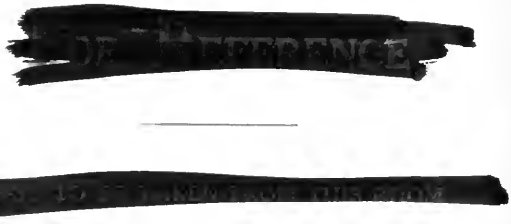

OPERATIVE SURGERY

OF THE

NOSE, THROAT, AND EAR

OPERATIVE SURGERY

OF THE

NOSE, THROAT, AND EAR

FOR LARYNGOLOGISTS, RHINOLOGISTS, OTOLOGISTS, AND SURGEONS

BY

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VOL. II.

OPERATIVE SURGERY OF THE NOSE, THROAT, AND EAR.

CHAPTER VII.

OPERATIVE SURGERY OF THE NASAL CAVITIES.

By Hanau W. Loeb, M.D.

The history of the development of operative surgery of the nasal cavities affords very interesting reading. Before 1885, it was almost entirely limited to occasional major work about the nose and to the removal of polypi by methods which had been handed down with but slight modifications from Hippocrates and his successors.

The discovery of the anesthetic properties of cocain by Koller in 1885 was soon followed by its employment in a large variety of minor operations which were put into use on an extensive scale.

For some years operations were almost altogether performed in the office under very slight, if any aseptic conditions. This is not surprising considering that asepsis was but meagerly understood and that but few of the practitioners had had any training in that direction.

Asepsis.—During the past fifteen or twenty years, however, the field of operative surgery of the nose has increased so tremendously that it requires a more rational surgical basis and a stricter compliance with the rules governing the practice of surgery in other regions of the body. Fortunately, serious infection following nasal operations is exceedingly uncommon and this circumstance, coupled with the good results which are possible where the fullest aseptic details are not observed, accounts for the reluctance which some have felt about changing their methods. A closer study not only of the results of operations but also of the comfort of patients and of the remote effects of mild

infections, e.g., the interference with healing, is sure to convince anyone of the value of closest attention to aseptic details, and of the unpleasant possibilities which result when they are neglected.

Naturally everyone, nowadays, realizes that all instruments should be sterile and that all cotton, gauze, etc., used during the operation should be subject to the necessary sterilizing process. This implies instrument, utensil, and dressing sterilizers such as are found in all well organized modern hospitals. Activity in this direction should be carried far enough to include the sterilization of gowns, towels and everything that may come within the range of the operative field.

The operator, assistants, and nurses should comply with the re-

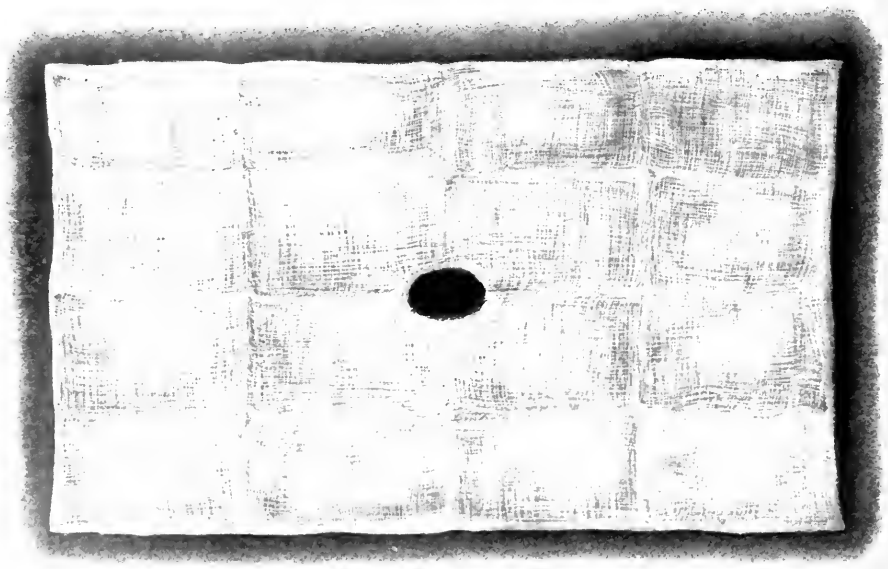


Fig. 110.
Mask for covering the face.

quirements exacted of those who operate upon other parts of the body. The hands and wearing apparel during operations should therefore be treated according to the usual rules.

While it must be admitted that sterile gloves are not absolutely essential for operative work about the nasal cavities, they possess many advantages. In the first place the assurance of sterile hands is worth a great deal; in the second place, the cotton saturated with cocain and dressings may be handled without the slightest fear of contamination; and, finally, the discipline resulting from the constant

practice in this particular, is of tremendous value when operating with gloves is required.

The preparation of the field is still an open question. Some maintain that the nose should be washed out with some watery solution more or less antiseptic; some apply the iodin solution to the vestibule. It it doubtful, however, if any decided degree of sterilization can be accomplished by douching the nose, and this practice should be used only when it is necessary to remove pus and crusts from the nose. The mucous secretion is said to contain certain enzymes which are bactericidal. Furthermore, it is quite likely that the system has become

Fig. 411.
Position of patient on table.

immunized against the bacterial flora of the nose; the danger lies in the introduction of other bacteria.

In order to avoid any break in the asepsis, the patient's body and extremities should be covered with a sterile sheet and the face with a sterile gauze mask in which there is a small opening for the nose. (Fig. 410.)

Position of the Patient.—We have inherited from the early days of rhinology, the practice of operating with the patient sitting in a chair in front of the operator. This is inconvenient and tiresome to the operator who must strain the muscles of his arm while his fore-

arm is more or less extended to reach the level of the nose. It is unpleasant for the patient who is compelled to sit up during what may be a tedious operation in spite of the tendency to faint from fear, cocain, or cerebral anemia; furthermore, he can be kept in proper position only when an assistant holds the head.

The recumbent position with the head slightly elevated offers relief from these disadvantages. The operator is, as it were, operating down on his patient instead of up; he may stand or sit, as he pleases, his instruments are convenient, his patient does not faint and no assistant is necessary to hold the head. The arrangement of the table, operator, light, etc., is well shown in Fig. 411.

Hospital Advantages.—With the requirements demanded by the new technic, it is clear that nasal operations are best performed in the hospital. Unless one has a very elaborate organization, he cannot hope to have adequate asepsis in his office; his routine work is not disturbed when he operates in the hospital rather than in the office; packing is required to a far less extent; and finally an organization of operative work on the nose can be established in the hospital which can be made of great value not only to the patient, physician, and hospital, but to rhinology as well. Patients should be wheeled to their rooms after operation instead of being allowed to walk. By keeping the head low, the patient is assured of greater comfort and post-operative fainting is prevented.

OPERATIVE SURGERY OF THE SEPTUM NASI.

Submucous Resection of the Septum Nasi.

The operation designated submucous resection of the nasal septum was introduced by reason of a desire to overcome the discomforts and unsatisfactory results of the removal of septal spurs by saws and chisels, and of crushing and cutting operations, so long in use. How completely this has been achieved is evidenced by the present rarity of these operations which had been made popular by Bosworth, Asch, Gleason, etc.

Although some observers had previously elevated the mucoperichondrium before removal of the bone or cartilage, Krieg, in 1886 and 1889 advocated the removal of the convex portion of the septum with its mucosa while leaving the concave mucosa intact.

Boenninghaus in 1899 announced a decided improvement in the technic which included the removal of the bone as well as cartilage, but after all, the present method was established by Killian, Freer,

and Hajek about the same time, viz., 1904. Killian and Freer perhaps deserve the greatest credit for its widespread adoption, the former for his clear description of the principles underlying the operation, and the latter for his earnest and painstaking efforts to popularize it in America. Ballenger's swivel-knife was a great contributing factor in the development of the operation. As now practiced, the operation has a real modern surgical basis, a statement which could be made of very few intranasal operations before its advent.

Indications.—The purpose of the operation is to establish a straight septum by removing all bone and cartilage that encroach from the perpendicular into either nasal cavity, at the same time retaining the mucosa on both sides. The indications therefore may be summed up as follows: Whenever a deviation, ridge, or spur of the septum causes or is likely to cause undue interference with the function of the nose or has induced or is likely to induce other harmful conditions in the nose, ear, or respiratory tract, the operation is indicated. For the marked cases, the indication is plain; for the more doubtful ones, the judgment of the operator alone must be the guide, or the operation must be postponed until the symptoms become more positive. A slight deflection may be the cause of a tubal inflammation; a marked deflection may exhibit no symptoms for years in children and young adults; a minor deviation in the middle turbinate region may be the cause of much trouble in the sinuses. The operation is also indicated when a visible deformity is present by reason of displacement of the anterior portion of the cartilage of the septum and when a small septal perforation exists which may be closed by the operation.

Contraindications.—1. Age.—After the age of fifty, the indications should be exceedingly definite, if an operation is to be performed. As a rule whatever harm can result has already transpired and the benefit to be derived may not justify the operation. However, in chronic catarrhal or suppurative middle ear conditions and in chronic sinus affections when the deflection interferes with drainage, there is, on this account, no contraindication.

It is inadvisable to perform the operation on patients under fifteen, for the reason that the development of the nose is not completed and it is unwise to interfere with this development by so radical an operation. If, however, the obstruction is considerable and the symptoms are marked, it will be well to do a modified operation, that is, to remove and to resect submucously sufficient of the convex portion of the septum to permit adequate breathing. The complete operation may be performed at a later time. This is better practice than to per-

form one of the older operations such as Gleason's, which permits only a modicum of success and makes the eventual submucous resection more difficult of performance.

2. Acute Inflammations of the nose and throat and ear call for a delay in the operation for obvious reasons.

3. Suppurative Processes in the Nose. It is best to postpone the operation until suppurative processes in the nose have been checked, unless the deflection itself is the basis of the suppuration. In any event, it is better in unilateral suppuration to operate through the unaffected side.

4. Concurrent Diseases. Cancer, diabetes, and other conditions likely to become fatal in a short time are contraindications for obvious reasons. Tuberculosis as a rule contraindicates the operation but when the condition, if not too far advanced, is showing a tendency to improve and when imperfect nasal respiration compromises the patient's well-being, the operation should be performed.

Syphilis in the active state calls for a postponement of the operation. Furthermore, it is well to exclude tertiary syphilis of the nose before operating, as there have been some cases of nasal deformity following the operation performed under those circumstances.

Hemophilia or low coagulability of the blood must be considered as contraindication factors.

Pregnancy calls for postponement of the operation unless the indications are specially urgent.

5. Vocation. Any vocation which subjects the nose to injury is a bar to the operation or suggests an incomplete operation, one that will weaken the septum less. Thus boxers, football and baseball players should be considered as a special class when estimating the indications for the operation.

6. Combined Operations. An operator is often tempted to combine the submucous operation with others, as for instance, resection of the middle turbinate, exenteration of the ethmoid, removal of the tonsil, etc. It may be laid down as a principle that simultaneous operations on the throat and nose of any considerable magnitude are not advisable. Combined operations within the nose may be performed, but the operator must expect a greater reaction and increased danger dependent on the extent and character of the two operations.

Preparation. Some operators go to a great deal of trouble preparing the field of operation by washing out the nose with a mild antiseptic or saline solution, some prepare the vestibule by the usual application of the iodin solution and others limit their preparation of

the field to cutting off the vibrissæ. The greatest reliance to insure asepsis should be placed on the suggestions made (see page 1) for preventing non-sterile appliances from reaching the field of operation.

Cocain anesthesia is very generally used, though some, for example, Mosher and Beck, prefer general anesthesia.

A satisfactory local anesthesia may be secured by filling each nasal cavity with larger or smaller pieces of cotton which have been dipped in a ten per cent solution of cocain. It is best to remove the cotton from the convex side and renew the cotton applications, as, on account of the pain, it is often impossible to reach every portion of the septum in the obstructed nasal cavity with the first application. After the

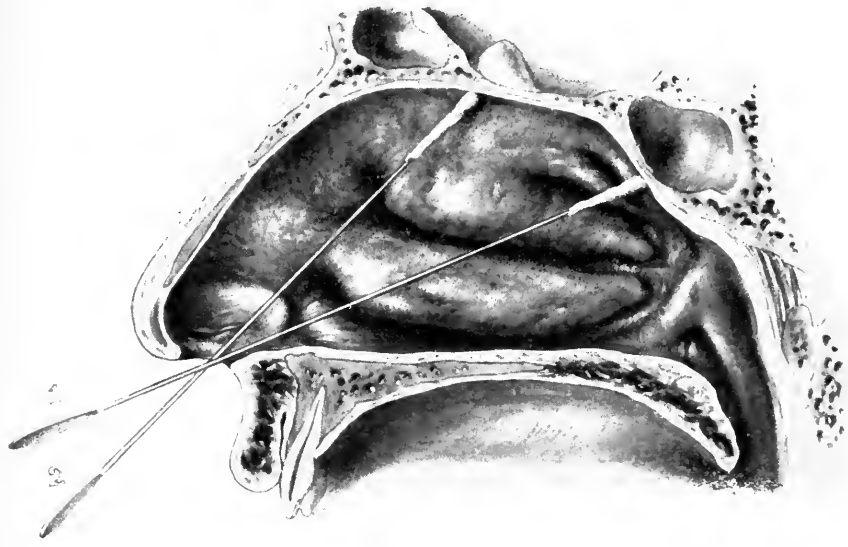


Fig. 412.

Application of cocain to the vicinity of the nerve trunks.

cotton has remained for from eight to twelve minutes, it is then removed and cotton moistened with one of the adrenal solutions is inserted and allowed to remain for two or three minutes. It is well to inject a solution of novocain, one-half of one per cent, below the mucosa at the vestibular portion of the septum as this does not take up the cocain sufficiently to produce complete anesthesia.

A 20 per cent solution of cocain applied for a shorter time may also be employed coincidentally with or without the adrenal solution.

*The author herewith expresses his thanks to Dr. R. Bishop Canfield, under whose supervision were made the drawings for Figs. 412, 414, 420, 426, 427, 428, 432, 437, 440, 441, 453, 454, 455, 456, 458, 459, 461, 474, 478, 481, 492, 493, 494, 495, 496, 497, 498, 505, 506, 517, 518, 519, 521, 543, 544, 545, 560, 563, 564, 565, 566, 567, 569, 570, 571, 572, 583, 586, 587, 588, 589, 603, 614, 615, 617, 634, 635, and 636.

If a 5 per cent solution of cocain is used, it must be retained for a longer time in contact with the nasal mucosa.

Another method comprises the use of cocain flakes moistened with one of the adrenal solutions and applied to the septum. Both nasal cavities are sprayed with a two per cent cocain solution, or the solution is applied to the mucous surface with cotton. A small nasal swab is dipped in a 1 to 1000 solution of adrenalin chlorid and the excess of the solution removed by squeezing the swab. This is then placed in the cocain flakes which have been put into a sterile watch crystal or shallow bowl (two grains being the limit of dosage for this operation). The cotton with the cocain which adheres is applied to the septal mucosa until it is completely anesthetized.

Submucous injections of one-fourth to one per cent solutions of novocain or other safe anesthetic along the nerve trunks have been

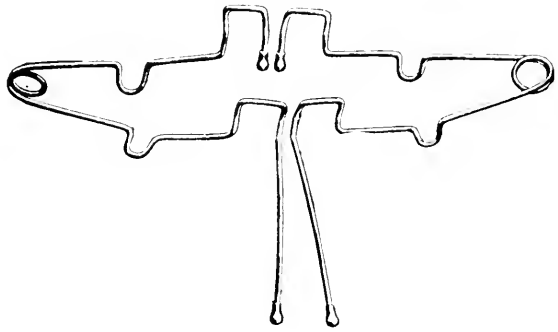


Fig. 413.

Hefferman speculum.

used with good effect by some, and applications of a 20 per cent solution of cocain as shown in Fig. 412 are efficacious.

Incision.—It is best to make the incision on the convex side, though most operators find it more satisfactory to operate when the incision is made on the left side of the septum. When the incision is made on the side on which the convexity is extreme and when there are sharp ridges, the tears, which are apt to occur in the mucosa under the circumstances, will be confined to the incised side while the opposite nasal cavity remains entirely intact. This plan will obviate post-operative perforation which occurs when there is a junction of perforating wounds of the two opposing mucous membranes.

Much of the deftness in making this incision depends on the use of a proper nasal speculum. Some form of bivalve speculum with which the operator is familiar will be found of value or one of the

self-retaining types, such as Hefferman's (Fig. 413) is particularly serviceable.

The incision (Fig. 414) commonly used is that of Killian, more or less curvilinear just behind the anterior border of the cartilaginous septum. Hajek's incision is made anterior to this in the vestibule. It is sometimes advisable to make an incision with a horizontal portion directed forward, or over the ridge, in fact it often happens without any unpleasant consequences that the mucosa is torn at this place during the process of elevation of the mucoperichondrium. The incision is best made with Freer's knife (Fig. 415), through the mucoperichondrium. It may be necessary to make several cuts to complete

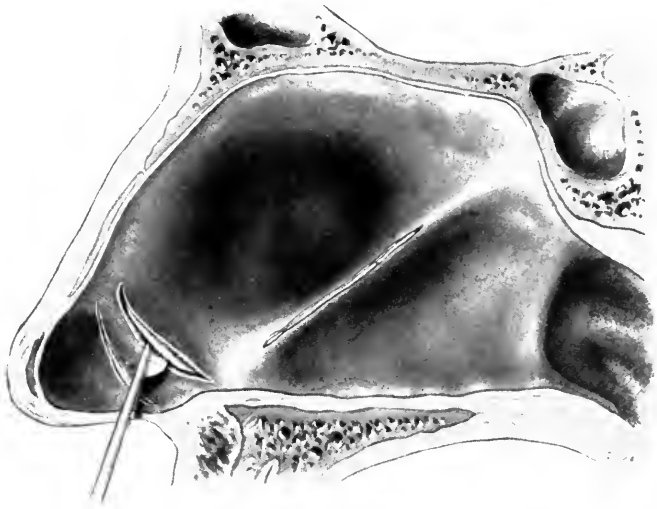


Fig. 414.

Incisions for submucous resection.

the incision down to the cartilage, but this is essential if the mucoperichondrium is to be properly elevated. It is important to limit the depth of the incision to the cartilage, otherwise an unusually deep incision may penetrate the mucosa on the other side.

There may be a little bleeding as the adrenal solution does not act well on a mucous surface that is approximating a cutaneous character. Small pieces of cotton placed between the lips of the wound soon check this bleeding. If a spurting artery is encountered, the bleeding will stop upon the application of a mosquito forceps.

Elevating the Mucoperichondrium.—For this purpose the writer has found the Freer sharp elevator (Fig. 416) the most serviceable instrument, applicable practically under all circumstances. However,

one must be accustomed to its use, otherwise it may be carelessly thrust through the mucous membrane. The duller elevators such as the Hajek-Ballenger's (Fig. 417), Killian's (Fig. 418) and Hurd's (Fig. 419) are less disposed to cause this accident. It is essential that the entire mucoperichondrium be included in the elevation, if this is to be accomplished without tearing. Most of the damage is done by elevating the external layer while the internal layer remains attached

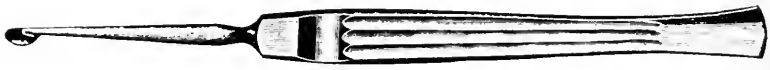


Fig. 415.
Freer's knife.

Fig. 416.
Freer's elevator.

Fig. 417.
Hajek-Ballenger's elevator (blunt).

Fig. 418.
Killian's elevator.

Fig. 419.
Hurd's elevator.

to the cartilage. Unless the cartilage appears glistening white at the incision, the operator may be sure he is not elevating the entire mucoperichondrium. Fig. 420 shows the best method of stripping the mucoperichondrium from the septum. Difficulty is experienced over extreme convexities and sharp ridges where great circumspection must be exercised. As has been pointed out, it often happens that fibers pass from one mucosa to the opposite at the ridge so that unless these fibers are cut, a tear is sure to result. However, as has already been

stated, this single straight tear will not be of any detriment whatever provided the corresponding portion of the mucous membrane on the other side is free from any wound. The fibers are best cut with the Freer knife.

It is also difficult to elevate the mucoperichondrium when the operation is secondary to a previous submucous resection and especially when one of the cutting or crushing operations has already been performed or if an ulcerative process has been present. Under such circumstances, the adhesions may be so great that perforation cannot be avoided. It is sometimes necessary virtually to dig the bone and cartilage out of the mass of cicatricial tissue. Sometimes the car-

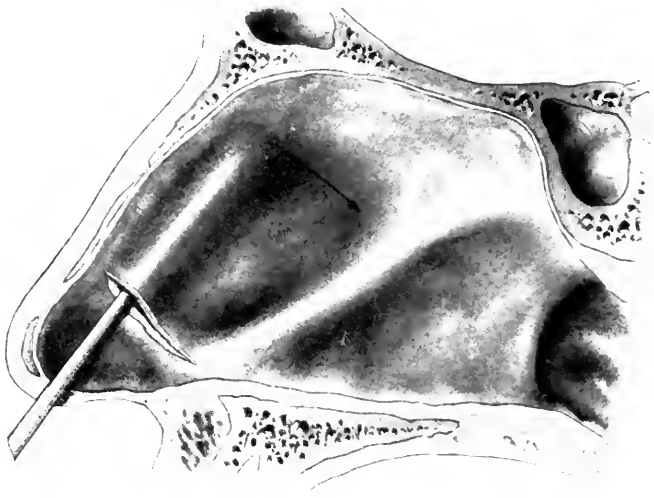


Fig. 420.

Elevating the mucoperichondrium.

tilage of the septum is displaced backwards, folded on itself, and massed together with a cicatrix. These cases require the greatest care and patience if a perforation is to be prevented. The cartilage is to be removed piecemeal as soon as a portion is uncovered. A previously resolved hematoma or septal abscess will leave adhesions which greatly impede the separation of mucous membrane and requires great skill for satisfactory results.

When there is much adhesion, it is often better to remove a portion of the bone and cartilage before completing the elevation of the mucoperichondrium. The elevation is complete when the septum has been stripped of the mucous covering from the floor of the nose to a reasonable distance from the roof, and from the incision as far back-

ward as desired. The region of the cribriform plate should be a *noli me tangere* in all nasal operations; at any rate it should be approached with great respect.

Incision Through the Cartilage.—The next step is to cut through the cartilage without wounding the mucosa on the opposite side. Va-

Fig. 421.
Ballenger's knife.

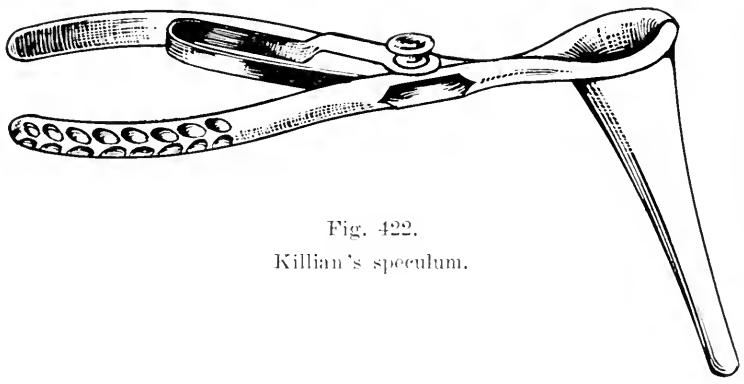


Fig. 422.
Killian's speculum.

rious expedients have been used to accomplish this. Beck's plow cuts a trough deeper and deeper until the cartilage is penetrated without endangering the mucosa. Some use a sharp elevator but the best plan, if the operator has any technical skill, is to use the Freer

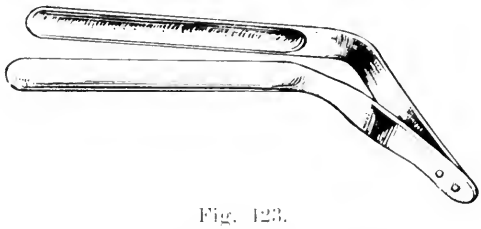


Fig. 423.
Foster Ballenger's speculum.

knife or the Ballenger knife (Fig. 421) to cut through the cartilage where the original incision was made. Some insert the finger in the opposite nostril, but this is unnecessary. Very little experience is required to tell just when the knife penetrates the cartilage without going through the opposite mucous membrane. The incision through

the cartilage should extend as far as the primary incision in the mucous membrane.

Elevation of the Opposite Mucoperichondrium.—The cartilage incision being completed, it is easy to insert a sharp elevator between this and the mucous membrane. With great care, the opposite mucous

Fig. 424.

Foster-Ballenger's speculum in position.

membrane is then elevated, the process being observed through the corresponding nasal cavity. If this is properly done, the mucous membrane peels away with great ease and the dissection is completed. The same difficulties may prevail in this elevation as were mentioned in the discussion of the other side.

Fig. 425.

Ballenger's swivel-knife.

Removal of the Cartilage and Bone.—The mucous membranes are now held apart either by the long Killian (Fig. 422) or the self-retaining Foster-Ballenger speculum (Fig. 423), one blade being between the cartilage and the mucous membrane on the side of the incision, and the other inserted through the cartilage incision and between the septum and the mucous membrane of the opposite side (Fig. 424).

As much of the cartilage as possible is then removed, preferably by the Ballenger swivel-knife (Fig. 425) or by the Freer knife or by forceps. The swivel-knife cuts in whatever direction it is pressed

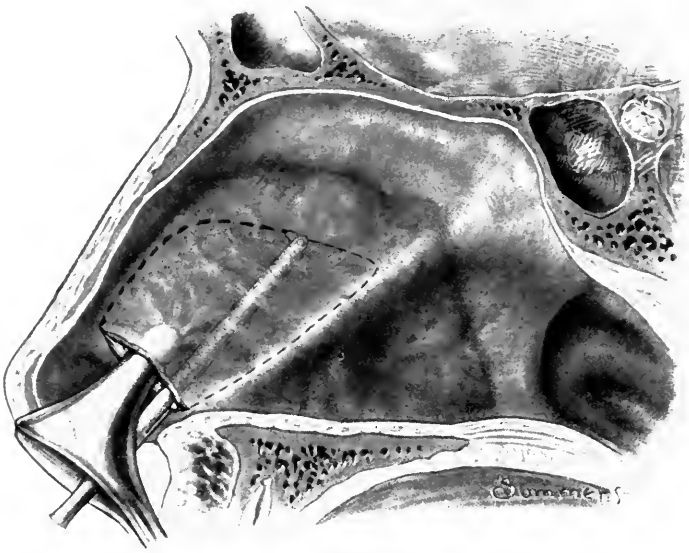
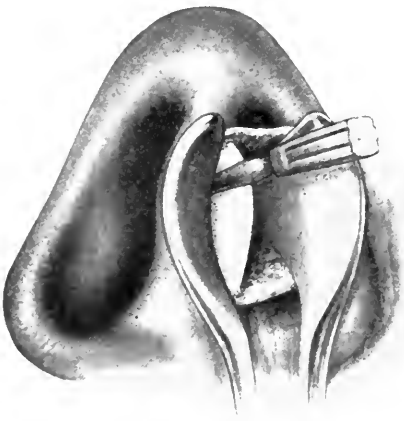


Fig. 426.

Method of using Ballenger's swivel-knife.



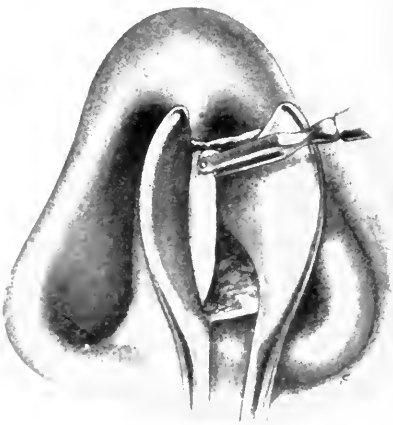


Fig. 427. Fig. 428.

Method of using Ballenger's swivel-knife with Killian speculum.

and hence by being pressed backward from the upper limit of the cartilage incision, then downward and then forward, the entire cartilage or at least a large portion of it may be removed. (Fig. 426.) The method of using this knife is shown in Figs. 427, 428, 429 and 430.

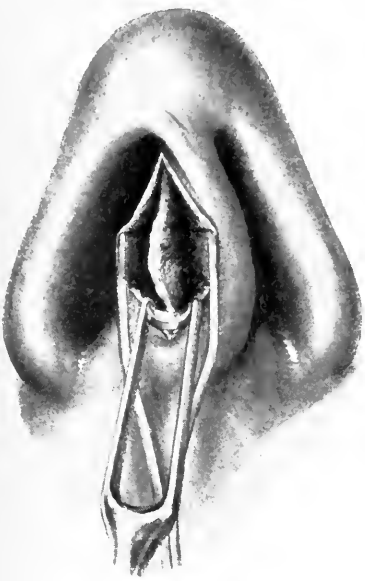


Fig. 429.

Fig. 430.

Method of using Ballenger's swivel-knife with Foster-Ballenger's speculum.

Fig. 431.

Appearance of septum after removal of cartilage.

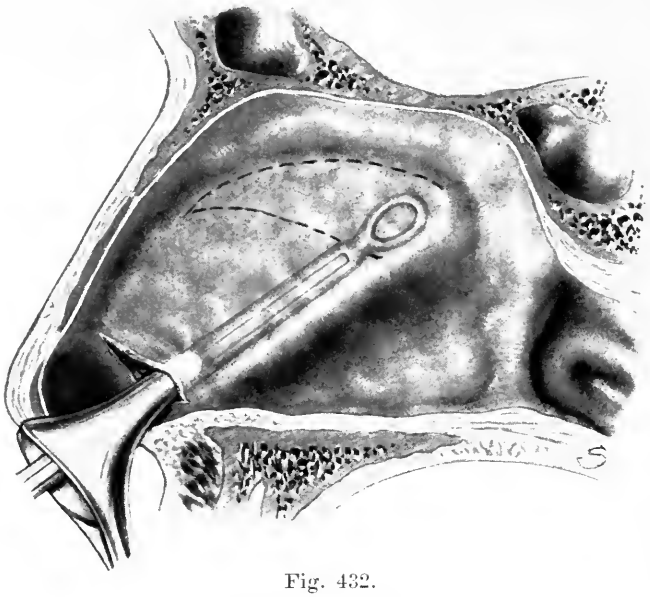


Fig. 432.
Removal of bone.

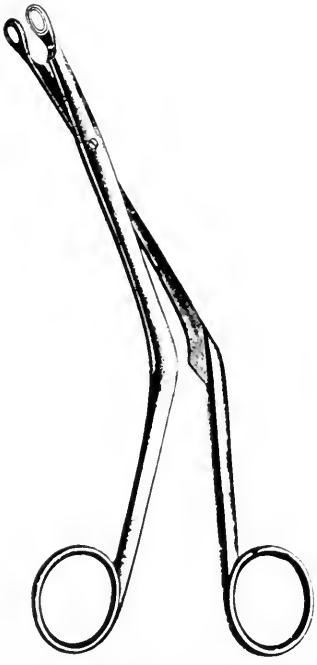


Fig. 433.
Brünings' forceps.

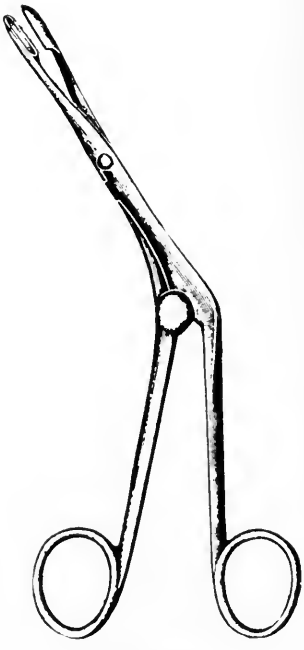


Fig. 434.
Knight's forceps.

The appearance of the septum after removal of the cartilage is well shown in Fig. 431.

A large portion of the bone posterior to the cartilage may be removed by forceps (Fig. 432) such as Brünings' (Fig. 433), Knight's (Fig. 434), Killian's (Fig. 435), or Freer-Grünwald's (Fig. 436). They should be employed so as to limit the fracture line and special precaution should be exercised in this respect when working in the vicinity of the cribriform plate.

The removal of the nasal crest (Fig. 437) is best accomplished with a chisel, Hajek's (Fig. 438) or Ballenger's (Fig. 439), although the

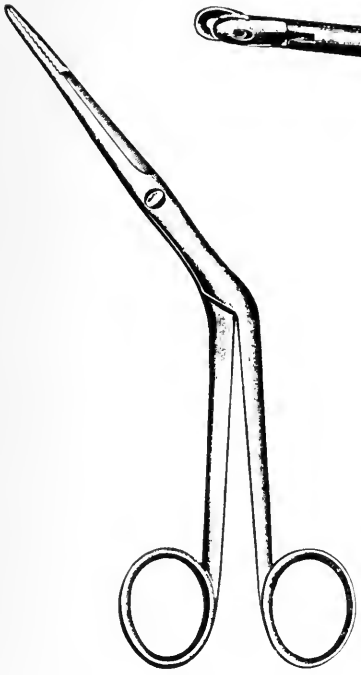


Fig. 435.
Killian's forceps.

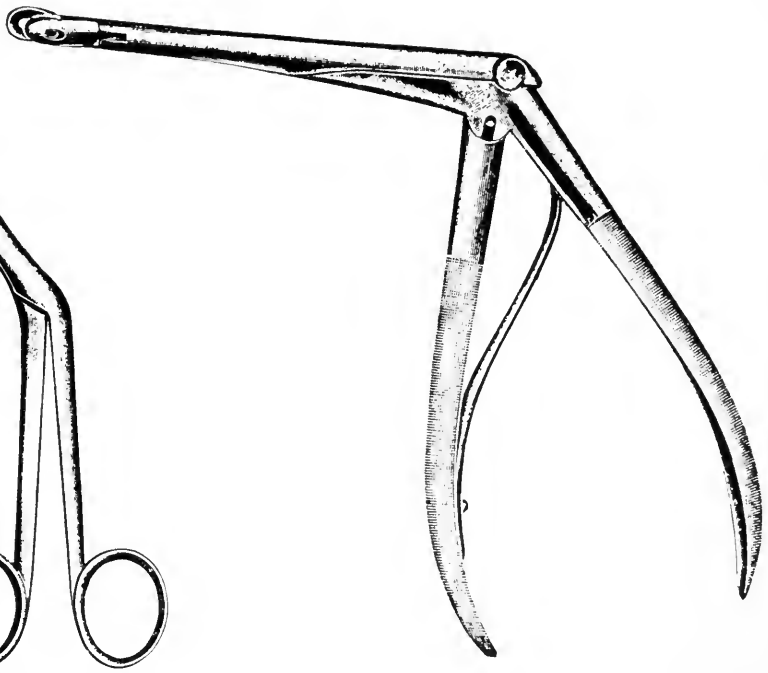


Fig. 436.
Freer-Grünwald's forceps.

Brünings or Knight sharp forceps will be sufficient in most cases. In the removal of the crest, there is great danger of wounding the mucosa as there may still be some fibers attached to it and it lies so low in the field that its attachment can easily escape notice. With the two mucous membranes approximated it is easy to note any remaining deflection, cartilaginous or bony, which can be removed from between the membranes with knife or forceps. It is then well to examine the field of operation for any loose pieces of bone or cartilage which may have become lodged between the two mucous surfaces.

When the deflection extends to the anterior border of the cartilaginous septum or when this anterior border is displaced into either vestibule it may be advisable on account of the danger of perforation to postpone its removal until a subsequent sitting, but this is a matter for the judgment and experience of the operator. (See page 23.)

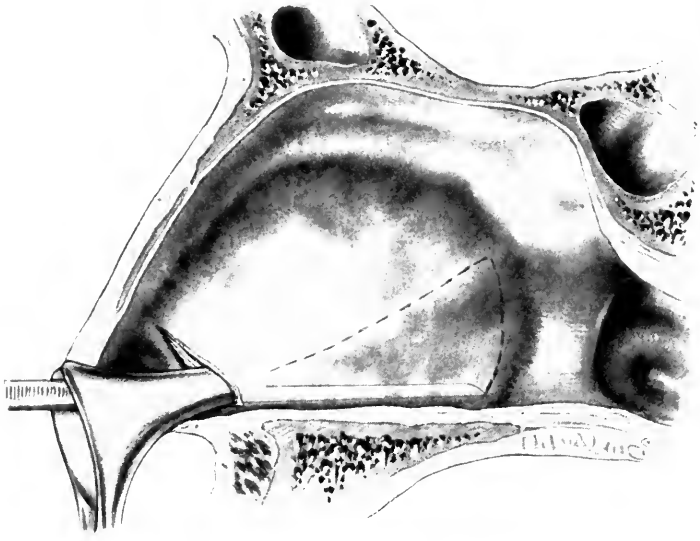


Fig. 437.
Removal of nasal crest.

Any tears that may be likely to result in perforation should be sutured. Some operators prefer to suture the original incision in every case. (Figs. 440 and 441.) This, however, is by no means neces-

Fig. 438.
Hajek's chisel.

Fig. 439.
Ballenger's chisel.

sary as the healing is not delayed and the drainage which the slight opening permits is probably of value. (For details of the nasal suture, see page 116.)

Freer uses a method which is somewhat elaborate in the instru-

mentation. (Fig. 442.) An incision in the shape of a letter L looking backward (Fig. 443), is made, the vertical cut following the vertical deflection, beginning high up on the septum above the deviation, the horizontal portion extending backward along the crest. An anterior flap is thus constituted. For crest-like deflections, an incision is made from behind forward along the whole length of the crest. This forms a superior instead of an anterior flap. Round-edged and half round-edged knives are used for the cuts in the mucous membrane.

The mucous membrane is carefully elevated, the sharp knife being used when necessary. The cartilage is cut through in the way

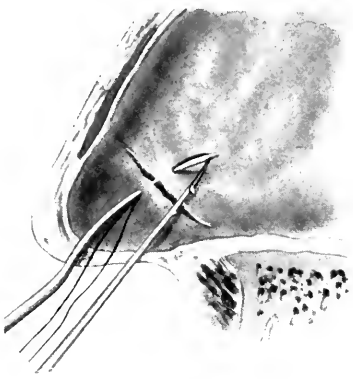


Fig. 440.
Introducing the needle.

Fig. 441.
Tying the knot.

already described. The Freer knife is used to cut away cartilage. Grünwald's forceps or Freer's modification are used for removal of the bone.

Dressing.—There is a great variety of opinion as to dressings. Among the most common are ordinary gauze strips a half an inch in width, the Bernays-Simpson splint moistened with water, peroxid of hydrogen or tincture of benzoin or other agent, after being placed in position, the Bernays-Simpson splint covered with rubber tissue and the various self-retaining splints of which Todd's (Fig. 444) is one of the latest. Some use the dressing on one side and some on both sides.

There is also a great difference of practice as to the length of time the dressing is to be retained. In the fear of hemorrhage and hematoma, some retain the dressing for forty-eight hours and others for twenty-four hours.

The author's practice is to use the cigarette drain (strips of gauze

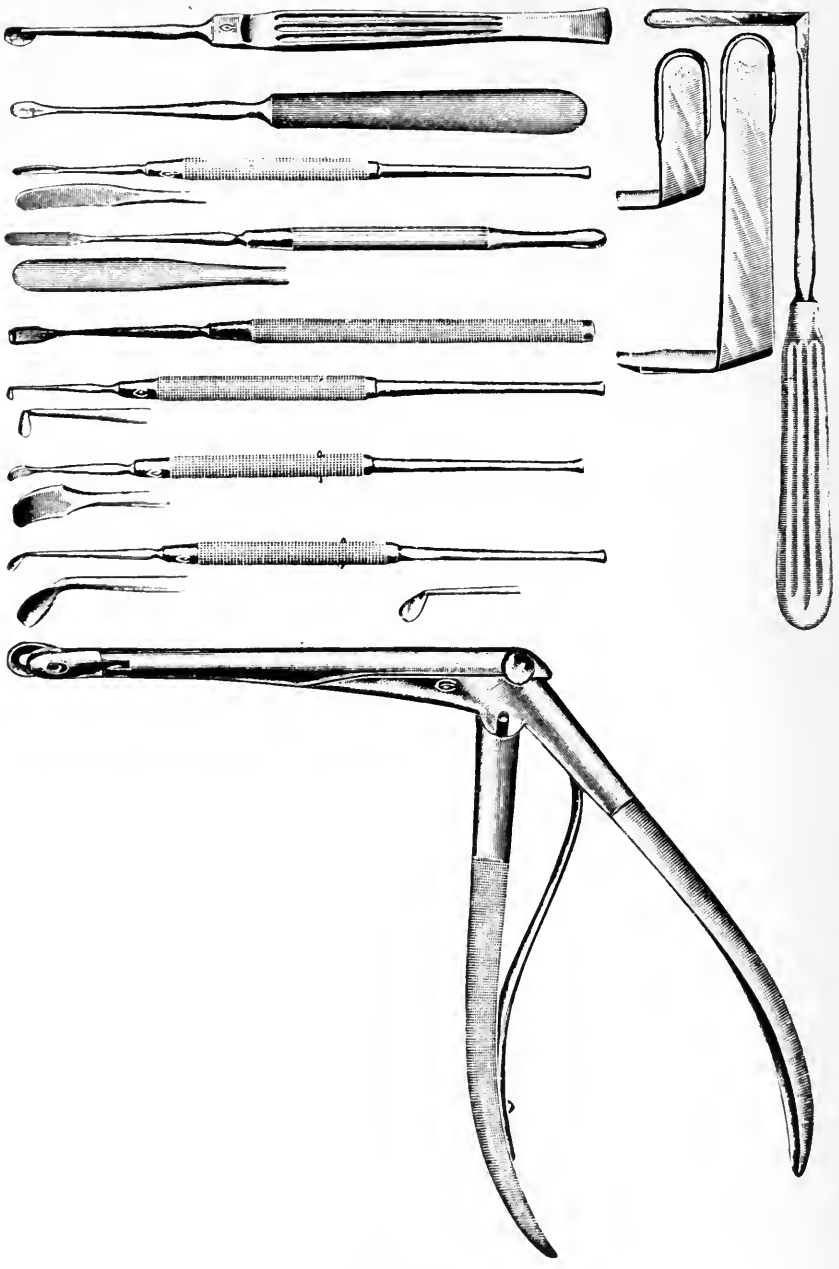


Fig. 442.

Freer's submucous instruments.

covered by rubber tissue). Two are generally sufficient; they are placed on the incised side only and are removed in from eight to ten hours after operation. No pain and very little bleeding are occasioned

and it was found necessary only once to replug the nose in ten years of this practice; hematoma has not occurred and patients are obviously more comfortable than is possible when the plug is retained a longer time.

When the dressing is removed, the patient sits up in bed with

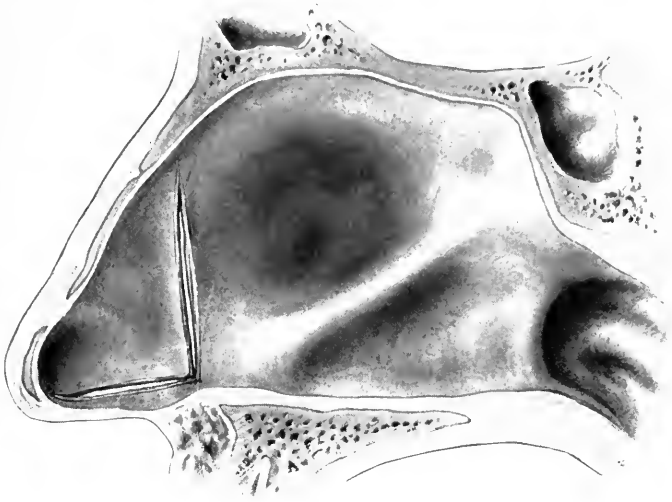


Fig. 443.
Freer's incision.

his head bent well forward, the nose being permitted to bleed until it ceases. Ordinarily there is only a slight bleeding which rapidly diminishes. This position prevents the blood from passing into the throat, a practice which causes the patient to draw it back continually thereby

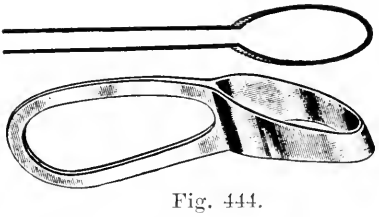


Fig. 444.
Todd's splint.

prolonging the bleeding. Susceptible patients may faint but this causes an immediate cessation of the bleeding.

After-treatment.—Very little after-treatment is required. For several days there is considerable swelling of nasal mucosa, with some discharge and crusts at times. If the patient is uncomfortable, it is a good plan to clean out the nose daily for a week or so by removing

crusts with forceps. Solutions of adrenalin and similar agents may be used to reduce the swelling materially, making a good view of the nasal cavities possible. Washing the nose with watery solutions, in the opinion of the author, is harmful and unnecessary. Sterile vaselin and other ointments add to the comfort of the patients.

Complications and Accidents.—Perforations result when there are coincident wounds of the two septal mucous membranes at corresponding places. They may be usually averted by suturing. The Yankauer method (see page 116) is best to use, especially if the wound is some distance from the nasal orifice. If close to the vestibule, an ordinary curved needle may be employed.

Halle utilizes an appropriate piece of the removed cartilage which has been put in sterile normal salt solution. This he places between the two mucous membranes. As a rule union takes place without incident. The author has used this plan a number of times with complete success. While the cartilage is absorbed, it remains long enough to assure the formation of cicatricial tissue sufficient to occlude the perforation.

Septicemia may occur, of course, from septic invasion accidentally encountered or from unsterile instruments, but septic symptoms are far more apt to follow when the packing is retained than when it is removed soon after the operation.

Crusting may continue some time after the operation, particularly if the mucous membrane is thin and if it has been badly injured in the operation. Scarlet red ointment will increase the tendency to epidermization. Other ointments are also of service and oily sprays will improve the condition.

Hematoma.—Since the introduction of the submucous method of operating on the septum, there has been a fear of hematoma, which, however, is largely fatuous so far as any harm resulting from its presence is concerned. As a rule, the swelling disappears in a week or two unless infection occurs with abscess formation. In this event, incision and drainage are usually followed by cure. Rarely the clot becomes organized and a permanent thickening results, causing a more or less pronounced obstruction.

Undue Movement of the Septum.—If there is any considerable redundancy of the mucous membrane on either or both sides after removal, the septum may flap to and fro with passage of air through the nose. A minor degree of this condition is not so uncommon soon after healing, but it soon passes away or at least the patient fails to notice it.

There have, however, been some extreme cases in which the mucosa on both sides takes on a condition not unlike intumescent inflammation. For this very little can be done. One may be justified in taking a section out of the mucosa and establishing a perforation.

Acute Tonsil Infections.—These are not at all uncommon during the first week after operation. They seem to result from the passage of the septic discharges down the pharynx. Generally they yield speedily but some cases of general infective results such an endocarditis and nephritis have been reported.

Ear Complications.—While ear complications are rare, their possibilities in view of the presence of inflammatory discharges must be considered. Otitis media acuta and even mastoid abscess have been reported. The likelihood of an aural infection is greatly increased by the retention of a plug in the nose for too long a time.

Nasal Deformity.—This accident is exceedingly rare. It may result from coincident syphilis, infection and abscess of the septum, or from the removal of too large an amount of the bony septum. When this accident occurs, recourse must be had to one of the operations described in Vol. I, Chapter VI.

Pharyngitis and bronchitis not infrequently follow submucous resections and other operations on the nose, probably from the resulting interference with nasal respiration or from the inhalation of septic matter.

Projection of the Anterior Portion of the Septal Cartilage.

As has already been stated (page 18) the removal of the dislocated or deviated anterior portion of the septal cartilage may be undertaken when the submucous resection of the septum is done or it may be postponed.

The indications for operation are interference with breathing, unsightliness of the projection, irritation incident to the impact of solid matter in the air or other substances and the ready formation of ulcers.

The following methods of dealing with the condition are advised:

1. Resection of the projection alone.
2. Resection of the projection and of the septum at the same time through the one incision.
3. Resection of both in two sittings.
4. Resection of the projection through an incision on one side and of the septum through an incision on the other side.

The vestibule should be thoroughly cleansed and its surface painted with the usual iodin solution. A one per cent novocain solu-

tion should be injected on either side of the cartilage under the soft parts. Unless the septum is to be resected through the same opening, the incision should be made immediately over the projection and along its entire extent from above downwards. The projecting cartilage held by rat-tooth forceps is freed from the soft parts and removed with knife or scissors. A small artery in the columella near the floor of the nose is apt to be severed. It may be crushed with artery forceps or ligated. The wound is closed with two sutures preferably subcuticular and then sealed with collodion.

The results are practically always satisfactory.

Other Operative Methods for Septal Deflections.

There is a long list of operations once in great favor which are now either obsolete or are becoming so. They are, however, worthy of mention.

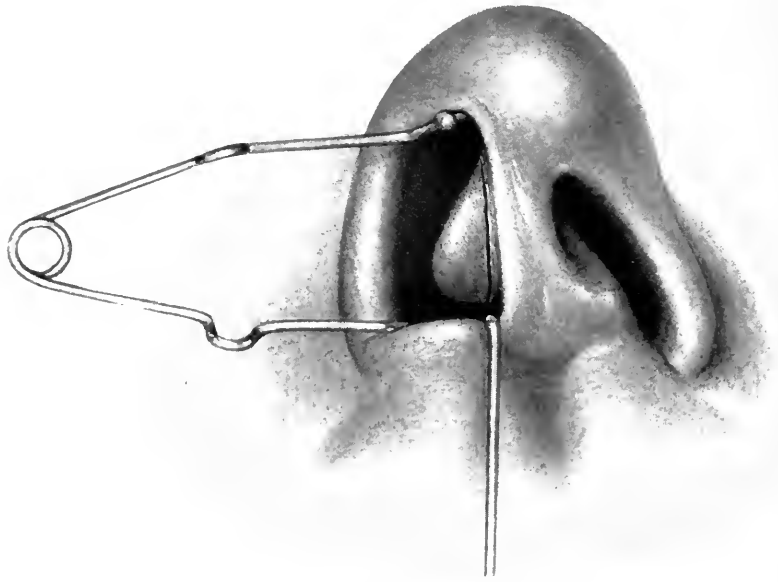


Fig. 445.

Bosworth's saw operation.

The Saw Operation.—The purpose of this operation is simply to remove the obstruction by sawing away the projecting ridge or spur including the mucous membrane covering it. (Fig. 445.) It was made popular by Bosworth who devised a most effective instrument (Fig. 446) for the purpose. The operative results are usually satisfactory so far as the removal of the particular obstruction is concerned, but

there is considerable post-operative scabbiness as a rule for some time; in addition there may be a cicatricial thickening at the site of the removed cartilage or a recurrence of the ridge.

Removal by Chisels and Heavy Knives.—Chisels driven by hammers or heavy knives with a handle for pulling through the obstruction have been used with a variety of specifications. The so-called septotomes and spokeshaves (Figs. 447 and 448) belong to this class.

Trephine.—A trephine or burr driven by an electrical dental engine was much in vogue fifteen years ago. Some operators claim

Fig. 446.
Bosworth's saw.

Fig. 447.
Nichols' spokeshave.

Fig. 448.
Moure's spokeshave.

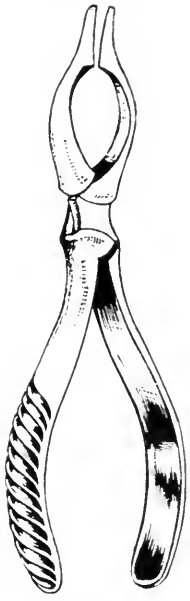


Fig. 449.
Asch's scissors.

that with this method they can remove the projection and retain most of the mucosa on the corresponding side.

Asch's Operation.—This operation supplanted most of the procedures the basis of which was the fracture of the bone or cartilage. An ingenious strong pair of scissors (Fig. 449) is used to make a crucial incision in the cartilage, the four triangular segments are then fractured at their bases by pressing them through to the other side with the finger (Fig. 450), and then a self-retaining splint of the Mayer (Fig. 451) or Kyle (Fig. 452) type is inserted and retained more or less constantly for five or six weeks. That it has been replaced by the submucous resection operation is easy to understand, as there is much discomfort in wearing a splint for six weeks, and the results cannot be so complete.

Watson's Operation.—This consists in making several incisions through the cartilaginous part of the septum so that they present a beveled edge which retains the flap in position when it was forced through from the convex to the concave side.

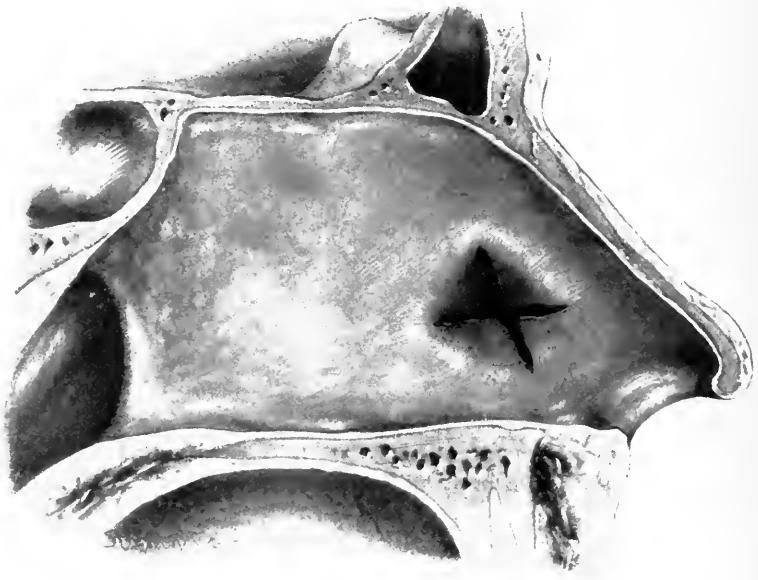


Fig. 450.
Fracture of septum after use of Asch's scissors.

Gleason's Operation.—A cut is made through the convex portion of the cartilage leaving a flap (Fig. 453) which is pushed through to the concave side. The operation is still used by a fair number of operators especially for children in whom a submucous resection is not advisable.

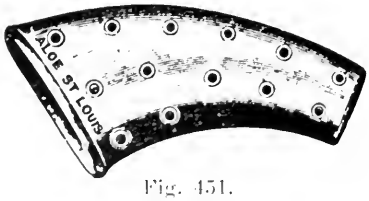


Fig. 451.
Mayer's splint.

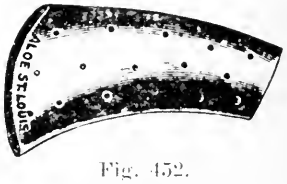


Fig. 452.
Kyle's splint.

Roberts' Operation.—The septum is crushed by strong forceps and the fragments held together in the perpendicular plane of the septum by two or more pins passed anteroposteriorly through the fractured septum.

Sluder's Operation.—Three parallel anteroposterior incisions are made through the septum, the middle one being made horizontally through the ridge, the other two at an angle (Fig. 454) and these are held in place with splints for several days. Fig. 455 shows where the incisions are made with respect to the deflection and Fig. 456 the appearance after the fragments are adjusted.

Kyle's Operation.—The ridge is cut away in part by Fetterolf's wedge-shaped rasp (Fig. 457) after an incision has been made in the mucosa over it, and the Kyle block tin splints (Fig. 452) are used to force the septum into position and to retain it.

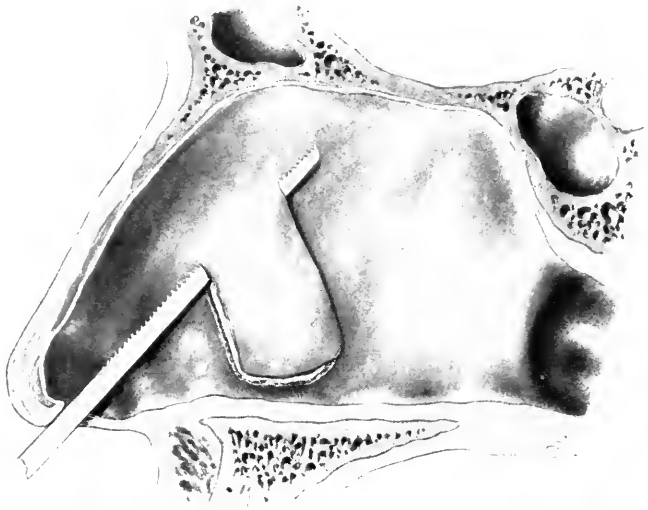


Fig. 453.

Gleason's operation.

Price-Brown's Operation.—An H-shaped incision is made in the cartilage forming two quadrilateral flaps with beveled edges. These are pushed from the convex into the concave side and are held in position by a retaining splint.

Moure's Operation.—Two incisions are made through the cartilage, one parallel with the floor, and one parallel with the anterior border of the septum. (Fig. 458.) The cartilage is then displaced to the concave side by a specially constructed instrument one arm of which is fixed against the outer wall of the nasal cavity and the other of which, being movable, forces the cartilage when pressure is applied.

The Oral Method of Resecting the Nasal Septum.—Kretschmann advocates this method of operating, which is best done under endotracheal

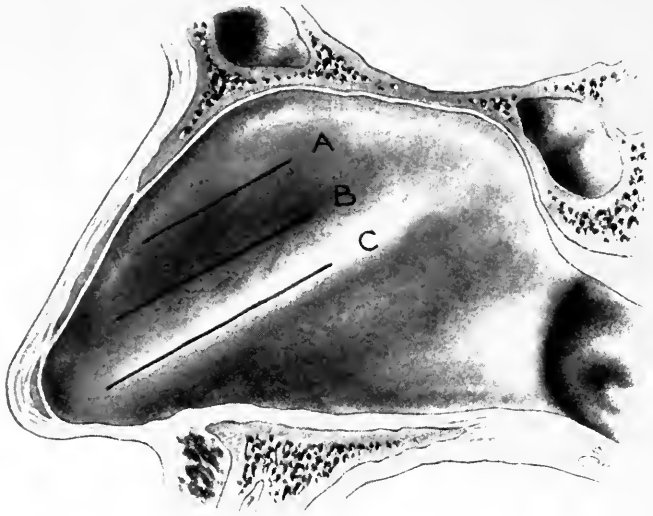


Fig. 454.
Incisions for Sluder's operation.

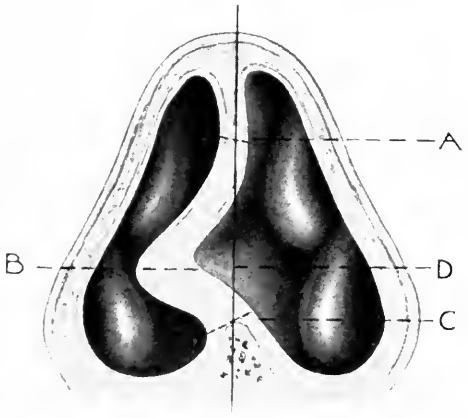


Fig. 455.
Incisions for Sluder's operation.

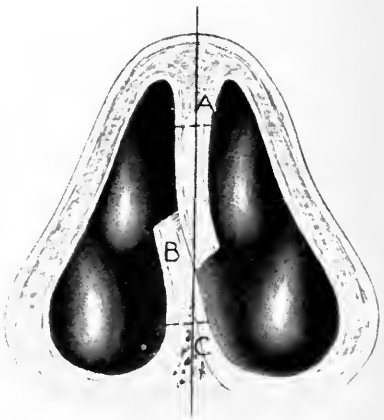


Fig. 456.
Sluder's operation. Fragments placed in position.

Fig. 457.
Fetterolf's wedge-shaped rasp.

anesthesia. The incision is made down to the bone at the gingivo-labial fold (Fig. 459) from one canine tooth to the opposite. The periosteum and soft parts are elevated, the denudation being continued as

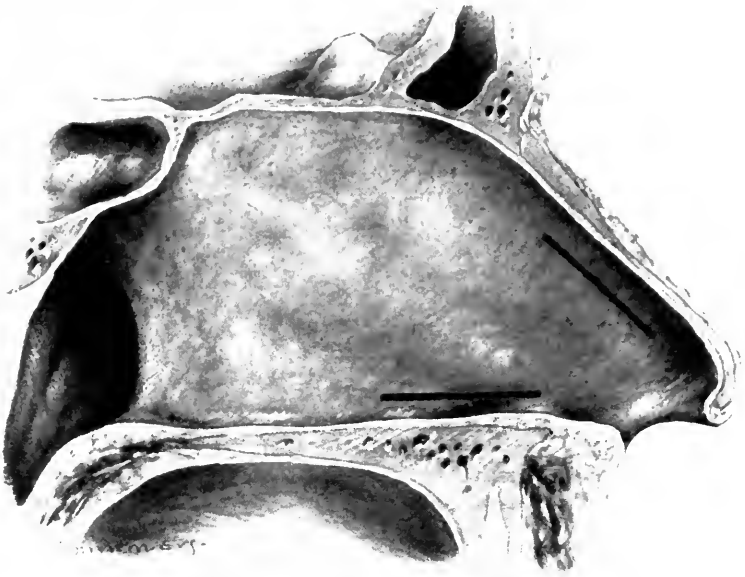


Fig. 458.
Moure's operation.

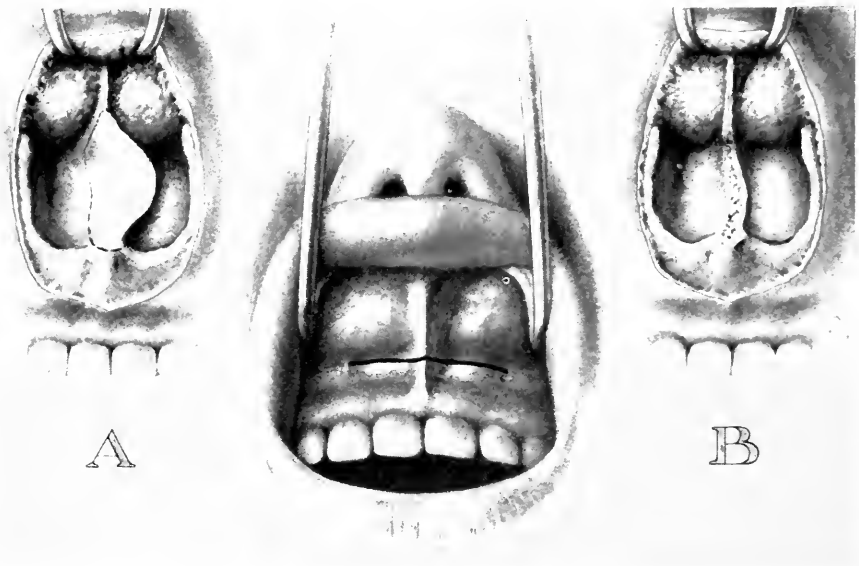


Fig. 459.
Kretschmann's method.

far as the apertura pyriformis (A). The mucosa of the septum from the floor of the nose upwards is elevated to the extent desired and the deflected portion of the septum removed (B). The soft parts are replaced and the tips of the wound sutured.

This operation is not to be recommended as it accomplishes nothing that cannot be done equally as well or better by the submucous resection under local anesthesia.

RESECTION OF THE INFERIOR AND MIDDLE TURBINATES.

Various methods have been in use during the past thirty years to reduce hypertrophies of the inferior turbinate and middle turbinate as well. Almost anything that would cause a scar has been employed: chemical cauterants, actual cautery, and galvanocautery.

These are applied superficially or by some of the submucous methods that were devised. But while some temporary or even permanent good was accomplished, the indiscriminate use of the methods advised was not followed by the most satisfactory results. An era of total resection almost indiscriminate followed, but this operation too was found unsatisfactory until at the present time each case is carefully considered before resection is advised. As for cauterization, its use has been greatly reduced.

Resection of the Inferior Turbinate.

Indications.—Before the operation is determined upon, the possibility of relieving the symptoms by a septum operation must be considered. It is far better to subject the partition wall of the nose to operative procedure than to remove any part of the inferior turbinate which has such an important function in connection with nasal respiration.

The amount of tissue to be resected must also be carefully studied for while the removal of any portion of the mass will be followed by relief from the mechanical obstruction, other symptoms may result more distressing than those present at the time of operation. Crustiness, dryness of the throat, uncomfortable patency of the nasal cavity are among those to be enumerated. When there is a large redundancy of the mucous membrane, causing it to lie upon the floor of the nose, when the posterior end is hypertrophied or when the anterior end is thickened without corresponding septal deflection, resection alone is of any avail.

However, it is better to take too small a portion and to follow this

with a second operation than to remove too much in the first instance.

Some of the maxillary operations (q. v.) require the removal of the inferior turbinate.

Contraindications.—The usual contraindications to nasal operations obtain, such as the age, and poor state of health not dependent

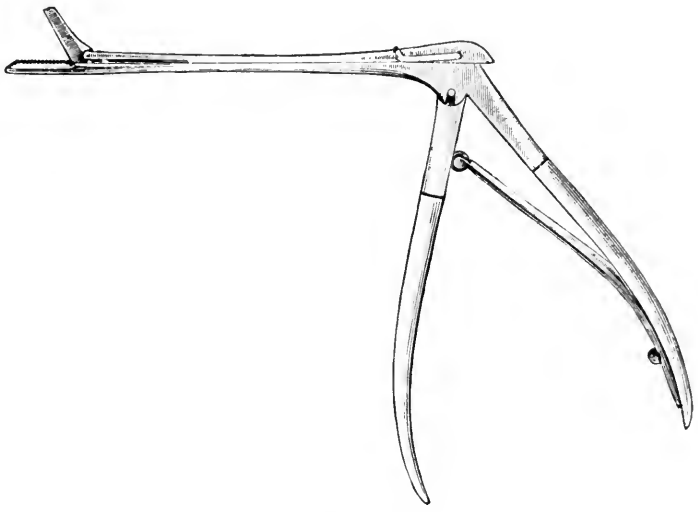


Fig. 460.

Struyken's forceps.

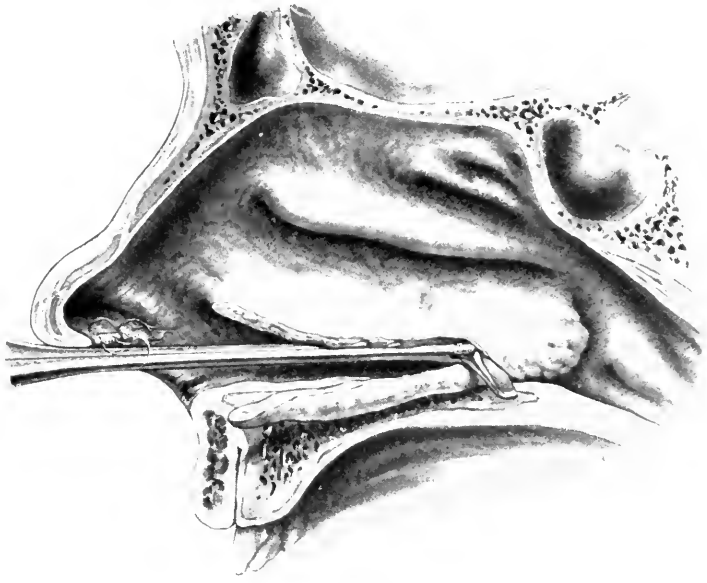


Fig. 461.

Resecting inferior turbinate with Struyken's forceps.

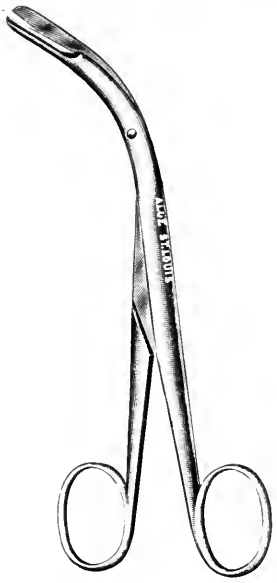


Fig. 462.
Beckmann's serrated scissors.

Fig. 463.
Heymann's scissors.

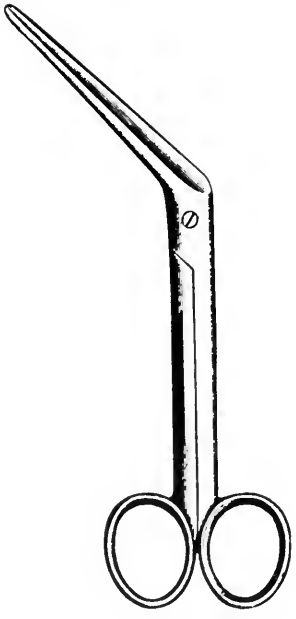


Fig. 464.
Seiler's nasal scissors.

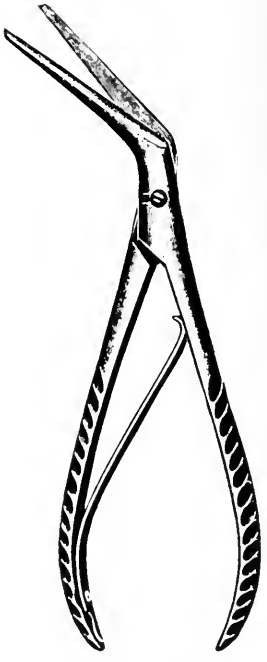


Fig. 465.
Jackson's turbinotome.

on the nose. While this operation is not uncommonly required in children, the removal of any considerable portion of the inferior turbinate in such cases must always be looked upon as the source of eventually unpleasant nasal symptoms. Any tendency to ozena or atrophy in other parts of the nose constitutes a possible if not a positive contraindication.

Preparation.—The cocain is applied as in the submucous resection but it is limited to the inferior turbinate. It need not remain so long in the nose as it becomes rapidly effective. The adrenal preparation is to be retained but a few moments.

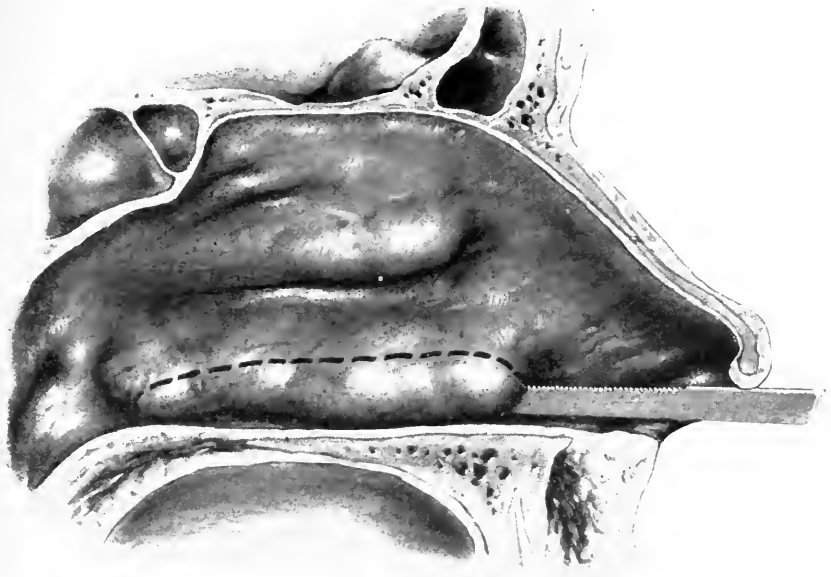


Fig. 466.

Resection of inferior turbinate with the saw.

Cutting instruments of various types are used, depending upon the operator's choice.

Cutting Forceps and Scissors.—Struyken's cutting forceps (Fig. 460) are perhaps the most serviceable, particularly as the amount of tissue removed can be easily delimited. Fig. 461 shows the method of using this instrument to resect the lower portion of the turbinate. It can be used quite as well to remove the anterior portion of the turbinate or even a posterior turbinate hypertrophy.

Beckman's serrated scissors (Fig. 462), Heymann's (Fig. 463), Seiler's (Fig. 464) or Jackson's turbinotome (Fig. 465) may be used for the same purpose in a similar way.

The **spokeshave** which may be employed has fallen into disrepute by reason of the indiscriminate use made of it soon after it was introduced and on account of the inclination it seems to foster in the operator to do a total resection when a partial resection is sufficient.

The **Bosworth saw** was among the earliest instruments devised for this operation. Its use supplies a very simple method of sawing the soft tissues and bone (Fig. 466) removing just what is desired, but it is more difficult to limit the amount resected anteroposteriorly with this type of instrument.

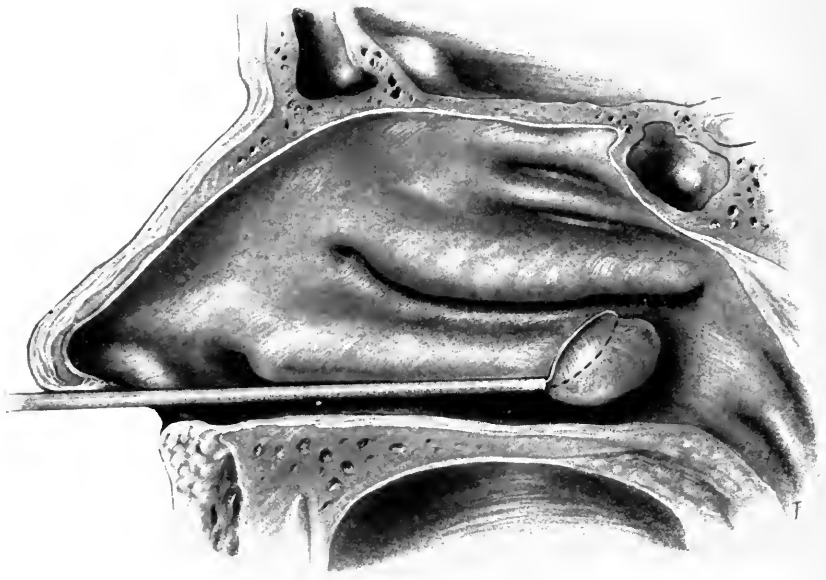


Fig. 467.

Resection of the posterior end of the inferior turbinate by the cold snare.

A favorite plan in selected cases is to saw through the turbinate close to its maxillary attachment then to press it towards the outer wall and permit union to take place to the end that the nasal cavity be correspondingly enlarged without removal of turbinate tissue.

The **cold snare** is effective especially in removing posterior turbinate hypertrophies. (Fig. 467.) In some cases, the snare may be thrown over the posterior turbinate enlargement under inspection through the anterior naris but it is generally necessary to guide the wire loop with the finger inserted in the nasopharynx. The snare is of service also in removing the redundant portion of the hypertrophied turbinate mucosa.

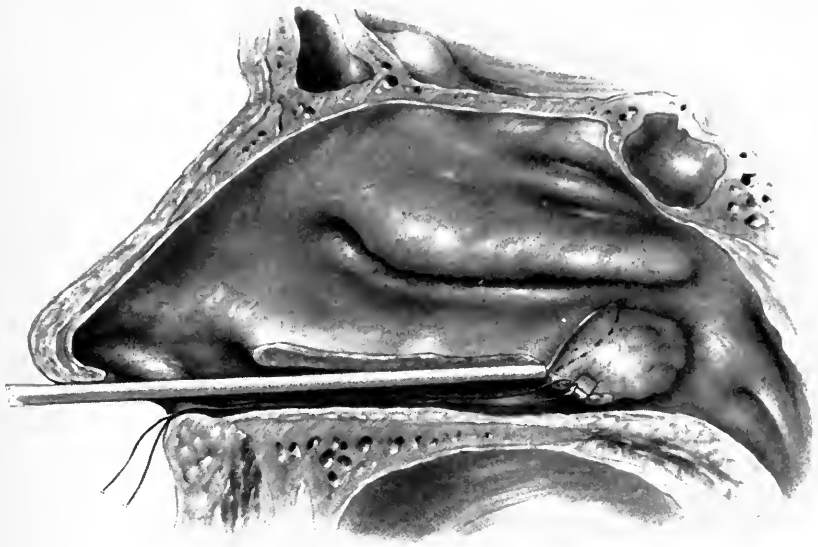


Fig. 468.
Beck's operation with guide for snare.

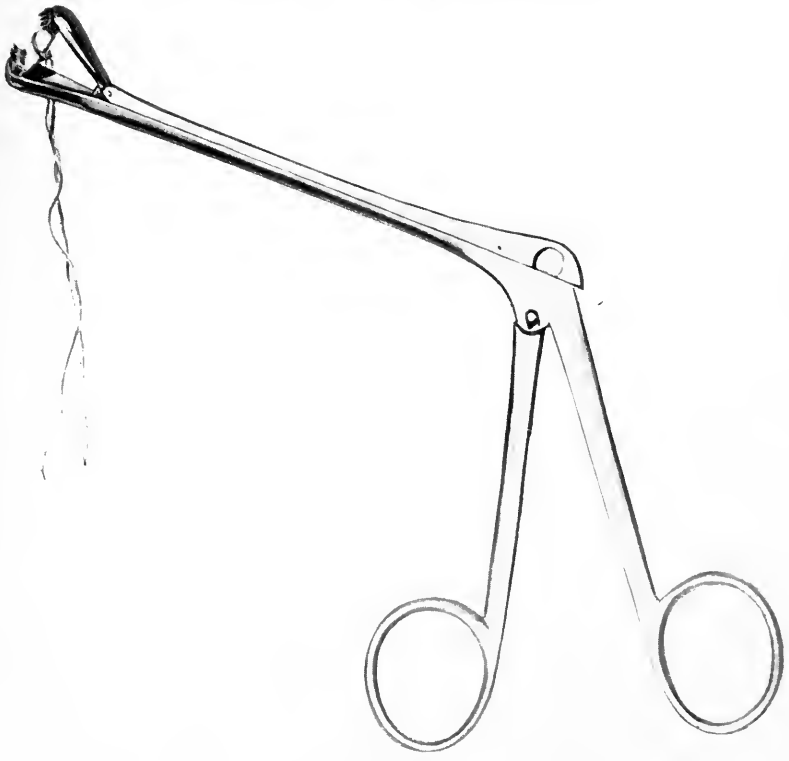


Fig. 469.
Beck's clip introducer.

Beck's Method.—To overcome the difficulty of engaging the mass, Beck uses a Michel clip attached to a string as a guide. (Fig. 468.)

The instrument with Michel clip as shown in Fig. 469 is introduced along the floor of the nose until it reaches the posterior turbinate hypertrophy into which the clip is inserted leaving the string to guide the snare.

The **Ballenger swivel-knife** with widely separated tines may be used to resect the turbinate in whole or in part. (Fig. 470.) However, difficulty is often experienced in forcing the knife through the bone.

The **submucous method** has had some vogue. An incision is made

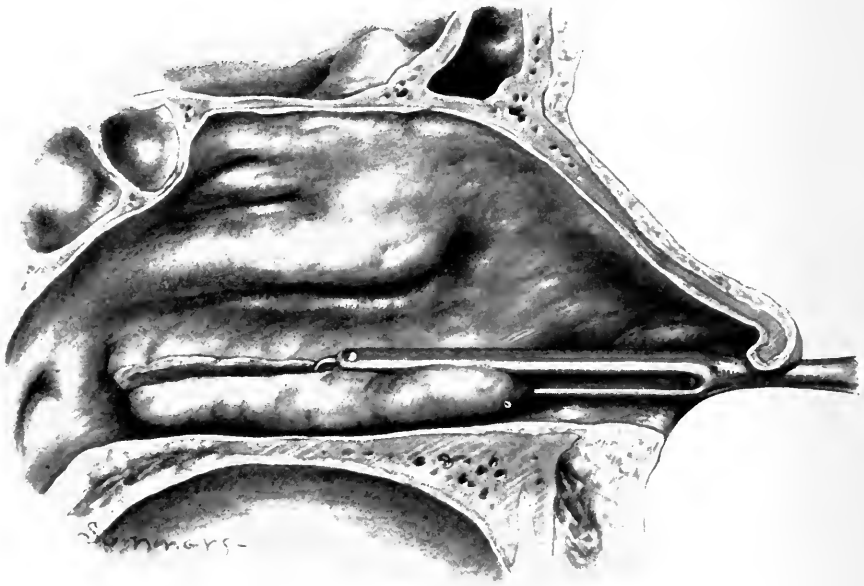


Fig. 470.

Ballenger's method of resecting the inferior turbinate with the swivel-knife.

over the anterior end of the turbinate reaching to the bone. The soft parts are elevated from the bone. This is often difficult, sometimes causing considerable laceration of the tissues. After this, as much of the bone as is desired is removed and the soft parts are allowed to heal. This operation is of little avail when there is much redundancy of the mucous membrane but it is of value when the turbinate bone itself encroaches on the nasal cavity. The method as applied to the middle turbinate is illustrated in Fig. 478.

Freer's Operation.—Freer uses a special set of instruments by which he removes a portion of the bone without destroying the mucosa.

(Fig. 471.) An incision is made at the inferior portion of the turbinate, beginning at the posterior end and extending forward and upon the anterior extremity. The soft parts are elevated by means of knife, elevator, and raspatory from the internal and anterior portions of the turbinate, and the flap is pushed upward into the middle

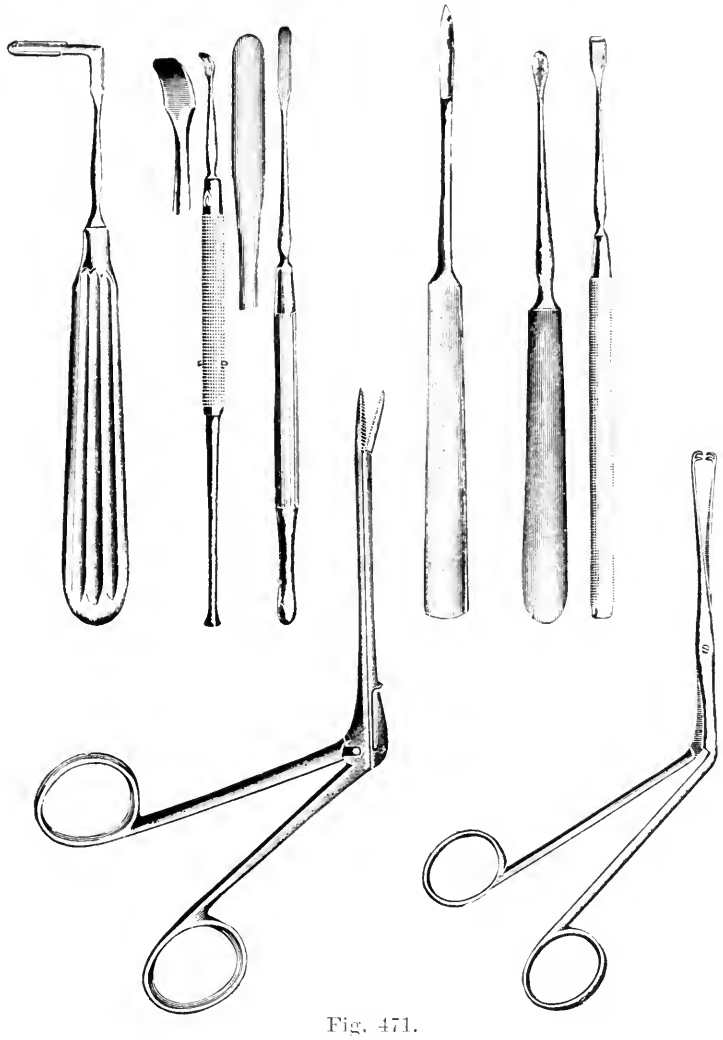


Fig. 471.

Freer's instruments for resecting the inferior turbinate.

meatus out of the way. As much of the bone and mucosa of the inner side of the turbinate as desired is removed with chisel or other appropriate instrument. The bone is covered over smoothly with the mucosa flap. If there is any redundancy in the posterior portion of the mucous membrane, it is removed.

Yankauer's Operation.—An incision is made above the hypertrophy and another below, both meeting at a sharp angle in front and behind. The included mass is dissected out with elevators and scissors and enough of the bone is removed with punch forceps or scissors to permit the close approximation of the lips of the wound. These are sutured together with No. 0 catgut which has been sterilized by boiling in a supersaturated solution of ammonium sulphate.

Beck's Conchotribe Operation.—After cocainization, the conchotribe (Fig. 472) is inserted along the floor of the nose, the two blades engaging the lower border of the inferior turbinate. Beginning in front, the entire lower edge comprising the soft parts and some of the bone is crushed between the blades. A partial necrosis of the tissue results with consequent shrinking from the reactive inflammation which

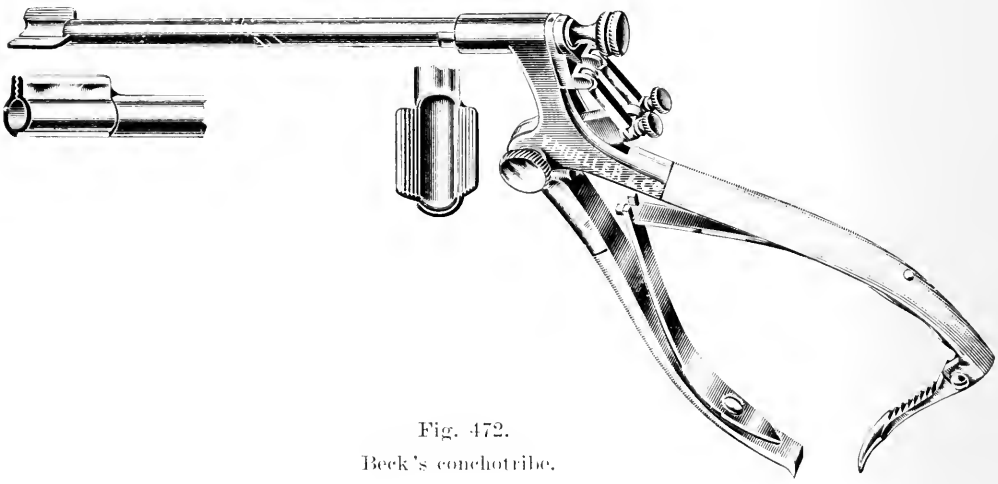


Fig. 472.
Beck's conchotribe.

follows. It is particularly of use in turgescence or mild hypertrophy, but not in large posterior hypertrophies. The conchotribe is of value in producing hemostasis after snaring for posterior hypertrophy.

After-treatment.—No dressing is usually required after operations on the inferior turbinate, in fact it is better not to pack the nose. After the vascular constriction induced by the adrenal preparation has passed, some slight bleeding will ensue, but this soon ceases, particularly if the patient is kept in bed.

Subsequent attention is limited to clearing the nose of discharge and crust formation and applications of ointment when desired. Resolution takes place in a week or ten days, though crust formation may continue for a longer time. Packing greatly increases the danger of infection and is of no value unless hemorrhage results.

Complications and Accidents.—There are practically no post-operative complications and accidents except hemorrhage. An otitis media acuta may follow removal of the posterior end of the turbinate, in view of its proximity to the Eustachian tube. Post-operative hemorrhage has proved alarming after posterior turbinate operations. When it occurs, recourse must be had to plugging the posterior naris by drawing through it a gauze pack attached by a thread to a catheter, which has been passed from the nose into the pharynx and out through the mouth. It is usually necessary to plug both posterior nares. Beck's conchotribe will also be found of service in active hemorrhage of this character.

Resection of the Middle Turbinate.

Operative procedures on the middle turbinate were developed along with those of the inferior turbinate. In the beginning, the obstructive nature of the enlargement was the paramount influence, but after a time when the peculiar relation of the middle turbinate to the orifices of the adjacent sinus was recognized, this became the main basis for operation. It is perhaps for this reason that resection of the middle turbinate has maintained its popularity while resection of the inferior turbinate is far less frequently employed than formerly.

Indications.—Obstruction to respiration is the least important indication except when an ethmoid cell projects into the anterior portion of the turbinate constituting what is known as the concha bullosa.

In the main, resection is called for whenever the turbinate interferes with the drainage of the adjacent accessory sinuses, particularly after there has been an acute infection or when a chronic suppuration is present. It is frequently removed to gain access to one or more of the nasal sinuses.

In the case of acute suppurative diseases of the ethmoid, frontal or maxillary sinus, it is best to postpone the operation until the acute manifestations pass away in view of the dangerous complications which may supervene.

When polypi are removed, it is usually impossible to secure freedom from recurrence unless the middle turbinate is resected in part.

Headaches, sneezing, epiphora, and other eye symptoms and hyperesthetic nasal conditions are frequently dependent upon enlargement or disease of the middle turbinate and the adjacent ethmoid cells and constitute valid justification for operation.

Contraindications.—The contraindications are practically the same as designated under resection of the inferior turbinate.

Preparation.—This is identical with that required for the operation on the inferior turbinate except, of course, that the cocain application must be made higher in the nasal cavity.

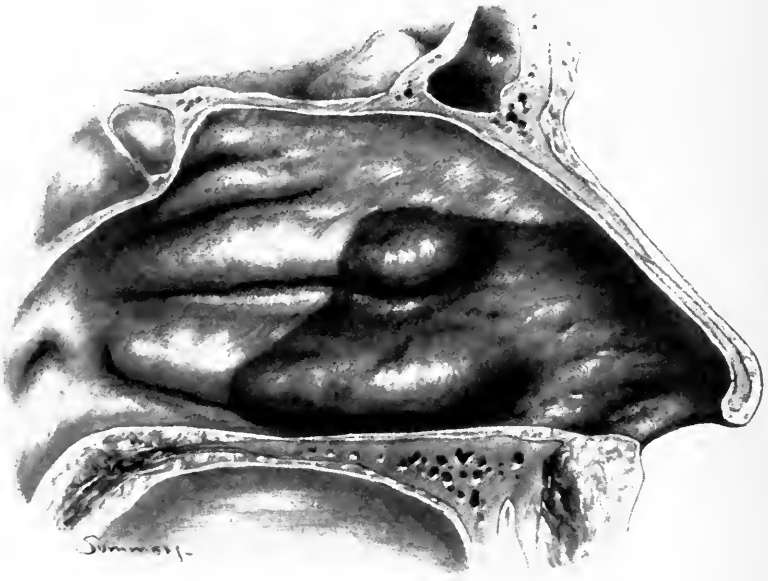


Fig. 473.

Showing visible portion of the external wall of the nose on inspection.

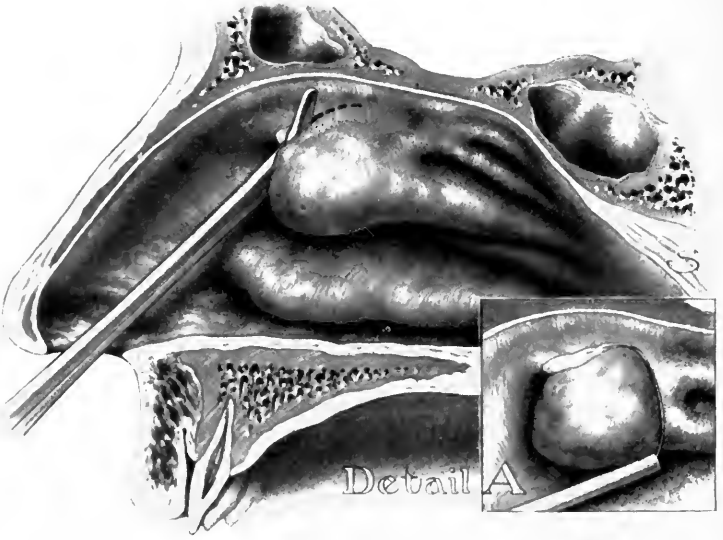


Fig. 474.

Operation with Struyken's forceps.

It must be remembered that the middle turbinate runs more or less horizontally from before backward, paralleling the inferior turbinate, although as one looks into the nose it appears to be a small mass hanging from the anterior portion of the roof of the nose. Fig. 473 shows how the posterior half or three-fourths of the middle turbinate is cut off from view by the external wall of the nose, causing this peculiar appearance. As can be observed, the inferior turbinate thus shows its parallel relation to the floor of the nose.

Struyken's Forceps.—The simplest plan of operating is with Struyken's forceps by means of which whatever portion of the tur-

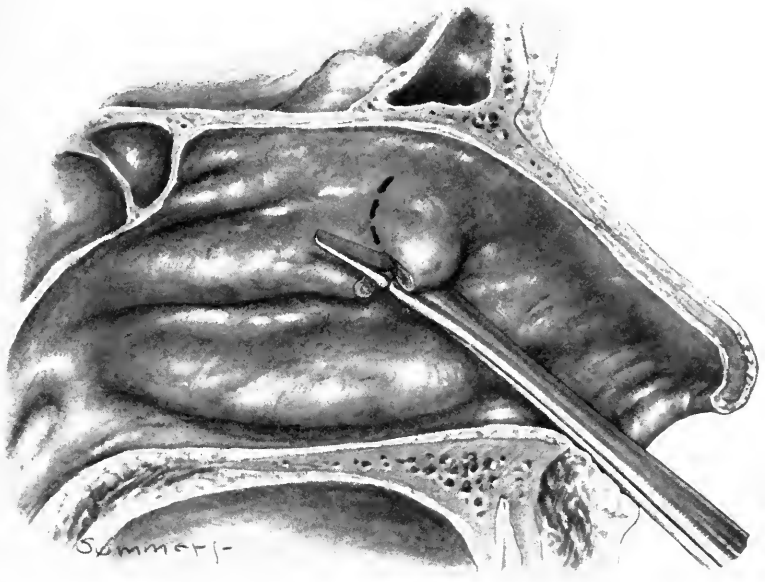


Fig. 475.

Operation with Struyken's forceps.

binate is to be resected is severed from its attachment to the maxillary (Fig. 474) the operation being completed by the wire snare as shown in detail A of this figure.

Struyken's forceps can also be used to cut upward into the middle turbinate, the fragment being removed by snare or forceps. (Fig. 475.) This will be found serviceable when the nasal cavity is narrowed by a deflection which does not readily permit the introduction of the forceps between the turbinate and its maxillary attachment. Care must be exercised when forceps are used to pull away portions of the turbinate for it is important not to risk a fracture into the cranial cavity by injury to the cribriform plate.

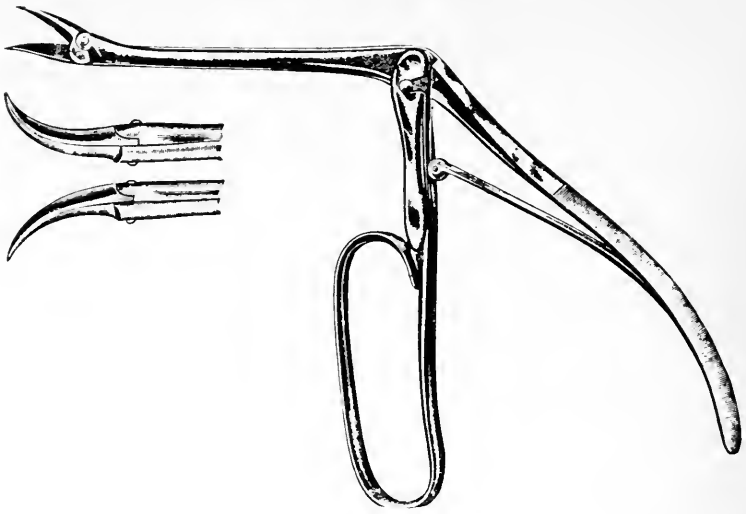


Fig. 476.
Holmes' scissors.

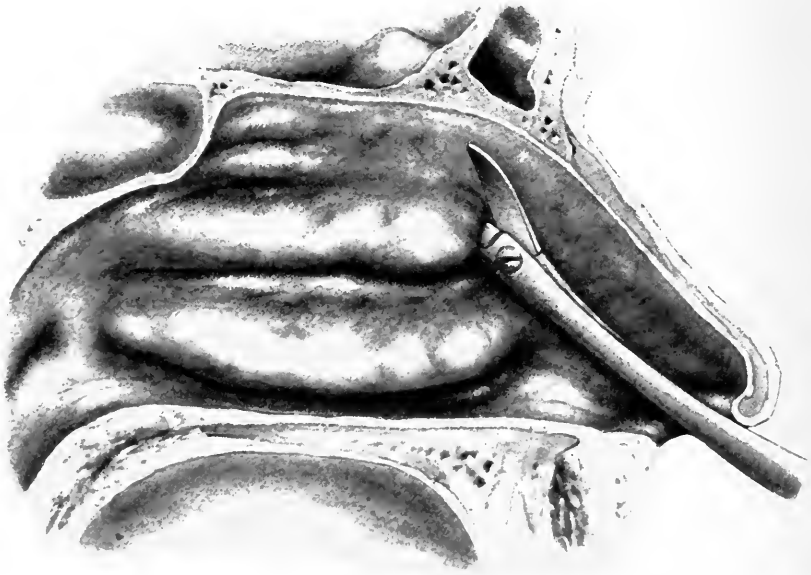


Fig. 477.
Resection of middle turbinate with Holmes' scissors.

Holmes' Scissors.—This instrument (Fig. 476) which has strong short cutting edges and which is properly curved, severs the turbinate from its superior maxillary attachment or resects whatever portion is desired. Fig. 477 shows the method of its use.

Submucous Resection.—An incision is made along the anterior border of the turbinate, the soft parts elevated (Fig. 478) and the amount of bone desired removed with the forceps.

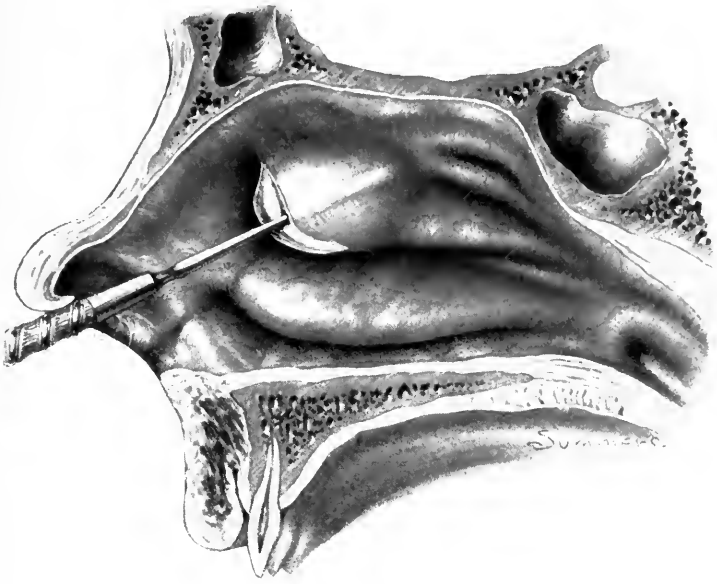


Fig. 478.
Submucous resection of the middle turbinate.

Fig. 479.
Andrews' turbinate chisel.

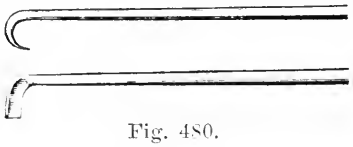


Fig. 480.
Hajek's hooks.

Other Instruments such as sharp hooks, chisels, snares, and cutting forceps are popular with some operators, but most of the work is now being done with Struyken's forceps and Holmes' scissors. The use of Sluder's knife in resecting the middle turbinate is shown in his sphenoid operation (page 534). Andrews' chisel (Fig. 479) is used

to sever the maxillary attachment from before backwards and Hajek's hook (Fig. 480) is employed to detach the middle turbinate by being introduced behind its palatal junction and then drawn forward.

Posterior Middle Turbinate Hypertrophy.—The procedure for resecting the posterior end of the middle turbinate is practically the same as that for the inferior turbinate and the same methods may be applied. As a rule, however, the entire middle turbinate is removed whenever resection of the posterior end is undertaken.

After-treatment.—No packing is required. The post-operative bleeding as a rule is insignificant, but if it shows no tendency to stop, a gauze packing over the field of operation will arrest it. Packing in this region is very likely to be followed by sepsis so it is advisable to remove it as soon as possible.

The nose should be freed from crusts and discharge daily for a short time if necessary.

Post-operative Accidents.—Some cases of sepsis and meningitis have been reported. It should not be forgotten that these may be the direct result of the condition present and not of the operation. There is no doubt, however, that attention to the details of asepsis as already stated will greatly reduce the tendency to septic results.

REMOVAL OF POLYPI.

Polypi are mentioned in the works of many of the first writers on medicine. Their removal was accomplished by methods which even in those early times were quite successful.

A common practice was to introduce a sponge into the nose, allow it to swell up from the moisture absorbed and then to withdraw it from the nose or nasopharynx with whatever polypi it might drag with it. According to Wright, loops were adjusted over the polypi after which they were evulsed. Later they were removed by hooks and forceps. During the last two decades of the nineteenth century, much attention was paid to the removal of polypi with the snare. Some operators cauterized the base in the hope that recurrence would be prevented; others endeavored to accomplish the same purpose by using the electrocautery snare.

With the improved understanding of the relation of polypi to sinus diseases, naturally less attention has been paid to refinements of technic in the removal of polypi.

Indications. The presence of the pendent growths in the nose is under practically all circumstances sufficient reason for removal. Except when there is some good cause for delay, the sinus operation

should be performed at the same sitting. At least the accessible ethmoid cells may be cleared out. If the polypi be particularly numerous, however, the sinus operation may be postponed.

Contraindications.—Acute suppurative processes contraindicate the performance of the operation unless they are directly dependent on the polypi.

Preparation.—Cocain in five per cent solution usually suffices, with an application of an adrenal preparation for a very short time. These applications are inclined to cause the polypi to shrink up in volume, giving a very different picture from what it was before.

As has been already intimated, the mere method of removal of

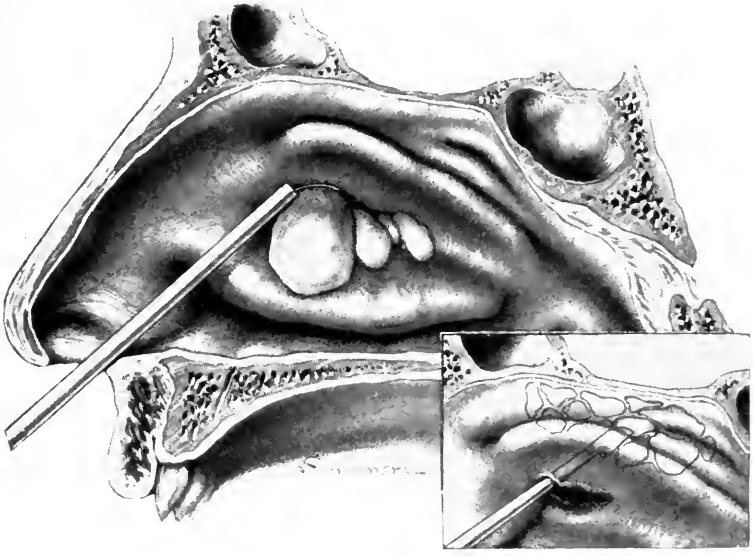


Fig. 481.

Removal of polypi. Smaller drawing shows how the ethmoid cells may be exenterated after the removal of polypi.

polypi is unimportant and may properly be left to individual preference. The important part of the work is to remove them as completely and quickly as possible so that the sinus trouble may be relieved.

Snare.—The polypi are encircled by the wire loop and are removed when the loop is drawn into the cannula. (Fig. 481.) If a number of snares (Fig. 482) are at hand this can be done with great rapidity. A number of years ago, the writer removed 100 at one sitting with the electrocautery snare. In the light of what is now known, he considers himself very fortunate that the operation was not followed by grave sepsis, meningitis, or thrombosis.

Forceps.—Some form of forceps is used. The Knight's or Brünings' instrument, or some modification of Luc's is very satisfactory. The polypi are grasped and evulsed with the forceps with but little attention except the assurance that no other structure lies between the blades of the instrument. Diseased portions of the middle turbinate and ethmoid cells may be removed with the same instrument.

After-treatment is the same as for resection of the middle turbinate. The tendency to recurrence is very apt to manifest itself if there is

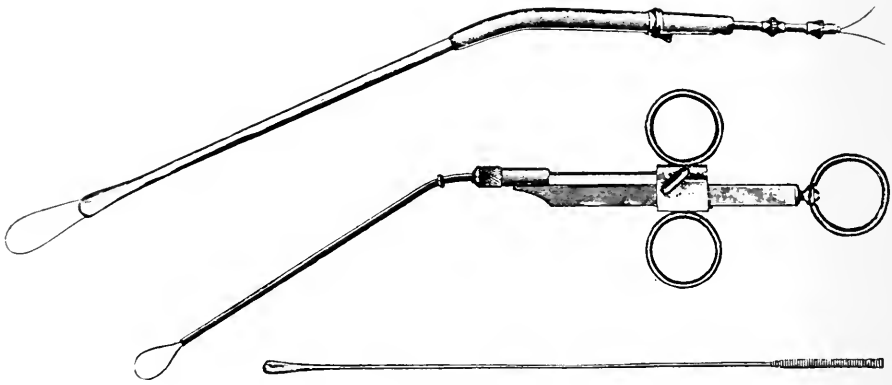


Fig. 482.

Nasal snares.

any sinus disease remaining. Sometimes small polypi which are allowed to remain in the ethmoid cells will come down after the operation and rapidly enlarge, so that in a few days there is as much obstruction as before the operation.

OPERATIVE SURGERY OF THE ACCESSORY CAVITIES OF THE NOSE.

Practically the entire progress of knowledge in connection with operations on the nasal sinuses has been made within the past thirty years. That is to say, at the beginning of this period, virtually no operative work was done on the sinuses, while today they are all subject to operative intervention under indications that are fairly well established.

The maxillary sinus was, as might be expected, first brought into the surgical field, by forcing an opening through the alveolus after a tooth had been removed. Even in the early days some effort was made to open the antrum through the nose.

The frontal sinus was studied between twenty and thirty years

ago to determine whether or not it could be satisfactorily opened through the nasal route, and the present status of this question has naturally evolved from the work of the earnest pioneers in this field. The external operation developed along with the intranasal, but it is not employed relatively as frequently as it was in the early period of its establishment.

Operations on the ethmoid and sphenoid were brought to the notice of surgeons later than those on the maxillary and frontal, although they soon outstripped the latter in perfection of detail. After Zuckerkandl's masterly study of the normal and pathologic anatomy and Grünwald's work in connection with operative surgery, a host of followers carried the subject to its present state.

Today the operative procedure centers around the necessity of obtaining adequate drainage if resolution of the chronic suppuration of these sinuses is to take place. If this can be secured by an operation from within the nose, well and good, but if not, an extranasal operation is indicated. Furthermore, the non-suppurative forms of sinus disease are being brought into operative range, especially those pertaining to the ethmoid and sphenoid.

OPERATIVE SURGERY OF THE ETHMOID CELLS.

Departing from the usual rule of writers on sinus diseases, the ethmoid cells are considered first, for the reason that they are usually involved whenever any of the other sinuses are affected and because suppuration of the adjacent sinuses not infrequently ceases when the ethmoid cells are properly drained. There can be no hope of saving an ethmoid cell when once it is subjected to a chronic suppurative process, that is, the cells are so small and the boundaries so varied that anything short of exenteration of the particular cell cannot be expected to result in cure. As a consequence, operations on the ethmoid cells contemplate removal of all diseased cells and even of the immediately adjacent normal structure. Some go so far as to advocate a complete exenteration for all cases of chronic suppuration. Such practice, however, is warranted neither by good logic nor by good results.

Intranasal Operations on the Ethmoid Cells.

Indications.—Persistent chronic hyperplastic or hypertrophic inflammatory conditions and chronic suppurative processes of the ethmoid, recurrent acute attacks and similar conditions of the adjacent

sinuses call for operation upon the ethmoid cells. Headaches, sneezing, ocular conditions which can be shown to bear relation to the disease of the ethmoid cells are most commonly relieved by operation on the ethmoid cells. Hence the presence of these symptoms constitutes an important factor in the operative indications. In addition to these, one is justified in curetting the ethmoid cells in ozena when the crusts come from the accessory sinuses and when there is not too large an amount of atrophied tissue already present.

Roentgenography is of little service although suppuration can frequently be demonstrated by the shadow on the plate. However, the presence of pus can be better determined by direct examination.

Contraindications.—There are practically no contraindications except those which would contraindicate any nasal operation; for example, age and a poor general condition. This, however, does not

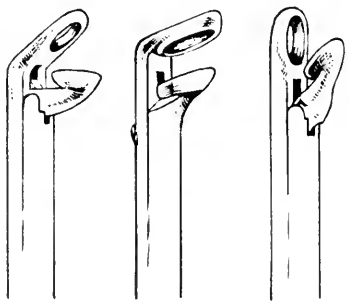


Fig. 483.

Grünwald's cutting forceps.

mean that an extensive exenteration of the ethmoid cells should be undertaken whenever there is a slight ethmoid disease present.

Preparation.—In all intranasal operations on the ethmoid, the cocainization, which must be thorough, and the constriction of the blood vessels are effected in the same manner as in resection of the middle turbinate. It is wise, however, to leave the anesthetic in the nose for a somewhat longer time. The cocain flakes are particularly serviceable as they can be carried into the smaller recesses. While the hemorrhage is usually greater in this operation than in the inferior turbinate resection, it requires, as a rule, no additional precaution.

Curettement with Resection of the Middle Turbinate.—The resection of the middle turbinate is performed according to any of the designated plans. A greater or less amount is removed, dependent on the extensiveness of the ethmoid involved.

After this, the bulla is opened with a sharp curette or one of the

various types of cutting forceps used for that purpose. If polypi be present they should be removed as expeditiously as possible. The diseased cells are then cleared out by curette or forceps (Figs. 483 to 488) or hook, all tags of bone and soft tissue being removed as far as possible. Fig. 489 shows the operation as performed with cutting

Fig. 484.
Myles' cutting forceps.

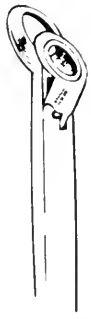


Fig. 485.
Grünwald-Kümmel's cutting forceps.

forceps, and Fig. 490, with the hook. In operating it should be remembered that safety lies in keeping below the roof of the nose and in following the cells backwards towards the outer wall. It must be observed, however, that the internal orbital cavity wall is the outer boundary of the cells. (See Figs. 9 and 10, Vol. I.) While the cribri-

Fig. 486.
Lermoyez's cutting forceps.

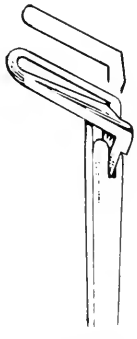


Fig. 487.
Jackson-Dabney's cutting forceps.

form plate is compact bone, as a rule there is great danger in continuing the operation until the bone becomes hard to the touch.

Certain affected cells may be overlooked, causing delay in resolution. Still, according to the writer's view, it is better to be called upon to do a second operation than to clear out unnecessarily a large number of normal cells.

The two main difficulties with this operation are that it does not succeed in freeing the most anteriorly placed cells and that some of the cells are inaccessible from the nose.

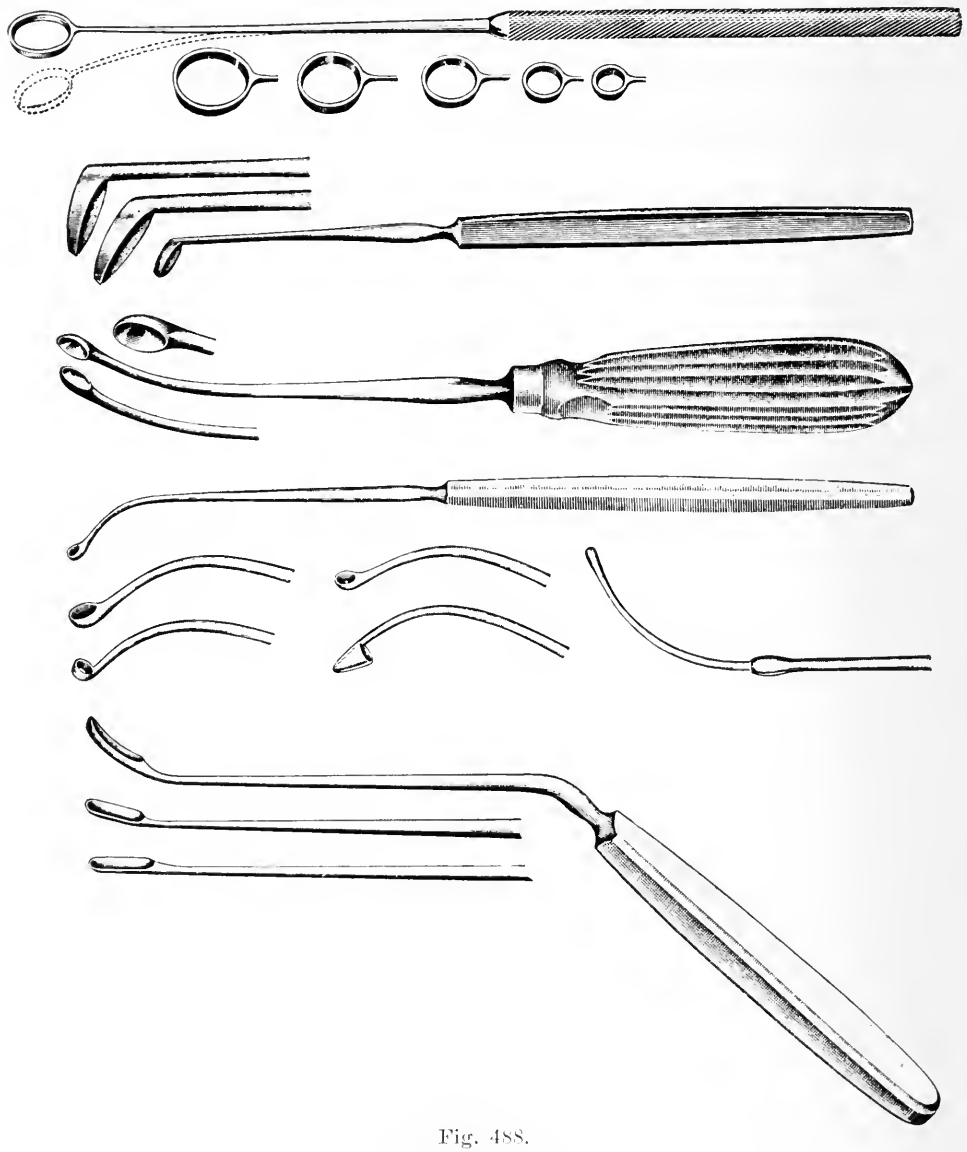


Fig. 488.

Nasal curettes.

Hajek's Operation.—The middle turbinate is resected completely by means of Hajek's hook (Fig. 480) passed behind the palatal attachment of the middle turbinate, through which it is thrust by being pulled forward. The superior turbinate is removed in a somewhat

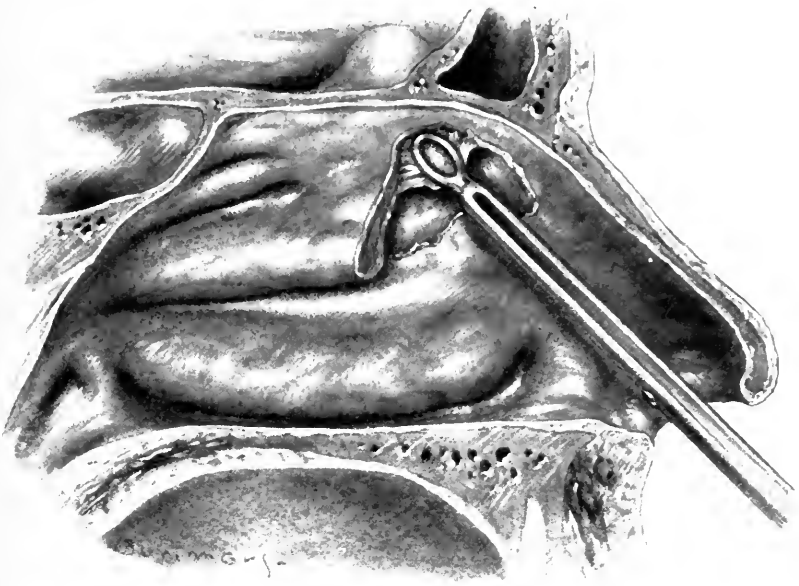


Fig. 489.
Clearing out the ethmoid cells with forceps.

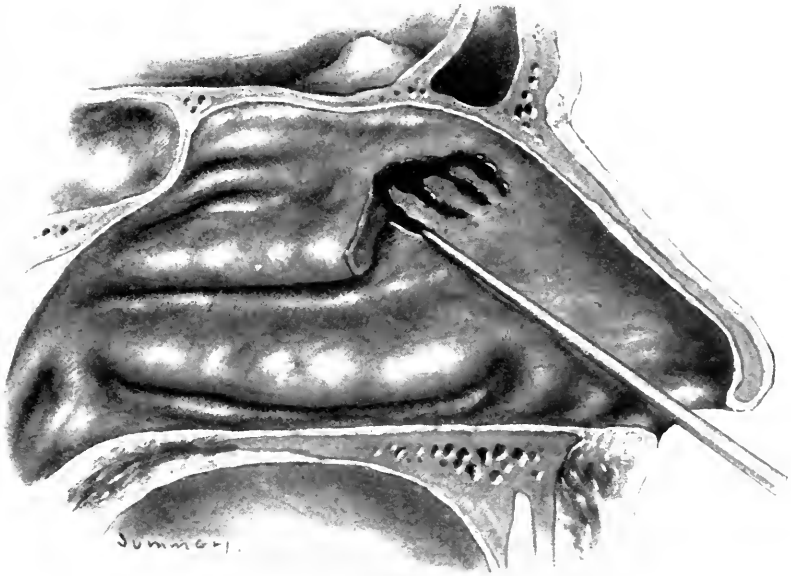


Fig. 490.
Exenteration of ethmoid cells with hook.

similar fashion, the hook being inserted, and pulled forward at the highest point of the sphenoidal wall behind the palatal attachment of the turbinate. The point of the hook is always held against the external wall below the lamina cribrosa. The hook is now drawn forward a number of times through the external wall from which the turbinates have been removed until the bone constituting the inner wall of the ethmoid has been reduced to shreds. (Fig. 490.) The loose fragments are removed by forceps until a smooth cavity is presented.

Ballenger's Operation.—Ballenger devised a single instrument for the complete exenteration of the ethmoid cells. As he used it, there was no question but that a most extensive exenteration was effected. In other hands, however, the use of the instrument has been found fraught with danger, encouraging too radical a removal of tissue in unselected cases.

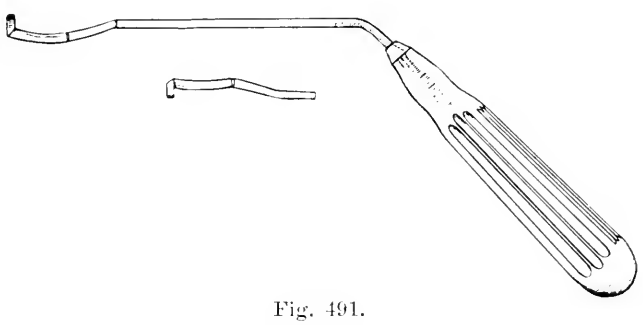


Fig. 491.

Ballenger's ethmoid knife.

The knife (Fig. 491) cuts in three directions depending on how the handle is held. In the first position, horizontally to the opposite side, the short blade is carried against the lower portion of the anterior wall of the sphenoid sinus until it engages the posterior end of the middle turbinate after which it is thrust into the bony tissue of the outer wall. In the second position, in the plane of the nose, the short blade is forced to the upper nasal limit of the anterior wall of the sphenoid, the long blade lying between the middle turbinate and the outer wall of the nose. By a rocking movement the knife is brought forward to the anterior portion of the attachment of the middle turbinate to the maxillary bone. The handle is then placed in the third position, horizontally to the corresponding side, which causes the short blade to point downwards towards the floor of the nose. When the knife is drawn downwards and forwards the operation is accomplished and the resected mass may be withdrawn from the nose.

Sluder's Operation.—Sluder has modified the sharp hook operation. It is better, however, to describe this modification in connection with his operation on the sphenoid sinus. (See page 86.)

Luc's Operation consists in breaking away the middle turbinate with forceps, following this by a similar removal of bulla and all cells involved in the disease.

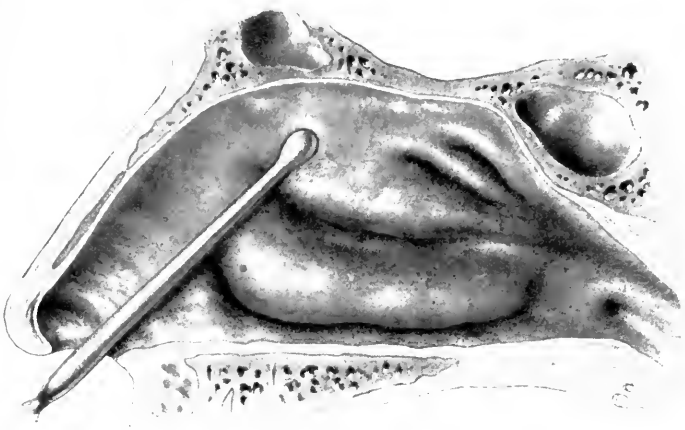


Fig. 492.

Mosher's ethmoid operation. Curette entering the upper overhang.

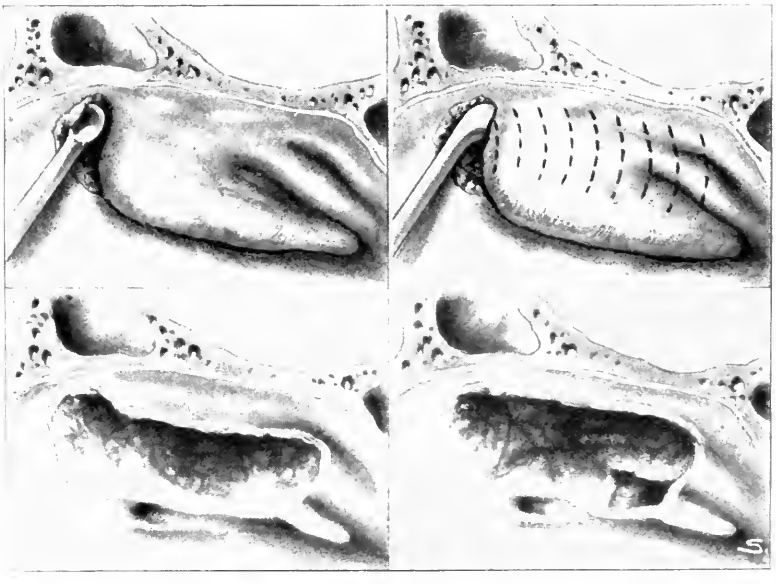


Fig. 493.

Steps of Mosher's ethmoid operation.

Mosher's Operation.—Mosher advanced the surgery of the ethmoid very greatly in devising the operation which goes under his name. He designates as the "lower overhang" that portion of the middle turbinate which lies below the summit of the superior meatus; and as the "upper overhang," that portion above and in the front of this summit. After removing the "lower overhang" with scissors, he enters the ethmoid labyrinth at the "upper overhang" with a sharp curette (Fig. 492), especially made for that purpose. The curettement is continued through the opening thus made, and the curette is carried first forward against the ascending process of the superior maxilla and then downward and backward between the orbital plate and the middle turbinate as far back as the ethmoid cells extend. The middle and superior turbinate bones are then carefully removed, by sweeps of the curette as shown in Fig. 493, after which, whatever tags or broken pieces of bone remain, are removed by forceps. The advantages of this operation are the easy access to the frontal sinus and the possibility of clearing out the most anteriorly placed cells which ordinarily escape in other operations.

Halle's Operation.—Halle has recently described (Archiv. für Laryng., vol. xxix, p. 82) a new method of approach to the ethmoid cells which bids fair to supplant some of those now employed. It is based on the use of a mucoperiosteal flap by which the bone is exposed over the preturbinate area, just as is done in the lacrimal sac operation. The incision (Fig. 494) is made with a small knife on the lateral wall of the nose as near the roof of the nose as possible. It is carried downward as far as the apertura pyriformis. From the upper limit of the incision, another is made extending downwards and backwards around and slightly under the anterior end of the middle turbinate. The lower limb of the incision passes backward to the maxillary attachment of the inferior turbinate.

The flap is then carefully elevated from the bone and placed downward upon the inferior turbinate (Fig. 495) away from the field of operation. It is remarkable what a satisfactory view is thereby secured. The anterior end of the middle turbinate is then separated with scissors from its maxillary attachment and the turbinate is bent medially out of the way. It is not necessary to remove any of the middle turbinate except the hypertrophied portion or that subjected to polypoid degeneration.

The ethmoid cells can now be opened under clear view with forceps (Fig. 496), curette (Fig. 497), or dental burr. Halle insists upon a complete knowledge of the anatomy of the parts as a prerequisite of

the operation. He calls attention to the value of the retained middle turbinate as a landmark serving to limit the operative procedures below the lamina cribrosa. When the exenteration is completed, the mid-

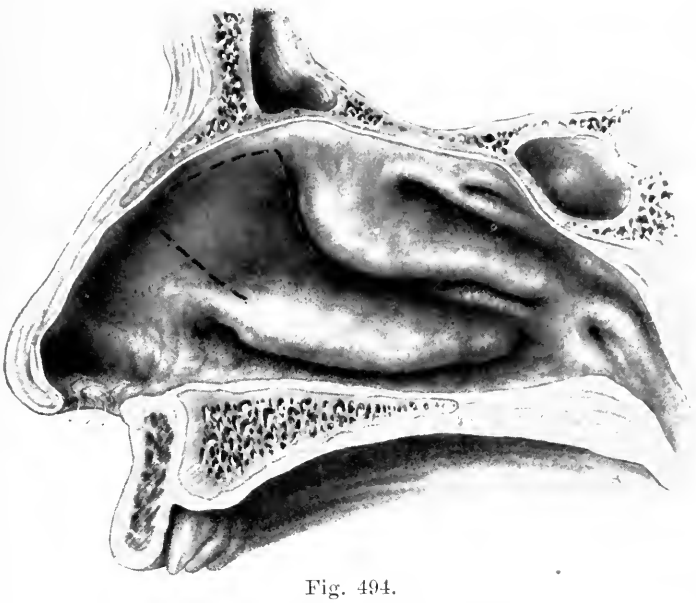


Fig. 494.

Incision in Halle's ethmoid operation.

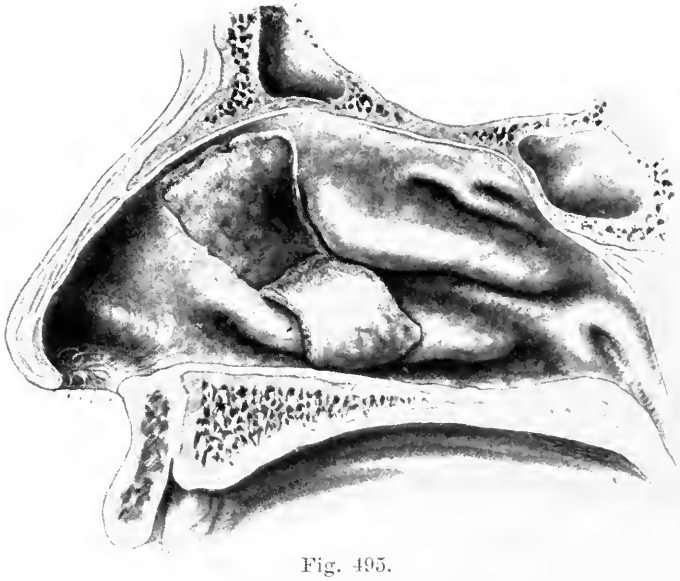


Fig. 495.

Flap in Halle's ethmoid operation.

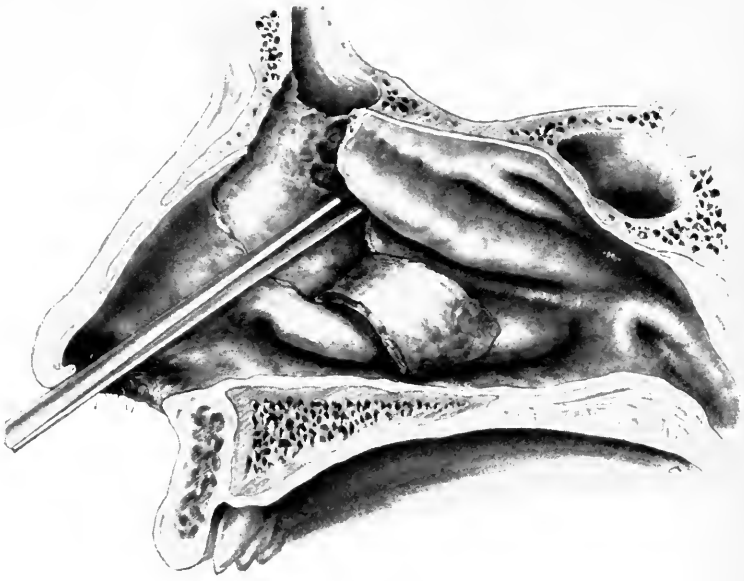


Fig. 496.

Cleaning out ethmoid cells with forceps in Halle's operation.

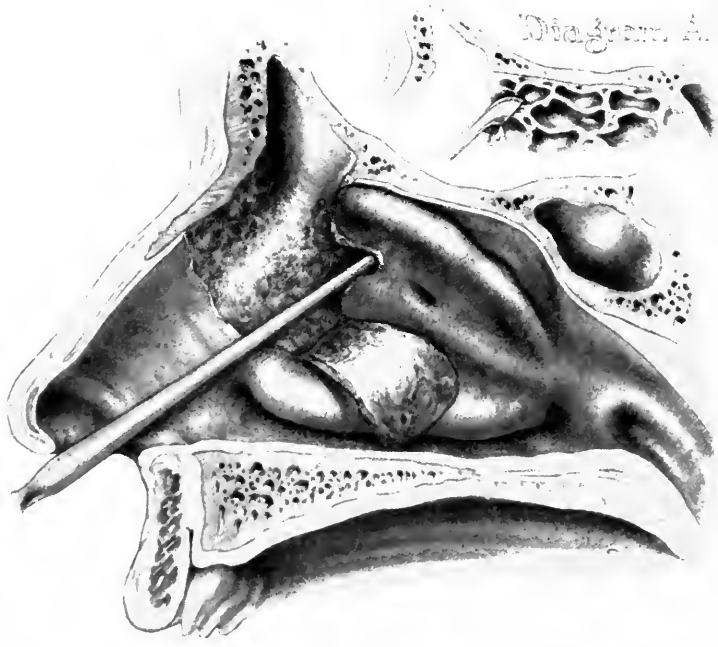


Fig. 497.

Clearing out ethmoid cells with curette in Halle's operation.

dle turbinate is replaced, and the flap restored to its original position. (Fig. 498.) A small piece of gauze is placed over the flap. In a few days the wound is entirely healed.

After-treatment.—Very little after-treatment is required after ethmoid operations. It is best not to pack the nose, unless hemorrhage should be excessive and this is exceedingly uncommon. The nose should be cleaned out by freeing it of crusts and inflammatory exudates which may form. After a day or so, the patient will be able to blow his nose and to rid himself of these formations.

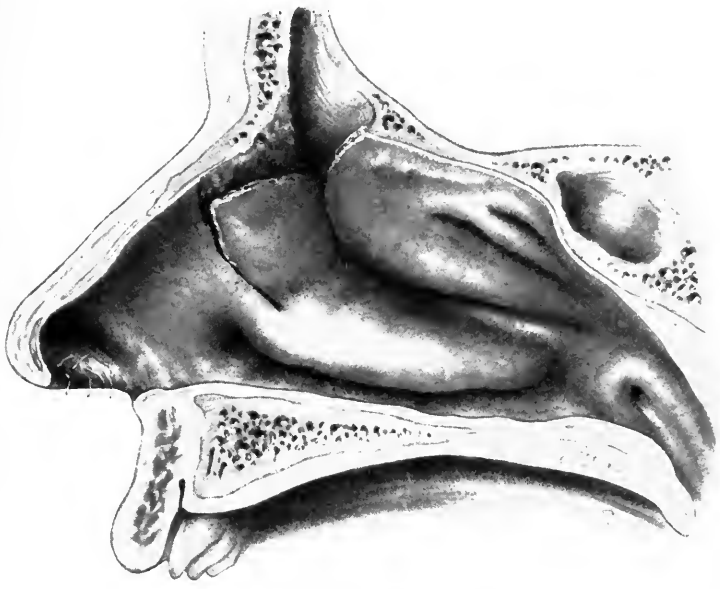


Fig. 498.

Replacement of middle turbinate and flap in Halle's ethmoid operation.

Results.—As a rule, these operations are followed by a cure of the process. Sometimes, however, by reason of small infected cells which could not be reached by the operative procedures, the condition is not fully relieved, in fact, there may be renewed infection of whatever part of the ethmoid cells remains. It must not be forgotten that some of the ethmoid cells are sometimes inaccessible to operation, particularly those which lie on the roof of the orbit and some of those most anteriorly placed. Mosher's operation offers the most satisfactory results for these types of cells. The recurrence of polypi signifies that either some diseased portion was left in the ethmoid or that an additional focus has been developed.

Serious Results.—Operations upon the ethmoid cells have been

followed by serious results such as sinus thrombosis, meningitis, and death. The possibility of these untoward results can be lessened by refraining from post-operative packing, postponing operation when possible in the presence of an acute infectious process in the nose, and by avoiding any injury in the vicinity of the cribriform plate.

Hemorrhage.—When nasal hemorrhage occurs after this or any other sinus operation, it can generally be arrested by having the patient hold his head forward over a pan for a short time. As a rule there will be a gradual cessation of the bleeding. If the blood is permitted to flow from the nose into the throat, the hemorrhage will be increased or prolonged by the hawking occasioned thereby. If the flow of blood is not stopped, cotton soaked in hydrogen peroxid or in some adrenal preparation may be applied. If nothing else suffices, the nose may be plugged with a gauze tampon which, however, should be removed within twelve hours if possible. Such tampons should be soaked in tincture of benzoin to prevent decomposition.

Orbital Complications.—Swelling of the eyelids is not at all uncommon; it usually disappears without treatment in a few days. Hyperemia of the conjunctiva or suffusion of blood in the loose tissues about the eye may occur. In one case of the writer's in which he is certain that some periorbital fat was removed at the time of the operation, the hyperemia was extreme, the suffusion of the entire conjunctiva remaining for two weeks, after which it disappeared. The usual eye compresses are indicated.

Emphysema of the subcutaneous tissue in the vicinity of the orbit and nose may ensue upon an operation on an air cavity in the region of the skin or mucous membrane. It disappears in a few days. It may be prevented by prohibiting blowing of the nose for a day or two after the operation. At times, infection of the orbit follows emphysema or the operation directly, causing retrobulbar cellulitis, panophthalmia, and abscess.

Extranasal Operations on the Ethmoid.

It is extremely rare that an extranasal operation is performed on the ethmoid cells except in connection with an operation upon adjacent sinuses. Nevertheless, it may happen that a periorbital abscess of ethmoid origin will require an external operation for its cure, especially in the acute cases. The method now in use is virtually that part of the modified frontal operation (q. v.) which permits the complete exenteration of the ethmoid cells. An incision is made beginning at the supraorbital margin and extending internally to the inner canthus

along the lateral surface of the nose to the anterior lacrimal crest. In elevating the periosteum care must be taken in the neighborhood of the fossa trochlearis. At the same time it will be wise to lift the lacrimal sac temporarily out of the lacrimal groove. The operator should take the necessary precautions to avoid wounding the tendon of the superior oblique muscle. The size of the opening depends upon the extent of the disease process. The lacrimal bone and a portion of the frontal process of the superior maxillary are resected with chisel, forceps and curette, thus giving entrance to the ethmoid cells.

The remaining ethmoid cells are carefully curetted and a gauze drain inserted in the ethmoid wound with one end in the nose. The external wound is sutured with the exception of its lower end which is left slightly open for a small drain.

Those who contemplate the performance of this operation are advised to follow the technic as described in the modified Killian operation.

Operation through the Frontal.—When the radical frontal operation is performed, it is good practice to exenterate the diseased ethmoid cells by means of a curette passed into the opening made in the frontal sinus. The cells can very easily be cleared out in this manner.

Operation through the Maxillary.—Jansen suggested the plan of curetting the ethmoid cells to reach the sphenoid from the maxillary sinus when a radical operation is being performed on the latter. There is no good reason for not clearing out any diseased ethmoid through this route under these circumstances. It must be remembered that the cells lie internal to the nasoantral wall, along the upper level of the maxillary sinus. Unnecessary exenteration of non-diseased cells should be avoided.

OPERATIVE SURGERY OF THE FRONTAL SINUS.

Intranasal Operations.

Jurasz was the first to introduce a sound into the frontal sinus through the nasal opening and Killian is responsible for the first systematized work in draining the frontal sinus by operating through the nose. The successful operative work of this character was, however, developed more recently by Ingals, Good, Halle, and Mosher through the operations which bear their names.

The aim of all intranasal operations on the frontal sinus is to improve its drainage by removing obstructions within the nose or by enlarging the nasofrontal opening.

The removal of polypi, resection of the anterior end of the middle turbinate, and curettement of the ethmoid cells are so frequently followed by relief of frontal suppuration that they should be undertaken before the specific frontal sinus operation is performed. Even though all these operations may be done at the same sitting without any harm to the patient, it is just as well to postpone the enlargement of the nasofrontal duct, unless the frontal symptoms are severe and have continued for some time.

Indications.—Pus in the frontal sinus can almost always be demonstrated by roentgenography. The pus producing mucosa and the superficial ostitis cast a distinct shadow which is shown on the plate. The opposite sinus, if not diseased, should be compared, the suppurative process being manifested by the lighter shade in the negative produced by the obstruction to the rays. The picture gives also a good understanding of the shape and size of the sinus. As in other roentgenograms of the sinuses, stereoscopy is of the greatest service and for this reason stereoscopic pictures should be secured whenever possible.

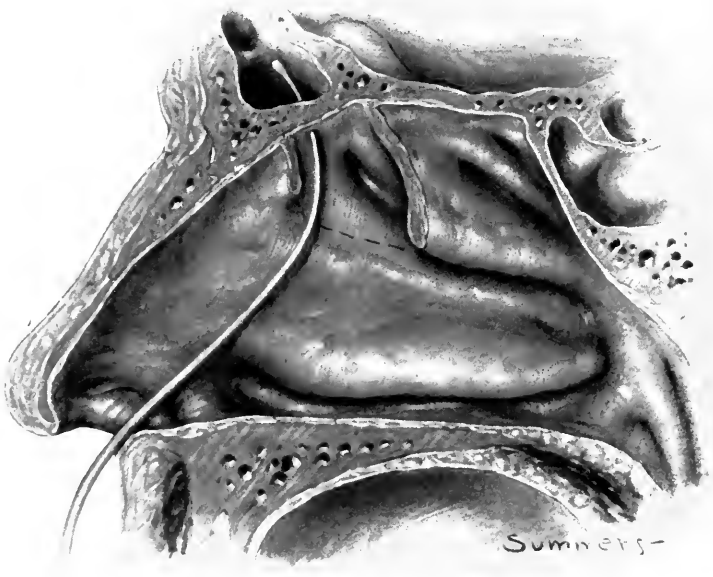


Fig. 499.

Sound introduced into the frontal sinus through an orifice in the floor.

Translumination is of little beyond incidental value; it is replaced almost entirely by roentgenography.

Visual evidence of pus coming from the frontal sinus may best be elicited by the use of a frontal sound. In a fair proportion of cases a sound may be introduced into the frontal sinus without resecting the middle turbinate. It must be remembered that the sinus does not always open into the nose through the infundibulum, but often through a little depression anterior or posterior to its extended upper extremity. Figs. 499 and 500 show how probing the sinus is modified by these variations. In addition to this, as the writer has pointed out, an ethmoid cell may be placed so far forward that the sound passed into it may give the impression that it is in the frontal which lies behind it. In introducing the sound, great caution must be exercised for it

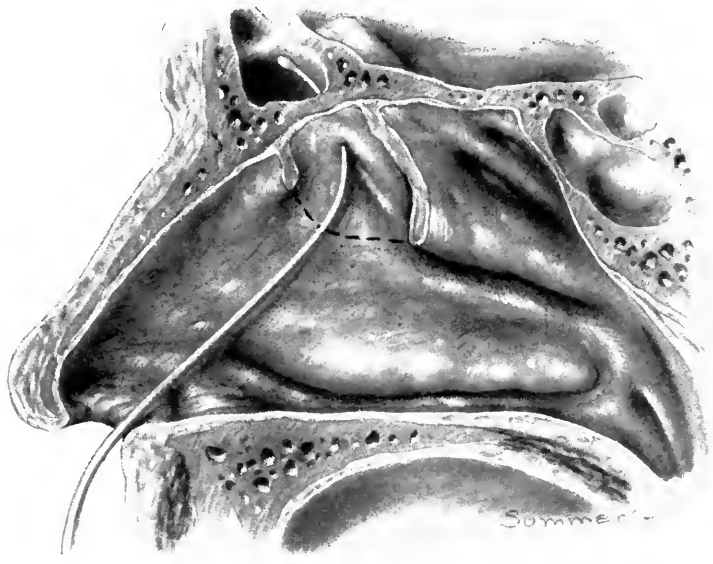


Fig. 500.

Sound introduced into the frontal sinus through the infundibulum.

may penetrate the orbit through the lacrimal bone, the lamina papyracea, or the cranial cavity through the lamina cribrosa.

The main value of the sound is to effect a flow of pus from the frontal, thus proving its presence and location.

A cannula may be introduced in conformity with the curve of the sound, and through this the sinus may be washed out, or drained by suction, giving additional evidence of the presence of pus. Great care must be exercised in all these manipulations as inflation with air may result in emphysema and serious infection.

The finding of pus in the sinus, which has persisted for some time,

almost establishes the indication for operation. In acute cases, it is best to wait unless the symptoms continue but in chronic cases, it is of very little value to delay operation, for other remedies are of slight avail, unless syphilis be the basis of the disease. The external operation should be postponed until the intranasal has been tried unless there are convincing circumstances to the contrary.

Contraindications include the presence of an acute process which is yielding to treatment; imminence of endocranial or orbital complication; serious conditions of the patient not dependent on the frontal sinus process.

Preparation.—All of the intranasal operations may be performed under cocain anesthesia with the aid of an adrenal preparation, but the application should be made as high up as possible.

It may be necessary after the resection of the middle turbinate to apply additional cocain. For the more extensive operations cocain in 10 or 20 per cent solutions may be injected into the nasofrontal canal with a syringe. If it is desired a general anesthetic may be administered. It is needless to state that the operation should be performed in a hospital.

Operation.

After the usual resection of the middle turbinate, the nasal wall above the anterior end of the resected turbinate is removed with appropriate forceps and the bulla and uncinate process and neighboring ethmoid cells resected with cutting forceps (Fig. 489), sharp curette or Hajek's hook. As the sound now readily passes into the frontal sinus, its pathway may be enlarged and cleared out by the careful use of curettes. In all this work, the experienced operator alone can be trusted with the curette in this region. The repeated statement that the cells are soft and the lamina cribrosa is hard is fallacious and makes the operator venturesome. Moreover the cribriform plate is sometimes not so hard as the surgeon anticipates.

Mosher's Method.—As a preliminary to his ethmoid operation (Fig. 493), Mosher advises freeing the nasofrontal opening of obstruction. The curette is employed for entering the external wall of the nose, to enlarge the opening and to remove whatever interferes with drainage of the frontal. If the process is limited to the frontal area, the ethmoid exenteration may be confined to that region. The advantage of Mosher's method is the accessibility to the frontal opening and the rapidity with which the free passageway is secured.

Ingals' Method.—After the preliminary middle turbinate resection, a pilot probe is introduced into the frontal sinus. A hollow burr

attached to a dental engine is slipped over this as far as the lower end of the nasofrontal canal (Fig. 501) and pushed gently into the frontal sinus, forming in this way a decided enlargement of the nasofrontal canal. A gold drainage tube of special design (Fig. 502) is used, its lower end being cylindrical, the upper and retaining end being formed

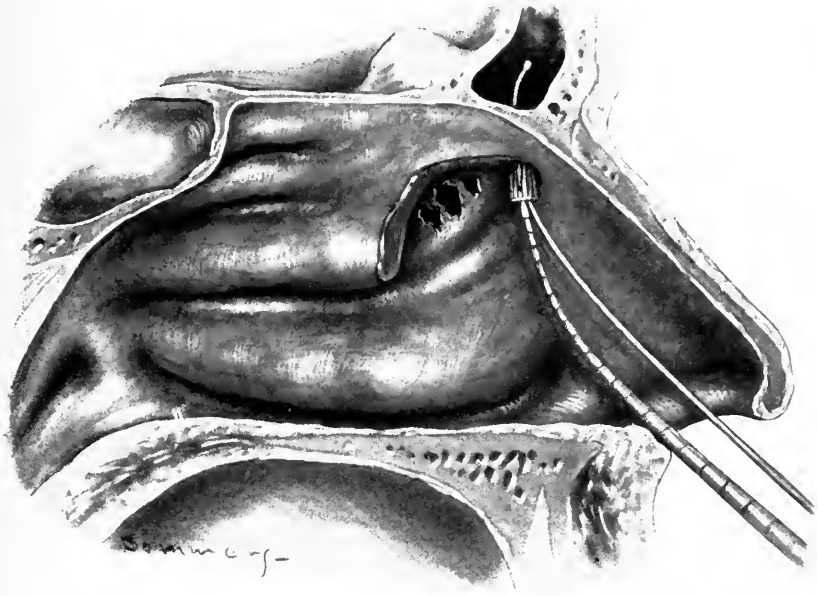


Fig. 501.
Ingals' frontal sinus operation.

Fig. 502.
Ingals' frontal sinus drainage tube.

of six or eight strips which are held in cylindrical shape by a gelatin capsule placed over them. This gelatin covered end is introduced into the opening that has been made and after the capsule dissolves the strips spring open and hold the tube in place. It can be retained for several months. No one should undertake this operation unless he is skilled in operative work upon the nose and unless he has had ample

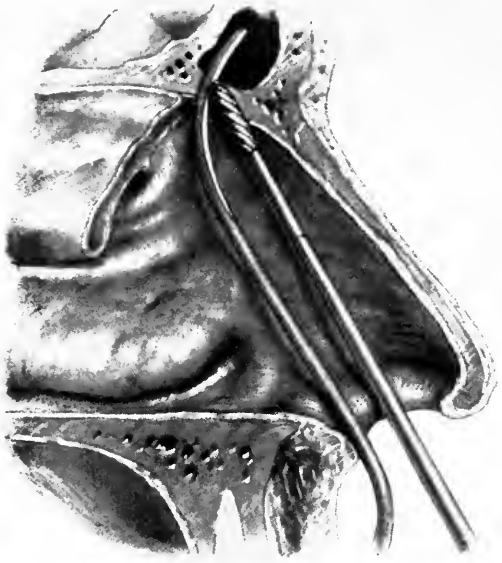


Fig. 503.

Halle's frontal sinus operation. Introducing the pointed frontal dental drill through the floor of the frontal sinus in front of the protector.

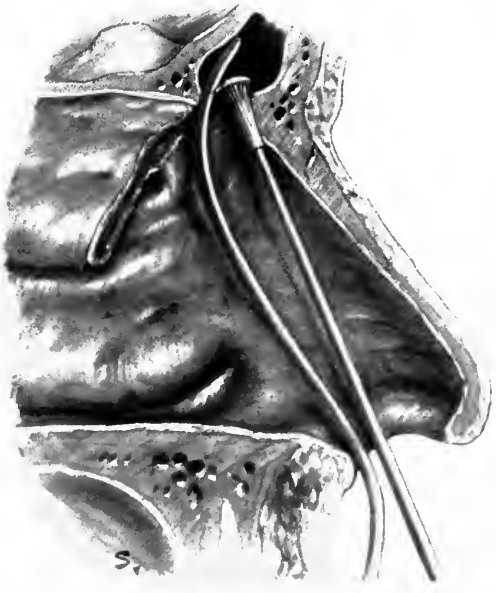


Fig. 504.

Halle's frontal sinus operation. Enlargement of the opening with the pear-shaped burr.

experience with the dental engine in nasal work as the danger of permanent injury is not slight.

Halle's Method.—This consists in removing the spina nasalis interna, giving access to the frontal sinus through its floor. He uses a soft metal protector introduced along the frontal probe, the function of which is to prevent injury to the posterior cranial wall of the sinus and the lateral wall of the orbit. After appropriate cocainization and constriction of the blood vessels, the resection of the middle turbinate and the removal of polypi and diseased ethmoid cells, the introduction of the protector and removal of the sound, the pointed dental drill is pressed through the bone in front of the protector. (Fig. 503.)

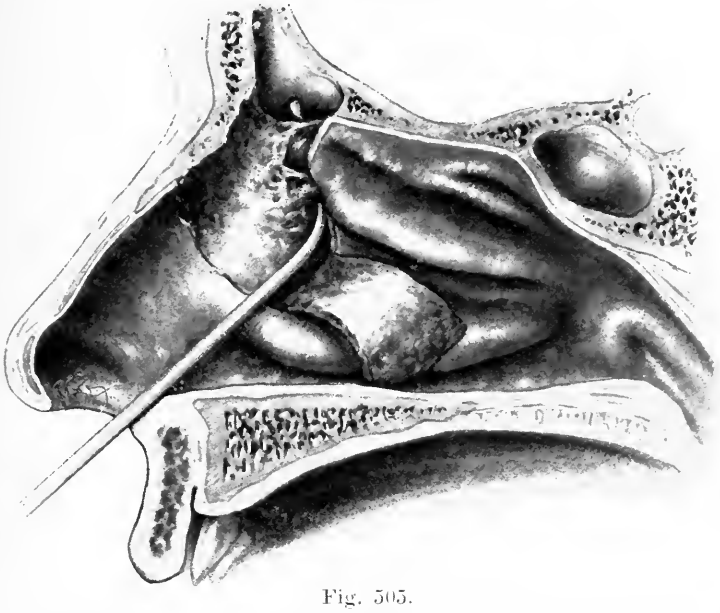


Fig. 503.

Halle's new frontal sinus operation. Introducing the probe.

As soon as it has entered the sinus this drill is replaced by the smooth-topped pear-shaped burr (Fig. 504) which would be difficult to force through the upper wall of the frontal sinus into the cranial cavity. With this drill, the bone of the nasal floor of the sinus is cut away. It cuts only circumferentially and therefore danger of injuring the cranial cavity is minimized. The cavity is packed primarily with gauze and later a tube similar to that of Ingals' is inserted and worn as long as necessary. The cautions suggested in connection with Ingals' operation must be observed also in Halle's.

Halle's New Method.—Halle has lately modified his plan of operation by making a preturbinate flap and entering the frontal sinus

through the denuded bone. This operation has been described in part under the heading of Halle's Operation on the Ethmoid (page 54, Figs. 494 to 498). After making observations with a frontal probe (Fig. 505), his pear-shaped burr may be introduced into the sinus under good view and not in the dark as in other operations. This burr is used to cut away the spina nasalis interna, that is, the floor of the sinus from behind forwards and from above downwards, thereby greatly minimizing the danger. Several burrs should be used as they become quite hot in this process. The result is a wide opening in the floor of the frontal sinus (Fig. 506).

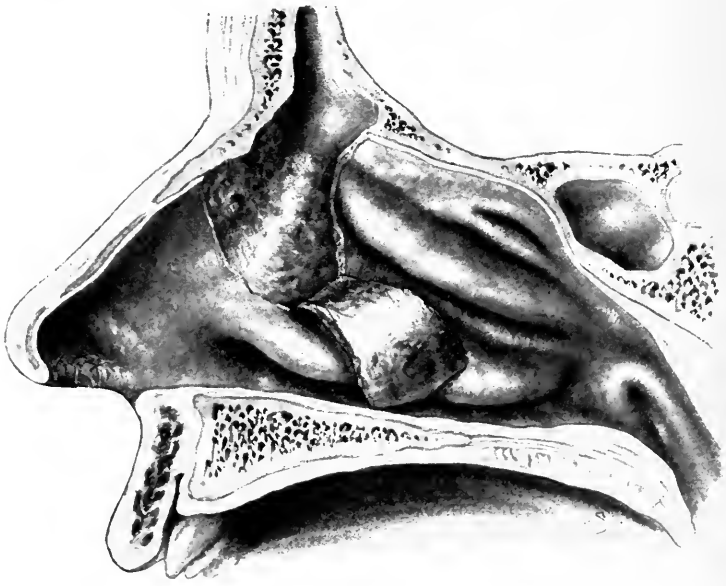


Fig. 506.
Halle's new frontal sinus operation completed.

Good's Method.—In order to enlarge the nasofrontal duct, Good devised a rasp for filing away its bony walls and the nasal floor of the frontal sinus. (Fig. 507.) A guide is used to protect the posterior and inner side, although if the rasping edges are held anteriorly and externally, there will be little danger. A gold mesh drain is used to assure drainage. A number of different types of rasps have been devised.

After-treatment.—The use of a metal drain, usually gold, has been discussed under the heading of the various methods. Ordinarily it is not necessary to use any gauze packing, although many operators still cling to it as important. It should be removed as soon as possible so as to reduce the danger of infection to a minimum.

The nose should be freed of crusts and discharge in the usual way. It may be necessary to irrigate the sinus particularly if there is any tendency to blocking up of the discharge.

Results.—All of these operations are followed by satisfactory results, in fact, it may be stated that the external radical operations are becoming less and less necessary in view of the success which attends the intranasal.

These operations are somewhat more likely to result unfowardly

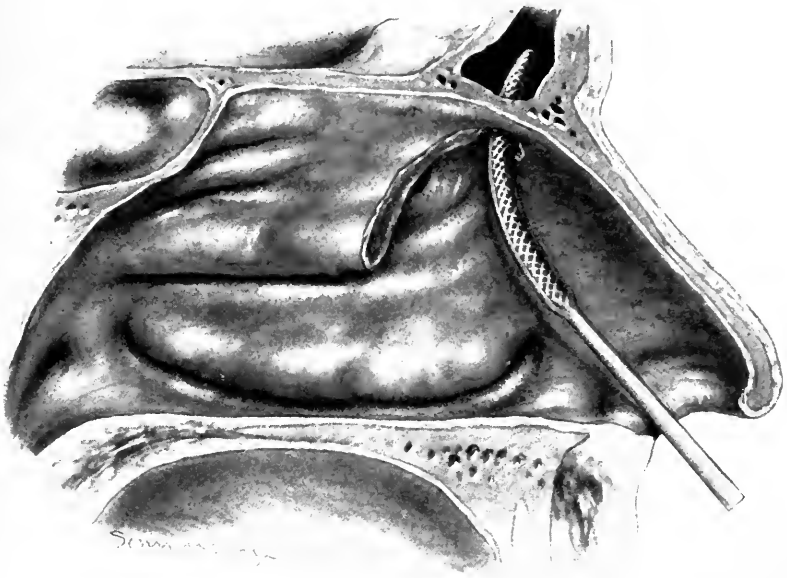


Fig. 507.

Good's frontal sinus operation.

than those on the ethmoid if complications should arise, and what has been said with reference to the latter holds good for the accidents following frontal sinus operations.

Extranasal Operations.

The frontal sinus was originally opened externally for empyema in the hope that an external drain would relieve the pus formation. To this end, a simple opening in the bone was made by trephine or chisel. That this failed is easily understood in the light of what we know about the drainage requirements of such an irregularly shaped cavity as the frontal sinus, especially as the opening cannot be at its most dependent portion.

The progress that has been achieved in this operation has been due to the methods which overcome the ineffectiveness of the drainage. Killian deserves the credit for placing the operation upon an

Fig. 508.

Bone removed in Ogston-Luc's operation on the frontal.

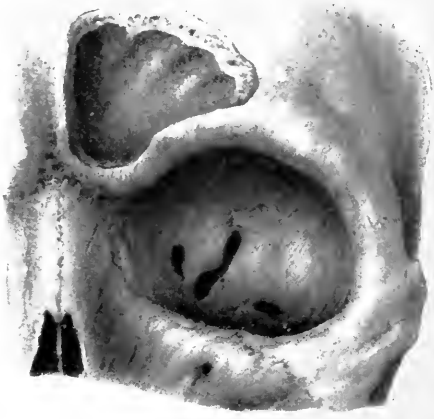


Fig. 509.

Bone removed in Kuhnt's operation on the frontal.

Fig. 510.

Bone removed in Taptas' modification of Kuhnt's operation on the frontal.

Fig. 511.

Bone removed in Killian's operation on the frontal.

acceptable basis, for, by his method, the curative results have been improved and the cosmetic results made satisfactory.

The simple opening is not often used at the present time though it may properly be employed in acute fulminating cases or in threat-

ening endocardial complications when neither diagnostic data nor shortness of time justifies a more radical operation, and when a recent violent orbital complication prohibits such an operation.

In all external operations upon the frontal sinus, roentgenographic pictures, stereoscopic, if possible, are invaluable, especially to determine anatomic characteristics. The amount and position of the bone removed in the various operations are shown in Figs. 508 to 513.

Indications.—The indications for an extranasal frontal operation are the following: when a chronic suppuration of the frontal sinus is not relieved after a fair trial by intranasal operation; when headache or severe symptoms persist; and when there is an orbital fistula in the neighborhood of the frontal which fails to heal.

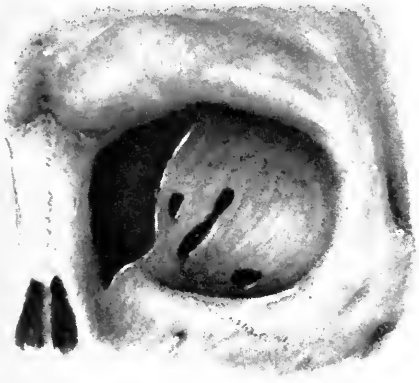


Fig. 512.

Bone removed in Jansen's operation on the frontal.

Fig. 513.

Bone removed in Riedel's operation on the frontal.

Preparation.—These operations should be performed under general anesthesia with the usual preanesthetic preparations, the insufflation method being preferable. The hair is covered with a sterile towel or is protected by a collodion application. The nose on the corresponding side is packed with gauze to prevent bleeding into the pharynx. The roentgenogram should be kept in constant view so as to indicate to the operator the extent of the sinus. As a rule, operators prefer not to shave the eyebrows as the hair sometimes fails to return. Iodin applications assure a sterile field.

Ogston-Luc's Operation.—This operation which was first performed in 1884 by Ogston, the pioneer of external surgery of the frontal sinus, and ten years later by Luc, consists in the resection of a portion of

the facial wall of the sinus (Fig. 508) with curettement of the nasofrontal duct and removal of adjacent ethmoid cells. The operation is performed through an incision along the inner third of the eyebrow. Either a tube or gauze is introduced into the nose from the sinus and the lips of the incision are closed with sutures.

Kuhnt's Operation.—The incision is bow-shaped from the middle of the eyebrow to the root of the nose and then runs perpendicularly upwards from 3 to 5 cm. The entire anterior wall is then resected with a chisel (Fig. 509), allowing a margin of one-half cm. at the supraorbital margin to protect the contour of the orbit. The entire mucosa is then removed, the upper portion of the ductus nasofrontalis is curetted, and the adjacent diseased ethmoid cells are exenterated. A drainage tube is introduced into the nose and the external wound closed with the exception of the lower internal angle in which a small drainage is retained for several days.

Luc's Modification of Kuhnt's Operation.—This consists in removing the ethmoid cells whether diseased or not in order to secure a wider opening into the nose. It dispenses with the external drain.

Taptas' Modification of Kuhnt's Operation.—Taptas extended the bone removal so as to include the frontal process of the superior maxillary bone. (Fig. 510.)

The incision is of the usual Killian type which permits the soft parts to be elevated from the field of operation. The frontal process is removed with bone forceps or chisels exposing the lower portion of the frontal sinus and the nasofrontal canal to the operator's view. The wound is packed with gauze, the end is passed into the nose, the external wound is sutured and the small drains are placed in the wound at the inner canthus for several days.

Jansen's Operation.—The entire orbital wall of the sinus is removed (Fig. 512) through the regular Killian bow-shaped incision, the ethmoid cells are exenterated, and a wide opening into the nose is effected. The operation is not satisfactory in large sinuses.

Riedel's Operation.—Both the orbital and facial walls of the sinuses are removed. (Fig. 513.) It is serviceable only in very small frontal sinuses.

Lothrop's Operation.—Lothrop combined the intranasal and extranasal operations, effecting a large permanent drainage opening by removing the bone surrounding the ostium. Furthermore, he favors making a similar opening in the opposite sinus and uniting the two in the manner which is here described.

Before etherization an application of cocain and an adrenal preparation should be made to lessen the hemorrhage and to facilitate the operative procedure within the nose. The posterior nares are tamponed to prevent the blood passing into the pharynx.

A single curved one-inch incision is made in the inner portion of the eyebrow limited externally by the supraorbital notch, in this way avoiding involvement of the supraorbital nerve. The periosteum is elevated and the bone removed by chisel and rongeur forceps (Fig. 514), making an opening approximately three-quarters of an inch long. The sinus is explored with a probe, and polypi, granulations, and pus gently removed.

Fig. 514.

Lothrop's operation on the frontal sinus. Relative amount of bone removed.

A curved probe is now passed through the ostium into the nose and left *in situ* as a guide. Small curved curettes are then passed down from above just in front of the probe and the walls of the cells on the floor of the sinus are broken up. The posterior angle of the sinus should be entirely avoided on account of the proximity to the cribriform plate which may be injured. Burr drills and rasps are used to complete the removal of bone. The rasps which may be used from above and from below through the enlarged ostium should be made to cut forward and laterally in order to avoid danger. The burrs should also cut in these directions. The bone removed includes the nasal crest and spine of the frontal bone, the thick part of the nasal bones, and the nasal process of the superior maxilla.

The interfrontal septum is perforated and cut away, giving access to the opposite sinus. The perpendicular plate of the ethmoid is then

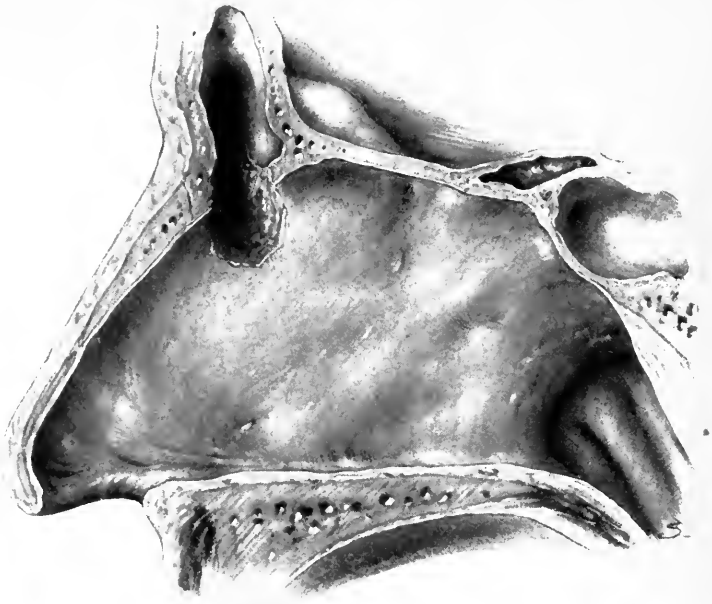


Fig. 515.

Lothrop's operation on the frontal sinus, showing the removal of the interfrontal septum, nasal spine, and perpendicular plate.

Fig. 516.

Lothrop's operation, front view.

cut away, as shown in Figs. 515 and 516 through the opening thus made and through both sides of the nose the bone of the floor of the opposite sinus is also cut away, so that only a thin shell of bone remains surrounding the wide opening in both frontal sinuses. The ethmoid cells in the neighborhood of the lacrimal bone and the agger nasi are opened up, leaving an opening in the floor of both frontal sinuses ample for drainage. The skin incision is closed. Cleansing is the only after-treatment required.

Killian's Operation.—This operation, which is somewhat modified from the original one devised by Killian is the most popular of all

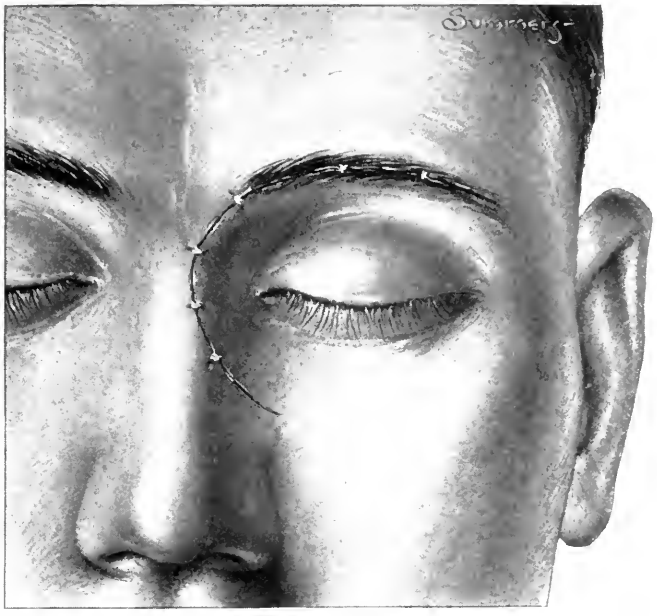


Fig. 517.

Killian's operation on the frontal sinus. Incision closed with interrupted sutures.

at this time and its results, therapeutically and cosmetically, are better than those of any other type of external operation on the fronal sinus. The operation comprehends the removal of the anterior wall of the sinus, the inferior wall, the processus frontalis of the superior maxilla, the upper portion of the lacrimal bone and the adjacent ethmoid cells, the complete curettement of the sinus mucosa and the preservation of a strip of bone at the orbital margin for cosmetic purposes.

An incision is made through the eyebrow following its curve, extending downwards along the outer side of the root of the nose and cheek as shown in Fig. 517. This incision should extend only to the

periosteum, not through it. It is well first to make a shallow incision through the skin and then to make nicks as markers at regular intervals across this incision so as to assure perfect orientation and coaptation when the sutures are made. Great care must be taken not to extend this incision through the periosteum as this would counteract the main value which this operation has over other types, namely, the preservation of the arch of the orbit. The hemorrhage is readily controlled by hemostat forceps, but the globe of the eye must be carefully protected from the weight of the forceps and other instruments

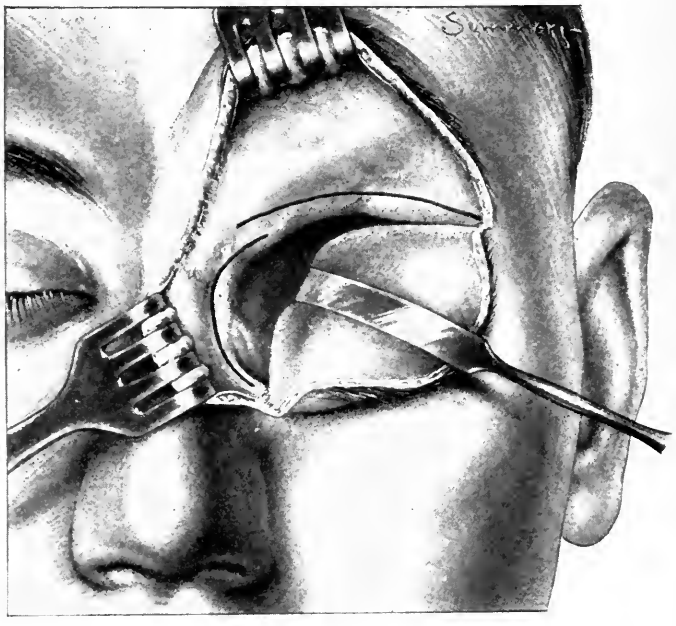


Fig. 518.

Killian's operation. Incisions through periosteum.

by pads of gauze. After the soft parts have been elevated from the periosteum, two incisions are made through the periosteum to the bone as shown in Fig. 518. The upper incision is made from 5 to 10 mm. above the supraorbital margin extending parallel to it from the outer limit of the incision internally to the nasal bone. The periosteum is now elevated from the incision upwards (Fig. 519), and the entire anterior wall above the incision resected. For this purpose the triangular chisel of Killian (Fig. 520) is used to make the first opening through the bone without wounding the mucosa. The remaining portion is removed with forceps or chisels. It is sometimes necessary to enlarge the incision and to elevate the temporal muscle if the

sinus is large. In removing the bone care must be observed not to encroach upon that portion covered by periosteum which is to form the bridge preserving the contour of the orbit.

The entire mucosa is removed with curette; none should be allowed

Fig. 519.

Killian's operation. Elevation of the periosteum.

to remain. Any septa which project into the sinus are removed so as to secure a smooth cavity.

The lower incision is now made in the periosteum beginning at the lower end of the skin incision and extending along the nasal and lacrimal bones and supraorbital margin as far as desired, preferably

Fig. 520.

Killian's frontal sinus chisel.

to the limits of the inferior wall of the sinus. Where the incisions run parallel, a bridge of periosteum about 7 mm. wide must be retained.

The periosteum and soft parts, including the trochlear nerve and the attachment of the superior oblique and the lacrimal sac, are now elevated, thus exposing the bone of the inner and superior portion of

the orbit. Care must be taken not to wound the periorbita on account of the possibility of consequent infection.

After the hemorrhage has been checked by gauze compresses, the bone of the inferior wall is removed with the Killian chisel, forceps, or other types of chisels. (Fig. 521.) As much of the frontal process of the maxilla and of the superior portion of the lacrimal bone as is necessary to secure free access to the middle turbinate and ethmoid cells is now removed with chisels and forceps and the ethmoid cells are exenterated as far as desired. The anterior wall of the sphenoid may also be resected. The cavity now has no anterior or inferior

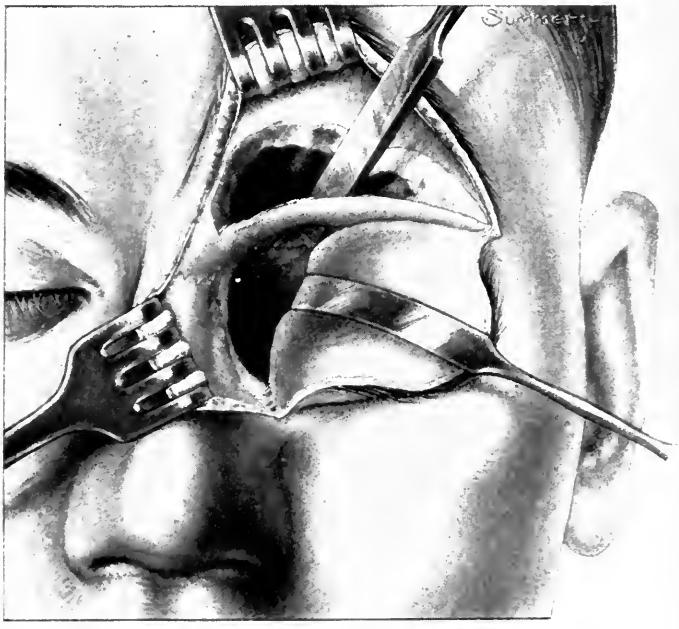


Fig. 521.
Killian's operation. Removing the inferior wall.

wall, is free of mucous membrane and communicates by a wide opening with the nasal cavity, the adjacent ethmoid cells and middle turbinate being removed.

The preliminary gauze packing is now removed from the nose and after cleansing, the sinus is loosely packed with sterile gauze, the end being carried from the sinus into the nose. The wound is sutured, the proper approximation being determined by the little cross-cut incisions made at the beginning of the operation. (Fig. 517.) A small rubber drain is usually put into the wound just above the inner canthus and retained for several days.

The after-treatment consists of the following: The packing is removed from the nose on the second or third day, the dressing changed and stitches removed on the third, fourth or fifth day.

For the first few days, the patient is required to lie on the sound side and is forbidden to blow his nose, on account of the danger of emphysema. The secretions should be drawn backwards into the pharynx and expelled through the mouth during that time. The ordinary wound accidents are treated as usual. After a few days, the patient may leave the hospital and with the exception of cleansing the nose, no further treatment is required.

Some modifications of Killian's technic have been made. Thus Eschweiler and Hajek do not find it necessary to limit the elevation of the periosteum of the supraorbital margin to that portion internal to the supraorbital notch, in order to avoid diplopia. They show that even if it does occur, it soon disappears. Boenninghaus has found that far less likelihood of injuring the lamina cribrosa was secured by extending the inner margin of the bone wound to the interfrontal septum.

Knapp's Operation.—This differs from the Killian in this, that the skin incision is made below the supraorbital margin, the periosteum being incised at the supraorbital margin. The periosteum and soft parts are elevated from the bone downwards, and the pulley of the superior oblique is slowly detached from its bed. Care should be taken not to disturb its relations between the tendinous ring and the periosteum. The lacrimal sac is pushed aside and the inferior wall of the sinus, the frontal process of the superior maxilla, and a portion of the lacrimal bone are removed, and the frontal mucosa is curetted away. When necessary a portion of the anterior wall is also removed, leaving a broad periosteum covered bridge of bone at the supraorbital margin, as in the Killian operation. The ethmoids are exenterated through the frontal sinus opening.

Hajek's Operation.—Hajek acknowledges that osteoplastic operations upon the frontal sinus were performed by Brieger, Schönborn, Vittkop, and Golovine. His own operation consists in making a somewhat right-angled triangular flap of bone, the horizontal portion of which is parallel to the supraorbital margin, while the perpendicular portion follows the interfrontal septum. He cautions against making these bone sections absolutely right-angled, because to secure the best results, they must follow the sinus curves. The incision is right-angled as shown in Fig. 522. A fine chisel is used to cut into the bone, through a small opening of which a sound is introduced to determine the extent of the sinus. A roentgenogram must be kept in view throughout the

operation, for the same purpose. After the horizontal and vertical openings have been made through the bone, the small bridge thus remaining is fractured by means of an elevator thrust through the opening. When the bone flap is elevated (Fig. 523), the frontal mucosa then comes into good view and may be treated according to indications. A good opening must be established into the nose when the nasofrontal duct is too small, as it usually is. This is done by chiseling away the internal nasal crest. Some of the ethmoid cells are curetted. A large drainage tube is introduced and held in position by a suture, the flap restored and the wound sutured. The drainage is retained for several weeks and even after removal, Hajek advises that applications be made to the ductus nasofrontalis for several weeks.

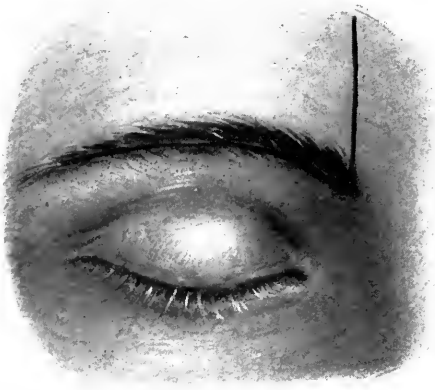


Fig. 522.
Hajek's operation. Incision.

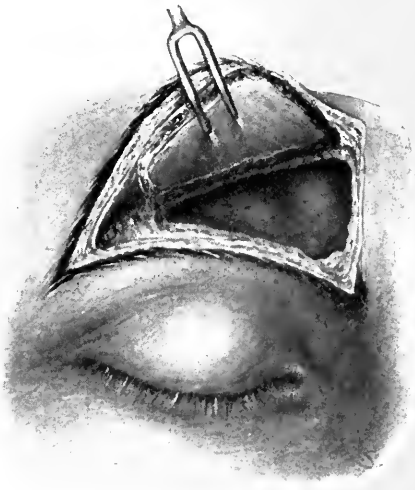


Fig. 523.
Hajek's operation. Bone flap.

Beck's Osteoplastic Operation.—Beck makes a flap out of the anterior bony walls of both sinuses, the flap being attached below. A celluloid model of both sinuses is made from a good roentgenogram and sterilized by immersion in a 1 to 1000 bichlorid solution and placed over the bone in its proper position to act as a guide over the bone resection.

The incision is made through both eyebrows, nicked with cross cuts for orientation. At the root of the nose, however, it is made at a somewhat lower level. The soft parts are elevated down to the periosteum. The celluloid model is placed in position and the periosteum is cut in conformity with it except in that portion which lies over the root of the nose which is kept intact to serve as an attachment for the flap.

A fine chisel should be used to make a groove in the bone at the upper margin of the sinus (Fig. 524) in order to permit the Gigli saw to engage. By means of this instrument, the whole anterior wall of both sinuses is sawed through as far as the supraorbital margin. The Gigli saw is now employed to cut forward half way through the bony attachment remaining. With the aid of a chisel to force the bony flap forward, this bone attachment is fractured without detaching the periosteum. (Fig. 525.)

The diseased mucosa is curetted entirely away and the nasofrontal opening enlarged by trephine or rasp, but the mucosa in the nasofrontal duct covering the internal nasal crest is not disturbed. All diseased

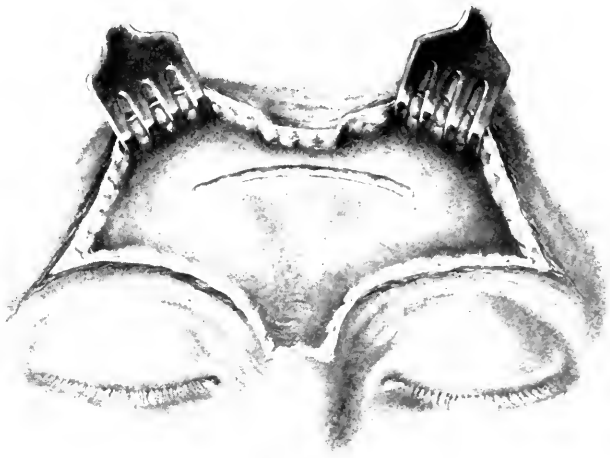


Fig. 524.

Beck's operation. Groove to guide the Gigli saw.

ethmoid cells are exenterated. A rubber tube containing a gauze wick is introduced from the diseased sinus into the nose, the continuation of this wick being packed loosely into the sinus.

The osteoplastic flap is replaced in position, the skin and soft parts are drawn over it and the wound is sutured. The gauze drain is removed on the following day, and the rubber tube is retained for several days.

Results.—External operations on the frontal sinus must not be considered as free from danger nor should a good result be expected with too much confidence. In quite a fair proportion of cases, the suppuration continues or the fistula persists. Even if suppuration sub-

sides, the symptoms for which the operation was performed may not be alleviated. Secondary operations are not uncommon.

Fatal Results.—Death has followed these operations from meningitis, subdural abscess, osteomyelitis and pulmonary abscess. Considering the proximity of the operative field to the brain, the greatest care must be exercised to prevent meningitis and infection of the bone and its coverings, periostitis, osteomyelitis, etc.

Deformity.—The Killian, Beck, Hajek, Luc, and Lothrop operations give the best results so far as deformity is concerned. The Riedel operation makes no pretense of saving the orbital margin and the Jan-

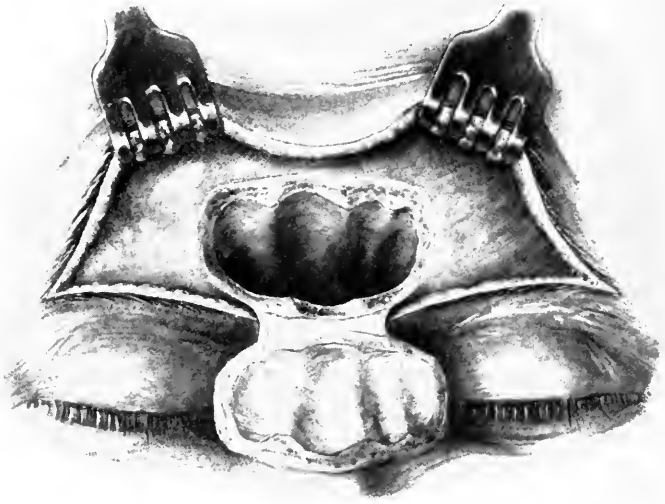


Fig. 525.

Beck's operation. Formation of bone flap.

sen operation is sure to leave an unsightly deformity if there is a large frontal sinus present.

Diplopia may occur from injury of the trochlearis or its involvement from wound infection, cicatricial inclusion, etc. This is not so frequent as might be expected and when it occurs it may be transitory.

Anesthesia from involvement of the supraorbital is not uncommon, but it generally disappears without having occasioned any notice on the part of the patient.

Neuralgia.—Severe pain may follow the operation from neuromata or other process affecting the severed nerves. In quite a few instances neurectomy has been necessitated for relief.

OPERATIVE SURGERY OF THE SPHENOID SINUS.

Before the advent of cocain, the sphenoid sinus was not a subject for surgical consideration, except with reference to foreign bodies and neoplasms. Hyrtl, in 1882, wrote that the sphenoid was entirely beyond the range of manual and instrumental attack. But the wonderful work of Zukerkandl, published the same year, changed the entire conception of the subject by giving to the study of the normal and pathologic anatomy of the sphenoid an impetus which it retains to this day. Schäffer was the first to open the sphenoid, in 1885, and he was followed by Berger and Tyrman, Rolland, Heryng, Rualt, Quenu, Clark, Cozzolini, and others. Schäffer and his followers endeavored to secure drainage of the sinus by simply enlarging the natural opening, although Schäffer himself attempted to extend the enlargement to the floor of the cavity. Killian, in 1900, called attention to the frequency of the coincident involvement of the last posterior ethmoid cell and the possibility of securing a larger opening by operating through the pars ethmoidalis. However, it was Hajek who demonstrated that the best results could be secured only by a resection of both the pars ethmoidalis and the pars nasalis of the anterior walls.

Indications.—The necessity for operation is evidenced by the presence of pus in the sphenoid cavity in association with symptoms which call for relief. The graver and the more prolonged the symptoms, the more urgently is the operation indicated. These symptoms include headaches, profuse discharge from the nose into the pharynx, and ocular manifestations. As all of these symptoms may arise from affections of other sinuses and in fact without sinus involvement, it behooves the surgeon to be on secure ground before operating with hope of cure. On the other hand, in many cases the sphenoid empyema occasions no recognizable symptoms, probably because the drainage is ample. Such cases, however, should be looked upon as of potential harm. At any time, the empyema may assume the closed type, serious eye symptoms may develop or remote lesions from absorption of pus or its associates may present themselves. The headaches are generally referred to the back of the eye, the back of the head, and the posterior cervical region. The ocular conditions that may develop include orbital infections, paralysis of the ocular muscles, diminution of the field of vision, and optic neuritis. Bilateral ocular conditions may be rhinogenous in origin, both by reason of the frequent coincidence of bilateral suppurations of the nasal sinuses and on account of the frequent relation of one sphenoid to both optic nerves as shown by Onodi, the writer (See Vol. I, p. 40 et seq.), and others.

The presence of pus is to be determined in several ways. Roentgenography has thus far not been of much service. On account of the great distance of the sinus from the plate, the pus and the diseased mucosa cannot show a shadow in the anterior and lateral views. There is some hope for pictures in which the shadows are thrown through the orbit or through the palate.

The Holmes nasopharyngoscope makes it possible to see the pus exuding from the sphenoid orifices in a fair proportion of cases.

In some, pus will be seen with the use of a postnasal mirror passing over the superior surface of the superior turbinate bone, practically defining its origin from the sphenoid.

Pus may sometimes be seen in the region of the sphenoid opening after thoroughly cocainizing the nose, applying one of the adrenal preparations and using a long-bladed Killian speculum.

By the use of a sound (Fig. 526) introduced into the sphenoid sinus, the presence of pus may be elicited and the abnormal character of the mucosa established. The sound is passed along the roof of the

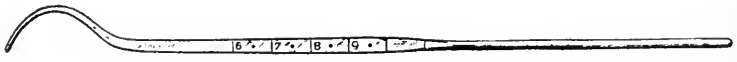


Fig. 526.

Andrews' sphenoid sound.

nose with the end directed downward and backward. By careful maneuvering and practice, the sound will be engaged in the sphenoid orifice, which is from 7 to 8 cm. from the anterior nasal spine.

Force must not be used especially in the anterior part of the roof of the nose for fear of injuring the lamina cribrosa. Furthermore, it must not be forgotten that the anterior wall of the sphenoid constitutes the upper portion of the posterior extent of the nose, in other words that the nose extends above the posterior nares. (See Figs. 8 and 19, Vol. I.)

To establish effectively the presence of pus in cases that are not marked, it is generally necessary to resect the posterior portion of the middle turbinate which will bring the nasal portion of the anterior wall of the sphenoid into view. If desired, the sphenoid operation can be performed at the same sitting.

When all these symptoms are properly weighed, the headache, ocular symptoms, presence of pus, the indications for the operation are established. It is best to remove as much of the anterior wall as possible, as simple enlargement of the ostium is usually followed by early closure and the recurrence of symptoms.

Contraindications.—The usual contraindications against nasal operations obtain, especially the presence of acute nasal or sinus infections unless there are urgent symptoms dependent upon them which can be relieved in no other way.

Anesthesia.—All the sphenoid operations may be done under local anesthesia, though some prefer a general anesthetic.

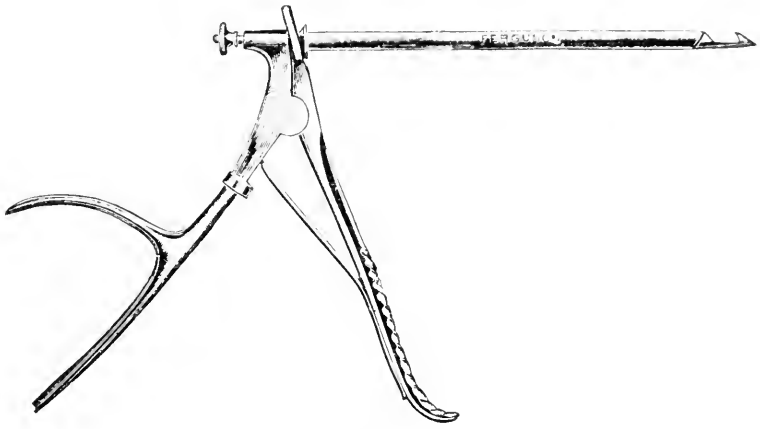


Fig. 527.
Faraci's forceps.

Enlargement of the Ostium Sphenoidale.—This was the earliest operation performed. After preliminary cocainization and constriction of the blood vessels with one of the adrenal preparations, an instrument is introduced into the ostium to enlarge it. For this purpose the

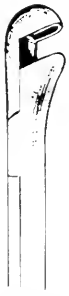


Fig. 528.
Hajek-Skillern's punch forceps.

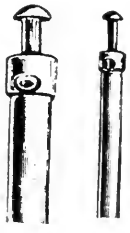


Fig. 529.
Fletcher-Anderson's punch forceps.

Faraci forceps (Fig. 527), Hajek-Skillern forceps (Fig. 528), Fletcher-Anderson forceps (Fig. 529), Hajek's hook (Fig. 480), Grayson's hand burr (Fig. 530), chisel or electric burr is used. While the operation may be performed without resecting the posterior portion of the middle turbinate, it is practically always best to add this to the operation. Fig.

531 shows the use of the electrically driven burr, chisel, and forceps in the performance of this operation. No dressing is required. The result of this operation is shown in Fig. 532; however, in this instance a flap dissected from the anterior wall has been utilized to cover the lower margin of the opening.

Fig. 530.

Grayson's hand burr.

Resection of the Pars Nasalis.—The extent of the sinus and its anterior wall is determined by use of the sound, and the posterior portion of the middle turbinate is resected. The enlargement of the ostium is extended so as to remove all of the anterior wall of the sphe-

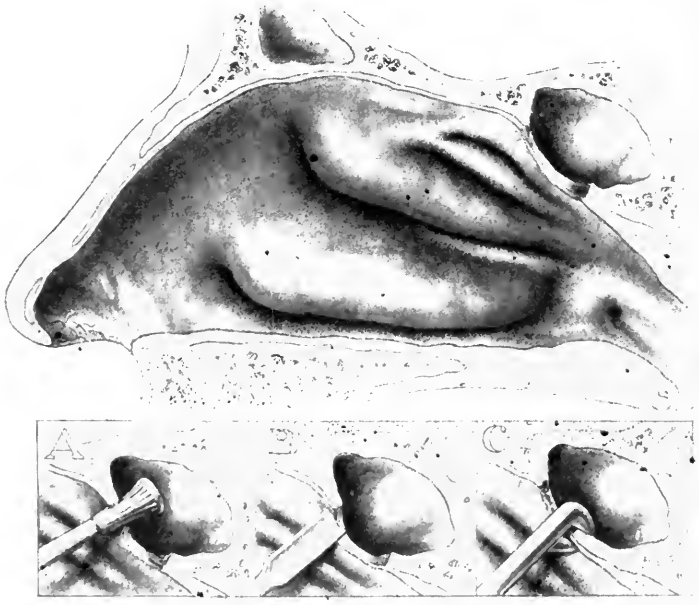


Fig. 531.

Enlargement of the ostium sphenoidale.

noid in relation with the nasal cavity. The same technic may be used as in the operation just described, the removal of the bone being made more extensive. No dressing is required.

Hajek's Operation.—After the usual preliminaries, including the sounding of the sinus and the resection of the posterior portion of the

middle turbinate, the posterior ethmoid cells are opened and broken into shreds by Hajek's hook, which is introduced in front of the anterior wall of the sphenoid and drawn forward with the cutting edge

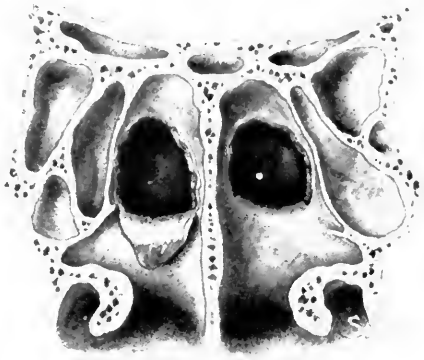


Fig. 532.

Enlargement of the ostium sphenoidale; flap used to cover lower margin of the opening.

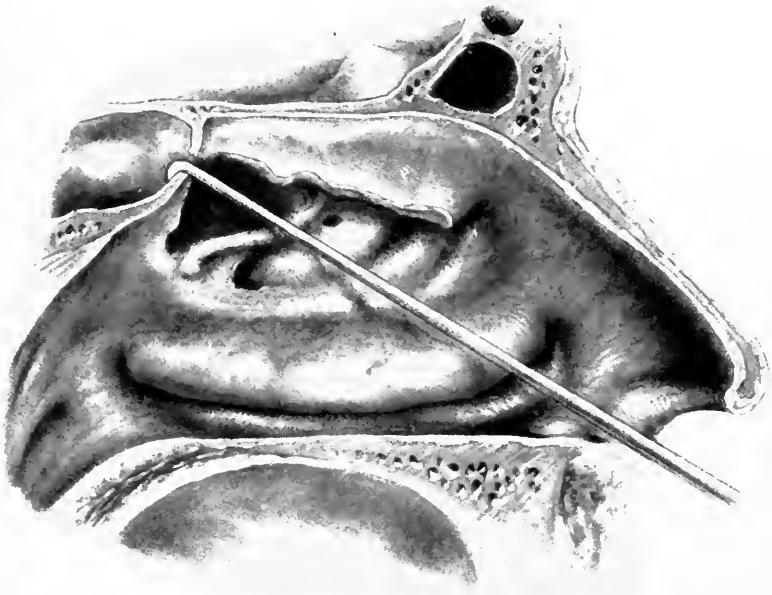


Fig. 533.

Hajek's operation on the sphenoid.

turned forward and outward toward the eye. (Fig. 533.) The fragments are removed with forceps. This liberates the pars ethmoidalis

and brings the entire anterior wall of the sphenoid into relation with the nose. The ostium is then enlarged sufficiently to admit the Hajek sphenoid forceps (Fig. 528) by means of which the anterior wall is entirely resected. The resection may be affected by other bone cutting forceps or the electric burr.

The great value of Hajek's operation is due to the removal of the entire anterior wall of the sphenoid and the pars ethmoidalis, as well as the pars nasalis. When the latter only is removed, the suppurative process in the posterior ethmoid cells may be overlooked and may cause reinfection of the sphenoid sinus.

It is unwise to curette the mucosa of the sinus and if attempted at all, it should be done with the greatest circumspection. No dressing should be applied.

Even this large opening has a tendency to diminish and it may be necessary after ten days to cauterize carefully the edges of the wound—Hajek says, for six weeks—every five or eight days. No other treat-

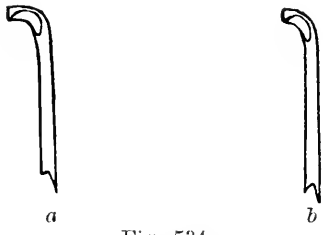


Fig. 534.

Sluder's knife. *a*, middle turbinate knife; *b*, sphenoid knife.

ment is usually necessary except to free the nose from time to time of accumulated secretion. Irrigation is not advisable.

Sluder's Operation.—Sluder's operation has the same purpose in view as Hajek's, the resection of both the pars nasalis and the pars ethmoidalis of the anterior wall of the sphenoid. He uses a knife (Fig. 534) with a cutting edge turned at a right angle to the shaft and sharpened so as to cut on the pull. It is also sharpened on the face parallel to the shaft. This knife is introduced under the anterior third of the middle turbinate as far as the uncinate process and as high as the cribriform plate, with its cutting edge facing forward. The knife is then drawn forward through the bone. (Fig. 535.) It is reintroduced internal to the turbinate some distance back of the first cut along the cribriform plate (Fig. 536), the middle turbinate is severed from its attachment, and, with the cutting edge directed forward and inward, most of the ethmoid capsule is resected by drawing the knife forward as indicated in Fig. 537. The knife is then passed carefully along

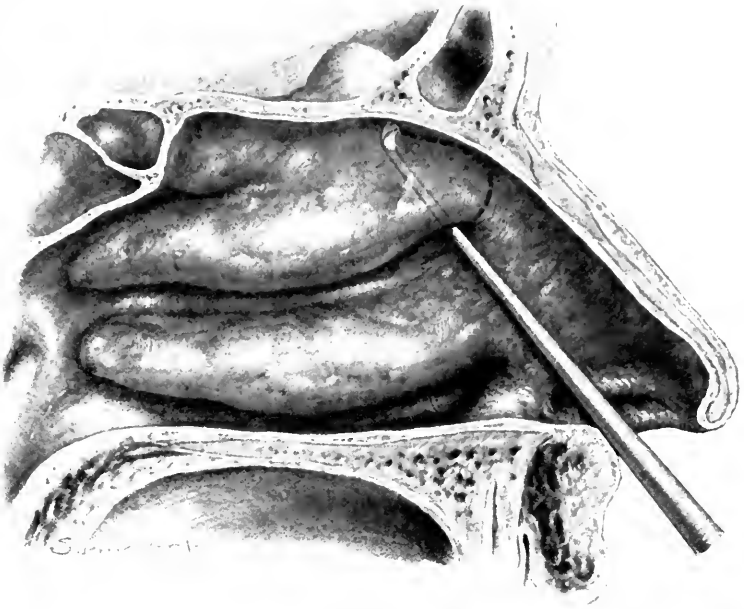


Fig. 535.

Sluder's sphenoid operation. Resecting the anterior third of the middle turbinate.

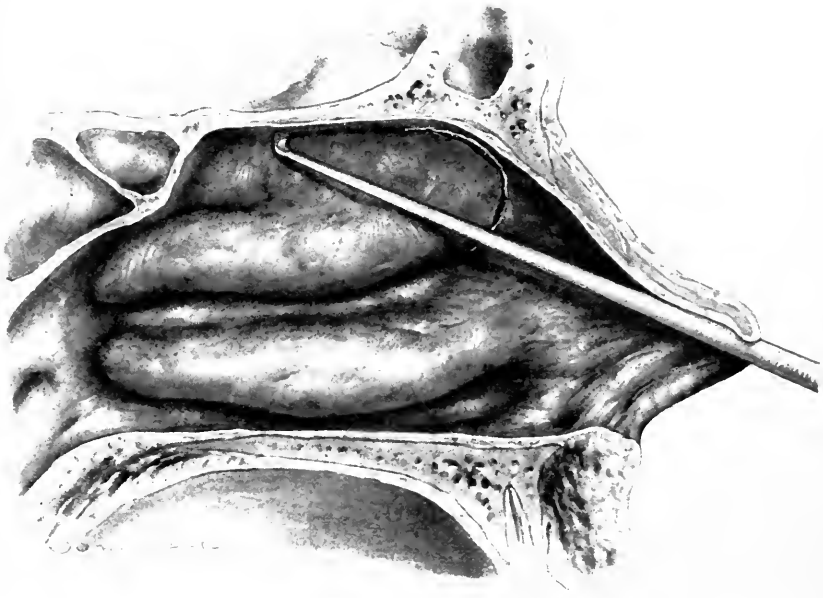


Fig. 536.

Sluder's sphenoid operation. Middle turbinate severed from its attachment.

the cribriform plate with its cutting edge directed downward. When the sphenoid is reached gentle pressure is made and it soon penetrates the anterior wall of the sphenoid, which is thin near the roof. No attempt is made to enter the sphenoid ostium. (Fig. 538.) It is then pulled forward and carried through the ethmoid cells. This method permits the opening of a posterior ethmoid that would be overlooked in another procedure. The knife is introduced again and a third time, making cuts more or less parallel to the first. (Fig. 539.) The knife is

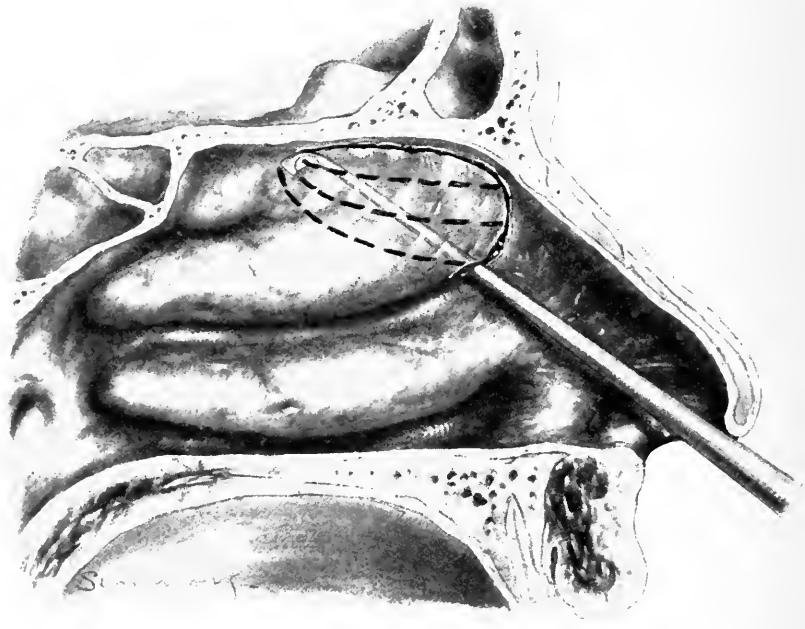


Fig. 537.

Sluder's sphenoid operation. Resection of the ethmoid capsule.

then passed into the uppermost portion of the opening in the sphenoid already made, is carried through the pars nasalis of the anterior wall of the sphenoid, the cutting edge being directed medially and downwards. By directing the knife downwards and forwards, it always cuts away from the cranial cavity. Two other cuts are made continuing the cut portion down to the floor of the nose as shown in Fig. 540 and the fragments are then removed with appropriate forceps.

Operation through the Frontal.—The sphenoid is readily opened in connection with any of the external frontal operations. After the ethmoid labyrinth is exenterated, the operative procedure is continued so as to include the resection of the anterior wall of the sinus. This method which assures a very wide opening in the nasal wall of the

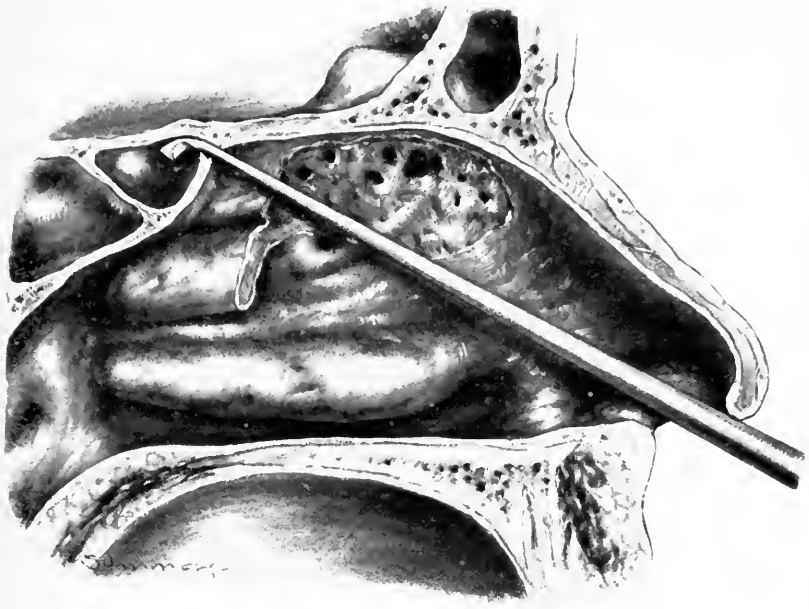


Fig. 538.

Sluder's sphenoid operation. Knife penetrating the anterior wall.

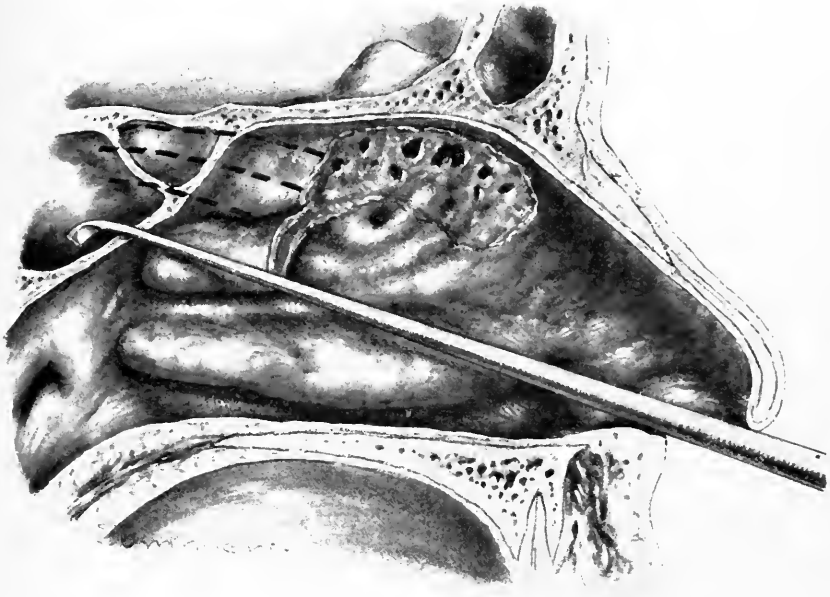


Fig. 539.

Sluder's sphenoid operation. Method of making the three cuts through the anterior wall of the sphenoid and the posterior ethmoid cells. Knife introduced for cutting through the pars nasalis.

sphenoid sinus adds practically nothing to the time required when the ethmoid operation is coincidently performed.

Operation through the Maxillary.—According to the Jansen procedure, when the maxillary is cleaned out through resection of the anterior wall, the ethmoid cells are exenterated in front of the sphenoid and then the anterior wall of the sphenoid is resected. The ethmoid cells lie just internal to the angle made by the nasal wall and roof of the maxillary, and can, therefore, be readily entered from the maxillary sinus by curette or forceps. Continuing this exenteration posteriorly, the anterior wall of the sphenoid can readily be removed according to the operator's preference of instrument.

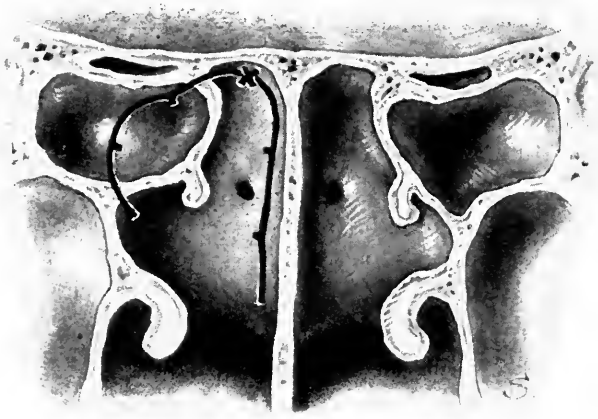


Fig. 540.

Sluder's sphenoid operation. Position of the cuts made in the anterior wall of the sphenoid.

Results of Sphenoid Operations.—All operations on the sphenoid vary greatly in results as to cure, but it is safe to say that the larger the amount of the anterior wall resected, the more likely is a cure to follow. This is true, especially as to suppuration, although as has already been stated, the opening has a great tendency to decrease in size with a consequent continuance of the suppuration. As to the cure of symptoms ascribed to sphenoid disease, results are not so satisfactory, as operators are often too sanguine before operation in holding the suppuration responsible for coincident symptoms. This should not, however, deter one from operating in cases that give any promise of relief.

Serious effects sometimes follow operations; death, severe headache, blindness, cerebrospinal rhinorrhea have been reported. In this connection it is perhaps not amiss to advise the operator to have a whole-

some respect for the *locus operandi* which brings him close to such important structures as the brain, cavernous sinus, internal carotid arteries, and optic nerves.

OPERATIVE SURGERY OF THE MAXILLARY SINUS.

The maxillary sinus was the first of the accessory sinuses to engage the attention of surgeons in any considerable way. In the early days, however, and even until the last two decades, it was considered more of a factor in dental than in nasal diseases. Cowper, in 1707, introduced the method of draining the antrum through an opening made in the alveolus and this operation survived two hundred years and was supplanted only by more rational operations, when its utter ineffectiveness, in most cases, was demonstrated. Mikulicz is responsible for the inauguration of the operation through the nasal wall, while Caldwell, Luc and Denker, following Lamorier (1743), Desault (1798) and Küster (1889), perfected the method through the facial wall.

Indications.—The presence of pus in the maxillary sinus, with no tendency to recover spontaneously or by non-operative treatment, or a frequently recurring maxillary suppuration, constitutes an indication for one of the types of operations. Some laryngologists treat acute processes involving the maxillary sinuses by puncture through the inferior meatus and irrigation; others pursue a more expectant plan relying on washing the nose, irrigating the sinus through the natural opening and general therapy.

The presence of pus in the maxillary is easily determined. If pus is found in the nose coming from the middle meatus, its origin from the maxillary sinus may be established if, after it has been wiped away, it appears immediately upon placing the patient's head on his knees with the unaffected side downwards. This has the effect of placing the ostium in the most dependent position, promoting the outflow of whatever fluid is present. When the patient has been in the reclining position for some time, as for instance in bed, the pus will accumulate in the sinus or in the nose and nasopharynx, causing the very common symptom of hawking and clearing the throat after the patient arises.

Translumination is positive in most cases, the darkened area under the eye of the affected side being fairly good evidence. The light is usually visible in the pupil of the sound side and invisible in that of the diseased side.

Roentgenography has, however, practically supplanted most of

the methods as its evidence is the most convincing. The obstructive character of the pus and diseased mucosa to X-rays causes the negative to show even minor grades of disease.

The chronicity of the process has much to do with the selection of operation and it is a fair rule to follow, that the simple methods should first be used.

In early cases, operation through the nasal wall is successful. In cases in which this has failed, the Caldwell-Luc or Denker operation

Fig. 541.

Lichtwitz's antrum needle.

must be undertaken; and when these are ineffective, nothing short of an obliteration operation such as Beck's will be of any value.

The Canfield operation gives the greatest satisfaction of any of the intranasal operations since a wider opening is secured by means of it than with any other method.

It may be necessary even to operate through the alveolus, especially when the process is of dental origin and is accompanied by caries of the teeth or alveolus, but the liability to reinfection from the mouth and the difficulty in securing full relief by this method later calls for one of the other types in any event.

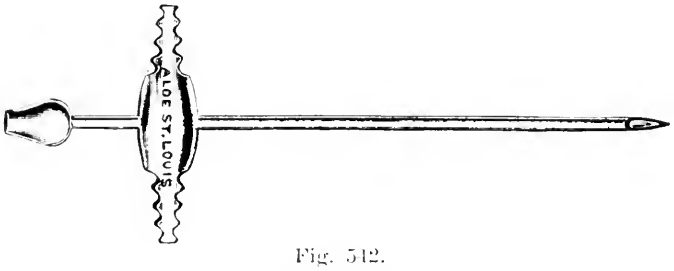


Fig. 542.

Fein's antrum needle.

Contraindications. As far as possible, operations should be avoided during the presence of acute processes involving the maxillary sinus. The practice of puncture with irrigation through the nasal wall in acute sinusitis, while often most satisfactory, is open to objections not the least of which is the fact that deaths have occurred in connection with its performance.

Puncture Through the Nasal Wall. A hollow needle, of which Lichtwitz's (Fig. 541) and Fein's (Fig. 542) are the most commonly em-

ployed, is thrust through the middle or inferior meatus into the maxillary sinus. The operation through the middle meatus must be performed with great care on account of the danger of wounding the orbital contents. In this region the distance to the orbit is not great and hence if the bone is penetrated unexpectedly, the force applied to the needle, may carry it into the orbit.

The inferior meatus offers a better location for the puncture on account of the greater distance to the orbit and because it enters at a more dependent portion of the sinus and thus is more likely to discover the presence of pus. The needle should be introduced, after the

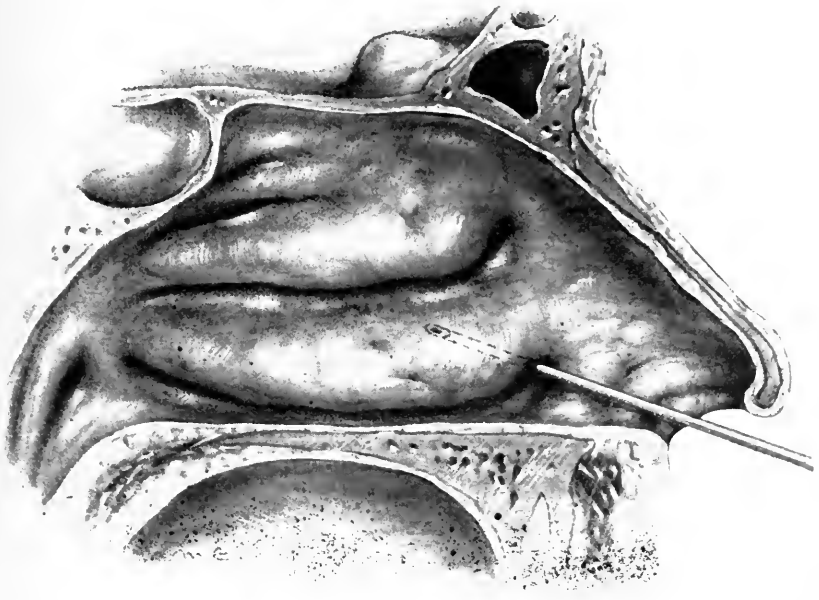


Fig. 543.

Introducing Lichtwitz's hollow needle into the maxillary sinus.

application of cocain, just under the anterior end of the inferior turbinate and thrust through the thinnest part of the wall which is opposite the middle third of the inferior turbinate. (Fig. 543.) This naturally requires that the handle of the needle be carried far to the opposite side of the nose. (Fig. 544.) The pus may be withdrawn by applying a suction syringe on the end or the sinus may be irrigated through the needle.

The needle operation may be ineffective by being thrust entirely through the antrum, or its lumen may be occluded by bone, swollen mucosa, polypi or pus, or it may be engaged beneath the mucosa of the antrum. For these reasons it is better to use a trocar with cannula that

is bent at a right angle or is properly curved and that is strong enough to be thrust without difficulty through the nasal wall. (Fig. 545.) Among those in common use are Pierce's, Fletcher's and Killian's.

Fig. 544.

Introducing Lichtwitz's hollow needle into the maxillary sinus.

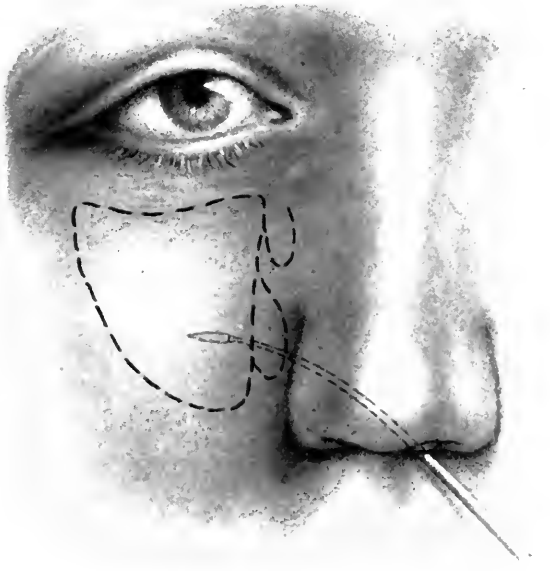


Fig. 545.

Introducing curved hollow needle into the maxillary sinus.

(Figs. 546 to 548.) The curative value of this method of operation is not great except in the acute cases. It goes without saying that attention should be paid to all accompanying conditions, such as the removal of all abscessed teeth or roots, the removal of polypi and the correction of other coincident nasal conditions.

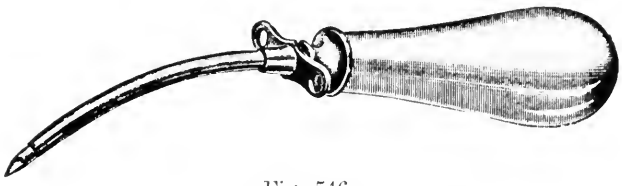


Fig. 546.
Pierce's antrum trochar.

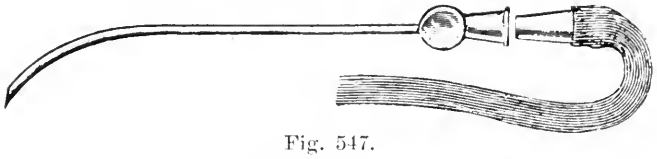


Fig. 547.
Fletcher's antrum trochar.

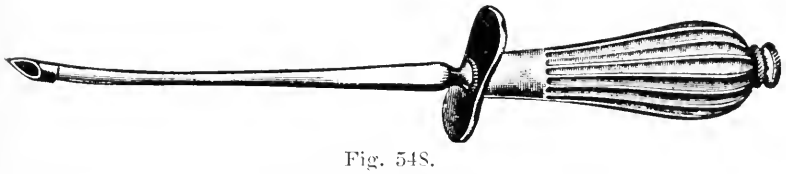


Fig. 548.
Killian's antrum trochar.

Resection of the Nasal Wall.

Preparation.—In all the nasal operations for the relief of maxillary suppuration, the cocainization must be thorough if local anesthesia is to be depended upon, for pain is more likely to be caused than in operations on any of the other sinuses. A ten per cent solution should be applied for at least ten minutes or cocain flakes applied on cotton moistened with a solution of adrenalin and from time to time in the course of the operation reapplications should be made when necessary. Submucous injections of novocain solutions are called for in some of the longer and more extensive operations such as Canfield's. Hemostasis is secured by the use of one of the adrenal preparations.

All polypi should be removed, and other coincident nasal conditions should be corrected. The usual aseptic conditions should prevail.

Simple Resection of the Nasal Wall Through the Inferior Meatus.—If simple puncture through the nasal wall can be of any service,

the removal of a portion of that wall must be of greater value. Mikulicz deserves the credit of presenting this plan of operating through the inferior meatus and this was further developed by Lothrop and Claoue.

The operation may be performed with or without removal of the inferior turbinate or a temporary resection of the turbinate may be

Fig. 549.
Welhelmenski's antrum trocar.

made, being replaced after the operation. If the inferior meatus is small or if the disease process is extensive, it is best to remove a portion of the inferior turbinate in order to be sure that the drainage will be ample. Otherwise, the operation may be performed without resecting the turbinate or with temporary resection.

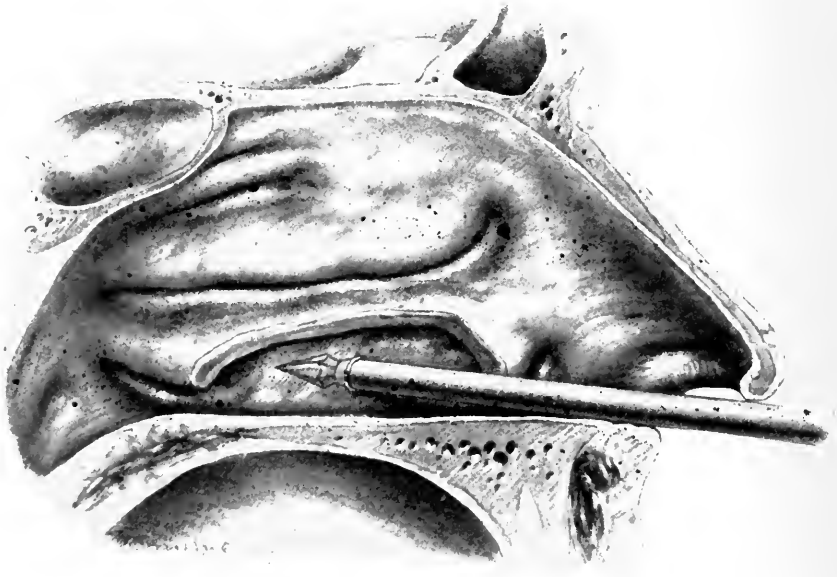


Fig. 550.
Penetrating the nasal wall of the antrum.

A firm, sharp instrument of the type of Mikulicz, Myles, or Welhelmenski (Fig. 549) is thrust through the nasal wall into the antrum (Fig. 550). The opening thus made is enlarged by a hand burr at right angles to the handle (Fig. 551), or with forceps of the Wagner (Fig. 552),

Ostrom (Fig. 553), Spies (Fig. 554), Yankauer (Fig. 555), or Fletcher (Fig. 556) pattern. Fig. 557 shows an operation with Wagner punch forceps. Chisels may be used for this purpose or the Vail saw (Fig. 558), or the dental engine which is well adapted for this type of operation. Great improvement has been made in the electric engine

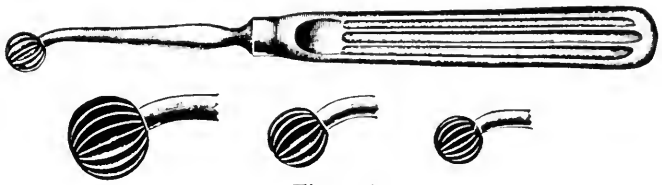


Fig. 551.
Tilley's antrum burr.

Fig. 552.
Wagner's antrum punch.

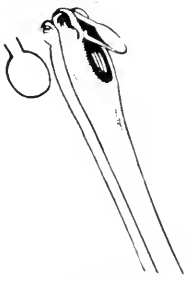


Fig. 553.
Ostrom's antrum punch.

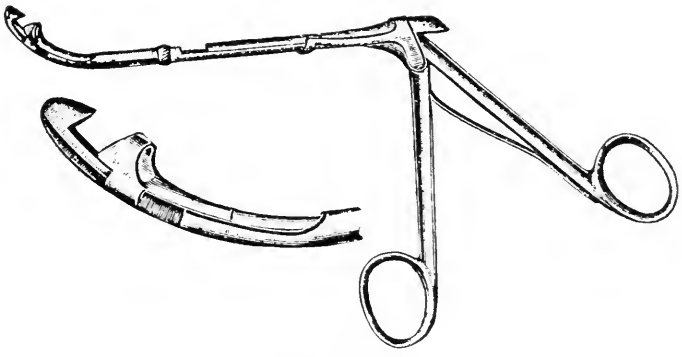


Fig. 554.
Spies' antrum punch.

for bone work and when the operator becomes accustomed to its use, it becomes the most serviceable instrument for sinus work. The Halle handpiece which permits the movement of the burr only when the trigger is held back by the index finger has greatly increased its utility.

Fig. 559 shows this handpiece with some of the more commonly used burrs.

Fig. 560 illustrates a good plan of operating. An opening is made

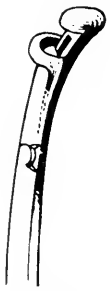


Fig. 555.
Yankauer's antrum punch.

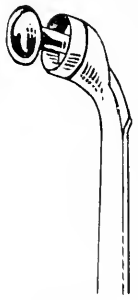


Fig. 556.
Fletcher's antrum punch.

into the antrum as already described; the nasal wall is partially resected with Struyken's forceps without removing the inferior turbinate and the operation completed with a curette.

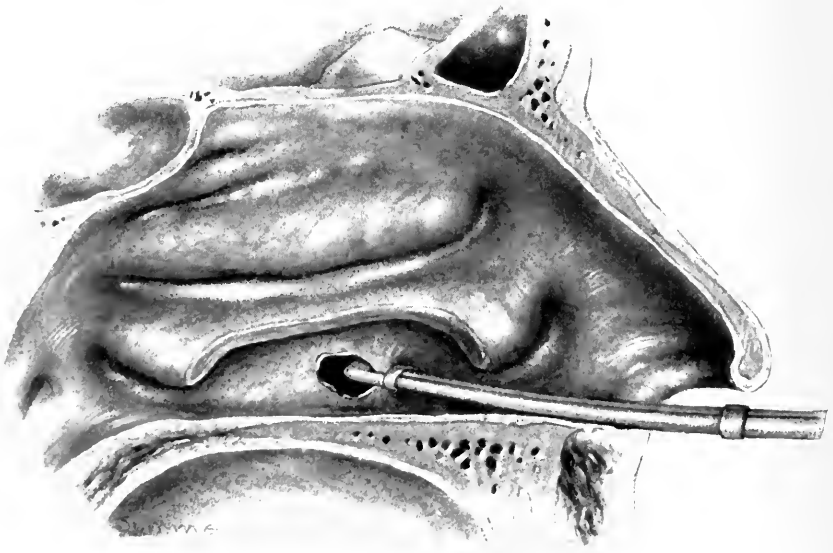


Fig. 557.
Removal of the nasal wall of the maxillary sinus with Wagner's punch forceps.

Another method comprehends fracturing the inferior turbinate at its maxillary attachment, displacing it upward and inward away from the field of operation and, when the nasal wall is resected, restoring it to position.

Fig. 558.
Vail's saw.

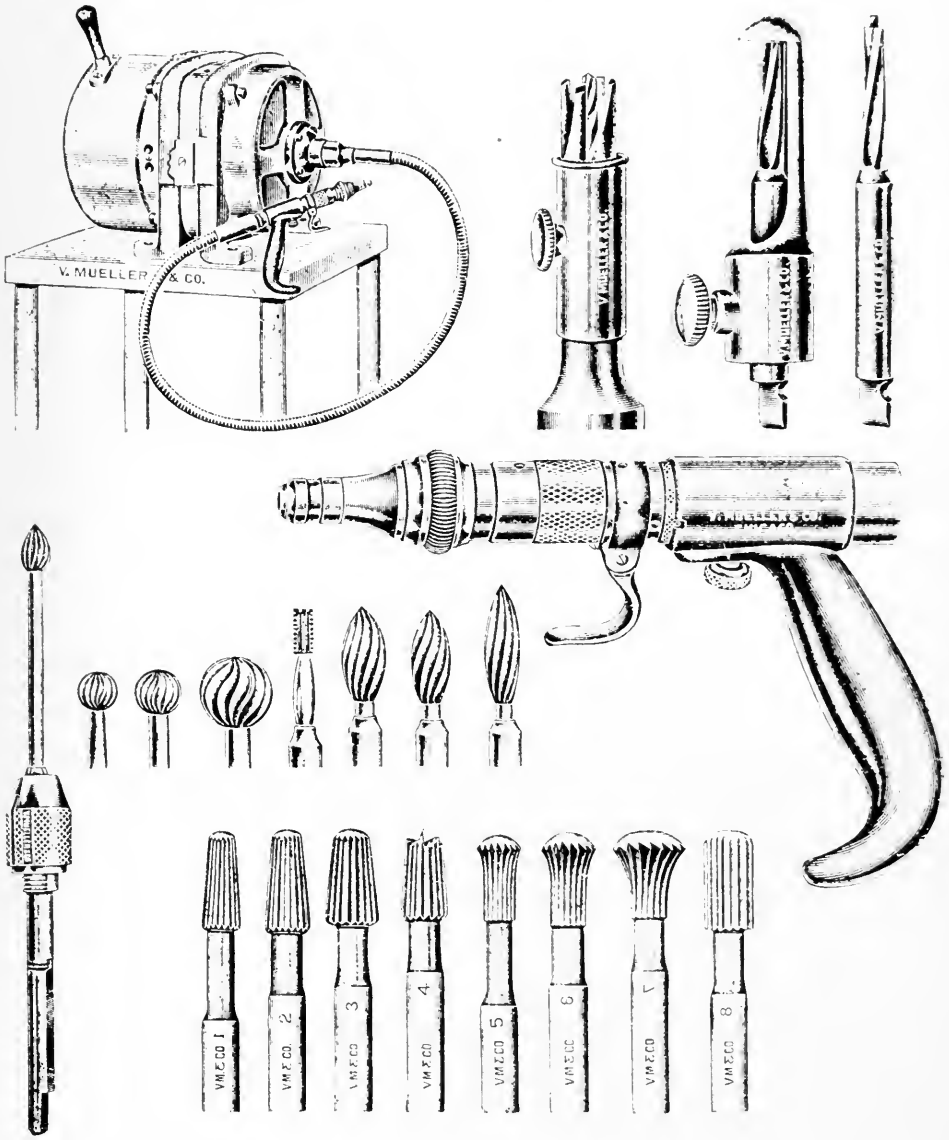


Fig. 559.
Dental engine and Halle's handpiece with burrs.

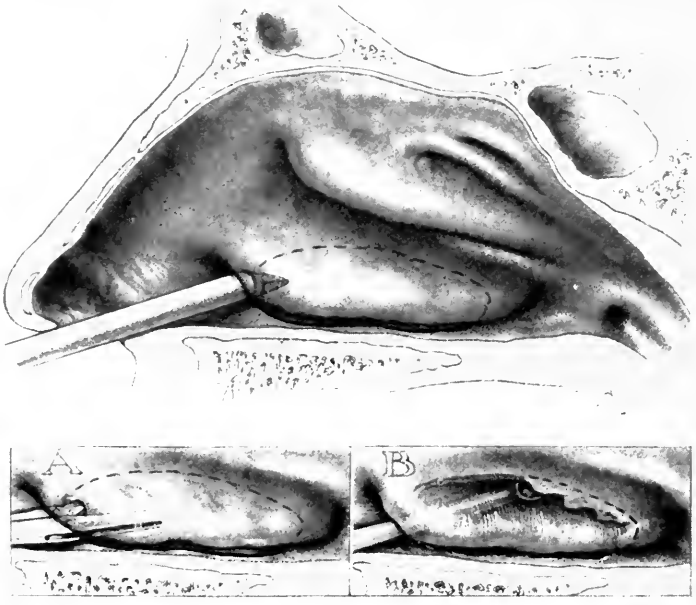


Fig. 560.

Removal of nasal wall of maxillary sinus with Struyken's forceps and curette without disturbing the inferior turbinate.

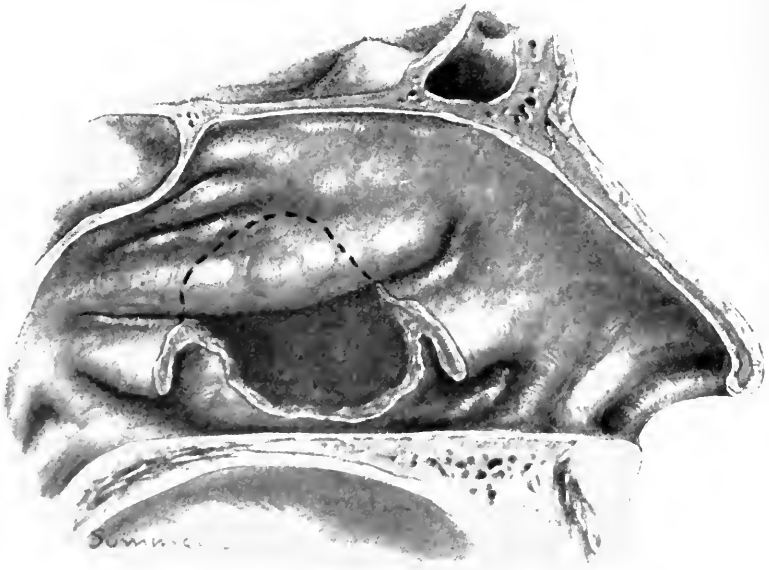


Fig. 561.

Operation through middle and inferior meatus.

It is best to make an extensive opening both because ample drainage is desirable and because the tendency of the opening to diminish and even to close is extreme. A gauze drain may be inserted and left for a day or so.

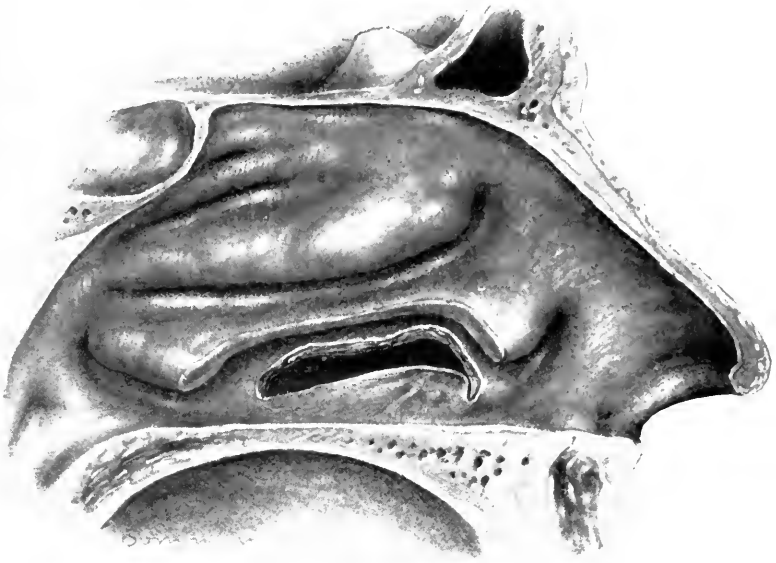


Fig. 562.

Dahmer's method of using a nasal flap for the floor of the maxillary sinus.

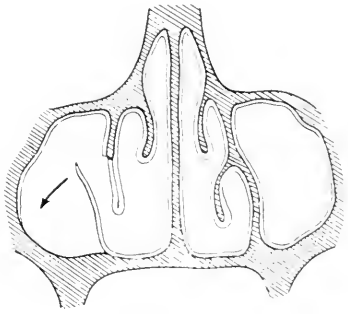


Fig. 563.

Dahmer's method diagrammatically shown.

Operation Through the Middle and Inferior Meatus.—The operation just described may be extended so as to include a portion of the middle meatus. It involves resection of the inferior turbinate, perforations through the nasal wall, and enlarging the opening by taking away

with chisel, burr, or forceps, whatever portion is desired of the nasal wall in both the middle and inferior meatus. (Fig. 561.)

The advantage of this operation over the one previously described is simply the greater size of the drainage opening into the nose. It is far less likely to diminish materially in size, but of course there is some objection involved in removing so much of the nasal wall. In the after-treatment the same plan should be followed as after the opening through the inferior meatus.

Dahmer's Nasal Flap Method.—Dahmer improved the ordinary operation through the nasal wall by using a flap of the nasal mucosa to cover the floor of the maxillary sinus of which the mucosa has been curetted away.

After ample cocainization and submucous injection of novocain, the anterior portion of the inferior turbinate is resected.

A quadrilateral flap of the mucous membrane of the inferior meatus of appropriate size is cut on all sides except the inferior which serves as its attachments to the mucosa of the floor of the nose. This flap is then folded over the floor to the septum so as to be out of the range of operation.

The nasal wall of the maxillary sinus is now perforated and the opening enlarged in all directions so as to accommodate the flap already prepared. The antrum is then curetted to as great an extent as possible, especially the inferior wall. The flap is now placed over the denuded floor of the maxillary sinus (Figs. 562 and 563) and strips of sterile gauze put into the sinus from the nose to hold the flap in position. In the after-treatment, it is important to avoid displacement of the flap by using an elevator or probe during the irrigation to hold it in place.

Canfield's Operation.—By resecting the nasoantral wall and extending the opening so as to include the anteroinferior angle of the apertura pyriformis, Canfield was enabled to devise an operation which permits a direct view from the nose into the maxillary sinus and a far greater curettement of the mucosa than any other nasal operation.

If the operation is to be done under a local anesthetic, great pains must be taken to cocainize the nasal mucosa. This must be supplemented with injections of novocain or of other safe anesthetic from the nose below the periosteum of the facial surface of the maxilla. The region in which the operative work is to be performed should also receive similar injections. Constriction of the blood vessels is secured in the usual way by adrenal preparations.

The incision is made anterior to the inferior turbinate as shown in Fig. 564 through all the tissues down to the bone.

The periosteum and soft parts are elevated through the incision from the facial surface adjacent and lateral to the apertura pyriformis. (Fig. 14, Vol. I, p. 17.) The Freer submucous elevator is the best instrument for this purpose. In doing this, care must be taken not to

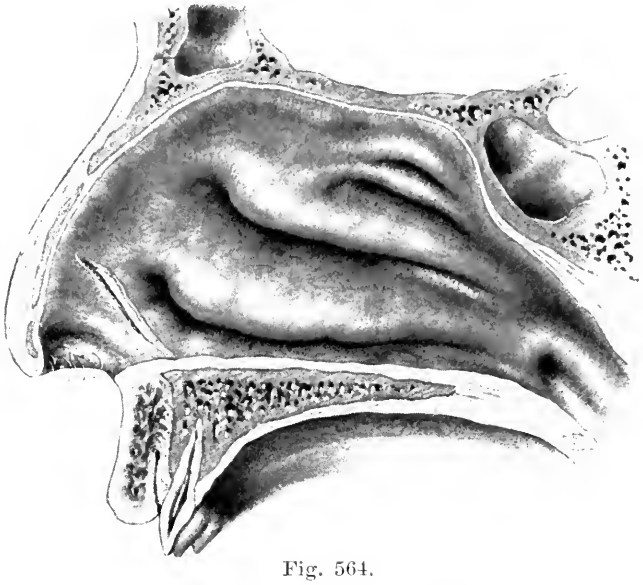


Fig. 564.

Canfield's operation. Incision.

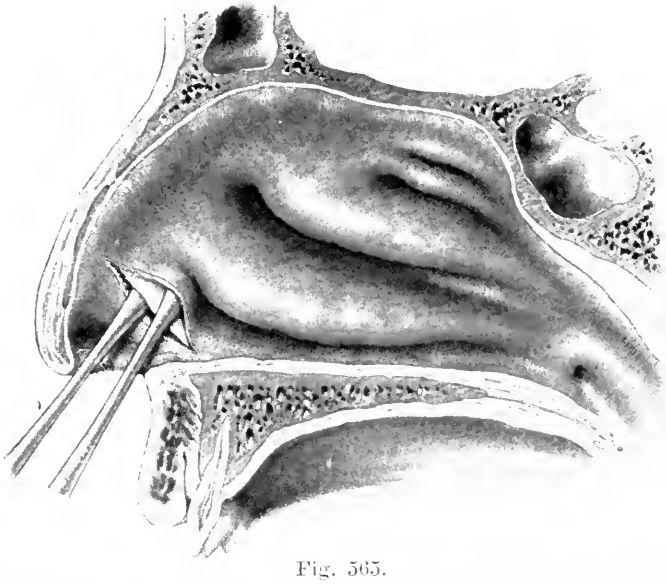


Fig. 565.

Canfield's operation. Elevating the periosteum and soft parts from the facial surface and from the nasal wall of the maxillary sinus.

carry the instrument too far upward where it might injure the infraorbital nerve.

The mucous membrane and periosteum are then elevated from the nasoantral wall of the inferior meatus, care being taken to avoid tearing them. (Fig. 565.) If desired, the mucous membrane and periosteum of the nasal wall are cut so as to leave a quadrilateral flap as in the Dahmer method. The sinus is opened with chisel or trephine at the anteroinferior angle of the apertura pyriformis. The bone will be found exceedingly hard in this locality, but it will yield after a time.

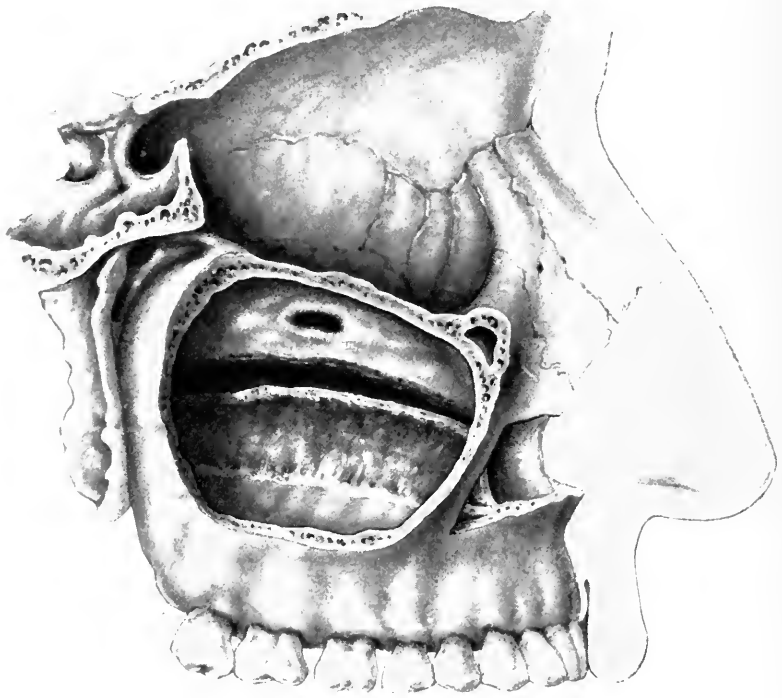


Fig. 566.

Canfield's operation. Diagrammatic illustration of using the flap from the nasal wall.

The sinus having been opened, the opening is enlarged by extending it externally for some distance on the facial surface of the maxilla. The nasal wall of the sinus is then removed with forceps, chisel or dental burr, as far back as possible, the nasal mucosa being carefully preserved.

The entire maxillary mucosa is then removed with curettes. The nasal flap is placed upon the floor, as diagrammatically shown in Fig. 566, the sinus and gauze packing being used to hold it in position and

to fill up the opening into the sinus. This packing is retained for a day or so and renewed if necessary to hold the flap in position. The completed operation is shown in Fig. 567.

Very little after-treatment is required except to keep the parts clean by removing crusts, etc., and by irrigation when necessary. The operation may be performed without the flap or with resection of the inferior turbinate.

The amount of the maxillary sinus which is brought into view by this operation is quite surprising and most acceptable from the viewpoint of after-treatment.

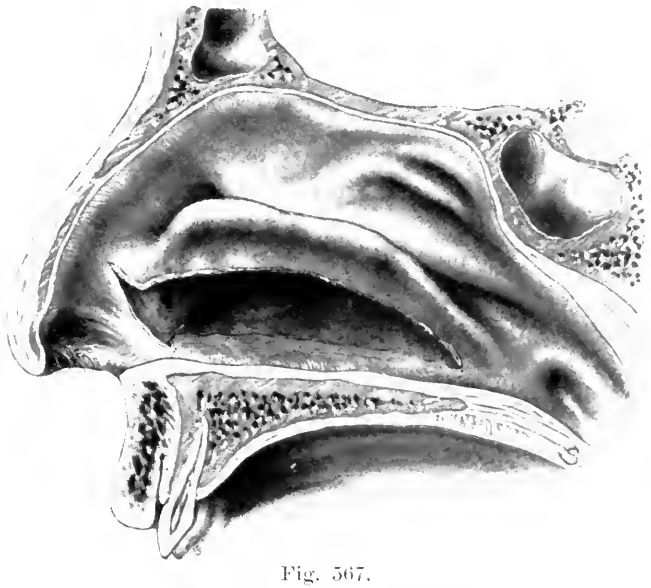


Fig. 567.

Canfield's operation completed.

Skillern's Operation.—Skillern has modified the Canfield operation to the effect of making it less extensive and somewhat easier to perform. He makes an incision through the mucosa to the bone just in front of, and above the anterior end of the inferior turbinate. Another incision is made anterior to this, meeting the first incision above and below, and the mucous membrane between the two is removed. The periosteum is elevated from the crista pyriformis externally toward the canine fossa and internally towards the inferior turbinate. The sinus is then opened through the exposed bone and the opening enlarged according to the requirements of the case.

Results of Intranasal Operations on the Maxillary Sinus.—Unless the disease has existed for a long time, a properly performed intranasal

operation is almost uniformly followed by resolution. Some possible unpleasant consequences, however, must be mentioned.

1. The swelling and inflammatory reaction following the operation is usually very great; hence it is desirable to clear out the nose from time to time, using a weak solution of cocain to facilitate the process and to render it painless.

2. Injury of the duct may cause stenosis and consequent epiphora.

3. Section of some of the dental nerves may cause numbness in the region of the central and lateral incisors.

4. Excessive granulation of the antral cavity may follow removal of the entire mucosa of the sinus.

5. Secretion and exudate in the antrum which have accumulated may pour suddenly out of the nose when the patient leans his head forward.

6. Crust formation is common.

Oral Operations on the Maxillary Sinus.

Operation Through the Alveolus.—For many years this was practically the only operation performed for maxillary empyema. It was commendable for its ease of performance and the quick relief which followed.

Unfortunately, reinfections from the mouth were common. Sometimes the opening was so small that it would close, and usually, in fact, the opening had such a tendency to close that an obturator was necessary to keep it patent.

As a matter of fact, one of the common requirements of this operation is that the opening be kept permanent for irrigating purposes. For this reason, it should be done only to relieve symptoms pending the performance of a more satisfactory operation and in acute empyema of dental origin.

If local anesthesia is to be employed, the neighborhood of the operation should be painted with a ten or twenty per cent solution of cocain and novocain injected into both the lingual and labial surfaces of the alveolar mucous membrane.

As wide an opening as possible is made with a dental burr (Fig. 568) in the alveolus through the socket of a tooth that has been withdrawn and the opening is packed with gauze. This is removed daily and the sinus washed out with permanganate solution or some other type of irrigation. After a few days it will be necessary to have a gold or rubber obturator made to be constantly worn in the opening to prevent its closure. Irrigations are to be continued indefinitely. The sinus

may be opened without the removal of the tooth, but this is, as a rule, not satisfactory.

Küster's Operation.—Following Desault nearly one hundred years, Küster established the plan of opening the maxillary sinus through the canine fossa. A horizontal incision is made through the mucosa and periosteum above the alveolus running through the canine fossa at the gingivo-labial fold. After elevating the periosteum, the sinus is entered through the fossa by burr or chisel and the opening enlarged as much as desired. The wound is treated through the mouth, some type

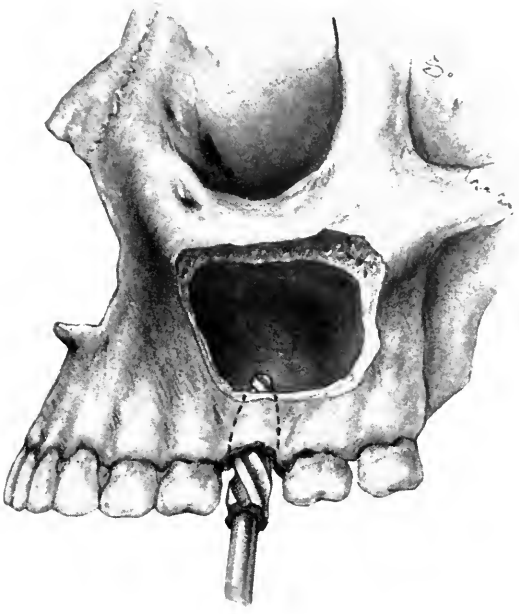


Fig. 568.

Operation through the alveolus.

of obturator being used to keep it closed during the intervals. The operation is very unsatisfactory as to ultimate cure.

Caldwell-Luc's Operation.—Caldwell undertook to overcome the uncomfortable character of the post-operative treatment of the Küster operation by combining the operation with a resection of the nasal wall of the sinus, through which the after-treatment was conducted, the wound in the mouth being sutured. Luc, quite independently, described a similar operation a year later and thus the operation is now known under the name of Caldwell-Luc. In the development of the operation there have been numerous modifications, but in the main, the usual plan pursued is to open the sinus through its facial surface.

to curette the sinus wall extensively, and to resect the nasal wall at the inferior meatus with or without resection of the inferior turbinate. An important modification which is in quite general use at the present time consists in forming a flap of the nasal mucosa and covering the floor of the antrum with it.

The operation is best done under general anesthesia although it is possible under morphin and thorough cocainization and the use of submucous injections of novocain.

The incision is made at the line of union of the upper labial and gingival mucous membrane from the midline to the third molar

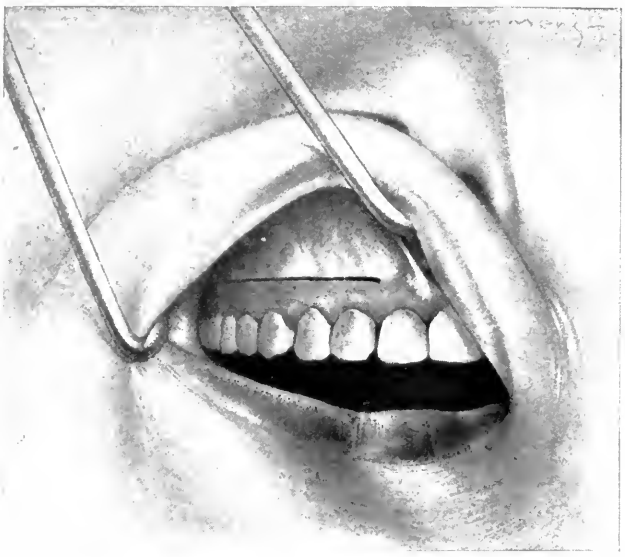


Fig. 569.

Caldwell-Luc operation on the maxillary sinus. Incision.

tooth. (Fig. 569.) The incision should be extended through the periosteum to the bone. After the bleeding is checked, the periosteum is elevated from the greater portion of the facial surface of the maxilla, avoiding the infraorbital nerve. The sinus is opened in the canine fossa with chisel (Fig. 570), or dental trephine, and the bone is removed with chisel, burr or bone forceps, to as wide an extent as desired. (Fig. 571.) It is well to make a large opening, extending from the malar process to the anterior extremity of the sinus and from the alveolus to about 1 cm. from the orbital margin avoiding the infraorbital nerve. The roots of the teeth should not be uncovered, except where there is caries involving the sinus floor. If these teeth show unmistakable evidence of disease and have already been condemned for extraction, they

should be removed at the time of the operation. The entire sinus mucosa is curetted away. Some operators, however, are content with curettement of the inferior, nasal, and posterior walls.

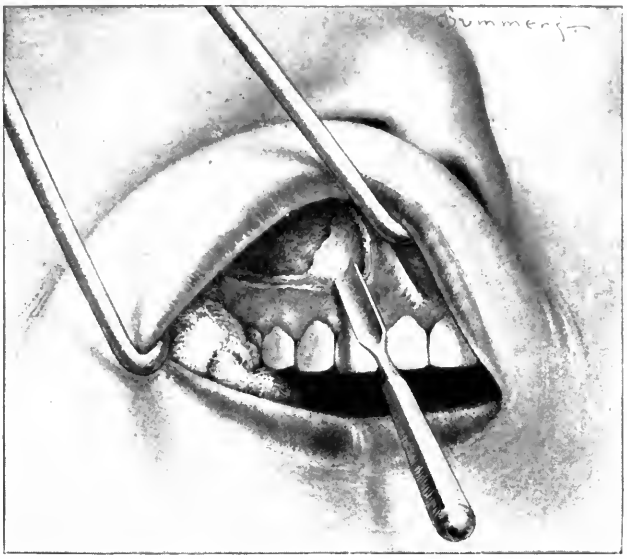


Fig. 570.

Caldwell-Luc operation. Chiseling the facial surface of the maxillary.

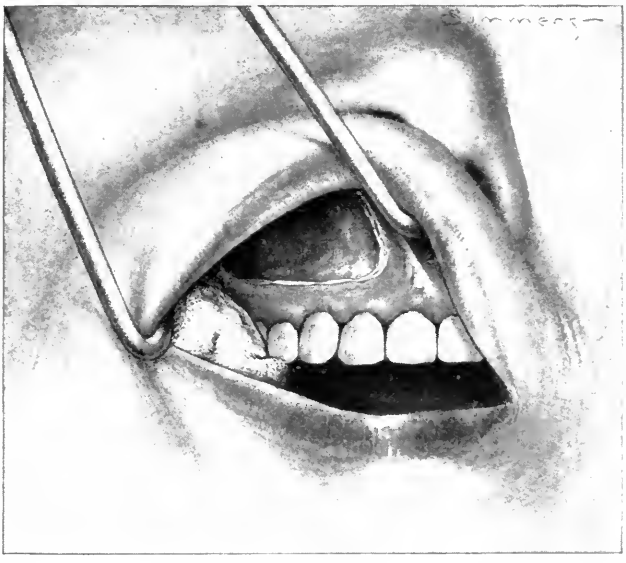


Fig. 571.

Caldwell-Luc operation. Bone removal completed.

Steps should now be undertaken to remove the nasal wall. If the flap method is to be used, the mucous membrane of the inferior meatus is elevated through a small incision, the rectangular flap being made of this mucosa for covering the sinus floor and laid across the floor of the nose so as not to be injured. The inferior turbinate is resected in part or left intact. The nasal wall is then removed by appropriate forceps or burrs, etc. (Fig. 571), or it may be resected through the sinus cavity, care being taken not to injure the nasal mucosa if the flap has not been made. After thorough cleansing and drying, the nasal flap is reflected upon the floor of the sinus, gauze packing is introduced into the sinus and passed into the nose through the opening made and the

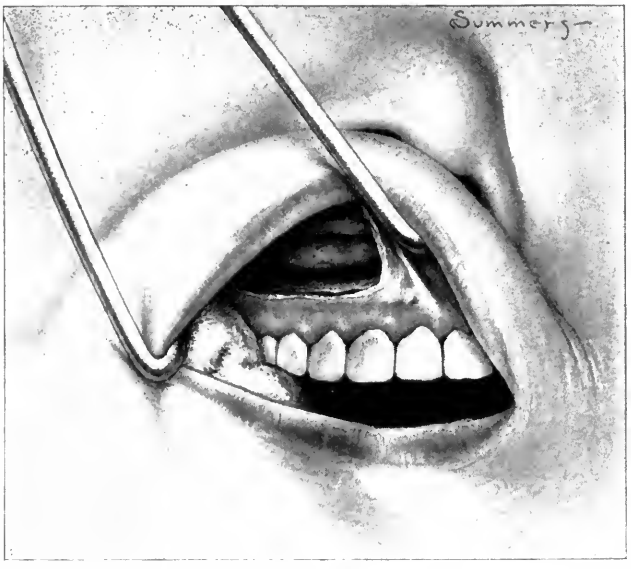


Fig. 572.

Caldwell-Luc operation. Nasal wall removed.

mucous membrane of the facial surface of the sinus appropriately sutured. It is best to cover the gauze packing with rubber tissue so as to permit its ready removal without pain. If the flap method is not to be used, no attention need to be paid to the mucous membrane of the nasal wall through which the opening is to be made.

In many cases in addition to the resection of the inferior turbinate it may be found necessary to resect the anterior end of the middle turbinate. This does not hazard the function of the nose as usually in these cases the middle turbinate is so compromised by disease that it is of little value to the function of the nose.

Denker's Operation.—The Denker operation which comprehends

the removal of the bridge of bone between the apertura pyriformis in addition to opening the facial wall of the maxillary sinus, as in the Caldwell-Luc operation, provides a much better post-operative view into the sinus. The dressing is accomplished with greater ease and complications are more readily treated.

Fig. 573.
Bone removal in the Caldwell-Luc operation.

Fig. 574.
Bone removal in the Denker operation.

Fig. 575.
Bone removal in the Canfield operation.

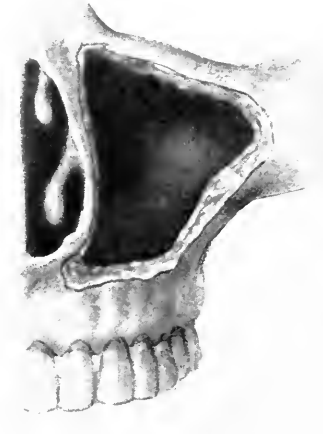


Fig. 576.
Bone removal in the Beck operation.

The operative procedure is identical with that of the Caldwell-Luc method except that the removal of the facial wall is continued so as to include the inferoexternal angle of the crista pyriformis. The incision is carried medially to the frenum labii superioris and the elevation of the periosteum is correspondingly more extensive. Figs. 573, 574, 575

and 576 show the extent of the bone removal in the two operations comparing them with the Canfield and Beck operations.

Beck's Obliterating Operation.—Refractory cases, those which the Denker or Caldwell-Luc operations fail to relieve, must be subjected to even more radical treatment.

Beck removes the entire facial wall, as well as the lateral wall under the malar bone as far as the zygomatic fossa, resects the infra-orbital nerve both in the foramen and in the canal, curettes thoroughly the entire mucosa, and removes with a burr the underlying superficial layer of bone so that prolific granulations may form. The wound is dressed entirely through the nose, the mouth incision being completely closed. As a rule this operation is not undertaken until after other procedures have left a permanent opening between the nose and the sinus. If any portion of the mucosa remains, cure will not result. In resecting the nerve, it must be twisted after grasping it with a pair of forceps until it yields by breaking within the canal.

If the nerve is permitted to remain, it will likely be caught in the cicatrix with the result that great pain is caused to the patient.

Partsch's Operation.—This very extensive operation, the technic of which is quite well shown in the drawings is only to be used in those cases of bilateral maxillary empyema, in which the prospect of recovery by means of other operations is not promising. A wide incision is made at the gingivolabial fold on both sides (Fig. 577), and the maxillary bone on both sides and the septum nasi is cut through with a chisel just above the alveolus (Fig. 578), the lower fragment is pulled downward (Fig. 579), the inferior turbinates are resected (Fig. 580), the nasoantral wall is removed, the antral mucosa is cleared of the pathologic process by sharp curettes, the maxillary sinus is dressed with gauze which is carried by way of the nasal cavity through the anterior nares (Fig. 581). The fragments are brought together and soft parts sutured (Fig. 582).

After-treatment of Oral Operations on the Maxillary Sinus. The swelling is usually very great and demands cold or hot applications for several days. It is best to leave the gauze tampons in place for four or five days to permit the nasal flap to attach itself to the sinus floor, but, as the dressing becomes foul, it may be necessary to remove it carefully without disturbing the flap and replace with a smaller gauze packing. Saturating the gauze in tincture of benzoin is of service in preventing the gauze from becoming foul smelling. After a few days the after-treatment resolves itself into irrigation from time to time through the nose. The sutures should be removed in four or five days.

Fig. 577.

Fig. 578.

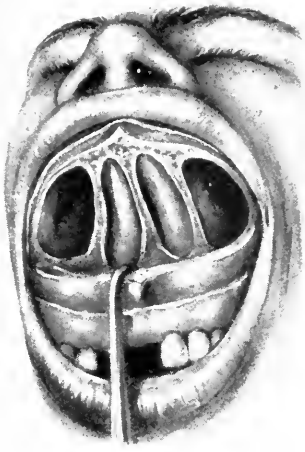


Fig. 579.

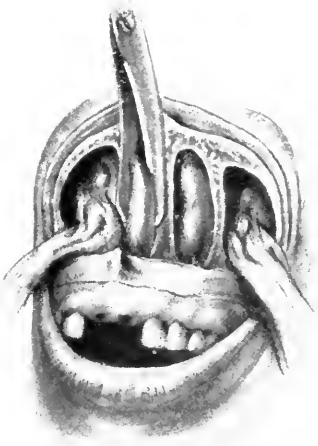


Fig. 580.

Fig. 581.

Fig. 582.

Figs. 577 to 582.—Partsch's operation.

Results.—Very good results follow these operations as good drainage is established through the nose and reinfection is uncommon.

Various wound accidents and other unpleasant results may follow this operation. Among them may be mentioned: Aspiration pneumonia, anesthesia of the cheek or teeth, emphysema of the cheek, neuralgia of the fifth nerve, stenosis of the nasal duct, and osteomyelitis of the maxilla.

MISCELLANEOUS MINOR OPERATIONS WITHIN THE NOSE

Synechia.

Adhesions are usually traumatic in origin although they may follow a syphilitic, tubercular or even a simple inflammatory process in

Fig. 583.

Removal of synechia with Struyken's forceps.

the nose. Their removal is easily accomplished, but the tendency for the adhesion to reform is so great that a fairly large amount of the tissue must be removed. Struyken's forceps (Fig. 583), or Pynchon's forceps, will ordinarily remove a sufficiently large section. The two cut surfaces may be held apart by gauze packing, celluloid splint, or gauze covered with rubber tissue or cargile membrane.

As a rule, however, no packing is required. Both the surfaces should be separated daily for a short time under cocain, so that new adhesions may not be allowed to form.

In extreme cases, it may be necessary to resect the septum or to remove a portion of the adjacent turbinate.

In determining to operate on an adhesion, consideration must be given to the likelihood of cure, the interference with nasal functions occasioned by the adhesion and the nervous manifestations accompanying it.

Atresia of the Anterior Nares.

Cicatricial closure of the anterior nares complete or in part resulting from traumatism, small-pox, or other causes may usually be relieved by a procedure adopted by the author in two cases.

Fig. 584.

Author's operation. Splint in position.

In these cases, the cicatricial web was cut away from its dermal and mucosal attachment. The skin and mucous membrane thus denuded were stitched together around the newly formed nasal orifices. Into these openings was placed a tube made after a model of Thudicum's nasal speculum with a large flange in which four openings had been made. Silk threads are inserted into these openings and are used to hold the tubes in place by being tied together behind the head (Fig. 584). The tube must be worn constantly for a number of weeks, after which it is worn only at night. In a short time the contraction of the naris will cause the tube to be held without the use of threads.

In one case of bilateral atresia, the patient, after fifteen years, wears the tube in one naris one night a month. The other naris remains free from stenosis.

Bony Occlusion of the Posterior Nares.

Bony occlusion of the posterior nares, unilateral or bilateral, complete or incomplete, may be relieved by removing the bony mass by means of chisels or burrs driven by a dental engine. After the opening is made, it may be enlarged by cutting forceps. In any event it is important to have a sufficiently large opening, for there is always a tendency for any artificial opening to diminish in size.

If the finger is held in the nasopharynx as a guide, the extent of the removal can be limited to the affected portion and all danger of injuring important structures can thus be avoided. In performing the operation, it must be remembered that the diaphragm is not always entirely bony, nor does it always have a plane or a perpendicular surface.

Some operators remove the bony occlusion through a submucous resection but there is no advantage in this procedure and the difficulties of the operation are greatly increased.

Gauze packing, covered with rubber tissue, should be placed in the opening made, removed within twenty-four hours and renewed if necessary. Dilatation with metal or hard rubber sounds may be required for a short period.

If possible, local anesthesia should be employed as these patients, like others suffering from congenital malformation, do not bear general anesthetics well; the author had a death from chloroform anesthesia in such a case.

The Nasal Suture.

To suture the mucous membrane of the nose an ordinary curved needle may be used or a curved needle on a fixed handle, if the work to be done is within easy access. Where it is too far back for such practice, the Yankauer method offers the one available plan.

The sutures are always to be made at right angles to the wound, hence there are several patterns of needles necessary. Nos. 1 and 2 (Fig. 585) pass the suture vertically and are used in horizontal wounds; Nos. 3 and 4, in oblique wounds; and Nos. 6 and 7, in vertical wounds. The crotch forceps (17) is important for grasping the flap of mucous membrane previous to the introduction of the needle. The hook (8) is used to grasp one of the threads after the needle has carried it through the flap and to hold the thread while the needle is withdrawn from the flap. The hook should be kept close to the flap so as to prevent the

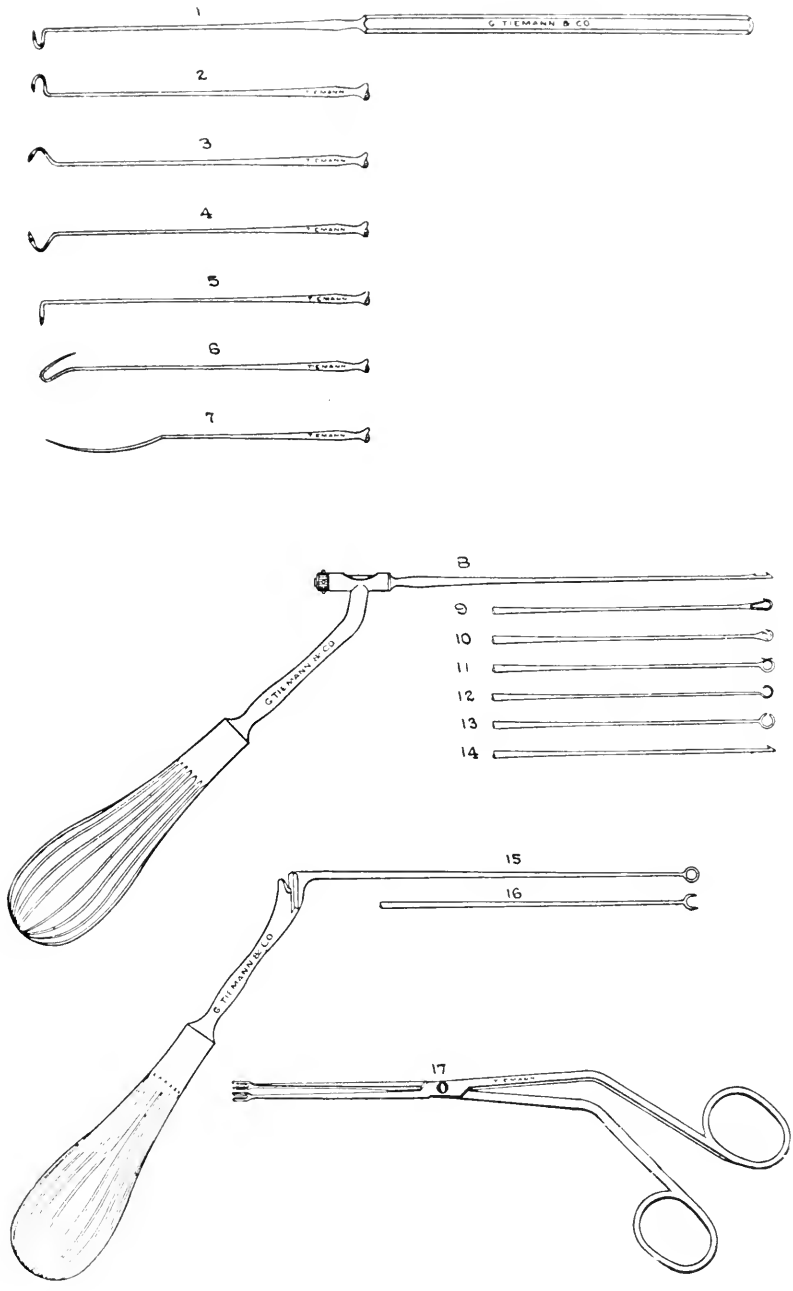


Fig. 585.

Yankauer's needles and appliances for nasal suture.

thread from pulling through the mucous membrane. A slip-knot is then made (Fig. 441) and this is carried to the wound by the suture closer (15) which makes the suture tight by forcing the slip-knot to the edges of the wound.

Operations on the Lacrimal Sac.

For many years various procedures had been suggested for relieving stenosis of the lacrimal sac or duct by making an artificial opening through the nose. The treatment by probes is not only tedious and trying but is also often ineffective. Caldwell in 1893 introduced a probe into the canal through the canaliculus, and then made an opening with a burr in the external nasal wall at the lower end of the probe. Kil-

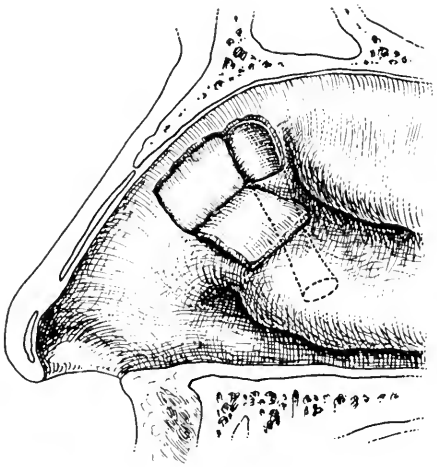


Fig. 586.

West's operation. Formation of flap.

lian in 1899 and Passow in 1901 also suggested methods for the same purpose but they all involved destruction of a portion of the inferior turbinate. They were frequently without good results as the stenosis is usually at the upper end of the duct.

West in 1910 published a report of an operation by means of which he was able to effect an opening in the nasal duct without resecting any part of the middle turbinate. Operations have since that time been devised by Polyak, Halle, Choronshitzky, Mosher, West, Green, Wiener and Sauer, Yankauer, and Beck. In this connection mention must be made of Toti's method of establishing an artificial communication between the nose and lacrimal sac by means of an external operation.

West's Operation.—West's operation as now performed is as follows: A flap is made as shown in Fig. 586 and is folded downward

and backward towards the inferior turbinate. The mucous membrane corresponding to the torus lacrimalis is removed and the bony boundaries of the lacrimal sac (Fig. 56, Vol. I, p. 50) are laid bare. In capacious nasal cavities it is not necessary to make the flap. The bone over

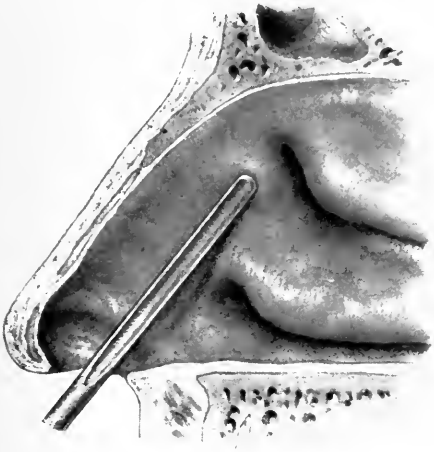


Fig. 587.

West's operation. Method of chiseling through the torus lacrimalis without flap formation.

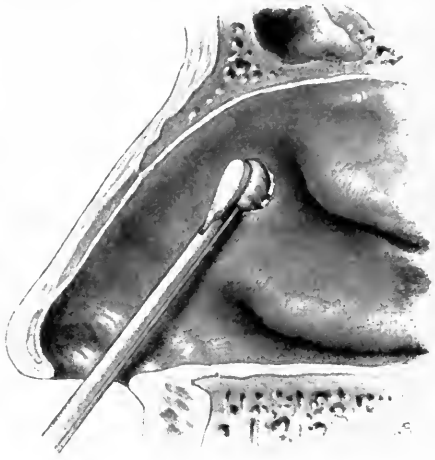


Fig. 588.

West's operation. Cutting away the nasal wall of the lacrimal sac.

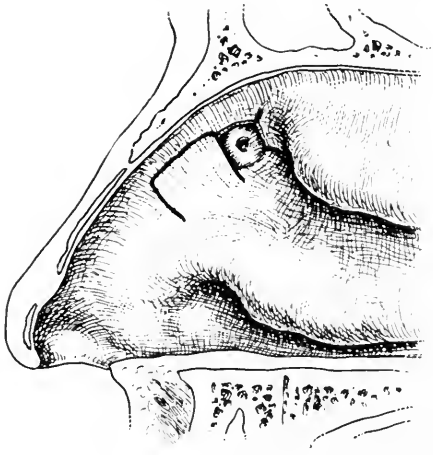


Fig. 589.

West's operation. Establishing a permanent opening by the use of three small flaps.

the sac is then chiseled away (Fig. 587) causing it to lie free on the lateral wall of the nasal cavity. The nasal wall of the lacrimal sac is then cut away as shown in Fig. 588 establishing an artificial communication with the nasal cavity above the inferior turbinate.

It is best to remove the bone in such a tapering manner that the opening is widest at the nasal wall. In order to assure a permanent opening of the sac into the nose, West makes the opening in the mucous membrane somewhat smaller than that in the bone over the sac. As shown in Fig. 589, by incising the mucous membrane at the posterosuperior and posteroinferior angles of the opening he secures three small flaps which cover the margins of the bone, assuring smooth edges.

The flaps are replaced and a small gauze covering is applied. Green includes the mucosa over the sac in the original flap and then removes from the flap the part corresponding to the sac (Fig. 590).

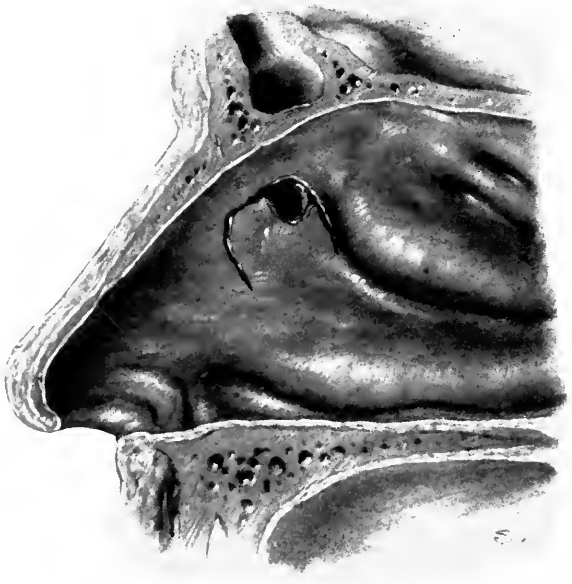


Fig. 590.
Green's operation.

West's instruments which are pretty generally used in all the operations are illustrated in Fig. 591.

Halle's Operation.—Halle devised a plan which makes it possible to secure a wide operative field without the usual consequence of scar formation. He makes a circular incision over the torus lacrimalis just at the anterior attachment of the middle turbinate as shown in Fig. 592. The mucosa and periosteum within this circular incision are elevated and removed. A rhomboid shaped incision is made from the attachment of the inferior turbinate forward as far as possible and extended upward as far as possible and then backward. The flap result-

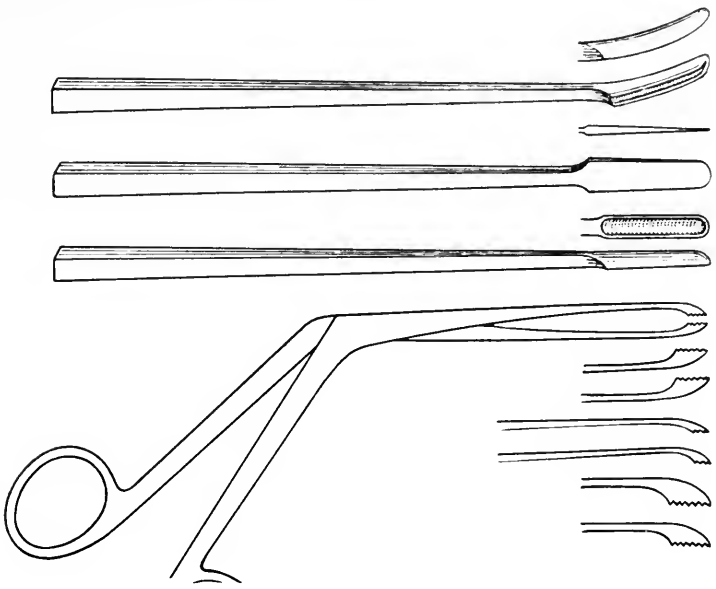


Fig. 591.

West's instruments for the lacrimal operation.

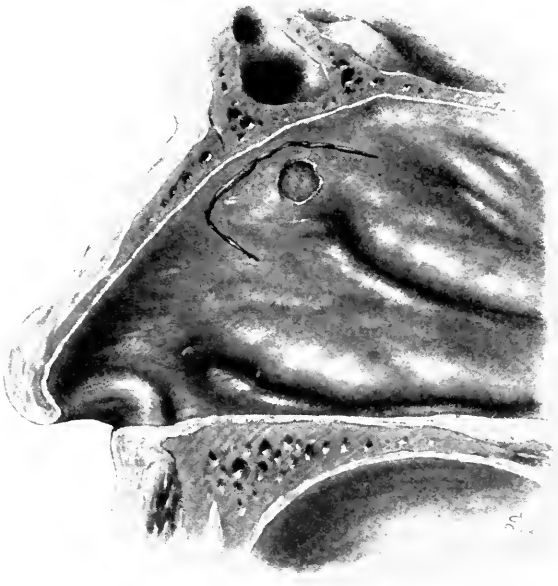


Fig. 592.

Halle's operation. Circular incision and formation of flap.

ing from the elevation of the soft parts is folded backward so as to permit a good field of operation. (Fig. 593.)

The bone is now chiseled away over that portion which corresponds to the torus lacrimalis (where the circular incision was made) in such a manner that the nasal side of the bone opening is wider than the sac side, thus making it possible to secure free access to the sac. Sometimes the bone is exceedingly hard and sometimes an ethmoid cell must be opened before a sufficient amount of the sac is exposed. A probe is next introduced into the lacrimal sac through the canaliculus and the wall of the sac cut through to the probe. A piece of the upper end of the duct corresponding to *abcd* in Fig. 594 is cut away. The

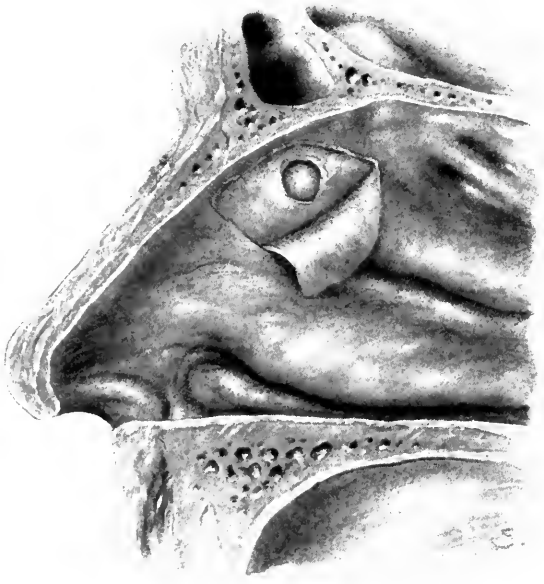


Fig. 593.

Halle's operation. Flap folded back and lacrimal sac exposed.

sac above this is then drawn inward with forceps and freed from its bed and the lateral portion corresponding to *cefg* excised. The flap is then replaced, care being taken to allow a sufficient opening to permit the inspection of the sac. A small piece of gauze is placed over the flap. After-treatment is unnecessary.

Polyak's Operation.—Polyak makes a rhomboid flap like that of Halle but removes it. He then cuts away the entire nasal wall of the lacrimal sac by chisel, forceps, or burr, resecting a portion of the lower part of the middle turbinate (Fig. 595). The extent of the removal of

bone depends somewhat on the exenteration of the ethmoid cells which happen to be adjacent.

A probe is then introduced into the sac through the nasal wound in order to ascertain the situation of the sac which is now opened and resected, and a wide passageway between the sac and the nasal cavity is established. A small gauze dressing is placed over the wound. Polyak

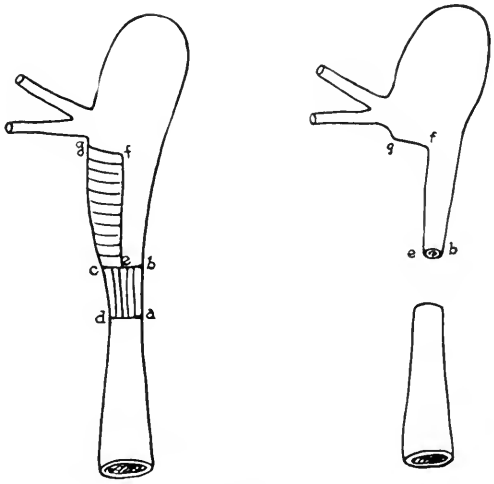


Fig. 594.

Halle's operation. Diagram showing portion of sac removed.

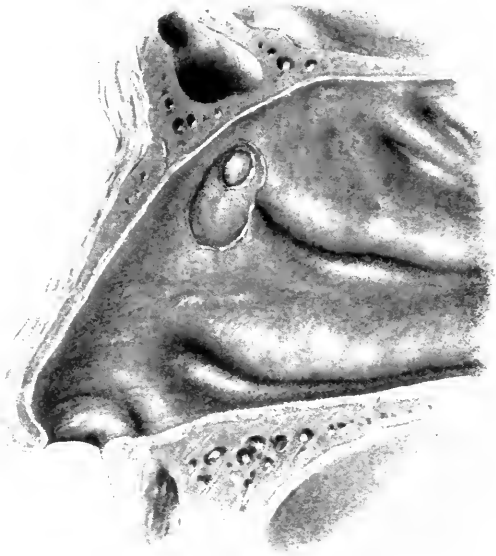


Fig. 595.

Polyak's operation.

resects not only the bony canal but also the nasal bony wall of the sac, the fovea lacrimalis and the entire wall of the sac.

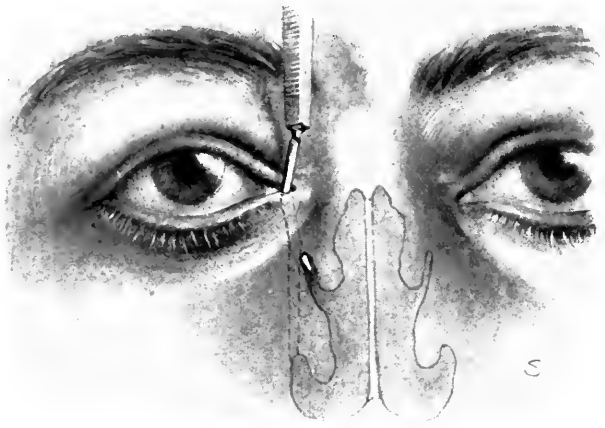


Fig. 596.
Wiener and Sauer's operation.

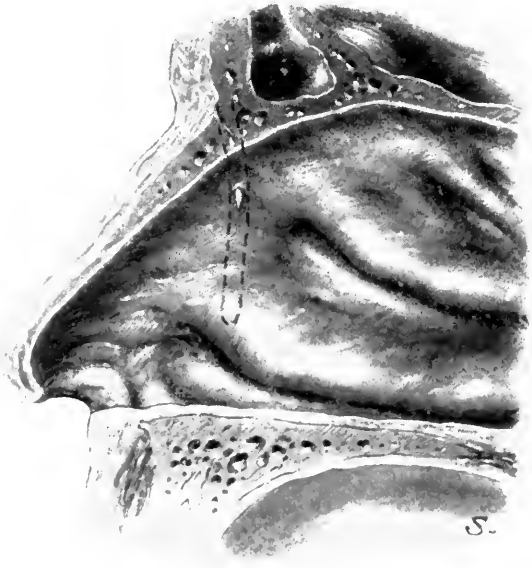


Fig. 597.
Wiener and Sauer's operation.

Choronshitzky's Percanalicular Puncture of the Tear Sac. Choronshitzky introduces a conical probe into the inferior lacrimal canaliculus and forces it downward and inward through the lacrimal bone until it emerges into the nose just anterior to the middle tur-

binate. While there is no great harm occasioned by forcing the probe through the anterior end of the middle turbinate, the operation should not be proceeded with until this instrument has been replaced on the outer wall just anterior to the turbinate. With the probe as a guide, but withdrawn by an assistant to prevent it being struck, the nasal wall covering the lacrimal sac is chiseled away, and the sac itself resected.

In cases in which long continued drainage is necessary he introduces through the opening made from the canaliculus to the nose a threaded needle held by artery forceps or a small cannula through which catgut is passed into the nose.

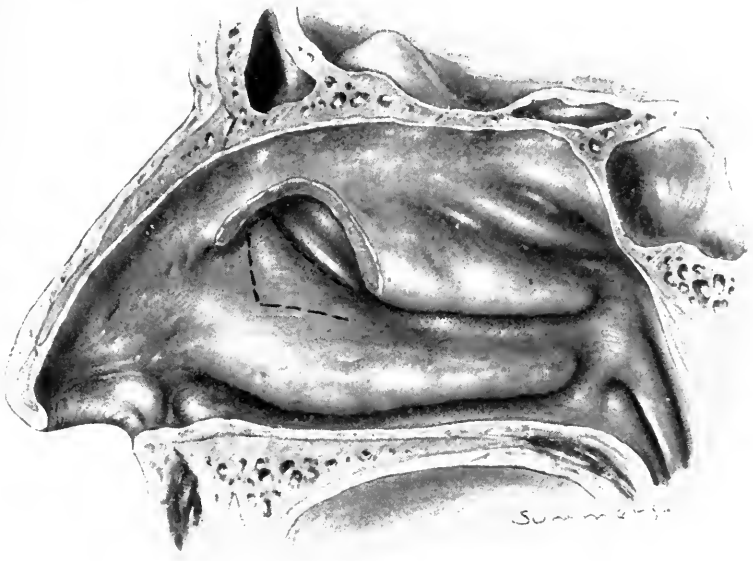


Fig. 598.

Mosher's operation. Exposure of uncinate process and incisions.

Wiener and Sauer's Operation.—Wiener and Sauer advocate a somewhat similar method, introducing a Ziegler's probe through the inferior canaliculus into the lacrimal sac. It is then forced internally through the external wall into the nasal cavity (Figs. 596 and 597). This furnishes the guide for the removal of as much of the bony covering of the lacrimal sac as is deemed necessary to establish a permament opening. If it is desired any of the flap operations may be made.

The advantages of the Ziegler probe is its stiffness which permits its end to be readily forced through the nasal wall.

Mosher's Operation.—In this operation, the sac is approached by way of the uncinate process. The anterior end of the middle turbinate

is first removed, taking away as much of the superior overhang as possible and exposing the uncinate process (Fig. 598). A flap is made, as shown in the same figure, by an incision running first parallel with the cut edge of the middle turbinate, then downward along the posterior edge of the ascending process of the maxilla to the upper border of the inferior turbinate and then along this border for about a half inch. Another incision is made along the upper border of the uncinate process, extending about the same distance posteriorly on the lower incision. A flap is now made by elevating the mucous membrane and periosteum and is tucked downward and backward, exposing the unciform

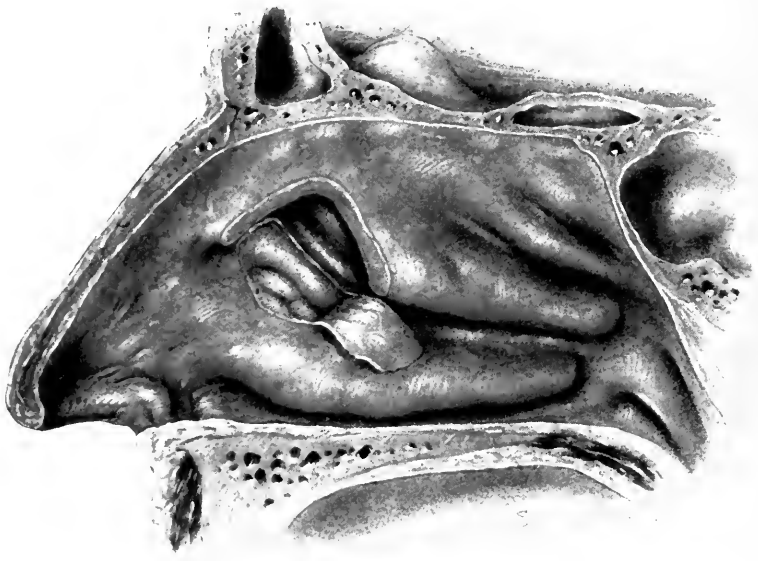


Fig. 599.

Mosher's operation. Flap formation.

fossa (Fig. 599). During these procedures the Mosher stiff probe has been kept in the nasolacrimal duct. This is now slowly withdrawn until it escapes the upper rim of the inferior turbinate, when it is made to break through the inner wall of the nasal duct into the nose and is carried upward to the top of Horner's muscle leaving only the upper two or three mm. of the inner wall unopened. The probe is then reintroduced and held while the operator curettes along the whole length of the posterior surface of the ascending process of the maxilla. The bed of the nasal duct is now widened by biting away its inner wall and a ligature carrier is introduced into the slit punctum from the nose. To the ligature which is thus made to traverse the sac is attached a small

piece of gauze which holds the replaced flap in position (Fig. 600). The upper end of the ligature is secured by a piece of adhesive plaster to the skin of the forehead. The plug is removed in two or three days.

Yankauer's Operation.—A flap is made as follows: An incision down to the bone is made from the anterior end of the attachment of the middle turbinate 0.5 cm. forward, from this point to the anterior attachment of the lower edge of the inferior turbinate, and continued for 2 cm. along the upper margin of the inferior turbinate. The flap thus formed is tucked away, its upper portion being held backwards under the middle turbinate. The mucoperiosteum is then carefully

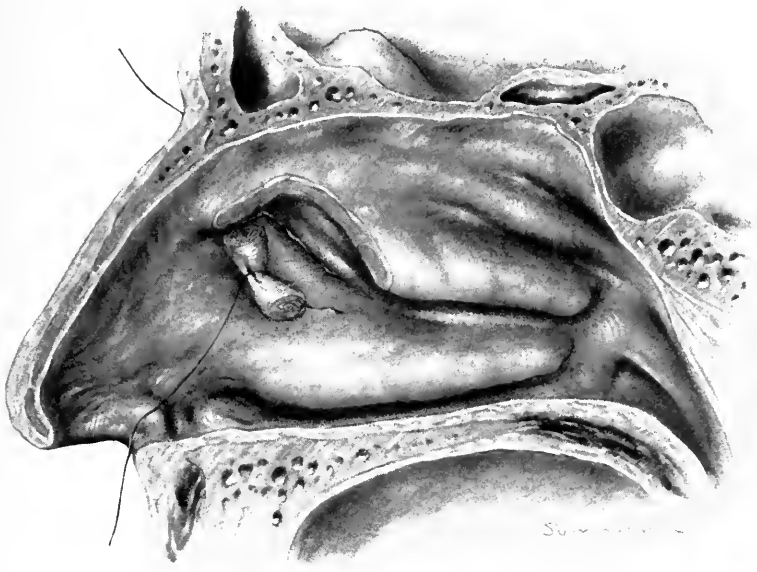


Fig. 600.

Mosher's operation. Ligature with gauze attached in position.

separated from the outer side of the inferior turbinate, so as to avoid cicatricial contraction of the orifice. The anterior third of the inferior turbinate is then resected and a probe introduced into the lacrimal canal. With this as a guide the bone constituting the inner wall of the canal is removed carefully with Yankauer's specially devised forceps, avoiding injury to the membranous canal and the antrum. The membranous canal is now slit longitudinally and that portion anterior to the slit is brought forward and laid against the bone (Fig. 601). The flap is now replaced and held by a single suture at its anterior inferior border. If there is pus in the lacrimal sac a piece of the flap about 4 mm. in diameter is removed corresponding in position to the incision in the sac.

Beck's Operation.—Beck has devised two operations. In the first, the lower canaliculus is slit and the fibers of Horner's muscle are spread apart with a mosquito artery forceps. A small oval dental burr is introduced into the slit canaliculus downwards and inwards as far as the inner wall of the sac. The burr is then set in motion and carried through the mucous membrane and bone into the nasal cavity at the anterior end of the middle turbinate at its upper margin. This opening is enlarged with the small burr to twice the diameter of the burr and a Weber-Liel catheter introduced through the opening with the trumpet-shaped end at the inner canthus. This is allowed to remain *in situ*

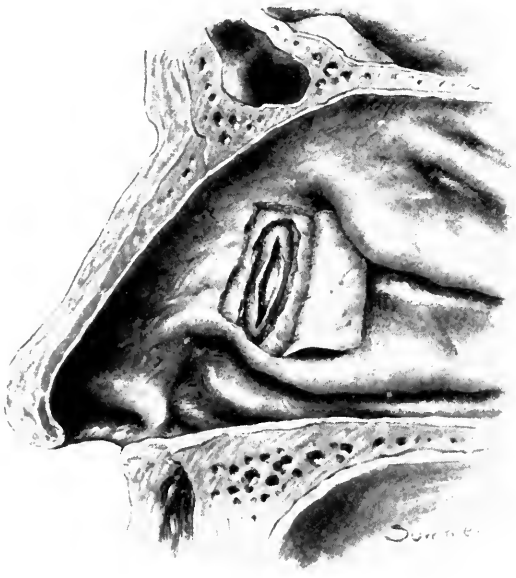


Fig. 601.
Yankauer's operation.

for a week. After this, blunt pointed probes should be used for dilatation until the passageway remains patent. If any remaining part of the tear sac gives further trouble, the Gifford method of applying trichloracetic acid should be used to destroy it.

Beck's second operation is performed as follows: An incision is made over the region of the lacrimal sac after a Bowman's probe has been passed into the canaliculus. The incision is carried down to the probe. Then the mucous membrane and skin on either side are stitched together leaving threads which are to act as retractors (Fig. 602). The probe is then withdrawn and an electric burr is used to cut away the nasal wall of the sac, being directed inwards, downwards, and back-

wards into the nose. This procedure is specially valuable in children and in those cases in which stenosis of the nasal vestibule is present.

Results.—The artificial opening made in the nose has a great tendency to become stenosed and in fact to close by cicatrization. It is often necessary to use lacrimal sounds for a short period and sometimes to perform a secondary operation. The flap procedure gives the best results.

Injection of the Sphenopalatine Ganglion.

Sluder, in 1908, called attention to the possibility of securing relief from symptoms referable to the ganglion or its nerve distribution

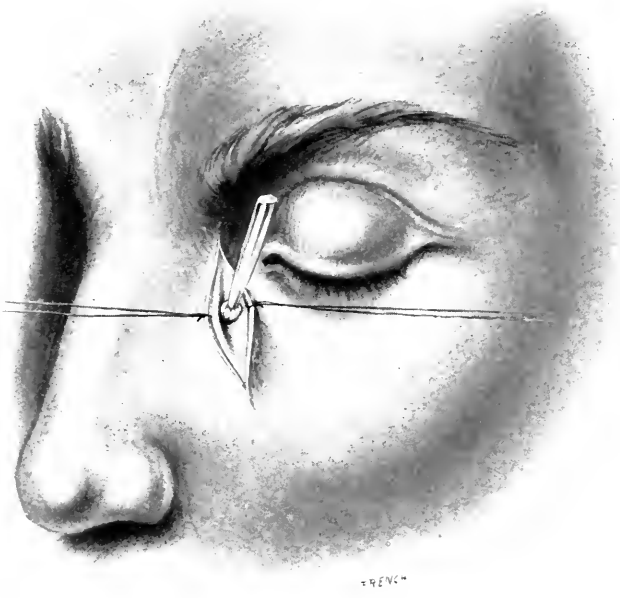


Fig. 602.
Beck's lacrimal operation.

by injecting it with alcohol where it lies in the sphenopalatine fossa (Fossa pterygopalatina, Fig. 16, Vol. I) just behind the middle turbinate bone.

Indications.—The most positive indication is pain which is not relieved by simpler remedies, about the eye, supraorbital region, ear, or occiput and back of the neck and shoulders usually known as the "sphenopalatine syndrome." Hyperesthetic rhinitis is also said by Stein and Pollock to be relieved by this method of treatment.

Operation.—Anesthesia is obtained by cocainizing the posterior portion of the middle turbinate and its vicinity with a 20 per cent solution of cocain, or by applying a small quantity of saturated solution directly over the ganglion. According to Sluder this will relieve the pain symptoms of which the patient may be complaining at the time of the operation.

The needle is introduced as shown in the drawing (Fig. 603) being made to enter the fossa just behind the middle turbinate, and 2 to 5 drops of a 2 per cent solution of carbolic acid in 95 per cent alcohol, is injected into the ganglion. According to another method, the operator transfixes the posterior end of the middle turbinate with Sluder's hollow needle until the posterolateral wall is felt, then pushes the needle

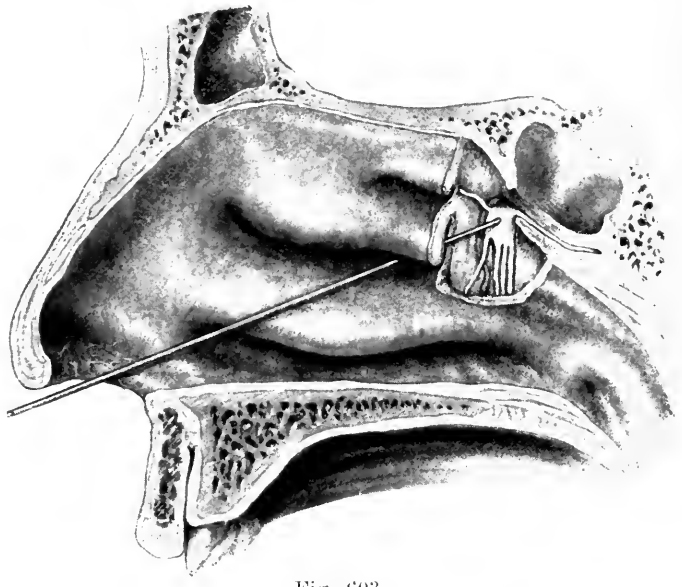


Fig. 603.

Injection of the sphenopalatine ganglion.

upwards, outwards and backwards through the bony wall into the fossa.

When the ganglion is penetrated the patient experiences intense pain in the eye, ear, vertex, occiput, and shoulder. If the injection is made in the vicinity of the ganglion without striking it, the pain is less severe. As a rule, this pain disappears in from 24 to 48 hours.

Results. In some cases the relief is complete after one injection. In other cases several injections are required. Sometimes no relief follows. Beyond the severe pain that usually follows the injection and that at times persists for a short period, no untoward results are to be expected.

OPERATIVE SURGERY OF THE HYPOPHYSIS, BY WAY OF THE NOSE AND ITS ACCESSORY CAVITIES.

The development of the operative surgery of the sphenoid sinus is responsible for the invasion of the pituitary fossa through the nose and for the really marvelous results which have followed. As early as 1904, Horsley operated on a case by the endocranial method. Following him, the endocranial route was subjected to much investigation, but in actual practice it proved to be exceedingly hazardous to the patient.

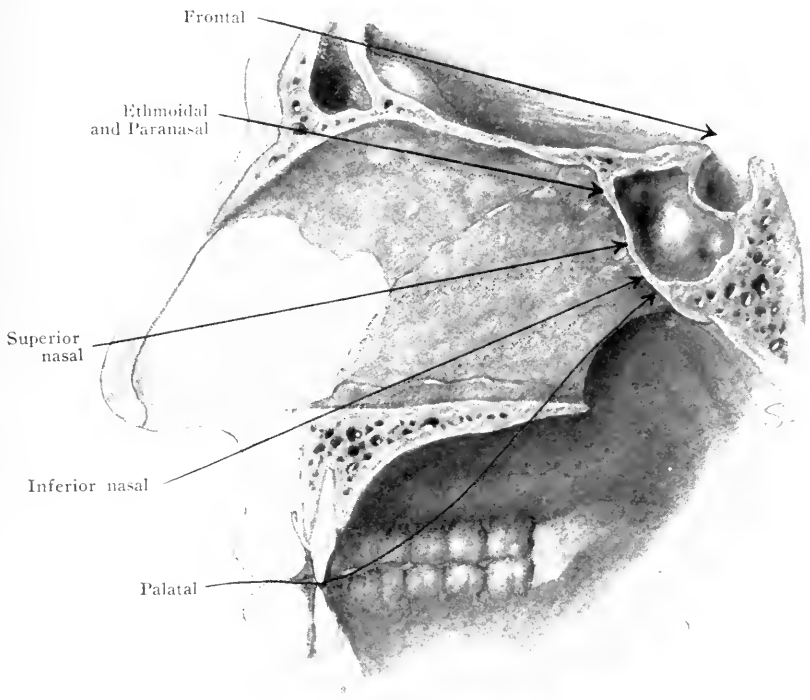


Fig. 604.

Operation pathway of operations on the hypophysis.

Schloffer in 1906, virtually inaugurated the nasal approach. His work at least encouraged the study of this route to such an extent that at the present time there are a number of methods which are fraught with but slight danger and which are followed by most satisfactory results.

Indications.—The indications for the operation depend on symptoms due to pressure or change in the hypophysis and those which result from pressure on neighboring structures. In the former class

may be grouped acromegalia, hypophyseal headaches, obesity, polyuria, and minor symptoms which are now known to be due to hypophyseal insufficiency or hypersecretion. According to Cushing, individuals who manifest acromegalic tendencies generally represent cases of primary glandular (intrasellar) tumor, and those with adiposogenital dystrophic tendencies, supraglandular (suprasellar) tumor. Cushing states, however, that there are numerous exceptions.

The second group comprises ocular symptoms in the main, such as hemianopsia and complete blindness. The restoration of vision which so often follows the operation is one of the most startling results.

Roentgenography is an essential aid in the establishment of the indications and in the operation itself, with respect to the size of the pituitary fossa and of the sphenoid cavity and the distance of the anterior nasal spine from the sphenoid sinus.

Operation.

The methods of operation, as based upon a summary by Cope, are as follows:

CRANIAL.

Temporal (intradural)	Horsley
Temporal (extradural)	Braun, Cushing
Frontal	Krause, Killian
Fronto-orbital	Frazier, McArthur
Colossal puncture	

FACIAL.

Nasal	Septal Resection	Schloffer, Cushing, Hirsch, West, Citelli, Kanavel, Halstead
	Ethmoid Resection	Hirsch
Paranasal		Chiari, Kahler
Palatal		Koenig, Preysing
Maxillary		Bourget and Dansan, Beck

Fig. 604 shows the operation pathway of most of the methods.

Eiselsberg's Operation.—Of the various modifications of Schloffer's operation, Eiselberg's is perhaps in most common use. An incision is made as shown in Fig. 605 and carried down to the bone. The

nasal bones on both sides and the frontal process of the left maxilla are cut through, after which the septum is severed in such a way as to leave a fair portion attached to the free portion of the nose which is

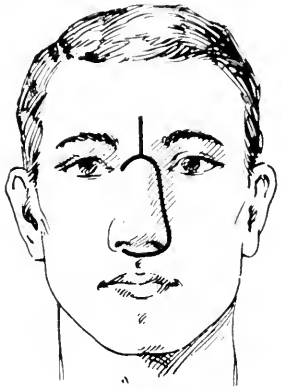


Fig. 605.

Eiselsberg's operation. Incision.

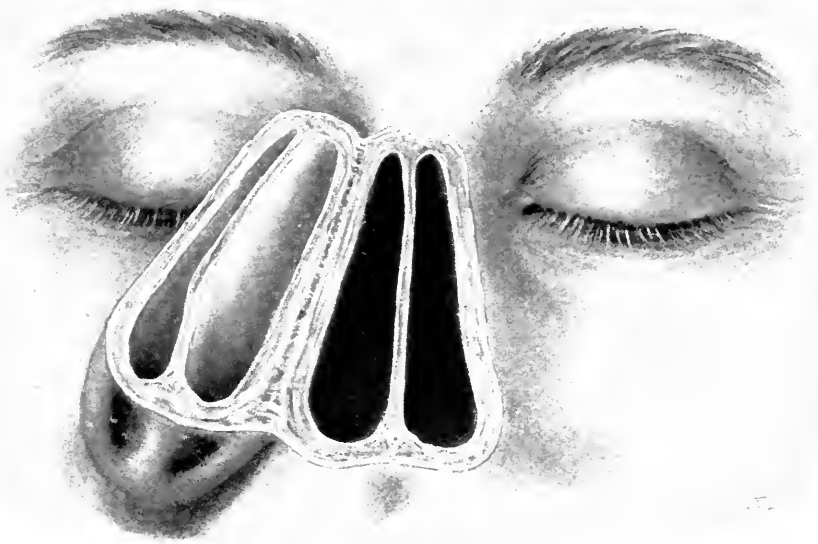


Fig. 606.

Eiselsberg's operation. Nose turned to the opposite side.

turned to the opposite side. (Fig. 606.) The septum remaining as shown in Fig. 607 is resected, the turbinates removed and the ethmoid cells exenterated. This brings the sphenoid into good view. The anterior wall of the sphenoid is then removed and following this, the

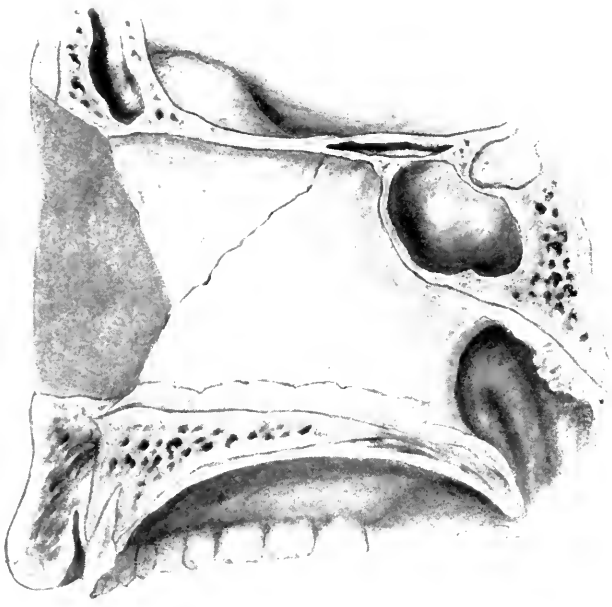


Fig. 607.

Eiselsberg's operation. Septum to be resected.

Fig. 608.

Eiselsberg's operation. Completion.

hypophysis is exposed through the roof of the sphenoid sinus (Fig. 608). The mere decompression may suffice or it may be necessary to remove a growth or to open a cyst. The nose is slightly packed with gauze, the bony wall of the frontal sinus replaced, the nose returned to its proper position and the lips of the incisions united with sutures.

Halstead's Operation.—Halstead describes an operation in which he adopted the following procedure:

The patient was first anesthetized with ether. A high tracheotomy was performed and a Trendelenberg balloon cannula was inserted and substituted for the ether mask. The upper lip was raised and an

Fig. 609.

Halstead's operation.

incision made in its mucous membrane about five-sixths of an inch from the mucocutaneous junction, parallel to the alveolar process. The soft tissues were freed from the bone and the nose gradually drawn up with retractors. The cartilage of the septum was divided and displaced laterally (Fig. 609) and the inferior turbinates, the vomer, and the perpendicular plate of the ethmoid were removed, the middle turbinates having been previously resected. The anterior wall of the sphenoid was removed, revealing a pulsating tumor in the sinus.

The soft parts were restored, the cartilage of the septum and the oral mucosa sutured into place.

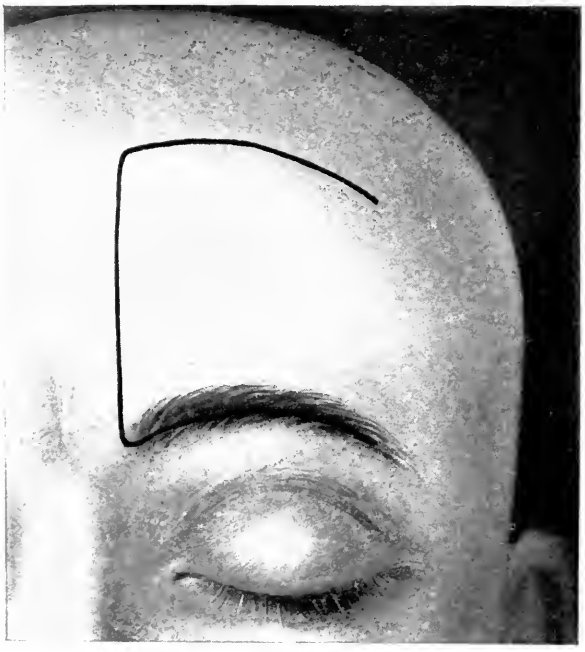


Fig. 610.
Frazier's operation. Incision.

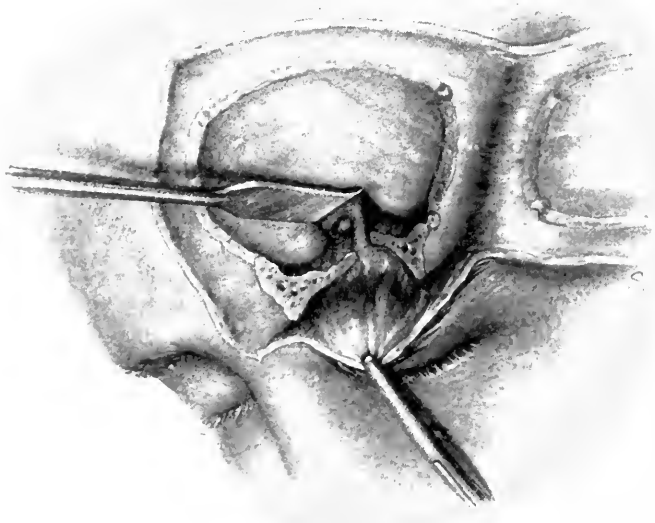


Fig. 611.
Frazier's operation completed.

Frazier's Operation.—An incision is made as indicated in Fig. 610 along the supraorbital ridge to the root of the nose, then perpendicularly upward beyond the superior margin of the frontal sinus and then horizontally outward parallel to the first arm of the incision. After elevation of the periosteum and soft parts, a more or less quadrilateral section of bone beveled around the edges is temporarily resected and turned outward as shown in Fig. 611. The periosteum is freed from the orbit and the roof removed as far back as the optic foramen. The orbital contents are displaced downwards and outwards with flat retractors and the frontal lobe covered with dura is elevated until the optic nerve can be seen passing from the optic foramen to the sella.

Cushing's Operation.—Cushing originally laid special stress on two factors in his operation: (1) anesthetization through a hollow metal tube soldered to a blade which depresses and holds the tongue forward, by which warmed ether is conveyed directly to the opened glottis, and (2) the administration of hexamethylenamin as a prophylactic against infectious meningitis. The first of these may be replaced by intratracheal anesthesia.

The patient is placed in a moderate Rose position and applications of adrenalin are made to the nasal mucosa. The upper lip is drawn upward and the usual lower transverse incision is made across the labial frenum. The incision is carried down to the bone and the soft parts are scraped back by blunt dissection on each side from the lower margin of the apertura pyriformis until the cartilaginous septum is exposed.

From this point on, the mucous membrane is elevated from the septum as in a submucous resection (Fig. 612) and if there is no tear in the mucous membrane, the operation can be performed without entering the nasal cavity. With the aid of retractors (self-retaining, or Killian's) a considerable portion of the bone and cartilage is removed, including cartilage, the lower end of the perpendicular plate of the ethmoid, and most of the vomer (Fig. 613). The turbinates on both sides are flattened against the external nasal wall with plugs introduced between the retractors and the external wall in order to enlarge the space through which the operation is made. The anterior wall of both sphenoids is removed through the intermembranous space, and, when this is accomplished, the bony floor of the fossa is removed from the roof of the sphenoid sinus (Fig. 614). A method of exposing the hypophysis, applicable in all nasal operations, is shown in Fig. 615. Drainage is not necessary.

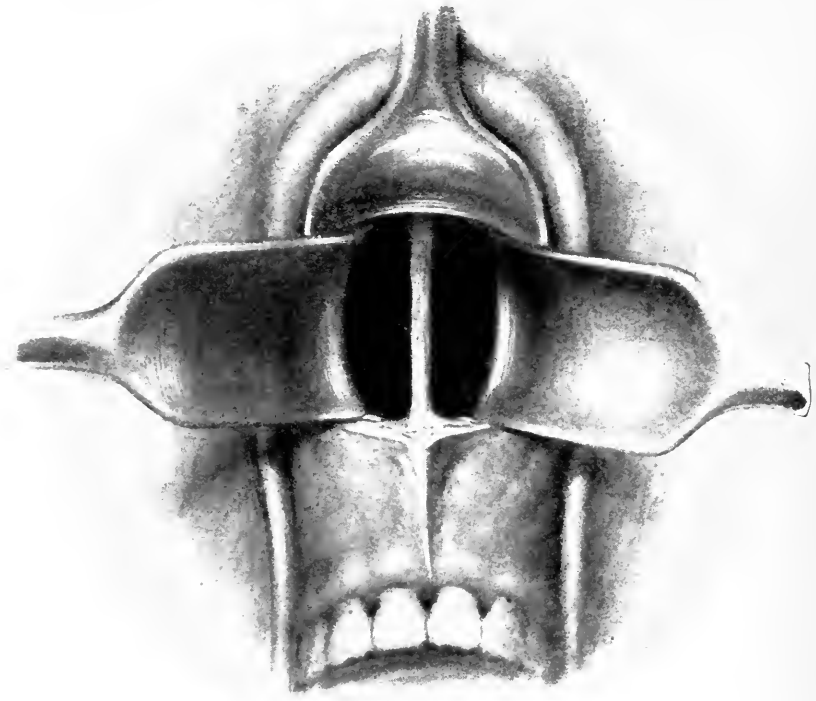


Fig. 612.

Cushing's operation. Mucoperichondrium elevated and refractors introduced preparatory to resecting the septum.

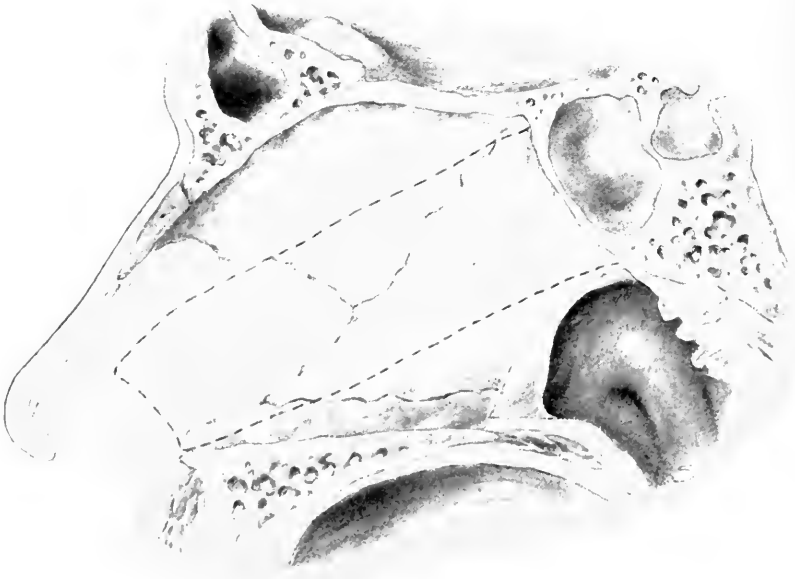


Fig. 613.

Cushing's operation. Septal bone and cartilage to be removed.

Kanavel's Operation.—An incision is made down to the bone close to the creases at the alæ and close under the nares so as to have a minimum of scar. After the hemorrhage is checked, the nose is turned up.

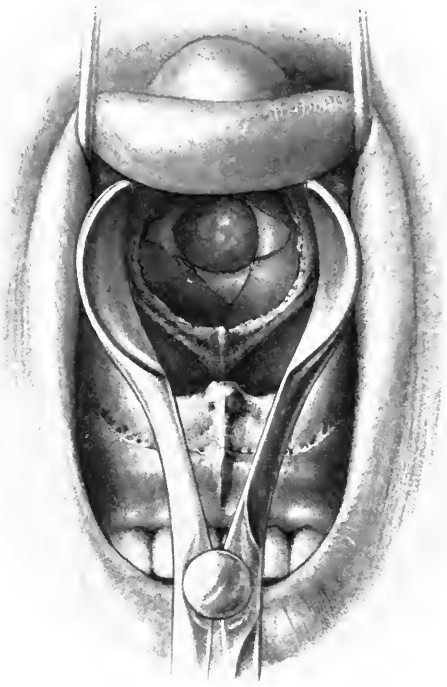


Fig. 614.

Cushing's operation. Exposure of hypophysis through the roof of the sphenoid.

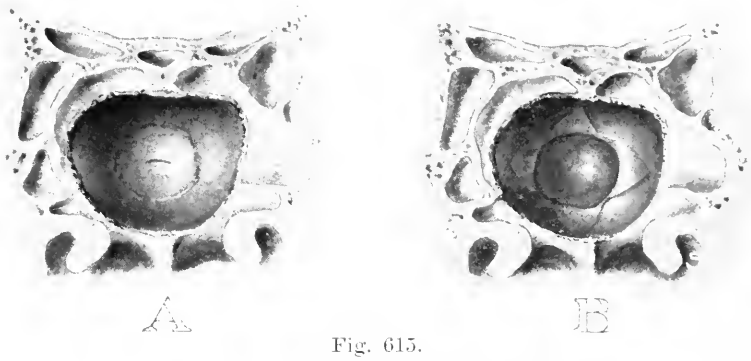


Fig. 615.

Method of exposing the hypophysis.

It is sometimes necessary to remove the anterior ends of the inferior turbinate. An incision is made through the inferior part of the nasal

cartilage and at its attachment to the perpendicular plate of the ethmoid. The cartilage of the septum is then bent to one side and the middle turbinate is resected, affording a fine view of the field of operation. The bony septum is removed to whatever extent is necessary for the purposes of the operation. The foramina of the sphenoid are located, the anterior wall removed and then with great care the inferior wall of the sella turcica (superior wall of the sphenoid) is removed and the decompression accomplished. If desired, a tumor of the pituitary may be removed in this way, if it is accessible. The nose is replaced and

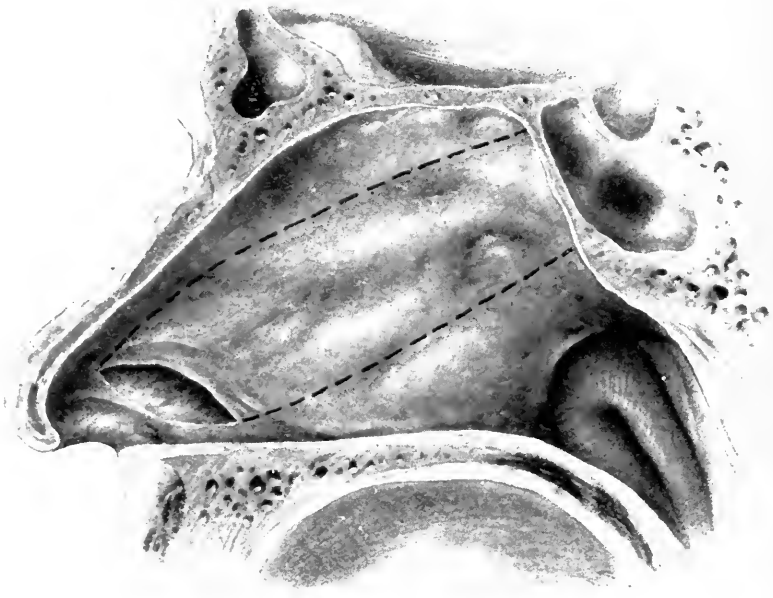


Fig. 616.

Hirsch's operation. Elevation of the septal and sphenoid mucosa.

sutured into position and a light gauze dressing covered with gutta percha tissue is placed within the nasal cavities.

Hirsch's Operation.—Hirsch has devised two operations. The first, which he calls the ethmoidal operation, has been largely replaced by the second, or septal operation. The steps of the ethmoidal operation are as follows: 1st step, removal of middle turbinate on side; 2nd step, several days later, removal of the posterior ethmoid cells and a portion of the anterior ethmoid cells; 3rd step, removal of the anterior wall of the sphenoid and removal of the sellar wall.

The septal method can be performed in one sitting and is the plan most commonly employed. The septum is resected according to

the usual submucous plan except that the mucosa of the entire posterior portion of the septum is elevated (Fig. 616) and the elevation extended so as to include the mucous membrane and periosteum of the nasal walls of both sphenoids. The septum is removed as shown in the illustration and the anterior walls of both sphenoid cavities are resected between the two mucous membranes. The septum sphenoidale is resected, and the roof of the sphenoid underlying the pituitary is removed (Fig. 617). The operation can easily be performed under cocain anesthesia and adrenalin. The strictest asepsis should be observed in

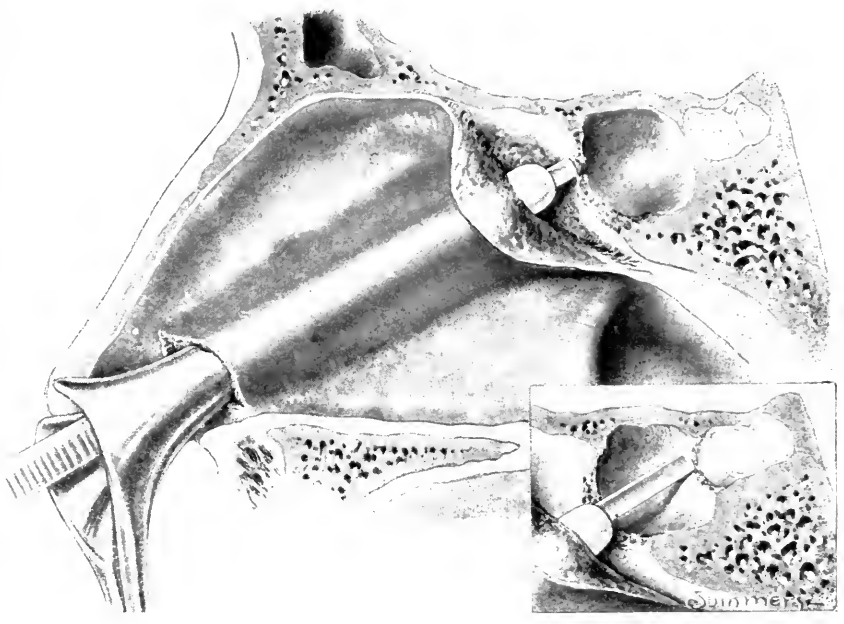


Fig. 617.

Hirsch's operation. Removal of anterior and superior sphenoid walls.

pituitary operations of this type for it must not be forgotten that the cranial cavity is opened and the meninges are exposed.

Hirsch advises making an incision in the dura in the form of a flap which is drawn away with an elevator. The knife is introduced into the tumor to determine whether it is cystic. If it prove to be, the cyst is cut away as far as it lies free. If there is no cyst present then the tumor is carefully removed with sharp curettes cutting away from the growth. The instrument should not be used in a lateral or upward direction except under the most extreme caution for fear of wounding the sinus cavernosus or the third ventricle.

Gauze is lightly packed between the mucous surfaces for drainage.

The recovery is usually but little less rapid than in ordinary submucous resection.

Beck's Operation.—Beck utilizes the maxillary sinus as an approach to the sphenoid. A wide opening is made in the anterior wall through the mouth after the plan used in his maxillary operation (page 112). The ethmoid cells are exenterated and the anterior wall of the sphenoid resected after the method of Jansen. The usual operation through the sphenoid roof is then performed. The entire work is done with the electric engine.

The availability of this route is shown in Fig. 618. The posterior

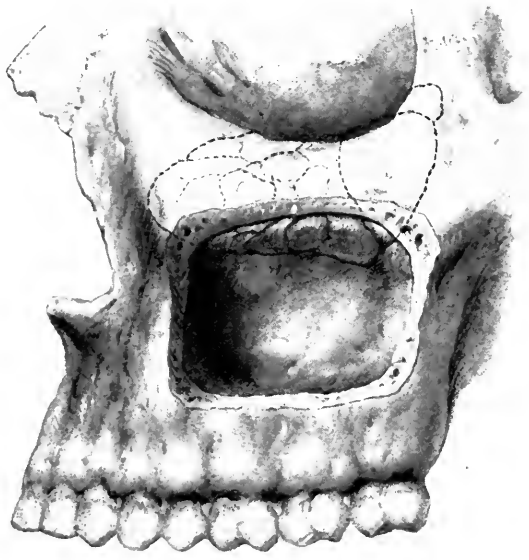


Fig. 618.

Beck's operation. Reconstruction of ethmoid cells, sphenoid sinus and pituitary, showing method of reaching the pituitary fossa through the maxillary sinus.

ethmoid cells and sphenoid lie at the junction of the superior and inner walls of the maxillary sinus. This operation brings the pituitary fossa nearer to the operator's hands than any other method.

MAJOR OPERATIVE SURGERY OF THE NASAL CAVITIES.

Under this heading are grouped the surgical operations which require extensive resection, permanent or temporary, of the nose or adjacent structures.

The operations upon the pituitary, some of which should be included in this group, have already been considered.

Operations for carcinoma, sarcoma, and other tumors which continue to grow beyond the limits of the nasal cavities fall naturally within this classification although in the early stages some of these conditions may be relieved by simpler methods of excision than are here described. Furthermore, the operations already detailed may be used with but slight modifications for relief in some instances. Thus the Denker, Caldwell-Luc, or Beck operation may be used in cysts of the maxillary sinus, the various external frontal operations for mucocele or other growths involving the frontal sinus; a submucous resection or resection of the turbinates may be employed as a preliminary to the ablation of a fibroma or sarcoma within the nasal cavity.

From the nature of carcinoma and sarcoma, the incomplete removal can be of only temporary relief, if indeed it does not accelerate the growth or cause it to spread by implantation.

Indications.—The indications for all these operations are based on the doubt of securing relief or cure by any other method of treatment and the possibility that such extensive operative procedures may be followed by good results in spite of the danger, deformity or apparent helplessness of the condition.

Contraindications depend upon the general condition of the patient and upon the absence of any prospect of recovery as, for instance, when metastases are already present.

Anesthesia.—In all the operations of this character, intratracheal anesthesia is the most satisfactory since the administration of the anesthestic proceeds without interfering with the operator, without requiring a preliminary tracheotomy and without danger from blood aspiration. Where this method is not available or is contraindicated, some other plan must be employed such as scopolamin, morphin and gas anesthesia, or the rectal administration of ether.

Some cling to the older methods such as chloroform anesthesia, ether anesthesia with interruption of the operation from time to time to renew the anesthesia, and preliminary tracheotomy with ether administration through the tracheal tube, etc.

The operations which are undertaken are as follows:

1. Resection of the nasal walls.
2. Temporary resection of the nose.
3. Excision of the maxilla.
4. Resection of the palate.

Resection of the Nasal Walls.

To obtain a maximum of room for operation, various methods have been devised by which the bony wall of the nose is resected in part or

the external nose is temporarily resected and replaced when the operation is completed.

Moure's Operation.—A curvilinear incision is made from the inner extremity of the eyebrow below the lower eyelid to the prominence of the malar bone as shown in Fig. 619. A second incision is made along the junction of the nose and cheek curving under the ala nasi. As far as possible, these incisions should follow creases in the skin already present, as the scar thus becomes less pronounced. The periosteum

Fig. 619.
Moure's operation. Incisions.

and soft parts are elevated and the bone exposed. The bone is chiseled at the lines indicated in Fig. 620 and is then removed with strong forceps. The bone removed comprises the nasal bone, the frontal process of the maxillary and, if necessary, a portion of the lacrimal, from the frontomaxillary suture to the pyriform fissure. As much of the maxilla should be removed as is necessary to provide ample space for the operative work contemplated but the intraorbital nerve should be avoided if possible. This operation, as recently pointed out by St. Clair Thomson, affords a wide space for inspection and removal of very ex-

tensive neoplasms of the nose and accessory sinuses (Fig. 621). After the operation is completed the soft parts are brought together and sutured, the cavity being dressed through the nose.

Preysing's Operation.—The purpose of this operation is to obtain access to the upper portion of the nose and to the frontal, ethmoid, and sphenoid regions. A T-shaped incision is made, the horizontal portion extending an equal distance on either side at the level of the eyebrow and the vertical portion extending downward at the midline of the

Fig. 620.

Moure's operation. Periosteum and soft parts elevated showing where the bone is cut.

nose. After elevating the periosteum and soft parts, the two nasal bones and the frontal processes of the two maxillæ are removed, leaving a bridge of bone just above the apertura pyriformis to support the soft parts. As much of the septum, ethmoid and lacrimal bones is removed as is necessary for excision of the growth. The wide opening affords an extensive view of the entire nasal cavity. The soft parts are replaced and sutured according to any of the acceptable methods.

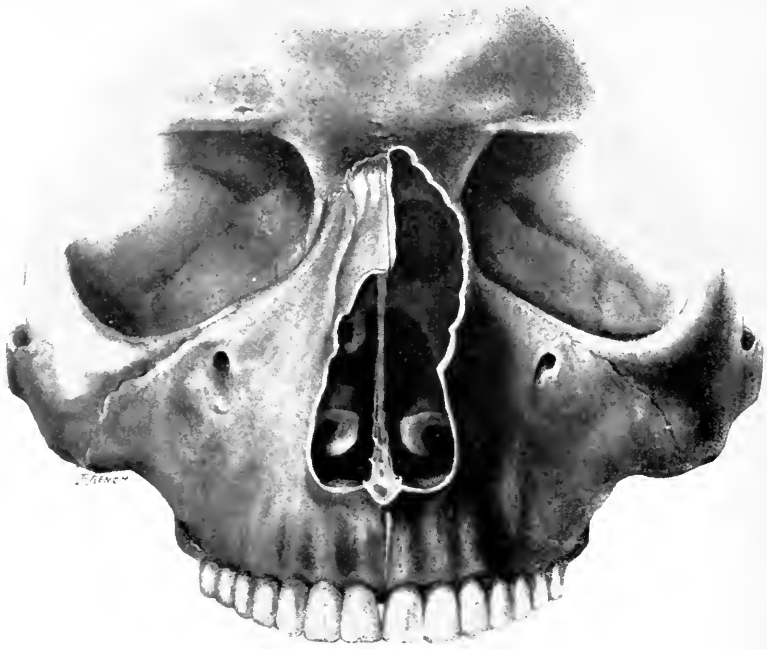


Fig. 621.

Moure's operation. Space afforded by removal of bone.

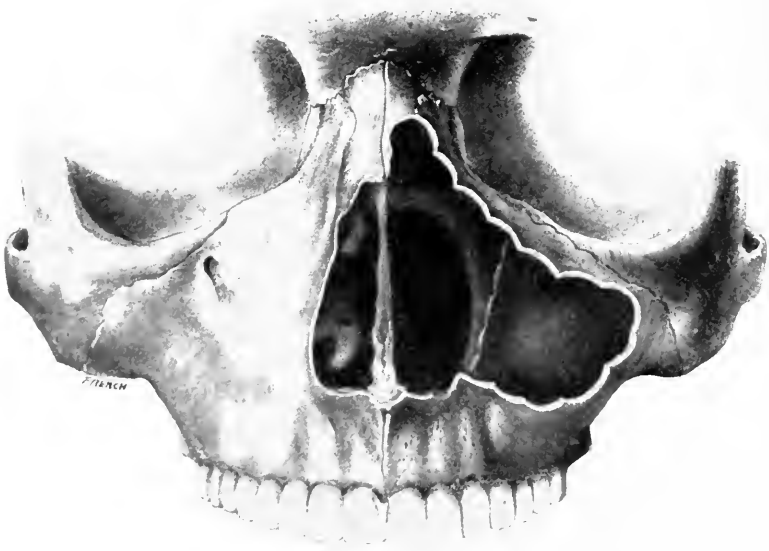


Fig. 622.

Denker's extended operation.

Denker's Extended Operation.—By including the resection of a larger amount of bone than in his usual maxillary operation, Denker extended the operative field so as to afford a wide space for exsection of growths involving the maxillary sinus and outer wall. Almost the entire anterior wall of the maxilla, a portion of the nasal bone, and of the frontal process of the maxillary are removed for this purpose. The illustration (Fig. 622) gives a sufficiently clear understanding of what removal of the bone is required for this operation.

Temporary Resection of the Nose.

The nose may be resected and temporarily displaced upward, downwards or laterally according to the method used.

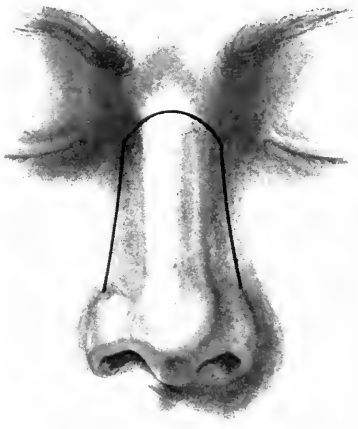


Fig. 623.
Ollier's method.

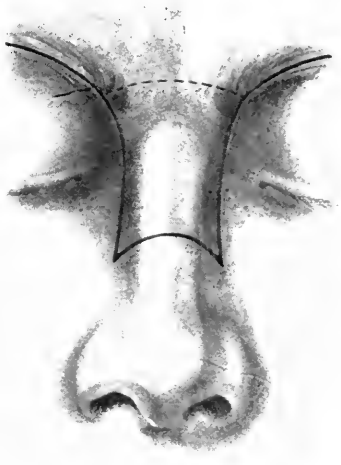


Fig. 624.
Gussenbauer's method.

Ollier's Method.—The incision is made as indicated (Fig. 623) on both sides of the nose at the junction with the cheek and the two limbs are united over the bridge of the nose. The frontal process of the two maxillæ and the nasal bones are cut through at the line of the incision and the septum is divided parallel to the cut edges of the outer nasal walls and the nose is reflected downwards.

Gussenbauer's Method.—Incision is made as shown in the Fig. 624 including the inner half of the superciliary ridge and the frontal processes of the maxillæ to the lower limit of the nasal bones. A transverse incision is made at this point running over the bridge of the nose

and uniting the two incisions. The bone is cut through along the incisions and in addition the frontal processes of the two maxillæ and the frontal bone are divided subcutaneously as indicated by the broken lines, after which the nose is reflected upwards and the operation is completed.

Chassignac-Bruns' Method.—The incision is made as shown in Fig. 625 from the inner canthus of one eye to that of the other, then along the junction of the nose and cheek and along the upper lip, encircling the two alæ of the nose. The bone is correspondingly divided and also the septum nasi and the frontal process of the maxilla on the

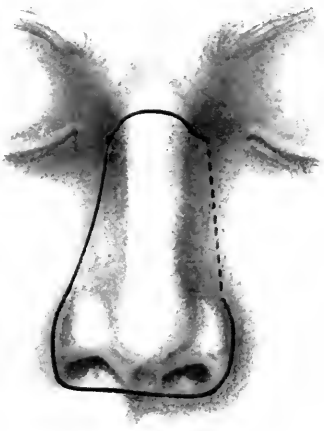


Fig. 625.
Chassaignac-Bruns' method.

Fig. 626.
Langenbeck's method.

uncut side is severed subcutaneously between the ends of the incisions. The nose is reflected to the side opposite to the incision affording ample room for operation.

Langenbeck's Method.—The incision begins just above the inner canthus and is carried to the midline of the root of the nose whence it is continued downward following the lower edge of the nasal bone to the junction of the nose and cheek, then encircling the ala of the nose to the lip (Fig. 626). The bone is severed following the incisions as far as the upper extent of the ala and subcutaneously along the base of the flap. The cut portion of the nose is then reflected over the corresponding side of the nose.

Excision of the Maxilla.

The maxilla with its attachments, the turbinates, ethmoid, and lacrimal bones, constitutes the external wall of the nasal cavity and as such is readily involved in any malignant process affecting the nose. When once the process includes the external wall beyond the turbinates, any operation short of an excision of the maxilla is not apt to be successful.

The maxilla has been resected by surgical operators in a variety of

Fig. 627.

Cut made in the bone in resection of the maxilla.

ways. Most of the differences, however, are technical and depend upon the incision and the amount of the adjacent structures removed. The ultimate purpose is to cut through the bone connections of the maxilla in such a way that it may be removed with the accompanying neoplasm with the least deformity and bad results possible.

Removal of Bone.—Fig. 627 shows the location of cuts to be made in the bone. On the one side is illustrated the section as made through the frontal process of the maxilla, the orbit and the malar attachment and the alveolar process; on the other, the entire malar bone is included

in the exsection. The amount of the bone removal may be made to vary with the requirements of the case.

Removal of Palate and Alveolar Process.—The character and extent of the neoplasm determine the amount of the palate and alveolar process to be resected.

Removal of the alveolar process alone (Fig. 628) may be required, or it may be necessary to remove the entire hard palate (Fig. 629) or in

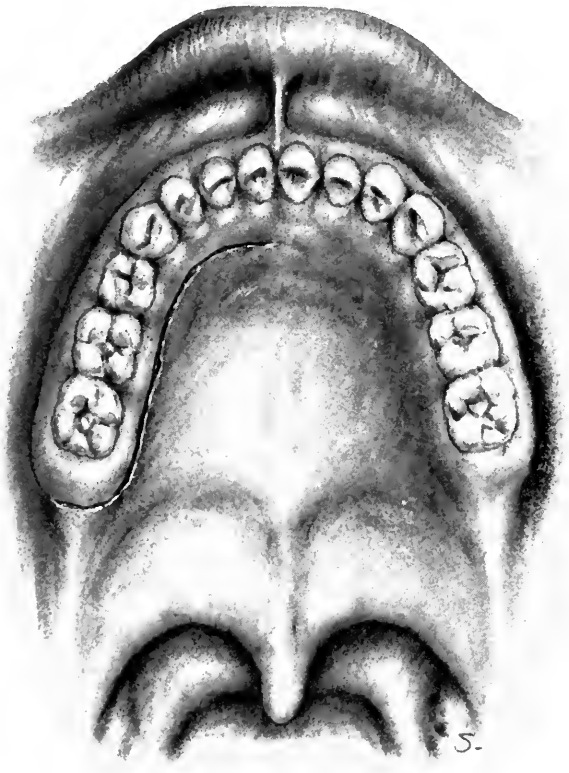


Fig. 628.

Incision along the alveolar portion of the palate mucosa.

addition to this, the process may call for splitting the soft palate (Fig. 630) with removal of entire palate bone and the pterygoid process of the sphenoid.

Preparation.—In an operation as grave as this, the greatest pains must be taken with the preparation. In view of the danger of aspiration pneumonia, many operators are disposed against the use of general anesthesia, but the introduction of the Meltzer insufflation method has greatly simplified this feature of the case, as the narcosis is readily

continued without interference with the operation and the danger of aspiration is greatly reduced in that nothing solid nor fluid can enter the larynx during narcosis.

Trendelenburg devised the method of preoperative tracheotomy with administration of the anesthetic through a cannula introduced into the trachea while blood and secretions are excluded, as entrance to the larynx is closed by packing the pharynx with gauze.

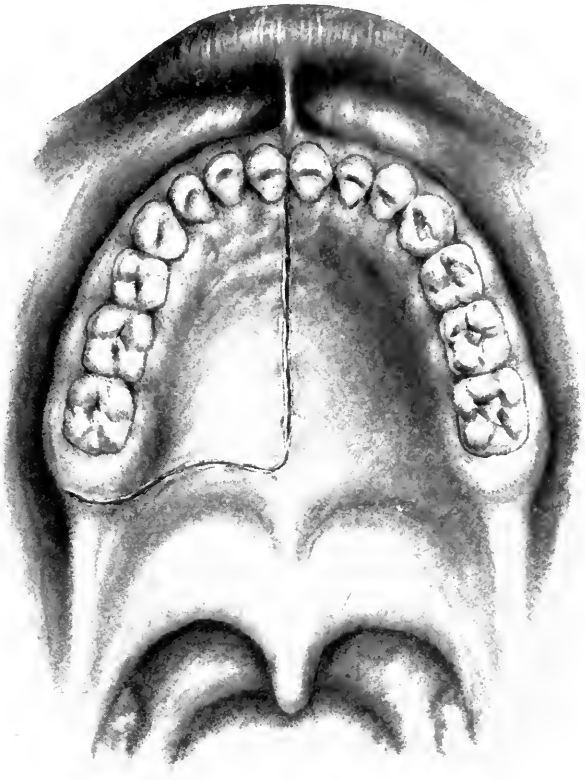


Fig. 629.

Incision through the medial portion of the palate mucosa.

The Braun method of local anesthesia is as follows: Injection of the maxillary branch of the trifacial nerve with a one per cent novocain solution with suprarenin. The needle is introduced through the masseter muscle just behind the articulation of the malar bone and the maxilla, and is pushed along the tuberosity of the maxilla to a depth of 5 to 6 cm. within the fossa pterygopalatina. The injection is made as soon as the patient complains of radiating pains in the face. As the needle is withdrawn 5 c.c. of the solution is injected behind the maxilla

in order to cause contraction of the branches of the internal maxillary artery. The ophthalmic branch of the trifacial nerve is injected with 5 c.c. of the solution, the needle being introduced just above the external canthus. Care should be exercised not to have the needle point leave the bone until it reaches a depth of 4½ to 5 cm. at the superior orbital fissure. This nerve is also injected with 5 c.c. of the solution by

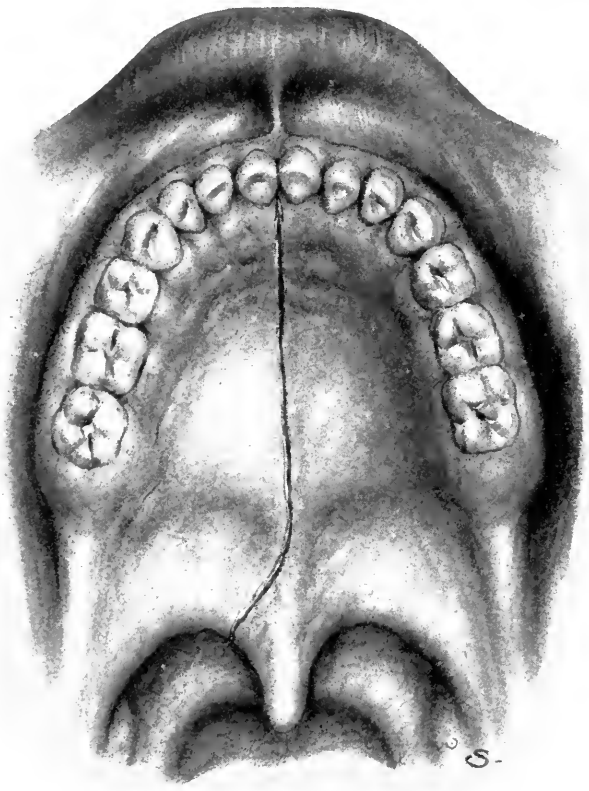


Fig. 630.

Incisions through the medial portion of the hard palate mucosa and through the soft palate.

carrying the needle introduced 2 cm. above the internal canthus along the bone in the roof of the orbit to a depth of 4 to 5 cm., the injection being distributed along the orbital roof. In addition the injection is made along the outer field of operation and into the mucosa of the hard and soft palate and alveolus.

Some type of suction apparatus is invaluable in this operation. The Beck-Mueller instrument illustrated in Fig. 716 is of additional

service in this particular, as it also provides a pump for the ether administration.

The temporary compression of the external carotid artery after the method of Crile and others is of great value. Almost complete absence of bleeding may be secured by ligating both external carotids immediately beyond the place where the superior thyroid artery is given off. The collateral circulation is carried on through the anastomosis of the superior and inferior thyroid arteries. Some adrenal preparation should be applied to the mucous surface as the operation is greatly facilitated by the hemostasis which it causes.

It is important to arrange for a thorough cleansing of the mouth

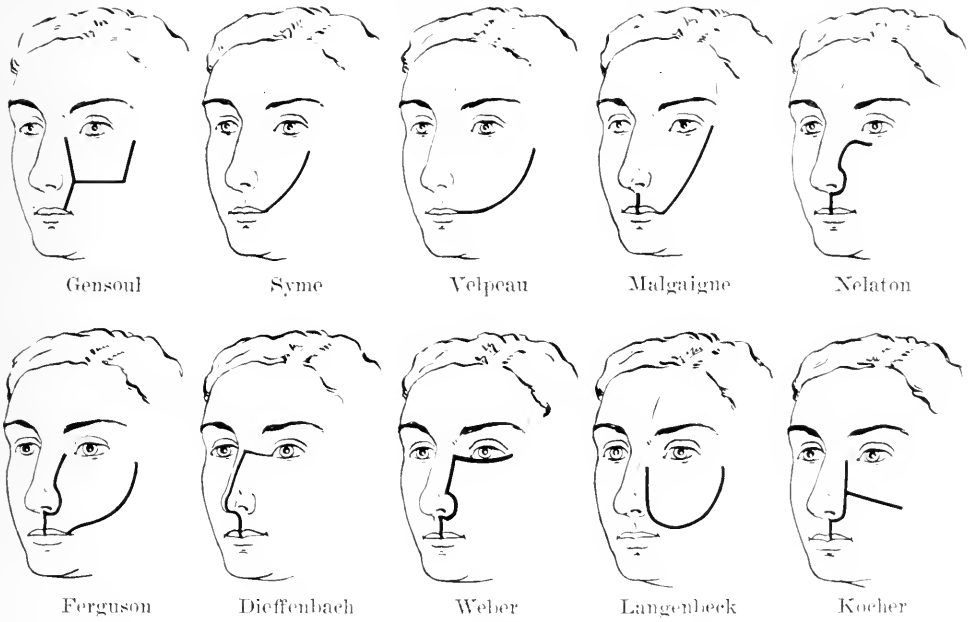


Fig. 631.

Incisions for resection of the maxilla.

for some days prior to the operation. Close attention should be paid to the teeth so that all infective foci may be eliminated as far as possible. Furthermore, the dentist should make a study of the patient's mouth in advance so as to plan the prosthetic appliance which must be constructed eventually and which is an important factor for the patient after the operation is completed.

Incision.—The choice of a large number of incisions is given to the operator as is shown in the accompanying illustration (Fig. 631). The most favored ones are the Dieffenbach, the Weber, and the Kocher incisions.

Fig. 632.

Excision of the bone after elevation of the soft parts.

Fig. 633.

Suture of the palate after resection of the maxilla.

When the soft parts are not affected by the neoplasms, the periosteum is elevated in the usual way, otherwise the part involved must be removed with the bone. The palatal incisions are made according to indications and as in the case of the skin incisions, where the palate is not involved, the mucosa and periosteum are elevated.

Removal of Bone.—When the soft parts have been elevated as far as possible and the bleeding checked, the bone is removed with chisel, bone saw, rongeur, or Gigli saw as shown in Fig. 632.

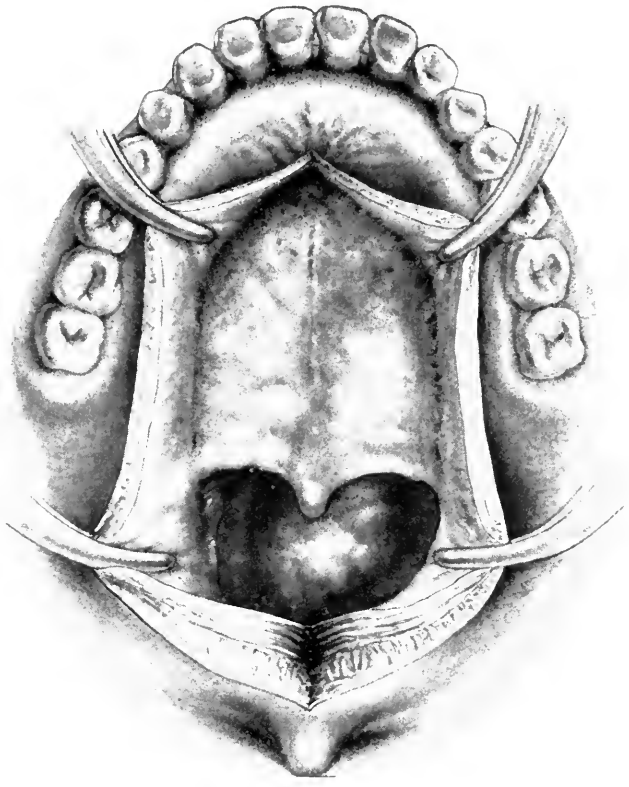


Fig. 634.

Elevating the periosteum and mucosa of the palate.

Completion of Operation.—The constriction of the external carotid is gradually relieved and all bleeding vessels ligated or crushed. The palatal mucosa and periosteum are brought together and sutured as shown in Fig. 633. This is not always possible, as for example, when the neoplasm involves the palate, under which circumstances a defect is apt to remain. The cavity is filled with gauze preferably saturated with tincture of benzoin, the ends being carried through the anterior nares. The lips of the external incisions are now brought together and

sutured and an appropriate dressing applied. Where a defect in the skin persists, some appropriate form of plastic operation must be adopted.

Results.—Deaths occur from suffocation, shock, aspiration pneumonia, pulmonary embolism, hemorrhage, and cerebral softening usually accompanied by hemiplegia due to ligation or compression of the carotid artery. Complete recovery from operation and pathologic

Fig. 635.

Removal of posterior portion of the palate, exposing growth.

process occurs in sarcoma; less frequently, however, in carcinoma. Recurrence of the neoplasm is in keeping with its character, duration, and extent.

Resection of the Palate.

Tumors involving the posterior portion of the nose and the nasopharynx may be reached by splitting the soft palate and resecting the hard palate to the extent necessary. Healing as a rule proceeds satisfactorily and there is little post-operative difficulty.

The operation is especially applicable in fibromata and sarcomata in the region of the sphenoid and of the nasopharynx. The author found the method acceptable in a case of carcinoma of the nasopharynx in which the neoplasm was removed and the base cauterized.

The plan used consisted in making an incision which proceeds medially from the anterior extremity of the hard palate to the soft palate where it is deflected so as to leave the uvula connected with the palate on the unaffected side (Fig. 630). The periosteum and mucosa were elevated and the posterior portions of the hard palate and of the nasal septum were removed after which the growth became accessible for ex-

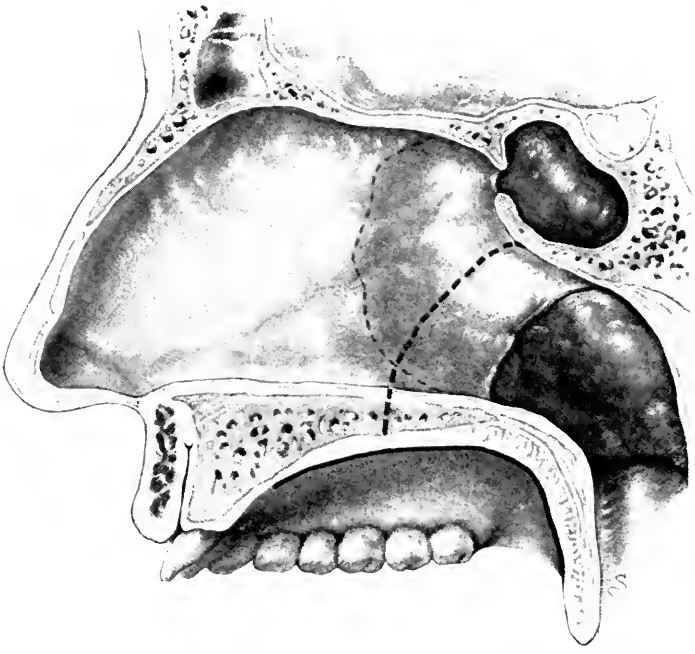


Fig. 636.

Extent of tumor and portions of septum and palate removed.

cision and cauterization. The soft parts were then brought together and sutured.

From the very nature of the process and its location, very little hope of recovery can be given. Recurrence is early and the growth is usually more rapid than before the operation. Still one should not hesitate to take advantage of even the slight possibility of relief in the early and less extensive cases.

Another plan utilizes the incision (Fig. 629) which does not include the entire soft palate and uvula. It is serviceable in nasopharyn-

geal fibroma and sarcoma attached to the posterior portions of the nose and sphenoid. The periosteum and mucosa are elevated (Fig. 634) and the posterior portion of the palate removed from one or both sides bringing the growth into good view (Fig. 635). Another view showing diagrammatically the extent of the tumor and the amount of palate and septum removed is shown in Fig. 636.

Tumors of this type are usually very vascular. Indeed, the resulting hemorrhage during operation is one of the most serious problems. Constriction or ligation of the carotid may be required although the bleeding usually subsides if the nasopharynx is packed tightly with gauze.

CHAPTER VIII.

OPERATIVE SURGERY OF THE PHARYNX.

By George L. Richards, M.D.

ADENOIDS.

E. Meyer of Copenhagen was the first to demonstrate clearly the condition commonly known as adenoids, although others had seen and described tumor masses, which, without doubt, were adenoids. Hippocrates gives a very good clinical description of the symptomatology of adenoids; writing of individuals "who suffer from headaches and discharging ears," he says, "they have hollowed out palates, and badly arranged teeth." Itard, Bonnet, and Martel describe masses or hypertrophies which were without doubt adenoids. Martel says that the glands of the nasopharynx become enlarged and project into or against the Eustachian tube, and so causes deafness. Toynbee, von Tröltsch, and others give histories which are dependent upon adenoid vegetations. Meyer, however, was the first one to appreciate the clinical significance of the hypertrophied adenoid tissue, and to study it from all points of view. Previous to him, no one had determined that the nasopharynx tumors observed were hypertrophied lymphoid tissue, for no histologic observations of the growth had been made. Meyer's monograph, embracing a study of 175 cases, was published in 1873.

General Conditions Indicating Removal.—Mouth-breathing, deafness, suppurative otitis media, thick speech with impaired resonance, faulty development of the palate, open mouth, short upper lip, obstructed nose, retarded mental and physical development, faulty chest development, nasal discharge, chronic nasopharyngitis, inability of young infants to nurse properly, and earache, are all symptoms, one or more of which may be present in adenoids, and any or all of which should suggest the examination for them.

Digital examination gives the most satisfactory information as to the diagnosis and call for the operation. The forefinger of the right

hand, previously cleansed, and covered with a rubber finger-cot should be used. A gag or the edge of a tongue depressor is inserted between the posterior molar teeth, or the cheek is pushed between the teeth by the examiner's finger. The gag is kept adjusted by the left hand carried around the patient's head, while the head is held by the arm against the examiner's body. The hands should be grasped by the assistant. The tongue should be slightly depressed with the finger when it is introduced into the mouth, and then the finger is inserted behind the soft palate, and at the side between the uvula and the palatine pillars. The tip of the examining finger is swept quickly over the pharyngeal vault, over the growth, the Eustachian tube eminences, Rosenmüller's fossæ, and the posterior nares, and the exact relationship and size of the growth are noted. This examination is important, for besides giving evidence of the presence or absence of the adenoids, it also shows the amount and consistency of the growth, and the type of operation to be chosen, if any be necessary. Last, but not least, the tractability of the child is tested, and on this may depend the question of anesthesia, and the choice of an anesthetic.

Anesthesia.—Adenoid growths are not very sensitive, the duration of the operation is not long, and the pain cannot be very great. On the continent of Europe, anesthesia is rarely given for the operation, while in England, Scotland, and America it is the rule to use nitrous oxid, chlorid of ethyl, ether or chloroform, especially for younger children. The prevailing practice makes it advisable to examine the area before, during and after the operation. For this reason, anesthesia is desirable for all patients under twelve to fifteen years of age, and sometimes even at this age. In older children and in adults, who have very good control of themselves, it is not necessary, as the area can be sufficiently well cocainized.

Nitrous oxid answers very well as an anesthetic in these cases, but it should be given by one experienced in its use. The time allowed for operating is very slight, and if the tonsils are to be removed as well, it is not altogether satisfactory. Chloroform is successfully used in England and Scotland for the removal of adenoids, though rarely in America. As the growth to be removed is lymphatic in character, chloroform is contraindicated, if the operation is to be done in the upright position. Chlorid of ethyl is sometimes used by inhalation, but its anesthesia is rather short. It is usually followed by ether if more time is required. Ether is safest and most commonly used. Cocain in from five to ten per cent solutions constitutes a satisfactory anesthetic when general anesthesia is not desired.

Preliminaries.—The operation may be done in the upright position or in the horizontal, and in the latter on the back, the side, or with the head hanging over the end of the table. In the upright position the child is held in the arms of a nurse or is seated upon a chair. Dr. Thomas R. French has devised a table (Fig. 637) which is adapted to both the upright and horizontal positions, and capable of so many transformations as to be especially applicable to ear, nose and throat surgery. Experiments made by him seem to show that the upright position has no more risk attached to it than the horizontal one. With the aid of this table a change from one position to the other is quickly made and the Trendelenburg position is also easily obtained. Direct or indirect illumination may be used, though most operators prefer the latter. The operator sits in front, the instruments are laid on a table

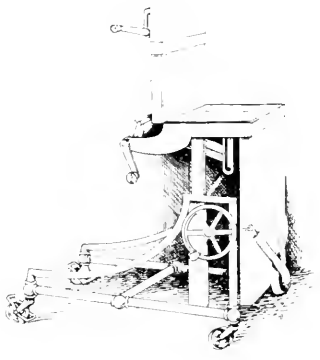


Fig. 637.
French's table.

at the left, and a bowl is placed between the operator and the child. While the operation may be performed in the physician's office, it is always better to do it in a hospital.

The nasopharynx and mouth cannot be made sterile but the usual rules of operative asepsis should be carried out with respect to instruments, hands and dressings.

Instrumentarium.—A large number of instruments have been devised for the removal of adenoids, a number so large as to make it evident that no one instrument is an unqualified success. They consist of forceps, curettes, adenotomes, with many forms of each class.

Forceps.—These are introduced into the nasopharynx, opened widely, and then closed. They are supposed to be so shaped as to grasp the entire growth within their jaws. The original forceps of

this kind were known as those of Löwenberg (Fig. 638), which removed the growth in small pieces, their cutting surface being not much larger than that of a large pea. The type most in use at the present time is that of Brandegee. (Fig. 639.) The Brandegee forceps are constructed in shapes to fit the posterior and superior wall of the nasopharynx. The jaws meet but do not overlap, and on account of the extreme forward projection there is some danger of biting off a piece of the vomer.

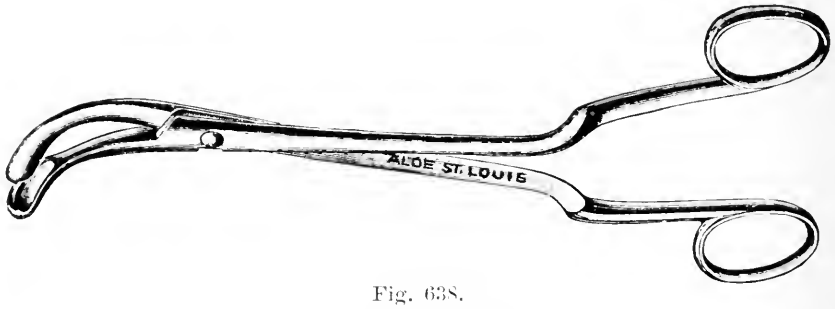


Fig. 638.
Löwenberg's forceps.

The instrument of Manasse is rounded on the surface which goes against the vomer, and the jaws overlap slightly so as to cut off the growth entirely without tearing.

Curettes.—The two best patterns are known as Beckmann's (Fig. 640), and Barnhill's (Fig. 641). The curves of these instruments approximate the average curve of the nasopharynx. The curette should

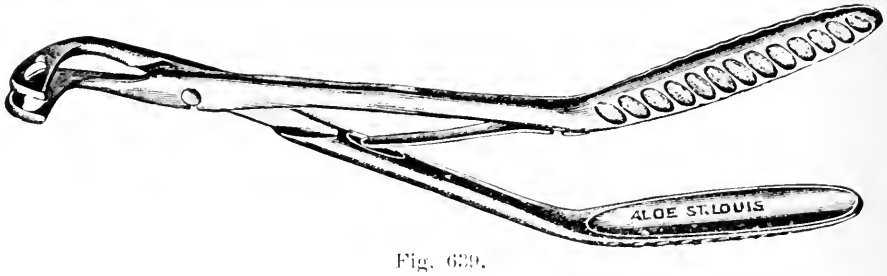


Fig. 639.
Brandgee's forceps.

be sharp so as to cut and not to tear, and as large a size should be used as will comfortably pass between the Eustachian eminences. To use the instrument, it is introduced to the upper edge of the vomer, pressed firmly backward behind the palate, and with a sweeping motion downward is made to pass over the entire surface of the nasopharynx, from the border of the vomer backwards and downwards.

Adenotome.—This instrument, designed on the plan of the tonsillotome, was intended to be introduced open, and to enclose the entire

adenoid mass in its grasp. It is not a perfect instrument for it is not possible to design an instrument of this type, even though in several sizes, which will fit every nasopharynx. When such an instrument does not fully approximate the pharynx wall, some tissue may be left.

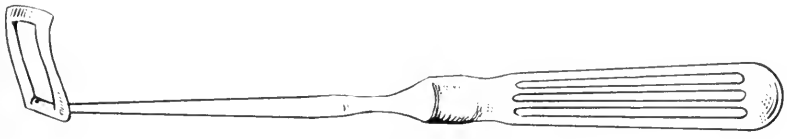


Fig. 640.

Beckmann's adenoid curette.

Supplemented by curettes, to be used when needed, it is nearly ideal. Although Schütz and Gradle have devised instruments of this type, that of LaForce (Fig. 642), is most commonly used. Its curve more nearly approximates that of the pharynx; it has a box which prevents

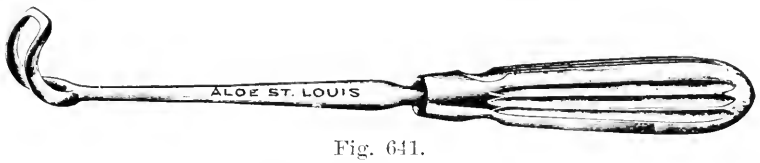


Fig. 641.

Barnhill's adenoid curette.

the loss of the adenoid, and a knife which can be sharpened and will not break. In the Schütz instrument, on the other hand, there is danger of breaking the knife, as it is very delicate.

Subsidiary Instruments.—Under this heading are included the

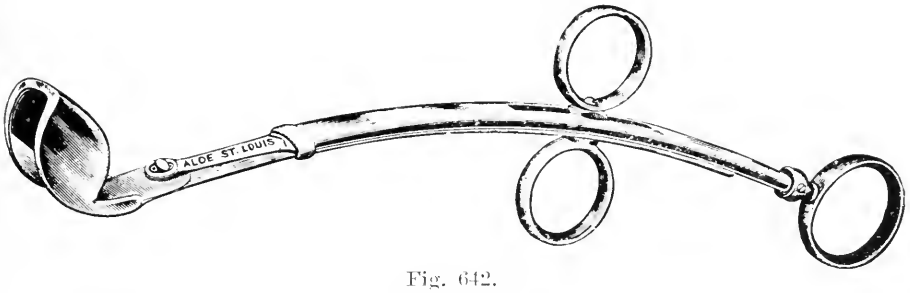


Fig. 642.

LaForce's adenotome.

right angle tongue depressor, palate elevator, curved scissors, and long curved uterine dressing forceps several in number each holding a pledget of sterile gauze large enough to fill the nasopharynx. These are used to stop the flow of blood at any stage of the operation.

Operation.—Anesthesia may be induced or not, as may seem desirable in the individual case. The upright or the side position may be adopted, or the head may be allowed to hang over the end of the table. The mouthgag is introduced; the tongue depressor and other instruments should be at hand. Before using any instrument the index finger of the left hand, previously carefully sterilized, and covered with a sterile finger cot, unless rubber gloves are worn, should be introduced for the purpose of orientation and of drawing the adenoid tissue from the mouth of the Eustachian tube, from Rosenmüller's fos-

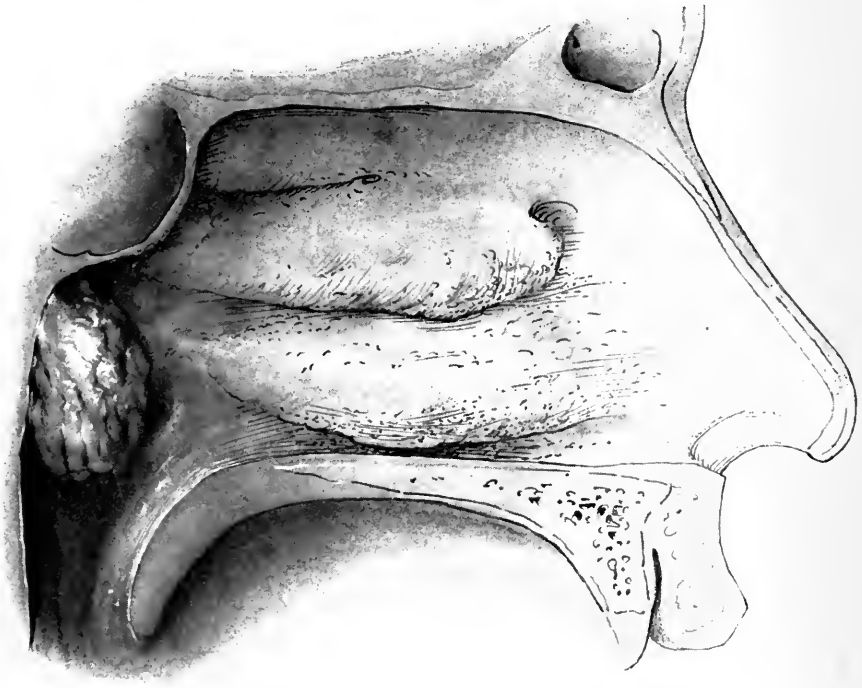


Fig. 643.

Adenoid shown in situ.

sæ, and from the border of the vomer above. This leaves the adenoid tissue in a mass at the center of the nasopharynx, as shown in Fig. 643, and allows whatever instrument is used to be placed over it. While this, in many cases, will not be absolutely necessary, its routine performance results in more thorough operation, and may prevent any injury to the mouths of the Eustachian tubes. Whatever plan is pursued, when the operation is completed, the child's head is brought forward, if in the upright position or to the edge of the table if reclining, in order to prevent the aspiration of any blood.

Operation With Forceps.—The palate is drawn forward with a

palate hook, held in the left hand. The forceps are introduced slightly open and pressed firmly upwards and backwards against the upper and posterior wall, the jaws are opened as widely as possible and the blades are then brought together; they are then withdrawn, special care being taken not to catch the edge of the vomer in the anterior tip of the forceps or the uvula in the lock of the forceps. If there should be any difficulty in withdrawing the instrument, something besides the adenoid has been grasped, or else the blades have not been properly brought together. In this case, with the forceps *in situ*, the finger is introduced for the purpose of examination. The finger will instantly discover the situation, and under its guidance further cutting may be done or the instrument may be withdrawn. When using the Brandegee instrument, the handles are held against the upper teeth, care being taken not to depress the handles too much, on account of the danger of biting off a piece of the vomer, as already mentioned. The forceps being removed, the nasopharynx should be re-examined with the finger, and the forceps reintroduced until all the tissue is removed. The principal objection to an instrument of this class is

Fig. 644.

Vogel's adenoid curette.

that unless the adenoid is pushed away from Rosenmüller's fossæ, no such instrument can be depended upon to remove it in its entirety. Only careful examination with the finger will determine this, and such an examination should never be omitted. Supplementing the forceps, the curette of Beckmann (Fig. 640) and the small curette of Vogel (Fig. 644) should always be at hand, and should be used if necessary. Bleeding if considerable can be controlled at any moment by introducing the gauze pledgets on forceps, and holding them in position for a few moments. The bleeding is quite free at first, but usually subsides quickly, even though no effort is made to stop it.

Operation With the Curette.—The curette is held firmly in the right hand, and after introduction to the top of the nasopharynx and forward to the vomer, it is pressed firmly backwards, sweeping the superior and posterior pharyngeal wall. During this process, the blade of the instrument is held in the same position, as though it were being used as a razor, with the handle in the same vertical plane as the nose. The adenoid, if the instrument is very sharp, will usually come out in one piece, and appear in the throat, but may be left behind,

hanging in the pharyngeal wall by a light tab of tissue. (Fig. 645.) This is due to the dullness of the instrument or to the slipping out of the adenoid mass from the curette before excision has been completely accomplished. When present this tab is then cut off with a pair of curved scissors, which should be at hand. If examination with the finger shows that any tissue remains the curette should be reintroduced and the portion removed. Sweeping aimlessly with the curette in the hope of removing some tissue which may be left should be avoided, as this produces a needless amount of trauma. Every movement should be a defi-

Fig. 645.

Tab of adenoid tissue hanging from the mucous membrane.

nite one, and the whole operation should be performed in a surgical manner.

Operation With the Adenotome.—The steps are (1) orientation with the finger; (2) introduction of the open adenotome, which is carried high up and then backwards, so that it feels as though it embraced the entire space between the Eustachian eminences. The instrument must be placed squarely against the back wall (Fig. 646) of the nasopharynx with reference to the plane of the body. If this is not done, it is possible to place it so diagonally as to lay it to one side against the Eustachian prominence. Under such circumstances some of the lip of the Eustachian tube may be engaged in the fenestrum.

This is a failure in technic which should never occur. When it is certain that the instrument is in proper position, the blade is closed. In hard, somewhat fibrous adenoids, a little force may be required for this; usually, but little is necessary. When the instrument is withdrawn the adenoid will be found in the cage. In the Schütz and Gradle instruments the adenoid may be left above, to be removed with the finger or with an instrument, though it usually happens that when a fragment

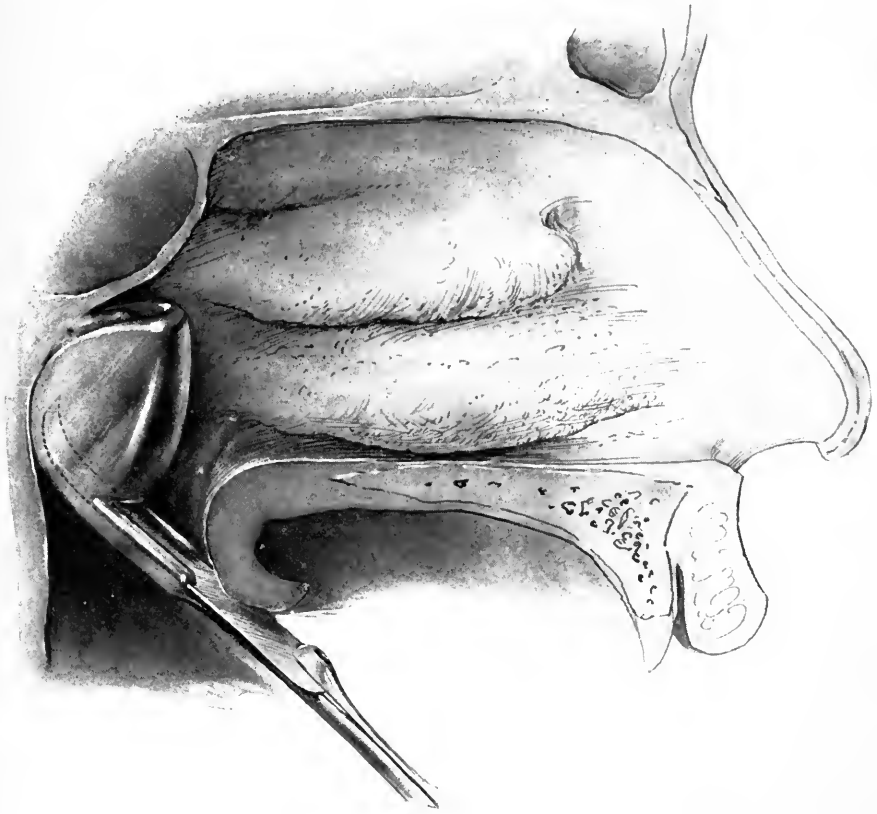


Fig. 646.

Operation with LaForce's adenotome.

is caught by the blade, the adenoid is brought out whole. If examination with the finger shows that a portion of the adenoid is left in any irregularities, removal is effected with curette of Vogel. This will seldom be found necessary, provided that orientation of the entire mass is effected with the finger before the introduction of the adenotome. When the operation is finished, the entire cavity should be left smooth and free from adenoid tissue. When the LaForce instrument of the proper size is used, one introduction is frequently sufficient to clear the

pharynx of the growth. The objection sometimes urged against this method is that no instrument of this type can be made which will conform to every nasopharynx. This point must be conceded, but the orientation already described takes care of this. The principal difficulty in the use of this instrument is that it sometimes fails to get all of the adenoid which is in the superior portion of the vault, and, as already stated, a curette may occasionally be required to remove any remaining portion.

Fig. 647.

Beck's method of bringing the nasopharynx into view.

To bring every portion of the operative field into view Beck introduces one end of a long, soft-rubber catheter into each nostril bringing the ends down into the nasopharynx and thence outward through the mouth where they are held by firm traction in the hands of an assistant. This lifts the soft palate and brings into view the whole or nearly the whole of the field of operation (Fig. 647). The two ends of the catheter are not in the way of the operator. This procedure is adapted to both direct and reflected light, and to any of the methods previously described.

After-treatment.—None is necessary, nor is any other examination necessary. The child should be put to bed for a day or two. Adults require very little after-treatment. The time required for complete healing with the formation of new mucous membrane is about four weeks. Children should be kept from school for a few days.

Recurrence.—The number of observations of the recurrence of adenoids after a thorough removal is sufficient to authenticate the statement that they occasionally recur. That there are such recurrences is in no sense a condemnation of the operation. Adenoids have such a deleterious effect upon the entire development during the growing period that they should be removed even though it were known that a few years later the operation would be required again.

Complications.—As a rule but few accidents occur. Reports have been made of fatal results a few hours after an adenoid operation. No assignable cause is given other than so-called "enlarged thymus." A few cases of death from hemorrhage have also been reported, the death occurring at varying periods from a few hours to several days after the operation. These deaths have been due either to anomalous distribution of blood vessels, or to unforeseen hemophilia. Failure to remove all the adenoid or the leaving of a tag of adenoid may be responsible for secondary hemorrhage. Beck avoids the possibility of hemorrhage by clamping all bleeding points at the time of the operation, using his catheter method for the purpose of bringing the field into view. (Fig. 647.) In the presence of post-operative hemorrhage, the nasopharynx should be firmly packed with sterile gauze, which should be retained for twenty-four hours and the patient put to bed and a sedative given.

Compared, however, with the number of operations, the number of fatal results and of accidents is very small, and is practically negligible.

Acute middle ear inflammation coming on within twenty-four hours after the operation occasionally occurs, due probably to some injury of the orifice of the Eustachian tube during the operation or to infection induced by the operation. This, also, is rare.

Results.—When satisfactorily done, no operation in surgery has more far-reaching beneficial results. The whole character, physical, mental, and moral, of the individual frequently improves.

Mouth-breathing After the Operation.—Mouth-breathing may continue after the operation for the habit, once established, may be difficult to overcome, and a concomitant nasal condition may interfere with nasal respiration. Parents should be instructed to teach proper breathing exercises to the child.

OPERATIVE SURGERY OF THE TONSILS.

Hippocrates, as early as 460 B. C., advised evulsion of the tonsils. Celsus separated large tonsils from the side of the throat with the finger, and tore them out, or drew them inward with a hook, and cut them off. He was probably the originator of finger dissection. That tonsillotomy is one of the oldest of operations is evidenced by the numerous tonsillotomes which were devised when instruments of all kinds were rare. Those shown in Fig. 648 were collected by Friedberg, who made an extensive study of the history of the tonsillotome.

Minor Local Procedures.

Besides ordinary therapeutic agents such as chemical caustics, electrolysis, high-frequency spark, and other topical applications, the following are used in an operative way to reduce the size of the tonsil without removing it: galvanocautery, crypt knives, crypt forceps, and punch forceps.

While their use is opposed by many rhinologists, they nevertheless have their place. There are many cases of tonsillar trouble where, for one reason or another, more radical surgery is contraindicated; furthermore, notwithstanding the indication for a radical procedure the patient or his family may refuse to give consent.

Galvanocautery.—This is serviceable for shrinking the crypts. In fact, the entire tonsil or any part of it may be dissected out after the method of Pynchon. By way of disadvantage, it may be stated that it is difficult to maintain sufficient anesthesia by local application, and even when this is done, there is an undue amount of pain and swelling for a number of days thereafter. In chronic inflammation, with diseased crypts, it may often be used to advantage. The cautery point (and there should be several of these at hand, viz., the straight tip and probe-pointed tip), should be introduced cold, the tonsil being previously well cocainized. Then the current should be turned on and the cautery removed while hot. Sufficient current should be used to bring the electrocautery between red and white heat. This leaves a funnel-shaped cavity with the diseased area destroyed. Healing first takes place at the bottom. The cautery should not be reapplied oftener than once a week. Bleeding primary or secondary is unlikely to occur.

Incision of the Crypts with a Knife.—A hook knife introduced deeply into the crypt, and then withdrawn, opens the crypt widely, and in chronic inflammation of simple or mycotic character, it is a useful measure to precede the introduction of the chemical caustics.

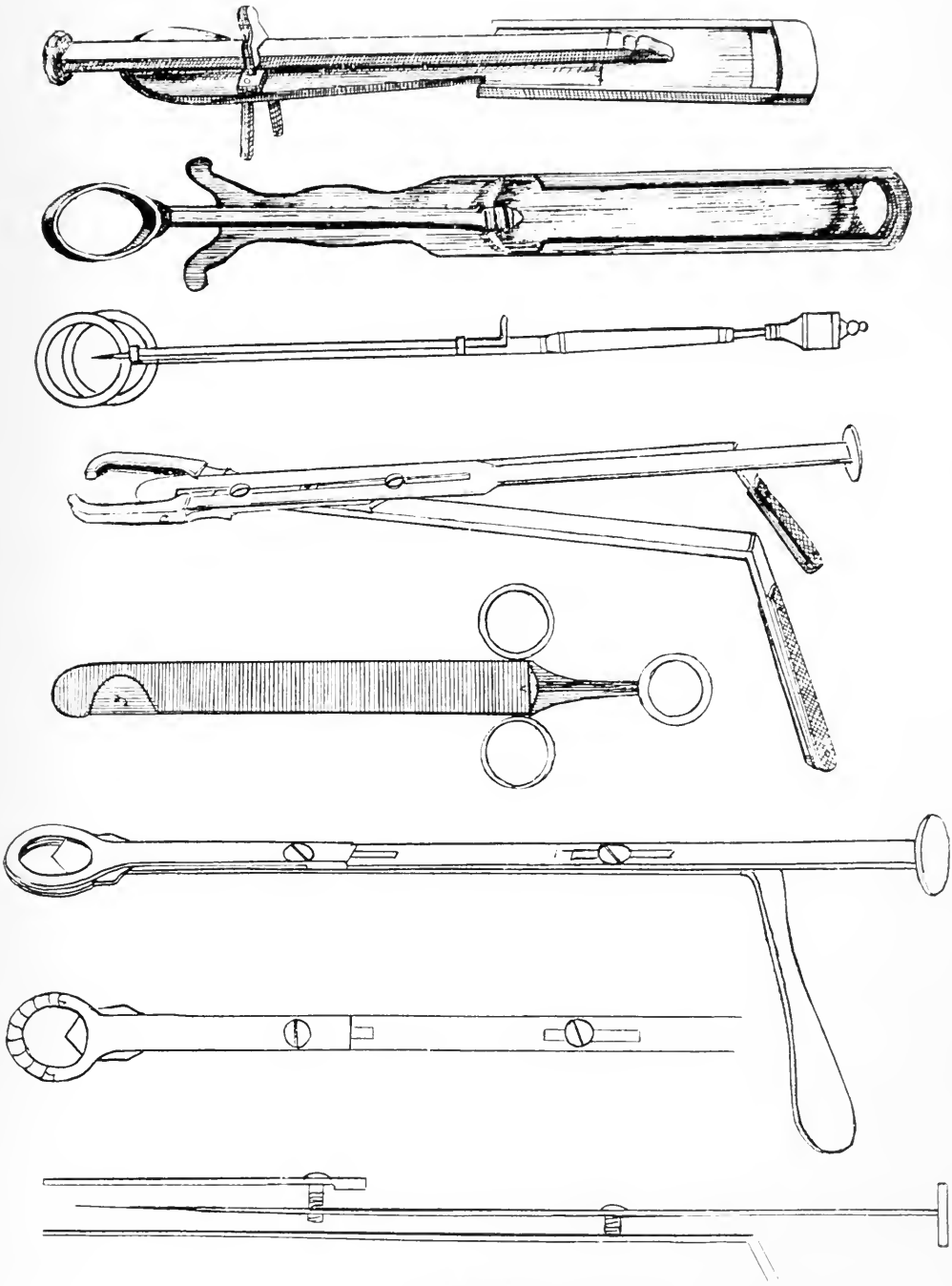


Fig. 648.

Old types of tonsillotomes (Friedberg).

Crypt Forceps.—Where the disease seems localized to one or two crypts, the forceps of the hawk-bill type, one blade being introduced into one crypt, and the other into another, can be used with very little pain, and quite efficiently, both to open the crypt, and to destroy it at the same time. The best forceps of this type are known as Freeman's crypt forceps. This method, although of limited service, is occasionally of value.

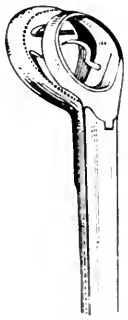


Fig. 649.
Roberts' forceps.

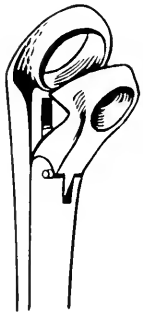


Fig. 650.
Myles' tonsil punch forceps.

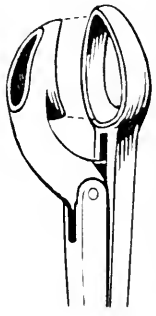


Fig. 651.
Farlow's tonsil punch forceps.

Punch Forceps.—These are of the alligator type, one jaw fitting into the other, and are used to remove any loose bits or tabs of tonsillar tissue, either after the crypt forceps, or after any other procedure. The best instruments of this class are those of Roberts (Fig. 649), Myles (Fig. 650), Farlow (Fig. 651), and Hartmann (Fig. 687).

Removal of Tonsils.

In deciding for or against an operation, and as to whether a tonsil is diseased or not, the technic of the examination of the tonsil is important, and should consist of the following:

1. Examination with the eyes, to determine the form, position relative to the pillars and uvula, size and character of the crypts, condition of the crypts. The patient should be made to gag during this examination. This will often show a tonsil previously considered small and unimportant to be greatly hypertrophied, demanding removal. Many tonsils are almost completely hidden by the anterior pillar.

2. Examination by palpation with the finger, to determine the density and position, and with a hook, to bring the tonsil forward and inward, so as to show the size and relation to the pillars. This examination will often reveal the presence of embedded tonsils and determine the type of operation to be performed.

3. Examination with probe to study the contents of the crypts. A compressed air syringe with fine tip applied to crypts will clean them out, and show debris in a tonsil previously considered to be healthy.

4. Finally, it may be impossible to determine with accuracy from inspection alone whether the individual tonsil is healthy or menacing the organism. In such cases, the decision as to the operation must depend upon the symptom-complex as a whole.

Indications.—The tonsil should be removed for recurrent tonsillar abscess or quinsy; for recurring simple tonsillitis; for benign tumors and new-growths of any kind in the tonsils, when their removal is not prejudicial to life; for diseased crypts with or without hypertrophy, when they do not respond to the milder treatment already described, and whenever there is evidence of septic absorption from the tonsil present; for coexistence of rheumatism or its congeners, arthritis and arthritis deformans, and diseased tonsils, when the rheumatism does not respond to treatment (some brilliant results have followed removal of tonsils in such cases); for enlarged cervical glands of a tubercular nature; for middle-ear disease when enlarged tonsils are present; for mouth-breathing accompanying enlarged tonsils, if the tonsil is apparently at fault. General toxemia, impaired nutrition, some cases of nephritis, systemic dyspnea, and some diseases of septic origin, according to many reports occur with, or as a result of, tonsillar inflammation. In a word, the tonsil should be removed whenever its pathologic condition cannot be cured with treatment, when it obstructs the oral or nasopharyngeal cavities, or when it is directly or indirectly menacing the well-being of the organism in general.

Contraindications.—Unless there are symptoms which are undoubtedly tonsillar in origin, it is desirable not to remove the tonsils in children under five. Recent studies by George Wright have shown that at the periods of the molar tooth eruption, namely, at the ages of two, six, twelve, and seventeen years, the tonsils enlarge somewhat, returning to a normal condition after the complete eruption of these teeth. At this time, Wright regards the enlargement without infection, as a normal expression of the active function of the tonsillar gland.

Hemophilia or any suggestion of it is positive contraindication to tonsillar removal.

The tonsils of children, which are causing no trouble, should not be removed simply because the child is being operated upon for adenoids.

It is better not to remove the tonsils in women and young girls when menstruating, as they are more likely to bleed at that time.

The tonsil should not be operated upon when it is acutely inflamed, or when there is any sore throat. If in doubt as to conditions, bacteriologic examination of the throat should be made before operation, as infection may follow from material in the crypts.

Choice of Operation.—There are two types of operation—tonsillotomy and tonsillectomy.

Tonsillotomy.—By this is meant the removal of a portion of the tonsil, usually of that which projects beyond the anterior and posterior pillars. No attempt is made to remove the entire tonsil with its capsule. Tonsillotomy is the operation of choice on the part of many laryngologists particularly in Europe. In America, however, the great majority prefer tonsillectomy, and some insist that tonsillotomy is not only inadequate, but positively harmful. The amount of tonsil actually removed in tonsillotomy varies with the type of operation, and the technic of the operator. Many shallow, not deeply embedded tonsils are very nearly enucleated by the operation of tonsillotomy, especially if traction on the tonsil, or pressure externally, is made at the moment of removal. At other times, and in fact usually, the major portion of the tonsil remains after the operation.

Tonsillectomy.—By this term is meant the complete removal of the tonsil with its capsule. Tonsillectomy is the operation of choice, especially in America, where it has seen its greatest development. There is abundant evidence that the stump, after tonsillotomy, is as potent for harm as the tonsil before the operation. Hence, it is believed by many operators that if the tonsil is to be removed at all, it is best to remove it *in toto* as its value to the organism when it is diseased seems problematic. Whatever may be its function, it does not seem to be necessary to good health, and its complete removal does not appear in any way to be injurious. With reference to the danger of bleeding, it is probable that, taking all cases recorded to date, the risk can be but little greater after tonsillectomy, although as to this there is some doubt. Nearly all cases of severe bleeding recorded in the literature occurred after tonsillotomy.

Blood Supply of the Tonsil.—Hemorrhage is the one accompaniment of all tonsil operations, which is the source of the principal annoyance and danger, and its possible occurrence should always be in the mind of the operator. Hence, it is advisable to know the location and source of the blood supply of the tonsil. A description of this is given on pages 62 and 63, Vol. I.

Preparation for Operation.—The points common to all methods will be first considered, and then each method will be described in detail.

A radical operation upon the tonsil is important, and therefore, preparations should be made accordingly. A sufficiently thorough general examination should be made to assure knowledge that the heart, lungs, and kidneys are functionating properly, and that there is no reduction in the coagulation power. The bowels should be evacuated, and the patient placed in as good physical condition as possible. In adults, according to the testimony of many observers, calcium lactate, given for three days previous to the operation, seems to lessen the liability of bleeding. Fifteen grain powders are given every four hours.

Local Anesthesia.—The choice of anesthesia depends largely upon whether a tonsillotomy or a tonsillectomy is to be done. For tonsillotomy, local anesthesia may suffice, though in young children it is preferable to induce general anesthesia. A rapid operator, however, using the tonsillotome only, and with good assistants, can do very well without any anesthesia. It is not common on the continent of Europe to anesthetize children for tonsillotomy. In England and America it is customary, as most parents prefer to have the child spared the shock and pain of the operation, even though it be not very great. Adults are frequently operated upon under local anesthesia.

Local anesthesia is attained by a 20 per cent cocain solution painted on the whole area a number of times, or by injection of some one of the following:

a. Cocain gr. i
Adrenalin 1 to 1000 ♏ i
Sterile water ♏ i
♏ i of this in each tonsil.

b. Alypin, a 2 per cent solution, six to eight minims in upper and lower point of tonsil.

c. Novocain tablet each 0.125 gram novocain.
0.000125 suprarenin boric.

Dissolve one tablet in 100 minims of sterile water for a 2 per cent solution. 200 minims of sterile water for 1 per cent solution. In 400 minims of sterile water for 1/2 per cent solution.

A one-half to one per cent solution will usually suffice.

The injection should be made into each pillar, forming the characteristic whitish swelling (Fig. 652), and also into the substance of the tonsil.

The twenty per cent cocain solution applied on a small cotton swab

is sufficient for tonsillotomy; the other formulæ for hypodermic injection give adequate anesthesia for tonsillectomy. Novocain solution is especially to be recommended since it is less toxic than cocain. Adrenalin preparations have the possible disadvantage that, although there is less danger at the time of operation, there may be unexpected bleeding some hours afterward, owing to the subsequent relaxation of the vessels, which follows the primary contraction. The anesthesia, after hypodermic injection, is intensified by waiting ten to fifteen minutes or even longer, before beginning to operate.

Fig. 652.

Method of injecting solutions for anesthetizing the tonsil.

Place of Operation.—In connection with the question of local anesthesia, the place where the operation should be performed comes into consideration. The physician's office or the ordinary out-patient clinic, unless provision be made for the patient to remain several hours, is hardly the proper place for tonsil removal. Too much risk is taken if a patient is operated upon, and allowed to go home at once, even though there may be no apparent bleeding. Patients should be operated upon in the morning, and remain in bed at least until the afternoon. As such patients may not be able to go home, the only proper place to do the operation is at the hospital. In case of operations done in a private

house, a nurse should be left in charge with detailed instruction as to what to do in case of bleeding.

General Anesthesia.—Sometimes used for tonsillotomy, general anesthesia is almost always to be preferred for tonsillectomy. The

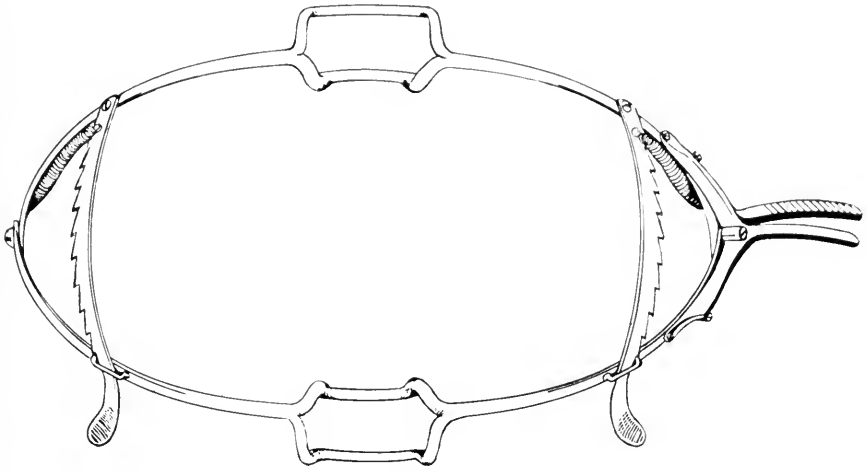


Fig. 653.
Whitehead's mouth-gag.

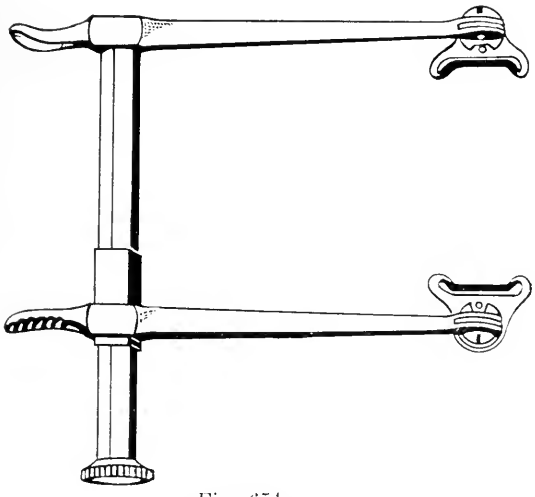


Fig. 654.
Beck's mouth-gag.

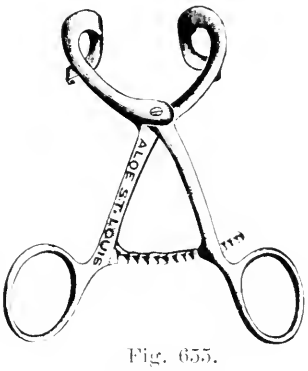


Fig. 655.
Jansen's mouth-gag.

following anesthetics may be employed: ether, chloroform, chlorid of ethyl, A.C.E. mixture, nitrous oxid gas. Of these, nitrous oxid and ether are the safest. Packard has reported three deaths from chloroform that occurred before any attempt at operation had been made.

The anesthesia from ethyl chlorid and nitrous oxid is of too short duration for tonsillectomy except by the rapid method, but long enough for tonsillotomy. Ether may be administered by the cone method, in

Fig. 656.
Pierce's tongue depressor.

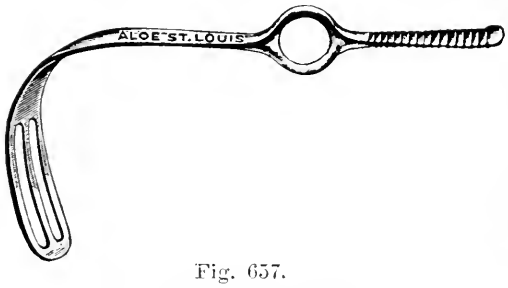


Fig. 657.
Pynchon's tongue depressor.

Fig. 658.
Layman's tongue depressor.

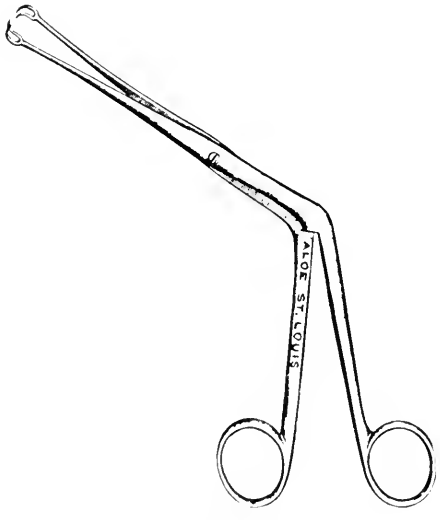


Fig. 659.
Tydings' tonsil forceps.

which case the operator must stop at intervals while the anesthesia is continued, or by one of the double bulb or foot-pump apparatus, whereby the vapor is pumped through a tube, and the tube held at the

corner of the mouth. The latter is more comfortable for the operator, and with a good anesthetizer the anesthesia is sufficient. Primary anesthesia is previously induced with the cone.

Position.—Under local anesthesia the patient sits erect in a chair, or lies on a table in the semirecumbent position, facing good daylight, preferably from the north (avoid sunlight). A forehead mirror may

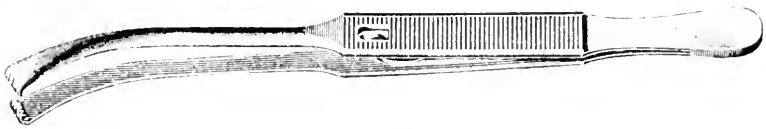


Fig. 660.
Robertson's tonsil forceps.

Fig. 661.
Canfield's tonsil forceps.

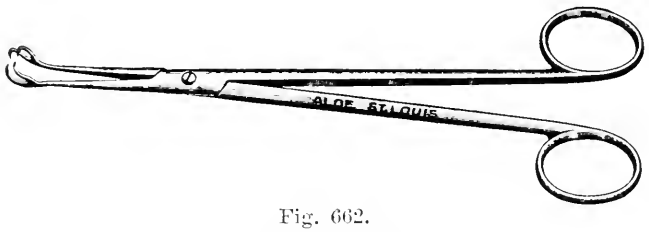


Fig. 662.
Dean's tonsil forceps.

Fig. 663.
Lewis' tonsil screw tenaculum.

be used with ample illumination from a good source. The head is held by an assistant. The technic for the upright position under general anesthesia is the same as for local anesthesia. The patient is anesthetized, with ether only, on the table or in bed, and is then put into the operating chair or brought into a sitting or semirecumbent position as desired. The advantage of this position is that all parts are seen in their usual relations. The disadvantage is the danger of blood

getting into the larynx, or that more blood is swallowed than is known. The anesthesia should not be profound enough to abolish the pharyngeal reflexes. The writer believes that the upright position is equally as safe as the recumbent position. Most operators, however, prefer some form of the recumbent position, and that position should be chosen which will be most comfortable for the operator, with the least risk to the patient.

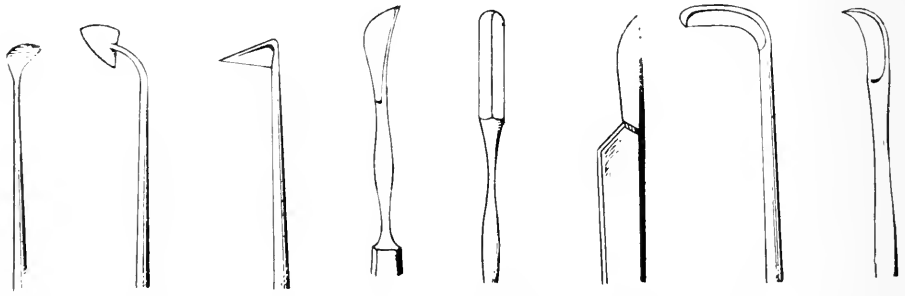


Fig. 664. Fig. 665. Fig. 666. Fig. 667. Fig. 668. Fig. 669. Fig. 670. Fig. 671.

Fig. 664.—Pierce's tonsil knife.
Fig. 665.—Stuckey's tonsil dissector.
Fig. 666.—Kyle's tonsil knife.
Fig. 667.—Beck's tonsil bistoury.
Fig. 668.—Dean's double edge tonsil knife.
Fig. 669.—Ballenger's tonsil knife.
Fig. 670.—Killian's tonsil knife.
Fig. 671.—Canfield's tonsil knife.

Fig. 672.

Robertson's double edge tonsil knife.

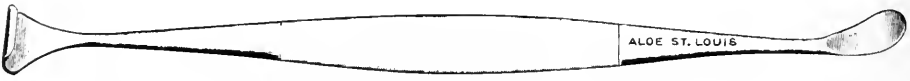


Fig. 673.

Hurd's tonsil dissector and pillar refractor.

Fig. 674.

Harris' knife and blunt dissector.

While there are many variations of the recumbent position preferred by various operators, they all resolve themselves into three, with such modifications as the operator may desire.

1. Patient on the side, right or left, corresponding arm crooked beneath the body, leg semi-flexed, sand bag or assistant behind to maintain the position. The operator sits on a stool, and uses direct

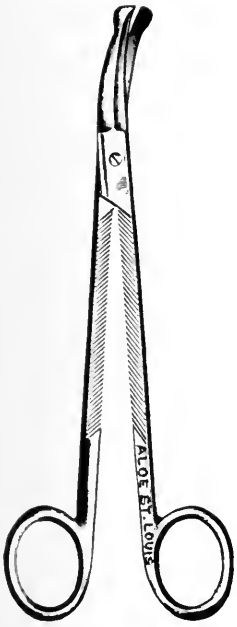


Fig. 675.
Good's tonsil scissors.

Fig. 676.
Metzenbaum's tonsil scissors.

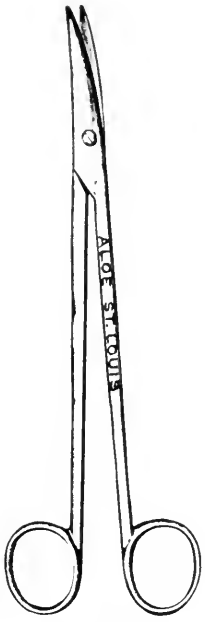


Fig. 677.
Maclay's tonsil scissors.

Fig. 678.
Yankauer's tonsil scissors.

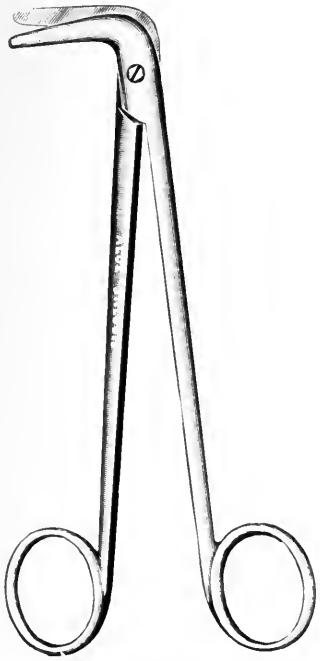


Fig. 679.
Murphy's tonsil scissors.

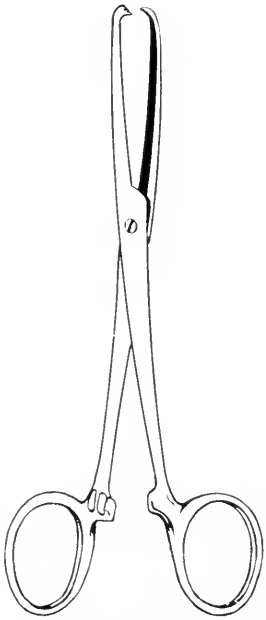


Fig. 680.
Tuffier's pillar grasping forceps.

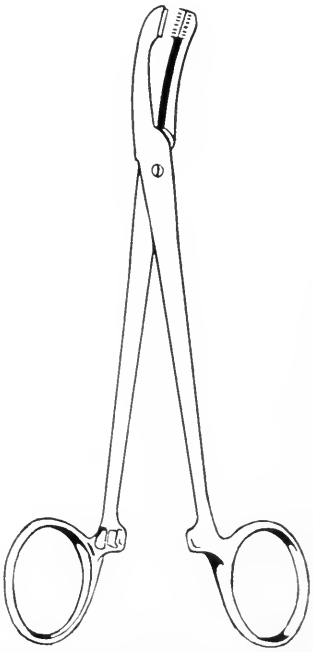


Fig. 681.
Beck's tonsil angiotribe.

daylight or reflects light directly into the patient's mouth. The lower tonsil is operated upon first.

2. Patient on back, head lying over end of table. Operator sits on stool directly in front of patient, or stands above. The tonsil being lower than the entrance of the esophagus or larynx, blood is less likely to enter either of these. Good light, either direct or reflected into the mouth is necessary.

3. Patient on the back, operator standing at the side of the patient, light reflected directly into the pharynx.

Instrumentarium.—For simple tonsillotomy; mouth gag, tongue

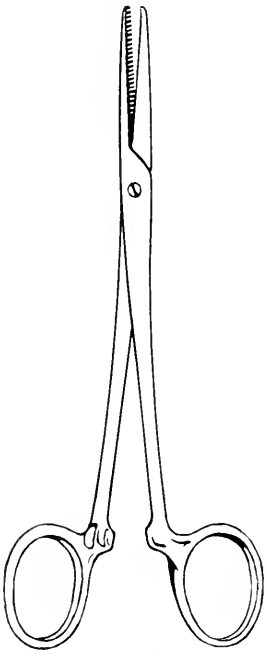


Fig. 682.
Jackson's tonsil artery forceps.

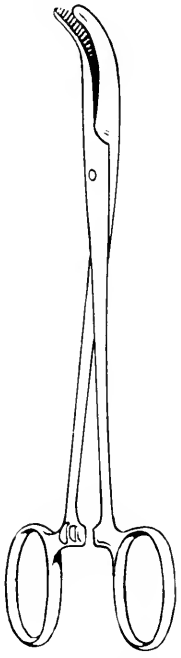


Fig. 683.
Dean's hemostat.

depressor, tonsillotome, gauze holders and a pair of grasping forceps are all that is necessary.

For tonsillectomy, all of the following instruments have been mentioned: mouth gag, tongue depressor, grasping forceps, separators, cutting instruments, scissors, snares, tonsillotomes, knives curved and straight, and punches, of each of which there are many patterns. (Figs. 653 to 689.)

Suction Apparatus.—To remove the blood from the operative field, several types of suction apparatus have been recommended. In essence, they are all the same, securing suction either by means of an electric

pump, or by means of a Woulff bottle connected by rubber tube to a spigot or tap. The tube leading to the Woulff bottle is joined by a three-way connection to two soft rubber catheters, one of which is

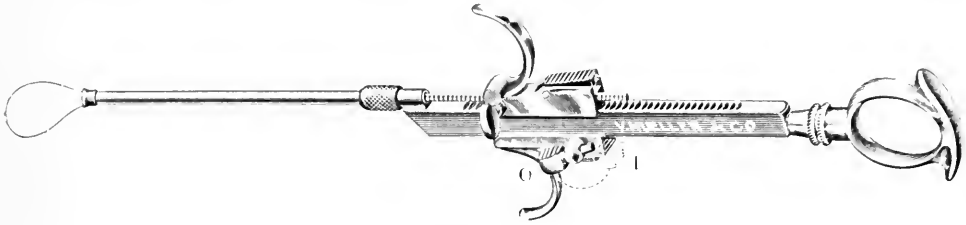


Fig. 684.

Pierce-Mueller tonsil snare.

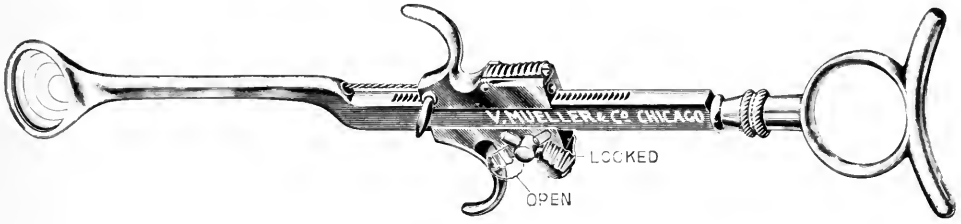


Fig. 685.

Beck-Mueller tonsil snare.

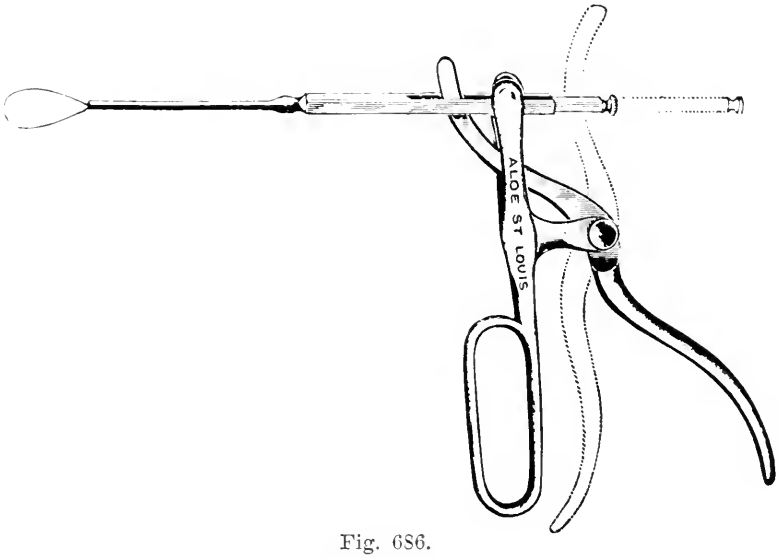


Fig. 686.

Tydings' tonsil snare.

passed through each nostril to the nasopharynx, while the patient lies on the side or with his head hanging over the end of the table. The blood will be sucked out as fast as it accumulates. Beck's instrument (Fig. 716) is a particularly serviceable one in this respect.

Tonsillotomy.

If only the hypertrophied portion beyond the pillars is to be removed, the ring of Mackenzie (Fig. 690), the Mathieu tonsillotome (Fig. 691), or some other type is applied from below upwards, while

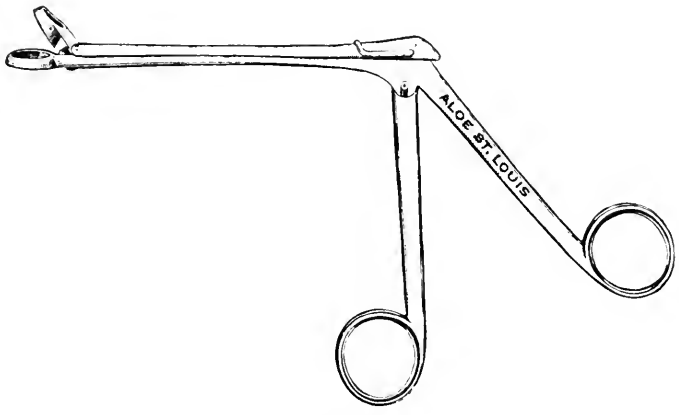


Fig. 687.
Hartmann's tonsil punch.

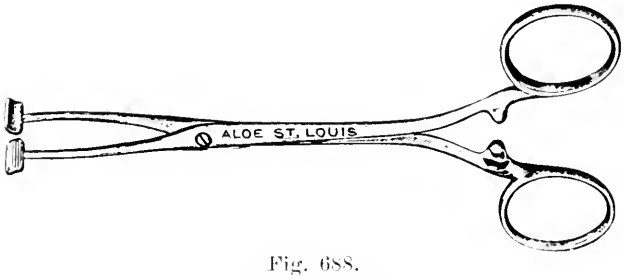


Fig. 688.
Bergeron pillar forceps.

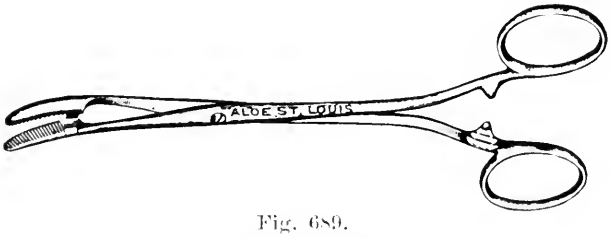


Fig. 689.
Murphy's artery forceps.

an assistant presses gently inward, with little force, at the angle of the jaw. The knife is then pushed home, or the cut is made with the ring knife. The same procedure is repeated on the other side.

If a tonsillotome of the Mackenzie or Mathieu type with forks, or Casselberry's, is used and also a pair of grasping forceps, an approach to a tonsillectomy is made.

Another method is as follows: The tonsil is seized with a pair of

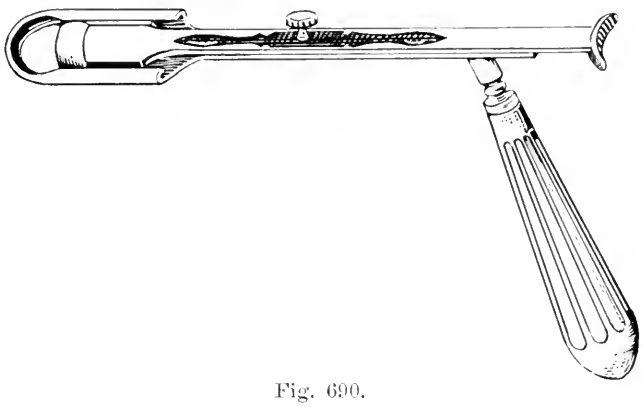


Fig. 690.

Mackenzie's tonsillotome.

grasping forceps. There are many models, several forms of which are illustrated. If the author's grasping forceps (Fig. 692) are used, the ring of the instrument is placed over the forceps and pressed firmly against the tonsil. At the same time traction is made and the tissue cut.

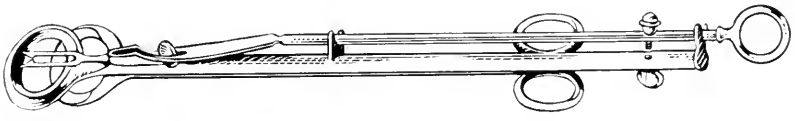


Fig. 691.

Mathieu's tonsillotome.

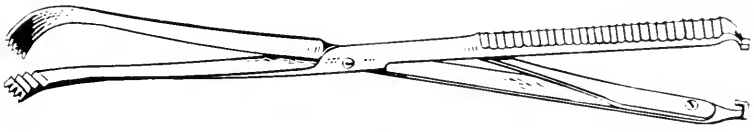


Fig. 692.

Richards' tonsil forceps.

The same plan is followed on the other side. Examination should be carefully made for bleeding vessels which should be treated as described later. If any considerable portion of the tonsil remains, which it is desired to remove, the tonsil punch may be used and the remnants punched out.

Snare Operation.—The cold or galvanocautery snare may be used. In this operation, the tonsil is pulled by grasping forceps through the snare which is made to excise the encircled portion by forcing the wire through the tissue in the first instance and by burning its way through in the second. The types of snares used are those of Farlow (Fig. 693), Tydings (Fig. 686), Pierce (Fig. 684), Loeb (Fig. 694), Knight (Fig. 695), and Beck (Fig. 685).

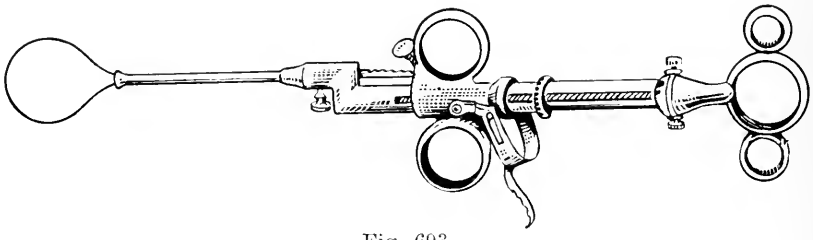


Fig. 693.
Farlow's tonsil snare.

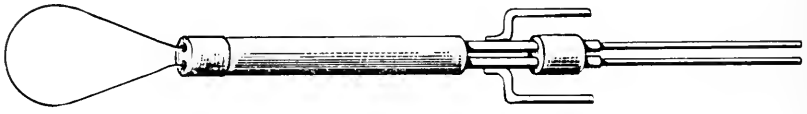


Fig. 694.
Loeb's galvanocautery tonsil snare.

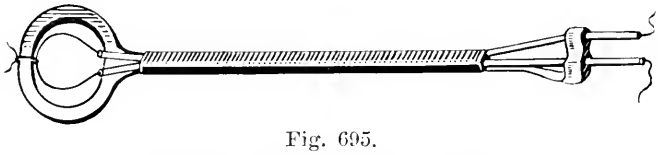


Fig. 695.
Knight's galvanocautery tonsil snare.

Tonsillectomy.

Here the essential part of the operation is to remove the entire tonsil with its capsule. This requires first the division of the attachments of the outer capsule surface and inner mucous surface of the tonsil to the border of the anterior pillar, which divides at this point into two layers, a posterior one continuous with the capsule of the tonsil, and an anterior one continuous with the mucous membrane of the tonsil surface. The free mucous portion of this, with probably a few muscle fibers, forms the so-called plica tonsillaris when folded over the front of the tonsil, usually below, sometimes above. A similar sort of

attachment holds the tonsil to the posterior pillar, and to the superior border where the two pillars meet. When this separation has been made all around, i. e., superiorly and posteriorly as well as anteriorly, the tonsil, with capsule intact, can be detached from the fibrous fascia by which it is held to the inner border of the superior constrictor muscle. Some of the fibers of this muscle run into the capsule, and occasionally a small bit of muscle tissue may be seen attached to the capsule. In other cases, the capsule can be separated without apparently removing a single muscle fiber.

To accomplish this separation from the pillars, some form of dissecting instrument, sharp or blunt, is required. These are very numerous, consisting of knife, scissors, and blunt dissectors of various shapes. The tonsil is grasped with a good vulsellum forceps, and traction is made. This stretches the tonsil and brings out the line of the border. The knife or dissector frees the tonsil from the supratonsillar fossa, being entered, about one-third of the way from the superior portion of the tonsil. The limits of the tonsil are followed by the dissector while traction is being made, enabling the operator to shell out the tonsil from the anterior and posterior pillars, and supratonsillar space, and then by continued traction, to remove it entirely from its attachments, except at the lowermost portion. Traction is increased, and the tonsil nearly free and lying on the base of the tongue is detached with the tonsillotome, scissors, or snare. For the final removal, a very dull tonsillotome or the snare is to be employed. The snare is often recommended because of lessened liability to hemorrhage, though it is not certain that it deserves this excellent reputation. It has another advantage, however, which is very definite, namely this, that when it is applied to the partially enucleated tonsil it tends to follow down the surface of the tonsil capsule, and to remove it more cleanly from its bed than does the tonsillotome. The latter will cut through any resistant portion rather than follow its irregularities. There are many types of snare. They should be made very strong, should carry No. 7 wire and have both simple draw closure and a good strong screw movement, preferably managed from the handle. Farlow's (Fig. 693) and Pierce's (Fig. 684) are good types.

Tydings' snare (Fig. 686), in which the wire is carried on the inside of a fenestrum (several sizes being provided), is worked with a powerful lever action and is very serviceable. It has the disadvantage that the removal cannot be as slowly graduated as in snares of the Farlow type.

The hot wire galvanocautery snare is not recommended.

Tonsillectomy by Finger Dissection.—Enucleation of the tonsil

with the finger, has, within the last few years, been revived by many operators, most of whom worked it out as a sort of independent method. It is, however, one of the oldest operations in surgery.

Celsus, in the tenth year of our era, described finger dissection in the following language: "Tonsils which remain indurated after inflammation, if covered by a thin membrane, should be loosened by working the finger round them, and then torn out; but when this is not practicable, they should be seized with a hook, and excised with a scalpel."

Borelli, an Italian surgeon of Sardinia, described his revival of the method of Celsus; namely, "The index-finger is placed behind the summit of the gland, and by working from above downward with the nail and making traction, the tonsil is detached from its bed. A small piece which does not afford sufficient purchase to the finger, in order to be torn away, is generally left at the inferior part. This is seized with the forceps, and separated by a slight movement of torsion."

The following is the usual technic:

First, the entire tonsil is oriented with the finger, which may be bare or covered with a glove or double finger cot. The glove is worn as much for the protection of the operator, as of the patient, and does not materially interfere with the use of the finger, though the initial separation is made more easily with the bare finger. The finger, palm outward, is carried to a point near the junction of the middle and upper third of the anterior pillar and at the point of its attachment to the tonsil (Fig. 696), and an endeavor is made to penetrate the point of attachment. In by far the majority of cases this is readily done, only a small amount of force being required. As soon as a penetration occurs, the finger is felt to be in a space and between the tonsil capsule and the muscle. The finger is now carried upward into the supratonsillar space, and the separation of the tonsil effected. It is then carried downward in front, in the same way, then backward, separating the tonsil from the posterior pillar from above downward. (Fig 697.) The attachments give way under gentle force, until the whole tonsil is separated, except at its base. (Fig. 698.) If the initial separation is not easily obtained, knife or scissors must be used as in other operations. The tonsil now lies on the base of the tongue. It is then grasped by the forceps, drawn forward (Fig. 699), and the detaching instrument, tonsillotome or snare, passed over the forceps and the tonsil, when the separation is readily made. In general, it may be stated, that the finger operation while successful in the hands of those accustomed to it, has been practically superseded by the other operations described as these are less likely to produce trauma.

Fig. 696.

Beginning the finger dissection of the tonsil.

Fig. 697.

Finger dissection of the tonsil. Separating the tonsil from the two pillars.

Fig. 698.

Finger dissection of the tonsil. End of finger dissection.

Fig. 699.

Finger dissection of the tonsil. Tonsil grasped by forceps ready for the removal by snare or tonsillotome.

Difficulties may arise when the tonsil is adherent following repeated attacks of inflammation, making it almost impossible to separate the capsular surface from the superior constrictor muscle. Under

Fig. 700.

Loeb's method of tonsil dissection; point of entry of knife.

Fig. 701.

Loeb's method; knife carried upward between the anterior pillar and the tonsil.

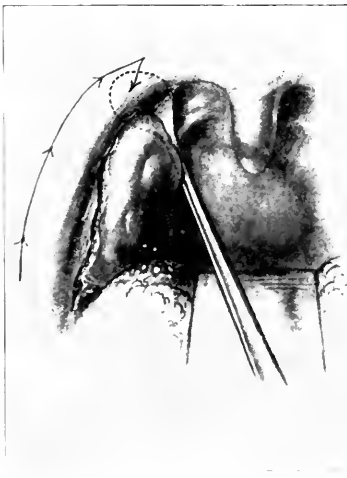


Fig. 702.

Loeb's method; knife turned to separate the tonsil from the posterior pillar.

Fig. 703.

Loeb's method; completing the dissection.

such circumstances scissors or knife should be used for the initial separation rather than to exercise too much force with the finger. The pillars should not be injured.

Yankauer's Method.—Yankauer divides the plica triangularis at its junction with the anterior pillar, after freeing the upper part of the tonsil, using an ordinary pair of surgical scissors curved on the flat. (Fig. 678.) This is done because after dissection of the plica, the tonsil becomes freely movable, so that if downward traction is made upon it, the entire organ can be pulled down from its place of concealment in the velum of the soft palate, even when the velar lobe is quite large.

Loeb's Method.—This has for its essential feature, the separation of the tonsil and the anterior pillar from below upward. A Pierce knife is introduced between the tonsil and the anterior pillar where it is attached to the tongue. (Fig. 700.) The tonsil is never adherent at this place which can readily be found by depressing the tongue. The knife with horizontal portion outward is carried between the tonsil and anterior pillar (Fig. 701) from below upwards until the upper pole is reached when the knife is turned (Fig. 702) and the posterior separation completed in a similar way (Fig. 703). The capsule is then grasped, traction is made medially on the tonsil and whatever additional dissection may be necessary is then made. The snare is then employed in the usual way.

Sluder's Method of Tonsillectomy.—Sluder has revised the employment of the tonsillotome as an instrument for tonsillectomy, using for the complete removal of the tonsil a single instrument, the Physick guillotine, modified by him to give it strength and leverage. The technic is based on the anatomic point, that the alveolus of the jaw always ends in a well marked eminence extending upward to the mylohyoid line, the alveolar eminence of the mandible. This formation varies at different ages, and knowledge of this variation is desirable. The tonsil lies posterior to, and for the most part below, this eminence, and is much more prominent in the young, than in adults.

The guillotine is introduced into the mouth from the opposite side, holding the handle somewhat downward toward the feet, and placed so that its ring sets behind and below the tonsil (Fig. 704). The entire instrument is first pressed firmly outward, until its ring meets the resistance of the ramus of the jaw, or the contracted internal pterygoid muscle. The handle is then raised slightly and rotated so that the ring includes the upper part of the tonsil. In this position the instrument is drawn forward and upward. The ring acts very much like a scoop, securing the tonsil from below and behind, and bringing it to the alveolar eminence. The handle is now carried toward the median line. This movement applies the ring to the eminence in such a way that the latter acts as a finger tip stuffing the tonsil through the ring, or the ring of the guillotine may be firmly held

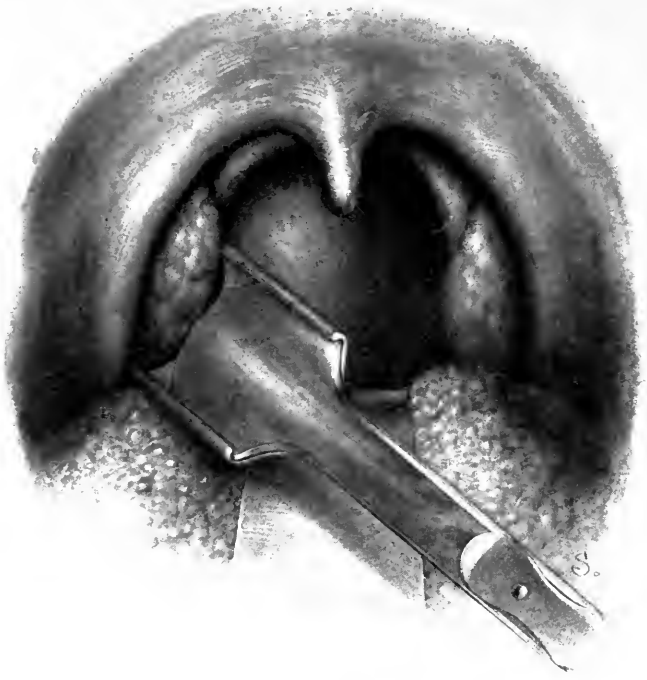


Fig. 704.

Sluder's method: application of the tonsillotome below and behind the tonsil.

Fig. 705.

Sluder's method: pushing the tonsil through the ring.

upon the eminence after the instrument with the included tonsil has been drawn upward and forward. The tip of the index finger of the other hand is now placed in front of the plica triangularis, and is used to push or to stroke the unengaged tonsil mass through the ring. (Fig. 705.) At the same time that the tonsil is being put through the ring, the blade is gently pushed, so as to partly engage the tonsil. The tonsil is now gently pushed through the ring by the finger tip, and the blade slowly and completely closed. (Fig. 706.) The final judgment as to whether the tonsil is completely within reach of the instrument is attained by drawing the handle upward. This opens the

Fig. 706.

Sluder's method; tonsil completely within the ring.

field of operation. The finger tip is passed over the distal arc of the closed ring which is holding the tonsil like a pair of forceps. If the entire tonsil has gone through, the ring will be felt smooth and hard, under what seems to be a thick membrane. If there is still a portion of the tonsil remaining it can almost always be felt under the membrane as a hard irregular lump by passing the finger tip gently over the distal arc. If the position is right, the instrument is now completely closed by pushing the blade. In order to permit the use of a duller blade, with the strength of an ordinary man's hand, Sluder has attached a mechanic's "dog" to the original guillotine (Fig. 707) and

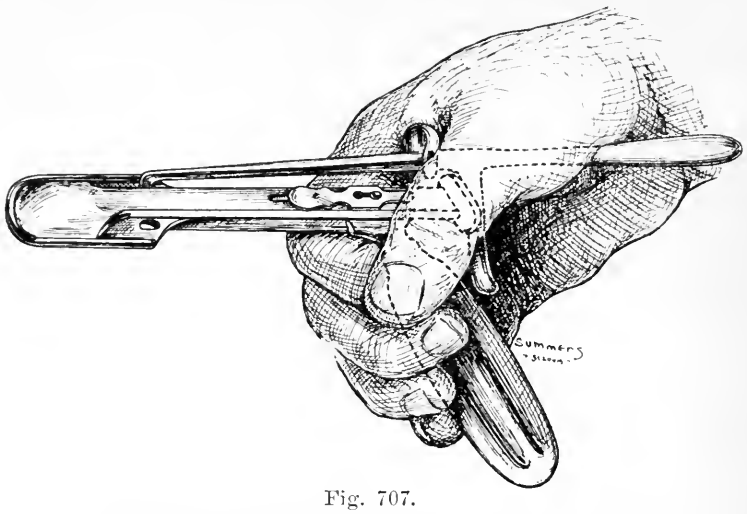


Fig. 707.

Sluder's method showing use of the mechanic dog.

Fig. 708.

Stripping the tonsil away by pressure around the ring.

this furnishes unusual power. If the blade be sharp it will not follow the connective tissue bed, but will cut off any irregularity on the capsule side of the tonsil. If it be too dull, the tonsil will sometimes slip out from under the grasp of the blade despite all the care the surgeon may exercise. If it be merely quite dull, without being blunt, it follows the loose connective tissue bed, and holds the tonsil fast in its grasp. A recently introduced plan for removing the tonsil after it has been pushed completely through the ring of the tonsillotome is to detach the tonsil by the pressure of the index finger directed around the ring of the instrument. (Fig. 708.) This obviates the necessity of any great force to excise the tonsil.

Modifications of Sluder's Method.—Beck has introduced several new features which have been accepted by many followers. He passes a long catheter through both nostrils into the pharynx and draws the ends through the mouth. In this way he can pull the palate forward.

The tonsils are removed by the Sluder method with the Beck snare (Fig. 709), after which the cavity made by the removal of the tonsil is filled with gauze (Fig. 710) and the anterior pillar sutured to the posterior pillar, causing an entire cessation of hemorrhage. The stitches and the plugs are removed on the following day. The catheter by its traction on the palate makes it possible to keep the field of operation constantly in good view and the snare has an advantage over the knife in that hemorrhage is less and in that only the tonsil with the capsule will be removed.

Makuen of Philadelphia has recently described an operation which in theory would seem to be an ideal tonsil operation. As described by Makuen it is essentially a modification of the Sluder operation. The tonsil is forced into the ring of the Sluder instrument in the same manner as though the complete Sluder operation were to be performed. The knife is pressed down in the same way, but is not made to go through at the point of attachment of the capsule and the external fibrous tissue. While this instrument is still in position a snare is placed around the partially removed tonsil, and the snare then tightened and the tonsil separated. The Sluder instrument is then released and removed. This results in a splitting of the capsule, a proposition which at first sight would seem to be impossible, but when one recalls what has already been done, namely, that by the first portion of the operation the capsule has been compressed and partly purse-strung, it is evident that it would be possible by a snare in close proximity to this purse-strung capsule to split it in such a way that one layer of the capsule is attached to the tonsil while a portion of the capsule still remains *in situ* as a protection to the lymphatic area, the superior con-

strictor muscle and the anterior and posterior pillars. Lynch of New Orleans has still further modified this procedure and in the opinion of the writer advantageously. He pushes the tonsil into the ring of the Beck-Mueller snare in the same way as in the operation of Beck just described, tightens the snare so as to grip the capsule external to the tonsil in the same manner as does Makuen with the Sluder instrument. The snare is then applied on the uvula side of the tonsil as just de-

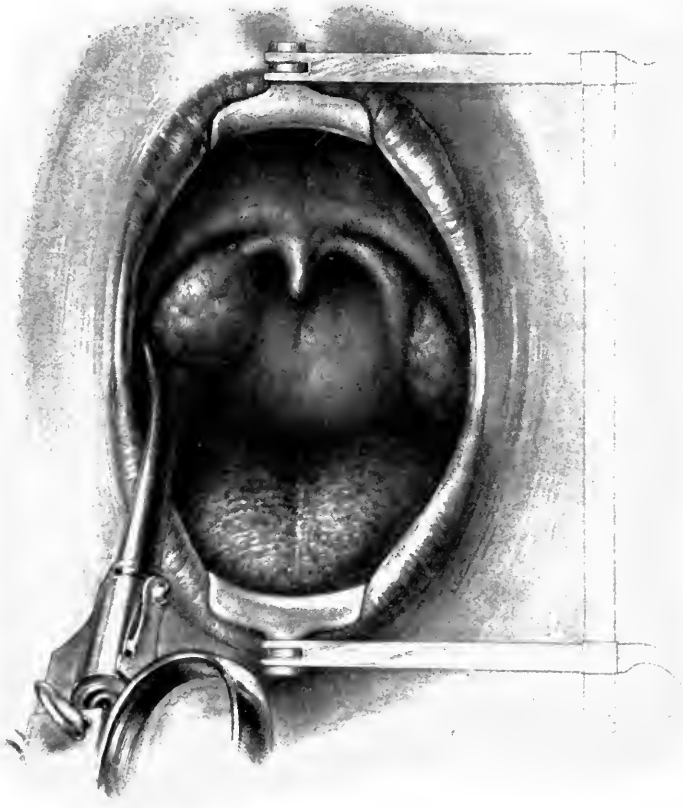


Fig. 709.

Beck's method of removing the tonsil.

scribed, the tonsil is detached with the second snare and the first snare released. The great advantage of this procedure is that in the application of the first instrument the tonsillar vessels are so far compressed that when the final detachment occurs, there is in many cases absolutely no bleeding and in no case more than a few drops. Contrary to the application of the Sluder instrument the Beck snare is applied from behind forwards, and if this is carefully done there is no possibility of injury to either pillar or to the apex of the tonsillar

ring, for what is left are two folded-in pillars, two mucous surfaces rather than raw surfaces facing each other. Should any little piece of tonsil tissue remain after the removal of the first snare it is easily cut off with the scissors. As a rule the capsule will appear noticeably blanched, due to the compression from the snare. This operation cannot be done as rapidly as many of the preceding which have been described, but it is ideal, for it corresponds in every feature to the essen-

Fig. 710.

Beck's method, showing the bed of one tonsil filled with gauze and the palate pulled forward ready for suturing.

tial requirement of a satisfactory tonsil operation, namely, complete removal of the tonsil with a thin layer of capsule, pillars uninjured with folded over edges and with free mucous borders, a minimum amount of trauma, no hemorrhage, no scar tissue, quick recovery, practically no sore throat even in the case of adults. Cutting from behind forward seems to the writer preferable to the use of the Sluder instrument which cuts from before backward, with some liability of engaging a portion of the anterior pillar, especially at its inferior bor-

der. For this operation to be satisfactorily performed the compressed air ether apparatus and suction apparatus are essential, the first keeping the ether entirely out of the operator's way, and the second taking care of the discharges which are liable to accumulate in the throat. In performing this operation or any of its modifications, care must be taken not to injure the palatine arch by too forcible application of the finger when pushing the tonsil into the ring of the instrument, and also not to catch the uvula in the snare.

Sauer has modified Sluder's tonsillotome by using a dull blade, which is forced through the tonsil by means of a screw which is easily manipulated. (Fig. 711.)

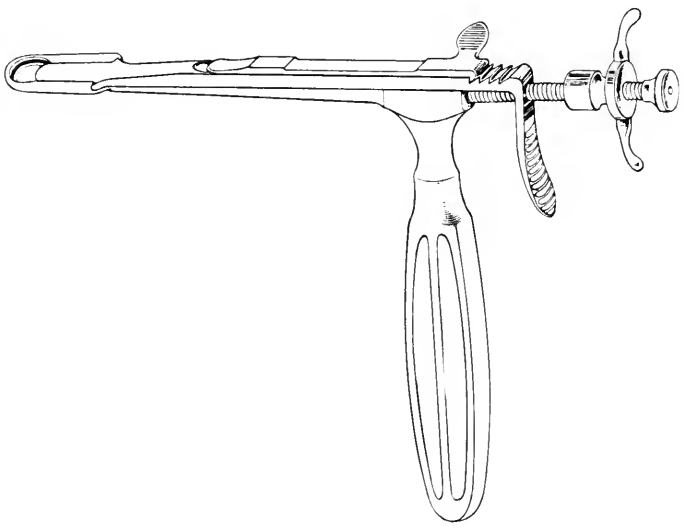


Fig. 711.
Sauer's tonsillectome.

Ingersoll's Method.—Ether is used for the anesthesia, and enough is given to relax completely the muscles of the jaws. Then a self-retaining mouth gag (Whitehead's) is placed in the patient's mouth, and the patient is moved along on the table so that the head hangs over the end. One assistant sits on the left and holds the head firmly with both hands, turning it slightly to the patient's left side when the left tonsil is being operated upon, and vice versa for the right tonsil.

A second assistant stands on the patient's right side, holds the tongue depressor with his left hand, and sponges with his right. A fairly broad, flat tongue depressor is used, its distal end being bent downward slightly so that it can be hooked down back of the tongue,

and thus pull the tongue forward as well as depress it. The operator sits at the end of the table with the patient's head directly in front of him, so that the relative position of each tonsil is the same. If daylight is used, the operator's head should be toward the window.

One tonsil is grasped with a pair of forceps, and pulled forward and inward toward the median line. Then the mucous membrane over the superior part of the tonsil, just in front of the anterior pillar is cut with a pair of scissors.

This primary incision is made through the mucous membrane only. When the incision extends down into the tonsillar tissue, the tonsil itself is more liable to tear, and the dissection becomes difficult, or almost impossible. Usually the glistening capsule of the tonsil can be seen through the primary incision. A blunt dissector is inserted behind the capsule, and the velar lobe of the tonsil is freed from its attachment to the anterior and posterior pillars, and the surrounding tissue. If the blunt dissector does not separate the tonsil from the surrounding tissue when moderate force is used, the firmer attachments are severed with the scissors. In this way, the tonsil with its capsule is dissected entirely free from the anterior and posterior pillars and from its attachments superiorly and somewhat inferiorly.

When the dissection is complete, the tonsil should be so free that it can be easily drawn out beyond the faucial pillars.

The wire loop of a Tydings' snare is placed over the tonsil, which is then grasped with the forceps, one blade in the supratonsillar fossa, and the other in the inferior part of the tonsil, and pulled forward so that the whole tonsil extends through the loop, caution being used to see that the uvula is not caught in the snare. The snare is closed slowly, as it naturally follows the line of least resistance, namely, the attachment of the capsule to the surrounding tissue, and the tonsil with its capsule is shelled out from the tonsillar fossa.

A gauze sponge is then packed into the fossa, and held in position for two or three minutes by firm pressure with the index finger or forceps while more anesthetic is being given if it is needed. This firm pressure usually stops the bleeding, and when the sponge is removed the fossa is carefully inspected. If there are any bleeding points, they are grasped with ordinary hemostats, and twisted. If an artery large enough to spurt has been cut, it is grasped and a buried catgut ligature is passed around it, and tied tightly. Unless the ligature is anchored in the tissue around the artery, it is liable to slip off, and cause secondary hemorrhage.

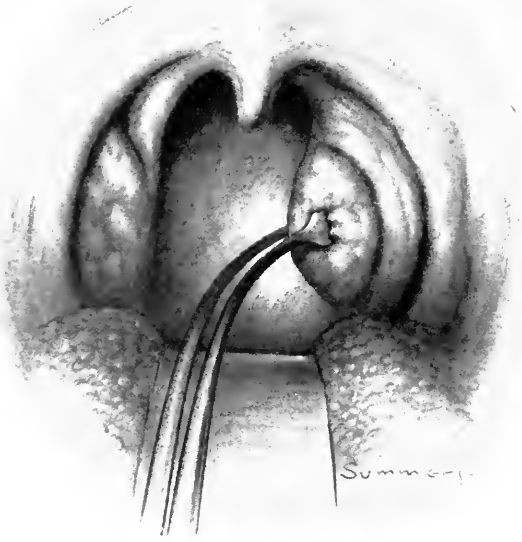


Fig. 712.

Boston method; grasping the tonsil with forceps.

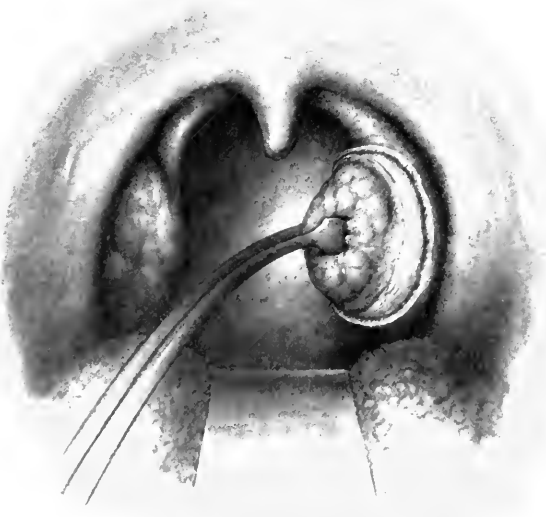


Fig. 713.

Boston method; incision down to the capsule.

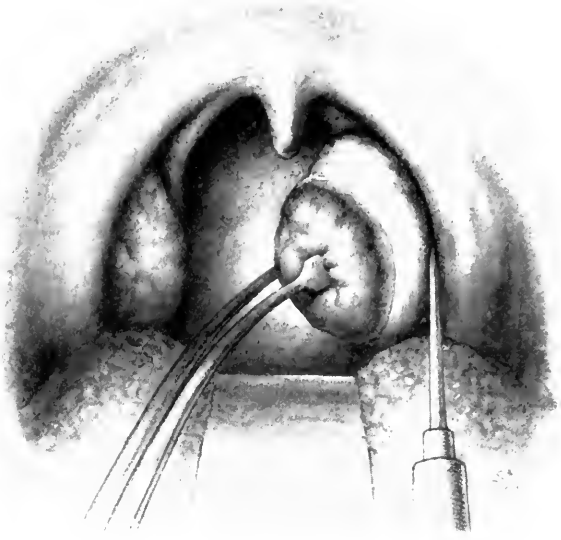


Fig. 714.
Boston method; dissection completed.

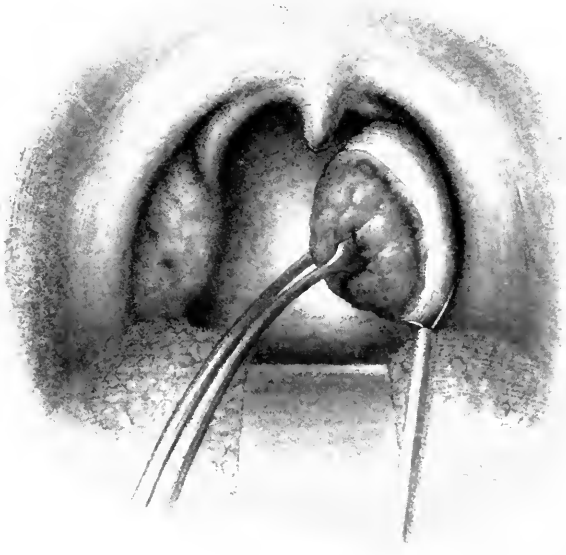


Fig. 715.
Boston method; application of the snare.

The Method in Common Use in the Boston Hospitals; Ether Anesthesia; Erect Position.*—A good hold is taken of the tonsil with tonsil forceps (Fig. 712), and it is drawn out into the throat, so that a good view of the contour is obtained. An incision is then made close to the margin of the anterior pillar (Fig. 713), or from the plica down to the capsule of the tonsil, cutting through the anterior pillar being avoided.

The capsule being reached, it is dissected free from all fibers of connective tissue. When this has been done, a scalpel or blunt-pointed knife is swung over the top of the tonsil to the posterior pillar a short distance down along the margin of the pillar. In the same way, the scalpel is brought from the original incision down close to the base of the tonsil, along the anterior pillar. (Fig. 714.)

It will now be found that the tonsil is almost entirely free, and no further dissection with a blunt dissector or fingering will be necessary.

The snare is next applied. (Fig. 715.) The only precaution to be taken is to see that the mucous membrane above the tonsil, which is freely movable, is not engaged in the snare loop. As the essential cut is made with a sharp knife, there is no bruising and mauling of the tissues.

West's Method.—West dissects the tonsils from the posterior pillar with a right-angled knife, makes a circular cut around the tonsil through the mucous membrane, using traction while cutting with a knife through the loose tissue connecting the capsule to the fascia of the superior constrictor muscle, and thus completes the enucleation. He begins posteriorly, as he finds the hemorrhage is lessened by this method.

The essential principle of all operations is the same, and any method which frees the tonsil, with the minimum of trauma, and without injuring the pillars, is a good one.

Dissection with Scissors.—Quite a few operators prefer the plan of using scissors of various angles and curves to dissect the tonsil from its palatal bed. It may be said that in the hands of those skilled in this method the results are most satisfactory.

Galvanocautery Dissection. (After the manner of Pynchon.)—This is one of the earliest methods of enucleation, but is now seldom used, and is not recommended, on account of the pain and discomfort which follow the operation, though Pynchon says that the degree of soreness may be no less when cutting instruments are used. The soreness is greater in adults, and in men than in children and women. Only

*Description furnished by Dr. Chandler Robbins.

one tonsil is operated upon at a time; anesthesia is obtained by submucous injections, with a weak solution of cocain. A very clean dissection is made by the galvanocautery point, traction on the tonsil being maintained at the same time. The resultant wound is free and open.

Complications.—Hemorrhage.—Provision must be made for hemorrhage which occasionally occurs. In doing tonsillectomy, the second tonsil, should not be operated upon until the bleeding has partially ceased from the first one. However, many operators using the Sluder method find it just as satisfactory to remove both tonsils be-

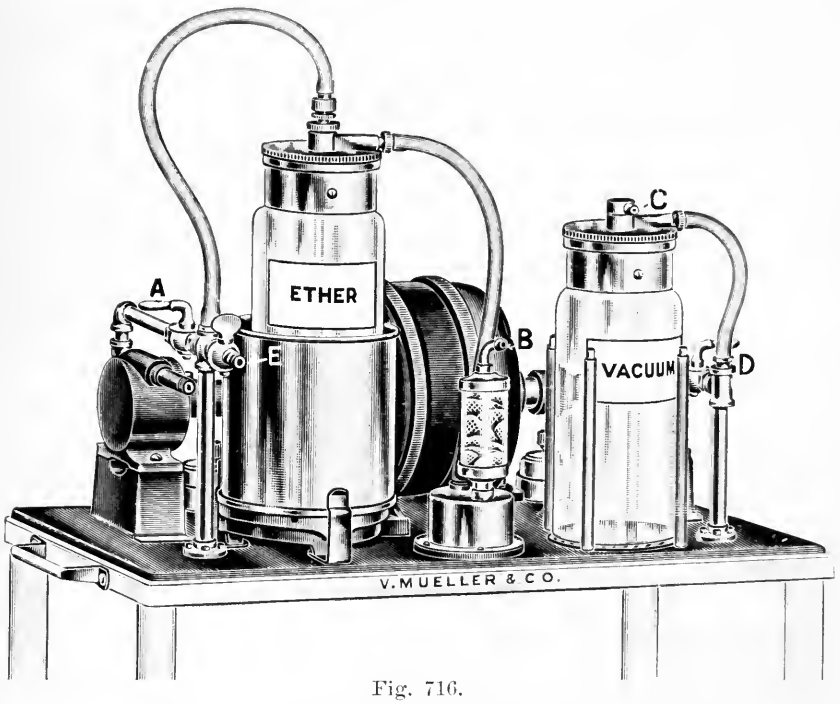


Fig. 716.

Beck's combined suction and etherizing apparatus.

fore attempting to check the bleeding. In operating in the upright position the bleeding is stopped during each stage of the operation by gauze pledgets held in long uterine dressing forceps, and if any blood accumulates in the mouth, the head is held forward over a basin, or at the side of the operator. A good suction apparatus like Beck's (Fig. 716) is most desirable in this connection as its use permits a far better view of the field of operation and thus makes it possible to see the bleeding point.

The hemorrhage is most likely to come from vessels around the base of the tonsil or along the edge of the pillars, or from oozing from

any portion of the tonsillar bed. The muscular tissue of the superior constrictor usually contracts to such an extent as to completely close the opening of the vessels in this tissue.

As to the best method of treating hemorrhage simple pressure with a good-sized cotton or gauze tampon, carried into the tonsillar cavity, and maintained for a short time will usually be sufficient. If it is not, the tampon may be soaked in a weak solution of nitrate of silver or alcohol or may be covered with powdered alum or tannin or ferropyrin. Pressure may be continued for several hours with one of the tonsil pressure hemostats which are in use (Figs. 717 and 718). If simple pressure is not sufficient, the bleeding point may be grasped

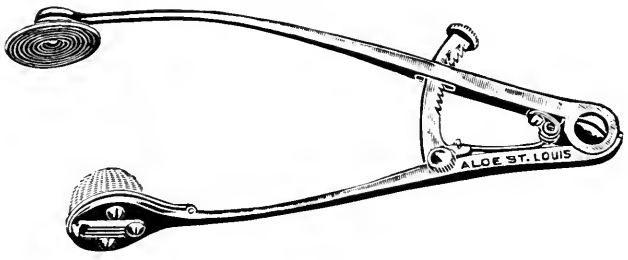


Fig. 717.

Beck's tonsil hemostat.

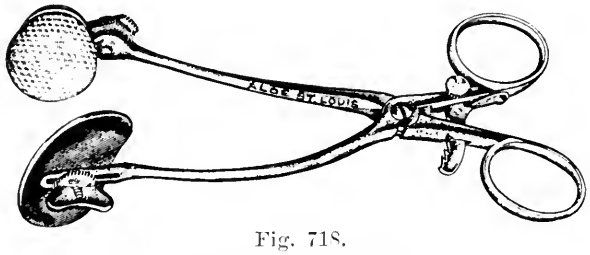


Fig. 718.

Cullom's tonsil hemostat.

with a tonsil hemostat and the vessels twisted or tied. With proper arrangement of the pillows a long tonsil hemostat may be maintained in position for several hours without great discomfort to the patient, especially if the hemorrhage occurs after recovery from the anesthetic. For oozing there are several types of broad hemostats which may be used in the same way. Tying the vessel is difficult, but will seldom be necessary. When it is, a good bit of the surrounding tissue should be grasped. The best method of tying blood vessels in the tonsil fossa is that of Cohen, which may be described as follows:

If the bleeding be so profuse as to make it difficult to see the bleeding point, the fossa is quickly packed with small gauze sponges,

held in long clamps. By the removal of one sponge after the other, beginning from below, each section of the fossa can be inspected separately, the bleeding points located, and tied successfully while the hemorrhage from any other part is controlled by the sponges not yet removed. The particular difficulty in tying vessels of the tonsillar fossa is in slipping the ligature from the end of the forceps over the tissue engaged. This arises from the tendency, in most instances, to catch too deep a bit with the forceps, thus preventing the sliding of the catgut from the clamp to the tissue. It is necessary to use broad, flat artery forceps, and to engage but a portion of the broad end of the

Fig. 719.

Cohen method of ligating a vessel after tonsillectomy.

hemostat, thus leaving one edge of the forceps free so that the catgut loop may slide easily under it during the process of tightening. (Fig. 719.) A broad hemostat has an additional advantage that it does not injure the nutrition of the tissue should a non-bleeding point be caught. The bleeding point being engaged, an assistant holds the forceps while the operator, with a piece of catgut about eighteen inches long, loosely ties a single loop below the shank of the hemostat.

It should always be borne in mind that the angles of the mouth are elastic, and can be stretched downward to a very great extent. The depth which can then be reached with an index finger of average length, in tying a vessel within the throat, is truly surprising.

Presuming that the operator stands to the right of the patient, the left index finger will reach with ease all parts of both fossæ, excepting deep in the right fossa near the base of the tongue. In this situation only, is it better to stand directly at the head of the table, from which point, by depressing the left angle of the mouth as much as possible, we can readily reach under the right anterior pillar which stands in the way when tying from the right side.

In the supratonsillar fossa, the bleeding point is often concealed under the angle formed by the junction of the faucial pillars. Its exact location is best found by completely everting the pillars with forceps and pillar hook.

A full, curved, medium-sized needle with a stout piece of silk is passed from before backward beneath the bleeding point, the operator being careful to grasp sufficient tissue. A needle is carried upward, then forward and then downward to the spot where it first entered. This forms a buried ligature, which may be removed in a few days or allowed to slough out.

For continuous oozing, lactate or chlorid of calcium may be given internally. Monsell's solution should never be applied as it is dirty, ineffective, and may cause secondary hemorrhage from sloughing. Sometimes, mere expression of the clot from the tonsillar cavity causes a cessation of the hemorrhage; in any event, it should be removed, when present, as a preliminary to other measures.

Not a few deaths have occurred from tonsillar hemorrhage. Therefore, response should be made immediately to any call for bleeding after the tonsil operation, and great care exercised until all danger is past.

As a patient lies in bed considerable quantity of blood may be swallowed before any attention is called to the matter, even when the operation has been done in a hospital. Strict injunction should be given to watch for swallowing, and the patient should be ordered to spit out, and not to swallow anything which comes into the throat.

In general, it may be stated that if the hemorrhage is venous, it is little to be feared. If it is arterial, and due to the abnormal course of some vessel, it may be serious or fatal, from inability to get assistance in time. In the presence of such an accident, an endeavor should be made to grasp the vessel with a stout hemostat, to get assistance at the earliest moment, and to tie the external carotid if necessary.

Suturing the Pillars. A pad of gauze moistened with tincture of benzoin or some other astringent antiseptic (never peroxid of hydrogen), is introduced into the tonsillar cavity and the anterior and posterior pillars are sutured together at one or more points, as may be

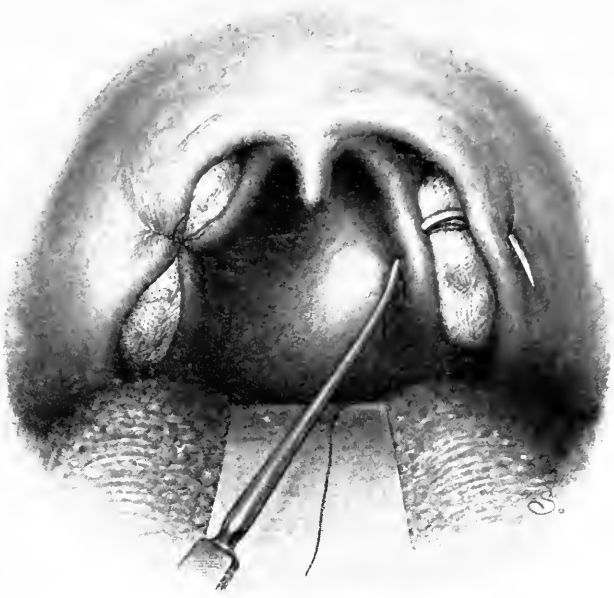


Fig. 720.
Suturing the pillars of the palate over gauze.

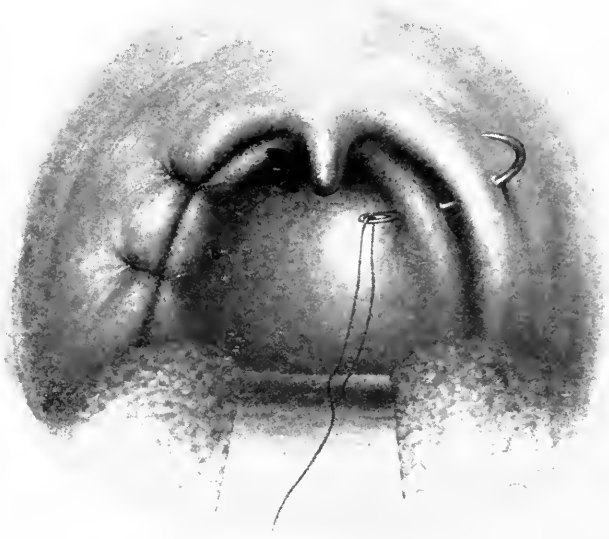


Fig. 721.
Suturing the pillars of the palate without interposition of gauze.

necessary, with an ordinary full-curved needle, or with one of the types of tonsil needles now in use. (Fig. 720.) If desired, the pillars may be sutured without interposing any gauze between them. (Fig. 721.) The suture is removed in twenty-four to forty-eight hours. An adaptation of Michel's wound clips may also be used for uniting the pillars. (Fig. 722.)

Secondary Hemorrhage.—Secondary hemorrhage, occurring in from two to five or more days after operation, is not frequent and is due to a detached slough or erosion which leaves an open vessel. It usually ceases spontaneously. Pressure should be used whenever it occurs, and the patient put to bed for a few days. If it continues in spite of pressure, the pillars should be sutured over a pad of gauze or the bleeding vessel ligated.

In any case of hemorrhage, as long as the patient is alive, there is a possibility that the bleeding may cease at any moment, or may be stayed by fainting.

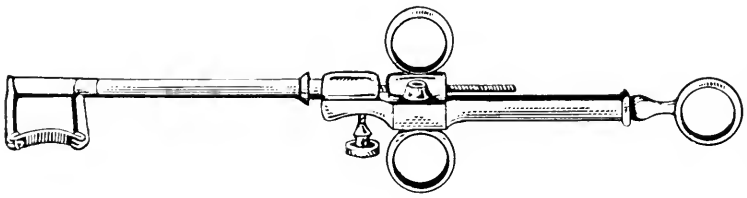


Fig. 722.

Instrument for use of Michel clips.

Injection of Salt Solution.—Transfusion should be a last resort as it lessens coagulability while increasing the quantity and tension of the blood.

Tying a ligature around the upper thighs and shutting off some of the blood may be tried in extreme cases. This ligature must not be too tight, and must be watched.

Hemorrhage may come after any type of operation. Most of those reported in literature have occurred after the use of the guillotine or tonsillotome, doubtless because the operation with these instruments has been performed so much oftener than tonsillectomy.

Although the external carotid has been ligated for hemorrhage, the writer agrees with Butlin, who thinks that in most cases of really serious, sudden and violent hemorrhage, there is neither time nor opportunity to ligate one of the large vessels.

Butlin records a case in which the hemorrhage had been so great that the operator was sure that the patient was about to die, pressure

seeming to have no effect. The child, however, went into a state of collapse, the bleeding instantly ceased, and recovery took place. He further states that the records of cases in which the common carotid has been tied shows that the blood has not always ceased upon the application of the ligature, but has continued until the patient fainted from loss of blood. He says he would wait for this, in the meantime filling the cavity with gauze and passing sutures through the palatine arches, as already recommended.

A plentiful supply of long hemostats, some with broad bases, by means of which he may grasp the bleeding points, should enable the operator, in most instances at least, to handle the bleeding until further assistance can be secured.

In general, it may be said in reference to hemorrhage, that moderate hemorrhage is common, serious hemorrhage is not unusual, dangerous hemorrhage may occur, and fatal hemorrhage is rare.

Injury to the Palate and Uvula.—Unless one is careful, injury to the uvula or a portion of the palate may occur by grasping it in the snare or tonsillotome. If the possibility of this is borne in mind, such an accident ought not to occur. Some of the more common results of these injuries are shown in Figs. 723 to 726. Beyond the visible deformity, as a rule, no harm results, but in extreme cases there may be interference with deglutition and voice production, in fact, it may transpire that the voice assumes an exaggerated nasal quality on account of loss of palatal tissue and corresponding cicatrization.

Infection.—After removal of the tonsil, two large open spaces more or less absorbent, are left in the throat, and it is possible for fever and some general infection to occur. Fortunately, this is rare.

In from twenty-four to forty-eight hours, a white exudate covers the wounded surface and remains for several days without occasioning any trouble. Sepsis may occur whatever type of operation has been performed. This will depend upon the resistance of the tissues, the virulence of the absorbed organisms, and the cleanliness of the operation.

Of late, cases of pulmonary abscess have been reported, possibly due to infection following the aspiration of blood or inflammatory products.

Effects Upon the Voice.—The question as to whether the tonsil operation injures the voice has been a much discussed one. By far the great majority of operators have seen only improvement, and not injury to the voice. Those physicians, however, having most to do with professional singers, have given a somewhat guarded opinion as to this, and admit that for a time at least there is an alteration in the voice, followed later by improvement. The range and power of the

voice should be increased after tonsillectomy, provided the pillars are uninjured, as in many cases, the tonsil by its firm attachment to the pillars hinders the mobility of the muscles. Most of the reported cases of injury to the voice have probably been due to the tonsil stumps

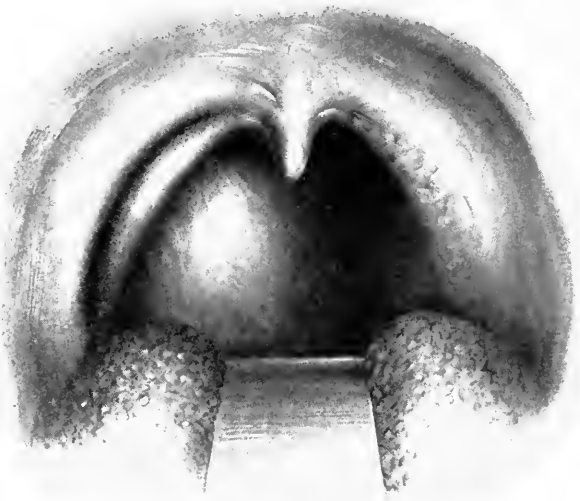


Fig. 723.

Right side perfect, left pillars cicatrized together.

Fig. 724.

Left pillars cicatrized together, right and posterior pillar injured causing an attachment higher up on the pharyngeal wall.

which were still present, and which hindered the mobility of the muscular action, or to injury done to the pillars themselves by the operation.

After-treatment.—After the removal of the tonsil, by whatever

Fig. 725.

Right and left posterior pillar almost entirely destroyed, portion of left side of palate destroyed.

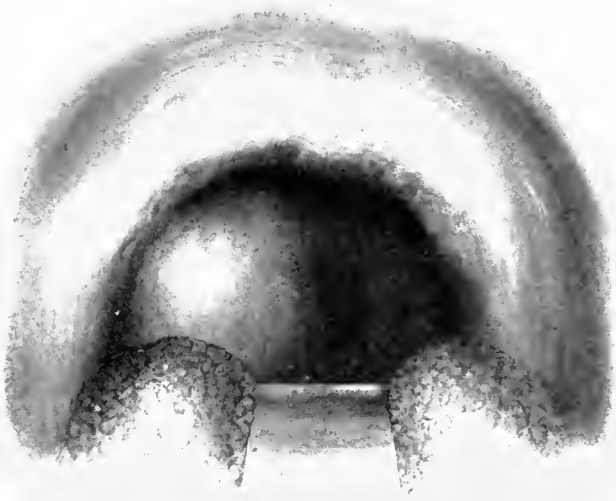


Fig. 726.

Uvula and portions of anterior and posterior pillars on both sides destroyed.

method, the use of fifty per cent of normal tincture of iodin, i. e., 3½ per cent of iodin, on a cotton pledget applied to the fossæ or of compound tincture of benzoin materially increases the rapidity of recovery. Children recover very quickly. They should be kept quiet for several days, and given a light diet. In adults, depending upon the severity of the operation, the convalescence will require from five to ten days. The throat is very much more painful after tonsillectomy than after tonsillotomy. Patients should be put on light diet and confined to bed. Swallowing is painful for about five days. Gargles of antiseptic solution may be allowed, although they hardly hasten convalescence. Anesthesia used with a powder blower is of service in alleviating the pain.

PERITONSILLAR ABSCESS.

This is an abscess usually situated in the supratonsillar fossa in a space bounded below by the tonsil, externally by the superior constrictor, in front by the palatoglossus and behind by the palatopharyngeus muscle, and above by the angular space formed by the union of these muscles with the superior constrictor. The abscess is external to the tonsil itself, not in the tonsil as is often thought, though it may be located anywhere in the neighborhood of the tonsil.

Preparation.—The affected area should be cocainized as thoroughly as possible. This may be done by injection, by several applications of a 20 per cent solution, or by moistening a cotton-tipped pledget in powdered cocain, and rubbing this over the affected area. Examination with a probe frequently shows one part more tender than any other, giving a suggestion of fluctuation to the probe or finger. This is probably the best point for puncture. Sometimes the probe inserted at the upper pole of the tonsil will lead, helped along with a little pressure, directly into the abscess cavity. The cocain anesthesia will be only partial, as the inflamed area absorbs but poorly, although sufficiently to be of some value. As soon as the site of pus is determined, the abscess should be freely opened. A knife with a long handle and preferably with a short, narrow blade is chosen. A double-edged knife answers very well. If the blade is too long, it may be made safer by wrapping all except the tip with cotton or adhesive plaster. The patient is placed in a chair having a firm back with his head and hands held by an assistant. The mouth should be opened as wide as possible, and preferably by a mouthgag. Under no circumstances should an attempt be made to operate upon such an abscess with the patient on the bed, unless the light and all the conditions are favorable, as only disap-

pointment will result. If the abscess has pointed, it is best to follow its lead, otherwise the incision must be made in one of two places, according to preference.

First Point of Incision.—This is a point (on a line) which is midway between the extremes of a vertical line drawn from the last molar tooth, that is, the gingivopalatal fold, to the free border of the anterior pillar, which, in this case, is pushed toward the middle line of the throat, and is situated at or a little above the tip of the tonsil. At this point pus will usually be reached at the first incision. If not, the incision must be made a little deeper, in order to reach the abscess. When pus is found the incision should be enlarged as the knife is withdrawn, so as to leave a free, gaping opening sufficiently wide for good drainage. The finger may be placed in the cavity, and the area enlarged with it. A favorite plan is to widen the opening by the use of forceps which are spread open after being introduced. The bleeding will be profuse for a few moments as all the tissues are gorged with blood, and so the natural tonicity of the vessels is in a measure lost. If pus is considerable in amount, the patient's head should be brought forward so as to avoid the danger of aspiration, and of swallowing the pus. There is little likelihood of injuring any important vessels as according to Woolsey's *Surgical Applied Anatomy*, "Wounding the internal carotid is out of the question, for in the adult it lies three centimeters (1¼ inches) behind this point in the normal state, and probably twice as far when the parts are bulged forward by the inflammation. In children, the distance is relatively even greater, though of course, actually somewhat less."

Second Point of Incision.—If pus is not reached when the incision is made as just directed, the knife should be carried above the tonsil between the anterior and posterior pillars in a direction outward and upward into the supratonsillar fossa. Pus can usually be found in this way. Many operators prefer this point to the one first described.

But pus may not be reached in either situation. In that case, there will be a little temporary relief from the free bleeding, but nothing more. The following day incision should again be made in one or both situations. In the meantime, it is not infrequent for the abscess to discharge itself along the line of the incisions or even independently. Failure sometimes comes even when pus is present because the operator does not take into sufficient account the position of the abscess, but penetrates the tonsil substance instead of the abscess.

After-treatment.—This is simple, consisting of a gargle or alkaline

cleansing washes, introduced through a syringe. Recovery is complete in a few days.

Complications.—The swelling is sometimes enormous, and great risk of suffocation may supervene, not only from the condition but from pus aspiration at the time of operation. Although as a rule, the abscess can be opened with safety, while the patient is in the upright position, it is better whenever there is marked dyspnea or when the throat seems unduly filled, to open the abscess while the patient is on his back, with his head over the end of the table. Occasionally, though rarely, the pus may work down the neck between the superficial and deep fascia. In one case of this kind, my failure to open the abscess while the patient was on his back, necessitated a tracheotomy. The patient nearly lost his life because all of the things required were not instantly at hand. As it was, artificial respiration was necessary. If the operation had been performed at the patient's home instead of in a hospital, where the delay and confusion were only momentary, it is probable that a fatality would have resulted. The initial opening had been made without difficulty, but on enlarging it, the abscess was found to be far more extensive than was supposed; aspiration into the larynx took place and immediate cessation of breathing. When the tracheotomy was performed in this hurried emergency, it was found that the trachea had been pushed sideways by the pus which extended as far down as the clavicle. The tracheotomy incision first entered the abscess cavity, instead of the trachea. Recovery took place without incident. The abscess drained through the wound in the throat, and through the opening at the side of the tracheotomy wound. The patient was maintained in bed for three days with the head considerably lower than the heels for fear of aspiration pneumonia.

Results.—One attack of peritonsillar abscess rather predisposes to another. Removal of the tonsils is to be advised where such an abscess has once occurred. After the second attack, their removal should be urged. The advice may not be taken, but it ought to be given.

GRANULAR PHARYNX (FOLLICULAR PHARYNGITIS).

The treatment is first directed toward the cause in as far as it can be determined; and secondly, the granulations are to be destroyed.

Mild measures, such as astringents, chromic acid, trichloracetic acid and silver nitrate are sometimes effective. Otherwise the operative plan will be required.

Galvanocautery.—When the masses are large they are best destroyed with the galvanocautery point, care being taken to destroy the granulations only, and not to burn any deeper than the granulations. The cautery point is to be used at nearly white heat, but the current should not be turned on until the burner is in contact with the mass. It is then placed over the granulation; the current is turned on momentarily and then shut off. If the burner is introduced while still hot, the gagging of the patient may cause the operator to burn some portion of the healthy pharynx. Only light cauterizing is to be done. To avoid gagging, it is necessary to cocainize the entire pharynx with a two to four per cent solution of cocain while the granulations should be touched with a ten to twenty per cent solution. No after-treatment is necessary. Several sittings may be required, and if so, they should take place at intervals of about one week.

RETROPHARYNGEAL ABSCESS.

Instruments.—Mouthgag, tongue depressor, and a knife. Guard the knife with a piece of adhesive plaster, leaving the tip only exposed.

Position.—Operations may be done with the patient in either of two positions, sitting up, or lying down with the head over the end of the table. A general anesthetic is inadvisable as its use adds greatly to the danger.

In the upright position the patient should be in the arms of the nurse or assistant with the head held firmly with one hand. A bowl or basin should be close at hand. The operator sits in front of the patient and should have good illumination, direct or indirect. The mouth is held widely open with the mouthgag. The finger of the left hand may be used as a tongue depressor. The prominent and dependent portion of the abscess should be incised, making a small cut to determine the presence of pus. As soon as pus is found the patient's head is lowered so that it is below the shoulders, and then the opening in the abscess should be enlarged with the knife, forceps or finger. The finger of the left hand answers very well, and once the opening is made, is to be preferred to a knife, since information as to the extent of the abscess and the condition of its walls is at once obtained by means of the finger while the enlargement of the incision in the vertical direction is readily made. The enlargement of the incision should be continued to the lowest point of the abscess cavity. The bleeding is slight.

In the recumbent position, the technic is the same as already described, except that from the beginning the patient's head is held lower than the entrance to the larynx. A very good plan is to have the patient's head hanging over the end of a table. In adults with retropharyngeal abscess, since the sudden change of position is not as quickly made as with the child, the recumbent position is preferable as there is some danger of aspiration of pus into the larynx. No pus-containing pocket should be left unincised.

After-treatment.—Examination should be made on the following day so as to be sure that no pocket has been overlooked. No dressing is required.

Accidents and Complications.—Other than suffocation, none is likely. No large vessels are apt to be wounded as long as the cut is made near the middle line. Provision should always be made for a tracheotomy, which may be necessary, although it is not often required as the inverted position will usually provide for any emergency. Relief is immediate, but the causal condition, whatever that may be, remains and should receive appropriate treatment. The operation in children is frequently an emergency one, rarely so in adults.

PHARYNGOMYCOSIS.

The galvanocautery, if persistently used, and carried deep enough, will permanently destroy the mass. A more effective method is the removal of the plug and its entire base with sharp biting forceps of the small alligator-jawed type. A combination of these two methods will give the most rapid and satisfactory results. The condition tends to recur. It also sometimes disappears without treatment. Many treatments will be required for a cure.

Cocain in four to ten per cent solution should be used as a local anesthetic.

ELONGATED OR HYPERTROPHIED UVULA.

Indications.—The operation is indicated whenever the elongated or hypertrophied uvula is causing trouble, and is of such degree that astringents have either failed or do not give promise of success in their use.

Contraindications.—Contraindications are limited to hemophilia. It is always unwise to remove the entire uvula.

Anesthesia.—Cocain is applied locally until the uvula is no longer sensitive, in four, ten or twenty per cent solutions. The pharynx in

the neighborhood should be sufficiently anesthetized to abolish the reflexes and muscular movements of the uvula up and down for they may be very annoying and result, if the operator is not careful, in the removal of more of the uvula than is desirable.

Instruments.—Long forceps, long scissors, long sharp knife (probe-pointed and slightly curved preferable), tongue depressor.

The old type of uvula instruments with scissors having hook attachments are obsolete. While asepsis of the field is impossible, only sterile instruments should be used.

Operation.—Forehead mirror and good light, or good direct light, and a quiet patient free from fear are requisites. The patient or assistant should hold the tongue depressor. The uvula hanging free, without muscular or pharyngeal spasm, is grasped with forceps and put slightly on the stretch, being held vertically downwards and forwards. With knife or scissors the redundant portion is cut off slightly diagonally from before backward, so as to have the denuded surface point backward rather than forward. Examination of the field, with the patient's mouth open naturally, is then made in order to ascertain if enough has been removed, and to determine whether or not the uvula has been so cut as to leave a blunt stump. In this event it will be necessary to take sharp scissors and convert it into a pointed stump by taking off a little from each side of the center portion. It is possible to do the whole operation with very sharp scissors, and in this case the operator, or an assistant, depresses the tongue.

When the guillotine instrument is used, the tongue depressor is held by the physician and the guillotine is encircled around the uvula which is held in the right position and in the proper direction; the handle is somewhat depressed, and the cut is made. If the instrument should cut through the muscular portion only, the operation is completed with scissors.

D. Braden Kyle recommends incising a wedge-shaped piece from the uvula tip, the apex of the wedge being upward. A stitch is then put in. This gives a pointed uvula.

After-treatment.—Swallowing is painful for a few days on account of the swelling which follows. A simple gargle may be used, but, as a rule, none is necessary.

Complications.—Hemorrhage is usually slight. Exceptionally it may be considerable, and last for a long time. Astringents and the galvanocautery may be used, and if the hemorrhage still persists to an alarming and troublesome degree, a suture may be put through the middle of the uvula tip, divided, and then each half tied. Recovery

from the operation takes place in from five days to a week, by which time the swelling has ceased, and a new mucous membrane has begun to form.

If complete extirpation is performed, the complete closing of the nasopharynx for a time may be impossible. Fluids swallowed may come partially through the nose. Eventually the palate stretches sufficiently, and its function is restored.

Bifid Uvula.—This is uncommon, but of no importance unless it is too long, under which circumstances an operation may be performed. Each horn is removed in the same manner as a simple elongated uvula. If short enough, and still apparently an annoyance from its bifid nature, the two opposing surfaces may be denuded and united with a stitch.

EDEMA OF THE UVULA.

When slight in amount, no treatment is necessary; when considerable, minute scarifications with a small, sharp knife, such as is used for incision of the drum membrane, or with a small tenotomy knife, are made over the edematous surface. Considerable relief at once follows, and serum drainage continues for some time. Air edema resulting from Eustachian catheterization responds to this treatment.

ADHESIONS OF THE SOFT PALATE TO THE PHARYNX. RETROPHARYNGEAL ADHESIONS.

The condition present varies from simple narrowing of the opening into the nasopharynx to complete closure and complete merging of the soft palate with the pharynx wall. The place from which the contraction begins is one or the other of the posterior pillars or both.

The question of operation depends upon the amount of discomfort which is sustained, and upon the degree of occlusion, mouth-breathing, difficult breathing, impaired phonation, dry throat, bronchitis, inability to blow the nose with retention of secretion, deafness, and the like. Whenever the adhesions are of such a character as to interfere with respiration, and produce positive distressing symptoms, an operation should be performed even though it results only in improvement, and not in absolute cure.

The result depends upon the cause, the degree of contraction and the amount of good tissue available, and will be better when congenital, inflammatory, or traumatic in character, than when syphilitic in origin or when due to burns which tend to produce scar tissue almost as badly as does syphilis.

The entire area should be carefully probed to map out just what operative work is to be done. The field should be anesthetized with equal parts of a 20 per cent cocain solution and a 1 to 1000 solution of adrenalin chlorid applied locally; in addition a hypodermic injection of a one per cent solution of novocain should be made at the center and at each border of the adhesion.

Instruments.—Sharp-pointed curved scissors, probe-pointed double-edged, curved knife, sharp-pointed curved knife, right-angled double-edged knife, long angular nasal forceps, mouthgag, tongue depressor, small cotton tampons, gauze tampon with two stout long silk sutures attached. The patient should be in the sitting or reclining position.

Operation.—If no opening whatever is present between nasopharynx and mouth the large probe, bent like an Eustachian catheter is introduced point downward through the nose until its position is manifest in the mouth and the soft palate at this point bulges out somewhat. A cut is now made through the tissue to the probe in a vertical direction, with the double-edged knife, enlarging each way, the cut always being directed downward and sideways so as to form as much of a palatine curtain as possible. With the probe-pointed curved knife, the cut is continued from this point down the lateral wall of the pharynx on each side so as to approximate the natural shape, as much as possible. The separation being made, a folded iodoform gauze tampon as large as can be comfortably borne is introduced into the nasopharynx and covered with an ointment. The tampon has two threads, one of which is caught on a probe and brought out through the nose; the other passes out through the mouth. These two threads are tied together. This prevents swallowing the tampon, and allows a new one to be tied to the nasal thread if required. This or a similar one is maintained until complete healing takes place, and there should be one for each nostril. The cooperation of a dentist must be now sought, and an obturator so constructed as to maintain the maximum amount of room with the minimum of discomfort. The ultimate success depends entirely upon how satisfactorily this can be done.

Roe's Operation.—An operation recently described by Roe has as its principle the avoidance of the use of the obturator. After separating the adhesion and forming the new soft palate, a mucous membrane flap is taken from the side of the palate and inside of the cheek so as to cover the posterior denuded surface of the newly made soft palate. The flap is attached above and is free on three sides. It must include some connective tissue to provide for nutrition. The flap is brought

down and turned backward and upward around the outer and lower border of the soft palate and stitched at the side and free border of the palate. The lower border of this flap, which must be cut long enough, is turned up behind the palate and stitched to the latter by sutures passed through the palate. The surface from which the flap is taken soon covers with mucous membrane. The procedure is better adapted to the simple nonspecific forms of palatine adhesion. Whenever sufficient good material is available for the flap this method may be tried for the syphilitic adhesions. No attempt at operation should be made upon the syphilitic contractures until it is certain that the syphilitic process is healed, or a least latent. Possibly cases healed with Ehrlich's salvarsan at the moment of beginning contraction would be saved the contracture.

The galvanocautery is under no circumstance to be used in the treatment of the trouble, as after its use, the adhesions are only worse.

Operation of Nichols.—The parts are thoroughly cocainized from above and below. There is no case reported in which a slight opening has not been found. Usually it is present posterior on one side of the uvula. The curved needle, threaded with a long length of the finer silk, is passed through this opening, care being taken not to wound the membrane. The point is now in the nasopharyngeal chamber above the adhesion. It is then carried as far laterally as the radius of the curve will permit, and brought down through the adhesion as far back as possible and on a plane parallel to the pharyngeal wall. When the point appears through the adhesion the loop of thread is engaged in the hook, and pulled out into the mouth and the needle withdrawn. To the end passing through the central opening is attached a length of the thicker, heavier silk braid (No. 16). While traction is made on the other end of the thread, and the forefinger is used as a guide, the braid is gradually drawn through the canal made by the needle. The braid should be long enough to allow ease in tying. The two ends are then tied in a square knot (not a "granny" knot, which will soon undo) near the tissue inclosed in the loop, but not close enough to strangulate it. When the double knot is firmly tied, the ends are cut off, and by a process of coaxing with hook, the loop is pulled around until the knot passes up through the central opening into the nasopharynx, where it is not a source of annoyance to the patient.

This loop is left in position for a period of a week to two weeks, according to the rapidity of healing. The movements of the pharynx prevent its becoming attached at any point. At the end of this period the little canal in which the loop lies will have become cicatrized

and firm tissue will have formed. The loop is then cut and withdrawn, leaving the canal free. The parts are douched with an alkaline solution and cocainized. The right-angled knife is pushed carefully through the cicatricial canal with its edge toward the median line, and the tissue intervening between it and the central opening is cut through, care being taken not to injure the tissue lying at the back of the knife. The parts are kept clean for a few days, when healing will have taken place along the cut edges. They will remain separated because of the narrow band of cicatricial tissue at the apex of the cut, and the nasopharynx will be opened by just the depth of the incision. It may be necessary to repeat the operation several times on each side until the required space is obtained. One must look for a small amount of contraction afterward, but the passage always remains free and functionally adequate. In all the cases which have been operated on, the resultant opening has been large enough to admit freely a No. 3 laryngeal mirror after the first operation, while in those in which a second or third operation has been done, a permanent opening admitting a No. 5 mirror, or approximately the size of a normal passage, has been secured.

A. G. Spencer modifies this procedure by first separating the soft palate from its adhesions to the pharyngeal wall, and then, by means of two silk sutures, draws it forward and fastens it to the mucoperiosteum of the hard palate. To achieve the same purpose, Tilly takes strong silver wire, threaded into the soft palate on each side, and anchored to the incisor teeth. By the time the wires are cut out, considerable repair will be found to have taken place over the raw surface, and the liability of reunion greatly lessened. If necessary, another set of sutures can be inserted.

Mackenty's Operation.—The principle of this operation is to line the posterior surface of the palate with two flaps, one for each side, taken from the posterior wall of the pharynx below the original curve of the soft palate, and as far down the pharyngeal wall as the atresia extends up the nasopharyngeal wall, so as to cover completely the denuded area. The author regards this as the operation of choice.

A curved needle armed with a fine silkworm-gut is introduced into the mucous membrane of the posterior pharyngeal wall just to the outer side and about 1 to 2 cm. below the central opening and is carried laterally to emerge at the edge of the posterior pillar. A similar stitch is taken on the other side. The points of entrance and emergence are about 1.5 cm. apart. With a sharp scalpel the flaps are now

outlined, beginning at the outer side of the points of emergence of the stitches, curving downward and inward, then upward to end at the entrance of the small probe opening into the nasopharynx (Fig.

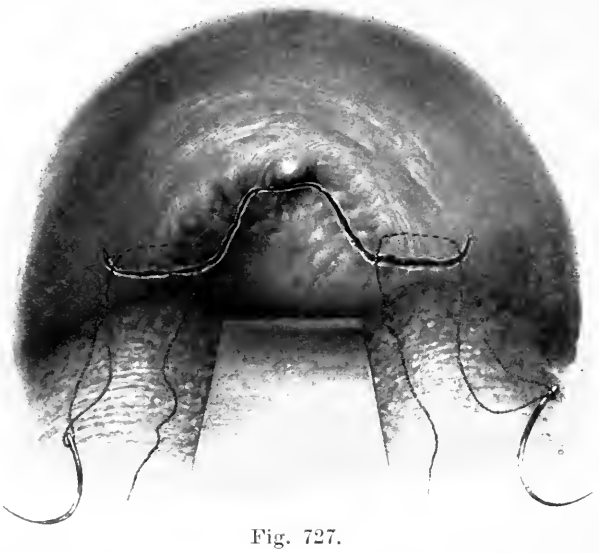


Fig. 727.

Mackenty's operation. Introduction of sutures and formation of flaps.

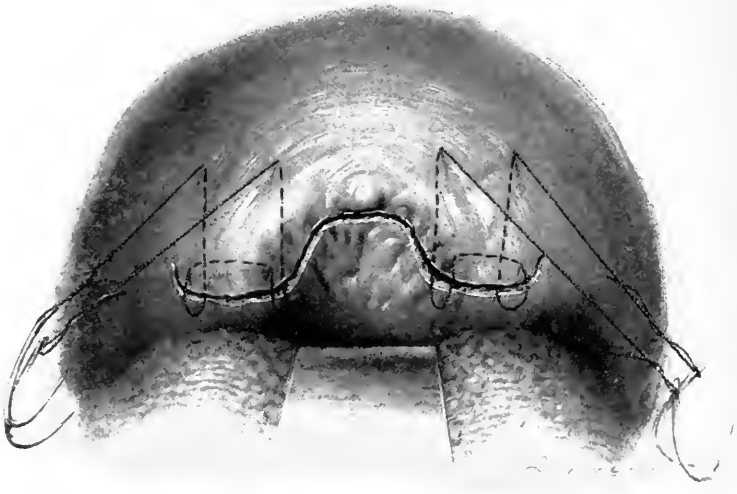


Fig. 728.

Mackenty's operation. Method of introducing the sutures so as to pull the flaps upward and backwards.

727). Then with an angular knife or curved scissors introduced through the opening into the nasopharynx, the atresia is separated out to the lateral pharyngeal walls and downward to the outlined flap

incisions. The stitches are held as traction sutures, keeping the tissues taut while the flaps are being separated from the pharyngeal wall.

The nasopharynx now lies wide open and from the lower margin of the soft palate hang two flaps transfixed near their lower margins by two sutures. All that remains to be done is to turn these flaps backward and upward against the raw posterior surface of the palate and stitch them in position. Four ends of sutures now project from the mouth. Each end is threaded on a sharply curved needle. The needle is held in a special holder which grasps the needle parallel with the long axis of the handle. The needle is passed well up behind the palate and its point drawn forward through the palate above the raw

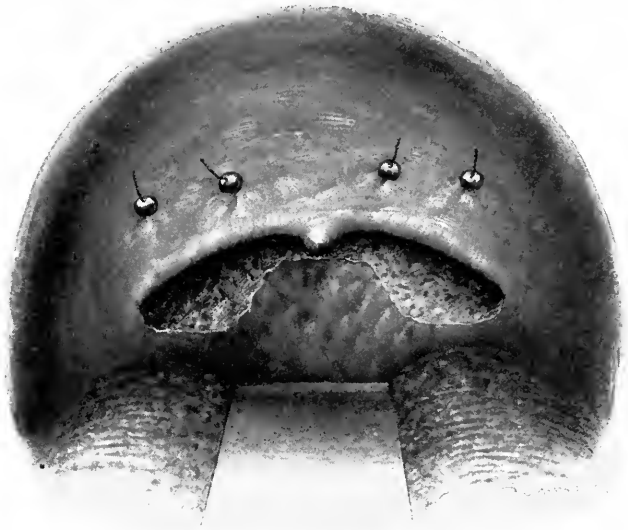


Fig. 729.

Mackenty's operation. Completed operation.

area on the posterior surface. (Fig. 728.) Similarly each of the four needles are brought through on a line with their relative places in the flap. By drawing them taut the flaps ascend and take their positions against the posterior surface. Fine perforated shot are threaded on each suture and clamped in position near the anterior surface of the palate, care being taken to allow for considerable post-operative edema. (Fig. 729.) The contraction which takes place on the posterior pharyngeal wall from which the flaps are taken, is negligible, since the surface is soon covered by a mucous membrane graft from the edges. The stitches are removed in four or five days. Two weeks after the operation the finger is passed into the nasopharynx. This

is repeated every four or five days for a month. Then (if deemed advisable) the patient is given a dilator to use at home, to be passed by him twice a week for three or four months. This dilator is a cone set at a right angle upon a handle and made in sizes to suit the individual case.

The Obturator.—As this must be worn for months, at least, and perhaps longer, it should be constructed so as to fulfill its purpose. Obturators have been used and described by many surgeons, and all embody modifications of the same idea. The one perhaps best suited of all is the one described by Schadle and here illustrated (Fig. 730). Plaster or gutta-percha can be used in making the model, which is afterwards made in hard rubber. It consists of a plate such as is

Fig. 730.
Schadle's obturator.

used to carry artificial teeth, and an obturator tube molded to the shape of the reconstructed nasopharynx opening. The tube is made as large as possible, and projects upward into the nasopharynx an appreciable distance above the palate. Above it is curved forward, and has three openings, one at either end, and another or fenestrum, reaching from just above the upper border of the soft palate nearly to the tip. This double opening in the nasopharynx favors not only breathing, but the removal of secretions and the drainage from the nasopharynx and nose. When vulcanite is used, a wire should be placed between the plate and the obturator, and molded into it so as to render it impossible for the obturator to break off from the plate and perhaps be swallowed in sleep. It must be made so that the patient may be able to remove and reintroduce it.

Other Methods.—Mechanical dilatation at intervals without permanent obturation has proved a failure. Suturing usually fails, though Roe and Nichols have reported success by this method.

Cutting out all the cicatricial tissue is not practicable except in very limited areas.

Possible disadvantages after operation are nasal tone and perhaps regurgitation of food now and then, but these are more than compensated for by the benefit which results.

Final Results.—These are always somewhat uncertain, owing to the great tendency to reformation of the adhesion, even after apparently successful results. Newly formed connective tissue may be sufficient to amount to an actual hypertrophy, thereby diminishing the area of the pharynx.

HYPERTROPHY OF THE LINGUAL TONSIL.

Examination with the laryngeal mirror shows hypertrophy of the lymph follicles at the base of the tongue. This occurs in a varying degree. The hypertrophied follicles are not infrequently visible by direct examination when the tongue is strongly depressed.

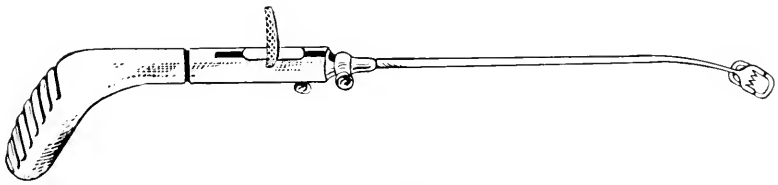


Fig. 731.

Myles' lingual tonsillotome.

When larger, galvanocautery may be applied by using a curved burner at red heat and under illumination with the laryngeal mirror. There is a little risk of burning where it is not desired, hence a burner with protected back is to be preferred. After the use of the galvanocautery at the base of the tongue the inflammatory reaction is apt to be greater than when cutting measures are employed, hence the galvanocautery, while reasonably efficient, is not to be recommended.

Lingual Tonsillotomy.—When the follicles are large, direct removal with the lingual tonsillotome is the most efficient method for the treatment of the condition. The best instrument is that of Myles here illustrated. (Fig. 731.)

Anesthetization is effected with a 20 per cent cocain solution swabbed on with a pledget of cotton. The laryngeal mirror may be

used with tongue held, or direct vision with the tongue strongly depressed. The choice of method will depend upon the individual case, though as a rule, a laryngeal mirror will be required. The instrument is pressed down upon as large a mass as is desired and the fork pushed into it. The knife is then made to cut like a tonsillotome. Masses of considerable size are easily removed in this way, though the smaller ones are more difficult to remove. The pain of the operation is not great, but there is usually some.

Complications.—Some bleeding at once follows, sometimes so much that it is impossible to remove all that is desired at one sitting. However, it soon stops. Occasionally it may be very annoying, never, however, requiring more than simple astringents and a comparatively short time for cessation.

After-treatment.—Nothing but soft food for a few days.

FIBROMA OF THE NASOPHARYNX.

Indications.—Obstruction to breathing, obstruction to swallowing, pain from pressure, rapid growth, hemorrhage, and change in voice, reflex symptoms from pressure.

The question of operation depends upon the seat, probable histologic character, consistence, amount of obstruction, rate of growth, age of patient and character of growth, and as to whether the base is broad or pedunculated. Whenever it is apparent that the fibroma is a menace to the individual, either from its mechanical obstruction to breathing or its danger from pressure upon other structures, it should be removed, as the tendency is to continued growth with constant danger to the nasopharynx, the choanæ, the orbit and sometimes the brain. There is always the potential danger of the conversion of a simple fibroma into a fibrosarcoma. As soon as a diagnosis can be made, removal should be attempted. The earlier this is done, the more successful it will be.

Contraindications.—Too broad a base to allow of successful removal; invasion of orbit or brain; age and bad condition such as to make operation too great a risk. Where the growth is malignant, it is usually a fibrosarcoma, and has so invaded neighboring structures as to render complete removal impossible. A portion of the tumor should, if possible, be obtained for histologic examination. Very careful examination by mouth, nose and, most essential of all, with the finger, is necessary before deciding whether an operation is or is not indicated. With the finger one determines the point of origin, the

density, the size and the character of the base, whether pedunculated or not. The type of operation to be performed and even the probable prognosis are all determined by this examination. It is important to learn during the examination whether there is any tendency to hemorrhage and if any ulceration is present. These tumors often contain large blood vessels and when removed the bleeding is excessive; hence the importance of obtaining all the preliminary information possible. The digital examination must be gentle, as it may of itself provoke severe hemorrhage.

Prognosis.—This is always doubtful, and should be so stated. The pedunculated tumors are not very difficult to remove. On the other hand, the broad-based ones are very difficult, and may be impossible of complete removal. While the fibromata or fibrosarcomata of youth may disappear spontaneously, they may also grow rapidly, and threaten life.

Anesthesia.—The author prefers ether anesthesia in the Trendelenburg position or with the head hanging over the end of the table, the ether being given preferably by a tube, and being vaporized by hand or foot pressure. Intratracheal anesthesia may be used or the peroral intubation method of Kuhnt. This latter allows the patient to be in any position agreeable to the operator, while the lower pharynx can be packed, and the entrance of blood either into the larynx or esophagus entirely prevented, without the necessity of a preliminary tracheotomy. Provision must, however, always be made for tracheotomy should it be necessary, as in some cases respiratory arrest seems to come on with the advent of unconsciousness, rendering an immediate tracheotomy necessary. This question of tracheotomy applies particularly to the large, broad-based tumors, which are most liable to hemorrhage and most difficult to remove. Jackson does not consider it justifiable to administer a general anesthetic until after the trachea has been opened, if the growth be large enough to press the velum forward on the tongue. Under these circumstances, the tracheotomy should be done under local anesthesia, by injection of cocain or novocain and adrenalin.

Operation.—The operation must be planned for the individual case. Only general directions can be given. If the tumor has a fairly narrow pedicle, removal with the cold wire snare or galvanocautery snare is the best method. When feasible the snare is always to be preferred. A stout cold wire snare should be fitted with a screw which can be slowly tightened. Farlow's tonsil snare, with fairly large wire (No.

7 piano), answers very well. Both snare and wire should be chosen in accordance with the size and apparent consistency of the tumor, and should each be sufficiently strong. To have either snare or wire break is an accident of danger to the patient. General anesthesia is to be used as this allows the snare to be placed with care and deliberateness without disturbing the patient. A gauze tampon of sufficient size to fill the nasopharynx completely is first prepared and attached to stout silk which will not break even when tightly drawn. One end of this silk string is passed via the pharynx and through the nose while the tampon and other end of the silk are outside of the mouth, but ready to be drawn into the pharynx at a moment's notice if it should be necessary. The silk is easily drawn into the nose by attaching it to the end of a soft rubber catheter passed from the nose to the nasopharynx. The snare should be introduced through the widest nostril, and should be of the type in which the wires both come through to the handle so that a large enough loop can be used in the nasopharynx, and drawn around the growth before being made fast. The cannula, armed with the wire, is carried into the nose. The operator introduces the finger into the nasopharynx, and feeling the wire, endeavors to place the loop around the tumor as near to its base as possible. This may require considerable manipulation. When this has been done the assistant tightens the wire as much as possible, and then makes it fast to the snare handle, the loop being maintained in the proper position by the finger still in the nasopharynx. The screw is slowly tightened, the rate being in accordance with the size and consistency of the tumor, and the presence or absence of much bleeding. The loop may have to be retightened once or several times. The time required for this type of operation is from a few moments to hours. It should be done only in a hospital, and when the operator and assistants are prepared to devote as much time as may be needed. When the tumor is finally detached and removed either through the nose or pharynx as may be, the tampon should be drawn into the nasopharynx and left there for forty-eight hours as a precautionary measure against bleeding, which may start up again. No type of snare should be used which will not allow the wire to be released and the snare to be withdrawn in an emergency. Wire-cutting forceps should be at hand for this. The galvanocautery wire is theoretically better than the cold wire snare, but practically is very difficult to handle when one must work by the sense of touch alone. Furthermore, it has the great disad-

vantage that it is very difficult to determine the proper amount of current to apply when the wire is around the growth.

Many times the wire will break or the screw on the snare will not be heavy enough to force it through. If the wire breaks, it may be necessary to tear off the growth by evulsion through the nasopharynx by way of the mouth, by some sort of grasping or biting forceps or to cut it away with scissors, and these should be at hand before beginning the operation with the cold wire snare.

It may be possible to apply the loop through the mouth with a bent cannula for the wire, and with the soft palate drawn forward, by a rubber catheter as described in Beck's adenoid operation. The slow cutting of the tumor through the mouth, however, is not as comfortable for the patient, and whenever practicable, the nasal route is to be preferred.

Evulsion by the Lange Method.—This is feasible when the tumor has a broad pedicle. The left index finger is introduced into the nasopharynx and with a sharp dissector, the tumor is separated as close to the base as possible. The dissectors of various widths should have long handles. Lifting the soft palate may bring the greater portion of the tumor into view. Severe hemorrhage must always be expected, and preparation for it made. The tumor should be grasped with a stout pair of spoon-shaped forceps, traction being made simultaneously with the dissector.

Brown operates in a similar manner, using his finger as a dissector on the theory that "union of the tumor elements is a much stronger one than of the tumor mass as a whole to the tissues around it. Therefore, if we can secure a firm grasp upon a portion of this, especially when this is a postnasal grasp, we may be able to completely remove by traction, when operative procedures of another nature might be entirely out of the question." Tumors with broad bases can be removed in this way.

Löwe recommends the making of an artificial fissure of the palate in order to reach the fibromata. The cut begins on the posterior border of the soft palate to the right or the left side of the insertion of the uvula, and goes in a diagonal direction to a point just in front of the posterior inferior nasal spine. This incision can be made without loss of blood if the soft palate is sutured on both sides of the intended line of incision before hand. After this cut is made, the two sides of the wound are drawn apart, in order to get a general view of the situation of the tumor, and to obtain room enough for removal.

If this is insufficient the fissure in the palate is brought still further forwards, even to the teeth, if necessary, so that the entire bony portion of the hard palate lies bare. As much as necessary of this is removed, until the entire fibroma is accessible. It is then removed in accordance with its location and character.

King recommends cutting the tumor with a strong pair of scissors introduced through the nose. These scissors have long handles, and are curved on the flat. The tumor is divided from its attachments with the scissors, and is removed through the mouth.

Hinsberg's Operation.—Complete cocainization and adrenalization of the nasopharynx is necessary. The index finger of one hand is inserted into the nasopharynx, the tumor thoroughly oriented, and any adhesions broken. Next the forceps are put in the side of the nose where the tumor seems most evident. The finger in the nasopharynx pushes the tumor against the nose, and the forceps are used to cut out a large piece or the whole if possible. In several cases Hinsberg was able to completely remove the entire tumor in one sitting together with all its attachments. The forceps of Schäffer, which should be made very strong yet light, are preferable. In many cases absolutely good results were obtained in one or more sittings, and without severe bleeding. In two out of seven cases reported there was return in one after four months, in the other after one year and a half. The bleeding was not severe, and in only one case was it necessary to tampon. When postnasal tamponing is done there is always danger of otitis media and it is not to be used except in cases of great danger.

Ingals has suggested the injection of lactic acid to bring about shrinkage of the growth.

Ignipuncture is mentioned only to be condemned, as it excites too much inflammatory reaction.

In large vascular nasopharyngeal fibromata, the immediate danger is profuse hemorrhage, with a possibility of septic pneumonia, the latter due to the entry of blood and discharges into the lower air passages. To avoid these dangers, Tilly advises a preliminary laryngotomy, and the insertion of an aseptic sponge in the lower pharynx. The anesthesia is administered through the laryngotomy tube, and the growth then removed by Denker's method: namely, by first removing the ascending process of the superior maxillary and then the anterior wall of the antrum. This gives full access to the growth, and leaves no external scar or deformity.

Jackson considers no operation for true fibroma of the nasophar-

ynx justifiable without preliminary tracheotomy and the ligation of one or both external carotid arteries; on one side if it can be determined from which side the growth springs, and on both, if this cannot be determined. If the carotid is tied on both sides there should be an interval of three or four days between the two operations during which the tracheal wound is to be kept from healing by packing with gauze wrung out of a weak bichlorid solution, and no air should be permitted to pass through the wound. The ascending pharyngeal artery, if very large, may also require ligation. As tying the external carotid throws more blood than normal into the cerebral circulation by way of the internal carotid, there is less tendency to shock and to hemorrhage. Clamping one or both of the external carotid arteries may be equally effective.

Braley, of Sydney, recognizing that the vascular region of the growth is its capsule, conceived the idea of removing it from its bony attachments with as little interference with the capsule as possible, until the bony attachments were separated. The growth is then seized in the nasopharynx with strong vulsellum forceps, and its attachments from the capsule are separated partly by enucleation and partly by tearing portions of it across. At this stage of the operation there is some hemorrhage, which is controlled by pressure sponges. When the growth is entirely removed, a sponge of suitable size is firmly pressed in the nasopharynx for a few minutes. The elevator is used to separate the growth from its bony attachments. This instrument should have a broad face and a large handle in order to give a good grip and perfect control to the operator. No after plugging has been found necessary. The first patient operated on by this method had a preliminary tracheotomy, but Braley has not found this necessary since then. To gain room for the use of the periosteal elevator, an incision is carried down in the angle between the cheek and the nose, and into the nostril; another incision, joining this at right angles, is carried outwards for about two inches. The several parts, including the periosteum, being separated from the bone and drawn outwards, enough of the nasal process of the superior maxilla is removed to allow the finger to pass through the nostril. This gives ample room to reach the base of the growth. The index finger of the left hand is inserted into the nasopharynx, and the periosteal elevator passed through the nostril from the front. The face of the elevator, guided by the finger in the nasopharynx is kept close to the bony attachments of the growth, which are now rapidly separated by a pushing movement of the instrument, as in separating periosteum from the bone.

As soon as the attachments of the bone are separated, the growth is seized in strong vulsellum forceps, and drawn out through the mouth. The incision is now closed in the usual manner. The slight scar remaining on the face is hardly noticeable. This operation is done in Rose's position, the head being drawn over the end of the table. Should there be a considerable degree of hemorrhage, normal saline solution may be given. The major surgery of this region is discussed in greater detail in Chapter I, page 142.

Electrolysis.—With broad-based tumors the snare may not be feasible. Again the bleeding may be so great that it is impossible to go on with safety to the patient. In such cases, electrolysis may be tried. Many sittings will be required, and much patience on the part of both operator and patient. The operation is tedious though not very difficult, and may result in much shrinking, or entire disappearance of the growth. A small, well-insulated needle is introduced through the nose or through the mouth into the growth, and treatment continued as long as the patient will permit. The negative pole is attached to the needle, the positive is placed upon the back of the neck or in the hand. Ten milliamperes are first used, increasing to forty according to the result and the ease with which the current is borne.

The use of seventy, eighty, one hundred and even three hundred and forty milliamperes is described in the literature. The electrolysis does not effect absolute freedom from blood which may come from separation of the slough some days afterward.

Another method is to introduce two iridioplatinum needles directly into the growth, reversing the current at the moment of removal of the needle. The combination of the galvanocautery snare will hasten the healing. It can be used whenever the snare can be made to encircle any portion of the growth. Loeb has reported a very successful case in which both methods were combined.

After-treatment.—The nasopharynx should be kept plugged with a close fitting gauze tampon for 24 to 48 hours. This plug should have attached to it at least three stout pieces of silk, one of which projects from each nostril, and the third out of the mouth. The latter is to be used for removal. The two coming through the nostrils are to be tied over a piece of gauze placed in front of the nose. This avoids any possibility of the tampon slipping back or falling out.

When tracheotomy is done the wound is to be allowed to close at once.

The patient is kept in the hospital and under observation for several days.

Complications.—Hemorrhage.—Excessive hemorrhage must be met by tamponing. When hemorrhage occurs the operation will be greatly prolonged.

Suffocation.—This can be avoided during the operation by previous tracheotomy, by the peroral intubation of Kunht or by the intratracheal anesthesia.

Aspiration Pneumonia.—This will rarely occur when the operation is done in the Trendelenburg or Rose position, fortified in the severer cases by preliminary tracheotomy, intratracheal anesthesia, or peroral intubation, whereby the cavity of the pharynx can be completely closed off from the respiratory tract during the operation. As the operation for fibromata is seldom performed in an emergency, ample time is afforded to consider every phase of the individual case, and to prepare for any possible contingency which is likely to arise.

Incomplete Removal.—True, broad-based fibromata may be so difficult of removal as to render it impossible to get all of the tumor, in which case the question of recurrence must be considered and the case kept under observation.

Mortality.—No correct statistics of mortality are available. Bosworth quoted statistics of fifty-eight cases, collected by Lincoln, of which ten died. Only nineteen were reported cured. Recurrence took place in sixteen.

BENIGN GROWTHS IN THE PHARYNX.

Fibroma, papilloma, lymphangioma, lipoma may come from the palate or from the mouth, and, when nonmalignant and well defined, usually present no special difficulty incident to their removal.

Angioma of the Velum.—Cysts.—These may occur in all parts of pharynx and fauces, or in the tonsil. Dermoid cysts have been found in the tonsil, but are very rare. Retention cysts either of the crypts of the tonsil, or of the mucous glands are not infrequent. Their character and appearance are dependent upon the region of occurring. Diagnosis is not difficult. Incision of the cyst with cautery of the cyst wall is usually sufficient. Should cysts recur, they should be dissected out completely.

Lipoma.—Lipoma sometimes grows out from the tonsil.

Papilloma and Fibroma.—These may arise from the soft palate and pillars. Papillomata are usually pedunculated, and easily removed.

They may be mistaken for epitheliomata. They grow, however, outward, while epitheliomata grow inward. Fibromata have a connective tissue core, and are abundantly supplied with blood vessels. While usually pedunculated, they may be simple, multiple or sessile.

The tumor should be removed down to its base with knife, scissors, or galvanocautery, and then the base cauterized with the galvanocautery.

Teratoma.—This is very rare, but it may be found in all parts of the pharynx. The growth is removed in the same manner as papilloma; that is, with knife, snare, scissors or galvanocautery.

Angioma and Lymphangioma of the Pharynx.—These occur, although but rarely. They may be found on the palatine arches and the uvula. They are usually of no significance unless they are large or bleed. In this latter case they are to be treated by ligation or the galvanocautery. Large angiomata, unless producing symptoms, are better left alone. The safest method of dealing with the angiomata is electrolysis, or ligature. In electrolysis, ten to twenty-five milliamperes are to be applied with negative pole for five minutes, once a week. To ligate, tie off the supply vessels one by one with a ligature until the blood supply has ceased, and the angioma will disappear of itself. Local anesthesia can be used for this purpose.

Lymphoma, Lymphadenoma, and Myoma.—These are also rare among pharynx tumors. These have a connective tissue matrix with aggregated lymphoid cells. The adjacent glands of the neck are likely to be enlarged. Removal is indicated, and the particular operation must depend upon the location and size of the tumor.

MALIGNANT DISEASES OF THE PHARYNX.

Carcinoma and sarcoma frequently invade the tonsil or mucous membrane of this area, either directly from the neck glands or tongue, or the growths may primarily involve the tonsil or the mucous membrane. Cancer here does not differentiate itself in any way from cancer in any other mucous membrane. When present, it soon invades the neighboring lymph glands, and often is not called to the attention of the physician until the glands of one or both sides are already affected. Prognosis is always bad, death occurring from starvation, suffocation or bleeding. Only the very earliest removal with so much of the surrounding tissue as is possible, offers a possible cure. In exceptional cases, resection of a portion of the lower jaw or extensive dissection will be required.

Sarcoma occurs in the following types: round-celled, spindle-celled, myxosarcoma and lymphosarcoma. Clinically, the result is the same whatever the pathologic variations in the tumor. When growths cannot be totally removed, the external carotid artery can be tied, in the hope that the tumor may be limited or destroyed by lack of nutrition.

Carcinoma appears in middle or advanced life, while sarcoma may appear much earlier. Syphilis may be mistaken for malignant disease. The history and the result of treatment will usually determine the diagnosis in a short time.

The uvula may be invaded by both carcinoma and sarcoma, and if limited to the uvula alone it is susceptible of removal, and with good results. Diagnosis may be difficult as sarcomata are slow and painless in progress until ulceration appears or deglutition has become difficult.

Any operative procedure should be performed at the earliest possible moment, and before involvement of the other portion of the pharynx takes place. If this is not done, a steady invasion of the neighboring areas goes on, and the operative prognosis is not good.

Here, as in all cases of malignant disease, no definite operative rule can be laid down. All the diseased area should be removed, some of the healthy tissue being included in order to be secure.

The tonsil is fairly frequently the seat of carcinoma. Early diagnosis is important. The disease is most likely to be mistaken for syphilis. The inflammatory symptoms may so far overshadow the carcinomatous manifestations as to make the diagnosis doubtful for a short time. Histologic examination is necessary for an accurate diagnosis.

At first, carcinomata are rather sharply differentiated, later involving the whole pharynx. At times, it is difficult to tell whether the tumor originates in the palate or in the tonsil. The types of sarcoma are the round-celled, less often the spindle-shape-celled variety, and the lymphosarcoma and angiosarcoma. Lymphosarcoma is more common, and is accompanied by the swelling of neighboring lymph glands, and a rapid course to large tumor. Carcinoma of the tonsil is sometimes scirrhous, sometimes medullary, and is characterized by early involvement of neighboring glands. It is often discovered when the patient seeks advice for swelling of the glands at the side of the neck.

Prognosis is very bad. Death may occur from starvation, suffo-

cation, bleeding or exhaustion. Only the very earliest complete excision effected preferably by external operation offers any hope.

Treatment.—The treatment of a malignant disease, whether carcinoma or sarcoma, depends upon its location and character. When limited to a particular place, as sometimes happens in the tonsils, it may be possible to remove the growth completely and this followed by the removal of the glands, will stay the progress of the disease, for a time at least. When limited to the tonsil, the growth, together with as much of the palatine pillars as may be necessary, should be carefully and thoroughly enucleated with scissors, due care being taken not to leave any disease behind nor to injure any of the great vessels. Butlin prefers to do the tonsil operation at one time, and then at another sitting, to deal with the glands in the neck. He thinks that if the primary disease be squamous-celled carcinoma it may be dealt with through the mouth, but if it be sarcoma, and involves the entire tonsil, the prospect of local recurrence is so great that it is doubtful whether a sufficient removal can be effected through the mouth.

When the pharynx is extensively involved, external pharyngotomy may be done after the methods of Jäger and Langenbeck or the subhyoid pharyngotomy of Mikulicz.

CHAPTER IX.

ENDOLARYNGEAL OPERATIONS WITH THE AID OF THE LARYNGOSCOPE.

By Robert Levy, M.D.

REQUISITES AND AIDS.

For the successful endolaryngeal operation, proper illumination is absolutely essential. The source of light must be brilliant, white, uniform and free from conflicting shadows. These qualities are best obtained by using the Nernst electric light placed in a suitably constructed metal cylinder, in which a planoconvex lens properly hooded is inserted at its proximal end. (Fig. 732.)

The patient is seated in a straight-back chair, the operator sitting immediately in front. The greatest convenience is insured by placing the source of illumination to the patient's right, slightly behind and on a level with his head. The instrument table should be to the operator's left and should contain besides the instruments needed for the operation, gauze sponges, sterile napkins, sterile water for cleansing the laryngeal mirror and a spirit lamp for warming it.

Three assistants are desirable. The first assistant should be seated to the operator's right and somewhat nearer to the patient. His duties are most important and consist in holding the patient's tongue if it is found that the patient cannot do this himself, in controlling the epiglottis and in manipulating intralaryngeal instruments under the direction of the operator if it should be found necessary to use more than the one in the hand of the operator himself. This is called for only in certain operations. A second assistant presides over the instrument table and a third holds the patient's head and retains the mouth-gag in position when necessary to use one.

If the patient's cooperation cannot be satisfactorily enlisted, as often occurs, the tongue should be held by the first assistant, being grasped between the two folds of a napkin. If this proves unsatisfactory, a silk ligature may be placed through the tip of the tongue

thus enabling the assistant to hold it well forward without interfering with the operator. This procedure is usually adopted when operations are performed under general anesthesia. The soreness of the tip of the tongue resulting from the ligature is trivial and disappears rapidly.

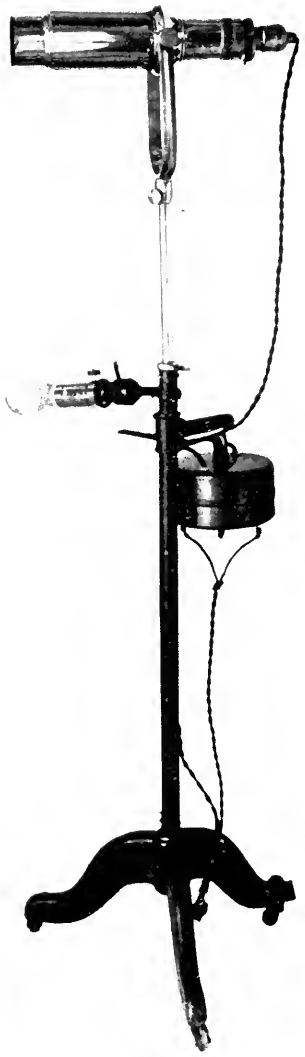


Fig. 732.

Nernst lamp with current controller and reducer.

One of the greatest obstacles to satisfactory endolaryngeal operations is a depressed epiglottis. This is particularly apparent under general anesthesia although in the majority of operations in the anterior half of the larynx, the epiglottis is decidedly in the way.

Various forceps have been devised to overcome this difficulty. The best procedure however is that described by Horsford in which a properly constructed needle holder enables one to pass a ligature

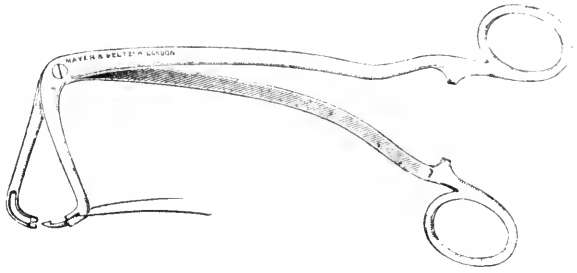


Fig. 733.
Horsford's epiglottis needle forceps.

through the free border of the epiglottis. This ligature may either be held by the first assistant, or it may be grasped by a pair of hemostat forceps and allowed to hang out of the mouth. The weight of the for-

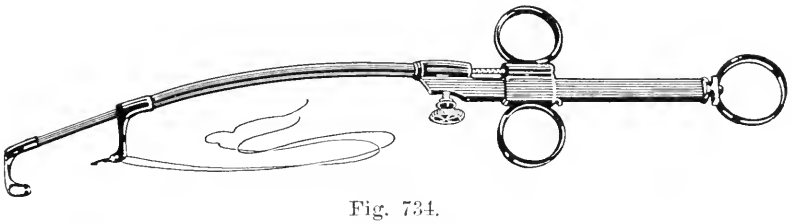


Fig. 734.
Pfau's modification of Horsford's epiglottis needle forceps.

ceps will hold the epiglottis well upward and forward. (Fig. 733.) Pfau's modification is shown in Fig. 734.

This instrument is a modification of the Kurz needle holder. By

Fig. 735.
Brünings' laryngeal mirror.

its use a needle properly threaded is placed in one of its blades which when closed upon the opposite blade permits the needle to be grasped and withdrawn with the instrument, the ligature remaining in the tissue.

An additional aid to endolaryngeal operations, as indeed it is to careful laryngoscopic examination, is the magnifying anastigmatic mirror of Brünings. This mirror enlarges the laryngeal picture two and a quarter times. (Fig. 735.)

For examining parts not seen in ordinary laryngoscopy, namely the under surface of the vocal bands, portions of the posterior surface of the epiglottis and of the posterior wall of the larynx as well as the ventricle of Morgagni, Gerber described a method of subglottic laryngoscopy. A mirror 10 mm. long by 8 mm. wide is attached to a shank which is properly bent downwards for a distance of 9 cm. After thorough cocainization of the larynx this mirror was placed within the larynx permitting Gerber to view these otherwise inaccessible regions.

Anesthesia.

Endolaryngeal operations may be conducted under local or general anesthesia.

Local Anesthesia.—Since the advent of cocain, operations within the larynx have become greatly simplified and many of the previous difficulties such as preliminary training have been almost completely overcome. The proper local application of cocain or some of its substitutes is productive of uniformly satisfactory anesthesia. Cocain remains the most reliable drug but owing to its toxic properties, beta eucain may be substituted at times. Where unsatisfactory results are obtained one can usually determine a faulty technic in its application. In a few rare instances the use of this local anesthetic in quantity approaching the danger line has failed to anesthetize the mucous membrane of the larynx, so that the slightest touch of the instrument has resulted in a violent exhibition of the laryngeal reflex. There is a distinct difference between the retention of sensation and the reflex contraction of muscles. In these cases local anesthesia may fail.

Cocain poisoning is less likely to occur if the drug is so applied that little if any is swallowed by the patient. Its application directly to the field of operation is therefore desirable. Reflex contraction may be avoided by applying the anesthetic to the soft palate, posterior pharyngeal wall and posterior surface of the epiglottis. This being a large surface to cover, a solution of at most two per cent may be sprayed upon the parts as a preliminary procedure. The immediate effect of this is to cause in addition to anesthesia a most disagreeable and, to some individuals, alarming sensation of constriction. The dangers of poisoning are much greater when solutions are used in spray than when the remedy is applied by cotton applicator. The addition of a

solution of one of the adrenalin preparations in the strength of 1-8000 will inhibit the cocain intoxication. This may be almost completely avoided however by substituting a two to four per cent solution of beta eucain. It has been shown that this drug is very much less toxic than cocain and while its anesthetic properties may not be so pronounced or reliable, it generally answers for the preliminary spraying.

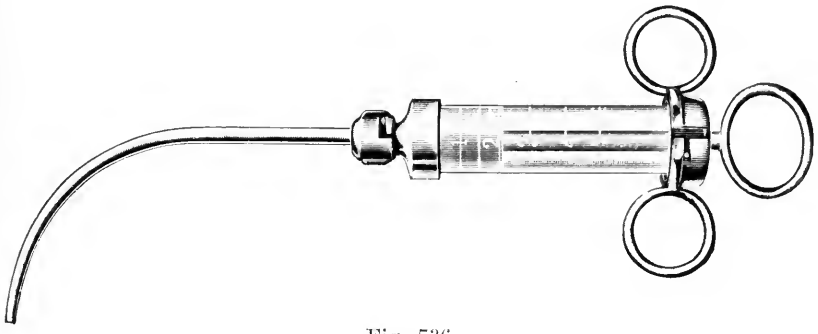


Fig. 736.

Record laryngeal syringe.

After waiting five minutes the field of operation should be carefully painted with a twenty per cent solution of cocain by means of the cotton applicator. This should be thoroughly moistened with the solution but not to the extent of permitting any of it to drip from the cotton. Repeated applications of the stronger solution should be made at intervals of two minutes until it is determined, by manipulating the

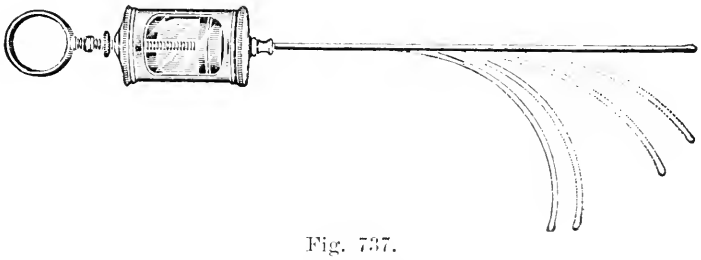


Fig. 737.

Muer's pliable laryngeal syringe.

parts, that anesthesia is complete. The patient's sensation of local constriction may also be a guide.

In a certain proportion of cases the application by means of the cotton swab is ineffectual. Here five drops of the twenty per cent solution may be applied directly to the field by means of the laryngeal syringe. (Figs. 736 and 737.)

This should of course be preceded by the preliminary spraying with the weak solution.

The submucous injection of cocain solution for anesthesia has been practiced by Heryng and others. This is particularly recommended for those cases in which swollen or infiltrated masses are to be extirpated such as are found in tuberculosis. The technic of this method is greatly facilitated by the use of Chappell's syringe. (Fig. 738.) Having produced preliminary anesthesia, the needle of this instrument is pressed well into the submucous tissue and by a slight movement of the thumb the spring releases the piston forcing the fluid into the parts. The advantage of this instrument is the accuracy with which it can be used. Anesthesia by this method is more rapidly produced and persists for somewhat longer time than by the method of topical application.

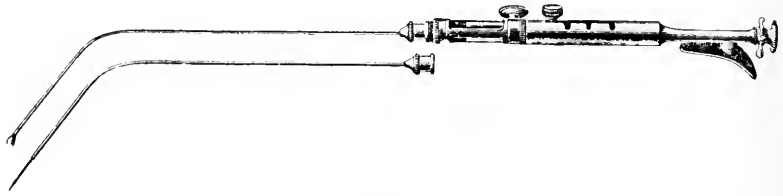


Fig. 738.

Chappell's laryngeal syringe.

Local Anesthesia by Injection Into the Superior Laryngeal Nerve.—This method is described by Frey as follows:

"By palpation we determine the position of the greater cornu of the hyoid bone and of the posterior superior process of the thyroid cartilage on the left side of the neck. The entire larynx being gently pressed towards the left with the left hand, the fine pointed needle is inserted, observing the usual asepsis, a little below the middle of a line drawn between these two landmarks. The needle is held vertically to the skin and directed towards the median line. In puncturing the platysma the needle should be held exactly horizontally towards the medial line. After puncturing that muscle which is felt as a firm resistance, the larynx need no longer be pushed towards the opposite side. We now have the feeling that the point of the needle is in an open space; this is the space behind the thyroid muscle which is bordered medially by the thyroid membrane. The point of the needle which is now about 1 cm. below the skin should not be inserted any deeper in order to avoid penetrating through the membrane into the larynx. Although the first injections were made in this manner and the entire amount at once injected towards the medial line further ex-

perience has shown it to be advisable after penetrating the platysma to plunge the needle slightly backward in the direction of the course of the nerve. About ½ c.c. is then injected after which the syringe is gradually emptied while directing the needle again towards the medial line. For the right side the operator stands to the right and behind the patient. In this position palpation and injection are carried out in the same manner as described for the left side. It is especially important that the patient refrain from swallowing while receiving the injection because the motion of the larynx consequent upon the act of deglutition may cause deviation of the needle." Satisfactory results by this method may be obtained by using twenty drops of a one per cent solution of cocain in combination with a 1 to 10,000 solution of adrenalin. It is particularly recommended in excessive irritability of the upper half of the larynx which is supplied by that highly sensitive nerve, the superior laryngeal. The success of this method depends largely upon waiting for the proper length of time after the injection before beginning intralaryngeal manipulation. This varies in different individuals. Anesthesia in some may be complete in three minutes in others twenty minutes must be allowed to elapse.

General Anesthesia.—In relatively few instances does it become necessary to administer a general anesthetic for endolaryngeal operations except in cases of children or young adults. In the author's experience the adolescent age is particularly resistant to satisfactory local anesthesia of the larynx. Where general anesthesia is necessary the choice of anesthetic becomes a question of considerable importance. Generally speaking, ether is to be preferred although its well-known irritating effect upon the mucous membrane of the upper air passages, producing excessive secretion, is a decided disadvantage. On the other hand the element of safety enters as a more important factor and particularly when the almost erect or sitting position of the patient becomes a necessity. While chloroform produces an ideal anesthesia and is especially useful in children it adds greatly to the dangers. Its employment makes it necessary to keep the patient in a reclining or semi-recumbent position, a most difficult and at times, impossible one for intralaryngeal operations.

The excessive secretion in ether anesthesia may be greatly diminished by the administration of atropin one hour before the operation.

In using general anesthesia, the patient should be placed in an operating chair so constructed that he may be raised to a sitting, or lowered to a recumbent position at will. Anesthesia should be begun in the recumbent position and when complete the patient should be raised gradually. A chair is preferable to an operating table in that

it permits the operator to sit directly in front of the patient. When the operator stations himself on either side, he is at an inconvenient angle for ease and accuracy of manipulation. In the case of young children the anesthesia may be begun upon a table, the patient being lifted to the lap of the nurse before the operation is begun.

Complete surgical anesthesia is absolutely essential for operations in this region. It is extremely difficult to continue the administration of the anesthetic during operative manipulation. This may be partially accomplished either by holding a gauze sponge grasped by a long pair of forceps and saturated with the anesthetic in the vicinity of the nose and mouth, or by placing a properly constructed tube similar to that of the Junker inhaler (Fig. 739) in the right angle of the mouth. As a rule this will not interfere with the use of the laryngo-

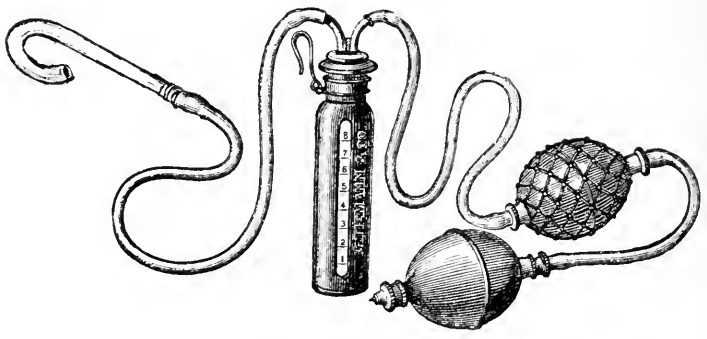


Fig. 739.
Junker's inhaler with Kenney's tube.

scope and it is out of the way of laryngeal forceps or other operating instruments.

It is well known that the laryngeal reflex is one of the last to disappear under anesthesia. Even when profound narcosis has been established the moment an instrument is introduced into the larynx reflex spasm occurs. In order to overcome this a solution of cocain and adrenalin should be applied especially over the posterior surface of the epiglottis. This can best be done by means of the cotton applicator. The strength of the solution should vary with the age of the child. Young children do not bear cocain well. A one or two per cent solution in combination with a 1 to 10,000 adrenalin solution answers every purpose. In young adults stronger solutions may be used, five per cent being generally sufficient. If this does not answer the percentage may be increased to fifteen or twenty per cent, care being observed to have the cotton moist but not dripping.

MINOR OPERATIONS.

Puncture—Scarification—Incision.

Indications.—One or all of these procedures are indicated in inflammatory or non-inflammatory swelling involving the mucous membrane and submucous connective tissue of the epiglottis, aryepiglottic folds, ventricular bands or arytenoids. The choice of operation depends upon the stage or degree to which the process has extended.

Puncture is useful in the swollen mucous membrane found in the severe type of acute catarrhal laryngitis of children, and in acute inflammatory or non-inflammatory edema of the larynx.

Scarification is preferable when these processes continue to more advanced stages. It is also indicated in edema attending perichondritis from whatever cause, edematous laryngitis of influenza, streptococcic or other severe infections, phlegmonous laryngitis and edematous epiglottiditis.

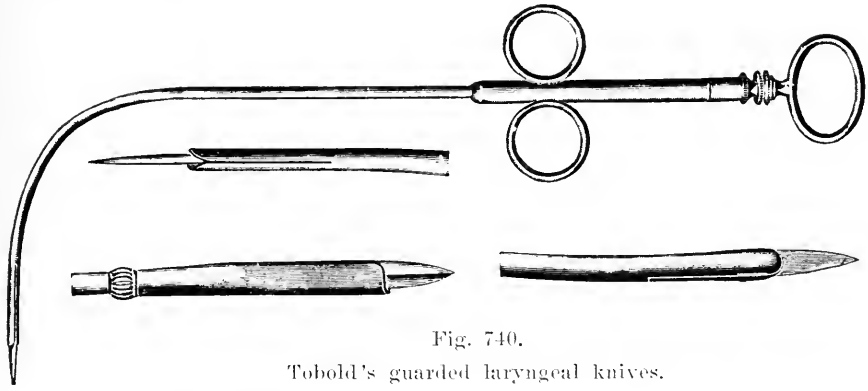


Fig. 740.

Tobold's guarded laryngeal knives.

Incision is called for in abscess of the larynx from whatever cause such as tuberculous perichondritis, syphilitic perichondritis, trauma or foreign bodies and in abscess consequent upon glanders. Incision has been found necessary in hematoma of the larynx. Cystoma of the vocal cords should be incised when its removal can not be effected by other methods. Strictures following tuberculous or syphilitic ulceration, congenital webs or those due to other causes may be incised prior to dilatation or for the excision of cicatricial tissue.

Anesthesia.—Except in rare instances local anesthesia will be found sufficient. It should always be the method of choice where laryngeal obstruction of even moderate degree exists. Exceptions to this may be found in those cases attended with laryngeal dyspnea and in which a prolonged operation is called for as in the case of cicatricial

contraction. Here preliminary tracheotomy may be performed and a general anesthetic administered through the tracheal cannula.

The method of producing local anesthesia in acute inflammatory conditions should be preferably by spray and topical application as already described. For the other conditions mentioned it may be

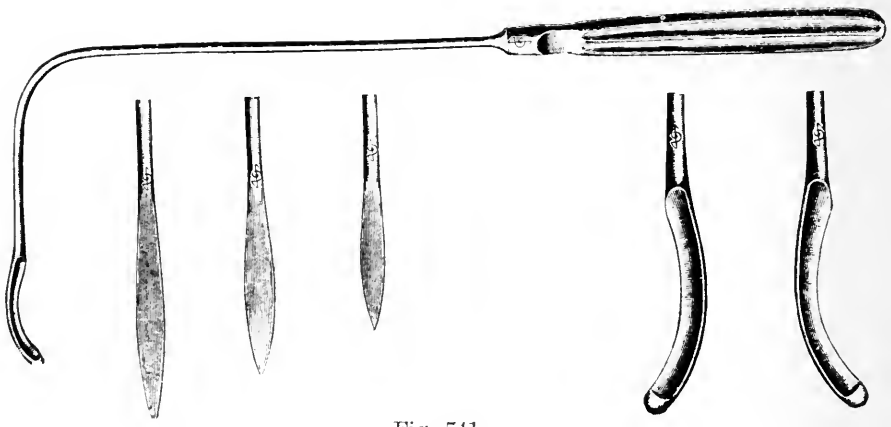


Fig. 741.

Tobold's unguarded laryngeal knives.

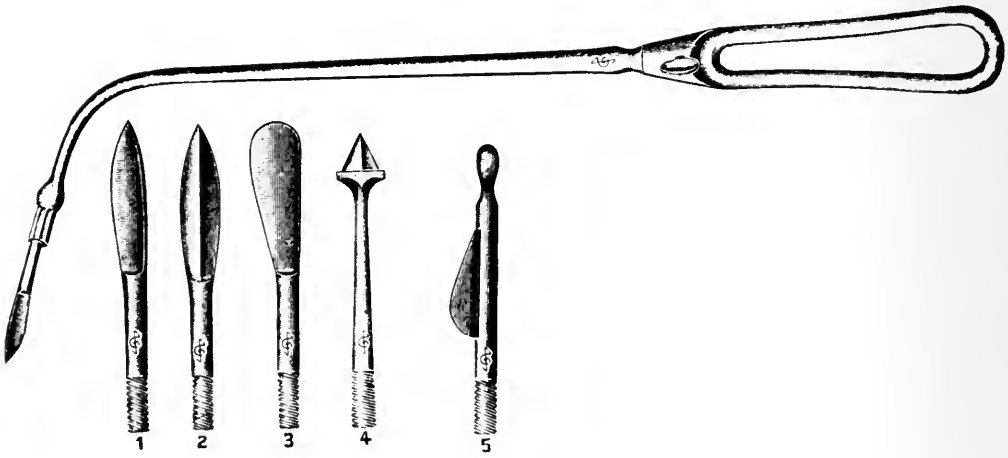


Fig. 742.

Heryng's laryngeal knives.

found necessary to resort to submucous injection or injection of the superior laryngeal nerve.

Technic.—The instruments most generally useful for these operations are the laryngeal knives of Tobold or those of Heryng. The former may be guarded or unguarded. (Figs. 740, 741, and 742.)

The unguarded instrument although requiring greater perfection

of technic is simpler and more accurate in its application. It should be chosen in preference to the guarded instrument.

The patient is seated in the usual position for laryngoscopy, and the laryngeal knife is carried, under the guidance of the laryngoscope, to the swollen parts and numerous superficial punctures are made with its point.

Scarification is accomplished by drawing the point of the knife over the arytenoids, or the ventricular bands, or in the case of the epiglottis, drawing the cutting edge of the instrument over its surface. These scarifications should cover the length of the swelling.

Incision is accomplished by the same instrument placed more deeply into the tissues and, in the case of abscess, an incision sufficiently deep and long should be made to evacuate thoroughly its contents. The evacuation of a large abscess may be attended by a sudden in-

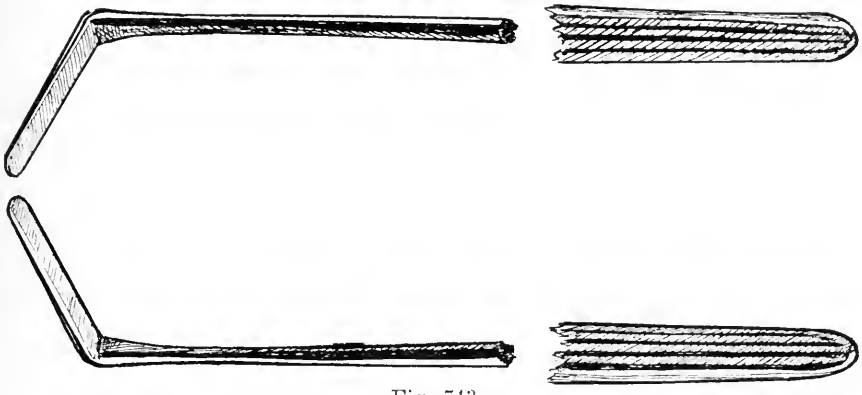


Fig. 743.

Lateral laryngeal knives.

spiration of a quantity of pus. To avoid serious consequences it is desirable in such cases to turn the patient rapidly to one side with the head down. Cicatricial bands and tissue situated upon the right or left and in the upper half of the larynx or at its orifice may be more satisfactorily incised by using the lateral knives as shown in Fig. 743.

After-treatment.—This consists essentially in the local treatment indicated for the particular disease for which the operation is undertaken. Cracked ice is usually grateful to the patient after these procedures. Hemorrhage is rarely if ever of importance. It may be controlled by spraying with adrenalin.

Value of Operation.—In edematous swelling of even considerable degree these procedures frequently terminate the case successfully. If however the edema persists to the extent of interfering markedly with breathing, these simple measures must give way to more radical surgical intervention, namely, tracheotomy.

Curettage.

Indications.—This operation is called for in lupus, papillary nodules found in secondary syphilis and soft papillomatous excrescences and sluggish ulcerations of tuberculosis.

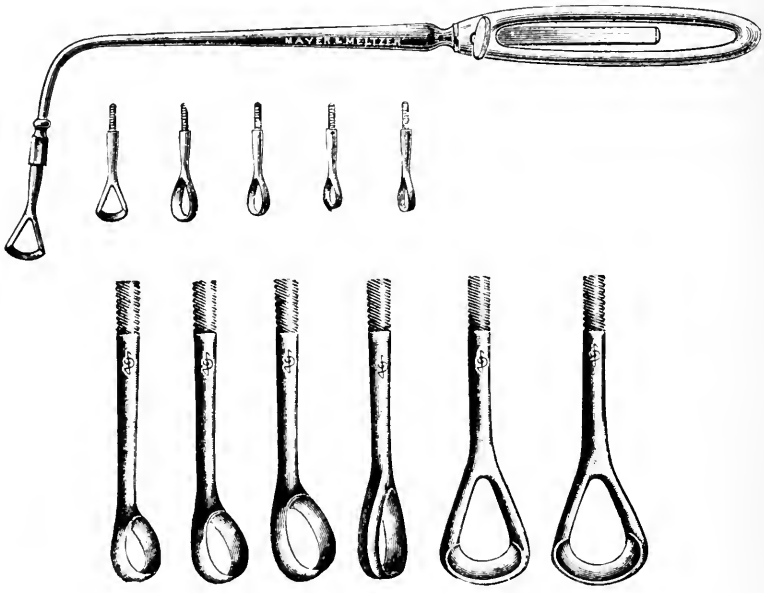


Fig. 744.

Heryng's laryngeal curettes.

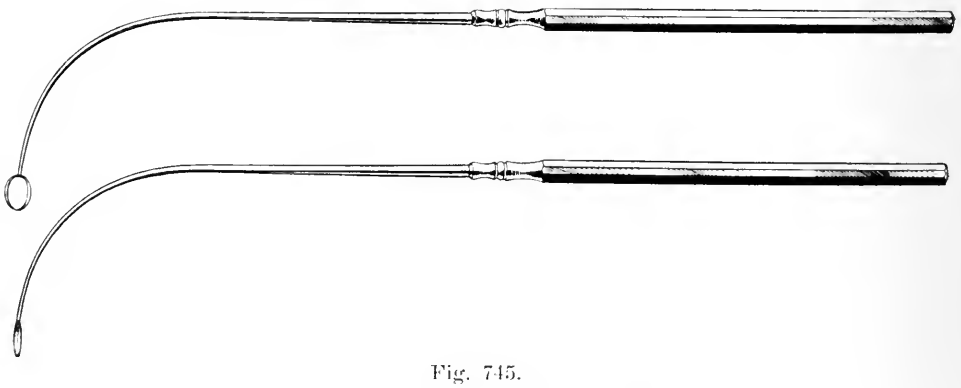


Fig. 745.

Levy's sharp laryngeal ring curettes.

Contraindications.—It is not recommended in hard or firm infiltrations and should be avoided in those tuberculous ulcers which are attended with edema, high temperature and other manifestations of an acute or rapidly progressing infection.

Anesthesia.—Local anesthesia should be as complete as possible. This is particularly necessary in tuberculous cases where pharyngeal and laryngeal reflexes are usually exaggerated and where pain is a common symptom.

Technic.—The sharp curettes of Heryng (Fig. 744) are applicable to the majority of cases. The author's ring curettes (Fig. 745) are useful where great delicacy of manipulation is required. Generally curettage should be practised with considerable force leaving beneath a smooth and bleeding surface.

After-treatment.—The pain following this procedure is frequently considerable especially in cases of tuberculosis. This may be alleviated by insufflating the following powder:

R Pulv. Iodoformi
Pulv. Orthoformi
Pulv. Acaciæ.....āā
Misce.

Electrolysis.

Indications.—Conditions in which it is desirable to avoid post-operative reaction or where hemorrhage is to be feared may be treated by this procedure although its operation is extremely slow, requiring time and patience. It has been successfully used in pachydermia, in tuberculous infiltrations and in stenosis of the larynx due to changes following the prolonged wearing of a tracheotomy tube. (Boulay.) It is a method of considerable value in angiomata and may be used in otherwise inoperable malignant tumors.

Technic.—The best method of carrying out this procedure is by means of the bipolar electrode. (Fig. 746.) The current should be carefully tested before the operation by placing the electrode in water and should be controlled and accurately measured by a reliable milliamperemeter. One may begin with ten milliamperes at a sitting of not more than one minute. This may be repeated every second or third day, the strength of the current and the length of time of each sitting being increased. The intervals between the sittings may be regulated by the scar produced.

Galvanocautery.

The galvanocautery is used in the larynx for superficial application, for deep puncture or by the snare.

Indications.—Laryngeal hemorrhage in which the bleeding point is so situated that it can be seen by laryngoscopic examination, small

granulations following the removal of tumors or other surgical procedures within the larynx, small tumors, especially of the bleeding variety, the destruction of veins which mark the remains of an angioma are definite indications for the application of the cautery point or the flat electrode. Lupus nodules may be removed readily by this

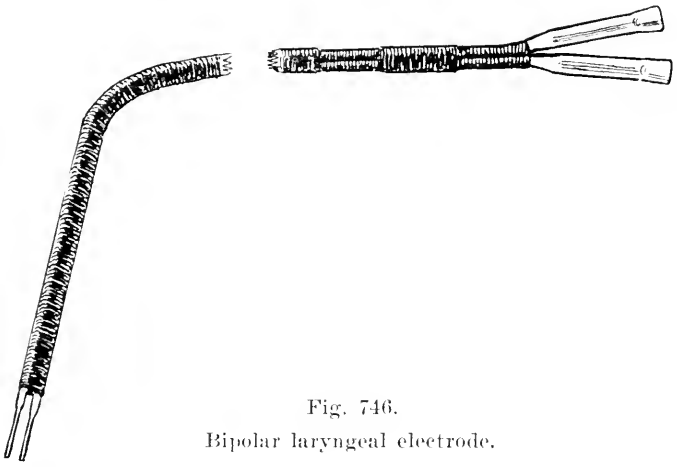


Fig. 746.
Bipolar laryngeal electrode.

method applied somewhat more firmly. Cicatricial webs or those due to congenital malformation may be incised by the cautery knife. The galvanocautery puncture is applicable to tumors, excrescences and

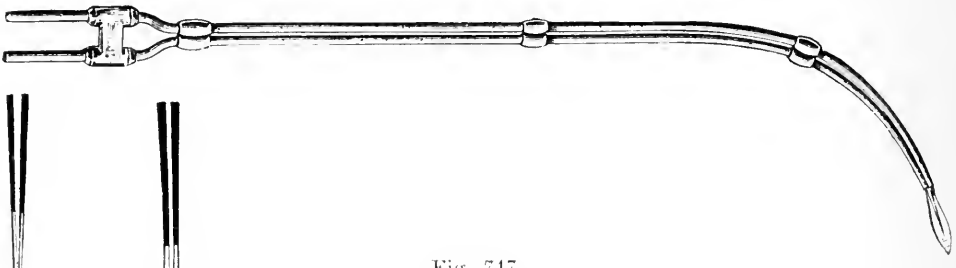


Fig. 747.
Galvanocautery laryngeal electrode.

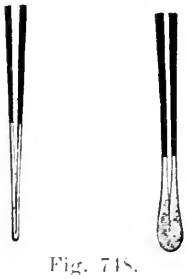


Fig. 748.
Broad flat and pointed electrodes.

infiltrations due to tuberculosis and lupus, and for the destruction of cysts.

The galvanocautery snare is useful for the removal of portions of tumors that are firm and fibrous in character, bleeding tumors, and pedunculated infiltrations.

Anesthesia.—This must be exceptionally complete because of the tendency to laryngeal spasm from procedures of this kind.

Technic.—The curve of the laryngeal electrode as well as its length should be carefully chosen according to the region to be attacked. (Fig. 747.) The anterior portions of the larynx require a more nearly right angle than the posterior portions. For superficial cauterization

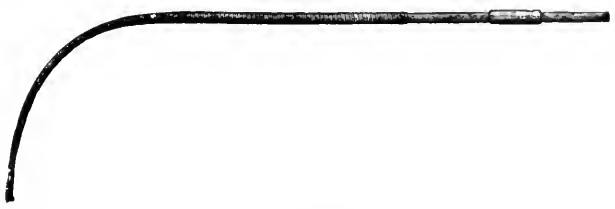


Fig. 749.

Laryngeal cannula for galvanocautery snare.

a small short point or broad flat electrode should be used. (Fig. 748.)

For deep puncture it is necessary to use a point not less than half an inch long. Broad flat cautery knives are best adapted for incising bands or webs.

The cautery snare should be threaded with platinum wire. (Fig.

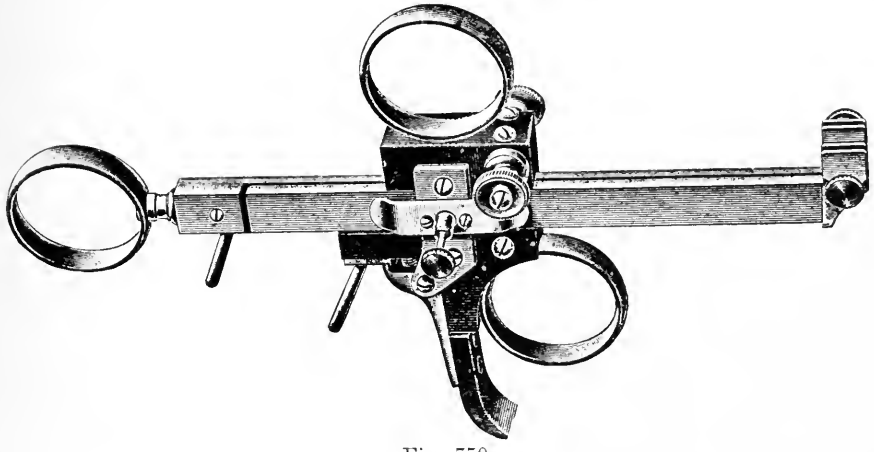


Fig. 750.

Kuttner's galvanocautery snare handle.

749.) Where it is difficult to apply this wire on account of its pliability, steel wire may be substituted but in this case the operator must proceed quickly for fear of burning the steel wire through before the operation is finished. The cautery handle should be chosen with the view to quick and easy manipulation. Usually the cautery point can be controlled best by means of the Kuttner handle which is held firmly

in the hand, contact being made by a trigger-like device. (Fig. 750.) Where great delicacy of manipulation is necessary the current may be controlled by a foot switch.

Before using the galvanocautery one should carefully test the instrument. A controller capable of accurate regulation is absolutely necessary. The platinum electrode should be brought to a bright red heat except in the case of bleeding points or bleeding tumors. Dull red heat is more efficacious in controlling hemorrhage. Having determined that the proper degree of heat can be instantly obtained, the instrument is introduced cold to the site of operation. For superficial cauterization a short light contact is then made. For deep puncture such as is recommended for tuberculous infiltration, Grünwald advises the point to be applied to the field, the current turned on and the tissues slowly penetrated until the resistance of the healthy structure is obtained or until one sees the red gleam in the subglottic region. The burning should continue until one feels the points of the electrode freely movable. This condition is obtained usually in from five to ten seconds. Not more than two punctures should be made at one sitting.

The cautery knife for incising cicatricial bands must be used with somewhat greater force and it is frequently necessary to begin with an initial heat approaching white heat. This degree of heat is sometimes necessary also in using the snare on account of the rapidity with which the tissues cool the electrode.

After-treatment.—The reaction following galvanocautery applications within the larynx is at times considerable. It can be controlled best by applying an ice bag around the neck or by instructing the patient to swallow small pieces of cracked ice at frequent intervals.

Untoward Effects.—Some authors have discarded the use of this agent because of the severe and at times alarming reactions that have followed. By exercising care in its application to the end that the surrounding normal tissue is not greatly injured or by limiting the extent of its application, one may usually avoid serious consequences. The galvanocautery is not intended for extensive laryngeal operations. If much tissue is to be destroyed it may be done by frequent sittings with very limited cautery application. One should not repeat the application until all reaction from the former cauterization has disappeared. An average interval of ten days is usually sufficient.

The reaction following galvanocautery usually manifests itself by acute edema. During the operation glottic spasm may occur. The possibility of this is greatly diminished by thorough anesthesia. The objection has been raised that disagreeable effects are produced by the smoke resulting from the burning.

Should the current fail or be reduced in quantity during the use of the snare it may be impossible to remove the wire. This is an extremely grave accident and may call for immediate tracheotomy. One should never attempt an endolaryngeal operation of this character unless prepared to open the trachea at any stage of the procedure.

TUMORS.

Although intralaryngeal tumors were probably recognized and removed prior to the advent of the laryngoscope, it was not until this instrument came into use that their recognition or removal was attended with any degree of accuracy. Within a few years however of Garcia's discovery the first operation for laryngeal neoplasm was performed. The question of priority as in many other subjects is a vexed one. Wright gives Lewin credit for the first intralaryngeal operation, for the removal of a laryngeal growth under the guidance of the mirror, which he is said to have performed July 20, 1860, while Jurasz credits Victor von Bruns with the first operation performed in 1861 and does not even mention Lewin. From these dates the number of tumors observed and extirpated by this method grew with great rapidity and the scarcity of these growths of recent years has been ascribed to the avidity with which they were removed in the early days of laryngoscopy. As Wright so well expresses it, "no subject so immediately engaged attention as that of laryngeal tumors, forming striking pictures in the laryngeal mirror, causing marked and distressing symptoms, capable of immediate relief by means of instruments under the guidance of the laryngoscope and last, but by no means least, affording the operator a chance to display in the most brilliant manner his newly acquired skill."

The Laryngoscopic Method.—The removal of tumors from the larynx *per vias naturales* and under the guidance of the laryngoscope may be termed the laryngoscopic method to distinguish it from more recent intralaryngeal manipulations by means of endoscopic instruments, and from all extralaryngeal operations. Its performance requires great manual dexterity and the exercise of peculiar skill which can be acquired only by prolonged training, an accurate eye, and a steady hand. It is an operation of the greatest delicacy but should be, nevertheless, the acquisition of all laryngologists. Moreover the competent man should be proficient in intralaryngeal manipulations of whatever character, the particular instrument or instruments used being equally well at his command. The difficulties encountered have favored the resort to other methods of procedure so that the question

often arises as to which method should be adopted in a given case. That grand old man in laryngology, Massei, very aptly says, "In our times, when broad culture is indispensable for a specialty, we veterans of a very recently formed army note the tide which carries the young toward general surgery and tends to throw aside operations through natural routes which are more simple and frequently offer greater chance of success."

In order to overcome some of the difficulties encountered in intralaryngeal operations, the training of a patient was necessarily attended by many annoyances and much delay. Infinite patience on the part of both subject and operator was demanded. The administration of bromid of potassium for days beforehand produced local analgesia. The use of ice pellets assisted somewhat at the time of operation.

Since the discovery of cocain and allied local anesthetics many of these difficulties have been completely overcome; nevertheless, it is still necessary in certain cases to give the patient some preliminary training. Merely holding the tongue in some patients induces retching. The patient should be instructed to manipulate his tongue at home and frequently to pass a blunt lead pencil or similar instrument to the base of the tongue and pharynx. Besides this, one may accustom the patient to the introduction of the instruments by using them daily for two or three days prior to the date of operation. These preliminaries are necessary only in exceptionally sensitive subjects. In the majority of cases thorough cocainization enables one to operate at the first examination if desirable.

Benign and Malignant Tumors.

Laryngeal tumors may be divided into benign and malignant. Generally speaking all benign tumors should be removed through the natural passages rather than by external incision. The question of malignant growths and their removal by this method will be considered later. The size and position of the tumor are the most important determining factors in the method of its removal. Small growths situated in the supraglottic region should invariably be removed by this method. Many infraglottic tumors, provided they do not extend too far downward, and even intratracheal growths may be extirpated under the guidance of the laryngoscope. The question of choosing between this method and the direct endoscopic procedure described and perfected by Killian, Jackson, and others is one of very recent date and on this account is not as yet capable of absolute determination. Suspension laryngoscopy has greatly simplified direct endoscopic

procedures so that many of the difficulties have been eliminated. Owing to the large number of laryngologists who have been trained in the use of the mirror as compared with the few whose technical skill enables them to use the direct method easily, the former will doubtless for many years be the method of choice. It must be conceded also that patients are more readily trained to the required manipulation of the laryngoscopic method than they are to the method by the direct laryngeal speculum; and this offers another reason for adopting the former. On the other hand it is self-evident that on account of the situation of a tumor, it may be inaccessible except by direct laryngoscopy. This is peculiarly true of growths situated low in the larynx or in the trachea. The trained laryngologist therefore may proceed with safety by first attempting the laryngoscopic method which subjects the patient to comparatively little discomfort, failing in which he may then adopt the direct method.

Benign Tumors.

Benign tumors may be classified as follows: papilloma, fibroma, cystoma, lipoma, angioma, lymphoma, myxoma, and chondroma. Mixed varieties are frequently found, such as fibro-angioma, fibromyxoma, etc. In addition certain growths developing upon the edges of the vocal bands in singers have been described as singers' nodules while pachydermia laryngis has resulted in the development of circumscribed neoplasms. Prolapse of the ventricle of Morgagni although not definitely a neoplasm has been classified as a laryngeal tumor. The thyroid gland has been seen as an intralaryngeal tumor and calcareous concretions in gout have been described as tumors under the term tophi. Syphilis, tuberculosis, lupus, and leprosy have all presented intralaryngeal manifestations of circumscribed and distinct new growths known as granulomata. Of these tuberculomata and syphilomata are recognized as specific tumors.

Tumors may be removed from the larynx by chemical caustics, by galvanocautery, by electrolysis, by the sponge method of Voltolini, by incision, by forceps, by the snare, or by the guillotine.

Chemical Caustics.—This method has a very limited application. It may be used in small nodules, small papillomata, pachydermia and tuberculous or syphilitic excrescences. It has been of much value in the prevention of recurrences, especially in the case of papilloma and fibroma. It is also valuable in that form of multiple papillomata in which the neoplasms seem to take on the nature of diffused papillomatous infiltration. This condition is well illustrated in Fig. 751.

In such cases the most prominent masses may be removed by cutting forceps but it becomes quite impossible to remove the last vestige of the irregular papillomatous deposit. The method by chemical caustic becomes a useful auxiliary.

Numerous chemicals have been used for this purpose, the most desirable being chromic acid and trichloracetic acid.

Fig. 751.

Multiple papillomata with papillomatous infiltration.

Chromic acid is best used by fusing a crystal upon a laryngeal applicator. (Fig. 752.) The acid may be fused upon the end or upon either surface of the applicator depending upon the position of the tumor. Trichloracetic acid may be best applied by the specially constructed applicator shown in Fig. 753. Into the fenestrum of this applicator a crystal of the acid is firmly placed enabling one to pass the

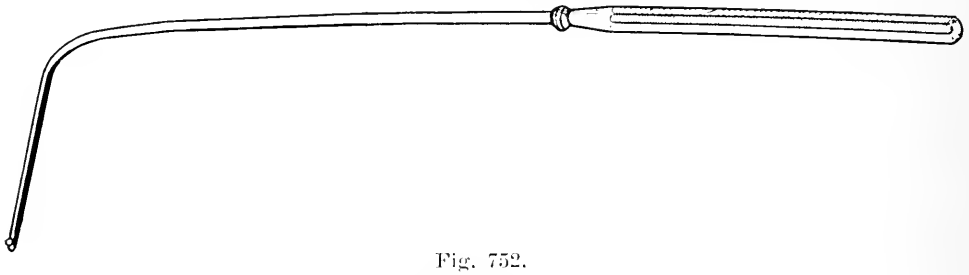


Fig. 752.

Bead of chromic acid fused on a laryngeal applicator.

instrument directly to the seat of the tumor without the danger of cauterizing other regions in its passage.

The larynx should be thoroughly cocainized by one of the methods previously described, and after having been tested by the introduction of a cotton applicator to determine whether it can be manipulated without producing spasm or sudden movement, the caustic-armed instrument is passed directly to the site of operation and gen-

tle pressure made upon the desired region. In using chromic or trichloracetic acid it is well to remember that these agents are hygroscopic and the attempt should therefore be made to dry the field of operation as much as possible by gently mopping with absorbent cotton.

Galvanocautery.—This method is capable of much delicacy and accuracy of application. Its effect may be more carefully regulated than that of chemical caustics.

It may be applied to the removal of small hard growths and small bleeding tumors. Cysts of the larynx may be satisfactorily

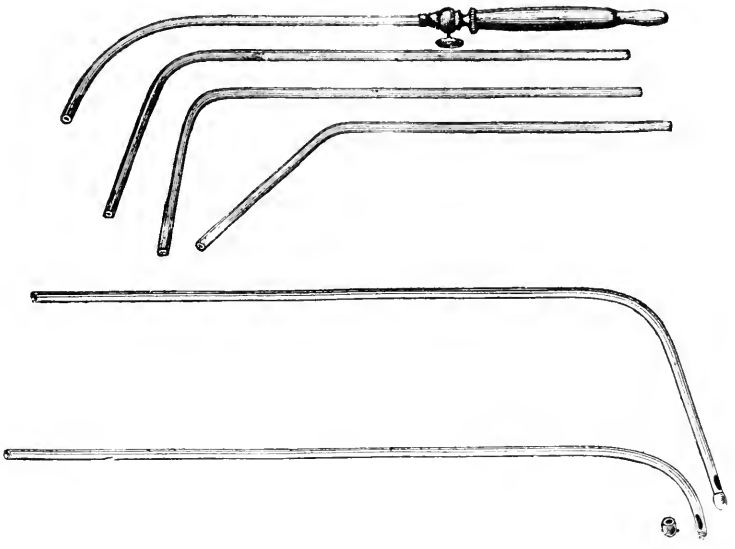


Fig. 753.

Trichloracetic acid applicators.

treated by puncturing with the galvanocautery. Care should be observed to make the opening as large as possible.

The method of procedure is described on page 249.

Electrolysis.—The removal of tumors by electrolysis has already been discussed.

The tumors to which this method is applicable are those with very broad sessile bases such as are sometimes found in fibromata, cystomata and chondromata, those in which hemorrhage is liable to be an important factor and such malignant growths as are otherwise inoperable. In the latter one cannot hope for cure by electrolysis but some comfort may be afforded the patient by reducing the size of the growth.

The Sponge Method of Voltolini.—This consists in an attempt to rub the tumor off by a properly curved applicator armed with a small

dry sponge. The method is unsatisfactory, unscientific and uncertain. It may be followed by very marked reaction and secondary inflammation. It has been successful in the removal of small soft growths of the papillomatous variety.

Incision.—Cystoma, especially when growing from a vocal band or the epiglottis is often attached by a broad base. By incising it one may evacuate its contents. This may then be followed by the application of a chemical caustic which destroys its walls. The method is recommended where sharp forceps are inapplicable. Fig. 754 illustrates a cyst of the right vocal band whose base was so broad that it was impossible to grasp it with the ordinary forceps. It was therefore incised by means of the laryngeal knife devised by Heryng. (Fig. 742.) Its contents consisted of a small quantity of thick opaque fluid. Two months after the operation no trace of the cyst could be seen and the patient's voice was normal.

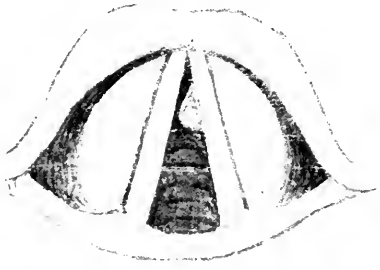


Fig. 754.
Cystoma removed by incision.

Forceps.—The removal of tumors by laryngeal forceps is the most generally applicable of all methods.

Numerous other conditions besides tumors have been removed by sharp cutting forceps; namely, the nodules due to infiltration in chronic laryngitis and in pachydermia; the hyperplastic or papillary growths found in syphilis, tuberculosis, lupus, leprosy, and scleroma; prolapse of the ventricle of Morgagni; necrosed or dislocated cartilages the result of syphilitic or tuberculous perichondritis; one or both vocal cords in double abductor paralysis; and thyroid structure as seen in cases of intralaryngeal or endotracheal goiter.

Many varieties of forceps have been devised according to the particular action desired. Tumors have been removed by evulsion, by crushing and by abscission. To meet these various methods laryngeal forceps have been made with blades so constructed that they are capable of grasping the neoplasm and of forcibly tearing it from its at-

tachment; with blades which permit crushing the tumor and thus removing it piecemeal, and with sharp blades. It is generally conceded that, where possible, cutting forceps are the most desirable, their action being more precise as well as more readily controlled. Forceps have been made of different lengths, different angles and with many mechanical niceties. They have been so constructed that various portions of the larynx may be readily reached. Forceps which permit anteroposterior as well as lateral movements are essential. The angle at which the forceps are bent should be almost a right angle. This permits more general application to various portions of the larynx. Mackenzie's forceps are among the most generally useful. They may be obtained with the lateral or the anteroposterior action and in various lengths and sizes. (Fig. 755.) The cutting forceps of Scheinmann (Fig. 756) are made in sets of four and are so constructed that small neoplasms may be readily grasped in almost any situation. They are particularly useful for reaching the immediate subglottic space or the anterior commissure. Most excellent cutting forceps are those known as Cordes (Fig. 757). These are attached to the Krause universal handle (Fig. 758) and act from below upward permitting the removal of tumors from the edges of the vocal bands (Figs. 759, 760 and 761) and from the posterior and anterior commissures with the greatest accuracy and delicacy. Among the numerous varieties of laryngeal forceps, all of which may have some special advantage, the safety endolaryngeal forceps devised by Dundas Grant are most unique. (Fig. 762.)

Technic.—Local anesthesia is induced in the usual way. Before proceeding with the operation it is desirable to pass a probe or cotton applicator over the entire laryngeal surface in order to determine whether complete immobility of the larynx can be maintained. The patient takes his tongue, between the folds of a gauze sponge, and holds it well forward and out of the mouth, using his right hand. If it should be found impossible for the patient himself to control this part of the operation the tongue may be held by an assistant who sits to the right of the operator. The laryngoscopic mirror is held by the operator in his left hand, the forceps in his right. The latter having been slightly warmed are introduced closed until they are directly opposite or in contact with the neoplasm. They are then opened and carefully closed upon the growth. This must be done under constant view by means of the laryngeal mirror. If any contraction or spasm of the pharyngeal or laryngeal muscles occurs the instrument should at once be removed and further operation deferred until the parts have been rendered more thoroughly anesthetic. In no manipulation is it more essential to view every stage of the operation than in the removal of tumors by this

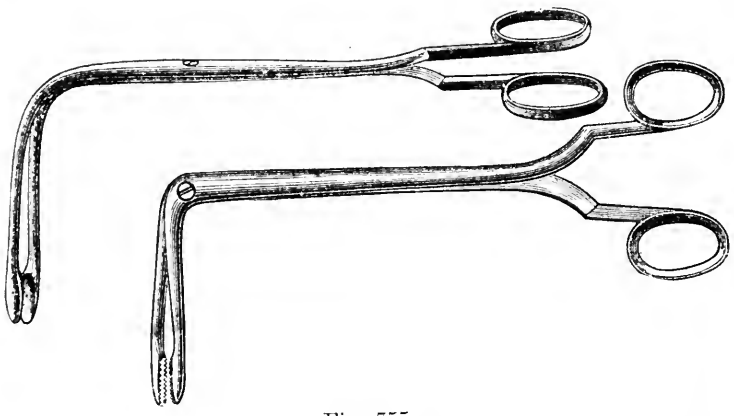


Fig. 755.

Mackenzie's laryngeal forceps.

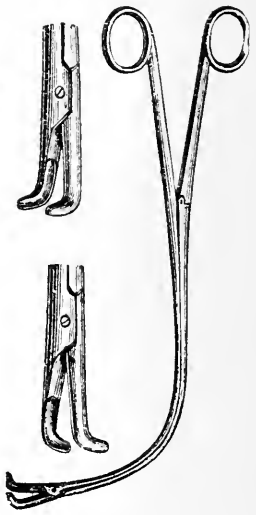


Fig. 756.

Scheinmann's laryngeal forceps.

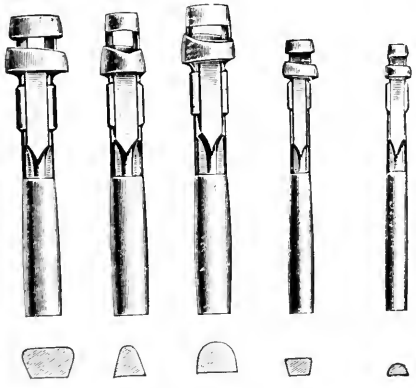


Fig. 757.

Cordes' laryngeal forceps or double curette.

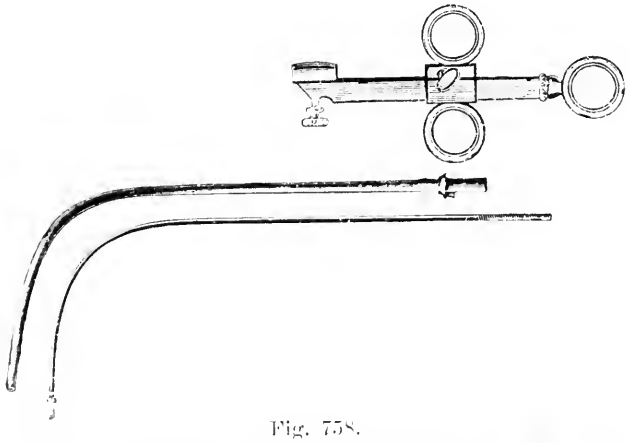


Fig. 758.

Krause's universal handle and stylet for Cordes' forceps.

method. It is generally feasible to grasp the tumor while the larynx is in the position of tranquil respiration. Tumors, however, that are movable by reason of a narrow pedicle may be more readily seized during forced inspiration or expiration or during phonation. This must be determined by previous careful examination and manipulation. (Figs. 763, 764 and 765.)

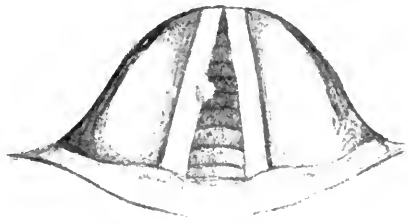


Fig. 759.

Fibroma of the right vocal band during inspiration.

Loeb has reported a case in which the growths were unusually pedunculated. Fig. 766 shows what could be seen on quiet inspiration, the masses hanging down in the trachea. In quiet expiration only one of the growths (Fig. 767) could be seen above the vocal bands; on forced expiration two appeared (Fig. 768); and on phonation a portion of the largest growth was caught between the two vocal bands (Fig.

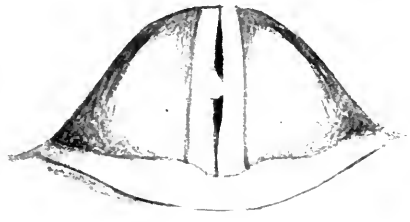


Fig. 760.

Fibroma of the right vocal band during phonation.

769) interfering correspondingly with voice production. The growths which were fibropapillomata, attached to the under surface of the right ventricular band, were removed with the Krause forceps. The shape and outline of the growths are shown in Figs. 770 to 772.

Accidents.—It is extremely rare that untoward accidents occur during the removal of tumors by means of forceps. Spasm is practically eliminated by the complete anesthesia. In extremely large

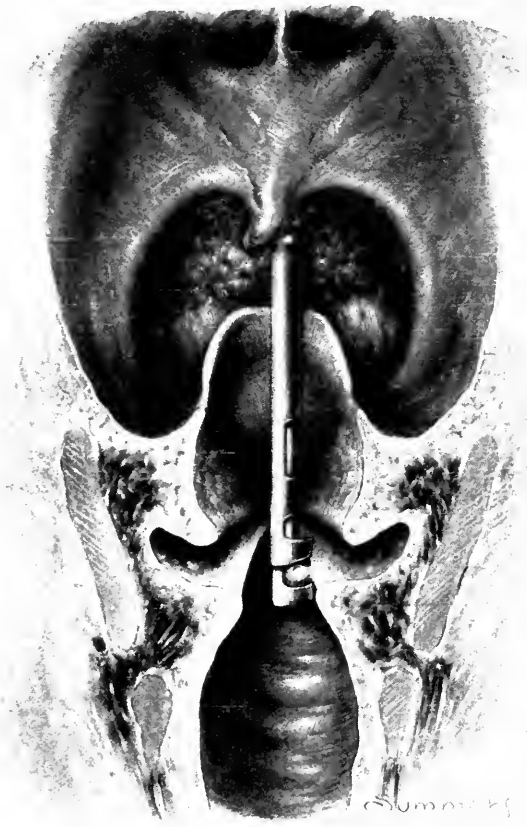


Fig. 761.

Fibroma of the right vocal band showing method of using Cordes' forceps, posterior view.

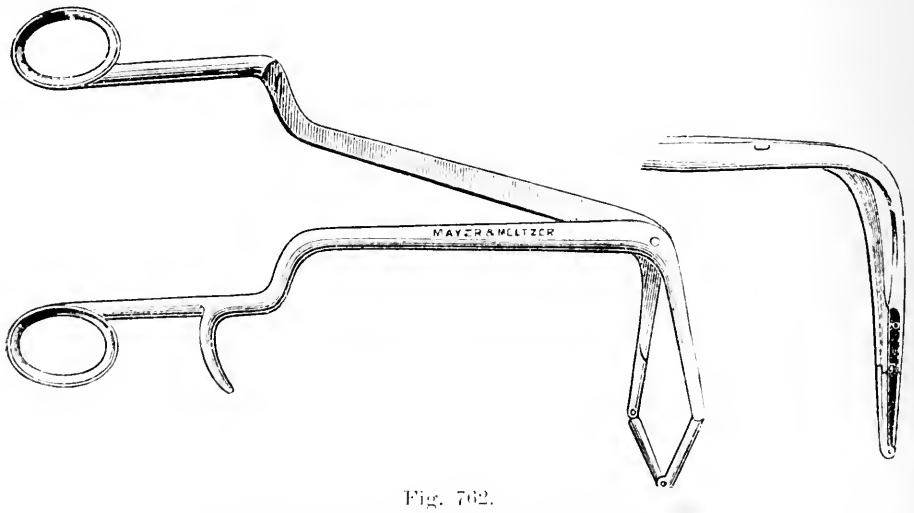


Fig. 762.

Dundas Grant's safety endolaryngeal forceps.

tumors the introduction of an instrument may increase the existing dyspnea bringing it to the danger line. The operation in such a case must be conducted with rapidity. No one should undertake an operation in the larynx in which the slightest danger from sudden apnea exists without being prepared to do an immediate tracheotomy. The possibility of accidents from defective instruments should be borne in

Fig. 763.

Fibroangioma of the right vocal band during phonation.

mind. The author met with a case in which one blade of a cutting forceps (Cordes) broke during the removal of a dense cicatricial band. Fortunately the broken blade was held by the opposite blade firmly enough to prevent its dropping into the trachea.

After-treatment.—With the exception of the few cases in which crushing or evulsion is performed the reaction following the use of

Fig. 764.

Fibroangioma of the right vocal band during forced inspiration.

forceps is extremely slight and therefore very little after-treatment becomes necessary. One should caution the patient, however, not to use his voice for several days and to avoid very hot or highly seasoned articles of food. Pieces of ice are grateful and assist in reducing the slight congestion that sometimes follows. Where tumors have been removed from the vocal bands particularly from their edges, it is wise to insist upon complete rest of the voice for a period of three weeks.

The Galvanocautery Snare.—The galvanocautery snare and the cold wire snare may be used for the removal of certain tumors, the operation by means of the latter being known as ecrasement.

The cautery snare is particularly applicable to bleeding tumors such as angiomata. It may also be used for the removal of portions of neoplasms which cannot be removed *in toto*.

The wire used should be either platinum or steel and should be

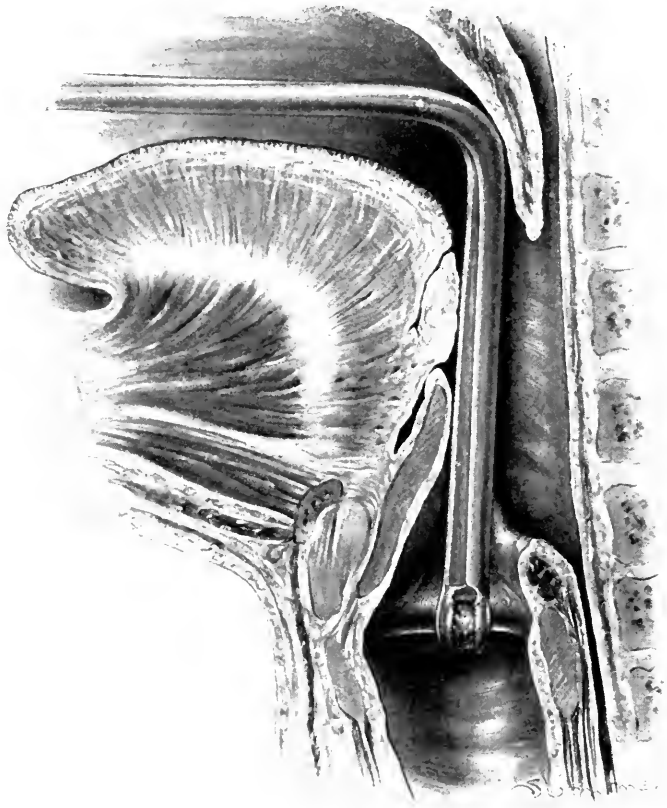


Fig. 765.

Removal of fibroangioma of the right vocal band, view from the left.

threaded through a properly curved insulated cannula and fastened securely into a small wheel or reel, or by means of set screws to the sliding portion of a handle. (Figs. 749, 750.) In using the galvanocautery snare great care should be observed in obtaining the proper degree of heat. As the wire passes through the tissue it is apt to become somewhat cooled and therefore the degree of heat should be greater than for ordinary galvanocautery applications. If in drawing the wire through it becomes so cold that it requires greater traction the operator should

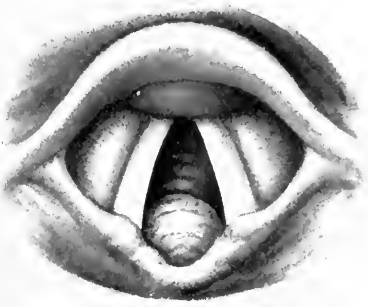


Fig. 766.

Loeb's case of pedunculated fibropapilloma on quiet inspiration.

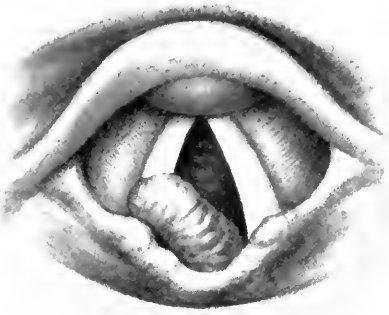


Fig. 767.

On quiet expiration; one growth ascending between the vocal bands.

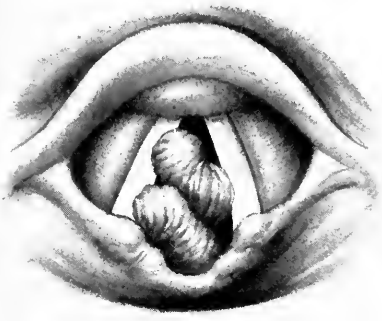


Fig. 768.

On forced expiration; two growths now appear.

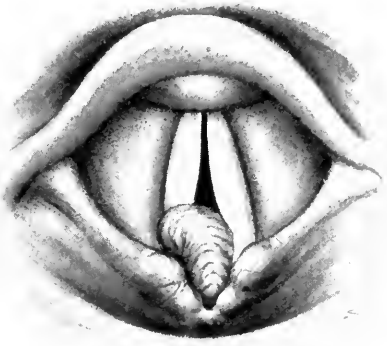


Fig. 769.

On phonation. A portion of one growth caught between the posterior portions of the vocal bands.

Fig. 770.

Growth removed.

Fig. 771.

Growth removed.

Fig. 772.

Growth removed.

stop the procedure for a few seconds. An assistant may then increase the degree of heat by stepping up the controller. If contact is now renewed the wire may be readily drawn through the mass. This complication in the use of the cautery snare can occur only when an attempt is made to remove tumors of large size.

In using the galvanocautery snare it should be borne in mind that the danger of injuring surrounding parts is considerable. To avoid this the wire should be applied with great accuracy and the procedure conducted with rapidity. As in the use of other galvanocautery operations the wire should be introduced cold, then carefully drawn tightly around the tumor and contact rapidly made. In order to facilitate the latter and to prevent unnecessary movement of the instrument within the larynx, the foot switch as mentioned on page 252 is very useful.

The Cold Wire Snare.—All tumors of whatever nature presenting any degree of pedunculated attachment may be readily removed by this

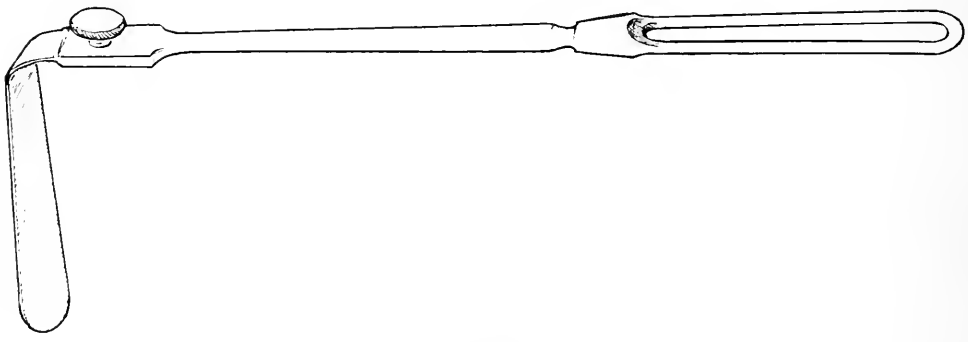


Fig. 773.

Tongue depressor with long handle.

method. Even tumors that have a sessile base may be attacked in this manner provided the projecting portion of the neoplasm is no smaller than the base.

Tumors springing from the epiglottis are readily surrounded by the snare wire. The most frequent varieties of tumor found here are the lipoma and the cystoma. The snare is much more applicable to the former than to the latter.

It is generally necessary to use a cannula with the proper curve under the guidance of a laryngoscope. However, the straight variety of snare used for operation within the nose or that possessing a slight curve may be easily applied to tumors of this region. The method of procedure is slightly modified from that used for ordinary intralaryngeal operations. The modification consists in depressing the tongue instead of drawing it forward. For this purpose a tongue depressor with

a long handle is desirable, the patient being instructed to hold the instrument in position himself. (Fig. 773.) The laryngoscopic mirror may in such a case be entirely discarded.

Tumors situated below the epiglottis whether large or small may be reached by the snare without much difficulty provided they are slightly pedunculated. Among the numerous instruments devised for this purpose the Schroetter snare as improved by Coakley (Fig. 774) is one of the best. The wire used should be sufficiently firm to remain in whatever position it is placed. It should be of fair strength al-

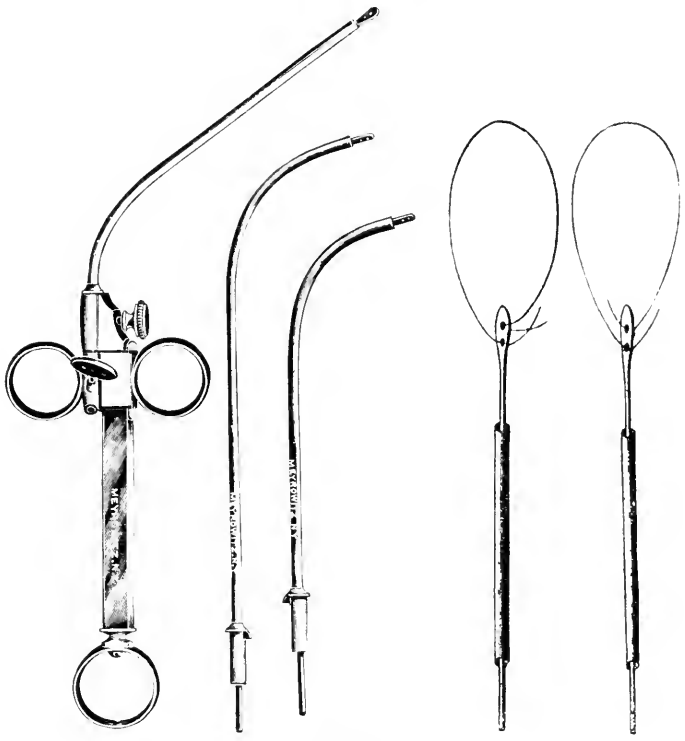


Fig. 774.

Coakley-Schroetter snare.

though this is of less importance than in other snare operations such as are performed in the nose or for the removal of tonsils. Number 6 piano wire is small, strong, and sufficiently stiff for all purposes. It should be threaded to the snare in such a manner that the loop rests in an anteroposterior direction for tumors situated upon the lateral walls and in a transverse direction for tumors situated in the anterior or posterior portions of the larynx. The desired position of the loop may be obtained by introducing the ends of the wire into the eyes of the stylet either from opposite sides or from the same side. The loop

should be large enough to surround the neoplasm readily. It should not be too large, however, for the reasons that it will be difficult to enter the larynx with it and that the manipulation of drawing the wire tightly over the growth is thus prolonged.

In removing a tumor by this method the snare is accurately applied over the tumor mass, then by gentle movements to and fro or from side to side depending upon the position of the tumor, it is

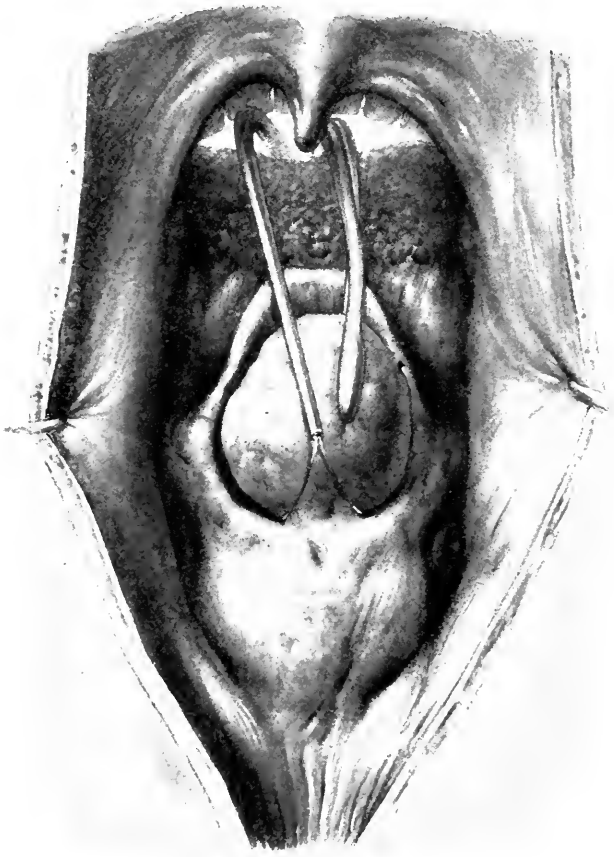


Fig. 775.

Levy's case of pedunculated carcinoma, showing method of removal with folding forceps and snare.

brought as close to the point of attachment as possible. The wire is now carefully drawn taut and by gentle traction it may be determined whether the tumor is held well in the grasp of the wire. If the tumor does not slip out of the loop it is certain that the position of the instrument is correct. The next step in the procedure consists in removing the growth and this is best accomplished by gentle traction at the same

time that the wire is drawn through. By this method the tumor is removed by a combination of cutting and pulling.

The entire operation can be performed in a few seconds, in much shorter time in fact than is required to describe it.

For the removal of large tumors of the larynx the ordinary method of using the snare should be modified. It may be difficult and at times impossible to introduce a wire snare in such a manner that it will completely surround the entire mass, especially if but little space remains unoccupied by the growth. This difficulty may be satisfactorily overcome by proceeding in the following manner: First a pair of laryngeal forceps the handle of which may be locked is passed through the loop of wire. An assistant holds the snare steady while the operator passing the forceps into the larynx and grasping the tumor locks them. The forceps are now passed to an assistant, the operator exchanging them for the snare. The tumor being held firmly by the forceps it becomes a simple matter to pass the snare loop completely over the growth.

Fig. 776.

Levy's case of pedunculated carcinoma. Tumor removed.

This step may be facilitated by instructing the assistant to make gentle traction thus drawing the tumor into the loop at the same time that the operator passes the loop around the tumor. Having completely surrounded the neoplasm in this manner the rest of the procedure is accomplished in a manner similar to that employed in snare operations as described above. In a large pedunculated carcinoma situated in the opening of the larynx and attached to the right aryepiglottic fold and ventricular band the author succeeded with great ease in removing the tumor *en masse*. At the site of attachment and in its immediate vicinity a marked irregular infiltration remained which could have been removed only by external radical operation, or by dissection under suspension. Previous attempts at surrounding the tumor with the wire in the ordinary method had failed owing to its size and position. (Figs. 775 and 776.)

After-treatment.—The reaction after the galvanocautery snare may be very considerable and may call for active antiphlogistic meas-

ures. It may be relieved by spraying with weak solutions of cocain or eucain or by the insufflation of orthoform. The inflammatory swelling may be somewhat modified by the use of adrenalin 1-8,000 sprayed every hour into the larynx. Ice externally and cracked ice by the mouth will add to the comfort of the patient and assist in controlling the reaction. The diet should be bland, soft and unirritating. Mucilaginous drinks are grateful.

The amount of traumatism produced by the operation with the cold wire snare is so slight that practically no reaction follows and therefore the after-treatment is unimportant. Rest to the larynx and pellets of ice will quickly dispel the slight soreness following.

The Guillotine.—This instrument (Fig. 777) consists of a guarded circular knife, the latter being manipulated by a stylet passed through

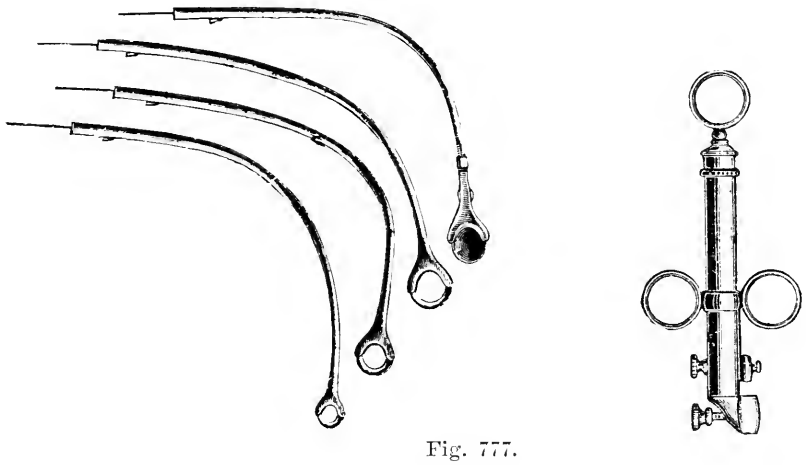


Fig. 777.

Laryngeal guillotine with modified Krause handle.

a tube of the laryngeal forceps and attached to the Krause handle. It is rarely used, being applicable to tumors of such density and hardness of structure that other methods cannot be successfully applied. It has been used, however, in the removal of chondroma, which is a tumor springing usually from the cricoid cartilage by a process of extensive proliferation of cartilaginous cells. It has therefore a broad sessile base and can be removed only by a cutting instrument which may be so manipulated that it will slice the tumor off as close to its point of attachment as possible.

In case the removal of the chondroma is inadvisable and the tumor is of small proportions, electrolysis may be tried in the same manner as has been recommended for the removal of cartilaginous growth from the nasal septum. The bipolar method (page 249) is the most feasible.

Malignant Tumors.

Although the laryngoscopic method is less applicable to carcinoma, even here it may be of value. It has been advocated by Goughenheim and Lombard:

First, in certain varieties of intrinsic cancer which remain limited for a long time showing no tendency to spread.

Second, in old people whose advanced age makes the operator hesitate before proposing a large surgical intervention.

Third, in certain pedunculated epitheliomata the rapid removal of which is necessary to prevent suffocation.

The most generally useful purpose in these cases after all to which intralaryngeal surgery may be put is for that of diagnosis. The operation of removing a section should be performed even though there be fear of increasing the rapidity of the growth or of encouraging metastasis. The caution so frequently given, that unless the patient be prepared for a radical operation, the growth should not be attacked, is of more than minor importance. It is however essential to confirm the clinical diagnosis by histologic examination. If this examination proves negative no harm has been done and the way is clear for further and possibly successful treatment. If this examination proves positive the tumor may or may not take on rapid growth. If the patient refuses more radical operation and the tumor progresses rapidly, the fatal termination may be somewhat advanced; this however must be looked upon as of much less importance than the question of an early confirmed diagnosis which must remain as previously stated, the saving factor in a possible cure. If the malignant growth has already assumed large proportions and the surrounding glands are invaded, the clinical diagnosis usually suffices. The tumor may have been of very slow growth and it is much wiser to leave it alone rather than to encourage its growth by removing a section to confirm a diagnosis which needs no confirmation. What has been said with reference to removing a piece for diagnostic purposes applies only to small circumscribed tumors of doubtful diagnosis.

The two varieties of malignant growths found in the larynx, as elsewhere, are sarcoma and carcinoma. For many years the relative value of endolaryngeal and extralaryngeal operations for these neoplasms has been a matter of much discussion the burden of which has had reference to carcinoma. Sarcoma has been given comparatively little consideration, evidently due to the fact that it is of relatively rare occurrence. The fact that sarcoma is less likely to spread to adjacent structures, remaining circumscribed and confined, especially in its

early stages, makes the endolaryngeal method somewhat more favored in this variety of malignant growth than in carcinoma. Laryngologists have in the beginning leaned naturally to the laryngoscopic method. Unfavorable results however have forced the conclusion that in but few instances is it possible to completely eradicate a malignant growth by removing it through the natural passages. A few brilliant results have been reported especially by Fraenkel who among others has been the most ardent advocate of this method. Statistics have been of comparatively little value for as Jurasz has pointed out, the value of statistics depends upon more careful differentiation of the period or state of development of the growth at which the operation is undertaken. Cases of cure by both methods have been reported, the early diagnosis being in all instances the important factor. The improved technic of today renders it possible to obtain results by radical external operations which were impossible a few years ago. At that time, while it was possible to extirpate completely a growth by radical measures, the gravity of the operation was so great that the attempt was generally made to remove the mass by simpler procedures. Today, however, less is to be feared from the operation than from the rapid development and extension of the malignant growth; and therefore, those cases which were formerly attacked by endolaryngeal methods in the hope of avoiding more serious operation, and were followed by indifferent results, are today more generally and more successfully removed by laryngectomy or thyrotomy.

Nevertheless the endolaryngeal procedures in malignant growths may find their uses. Of these methods, only those of cutting instruments or snare are recommended.

Attacking these growths by chemical caustics or galvanocautery should be condemned and although it is claimed by Jurasz that the galvanocautery does not increase the rapidity of the growth it may well be stated that used in this way it cannot diminish it.

Electrolysis has been recommended in recurrence after more radical procedures although but one case, that of Schoetz, has resulted satisfactorily; nevertheless, it is an additional method which may be tried in the attack upon one of the gravest of all diseases of the larynx.

Sarcoma offers some hope by the laryngoscopic method. This tumor may be localized in any portion of the larynx. When accessible the operation by the sharp cutting forceps should be the method of choice. The Cordes instrument described on page 260 is the one most likely to give satisfactory results as it permits of more accurate adaptation and more thorough, precise, and clean excision.

Tumors of the Trachea.

Before resorting to tracheo-fissure for the removal of intratracheal neoplasms, the attempt should be made to remove them through the natural passages. The laryngoscopic method may not be applicable as generally as the method of direct tracheoscopy by means of the Killian or Jackson instruments, nevertheless, it is useful in certain cases. Tumors which are situated in the upper part of the trachea, that is to say, above the fourth or fifth ring, may be reached by this method. The operation is very much more readily performed today than in former years owing to the complete anesthesia that may be brought about through the use of cocain. Tumors situated as low as the eighth and ninth tracheal rings have been successfully operated upon by this method although in this situation the procedure is attended with very great difficulties. The character of the tumor should also be taken into account before deciding upon the method of attack. No attempt should be made to remove malignant tumors in this way. Of the benign tumors, those possessing a pedicle or those having a base which is not too broad and which are soft in character are most readily extirpated by this means.

Operative Methods.—Before attempting any endotracheal operation by the laryngoscopic method, one should be assured of the best possible illumination. For this purpose it is recommended that sunlight be used whenever practicable.

Tracheal growths may be removed by means of galvanocautery, by the injection method, by forceps or by snare.

The cautery which should be used with great care is applicable to growths of small size only. The electrode should be sufficiently long and possess a sharp curve. A certain amount of danger arises from the possibility of injuring the vocal bands. The instrument should therefore be introduced cold and should be retained in the trachea until it has cooled before withdrawing it. Special care should be given to its insulation.

The injection method was successfully applied by Schroetter who reported a most satisfactory result after the injection of a few drops of a solution of two parts of sesquichlorid of iron with one part distilled water into the depth of the growth.

Forceps or snare for the removal of intratracheal growths should be constructed in accordance with the anatomic peculiarities of the region. They must be of exceptional length and possess a curve which will permit them to pass through the chink of the glottis. A tumor of small size situated in the anterior wall of the trachea can hardly be

reached by this method. When situated in the posterior wall the operation is more likely to be successfully accomplished.

Asphyxia and hemorrhage are the two greatest dangers to be feared during the removal of intratracheal growths. It becomes important, therefore, to determine whether the operation should be attempted without a previous tracheotomy. The attempt should never be made to perform an intratracheal operation without full preparations for an immediate tracheotomy. In case the tumor is of sufficient size to cause decided stridor in the breathing, the safest plan is to perform tracheotomy first, several days before the removal of the tumor is attempted. The danger of asphyxia being now eliminated one may operate through the larynx with deliberation and safety.

Hemorrhage following the removal of tracheal tumors has been known to be attended with serious consequences. Its treatment consists in injecting a few drops of adrenalin solution by means of an endotracheal syringe. Ice applied internally and externally may be of advantage.

If the hemorrhage continues with any degree of severity, it may be controlled by a tampon tracheal cannula.

LARYNGEAL TUBERCULOSIS.

The history of the treatment of tuberculosis of the larynx is intimately bound up with the history of its curability. The latter is largely dependent upon an early diagnosis which until comparatively recent years was the subject of but little consideration. Those cases which were in advanced stages and those complicated with extensive pulmonary tuberculosis were the only ones to which attention was directed. Such a case was the subject of the first surgical intervention by Voltolini.

Galvanocautery.—Voltolini in 1867 reported the case of a man aged fifty-four suffering from advanced tuberculosis whose larynx was filled with excrescences and covered with ulcerations. This case was treated by galvanocautery until the entrance to the larynx was freed. The deeper portions of the larynx were now seen to be filled with infiltration to such an extent that Voltolini was completely discouraged and discontinued treatment, leaving the patient to his fate. This form of surgical treatment seems to have received but little attention and still less encouragement. In fact Gottstein, 1893, condemns the treatment on the ground that it may increase the trouble by producing postoperative edema. Other men, notably Schech, Gleitsmann, Schmiegelow, and Serebrny recommended this treatment more or less enthu-

siastically but it was not until 1907 when Ludwig Grünwald published his monograph entitled, "Die Therapie der Kehlkopftuberculose mit besonderer Rücksicht auf den galvanokaustischen Tiefenstich und äussere Eingriffe" that the galvanocautery received its just consideration.

The methods of employing this form of treatment are by the cautery snare, superficial burning and deep puncture.

The galvanocautery snare may be employed for the removal of tuberculous tumors or epiglottis. The use of this instrument is limited. It needs no further consideration.

Superficial cauterization is employed according to Grünwald for the treatment of superficial lesions of large area whether ulcerated or not. In addition to this the galvanocautery is most frequently used in the treatment of small, sluggish ulcerations when not too numerous or too diffused, in other words, isolated, circumscribed tuberculous ulcers showing but little or no acute process. Grünwald recommends deep puncture in all cases of extensive, deeply situated tuberculous infiltration.

For the description of the technic employed the reader is referred to the article on galvanocautery, page 249.

The question as to whether the galvanocautery should be applied extensively at one sitting or whether small areas should be treated at intervals can only be settled by a study of the individual case. Generally speaking the amount of reaction such as edema will be greater the more widely the instrument is used. The author's preference is for limited cauterization repeated at intervals of from five to ten days.

Incision and Scarification.—This procedure was advocated in 1880 by Moritz Schmidt of Frankfort. This operation was performed by knife or scissors and consisted of incising the posterior wall and arytenoid in cases of dyspnea or dysphagia due to tuberculous edema or infiltration.

It is particularly useful when there exists pronounced edema or extensive, uniform, smooth infiltration. The parts involved may be the posterior wall of the larynx, the aryepiglottic folds, the arytenoids or the epiglottis. There may exist difficult deglutition with or without pain or respiratory distress.

The instrument to be used is the laryngeal knife of Tobold or that of Heryng. (Figs. 741, 742.) Schmidt recommends scissors of special construction.

Having produced thorough anesthesia by the local application of 20 per cent cocain solution or by the submucous injection of a 2 per cent cocain solution with 1 to 8,000 adrenalin, repeated punctures are made by means of the pointed knife. Each puncture should extend through

the edema or infiltration to the cartilage and should be continued along the greatest diameter of the swelling so that a slightly gaping wound results. If it is desirable, as has been recommended, to apply lactic acid, it should be done by thoroughly rubbing the acid into the incision using considerable friction. One should remember that lactic acid rubbed into these incisions may be followed by considerable reaction and therefore fewer incisions should be made at one sitting than if the operation is carried out without the lactic acid. It is not necessary to begin with very weak solutions of the acid. Not less than 50 per cent should be used and in the majority of instances the full strength may be applied.

Submucous Injection.—This was first recommended by Major of Montreal in 1886. He injected five drops of a thirty per cent solution of lactic acid into the infiltration of the aryepiglottic fold and into a diffuse swelling of the epiglottis. Later Heryng injected iodoform emulsion while other authors advised a variety of remedies. Chappell of New York described a special syringe which makes it possible to inject the desired remedy with greater accuracy. He recommended solutions of creosote.

This method has been recommended in cases of early infiltration involving the aryepiglottic fold and epiglottis, also in circumscribed tumor formation of the arytenoids.

The laryngeal syringe of Chappell is the best instrument for this method of treatment. It consists of a cannula of proper length and curve, at the end of which is a needle of sufficient length to enable one to introduce it deeply into the tissues. The barrel of the syringe is an ingenious arrangement containing a plunger controlled by a spring. (Fig. 738.)

The parts are thoroughly cocainized by spray and topical application; after this the syringe is filled with the quantity of the fluid desired and the needle introduced well into the infiltrated tissue. The spring which controls the plunger is easily released by a touch of the thumb, the contents of the barrel being thus forced into the parts with the least possible motion apparent at the extremity of the instrument. This is of great advantage in that it enables one to hold the needle steady during the process of injection, forcing the remedy into the tissues at the exact point of penetration.

The remedies used have been various. Lactic acid in solutions of from 5 to 50 per cent and the solution of creosote recommended by Chappell have been employed most frequently. Chappell's formula is as follows:

R	Creosoti	ʒ i
	Ol. ricini	ʒ iii
	Ol. gaultheriæ	ʒ iii
	Ol. petrolati	ʒ iii
	Mentholis	gr. x

Misce.

Sig.: Five drops may be injected every fifth day.

The reaction following this injection is sometimes quite severe, sloughing having resulted, but in those cases in which it acts successfully, the swelling is seen to shrink considerably.

Curettage and Excision.—In 1886 Heryng of Warsaw advanced a form of treatment which may be said to be more distinctly surgical than any method previously suggested. The idea of active surgical intervention more or less radical in character appears to have been the culmination of a gradual change of view from the former mild or entirely passive treatment in vogue. In 1879 Robinson wrote that he believed that all "caustic substances are radically wrong when applied to the ulcerated laryngeal surfaces of phthisis." Heryng's brilliant results were not confirmed by other observers. Nevertheless, the surgical treatment recommended by him was based upon purely scientific principles and therefore the removal of tuberculous masses by excision and the stimulation of tuberculous ulcers by curettement has been adopted as a recognized form of treatment. Krause of Berlin in 1887, Goughenheim of Paris in 1887, Gleitsmann of New York, and numerous other reliable authorities have added their testimony to its value.

At the present time the true status of the surgical treatment of tuberculosis is between the extremely radical measures first advocated by Heryng and others and the extremely conservative method representing the relic of the early writers. Its true position has been more clearly defined by recognizing the fact that certain cases offer definite contraindications while others present ideal indications for surgical interference.

Curettage.—This procedure is probably the most frequently applicable of all surgical measures in laryngeal tuberculosis. It is indicated in ulcerations and soft excrescences. On the other hand it is contraindicated whenever the condition is associated with evidence of an acute or active process such as marked local edema, high temperature, rapid emaciation. The ulcerations which are best adapted for this method are the circumscribed chronic ones the bases of which are infiltrated. This form of ulceration is sluggish in character and resists the ordinary methods of treatment. Soft tumor-like masses, so-called excrescences, which are circumscribed and usually situated in the posterior laryngeal wall are readily removed by curettage.

The instruments used for this purpose are the curettes of Heryng (Fig. 744) or those devised by the author. (Fig. 745.) The latter possess the advantage of being sharp and very delicate in construction, at the same time possessing the requisite strength for forcible manipulation. They are made in sets of two, the ring of one being placed at right angles to the shaft for the purpose of attacking the posterior wall while the ring of the other is attached in the same plane as the shaft, thus enabling the lateral walls of the larynx to be reached with ease.

Having produced local anesthesia, the curette is applied to the ulcerated surface or to the excrescence to be removed and a rapid and thorough scraping is carried out. The curettement should be done with sufficient force to reveal a smooth and bleeding surface beneath. It is not necessary to attack all of the ulcerations nor all of the tumors at one sitting. As the operation is attended with comparatively little disturbance, it may be repeated at intervals of seven to ten days. In this way the patient suffers less after-pain and the same result is accomplished although somewhat longer time is required. In order to supplement the operation and at the same time to check bleeding, the scraped surface may be rubbed with lactic acid. This should be applied with decided friction, the strength of the solution varying from 50 to 80 per cent.

After-treatment.—The patient should be instructed to give his larynx as complete rest as possible. Food should be bland and unirritating. The post-operative reaction may be modified by sprays of adrenalin, one to eight thousand. Pain may be controlled by the local application of cocain solutions or ice externally and by the mouth. The following powder assists healing and also relieves much of the after-pain:

R	Morphin acetatis	gr. ii
	Orthoformi	ʒ iv
	Iodoformi	
	Pulv. acaciæ	ää ʒ ii
	Misce.	

The successful issue of this procedure is recognized by the growth of small granulations and the gradual cicatrization of the ulcer. It may become necessary to aid the healing process by further stimulating applications. The lactic acid and formalin solution of Lake answers the purpose admirably. It consists of the following:

Lactic acid	50 parts
Formalin	7 parts
Carbolic acid	10 parts
Water to	100 parts

Excision.—This is an ideal method of operating upon tuberculous deposits. Its application is limited to those cases in which there is a certainty or strong probability of completely removing the entire focus of disease. Nevertheless much benefit has resulted from the removal of isolated ulcerations with their surrounding infiltration or of circumscribed infiltrative or hypertrophic tuberculous masses even though it is impossible to extirpate the entire local lesion. The true tuberculous tumor which is frequently and fortunately among the earliest laryngeal manifestations is the ideal lesion for excision. The epiglottis at times may be the sole structure involved or its involvement may be in such excess that the lesions found elsewhere in the larynx may be disregarded. In such cases a portion or all of the epiglottis may be removed with benefit. A few authors, very ardent among whom is Lockard of Denver, find an indication for excision of the epiglottis even in advanced cases in which the surrounding parts are also extensively involved. These authors remove the epiglottis for the relief of excessive odynophagia or for the purpose of more readily applying local treatment to the rest of the larynx.

Heryng lays down the following contraindications to surgical intervention: (a) In severe pulmonary phthisis combined with malnutrition and wasting. (b) In diffuse miliary tuberculosis of the larynx, or of the larynx and pharynx. (c) In severe laryngeal stenosis caused by inflammatory swelling of the affected parts. (d) In all cachectic conditions. (e) In frightened, nervous, irritative, distrustful, listless patients and those who frequently change physicians, but especially in persons whose general condition promises little for cure

In addition to these contraindications, the author feels that much attention should be paid to the appearance and site of the local manifestation. If it present evidences of marked activity such as pronounced edema or if the lesion be apparently quiescent but diffused and extensive, little permanent good may be expected from the removal of a portion. Moreover it is possible to excite by surgical intervention, renewed activity in the process and although the author believes this danger has been largely exaggerated, abundant proof may be presented to show that it is a condition to be feared.

It might be emphasized that the best results from surgical treatment and especially from excision are obtained in those cases in which the lesion is small, definitely circumscribed, limited to a portion of the larynx which is capable of complete extirpation and in which the general condition of the patient is of the very best.

For the removal of a portion or all of the epiglottis special instruments are necessary. These will be described later. Infiltrations or

tumor masses in other portions of the larynx may be satisfactorily attacked by a sharp double curette or forceps.

Technic.—Among the best instruments are those devised by Cordes, Krause and Heryng. (Fig. 778.) They are all attached to the Krause handle and stylet as shown in Fig. 758. The original Krause double curette (Fig. 779) was modified by Heryng (Fig. 780). The Cordes instrument (Fig. 757) is a further modification.

These instruments are really cutting punch forceps so constructed

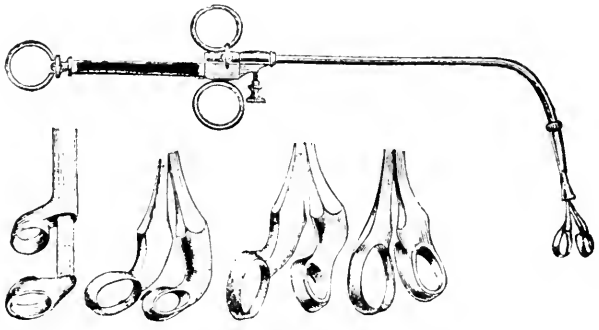


Fig. 778.

Krause and Heryng double curette or forceps.

Fig. 779.

Krause double curette or forceps.

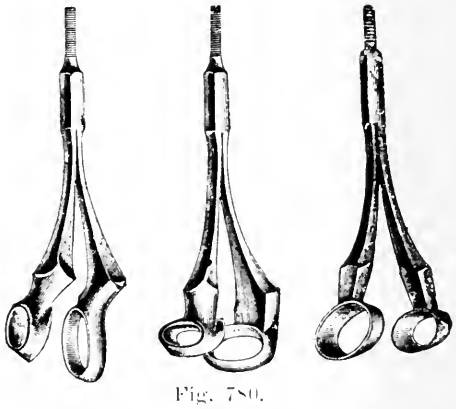


Fig. 780.

Heryng-Krause double curette or forceps.

that the blades may include between them the tissue to be removed. Their action may be anteroposterior, lateral or vertical. The blades being sharp and one fitting well into the other the tissue included between them may be excised with accuracy and precision. Anesthesia as in all intralaryngeal operations must be as complete as possible. Tuberculous patients resist the action of local anesthetics to such an extent that it is frequently necessary to use large quantities and strong

solutions of cocain before the pharynx and larynx become quiet enough for delicate manipulations. This is due to the excessively irritable reflex in the upper air passages and particularly in the pharyngeal mucous membrane. The interior of the larynx is also more readily excited to spasm in these cases as is evidenced by the persistent cough. However if one follows the rules laid down for anesthetizing these parts (page 240) and exercises sufficient patience he may bring the most sensitive throat under control. It should be borne in mind that the fauces, including the base of the tongue, must be rendered as anesthetic as the interior of the larynx or other fields of operation.

The technic for the removal of tuberculous ulcerations, infiltrations or tumor masses by means of the double curette or punch forceps differs in no respect from that employed in the removal of laryngeal tumors by the same instrument (page 258). The operator should aim

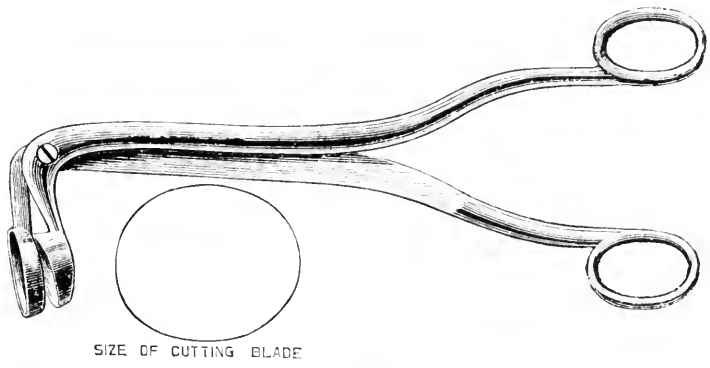


Fig. 781.

Barwell's epiglottis punch forceps.

to be thorough even to the extent of excising portions of the surrounding apparently normal tissue.

Removal of the Epiglottis.—A portion or all of the epiglottis may be removed depending upon the character and extent of the lesion. Circumscribed ulcerations that have resisted treatment by galvanocautery or other stimulating application may be excised with fair prospect of complete healing. The punch forceps of Barwell (Fig. 781) are well constructed for this purpose.

When the tuberculous process, whether ulcerative or infiltrative, has become diffused, involving more than a few circumscribed areas, the entire epiglottis should be removed providing of course contraindications as outlined for other surgical procedures do not obtain.

The instruments that have been recommended for this operation are the cold wire snare, the galvanocautery snare and the large speci-

ally constructed punch forceps. No advantage can be claimed for the galvanocautery snare, while the reaction following, and the almost necessary scorching of the surrounding parts condemn this method as the least desirable. The cold snare has been successfully employed by Gerber, Lockard and others who claim that by this method the removal of the epiglottis is accomplished more readily and with a saving of time in its performance. The author has obtained satisfactory results by the use of the Barwell forceps. The objection that the entire organ cannot be removed at one bite of the instrument may be over-

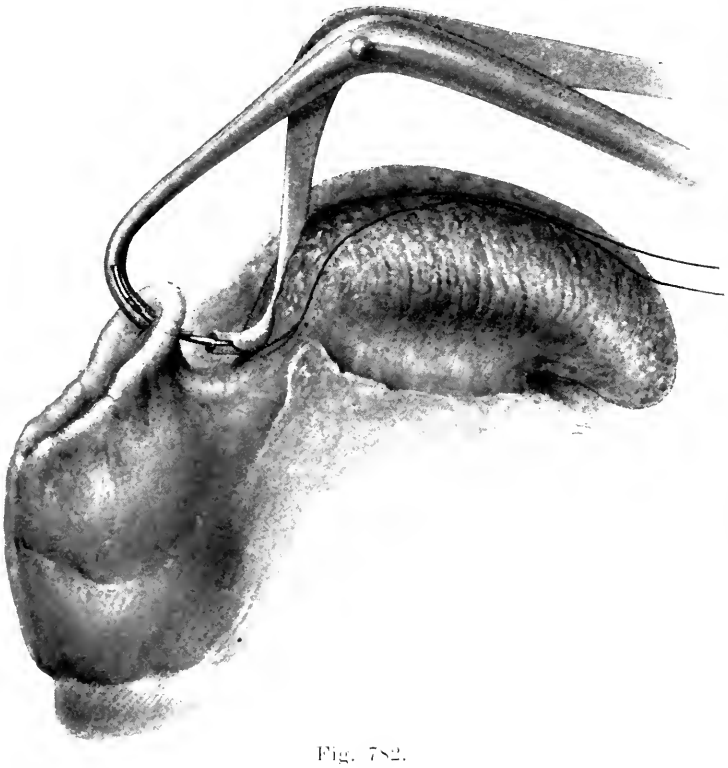


Fig. 782.

Introducing Horsford's needle into the epiglottis.

come by adopting the simple procedure recommended below. In fact this same objection may be applied to the snare, but by the method here recommended it may be obviated, whatever instrument be used for completing the operation. The difficulty has arisen from the fact that the epiglottis being movable cannot be entirely enveloped in the grasp of the instrument. In order to overcome this the free margin of the epiglottis should be controlled, and at the same time the epiglottis drawn well into the loop of the snare or into the ring of the forceps. The best instrument for this purpose is the Kurz needle as modified by

Horsford. (Fig. 733.) By means of this needle one may readily pass a suture through the free margin of the epiglottis and by this suture control its movements, elevating and drawing it into the instrument to the desired position.

The epiglottis and surrounding parts including the fauces having been thoroughly anesthetized the patient is instructed to hold his tongue well forward. In the case of nervous or restless individuals an assistant may hold the tongue between the folds of a gauze napkin.

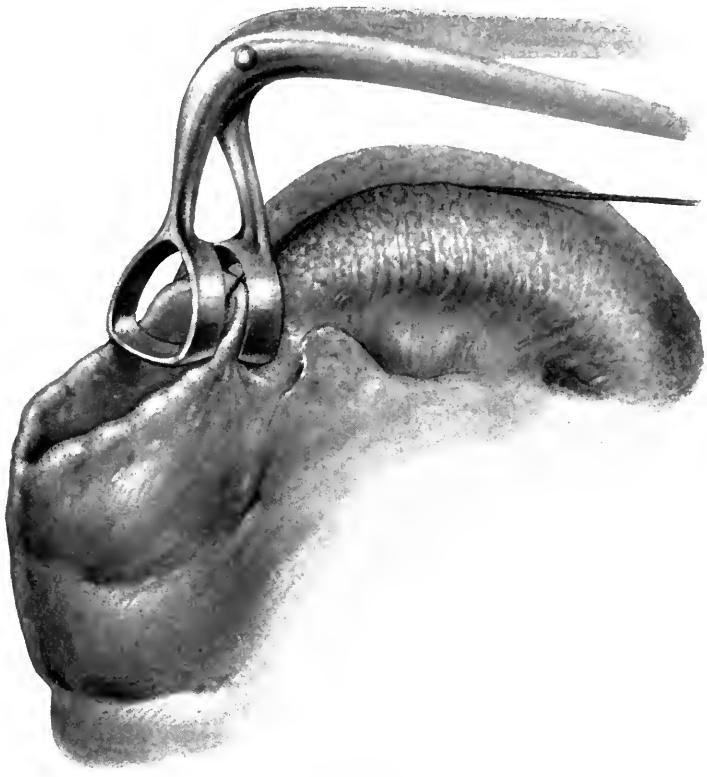


Fig. 783.

Removal of the epiglottis.

The first step in the operation consists in passing the needle armed with a strong silk ligature through the free margin of the epiglottis. The needle being now withdrawn the ligature is passed to an assistant who by this means controls the movement as well as the position of the epiglottis. (Fig. 782.) In some instances the operation is facilitated by depressing the tongue instead of drawing it forward, in which case this step in the operation may be accomplished without the use of the laryngoscopic mirror.

The second step in the operation consists in drawing the epiglot-

tis well into the grasp of the forceps. The ligature is first passed through the anterior or proximal ring of the cutting forceps. The tongue is now drawn well forward and the forceps, under the guidance of the laryngoscope, are applied to the base of the tongue. By a combined action which draws the epiglottis into the forceps at the same time that the latter is pressed well downward to the base of the epiglottis the entire structure is gathered into the bite of the instrument. (Fig. 783.) The amputation of the epiglottis is now easily accomplished by rapidly closing the forceps upon it, the result being a complete and clean operation. Central tags are not left although in cases in which the base of the epiglottis is unusually broad, small lateral fragments may remain. These, however, are of little if any importance and may be disregarded.

Complications and After-treatment.—Hemorrhage following excision of tuberculous masses or of the epiglottis has been of very rare occurrence. A moderate amount of bleeding is usually present but this ceases spontaneously within a few moments. In one case following amputation of the epiglottis the hemorrhage which had ceased promptly at the time of the operation recurred within twenty minutes and after the patient had been taken to the ward. Upon examination it was found that blood was flowing freely from the left side of the stump. In spite of active measures for its control, the bleeding continued with rather alarming severity, filling the larynx and passing backwards into the esophagus. The patient complained of marked choking sensation although there was no dyspnea, the blood being rapidly expectorated or vomited. Bleeding continued for something over an hour but was finally brought under complete and permanent control. This patient died from general tuberculosis nine months after the operation. Post-mortem examination showed the epiglottis completely removed and upon the left side a portion of the aryepiglottic fold. It was plain to see that this was the cause of the hemorrhage, the probabilities being that had the operation been less thorough, including only the epiglottis, this serious complication would not have occurred. (Fig. 784.)

This complication may be treated by frequent sprays of adrenalin solution, 1 to 1,000, and by local applications of adrenalin on a large firm cotton applicator, pressure being maintained at the same time. Other remedies such as tincture of chlorid of iron or tannic acid solution or the insufflation of powdered ferropyrin may be recommended. Finally the galvanocautery will almost certainly control the bleeding. Should the hemorrhage persist to such an extent that life is endangered, tracheotomy and tampon may become necessary. The hypo-

dermic injection of a quarter of a grain morphin will assist materially in quieting the patient and will make the necessary local treatment possible. Pain following the operation is in some instances very slight while in others it causes much distress. The swelling of the stump may be the source of some discomfort but it is rarely of much importance. This as well as the pain may be controlled by spraying the larynx with

Fig. 784.

Specimen showing resection of epiglottis.

one per cent cocain solution to which adrenalin, 1 to 4,000, has been added. A powder consisting of equal parts of orthoform and iodoform will also be found useful if carefully insufflated over the wounded surface. This may be repeated three or four times a day as it is found necessary. Should the pain be excessive, morphin or codein should be administered.

Much has been said concerning the interference with swallowing

following the removal of the epiglottis. If it were not for the swelling of the surrounding parts and for the tuberculous infiltration of the aryepiglottic folds which is frequently found in cases in which the epiglottis is involved, there would probably be only slight difficulty in swallowing after the first forty-eight hours. It is remarkable how rapidly the parts accommodate themselves to the loss of this structure if the muscles are given an opportunity of acting unhindered. The larynx is protected more by the base of the tongue and by the closure of the laryngeal cavity during the act of swallowing than by the epiglottis but when the arytenoids or aryepiglottic folds are swollen the muscles controlling the closure of the larynx do not readily accomplish their function. The consequence is that food may enter the larynx causing cough. To overcome this the patient's food should consist of semisolids whose cohesiveness prevents portions from dropping off into the air passages. In addition to this the act of deglutition may be accomplished without discomfort to the patient by placing him in the inclined plane position such as is used for feeding children after intubation. Even in cases in which this difficulty was most pronounced it did not continue for any length of time, two weeks being the longest in the author's experience. Usually all difficulty in swallowing disappears in from two to seven days. Of all articles of food water is most likely to cause trouble. A few drops easily enter the larynx and it may be several weeks before the swallowing of water is accomplished without causing some cough.

Electrolysis.—This method has not been extensively employed in any intralaryngeal condition and perhaps less so in tuberculosis.

Tuberculous infiltrations that have undergone hard fibroid change, broad infiltrations upon the inner surface of the epiglottis, and deep tuberculous deposits which have not been satisfactorily removed by other surgical procedures, offer opportunities for a trial of electrolysis.

The technic employed differs in no respect from that already described. It should be borne in mind that patients suffering from tuberculosis resist, more than any other, intralaryngeal manipulation on account of the excessively sensitive pharyngeal and laryngeal reflex. In order to bring about a satisfactory result by the use of electrolysis, the electrode must remain in the tissue not less than one minute which in the case of these patients is frequently impossible or, to say the least, extremely difficult.

Stenosis of the Larynx.

The endolaryngeal treatment of stenosis of the larynx under the guidance or with the aid of the laryngoscope so far as acute inflamma-

tion or edema are concerned has already been discussed under incision and scarification, page 245.

Intubation.—Acute stenosis due to diphtheria is treated by intubation or tracheotomy. The laryngoscope is not used in intubation for children but may be an aid to the introduction of the tube in adults.

Intubation in chronic stenosis especially when due to the scars of syphilis, lupus, or scleroma may frequently be performed with greater

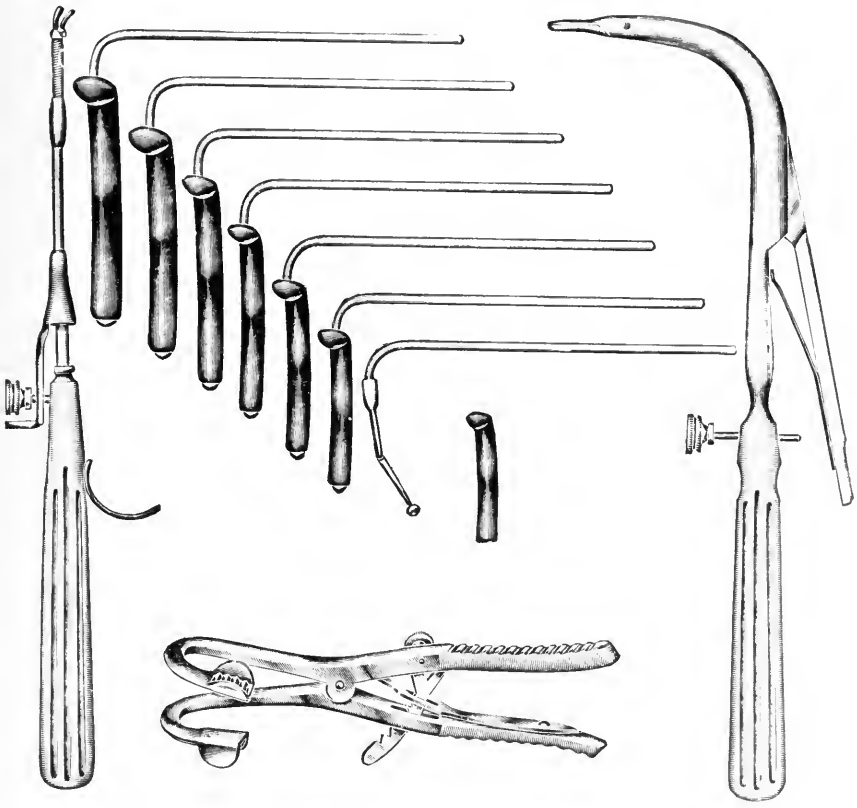


Fig. 785.

O'Dwyer's tubes.

ease under the guidance of the laryngoscope than by the sense of touch as it is usually performed in children. This is particularly true in those cases in which the landmarks have been destroyed by ulceration and cicatrices.

The O'Dwyer tube is the most satisfactory (Fig. 785). Its size should depend upon the caliber of the narrowed larynx. As a general rule it should be much larger than the largest child's tube and on this account should be made of some material lighter than the heavy metal

tubes ordinarily used in children. Tubes made of hard rubber are light and may be worn indefinitely without much discomfort.

It is rarely necessary to cocainize the larynx for this operation, however in cases of extreme irritability spraying the larynx with a small quantity of a 4 per cent solution of eucain or cocain may be found necessary. The patient being instructed to hold his tongue well forward, the intubation tube is carried to the orifice of the larynx under the guidance of the laryngoscope. The handle of the introducer is now raised, and the tube, being pushed by the obturator, drops readily into the larynx. Simultaneously the laryngeal mirror may be removed and the index finger of the left hand may be used to assist in placing the tube in position. In some instances the contraction of the laryngeal cavity is so great that the tube does not readily enter although it is of the proper size. Some force may be necessary and is entirely allowable for satisfactory intubation. In this respect the operation differs from the method employed for acute stenosis in children suffering from diphtheria where force should never be used.

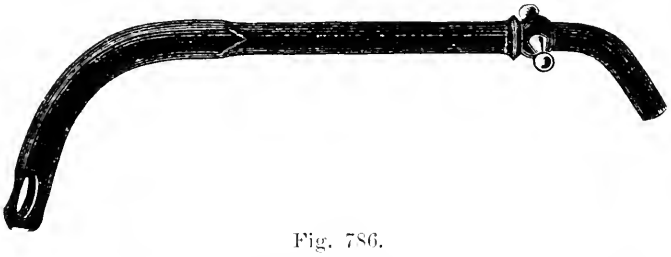


Fig. 786.

Schroetter's tube for gradual dilatation in laryngeal stenosis.

The author does not wish to be understood as recommending the use of the laryngoscope for all cases of intubation. It is however of advantage in adults in whom, owing to the long reach, the guiding index finger may have difficulty in locating landmarks or in those cases in which distortion of the parts makes it desirable to place the intubation tube in position under the guidance of direct vision.

Another procedure for the treatment of chronic stenosis of the larynx is incision or excision of cicatricial bands due to syphilis, scleroma, lupus, healed perichondritis, congenital webs or those following cut throat.

The method of incising or excising cicatricial tissue differs in no respect from that already described.

Dilatation.—Following incision or excision of bands or webs from whatever cause, it is usually necessary to adopt some method of gradual and persistent dilatation.

Schroetter's hard rubber tubes (Fig. 786) or some modification of these are usually employed. These tubes are most satisfactorily introduced in adults under the guidance of the laryngoscope. The size chosen should be as large as may be conveniently introduced with but gentle force. Anesthesia of the parts is not absolutely necessary although it is of some advantage. The tube having been placed in the larynx should be retained as long as fifteen or twenty minutes if possible. It will be found that the first introduction of the tube causes considerable cough and it is with difficulty retained for even a few seconds. By repeating the procedure two or three times a week the patient rapidly becomes accustomed to its presence within the larynx so that it may be retained for the desired time. Its caliber should be increased as rapidly as possible until the largest tube is used. The

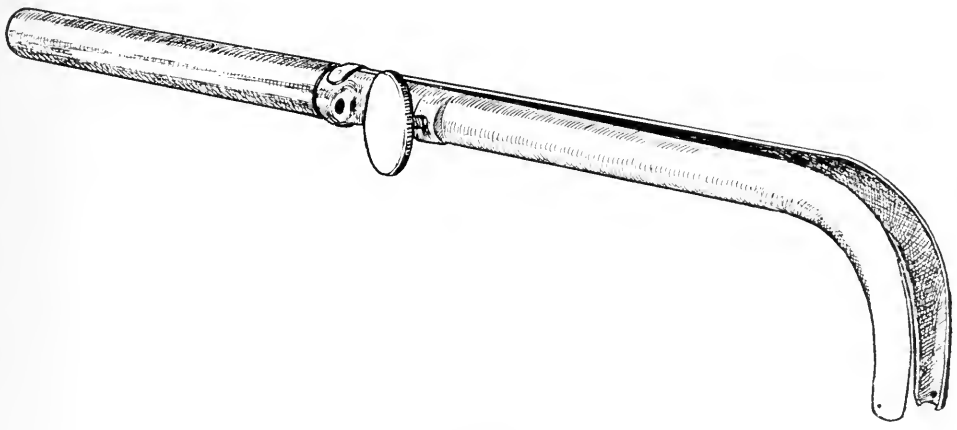


Fig. 787.

Levy's tube for dilatation in laryngeal stenosis.

treatment should never be attempted during attacks of acute inflammation. When used for the stenosis following abscess or necrosis of perichondritis, Chiari recommends that two years be allowed to elapse before systematic dilatation is undertaken.

In congenital webs the effects of Schroetter's tubes must be more carefully watched than in webs following syphilitic ulcerations, on account of the greater liability to acute inflammatory reaction and rapid proliferation of embryonic tissue. This was specially impressed upon the author in a case of web of the anterior two-thirds of the larynx in a child six years of age. After incision, dilatation with a small Schroetter tube was systematically carried out. Following an attempt to use a larger tube acute inflammatory reaction resulted causing marked though not alarming stenosis. Two months elapsed before it was

deemed advisable to introduce a tube again. In all cases the size of the tube should be increased very gradually.

In many instances the patient may be instructed to introduce the dilating tubes himself. This is particularly true in cases in which the stenosis is situated in the upper part of the larynx such as is frequently found following syphilitic ulcerations. In these cases the epiglottis is usually destroyed which still further facilitates the passage of the instrument when in the hands of the patient. Fig. 787 shows a tube of metal devised by the author for this purpose. The patient is readily instructed in its use and by means of a screw placed near the proximal end it may be gradually dilated while in position. The patient himself is frequently the best judge as to the amount of dilatation at each sitting.

CHAPTER X.

OPERATIONS ON THE EXTERNAL EAR AND THROUGH THE CANAL.

By William H. Haskin, M.D.

Under this heading are included operations for diseases involving the auricle and external auditory canal and also for conditions of the middle ear which are amenable to surgical treatment directed through the external auditory canal.

Instruments.—A complete set of instruments, in perfect condition, should always be at hand. They should include a set of specula of six sizes, several applicators, a pair of dressing forceps, a set of middle ear instruments (Fig. 788), a Blake's aural snare (Fig. 789), Hartmann's alligator forceps of various shapes (Fig. 790), an attic cannula (Fig. 791), a large ear syringe (Fig. 792), a strong hypodermic syringe with rigid needles, a Siegel's otoscope, several Eustachian catheters of different sizes with a Dench inflator and diagnostic tube, Lucae's aural pressure probe, Yankauer's salpingeal curette (Fig. 793), and a Buck ear probe. With these instruments in perfect order at hand, any of the following procedures may be undertaken.

Before operating, all instruments, except knives, should be carefully sterilized by boiling in a one per cent solution of sodium carbonate. Knives should be placed in 95 per cent alcohol.

Preparation of Field.—The site of the operation and the surrounding field should be cleansed and rendered as nearly sterile as possible. A 75 per cent alcohol solution, or the usual solution of tincture of iodin, applied directly on cotton and allowed to remain in the external auditory canal for five minutes is the most satisfactory. If iodin is used, it should not be preceded immediately by any watery solution but if it is desired, the seat of operation may be cleansed with green soap and alcohol twenty-four hours in advance. The skin is scrubbed with tincture of green soap for two minutes and then washed clean with sterilized water. This is followed with 95 per cent alcohol to dry the skin, and tincture of iodin is applied twenty-four hours later just before beginning the operation.

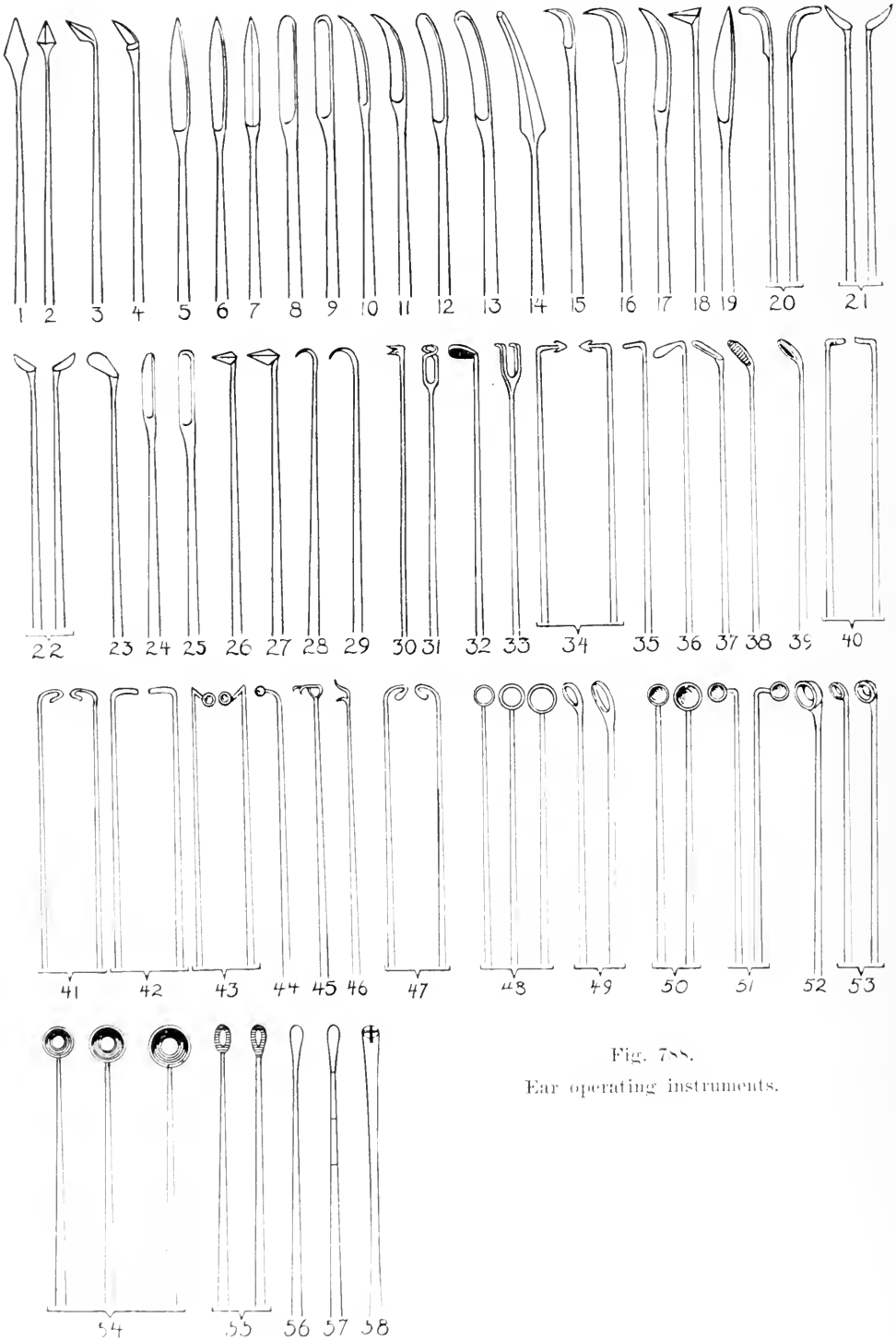


Fig. 788.

Ear operating instruments.

FIG. 788.—EAR OPERATING INSTRUMENTS.

1. Politzer's tympanum perforator.
2. Troeltzsch's tympanum perforator.
3. Tympanum perforator, angular blade.
4. Pierce's tympanum perforator.
5. Sexton's sharp knife.
6. Dench's myringotome, single edge.
7. Dench's myringotome, double edge.
8. Hotz's straight knife, blunt point.
9. Sexton's straight knife, probe point.
10. Politzer's furuncle knife.
11. Buck's curved bistoury, sharp point.
12. Curved bistoury, blunt point.
13. Buck's curved bistoury, probe point.
14. Curved bistoury, double edge, blunt point.
15. Full curved knife, sharp point, small.
16. Full curved knife, sharp point, large.
17. Buck's lancet, curved, sharp.
18. Buck's furuncle knife.
19. Sexton's knife, large.
20. Schwartze's tenotome, right and left.
21. Hartmann's knife, right and left.
22. Sexton's ossicle knife, right and left.
23. Sexton's trowel-shaped perforator.
24. Sexton's straight knife, blunt point, small.
25. Sexton's straight knife, blunt point, large.
26. Jacobson's furuncle knife.
27. Jacobson's furuncle knife, lateral bend.
28. Hartmann's sharp hook, large.
29. Hartmann's sharp hook, small.
30. Hartmann's sharp hook, double.
31. Deville's double hook.
32. Hartmann's spatula.
33. Double-pronged tenaculum, sharp.
34. Double sharp hook, right and left.
35. Blunt hook, right angle.
36. Blunt hook, acute angle.
37. Hartmann's lever, obtuse angle.
38. Moldenhauer's lever, serrated.
39. Hartmann's grooved lever.
40. Right angle blunt hook, right and left.
41. Ferrar's incus hook, right and left.
42. Ludwig's lever, right and left.
43. Kretschmann's incus curette, right and left.
44. Allport's incus hook.
45. Hewitt's stapes hook.
46. Bishop's ossicle vibrator.
47. Incus hook, probe point, right and left.
48. Buck's ear curette, blunt.
49. Sharp ear curette, oval.
50. Spoon curettes, round, sharp.
51. Dench's ear curette, right and left.
52. Bishop's middle ear curette, sharp.
53. Sharp ear curette, fenestrated.
54. Politzer's ear curette, sharp.
55. Hartmann's serrated ear curette.
56. Ear probe, straight, plain.
57. Ear probe, straight, graduated.
58. Trautmann's cotton packer.

The middle ear is much more difficult to cleanse, yet every means should be employed to secure a clean field before any operation is undertaken. By means of appropriate cannulæ, the canal and middle ear should be irrigated with an alkaline solution, special attention being given to the attic and hypotympanum. An attempt should be

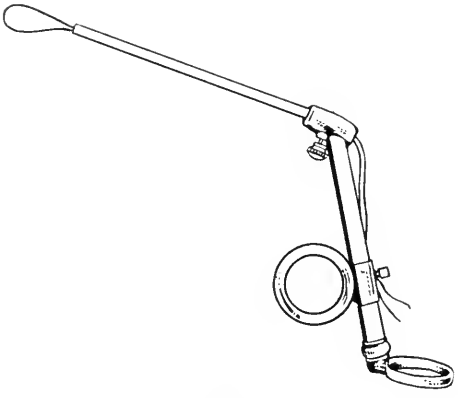


Fig. 789.
Blake's aural snare.

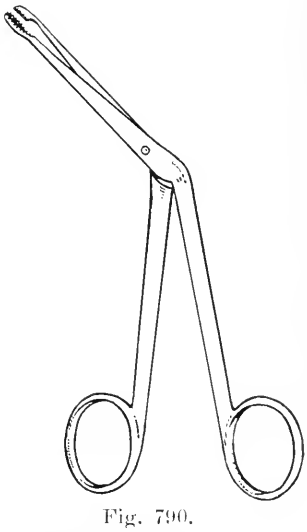


Fig. 790.
Hartmann's forceps.

made to force the solution through the Eustachian tube, as recommended by Politzer. This is not difficult to accomplish in most cases and no ill effects need be feared. After cleansing the canal it should be partially filled with the solution which is then gently forced through with the Siegel otoscope held firmly in the meatus. The advantage of

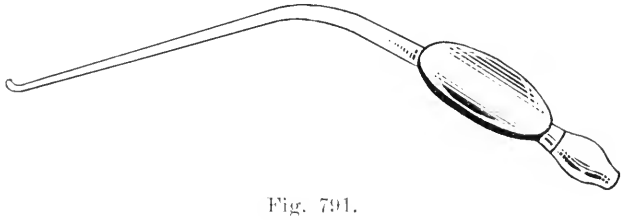


Fig. 791.
Pierce's attic cannula.

using the otoscope is that the flow can be watched, though the patient soon learns when the fluid reaches the throat. The same result can be obtained by using any syringe with a well rounded or olive-shaped nozzle. After thorough irrigation, the canal is filled with 75 per cent alcohol, which is allowed to remain for two minutes before drying.

Anesthesia.—Since Gomperz and Neumann discovered that complete local anesthesia and an almost bloodless field of operation may be secured by injecting a few minims of a half per cent solution of cocain to which a few minims of 1 to 5,000 solution of adrenalin chlorid is added, most operations in this department are best done under local anesthesia. When the middle ear is to be anesthetized, the pain of the first injection can be overcome by first freezing the skin just behind the concha with ethyl chlorid.

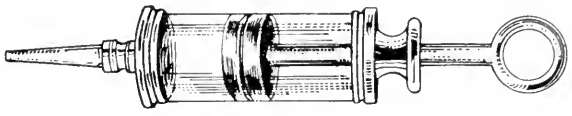


Fig. 792.

Vienna ear syringe.

If the ear is then pulled forward and upward the needle can be inserted and pushed into the canal beneath the periosteum and two or three minims can be forced into the tissue. A second and third injection can then be made via the meatus without causing pain. In ten minutes, anesthesia should be complete and the tympanum should appear blanched, unless there is much granulation tissue present. As the anesthesia lasts about forty-five minutes and the field is almost

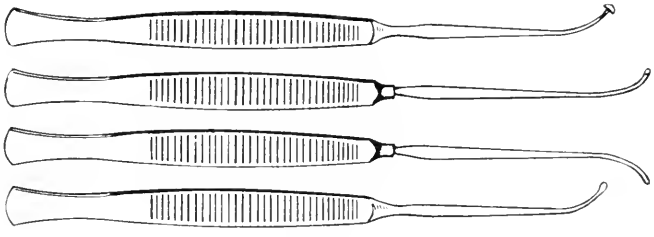


Fig. 793.

Yankauer's salpingeal instruments.

entirely bloodless, there is ample time in which to perform any operation called for in this region without undue haste.

Nitrous oxid gas may be used for such operations as myringotomy, although any of the operations enumerated may be performed under an anesthesia induced by the method of prolonged nitrous oxid and oxygen administration. Ether may, of course, be utilized by those who prefer.

In all prolonged operations a hypodermic of morphin sulphat gr. $\frac{1}{4}$ and atropin sulphat gr. $\frac{1}{150}$ should be administered one-half an hour before starting the local anesthesia.

AURICLE.

Operations for the correction of deformities are described in Vol. I. All others may be classified under three headings as follows:

1. Operation for removal of tumors.
2. Operation for relief of hematomata.
3. Operation for perichondritis.

Tumors.—The auricle may become the seat of growth of various tumors, benign or malignant, and operation may be called for either to correct the deformity or to attempt a cure if the tumor should prove to be of a malignant nature.

The chief benign tumors are either fibrous or sebaceous and require no special operation other than complete removal, the cyst wall of the sebaceous tumors being entirely removed.

Sarcomata are comparatively rare, but if an early diagnosis has been made operation should be advised at once. This operation should remove not only the actual tumor but should also include a wide area of healthy tissue, even if it causes marked disfigurement, for in this way alone, is a cure possible. If the growth is of long duration and has invaded the osseous tissues, little benefit will be obtained from operation, which should not be advised.

Epithelioma of the auricle is generally preceded by a long standing otorrhea and involves the tissues so deeply before the patient comes under observation, that it is generally impossible to remove entirely all traces of the growth. Cures of these cases by radium and by the X-ray have been reported and these measures should be advised rather than removal, which is so universally unsuccessful, unless the growth is limited to the auricle.

Hematomata or Othematomata.—These fluctuating tumors, produced generally by traumatism, but occasionally occurring spontaneously, should be relieved by free incision and complete evacuation of the blood by means of the curette, suction, and irrigation. If this is done under absolute aseptic precautions, the danger of subsequent disintegration of the cartilage, with its resulting atrophy and disfigurement, will be avoided. The hemorrhage generally occurs on the anterior surface of the auricle, between the cartilage and its perichondrium, and the incision should be made over the swelling and should be carried through the perichondrium. After all the clot has been removed, the edges of the wound should be nicely adjusted with sutures, a small drain of silkworm gut being left for twenty-four hours. A firm moist dressing should then be applied, strips being packed into

the various convolutions to secure an even pressure over the whole surface. The dressings should be changed daily and removed entirely as early as possible.

Perichondritis.—This condition frequently follows an othematoma which has not been properly treated, but it is generally due to some septic infection such as from furunculosis. It is one of the dangers of the modern radical operation that should be gravely considered and about which the patient should be informed before operation. When the disease is allowed to run its course, the greater part of the auricular cartilage is destroyed and the disfigurement caused by this and the ensuing cicatrization is very marked. It is therefore demanded that very radical measures be adopted wherever the disease is encountered. The old method of simply incising and draining is not sufficient to abort a process, which is usually very slow but progressive.

It will be wise in these cases, unless complete loss of cartilage has already taken place, to make an extensive incision through to the cartilage, which will frequently be found denuded of its perichondrium on one or both sides. By immediately excising all such denuded cartilage and carefully packing the cavity with iodoform gauze, the further loss of cartilage will often be stopped and there will be proportionately less deformity. As soon as it is certain that the progress of the disease has been arrested and healthy granulations have been formed, tight packing of the wound should cease and every effort should then be made to lessen the amount of cicatrization. Although there is bound to be more or less deformity as a result of this inflammation, this method of procedure, in the great majority of cases, will give the best results, that is, the least deformity.

OPERATIONS WITHIN THE CANAL.

Tumors.—These are generally osteomata and may be either sessile or pedunculated. Unless they cause pain or deafness, or are a source of danger because they block the escape of pus from an otorrhea, they are best left alone. When it is necessary to operate, it is better surgery, in most cases, to make the usual incision for the radical operation, separate the auricle and cartilaginous canal from the bone and then chisel off the growth and remove it. The posterior wound can then be sutured, the canal tightly packed for a couple of days, and a cure may be confidently expected. Occasionally, when the growth is pedunculated or is not too large to extract through the external meatus, it can be separated with a sharp blow of a chisel. The instrument

must be held very firmly in order to avoid injuring the tympanum or its contents.

Granulomata.—These often spring from the canal wall, arising from furuncles or other inflammations. They may be sessile or pedunculated.

When pedunculated the granulomata can be readily removed either with the Blake snare or with the Hartmann alligator forceps, provided that the site of attachment can be determined. Polypi of the canal may also be the result of mastoiditis which has ruptured spontaneously through the canal, the polypi being granulation tissue from within the mastoid. Their removal, therefore, should be done most carefully, as they may arise from the dura, in which event removal would open direct channels for infection.

Sessile growths are best treated by cauterization with silver nitrate, liquor ferri sesquichlorid, chromic acid or trichloracetic acid, followed by daily instillations of alcohol. The author has repeatedly seen these growths disappear rapidly during the use of pure cultures of the lactic acid bacillus in the treatment of chronic otorrhea.

Granulomata springing from the tympanic cavity should always be treated with caution, as deaths from meningitis and septic thrombosis following their removal have been reported. When the base of the pedicle can be seen the dangers are generally lessened but one should always remove these growths with slow constriction in order to shut off any portal of infection that might otherwise remain open. If the growths spring from a carious malleus or incus there is much less danger.

The tympanic cavity should never be curetted via the canal. If the growth cannot be removed by treatment the best policy is to recommend that the radical operation be performed. After removal of polypi there is but little bleeding, yet even this should be controlled and the canal washed and dried. Then a small quantity of boric acid powder should be blown into the cavity and the canal packed tightly with sterile gauze. In many cases where the otorrhea has been kept up by the polypi a cure will be obtained as the stump will heal over within a few days.

Furunculosis.—As it is necessary in these cases to make a comparatively long and deep incision, owing to the dense structures involved, and especially in multiple cases on account of the necessity for making more than one incision, a general anesthetic should be administered. Nitrous oxid gas is usually sufficient. When the furuncle is deeply seated on the inferior wall of the canal there is some danger of perforating the carotid, thus causing profuse hemorrhage which must be controlled by tight packing. There is also danger of perforating the

anterior wall, thus producing an abscess of the maxillary joint or a diffuse cellulitis. The writer recalls one serious retropharyngeal abscess produced in this way. After the incision has been made and the cavity evacuated the latter should be swabbed with carbolic acid followed by alcohol; the canal should then be packed with strips of gauze dipped in pure ichthyol and hot compresses applied over the ear constantly for twenty-four hours. The strips may be changed every three hours. This course of treatment will succeed in the majority of cases; some, however, will not be relieved. When there is a tendency to recur many times, the treatment with autogenous vaccines will often arrest and ultimately cure furunculosis. In all recurring cases the urine should be examined for diabetes, which is not infrequently present and which requires treatment.

MEMBRANA TYMPANI.

Myringotomy or Paracentesis.

General Considerations.—In adults the contour of the membrane can usually be clearly defined unless there is some irregularity of the canal itself, but when there is great thickening of the membranous canal and bulging of the membrane, as is found in severe cases of otitis media accompanied by mastoiditis, it is often very difficult to determine the outline of the annulus or of the malleus. This is especially true in infants in whom the normal position of the membrane is so much more oblique. In these cases very slight bulging of the membrane or thickening of the canal walls will obliterate the lumen and make it impossible to define the membrane. Politzer says that "Paracentesis is a simple, easily performed operation with which every practitioner should be acquainted." The writer cannot agree with him in this, "that it is an easily performed operation," and does not doubt that any otologist can recall many cases in which the attempt has been made by the general practitioner, with failure to reach the membrane, and with consequent loss of much valuable time. These cases are generally severe infections involving also the mastoid cells and requiring immediate drainage. Again, in the hands of unskilled operators, injury which cannot be repaired is often done to the ossicular chain.

Indications.—In all cases of suppurative middle ear inflammation with marked bulging and severe pain, paracentesis should be performed at once. In many cases, however, with secretion in the tympanum but without bulging or marked myringitis, the secretion can be removed by careful inflation and a more rapid and successful cure can often be effected, by a skillful otologist, without operation.

Anesthesia.—The operation is very painful and frequently causes the patient to faint if done without an anesthetic. This, of itself, does not matter if it were not for the fact that owing to the difficulty in keeping the patient's head rigid the incision may not be made sufficiently large to secure free drainage. Local anesthesia can sometimes be obtained by strong solutions of cocain in anilin oil, or equal parts of cocain, menthol and carbolic acid. In Germany it is recommended to fill the canal with an emulsion of 20 grains of alypin in a few minims of a solution of adrenalin chlorid, allowing it to remain for twenty minutes. As so much depends upon securing a free incision in the beginning, it is better to use a general anesthetic at once, nitrous oxid gas being sufficient, and to have the patient's head held firmly to the opposite side while he is in the recumbent position.

Technic.—The largest speculum that can be inserted well into the canal should be selected. It should be held in place with the thumb and second finger of the left hand, while the auricle is grasped with the first and second finger and is drawn upwards and backwards. The light should then be focused on the membrane and the incision made through the point of most marked bulging. It is immaterial in what direction the incision is made, although in most cases a curved incision through the posterior quadrant from the middle of Schrapnell's membrane down to the floor is best. Where there is great sagging of the canal wall the incision may be made from below upwards and should be carried through the annulus and along the posterior superior angle of the canal down to the bone. In doing this the chorda tympani will be severed and will cause temporary disturbance of the sense of taste which may last for a few days.

After careful inflation the canal should then be syringed with hot boric acid solution, dried, and lightly packed with sterile gauze strips impregnated with boric acid powder. The packing should be changed every two hours and the canal irrigated with hot solutions until all secretion has ceased. The ear should be inflated at least daily and every care be given to the nose and nasopharynx, as neglect of these measures will undoubtedly prolong any otitis media. It makes little difference whether the knife is straight or sickle-shaped, providing its edge is sharp. Calomel should be given the first night and a saline purgative for several days following. Rest in bed must be insisted upon; the diet must be very light and all alcohol and tobacco should be prohibited.

The possibility of injuring the ossicular chain, of opening the foramina, of dividing the facial nerve, and of opening the carotid or jugular bulb when in an abnormal position, must always be borne in

mind and because of these dangers the author feels that this so-called simple operation should always be performed by the otologist. As so much depends upon securing free drainage from the first it is far wiser, as said before, to use a general anesthetic so that the first incision may be complete and may not have to be repeated.

Removal of the Drum Membrane to Improve the Hearing.

Removal of drum membrane to improve the hearing has recently been recommended by Sidney Yankauer, and he has kindly furnished his own description of his operation as follows:

Various attempts to improve hearing by perforating the drum have been made and abandoned because the results have been unsatisfactory, i. e., closure of perforation, suppuration, no permanent improvement in hearing.

The indications are progressive deafness, accompanied by negative Rinne test (Lucae) when improvement follows preliminary incision. Local anesthesia after Naumann's method is advised and through the catheter with Eustachian applicator.

Complete test of hearing must first be made. Curved incision in posteroinferior quadrant is then made so that the wound will gape and admit sound vibrations to round window. A second complete test of hearing is then made. If hearing does not improve over first test, the ear is powdered and closed with cotton until perforation closes. If on the other hand improvement follows, the entire drum membrane and malleus are removed and the isthmus of the tube curetted.

Accidents, Results and Complications.—Progressive improvement in hearing follows, lasting a year, after which hearing apparently remains permanent. As only such ears have been operated upon in which the hearing was almost completely lost, the total amount of hearing regained is limited.

Simple Myringotomy.

Single or multiple incisions are often necessary to correct anomalies of tension or to relieve secretion retained in pockets caused by adhesions. Much benefit is often derived by these incisions in those cases in which careful examination has demonstrated that the symptoms complained of are produced by abnormalities of tension or by adhesions. The examination should be thorough and should include inflation and the use of Siegel's otoscope and Lucae's aural pressure sound to determine whether pressure increases or decreases the symptoms. It has also been recommended in cases of very flaccid membranes

to incise the membrane at several points, the resulting scars being said to decrease the flaccidity, but the results are doubtful. Anesthesia may be obtained by the hypodermic injection of cocain. No rule can be laid down as to the place or direction of incision as no two cases are alike. Where adhesions exist behind the membrane they can be divided with the Sexton right-angle knives. Division of tense bands in the membrane should be made with a sharp myringotomy knife, or, if perforation is present, the blunt knife may be used as it is less likely to injure the inner wall.

There is practically no hemorrhage in these operations. After drying the canal with alcohol it should be dusted with boric acid and lightly packed with sterile gauze. The ear must be inflated daily for some time and any reforming adhesions must be broken down. The relief afforded is often very marked, the tinnitus disappearing and the limit of hearing being increased, but permanent results should never be guaranteed.

Tenotomy of the tensor tympani was advocated at one time, but as Politzer says, "it may therefore be used in certain cases only as an experimental procedure, the result of which can never be foretold," and it should be discarded. Operations involving the stapes should never be attempted via the canal.

MIDDLE EAR.

Ossiculectomy.

In a large number of properly selected cases the removal of the malleus and incus will secure good and permanent results and will obviate the necessity of the much more dangerous radical operation.

The operation for the removal of the malleus and incus was first performed by Schwartze, in 1873, and has since been improved upon by many others, including Reinhard, Stacke, Grunert, Panse, Stucky and Neumann.

Indications.—The indications and contraindications for this operation have recently been stated by O. A. McKimmie and are given in full.

1. Caries of the ossicles.

2. Intractable discharge of not greater quantity than could be produced in the middle ear.

3. Perforation in Schrapnell's membrane with odorous discharge and marked deafness.

4. Recurring granulation polypi.

5. Adherent malleus with marked deafness.

6. Large kidney-shaped loss of drum membrane with the remains of the ossicles blocking the attic.

7. Recurring middle ear vertigo caused by thickened discharge or granulation pressing on the round window.

Perhaps the most common cause of chronic suppuration of the ear is caries of the malleus or incus or of both these bones. Caries of the malleus handle is readily recognized, and if the perforation is in the upper portion of the vibrating membrane or in Schrapnell's membrane, disease of the neck and head of this ossicle is easily determined.

When the perforation involves the posterosuperior quadrant of the drum, the long process of the incus can be seen and its condition determined with the probe. In some cases, however, the long process has disappeared and the body of the incus lies too high to be seen or its condition or even its presence to be determined with certainty by the use of the probe. In other cases the posterior part of the tympanic ring projects so far forward as to hide the incudostapedial joint.

In such cases if the tympanic ring is intact, ossiculectomy is preferable to the radical operation.

Many cases present a perforation so small or so situated that efficient cleansing of the middle ear cannot be effected and the condition of the ossicles cannot be determined with certainty, the discharge, however, indicating by its persistence and odor the probability of disease of some bony structure.

These cases are particularly dangerous inasmuch as the drainage may become blocked at any time and so give rise to acute mastoid disease, or spread the infection to the sigmoid sinus, internal ear, meninges or brain.

A perforation in Schrapnell's membrane indicates disease of the neck or head of the malleus or of the body of the incus. Not infrequently the head has disappeared as a result of the suppurative process and one can look through the perforation and see the internal wall of the middle ear. The hearing is affected not only by the chronic inflammatory changes in the cavity but also by the fact that the opening is so high that the cavity can never fully discharge itself.

A granulation polypus presenting through a perforation is practically always indicative of carious bone and nature's effort to cure it. The site of the base of the granulation is a matter of importance. If it springs from the internal wall of the middle ear or projects through a perforation in Schrapnell's membrane and keeps recurring after removal, the case is one suitable for ossiculectomy.

On the other hand, if it comes through an opening in the upper posterior part of the drum, I consider the radical mastoid operation

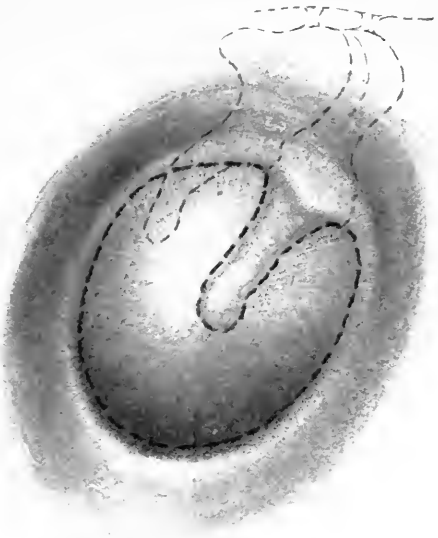


Fig. 794.

Ossiculectomy. Incision of membrana tympani.

Fig. 795.

Ossiculectomy. Cut membrana tympani exposing malleus and incus.

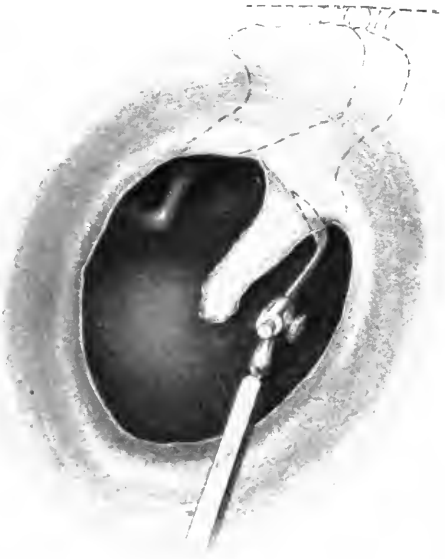


Fig. 796.

Ossiculectomy. Dividing the external malleal ligament.

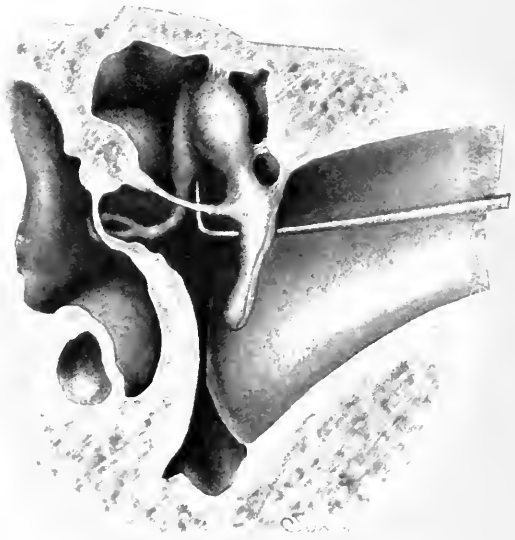


Fig. 797.

Ossiculectomy. Dividing the external malleal ligament.

indicated. Adhesion of the malleus handle to the internal wall of the ear is not only destructive of hearing but in itself may prove a distinct menace to life by gradually blocking drainage from above and causing pocketing and retention of secretion, and thus it may lead to an extension of the infective process.

The number of patients showing almost complete disappearance of the vibrating portion of the drum, with the carious shortened malleus handle presenting at the margin of a large kidney-shaped perforation, is large, especially in cases of long standing.

Such cases are apt to have an attic packed with granulations and the remains of the malleus head and sometimes part of the incus which not only keep up discharge but tend to block up the aditus and prevent healing of possibly superficial and otherwise curable caries in that locality.

A relatively small number of cases present occasional attacks of vertigo coincident with diminished discharge due to thickness of the discharge itself or to its crusting over the perforation.

This brings about accumulation of the discharge in the middle ear and resultant increased labyrinthine pressure by way of the round or oval window.

The radical mastoid operation is not to be discountenanced. It must be admitted that some cases which are subjected to ossiculectomy eventually require the radical operation; many, however, are cured by the simpler operation in which the risks are not so great. Careful consideration of the indications outlined will establish the selection of those cases in which ossiculectomy is indicated and of those in which the radical operation is to be selected.

Anesthesia.—Anesthetization may be secured by cocain and adrenalin given hypodermically.

Operation.—The remains of the membrane are divided from the annulus and all adhesions to the promontory are severed (Figs. 794 and 795), using the Sexton angle knives, which can also be used to divide the anterior or external malleal ligament and the tensor tympani muscle (Figs. 796 and 797). Then a Delstanche ring knife with its cutting edge up, is placed around the handle of the malleus and is pressed up as far as possible to sever the attachment of the tensor tympani. The malleus is grasped with the Hartmann alligator forceps, is pressed down to the floor of the tympanum and then extracted (Figs. 798 and 799). Very rarely, it will be found difficult and even impossible to extract the malleus because of firm adhesions which may bind both the malleus and the incus to the tegmen tympani. The malleus should always be dislodged downwards before attempt is made to extract it.

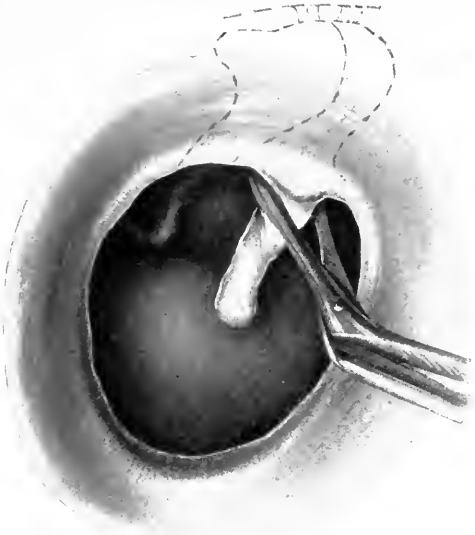


Fig. 798.
Ossiculectomy. Removal of malleus.

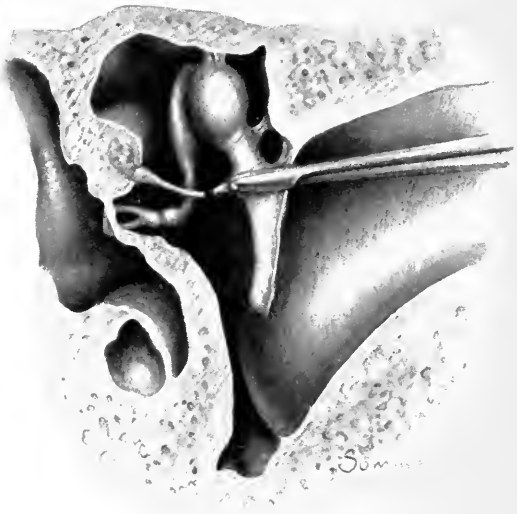


Fig. 799.
Ossiculectomy. Removal of malleus.

Fig. 800.
Ossiculectomy. Removal of incus.

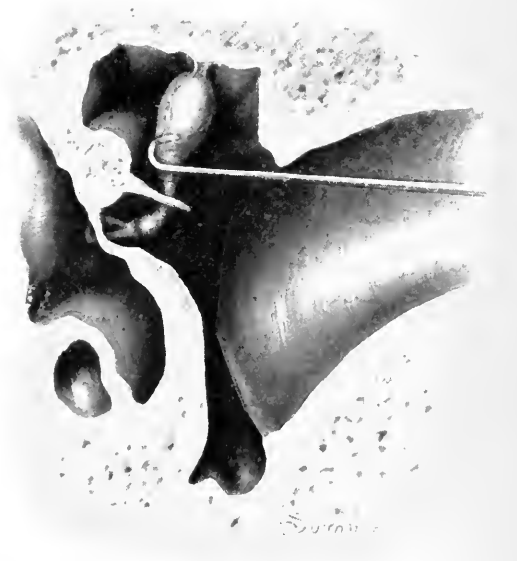


Fig. 801.
Ossiculectomy. Removal of incus.

Removal of the malleus alone is of little benefit and must be followed by removal of the incus, as it is found to be carious even more often than the malleus. The writer has frequently removed the incus with the Hartmann forceps having their grasping blades at right angle to the shaft. These can readily be introduced beyond the annulus, then opened and pressed upward, being kept close to the annulus, and the incus can be grasped and extracted in the same manner as the malleus, that is, downward first and then outward. When this method fails, the operator may introduce the proper angle attic curette of Reiner, or the Zeroni incus extractor or other form of incus hook (Figs. 800 and 801), into the anterior portion of the attic, keeping close to the annulus. With a rotary movement he should sweep the instrument along the tegmen from before backwards being careful not to injure the foramen ovale or even the facial nerve in the event of there being a marked dehiscence in the canal. When the incus is felt it should be pressed downwards to the floor where it may be grasped and extracted. It is not necessary to divide the incudostapedial joint, as it is easily torn apart without injury to the stapes when the incus is extracted.

The removal of the ossicles should complete the operation, and further curettement of the attic walls or removal of the annulus above should not be attempted at this time. Further work could be only imperfectly done while the patient is in this position, and might result in much harm.

Curettage of the Isthmus of the Eustachian Tube.

The original operation was first performed in 1907 and first published in 1910.

Local anesthesia is induced by application of cocain-adrenalin through the tube and through the external auditory canal.

When the parts have been thus anesthetized, cleansed and dried, the largest curette which will pass the isthmus is inserted through the canal into the tube. A short aural speculum is introduced into the external auditory meatus without making traction upon the auricle, and the instrument is introduced into the canal as far as the eye can see. Traction is now made upon the auricle in an upward and backward direction, the instrument being advanced at the same time under the guidance of the eye. When the tympanic cavity is reached, the instrument is rotated, so as to bring its end into the anterior part of the cavity, and as soon as the opening of the tube is brought into view, the end of the instrument is introduced into it. Traction upon the auricle is continued, and the instrument finds its way into the tube with-

out difficulty, until the entire curved portion of the instrument has passed out of view beyond the anterior margin of the drum membrane. In this position the end of the instrument is a few millimeters beyond the isthmus. It is not fixed, but slight lateral and rotary movements may be carried out. By a circular motion, the cutting-edge is forced through the mucous membrane down to the bone on all sides of the isthmus, so as to sever it completely from the mucous membrane of the pharyngeal portion. By an inward and outward movement of the instrument, the mucous membrane is then separated from the bone all around the tube for a distance of about 3 mm.; the isthmus is then again encircled, so as to separate the mucous membrane for about 5 mm. all around the tube. The curette is then sharply withdrawn, bringing the separated mucous membrane out with it, i. e., the mucous membrane is inverted like the finger of a glove, the cut-end becoming visible in the middle ear. When the isthmus is fairly large and round, this procedure will usually be successful; when it is angular or slit-like, the mucous membrane cannot be inverted successfully. In cases of the latter kind the smallest curette is introduced and the angles and corners are thoroughly curetted, so as to destroy or completely remove the mucous membrane. The ear is then powdered with iodoform or a similar powder, and the canal plugged with gauze.

The after-treatment is similar to the ordinary conservative treatment of aural suppuration.

Hemorrhage is very slight. Some after pain continues for twenty-four hours.

Spontaneous cure of the suppuration follows in about sixty per cent of the cases.

Value of the Operation.—Inasmuch as the closure of the tube is essential for the cure of aural suppuration whether the ear is treated conservatively or whether a radical operation is contemplated, the operation is indicated in practically all cases. The radical operation becomes necessary in only forty per cent of the cases, and should be considered as indicated only when the suppuration persists for a long time after the tube has been successfully obliterated.

CHAPTER XI.

SURGERY OF THE MASTOID PROCESS.

By Hanau W. Loeb, M.D., and Joseph C. Beck, M.D.

WILDE'S INCISION.

About the middle of the last century, Wilde recommended and practiced his incision for the relief of periostitis occurring in connection with mastoiditis. This incision, which was made parallel to the postauricular fold, was carried through the periosteum and was supposed to afford relief by evacuating the contents of the abscess cavity. The operation passed out of vogue, however, after it had been quite generally accepted, because the process which caused the abscess continued in spite of the evacuation of the pus.

Indications.—Most observers of authority refuse to recognize any indication for the operation. Still it must be admitted that it has occasional usefulness in those rare cases in which age (infancy) or the physical condition of the patient renders the simple mastoid operation inadvisable. In these cases, it is usually possible to extend the operation rapidly into the bone by the use of curettes.

Another indication is to be found when a mastoid gland has become infected without any involvement of the middle ear. For this condition, the simple incision may suffice, or it may be necessary to dissect out the gland, as happened in a case treated by one of the authors (Loeb).

A further indication is given in those extremely rare instances of periostitis without middle ear involvement which follows an acute otitis media or an accidental infection of the soft parts immediately adjacent to the mastoid process. Such cases have been known to result in acute mastoiditis. An incision made before the deeper structures are affected results in a cure.

Operation.—After proper preparation of the skin, an incision is made through the soft parts and periosteum, preferably at one stroke. If the gland is to be removed, the usual technic of dissection of a gland is followed. A drain of gauze or rubber is advisable in all cases.

SIMPLE MASTOID OPERATION.

Operations on the mastoid process were first suggested for the relief of deafness and tinnitus by Rolfinck and Riolan who recommended this practice in the last half of the seventeenth century. Petit, in 1774, described the operation and reported cases of suppuration of the mastoid, which he had treated by opening the bone with a trephine, chisel or drill. Jassen, in 1776, after an incision, perforated the outer table with a trochar and entered a pus cavity, thus establishing a communication with the antrum. In the main, the operators of this time were favorable to the operation only because they thought that it provided a means of relieving deafness.

The failures and even fatalities which followed this practice soon brought it into disrepute; it was probably on this account that, notwithstanding the development of pathology in general, no progress was made for many years in the methods of effecting postauricular evacuation of pus and drainage. However, about this period, Wilde urged the value of an incision through the soft parts and periosteum down to the bone, and from that time until now, the procedure has been known as Wilde's incision. Although at present some authors consider its usefulness restricted to infants, while the majority discard it altogether, it had a tremendous influence in directing the attention of the profession to mastoid suppuration and paved the way for rational surgical intervention.

Turnbull, Crosby, and Ludwig Mayer, in 1864, opened the mastoid cortex purposely for mastoid suppuration by simple perforation, but so uncommon was this operation that Buck records that up to 1873, only thirty-five cases had been thus treated. After this it was common enough in competition with the Schwartze operation. Ten years of this competition, however, served to demonstrate the supremacy of the one and the utter inadequacy of the other.

In 1873 Schwartze demonstrated the operation which has been known as the Schwartze operation, or the simple mastoid operation. Originally a drill was employed for entering the mastoid cells and the antrum or a curette was used to open the latter. The ingenuity of a great host of operators since that time has multiplied the number of instruments, so that at the present time the drills, burrs, trephines, curettes, forceps, chisels, and gouges are legion, not to speak of those that have been devised and consigned to oblivion.

The development of this operation by modern otologists has been in keeping with the improved surgical technic of today and for this reason we now have at our command for the relief of mastoid suppura-

tion a most beneficial operation, which is associated with a minimum of danger and discomfort.

Indications.

In order to understand fully the indications for the simple mastoid operation, it is necessary to know the character of the pathologic process present. The middle ear is a cavity lying mainly within the petrous portion of the temporal bone, having its bony opening into the external auditory canal closed off by the membrana tympani. It communicates with the nasopharynx through the Eustachian tube, lined with mucous membrane, and with the mastoid cells by way of the antrum, in its uppermost portion. For this reason an inflammation resulting in suppuration has three drainage possibilities: through a perforated drum, through the Eustachian tube, and through the aditus ad antrum, antrum and mastoid cells. The usual way is through a perforated membrana tympani made artificially by the surgeon or by an ulcerative process from the middle ear. If the flow is free, if the perforation is early and the infection is not too virulent, or if infection is not occasioned by improper or careless treatment, a complete cure usually results. But if for any reason, the outlet of the pus into the external ear is delayed or prevented, the pus is apt to continue forming and must drain through the other openings. There is no reason to doubt that pus is frequently drained through the Eustachian tube, but any reliance placed upon this is most hazardous. The opening is far from the dependent portion of the middle ear and the tubal caliber is easily occluded or soon becomes obstructed by the swollen mucosa.

A most convenient drainage for the pus is into the antrum and the mastoid cells, thus extending the infection into these cavities and through them into adjacent structures. In this way the infection may extend from the middle ear to the meninges, the internal ear, the facial nerve, and even to the vascular system.

In the process of mastoid cell involvement, the inflammation causes the development of certain signs which constitute the indications for operation, as follows:

1. Pain.
2. Swelling of the soft parts over the mastoid.
3. Sinking in of the posterior or superior wall of the canal.
4. Persistence of copious discharge and pain.
5. Sudden cessation of discharge with continuance or accession of pain.
6. Swelling of the posterior cervical lymph-nodes.
7. Roentgenographic evidences.

8. Infective agent.
9. Meningeal symptoms.
10. Fever.
11. Blood picture.
12. General indisposition.

1. **Pain.**—Pain is a common symptom of mastoiditis, but it may be entirely absent or may disappear under treatment, even though the mastoiditis persists or increases. As a rule, the patient describes the pain as being located behind the ear running down the neck or up towards the parietal or occipital bone. It is sometimes felt just anterior to the auricle above the external auditory orifice.

Pain on pressure is one of the most convincing signs, being elicited most commonly over the antrum or over the tip of the mastoid process, on the posterior wall of the bony meatus or occasionally over the point of emergence of the emissary vein, usually at the middle of the posterior portion of the mastoid process. On the other hand, pain on pressure is sometimes felt in uncomplicated otitis media suppurativa acuta. Under all circumstances the two sides should be compared as to tenderness on pressure, but the diagnostician should remember that pain can almost always be elicited by strong pressure on the tip of the mastoid. Furthermore, infection from streptococcus mucosus is often unaccompanied by any pain whatsoever, although it is one of the severest types.

2. **Swelling of the Soft Parts Over the Mastoid Process.**—As a rule this indicates a periostitis with or without fistula through the cortex of the mastoid process. The sign is best elicited by placing the patient in such a position that both mastoids may be examined at the same time; for instance, the examiner standing in front of the patient, has him bend his body forward and studies the two mastoids at the same time in a good light. This sign is frequently dispelled by treatment without corresponding diminution of the process, especially after ice applications for twenty-four hours or longer.

Sometimes the swelling disappears or is greatly reduced without local treatment, giving the impression that the infective process is subsiding, instead of which it is increasing in extent. This may be due to increased drainage through the perforate membrana tympani or through the Eustachian tube or through an opening at the inner side of the mastoid tip, produced by erosion (Bezold's mastoiditis).

3. **Sinking in of the Posterior or Superior Wall.**—This is a very characteristic sign, one which is practically not to be observed in any other condition. The degree of sagging is said to depend upon the

quantity of pus in the antrum and upon the amount of swelling of the bone and its coverings between the antrum and the external auditory canal.

4. **Persistence of Copious Discharge and Pain.**—A resolving acute middle ear suppuration should exhibit a greater or less diminution of both pain and discharge—a diminution of pain after the first day, and of discharge after a few days. The continued copious discharge without pain may be due to middle ear infection alone, but if it is associated with continued or increasing pain in the ear or mastoid region, it is apt to be due to extension to the mastoid cells. Otherwise the free outflow of pus would lessen the tension and hasten resolution. Staphylococcal and influenzal infections are accompanied by a more copious discharge than streptococcal and pneumococcal.

5. **Sudden Cessation of Discharge with Continuance or Accession of Pain.**—This is an evidence of interference with drainage and of a probable extension of the process to the mastoid cells. As a rule, free incision of the membrana tympani will relieve the symptom and perhaps prevent extension, but on the other hand, this is often too late to be of material benefit.

6. **Swelling of the Posterior Cervical Lymph-Nodes.**—This is an uncommon sign but one which is of value in locating the infection. Middle ear suppuration affects the anterior cervical lymph-nodes mainly; mastoid suppuration, the posterior, largely. In the condition known as Bezold's mastoiditis, the swelling in the neck either from an infected gland or from a cervical abscess is most characteristic. Persistence of this symptom justifies early operation.

7. **Roentgenographic Evidences.**—A suppurative inflammation in the mastoid cells shows its presence roentgenographically in two ways: by pus and granulations obstructing the passage of the rays, and, secondly, by showing the destruction of the intercellular walls on the plate. Comparison, however, must be made between the two mastoids, hence the pictures must be taken as nearly uniform as possible. Stereoscopic pictures are to be preferred. The internal auditory canal stands out clearly as a more or less black oval-shaped spot. If the picture is taken properly the lines of the cartilages of the auricle establish the relations of the various structures which can be defined. Thus the mastoid cells will be seen above, behind and below the internal auditory canal, more or less obscured by pus or fused together into one larger cavity, and dark in appearance from the ready penetration of the rays. The lateral sinus can easily be followed and the ossicles often distinguished. Care must be taken not to confuse a sclerotic or diploic mastoid with a mastoid full of pus. In the former case, the

white shadow is denser and smaller, as a rule, than in the latter. In addition, a sclerotic mastoid is apt to be associated with a similar picture on the other side. Roentgenograms are of less value in bilateral mastoiditis as the usefulness of comparison is lost.

Roentgenography is to be encouraged, for proficiency in diagnosis is greatly increased by experience.

8. **Infective Agent.**—Bacterial examination of the discharge from the ear is of no diagnostic value unless the canal is first rendered practically free from bacteria by liberal applications of tincture of iodin. Smears and cultures are then made from the pus which is drawn out of the middle ear by means of a suction apparatus.

The streptococcus mucosus and the streptococcus pyogenes strongly indicate operation as resolution without mastoid involvement is uncommon when they are present. The pneumococcus accompanied by the micrococcus catarrhalis is considered an almost positive indication. The pneumococcus alone, or with the staphylococcus, or the staphylococcus alone, produces a milder infection which is usually followed by rapid resolution. Other organisms that are found are of no particular concern in this connection.

9. **Meningeal Symptoms.**—Nausea, convulsions, high temperature and severe headaches, associated, call for immediate operation, even if the case seems hopeless. It must be remembered, however, that these symptoms may occur in young children suffering from middle ear suppuration without mastoid or meningeal involvement. However, if they persist after paracentesis, they indicate a mastoid or meningeal attack.

10. **Fever.**—Except in very virulent cases, the temperature is never very high; it ranges from 98° to 103° ordinarily, but as a rule it is seldom above 102°. The important characteristic is its remissions. The chart when temperature is taken every two hours, shows the typical pus curve, up and down, with the intervals of fever more or less irregular. To be of value, the patient should be observed in a hospital for at least twenty-four hours, no medicine being administered and the temperature taken every two hours. A sudden rise of temperature followed by a sudden fall with chill should make one suspicious of involvement of the lateral sinus and calls more urgently for the mastoid operation than the usual temperature curve. An excessively high temperature, without a succeeding fall within a reasonable time, points to the likelihood of a septicemia, pyemia or meningitis, and naturally justifies immediate operation if there is any other evidence of mastoid suppuration present. Of course there are many cases in which the temperature is altogether atypical, which is not remarkable in view of

the numerous factors upon which it depends, such as, character of the infection, drainage, absorption of septic products, area of involvement, etc.

11. **Blood Picture.**—The leucocyte count, which is always increased as in all other acute infections not involving the blood stream, varies from 11,000 to 18,000. The polymorphonuclear neutrophiles are particularly increased, from a normal of 72 to 75 per cent to 85 to 90 per cent, at the expense of the small mononuclear leucocytes which are decreased. If the mastoid abscess is complicated by a bacteremia by way of the lateral sinus or the smaller vessels of the mastoid process (osteophlebitis), the leucocytes are markedly increased, often from 25,000 to 30,000. Higher counts have been reported. It must be borne in mind that the polymorphonuclears should always represent at least 72 per cent of the white cells and a sudden drop, as for instance from 85 to 70 per cent, is indicative of collapse or at least of loss of resistance.

12. **General Indisposition.**—Patients suffering from mastoid abscess as a rule look sick, often to a degree out of proportion to the other symptoms of which they complain. On the other hand, it is remarkable how they protest against confinement to the house or hospital for observation, with the claim that they do not feel sick in any way. Such a state of affairs cannot be accepted as any proof that the process is a slight one, for the destruction may be very extensive. The power of observation achieved by an abundance of experience is of the greatest value in weighing this particular evidence of the morbid process.

On the whole the presence of the signs that have been enumerated make the indication for operation comparatively clear. Certainly when a fair number are present coincidently there should be no difficulty in this respect. In addition it should be noted that the mastoid operation is often indicated when the symptoms suggest the presence or development of a graver affection, such as meningitis, facial paralysis, thrombosis of the lateral sinus, endocranial abscess and acute general septicemia from middle ear infection.

Contraindications.

Advanced tuberculosis, diabetes, cancer, or other fatal diseases and hemophilia play a considerable part in contraindicating the operation. Under such conditions, the surgeon must weigh the conflicting circumstances and determine the proper course to pursue.

Operation.

Preparation of Patient.—The usual surgical rules obtain in the preparation of the patient. A purgative should be administered on the day before, and an enema given on the morning of the operation. It is well to give urotropin for a day before any operation, especially about the cranial cavity, as this drug is supposed to have the property of preventing septic involvement of the meninges. If symptoms permit, the patient should be admitted at least twenty-four hours before the operation. The following details are important in the preparation of the field of operation.

Shaving the Scalp.—It is best to shave enough of the scalp on the night before the operation so that what remains of the hair may be entirely excluded from the skin exposed during the operation. This practice meets with no opposition on the part of men, but women frequently object for the reason that it takes the hair a long time to grow to a length corresponding to that which remains. When the patient refuses to allow the hair to be cut, the entire head may be covered with a starch bandage applied while wet an hour before the operation. It is to be removed upon the completion of the operation, before the bandage is applied.

However, it must be admitted that asepsis at the operation is not so easy to attain under these circumstances and that the hair often causes inconvenience, to say the least, in the subsequent dressings. In emergency operations, the site is shaved immediately before or after the anesthesia is instituted.

Cleansing.—When possible, the auditory meatus, auricle and retroauricular region should be thoroughly cleansed on the night before with benzine, alcohol, and ether in the order named, followed by the application of a sterile gauze pad covered by a roller bandage. Soap and water may be used instead. Some surgeons use a moist boric acid dressing with or without cleaning the surface of the skin. Others use a bichlorid pack, but there is always a danger of bichlorid eczema especially on the auricle and within the canal and there is no more assurance of asepsis from such a process than from any other.

Application of Iodin.—As is now generally done, just before the incision is made, the field of operation is covered with an application of iodin (official ten per cent tincture) followed by a generous amount of alcohol. No soap and water should be used to cleanse the integument just before the application of the iodin. In fact, when the operation is an emergency or when the patient has not been in the hospital on

the night before, it is now customary to rely on the iodin and alcohol applications alone.

Anesthesia.—The rules for the administration of the anesthesia in mastoid operations are the same as those to be observed in other operations of equal gravity and the same general character. However, in view of his proximity to the operation, the anesthetist must not be permitted to interfere with the asepsis of the operation. He must be altogether excluded from the field of operation by sterile towels cov-

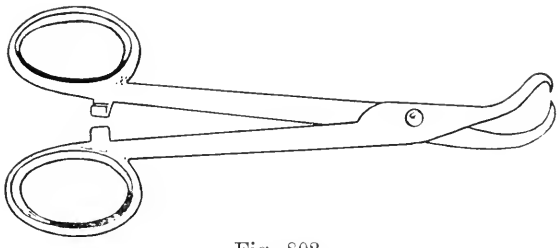


Fig. 802.

Towel clamp.

ered by a sterile abdominal sheet or he must give a sterile anesthesia. The choice of anesthetic to be used must depend upon the operator and the condition of the patient.

Ether.—In the majority of cases, ether is the most desirable and is applicable in most instances. It is contraindicated in certain types of kidney affections, in diabetes and in patients whose condition renders them liable to pulmonary edema. Even in these, ether may be used with careful circumspection, if other methods are not acceptable.

The drop method, preceded by gas-oxygen anesthesia when there

Fig. 803.

Ballenger's periosteal elevator.

are no cardiac contraindications, is by far the best. The use of the pumping apparatus in the administration of ether lessens the quantity used, controls the anesthesia better, and permits the supply of oxygen when necessary. Beck's apparatus is very acceptable because a suction appliance is combined with it (Fig. 716). The rebreathing method may be employed as follows:

Ether to the amount of two or three ounces is poured into a rubber

bag of one gallon capacity, attached to a rubber face mask so tightly applied to the face that no air can be admitted, and the patient made to breathe and rebreathe the air contained in the bag. This is said to be the safest and most economical procedure.

Fig. 804.

Dean's periosteal elevator.

Anesthesia is promoted and rendered more effective in adults by the hypodermic administration of morphin sulphat gr. ¼ and atropin sulphat gr. 1 120, one-half an hour before the operation.

The rectal administration of ether is often found serviceable. For a full grown adult weighing 140 to 180 pounds, a mixture of six ounces

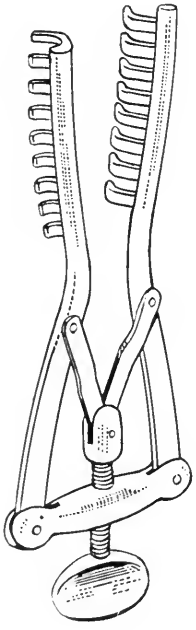


Fig. 805.

Allport's retractor.

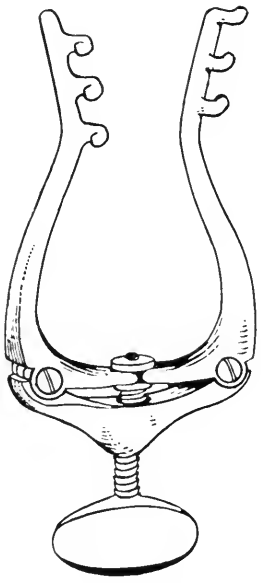


Fig. 806.

Jansen's retractor.

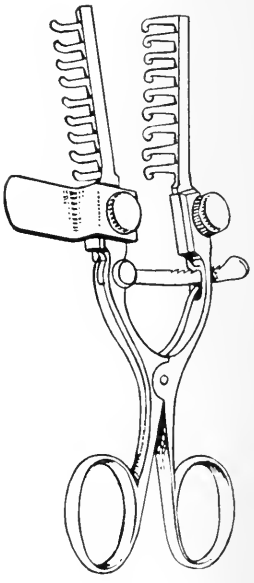


Fig. 807.

Jack's retractor.

of ether and two ounces of olive oil is allowed to flow slowly into the rectum which has been previously washed out. This should be done one-half an hour before the operation. The quantity used is reduced for smaller individuals, only about half being required for children and light weight adults. If toxic symptoms supervene, the solution is removed by washing out the rectum with cold water.

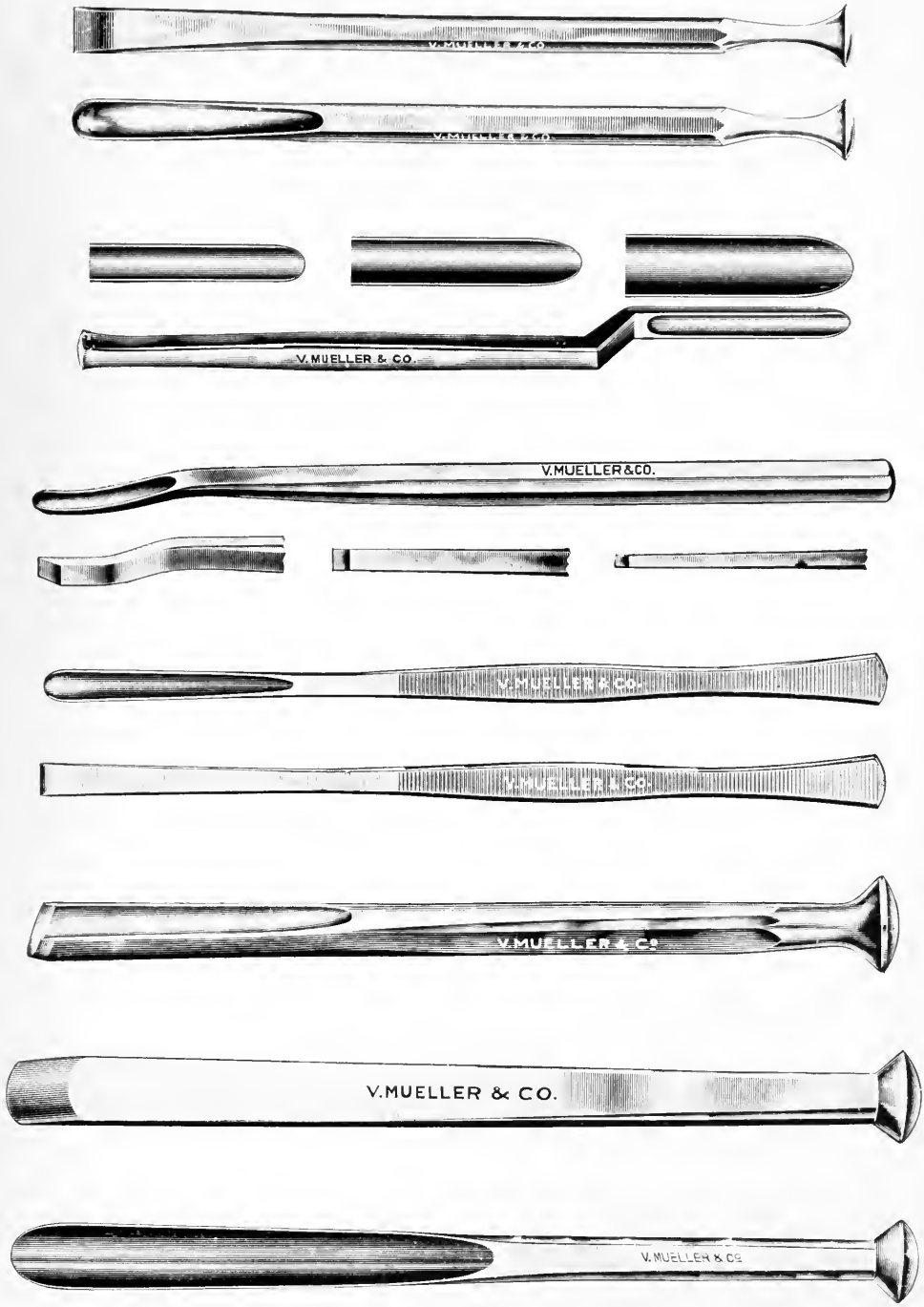


Fig. 808.

Mastoid gouges and chisels.

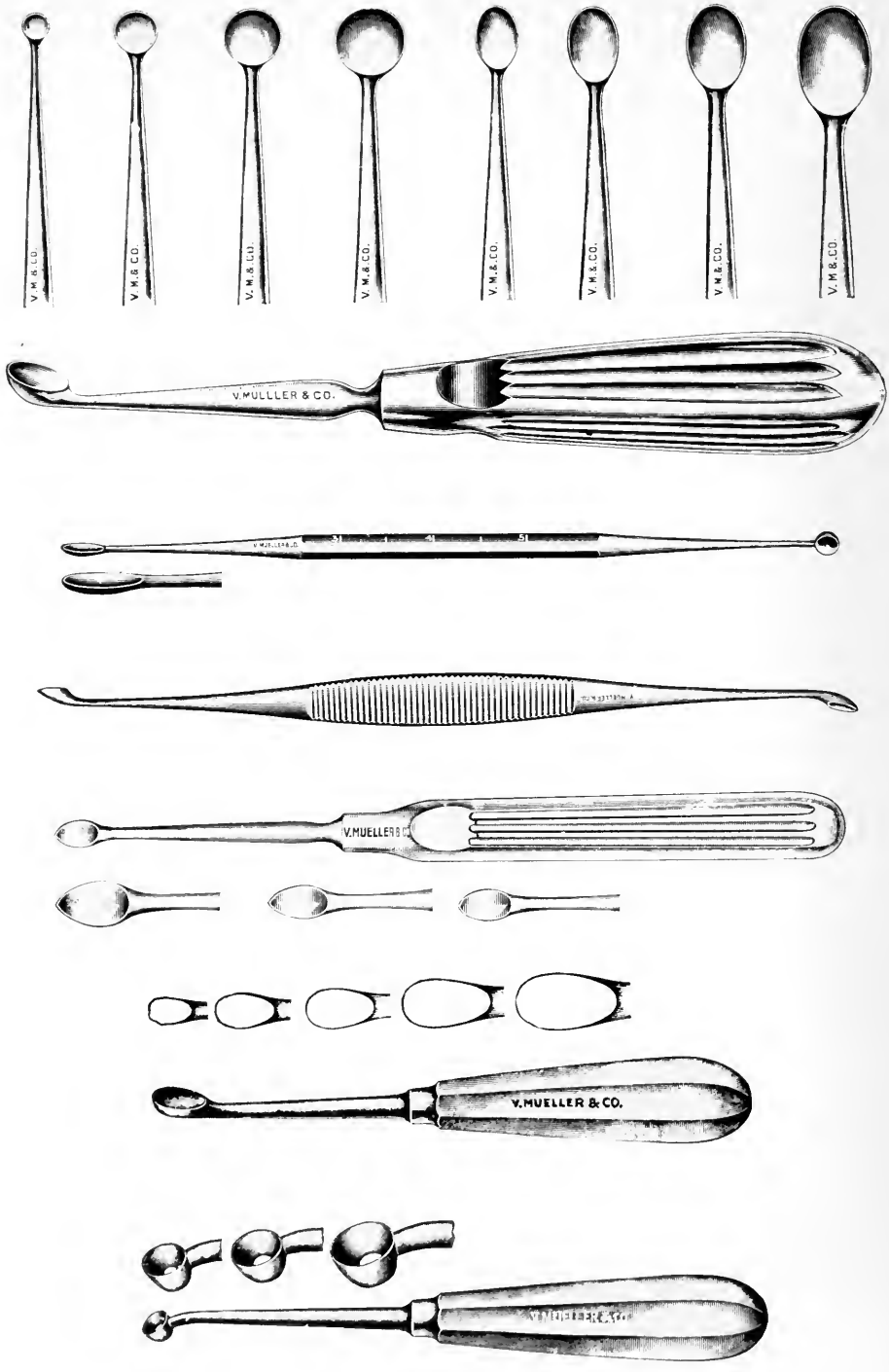


Fig. 809.

Mastoid curettes.

Nitrous Oxid Gas.—As in other operations, prolonged administration of nitrous oxid gas may be employed when it is not contraindicated. The advantages are comparative safety and immediate recovery from the anesthesia. However, only experts should administer the anesthetic.

Chloroform.—This is an ideal anesthetic but is now seldom em-

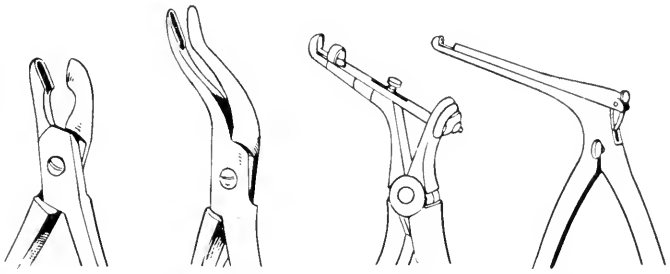


Fig. 810. Fig. 811. Fig. 812. Fig. 813.

Fig. 810.—Luer's forceps.
Fig. 811.—Jansen's forceps.
Fig. 812.—Citelli's forceps.
Fig. 813.—Kerrison's forceps.

ployed in America on account of the dangers, and the practical impossibility of foreseeing and preventing them.

Other general anesthetics, such as somnoform, A.C.E. mixture, etc., present no advantages over ether.

Local Anesthesia.—Infiltration with one-half to two per cent solu-

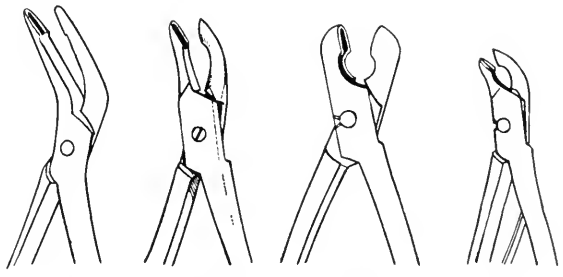


Fig. 814. Fig. 815. Fig. 816. Fig. 817.

Fig. 814.—Lucae's forceps.
Fig. 815.—Bane's forceps.
Fig. 816.—Whiting's forceps.
Fig. 817.—Bacon's forceps.

tion of novocain may be used to produce sufficient anesthesia to permit the performance of the operation but the patients are far from comfortable. Morphin sulphat alone or in combination with atropin or scopolomin is of great assistance in this particular. The infiltration is accomplished by injecting the novocain after the method of Neumann.

Instrumentarium.—The number of instruments in common use for the mastoid operation has multiplied greatly since the operation became popular. Each operator adapts himself to certain varieties of the instruments used, through the practice of his teachers or associates or the incidence of his opportunity and experience. The following list includes practically all the groups of instruments employed:

Towel clamps (Fig. 802).

Knives, two.

Artery forceps, 12, two sizes of any pattern desired.

Fig. 818.

The mastoid process of the temporal bone and its vicinity.

Scissors: one curved, one straight.

Periosteal elevators: Ballenger's (Fig. 803), Dean's (Fig. 804).

Retractors: Allport's (Fig. 805), Jansen's (Fig. 806), Jack's (Fig. 807), sharp retractors.

Chisels and gouges: Vienna pattern, Alexander's, Trautmann's, Schwartze's (Fig. 808).

Curettes: three different sizes, round or oblong, (Fig. 809), Yankauer's tube curettes (Fig. 793).

Probes: a variety.

Anatomic forceps.

Rat-tooth forceps.

Tuffier's forceps.

Dressing forceps; angular.

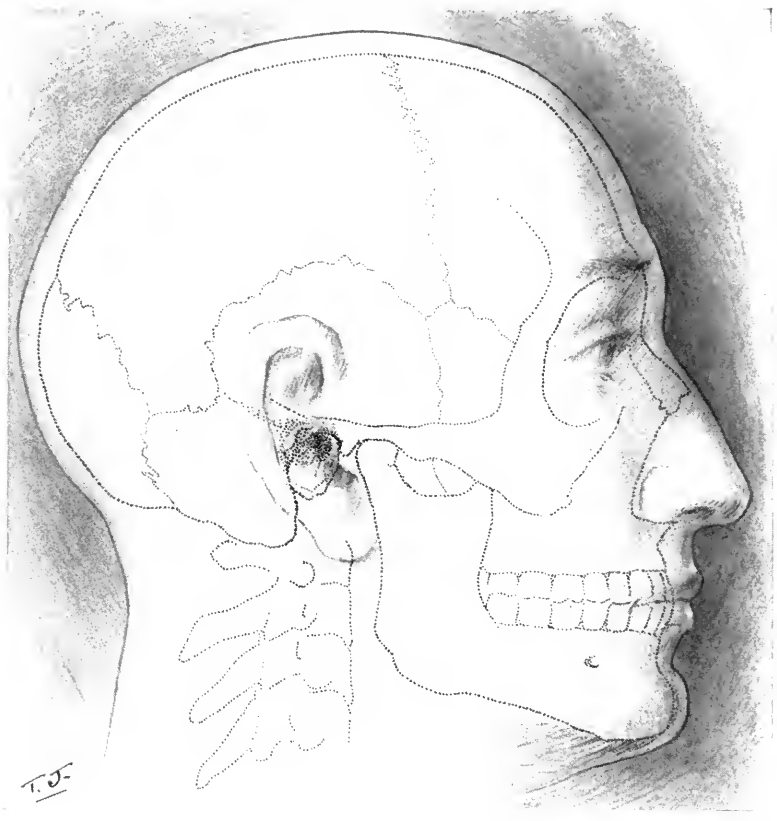


Fig. 819.

Reconstruction of the bones of the head and face showing their relation to the mastoid.

Bone forceps: Luer's (Fig. 810), Jansen's (Fig. 811), Citelli's (Fig. 812), Kerrison's (Fig. 813), Lucae's (Fig. 814), Bane's (Fig. 815), Whiting's (Fig. 816), Bacon's (Fig. 817).

Mallet: wood, metal, rawhide.

Ear specula.

Hand burr: Whiting's, Ballenger's.

Bone drill: electric.

Needle holder.

Needles.
Skin clips.
Suture material.

The operating table should be provided with a head rest or block for keeping the head in proper position.

Light.—The operation may be performed in an operating room with a good north light, but it is generally necessary to resort to arti-

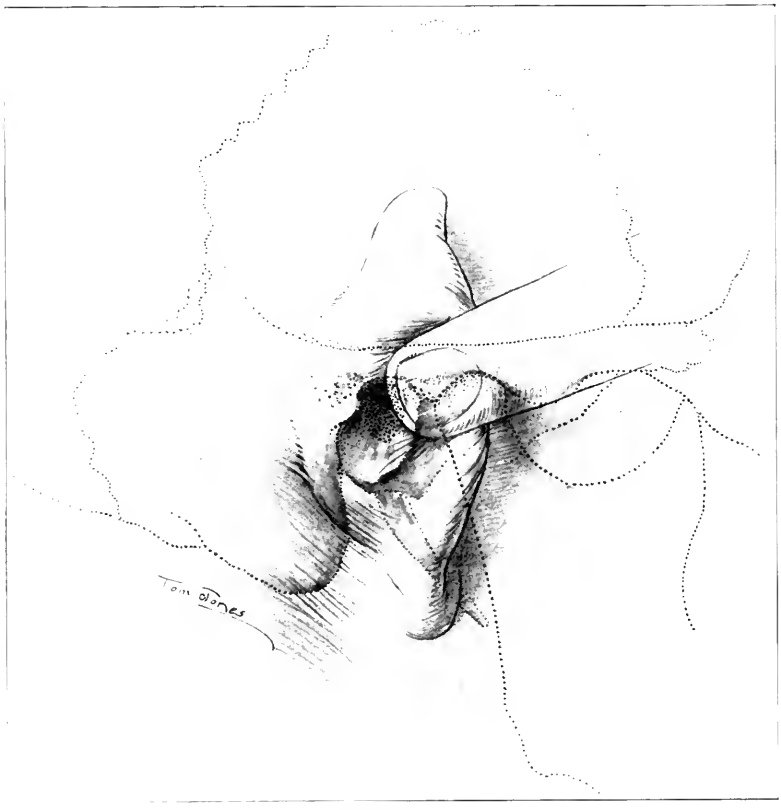


Fig. 820.
Bone relations in the immediate vicinity of the mastoid.

ficial light before the operation is completed. This may be secured in three ways:

1. By direct light through the agency of one of the newer types of electric lights, such as the nitrogen lamps, 60 to 100 watts.

2. By reflected light by means of a mirror on the operator's head.

3. By a movable electric light worn on the operator's head. Of this type, the Klar and Beck headlights are the best.

Bone Relations.—A study of the bone relations is of importance to

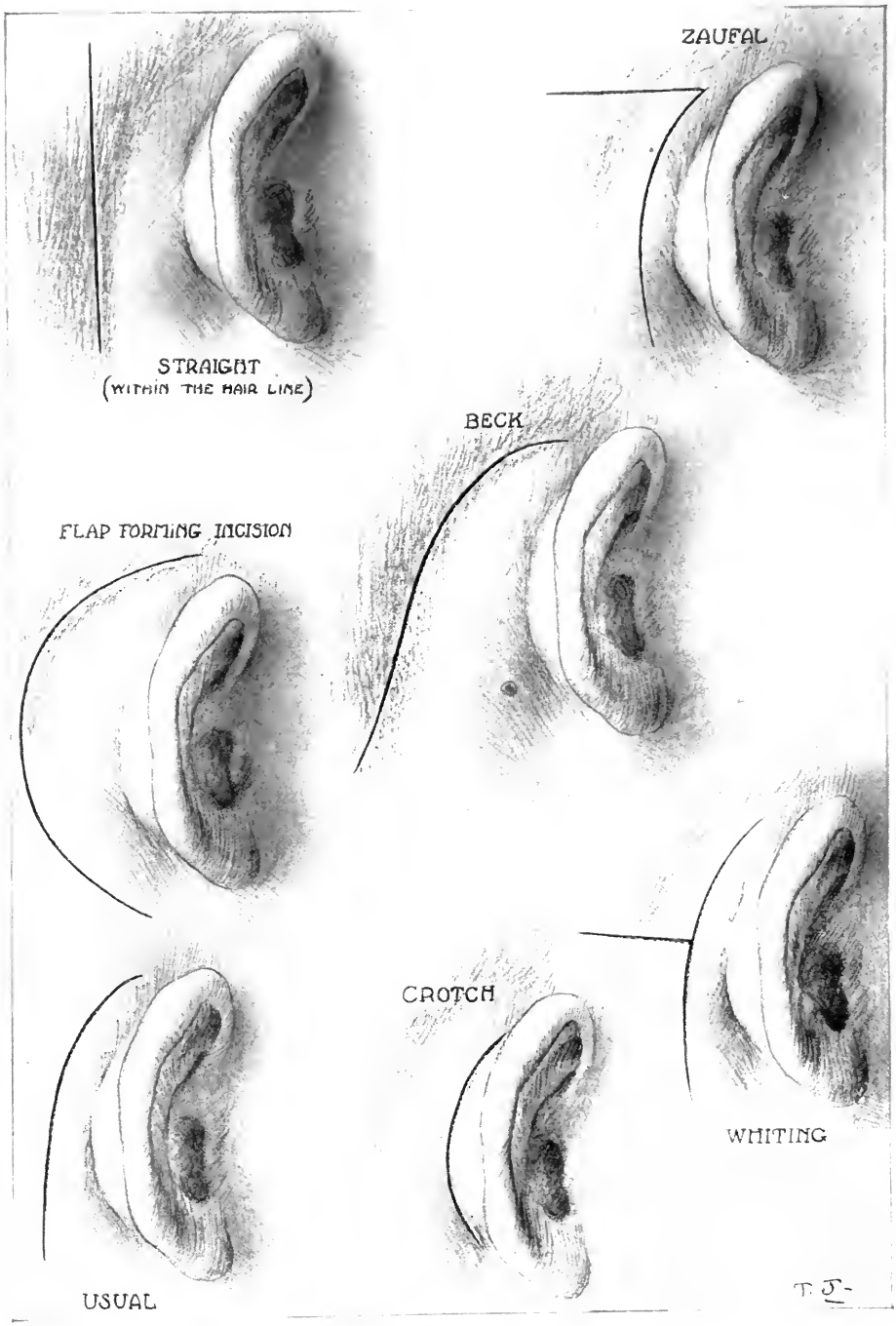


Fig. 321.

Incisions for the mastoid operation.

inexperienced operators. An understanding of the anatomy of the temporal bone (Vol. I, p. 99) is essential. Fig. 818 shows the external auditory canal, the root of the zygoma, the suprameatal spine and the relation of the mastoid process to the other portions of the temporal bone. In Fig. 819, the reconstruction of the bones of the face and head shows their relations to the mastoid, and in Fig. 820, a more detailed view of these relations in the immediate vicinity of the auricle is given.

Assistants.—At least one assistant besides the nurse is necessary. The performance of the operation depends quite as much upon the assistants as upon the operator and almost as much harm can be done by them as by the operator. The assistant and nurse should be taught to sponge quickly and to remove the sponge immediately, so that the operator may not be delayed; and to exercise due caution so that spicula of bone may not be driven through the wall of the lateral sinus or the meninges.

Incision.—The various types of incision are shown in Fig. 821. The incision is carried to the bone through the periosteum except in the uppermost portion where it is inadvisable to cut through the temporal muscle on account of the hemorrhage and injury to the muscle. It is best to detach it from below after the periosteum is elevated. The bleeding points may be caught by artery forceps which are to remain clamped until the completion of the operation. If the bleeding is slight, it will be stopped by the application of retractors. The swelling of the soft parts is apt to confuse the inexperienced operator on account of the depth to which he must carry his knife before he reaches the bone and on account of the difficulty of retracting the swollen tissues. (Fig. 822.)

If the pus has penetrated the bone there will be a free flow when the incision is made or when the periosteum is cut. Under these circumstances, the pus is wiped away with gauze until it ceases to flow and the operation continued as when no such difficulty is encountered.

Of the types of incisions used by various operators, Whiting's gives the most satisfactory access to the field, especially when operating on the lateral sinus, and avoids the necessity of using retractors on the posterior lip of the wound. Beck's accomplishes the same thing but the scar is in the hair line.

Elevation of the Periosteum.—It is important to elevate the periosteum with as little injury as possible for the reason that healing is more rapid and there is less deformity. This can be well accomplished by means of a periosteotome and a piece of gauze, by forcing the periosteum away from the bone without tearing it. (Fig. 823.)

With Ballenger's periosteal elevator, the periosteum can be pushed

towards the auricle on one side of the incision and pulled towards the occiput on the other.

The attachment of the sternomastoid to the mastoid tip is severed by knife or curved scissors (Fig. 824), care being taken not to penetrate into the digastric fossa thereby exposing the deeper structures to infection or injuring the facial nerve as it emerges from the stylomastoid foramen. There will be no danger of this, especially in children, if the

Fig. 822.

Incisions through edematous tissues.

cutting is not extended below the inferior and anterior margins of the tip.

Retraction of the Soft Parts.—In order to expose the operative area of the bone, the two lips of the incision are held apart by retractors. The self-retaining types are most in demand although the ordinary sharp surgical retractors held by an assistant are satisfactory.

Landmarks.—The landmarks are thus brought well into view. The bony canal is noted just internal to the anterior retracted flap, with the spina suprameatum generally just below the superior margin or

Fig. 823.
Beck's method of elevating the periosteum.

Fig. 824.
Severing the attachment of the sternomastoid muscle.

along the posterior margin of the bony canal. It is sometimes found nearer the middle of this posterior margin, indicating a low position of the antrum. It may be entirely posterior to the canal. It is important since it usually indicates the upper level of the antrum.

The suprameatal triangle, indicating the probable position of the antrum, is easily made out lying between the posterior margin of the bony canal and the posterior root of the zygoma as shown in Fig. 825.

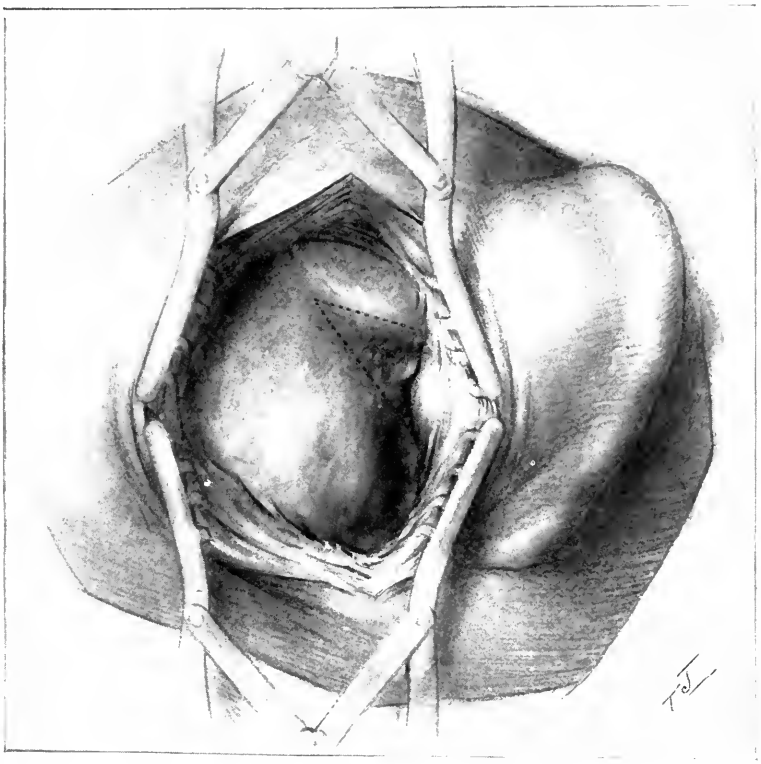


Fig. 825.

Suprameatal triangle.

It is well to keep this space in mind for the antrum is the objective point of the operation.

The Exenteration of the Bone.—The instruments used for the removal of bone are gouges, chisels, forceps, curettes, and the electric drill.

As a rule, chisels and gouges are employed for the original attack of the bone and many operators complete the bone operation with these instruments. Others use forceps to remove the margins or overhanging edges of the bone and bone curettes to scrape out the softened bone

Fig. 826.
Mastoid fistula.

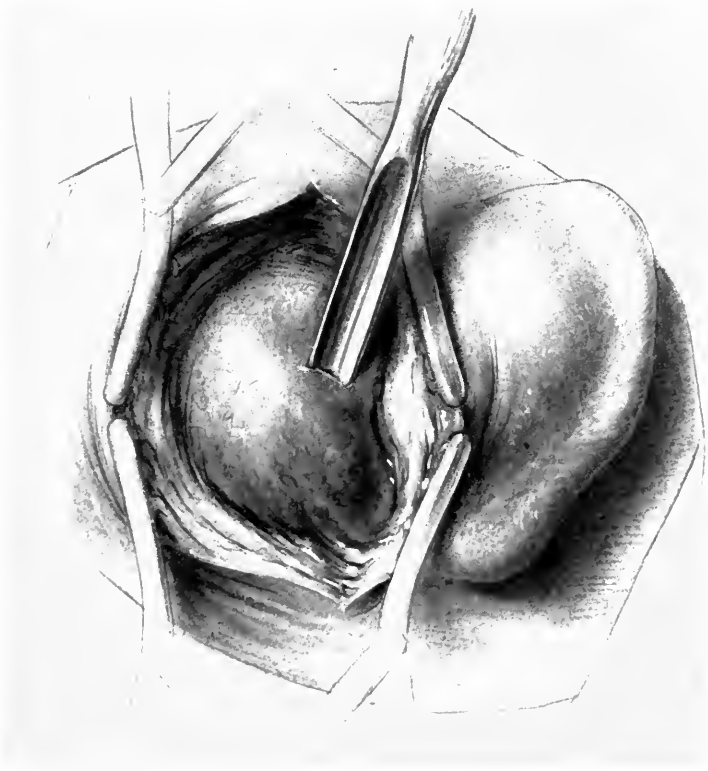


Fig. 827.
Beginning the bone exenteration with Alexander's chisel.

after the cells are reached by the chisels or gouges. Others among whom may be mentioned Jansen, Allport, Boetcher, and Beck, prefer the hand burr or electric burr to ream out the cell walls. This is, however, a matter of training and experience. The end to be attained is the same —to free the temporal bone of its mastoid cells with their bony wall, whether diseased or normal, with as much safety and expedition as the condition warrants.

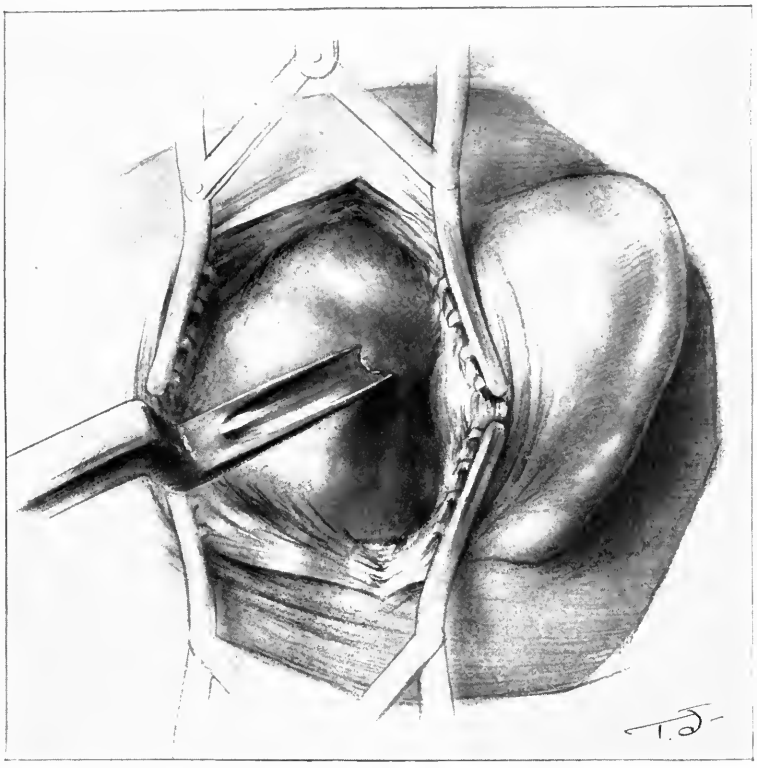


Fig. 828.
Beginning the bone exenteration with bayonet-shaped gouge.

It is best to begin the operation at the fistula (Fig. 826) through the cortex, if there be one present, proceeding cautiously with chisel and curette, and having in mind the locations of the lateral sinus and of the antrum with respect to the suprameatal spine.

If there is no fistula present, the opening in the bone is usually made parallel to, and about two millimeters behind, the bony canal (Figs. 827, 828 and 829) from the suprameatal triangle to the tip of the mastoid process. An opening is made from 5 to 15 mm. in length, the cortex being removed until the opened cells come well into view. After

an operator has had some experience this can be done rapidly without the slightest danger. When this opening is established, the operator proceeds with caution to increase it. He does this by removing the bone adjacent posteriorly and internally, with special reference to the antrum. This cavity lies from 1 to 2.5 cm. internal to the surface of the bone, marked by the suprameatal triangle, and extends in the same direction as the external auditory canal though a trifle higher. In ap-

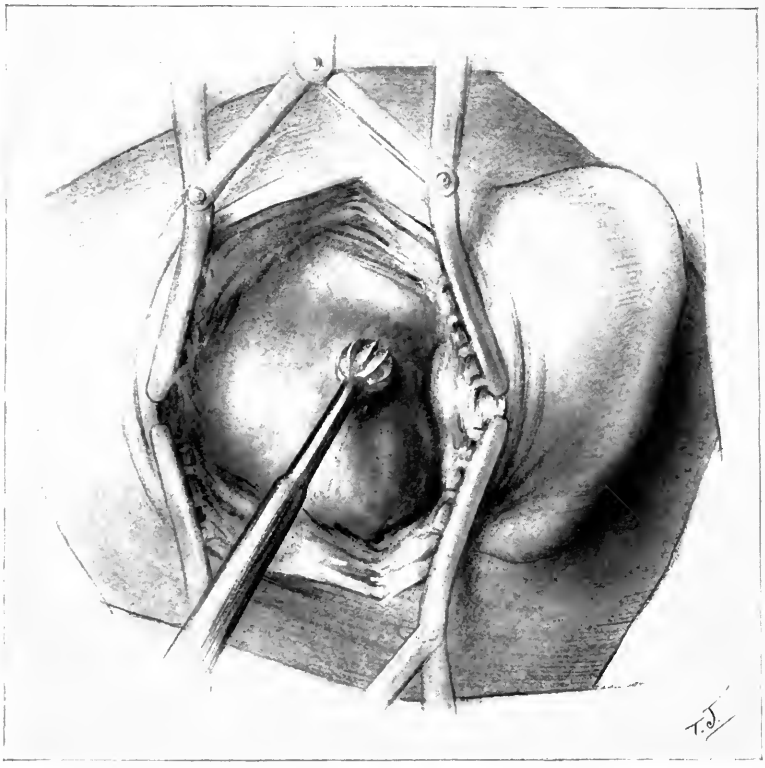


Fig. 829.

Beginning the bone exenteration with the hand burr.

proaching the antrum, much depends upon the position of the lateral sinus which is sometimes uncovered in the process of bone removal. Its usual position is a considerable distance behind and below the antrum as shown in Fig. 830. Not infrequently, however, the sinus is found much farther upward and forward sometimes almost touching the antrum, especially in children and in small-celled diploic mastoids. Under these circumstances, it is necessary to proceed with extreme caution so as to avoid injuring the sinus while exenterating adjacent cells or approaching the antrum. When there is abundance of space between

the antrum and sinus, care must be exercised while removing bone in proximity to the sinus. Little spicula of bone may be thrust inadvertently through the sinus wall. On the other hand, every cell bordering on the sinus must be cleared out to secure uninterrupted resolution and to avert sinus thrombosis.

In opening up the antrum or cells in its vicinity, the location of the facial nerve must be kept in mind, for, when operating in this region, it

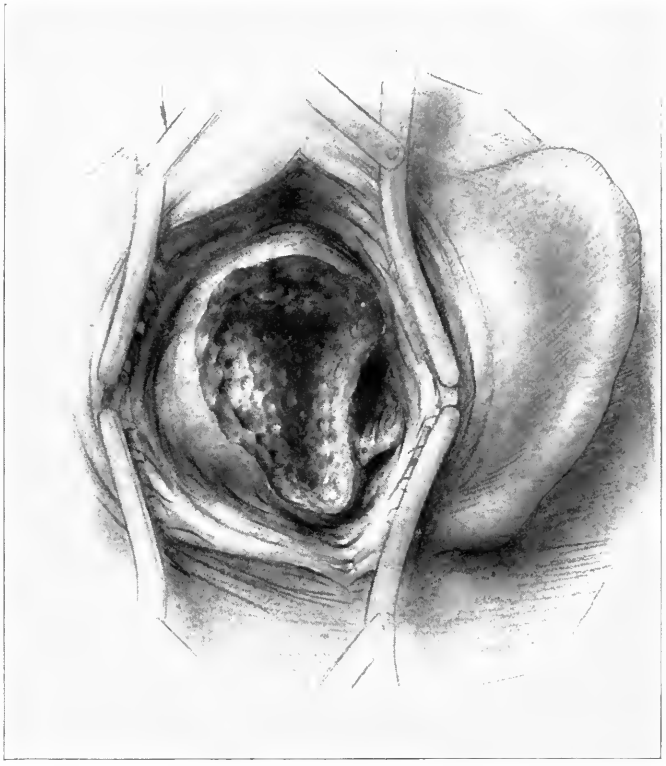


Fig. 830.

Projection into mastoid cavity showing location of lateral sinus and Trautmann's triangle.

becomes a factor, though a minimal one, in the simple mastoid operation.

In clearing out the upper cells (squamozygomatic) one is apt to uncover the dura of the middle fossa. As has been stated, the temporal ridge (posterior root of the zygoma) usually indicates the lower limit of the middle fossa, but it sometimes extends below this level and may be mistaken for the lining of a mastoid cell. A radiograph taken before the operation will be of service in this particular. The possibility of

exposing the dura should not prevent the thorough exenteration of all the mastoid cells adjacent.

The tip cells may often be removed with the single stroke of a chisel, but most operators prefer to exercise more care by using forceps, curettes, chisels, or drills with less radical efforts.

Here, too, the facial nerve must be considered by reason of its relation to the tip as it passes through the stylomastoid foramen, internal to the lobule, toward the parotid gland.

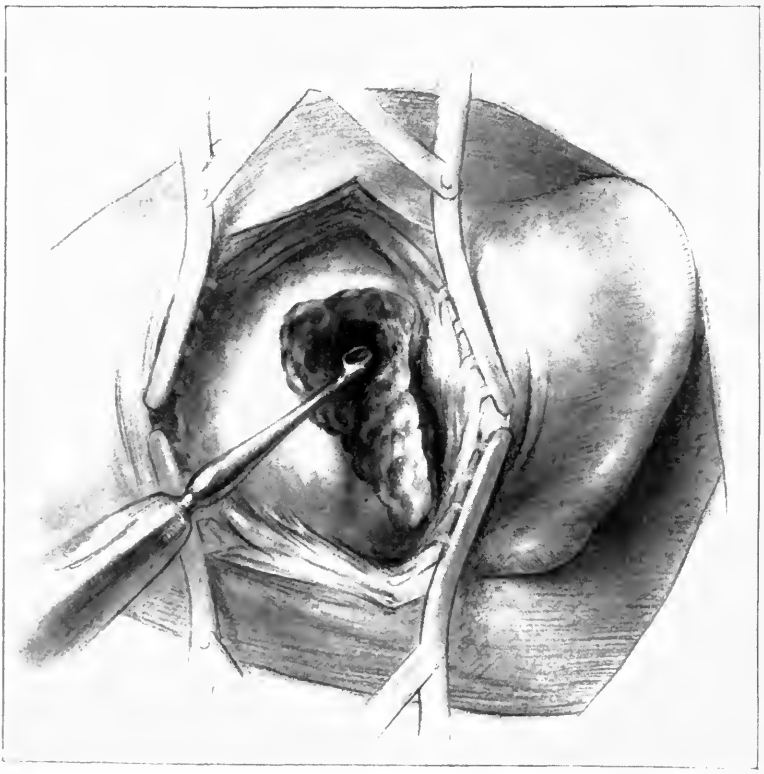


Fig. 831.

Curetting the antral wall.

When the cells have all been disposed of, the operator may complete the measures necessary for the proper drainage of the antrum by means of the curette (Fig. 831). Whatever bone overhangs the antrum above and externally should be removed, with special attention to the relation of the dura and facial nerve. In the manipulation of the antrum, caution should be exercised to avoid injury to the antral mucosa and to the horizontal semicircular canal which lies in the floor of the antrum. (Fig. 837.)

The probe is an important instrument to determine whether a given opening is the antrum. The probe should be blunt-pointed, about one or two millimeters in diameter, and should always be used with great care to avoid any injury to important structures. Sometimes when the antrum lies deep, a cell located superficially to it, may be mistaken for it. Again, the middle fossa may be opened and taken for the antrum.

To explore the antrum, the end of the probe, about a centimeter in

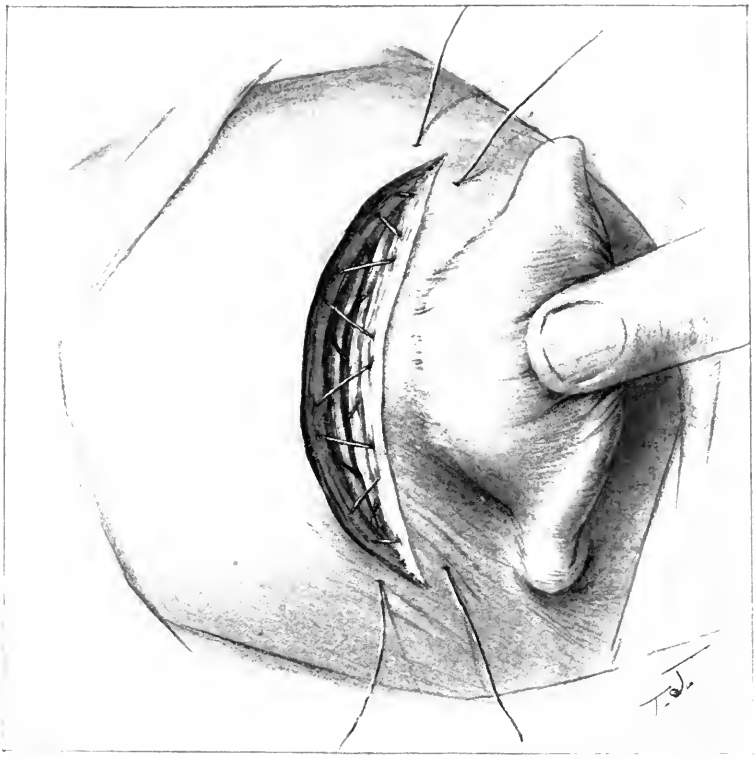


Fig. 832.

Suture in blood clot method.

length should be bent at a right angle. Such a probe will enter the middle ear through the antrum, and bone will be felt on all sides except anteriorly.

If the probe should be introduced into a cell, it will encounter the bony wall internally or anteriorly and if into the middle fossa, no bone will be felt in anterior or posterior direction.

When there is free opening in the antrum and the cells are completely cleared away, the rough edges of the bone are made smooth by

curettes, hand burr, or preferably, the electric burr. The healing process is greatly facilitated by providing a smooth surface throughout the operative area by the absence of all overhanging edges.

It is well to syringe the wound with hydrogen peroxid or a combination of hydrogen peroxid and alcohol. This stops the slight oozing of blood in the bone and frees the cavity of little spicula of bone that might have been allowed to remain in the bone cavity inadvertently.

Fig. 833.

Wound packed with gauze and rubber tubing.

Primary Treatment of Wound and Dressing.—For years the only plan used was that of packing the wound with gauze strips, iodoformized or plain sterilized, allowing the wound to heal by granulation from the bottom. This plan called for repeated dressing continued over a long time, entailing much suffering at each dressing. Of late, advanced operators have been using more modern methods by which rapid healing is promoted.

The Blood Clot Method comprehends the filling of the exenter-

ated mastoid cavity with blood which clots, and over the clot the periosteum and skin are closed by sutures. No drainage is allowed except such as takes place through the opening in the tympanic membrane. This is enlarged if necessary to afford adequate drainage.

The cavity is first disinfected by mild antiseptics, particularly iodin. It is then closed by suture (Fig. 832). If infection occurs, it is necessary only to make an incision at the dependent portion and

Fig. 834.

Drainage through stab incision.

insert some form of drainage. Resolution will follow with little danger and loss of time. It is claimed in favor of the blood clot dressing that healing is more rapid and that there is no retroauricular depression. It is applicable, however, only when the infection is of mild virulency and when there is no complication. It is inadvisable to close up completely the cavity when the streptococcus mucosus or hemolyticus is the infecting agent or when an extradural abscess or sinus thrombosis has been encountered.

Furthermore, the blood clot method allows drainage only through the middle ear and the perforation in the tympanic membrane.

Postauricular Drainage Method.—This plan comprehends the closure of the lips of the wound by sutures or clips and the use of some form of drainage material which passes out through the lower portion of the wound or through the stab wound made for that purpose.

A favorite method is to insert split rubber tubing containing a folded wick of gauze into the antral opening. The remaining por-

Fig. 835.

Drainage through dependent portion of wound.

tion of the cavity to be drained is loosely packed with gauze in long narrow strips. (Fig. 833.) The rubber tube and the end of the gauze are thrust through the stab incision (Fig. 834) which has been made, the periosteum is stitched with a few interrupted catgut sutures. The skin sutures are introduced subdermally and removed five days later.

Another method is to close the wound with two or three deep silkworm gut sutures through skin, subcutaneous tissue, and periosteum, and then to unite the skin by continuous or interrupted sutures. The

gauze ends and rubber tubing are permitted to leave the mastoid opening at its most dependent portion (Fig. 835).

Catgut sutures may be employed for the periosteum and metal clips for the skin. Catgut or silk sutures may be used through the periosteum and soft parts without additional sutures or clips.

Another common method is to use gauze strips (generally two) loosely packed in the antral and mastoid cavity, the ends being allowed to pass out of the lower unsutured portion of the wound (Fig.

Fig. 836.
Gauze drainage through unsutured portion of wound.

836). A small gauze wick is introduced into the external auditory canal draining the middle ear, a light gauze fluff and pad applied over the area and the whole enclosed with a mastoid bandage. It is better to use a simple head bandage to retain the dressing than to carry the roller bandage around the neck, which causes the patient a great deal of discomfort.

After-treatment.—The patient may lie on his back or on the side not operated upon as the pressure of the head on the dressing may

militate against good drainage and may often cause much discomfort.

Patients who have been etherized may be given water earlier and in larger quantities than after abdominal operations. The vomiting which is often incident thereto does no harm and soon frees the stomach of its accumulation. The recovery from the effects of the anesthetic is accordingly more rapid.

If the temperature is not unfavorable or if there has not been too much oozing of blood or inflammatory discharge through the gauze, the dressing need not be changed until the third, fourth or fifth day after operation.

When the rubber tube containing the gauze wick is used, the wick is removed, leaving the tube in place, and the gauze strip is removed from the external auditory canal at the same time. If there are other gauze strips in the wound they are loosened by drawing the projecting ends a trifle. Every day they are withdrawn more and more until the sixth day when they are removed altogether and a small piece of gauze is placed within the wound. After this, bismuth paste may be injected into the wound if it is desired, always remembering that the drainage from the antrum must be continued until at least forty-eight hours after the middle ear is dry.

When gauze strips alone are used, they may be removed at the first dressing, in whole or in part, and a small fresh piece of gauze or rubber tissue introduced a slight distance into the wound. This is repeated several times until the wound is practically closed.

Wire or silkworm gut sutures should be removed on the fifth day and silk or skin clips on the third, fourth, or fifth day as they irritate the skin and often lead to stitch abscesses.

If the catgut becomes infected causing a reaction, a small opening should be made where the softening is noted and the serum drained away by a small wick of gauze. When the infected catgut comes away, the opening will close spontaneously and no increase in the scar will result.

When the old open method is used, the gauze is removed on the third day or before, and fresh gauze is loosely packed in the cavity. This is repeated daily or every other day until complete healing by granulation takes place. The process may be facilitated and the depression lessened by the use of adhesive strips drawing the edges of the wound together, but this should not be done until after cessation of the discharge from the middle ear.

The usual external bandage may be replaced, when the discharge diminishes sufficiently, by collodion which is more comfortable. Later

adhesive strips may be substituted and when the discharge ceases, an ordinary mastoid shield may be used.

Complications.

As a rule a properly performed operation is followed by a speedy resolution. This fact, however, must not be overlooked, that complications which were developing before the operation may manifest themselves afterwards, such as sinus thrombosis, meningitis, labyrinthitis, general sepsis, remote septic conditions such as arthritis, nephritis, etc. Local infections may follow as in other operations. Among these may be included erysipelas, stitch abscess, cervical adenitis, and abscess in adjacent tissues. A fistula may persist or reform when necrosis of any portion of the bone is present.

RADICAL MASTOID OPERATION.

Credit must be given to Zaufal for originating the modern radical mastoid operation for the cure of chronic suppuration of the middle ear. Küster, Koerner, Politzer, Stacke, and Schwartze followed with modifications and after them many workers in otology brought out continuous improvements in technic, resulting in the satisfactory plans now in vogue.

Purpose of the Operation.—The radical mastoid operation has for its purpose the union of the external auditory canal, the middle ear, antrum and mastoid wound into one cavity with smooth walls, capable of being drained without interference. To achieve an entirely satisfactory result, the wound should be thoroughly covered with epidermis and recurrence of suppuration made impossible by closing up all avenues of reinfection.

To particularize, epidermization is accomplished by implantation of a flap from the canal well into the mastoid wound, and by insuring freedom from reinfection by removing all the mastoid cells and infected foci, and by closure of the Eustachian tube.

Indications.

This operation is called for in two principal classes of cases:

I. Acute suppuration of the mastoid in which there is extensive involvement of the region of the facial nerve or horizontal semicircular canal or when there is an accompanying destruction of the posterior bony canal wall.

II. Chronic suppuration of the middle ear or mastoid cells and

adjacent structures, which has resisted treatment, or which is accompanied by urgent symptoms.

Acute Suppurations.—In the first group, the indications are practically the same as those for the simple mastoid operation, the decision to perform the radical being dependent upon findings at the time of operation: extensive destruction of the posterior bony canal or large focal infection in the neighborhood of the facial or horizontal semicircular canal. Sometimes the radical operation is partially completed by the destruction of the bony canal wall by the inflammatory process.

Chronic Suppurations.—This group includes those cases in which the suppuration from the middle ear has persisted for some time. They may be subdivided as follows:

1. Acute mastoiditis supervening upon a chronic otitis media suppurativa. In these cases it is better to perform the radical than the simple mastoid operation. The indications are the same as those enumerated under the head of the simple mastoid operation. (Page 311.)

2. Those in which evidence of facial paralysis appear. No time is to be lost in these cases, for irreparable damage may be done in a short period. The radical operation is indicated inasmuch as the simple will not reach the seat of trouble.

3. Those in which symptoms of labyrinth irritation or involvement are present. These are nystagmus, vertigo, interference with equilibrium, nausea, and sometimes vomiting. Considerable discrimination must be exercised not to operate when these symptoms arise from the acute suppurative labyrinthitis, in which event it is often necessary to wait until the symptoms have subsided. However, in these cases the danger of an ensuing meningitis, generally fatal, must have due weight.

4. The signs and symptoms of endocranial complications call for the radical mastoid operation. These comprise vertigo, severe headache, generally hemicranial in character, nausea, vomiting, Kernig's sign, interference with equilibrium, impaired sensorium, exaggeration of the reflexes, positive findings on lumbar puncture. The signs must be taken collectively and the patient studied with reference to them.

5. Otitis media suppurativa chronica which does not yield to treatment, with or without evidence of cholesteatoma. This constitutes by far the largest number of cases subjected to the radical operation. It must be confessed, however, that there is much less inclination to operate than there was some years ago, when every case of chronic otorrhea was looked upon as legitimate operative prey. There are now many qualifications, in spite of the fact that the potentiality of endo-

cranial complications is recognized. Nowadays we endeavor to cure the process by local agencies applied for a long time.

Considerable attention is paid to the location of the perforation and the frequency of acute exacerbations. Marginal perforations particularly if they are small or situated in the upper or posterior quadrants justify the operation more than other types. This justification is still further increased in necrosis of the annulus or ossicles or if evidence of cholesteatoma is present. Perforations in Shrapnell's membrane are also dangerous. The time limit for local treatment depends upon the operator who must be guided by his experience with due regard for the best interest of patient, as no hard and fast rule can be made.

6. General symptoms due to chronic focal infection, other locations being excluded. It should not be forgotten that a chronic otorrhea may produce such symptoms from absorption of the inflammatory products, toxins, and even bacteria, hence radical operation may be required to obliterate the focus.

7. Secondary mastoid operations. If a simple mastoid operation has not resulted in cure or if a secondary operation becomes necessary, the radical operation is usually performed.

Contraindications.

Advanced tuberculosis, carcinoma, and other fatal diseases, hemophilia, and recent syphilis are contraindications. Moreover, as a rule, the operation is one of election and can therefore often be postponed until conditions are the most favorable. While diabetes is a contraindication, the operation often becomes imperative in spite of the risk. Under such circumstances a local anesthetic is to be preferred.

Operation.

Operative Field.—No objection can be made to the reiteration of the statement that, under all circumstances, it is essential for the operator to understand the anatomy of the field in which he is operating. In the chapter on Anatomy of the Ear (Vol. I, p. 99) may be found the details of the anatomy of the ear. Fig. 837 presents a view of the structures in danger from this operation. They are the semicircular canals, particularly the horizontal, and the facial nerve which runs along the floor of the antrum and which becomes more and more superficial as it approaches the stylomastoid foramen at the tip. The stapes is also a vulnerable object, because its injury endangers the labyrinth. The lateral sinus which lies posteriorly and internally, and the middle

cranial fossa which lies superiorly to the field of operation must always be kept in mind.

Preoperative Procedures.—The preparation of the patient, anesthesia, and arrangement of assistants are practically the same as for the simple mastoid operation, allowance being made for the longer time required for the operation. The few special instruments desirable for the radical mastoid operation are included in the list of those mentioned under the simple mastoid operation (page 318).

Preliminary Details.—The simple mastoid operation is performed in the manner already described except with respect to the following:

The incision is continued somewhat further forward above the auricle in order that the external attic wall may be more easily re-

Fig. 837.
Radical mastoid operation. Preparation showing field of danger.

moved. This extended upper portion of the incision should be quite superficial so as not to sever the fibers of the temporal muscle and veins, as secondary edema of the temple and eyelids may follow and may be taken for a cavernous sinus thrombosis.

Membranous Canal.—After the simple mastoid operation is completed and the antrum opened up more extensively than is required for that operation, the horizontal semicircular canal, an important landmark, is brought well into view where it lies in the inferior and anterior portion of the antrum. At this stage of the operation or when the periosteum is retracted, the membranous portion of the external auditory canal is carefully separated from the posterior bony canal and from its attachment to the annulus tympanicus. The success of the

operation often depends upon the smoothness and intactness of the membranous canal after removal and for this reason great care is to be exercised.

This canal is now held away from the posterior bony canal by means of a retractor (Allport's), or by a gauze strip introduced through the membranous canal from the external auditory canal to its inner detached portion, and out between the bony and membranous canals.

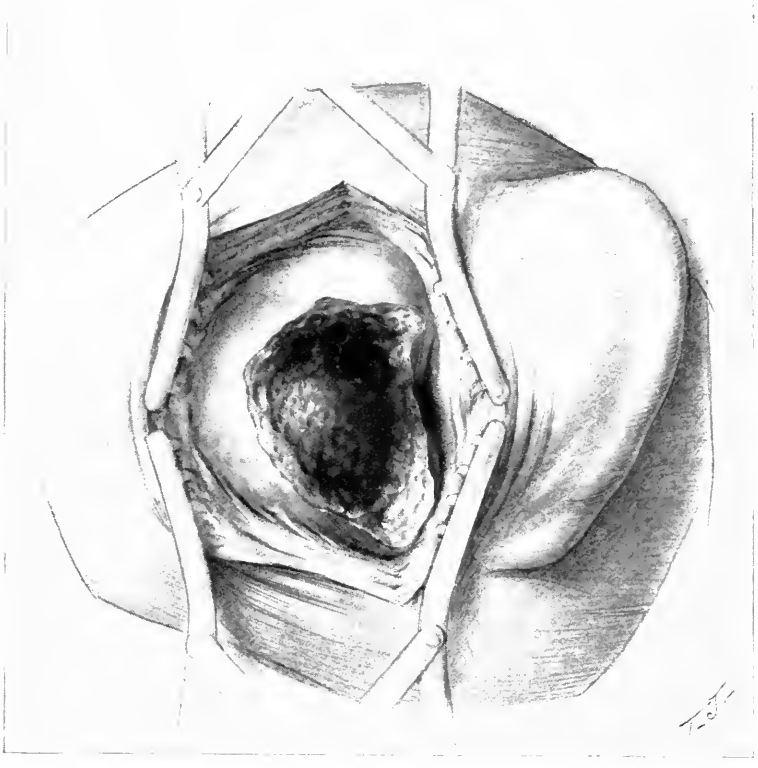


Fig. 838.

Removal of posterior bony canal wall; beginning.

By pulling the two ends forward, a good view of the remains of the tympanic membrane is obtained.

Removal of the Posterior Bony Canal.—The posterior bony canal is now removed by chisels, gouges, bone forceps or burrs as far as the prominence of the horizontal semicircular canal. In removing the posterior bony canal it must be remembered that the facial nerve, as it runs through the aquæductus fallopii, lies superficial in its inferior portion where it emerges through the stylomastoid foramen, and deeper and more internal as it approaches the horizontal semicircular canal

which is just posterior and parallel to the nerve (Fig. 837) at the promontory. It is therefore necessary to remove the bone with this in mind so that the amount of bone remaining will be less and less as the operator approaches the semicircular canal in the floor of the antrum. (Figs. 838 and 839.)

The greatest circumspection should be exercised at this stage of the operation—it is well to repeat that the danger of irreparably wounding the facial nerve is so great that only those sufficiently versed

Fig. 839.
Removal of posterior bony canal wall; at the bridge.

in its anatomy and who have knowledge of its course should undertake the operation. During the manipulation in this region, the anesthetist must keep watch over the corresponding eye and lip, and must give warning of any twitching movement which indicates that the operator is working near the facial nerve.

The attic is reached by removing the upper part of the posterior bony canal wall which corresponds to the external wall of the aditus ad antrum. The last of the bone to be removed, known as the bridge,

corresponds to the annulus tympanicus. In using a chisel or gouge or burr for this purpose, there is great danger of accidentally injuring the facial nerve, the horizontal semicircular canal, or the inner wall of the middle ear by striking them with the instrument or with a dislodged piece of bone. A better plan is to use the Kerrison or other type of bone forceps which cuts from below upwards.

Whatever illumination has been used in the operation, some concentrated type of light directed into the cavity must now be brought into play. The opening of the antrum into the tympanum must be enlarged by removing the external wall of the attic and the cavity made smooth and as large as the danger to the important structures permits. The operator must still bear in mind the location of the facial nerve and horizontal semicircular canal just internal to the bridge, the facial nerve in the wedge of the bone remaining after the removal of the posterior bony canal wall, the middle fossa above, and the stapes within the tympanic cavity internal and posterior to the remaining ridge of bone. Furthermore, it must not be forgotten that dehiscences are not uncommon. The lateral sinus often lies exposed just behind the antrum. In spite of all these important structures there should be no compromise in securing the widest opening possible under the circumstances. In this connection, attention must be paid to the removal of the facial spur which is a sharp projection from the innermost end of the facial ridge which remains after the last part of the posterior canal wall has been removed.

If cholesteatoma be present, it is incumbent on the operator to remove every vestige of the mass, following it wherever it leads, as there is great tendency to recurrence unless the removal is complete.

Removal of the Ossicles.—After the tympanic cavity is well exposed, the white outline of the incus generally comes into view. It is to be removed with angular forceps, slight force only being necessary to separate it from its attachment to the stapes. If the attachment has become firmer by reason of a pathologic process, the force necessary to dislodge it may carry with it a part or the whole of the stapes, an accident which may lead to a serous or purulent labyrinthitis or a meningeal or cerebral infection. In the presence of such dense adhesions of the incudostapedial articulation, it is wise to separate the incus with a miniature backward cutting forceps.

After the removal of the incus, the malleus appears as a white prominence. It is, as a rule, easily removed by an angular forceps though it may be firmly held by adhesions, remains of the tympanic membrane, or the tensor tympani muscle. Sometimes a rocking motion to and fro may be necessary to dislodge it.

There are now visible two over-hanging masses of bone, the external attic wall, and the ledge where the bridge or annulus tympanicus was taken away. These should be removed by chisel, gouge or burr until the external auditory canal is practically on a level with the floor of the tympanic cavity. Great care should be exercised to prevent injury to the facial nerve at this stage.

The entire attic and middle ear cavities are now thoroughly cleared of any diseased mucous membrane, granulation tissue or debris, preferably by means of a small curette. Extreme caution must be exercised in working over the promontory for the bone is sometimes very thin. The region of the oval window must be carefully avoided. It is fairly well protected, however, by the difficulty of access from the operative field. There is also danger of penetrating into the glenoid fossa if the curette is used far forward with too much force.

The Management of the Eustachian Tube.—In view of the recurrence of infection through the Eustachian tube, and the interference with healing which results from the patulous condition of its middle

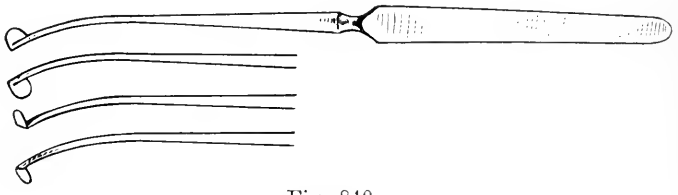


Fig. 840.

Beck's Eustachian knives.

ear extremity, it is usual to adopt some plan for the obliteration of its lumen.

There are several methods used for this purpose:

1. A flexible blunt pointed probe is passed through the antero-inferior region of the middle ear in the direction of the nasopharynx. This is then withdrawn and a small curette introduced in the same manner and used to scrape away, gently but persistently, the entire mucosa down to the bone.

2. By means of Yankauer's curettes (Fig. 793) the closure is apt to be more effective, because they reach nearer the isthmus.

3. Beck's method of closure of the Eustachian tube from the pharyngeal side. This is usually performed as a secondary operation when the tube remains patent after a radical mastoid operation. Two rubber tubes are introduced through the nose into the pharynx and then out of the mouth after the manner described in Beck's operation on adenoids (see Fig. 647, p. 168). Traction on these brings the pharyn-

geal orifice of the Eustachian tube forward. Incisions are made, one posterior, and one anterior, from the isthmus to the lip of the tube with specially devised knives (Fig. 840), and the entire mucous membrane

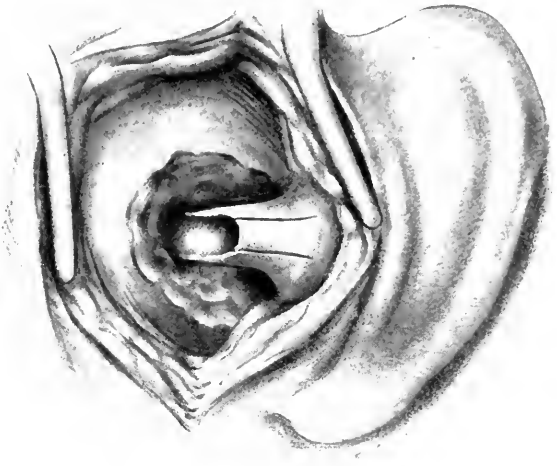


Fig. 841.
Koerner flap. Incision.

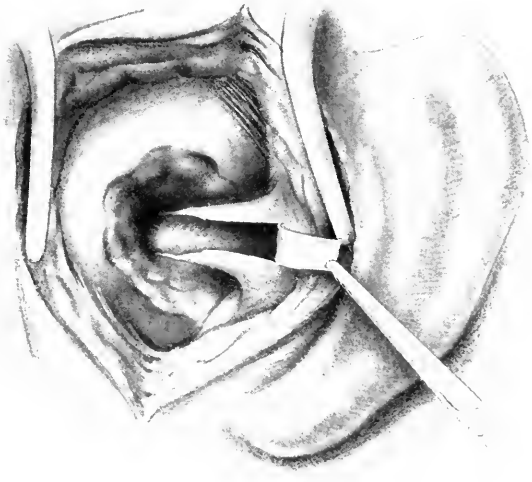


Fig. 842.
Koerner flap in position.

is pulled out of the tube. This will result in an atresia of the cartilaginous end of the tube. The recurettement of the tympanic end of the tube by the Yankauer method in addition is also recommended.

At the tympanic orifice of the Eustachian tube there are often found some rough places which correspond to the small pneumatic cells of Koerner. These may be destroyed by means of Whiting's hand burr.

The bone work completed, the cavity is filled temporarily with dry gauze so as to assure dryness if primary skin grafting is to be undertaken.

Plastic Flaps.—The operative field is now ready for the plastic flaps. The purpose of the flaps is to permit the closure of the postauricular wound, to provide a sufficiently wide opening for dressing and drainage through the external auditory meatus and to encourage the growth of an epithelial covering over the cavity in the bone made by the operative procedures.

The following flap operations are in more or less common use:

1. Koerner.
2. Ballance.
3. Panse.
4. Whiting.
5. Siebenmann.

Koerner Flap.—This is a flap made by two parallel incisions through the posterior wall of the membranous canal, reaching from the portion detached from the annulus to the concha (Fig. 841). The flap is pushed backward into the cavity (Fig. 842) and held against the bone by the dressing placed in the mastoid cavity and the external auditory canal with or without suture.

Ballance Flap.—One incision is carried from within, outward to the conchal margin, somewhat towards its lower extremity, then a round flap is cut out of the concha so that the incision ends at the canal margin (Fig. 843). This will form a superior flap. If a flap is desired to line the lower part of the cavity, the incisions are reversed. The cartilage of the concha exposed by the flap is removed and then the flaps are sutured (Fig. 844) and the wound packed.

Panse Flap.—Two flaps are made by a T-shaped incision, the vertical portion being through the middle of the posterior canal wall extending from the concha to the part detached from the annulus. The horizontal incision is made perpendicular to the first incision at its conchomeatal junction (Fig. 845). The upper flap is attached to the attic vault, the lower one to the facial spur (Fig. 846) by a stitch to the temporal muscle above the sternomastoid aponeurosis below.

Whiting Flap.—The membranous canal is split horizontally, well into the concha at its lowest portion and then is carried at the con-

chomeatal junction to the superior portion forming a triangular flap with its pedicle upwards. The flap is stitched with two or three interrupted catgut sutures to the temporal muscle or fascia.

Fig. 843.
Ballance flap. Incision.

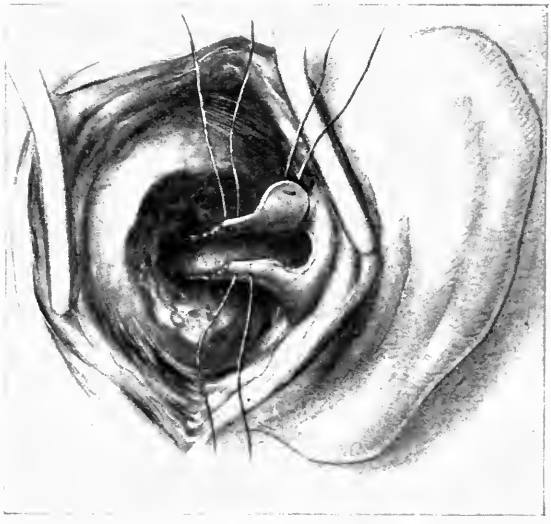


Fig. 844.
Ballance flap. Suture.

Siebenmann Flap.—An incision is made as in the Panse flap, except that the perpendicular portion does not extend to the conchomeatal

junction and that, at the extremity, one limb extends upwards and one downwards at an obtuse angle (Fig. 847). The three flaps thus formed after removal of the cartilage present are sutured as shown in Fig. 848.

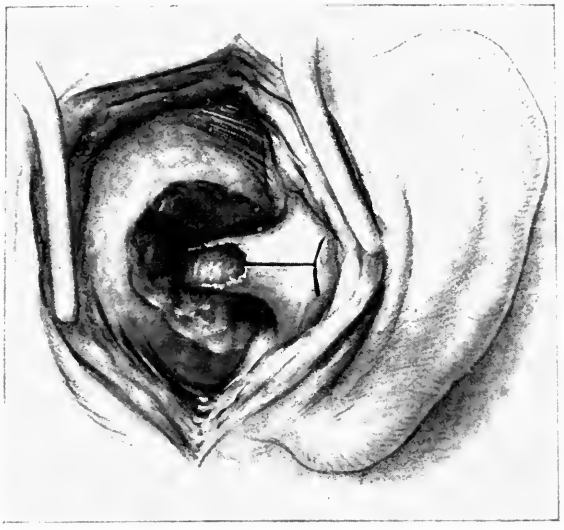


Fig. 845.
Panse flap. Incision.

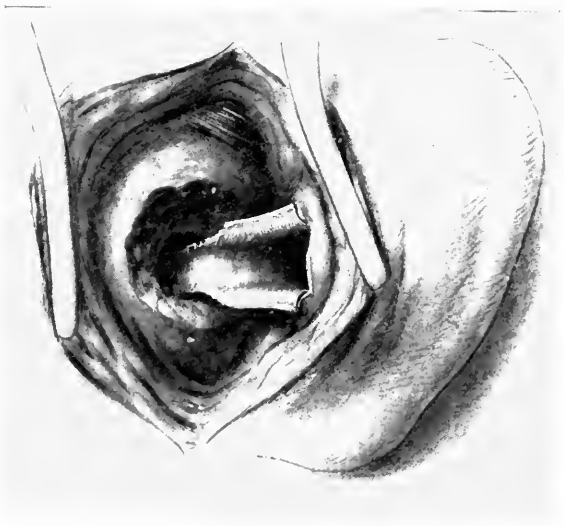


Fig. 846.
Panse flap. In position.

Skin Grafting.—When the selected flap has been made, the wound may be dressed immediately or the cavity may be covered with skin

grafts. As to the advisability of the procedure, there can be no doubt but its success requires most careful technic.

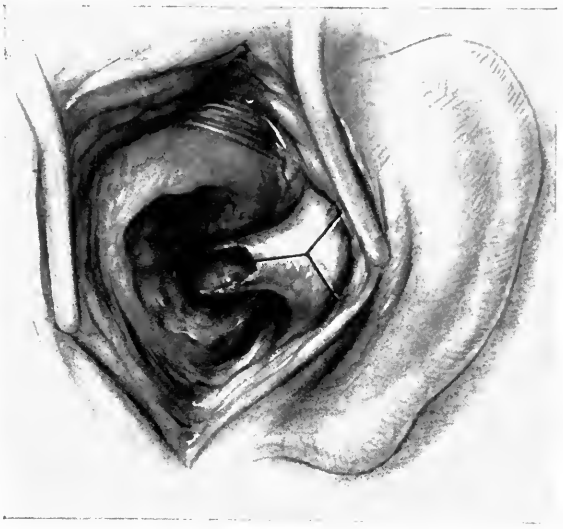


Fig. 847.

Siebenmann's flap. Incision.

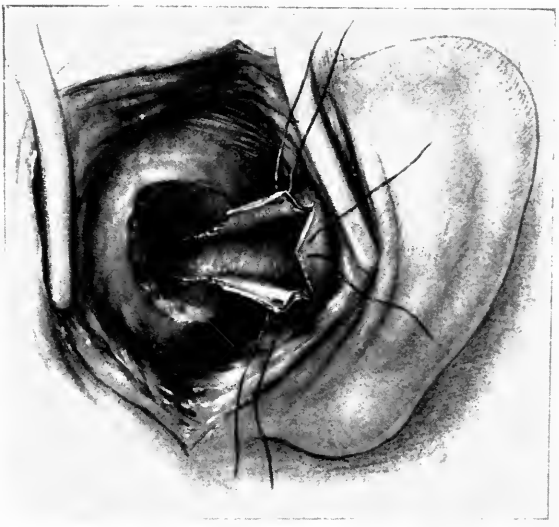


Fig. 848.

Siebenmann's flap. Suture.

The wound cavity must be absolutely dry. To secure this, it may be necessary to apply dry gauze repeatedly, or Hartley's bonewax may

be used to stop the flow of blood from the bone, while adrenalin will prevent bleeding from the soft parts.

There is some difference of opinion as to the best size for the skin grafts, some preferring small, others large ones. According to our experience, grafts one-eighth of an inch wide and one-fourth of an inch long adhere better and are not subject to crinkling as the larger ones are.

The grafts are best obtained from the lower third of the thigh on the anterolateral surface. The fleshy part of the thigh is grasped by the left hand; stretching the integument, the grafts are made by a sharp flat knife (Fig. 226, Vol. I), or the razor is held in the right hand, and moved with a sliding side-to-side motion. The knife and graft should be kept moist by dropping normal salt solution over them. If the surface from which the grafts are to be taken is coated with a thin layer of vaselin, the grafts will be thinner and easier to cut and the use of the saline solution will be unnecessary. The graft is dragged to the tip of the grafting knife or is transferred to a graft spatula and is then applied to the wound surface.

For this purpose, a needle held by an artery forceps is used, the graft being handled like a microscopic specimen. The grafts should be applied systematically from within outwards. An attempt should always be made to cover the osteum tubæ tympanicum because it may aid in closing the tube, while the oval window should be carefully avoided, as the graft may interfere with the conduction of sound vibrations.

If there is any bleeding during the deposit of the grafts, the blood should be removed by gentle suction by means of a pipette because sponging and mopping interfere with the retention of the grafts already in place. Wiener has recently introduced a method of holding skin grafts in place, after enucleation of the eye which will be found of service in mastoid work. The grafts are held in place by means of silver tacks driven into the bone. Recently we have used specially prepared paraffin gauze which permits drainage but still retains the flaps.

Dressing.—The cavity is loosely packed with gauze strips through the external auditory meatus and the postauricular wound sutured without leaving any drainage opening. The interrupted, continuous, or subcuticular suture, or skin clips may be used as described under the simple mastoid operation.

In bandaging, the same rules are followed as in the simple mastoid operation.

Operation Without Flaps.—Some operators still follow the old plan of dressing the wound through the postauricular wound, thereby avoiding the necessity of making flaps and enlarging the external au-

ditory canal. In some instances likewise, it is customary to dress the wound in this way, as in sinus thrombosis, brain abscess, etc.

When postauricular dressing is relied on, the expectation is that resolution will take place by granulation filling up the wound cavity. This requires repeated dressings continued for a long time, causing great pain from the removal and insertion of the gauze strips, with pocket formation by no means infrequent. Hence it is advisable to use the flap plan at the operation or at least as soon afterwards as the conditions permit.

After-treatment.—The after-treatment of a radical mastoid operation is of importance in indirect proportion to the rapidity of recovery and absence of complications. Where there is rapid epidermization and freedom from retention, nothing is necessary beyond packing the wound lightly with gauze every second day and later relying solely on small pieces of gauze or cotton placed in the cavity from time to time. If skin grafts are not used, a good plan is to let the cavity fill up with blood clot.

When recovery is delayed, the utmost care must be taken to determine the cause and to find the appropriate remedy. Sometimes nothing suffices except a secondary operation, particularly when the meatus is too small or when the flaps through some accident have been permitted to adhere improperly, or when there is some complication. Sometimes the epidermization is retarded and the discharge continued by a persisting tubal orifice, calling for additional operative attention to obliterate it. At times there are exuberant granulations, or aural polypi which may be removed under cocain, gas, or ether anesthesia.

If epidermization is retarded the application of scarlet red (Scharlachroth) is often helpful and Beck's bismuth paste is of service in this condition, and also as a simple means of dressing. The healing period lasts from three weeks to three months ordinarily, though it is often prolonged beyond that time. In a large measure, this depends on the pathologic condition present. If the process is one of osteofibrosis, resolution may result in three weeks. On the other hand, healing will often be delayed for months by osteosclerosis with fistulæ and minute necrosis and sequestration. This is also likely when there is an osteosclerosis with cholesteatomatous infiltration, even when no masses of cholesteatomatous material were encountered during the operation. The tendency to delayed healing will also be increased if the Eustachian tube is patulous or if water is allowed to get into the ear. If a tuberculous process of the temporal bone is associated with the disease, epidermization and resolution may not take place unless the general condition improves. This also obtains in diabetes and other processes

causing malnutrition. An association with syphilis calls for appropriate treatment.

Complications.

As has been stated in discussing the simple mastoid operation, certain complications may have begun without being recognized before the performance of the operation. This refers especially to sinus thrombosis, labyrinthitis and endocranial complications and even to paralysis of the facial nerve. Among the other more common complications are delayed healing, persistent postauricular opening, stenosis of the auricular orifice, patent Eustachian tube, erysipelas, perichondritis.

Delayed healing is often caused by faults of technic, and it may be expected when cholesteatomatous deposits have not been entirely removed, when any granulating or suppurating portion is allowed to remain, when the antrum has not been opened to a sufficient extent, and when all overhanging masses of bone have not been cleared away. It is far better to spend a few moments longer completing the operation than to overlook such important details.

The postauricular fistula may be repaired by one of the methods described in Vol. I, page 378, and stenosis of the canal may be relieved by a plastic operation. The patent Eustachian tube is treated according to one of the methods described in this chapter (page 348).

Perichondritis is a complication which cannot be avoided. It results from infection of the cartilage or its perichondrium at the time of the operation or succeeding it. Its treatment must be exceedingly vigorous; the diseased cartilage must be cut away if the healthy portions are to be saved.

Facial nerve paralysis may be temporary or permanent, and may result from injury during operation, from infection or a toxic process occurring during or after operation, or from an inclusion cicatrix. While carelessness and lack of expertness in operation may account for an injury to the nerve, it can be positively stated that paralysis of the facial nerve following a radical mastoid operation may occur however careful or expert the operator is and without any fault being chargeable to him.

Most cases recover without treatment; some call for electric stimulation of the muscles to preserve their nervous irritability pending the recovery of the nerve. For those that persist, some form of facial nerve anastomosis as described on page 383, Vol. I, will be required.

MODIFICATIONS OF THE RADICAL MASTOID OPERATION.

Heath Operation.

The Heath operation has probably caused more discussion than any other operative procedure for the relief of chronic suppurative otitis media since Schwartze and Zaufal described the simple and radical mastoid operation respectively. The main cause of this discussion has doubtless been the claim of its originator that this operation will cure suppuration; that it will preserve or improve the hearing; that the facial nerve is not likely to be injured; that no deformity results; and the recovery is far more rapid than in other procedures.

No definite indication based on pathologic findings is assigned, but a great deal of attention is bestowed on technic and after-treatment and almost every step of the treatment requires a specially devised instrument. The directions are numberless and confusing. Heath believes that the chronic middle ear discharge is due to the infection of the antrum mastoidei and that a cure is to be accomplished by opening and draining this cavity, which he regards as a "cesspool" of infection. According to him, pathologic changes in the Eustachian tube and adjacent structures such as the nose, nasopharynx, the middle ear, ossicles and attic, play no role whatever in contraindicating the operation.

In making this assertion he stands alone, a circumstance which is of great importance in view of the fact that there are quite a few otologists of position who can discuss the matter in the light of their own experience. Of special value is the report of Mosher and Plummer on the results obtained by Heath himself at the Massachusetts General Hospital. This report shows that these cases, at least, in no wise justified the extravagant claims of Heath, but, on the contrary, demonstrated that they were not valid. While the operator himself did not carry out the after-treatment, the otologists, in whose hands it was left, cannot be subjected to criticism.

Indications.—In our opinion, it is best to limit the Heath operation and other modifications of the radical operations to the following classes of cases:

1. In children up to ten years of age, even if the discharge has lasted for several years, particularly if the functional test shows good hearing.

2. In bilateral chronic suppurative disease. The modified opera-

tion should be performed on the ear which shows better hearing, while the usual radical may be performed on the other.

Operation.—The method requires the opening of the mastoid process, particularly the antrum and the aditus ad antrum as far inward and upward as the annulus tympanicus, without disturbing the ossicular chain. Thus a communication is established between the aditus and middle ear sufficient to permit air and water to be forced through. The posterior bony canal wall is removed to within one-sixteenth of an inch of the annulus tympanicus. The posterior portion of the membranous auditory canal is split, and a flap is made which is sutured to a previously prepared periosteal flap. The primary skin incision is made just at the junction of the auricle and mastoid area.

The incision posterior to the auricle is sutured in any way desired and drainage is accomplished by means of the opening into the mastoid through the posterior canal wall. Care should be taken not to place any gauze or drainage material against the tympanic membrane. After a few days the mastoid wound is cleansed out with cotton and the tympanic cavity cleared of exudate by forcing blasts of air into it through the aditus by means of a rubber bulb and a special cannula which may also be used for the introduction of watery solutions for the same purpose.

Bondy Operation.

Bondy advises this operation merely as a makeshift where both sides are subject to surgical interference in order to retain the hearing in the better ear. Even this is not so positive, for he admits that the acuity of hearing may be reduced by injury to the ossicular chain, which is always possible in this operation. However, it is more disposed to prevent the extension of the suppurative process into the middle fossa than when no operation is performed.

Up to the removal of the annulus or bridge, the technic is the same as that for the radical operation. Then, instead of the usual procedure, the superior external wall of the attic is removed without in any way touching the annulus tympanicus or ossicles, even if, for this reason, it should be necessary to expose the dura.

The plastic closure and dressing are the same as in the radical operation.

The after-treatment is directed towards the control of the granula-

tions in particular so that the attic and aditus ad antrum remain as a distinct cavity external to, and above the annulus tympanicus, antrum, and mastoid.

Stacke Operation.

The new operation, which is not identical with the radical mastoid operation, formerly known as the Stacke-Schwartze operation, is one which Stacke devised a few years ago. It is recommended for those cases of chronic suppuration of the middle ear in which the perforation is located in Schrapnell's membrane or in any part of the tympanic membrane except in the membrana tensa, particularly when hearing is good after inflation, and when no escape of air is noticeable by the auscultation tube.

The technic is practically the same as that for the Bondy operation although both operations were developed independently of each other at about the same time.

Simple Mastoid Operation Suggested by Phillips.

Phillips advises an ordinary simple mastoid operation in chronic suppurative discharge from the middle ear, particularly in children when the discharge persists in spite of the correction of such contributing causes as hypertrophied tonsils, adenoids, etc. The postauricular opening is utilized for dressings and after-treatment; it is allowed to remain open until the middle ear is dry.

Murphy's Method.

J. W. Murphy, according to a personal report made to the writers, has used the following plan successfully in cases of long continued suppuration, particularly in children, without cholesteatoma and without facial nerve, labyrinth, or endocranial complication.

An ordinary simple mastoid operation is performed, all diseased cells being exenterated. The posterior canal wall and the ossicles are not disturbed. The cavity is treated as in the blood clot method, and the skin is sutured or united by clips. Resolution takes place, as a rule, within two weeks, and the middle ear suppuration ceases. In less than twenty per cent of the cases was the healing delayed by suppuration between the lips of the wound.

Ossiculectomy and Removal of the Lateral Attic Wall as Proposed by Neumann.

An ossiculectomy is first performed, and then by means of small chisels and gouges, the lateral wall of the attic is removed externally as far as the aditus ad antrum and sometimes even as far as the antrum. Neumann claims that the advantages of this operation are that only local infiltration anesthesia is required and that no external incision is necessary. It is more dangerous, however, than the radical operation and less likely to result in cure.

Procedures to Facilitate Resolution.

In order to facilitate resolution and to assure the absence of deformity, Iglauer implants a flap from the temporal muscle into the mastoid wound. Carpenter recommends a portion of the temporal fascia for this purpose, and Beck uses a transplant made of the fascia lata.

THROMBOSIS OF THE LATERAL SINUS, THE JUGULAR BULB, AND THE INTERNAL JUGULAR VEIN.

These conditions are considered together for the reason that they present a similar pathologic picture. In all instances, they depend upon a thrombophlebitis secondary to a septic process in close proximity to them. In lateral sinus thrombosis, pus in the mastoid cells comes into close relation with the sinus. Indeed the bony wall of the sinus is frequently eroded, causing the dural covering to be bathed in pus and to be surrounded by granulations (perisinus abscess). Thrombosis of the jugular bulb is usually coincident with thrombosis of the internal jugular vein and the latter is commonly secondary to lateral sinus and jugular bulb thrombosis, though, of course, it may be the first phlebitic focus. Furthermore, all of these conditions may be due to a middle ear suppuration without mastoid involvement. Cavernous sinus thrombosis is rarely of otitic origin, although a number of such cases have been reported. As a rule it is secondary to infections of the nose and accessory cavities.

While thrombosis of the lateral sinus was recognized many years ago, it is only within the last twenty-five years that the rationality of the operative procedure has been universally accepted. Zaufal, Horsley, Lane, Ballance, Grunert, Piffle, McKernon, and Jansen were among the most influential of the pioneers in this field.

Indications.

Whenever during the course of acute otitis media or an acute exacerbation of a chronic suppurative middle ear or mastoid process, repeated chills occur with rapid rise of temperature and pulse rate, with subsequent sweating and corresponding high leucocyte count, the exploration of the sinus is warranted provided other septic conditions and malarial fever may be excluded. The more specific indications are to be grouped as follows:

1. Fever.
2. Chills, nausea, and vomiting.
3. Other pyemic symptoms.
4. Positive findings on aspiration of the sinus.
5. Edema in the posterior portion of the mastoid region and tenderness on percussion over the sinus.
6. Cord-like feeling of the jugular veins.
7. Involvement of adjacent nerves.
8. Artificial papillitis (O. Beck and Crow).
9. Symptomatic and blood examination.
10. Roentgenographic findings.

Fever.—The fever is most characteristic and important. It oscillates, reaching the high and low limit rapidly with a difference of 4 to 5 degrees in these two levels. When such a temperature curve is recorded in the course of an acute otitis media suppurativa, or an acute mastoiditis particularly if accompanied by chills, it is almost a certain warning that the sinus has been attacked. When fever of this type suddenly manifests itself in the course of the after-treatment of a simple or radical mastoid operation, there is extreme likelihood that sinus thrombosis has supervened. As in other instances, other foci of septic invasion must be excluded; still, there is a decided presumption that the sinus is being invaded. If there has been no surgical intervention, a simple mastoid operation should be performed, and, if the other indications justify it, the sinus should at least be explored.

In children this indication is of less moment for they are far more likely to have a high temperature with or without the rapid declines, when there is no sinus involvement. Still when such a record goes on for a succession of days, the justification for the operation is increased. On the other hand, the fever range is sometimes lower, particularly when the infection is of a mild type or when it is so virulent that the resistance is overpowered.

Chills, Nausea and Vomiting.—These are common concomitants of pyemia. Chills are rather a constant symptom and when accompanied by the typical fever, usually indicate an invasion of bacteria or of bacterial products in the blood. Chills are absent sometimes in children and in the more virulent or mild cases.

Nausea and vomiting must always be looked upon with suspicion when they occur in connection with a known septic possibility.

Other Pyemic Symptoms.—These refer to cases in which the infection has been in the blood long enough to involve other organs and tissues, such as joint inflammations, central pneumonia or septic capillary bronchitis, endocarditis, and metastatic foci in various parts of the body. Operation in these cases may be of no avail, as the bacterial growth goes on in the vascular system; still, the removal of the focus in the sinus or jugular bulb may make it possible for the resistance of the body to overcome the blood infection.

Condition of the Sinus Wall.—The decision to open the sinus may have to be postponed until the sinus wall is exposed. In fact the condition of the wall may be the first indication of disease process in the sinus. A thrombosis may be suspected when the wall is discolored, black or grayish green instead of blue; when it is rough, presenting necrotic areas or small fistulæ containing pus; when the vessel has lost its elasticity; or when it is not readily compressible. On the other hand, it must not be forgotten that the condition of the sinus wall is often no evidence of what lies within.

There has been much discussion as to whether absence of pulsation of the sinus is any evidence of a thrombosis. The advocates of the affirmative rely on their view that the normal pulsation is provoked by the blood stream passing through the sinus. Others maintain that this pulsation is due to propulsion from the arterial pulsation within the brain. Be this as it may, it must be stated that in some instances of sinus thrombosis, the sinus pulsates and in others it does not.

Positive Findings on Aspiration of the Sinus.—Whenever pus or blood containing pus is withdrawn through the needle, the evidence is positive; but when blood alone is withdrawn, the needle may have escaped the thrombotic area. It is therefore easy to understand that the use of a hypodermic syringe for this purpose does not always result in satisfactory information. Furthermore the needle must be introduced with great care; if it is thrust into the sinus perpendicularly, it may penetrate the inner wall; if at too acute an angle, it may lodge in a thickened wall and thereby fail to reach the blood stream. Cases

have been reported in which the needle caused dislodgement of a portion of the clot followed by serious symptoms.

The strictest asepsis must be observed on account of the danger of causing infection of the sinus by the procedure. The site for the intended insertion of the needle should be touched with a drop of pure carbolic acid which should be immediately neutralized by an application of alcohol. Then the test may be made, using a syringe which has been prepared under the most rigid asepsis.

On the whole, considering the various factors, the value of the procedure is somewhat negligible, particularly as the incision of the sinus affords both the information and the remedy without materially increasing the risk as to life and comfort.

Edema in the Posterior Portion of the Mastoid Region and Tenderness on Percussion Over the Sinus.—These signs are sometimes present, but are of no special value.

Cord-like Feeling of the Jugular Vein.—In most cases in which there is a considerable thrombosis in the jugular, it can be traced along the sternomastoid muscle, giving the impression of hard cord following the course of the jugular. If the thrombosis is soft or if it is small, this sign will not be present. Small lymphoid glands accompanying a severe otitis media or mastoiditis may be confused with this sign.

Symptomatic and Artificial Papillitis.—O. Beck and Crow found that during compression of the internal jugular on the healthy side, a definite tortuosity of the central vein of the retina could be found on ophthalmoscopic examination in jugular or sinus thrombosis. This fact is due to the interference with the venous return as a result of the compression of the healthy jugular and to the presence of the obstruction in the sinus or jugular on the diseased side. The test is not always reliable.

Blood Examination.—Perhaps none of the findings in sinus thrombosis has received so much attention as the laboratory examination of the blood. It has been stated that, excepting septic endocarditis, sinus thrombosis is accompanied by a higher leucocyte count than any acute inflammatory infection to which the body is subject. A 50,000 count has frequently been reported. As the count is usually higher after a chill and fever, it is well to have a blood examination made as a routine measure in all cases that are likely to result in an involvement of the sinus. As to the differential count, the resistance is shown to be good as long as the polynuclear cells are normal (78-82 per cent) or

greater than normal. The resistance is reduced when the percentage of polynuclears is below normal and when they are replaced by mononuclears or small lymphocytes in a mixture of other pathologic white cells.

The percentage of hemoglobin is also of importance as a rapid diminution speaks for a reduction in the red cells.

The bacteriologic examination of the blood is of great value particularly in cases in which sinus thrombosis is feared; under these circumstances, the blood culture should be made as soon as possible. When pure cultures are recovered, the diagnosis is clear; the absence of such findings, however, does not exclude it. Repeated blood cultures should be made and the greatest care exercised in the matter of perfect technic.

In this connection, it should be remembered that the coagulation period is lessened in sinus thrombosis, hence it is well to determine the time required for blood clotting.

Roentgenographic Evidence.—Thus far roentgenography has been of little service in the diagnosis of sinus thrombosis. In the normal sinus, it is possible to distinguish the curve of the sinus groove from the torcular herophili to and through the mastoid region; if, however, the sinus is thrombosed, particularly with a dense organized clot, the outline of the groove will appear considerably diminished.

Contraindications.—There are practically no contraindications to the operations in view of the utter hopelessness of the cases with urgent symptoms in which no operation is performed. While an accompanying meningitis, metastasis in the lungs and kidneys and other important organs, or general pyemia may make one feel that the operation is entirely futile, it is remarkable how some cases recover in spite of the most desperate chances.

Jugular Ligation in Lateral Sinus Thrombosis.—Opinions are still divided on the question of ligating the internal jugular vein when the thrombus is confined to the lateral sinus. However, the majority of observers are in favor of the procedure. We are of the opinion the internal jugular should be ligated whenever the diagnosis of sinus thrombosis is established on the table or when there is little doubt of its presence.

If the thrombus extends only to the bulb or to the upper part of the internal jugular, ligation is sufficient; if beyond this, excision is required. At any rate, jugular ligation or excision should precede the packing of the lateral sinus.

Operation for Lateral Sinus Thrombosis.

The simple mastoid operation is preferably completed before anything is done with respect to the sinus. In this way, there is freedom from the embarrassment of having to attend to the details of the mastoid operation, after the sinus work is completed when it might be inconvenient or perhaps harmful and difficult. In order to secure a large operative field, it may be necessary to employ either the Whiting or Beck incision. (Fig. 821.)

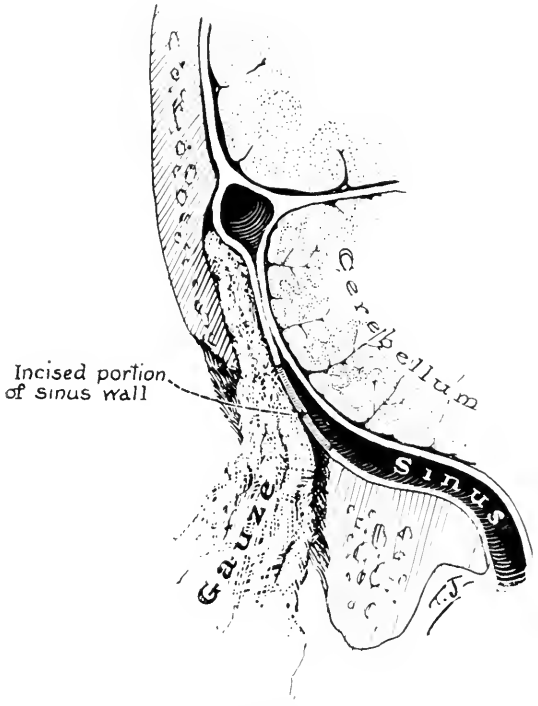


Fig. 849.

Gauze pack between bone and sinus wall.

If the bony wall of the sinus has been eroded by the disease process, the remaining bone is cut away so as to expose the sinus wall to the knee. If there has been no loss of the bony wall, the bone must be removed to the same extent.

Preparation should be made so that if the sinus be free from thrombus, no great amount of blood will be lost. An assistant should be ready with two small gauze rolls each held by a pair of forceps, for the purpose of controlling any hemorrhage that may occur above and below the incision.

Two parallel incisions about 1/32 of an inch apart should be made through the whole length of the exposed sinus wall, and the small strip excised. The clot is then delivered with a dull curette and kept for cultural and microscopic purposes. After the removal of a fair amount of the clot, a thin stream of blood will often be seen coming from either or both ends. This is soon followed by expulsion of the small clot and copious hemorrhage from what is now the unobstructed sinus. If the clot is not expelled, it should be removed with a dull curette with a

Fig. 830.

Incision for thrombosis of the jugular vein.

flexible handle so that it may be bent to follow the curve of the sinus, but it should not be introduced beyond the exposed portion of the sinus. Beck recently succeeded in removing a blood clot from both ends by means of suction. A glass tube fitting snugly in the lumen of the sinus was attached to the suction apparatus. On the bulb side, the glass tube was connected with a piece of rubber tubing which followed the natural curve of the knee of the sinus and by means of this, he was able to draw the clot out of the sinus. The torcular side is first freed from clots. When all the clots are removed, the free hemorrhage is checked by placing the firm tampon of iodoform gauze between the

bone and dural side of the sinus (Fig. 849). The lumen of the vessel should never be tamponed for the gauze may cause the formation of a new progressive thrombus. The jugular side is then treated in the same way as the torcular, special care being taken not to injure the

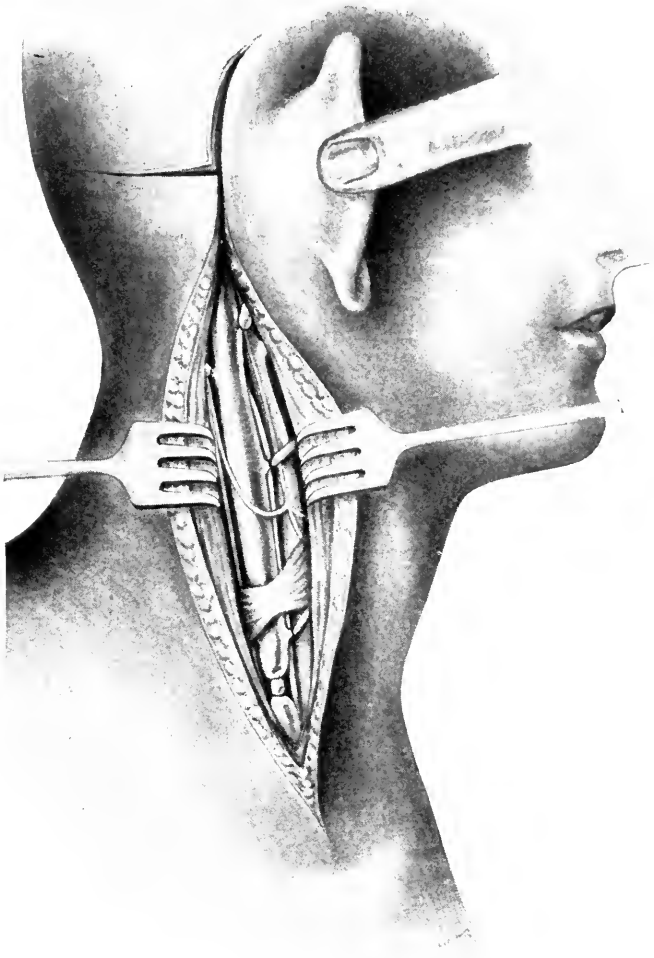


Fig. 851.

Dissection for resection of the jugular vein showing branches all ligated and relations of carotid artery and pneumogastric nerve.

facial nerve. If the thrombus extends into the jugular bulb or internal jugular vein, it will be necessary to ligate the vein and perhaps to resect it in part.

Ligation of the Internal Jugular Vein.

The incision should be continued from the mastoid wound downward and forward along the anterior border of the sternomastoid muscle to the sternoclavicular articulation (Fig. 850), passing through the skin, subcutaneous tissue, superficial fascia, platysma muscle and deep fascia. If the ligation is to be performed for any other purpose than for jugular thrombosis, the incision should begin at the level of the hyoid bone. The external jugular, which is exposed by the incision, should be ligated and all veins should be ligated both centrally and distally and cut between two ligatures. The anterior border of the sternomastoid is now separated from the fascia and retracted backwards bringing the common sheath of the great vessels of the neck into view. This sheath is opened with great care, so as to avoid injury to the vessels. The carotid will be felt pulsating with the internal jugular lying external to it, while the vagus nerve lies behind both vessels. The superior and inferior thyroid, facial, and occipital veins are now ligated well away from the jugular, which is now dissected free of its attachments. The jugular is then ligated above, as near the bulb, and below, as close to the sternoclavicular attachment as possible. (Fig. 851.) Any portion desired may be excised; in fact, when a thrombus is present, it is best to make a complete resection. At this stage, it will be well to try the plan of Neumann for clearing out the jugular bulb of clots and septic material by introducing a Nelation's rubber urethral catheter into the mastoid side of the jugular and permitting a gentle stream of normal salt or boric acid solution to flow through the vein at its cervical opening. However, this irrigation may be postponed for several days; besides there is some danger in this practice of forcing small masses of the thrombus into vessels which open into the jugular bulb as for instance, the petrosal sinus. The neck wound is drained from below, the lips of the wound being sutured and a small gauze drain passed through an opening left in the lower portion of the wound. The mastoid and sinus cavities are packed lightly with gauze which is carried through the lower portion of the mastoid wound, the upper portion of which is united by sutures. (Fig. 852.)

After-treatment.— The wound is not disturbed for three or four days unless the patient's condition warrants this. If the temperature rises sharply after having been more nearly normal than before the operation or if chills occur or marked hemorrhage, the dressing should be removed and changed at once. Otherwise on the fourth day, the packing in the mastoid wound should be loosened and day by day it

should be gradually withdrawn until it is all removed. In this way the possibility of sinus hemorrhage is reduced to a minimum. If the gauze is removed too soon or too forcibly, hemorrhage is likely to occur. After the gauze has once been removed, the mastoid wound is

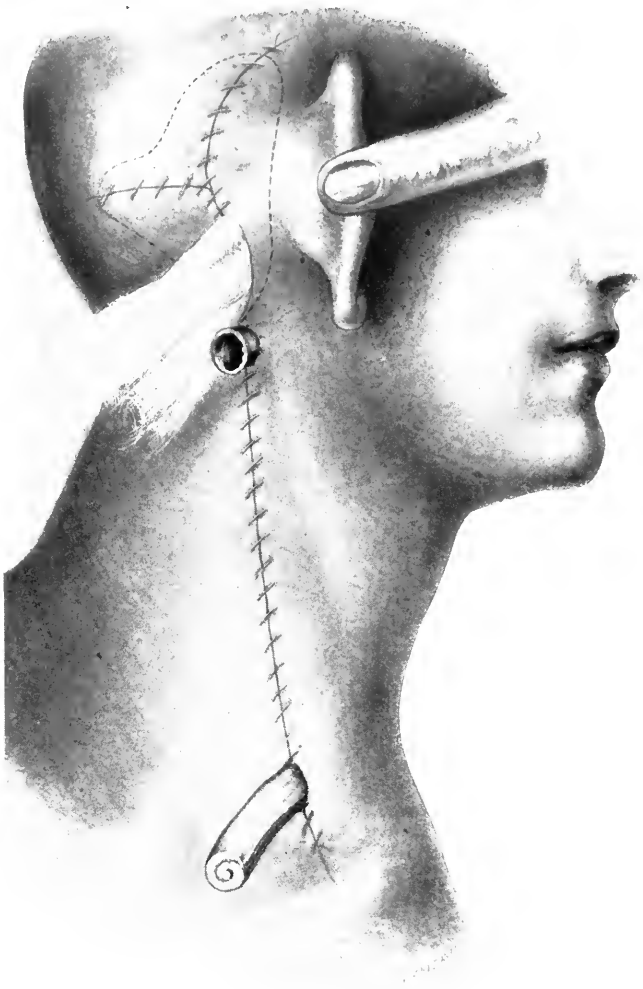


Fig. 852.

Resection of the jugular vein. Method of suture and drainage.

treated as in an ordinary mastoid operation. The neck wound requires no special treatment.

The gauze drain is removed on the third day unless infection has occurred. The irrigation of the jugular bulb may be continued for a short time, at least until the danger of its infectiveness has disappeared.

OPERATIVE SURGERY OF THE LABYRINTH.

The surgery of the labyrinth was not considered of any special importance until within the last few years. In fact, beyond the removal of cochlear sequestra, little was attempted. Jansen began to operate on the labyrinth in 1893 and devised two plans: 1. Exposure of the vestibule within the temporal bone by following the horizontal semicircular canal. 2. Removal of the posterior wall of the petrous portion of the temporal bone from the posterior cranial fossa.

Hinsberg published his method in 1901, Neumann in 1905, Richards in 1907, and Beck in 1915.

The real impetus which led to the performance of the operation proceeded from the work of Barany whose investigations into the physiology of the labyrinth clarified our knowledge of the confusion which had obscured it. The Vienna school, through the work of Barany, Neumann, Alexander, and Ruttin, is largely responsible for establishing the rationality of the procedure.

Indications.—In spite of the careful study which has been given to this subject, there is still a great difference of opinion as to what should justify the operation.

Neumann grouped the symptoms and vestibular tests with the view of establishing definite indications. In the main this grouping is accepted by the majority of operators, though there are some who oppose it vigorously. The table, modified for the purpose of clearness, is as follows:

Hearing	Vestibular Tests	Fistula Test	Spontaneous Nystagmus	Indication for Labyrinth Operation
Present	Positive	Present	Present	None
			Absent	None
Absent	Positive	Present	Present	None
			Absent	Positive when marked
Present	Negative	Present	Present	Positive when extending
			Absent	Positive when extending
Present	Negative	Absent	Present	Positive when extending
			Absent	Positive when extending
Absent	Negative	Present	Present	Positive
			Absent	Positive
Absent	Negative	Absent	Present	Positive
			Absent	Positive
Absent	Positive	Absent	Present	None
			Absent	None

While this schedule cannot be considered as absolute, it provides at least a reasonable basis for evaluating the tests and symptoms designated.

With reference to the pathologic process present, a circumscribed labyrinthitis occurring in connection with a chronic suppurative otitis media, as a rule, does not call for a labyrinth operation as the process may be indefinitely circumscribed. Under these circumstances the radical mastoid operation with the prospect of relieving the focus of infection will be all that is required. There is, however, danger of converting the process into a diffused serous or a suppurative labyrinthitis. The usual chain of labyrinthine symptoms is present, including vertigo, nausea, vomiting, and disturbances of equilibrium, with or without nystagmus. The attacks come on suddenly but the symptoms disappear soon and recur from time to time. There may be some loss of hearing, but tinnitus is uncommon.

If a diffuse serous labyrinthitis follows the circumscribed form of the disease or a radical mastoid operation, nystagmus directed towards the unaffected side and rapid loss of hearing will be added to the other symptoms mentioned. In the milder cases, these symptoms will disappear within a few days without loss of function. In more severe cases, the labyrinth is compromised by the inflammatory process and there result some loss of function in hearing and some labyrinth irritability. Operation is not indicated unless the symptoms persist.

Suppurative labyrinthitis occurs in two forms—manifest and latent. In the former the symptoms are exceedingly severe, including sudden deafness severe disturbances of equilibrium, nausea, and vomiting with rotatory nystagmus directed to the unaffected side. Functional tests are negative showing total loss of cochlear and vestibular function.

The symptoms of latent suppurative labyrinthitis are often very slight and there may be no history of any symptoms except loss of hearing or perhaps nausea, vomiting and vertigo.

The diagnosis of manifest suppurative labyrinthitis is exceedingly important as this determines the necessity for a labyrinth operation. For this reason differentiation between diffuse serous labyrinthitis and diffuse suppurative labyrinthitis is essential.

There is no difference of opinion as to the surgical indications in circumscribed and in diffuse serous labyrinthitis, but operators are by no means united as to the proper practice in manifest suppurative labyrinthitis. By some operators the labyrinth operation is strongly

advocated, by others, it is held that it is better policy to withhold operative intervention unless intracranial symptoms manifest themselves.

The serious danger in latent suppurative labyrinthitis is that it may be readily overlooked. When a radical mastoid operation is performed in the presence of a latent suppurative labyrinthitis, a spread of the affection to the meninges is likely to occur. To obviate this danger, it is only necessary to test the cochlear and vestibular functions which will be found negative. Under those conditions if a radical

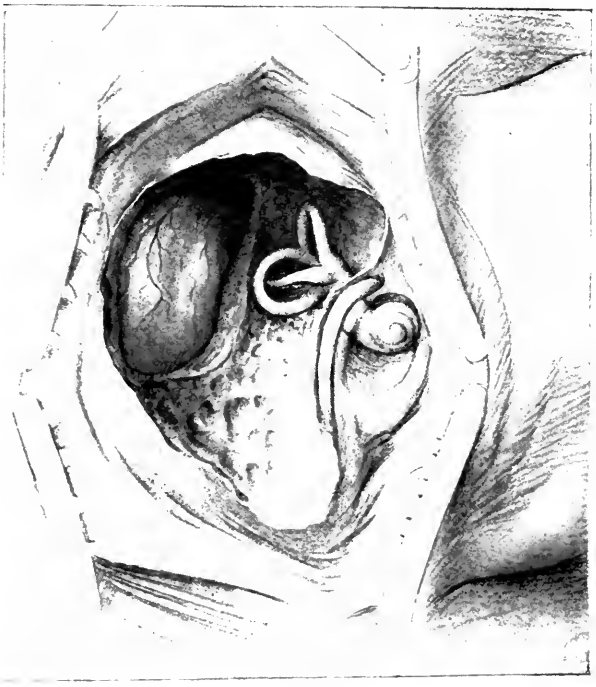


Fig. 853.

Jansen-Neumann's operation. Position of the labyrinth and cochlea with respect to the facial nerve and lateral sinus.

mastoid operation is performed, according to some authors, the labyrinth operation must be included. According to others, it is better to wait for the intracranial symptoms to appear, as autopsies have shown quite a fair number of resolved labyrinth suppuration. For this reason the decision is a matter of personal opinion.

Hinsberg's Operation. Hinsberg's operation has for its purpose the drainage of the labyrinth into the middle ear by the removal of the outer wall of the vestibule, anterior and posterior to the facial canal.

After the usual radical mastoid operation has been completed, the posterior wall of the external auditory canal is trimmed down as far as possible without injuring the facial nerve. If the stapes is present, it is removed. The oval window is then enlarged by removing the bridge between it and the round window with chisel or burr. The horizontal semicircular canal is then uncapped and a very fine probe (dental root canal explorer) is made to follow the membranous canal through the anterior crus into the vestibule. By firm pressure upon the probe, it will be pushed through the oval window. This establishes the drainage of the labyrinth. While not so efficient as other operations so far as the other two semicircular canals and cochlea are concerned, it answers the purpose of draining the labyrinth.

The two openings in the labyrinth are lightly packed with gauze, appropriate plastic is made, and the mastoid wound is sutured and dressed as in the radical mastoid operation.

Jansen-Neumann Operation.—The aim of this operation is to open the three semicircular canals, the vestibule, and the cochlea in all its whorls. As such, it is far more complete than the Hinsberg operation.

After the radical mastoid operation has been completed, Trautmann's triangle is located (Fig. 837), lying between the posterior crus of the horizontal semicircular canal, the outline of the knee of the lateral sinus, and the tegmen antri. The bone is removed from over the anterior portion of the lateral sinus in the mastoid area and the bone removal continued in an anterior direction until the projection on the posterior surface of the petrous portion of the temporal bone corresponding to the bony capsule of the labyrinth is reached. The bone in this position is very dense, and great care must be exercised not to injure the dura. The relations of the vestibular apparatus and cochlea is shown in Fig. 853, which illustrates a preparation in which these organs have been left free of their bony coverings for the purpose.

The cerebellar dura, which has been brought to view, is observed extending upward towards the middle fossa, backward to the lateral sinus, and forward to the petrous portion of the temporal bone containing the labyrinth. The dura is carefully separated from the petrous bone with the view of entirely preventing the occurrence of any tears. The bone is next carefully and gradually chiseled away, while the sinus and cerebellar dura is cautiously drawn away from the field with a flat retractor. Two openings soon appear, the upper one being that of the superior semicircular canal and the lower that of the posterior semicircular canal (Fig. 854). As the chiseling is continued, a third opening appears midway between the first two, which represents the

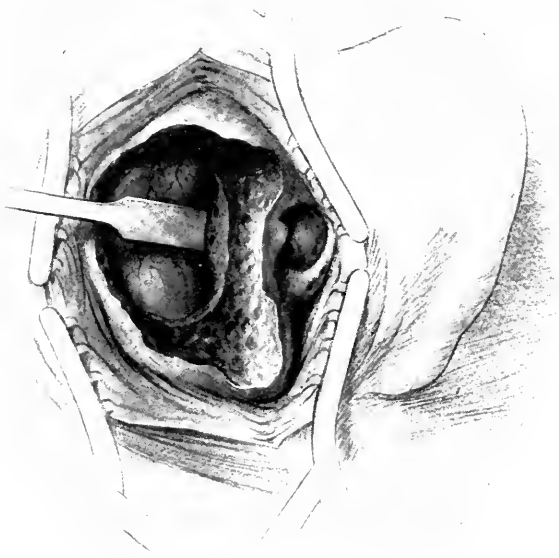


Fig. 854.

Jansen-Neumann's operation. Sinus and cerebellar dura held back by a retractor. Openings of the superior and posterior semicircular canals.

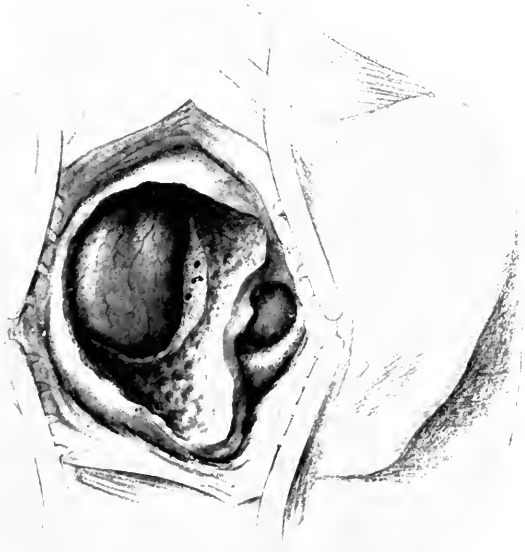


Fig. 855.

Jansen-Neumann's operation. Openings of the superior and posterior semicircular canals and of the posterior limb of the external semicircular canal.

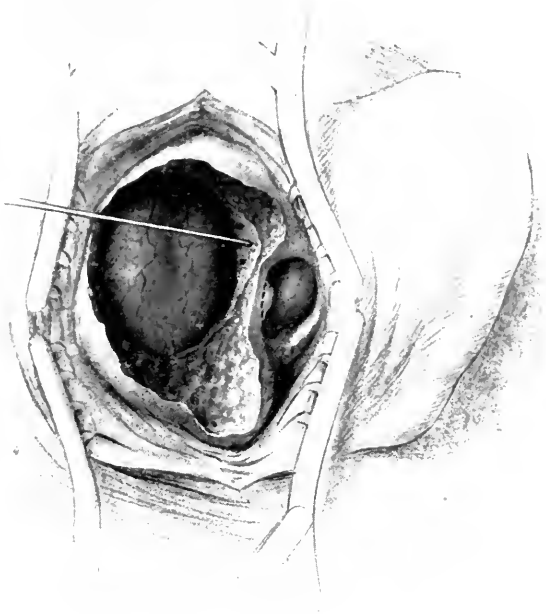


Fig. 856.

Jansen-Neumann's operation. Bone removal approaching the vestibule. Broken line shows portion of promontory to be removed.

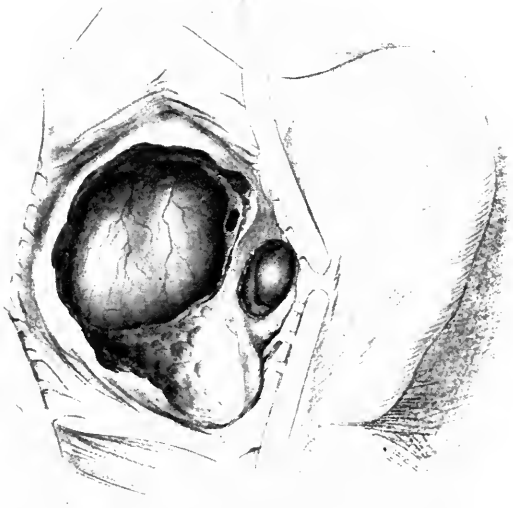


Fig. 857.

Jansen-Neumann's operation completed.

posterior limb of the external semicircular canal (Fig. 855). This canal is followed with the chisel strokes, a probe being introduced from time to time to show the pathway to the vestibule which is soon exposed as the bone removal extends. Neumann continues the removal of the bony covering of the vestibule as far as the internal auditory meatus, but this technic is followed by few operators on account of the danger to the meninges, and to the facial and abducens nerves.

The bony ridge containing the facial nerve is all that remains between the bone operation and the promontory of the cochlea (Fig. 856). A probe is now passed through the opening in the horizontal semicircular canal into the oval window as in the Hinsberg operation and the promontory is opened by applying the chisel flatly against the anterior wall of the external auditory meatus, the sharp end being placed above the tympanic end of the Eustachian tube. A gentle stroke is all that is required to penetrate into the cochlea and then the promontory may be easily removed by using the chisel as a lever (Fig. 857). If this opening is not large enough, a small chisel should be used to increase its size.

A primary dressing similar to that advised in the Hinsberg operation should be employed. However, in view of the fact that the dural surface is exposed it will be safer to leave a portion of the retroauricular opening unsutured or to make another incision for drainage in that region.

Richards' Operation.—After the performance of the radical mastoid operation, the widest operative field possible is secured by reducing the facial ridge to the utmost limits of safety, by removing the outer wall of the hypotympanum, and by lowering the level of the floor of the external auditory canal which provide the widest exposure of the outer wall of the vestibule, and of the dome of the jugular bulb if it should happen to be placed upon a high level.

The convexity of the anterior wall of the auditory canal is shaved down, the lip of bone overhanging the mouth of the tube is removed and the tensor tympani is evulsed, consideration being given to the propinquity of the carotid artery. The tube, which is now well exposed, may be curetted and the hemorrhage checked by packing the cavity with adrenalin gauze.

The prominence of the horizontal semicircular canal is then cut away with a chisel, the cutting edge of which is placed at a point below the summit but above the Fallopian canal, the stroke being made in the direction of the plane of the canal. The remaining semicircular canals

are then uncovered, a curved gouge being used for the superior (Fig. 858).

The semicircular canals are cut away, the bone being gradually removed at their solid angle and the vestibule thereby entered. In removing the inner lip of the horizontal semicircular canal, the greatest care must be observed in using the chisel which should under no circumstances be allowed to engage the outer lip adjacent to the Fallopian canal.

The vestibular opening is enlarged until the cavity is fully exposed and a search made for fistulæ. Such portions of the bridge supporting the facial nerve as necessary are removed, care being taken not to dislocate the nerve. The strokes of the chisel should be made from above downward or from before backward so as to shave away the bone in a direction parallel to the nerve. Whatever filaments of the nerve are exposed should be cut away, not torn. The facial canal is now converted into a gutter by chiseling away the bone as indicated (Fig. 859). All spiculæ and uneven edges should be carefully removed so that the nerve may lie in a smooth bed. The anteroinferior portion of the vestibule is now to be opened. A gouge equal in width to the distance between the round and oval windows is made to straddle and to remove the bridge of bone between them by a slight stroke directed from above downwards and forwards toward the first cochlear turn. A high placed dome of the jugular bulb is menaced in this position and if the chisel crosses the vestibule and fractures its inner wall, a loss of cerebrospinal fluid and a meningeal infection may result. Bone wax should be used to check the flow of cerebrospinal fluid.

The opening is enlarged and the entire vestibule explored. If the disease has invaded the cochlea, it must be followed accordingly. The roof of the first cochlear turn is removed from behind forward with a sharp gouge without a shoulder, its width being slightly greater than that of the cochlear whorl. In this position there is danger to the dome of the jugular bulb below, the carotid eminence in front and the base of the modiolus and the internal auditory meatus internally, although this may be obviated by confining the work to the roof of the cochlear whorl.

If the disease has progressed still further in the cochlea, the cochlear shell is shaved down from a point corresponding to its apex until the dark interior becomes visible (Fig. 860). The stroke should be directed from above downwards and forwards corresponding to the cochlear whorl. The opening thus made in the cochlear shell is gradually enlarged until the upper cavity of the cochlea is free.

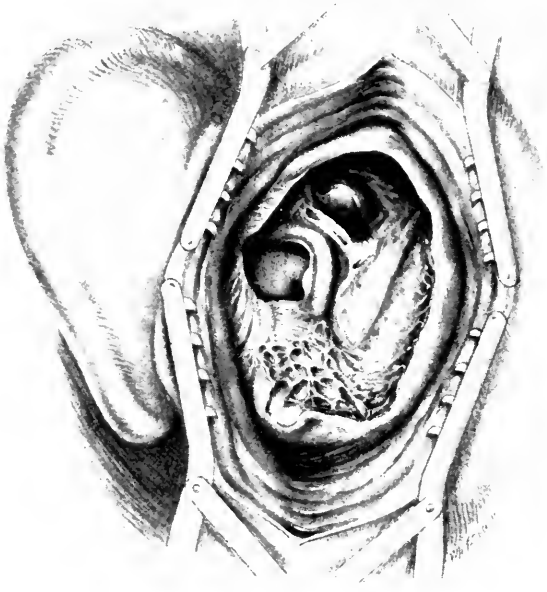


Fig. 858.

Richards' operation. Three semicircular canals uncovered, anterior wall of the external auditory canal shaved down, Eustachian tube exposed.

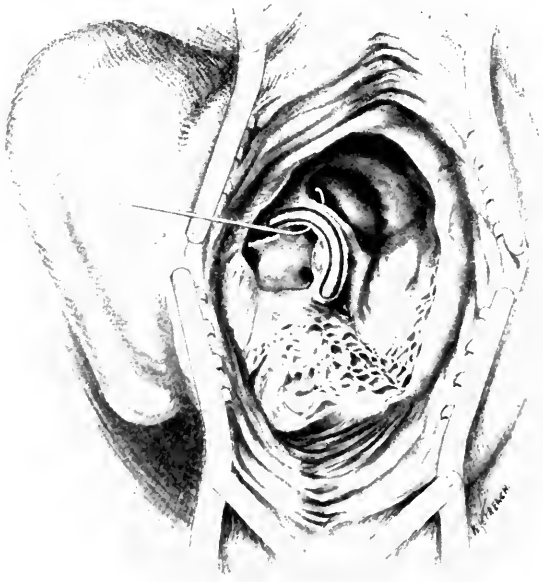


Fig. 859.

Richards' operation. Fallopian canal has been converted into a gutter in which the facial nerve lies uninjured. Probe passing from the foramen ovale into the denuded vestibule.

Fig. 860.
Richards' operation. Exposure of the first and second cochlear turn.

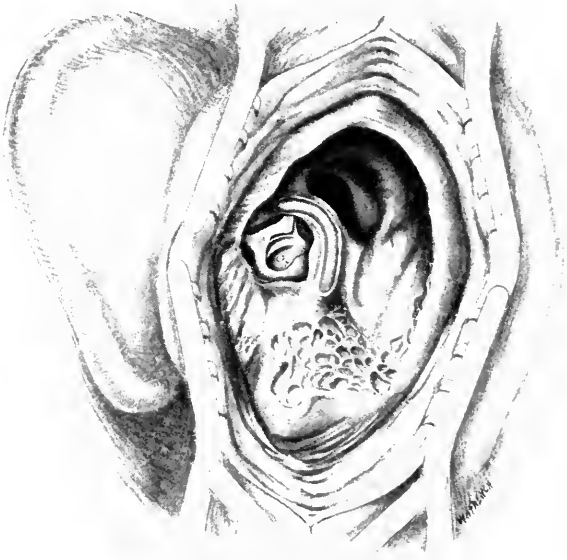


Fig. 861.
Richards' operation. Completed.

If it is desired to expose the other half of the first cochlear whorl, the shell of bone should be removed from the apex of the pyramid down to the end of the first cochlear turn. The roof is then carefully broken away from above, exposing the entire interior of the cochlea (Fig. 861). There are so many dangers encountered in performing this operation that only the most experienced operators should undertake it.

Beck's Operation.—The technic of this operation is based on the safety of the burr as an operating instrument, since by its employment, it is almost impossible for the skilled operator to injure the dural cov-

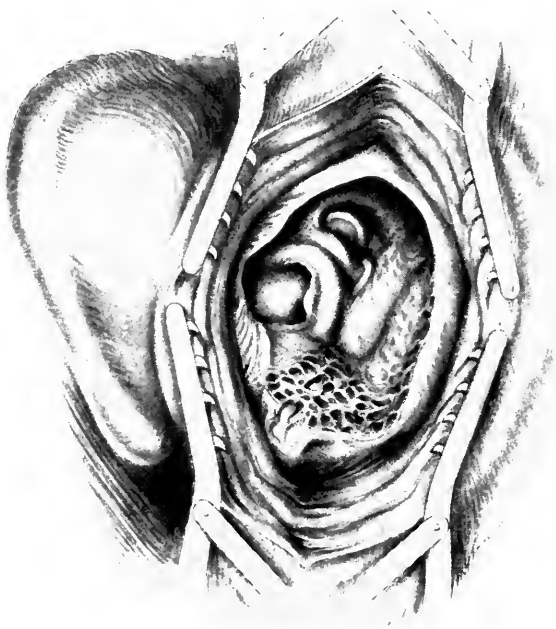


Fig. 862.

Beck's operation. Exposure of the semicircular canals.

erings, the brain, sinus, or sheath of the facial nerve. It causes less bleeding than the chisel, gouge, or forceps and it clears away the bone more rapidly than any other instrument of service in this operation. With a round burr of small size the bone is removed from around the semicircular canals without removing any or but little of the bony wall of the sinus. (Fig. 862.) The external semicircular canal is then opened with a burr and its prominence and posterior crus are removed, exposing the two openings of the superior semicircular canal. In this way the semicircular canals are all opened (Fig. 863) without

Fig. 863.
Beck's operation. All three semicircular canals opened.

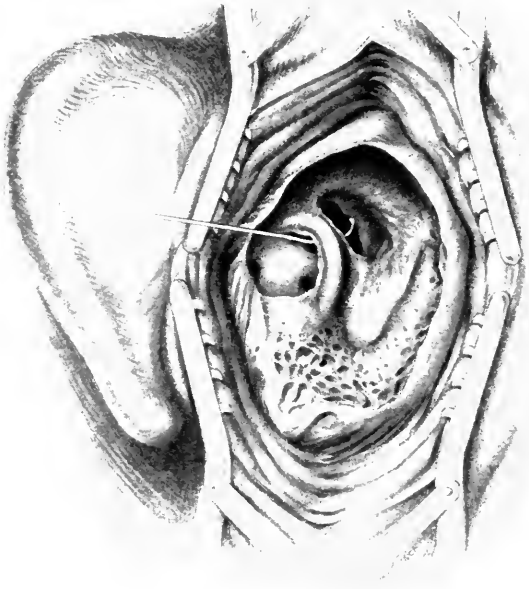


Fig. 864.
Beck's operation. Promontory of cochlea removed.

resorting to the dangerous procedure in the Jansen-Neumann operation of exposing a considerable portion of the dura.

The removal of the promontory of the cochlea is accomplished with a small round burr and is far easier than with a chisel. (Fig. 864.)

The primary dressing, plastic, and closure of the retroauricular wound are the same as in the Hinsberg and Jansen-Neumann operations but there is no need of a retroauricular drain.

After-treatment.—In view of the exposure of the cerebrospinal system to infection in labyrinth operations, it is of the greatest importance to administer urotropin both before and after the operation. It is astonishing what large doses will be tolerated.

The dressings should not be changed too often and the first should be retained as long as consistent in order that the plastic exudate may form and prevent the escape of cerebrospinal fluid. If the temperature is low, if no pain or headache is present, the dressings may be left for three days. When the cerebrospinal fluid ceases to flow, the procedures customary after a radical mastoid operation are adopted.

OPERATIVE SURGERY OF MENINGITIS OF AURAL OR NASAL ORIGIN.

It has been long known that there was an association between suppurative disease of the ear with meningitis and brain abscess, but up to the time of Morgagni, the ear discharge was considered the result and not the cause of the intracranial condition. Although for years, the surgical treatment of these conditions was left to the general surgeon in view of his wider operative experience, it is now being forced into the domain of the otologist and of those whose work is more or less confined to the surgery of the nervous system.

The etiology of these conditions makes the otologist familiar with the processes leading to the production of meningitis and brain abscess and the surgical requirements of his work bring him into close relation with methods of the operative detail necessary for their relief.

The diagnostic aspects of these conditions are so involved with those of other affections of the cerebrospinal system that such operative work should be undertaken only if the operator is familiar with the most advanced knowledge of the subject or if he can secure counsel who can supply it. In fact, the indications are far more important than the operative technic.

Indications.

It is impossible to establish a set of indications for operation without studying the types of the disease and the symptoms which may be present.

Types of Meningitis.—Meningitis of aural or nasal origin may be grouped as follows, depending upon the point of view:

1. Etiology.—This includes (a) the post-traumatic, such as fractures of the base of the skull; and (b) the infectious in which a variety of bacteria may take part, such as streptococci, staphylococci, pneumococci, and meningococci; and (c) the chronic forms, tuberculous and syphilitic.

2. Pathology.—It may be serous or purulent.

3. Anatomy.—The two types depending on structure are pachymeningitis and leptomeningitis.

As the value of any operative procedure in meningitis depends on the early recognition of the condition, the signs and symptoms should be grouped as early, intermediate, and terminal.

Early Signs and Symptoms.—The common early symptoms are as follows: Headache and somnolence; temperature of varying degree depending on the type of microorganism; sluggishly acting or inequality of the pupils with a tendency to myosis; spinal fluid sometimes showing increased intracranial pressure and other changes which may be classified as follows, in comparison with the normal:

	NORMAL	PATHOLOGIC
Color	Clear	Cloudy, turbid
Sugar	Present	Absent at times in tubercular meningitis
Cell count	10 or less to the field	Marked increase
Lymphocytosis or increase in the polynuclear types	Absent	Present
Bacteria	None	Many forms
Cultures	Negative	Positive
Wassermann, Noguchi Lange, Nonne	Negative	Positive

Intermediate Symptoms comprise the following: Increasing somnolence, alternating with irritability; cortical irritation producing contractions of the legs and arms, Kernig's sign, or convulsions; head drawn back, neck rigidity; choked disc; pupils irregular or unequal; pronounced projectile vomiting; septic temperature and pulse; irregular, somewhat slow respiration; constipation.

Terminal Symptoms.—The early and intermediate symptoms of cerebral irritation are changed into those of paralysis or convulsions.

The patient is unconscious, respiration and heart beat are much slower and irregular, temperature is often subnormal, tympanites is marked, urination and bowel movements are involuntary, pupils are widely dilated, anesthesia is complete. Death ensues from exhaustion.

Prognosis.—Pachymeningitis, when circumscribed, generally recovers without incident, or results in extradural abscess.

Leptomeningitis is much more serious though the prognosis depends on the extent and location of the process and the virulence of the bacterial cause. It may also result in abscess of the cortex or between the cortex and dura. Operative procedures to be of value must be performed early and must be radical. Diffuse leptomeningitis is usually rapidly fatal.

Tuberculous meningitis offers no hope to the operator; syphilitic meningitis is more hopeful. Its recovery depends upon the effect of antisyphilitic therapy.

Spinal Puncture.

Spinal puncture is not only a routine diagnostic measure but is also at times a valuable therapeutic measure. The pressure within the skull and the spinal canal is the cause of the greatest injury to the brain and spinal cord and the continuance of this pressure encourages the invasion of bacteria and the involvement of the brain tissue proper. By acting as a mild form of decompression, repeated spinal puncture offers a remedy which in serous meningitis may be of curative value.

Operation.—No anesthesia is necessary, though if the patient is nervous or easily affected by pain, an ethyl chlorid spray may be used, as there is only a slight pain when the skin is punctured. The field should be prepared with iodin solution and alcohol in the usual way. The patient may be in the sitting or recumbent position. In any case the back should be curved outward so as to separate the bodies of the vertebræ as much as possible. It is safer in the presence of a meningitis to perform the operation with the patient in the reclining position for the reason that the patient is seriously sick and there is less likelihood of the brain sagging at the foramen magnum during the escape of the spinal fluid. The patient should be placed on his side close to the edge of the bed, his head and neck bent forward, his legs flexed on the thighs, his thighs on his abdomen thus curving his back as sharply as possible. A line is now drawn across the back in the lumbar regions, between the fourth and fifth lumbar

vertebræ from the upper border of the crest of one ilium to that of the other.

The spinous process of the fourth lumbar vertebra should be located. The spinal puncture needle, which should always be provided with an obturator, is thrust through the skin at its lower end and to the side of the spinous process (Fig. 865). The needle is pushed forwards, upwards, and inwards between the spinous processes of the fourth and fifth vertebræ until the resistance of the dura lining the

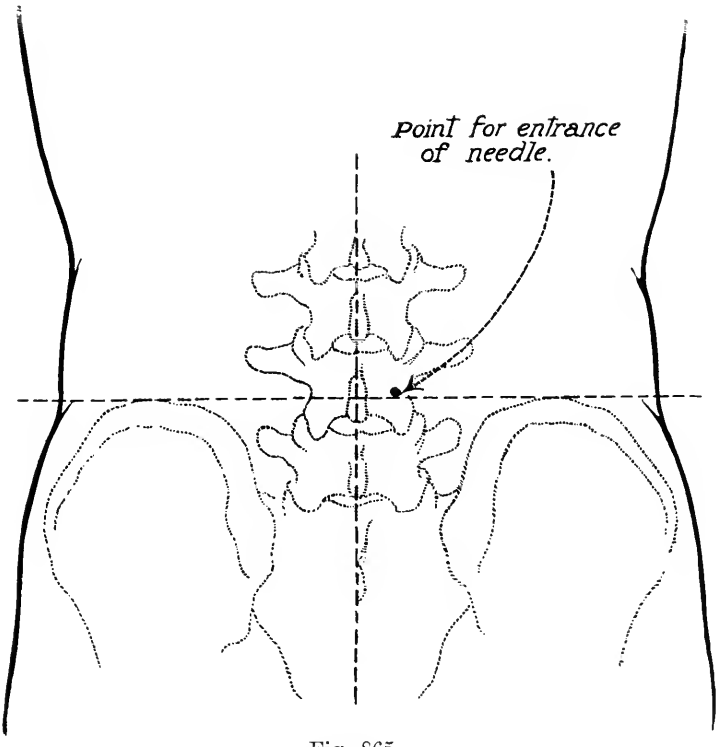


Fig. 865.

Spinal puncture.

spinal canal is felt to give way. The distance traversed varies from one and a half inches to the full length of the needle, depending upon the amount of fat and muscle through which it passes.

When the needle has entered the canal, the obturator is withdrawn to allow the spinal fluid to escape. If no fluid passes out, the obturator is replaced and the needle is either pushed in deeper or slightly withdrawn until the fluid flows. It may be necessary to do this several times in order to secure a result; the so-called dry tap is of no value. If the fluid escapes rapidly as from great pressure, it will be

well to retard the flow by placing the finger on the external outlet of the needle, in order to avoid the danger of suddenly withdrawing a large quantity of the cerebrospinal fluid. Sometimes it will be necessary to introduce a larger needle as blood or thick fluid may not pass through one of smaller caliber. When sufficient fluid has been withdrawn for testing or for therapeutic purposes, the needle is removed and the wound sealed with collodion.

Drainage of the Cisterna Magna.

Haynes and Kopetzky devised the method of relieving the tension in meningitis by draining the cisterna magna. The patient is placed

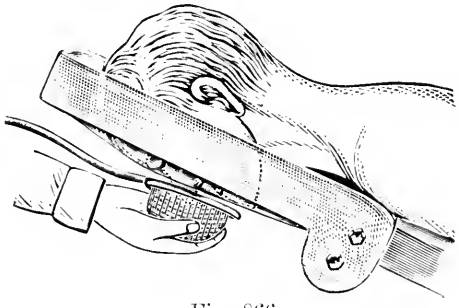


Fig. 866.

Beck's headswing.

on the table with the face down in a headswing of which Beck's (Fig. 866) is a good type. The operating table should be on an incline with the head much higher than the feet. The anesthesia is given from below preferably by the vapor method.

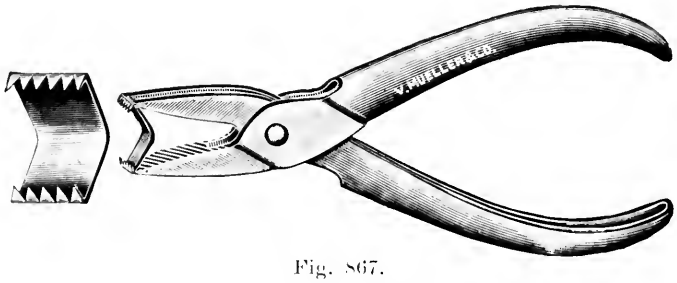


Fig. 867.

Beck's mass clamps.

An incision is made down to the bone from the occipital eminence to the neck. Various means have been used to hold the soft parts around the wound together. Beck's mass clamps (Fig. 867) are of particular service in this and other operations about the head for this

purpose and to check hemorrhage without the use of a large number of bulky artery forceps. After the application of the clamps (Fig. 868), the periosteum is elevated and a self-retaining retractor is used (Fig. 869) to expose the area to be trephined. An opening is made on either side of the occipital sinus, with an electrically driven trephine and an elliptical-shaped piece of the skull removed (Fig. 870) by rongeur forceps or an electrically driven skull saw, carefully avoiding injury to the occipital sinus. The sinus and dura may be separated from the bone with a flat dural spatula before introducing the rongeur or saw. The dura is now incised on one side of the occipital sinus and the cisterna magna opened with an artery forceps where it is located

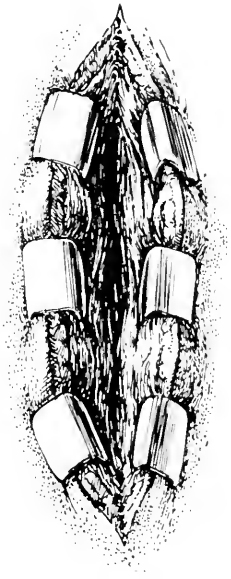


Fig. 868.

Haynes' operation. Beck's mass clamps in position.

at the junction of the cerebellum and spinal cord. To guard against the sudden escape of cerebrospinal fluid, a wet sponge should be held against the opening made. After a sufficient quantity of fluid has been removed to reduce the excessive pressure, a fine cigarette drain is introduced as far as the cisterna magna and a gauze pad placed over the opening. The self-retaining retractor is removed and all bleeding vessels tied. If desired, several mass ligatures may be introduced through the periosteum muscle and subcutaneous tissue. The wound is closed at the extremities and only sufficient space is left open to permit the introduction and removal of the gauze pad and cigarette drain. A fairly firm bandage is applied so as to prevent the escape of too much

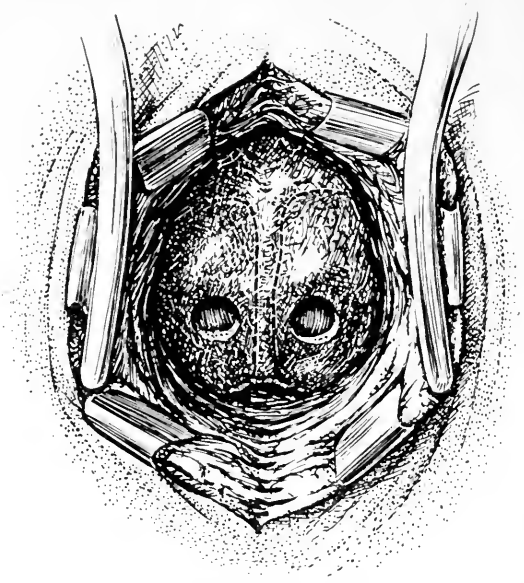


Fig. 869.

Haynes' operation. Openings made with electrically driven trephine on each side of the occipital sinus.

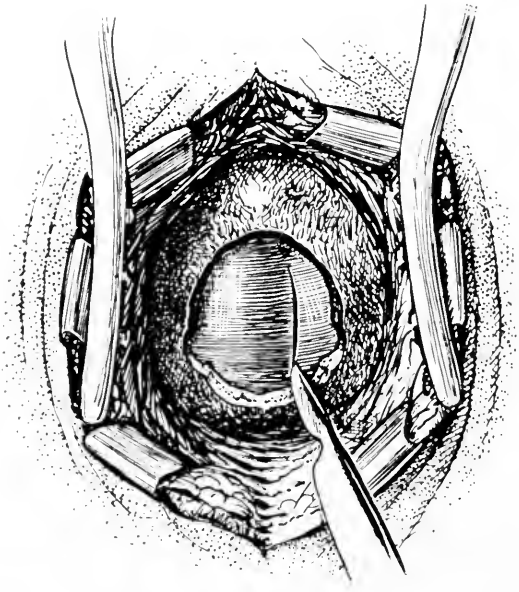


Fig. 870.

Haynes' operation. Elliptical portion of bone removed. Incision of dura.

cerebrospinal fluid and for the same reason the patient should lie on either side rather than on his back.

The external dressing need not be changed for two or three days unless it is too much saturated with cerebrospinal fluid and inflammatory discharges. If there are no signs of intracranial pressure on the fourth day, the gauze pad and cigarette drain are to be removed but the lips of the wound should be kept apart by the interposition of gauze. This is for the purpose of permitting the reintroduction of the drain into the cisterna magna, if pressure symptoms recur.

Crockett's Method.

Crockett has had success in serous meningitis by adopting the following method. A semicircular incision is made through the temporal fascia and muscle above the auricle and the flap retracted upward. A button of bone about one inch in diameter is then removed. After a lumbar puncture is performed and sufficient fluid removed to reduce the pressure, the dura is incised and a rubber protective drain is introduced beneath the dura for about three inches along the petrous portion of the temporal bone and sutured to the skin. The external flap is closed except at the drain.

Puncture of the Corpus Callosum.

This recently devised plan for reducing intracranial pressure is of some service in meningitis, particularly in those cases in which the free circulation of the spinal fluid is blocked below the ventricles. An incision about two inches long is made in the parietal region about a

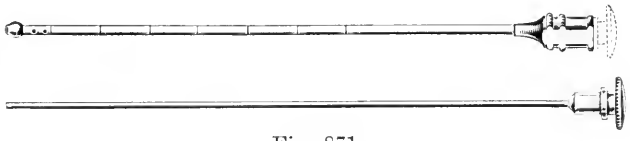


Fig. 871.

Kanavel's graduated blunt needle for puncture of the corpus callosum.

half inch from, and parallel to, the superior longitudinal fissure. Mass clamps are used to stop the bleeding and a self-retaining retractor exposes the area to be trephined. A fairly large button of bone which is preserved for replacement is removed with a hand trephine.

The dura is incised so as to form a small flap. At this stage, large blood vessels may be encountered in the pia which will require ligation to prevent dangerous hemorrhage.

The graduated blunt needle (Fig. 871) devised by Kanavel is intro-

duced through the trephine opening and is carried towards the median line (superior longitudinal sinus) and then the point is directed downwards between the two cerebral hemispheres for about one and a half inches until the corpus callosum is felt (Fig. 872); when the arachnoid is penetrated, the cerebrospinal fluid will usually escape from the needle. It is sometimes necessary to attach a Record syringe for the purpose of aspirating the fluid which may be too thick to pass through the needle otherwise or which may be obstructed by plugging of the needle with tissue, exudate, or blood. After the desired amount of

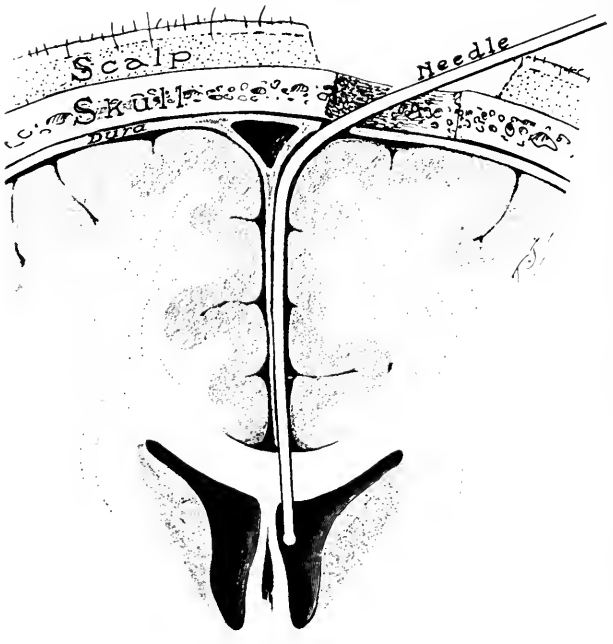


Fig. 872.

Insertion of the needle for puncture of the corpus callosum.

fluid is removed, the blunt-pointed needle is employed to rupture the membrane so as to permit as large an escape of fluid between the inner and outer cerebral fluid systems as possible. The dural flap is then sutured, the bone button is replaced, and the skin wound closed.

BRAIN ABSCESS OF AURAL AND NASAL ORIGIN.

Pus collections within the cranial cavity are found between the dura and the bone, called respectively, extradural and intradural abscess. In the latter are grouped those which lie between the dura and the cortex and those which are found within the brain substance itself.

The temporosphenoidal lobe is the most common location in view of its relation to the ear, but abscesses are also found in the parietal

portion of the cerebrum and in the cerebellum. Abscess in the frontal lobe usually results from infection from the nose or the accessory sinuses.

As a rule, a brain abscess forms slowly; in fact, it may remain quiescent for a period, after which it becomes active, constituting what is known as the attack period.

Indications.

A very careful study of the signs and symptoms is necessary to differentiate abscess of the brain from other intracranial and extracranial conditions and to determine the location of the process. To accomplish this, it is necessary to understand neurologic diagnosis or to have the counsel of one who does. The following are the most important symptoms pointing to the disease:

Pain in the head may be called the cardinal symptom suggesting the possibility of a brain abscess, especially when there is an infective focus accessible to the brain as in mastoid or sinus suppuration. The pain is persistent and severe, and increased when the abscess is increasing in size and involving sensory nerves or new areas of the meninges. These are the so-called attacks.

Pulse Rate.—One of the most characteristic signs of brain abscess is the lowered pulse rate which frequently drops to 50, and even less. This does not appear to depend upon the size or location of the abscess.

Fundus Oculi findings are much more pronounced than they are in meningitis or sinus thrombosis. Marked choked disk is sometimes found, especially if the abscess is of any considerable size or is located in the posterior fossa.

Focal Symptoms.—Symptoms due to pressure or disturbance of any of the cortical centers or cranial nerves are of great importance when they can be elicited. However, it must be remembered that these do not necessarily determine the location of the abscess for they may result from a lesion at some distance away, which affects them by the pressure which it induces.

An abscess of the temporosphenoidal lobe will likely produce a definite aphasia, if located on the left side in right-handed people or the reverse in left-handed, and as the abscess encroaches upon the Rolandic area, motor disturbances are apt to occur, such as spasmodic action of the muscles from cortical irritation, or, more frequently, paralysis caused by destruction and pressure.

Abscess in the prefrontal lobe is usually accompanied by mental

apathy; in the occipitoparietal, by increased sensitivity when it is confined to the cortex and by irritation when pressure is the cause.

An abscess in the occipital area is accompanied with loss of vision, various types of hemianopsia, and other sight defects, which must be considered in connection with the papillitis present.

In abscess of the cerebellum, spontaneous nystagmus and incoordinated movements of the limbs and body are often found. In differentiating cerebellar abscess from labyrinth conditions, the essential factors are that in the former the nystagmus may be directed to the affected side, to the sound side, or both, and may vary from time to time.

Spontaneous nystagmus lasts but a short time in suppurative labyrinthitis and is usually directed to the sound side. When the labyrinth still reacts it shows the usual labyrinth characteristics, among the most important of which are the pointing test in the direction of the slow component and positive caloric tests.

An abscess at the base of the brain usually shows involvement of one or more of the cranial nerves which is of assistance in locating it. There is, however, much difference in the resistance and vulnerability of the various nerves. Thus the sixth nerve is particularly disposed to paralysis in brain abscess. This, however, has been explained on the basis of its unusually long course within the cranium and upon the occurrence of an ostitis or a necrosis of the petrous portion of the temporal bone in close proximity to the nerve.

There are certain areas of the cerebrum and cerebellum which may be involved without giving rise to any focal symptoms. These are to be found in the frontal lobe, in the corpus callosum, between the two hemispheres, on the under surface of the occipital lobes, and on the under and outer surface of the cerebellum. A diagnosis of abscess in these regions must be made by exclusion.

Spinal Puncture shows changes similar to those found in meningitis (see page 383) as the abscess is usually accompanied by a serous meningitis or by a meningeal irritation. The reaction is usually less pronounced and the cytologic findings less marked.

Extradural Abscess.—It is not easy to distinguish extradural from intradural abscess, although the symptoms in the former are less intense than in the latter. An extradural abscess is always to be considered as a potential factor in the production of an intradural abscess. Such an extradural abscess may remain latent for a long time until a trauma or an adjacent acute inflammation of a sinus, middle ear, or mastoid causes it to flare up, resulting in a meningitis

or an intradural abscess. A similar occurrence may follow an operation on the mastoid or one of the sinuses, in the presence of an undiscovered latent extradural abscess. We have records of post-mortem examinations which show the possibility of such a complication. On this account, it is well to look with suspicion on a headache which increases after a sinus or a mastoid operation.

Pathologic Manifestations.—If the abscess cavity is surrounded by a firm wall or capsule the chances for recovery are greatly increased. It is not desirable to disturb this wall which is the best protection against extension that can be afforded.

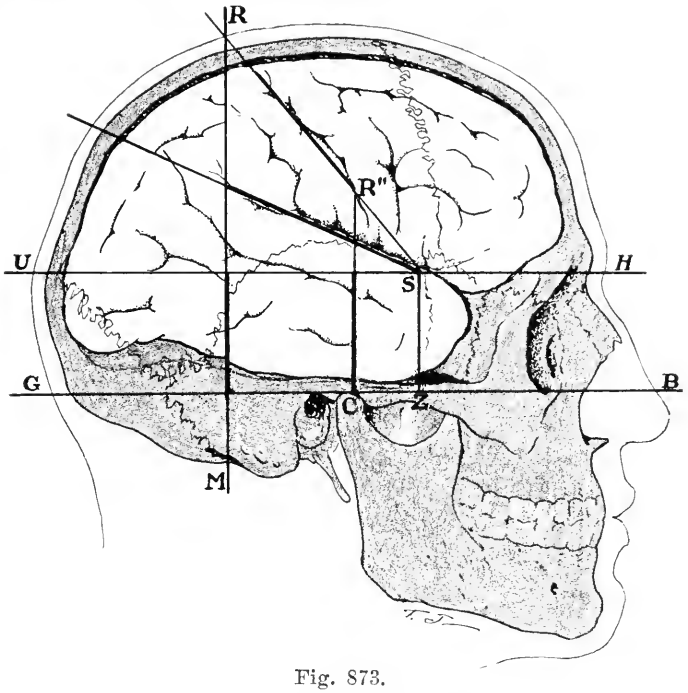


Fig. 873.

Kroenlein's craniometric lines.

The type of bacteria present has much to do with possibility of recovery. Infection by the streptococcus, particularly the viridans variety, the streptococcus mucosus capsulatus, and the bacillus fusiformis, is gravest in type.

Localization.—In order to subject the undiseased portion of the brain to the smallest amount of interference and manipulation, it is important to evacuate the abscess as near its situation as possible. This implies a careful survey of the signs and symptoms in order to locate the abscess with respect to the brain and to the cranium.

There are several plans for mapping out the endocranial struc-

tures on the surface of the head, the most commonly used being those of Kroenlein, of Quain, and of Kocher.

Kroenlein's plan (Fig. 873) follows the reconstructions made by Froriep. The base line *GCZB* is drawn between the lower rim of the orbit and the highest level of the external auditory canal. A second line *USH* is drawn parallel to this through the upper margin of the orbit. The line *SZ* runs perpendicular to these lines through the middle of the zygoma and the line *C* extended to *R''* runs vertically from the condyle of the jaw. The line *MR* runs similarly from the

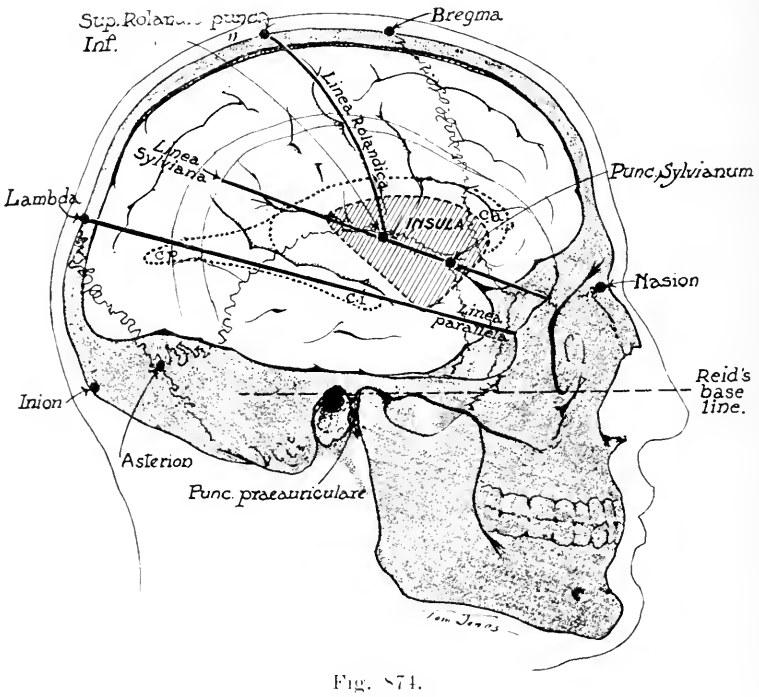


Fig. 874.

Quain's craniometric lines.

posterior border of the mastoid process. The Rolandic line *RR''* designates the location of the fissure of Rolando and the line bisecting the angle, *RSU*, the location of the fissure of Sylvius.

The plan given in Quain's Anatomy (Thane) somewhat more detailed, is rendered clear by the drawing Fig. 874.

Kocher employs an adjustable steel band which encircles the head *NVH* (Fig. 875) from the glabella to the occipital protuberance. Another steel band is run sagittally and is connected at the glabella and the occipital protuberance with the first band. A third band is attached to the sagittal band, midway between the glabella and occi-

pital protuberance, in such a way that its unattached extremity may be moved along the first band. When this band is placed at an angle of 60 degrees forward, corresponding to the course of the precentral fissure, it will lie over the posterior ends of the superior and inferior frontal sulci at the points indicated by the circles. When the band SH is placed at an angle of 60 degrees backward and another band *NL* added from the glabella to the summit of the occipitoparietal suture, it will make that portion between the bands *NL*, and *NH*, the division between the temporal and occipital lobes. Above the band *NL*, it marks the division between the central and parietal lobes.

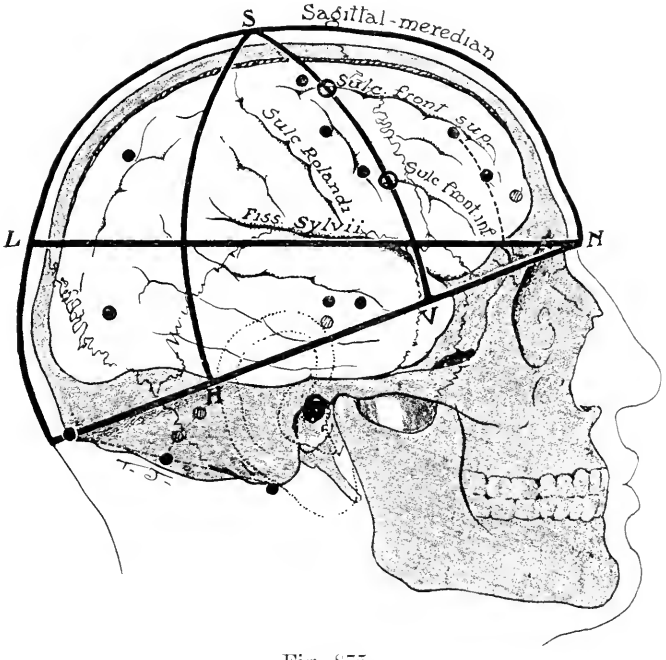


Fig. 875.

Kocher's craniometric lines.

The fissure of Sylvius lies along the band *NL*, as indicated in the illustration. The black dots show the puncture points which may be made in the various lobes without injury.

Operation.

Temporosphenoidal Abscess.—Abscesses of the temporosphenoidal lobe were formerly opened through the squamous portion of the temporal bone; this is still desirable when there is no connection with ear disease and when for some reason it is not desired to open the mas-

Fig. 876.
Temporosphenoidal abscess. Tegmen tympani and portion of squama removed.

Fig. 877.
Temporosphenoidal abscess. Brain cavity walled off by gauze cofferdam.

toid. As a rule, however, these abscesses have their source in the middle ear or mastoid cells and the mastoid operation has been performed or is to be performed.

Fig. 878.

Gifford's brain abscess explorer.

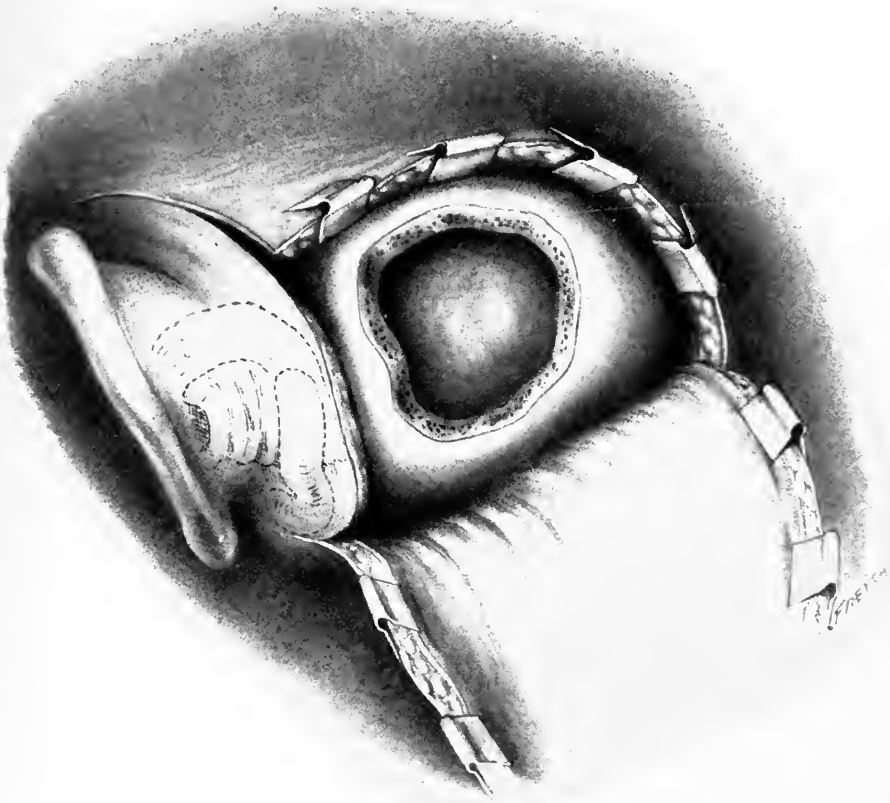


Fig. 879.

Cerebellar abscess. Incision, opening in bone, mass clamps in position.

Under such circumstances, the abscess may be reached by way of the mastoid operation, the tegmen tympani is removed by rongeurs or electric burr, as far forward and as high over the squama as necessary (Fig. 876), care being taken when operating in the region of the middle meningeal artery. The abscess will be accordingly evacuated, if the process is extradural, and all that will be required will be to put

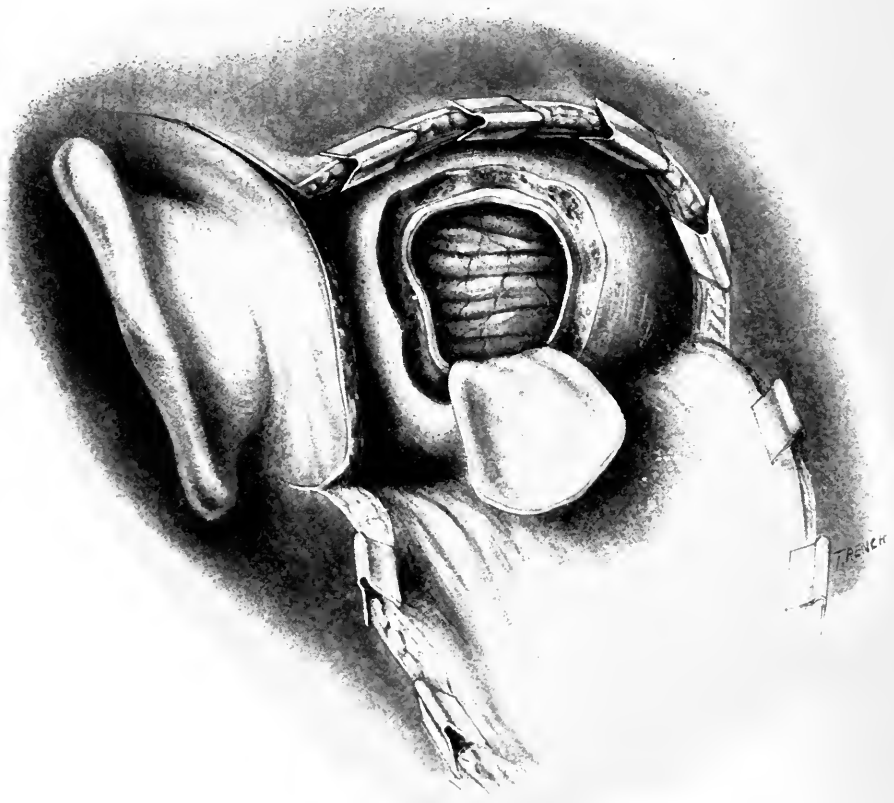


Fig. 880.

Cerebellar abscess. Formation of dural flap.

in a gauze drain and to close up as much of the wound as required. If, however, the abscess is within the cortex, the dura is split so as to form a crucial incision, but no puncture or palpation of the exposed brain tissue should be permitted. This is at variance with the common practice up to a few years ago. Iodoform gauze is inserted between the dura and the pia around the entire opening, constituting a sort of cofferdam (Fig. 877). The purpose of this procedure is to

wall off the exposed portion of the brain by the formation of an inflammatory adhesion and also to encourage a deep seated abscess to approach the surface at this position.

Furthermore, the decompression induced relieves the pressure symptoms and prevents to a great extent the progress of the destruc-

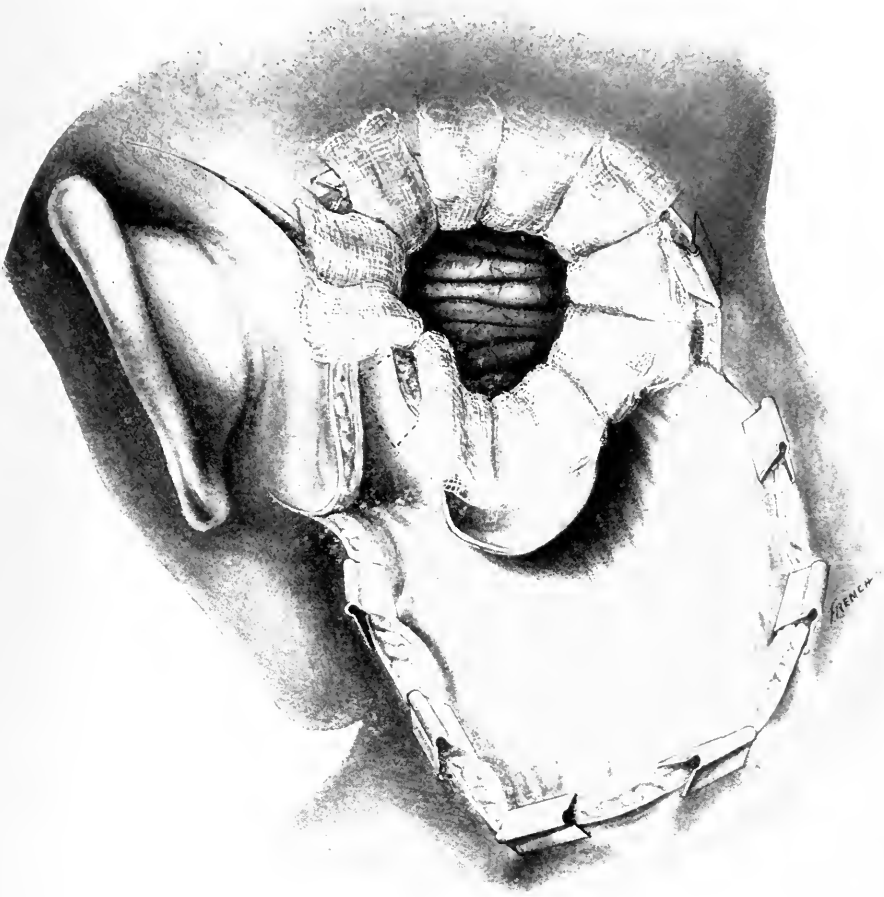


Fig. 881.

Cerebellar abscess. Formation of cofferdam.

tion for which the abscess may be responsible. If the symptoms continue or increase for forty-eight hours, the location of the abscess may be sought by using one of the various brain explorers of which Gifford's (Fig. 878) is most favored. If pus is encountered, it is allowed to escape slowly and a wick of gauze surrounded by gutta percha or cargile membrane is inserted into the abscess for drainage.

Great care must be exercised in handling the brain tissue so as to avoid too great protrusion of the brain substance with the subsequent development of cerebral hernia. A gauze pad is then applied and retained by an appropriate bandage.

Cerebellar Abscess.—If a labyrinth operation is performed coincidently, the cerebellum may be opened from the mastoid wound, the

Fig. 882.

Cerebellar abscess. Suture and drainage.

bone removal being continued posteriorly so as to expose the cerebellum as far as desired.

If no labyrinth operation is to be done, an incision of sufficient size to permit a good view of the cerebellum is to be made over the occiput, as shown in Fig. 879. The mass clamps are applied to the soft parts and by means of a hand or electric trephine, the dura is exposed externally to, and below, the sinus. The bone is removed with

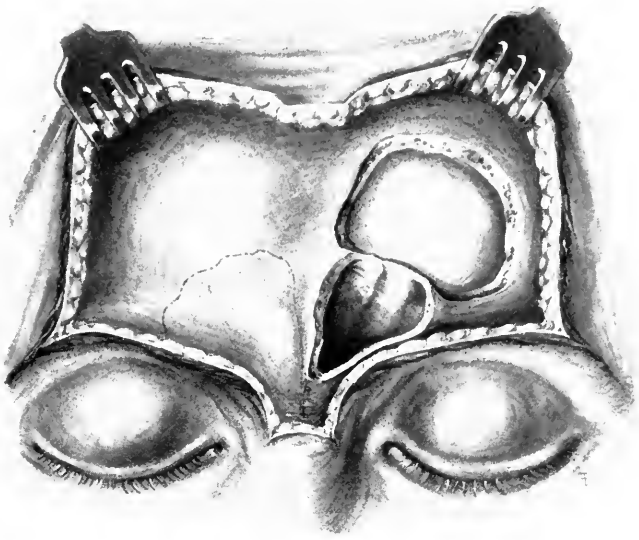


Fig. 883.

Beck's prefrontal operation. Incision, removal of anterior wall of cranial cavity and of the frontal sinus.

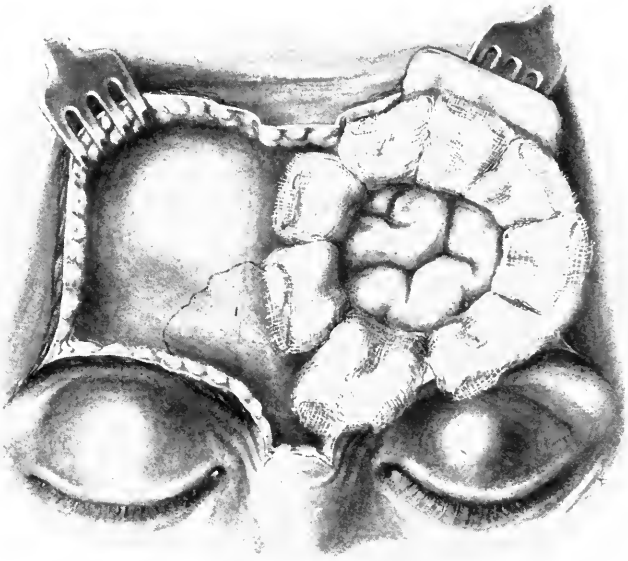


Fig. 884.

Beck's prefrontal operation. Brain cavity walled off with gauze cofferdam.

rongeurs or electric saw making an opening at least as large as a half dollar. If the abscess is extradural, nothing further is required except to provide for adequate drainage; however, extradural abscesses are uncommon in the cerebellar region.

In searching for cerebellar abscess the same procedure is used as for temporosphenoidal abscess. A dural flap is made (Fig. 880), and the dura is packed against the bone with gauze so as to wall off the exposed cerebellum as with a cofferdam (Fig. 881) and, after a few days, an effort is made to find the abscess.

The operation is completed by inserting the drainage wick, the

Fig. 885.

Beck's prefrontal operation. Suture and drainage.

skin and dural flaps being incised to permit the introduction of the wick drain, replacing the dural flap, removing the mass clamps, ligating what vessels are necessary, and suturing the soft parts around the incision (Fig. 882).

Brain Abscess in Other Locations.— In operating on brain abscesses not situated in the temporosphenoidal lobe or the cerebellum, the technic is practically the same. The skull should be opened with due regard to the focal signs and also to the danger to adjacent structures such as the middle meningeal artery, medulla, etc.

Beck's Operation on the Prefrontal Lobe.— Beck has recently de-

vised an operation for abscess of the prefrontal lobe in connection with empyema of the frontal sinus.

An incision is made through the skin and periosteum over the eyebrows and across the root of the nose (Fig. 883) as in his frontal sinus operation. The skin and periosteum are elevated from the bone covering the frontal sinus and the prefrontal lobe. The frontal sinus is then opened and its entire anterior wall and that portion of the frontal bone over the prefrontal lobe are removed. The diseased sinus mucosa is thoroughly curetted and a wide opening made into the nose by way of the nasofrontal canal. The bone of the posterior wall of the frontal sinus is next cut away as far as the roof of the sinus. The dura is then incised and the brain walled off from the field of operation by the usual cofferdam of gauze (Fig. 884). The abscess is next opened and two different gauze rubber tube drains inserted, one leading from the frontal sinus into the nose through the enlarged nasofrontal canal; the other through the supraorbital portion of the incision. The soft parts are then stitched together, and the usual bandage applied. (Fig. 885.)

Results and Accidents.—In estimating results of brain abscess, it must not be forgotten that modern methods have not achieved so much in diagnosis that the presence of the abscess is determined early enough to afford the best results, and the operation is often performed too late to prevent permanent damage to the brain. Then too, if the operation is performed while the pus focus is small, it is extremely difficult to discover the abscess. For these reasons a fatal issue is common. Besides the usual wound accidents, shock, etc., the surgeon must be prepared to meet such results as brain hernia, mental defects, and paralysis.

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