

jury, as its resisting power is much reduced by the presence of several cavities within its substance—cavities which are separated only by very thin osseous walls. Force applied to the vertex extends itself on some distant point through elasticity of the cranium, and, owing to its weakness, the temporal bone is almost always damaged. The external auditory canal in the region of the fissura Glaseri is that portion of the temporal bone which is most frequently involved, yet the locality of the fracture depends on the site of the traumatism. If the violence is applied in the region of the occiput, fracture of the posterior osseous wall results, and this may or may not involve the mastoid; a severe blow or fall on the point of the chin may cause a fissure or comminuted fracture of one or both anterior walls. As a rule, however, fractures are rarely seen limited entirely to the auditory canal, for in most cases in which the traumatism has been severe, it is further complicated by a contemporaneous fracture of the superior or inner walls of the tympanum, and at times of the pyramid. Fracture of the walls of the tympanum may involve the facial canal in some portion of its course, producing a paralysis corresponding to the particular locality injured. There is always a laceration of the mucous membrane lining the cavity of the tympanum, corresponding to the line of fracture. Fracture of the ossicles or dislocations of their articulations or detachment of the drum membrane from its groove are seen only as a result of excessively violent traumatism. The membrana tympani, while not always involved, is ruptured most frequently in the neighborhood of Shrapnell's membrane. The perforation appears in the form of a linear or oblong slit traceable along the superior or anterior meatus. Multiple perforations of the drum membrane are most rarely observed. Concussion of the skull occasionally produces a hemorrhagic extravasation in the tympanum, causing a condition known as hæmotympanum. The drum membrane appears to bulge and is of a dark-blue color; sudden deafness, tinnitus aurium, pain, vertigo, and a feeling of fulness in the ear result, but upon absorption of the extravasation these subjective symptoms disappear. When the line of fracture passes through the petrous portion of the temporal bone, involving the internal auditory canal and the nerve trunks passing through it and lacerating the delicate membranous labyrinth, deafness is immediate and absolute, and it is observed as soon as the patient recovers consciousness. Damage to the nerves in the internal auditory canal is seldom if ever confined to the acoustic; the facial nerve is injured at the same time. A staggering gait, vertigo, nausea, vomiting, and facial paralysis generally persist for months, and in some cases these symptoms remain unchanged for years. Such functional disturbances are not always due to a fracture, however, but are seen as a result of pressure following an extravasation of blood. Injuries to the osseous portion of the Eustachian tube and the mastoid cells are rare, but the extension of the line of fracture to the nose through the anterior fossa and ethmoidal cells is more frequently observed. Paralysis of special nerves appearing immediately after the injury are due to laceration or compression; those seen to occur some time after the injury may be due to inflammatory action. Among the symptoms connected with fractures or diastases of the temporal bone, associated or not with a contemporaneous fracture of the base, and to which considerable importance has been attached, are: hemorrhage and an escape of a watery fluid from the injured ear. Profuse bleeding from the auditory canal, with a discharge of a watery fluid, can occur only when some portion of the membrana tympani is perforated or when the line of fracture and laceration of the soft parts extends well into the external auditory canal. Bleeding from the ear under these circumstances, even though it persists a comparatively long time, has not that critical significance which has heretofore been attributed to it. It does not necessarily indicate that the tympanum and one or more of the large vascular channels surrounding it have been opened, for the region in which these lacerations most frequently occur—the membrane of Shrapnell and the

superior wall of the auditory canal—is sufficiently rich in blood-vessels to account for it. Alarming hemorrhage from the ear has been known to follow injury limited to the osseous canal; it has also been observed in cases in which a rupture of the drum membrane and a laceration of the mucous membrane of the middle ear have occurred without any demonstrable evidence of the existence of a fractured base. As a symptom, therefore, bleeding from the ear means a rupture of the soft parts in the vicinity of the line of fracture, since authentic cases of fracture of the temporal bone have occurred without the slightest hemorrhage or bleeding from the ear. The escape of watery fluid from the ear is a symptom of graver import, and is generally considered to point to a fracture of some part of the petrous portion of the temporal bone, with a tearing of the cerebral membranes. When first seen its color is a reddish-white, but later it becomes clear as water, and is considered to be cerebro-spinal fluid. Every watery or serous discharge from the ear is not necessarily cerebro-spinal fluid, for this symptom occurs in acute inflammation of the middle ear of non-traumatic origin. The presence of this watery discharge from the ear in no way implies a fatal issue, as such patients have recovered, but the symptom aids in forming an estimate of the extent of the injury sustained by the temporal bone.

Diagnosis.—In trying to discover the extent of a fracture of the temporal bone in a general way, the use of the tuning-forks renders much valuable information. In fractures of the first class, a tuning-fork placed on the vertex will be heard better in the affected ear; in those of the second class, in which the fracture includes the pars petrosa, the tuning-fork will be perceived more distinctly in the unaffected ear. A complete or partial restoration of the hearing power may be looked for in the first class of cases; in the second, permanent deafness follows. Deafness following contusion of the head without symptoms of basal fracture is usually incomplete, and is generally first noticed some days after the injury. It may be caused by inflammatory neuritis, by hemorrhagic inflammation of the labyrinth, or by involvement of the acoustic centre.

Treatment.—In treating fractures of the temporal bone more attention should be devoted to learning the extent of damage sustained by the osseous canal, drum membrane, and middle ear, with the view of preventing any extension of the inflammation resulting therefrom to the adjacent structures. Acute inflammation of the tympanum follows these injuries, and when the cavity of the cranium and the delicate meninges are exposed through the line of fracture, thereby opening up paths of infection for countless numbers of micro-organisms, much might be done to reduce the development of meningitis. Both the external auditory canal and the membrana tympani should be thoroughly inspected to establish the presence of a fracture or a rupture. Copious hemorrhage might make this difficult of accomplishment, but still it can be done. The treatment usually employed in acute inflammation of the middle ear can be used with benefit in the inflammation arising from a traumatism. When the details cannot be carried out, a thorough drainage and cleansing of the middle-ear cavity through the mastoid is a surgical possibility not to be forgotten. To prevent the development of meningitis should be the effort of the surgeon, but the application of the ice cap and rest in bed will not suffice when the channel of infection is left totally neglected to the invasion of what too often proves to be the exciting cause. *James B. Clemens.*

EAR DISEASES: TUBERCULOSIS OF THE MIDDLE EAR.—The occurrence of a purulent discharge from the ear in the latter days of patients afflicted with phthisis pulmonum was observed by the earliest clinical writers, who attributed it to poison within, seeking its way out. Naturally, nothing very precise was written on the subject until the use of the head mirror, which afforded a more exact way of observing the conditions occurring in various diseases, had been discovered. After this discovery had been made, certain peculiarities of the

objective appearances in ear tuberculosis were soon chronicled.

As in most other pioneer otological work, so here also we find evidences of the fact that Politzer contributed his share. In his "Beleuchtungsbilder," published in 1865, he pictures one of the typical appearances of this condition. He was one of the earliest observers to write at all extensively on the subject, and gave one of the first satisfactory descriptions of the microscopic changes taking place in the mucous membrane of the middle ear in this disease. Still later, when tubercle bacilli were discovered, we find him one of the first to work out the presence of these in the discharge and in the ulcerated membranes.

During this interval many other observers worked upon the subject from various standpoints until to-day we find tuberculosis of the middle ear thoroughly well recognized, exhaustively studied, and in general as well understood as tuberculosis of any other organ or portion of the body.

ETIOLOGY AND PATHOLOGY.—Theoretically, there is no reason why a tuberculosis cannot begin primarily in the ear, but, owing to the fact that the middle ear is shut off from the rest of the body, and communicates only indirectly with the lymphatic system—the great disseminator of tuberculosis, and also in view of the fact that the only direct connection which it possesses with the outside world is through a very narrow tube which passes down into the nose, we have a right to assume that it can only rarely serve as the primary source of a general tuberculosis. Cases have been reported in which the discharging ear furnished the first objective symptom, while only later, sometimes after a considerable lapse of time, did the lung and other symptoms manifest themselves. I have myself, however, never seen any cases in which I could satisfy myself that I had before me a genuine instance of primary middle-ear tuberculosis. There is one fact, however, which is indisputable, viz., that in the vast majority of cases the ear tuberculosis manifests itself long after the disease has been more or less active in some other part of the body.

How often aural complications occur in tuberculous subjects, it is not possible to state in exact statistics, all of the latter being more or less modified by the fact that the ear trouble is often so little noticed by the patient (and even less so by his medical attendant) that a great many patients even in our best-managed institutions die without any mention being made on the record of any discharge from the ear. In private practice a still larger number of cases remain undiscovered, or, if mentioned, are soon forgotten as being, in the presence of disease elsewhere in the body, unimportant. For these reasons I am disposed to believe that tuberculosis affects the middle ear much more often than is generally supposed.

It is probable that tuberculosis in the middle ear develops in one of two ways; either the tubercle bacilli effect a lodgment in the relatively healthy but constitutionally vulnerable tissues of the membrana tympani and middle-ear mucous membrane, or else they are favored, in making a successful invasion of the ear, by the fact that these parts are weakened by disease (infection by streptococci, pneumococci, etc.). The mode of approach of the bacilli, which doubtless are in the air a large part of the time, is clearly by way of the Eustachian tube.

It is interesting to note, in this connection, that oftentimes the most careful and persistent search (microscopical and bacteriological) fails to discover the existence of tubercle bacilli in either the discharge or the affected tissues themselves, and that too in cases which present the strongest possible clinical evidences of the existence of a tuberculous process in the middle ear. This experience has happened to the author in a number of instances.

It seems natural to inquire next as to the nature of the pathological processes which take place in the ear; how they progress step by step. The inflammation is almost always of the sluggish, asthenic type. Without much disturbance a discharge appears, and then, shortly afterward, a large part of the drum membrane will frequently

disappear. Thus, sometimes, in the course of only a few hours, a whole quadrant will as it were melt away, or two independent perforations will form, will persist for a short time, and will then merge into one large defect. After this first loss of substance has taken place, frequently nothing further transpires beyond the simple conversion of the mucous membrane on the promontory wall of the middle ear into a granulating mass, and from this and the whole cavity of the middle ear there is secreted a thin acrid pus which, often in no very large amount, runs on for months and months until the demise

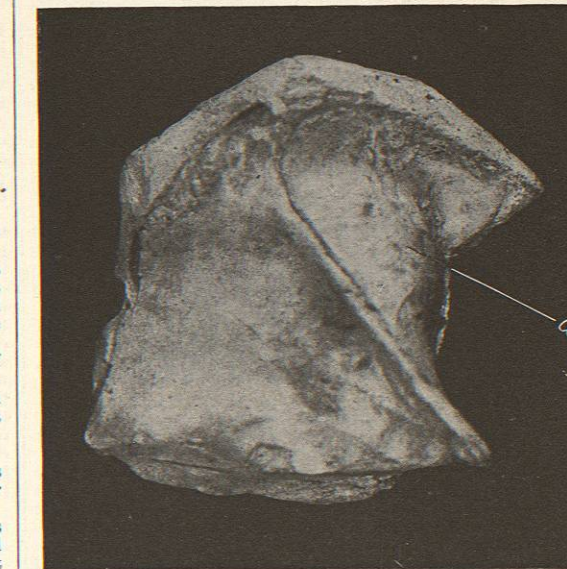


FIG. 1804.—Cast of Petrous Portion of the Temporal Bone, from a case of advanced tuberculosis of this part of the skull. (Original.) a, Roof of the tympanum, which is seen to be arched up into the middle fossa of the skull. The overlying brain substance at this point showed a corresponding depression.

of the patient. No very great further destruction of tissue takes place, and the granulating surfaces do not ulcerate, but most obstinately persist in giving forth the discharge.

In another group of cases the tuberculous process shows a most decided destructive tendency. Possibly this may be due in some measure to the fact that the patient lives longer, more time being thus afforded for the destructive processes to work. It is more probable, however, that there are real differences in the types of the disease itself. The drum membrane undergoes complete destruction. The ossicles become loosened and disappear in the discharge, and later we are able to discover that the bone on the promontory wall is bare underneath the granulating tissues which cover it. The process indeed does not even stop here, that is, with the formation of a limited area of bone caries; but, instead, quite large masses of bone tissue die. Especially is this liable to be the case in children in whom there is a well-developed general tuberculosis. The sequestra thus formed are sometimes of extraordinary size, including wellnigh the whole petrous portion of the temporal bone as well as the wall of the external auditory canal. Such pieces are only rarely extruded by natural processes; usually operative measures are needed for their removal. The periosteum or dural surface, in the specimen pictured in the accompanying cuts, presented an entirely healthy appearance except at the spot where the bone has been sawed in two, as is shown in Fig. 1805. At this spot the peri-

ostium was very much thickened and consequently must have served as a barrier to the invading forces trying to enter the skull from the middle ear. The bone was entirely gone in places, but the thickened subperiosteal

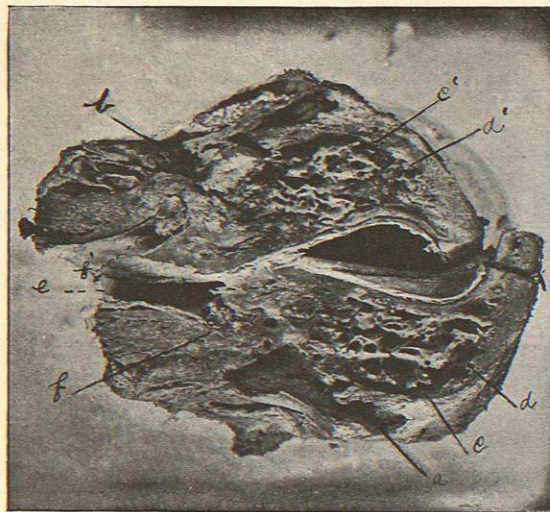


Fig. 1805.—Temporal Bone from the Same Case as that shown in Fig. 1804. The section (made with a saw) passes horizontally through the external auditory canal. Slightly reduced. (Original.) a, The floor of the external auditory canal and lower half of the middle ear; b, the upper wall of the canal, while the upper half of the middle ear is filled by a caseous mass. c, c', section of a sequestrum or of a portion of the bone which is in a condition of osteoporosis (the extent of the same may be readily distinguished); d, d', intact outer table of the skull; e, locality of the cochlea which had been involved in the necrosis of the neighboring bone structures; f, f', caseous mass in the internal auditory canal.

tissues were good for a long resistance, and the meninges of the brain were perfectly healthy, although there was at one point—corresponding to the projection shown on the temporal bone—a depression which extended into the brain substance and into which the ball of the thumb could be easily inserted.

Fig. 1805 shows also the marked osteoporosis, c and c', involving a large mass which includes the internal ear, e, and the auditory and facial nerves, f and f', especially the former, which had been reduced to almost a pul-taceous mass. Although death in this particular case was from pure asthenia, it could not have been long delayed, as a septic meningitis was imminent owing to the broken-down condition of the nerve tissues, as mentioned above. Such a meningitis occurred in another case the temporal bone of which I had the opportunity thoroughly to study. In this case I removed a specimen from a part where the roof of the tympanum was very thin, decalcified it, and cut it into sections. Except in those portions of sections where there were cheesy masses, I was disappointed in not finding by the microscope anything that was materially different from what we find in cases of rarefying osteitis, whether tuberculous or otherwise in its origin. In the deeper layers of the periosteum there was a certain amount of inflammatory tissue, and this was found to extend into the Howship's lacunae and Haversian canals, arranging itself in layers and tiers of cells close to the bone proper. As will be seen from Fig. 1806, the osteoclasts seemed to sink themselves into the bone substance exactly as in other forms of bone decay. The impression which I gathered from studying these sections was that the only difference between the conditions here and those which are observed in simple rarefying osteitis, is this: the osteoclasts in the tuberculous form are perhaps a trifle larger than they are in the simple variety.

In this case the tubercle bacilli were found back in the caseous tissue, where the coagulation necrosis was taking place, but were not discovered in the actually inflamed area where we assume that phagocytosis is most active, the latter being nature's attempt to throw a barrier around the diseased tissue for the purpose of separating it from the healthy.

In the milder cases we have in the mucous membrane of the middle ear, as occurs in the larynx, ulceration and the formation of granulation tissue; these alterations, which are caused by other micro-organisms than the tubercle bacilli, frequently yield readily to treatment. The other deeper lesions of the mucous membrane are found to have the giant cells and the coagulation necrosis as well as the tubercle bacilli.

This leads me to repeat the statement which I made in the earlier part of the article, viz., that the beginning of the trouble in the ear in many cases is probably simply a streptococcus or pneumococcus infection, and that it is only later that the tubercle bacilli get a chance to work out their full measure of mischief, the tissues being prepared for the latter by the previous inflammatory conditions.

SYMPTOMATOLOGY.—When a tuberculous patient comes to consult the aural surgeon for relief of his ear trouble he relates that he had a feeling of fullness and discomfort in his ear for perhaps only a few hours or for a number of days, but that his attention was only seriously directed to his ear when, on arising some morning, he discovered that his ear had been discharging as shown by the presence of dried matter on the outside of his ear or by the staining of his pillow. He will relate, further, that since this particular occasion he had experienced no trouble beyond the fact that the discharge and the deafness had both continued to exist. The latter symptom is frequently much less marked than that which would accompany any other purulent otitis media. So significant is this quiet beginning of the disease that whenever a patient comes complaining of painless discharge and

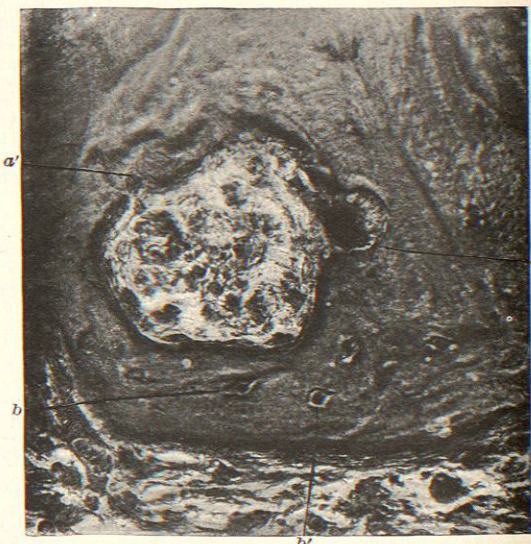


Fig. 1806.—Section through Decalcified Bone from Roof of Tympanum. X 1,000 diameters. (Original.) a, a', Osteoclasts resting in a hollow which they had made in the bone substance; b, b', bone cells of the still intact bone. The manifest difference in size, as compared with the osteoclasts, is noticeable.

persistent though not severe deafness, I am at once suspicious that the underlying cause is a tuberculosis of the middle ear.

If an examination is made early in the progress of the trouble, one often finds more than one perforation. Quite frequently I have seen these double perforations, but in no instance have I seen more than two. Troeltsch, however, records having seen on one occasion three. Multiple perforations are considered a sure presumptive sign of tuberculosis, and my own experience would lead me to place as high a value upon this piece of evidence as I would upon the presence of a pyriform swelling of the arytenoid cartilages of the larynx, or upon that of a dull apex of the lungs. These independent perforations persist for a shorter or a longer time and then merge into one large defect.

In carrying out the treatment of one of these cases of tuberculous disease of the middle ear the surgeon secures ample opportunities for observing closely the progress of events. Thus, for example, he will notice, in the milder cases, that after a certain period there ceases to be any further erosion of the drum membrane; the ulcerated edge retracts, folds backward, and is usually more or less overlapped by the granulation tissue which springs up from the promontory wall. Then, in a certain proportion of the cases, even when all local treatment is completely abandoned, the further formation of granulation tissue or of polypi ceases; in fact, such granulations may gradually shrivel up and the discharge become very scanty. Such partial spontaneous cures are not very uncommon. They remain in this state of comparative quiescence for varying periods of time; the patient finally dying without anything new of any importance having transpired in the middle ear.

In other cases the disease, from the start to the finish, pursues a very different course. In these cases, which belong to a more virulent type, and in which, after the destruction of the membrana tympani, the malleus and incus are exfoliated and washed out with the discharge at a comparatively early stage, the patients frequently complain that the ear is more or less painful and that there is a deep-seated boring; the discharge also becomes very foul-smelling, traces of blood are seen, and if one carefully cleanses such an ear and uses his probe with discretion he will easily discover that it passes through or between the portions of the granulating tissue and encounters bare bone. This bare bone sometimes is merely a simple caries of the bony wall of the middle ear and may be found in any portion of it, more frequently on the promontory wall,—perhaps because it is more accessible,—but it also occurs, as the probe will often discover, on the annulus tympanicus, on the roof of the tympanum, toward the mastoid, and even in the external canal itself. At a still later stage, in these progressive cases, it becomes evident to the medical attendant that he has to do with conditions of the ear such as are pictured in Figs. 1805 and 1806, i.e., with the formation of large necrotic masses and of sequestra. In children this will frequently progress in such a way that a little manipulation with the instruments or a little direct operative interference will disclose the fact that the masses are no longer attached to the healthy bone and consequently that they can be removed. Almost every aurist who has had more than a limited experience can recall cases in which larger or smaller masses have thus been removed either through the natural canal or by the various methods of laying open the ear from behind.

Occasionally, however, it transpires, as in the case from which the specimens which illustrate this article were taken, that the mass does not separate, does not give any evidence of loosening, and is so extensive as to deter one from even advising—in the weak condition in which these patients find themselves—any operative interference. In cases of this kind the infection which induces the terminal meningitis reaches the cranial cavity either by way of the roof of the tympanum, which breaks down and disappears, or by way of the labyrinth and internal auditory canal, after the destruction of the soft parts. The resulting meningitis in these cases is usually of the asthenic type. Gradually the patient succumbs to the slowly oncoming coma. He may have short at-

tacks of dizziness and headaches from which he seems to recover entirely; later, however, he generally sinks into the comatose condition as into a sleep, and never regains consciousness. It very rarely happens that a patient, in a case of this kind, develops a brain abscess or any other intracranial affection than the basilar meningitis which produces the fatal termination. In the simpler cases, on the other hand, one rarely has to do, from first to last, with any pain or inconvenience, such as are quite commonly experienced by the patients belonging to the class just described.

Prognosis.—As already stated in an earlier part of this article, it is sometimes a very difficult matter, or even impossible, to prove, in any given case of extensive necrosis of the temporal bone, that we are dealing with tuberculous disease. Furthermore, the formation of these large sequestra in the temporal bone has been known to follow a severe attack of scarlet fever, without the interposition, so far as could be judged, of tubercle bacilli. Consequently, when one of these large masses is cast off spontaneously, or is removed by operative interference, and the patient gets entirely well again, it is hard to maintain, with any degree of confidence, that the case in hand was a genuine instance of recovery from extensive bone disease due to tuberculosis of the middle ear. I have myself observed only one case in which I felt confident that my patient had really recovered from an extensive tuberculous necrosis of the temporal bone. Under these circumstances, therefore, I am scarcely warranted in saying very much about the prognosis of the disease. That it is very grave, but not absolutely unfavorable, is all that the facts permit.

DIAGNOSIS.—So much has already been said in various parts of the present article (in relation to the diagnosis) that it will suffice here simply to recapitulate the main points briefly. When the discharge is found, upon examination with the microscope, to contain tubercle bacilli, no further doubt can be entertained with regard to the nature of the disease. We are also warranted in feeling tolerably sure of our diagnosis when we find evidences, in other parts of the body, of the presence of tuberculous disease. The existence of multiple perforations in the membrana tympani, even when the presence of tubercle bacilli cannot be demonstrated, affords strong presumptive evidence of the tuberculous nature of the disease. The sluggish, asthenic type of the inflammation, the apparent ease with which bone caries develops, and the slight tendency of the tissues, or even the total absence of any tendency on their part, toward re-formation of the parts destroyed, furnish additional and strong evidence of the tuberculous nature of the disease.

A word more with regard to the search for tubercle bacilli. If we were to follow up all our cases of middle-ear discharge by carefully staining for the micro-organisms which are involved, I doubt not we should discover the tubercle bacillus where we never suspected it.

TREATMENT.—Under this latter head much or little might be said according to the view which is taken of the matter. It would seem perhaps better to consider first if there is anything specific for the tuberculosis which can be given as specific treatment *per se*. For example, lactic acid has been lauded in the treatment of tuberculous laryngitis, and has been thought by some to be almost specific in its working. Numerous experiments have been made in regard to tuberculosis of the ear, but, so far as I am able to judge, we have nothing for tuberculous disease in the ear which approaches being as nearly specific as lactic acid is for tuberculosis of the larynx. I have used this remedy by rubbing solutions of gradually increasing strength over the granulating surfaces in the middle ear, but have failed to get any better results than from other forms of careful treatment.

Iodoform has been recommended on account of the fact that it seems to act favorably upon tuberculous joints and bone tuberculosis in general. Perhaps it has some special usefulness in these cases, but I have not succeeded in obtaining specially favorable results. In view of the personal discomfort to the individual and to his environ-

ment which the use of iodoform always entails, and of the unfavorable results thus far obtained, I think it should never be employed.

Orthoform has been used in the advanced tuberculous cases in which the ulcerative process involved nerve trunks of sufficient sensitiveness to give more or less constant pain, and I have found that it acted, as it frequently does in the larynx, both to the comfort of the patient and to the cleaning up of the ulcerated surfaces.

The treatment then may be summed up under two heads: what the patient should do, and what measures the medical attendant should adopt. In mild cases in which the discharge is copious and the granulation tissue abundant, but without any involvement of the bone or any retention of large cholesteatomatous masses, the patient's portion of the treatment may be limited to the simple maintenance of cleanliness. A weak solution of carbolic or boric acid is to be syringed into the ear two, three, or four times a day, according to the amount of the discharge present. I have always found that the ear had less odor and was as a rule less offensive if, following the cleansing of the canal with an effective syringe, drops were instilled—as, for example, a solution of equal parts of glycerin and water containing one per cent. of zinc sulphate and two per cent. of carbolic acid. This simple astringent and antiseptic solution should be instilled warm into the ear.

In cases in which the granulation tissue seems to be abundant, equal portions of absolute alcohol and glycerin will be found to make an effective remedial solution for purposes of instillation. Before using this the ear should be very carefully dried out, as of course the effectiveness of this solution depends upon the hydrophilic properties of the materials employed. These instillations, if used at all, had better always follow the cleansing of the ear.

Peroxide of hydrogen is a much-used and in many quarters a much-lauded preparation, but it is more efficient when used by the physician himself than when given into the hands of the patient for daily use.

The physician who undertakes the treatment of a case of middle-ear tuberculosis should see the patient often enough to keep the granulations down, and if he succeeds in holding the disease in check, he has a right to believe that he is doing as well as can reasonably be expected.

It is only when the locality in which both physician and patient live possesses specially favorable climatic conditions that the former may hope to accomplish better results by the adoption of a more vigorous plan of treatment. Under ordinary climatic conditions, however, he should rest satisfied with the thorough cleansing of the ear; by which is meant that he should not merely syringe out the ear, but should also—by means of the swab and the curette, and by the use of the peroxide of hydrogen—remove all accumulations, of whatsoever nature, from every accessible place (more particularly the attic) where it may become lodged. After this has been accomplished, he should apply mild caustics to the granulating surfaces. If the latter are proliferating to such a degree as to produce polypoid masses, these should be removed by means of the snare or the sharp-edged curette. For simple stimulating purposes nitrate of silver, in strengths varying from fifteen to twenty per cent., will be found to answer well in this class of cases. Some authorities urge the necessity of using the stronger caustic preparations (chromic acid, nitrate of silver in the form of a solid bead) with great caution in cases believed to be of a tuberculous nature.

If the malleus is found to be necrotic, or the seat of a limited caries, this ossicle, together with all that may remain of the upper portion of the drum membrane, should be removed, in order that the freest possible drainage may be provided for the region of the attic.

Inasmuch as we can scarcely hope to do more than palliate the disease by the various measures which have been described above, and since it is further evident that even the most radical operative interference is not likely to be rewarded by materially better results, it is plainly our duty not to recommend these to this class of patients.

As regards the cases in which the tuberculous disease has produced such gross lesions as are shown in Figs. 1804 and 1805, it is not an easy matter to determine how far it is wise to proceed with surgical measures of a more or less radical character. Much will depend upon the condition of the patient's strength,—whether he can bear the strain of the operation,—and also upon the fact whether the sequestrum is or is not loose. If the patient's general condition is fairly good; if there are no evidences of meningeal, cerebral, or sinus involvement; and if the sequestrum appears to be of not too large size and disconnected from the surrounding living bone, it is fair to expect that operative interference will place the patient in a more comfortable condition and will probably prolong his life. That it can accomplish anything toward curing the disease is not to be expected.

As is so often the case with the treatment of these and other cases of tuberculosis, we can best sum up the whole affair by saying that each case will have to be treated thoroughly and solely on its individual merits or *pro re nata*.

Henry L. Scaïn.

EAR: SURGICAL ANATOMY OF THE MASTOID.—

The mastoid portion of the temporal bone takes its name from the nipple-like process which develops upon its outer surface to form the major insertion of the sternocleidomastoid muscle, but it comprises all the part posterior to this which articulates with the occipital bone and forms a considerable element of the skull base. Its demarcation from the petrous portion is indefinite and can be but arbitrarily stated by assigning to the latter all that encloses the labyrinth; but from the squamous portion it is easily separable at birth, and sometimes in later life, and its line of suture with the tympanic scroll is rarely effaced by growth. Its outer anterior part is largely enshathed by these portions, and, paradoxical as it may sound, much of our "mastoid operation" is done upon this extension of the squama (*vide* Fig. 1707, p. 622). Its surgical importance depends upon the liability of the tympanic structures within to incur septic infection, which is easily transmitted to it and to the more important adjacent structures, thus giving rise to a demand for intervention to eliminate such dangerous foci. Through the soft tissues, in life, little can be felt of the mastoid process except the convexity of the bony prominence, where the hairless skin and the periosteum form a thin covering, with only enough loose subcutaneous tissue to give free mobility to the skin (Fig. 1813). Inflammatory induration and oedema may distend this layer, however, to an inch or more in thickness, and so may render accurate palpation of the part impossible; but, so far as this difficulty is concerned, it is well to remember that, much as the two sides may differ in other respects, there is apt to be enough symmetry to make the other mastoid a fair criterion for the size and form of its fellow.

The mastoid process is a conoidal protuberance of the lower posterior portion of the temporal bone, and since it is in large part a response to the needs of the muscle inserted upon it, it shows an external form usually corresponding to the general osseous and muscular development of the individual; being large, rough, and massive in most strongly built males, and smaller, smoother, and thinner-walled in females and in males of slight physique. Its posterior boundary is partly marked by the deep groove of the digastric fossa, which intervenes between its apex and the skull base; anteriorly, its convex external surface slopes inward to become the back wall of the meatus. Above, it may be said to extend to the curving and often ill-defined temporal ridge which extends back from the root of the zygoma; but it is better to consider it as ending at the imaginary horizontal line on the level of the upper edge of the zygoma and the upper margin of the meatus. Almost exactly at the junction of these anterior and superior limits there may almost always be found a depressed groove or pit below which a spine or ridge projects toward the canal. This "suprameatal spine" (Fig. 1808), to which Henle and Bezold directed attention, is recognizable in the great

majority of cases and forms a fixed and definite guiding-point not only for the mastoid but also for the whole

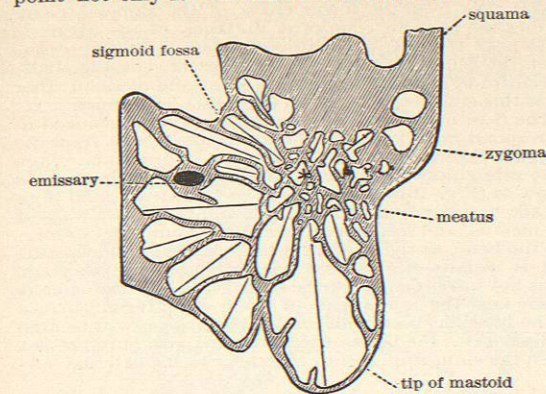


FIG. 1807.—Vertical Section of Mastoid Process at Right Angles to the Axis of the Auditory Canal, showing highly developed pneumatic cells and their radiating relation to the antrum. (After Eysseil.)

skull. Kiesselbach found it in eighty-two per cent. of juvenile and eighty-seven per cent. of adult bones, and I have rarely missed it among my specimens or in four hundred mastoids operated upon.

The mastoid process consists, externally, of a cortical lamina of compact bone, while in its interior it is more or less hollowed out by cavities, diploë or medullary in early life, but generally largely displaced, at a later period, by pneumatic extensions of the tympanum. As diverticula of the tympanic cavity these have a rather radiate arrangement in relation to it (Fig. 1807), and may extend not only throughout the mastoid but into all other portions of the temporal bone, and even inward, or backward into the occipital. They may be said to be always most marked in the large mastoids, fewer and more imperfectly developed in the less prominent ones. Zuckerkandl's finding that among 250 bones 36.8 per cent. were wholly pneumatic, and 20.4 per cent. wholly diploë, while in 42.8 per cent. various combinations of pneumatic spaces and diploë existed, has not been borne out by the writer's study of 500 temporals, which showed a surgically notable proportion of diploë in hardly 10 per cent. of adult bones. Whether the diploë or the pneumatic structure is the more prone to septic infection and transmission does not appear; and the spaces are devoid of known function except as aiding nature's economy of material in developing the process in response to the needs of the muscle inserted upon it. Their practical importance is that they in a sense hold away from the cortex the inner table and the deeper structures which are related to it.

These inner structures—which are the ones that concern us from a surgical standpoint—are the lateral sinus, the dura and brain of the middle cerebral and the cerebellar fossa, and the facial nerve; and while modern writings might seem to indicate that we now operate more often with the purpose of reaching than of avoiding them,

it will yet always be a piece of bungling needlessly or unintentionally to expose, still more to injure, any of them.

The lateral sinus occupies the sigmoid sulcus which grooves more or less deeply the inner posterior surface of the mastoid. The vessel itself is of very varying size, partly because the current of the longitudinal sinuses is rarely equally divided at the torcular—the main flow being often to the right; and the impress which it makes upon the bone is still more variable. In general, the larger

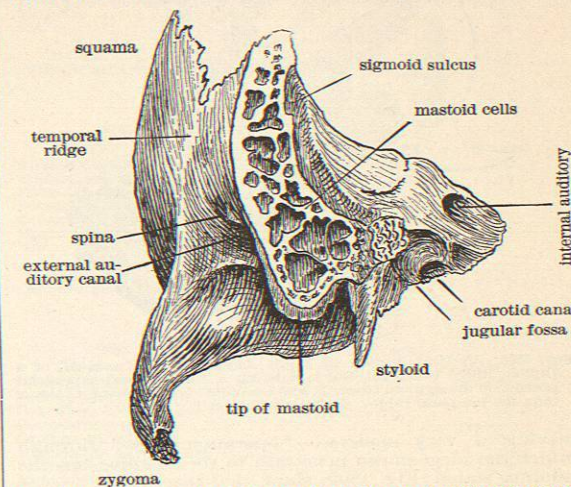


FIG. 1808.—Posterior Inferior Aspect of Temporal, sectioned nearly frontally to show the mastoid cells between the lateral sinus and the exterior, generally thin-walled toward the sigmoid sulcus and the digastric fossa within the mastoid tip.

the sinus is the more deeply do its curves hollow out the sulcus, pressing closer to the external auditory canal, to the mastoid cortex, or to both. The usual thickness of bone externally covering it averages 7 mm. (0 to 20), and this thinnest place is at a point averaging 17 mm. (0.5 to

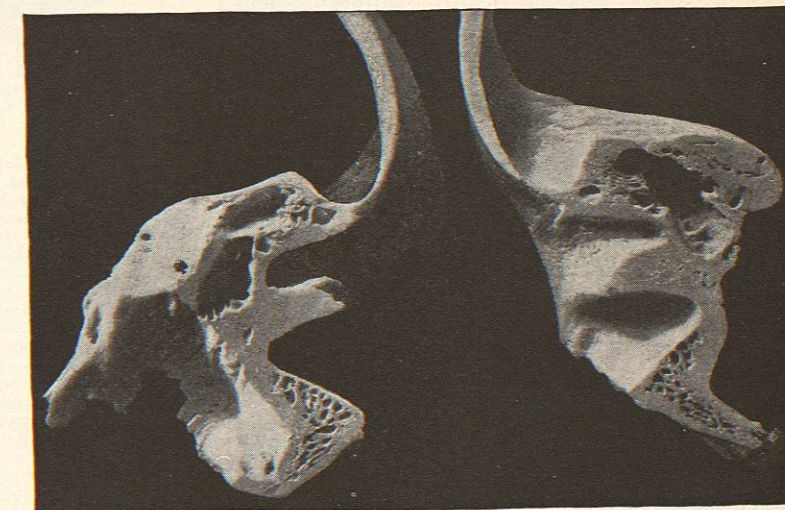


FIG. 1809.—Horizontal Section of Left Temporal Bone, showing an extreme anterior and superficial position of the sigmoid sulcus bringing the lateral sinus almost in contact with the meatus wall and the mastoid surface in the region of the spina, and rendering wholly impossible the ordinary operation for opening the antrum. (Randall, Photographic Illustrations.)