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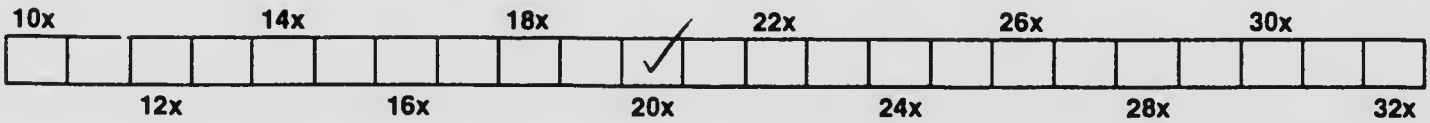

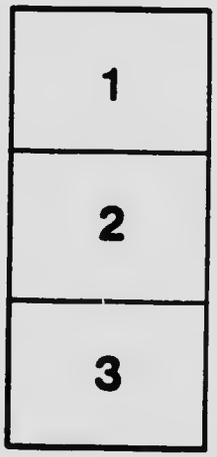

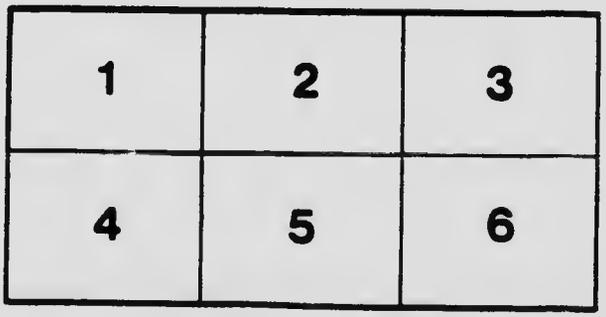

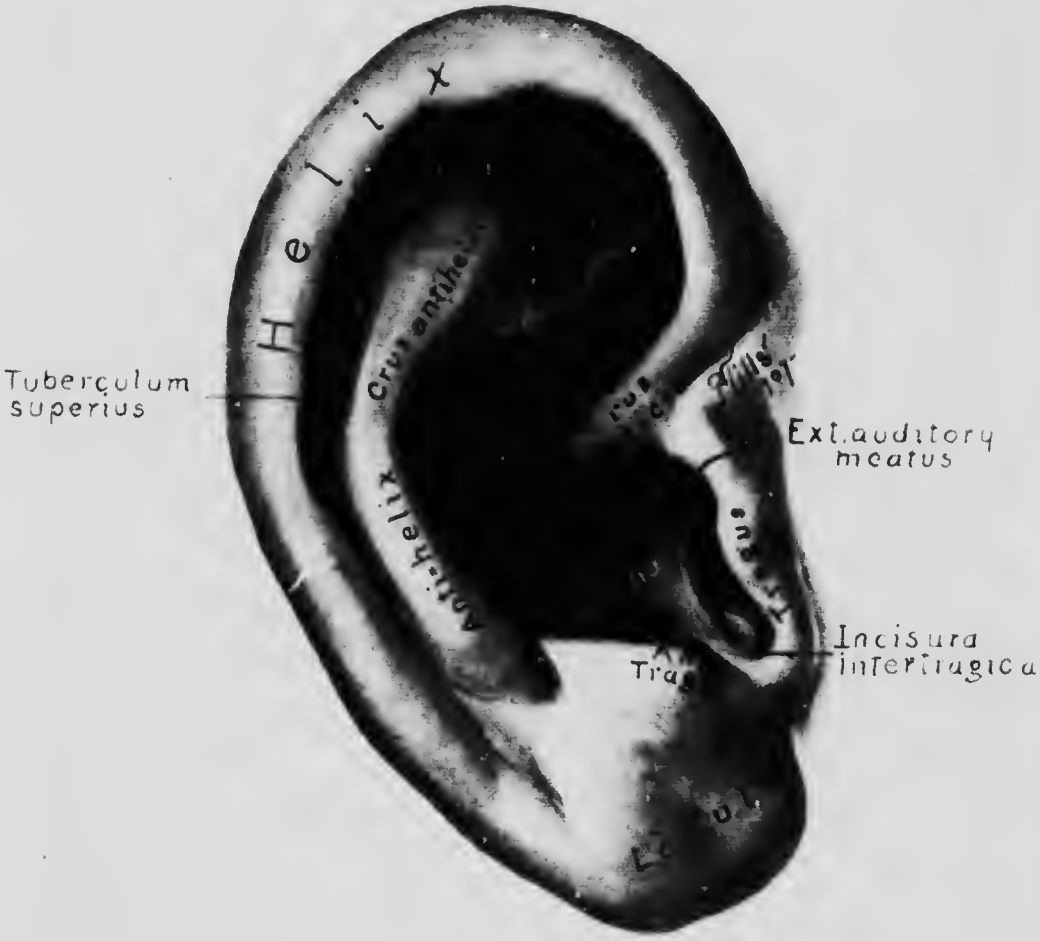
Helix
Tuberculum superius
Ext. auditory meatus
Incisura intertragica

A PRACTICAL GUIDE

TO THE

Examination of the Ear

BY

SELDEN SPENCER, A.B., M.D.

Instructor of Otology in Washington University; Aural Surgeon to the Martha Parsons Free Hospital for Children.

The Auricle (enlarged.)

With an Introductory Chapter

BY

H. N. SPENCER, M. D., LL. D.

Professor of Otology in Washington University.

C. V. MOSBY

Medical Book and Publishing Company

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NIXON-JONES PRINTING COMPANY
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NOTE.

My thanks are due to my father for the introductory chapter, to my clinical professor, Dr. D. C. Gamble, for his kind approval of this publication, and to my colleague, Dr. Eugene Senseney, for the suggestion that there was a necessity for such a treatise.

Dr. Eugene Senseney and Dr. W. Mills have rendered valuable service in making drawings.

2723 Washington Ave.,
St. Louis.

CONTENTS.

PREFACE.

This little book is offered as an aid to students in attendance upon the undergraduate course in otolgy. The hope is also entertained that it may be found useful to many physicians who, from lack of opportunity, have not acquired the experience and skill necessary to conduct an examination of the ear. It is not designed as a work on the anatomy so much as a method of study and the means by which a familiarity with pathological conditions of the ear may be acquired.

Diagnosis is the fundamental part of any branch; and essential to a diagnosis in otology is the ability to make an intelligent inspection of the drumhead, of the tympanic cavity and of the otitic region, as well as the nasal cavities and the pharynx. No one should attempt ear work without this ability; and to the end of aiding students and physicians in acquiring such ability this work is undertaken.

INTRODUCTION.

Specialism in medicine goes back to the beginning of medical history. It was the practice of the Greeks and of the Egyptians, and at no time has it interfered with the unity of medicine, but on the other hand we are able to trace to it whatever advancement has been most substantial and most enduring. The benefit of a part has redounded to the interest of the whole. It must ever be in the interest of progress that this division of labor should be maintained. There was true wisdom in the Hippocratic oath that surgery should be set apart and allowed only to those who make it a business. There was equal wisdom in the contention of John Hunter that surgery and medicine cannot be divorced. Just as the practice of medicine and surgery have been conducted with the full knowledge of their interdependence so the growth of specialism has been fostered and quickened by a knowledge of the interrelation of all the organs of the body. So great has been the advance of knowledge in scientific medicine and scientific surgery—the institution of such diverse methods, required in different regions, and the control of variable technics—that a distribution of labor is more necessary today than ever before. The advance which has been made in otology quite equals that which has been wrought in other departments. In the progress of investigation and clinical study it came to be known that the ear could not be considered as an independent organ. The evidence of ear disease, it was soon found, was often manifested by symptoms which appeared in other and remote regions of the body. Cough, spasm of the glottis, aphonia and asthma, in instances, were relieved by treatment of the ear. Faintness instead of being regarded necessarily as a cardiac lesion *per se*, it was discovered,

might be a reflex irritation due to an aural lesion, and so of nausea and vomiting. Vertigo, visual disturbances and headache, all were found to be common in association with disorders of the ear. Brain complications, as abscess of the brain, meningitis, phlebitis, sinus thrombosis, epilepsy and facial paralysis, were referred to the ear by clinical experience and post mortem examination. The rich supply of nerves to the external and middle ear and the free anostomoses of these nerves when traced out served to solve many and perplexing questions. Through the trigeminal and pneumogastric nerves, branches of which supply the external and middle ear, the stomach, lungs or diaphragm may suffer from reflex irritation induced by so simple a thing as the presence of a foreign body in the meatus, or lesions in the external auditory canal or tympanic cavity. On the other hand it came to be known that most diseases of the ear were the result of infection, directly or indirectly, the consequence of disease processes in other organs of the body or in the system. It is important for the student to learn and for the general practitioner to remember that the great majority of ear diseases have their incipiency in infancy and early childhood. Many of them are closely connected with such general diseases as the acute exanthemata. It is of the utmost importance to bear this in mind for the ear complication is liable to be overlooked, at the moment of crucial importance for the preservation of the hearing, by the medical attendant whose resources are severely taxed in combating the systemic trouble. During the course of any of the acute febrile or infectious diseases frequent and thorough inspection should be made of the ear even though there may be no aural symptoms complained of. The rhinitis of scarlet fever and measles especially predispose to ear trouble of virulent form. In pneumonia and

bronchitis a middle ear trouble may result from the passage of the infectious germ through the blood current to the middle ear or by the condensation of air in the tympanic cavity. Lesions of the ear are as common as lesions of the eye with kidney troubles. In Bright's disease a change in the tension of the labyrinth may be brought about by interference with the general venous circulation. Diabetic patients are commonly affected with eczema of the auricle or furunculosis of the external auditory canal. It would be tedious, as it is unnecessary, to continue this recital so as to include all the diseases in which an ear complication might arise. It is too well known to necessitate a mention of the fact that the syphilitic, rheumatic, tubercular and strumous cachexiae predispose to and unfavorably influence diseases of the ear. I have desired mainly to impress the undergraduate students with the necessity for the place which is given to this branch in the university curriculum.

To refer to the scope of otology and the many interesting problems which are engaging the minds of aurists today would be manifestly out of place in an introduction to this small volume which deals only with the first lessons.

The introductory study of otology contemplated in the undergraduate course of the university is well outlined in the pages of this little brochure. With the extensive curriculum necessary in the teaching of modern medicine it will be readily understood that more than this could not be undertaken even if more might be deemed desirable. The extent of the instruction in this branch is limited, and considering the difficulty of grasping a subject so intricate and so concealed, owing to the anatomical peculiarities of the part, the student, I am sure, will welcome the effort that is here made to assist him. The laboratory training has long seemed to me to require some such elucidation as this.

It is not intended to supplant but to supplement what is to be found in many admirable text books on diseases of the ear. Permit me to repeat: The necessity for some knowledge of the diseases of the ear and an understanding of their relation to other disease conditions is too well understood at the present time to require contention or argument on the part of those who have made special research and have had peculiar experience in this department of physiological and clinical medicine. The reflex phenomena have become better understood and the more immediate relation of the ear to the respiratory and nerve center functions emphasize the importance of this study and demonstrate its necessity to an intelligent practice of medicine. The difficulty of obtaining a clinical picture has been one of the chief hindrances in the way of studying the evidences of otic influence in disease. This can be overcome only through patience. By manipulation and observation the necessary skill will be gradually acquired, and a recognition of this fact is the best protection against the likelihood of venturesome interference. The limitations of the general practitioner will be comprehended and the better informed will be more ready to call into requisition the services of an accredited specialist.

The local and general therapeutics of the ear, the surgery of the ear and the physics of the ear may be considered as beyond the scope of this little volume and as belonging more properly to the post graduation study of this branch. The contributions of comparatively recent surgery to our former knowledge and the great possibilities of cure for many diseases of the ear which we were in the habit of considering incurable, have done much to exalt this branch in the confidence of the profession and has served to place otology in the front rank of recognized specialties.

GENERAL DIRECTIONS FOR STUDENTS.

Each student will be required to make his own diagnosis and will be graded on his work. Of course, due allowance will be made in the beginning for lack of experience. The only instrument which the beginner should use without the permission of the instructor is the speculum. Where any obstruction is to be removed from the external auditory meatus the assistants must first be consulted, and with their permission the students may use such means as these advise. Not even the speculum should be used until the history of the affection has been obtained and the external portion of the ear inspected. A strict observance of this rule will often save the physician from embarrassing experiences and the patient from needless pain.

In addition to diagnosis and ordinary treatment, an opportunity will be given students to witness such surgical procedures as will arise during the term.

The student should familiarize himself with the appearance of the normal drumhead, and the use of the head mirror and speculum, by supplementing his reading with practice on his fellow students.

INSTRUMENTS.

The following instruments will be found in each alcove for the use of the students in this course:

1. A set of three-ear specula, Wilde's.
2. Nasal speculum.
3. Cotton applicator.
4. Sexton's double blunt ring curette.
5. A set of three eustachian catheters.
6. Auscultation tube.
7. Politzer bag.
8. Ear probe.
9. Nasal wash apparatus (Spencer).
10. Spray apparatus (Devilbis).
11. Post nasal mirror.
12. Cotton box (Phillips').

In addition to the above, all solutions used in the clinic will be found on the tables. Each alcove is furnished with a strong artificial light, the McKenzie condensor being used in conjunction with the Wellsbach mantle. The student must furnish his own head mirror. All other necessary instruments for major or minor surgical work, for examinations, or for whatever purpose will, when needed, be furnished the student by one of the assistants. The clinic room is thoroughly equipped.

CHAPTER I.

METHOD OF PROCEDURE (GENERAL CONSIDERATIONS).

A brief history is essential; an elaborate one is unnecessary. We are to learn principally what can be obtained from objective symptoms. Do not place too much reliance on the patient's account. The first question should refer to the present trouble. What has led the patient to seek the advice of a physician? How long has the affection been in existence? What was its apparent cause? If these questions do not bring out a definite description the patient must be questioned as to pain, noises, deafness, and any sensation varying from the normal. If pain is present we should ascertain its location; its character, constant or intermittent; its duration and its severity. At this time it is neither practicable nor necessary to discuss the various causes of tinnitus aurium. The student should be aware that many causes exist extraneous to the ear, and he should only endeavor to find out if the ear itself is affected. In cases where deafness or tinnitus is present the duration, character and apparent cause should be ascertained and the hearing test made. If the patient complains of some peculiar sensation only, a definite description of this sensation should be obtained. In some cases it may be well to inquire as to former treatment, family history, occupation and previous health.

When a student has obtained by interrogation what he deems sufficient information, he should proceed with the physical examination. Make it an invariable rule, both

here and in your after life, always to examine both ears. Do not begin your examination by the introduction of an aural speculum, particularly if pain be a symptom. First of all an inspection of the external ear and the canal must be made. If the canal wall is not swollen or tender, the speculum should be gently introduced and the inspection extended to the entire canal and tympanic membrane, or, if this is lacking, the labyrinth wall. It may be necessary to extend still further this inspection so as to include the parts in the vicinity of the ear. Enlarged glands must be noted; nor should redness or swelling be overlooked. Palpation should be made, and any tenderness on pressure, especially over the mastoid tip, should be observed. Finally, the nasal cavities, pharynx, fauces and teeth should be examined.

This general examination may be augmented with the use of such instruments as the probe and the auscultation tube, to be used at the discretion of the assistant. A description of these will be found in this syllabus.

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CHAPTER II.

THE EXTERNAL EAR.

[illegible]—The auricle is not often the seat of disease but it should be examined for such as may occur. It [illegible] with an eczema, either limited to [illegible] with a similar condition in the external [illegible] may be due to an irritating discharge, [illegible] where there is no discharge. This, [illegible] the skin, will occur in this region [illegible] the points on diagnosis of [illegible] in the skin clinic and so [illegible] Othaematoma [illegible] rare occurrence. It [illegible] appearance. Perichondritis [illegible] to be practically the same [illegible] malformations of the auricle [illegible] recognized.

[illegible] in the neighborhood of [illegible] usually secondary and [illegible] Periostitis and [illegible] will cause swelling and [illegible] will show [illegible] mastoiditis, but the [illegible] are usually much more [illegible] ear will aid us in [illegible] operation is at times [illegible] swelling extends into the neck


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CHAPTER II.

THE EXTERNAL EAR.

THE AURICLE.—The auricle is not often the seat of disease but it should be examined for such as may occur. It is occasionally affected with an eczema, either limited to itself or associated with a similar condition in the external auditory canal. This may be due to an irritating discharge, or it may be present where there is no discharge. This, with other affections of the skin, will occur in this region and will need attention, but the points on diagnosis of these conditions will be obtained in the skin clinic and so need not now occupy our time. Haematoma is of especial interest to the otologist, but is of rare occurrence. It is readily recognized by a swelling, either tense and filled with fluid or very irregular in appearance. Perichondritis is so allied to this condition as to be practically the same thing. New growths and malformations of the auricle must be sought for and recognized.

THE PERIOTIC REGION.—Glands in the neighborhood of the ear may be enlarged. This is usually secondary and the trouble should be traced to its source. Periostitis and abscess in the post-auricular region will cause swelling and marked tenderness. Later on the process will show fluctuation. This trouble simulates mastoiditis, but the general symptoms in the latter case are usually much more severe. The condition of the middle ear will aid us in differentiating, but an exploratory operation is at times necessary. Where mastoid swelling extends into the neck

it usually indicates that some of the products of inflammation have escaped through an opening in the mastoid process. Such an opening may be congenital, or due to the disease. This is called Bezold's symptom. Any sinus in the post-auricular region must be carefully noted. The probe must be used to feel for dead or exposed bone; for a sinus in this locality, associated with destruction in the tympanic cavity, calls for radical procedures; no half-way measures will suffice.

THE CANAL.—Inspection is begun without the speculum, the ear being gently pulled upward and backward to straighten the canal. Marked swelling and redness of the canal walls, an unusual tenderness or some readily recognized condition, as, for example, a protruding polyp may lead us to eliminate the use of the speculum altogether. Where any such condition is present, it must be recognized and stated before proceeding further. If no such condition is present, the speculum should be introduced and the inspection carried out to cover the entire visible portion of the canal and drumhead. What was said of skin affections of the auricle will apply to the canal, but there are some peculiar local conditions that must receive due consideration.

Conditions which are not really pathological may annoy us and hinder our examination; such, for example, as an excessive growth of the vibrissae (the small hairs of the canal), soft wax, which piles in front of the speculum (if it is introduced before the canal has been wiped out), or a narrow or tortuous canal may make it difficult to see but a small portion of the drumhead. Before dealing with the pathological conditions of the canal we must consider the

subject of foreign bodies. All sorts of objects are reported as having been found in the external auditory meatus, and we must continually bear in mind the possibility of the presence of a foreign body, though these cases are by no means frequent. Examination by inspection is of the greatest importance in these cases. Too much reliance must not be placed on the history given by the patient, for it frequently leads us to believe some foreign body present when the examination discloses a very different trouble. Our inspection may have to be augmented by the gentle use of the probe to determine the character of the object and the best means for its removal. The kinds of bodies and the methods of removal need not be dwelt on; a warning as to the possible presence either with or without such history is all that is necessary here, but the necessity for a careful examination must not be forgotten.

CHAPTER III.

DISEASES OF THE CANAL.

IMPACTED CERUMEN.—Of the pathological conditions in this locality impacted cerumen is perhaps the commonest. The diagnosis is not difficult. The cerumen is seen as a brown mass, and the use of the blunt ring curette will confirm our diagnosis and give us valuable information as to the consistency of the mass, which may vary from a soft paste to a dense hardness. Sometimes a small quantity of cerumen, the size of a garden pea, will lie close to the entrance and fill the lumen, giving the appearance of a canal entirely filled with cerumen. Epidermal flakes mixed with cerumen may simulate the appearance of impacted cerumen; and this may be small in quantity and easily removed, or it may block the entire canal. Still another condition, at times similar in appearance but far more difficult of removal, is what is termed *keratosis obdurans*. This has been described as a "laminated epidermal plug, consisting of desquamated cells arranged in layers concentrically." The student should differentiate between these conditions by gentle and proper use of the blunt ring under the guidance of the assistant. A small quantity of cerumen lying near the orifice will be easily removed by the curette; if the canal is filled with cerumen we can learn in a moment by such use of the ring, whether it is soft or hard of consistency, and whether we should at once resort to the syringe or not. If the mass be keratosis obdurans we will dis-

cover the scales and the white appearance underneath the covering of cerumen and will recognize its denseness.

Diffuse External Otitis.—Before turning our attention to the diseases of the middle ear, there remains a word to be said concerning the various forms of external otitis. The presence of a diffuse inflammation in the external auditory meatus must be recognized and classified. There are several types of such inflammation. For example, there may be simply a diffuse redness and swelling of the skin; an exudate with this; a tendency toward granulation; or a desquamative process. If a diffuse external otitis is associated with a suppurative condition of the middle ear, it is in all probability secondary to it. If, however, we can eliminate a middle ear affection by the appearance of the drumhead, or by proving that no perforation is present and that the hearing is good, we can be sure that the disease is limited to the external ear, and that the secretion is an exudate from the inflamed skin. But it is no easy matter to determine whether such a disease is acute or chronic.

A form or a complication of diffuse external otitis is the parasitic affection known as otomycosis, due to the aspergillus. There are several varieties named in Latin terms, according to the color; for example, niger, flavus and so forth. By the fuzzy, powdery appearance, the diagnosis may usually be readily made; and this may be confirmed by the microscope.

Circumscribed External Otitis.—Furunculosis is of fairly common occurrence and is not difficult to recognize. In these cases the pain is severe, and such a history will lead us at once to be on the outlook for this condition. On

raising the auricle gently—and this will be painful—and looking without a speculum into the canal, it will be found swollen and often occluded by the swelling. Gentle pressure over the tragus will show the sensitiveness of this region. If it is necessary to differentiate this from a middle ear affection the hearing test may be of some value; but it sometimes happens that the middle ear is intact, although the canal is much swollen and the hearing greatly affected. There is usually little difficulty in making this differentiation.

What has been said concerning ordinary skin diseases, as these relate to the auricle, applies in a large measure to the canal.

Exostosis.—This is of comparatively rare occurrence. The bony growth is an osteoma, and may be either diffuse or pedunculated, and may obstruct the canal to a more or less extent. Suppurative otitis media may, or may not be present.


fig 3.

CHAPTER IV.

THE MIDDLE EAR.

The canal having been inspected, the ear drum next calls for our attention. The student must always be able to tell whether or not he sees the tympanic membrane, and if not why not. Is the view obstructed? If so, in what way? If the view is not obstructed, and the ordinary landmarks of the drum membrane cannot be seen, the student must again question himself as to the reason. Is the drumhead itself partly or wholly destroyed? Or is it so distorted by inflammatory [illegible] that one is unable to recognize [illegible]? If the membrane is present, we must be able not only to say how we know that it is present. We must describe its appearance and be able to name those points which I have referred to as "landmarks."

PLATE III.

Normal drumhead (enlarged).

Structure.—The drumhead is oval in shape and [illegible] obliquity, the upper and posterior portion being [illegible] to the eye of the examiner than the anterior and inferior portions. The following landmarks must be looked for and noted. The short process of the hammer, which is [illegible] the upper anterior portion, leading downward and [illegible] from this, terminating in the middle point, which is called the umbo, is the handle of the hammer (or malleus), leading downward and forward from this is the so-called [illegible] light spot, or cone of light. From the [illegible] which run forward and backward. These are the anterior and posterior folds. That portion of the drum

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NORMAL DRUMHEAD.—The drumhead is oval in shape and is set obliquely, the upper and posterior portion being nearer to the eye of the examiner than the anterior and inferior portions. The following landmarks must be looked for and noted: The short process of the hammer, which is found in the upper anterior portion; leading downward and backward from this, terminating in the middle point, which is called the umbo, is the handle of the hammer (or malleus); leading downward and forward from this is the so-called triangular light spot, or cone of light. From the short process folds run forward and backward. These are the anterior and posterior folds. That portion of the drum

above the folds is called Schrapnell's membrane, or the membrana flaccida, and the portion below is called the membrana vibrans. The color of the membrane is a pearl grey. In locating the landmarks just cited, make it a point to look first for the short process of the malleus, as it is the most constant, and all the other points can be traced in order from it.

Abnormal Conditions.—Before taking up the different diseases that may occur in the middle ear, it will be well to consider in a general way how the appearance of the drum membrane and the visible parts of the tympanic cavity may vary from the normal. These differences must be noted and their significance stated. What has caused these conditions, and what bearing they have on the diagnosis will be more fully discussed when considering the different diseases of the middle ear. Where no destruction of tissue has occurred, the commonest variation from the normal appearance will be in the color and luster of the membrane. It may be whiter and lusterless and have the appearance of being thickened, or it may be darker in color and almost as transparent as glass. More often in acute cases, but even in chronic cases, it may be red from congestion and inflammation. White, chalky spots are often seen, and scars of old perforations must not be overlooked. In addition to these discolorations of the membrane, we can find distortions and absence of the landmarks; where there has been no destruction of tissue, we often find the landmarks invisible on account of swelling and congestion of the membrane, or we find certain features accentuated, as when the short process is particularly prominent in cases where there is a marked retraction (or drawing in) of the drumhead. In

these cases the light spot is most often wanting or interrupted, and the handle of the malleus is foreshortened. The folds running from the short process are also prominent in these cases. Where there has been destruction of tissue we may find almost any amount of loss from a small perforation to an entire absence of the drum membrane, and even the ossicles and bony wall.

General Classification.—In giving a diagnosis of a middle ear condition, the examiner must first of all say to which of the following three main classes it belongs: suppurative, non-suppurative or post-suppurative, and, further, whether it is acute or chronic. A suppurative otitis media is an inflammation where pus is present in the middle ear, and can be recognized by the presence of a perforation. Before the membrane has perforated, it will be sufficient to diagnose acute conditions, simply as acute otitis media, and as in the purulent form a paracentisis will be indicated, the diagnosis will not be long in doubt. A non-suppurative case is one where no pus is present, either in the middle ear or in the canal from the middle ear, and where the drumhead is intact. A post-suppurative case is one where there are visible evidences of destruction of tissue due to a suppurative process. If a patient gives a definite history of previous suppuration, but no visible evidences of it are present the condition should not be called a post-suppurative one.

CHAPTER V.

THE MIDDLE EAR CONTINUED—NON-SUPPURATIVE CONDITIONS.

ACUTE NON-SUPPURATIVE OTITIS MEDIA.—In acute affections of the middle ear where there has been no perforation, the cardinal signs of inflammation will be present to a more or less degree. In the earliest stage the disease may be limited to the eustachian tube; indeed, a tubal catarrh or a eustachian salpyngitis may be a disease per se. The diagnosis in this stage is rather difficult, for the symptoms are not well marked. Deafness will be slight and pain will not be severe. The appearance of the drumhead may be slightly changed. There will be some retraction which will be recognized as described above, but it will be much less marked than in the chronic form of middle ear catarrh. The redness in these cases is limited to the line of the handle of the hammer and Schrapnell's membrane. However, such a hyperemia is so often produced by the manipulation, unless the examination is very carefully carried out, that we must be sure to eliminate this cause before attaching to it any significance. When the inflammation has extended to the middle ear all of the symptoms will be more marked. The membrane may be congested and severe pain and impairment of hearing may be associated with it. Where there is bulging of the drum membrane associated with deafness, pain and redness, there is fluid in the middle ear cavity; but it is not possible to state positively whether

this fluid is of a purulent nature or not, so that a diagnosis of acute otitis media is sufficient. Where severe pain and bulging are present a paracentisis is imperative, and it is advisable wherever bulging is at all marked. Pus may or may not be found. Milder measures may be used where the redness, swelling and pain are less severe.

Serous Effusion In Tympanic Cavity.—Another of the acute conditions found without perforation is effusion of a mucous or serous exudate into the middle ear. The diagnosis in such cases is comparatively easy. When the effusion is not so profuse as to cause bulging, or to fill the entire cavity, the line of the fluid will be plainly visible; this line will remain horizontal, and so its relation to the landmarks of the drum membrane will change as the patient tilts the head backward or forward. Inflation by the Politzer method or the catheter dispels this line and a foamy or bubbly appearance is the result. On auscultating with the rubber tube during inflation the characteristic bubbling sound unmistakably informs us of the presence of fluid. The subjective symptoms associated with this condition are impairment of hearing, noises and a disagreeable full feeling in the ear. Pain is not usually a symptom.

Chronic Non-Suppurative Otitis Media.—Subjective symptoms here vary in all degrees of deafness, with tinnitis aurium or peculiar sensations in the ear. The appearance of the drum membrane is of importance in all pathological conditions of the middle ear, but in this class of cases its significance must not be overestimated. It must be remembered that persons with practically normal hearing may show changes in the appearance of the drum, and we must consider the subjective symptoms of more import in this

class of cases than in others. The hearing tests will, of course, be of greatest importance. Where the subjective symptoms above referred to are associated with a drum membrane which is markedly retracted with thickening or atrophy of the membrane, a diagnosis of chronic catarrhal otitis media may be made. Where the appearance of the drum membrane is practically normal, and the subjective symptoms are as above stated, our diagnosis will be otosclerosis, provided the eustachian tube and the naso-pharynx are normal.

Where there is a markedly thickened membrane a diagnosis of hyperplasia may be made. Let us recapitulate the kinds of chronic non-suppurative otitis media and our mode of diagnosis.

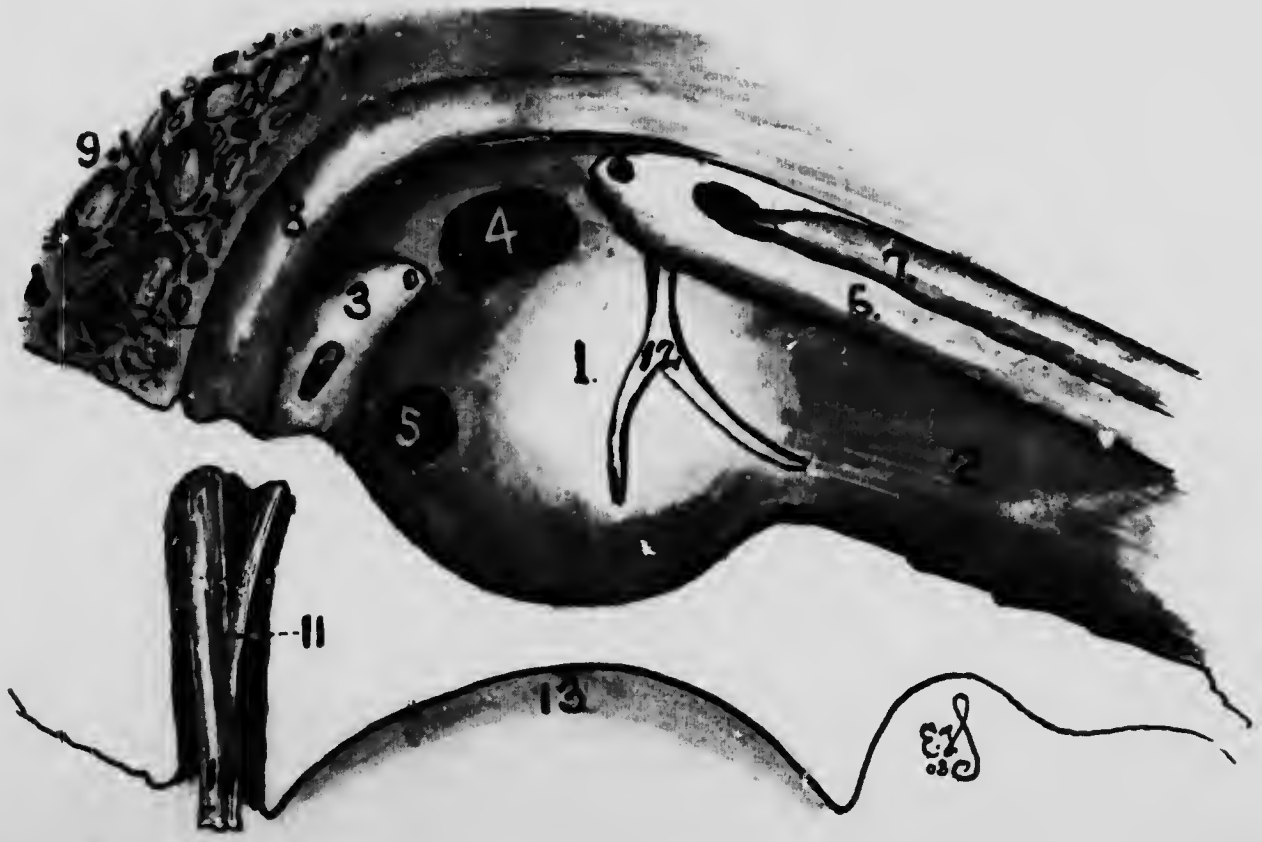
Otitis Media Catarrhalis Chronica.—Retraction marked, thickening or thinning of the membrane, deafness, tinnitus may or may not be present, and in association with these symptoms of a middle ear condition we find pathological changes in the nose or naso-pharynx, and more or less obstruction of the eustachian tube.

Hyperplasia.—Thickening, some retraction, tubal obstruction not marked.

Otosclerosis.—More nearly normal appearance of drum membrane and naso-pharynx; subjective symptoms the principal basis of diagnosis.

Without going too deeply into this subject I will mention the value of auscultation by means of the eustachian catheter and the tube. The auscultation sounds are difficult to describe and familiarity with them is only obtained by practice. The effect of catheterization on hearing should be noted, and it should influence our prognosis.

Siegel's otoscope will also aid in making our diagnosis.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CHAPTER VI.

DISEASES OF THE MIDDLE EAR CONTINUED—POST-SUPPURATIVE CONDITIONS.

Post-suppurative Conditions of the Middle Ear.—A post-suppurative condition is recognised by scars on the membrana tympani, or absence of a part or all of the membrane. The membrane may have been almost totally destroyed and a false membrane may have been formed; indeed, the membrana may be entirely wanting, the ossicles also lacking.

PLATE IV

View of [illegible] tympanum (chronic suppurative

1. Promon[illegible] 2. [illegible] 3. Tympanum, and
Oval [illegible] 6. [illegible]
form[illegible] 7. [illegible]
Fallopi[illegible]. [illegible]
tympan[illegible] evidence. Where
fossa [illegible] may be of almost any
[illegible] to be given it as such after a
[illegible] to whether a spot is
[illegible] a scar, we can readily recog-
[illegible]. If, however, the
[illegible] doubt, even
[illegible] and are get-
[illegible] cavity, we can place
[illegible] in a glass of water, and if
[illegible] will rise in the water as
[illegible] will also be of value in mak-

CHAPTER VI.

THE MIDDLE EAR CONTINUED—POST-SUPPURATIVE CONDITIONS.

POST-SUPPURATIVE CONDITIONS OF THE MIDDLE EAR.—A post-suppurative condition is recognized by scars on the membrane, or absence of a part or all of the membrane. The membrane may have been almost totally destroyed and a new membrane may have been formed; indeed, the membrane may be entirely gone and the ossicles also lacking. Of course, where such a condition is the result of operative procedures we can only learn of that from the patient, and we cannot be positive even from the history whether the operation was performed in a suppurative or non-suppurative case. Histories are not always reliable. In such cases the landmarks of the drum membrane will be lacking, and those of the labyrinth wall will be in evidence. Where the ossicles are still present the scar may be of almost any size. It is usually easy to recognize it as such after a little practice, but if we are in doubt as to whether a spot is still an unclosed perforation or a scar, we can readily recognize which it is by inflation and auscultation. If, however, the auscultation sound should leave us in some doubt, even though we are sure that we have located the tube and are getting air through it into the middle ear cavity, we can place the free end of the auscultation tube in a glass of water, and if a perforation be present air bubbles will rise in the water as we inflate. Siegel's otoscope will also be of value in mak-

ing our diagnosis. Before taking up the suppurative conditions of the middle ear, a word should be said about the appearance of the inner wall of the tympanum, as seen when the drum membrane and the two larger ossicles are lacking. If covered with epithelium the color may simulate that of the drum membrane, but when an active suppurative process is present the color is usually a vivid red. The anterior and central portion of what we now see is a convex surface, which is called the promontory. Above and posteriorily may be seen the long process of the incus articulating with the head of the stapes, which bone is inserted in the oval window. The chorda tympani nerve which passes over this process of the incus, is sometimes seen through transparent drum membranes, but where there is enough destruction of tissue to bring its position into view, it is itself destroyed. Behind the promontory below is seen the niche of the round window. Even though the drum membrane be completely removed, these landmarks may be obscured by granulation tissue or the swollen and hyperemic condition of the wall.

CHAPTER VII.

THE MIDDLE EAR CONTINUED—SUPPURATIVE CONDITIONS.

General Classification of Suppurative Otitis Media.—In considering suppurative conditions of the middle ear, we must divide these affections primarily into: first, acute cases; second, chronic cases. This classification is, however, an arbitrary one, and the dividing lines are not well defined; it must not be forgotten that there may be acute exascerbations of chronic cases. In making a diagnosis, then, the first thing to be said is whether, in so far as we can tell, we are dealing with an acute or a chronic condition. But when we have made this statement we have only begun, and such a diagnosis will not be accepted as final. Suppuration is not a disease of itself but the result of a disease. The presence of pus in the ear is only a symptom. This is notably true of chronic cases. In acute cases where there is nothing more than a suppurating mucous membrane present, the disease of the mucous membrane may be idiopathic. In classifying, then, as to acute or chronic cases, if we take duration as a guide, we may approximately place six weeks as the dividing line, and say that those cases of longer standing than this are chronic, and those of six weeks or less are acute. But such a classification is of very little practical worth, and the best rule for determining whether a case is acute or chronic, is to call all cases chronic in which the perforation is large enough to be

gaping and plainly visible. Even this rule is not constant, as often a great destruction of tissue may take place in very virulent cases of only a few days' standing, as in scarlet fever, for example. On the other hand, a case may have existed for the period of a year or more with small destruction of tissue, particularly in cases where there is some obstruction of the eustachian tube. In these cases, however, the perforation will usually be visible; and in the cases of a few days standing, with marked destruction of tissue, it will suffice to call them chronic for diagnostic purposes. As a rule, the history coupled with the appearance will enable us to make a diagnosis of the case readily, though sometimes more than one examination may be necessary. We must always remember not to lay too much stress on the history given by the patient.

A good working rule is that all cases with a plainly visible perforation may be considered chronic, and cases with a perforation which can only be seen with difficulty as during inflation, are acute. The beginner must be careful not to fall into the error of taking redness as an indication of an acute condition. Acute and chronic cases may be further subdivided with reference to the treatment into: first, operative cases, and, second, non-operative cases.

CHAPTER VIII.

THE MIDDLE EAR CONTINUED—ACUTE PURULENT OTITIS MEDIA.

Classification of Acute Purulent Otitis Media.—In acute cases where there has not been a perforation the appearance closely resembles the acute catarrhal condition, and the indications for treatment and surgical interference have been referred to under that subject, so that nothing further need be said. If a paracentesis has been performed, or spontaneous rupture has occurred and we have determined that the case is an acute one, we must decide whether or not any further operative measures are necessary. Whether the case is surgical or non-surgical must be part of the diagnosis. The correction of any pathological or abnormal condition in the nose or nasal pharynx, whether by treatment or operation, is of the greatest importance in these cases; but this subject is particularly treated in the nose and throat department. In acute suppurative otitis media, there are practically but two operations to be considered, namely, the simple extension of the perforation, and the mastoid operation. Indications for the mastoid operation, briefly stated, are: any symptom pointing to intra-cranial complication, pain and tenderness lasting over two days in the mastoid region, or lasting tenderness without pain. This is, of course, the briefest possible statement, and in actual practice other things must govern us in our choice of treatment. The micro-

scope, the clincical thermometer and the blood count, will give us valuable hints. Where a trouble practically acute, as to objective symptoms, persists, the mastoid operation might be indicated without any of the above symptoms, but I believe that to be of such rare occurrence as to be hardly worth mentioning, for if such a case were kept up by some condition in the nose, or naso-pharynx, the correction of this would hasten its cure, and it could hardly be kept up by any condition in the middle ear without having to be classed as a chronic case. Granulations occasionally arise in acute cases, and when present should be removed or cauterized. Of the extension of the perforation it is enough for the purposes of this sylabus to say that it is indicated when the perforation present seems inadequate for proper drainage.

CHAPTER IX.

THE MIDDLE EAR CONTINUED—CHRONIC PURULENT OTITIS MEDIA.

Classification of Chronic Purulent Otitis Media.—If the trouble is classified as chronic, we should first ascertain whether there is or is not bone involvement. In chronic cases where the bone is not involved, the surgical work is much the same as in acute cases. There will be necessary work in the nose and naso-pharynx, and there may be granulation to be removed. An extension of the infection to the mastoid cells being in evidence their opening would be called for. The symptoms that would indicate the necessity for such measures would be those mentioned under acute cases; indeed, it would probably be an acute axascerbation of a chronic mastoiditis. Where no acute condition is present, the indication for the mastoid operation would necessarily be very indefinite. If a chronic purulent process has continued for a long period in spite of the removal of all nasal obstruction, and the discharge is profuse, the opening of the mastoid antrum may be justified; but such cases are very rare, especially where there has been proper treatment.

When the bone is involved the diagnosis becomes an even more important and complicated matter, and the determination of what surgical interference is necessary, if any, is a matter for serious thought.

The appearance of the parts will materially aid us in our diagnosis. The location of the perforation and the ex-

tent of the perforation are the first things that engage our attention. Granulations and polypi must always be removed. These interfere with the complete diagnosis and constitute an obstruction to free drainage. Where there is no bone involvement the perforation is most probably in the anterior portion of the drum, or, if posterior, it will be situated rather inferiorily (inferior-posterior quadrant). It is most often just at the aural end of the eustachian tube. When the position of the perforation approaches the bony connection of the drum membrane it suggests bone involvement. The location of the perforation in these conditions will give us a hint as to what this bony involvement is. For example, when we find the drum membrane intact except for a perforation in Schrapnell's membrane (a. b. c.), we may be sure that the seat of the trouble is in the attic. If the perforation is in front of and above the short process of the malleus (c.) the head of the hammer is alone involved; if behind the short process in the membrana flaccida (b.) the body of the incus is affected; if directly above the short process of the malleus (a.) most probably both ossicles are carious. When the perforations in the flaccid membrane extend to the periphery, there exists most probably caries of the bony wall of the attic. In connection with a perforation in Schrapnell's membrane there may be a perforation in the membrana vibrans. Where there is no perforation in the flaccid membrane the location of the opening in the vibrating membrane has also an important bearing on the location of caries. If the perforation is in the upper posterior quadrant (d.) it indicates caries of the long process of the incus. When a great kidney-shaped perforation exists through which the handle of the hammer protrudes from above

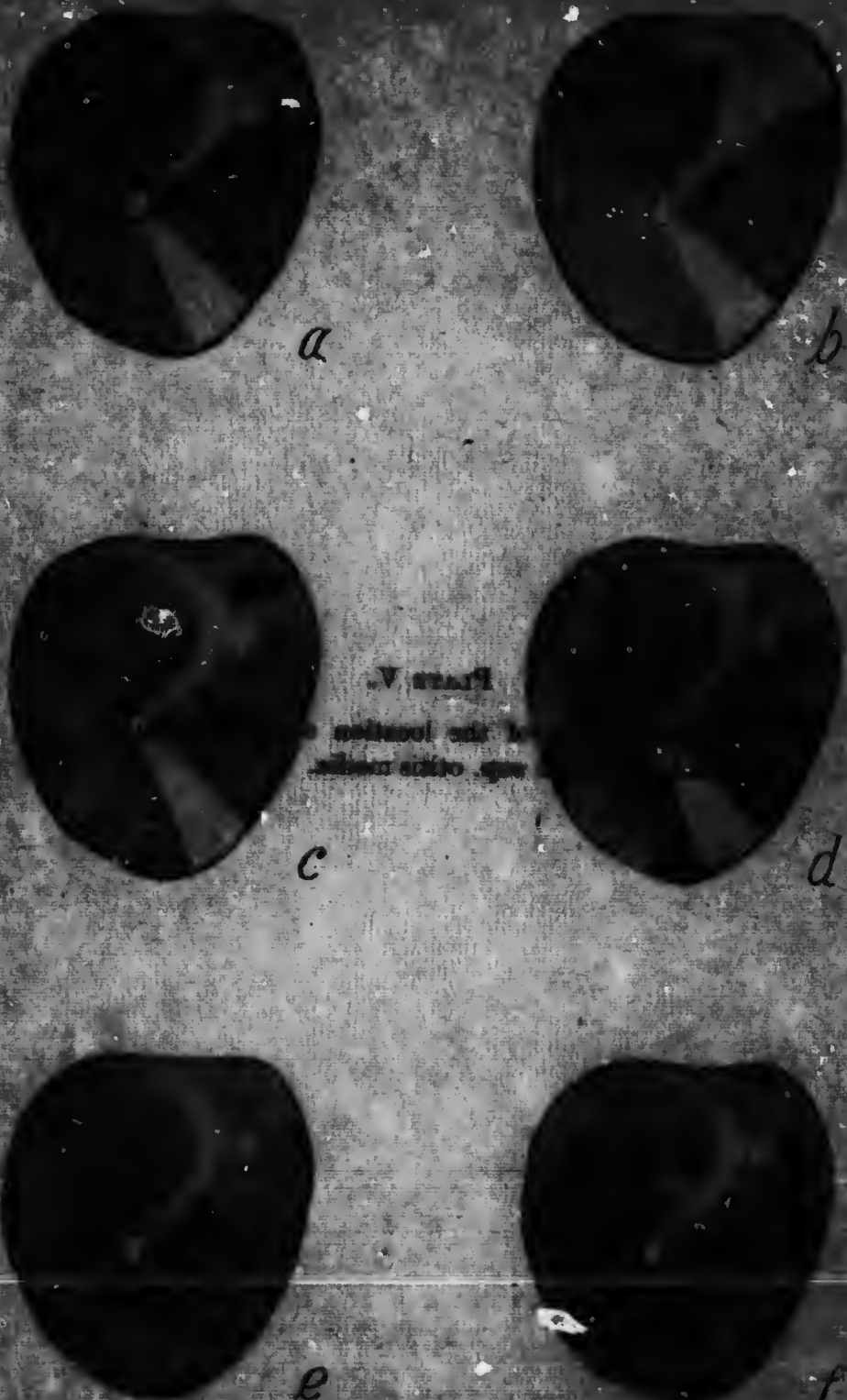
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PLATE V.

Diagnostic value of the location of perforation in Schrapnell's membrane.

of and above the short process of the malleus (c.) the head of the hammer is alone involved; if behind the short process in the membrana flaccida (b.) the body of the incus is affected; if directly above the short process of the malleus (a.) most probably both ossicles are carious. When the perforations in the flaccid membrane extend to the periphery, there exists most probably caries of the bony wall of the attic. In connection with a perforation in Schrapnell's membrane there may be a perforation in the membrana vibrans. Where there is no perforation in the flaccid membrane the location of the opening in the vibrating membrane has also an important bearing on the location of caries. If the perforation is in the upper posterior quadrant (d.) it indicates caries of the long process of the incus. When a great kidney-shaped perforation exists through which the handle of the hammer protrudes from above

a

b

c

d

e

f

(e.) the handle itself is carious. Where there is a large defect (f.) with granulations in the upper posterior portion, or where a drop of pus persists in this locality, even after it has been mopped off, caries of the incus exists. In addition to the defects of the drum there may be an entire absence of all visible portions of the ossicles, and more or less of the outer attic wall may be lacking. It is important to note the presence of cholesteatoma and the presence and location of granulations. The diagnosis is made from the appearance of the middle ear, and may be confirmed by the probe, which enables us readily to feel the portions of bare bone.

CHAPTER X.

THE MIDDLE EAR CONTINUED—OPERATIONS IN CHRONIC SUPPURATIVE OTITIS MEDIA.

It will be sufficient to mention briefly the operations that may be indicated, and to state in the briefest possible way what may call for any of these operations.

1. THE SIMPLE MASTOID.—We never use the simple mastoid operation in chronic cases, for where such an extensive operation is indicated, we deem it inadvisable to stop short of the radical. However, lately a compromise operation between the simple mastoid and the radical has been advised in some cases to conserve the hearing, for this purpose leaving intact as far as possible the drum membrane and ossicles, though removing the posterior superior wall of the canal.

2. OSSICULECTOMY.—When either of the ossicles are carious in a long standing trouble, or when they are an obstruction to drainage, if the case has not yielded to more conservative treatment, the ossicles may be removed before resorting to more radical measures. The removal of these may aid hearing where deafness exists in post-suppurative cases; but too much should not be promised, as such is not always the case.

3. EXENTERATION OF OUTER ATTIC WALL.—When the involvement seems more extensive than just mentioned, but the radical is not positively indicated, we may remove

the outer attic wall in conjunction with an ossiculectomy in the hope of attaining a cure, or we may perform the simple Stacke operation.

4. THE RADICAL MASTOID.—As to the radical, the indications may be divided into the positive and the prophylactic. The positive indications are those where threatening symptoms of intracranial complications are present. The prophylactic indications may be divided into the absolute or imperative, and the expedient. The absolute indications are those where the operation is positively required for prophylactic reasons, for example, where there is present an old bony sinus, or a sequestrum of great extent, or large masses of cholesteatoma persistently recurring. The expedient indications may be defined as being those wherein, after reasonable trial, all palliative methods have failed, and the operation seems expedient to arrest the further course of the disease. There is much difference of opinion as to when these various operations are indicated. Indeed, the subject does not admit of any general rule. It requires careful, conscientious thought as to what is the patient's best interests.

NOTE.—This hand-book is for the purpose of acting as a guide to attain a general knowledge of ear work, and not in any way to supplant the regular text-books on the subject, or to equip a finished specialist. To what has been said on physical examination of the ear will be added a brief description of work on the cadaver, or separate temporal bones, a word concerning intra-cranial complications and a few rough hearing tests.

CHAPTER XI.

THE INTERNAL EAR.

Only a few words need be said in regard to the diseases encountered in this region, and points in diagnosis.

LABYRINTHITIS.—Primary inflammation of the labyrinth is very rare. The symptoms are those of meningitis in a milder form and running a shorter course. Secondary inflammation of the labyrinth, both in suppurative and non-suppurative cases, will be often met with and must be looked for; it occurs much more frequently in chronic than in acute forms of middle ear disease. In non-suppurative conditions of chronic otitis we will rely largely on the hearing tests to determine whether the labyrinth is affected or not. In suppurative processes we will find sudden internal ear deafness associated with tinnitus and vertigo, and symptoms similar to those of cerebellar abscess, developing during a middle ear suppuration.

ANEMIA AND HYPEREMIA OF THE LABYRINTH.—These are rather symptoms of general conditions than diseases of themselves.

MENIERE'S DISEASE.—Meinere's disease is occasionally met with. The diagnosis is comparatively easy. The principal point is the sudden onset of the symptoms, which are vertigo and tinnitus associated with a high degree of deafness, and these by all tests will prove to be limited to the internal ear.

SYPHILIS OF THE INTERNAL EAR.—The deafness in this condition will be constant, and it will have come on suddenly without any middle ear disease preceding it. The history of the case and other evidences of the existence of syphilis will aid us in our diagnosis.

Labyrinthine diseases associated with deafness may be recognized by the tests for hearing, and the cause may be obtained by soliciting a careful history. In most cases the prognosis is bad, but appropriate treatment should be instituted.

CHAPTER XII.

HEARING TESTS.

First, the hearing distance for the whispered voice should be obtained for each ear. This is comparatively a rough test but a most important one, and in many ways the best. In testing with any noise-producing instrument one cannot be perfectly sure at what distance the patient first hears the sound, not even the patient himself. This is especially true in the case of children. If, however, the patient is made to repeat a whispered word or figure it is certain that he cannot repeat without hearing. Several words may be used to eliminate the element of guessing, and for fear of lip reading the mouth should be kept from the patient's view. This test is not absolutely accurate, for the voice may be louder at one time than at another; but if the lungs are emptied by an expiration it will force the voice to a whisper. It is well to use numbers and to note what numbers are used in each case, as the tones differ. In addition to the voice we will use the watch for the distance tests. Watches differ in pitch and are usually compound in tone. Often persons of advanced age do not hear the watch unless almost in contact with the ear, and this, notwithstanding the fact that in case of the voice test the hearing seems almost normal. Hearing deteriorates with advancing age, and this deterioration is in the high tones. Having noted in this way the extent of impairment the tuning fork must be used. By its use we may de-

termine whether the deafness is limited to the middle ear, or whether the nerve is involved.

FORK TESTS.—We should first of all determine whether the hearing is better for the high or the low tuning forks. Persons with normal hearing, and those with middle ear deafness, hear high tones better than low tones; but where deafness is limited to the sound perceiving apparatus the opposite is true. We should know about how long the fork we are using is heard by the normal ear and time carefullythe air conduction for at least one high and one low fork.

RINNE'S TEST.—The Rinne test is perhaps the most helpful one to resort to after we have determined whether the hearing is better for the high or low tuning forks. In making this test the low toned fork is placed on the tip of the mastoid process and held there until the sound is heard no more; then the fork is immediately placed in front of the meatus, and if the patient again hears the fork the test is positive; if the fork is not heard again the Rinne is negative. A positive Rinne indicates that the hearing is better by air conduction than by bone conduction. This is true in the normal ear and where the hearing is only slightly affected. Where the hearing is markedly impaired a negative Rinne indicates a middle ear deafness, and a positive Rinne an internal ear deafness.

WEBER'S TEST.—When one ear is more affected than the other the fork is placed on the middle of the forehead and the patient is asked in which ear it is most distinctly heard. If in the well ear it indicates that the trouble in the affected ear is limited to the sound perceiving apparatus. If more

distinctly in the affected ear it indicates that the trouble is a middle ear deafness.

The above tests are all that will be needed in our clinical work. More elaborate tests can be undertaken by those wishing to specialize.

CHAPTER XIII.

INTRA-CRANIAL COMPLICATIONS.

A word should also be said about intra-cranial complications so that such may be looked for and recognized. It is not practicable to go at length into the discussion on the diagnosis of all intra-cranial complications of otitic origin in a work of this scope, but we shall merely mention the forms of intra-cranial involvement and state what the suspicious symptoms of such are.

FACIAL NERVE PARALYSIS.—This condition may occur as a complication of acute otitis media, acute and chronic purulent otitis media, and may be associated with a chronic non-suppurative otitis media. The diagnosis is most simple and the presence of a facial paralysis can hardly be overlooked. The face is drawn to the unaffected side, and the eye on the affected side usually remains open while the other winks. If the patient attempts to whistle or to smile, the unevenenss of the face may be readily marked. The ears should be examined in all cases of facial paralysis even if they are supposed to be unaffected. If the paralysis is associated with an acute condition with an intact drumhead, a paracentesis should be performed at once. If the paralysis is a complication of a chronic suppurative condition with caries, and if it persists, it would call for the radical mastoid operation.

MENINGITIS.—The temperature is high without marked remissions; the pulse is usually rapid. Headache may be

either localized or diffuse. Vomiting is commonly a symptom. The respiration is of the Cheyne-Stokes variety. There is usually rigidity of the neck. Signs of general debility appear, then delirium, and finally coma. The eye symptoms are strabismus, pupils contracted or dilated, and usually choked disk or retinitis. EPIDURAL ABSCESS, shows symptoms like the above but the symptoms of abscess pressure are more defined. The pulse rate is slower and the temperature is not high, it may be sub-normal. Vomiting may occur, and sickness and general stupor may follow.

BRAIN ABSCESSES are located either in the tempo-sphenoidal lobe or the cerebellum of the diseased side, sometimes in both. Temperature sub-normal or only slightly raised, may be high at onset. Pulse is slow. Headache and vomiting are often present but may be absent. Babinski's sign may be present but is not constant. Respiration is normal or slow and may be of the Cheyne-Stokes variety. Eye symptoms, retinitis or choked disc may be present, pupils are contracted and often unequal. There is more or less stupor, slowness of speech and mental dulness which may end in coma.

SINUS THROMBOSIS.—Temperature high with repeated drops in temperature, oscillating. Rigors and profuse perspiration. Pulse is usually rapid. Respiration rapid or of Cheyne-Stokes variety. Sometimes stiffness of the neck and often tenderness; tenderness over mastoid region. Optic neuritis. Blood shows increase of white corpuscles. There is usually great depression and metastatic phenomena may be manifested.

CHAPTER XIV.

EXERCISES IN THE SURGICAL ANATOMY OF THE TEMPORAL BONE.

As anatomy is the foundation of medical science, a general knowledge of this subject is indispensable to the physician, be he general practitioner, surgeon or specialist; but to the aural surgeon an accurate knowledge of the anatomy of the temporal bone is an essential factor.

This accurate knowledge is to be attained by careful reading and by study of the bone itself and sections of it. If sections of the bone for purely anatomical study be made by the student himself, his idea of the relations in which the several component parts stand will be clearer and more exact, and this clearness and exactness is a necessary attribute of the surgeon.

In the exercises here set out the student is to apply this anatomical knowledge which, it is presupposed, he has already acquired. His knowledge of the anatomy of the temporal bone can now be applied in studying the surgery of this region.

The prime object of this short sketch is to describe very briefly some exercises in a course which is, as I have said, fundamental to the study of otology. It should be borne in mind that these are exercises in applied or surgical anatomy and that previous preparation in the anatomy of the temporal bone is necessary. The first three exercises will

be devoted mainly to a review of certain conditions and relations from an anatomical point of view.

For these exercises it is necessary to be supplied with human temporal bones previously removed from the skull with saw and chisel and preserved in 60 per cent. alcohol.

The pinna must be removed but the other soft parts left in place, the cartilaginous portion of the external auditory meatus and the skin lining the meatus being intact. If the specimens are hard when taken from alcohol they should be left in water twenty-four hours before using.

A general rule of procedure with these specimens is first to clean out carefully any dirt or foreign matter that may be in the external auditory meatus and then to examine with a speculum, always noting the condition of the drum-head. All work must be done under strong light reflected from a head-mirror. The light from a Welsbach burner is especially suitable because of its brightness.

The necessary instruments are a mallet (wood preferable on account of its size and weight), a set of chisels, of gouges, a surgical knife, a periosteal elevator, a paracentesis needle, one or two probes, a tenatome, a tenatome sound, Zeronii's incus extractor and pincettes and forceps. In working with the chisels or gouges the preparation must be made fast in a vise, the external surface pointing upward. The position may be changed to suit the comfort of the student, but the bone must always be fast and in such a position as to receive the light reflected from the head-mirror on the field of operation. The chisel, or gouge, should always be started at a steep angle, turning sharply after the first blow. This first steep placing is very aptly termed by Prof. Grunert," the paradox position," so called because if the chisel were driven

in as placed it would enter parts that it is not meant to enter. In the neighborhood of the sinus, however, the chisel should be placed flat. When working from within outward the probe should always be used to feel behind any prominence to determine whether it may be removed without endangering any important parts.

The first three exercises will be devoted to reviewing conditions and relations without particular regard to surgical technique. But in the remaining exercises careful attention must be paid to the technique as being of greatest importance.

First exercise. After having properly cleaned out the meatus as suggested, the following points should be noted: In the osseous portion of the external auditory canal the skin is very thin and smooth, and there are no glands or hairs present. Furuncle does not occur in this portion. An abscess might resemble a furuncle, but must not be mistaken for it. The narrowest portion of the canal is about the middle, and the osseous portion is narrower than the cartilaginous portion. The lumen is oval, its greatest diameter being superior-inferior. The inferior and anterior walls of the canal are longer than the superior and posterior.

Now, the drumhead should be examined and its principal points reviewed, recalling also its position and angle. It forms an obtuse angle with the posterior wall and an acute angle with the anterior wall. It is important to bear this in mind when removing foreign bodies. If the drumhead is normal its color is pearlish gray. The short process of the hammer is plainly seen and the hammer handle running downward and backward from it to the central point, which is called the umbo. From the umbo downward and forward shines the cone of light with its apex towards the

umbo and its base bounded by the periphery of the drumhead. Schrapnell's membrane and the anterior and posterior folds are seen, and when the drumhead is thin and transparent the long process of the incus shows through, not parallel to hammer as shown in some plates, but convergent to it. Very seldom the chorda tympani nerve is seen through the drumhead running in front of the bony process of the incus and just below the margo tympani.

At this point the cartilaginous canal, the skin covering it and the bony canal should be removed, care being taken not to disturb the drumhead. With a paracentesis needle a cut is now made in the drumhead, semi-circular in shape, extending from a point directly behind the hammer, as far above and in front as possible, to the middle point below, following the periphery of the drumhead posteriorly.

Fig. 1.

Right drum-head, dotted lines showing position of incision.

Fig. 2.

Showing the loose flap folded forward on to fixed portion.

In Fig. 1 the dotted lines show the position of the incision in a right ear-drum. Now fold this loose flap forward on the anterior portion of the drumhead as shown in Fig. 2. This brings into view the posterior portion of the inner wall of the tympanum. One now sees plainly the promontory across which superiorly-inferiorly runs Jacobson's nerve. The long process of the incus is plainly visible, and

by tilting the bone the chorda tympani nerve can be seen passing before it under the margo tympani. Dimly behind the long process of the incus a portion of the stapes is seen, the stapedius muscle somewhat limiting the view. The niche to the round window is inferior and posterior to the stapes. The rough condition of the bony floor of the tympanum is worthy of notice. In front of the base of the stapes the processus cochlearis may be seen with some difficulty. The points mentioned in this exercise may be profitably reviewed before taking up the second exercise.

Second exercise. In the same specimen the student should now proceed to remove with the chisel and mallet the roof of the bony canal, working from within outward, and remembering what has been said about the use of a probe and the position of the chisel. The outer wall of the attic is thus removed and the contents of this cavity are now brought into view. (The attic extends externally over the roof of the external canal and also behind the posterior wall of the canal.) The head of the hammer is seen and its articulation with the incus, of which ossicle we can now see the whole body and the short as well as the long process. Inferior and interior to the short process of the incus and on the inner wall is the canalis Fallopii, falsely called aqueductus Fallopii, seen as a thick, white line. In this passes the facial nerve. The canalis Fallopii is immediately superior in position to the stapes. In this location congenital defects are often present, and facial paralysis is caused by pressure in cases of purulent otitis media. With a probe it is very easy to enter the mastoid antrum, behind the attic, and by tilting the bone in the proper direction light may be reflected into the antrum, but the view that this affords is only a limited one.

Before finishing with this exercise the cellular condition of the roof of the attic is to be noted and particularly the position of the horizontal semi-circular canal which is above and behind the canalis Fallopii.

Fig. 3. Diagrammatic drawing to show the position of the planum mastoideum and opening into antrum.

Third exercise. As the work on this first specimen is chiefly to review one's knowledge of general relations, it will be completed by locating and entering the antrum from without. The bone may be further cleaned of its soft parts with a scalpel and a periosteal elevator.

Locate now on the exposed bone the linea temporalis, the spina supra meatum and the line of attachment of the sternocleido-mastoid muscle. Lines may be marked for convenience with a blue pencil. Fig. 3 is very diagramatic, a line being added behind to complete the boundary of the plane. The surface marked out by these lines is the

planum mastoidem and in the center of this plane the entrance is to be made into the antrum with a gouge and mallet, following the direction of the external auditory meatus downward, forward and inward. As the opening in this case is only to locate the antrum it should not be much larger than to admit the gouge with which it is made. The position of the horizontal semi-circular canal is to be especially noted through this opening. The first specimen is now ready and should be saved as a reminder of the steps taken in its preparation. In all of these exercises it is well to save the specimens when they are finished and when they show nothing of particular interest they may be worked out further as anatomical specimens.

Fourth exercise. In all the following exercises more or less attention is to be paid to the surgical technique; but in the present exercise the technique of the operation is to be carefully observed beginning with the initial incision in the soft parts.

The bone must be made fast in the vise with the external surface upward, after having been cleaned and the drumhead examined as mentioned. The initial incision is then made from a point superior and a little anterior to the external auditory meatus extending, semi-circular in shape, almost to the tip of the mastoid process. See Fig. 4. The incision must be made through the soft parts to the bone, except above, where care must be taken not to cut the temporal muscle. In using the scalpel the cutting should be done with the edge of the blade and not with the point. With the periosteal elevator the bone must now be laid bare, forward to the edge of the bony meatus and to the root of the zygomatic process, and backward to a distance of from a half to three-quarters of an inch. Caution must be

exercised in using the periosteal elevator. The thumb should be placed near the point to guide the instrument and to guard against using of too great force which might be very dangerous, especially in rachitic children where the bone is softened.

Fig. 4. Relation of initial incision to external meatus and mastoid process.

The planum mastoideum as described in the last exercise must be marked again. It is well to mention here that the relation of the lines described may sometimes give valuable hints as to the positions of the cranial fossa and the sigmoid sinus. When the positions of these important points are normal a line drawn through the spina supra meatum would about cut the planum mastoideum in two equal parts. Should, however, the linea temporalis lie so low that a line drawn through the spina supra meatum would be very close to it, this would indicate that the cranial fossa reached lower down than usual and that the sinus was farther forward, hence calling for special caution.

The opening from without into the antrum is begun by removing the cortex for a space taking up the greater part of the planum mastoideum. In the center of this

space the opening should be made into the antrum, running parallel to the external auditory meatus. Feeling the way with the probe, the opening should next be carefully enlarged and should extend to the tip of the mastoid process. This process is necessary for the proper drainage of pus, and furthermore, the walls must be smooth with no rough ridges left to hinder the outflow. This completes the opening into the antrum as done in the operation on the living subject. See Fig. 5. Where the point of the mastoid process is involved the entire point may be chiseled away. The best drain in these cases is a small rubber hose.

Fig. 5. Simple opening into the antrum as seen after the operation is completed.

Fifth exercise. This consists in performing what is falsely called the "radical operation." It is not a radical operation for the reason that in every case not all diseased parts are removed. It is really a complete opening into the middle ear and in the clinic at Halle the term "Totalaufmeisselung" has been adopted. The work on this operation for the complete opening of the middle ear will be continued on the same preparation used in the last exercise.

The bridge, or strip of bone between the meatus and the artificial opening, is to be removed. The large gouge is

to be used. The work is wedge-shaped, broad without and becoming narrower as it progresses inward. After the bridge is broken through below, the cavity should be carefully enlarged. Always sound with the probe before making a cut with the gouge, and after each cut the splinter of bone as it is loosened should be removed. When possible, it is well to throw out the piece of loose bone with the chisel after each stroke. This artificial opening should now form one large cavity with the meatus; the walls must be smooth and free from ridges and prominences. The sigmoid sinus must be avoided, and care should be taken not to injure the horizontal semi-circular canal or the facial nerve. It may be mentioned here that the facial nerve lies more externally below than it does above, so that if a probe were placed on the aditus of the antrum the part of the nerve above it would lie median to its point, while that below would be external to it.

The hammer and incus must be removed, a tenotome being used to cut the tensor tympani tendon before removing the hammer. The stapes should always remain in place and, as far as possible, intact. It is well to feel with the finger that the walls of the cavity are smooth and without marked ridges.

Sixth exercise. This exercise is to be devoted to practicing the extraction of the hammer and the incus through the external meatus, and the specimen must at first be so prepared as to allow the student to follow the steps with the eye. In order to work more freely the student may remove the soft parts when he first attempts this exercise. The drumhead, however, must be left in place.

The dura having been removed, an opening is chiseled through the tegmen tympani. This work must be done

lightly and carefully, especial care being taken not to disturb the ossicles. Through this opening the contents of the tympanum and the attic and their relations are now seen. The different points should be noted, but special attention must be paid to the tendon of the tensor tympani muscle, its attachment to the hammer and its relation to the facial nerve and to the horizontal semi-circular canal. Having fixed these points the student may proceed to practice the operation.

First of all comes the incision into the drumhead and this should be made to surround the hammer. The first cut is made parallel to the hammer and immediately behind it; the next cut is parallel to the hammer and in front of it. These cuts extend as far upward as possible and are joined below by a third cut. See Fig. 6. This method of making the incision in the drumhead is preferable to the old method of following the periphery because the bleeding

Fig. 6. In a right drum-head dotted lines show position of incision.

is less profuse; the danger of the knife coming in contact with the margo tympani is obviated and the hammer is easier to obtain.

The next step is the locating of the tensor tympani tendon with the tenotome from the outside through this incision; and to accomplish this the tenotome, with the cutting edge forward and the point upward, is passed

through the uppermost part of the incision behind the hammer, in an upward, inward and forward direction until its further progress is blocked by the bony wall of the attic. Now, slightly withdraw the tenotome outwardly until the point is just free of the bony wall and then turn it forward until it can be felt to be resting on the tendon. This should be followed at first by the eye in the opening in the tegmen tympani, and before cutting the tendon this location of it should be practiced again and again until the student is able to realize by the touch the position of the instrument. After sufficient practice the tendon should be cut by a slight sawing motion of the tenotome, and the other steps should be taken up. The hammer is now to be removed, and, with the tenotome, the handle is bent forward so that a wire snare may be passed around the neck of this ossicle and it is withdrawn by rotating it out of its position downward and outward.

After the hammer has been removed the incus must be attended to, and the best instrument for this purpose is the incus extractor which was invented by Dr. Zeroni. The instrument is so directed that it rests where the hammer did, the concave surface pointing toward the incus. The instrument is now turned until the concave portion rests on the body of the incus, and from this position the extraction is made. The obtaining of this position may be practiced again and again until the incus is finally removed by the same motion as that used in withdrawing the hammer. When the incus has fallen to the floor of the tympanum it should be removed with a bent probe. The use of the pincettes should be avoided.

This exercise is now complete; but these steps should be reviewed on a specimen in which the tegmen tympani has

not been opened and in which all of the soft parts have been left in place. This time the work should all be done through a speculum, for the sake of practice. If possible it is well to practice this particular operation on the cadaver and to have conditions as nearly as possible as they would be in an operation on the living subject. The absence of bleeding, however, is one great difference.

Seventh exercise. This exercise takes up the operation after Stacke, and the initial incision in this case is made just as it was described in the operation for the opening from without into the antrum. The bone is now laid bare with the periosteal elevator as far forward as the root of the zygomatic process, and in the meatus to the drumhead. Posterior to the incision the soft parts should be left adherent in this case, as the edges of the incision in the soft parts may be sewed together after the operation.

The chiseling is now begun from within outward following the general directions as given. This probe must be continually used, and every splinter of bone must be re-

Fig. 7. Diagrammatic illustration of meatus enlarged mostly superiorly. and posteriorly. Dotted lines show outline of complete opening.

moved as it is loosened. In this manner the opening is carefully enlarged until the antrum and the attic are well exposed. The meatus is thus enlarged especially superiorly and posteriorly. The walls of the opening must be smooth and even. See Fig. 7.

Eighth exercise. This consists in extending the simple Stacke into the operation for the complete opening. The dark portion in Fig. 7 shows the simple Stacke and the dotted lines show how it is to be enlarged to reach the point of the mastoid process. The opening thus enlarged must never have a sharp angle as is shown in Fig. 8a, but must be smooth and rounded off as in Fig. 8b. Fig. 8c shows how the work must progress from within outward.

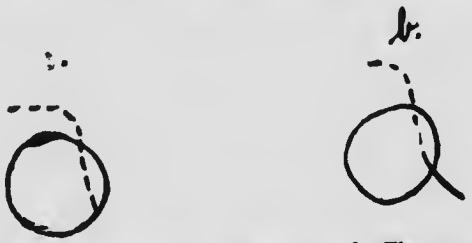
Fig. 8. Diagram illustrating incorrect (a) and correct (b) shape, especially of the inferior border, of the complete opening.

1. Antrum. 2. Meatus. 3. Probe. Diagrammatic sketch showing the position of the probe in sounding before moving posterior wall at W.

In so enlarging this cavity great care must be taken not to injure the facial nerve and this nerve may now be exposed at its most dangerous point, a short distance below the horizontal semi-circular canal. Above in the neigh-

borhood of the semi-circular canal where the course of the nerve may be seen it is not to be disturbed, nor is the semi-circular canal to be opened. The exposing of the facial nerve which is done further down is to show the danger of coming in contact with it in the course of an operation.

The course of the facial nerve is not always the same, and for convenience sake it may be said that there are two general types of its courses, the steep and the flat. This division is not arbitrary. Fig. 9a represents the steep course,

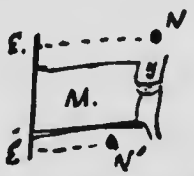


a. Steep. b. Flat.

Fig. 9. Diagram showing two types of the course of the facial nerve.

where the nerve keeps behind the margo tympanum and comes forward below. Here the danger of striking the nerve is reduced. Fig. 9b represents the flat course where the nerve comes forward over the margo tympanum. The danger of striking the nerve in this case is increased.

Fig. 10 is a diagram of the flat form looking down from



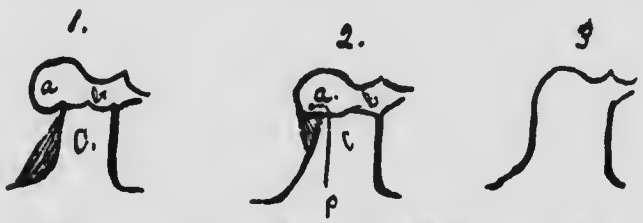
M. Meatus. N. Nerve. T. Tympanum. E. External Surface.

Fig. 10. Diagram of flat course of facial nerve. Looking down from above on meatus and tympanum. Line E-N drawn in front of meatus from external surface to point on nerve is longer than line E-N drawn from external surface to point on nerve behind.

above. It shows how much longer a line drawn from without to a point in the course of the nerve in front of the meatus is than a similar line drawn behind the meatus.

Ninth exercise. The work of this exercise consists in performing a modified Stacke. The meatus is first enlarged from without, a funnel-shaped opening resulting. This gives more room to proceed conveniently with the Stacke which has been described in the seventh exercise.

The shaded lines in Fig. 11 (1) show the place where the chiseling is begun. The funnel shape as seen in Fig. 12 (2) then results and the shaded lines here show where the



a. Antrum. b. Tympanum. c. Meatus. p. Probe.

Fig. 11. Diagram, looking down from above showing steps of enlarging opening in the modified Stacke.

Stacke is to be begun. Every stroke with the chisel must be preceded by the use of the probe. Fig. 11 (3) shows the opening that results; this may be further worked out into the complete opening.

The real Zanfal operation consists in working from without and enlarging the funnel-shaped meatus until the antrum is entered, without resorting to the method after Stacke. Fig. 12 (1). When the antrum is large it will be soon entered and the bridge at the point b in Fig. 12 (2) will be left. Shaded lines show the procedure of chiseling.

This subject is not exhausted, but a few brief descriptions of exercises have been given with the hope that they may

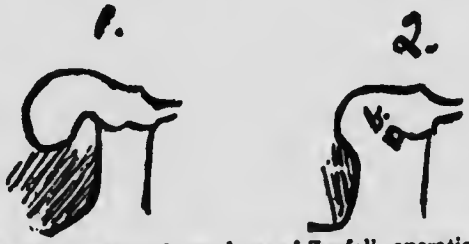


Fig. 12. Diagram from above of Zanfal's operation.

be of practical use, and that the student may be able to use this brief article as an introductory guide to a work so interesting that it will call forth his very best effort.

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