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. Swain.

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 sterno-cleido-mastoid 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 ensheathed 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 œdema 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

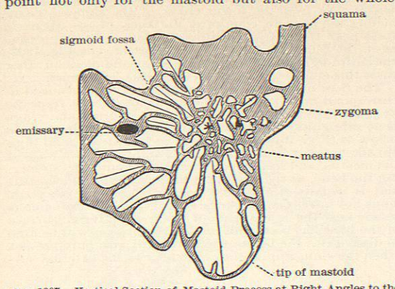

FIG. 1807.—Vertical Section of Mastoid Process at Right Angles to the Axis of the Auditory Canal, showing highly developed pneumatic cells and their radiating relation to the antrum ★. (After Eyssell.)

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, diploic 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 diploic, 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 diploic 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 oftener to the right; and the impress which it makes upon the bone is still more variable. In general, the larger

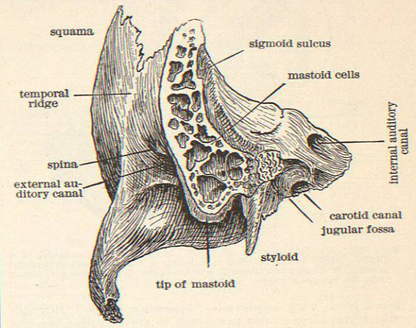

FIG. 1808.—Posterior Inferior Aspect of Temporal, sectioned nearly frontally to show the mastoid cells between the lateral sinus and the exterior, generally thin-walled toward the sigmoid sulcus and the digastric fossa within the mastoid tip.

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

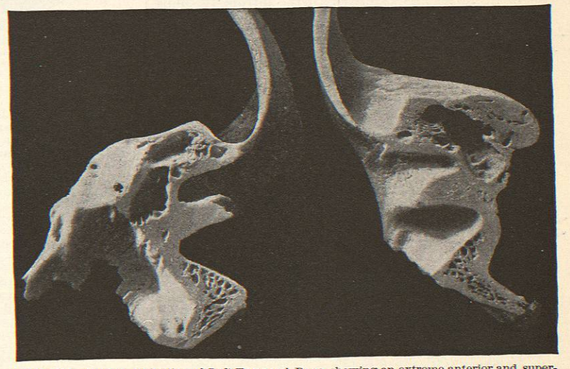

FIG. 1809.—Horizontal Section of Left Temporal Bone, showing an extreme anterior and superficial position of the sigmoid sulcus bringing the lateral sinus almost in contact with the meatus wall and the mastoid surface in the region of the spina, and rendering wholly impossible the ordinary operation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

40) back of the suprameatal spine. It approaches within 12 mm., on an average (0 to 25), of the external meatus,

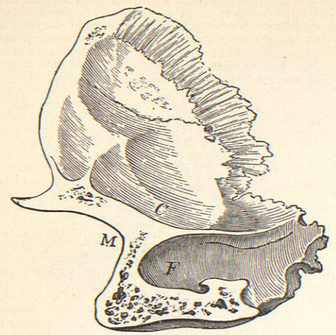

FIG. 1810.—Vertical Section at Right Angles to the Canal *M*, of a Diploic Right Temporal Bone, showing a forward and superficial position of the sigmoid fossa, *F*, and a middle cerebral fossa, *C*, lower than the temporal ridge. (After Hartmann.)

leaving a very moderate "operation space" through which the surgeon can penetrate to the antrum; but the minima stated (Fig. 1809) show that there can be no *assurance* of safe penetration in this direction, since no rule can be laid down by which the less favorable relation can be foretold. In spite of some assertions to the contrary it has been proved that the dangerous relations may be met in any type of skull and on either side. The only safe rule, therefore, is that of Hartmann, viz., to operate always as though the most dangerous relation were present until the contrary has been proved to be the fact. As regards its relations to the antrum, the sinus usually approaches it more nearly than it does either the

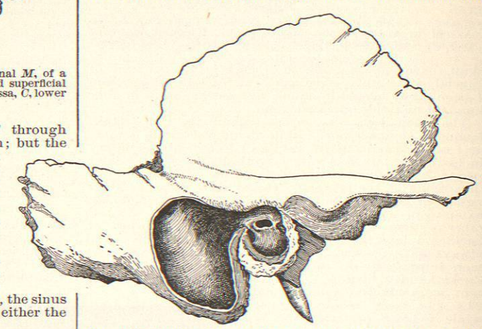

FIG. 1812.—Exenteration of Mastoid and Tympanic Cavities, showing prominence of facial canal above oval window, the sinus wall posteriorly, and the ridge covering the facial between.

outer surface of the mastoid or the external auditory canal, and the intervening bone is commonly occupied by cells. As a rule, therefore, the operator, in his work upon the mastoid, is brought into immediate touch with the thin wall of the sulcus—a structure brittle and easily penetrated even when healthy. A large emissary vein passes back from the lower curve of the sigmoid, channelling the bone to emerge at the back of the digastric fossa near the occipito-temporal suture. In rare cases, as in the fellow of the mastoid represented in Fig. 1809, the entire sigmoid sinus emerges here; and again in other cases this emissary may be as large as a lead-pencil.

The floor of the middle cerebral fossa has been said to correspond fairly with the ridge extending back from the zygoma above the meatus; but this supramеatal ridge is no safe guide, since the fossa not infrequently extends below it (Fig. 1810). The average height is 6 mm. (0 to 18) above the *spina supra meatum* and the upper wall of the meatus, and this should form our landmark in entering the bone, as the fossa can never be below the meatus and is usually higher and back of it. An embryonic sinus not infrequently persists along the petro-squamous suture near the lowest part of the fossa. If the surface of the bone has been well bared, the surgeon will be able to distinguish the bluish tinge which is generally present when the sinus approaches very near to the external sur-

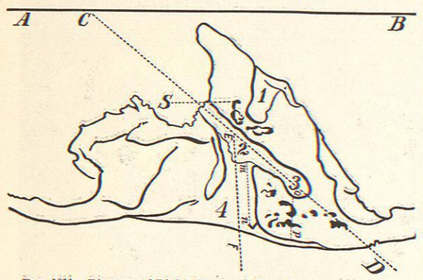

FIG. 1811.—Diagram of Right Temporal Bone Sectioned Horizontally and showing the Inclination of the Tubo-tympanic Axis, *C, D*, to the sagittal plane *A, B*; the length *m, n*, of the upper back wall of the meatus, and the depth, *o, p*, of the antrum from the operation point. 1, Meatus auditorius internus; 2, tympanic cavity; 3, mastoid antrum; 4, meatus auditorius externus. (After Allen.)

face. The outer wall of the antrum is rarely less than 15 mm. from the surface. (Fig. 1811.) Hence, in the adult, a penetration to a depth less than this will generally fail to enter the antrum. In the infant, however, the latter cavity is situated much nearer the surface. Nevertheless, one who has merely noted that it is just below the surface in the new-born will be surprised at the thickness of the bone which has to be traversed even in very young children before the antrum is opened. With them, fortunately, the separation of the sigmoid sulcus from the meatus is often actually, as well as relatively, greater than in adults, and, besides, this relationship is more constant. Mastoid operations should therefore be safer and easier in children.

The inner wall of the antrum is formed by the facial and semicircular canals (Fig. 1809); a fact which renders it dangerous, as regards the integrity of these important structures, unguardedly to enter this cavity, to curette its walls, or even in some cases to pack the cavity. Measurements indicate that the facial canal is probably never less than 12 mm. from the *spina*, although rarely more than 25 mm.; and the latter distance should in doubtful cases be the limit of our penetration even in a large mastoid.

The problem of avoiding injury to the facial nerve grows more difficult in exenteration of the tympanic

cavity, in Stacke's operation, or in the more radical tympano-mastoid exenteration. In either case it must be remembered that the canal of the facial forms the upper lip of the fossa of the oval window, and curves thence backward and downward to a point situated from 3 to 4 mm. back of the middle of the posterior margin of the tympanic ring. While the descending part of the

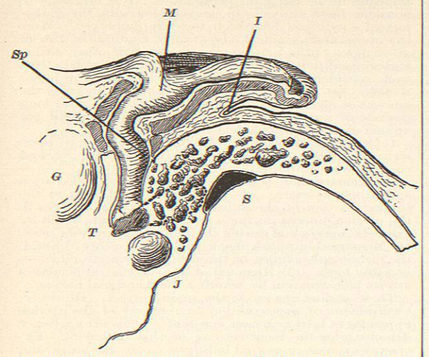

FIG. 1813.—Horizontal Section (upper half) of the Left Ear, with the Soft Parts in Place, showing the location back of the meatus, *M*, and the spina, *Sp*, of the posterior insertion of the auricle, *I*. The glenoid cavity, *G*, the tympanum, *T*, and the jugular, *J*, are also shown; and the sigmoid sinus, *S*, which in this case is safely distant from the field of operation, is seen to be most superficial opposite the insertion of the auricle. A dotted line indicates the antrum.

canal is usually exactly vertical, it seems clinically to pass somewhat outward, because we refer its course to the annulus and forget how very oblique the position of this really is. If we remove the tympanic margin above, without striking across to the inner side of the drum cavity (Fig. 1811), and in removing the posterior margin keep above its middle, the facial and its canal ought to remain untouched. A spur of bone at the back wall of the canal—largely the back portion of the tympanic scroll—will thus be preserved, and beneath this spur will be the facial canal (Fig. 1812).

It is well to note the relation of the soft parts to the underlying bony structures, as some errors in regard to this are prevalent. The incision preliminary to opening the mastoid has generally been made 5 or 10 mm. back of the apparent insertion of the auricle and parallel to its curve, and some of the older surgeons considered the boss of the mastoid, at or behind this insertion, as the proper point for entering the bone. At the present time the chosen point of entrance is well in advance of this, in the region covered by the concha (Fig. 1813). The finger thrust into the meatus and pressed upward and backward can generally feel the spina, and it is at a point close behind this that the chiselling usually begins. The insertion line of the auricle, back of the meatus, corresponds to the average position of the sigmoid sulcus at its most superficial and anterior position, *i.e.*, about 15 mm. back of the spina. *B. Alexander Randall.*

EASTMAN SPRINGS.—Berrien County, Michigan.
POST OFFICE.—Benton Harbor. Hotel.

Benton Harbor is in the midst of the fruit belt of Michigan, 60 miles from Chicago and 90 miles from Milwaukee. The springs are nineteen in number. Following are analyses of some of the representative springs:

KING DAVID SPRING.

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Sodium chloride	0.11
Sodium bicarbonate	.07
Potassium sulphate	.14
Calcium bicarbonate	8.12
Magnesium bicarbonate	3.53
Iron bicarbonate	1.29
Manganese phosphate	Well-marked traces.
Alumina	.11
Silica	.58
Total	14.55

Carbonic acid gas, 38.96 cubic inches.

SILVER QUEEN.

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Sodium chloride	0.09
Sodium bicarbonate	1.36
Potassium bicarbonate	1.07
Potassium sulphate	Traces.
Calcium bicarbonate	6.80
Magnesium bicarbonate	3.22
Silica	.11
Total	12.65

Carbonic acid gas, 35.46 cubic inches.

SILVER KING.

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Sodium chloride	0.10
Sodium bicarbonate	1.13
Potassium bicarbonate	1.05
Potassium sulphate	Traces.
Calcium bicarbonate	5.02
Magnesium bicarbonate	3.12
Lithium bicarbonate	3.03
Manganese phosphate	.01
Silica	.11
Total	13.57

Free of organic matter. Carbonic acid gas, 49 cubic inches.

BIMINI SPRING.

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Potassium sulphate	.05
Sodium sulphate	.52
Sodium chloride	.10
Sodium phosphate	.01
Sodium borate	Traces.
Sodium bicarbonate	.36
Magnesium bicarbonate	3.55
Calcium bicarbonate	7.48
Iron bicarbonate	.07
Alumina	.03
Silica	.54
Total	12.61

Gas not estimated.

GOLDEN FOUNTAIN.

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Potassium sulphate	0.11
Sodium sulphate	.26
Sodium phosphate	.04
Sodium chloride	.09
Magnesium sulphate	.18
Magnesium bicarbonate	3.21
Calcium bicarbonate	8.20
Iron bicarbonate	.38
Manganese bicarbonate	Traces.
Alumina	.01
Silica	.40
Total	12.88

Gas not estimated.

Other well-known springs are the "Colonel's Own," the "Saul," the "Psyche," and the "Winans."

This is quite a remarkable group of springs. They all appear to be more or less carbonated, some of them quite heavily so. They differ from most of the springs of Michigan in containing a much smaller proportion of chloride of sodium. The waters undoubtedly possess considerable medicinal value. Facilities for mineral and mud baths will be found at the springs; the waters are also used commercially. *James K. Crook.*