding an area of redness, which area is sensitive to touch. In certain cases, especially where the condition is deep, its location

can only be found after carefully palpating the surface of the canal at various locations until a point of extreme sensitiveness is found.

Occasionally a furuncle will be found in the deeper portion of the canal and, when on the posterior wall, may simulate clinically a mastoiditis by producing marked swelling over the mastoid with prominence of the auricle. A study of the character of the pain and the history of the case will aid materially in the diagnosis, for a mastoiditis is always preceded by either an acute or a chronic suppurative middle ear condition. The sagging of the posterior canal wall, frequently found in mastoiditis, often has the appearance of a furuncle but does not exhibit the extreme sensitiveness on palpation.

Frequently the entire side of the face may be swollen, this swelling often extending to the eyelids, which may be markedly œdematous.

Prognosis.—As this condition is apt to have frequent recurrences, it is well to inform the patient of this. It is nothing uncommon to have a series of these furuncles following each other rapidly or within a few days of each other, these recurrences frequently affecting both ears. The prognosis will naturally depend upon the underlying condition. The average course of a furuncle is about four days. Where the condition is deep, this time may be lengthened or, in very superficial furuncles, rupture may occur within a few hours.

Treatment.—As this condition is frequently produced by infection from scratching the canal walls or by improper methods of cleansing the canal,

patients should be cautioned to avoid the use of ear spoons, match sticks and various other objects, so frequently made use of to relieve itching, or for the purpose of removing cerumen from the canal. Also, they should be instructed not to attempt cleansing the canal by inserting the end of a wash cloth. They should be informed that, under normal conditions, the deeper portions of the external auditory canal are self-cleansing.

The formation of furuncles is also prevented, during the course of chronic otorrhœa, by care on the part of the physician in providing good drainage or, where the discharge is of an especially excoriating nature, by keeping the canal walls covered with a thin layer of some such ointment as cold cream, vaseline or boric acid.

Early, when the lesion is a hard painful swelling, the use of emplastrum fuscum will relieve the pain and frequently prevent suppuration. This is applied in cylindrical masses covered with one thickness of gauze placed in the canal over the inflamed area. The tampons should be renewed every four to six hours depending upon severity of the condition.

Carbolic acid, 25% in glycerine, applied upon cotton cones, is also used to good effect in the early stage.

Burrow's Solution (*Liquor alumni acetatis*) applied upon a gauze wick in the canal is particularly useful where there is considerable œdema over the mastoid as well as in the canal. The entire mastoid area may be covered with gauze saturated with the solution. At frequent intervals the dressings should be moistened by dropping fresh solution upon them.

Belladonna tincture applied locally on a cotton tampon and allowed to remain in contact with the inflamed area is recommended.

It is advisable to wait until the condition localizes before incising. This is a very painful operation and should be performed under a general anæsthetic such as somnoform or nitrous oxide and oxygen.

Radiant light is useful and should be applied for twenty minutes over the affected side. If the furuncle is accessible short radiations with the water-cooled quartz lamp should be employed. This is followed by radiant heat.

In cases where the furunculosis occurs in those generally debilitated, general exposure to the air-cooled quartz lamp is valuable.

The homœopathic remedies most frequently indicated are arnica, hepar sulph., and calcarea picrata. These are especially of use in the prevention of recurrences.

Diffuse External Otitis

In this type of inflammatory condition the entire, or greater, portion of the external auditory canal is involved and also the outer layer of the drum. It is not uncommon to find, in the same ear, the acute circumscribed and the diffuse types of inflammation, the former being consequent upon the latter and vice versa. The diffuse type of inflammation may run either an acute or a chronic course.

Causes.—This condition is frequently found in patients with a lowered resistance or in those of a gouty diathesis. It occurs also as a result of infec-



tion from trauma produced by patients in their efforts to relieve itching. It is frequently found in those who swim or bathe excessively, due to the irritation caused by the water within the canal. It follows frequently from irritation of middle ear discharge. It accompanies eczema and parasitic infection of the canal. It is often caused by irritating solutions which are used for cleansing the canal. It is not uncommon to have it occur following the acute circumscribed type of inflammation. It results also from general toxæmias occurring from tonsil and nasal accessory sinus infections.

Pathology.—There is a diffuse inflammatory condition of the integument lining the external auditory canal, this resulting in thickening and exfoliation of the superficial layers with consequent ulceration, the throwing off of a serous exudate and later pus. If the condition is not arrested, involvement of the perichondrium and periosteum may result, with consequent involvement of the cartilaginous and bony canal.

Symptoms.—In the acute form, the condition is usually preceded by itching, followed by heat and pain, the latter becoming intense and being aggravated by motions of the jaw, pressure on the tragus and traction upon the auricle. Dull hearing and stuffy feeling occur when the canal is closed by swelling. In the chronic form the main complaint is itching.

Objectively, in the beginning, the canal walls will be found reddened, shiny and sensitive to touch. In a short time the canal becomes narrowed and the walls

brawny and these are now seen to merge with the drum. Following this, there soon occurs a maceration and throwing off of the epithelium, in the form of small white, thin or large scales, which are readily removed with an applicator, exposing the excoriated canal walls, from which serum exudes. This soon becomes purulent in character, is often blood-tinged and very foul smelling. In some cases extensive ulceration occurs and in the aggravated form the bony walls of the canal may be exposed.

In the chronic type, there is less swelling, the canal is filled with foul-smelling pus and macerated epithelium, and, when this is removed, frequently granulations are found on the canal walls or drum. This may lead to narrowing of the canal through stricture formation. The discharge from this chronic type is exceedingly irritating and frequently produces eczematous conditions of the auricle.

Prognosis.—The acute type runs its course in from a few days to four or five weeks. The chronic type may run on for months, and in this type there is a tendency to permanent narrowing of the canal.

Treatment.—Constitutional treatment is highly important. Proper regulation of the diet and methods of living is necessary in order to increase the resistance of the patient—care of bowels, kidneys and skin in order to increase the elimination.

In the acute type of the disease, the patient should be put to bed. If the pain and swelling are intense, deep incisions should be made throughout the swelling. *All watery solutions should be avoided*, the canal being kept clean and dry by mopping with cotton

tampons. When secretion starts, a sterile gauze wick should be inserted in the canal, this being changed once a day or even more frequently if the discharge is profuse. In case the incisions do not relieve the pain, leeches may be used. These should be applied just anterior and posterior to the orifice of the canal, this being first closed with a plug of cotton, so that the leech cannot become attached within the canal. The auricle should be kept lightly covered with sterile vaseline, so that it will not become excoriated from the secretion.

In the chronic type, the canal should be kept dry by means of the gauze wick. Granulations can be removed by cauterizing with silver nitrate, 60 grains to the ounce. In stubborn cases, yellow oxide of mercury ointment, 2%, can be applied to the canal walls by inserting gauze covered with the ointment. The intense itching is often allayed by using 87% alcohol, this being applied with a cotton applicator, or it may be dropped into the ear. The burning caused by this, while at first intense, usually rapidly subsides. If there is a tendency for atresia to develop, an effort should be made to prevent this by inserting cones of gauze, so that some pressure is exerted upon the narrowed area. These cases need constant daily attention in order that secretions are not allowed to collect within the canal, the surfaces being thereby kept as dry and free from secretion as possible.

Internally, belladonna, hepar sulph., and apis are used in the acute stage, arsenicum, merc. sol., petroleum, graphites and nitric acid in the chronic form.

Eczema of the External Ear

Eczema of the external ear may be either acute or chronic and has in the main the appearance of eczema occurring elsewhere.

Causes.—Constitutional diseases, disorders of digestion, improper diet, faulty methods of living, or anything which interferes with normal metabolism.

Eczema of the external canal is often a part of a general eczema or may be a purely local manifestation either upon the auricle or in the external auditory canal, or it may involve both and extend to the integument of the head surrounding the auricle. In children the lymphatics of the neck are frequently involved.

It may be unilateral or bilateral. Unilateral appearance is usually due to local irritation of some kind; bilateral to constitutional disease.

Pathology.—Eczema of the external ear may be moist or dry, acute or chronic, unilateral or bilateral. It may be occasioned by a middle ear condition or a condition of the external canal such as a mycosis. The dry form may be primary. In eczema following middle ear disease, a gram diplococcus, accompanied by the bacillus proteus vulgaris, bacillus subtilis and butyricus have been found. The streptococcus is found in the red eczema of children and feeble adults.

Symptoms.—In the acute form, there are heat, tension, swelling and redness with itching. The ear projects from the head, exudation occurs beneath the epidermis, resulting in either desquamation or the formation of vesicles. There is an exudation from the surface of a sanguineous or purulent fluid. The skin

appears raw and swollen. The secretion dries upon the surface and forms crusts. If these are removed, a bleeding surface is exposed. The skin may be so swollen that the lumen of the canal is occluded. This condition lasts from a week or ten days to four or five weeks and will then either result in resolution or go over into the chronic form. If this latter occurs, then the chief symptom is pruritus. There is lacking the marked heat redness and swelling; instead we find the integument thickened and feeling like parchment to the touch, or it may appear thin or shiny as if tightly stretched. There are often fissures especially around the external canal.

Diagnosis.—Acute eczema of the auricle and external canal may be mistaken for erysipelas. In the latter condition, the swollen area shows a sharp line of demarcation; the swelling is usually more firm, spreads more rapidly and is accompanied by marked general symptoms, higher fever, chills and, at times, delirium.

Treatment.—First, constitutional: regulation of the diet, bowels, kidneys. Second, avoid watery solutions. Do not syringe the ear. Third, caution patient not to use water to wash the ears: use rather cold cream or alcohol.

In acute cases calamine lotion (pulv. calamine, zinc oxide, boric acid and glycerine of each 2 drachms, liquor calcis sufficient to make 8 oz.). Olive oil emulsion (zinc oxide, boric acid, bismuth sub-nitrate, glycerine of each 2 drachms, phenol $\frac{1}{2}\%$, lime water and olive oil equal parts to make 8 oz.). Boric acid ointment (bismuth sub-nitrate may be added if astringent is wanted).

Radiant light exposure for twenty minutes followed by close range air-cooled quartz lamp will benefit eczema. In sub-acute cases blistering by air-cooled ultra-violet ray is used.

The internal remedies applicable in eczema are many and the student is referred to works on materia medica and dermatology.

Erysipelas

Not infrequently cases of this disease are seen which seem to have originated in the nasopharynx, the condition then spreading through the Eustachian tube, involving the middle ear cavity, perforating the drum and then spreading to the external auditory canal and auricle. The middle ear condition appears first and, within a day or two after the discharge has started, the erysipelatous character of the disease is first recognized. From the auricle, the condition spreads rapidly to the face and head, then runs the usual course.

Pathology.—As a result of trauma or extension of disease from adjacent parts, a cellulitis occurs due to pyogenic infection. The cellular tissue becomes hyperæmic, the vessels are distended and obstructed by coagulated blood, the lymph channels are filled with leucocytes. Suppuration may occur with the formation of pus. Bacteria which have been found are streptococcus longus, brevis, diplococcus pneumoniae, staphylococcus albus and aureus. In infants, the gonococcus and bacteria coli communis have been observed.

Symptoms.—The onset is usually with a chill and

high temperature, the patient being usually markedly prostrated. Sore throat and dysphagia are complained of. As the ear involvement occurs, the usual symptoms of middle ear inflammation appear: pain, throbbing in character, dull hearing and tinnitus, followed by discharge of a peculiar thin, straw color and usually of a markedly excoriating character. The canal walls become swollen, the auricle thickened, red, tender, and the skin shiny. Early, small blebs are seen in the canal and on the surface of the auricle. Leaving the auricle the condition usually spreads forward to the face and upward into the scalp. It may extend down the back to the buttocks.

Treatment.—The general care of the patient is of great importance. He should be in bed. It is especially important that elimination be looked after. In severe cases enterocolysis will be found of great service, this increasing elimination and diluting the toxins.

Erysipelas antitoxine when administered early will frequently bring the process under control. In milder cases one full dose will suffice. In the more severe cases one dose daily over a period of two or three days may be required.

Locally 60% alcohol applied to the area on gauze. The dressing must be kept moist by frequently saturating with the alcohol. Arkase is applied to the involved area by gentle massage and repeated several times a day. Aristole and zinc oxide ointment, one dram of the powder to the ounce of ointment, is liberally spread over the involved area.

Internally belladonna, rhus tox., cantharis, apis and croton tiglium.

Hæmorrhagic External Otitis

A condition in which the bullæ appear upon the walls of the external auditory canal, usually the anterior and inferior walls. These bullæ, which contain a bloody fluid, eventually rupture and leave excoriated areas.

The condition is usually a complication of some form of acute otitis media, although it may occur as a disease *per se*. It frequently occurs during attacks of influenza.

Symptoms.—Marked pain, often assuming neuralgic character and radiating to the sides of the head. If it occurs during influenza, the patient will exhibit temperature ranging from 99° to 102° F. and be much prostrated.

Treatment.—Puncture the bullæ and then dust with boric acid powder. Internally belladonna, rhus tox., magnesia phos.

CHAPTER IX

ACUTE DISEASES OF THE MIDDLE EAR TRACT

As will be seen by referring to the chapter on Anatomy, the middle ear tract consists of the membrana tympani, the tympanic cavity with its contents, the Eustachian tube, the aditus ad antrum, the mastoid antrum and mastoid cells.

Before taking up the diseases of this tract, it will be well to recall some of its structures, so that we may more readily understand the conditions which we will later consider.

First, then, let us recall that the entire tract, from its beginning, at the orifice of the Eustachian tube, to its termination in the mastoid cells, is lined throughout with mucous membrane. This is supplied in a large part with glandular structures which, as elsewhere in mucous membranes, have a secretion, the function of which is to moisten the membrane. There is then, normally, a certain amount of secretion from this membrane, just as occurs from the mucous membrane lining the nose and throat and intestines.

The middle ear tract may be involved throughout its entire course, or only in small portions, just as we have small areas involved in the nose and nasopharynx. Inflammation may be confined to the Eustachian tube, to the middle ear cavity or to the

mastoid cells. This involvement may be a simple hyperæmia, a catarrhal inflammation resulting in increase in normal secretion, or we may have an infectious inflammation resulting in suppuration.

The catarrhal type of inflammation is one in which the mucous membrane alone is involved, the secretion being increased. This may involve the Eustachian tube alone, when we speak of it as a tubal catarrh; or it may involve the middle ear cavity, giving the so-called middle ear catarrh. The secretion collecting in the middle ear cavity may, through tension, cause a perforation of the membrana tympani. Through infection, the catarrhal type may become purulent in character. In the suppurative type of inflammation the entire mucous membrane becomes involved.

Myringitis

Before considering diseased conditions of the ear drum it is well to recall its histological structure. It is composed of three layers: (1) an outer or dermal layer, which is a continuation of the dermal layer lining the external canal; (2) a central fibrous layer; and (3) an inner or mucous layer, this being a continuation of the mucous membrane lining the middle ear cavity.

Understanding its structure, you can appreciate that its various tissues are liable to the same inflammatory changes as occur elsewhere in the body. Remembering also the position of the ear drum, between the middle ear cavity and the external canal, you will understand that it is readily injured from

the external canal or influenced by disease from the middle ear cavity.

In the average case, inflammation of the ear drum is secondary to inflammatory conditions of either the external auditory canal or middle ear. It is rarely a primary condition. It is, in reality, usually only one of the changes occurring from inflammatory diseases of either the external canal or the middle ear. The consideration and treatment of this condition therefore becomes a part in the consideration of the treatment of the diseases of the structures above named.

Rupture of the Ear Drum

By rupture of the ear drum we understand a break in the continuity of this membrane as the result of traumatism, in contradistinction to a perforation, or break in continuity, which results from inflammatory disease of the middle ear.

Causes.—(1) Direct traumatism produced by some foreign object; (2) those occurring as a complication of fracture of the skull; (3) those occurring from compression or rarefaction of the air within the external canal.

Direct traumatism is produced by patients in their efforts to remove cerumen with ear spoons, match sticks, etc., or by unskilled attempts at the removal of foreign bodies, or by unskilled manipulation of Eustachian bougies.

Rupture of the ear drum is common in fractures of the skull, especially those involving the base. Hæmor-

rhage from the canal is a common symptom in fractures at the base of the skull.

Blows upon the ear during boxing bouts, or with the open hand, produce rupture by compression of the air in the canal.

Symptoms.—Subjectively, at the time of the rupture, the patient feels as if an explosion had occurred in the ear. This is followed by lancinating pain, tinnitus and more or less degree of vertigo. These symptoms rapidly subside, there remaining only, for a time, a sense of fullness in the ear. The subsequent symptoms will depend upon the cause of the rupture. In those cases due to compression or rarefaction of air, there are no subsequent symptoms. If the rupture has been produced by direct trauma or fracture



PLATE IX. Traumatic rupture of the ear drum.

of the skull, suppuration of the middle ear may occur with its characteristic symptoms.

The position, form and extent of the tear will vary to some extent with the cause. Those occurring from fracture are apt to be extensive, the edges of the tear will be ragged, while those occurring from compression or rarefaction are usually small and oval in shape, the edges being sharply defined.

Prognosis.—Unless suppuration of the middle ear occurs, rupture of the ear drum usually heals readily with no loss of function. If suppuration occurs, the prognosis will depend upon the virulency of the secondary condition.

Treatment.—In cases of rupture of the ear drum due to compression or rarefaction of air, place a sterile pledget of cotton in the canal and leave alone. Where the drum has been ruptured by direct injury, it is better to follow the above treatment unless it becomes evident that the middle ear is infected, in which case the treatment will be that of any middle ear suppuration. The same applies also with those cases occurring with fracture of the skull.

Eustachian or Tubal Catarrh

Causes.—As it follows acute conditions of the nose and nasopharynx by direct continuity of structure, it is, therefore, frequently observed to occur during colds and influenza. It occurs also in cases of nasal obstruction and with adenoids. It is often produced by nasal douching, swimming and exposure to cold.

Pathology.—In studying the pathology we must consider first those changes due to primary inflamma-

tion in the tube and, secondly, those occurring in the middle ear cavity as a result of a closure of the tube. In the beginning, a simple hyperæmia is followed by swelling, secretion from the canal walls and, secondarily (see *Tubo-Tympanic Catarrh*), the occurrence of secretion in the middle ear cavity, due to the vacuum produced within this cavity by a closure of the Eustachian tube.

Symptoms.—The patient experiences a sensation of stuffiness or fullness in the ear, which he attempts

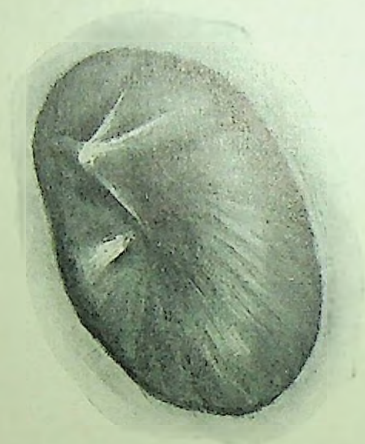


PLATE X., Depressed ear drum, showing the anterior and posterior folds, prominence of the short process displacement of the cone of light.

to relieve by compressing the air in the external auditory canal with his finger. At times there is dull aching in the region of the Eustachian tube, a greater or less degree of dull hearing is present, together with

subjective noises and, at times, a sensation of numbness in and about the ear. In marked cases, the patient states that, when he talks, it sounds to him as if he were talking into a tube or as if his voice came from the ear.

Objectively, the ear drum is markedly depressed, due to the pressure of the air in the external canal. The color of the drum is normal but the cone of light is either absent or lessened in size and its position changed. Examination of the tubal orifice in the nasopharynx will show this to be reddened and frequently secretion can be seen coming from the tube.

Functional examination proves a falling off for the watch or voice. Weber's test is referred to the affected ear, Rinne's test shows a shortening of aerial conduction and an increase in bone conduction. The perception for low tones is diminished.

On attempting to inflate the middle ear either by Politzer's method or by the Eustachian catheter, it will be found that this does not occur easily, it being necessary in many cases to make several attempts before the inflation is successful. As soon as inflation occurs, the subjective symptoms disappear and the drum will be seen bulging into the external canal. It will now be found, upon functional testing, that the hearing has improved.

Prognosis is usually good if properly and promptly treated. The danger is to the function of the ear from repeated attacks which may result in permanent changes in the middle ear, causing considerable loss

of hearing. *You should recognize this condition as the first stage of catarrhal deafness.*

Treatment.—The existing cause should be sought for and properly treated. Locally inflation of the ear should be performed either by Politzer's method or by means of the Eustachian catheter. The effect of the inflation lasts usually only for a few hours and should, therefore, be repeated by the physician until it is found that the condition is relieved. In order to reduce the congestion at the Eustachian orifice, cocaine, 4%, may be applied directly to the orifice of the tube, using cotton upon a nasal applicator, which has been bent so that it has the curvature of a Eustachian catheter. Nitrate of silver, from ten to twenty grains to the ounce, will prove of service in obstinate cases. Where the condition has become chronic, it may be necessary to make direct applications throughout the tube. This form of treatment should be carried out by one skilled in this work.

Patients suffering from tubal catarrh are very liable to recurrences. In order to prevent these, it is necessary that any existing condition, acting as a cause, should be removed, such as chronic inflammatory conditions of the nasopharynx, adenoids, nasal obstruction and apical abscesses.

Internally, kali bichromicum, pulsatilla, kali muriaticum, gelsemium, allium cepa and arsenicum.

Tubo-Tympanic Catarrh

This condition is a further stage of tubal catarrh, the tympanic element being the result of the existing tubal condition. Owing to the swelling of the tubal mucosa,

which closes the Eustachian tube, no air is admitted to the tympanic cavity. As a result of this a vacuum is produced in this cavity, this producing osmosis from the vessels of the tympanic cavity, and we thus have added to the tubal catarrh, the presence of fluid in the middle ear cavity.

Causes are the same as for tubal catarrh. The direct cause of the tympanic condition is above stated.

Symptoms.—Subjectively the symptomatology is



PLATE XI. Appearance of the ear drum in tubo-tympanic catarrh with secretion in the middle ear cavity.

the same as that of tubal catarrh, there being added to this a sensation of bubbling in the ear or of something moving in the ear, these symptoms being produced by the fluid in the middle ear cavity.

Objectively, the ear drum presents a different pic-

ture from that of tubal catarrh. Owing to the presence of secretion in the middle ear cavity, the drum shows less depression, or, if considerable fluid is present, this may produce bulging of the drum. At times, in classical cases, it is possible to note the presence of secretion in the middle ear cavity by seeing, through the semi-transparent drum, the upper surface of the secretion, this appearing as a thin, dark line across the drum. This will appear at different levels, depending upon the amount of secretion within the cavity. If this line is observed, while at the same time the position of the patient's head is changed, either forward or backward, it will be seen to change its position in relation to the drum. This picture is altered materially after the ear has been inflated. The air entering the middle ear cavity, when inflation takes place, produces bubbles and these are often seen through the drum, appearing as small, various-sized, golden circles, having dark centers. As these are observed, they are seen to move downward on the inner surface of the drum, eventually rupturing and disappearing. At times the vessels along the manubrium will be found injected. After inflation it will be noted that the drum is bulging more than it had previously done, due to the excess of air which has been thrown into the middle ear cavity. If there is a lack of transparency of the drum, the above picture may be noted. In such a case the presence of the secretion, within the middle ear cavity, can be demonstrated by using the Eustachian catheter and auscultation tube, when the bubbling sounds, produced by the air passing through the fluid in the middle ear cavity, can be heard through

the auscultation tube. The tubal orifice will appear as in tubal catarrh.

Functional examination will show the same results as in tubal catarrh, except the dull hearing is more marked owing to the secretion in the middle ear cavity.

Prognosis.—The prognosis as regards function is good in primary attacks. Lessening of function will occur from recurrences. This condition, it must be remembered is frequently the prodromal stage or the beginning of middle ear catarrh with its resultant dull hearing.

Treatment.—The treatment is the same as that for tubal catarrh, there being added the necessity for attention to the secretion within the middle ear cavity. This, if allowed to remain, may result in the formation of adhesions between the drum and the walls of the tympanic cavity, which, through contraction, will ultimately lessen the ability of the drum and ossicles to properly conduct sound. In the majority of cases, through inflation, the secretion eventually disappears, largely through drainage from the Eustachian tube and partially, undoubtedly, in that absorption can take place more readily when the fluid is thrown over the surface of the middle ear cavity by inflation. Where fluid is present, in order to secure the best drainage, it is advisable, during inflation, to have the patient hold his head to the side of the ear to be treated, while at the same time the face is tilted forward. This position of the head places the Eustachian tube in a vertical position so that, at the moment of inflation, the fluid will find its way through the Eustachian tube into the naso-

pharynx by gravity. If, after a few inflations, fluid is still observable, it is advisable to drain this into the external auditory canal through a small puncture of the membrana tympani, this being made in a dependent position which will allow of good drainage. This puncture, in addition to allowing drainage, also re-establishes the aerial pressure on the inner surface of the drum. If, after a few days' treatment, the closure of the Eustachian tube still exists, attempts must be made to open this by direct applications applied to the mucous membrane of the tube, or by the passage of bougies. This line of treatment, however, should be employed by one having experience.

In the very acute stage, inhalations of steam, which can be medicated with menthol crystals or compound tincture of benzoin, frequently give considerable relief. Small steam inhalers can be purchased at a moderate price from the average druggist. If, however, such an apparatus is not available, boiling water can be placed in a basin, the face held over this, a towel being draped over the head so as to prevent the escape of steam; or boiling water can be placed in a quart cup, the menthol crystals or the compound tincture of benzoin placed in the water. A folded towel is then made in the shape of a cornucopia, the broad end fitting over the cup, the steam being inhaled through the small end. Three or four crystals of menthol, to a quart of water, are quite sufficient to give the desired result. Stronger solutions are irritating. Compound tincture of benzoin should be placed on the surface of the water in the proportion of a teaspoonful to the pint.

Internally, belladonna in frequent doses of a low potency gives very good results. Bryonia and pulsatilla are also useful.

Acute Otitis Media

This condition is frequently a further stage, consequent upon a tubo-tympanic catarrh. In fact, it is undoubtedly so that the majority of cases of acute otitis media, occurring as they do from inflammatory conditions of the nasopharynx, by continuity of structure, have, as their first stage, tubal inflammation, which rapidly spreads to the middle ear cavity.

Causes.—It arises from various conditions of the nose and nasopharynx by extension. In children, adenoids, enlarged and diseased tonsils are frequently the primary causes of acute middle ear involvement. During the course of scarlet fever and measles it is one of the frequent and dreaded complications. It occurs also from typhoid fever, pneumonia and la grippe. It is due at times to a focus of infection, such as diseased accessory cavities and pyorrhœa alveolaris. It is consequent upon trauma produced by unskilled efforts in the removal of foreign bodies or cerumen, or produced by the patient himself in his attempts to relieve itching of the external canal. It occurs frequently in basal fractures of the skull which cause a tearing of the ear drum and involvement of the middle ear cavity. It occurs commonly in swimmers and divers.

Pathology.—As a result of bacterial invasion, hyperæmia of the mucous membrane occurs in either small isolated areas or throughout the tympanic

cavity. Exudation of serum and leucocytes occurs together with proliferation of the surface and glandular epithelium. If the exudate contains a predominance of serum the discharge is clear and thin; if leucocytes abound, the discharge is thick and purulent. The difference between the serous and the purulent inflammation is one of degree. In the serous condition, the infection is mild and the changes are superficial, while in the suppurative type, the infection is more intense and the deeper elements are involved. (While pathologically there exist a catarrhal and a suppurative type of this disease, clinically we shall consider the two types under the single heading *acute otitis media* for the reason that the symptomatology, both subjective and objective, is practically the same, there being only a difference in degree, the suppurative type being the more aggravated of the two and its symptoms more intense. Clinically, also, it is often impossible to differentiate the two types before rupture of the drum has occurred, and, as the treatment of the two types is essentially the same, there is no practical reason for such differentiation.)

Symptoms.—While in a certain percentage of cases, there is a preceding sense of fullness and warmth in the ear, the average initial complaint is *pain*, which increases rapidly in severity. This is aggravated by swallowing, belching, sneezing or any act which causes a forced opening of the Eustachian tube, and is referred usually "deep in the ear." (In acute external otitis, the pain is aggravated by motions of the jaw, as in chewing, or by traction of

the auricle, and the pain is referred usually anterior to the auricle.) The pain is not always constant, but frequently there are intermissions lasting several hours. This intermittency is especially noticed in children. The anatomical reason for this is that in children the Eustachian tube is shorter and its lumen greater than in adults so that the discharge frequently finds its way into the nasopharynx, thereby emptying the ear and relieving tension. After a varying period of hours, secretion again collects within the middle ear cavity causing tension, and pain again occurs. The intermissions are usually noticed during the daytime, due to better drainage afforded by the upright position of the head and also probably from the fact that more frequent efforts of swallowing during the waking hours promote drainage through the Eustachian tube. It is not uncommon after seeing a child, who is suffering intensely from earache during the night, to find it the next morning playful, free from pain and apparently in every way normal, and to be called again, in a few hours, to find the little patient suffering even more intensely than at the first visit. There may occur a number of such intermissions before the drum ruptures. Occasionally a case is encountered in which pain is complained of in the teeth, the parietal or the occipital region before it becomes localized in the ear. In such cases, the objective examination aids materially in the diagnosis. Patients suffering from acute otitis media seem to derive relief from pain by lying upon the affected ear and by the application of heat. (In acute external otitis, the patient avoids lying upon

the diseased ear as the pressure upon the auricle increases the pain.)

Cessation of the pain occurs with the perforation of the drum. Where this does not occur, it indicates that the case should be carefully watched.

Dull hearing is present in greater or less degree. In some cases it is a marked symptom, in others less so. In the beginning of the condition this is due to the secretion in the middle ear cavity. In the later stages, after perforation of the drum occurs, it is probably due more to the swelling of tissue. The secretion and the swollen tissues produce dull hearing by preventing sound conduction. This symptom is often pronounced throughout the greater part of the disease.

A sensation of marked fullness in the ear, or of numbness about the ear, is frequently complained of, and this class of cases also is prone to complain of the voice rumbling in the ear when they talk.

Tinnitus is a frequent complaint, the noises being usually pulsating in character and occurring synchronous with the pulse.

Temperature.—There is usually some rise in temperature, this varying with the severity of the attack, the character of the causal disease and age of the patient. In children, the temperature is apt to be high, reaching often 104° F., while in adults it may reach 102° F. In many cases it does not get above 99° or 100° F. The temperature found in many of these cases is undoubtedly due to the causal disease such as la grippe or tonsillitis. It may be of a septic type and show frequent fluctuations. While

the more severe attacks are accompanied by a proportionate rise of temperature, frequently a severe attack will run its course with but slight elevation. Where temperature has existed during an attack, it usually subsides rapidly after the drum has perforated. Should it continue after this has occurred and we are satisfied that the continued temperature is not due to some such existing condition as tonsillitis or la grippe, the case is one which will bear close watching. The continuance of temperature is frequently an indication of some deeper involvement, such as mastoiditis. In such a case a careful examination of the drum should be made to find whether the perforation is sufficiently large to allow rapid drainage. A too small perforation, by preventing a rapid discharge of the secretion, will frequently cause a continuance of the temperature. It is also important, when the temperature continues, to thoroughly examine the patient, as abdominal or respiratory conditions may accompany the ear condition and be the cause of the temperature. Especially in children it is frequently found that a thorough emptying of the bowels will at once bring the temperature to normal. *In all cases of high temperature occurring in children, the physician should examine the ears.* An acute otitis media will frequently be found either as the primary cause or as a contributing factor in respiratory conditions.

The *pulse* will, in the average case, follow the fluctuations in the temperature.

Gastrointestinal disturbances especially in children frequently accompany this disease, or there may be a

gastrointestinal symptom complex present as reflex from the aural condition, prior to the onset of the pain.

In very young children, convulsions are often observed at the onset of an acute middle ear infection. For this reason an aural examination should be made in every case presenting this manifestation. When it is due to an otitis media, there is prompt cessation of the convulsions as soon as the ear drum is freely opened.

Objectively, the patient presents a picture of intense suffering. If lying down, he will lie upon the affected ear. (The patient with an acute external otitis avoids



PLATE XII. Bulging ear drum showing absence of landmarks.

lying upon the diseased ear as the pressure upon the auricle causes an increase in the pain.) Traction upon the auricle or pressure upon this does not cause

an increase in the pain as it does in acute external otitis. In the very acute stage, before the perforation of the drum has occurred, *tenderness over the mastoid* may be elicited, this being due to the tension produced by the secretion accumulating in the mastoid. This usually disappears rapidly after the drum has been opened and tension is relieved. The objective appearance of the external canal and ear drum will depend upon the stage of the disease at the time of examination and upon the severity of the attack. In the beginning, no change will be noted in the external canal, but, upon examination of the ear drum, there will be found intense injection above the short process, this extending down along the manubrium of the malleus to the center of the drum. A little later, vessels will be seen radiating out from the manubrium to the periphery of the drum, with clear areas of drum between. Following this, anastomoses between the radiating vessels become injected, the drum gradually becoming diffusely reddened, the cone of light disappearing, as also the manubrium, while the short process may still be seen as a white spot in the anterior upper portion of the field. Later this disappears also and the drum is seen as an intensely red membrane presenting a circumscribed or diffuse bulging. After a varying time, a yellowish spot will appear in some part of the reddened field, this being the point at which perforation will occur. When perforation of the drum has occurred, *discharge* appears in the external auditory canal. At this stage a pulsation is seen in the fundus of the canal, this being at the point of perforation and due to a reflection from the light of the

head mirror upon the surface of the secretion as it passes through the perforation.

In a certain number of cases, which present all the clinical symptoms of an acute otitis media, the physician may be surprised to find objectively, instead of an intense red swollen membrane at the end of the canal, a chalky white appearance. This is due to the epithelium on the outer surface of the drum which has become macerated. If this is removed, the reddened drum will then be seen. Occasionally also the drum may remain pale throughout the attack. This occurs with a thickened drum and may be misleading. In these exceptional cases, the history of the condition, together with the characteristic clinical symptoms, will materially aid in the diagnosis.

In very intense cases, the injection extends to the external auditory canal in its deeper portions, so that it is difficult to determine the point of junction of the canal and membrana tympani.

Usually when the physician is called, the first stages of the changes in the drum, as above outlined, have occurred and it will be found, upon examination, the drum is already bulging and markedly inflamed.

The character of the discharge, when it first appears, is sero-sanguineous, this changing, in the average case, in from two to three days to muco-purulent and after two or three days it becomes more purulent. This lasts for a few days, then gradually lessens and eventually ceases after ten days or three weeks. While the character of the discharge in the average case will be as above described, cases occur in which the discharge may remain of a serous character through-

out the entire course of the disease. This type of discharge is frequently seen in cases of otitis media complicating influenza. In severe suppurative cases, the discharge, while at first sero-sanguineous, may become rapidly purulent. The first few days the discharge is rather profuse but tends constantly to diminish in amount. During this period, the drum loses its injection, throwing off macerated epithelium, which appears as whitish flakes and, if collected in a receptacle, after syringing, will be found floating on the surface of the water. With the cessation of the discharge, the perforation of the drum rapidly closes and within a few days the drum presents its normal appearance.

Complications.—On account of the close relation of the middle ear cavity to the middle cerebral fossa, the mastoid process, the internal ear and the facial nerve, cases occur in which extension to these surrounding structures has taken place, so that it is possible during the course of an acute middle ear condition, to have produced a mastoiditis, a meningitis, a brain abscess, a labyrinthitis or a facial paralysis. With this knowledge, you can see the importance of careful attention to your cases of acute otitis media, and it is well for you to be able to recognize symptoms or signs which may point to these various complications. Mastoiditis is the most frequent complication of this condition and, by careful observation, you can determine, in many cases, the occurrence of this at an early stage.

Prognosis.—On account of the complications which may occur during the course of this disease, a guarded

prognosis is at all times advisable. The prognosis depends, to a large extent, upon the causal factor and upon the method of treatment. Cases originating from scarlet fever, measles or diphtheria, are especially apt to be virulent and to become chronic. The otitis occurring with certain epidemics of influenza is also frequently of a very virulent character, while those occurring from simple colds, exposure and nasal obstructions are less severe in character and less destructive. The prognosis, in all cases, will depend also upon the type of infecting organism and the resistance of the patient. A virulent organism in a patient with good resistance may produce a mild type of otitis media, while in a patient with markedly lessened resistance it will exhibit its virulency to a marked degree. Among the most virulent aural bacteria are the different types of streptococci and the pneumococci. The prognosis, where these are present, is less favorable, as regards duration of the condition and tendency to complications, than it is if the staphylococci are the causal bacteria.

In general, the prognosis of acute otitis media, as regards its effect upon the hearing function and tendency to chronicity, is good if the case is properly treated. The average case returns to normal usually within a period of three weeks. *Cases in which the ear drum is allowed to rupture spontaneously, after a varying period of suffering, are more apt either to be delayed in returning to the normal, or to pass over into a condition of chronic suppurative otitis media, as the intense amount of pressure, which has existed within the middle ear cavity, has lessened the local resis-*

tance. Where the drum has opened early, before tension has been exerted for any length of time, the course of the disease is usually shortened, the tissues being more resistant and possessing a greater ability to bring about resolution.

Treatment: Prophylaxis.—It is highly important for you to see that the nasopharyngeal conditions of children are properly and promptly treated. The removal of adenoids and diseased tonsils should be considered in many cases, as also the proper attention to nasal obstructions of the various types. (See Chapter on Relation of Nose and Throat to the Ear.)

Frequent inspection of the ear drum should be made during the course of scarlet fever and measles, in which otitis media is a frequent complication, in order that early treatment be instituted.

Treatment of the attack.—Rest in bed, diet to correspond to the condition present, elimination and care of the underlying disease, are primary factors in the general treatment of the case.

Rest in bed is essential to conserve the patient's strength, to lessen the congestion, and to reduce the dangers of aggravation through exposure and fatigue. It is better to have the head high or even to allow the patient to sit propped up in bed, as the prone position may tend to increase the congestion. During the acute stage, a light, easily assimilated, nutritious diet should be prescribed, consisting of liquids, or semi-solids, such as milk, meat broths; albumin, flavored with fruit juice, such as grape or orange; junket, gelatin, corn-starch or ice-cream. More solid food, while not being easily assimilated, also produces

considerable distress to the patient during deglutition. The diet can be increased after the acute symptoms have subsided.

It is highly important that the bowels, kidneys and skin are kept active. On account of a toxæmia, which exists in the majority of these cases, there is a tendency to lessened elimination.

Because of the acuteness of the otitis media you are apt to overlook the underlying and causal disease, but this should always be kept in mind as the control of this will markedly influence the course of the acute otitis.

Local Treatment.—While many pages have been written upon the local treatment of acute otitis media and especially upon ways and means to lessen or control the pain occurring in these cases, we believe that the only treatment for the relief of pain, which occurs before the drum has perforated, is the establishment of good drainage by means of an *early and free incision of the drum*.

This procedure is exceedingly painful and should be performed under the influence of an anæsthetic. In young children it is advisable to administer a general anæsthetic. Somnoform or nitrous oxide and oxygen are admirable for this procedure. We advocate the use of general anæsthesia for adults although very satisfactory anæsthesia may be obtained by the application of Bonaine's solution. This

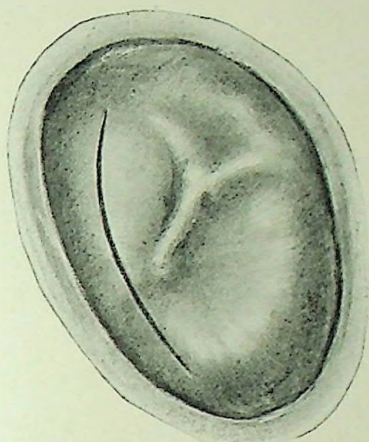


PLATE XIII. Position of incision of the ear drum to drain the middle ear cavity.

consists of equal parts of cocaine, menthol, and carbolic acid crystals triturated until they form a syrup-like solution. A small cotton tampon is moistened in this solution and carefully applied to the surface of the drum, care being exercised not to spread the solution along the walls of the canal. Neglect of this precaution may cause a diffuse external otitis. After applying the Bonaine solution to the surface of the drum, sufficient time should elapse to permit of anæsthesia before an attempt is made to incise the drum. This will vary in different cases. When anæsthesia is complete it is possible to touch the drum with a probe without causing pain.

The incision should be made with a myringotome in the posterior portion of the drum, starting just below the posterior fold of Shrapnell's membrane and

following the curve of the annulus to the floor of the canal. (See Plate 13.)

In the uncomplicated case, the pain subsides shortly after incision, due to the relief of tension in the middle ear cavity. This relief follows even the simple puncture or paracentesis of the drum. It is inexcusable for the present-day physician to allow his patient to suffer for hours or days, as sometimes occurs, attempting to control or relieve pain by various solutions dropped into the ear, by applying heat, or waiting for an internal remedy to act, when he knows that the opening of the ear drum will give almost immediate relief. We decry the use of various oily solutions within the external auditory canal for the relief of pain. The only virtue oils possess is that they hold heat longer than watery solutions. On the other hand, however, they form excellent media for bacterial growth and also, by filling in the canal and covering the drum, make it exceedingly difficult properly to treat the case. In view of the fact that the establishment of drainage gives relief of pain, the use of such solutions becomes valueless.

Should the physician not be skilled to perform free incision of the drum and not have at hand someone competent to do this for him, he should at least attempt the simple puncture of the drum. Not alone is the opening of the drum indicated for the relief of pain, but the early drainage, thus afforded, is conducive to an early resolution of the condition. Cases which are allowed to go on to spontaneous perforation are invariably of longer duration and often

show more local destruction than do the cases in which the drum is opened early.

Having opened the ear drum, it is important to inspect it carefully at each visit, in order to be sure that drainage is still good, as these clean incisions of the drum are very apt to close rapidly, necessitating often a reopening, in order to insure continuous drainage. The lessening or cessation of discharge, together with recurrent pain, is often indicative of a partial or a complete closure of the incision and calls for reopening of the drum. While, in the early stage of the discharge, when it is of a serous character, a small perforation may afford ample drainage, in the later stages, when the discharge becomes thicker, a small perforation may not afford sufficient drainage to relieve pain. The simple presence of a rather profuse discharge from the external auditory canal is not sufficient evidence of ample drainage as, upon inspection of the drum, it may be found that there is considerable bulging, this proving that the opening in the drum is not sufficiently large to allow a rapid emptying of the middle ear cavity. Being satisfied that the opening in the drum allows free drainage, the subsequent treatment will depend upon the character of the discharge. As long as this remains of a serous or sero-sanguineous character, it is sufficient to place a pledget of sterile gauze in the orifice of the canal, instructing the attendant to replace this frequently, keeping the pledgets, which are removed, for your inspection at your next visit, so that you can keep informed as to the approximate amount of the discharge. As soon as it is noted that the dis-

charge is becoming mucoid, or muco-purulent, it will be necessary to irrigate the external canal with saline or boric acid solution, as frequently as is necessary to remove the discharge, this frequency depending upon the amount of the secretion. It is necessary to irrigate during this stage of the discharge as, otherwise, the secretion may lie in the external canal and prevent proper drainage through the perforation.

As the discharge lessens and becomes of a thinner consistency, the syringing can be stopped. A soft rubber syringe is the best instrument to use for this purpose, care being taken that the tip of the syringe is inserted within the external auditory canal and in a proper direction for thorough cleansing of the canal. The failure to obtain results from syringing in these cases is due to improper technique. The physician should himself syringe the ear at each visit, collecting the water in a receptacle as it flows from the external canal, so that he can study the character of the secretion. The mucus will be found in the bottom of the receptacle, appearing as long, white shreds, the pus appearing in yellowish clumps, while the macerated epithelium will be found floating upon the surface, appearing as small or large flakes. Drainage is very frequently materially aided by having the patient lie on the diseased ear or when circumstances permit have the patient sit upright.

Inflation of the affected ear by means of Politzer bag or Eustachian catheter inflation is valuable in assisting the drainage of the middle ear and tube. This should be performed only when there is a free opening in the ear drum.

While in the average case the application of heat, after incision of the drum, is not necessary, in a small percentage of cases the associated irritation of the trigeminus which sometimes exists, is very frequently lessened by the application of the hot pad, bag or the use of radiant heat.

During the course of the condition, the indicated remedy should be prescribed; this is usually belladonna, although ferrum phos. and apis will at times be indicated.

Under this line of treatment, carefully followed, the average case will return to normal within from ten days to three weeks.

During the entire course of the disease, you must pay close attention to the general condition of your patient, noting any and all symptoms, the character of the temperature and pulse, watching for chilly sensations, sweating, headache, sensitiveness to light and suffusion of the conjunctiva, as any of these symptoms may be indicative of some intracranial involvement. You should, by palpation and inspection, keep yourself informed as to the condition of the mastoid. By inspection of the drum satisfy yourself that ample drainage is provided, while at the same time carefully noting the condition of the posterior superior wall of the external auditory canal close to the ear drum. A reddening or sagging of this wall will indicate a beginning mastoiditis. You should at all times watch carefully the character and amount of the discharge; by doing this you will, after treating a few cases, become familiar with the usual character and amount in the average case.

You will thereby learn to recognize changes in the character and amount of the discharge which are indicative of mastoid involvement.

A rapid change to a purulent character, with increased amount of the discharge, is usually indicative of mastoid involvement. Frequently, also, these patients will complain of intermittent pain followed by profuse discharge. Upon examination, pulsation may be noted at the inner end of the canal and a reddening or sagging, as above noted, may be seen. This condition, while when present it is evidence of mastoiditis, is not, however, a constant objective sign. A sudden cessation of the discharge will indicate either closure of the drum, or that the pus has found an outlet at some point in the inner plate of the mastoid.

CHAPTER X

MASTOIDITIS

Causes.—This condition occurs coincident with acute otitis media or consequent upon either an acute or chronic suppurative otitis media. Primary mastoiditis is usually due to direct trauma.

Pathology.—The extent of the pathological changes within the mastoid process will depend largely upon the character of the anatomical formation, the virulence of the infection and the resistance of the patient. In the pneumatic type of mastoid process, in which there are a large number of bony cells, the disease process has room to spread. In the diploëic or sclerotic type there are few cells hence the mastoid antrum and inner tables suffer most.

There are two types of acute mastoiditis: (1) that which occurs subsequent to middle ear invasion and designated *coalescent* mastoiditis; (2) that which accompanies middle ear invasion and spoken of as *hæmorrhagic* mastoiditis.

The coalescent mastoiditis is the result of infection of the mucous membrane leading to the formation of pus, stagnation and necrosis of bone. As the cells break down and coalesce, nature attempts to limit the process by the formation of granulations about the outer limits of the infected area. As the result of accumulation of debris within the mastoid there occurs an erosion of the mastoid capsule at some point. If this break occurs in the outer plate there results the formation of a subperiosteal abscess over the mastoid.

If the inner plate is eroded there may develop an extradural abscess or a peri sinus abscess, or the process may extend through the dura to develop a brain abscess or meningitis, or through the sinus wall for the development of a sinus thrombosis.

In the *hæmorrhagic* mastoiditis the pathology consists of a thrombosis of the smaller vascular channels. There is no breaking down of the intracellular trabeculæ and no pus formation. Extension of the process is by progressive thrombosis. These thrombi may extend to the brain with the formation of nonencapsulated abscess, or to the lateral sinus with the formation of a thrombus. The invading organism is a hæmolytic streptococcus.

In the chronic form of mastoiditis the important pathological changes are grouped under six headings as follows (Politzer): (1) Hypertrophy of the lining membrane of the antrum and mastoid cells, the result of proliferation of round cells which finally fills the entire cavity. This tissue may persist, or it may undergo transformation into bone with partial or complete (2) eburnation of the process; (3) granular osteitis and carious softening of the mastoid walls may result in a widening of the antrum and extensive sclerosis of the cells in the tip; (4) circumscribed or diffuse caries and necrosis with or without sequestration; (5) cholesteatomata, collections of pus or thickened caseous masses may occur; lastly (6) hyperostoses and osteosclerosis surrounding the seat of the disease. These changes may appear singly or in combination. They are rarely confined to the mas-

toid but combined with similar changes in the tympanic cavity and especially the attic.

Symptoms.—These must be considered under the headings: *acute, typical* and *atypical, hæmorrhagic* and *chronic*.

Subjectively, *pain* and *tenderness* are the main symptoms of the acute type. The *pain* in the typical case is referred to the mastoid region, is usually constant, dull and boring in character. This symptom is more prominent in children than in adults. The intensity will depend upon the virulency of the infection and, to some extent, upon the anatomical formation of the mastoid. When the mastoid capsule ruptures, there is a cessation of pain. On account of this cessation, the inexperienced physician is apt to think his case is improving.

Tenderness is usually found at some point upon the outer surface of the mastoid. This is usually over the diseased portion and, for this reason, its earliest development is directly over the mastoid antrum, as this is the area of the mastoid first affected. It may be found over the mastoid tip, when there are large cells in this region, or, when the entire cellular structure is involved, tenderness will be present over the entire mastoid. There is no increase in pain or tenderness from motions of the jaw or traction upon the auricle, as occurs in acute inflammatory conditions of the external auditory canal.

Sleeplessness is a symptom which will be found present in a large proportion of cases of acute mastoiditis and is one of considerable value from a diagnostic standpoint. Occurring early, as it does with

many cases, the symptom is of even greater value. The sleeplessness, as described by the patient, has no direct connection with the pain, for even in those cases where the pain has been materially lessened by the use of the ice-bag, the sleeplessness continues.

Objectively, the signs will depend, in the typical case, upon the stage of the mastoiditis.

The character and amount of *discharge* are of great importance in the early stages of mastoiditis. Usually, with the beginning of the condition, the character of the discharge from the middle ear becomes purulent and the amount increases. Associated with this, pulsation of the drum is often noted on examination through the aural speculum. In a certain percentage of cases there will be found, prior to the change in the character of the secretion, a redness of the canal wall in its upper posterior portion, close to the drum, and, a little later, this area will present a swollen condition giving the so-called sinking or sagging. This is due to a periostitis in the region of the mastoid antrum, which is in relation to the posterior upper wall of the external auditory canal. It is highly important, during the conduction of a case of acute otitis media, to be constantly on the watch for the occurrence of this objective sign. While it will not be found in many cases, when present it is a positive evidence of mastoiditis. Now and then a case of furuncle may simulate this appearance. It is, however, readily differentiated from a true sagging in that it is extremely sensitive to touch and, as a rule, there is lacking the middle ear condition which precedes mastoiditis.

Tenderness is frequently an objective sign in that it is not complained of by the patient and is only elicited by a careful palpation of the mastoid. It is important, during all cases of acute otitis media, to search systematically for this sign. In making this examination great care must be taken that no movement of the auricle occurs and that the pressure exerted is deep and direct. This is necessary in order to avoid mistakes in diagnosis, as, in cases of furunculosis of the external canal, tenderness will apparently be present upon pressure over the mastoid,

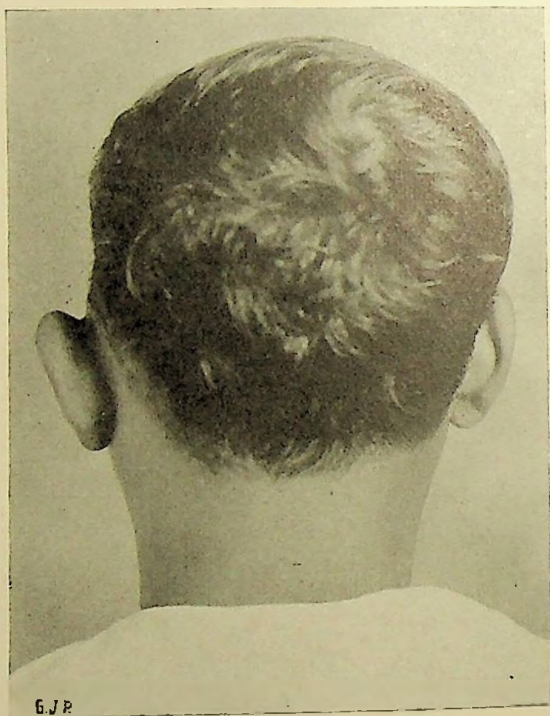


E. J. F.

PLATE XIV. Anterior view of typical acute mastoiditis, showing prominence of the auricle.

due to the fact that the auricle is moved at the time of palpation.

Œdema over the mastoid will occur with the involvement of the outer plate and its early recognition is of value. In deciding whether slight œdema is present, comparison with the other mastoid is an aid. As the condition progresses, œdema becomes marked and the tissues pit readily upon pressure. This œdema will extend over the entire mastoid area and the surrounding tissue and leads to the next objective sign.



6.J.P.
PLATE XV. Posterior view of typical acute mastoiditis showing prominence of the auricle and associated perichondritis of the auricle.

Prominence of the Auricle.—Following this, and with the occurrence of the rupture of the outer plate, there results fluctuation at some point over the mastoid due to the presence of pus beneath the periosteum and the œdematous tissues, this resulting in a further marked prominence of the auricle.

In the *acute atypical cases*, one or more of the typical symptoms (pain, tenderness, œdema over the mastoid) is lacking, owing to the fact that the anatomical structure of the mastoid precludes the spreading outward, the process working rather toward the inner plate, or roof of the antrum, or toward the lower portion of the process below the insertion of the tip muscles, or anteriorly into the zygomatic region.

Cases occur in which the *pain and tenderness are lacking*. A study of operative findings in such cases will show either a very dense outer plate or that the process has broken through the inner plate. Some of the most serious cases may have an absolute lack of pain or tenderness. We are inclined to look upon the absence of these symptoms as of value in pointing to the possibility of extension inward; whereas, in those patients exhibiting typical tenderness and pain, we would look upon the condition as of less immediate gravity.

Pain or Tenderness, Atypical in Position.—This is frequently noted over the entire surface or extreme lower portion of the tip in the beginning Bezold's type of mastoiditis, or, in the same type, the tenderness may be noted on the posterior wall of the external canal close to the orifice. In certain cases the pain

and tenderness are referred anterior to the auricle, in the zygomatic region, due to the anatomical extension of the mastoid cells in this region and the evolution of same.

Atypical Swelling and Œdema.—In *Bezold's mastoiditis* the swelling appears suddenly in the retro-maxillary fossa or posteriorly to the digastric fossa. The peculiarities of this swelling are: its sudden appearance, usually some weeks after the subsidence of the middle ear condition; the absence of fluctuation, which is present in typical mastoid cases; and also the associated masking of the mastoid tip, due to the undermining of the tip muscles. In another form of *Bezold's mastoiditis*, the swelling occurs on the anterior surface of the mastoid, causing a narrowing of the external canal near the orifice. Œdema may occur in the zygomatic region in cases where the suppurative process is active in the zygomatic cells.

Membrana Tympani Intact.—Atypical is that class of cases in which the mastoiditis exists with an intact membrana tympani. This is observed in *Bezold's mastoiditis*.

Hæmorrhagic mastoiditis occurs simultaneously with the occurrence of the otitis media, and systemic infection occurs simultaneously with the ear involvement. It occurs as the result of a hæmolytic organism such as occurs with influenza, tonsillitis or sore throat, measles, chicken pox, head colds, broncho-pneumonia and post operative tonsil complications. The temperature in these cases presents wide and abrupt fluctuations, and there is very marked prostration.

Objectively, the ear drum shows engorgement of the vessels but little bulging. Shrapnell's membrane is frequently involved. Drooping of the posterior superior wall is not observed. If the drum is incised there will be a bloody serous discharge. The discharge in these cases retains this character throughout.

Blood examinations will show decreasing red counts and hæmoglobin readings and positive blood cultures are observed early. There is also a tendency for the polynuclear cells to remain stationary while the leucocytes tend to increase.

The condition may subside after incision of the ear drum, but more frequently it assumes a virulent metastatic behavior. Mastoid operation is performed early to remove the infected thrombotic mucosa.

Chronic mastoiditis presents no special subjective symptoms other than a chronic aural discharge and dull hearing unless, through some obstruction to drainage, or because of extension, other symptoms develop. (See under symptoms of extension.) For the diagnosis of chronic mastoiditis, the objective examination is of the greatest importance. (See chronic suppurative otitis media.) Because of the lack of subjective symptoms and the necessity of thorough objective examination, and because of the possibility of grave intercranial extension from this condition, the diagnosis can usually be made only by one thoroughly skilled in the various methods of examination and familiar with the otoscopic pictures.

Symptoms Denoting Extension.—*Headache*, referred to the parietal and frontal regions of the affected

side, is suggestive of an erosion of the inner plate with exposure of the dura of the middle fossa.

Photophobia is noted in the beginning of meningeal conditions and is also found in cases of sinus infection.

Mental State.—Close attention should be given to the mental condition. Mental excitability, or the converse of this, apathy, may be noted. Either of these conditions is suggestive of deeper development.

Restlessness, with a desire to get out of bed, or lying on the bed with the limbs extended beyond the bed, are suggestive of meningeal irritation.

Epiphora, unilateral, is suggestive of involvement somewhere along the course of the facial nerve.

Laboratory Aids.—Examination of the blood will provide information as to the systemic reaction to the infection and also furnish additional data as to the local activity. White cell counts and differential studies should be made and repeated at intervals of one, two or three days in order to determine the progress of the infection.

Roentgenographic studies of the mastoid are valuable (except in the hæmorrhagic type) and offer distinct data when such examinations are conducted jointly by the radiographer and the otologist. Furthermore, in the acute cases, single studies, except in well-defined cases, are unreliable. Studies should be made and repeated in from forty-eight to seventy-two hours, or longer, if the clinical progress of the case is unsatisfactory or doubtful. In this manner it is quite possible to check up the activity in cases that are progressive and such information, in conjunction with the clini-

cal progress of the case, may be a deciding factor in the further treatment.

Prognosis.—In the acute type, whether typical or atypical, the prognosis is good if the case is operated early, before there is any marked constitutional involvement. The hæmorrhagic type presents a stormy course. As regards the hearing, the prognosis is good where the otorrhœa has not existed over a long time. Where, however, the mastoiditis is consequent upon a chronic otorrhœa, the hearing will be no better than it was prior to the onset of the acute mastoiditis. As regards the cessation of the aural discharge, in acute cases, the prognosis is good.

In the chronic type of mastoiditis, because of the possibility of extension to deeper structures, the prognosis should, in all cases, be guarded, although a large percentage of these cases respond to either local or operative treatment. The hearing function, in these chronic cases, is usually much lessened, due to the changes which have taken place on account of the chronic suppurative process.

Treatment.—Believing as we do that a large majority of the cases of acute mastoiditis are due to improper treatment of the preceding acute middle ear condition, it becomes necessary, under the head of *prophylaxis*, to consider briefly how this condition should be treated.

We look upon the middle ear condition as one which, if possible, should be under the care or supervision of a competent specialist.

As good drainage is the keynote to the successful resolution of these acute conditions, a properly per-

formed incision of the membrana tympani is an early essential in the treatment and will shorten very materially the course of the disease. Cases of acute otitis media coming to us within the first twenty-four or forty-eight hours very rarely go on to the stage of mastoiditis. After the incision is performed it is of greatest importance to view daily the membrana tympani and make sure the incision is not closing; in other words, make sure of constant free drainage. The average case is unfortunately allowed to rupture spontaneously; the lining tissues of the middle ear and mastoid are, therefore, subjected to severe tension for some time, thus causing local lack of resistance, and, even after spontaneous rupture has occurred, the opening is usually so small that tension continues.

If the physicians in attendance upon cases of acute otitis media will firmly realize the importance of early and wide open drainage the future will find many less cases of mastoiditis.

In the care of cases of acute mastoiditis the first question which arises is, *Have we already an operative case or are the symptoms such that we are guaranteed in attempting some local curative measures?* What are the symptoms or signs which we believe guarantee immediate operation?

1. When we are satisfied that a purulent mastoiditis is established we deem a mastoid operation imperative and would so advise. We, therefore, lay great stress upon the *character and amount of secretion*, for we believe that the study of the discharge is of prime importance in deciding when to operate.

2. If during the course of a middle ear condition,

which has been running the usual course, pulsation develops, with change in the character of the secretion, we would look upon this as a sign for operation.

3. The sudden cessation of a profuse discharge should necessitate operation.

4. In certain cases the discharge is changed in character although not profuse, but the associated symptoms, pain, tenderness, sleeplessness, etc., are such that we look upon the condition as a possible obstructive one and we would here advise operation.

5. Increasing pain and tenderness in connection with changed character of secretion demand operation.

6. As soon as œdema occurs the mastoid should be opened and this especially in adults. This stage having been reached it is seldom that resolution occurs.

The above we consider the imperative symptoms in a typical case. Sinking of the posterior wall, while evidence of a mastoiditis, is not in itself a symptom necessitating operation, but becomes so only in association with other symptoms, changed secretion, increase in pain, etc.

A positive X-ray associated with other symptoms, such as change in character of secretion, increase of pain or tenderness, suggests operation.

The character of infection is of value in determining the necessity for operation: we would delay longer with the staphylococcic than with a streptococcic.

In the atypical cases operation should be performed at once. In Bezold's mastoiditis, for instance, the swelling of the neck shows that there is a perforation of the mastoid capsule.

The occurrence of œdema and tenderness in the

zygomatic region should receive immediate attention because of the increased danger at this point from intracranial involvement.

We realize that the above statements may seem to some extremely radical. We believe, however, that anyone who thoroughly considers the anatomical structure of the mastoid and who realizes the variations in the structure and the density of its plates will admit, at least, that, once a purulent mastoiditis is established, further delay in opening the mastoid capsule subjects his patient to a certain risk. He must so admit, for he knows that he has at command no positive way to determine the resistance of the walls of the mastoid capsule and, therefore, cannot absolutely know what direction the pus will take. *Is there any other suppurative surgical condition which when determined should not be immediately drained?* We should not allow the natural desire of the patient to avoid an operation, nor should we allow any timidity which we might have for performing the operation, to influence our judgment, for we know that a properly performed mastoid operation, where no deeper complications already exist, stops the process and is not injurious to the patient.

In what class of cases then would local treatment be deemed advisable? Cases which, while presenting the symptoms of pain and tenderness, show no change in the character of the secretion, and little general reaction, or cases in which, while the discharge may be excessive, it is of a serous nature or mucoid, are those which are suitable for local treatment.

Any such case should be at once put to bed, elimi-

nation through the bowels and kidneys and skin should be looked after; the patient placed upon a light, sustaining diet. If the drum is not thoroughly opened, free incision should be made through the perforation under thorough aseptic conditions and an ice-bag placed over the mastoid region. If the discharge is of a mucoid character it will be necessary to use warm irrigations every two or three hours, depending upon the amount of the secretion, in order to prevent the damming up of same; but if the discharge is of a serous nature it is far better to avoid any other local treatment than simply the use of pledgets of gauze placed within the external canal and removed as frequently as necessary. If after twenty-four hours there is no change in the character of the secretion, the treatment can be safely continued; or if we find that there is less tenderness and pain and the secretion has lessened in amount, the ice-bag may be removed and after a period of six hours can be replaced upon the mastoid for a further period of a few hours. We realize that certain otologists claim that the ice-bag when once removed should never be replaced, but we have yet to see any deleterious effects from doing so, while, on the other hand, we are sure of the beneficial effect. During the course of the case the membrane is inspected carefully at each visit in order to make sure that the opening is sufficiently large for good drainage. If the discharge changes in character and becomes purulent we would at once advise operation. The continuance of temperature, increased pulse rate and blood counts denoting systemic involvement in spite of good drainage should suggest the advisability of operating.

CHAPTER XI

CHRONIC SUPPURATIVE OTITIS MEDIA

You should look upon this condition as a further step of the catarrhal or suppurative process, which process was the cause of the preceding acute otitis, the original condition having had its origin, in the majority of cases, in the nose and nasopharynx. The acute otitis media failing of resolution, there results the chronic condition in which there persists an otorrhœa, of varying character, which, finding its way through a persistent perforation of the drum, drains into the external auditory canal. Undoubtedly there are many cases of chronic aural discharge which are treated as cases of chronic suppurative otitis media, the real condition being a chronic mastoiditis. The changes found in the middle ear cavity are due to the irritation of the secretion from the mastoid, the middle cavity acting simply as a channel for drainage. Pathologically, in fact, it has been clearly demonstrated that there are present, in all cases of chronic suppurative otitis media, marked changes in the mastoid. From this it would seem that the classification here used is incorrect and that these cases should be looked upon as mastoiditis. While undoubtedly the pathological findings are correct, yet, clinically, many cases are seen in which the greatest destruction is in the middle ear cavity and especially in the region of the attic, so that the mastoid changes in this class of cases can be looked upon as secondary.

Causes.—The direct etiological factor is an unresolved acute otitis media; therefore, in considering the causes of chronic suppurative otitis media, we are in reality considering the factors which prevent resolution of the acute condition. A good majority of these chronic cases are the result of improper treatment of the acute condition. If this acute stage receives the proper attention, a very small percentage of such cases will reach the chronic stage. Carefully kept records of cases of acute otitis media will bear strong evidence of the truth of this statement. If the case, despite the careful treatment, passes into the chronic stage, there will usually be found some underlying factor, such as extreme virulence of the infection, as occurs in scarlet fever and measles, certain epidemics of grip or some general systemic disease, which tends materially to lessen resistance. Such systemic condition as syphilis, tuberculosis, anæmia or kidney disturbances must be sought for as the possible cause for the continuance of the disease. Also the condition of the nasopharynx, nose, nasal accessory cavities and the teeth should be carefully determined.

Pathology.—The mucous membrane of the tympanic cavity undergoes a marked thickening, losing its ciliated cells. This thickening is due to round-cell-infiltration, dilatation of the vessels and the formation of new vessels. The sub-epithelial layer becomes compressed and is eventually replaced by granulations or polypi which are very vascular and may completely fill the tympanic cavity. This gives the mucosa a much thickened and dusky red appearance. Ulcerative lesions may occur which destroy the

periosteum and even extend into the bone. The tympanic membrane is always more or less destroyed in the intermediate portion, that is between the periphery and the handle of the malleus, and thus are formed perforations of varying size and shape. Adhesive bands may form between the mucosa and the drum membrane or become attached to the ossicles. After the suppuration has run its course, the edges of the perforation become covered with a layer of epidermis and the perforation remains permanent.

Symptoms.—Subjectively these cases usually complain of but few symptoms. They consult the physician because of dull hearing and especially because of the presence of an aural discharge, this later causing annoyance because of the amount and odor. While these are the symptoms of which the patient complains, he may have a variety of symptoms due to systemic or local disturbance which he does not attribute to his aural condition. These symptoms are of great importance for the physician to elicit as they will have a marked influence upon his judgment in his conduction of the case. Acting as a focus of infection, the aural condition may produce symptoms of general toxæmia, which may be attributed by the physician to some intestinal disturbance. It is important to probe these cases for symptoms, to study any and all symptoms, and not lightly to attribute them to some other cause, as they have a marked bearing upon the case. The patient, as well as the physician, is frequently surprised, after the cure of a chronic suppurative otitis media, to find that

many symptoms which the patient complained of have disappeared and that there has been a marked improvement in the general condition.

Objectively, a discharge is found in the external auditory canal. This will vary in amount, character, color and odor. A study of the discharge from these standpoints is of great importance as bearing upon the severity of the condition present. (For details see under Prognosis.)

In the average case the *amount* of the discharge is sufficient to fill the canal, necessitating its removal before the drum and middle ear cavity can be examined.

In *character* it is usually muco-purulent or purulent.

Upon the character of the discharge and the type of the infecting organism, will depend the *color* of the discharge. The predominance of mucus or pus in the discharge will influence its color, and certain pathogenic bacteria, such as the bacillus pyocyaneus and yellow staphylococcus, produce characteristic coloring. Where much congestion is present, or granulations, the discharge will frequently be streaked with blood.

The odor is foetid and extremely disagreeable. This is due largely to stagnation of the secretion, although in certain cases it is influenced by the type of bacteria present, when it persists despite thorough cleansing.

After the discharge has been removed from the external auditory canal, a variety of conditions may be noted. Due to the irritation of the discharge, the canal walls may be found irritated or the epithelial covering of the walls of the canal may be macerated,

due to the constant moisture to which it has been subjected.

Changes in the ear drum will be noted. Chief among these is the presence of a perforation. This will vary as to its size, shape and location. It may be so large that only a small rim of membrane can be

PLATE XVI. Perforations of the ear drum as observed in chronic suppurative otitis media.



Fig. 1.—Central perforation.



Fig. 2.—Peripheral perforation.



Fig. 3.—Perforation above the short process.

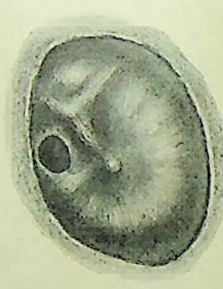


Fig. 4.—Perforation in the upper anterior quadrant.

found in the periphery, or it may be exceedingly small, and difficult to discover by simple inspection. In shape it may be round, oval, or kidney shaped, this latter type being found in the inferior portion

of the drum and due to the extension of the manubrium, with a small portion of the membrane attached, into the perforation. The location of the perforation is frequently a guide as to the location of the underlying condition and its severity.

PLATE XVI. Perforations of the ear drum as observed in chronic suppurative otitis media.



Fig. 5.—Perforation in upper posterior quadrant.



Fig. 6.—Large central perforation with granulations in the middle ear cavity and absence of the lower portion of the manubrium.



Fig. 7.—Large perforation with polypus presenting.



Fig. 8.—Large central perforation with manubrium extending into the perforation.

A centrally placed perforation usually indicates a mild process, while one which involves the periphery

is indicative of an underlying necrosis. Perforations above the short process point to necrosis of the ossicle or attic. A perforation in the anterior upper portion of the drum, close to the periphery, suggests that the underlying condition is in the Eustachian tube, while a defect in the upper posterior portion, close to the periphery, is indicative of involvement of the aditus ad antrum or mastoid. While perforations of the drum are usually single, occasionally multiple perforations will be found and these usually suggest a tubercular origin. That portion of the drum which remains, will be lacking in gloss and will appear opaque, thickened or mildly injected.

Be sure that all discharge and debris are removed from the external auditory canal before relying upon ocular findings.

Any or all of the "landmarks" of the drum may be lacking, this depending largely upon the position and extent of the perforation. The cone of light is invariably missing, either because of the loss of gloss of the drum, or because that portion of the drum upon which the cone of light is usually found has disappeared. If the opening is sufficiently large to involve the membrane around the manubrium of the malleus, this may disappear by necrosis, leaving only the short process in the anterior upper field. In many cases even this has necrosed and disappeared, so that all landmarks are lacking. In such a case there is usually only a narrow remnant of the drum around the periphery.

Unless the perforation is filled with polypi or granulations, a view of the middle ear cavity can

be obtained. The extent of this view, and the portion of the middle ear cavity which can be seen, will depend upon the size and location of the perforation. The view, so gained, furnishes valuable information as to the local condition within the middle ear cavity. *It is always well to verify the ocular findings by palpation with the aural probe.* Through the perforation, the mucosa of the middle ear cavity may be found intensely swollen and presenting a granular appearance, or it may appear pale and atrophic. By palpation, with a probe, the walls of the middle ear cavity can be felt and in this way necrotic areas can often be discovered. By slightly bending the end of the probe, the walls of the middle ear cavity can be explored. This, of course, should be carried out with great care, so that no damage can be done to the contents of the middle ear cavity, such as the disturbance of the ossicles, if present. If the perforation is sufficiently large to admit of a good inspection of the cavity, it is well, after removing all secretions with a cotton applicator, to watch for the occurrence of secretion; the direction from which this appears will frequently be a guide as to its source. If it appears from the anterior upper portion of the field, it is probably from the Eustachian tube. If from the upper posterior portion of the field, it is coming from the mastoid. If from the central upper portion, the condition is probably in the attic.

Granulations and polypi are of frequent occurrence in this condition. The granulations may appear around the edges of the perforations or in any portion of the middle ear cavity. In size, they will vary



from pin-head to that of a pea. The smaller granulations appear as reddish elevations and are frequently seen covering the inner wall of the middle ear cavity, lying closely together and giving the appearance of the outer surface of a raspberry. The larger granulations are frequently pedunculated and are movable with a probe. Granulations bleed very readily and are extremely sensitive.

Polypi vary in size from that of a pea to such size that they may fill the entire external auditory canal, often protruding from the orifice and, in extreme cases, hanging from the ear. They are, in appearance, smooth, somewhat shiny, grayish or pinkish in color, are freely movable, bleed easily, but are not sensitive. They may be single or multiple.

Microscopically, much can be learned concerning the condition through examination of the discharge, by means of spreads and cultures. These should be examined before the beginning of a course of treatment. By these means is determined the type of infecting bacteria. The types most frequently found are the staphylococci, bacillus pyocyaneus, pseudodiphtheria, streptococci and pneumococci.

Through microscopical examination the presence of cholesteatomata can also be determined by the finding of cholesterine crystals in the discharge.

Complications of Chronic Suppurative Otitis Media.—General toxæmia, mastoiditis, meningitis, brain abscess, labyrinthitis and facial paralysis.

General Toxæmia.—Acting as a focus of infection, a suppurative otitis media will frequently produce mild or severe general toxæmias. Patients will com-

plain of such symptoms as general malaise, lassitude, dull, stupid feeling in the head, inability to concentrate, drowsiness and mental depression. Frequently the aural cause of these symptoms is not recognized and the patient is treated for some other condition, such as intestinal intoxication. The possibility of such toxic symptoms, due to the aural condition, should always be borne in mind.

Mastoiditis.—This may be acute or chronic. For the diagnosis of these types, see Mastoiditis.

Meningitis.—Symptoms suggesting the possible occurrence of this complication are: photophobia, suffusion of the conjunctiva, headache, general hyperæsthesia, restlessness and mental unrest. With the occurrence of the attack, the usual high fever, delirium and rigidity of the posterior neck muscles will be noted.

Brain Abscess.—The study of the history of brain abscess, of otitic origin, would seem to prove that these patients exhibited, prior to the full development of the condition, a variety of symptoms, these having been attributed to other causes. Hemicrania, gradual dulling of mentality, apathy and loss of flesh are prominent symptoms in the histories of cases of brain abscess.

Labyrinthitis.—Involvement of the labyrinth is ushered in by vertigo, nystagmus, nausea and vomiting, loss of hearing and tinnitus. In some cases the sharp invasion of the labyrinth is preceded by mild and fleeting attacks of vertigo and nausea, while in others the patient is suddenly seized with the above-mentioned symptoms without a prodromal stage.

Facial Paralysis.—This occurs due to necrosis of the inner wall of the middle ear cavity and involvement of the nerve in its bony canal. The sudden occurrence of facial paralysis has frequently led to the discovery of an old and forgotten suppurative condition of the middle ear. Epiphora, especially unilateral, may be a prodromal symptom.

Diagnosis.—This will depend upon the history of the case, the occurrence of a discharge from the middle ear, and the local findings.

Prognosis.—From a prognostic standpoint, much will depend upon (1) the duration of the condition; (2) the casual factor; (3) the general condition of the patient; (4) the local condition found; (5) the character of the discharge; and (6) the type of the infection.

1. *Duration of the Condition.*—As a rule, the longer standing the condition, the less favorable the prognosis as regards the time required for treatment. Cases of long standing are not so apt to respond to local treatment as are cases which have existed for but a short time. The longer the condition has existed, the greater the destruction which has taken place and the greater the local resistance is lessened. Exceptionally there are cases of long standing, which respond quickly to local treatment. These are of a mild character in which the infection is not of a virulent and destructive type.

2. *Causal Factor.*—Experience has taught that cases which have had their origin in scarlet fever, measles or diphtheria are prone to marked chronicity and great destruction of tissue and do not respond

so readily to treatment as do cases which have originated from acute otitis media due to colds or influenza. The recognition of the underlying factor becomes, therefore, of great importance and should always be sought for. Cases due to syphilis, while not common, respond very readily to anti-specific treatment. A middle ear condition due to tuberculosis, while not offering the best prognosis, will frequently clear up under proper constitutional and local treatment.

3. *The General Condition of the Patient.*—This should always be carefully considered, as those with lowered vitality will not respond to treatment so readily as those whose general physical condition is good. *Every patient suffering from chronic middle ear suppuration should receive a thorough general examination.* Blood changes may be found or elimination may be faulty, and these should receive consideration.

4. *The Local Condition Found.*—The character of the changes which have taken place will have a marked bearing upon the length of time required for treatment, as well as upon the kind of treatment. As stated above, the position of the perforation is frequently a guide as to the underlying condition. Where the perforation is in the center of the drum, or in the anterior portion, the prognosis is more favorable than where it is found in the periphery or the upper posterior portion of the drum, as these latter positions point to the existence of necrotic changes, while the former are usually found in the milder types of the disease.

The presence of granulations and polypi are frequently guides to the existence of necrotic areas and such cases are usually rather resistant to local treatment. The presence of exostoses in the external auditory canal renders the prognosis, as regards success of local treatment, doubtful because of the obstruction they offer to employment of local measures. If cholesteatomata are present, the only chance of clearing up the condition is through operative measures.

5. *The Character of the Discharge.*—This is a very important factor in prognosis. A discharge in which pus predominates, by indicating an active suppurative process, offers a more unfavorable prognosis than does one in which the predominant component is mucoid in character. The finding of a bluish, black, scant discharge, adhering to the upper and posterior walls of the external canal, suggests necrosis in the aditus ad antrum or mastoid and therefore a case unfavorable for local treatment. A thin, watery, frequently excoriating discharge is also often due to necrosis.

6. *Type of Infecting Bacteria.*—Cases in which are found the streptococcus or bacillus pyocyaneus, present a less favorable prognosis than those in which the staphylococcus or the pseudo-diphtheria bacillus are found.

Treatment.—This will comprise the general, local and operative treatment.

General.—It is highly essential to pay careful attention to the general condition of the patient. Failure to do this is frequently the cause of lack of success.

For this reason *any departure from normal health should receive proper attention.*

Local Treatment.—On account of the varying local conditions which are found in these cases, it is impossible to give, in detail, the treatment which should be applied in every case. Only the more common conditions can be covered and a general basis for treatment given. As there is no one form of treatment which will cover all cases the physician, who adopts a routine method, will have but poor results in the majority of cases. Each case must be treated according to the condition found present and many of these are of such a nature that skilled treatment is required. Many cases which have failed to respond to indifferent treatment, have yielded promptly when placed in the hands of those more skillful.

The keynote in the local treatment is the establishment of free drainage, by the removal of anything which is obstructing drainage. Among such conditions are: a too-small perforation, granulations, polypi, exostoses, and adhesive bands within the middle ear-cavity.

In the presence of a profuse, or a very thick, discharge, a small perforation, by preventing a rapid removal of the secretion, may cause the continuance of the condition. In such a case the perforation should be enlarged by incision. Frequently this simple measure, if properly performed, will be all that is necessary to clear up the condition. It is important, after such an incision, to see that it does not close too soon, and that free drainage is assured. If the discharge is very thick, it may be necessary to

irrigate the ear with warm boric acid solution two or three times a day, this to prevent accumulation of the discharge which may act as an obstruction.

Small granulations can be removed by cauterization. For this purpose, trichlor-acetic acid, silver nitrate, and chromic acid are the substances usually used. Of these, trichlor-acetic acid is the one to be preferred, as it does not tend to spread so rapidly over the surface or attack the tissues so deeply as do the other chemicals named. In order to apply this properly, a few strands of cotton are wrapped tightly upon the end of a cotton applicator; the cotton is then moistened and brought into contact with the acid crystals. These are allowed to remain for a short time and are then shaken off, when sufficient of the acid will have been absorbed by the cotton. Under good illumination and after thorough drying of the external canal and middle ear, the acid is applied directly to the granulations, care being taken not to touch the canal walls or any other portion of the middle ear cavity. The area treated will immediately turn white and the patient will complain, for a few minutes, of a sharp burning sensation. The number of applications necessary will depend upon the size of the granulations, and the frequency with which applications should be made will depend upon the amount of local reaction.

Larger granulations can be removed by means of an aural snare.

Polypi.—Before attempting to remove a polypus, it is important that the point of attachment should be carefully determined. This can be done by means

of the aural probe. If the polypus is small, the attachment can be readily determined by moving the polypus with a probe, when it can be seen where it is attached. If it is large and fills the canal, the probe should be passed around it, when the obstruction offered by the pedicle will give a clue as to its attachment. In some cases it is impossible to determine exactly the position of the pedicle; this is especially so where a polypus extends through a small perforation in the drum. These polypoid growths, by offering obstruction to drainage, are frequently prime factors in the continuance of the suppurative condition, the removal of the growth, by allowing free drainage, being all that is necessary to bring about a cessation of the condition. Frequently, however, these growths cover necrotic areas as natural protections to these areas, so that, in addition to the removal of the growth, the underlying condition will need attention. The tendency of these growths to occur in the presence of necrosis should always be thought of and the necrotic condition sought for. If it is determined that the attachment of the polypus is the roof of the middle ear cavity or its inner wall, it is usually advisable not to attempt its removal through the external canal. Many cases are on record where such removal has caused an opening through the wall, with direct infection of the labyrinth or the cranial cavity resulting. Polypi in this position, or cases of recurrent polypi, usually point to the necessity for major operative treatment.

Where removal through the canal is indicated, the aural snare should be used, care being taken to reach well around the base of the pedicle and thus cut

through, with the snare wire, without any traction being produced.

Exostoses, should they prove an absolute obstruction to drainage, may need removal. This is a surgical measure to be undertaken only by one skilled in such work.

Adhesive bands within the middle ear cavity, between the drum remnants and the walls of the middle ear cavity, should be carefully located by palpating with the aural probe; they can then be divided by properly constructed instruments. This is also a form of treatment which should be carried on by a skilled aurist.

The establishment of drainage, by the removal of obstructions, together with subsequent cleanliness, will bring about a cessation of the discharge in many cases of chronic otorrhœa.

If, after free drainage has been established, there is no change in the amount or character of the secretion, it will then be necessary to consider a further line of treatment. Here we have the choice of a variety of methods, namely, the use of the gauze wick, treatment by irrigation, zinc ionization, dry treatment by means of powders, the quartz light and the use of cauterization by means of acids or the actual cautery.

The *gauze wick* is applicable in cases which present a rather large perforation. The success of this method depends largely upon the proper placing of the wick. The great essential is that the inner end of the wick shall extend into and through the perforation. The rest of the wick is then placed loosely in the external

canal, the outer end being at the orifice of the canal. A pledget of gauze, placed in the concha, receives the secretion, which passes along the drain by capillary attraction. This pledget of gauze can be renewed as often as demanded for the sake of cleanliness. As an additional aid, the wick may be saturated with boric acid. The wick should be removed every day, the condition noted, the middle ear cavity and external canal thoroughly dried and a fresh wick introduced.

In the *treatment by irrigation*, the solution to be used will depend upon the condition present. Among the solutions most commonly used are boric acid, alcohol, zinc sulphate, silver nitrate and enzymol.

Boric acid is used especially in recent cases where the discharge is principally of a mucoid character. It is applied by means of irrigation of a warm solution three or four times a day.

Alcohol is indicated where the mucosa of the middle ear cavity presents a raspberry appearance or where there is a tendency to the occurrence of pin-head granulations. While many patients will tolerate immediately absolute alcohol, in others it will be found advisable to begin with a weak solution (50%), gradually increasing this to full strength. It is best applied after irrigation with sterile water or boric acid solution. After irrigating, the head should be held well to the side which has been irrigated, so that as much of the solution will run out as possible. The head is then directed to the other side and the external canal filled with the medicament and allowed to remain for from five to ten minutes. This treatment should be applied by the patient three or four times a day.

the number of times depending upon the intensity of the condition present. The alcohol may also be combined with boric acid and applied in the same way.

Zinc sulphate is applicable in cases which present a mucous discharge, where the condition is of longer standing. It is applied in the strength of $\frac{1}{2}$ to 1 grain to the ounce. After irrigation of the ear, just as when alcohol is used, a few drops of the zinc solution should be dropped into the canal, it being retained for a few minutes by holding the head in the proper position.

Silver nitrate is indicated in solutions of from five to fifteen grains to the ounce, especially where there is marked swelling of the mucosa. This should also be applied, after irrigation, by filling the canal with the solution. It is always advisable to start with the weaker solution, the stronger one being used when it is evident that the results are not being obtained. Where the stronger solutions are used, they should be applied only by the physician, the weaker solution being given to the patient for home use. The frequency with which the application should be made will depend upon the local reaction. It is not necessary, nor is it advisable, to repeat the application before the white film produced upon the mucous membrane has disappeared. Should the reaction prove too sharp, saline solution can be dropped into the ear, thus neutralizing the nitrate of silver. This agent can be used in a saturated solution and is so indicated in the large, flat polypoid masses which at times develop in the middle ear. In this instance

very careful application under good illumination is necessary.

Enzymol is a valuable agent in that class of cases where there is a tendency to epithelial proliferation, as evidenced by the accumulation of epithelium within the canal or middle ear cavity.

Frequently it is advisable to extend the action of solutions by forcing them through the Eustachian tube and mastoid by the use of the pneumatic otoscope.

Zinc ionization is followed by favorable results in some cases and is applied as follows:—The external canal is irrigated with a one-quarter grain of zinc sulphate to the ounce of water. The patient then assumes a recumbent position with the ear to be treated up. The external canal is filled with a zinc sulphate solution, one grain to the ounce of water. A rubber speculum is introduced into the canal. Through this a zinc wire electrode connected with the posterior pole of a direct current is passed into the canal. The negative pole is placed in the patient's hand. Two to four milliamperes of current are allowed to flow for a period of fifteen minutes.

In appropriate cases, where the technique is properly carried out, very few of these applications are necessary.

This treatment is contra-indicated in cases where tuberculosis is suspected or present, or where there are granulations or polypi or where definite areas of necrosis are present. It is also contra-indicated where definite foci of infection exist such as purulent rhinitis and sinusitis or infected tonsils and adenoids.

Dry Treatment.—In applying the dry treatment, various powders are used, these being applied to the surface, after thorough drying, by means of powder insufflators. The powders most generally used are boric acid, stearate of zinc, aristol and iodoform. This method should never be used where the perforation is small, as, by crusting, they may close the perforation and cause obstruction. Aristol especially has this tendency.

The application of the *water-cooled quartz* light is of value in some cases. It has been of particular use in tubercular cases. The ear should be cleansed by suction and inflation, then thoroughly dried by cotton tampons. The patient is then placed upon the side, the ear to be treated up. Five drops of a 1 percent solution of acri-violet are dropped into the ear and allowed to remain for ten minutes, when the excess is removed. Following this the short quartz applicator of the water-cooled lamp is introduced and an exposure made for thirty seconds. The treatment should be repeated every three days and the exposure gradually increased by ten seconds until a maximum of ninety seconds is reached.

From the foregoing it can be seen that there is no one method applicable in all cases and because of the variety of conditions presenting in this class of cases, it is impossible to outline the treatment for each variety. Unless some results are noted within a few days, after any line of treatment, this method should be discontinued and the case thoroughly re-examined. The early finding of the proper means for securing results will depend largely upon the experience and

judgment of the physician. In any case the results of local treatment will depend upon the care and thoroughness of its application. It is highly necessary that the case should be frequently seen and thoroughly examined at each visit, in order to determine that there is constantly free drainage and also to note carefully any changes. The failure to obtain results is, in the majority of cases, due to this lack of attention on the part of the physician.

In exceedingly stubborn cases, cauterization by means of acids or the actual cautery may be resorted to. This method should only be used by those familiar with aural work.

Operative Treatment.—This will either be *minor* or *major* in character.

Minor operative procedures are frequently necessary during the local treatment of the case. The removal of polypi or large granulations by means of the aural snare, enlarging a too-small perforation by incision, and the division of adhesions have been previously mentioned. In addition to these the use of the curette, for removing necrotic areas, ossiculectomy, either for the removal or necrosed ossicles or for the purpose of securing better drainage in attic suppuration, are sometimes necessary. The very nature of these procedures demands considerable skill and should be undertaken only by the experienced aurist.

Major operative treatment consists in the radical opening of the mastoid, the so-called radical mastoid operation.

This is indicated especially in (1) cases evidencing

serious complications such as involvement of the mastoid, facial nerve, labyrinth and the intracranial contents; (2) cases which do not respond to minor local operative treatment, in which the character of the discharge or objective conditions, such as recurrent polypi, indicate a virulent destructive condition; (3) where cholesteatomata are present as evidenced by the presence of cholesterine crystals in the discharge or the presence of cholesteatomatous masses in the middle ear cavity.

Vaccine Therapy.—The use of vaccines has, by some authors, been given a prominent place in the treatment of this condition. It undoubtedly has its place in the treatment but the results have not been so flattering in the hands of others. In some cases we have had some very positive results especially from autogenous vaccines. In other cases the results have been quite disappointing. In any case we advise against the routine use of vaccines, and especially the use of stock vaccines.

The physician should look upon chronic suppurative otitis media as a condition demanding his closest attention, because of the serious complications which may arise from it.

Homeopathic Remedies:—*Calcarea carb.*, *calcarea iodide*, *calcarea fluorica* and *sulphurica*, *graphites*, *hepar sulph.*, *hydrastis*, *kali bichromicum*, *mercurius*, *pulsatilla*, *silicea*, *sulphur* and *tellurium*.

CHAPTER XII

CHRONIC CATARRHAL OTITIS MEDIA; OTOSCLEROSIS

This is one of the most common otological diseases. It is also often described as *chronic non-suppurative otitis media, dry middle ear catarrh, adhesive middle ear catarrh, and obstructive middle ear disease*. It is a further stage of tubal or tubo-tympanic catarrh, being one of the end results of these conditions.

Causes.—Being, as above stated, a further stage of tubal and tubo-tympanic catarrh, the causes of this condition are the same as those of the above-mentioned conditions.

Pathology.—The chief pathological changes are: (1) hypertrophy, (2) hyperplasia, and (3) atrophy.

1. Marked swelling and congestion of the mucosa of the middle ear tract leads to a true hypertrophy of the mucous membrane. This results in a narrowing of the lumen of the Eustachian tube and lessening of the size of the middle ear cavity. Due to these pathological changes, there results a lack of proper aeration of the middle ear cavity so that the drum is pressed inward by the aerial pressure exerted in the external auditory canal. Thus the movement of the drum and ossicles is limited. Increased secretion results; the fibrous elements may cause adhesive conditions within the middle ear tract, so that bands form between the walls of the middle ear cavity, the ear drum and ossicles, these resulting in further limitation

of motion. As the hyperplastic stage comes on, fibrous tissue forms and there occurs contraction, this resulting in a marked drawing backward of the ear drum and further restricted movement of the drum and ossicles. Strictures form, also, in the Eustachian tube, causing a marked narrowing of the tube. Atrophy follows this stage and as a result the Eustachian tube becomes abnormally widened, the mucous lining of the middle ear cavity having shrunk. If the condition has resulted in marked adhesive changes, the drum and ossicles will be firmly bound down by adhesions, the drum therefore markedly retracted. In those cases, where this tendency to adhesions has not been present, there will be found, in the atrophic stage, marked laxity of the ear drum.

Symptoms.—The subjective symptoms will depend upon the stage of the condition. During the stage of hypertrophy, these patients will complain of a full feeling in the ear, a sensation of stuffiness as if the ear were plugged. At times this symptom disappears and the patient is much more comfortable, but soon it recurs. This is due to the cessation of function of the Eustachian tube and the resultant pressure on the outer surface of the drum. With the consequent widening of the tube, as occurs in the later stages of the disease, this symptom disappears. Dull hearing is present to a greater or less degree from the beginning of the condition. In the early stages it is due to the closure of the Eustachian tube and the swollen condition of the mucosa of the middle ear cavity. During this stage, therefore, there are times when the hearing will markedly improve, due to a tem-

porary opening of the tube. In the later stages of the disease, these temporary improvements in the hearing are not noticed. The loss of hearing shows rather a tendency to gradual increase due to the connective tissue changes and contraction. A careful study of the symptom of dull hearing is highly important from the standpoint of diagnosis as to the stage of the disease, this giving us the prognosis of the condition. While the dull hearing appears eventually in both ears, it is the rule for it to be noted in one ear for some time before the other ear becomes involved. From the beginning it is of slow development and in the majority of cases months or years elapse before the patient realizes that he is becoming deaf. This is especially so when the involvement of the other ear is delayed. Because of this fact, the majority of cases are well advanced before they come for treatment. As mentioned above, the hearing, during the early stage of the disease, frequently exhibits periods of improvement, also, during this stage, improvement is noted at times when going from the warmth to the cold, or in changes from damp to dry fair weather, or vice versa. From a prognostic standpoint, this fluctuating character of the hearing is usually a hopeful sign, indicating the disease to be in the early stage. During the later stages of the disease, these fluctuations will not be noted. In the very advanced condition useful hearing is practically lost. Frequently the loss of hearing is more rapid in the ear which has been last involved. Even in high degree of dull hearing, these patients are still able to hear the whispered voice through a speaking tube and can

also often hear conversation over the telephone. Characteristic of this type of dull hearing, in the advanced stages of the disease, is the ability of the patient to hear better when riding in the cars or in places where there is considerable noise. This symptom is not encouraging from a prognostic standpoint. The hearing is markedly worse if the patient is present where many persons are talking at the same time, and is also worse when the patient is physically or mentally fatigued or worried.

Tinnitus is a very frequent symptom occurring in the majority of cases. There is nothing characteristic as regards the type of sound which is perceived by the patient. Buzzing, roaring, escaping steam, high-pitched, whistling sounds, bells, sea-shell sounds, and a variety of others will be noted in a series of these patients. In fact, one patient may complain that at times he hears a buzzing sound, at others a sound of escaping steam, or again a sound of bells ringing. From a diagnostic standpoint, the study of this symptom has not proven of great value. From the standpoint of prognosis, however, those cases in which tinnitus is a marked symptom, are usually less responsive to treatment than are those in which this symptom is not present. In a certain percentage of cases, the tinnitus is complained of before the patient notices any impairment of hearing. Patients who complain of tinnitus should, therefore, receive a very thorough aural examination, in order to determine whether the symptom is not due to a beginning catarrhal middle ear disease.

Pain and dizziness are occasional accompaniments

of this condition. These symptoms are usually of a mild and fleeting character.

Objectively, in advanced stages of this condition changes will be noted in the external auditory canal. These patients then exhibit a falling off in the secretion of cerumen, this in many cases amounting to an absolute cessation, with resultant dryness of the integumentary lining. Frequently, also, the canal lumen is widened through shrinking of the lining of the canal. This widening of the canal is often noticeable in advanced cases.

The main objective changes of this condition will be found in the ear drum and Eustachian tube. The changes in the ear drum affect the gloss, the landmarks of the drum, its position, transparency, movability and structure. Those of the Eustachian tube consist of changes in the mucosa due to the stage of the condition and to the narrowing or widening of its lumen.

A large percentage of the cases exhibit a loss of gloss of the drum as evidenced by the absence of reflection of light from its surface. This loss of gloss may not affect the entire surface of the drum, so that one sees a membrane, in which the one portion has lost its gloss, while another portion retains it.

The "landmarks" of the drum show changes from the normal as regards their position and prominence. In nearly all cases the short process of the malleus is more prominent than usual and the manubrium appears shorter than normal. This is due to the depressed, or retracted, position of the ear drum which, either through the pressure of the column of

air in the external canal is pushed inward, or through adhesive conditions is retracted so that the position of the drum is altered. Depending upon the degree of depression or retraction, there will be seen whitish lines running, anteriorly and posteriorly, from the short process to the periphery of the drum. These are known as the anterior and posterior folds and occur between Shrapnell's membrane and the lower portion of the drum. In marked cases these folds become very prominent, the short process can be seen sticking out prominently into the membrane and the manubrium drawn upward and backward so far that it is hardly perceptible. (See Plate X.) Changes in the movability of the drum will be found in the adhesive type of the condition. This lack of movability may be noticed throughout the entire membrane when it is totally adherent or in spots, when the drum is held backward only at certain points by adhesive bands. As the ocular appearances of the changes in position of the drum, due to depression or retraction, are identical, it is necessary to make use of either inflation of the ear or the pneumatic otoscope in order to differentiate. If, while you observe the ear drum through the aural speculum, the patient inflates the middle ear by Valsalva's method, the drum will move outward if there are no adhesions present. If the drum is totally adherent there will be no movement or, if only partially adherent, the non-adherent areas will move outward with the inflation, while the points at which adhesions are attached will show no movement. This can be verified by using the pneumatic

otoscope. If the drum is observed through this and suction is used with the otoscope, the same movement, or lack of movement, will be noted as during inflation.

Changes in the transparency of the drum are especially noticeable in this condition, these changes, for the greater part, being due to the involvement of the inner or mucous layer of the drum. These changes may involve the entire inner layer, in which case the entire drum will be opaque; or, if only small areas of the mucous membrane are involved, the lack of transparency will be evidenced by the appearance of opaque spots, while the remaining portions of the drum may show normal transparency.

Changes in the structure of the drum are especially noticeable in the advanced stages of this condition, due to atrophy, and are evidenced, clinically, by wrinkling of the surface of the drum and abnormal free movement when the pneumatic otoscope is used.

In the early stages of this disease examination of the Eustachian orifice, in the nasopharynx, shows a reddened, swollen condition of the mucosa. The extension of the swollen condition into the tube, with resultant narrowing, is recognized objectively by the difficulty in inflation. In the later stages of the disease, the mucosa of the Eustachian orifice will appear abnormally pale and, unless strictures are present within the tube, inflation occurs more readily than normal. It is highly important to study very carefully the condition of the Eustachian tube, as evidenced by the sounds produced through the Eustachian catheter and transmitted through the

auscultation tube. The physician who will pay close attention to this method of diagnosis will learn much of value as to the stage of the disease and as to the presence of obstructive conditions of any portion of the tube. Also, through the character of the sound produced, he can judge whether such obstructions are due to congestive conditions or stricture formation. In the early stage of the disease when, through congestion of the mucosa, the Eustachian tube is closed, it will be found, upon attempting to inflate the ear, by means of the Eustachian catheter, that the inflation is difficult. After three or four attempts, however, the air will enter the middle ear cavity and will be perceived through the auscultation tube. The sound thus produced will approach the normal tubal sound. In cases, however, where strictures are present, it will be found at all times difficult to inflate and the sound of the air which does pass through the narrowed portion of the canal will be lacking in its normal characteristics, being higher pitched and often of a squeaky character. In such a case the presence of a stricture can be verified by the use of aural bougies.

Functional Tests.—As we are dealing with a disease of the conducting apparatus, the results of the functional examination will be those characteristic of lesions in this portion. According to the degree of the condition, there will be a falling off in the hearing of the voice and the watch. In applying these tests it is necessary to observe carefully the rules given under Functional Examination. It will be found with the voice test that the soft, low-pitched

tones are heard less readily than the high-pitched tones. This inability to recognize the low tones as readily as high ones, can be frequently deduced from the patients' statements that they hear children's voices more readily than those of adults, and women's voices more readily than those of men, or that low, rumbling sounds of the street are not so readily heard as the shrieking of locomotive whistles.

All functional tests should be made before any treatment is instituted, and the results carefully noted, so that improvement, or lack of improvement, can be determined after treatment by retesting.

Prognosis.—The prognosis of this condition, as regards the loss of function, will depend upon (1) the general condition of the patient; (2) the cause; (3) the stage of the disease; and (4) the local condition.

Upon the *general condition* of the patient depends often the prognosis. It is highly important, therefore, to have a good understanding of the patient's general condition, as determined by thorough examination. Cases exhibiting any general disturbance, which directly or indirectly influences the mucous membranes, do not offer a favorable prognosis unless such conditions are amenable to treatment. Gastrointestinal, liver, kidney, heart, blood, arterial and thyroid disturbances must be considered as to their influence upon the local condition, and it must also not be forgotten that any such disturbance may be the causal factor of the aural condition. The consideration of the *causal factor* is extremely important from a prognostic standpoint, much depending upon the ability of the physician in overcoming any such factor. In many

cases the causative factor, as determined, will be of such a nature that it cannot be removed. In others, such as those occurring from diseased tonsils, the possibility of thorough eradication of this condition will favorably influence the prognosis. Where heredity is a factor, the prognosis is usually unfavorable. Occupation, from a prognostic standpoint, must receive consideration.

From the standpoint of the *stage of the disease*, the hypertrophic stage offers a better prognosis than does the stage of hyperplasia or atrophy. Such information is to be gained from the *local condition*. Thickening of the Eustachian tube will be observed in the hypertrophic stage, together with thickening and infiltration of the membrana tympani. Strictures, or wide, open tubes, with or without atrophic membrana tympani, offer a poor prognosis.

In any case a guarded prognosis should be given as regards the hearing.

Treatment.—Attention to the patient's general condition is extremely important. Regulation of the general hygienic conditions and methods of living must receive careful attention.

Where needed, thorough treatment of the nose and nasopharynx should be instituted for the removal of any existing causal factor.

Prophylactic measures should be executed, such as the removal of adenoids or any nasal or pharyngeal obstructive conditions.

The local treatment of the ears will depend upon the stage of the disease and the existing local condition. In the early stage, when there is closure of the

Eustachian tube, with resulting lack of aeration of the middle ear cavity, measures instituted for the purpose of restoring the function of the Eustachian tube are indicated. Of first importance is inflation of the middle ear, applied by either Politzer's method or the Eustachian catheter. If inflation is difficult, results are frequently obtained by making applications, which have the effect of reducing the swelling of the mucosa of the Eustachian orifice and the pharyngeal end of the tube. The best solutions are: adrenalin chloride, either in full strength or diluted with saline solution as indicated; cocaine, 4%; argyrol, 20%; and menthol, grains two, to the ounce of albolene. These should be applied by means of a cotton applicator, which can be bent to conform to the curve of the Eustachian catheter. After such application, it is advisable to wait a few minutes, for the action of the solution, before attempting inflation. The Eustachian catheter will prove the best instrument to employ where results are not readily obtained. In fact this method should be employed in all cases if you possess the requisite skill. At this stage of the disease the ear should be inflated at least three times a week and oftener if possible. Never advise patients to use Valsalva's method, as the frequent use of this will ultimately result in a marked laxity of the ear drum and the various ligaments of the ossicles. In very obstinate cases, in order to further reduce the swelling of the mucosa of the tube, medicated vapors may be blown into the tube through the catheter or direct applications of argyrol, nitrate of silver (in weak solutions), menthol or iodine can be made either by means

of specially medicated bougies, which are inserted in the tube, or by anointing the linen bougies and inserting these. This method of treatment, however, should only be applied by those having experience.

As one effect of the inflation is to restore the drum to its normal position, careful observation of the membrane and its position is therefore a guide as to the frequency of inflation necessary.

In the later stages of the disease, inflation of the middle ear is indicated only when it has been demonstrated that adhesive conditions exist within the middle ear cavity. In such cases an occasional inflation, by stretching the adhesion, will, in a small percentage of cases, be advisable. Where, however, there is no adhesive condition, inflation of the middle ear is contraindicated. At this stage the Eustachian tube is more patent than normal and there is a tendency to atrophic conditions of the drum and ligaments, so that inflation would result in increasing the laxity of these structures, thereby accentuating the dull hearing. If, at this stage, strictures of the tube are present, the use of bougies frequently relieves the patient of a distressing tightness in the ear, while at the same time, by allowing better aeration of the middle ear cavity, it may influence the hearing favorably.

In the adhesive type of the disease, in addition to the use of inflation of the middle ear, the use of the pneumatic otoscope, through alternate pressure and suction, may have a beneficial influence by stretching the adhesions and thereby allowing motion of the membrane and ossicles. The separation or division of the

adhesions may give benefit and should receive consideration. Such a procedure, however, should naturally be employed only by one skilled in this work.

Homœopathic Remedies: Calcarea phosph., hydrastis, kali hydroiodicum, kali mur.

Otosclerosis

This is a condition which simulates chronic catarrhal otitis media. It is, however, not a disease of the middle ear but one of the bony capsule of the labyrinth, there resulting, through pathological changes, a spongification of the labyrinthine capsule. As a result of these pathological changes deafness and tinnitus are produced, these varying in degree in different cases. In a well-marked case deafness will be pronounced, while in another case the pathological condition evidently becomes arrested and there is no further advance of the disease. The dull hearing produced in this disease is very frequently better in a noise.

Objectively, in the typical case, it will be found that the ear drum and middle ear tract are practically normal, this being strong proof that the condition is not of the middle ear tract.

Functional Tests.—As in chronic catarrhal otitis media, we find a falling off in the perception for low tones and, in well-marked cases, a falling off in the aerial conduction by the Rinne test.

Diagnosis.—In many cases it is impossible to differentiate this condition from chronic catarrhal otitis media, especially in those atypical cases where there are also present changes in the ear drum, indicating a catarrhal condition of the middle ear tract. In the

typical cases, however, the objective finding of a normal drum, together with patulous Eustachian tubes, a falling off in the perception for low tones and a negative Rinne, and also a persistent tinnitus, associated with dull hearing, which is better in a noise, is conclusive evidence of an otosclerosis.

Prognosis.—In otosclerosis the prognosis is always grave as regards the hearing. While in a certain percentage of cases there is an apparent arrest of the condition with the retaining of a certain amount of hearing, in the majority of cases a consistent progression is observed until deafness is marked, the tinnitus often continuing as a most distressing symptom.

Treatment.—No method of local treatment has been found which has proved of any avail, either in arresting the progress of the disease or in controlling the tinnitus. In all cases a great deal of care should be given in the general examination of the patient and the correction of any general derangement which may be found. It is along these lines that the most has been accomplished in otosclerosis. Homœopathically prescribed, phosphorus and causticum, calcarea fluorica and graphites, have yielded results in our hands. The iodides and bromides give temporary relief of the tinnitus.

CHAPTER XIII

DISEASES OF THE LABYRINTH AND AUDITORY NERVE

We are here dealing essentially with diseased conditions of the bony and membranous labyrinth and the effect of these diseased conditions upon the finer structures found within the above portions of the internal ear and eighth nerve. We must, however, constantly bear in mind the fact, that these finer structures are simply the nerve terminations, having their origin in distinct brain centers. In other words, that we are dealing with diseased conditions affecting only the end organs but that, while these may be directly affected by local pathological changes, their function can be also indirectly altered by conditions existing, either in the brain centers or at some point or points along the pathways of the eighth nerve leading from these centers to the end organs. For these reasons any consideration of diseases of the labyrinth, which did not embrace a consideration of the tracts leading from the end organs to the brain centers and those leading from the brain centers to the end organs, would give us a very superficial understanding of diseases of the labyrinth and disturbances of its functions.

For a long period of time the ear was looked upon as an organ, the sole function of which was that of hearing, and for this reason the nerve leading from the brain to the labyrinth was called the auditory nerve. At a later period it was understood, in a vague way, that the semicircular canals had something to do with

equilibration. In the earlier text-books on otology very definite knowledge of the auditory function was shown. Even at that period methods of determining the auditory function were practiced and understood, in fact little advance has been made since that time along these lines. Through the work of Flourens, Ewald, Cajal and others, definite knowledge was gradually procured concerning the function of the semi-circular canals.

It was not, however, until recent years that definite tests were discovered, by means of which it became possible to prove clinically the function of the semi-circular canals and the disturbances of this function. The result of these discoveries has proven that, in the semicircular canals and vestibule are found the terminations of the nerve structure which are essential factors in the preservation of body balance. Also, that diseased conditions within the labyrinth can produce, through irritation or destruction of these end organs, very characteristic disturbances.

With this knowledge at hand it is seen that the present-day division of the labyrinth into an acoustic and a static portion is necessary, in order to study and understand diseases of the labyrinth and eighth nerve and disturbances of its function. Further, it can be seen that it is necessary to have a knowledge of the pathways of the eighth nerve leading from the labyrinth, or end organ, to the brain centers, in order to obtain a broad understanding of the effect produced by diseases of the labyrinth and also in order to understand disturbances of the acoustic and static functions. In other words, that these functions of the ear are

dependent, not alone upon the integrity of the end organs, but also upon the integrity of the pathways to these end organs and the centers controlling these. Through the thorough work of Barany, who was the discoverer of the rotation and caloric tests, and through the further excellent work of Jones and Fisher, it has been determined that the pathways leading from the static labyrinth are twofold. One set of pathways passing from the horizontal canal while the other set passes from the two vertical canals. Further, it has been determined that these pathways pass through such important structures as the medulla, pons, cerebellar peduncles, the cerebellum and the cerebrum. Also, it has been determined through a study of the labyrinth, that it is possible, not alone to determine deviations from its normal function, but also, through a study of the reactions, or lack of reactions, produced by means of the rotation and caloric tests, to locate, in many instances, lesions along the pathways. Thus has been added a valuable aid in the diagnosis of many hitherto obscure lesions of the brain stem, the cerebrum and cerebellum.

These subjects, while proving of interest to the otologist, are of an intricate nature and are, therefore, not in place in a volume of this character. For this reason only a general outline of the subject has been given.

Causes.—Conditions causing labyrinthine and auditory nerve disturbances may be of either a local or a systemic nature. Among the principal local causes are the suppurative conditions of the mastoid and middle ear cavity and traumatic conditions such as basal frac-

ture involving directly the labyrinth, or hæmorrhagic conditions within the labyrinth, due to concussion.

Labyrinthitis is one of the most serious complications of suppurative conditions within the temporal bone, the greatest percentage of cases occurring with the chronic suppurative type either by erosion of the bony labyrinth, through the horizontal canal, or by extension of the infection through the oval or round windows.

The systemic causes are various toxæmias, producing a neuritis along the pathways. This occurs in such conditions as influenza, mumps, syphilis, tuberculosis, cardiovascular, gastrointestinal, renal conditions, and the effect of the toxins from foci of infection of the teeth, tonsils or nasal accessory sinuses.

Certain drugs have a distinct action upon the auditory nerve and labyrinth; chief among these are quinine, the salicylates, lead, arsenic, phosphorus, tobacco and alcohol.

Symptoms.—These will depend upon the portion of the labyrinth affected. In lesions affecting the cochlea alone, deafness and tinnitus will result, while in those affecting the vestibule or semicircular canals, vertigo, nausea, vomiting and disturbances of equilibrium will be present. If the entire labyrinth and auditory nerve are affected, this complete train of symptoms may be combined. The vertigo, nausea, vomiting and disturbances of equilibrium will ultimately subside, either through a clearing up of the condition, or, if destruction occurs, these symptoms will disappear through compensation of the other labyrinth. In the early stages of acute invasion of the labyrinth or neuritis,

the symptoms will be of an irritative nature, due to the hyperactivity of the irritated labyrinth. If the condition progresses and destruction occurs, there is an overtonus from the intact labyrinth, so that the symptoms persist until compensation occurs. The differentiation between an irritative and destructive symptomatology is, however, to be made mostly by objective study of the direction of the nystagmus and the reactions to the functional tests.

Temperature and headache are not characteristic of labyrinthine involvement. When they are present it is an evidence of extension beyond the labyrinth to the cranial cavity.

Objectively, in cases affecting solely the acoustic portion of the labyrinth, no objective changes will be noted. In those affecting the static labyrinth, however, a prominent and very important objective sign is the presence of aural nystagmus. (See under Functional Tests.) This is of a horizontal or horizontal rotary type. In irritative lesions it occurs to the diseased side; in destructive lesions to the opposite side. Occurring during the course of labyrinthine diseases, it is spoken of as a spontaneous nystagmus. This will not be constantly present but occurs at intervals. It is markedly increased by looking in the direction of the nystagmus; it is decreased or stopped by looking in the opposite direction. It is accompanied by vertigo of the rotary type, which is not influenced by lying down, but which is lessened when looking in a direction opposite to the nystagmus. As compensation occurs the nystagmus lessens and eventually disappears.

Disturbances of equilibrium are present. The patient tends to fall in the direction opposite to his nystagmus. On account of the intense vertigo, it is impossible for the patient to stand without supporting himself by grasping some object. When the patient is in the recumbent position, he will lie upon the side toward which the nystagmus is directed and turn his eyes strongly in the opposite direction, as, by so doing, he relieves his vertigo to some extent. This symptom also disappears as the condition subsides or becomes quiescent.

Functional Examination.—The results of the functional test will depend upon the part of the labyrinth affected. In those cases affecting only the cochlear branch of the auditory nerve, the acoustic function alone will be disturbed; and in those affecting only the vestibular branch, the acoustic function will be found normal while the static function will be altered. Where the entire labyrinth is affected it will be found that both the static and acoustic functions are altered.

It is highly important, in order to make a thorough examination of any case, to test both the acoustic and static functions. It is not safe, because the patient apparently hears well, to assume that the acoustic function is normal, nor should we neglect to test the static function, because our subjective examination has given no evidence of involvement of the static labyrinth. For this reason the more common tests for both the acoustic and static functions will be considered and the results of these as they occur in diseased conditions of the labyrinth.

Acoustic Function.—In the finer testing with the voice, with tuning forks or with the Galton whistle,

it will be noted that the low tones are heard much better than high ones. For the purpose of the beginner in otology, a fairly accurate conclusion can be reached as to whether the dull hearing present is due to labyrinthine involvement or not ((1) by means of the Weber, Schwabach and Rinne tests, these being applied by means of the Vienna Model A fork. By Weber's test the fork is heard best in the sound ear. Schwabach will show shortened bone conduction, and Rinne's test, bone and air will both be shorter than normal. These results are the direct opposite of those found with lesions of the conducting apparatus. (See under Functional Examination.) There will be a falling off in the perception of the voice, the amount depending upon the degree to which the acoustic function is affected. Here also it will be noted that high-pitched or sharp tones, such as S or T, are heard less readily than the lower pitched vowels such as A or O.

The static function.—Here we make use of the rotation, caloric and galvanic tests. (See Functional Testing.)

In *irritative lesions of the labyrinth* there will be a marked increase in the reactions, while in the *destructive lesions* the reactions will be much less than normal.

Prognosis.—This must be considered both as to the life of the individual and also the function of the labyrinth. In the acute suppurative invasions of the labyrinth, extension to the cranial contents is a frequent complication and, therefore, the prognosis, in this class of cases, is at all times exceedingly grave. Cases resulting from basal fracture offer a poor prognosis, both because of the existing fracture, as well as from the subsequent acute labyrinthine involvement. In

both of these classes, even if the individual recovers, there will be a permanent loss of function.

When the labyrinth and eighth nerve are involved, either directly or indirectly, through systemic causes, the prognosis, as to life, is good but in a large percentage of cases, after the subsidence or control through therapy of the systemic disturbance, the function of the labyrinth will be found lessened permanently or may be entirely destroyed.

The vertigo and other subjective symptoms, which occur in acute labyrinthine involvement, subside gradually, usually within three or four weeks. The tinnitus, which occurs with many of these cases, usually remains and in some cases is the source of great annoyance.

Treatment.—Where the labyrinth has been directly involved by a suppurative extension from a mastoiditis or a middle ear condition, the treatment is operative, this including also the care of the mastoid and middle ear condition or labyrinth. This class of cases is exceedingly rapid in its course and the case should at once be placed in the hands of a competent aurist.

Where the labyrinth is affected by systemic disturbance, drug action, etc., the treatment of the cause is of greatest importance.

This frequently requires the combined efforts of the internist, Roentgenologist, dentist, serologist, bacteriologist and the laryngologist.

Homœopathically in labyrinthine conditions we think of, in the acute conditions, belladonna, cocculus indicus, ferrum phos. and gelsemium.

In chronic degenerative lesions, kali phos., mercurius and strychnia phos.

CHAPTER XIV

THE RELATION OF THE NOSE AND THROAT TO THE EAR

As the influence of enlarged or diseased tonsils and adenoids, catarrhal conditions of the nasopharynx and obstructive conditions of the nasal cavities play such an important part in the production of ear diseases, it is highly important that they should be considered in a work of this sort. Many of these conditions are lost sight of in the consideration of dull hearing, because by the time the dull hearing is produced, the original causative factor has disappeared, as, for example, the disappearance of adenoids at the age of puberty. These may not be looked upon as a factor in the causation of deafness, which comes on at the age of 30 or 35 years and yet, if the history of the individual case is properly studied, the catarrhal condition, which has produced the deafness, can be proven to have had its beginning from the influence of adenoids, enlarged or diseased tonsils, or some of the obstructive nasal conditions. It is our experience that there are many fallacious views, which are rife in the medical profession, concerning the symptomatology of adenoids and diseased tonsils, and we wish, therefore, in this book, to call attention to some of these.

While the catarrhal symptoms produced during adenoids, the cold-catching tendencies, the mouth breathing, the retraction of the drums and dull hearing, subsequently disappear, or become lessened as the adenoids disappear, it will then be found upon careful study that the accessory cavities of the nose and the upper

respiratory tract have become diseased and that a rather chronic condition has been produced with an extension of the catarrhal trouble. The ear conditions, which up to this time have been intermittent in character, due to the fact that the condition in the Eustachian tube and middle ear is in the early stages, now changes in character, and we find pathological conditions in the Eustachian tube and middle ear which result in a more profound and permanent degree of dull hearing.

Adenoids are frequently overlooked in children because of the misunderstanding which the physician has as to the symptoms produced, it being thought that the child with this condition must of necessity have marked nasal obstruction; and many children are passed along as normal because this condition of nasal stenosis does not exist. It is, however, quite possible for a large amount of adenoid to exist within the nasopharynx, if properly located, and still nasal breathing may be perfectly normal. It is also possible for small amounts of adenoids to be present and produce marked changes without a condition of nasal stenosis. This being so, we must have ways of determining adenoids in order not to overlook this class of cases. The determination of adenoids is, of course, readily made by means of digital examination, or by means of a postnasal rhinoscopy, or examination by means of a nasopharyngoscope if the examiner be skilled in these methods, but, as many are not so skilled, it becomes necessary to pay close attention to the clinical symptoms, which, if carefully studied, will become a marked aid in the diagnosis. The child suffering from adenoids may exhibit one or more of the symptoms of this condition, but it

is not necessary for the entire picture to be present in order to suggest their presence. Children with adenoids are subject to frequent colds in the head, these usually disappearing in the warmer months. A certain number are loud or mouth breathers when asleep. They tire easily when at play. They cough frequently at night. They are restless in their sleep, talking in the sleep, often have nightmare. A certain percentage have nocturnal enuresis. Some show high arched palate. Nearly all exhibit intermittently slight or marked dull hearing when properly and carefully tested. If the ear drums are examined they are found to be depressed and dull.

The tonsils, as a factor in the production of ear disease, are very frequently overlooked by the general practitioner, because he bases his judgment, as to the removal of the tonsils, upon the apparent size of these. This is extremely misleading, for a small tonsil may give the appearance of an excessively large one, while a very large tonsil may appear exceedingly small. In order to understand the above statements it is necessary first to describe briefly the tonsil and its surrounding anatomy.

The tonsil lies in the tonsillar fossa which is outlined anteriorly by the anterior arch of the palate—the palatoglossus muscle—and extends from the uvula downward and forward to its attachment in the base of the tongue. Posteriorly this fossa is outlined by the posterior arch of the palate, which is formed by the palatopharyngeus muscle, this extending from the uvula downward and backward and attached to the posterolateral wall of the pharynx. These two muscles

outline a cavity or space known as the tonsillar fossa which, it will be seen, is triangular in shape, the apex of the triangle being at the base of the uvula while the base of the triangle rests upon the tongue. Mucous membrane covers the entire tonsillar fossa. In the majority of cases it will be further found, upon closer observation, that there is a fold of membrane extending from the anterior arch over a varying portion of the tonsil, especially in the lower portion, to the posterior arch. In some instances the entire tonsil is covered by this *plica triangularis*; in others, only a small portion of the base of the tonsil. This *plica* supports the tonsil in its fossa, just as the breast is supported in a sling. To the casual observer, the edge of the *plica* appears to be the edge of the anterior arch and it is due to this fact that so many practitioners believe the tonsil to be small, in that they form their judgment, of the size of the tonsil, by the portion which projects beyond the *plica*. That the edge of the *plica* is not the edge of the anterior arch, can readily be determined by pressing upon the base of the tongue with a tongue depressor, when the palatoglossus muscle, or anterior arch, will be placed upon the stretch; the *plica triangularis* will then be seen extending beyond the line of the arch. If in addition to this the anterior arch is pulled forward by a tonsil hook, some idea of the true size of the tonsil can be gained. Accordingly, then, as to whether the *plica* is present or not, we have either free tonsils or those in which very little *plica* is present or those in which the *plica* is well developed. The fact of the presence or absence of the *plica*, in producing the appearance

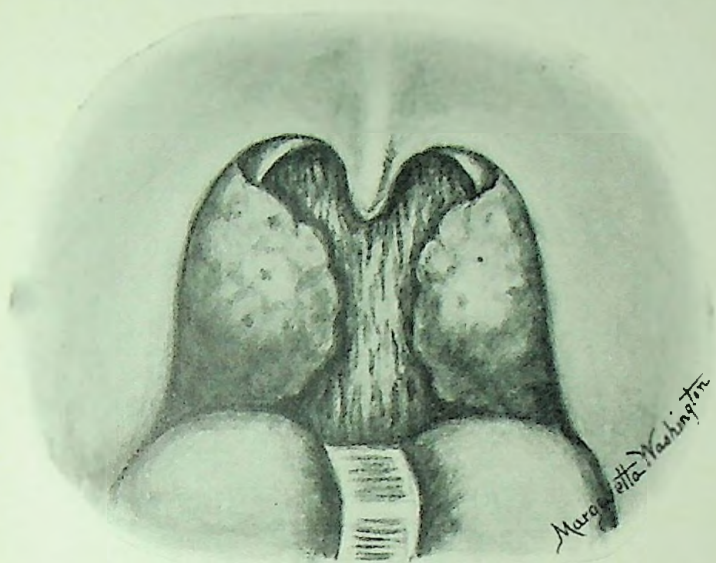


PLATE XVII Large free tonsils. The anterior arches appear sharply defined. As there is no restraining plica, the tonsil extends well into the pharynx.

of small or large tonsils, is shown in the accompanying cuts.

Another fallacy of the profession is the belief that the necessity for the removal of tonsils depends upon their size. As a matter of fact this enters very little into the question of the necessity for removal, except perhaps in those cases where the tonsils are so large that they form a mechanical obstruction to deglutition or to speech. The deciding point is whether the tonsils are diseased or not. In fact, the close observer will often find that exceedingly small masses of tonsil tissue are frequently the cause of most serious local and general infections. The general physician will

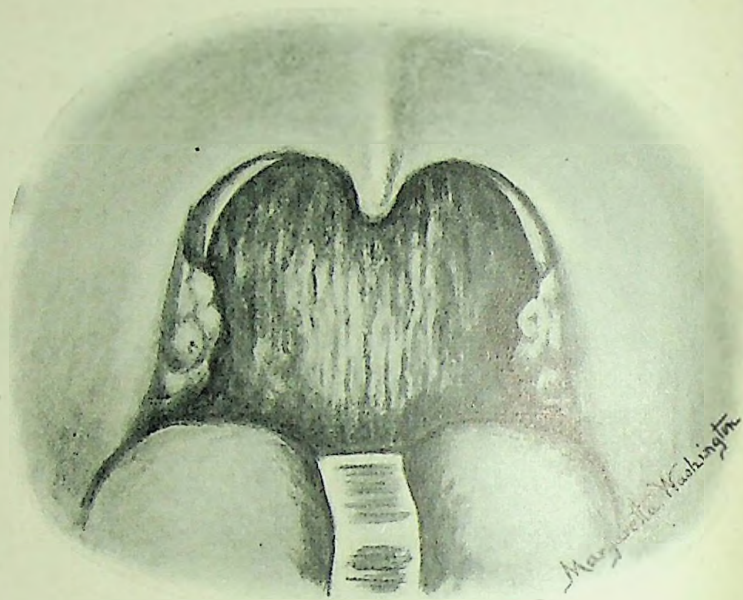


PLATE XVIII. Small free tonsils. The characteristics same as above, but the tonsil is much smaller.

do well to leave the deciding of this matter to the specialist, but he should not advise against removal of the tonsils, simply because of the apparent or real size of these.

A patient may have thoroughly diseased tonsils and still present no tonsil symptoms. It is not infrequent to find, in adults, thoroughly diseased tonsils although they do not in any way complain of these. In such cases it will often be found, upon careful inquiry, that as a child the patient suffered from frequent attacks of tonsillitis. These attacks of tonsillitis probably account for the present diseased



PLATE XIX. Large submerged tonsils. The anterior arches are illly defined due to the presence of the plica triangularis which are holding the tonsils back in the fossæ.

condition of the tonsils, and upon further inquiry it can be elicited that the patient is suffering from toxic symptoms, the origin of which is probably from a tonsillar focus.

The main effect of diseased tonsils upon the ears is due to the local disturbance, the production of catarrhal conditions, which by continuity of structure eventually involve the ears, and to the systemic infection, and its influence upon the labyrinth and eighth nerve. The removal of enlarged tonsils of normal structure is very often disappointing as regards the effect upon the hearing.

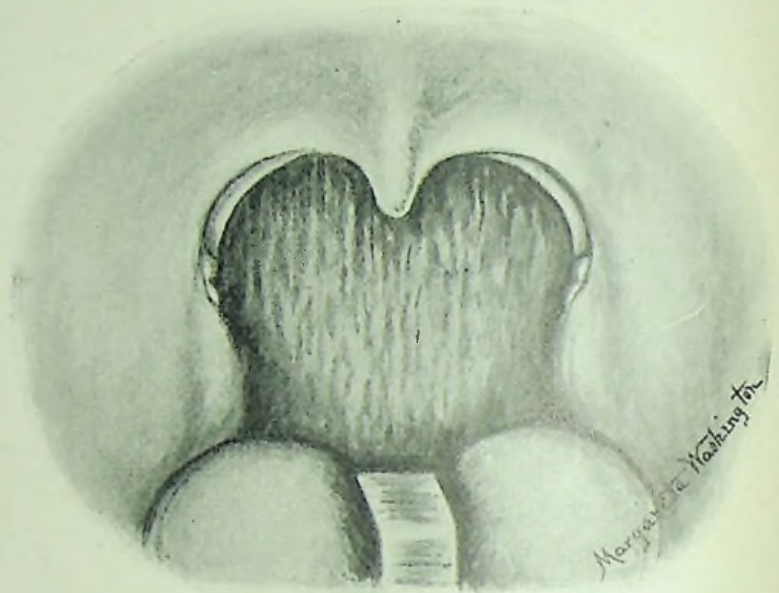


PLATE XX. Small submerged tonsils. The same characteristics as above, but the amount of tonsil tissue much less.

In order to prevent the ultimate results from tonsil infection, it is evident, therefore, that the physician must give careful thought to these cases as they occur in the child, keeping always in mind the possible effect upon the ears and general health.

The obstructive diseases of the nose, such as enlarged turbinates, deviated septa and various conditions resulting in pressure within the nasal cavities, are marked factors in the production of ear disease, so that, in the presence of an ear condition, the presence or absence of such conditions must be determined accurately. Every experienced otologist has seen numerous cases in which the ear condition was very

markedly improved by the correction of a deviated septum or the removal of a hypertrophied turbinate. Chronic disease of the sinuses, especially those cases of catarrhal ethmoidal disease, are marked factors in the production of ear disease. These patients usually exhibit a cold-taking tendency, which disappears when the catarrhal condition or the mechanical obstruction is eradicated.

Hold in mind the fact that the majority of ear conditions occur by continuity of structure, in other words by direct extension of catarrhal or infective conditions by way of the mucous membrane of the nasopharynx through the Eustachian tube. You, therefore, will then realize the importance of clearing up any and all conditions of a catarrhal nature, in order to prevent future occurrence of catarrhal conditions of the ears, resulting in severe and serious embarrassment of the hearing.

DEAF-MUTISM

This condition is dependent upon some lesion of the hearing apparatus either congenital or acquired early in child life which affects the hearing function to such a degree that the speech cannot be learned through the hearing or if the speech has already been learned it disappears. Deafness appearing later in childhood after the seventh year seldom results in loss of speech.

Acquired deafness or deaf-mutism may be caused by affections of the ear, by intracranial lesions and such general diseases as epidemic cerebro-spinal meningitis.

hydrocephalus, scarlet fever, typhoid, diphtheria, variola, syphilis, mumps, rickets, suppuration and injuries to the internal ear. -

Anatomically, congenital deaf-mutism may be caused by bilateral atresia of the external canals, impaired development or absence of the middle ear cavity, changes in and about the labyrinth windows, ankylosis of the stapes and changes in the labyrinthine structures of the eighth nerve, imperfect development of the inferior left frontal convolution and of the island of Reil and atrophy of the superior convolution of the temporal lobe.

The determination of deaf-mutism requires careful observation and experience. A suggestive test of use for the general physician is to stand behind the child to be examined and have another attract the patient's attention. The examiner then strikes a tuning fork close to the patient's ear. If the tone is heard there will be a blinking of the eyelids.

The prognosis is unfavorable.

Treatment.—Cases presenting local middle ear pathology such as suppurative otitis media should receive appropriate treatment as outlined in the chapter dealing with Chronic Suppurative Otitis Media. Cases presenting dull retracted membranes should be examined for tonsils and adenoids, and if deemed necessary these should be removed. Inflation should also be practiced over a period of a few weeks. No time should be lost in placing these little patients in the proper institutions or under proper private instruction. Lip reading and training in speech gives these patients an opportunity of becoming useful and happy.

ARTIFICIAL AIDS TO HEARING

Persons who have lost sufficient of their hearing function to make social intercourse difficult or who are afflicted with a condition that promises to later markedly reduce their hearing should be enjoined to learn lip reading. This practice is yielding splendid results.

Artificial aids to hearing consist of two types. Those which merely collect sound waves and focus them into the external auditory canal, and the electrical instruments in which the sound waves are recorded upon a diaphragm, amplified and carried to the ear through electrical current. Up to this time no one instrument can be placed first as giving the greatest amount of satisfaction to all. It is well for the patient who wishes to use an artificial aid to try out various instruments until he meets with the one best suited to his needs. These instruments do not bring about any harmful results and do not tend to make the hearing lazy as is so often expressed.

HOMŒOPATHIC REMEDIES

The choice of the homœopathic remedy in otological conditions should, of course, be based upon a consideration of the entire symptom complex of the patient, the otological symptoms or conditions being merely a part of complex. The remedies listed below are suggestions based upon clinical application. In many cases closer prescribing through reference to *materia medica* will be necessary.

Aconite 3X.—After exposure to cold winds, chill-

ing of the body, plethoric type of individuals who react energetically and are anxious and nervous. Acute inflammatory reactions of the middle ear, the early stage of an acute otitis media which results from exposure. It is also indicated in frost-bite of the auricle.

Apis mellifica 6X.—Puffy swelling of the auricle with stinging pains which are aggravated by heat and especially late in the day. This puffiness may be confined to the auricle in perichondritis of the auricle, it may be localized or diffused in the external auditory canal as seen in acute otitis externa. It is also indicated in erysipelas of the ear.

Allium cepa 3X.—Shooting pains in the ears and through the Eustachian tube. Active coryza of acrid type associated with much sneezing and copious watery secretion. These symptoms are worse in a warm room and better as soon as the patient goes into the open air.

Arnica 3X.—This remedy is recommended in hæmatoma of the auricle resulting from traumatism.

Arsenicum album 6X.—Dry, scaly conditions of the external canal, in eczema and dermatitis, especially that met with in elderly patients. Usually burning and itching are complained of. In chronic suppurating middle ear disease it is indicated where there is a thin, offensive, excoriating discharge. It is also indicated in hyperæmic conditions of the labyrinth, there being nausea, vomiting and dizziness. Patient's symptoms are worse after midnight, from cold and eating. Better from warmth and with head elevated.

Belladonna 3X.—This is a valuable remedy in otological practice having a very wide field of application

in all acute inflammatory conditions from the external ear to the internal ear. Hæmatoma of the auricle, circumscribed or diffuse external otitis, or otitis media; throbbing, shooting, tearing, throbbing pains associated with roaring, humming and singing tinnitus. The local findings are of acute inflammatory nature—heat, redness, and swelling. The ear drum is reddened and swollen. The patients are usually hyperæsthetic to sound or there may be painful hearing. We have continued this prescription in many cases of acute otitis media after discharge has appeared or until the character of the discharge changes from a serous to mucus. This remedy should not be forgotten in hyperæmic conditions of the internal ear.

Bryonia 3X.—This remedy is applicable in conditions causing a serous effusion into the middle ear cavity, the so-called tubal and tubo tympanic sub-acute processes. The drum head appears pale and dull and may even show some bulging. Frequently these ear lesions are associated with nasal sinusitis of the catarrhal type.

Calcaria carbonica 6X.—This remedy is to be considered in chronic suppurative disease of the middle ear where there is a tendency to the development of granulation tissue and polypi. In this connection *calcaria iodide*, *fluorica* and *sulphurica* must be differentiated.

Calcaria phosphorica 6X.—This agent is applicable to the catarrhal deafness of growing children who also present tardy dentition, are anæmic and show glandular enlargements.

Cantharis 6X.—Vesicular type of erysipelas where

there is great burning and restlessness and better from rubbing.

Capsicum 3X.—A remedy long lauded for mastoid pain associated with discharge from the ear.

Chamomilla 3X.—Valuable in children for earache, whether it be from an inflamed middle ear or reflex from erupting teeth. The irritable, unreasoning, peevish, youngster not satisfied with anything that is done but must be carried about is the ideal subject for this remedy.

Cocculus indica 6X.—Is to be thought of in connection with labyrinthine symptoms such as nausea, vomiting and vertigo. This drug affects the cerebral circulation and nerve centers.

Croton tiglium 6X.—Pustular type of erysipelas with marked itching and great pain.

Ferrum phos. 3X.—The localizing inflammations with burning and pulsating. Inflammatory conditions of the ear of less intensity than where belladonna is indicated. These patients are less sthenic than belladonna patients. This remedy should be remembered in hyperæmic conditions of the labyrinth.

Gelsemium 1X.—Ear conditions which have developed in conjunction with sore throat. Pains shoot from the tonsil to the ear and associated with marked occipital headache. The patient is chilly, creepy, and very much relaxed. The marked action of this drug upon the nervous system should suggest its application in labyrinthine conditions.

Graphites 30X.—Eczema of the external ear. Cracking of the skin with fissure formation. It is also suggested in otosclerosis.

Hamamelis 3X.—Suggested for hæmatoma of the auricle.

Hepar sulph. 3X.—Suppurative conditions of the external canal and middle ear. Suppuration is established and the discharge contains both mucus and pus. Very sensitive to changes of temperature. The cervical glands show early involvement in ear conditions. This remedy has a wide field of application in ear conditions in association with other upper respiratory lesions, such as chronic tonsil conditions and nasal accessory sinus infections.

Hydrastis 3X.—Chronic catarrhal lesions of the middle ear and Eustachian tube. The secretions of the nasal sinuses and nose are thick and yellow. In chronic suppurating ears where the lesion is confined to the mucous membrane and the discharge is thick and yellow, this remedy is indicated.

Kali bichromicum 3X.—Grayish, tough, stringy, tenacious mucoid discharge from the middle ear in chronic suppurative otitis media suggests the use of this remedy when other indications are present.

Kali hydroiodicum 6X.—Fluid in the middle ear as the result of active inflammation of the nose and nasopharyngeal mucosa. It is useful in tubotympanic catarrh.

Kali muriaticum 6X.—This is recommended for the absorption of interstitial deposits resulting from acute inflammations of the middle ear and Eustachian tube as occur in obstructive middle ear disease.

Kali phosphoricum 3X.—The action of this remedy upon nervous tissue suggests its application to degenerative processes of the labyrinth and eighth nerve.

Magnesium phosphoricum 3X.—Indicated in otalgia aggravated by cold and relieved by warmth and pressure. Very often of service in reflex pain in the ear.

Mezereum 3X.—Hypersensitiveness of the external ear to cold wind. Ears feel too open. Difficult hearing. Diplacusis.

Mercurius 3X.—Swelling of the walls of the external auditory canals with greenish, offensive discharge which excoriates the lining. Associated enlargement of the cervical glands. In middle ear suppuration after the acute symptoms have subsided and there follows a stubborn catarrhal activity of the mucosa. Temperature changes aggravate and the sticking pains are aggravated at night.

Mercurius dulcis 3X.—Useful in recurrent ear conditions which follow head colds.

Nitricum acidum 3X.—Hearing is dull but better in a noise. Sensitive to noises. Crackling in the ears when chewing. Splinter like pains in the ears.

Petroleum 3X.—Sensitive to noises. Eczema in and behind ears, with intense itching. Fissures in the external auditory meatus.

Picricum acidum 3X.—Furunculosis of the external canal in persons who are greatly debilitated.

Pulsatilla 3X.—This remedy is indicated in the later stage of acute inflammations of the middle ear tract. The discharge is thick, bland, yellow or greenish mucus. Pains are fitful and darting or jerking. These patients are made worse by heat; they prefer the cool room but feel chilly. There is lack of thirst. There is also the nightly aggravation and amelioration from gentle exercise in the daytime.

Rhus toxicodendron 3X.—Vesicular and herpetic conditions of the external ear. Vesicular erysipelas. Intense itching. Worse from cold, wet weather and better in dry warmth, from motion and changing position.

Silicea 6X.—For long standing chronic running ears. The discharge is foul and scanty and excoriates.

Strychninum phosphoricum 2X.—Is used in the degenerative changes of the auditory nerve.

Sulphur 30X.—Recurrences of external otitis. This remedy is often used as an intercurrent in aural conditions where there is a lack of progress.

Tellurium 6X.—Itching and scaling behind the ears. Eczema about the ears, with acrid discharge from old chronic middle ear disease.

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