hours after death. On removing the larynx and part of the trachea, the lumen of the glottis was found to be quite closed by œdematous swelling of the walls. In colour the swelling was pale yellow and glistening; on palpation it was soft. The epiglottis and aryteno-epiglottidean folds were comparable to sausages in shape. On separation of the parts the false cords were also found to be much swollen, and the true cords red but not swollen.

As we could not get permission, a further examination of the body was not made, but there was no reason to suspect any organic mischief which might have caused the rapid œdema.

EMPHYEMA OF THE MAXILLARY SINUS,

And its Relation to Diseases of the ANTRUM OF HIGHMORE.

By Dr. MOREAU R. BROWN, Professor of Rhinology
and Laryngology, Chicago Polyclinic.

(Presented to the *American Laryngological Association* as a Candidate's Thesis.)

THE past year has been fruitful of more progress in the line of study of diseases of the antrum of Highmore than any previous time. We are only beginning to clear up some of the many occult pathological conditions which have been overlooked in the past. To be the better enabled to substantiate my arguments for the proper treatment and the better understanding of antral diseases, I will introduce my subject by a brief sketch of the anatomy of the maxillary sinus.

Anatomy.—The superior maxillary sinus or antrum of Highmore is an irregularly pyramidal cavity. The walls are quite thin, and correspond to the facial, zygomatic and orbital surfaces. The base is directed to the nasal side, and the apex extends into the malar process of the superior maxilla. The lateral walls correspond to the orbital cavity and lateral plates of the superior maxilla. Its base or inner wall which separates it from the nasal cavity consists of a portion of the superior maxilla, palate, inferior turbinated and unciform process of the ethmoid. The opening which communicates with the nasal fossa is closed in the normal state to a considerable extent by the unciform process of the ethmoid, palate, and the inferior turbinated bones, reduced by the pituitary mucous membrane to one or two small apertures.

On *post-mortem* examinations, we frequently find bony projections and laminae similar to those in the cranial sinuses, sometimes dividing the cavity into compartments more or less complete, being both transverse and perpendicular. The floor is more or less irregular, being according to Reschreiter, always below the level of the floor of the nasal cavity in men, which fact was corroborated in a number of sections made, being assisted by my associate, Dr. J. F. Oaks, to whom I am indebted for the sections from which the accompanying photographs were prepared, in which we found the same fact to hold

good in the female as well as the male skull. There are seen conical eminences corresponding to the roots of the teeth in this situation corresponding to the first and second molars. In some instances the floor of the sinus is perforated by the dental roots in this situation. Examination of a number of cadavers disclosed a pretty uniform thinness of the antral walls, more especially the orbital surface, which explains the tendency to exophthalmos and orbital abscess, where there is obstruction to the escape of pus from the ostium. We also found, in five out of twelve antræ examined, disseminated and aggregated cysts studding the mucosa, usually of the floor and apex varying in size from three to six millimètres in diameter. The capacity varies greatly. It is relatively small in the young and larger in the adult. It varies much on the two sides. We found as a result of a number of measurements of adult antræ the maximum capacity to be 15 centimètres or 3.75 drams, the minimum 8.5 centimètres or 2½ drams, making an average capacity of 11.75 centimètres or 2.87 drams.

Etiology.—Opinion has been nearly equally divided as to the relative frequency with which empyema of the maxillary sinus is dependent upon dental periostitis and intra-nasal disorders. Dentists claim that the majority of cases observed by them are due to diseased teeth, while rhinologists of late consider intra-nasal diseases as a very prominent etiological factor.

In a report of twenty cases presented to the Illinois State Medical Society on May 8th, 1890, I assigned a very prominent position in the list of causes to the condition commonly known as "catching cold." More extended observation has but served to strengthen me in this opinion. The mucosa of the maxillary sinus becomes inflamed, the inflammatory exudate is retained by closure of the ostium from hyperæmia and infiltration of the mucosa, the exudate degenerates into pus, as described by Bosworth.

The following synopsis of a case taken from my note-book illustrates this condition. Mr. X., after exposure on a cold and windy day, was confined to the house with a severe pain in the left cheek, simulating neuralgia. In a few days a discharge of fetid pus set in from the nasal cavity of the affected side. This was followed by partial stenosis due to turgescence of the inferior turbinal, which was not present at the outset of the illness.

The inference in this case seems legitimate that the inflammation of the mucosa of the maxillary sinus was primary to and independent of, if not causative to, the inflammation of the nasal mucous membrane.

A claim might be made that the antral trouble had overshadowed the nasal disturbance in the beginning. That, however, is refuted by the fact that in other similar cases a careful examination in the early stages discloses no acute disorder of the nasal cavities.

As other causes of antral diseases, I will briefly mention stenosis or closure of the ostium maxillare by intra-nasal tumours, traumatism, extension of catarrhal inflammation from the nasal and accessory cavities, suppurative degeneration of cysts, dentigerous cysts owing to error of development and eruption of the teeth, epidemic furunculosis, scorbutus,

mercurialism, infection (erysipelas and the exanthemata), foreign bodies (teeth), papillary and polypoid degeneration of the mucosa, polypi extending into or taking their origin from the margin of the ostium, neoplasms, and la grippe.

Symptomatology.—The literature of antral disease in pre-rhinoscopic times is a very meagre one. The classical symptom was distension, with more or less marked exophthalmos and nasal stenosis on the affected side. Since 1886, Ziem and others have added much to the study of antral disease with its many and various subjective and objective symptoms. As to the first mentioned symptom, distension, it is rare, except in those cases where there is complete obstruction to the exit of the pathological contents by the normal ostium, absence of the usual communication with the other accessory sinuses, or in the presence of a neoplasm or cystic tumour (Virchow).

The more common symptoms of antral disease are, viz.: (1) Pain referable to the cheek of a neuralgic character, with a sense of fullness and sometimes pressure in the direction of the orbital cavity. (2) Odontalgia, with tenderness of teeth on pressure and over canine fossa. (3) Distension, if there be stenosis of the ostium, and consequent retention of pus, with intra-orbital and supra-orbital neuralgia, or diplopia. (4) Purulent discharge from the nose, periodic in character, free from odour or fœtid, unilateral or bilateral. (5) Boyer, of Brussels, has called attention to the more free discharge of pus by holding the head downward and leaning forward. (6) Link, of Lemberg, claims to have found a new diagnostic sign in the palpation of the hard palate. (7) McBride, of Edinburgh, has directed attention to "a marked redness of the gingival mucous membrane corresponding to the affected side." (8) Anterior rhinoscopy discloses pus in one or both nares of a thick, yellow and creamy nature, which can often be demonstrated by Boyer's position to come from between the middle and inferior turbinals or middle meatus in the vicinity of the ostium maxillare.

In the so-called latent form, where the disease is insidious and of slow evolution, there may be an entire absence of symptoms in the earlier stage, or the symptoms are quite mild. The individual imagines he has taken cold, and experiences but little pain. He seeks relief chiefly from the rather free discharge which necessitates the troublesome use of handkerchiefs, and perhaps for an uncomfortable feeling of partial occlusion of the nasal passage. The formation of pus may be preceded by slight rigors. Several of my patients complained of mental disturbances, a feeling (quoting the expression of the patient) "as if they were losing their mind." One man forgot entirely, within a few hours, things which in his ordinary physical condition would have been strongly impressed on his mind; another developed a sudden impulse to suicide.

Diagnosis.—There has been of late much speculation in reference to the diagnosis of diseases of the maxillary sinus. The attention of the workers in this comparatively new field has been especially directed to one of the more constant symptoms or objective phenomena, viz., a purulent discharge by way of the normal or accessory openings of the sinus into the nasal cavity, or an artificial opening made by one of the

methods of exploratory puncture. We may have all the classical symptoms of disease of the maxillary sinus, and yet no presence of pus or, as Ruault puts it (when he was disappointed by not finding pus in a case where transillumination showed a beautiful sub-orbital umbra), "we can have opacity without empyema, but we cannot have empyema without opacity." Pus in the maxillary sinus may be the result of an acute, sub-acute, or chronic inflammatory or suppurative process, due to extension from the nasal or accessory cavities, alveolar caries or pyorrhœa. It may owe its presence to the fact that, being on a lower level with the nose and other cavities, it becomes a receptacle of pus formed in the nose or the accessory sinuses to the retention of the normal secretions, from occlusion of the ostium maxillare, which, according to Bosworth, invariably degenerates into pus, etc. We must therefore demur to the emphatic statement of Garretson, that "diseases of the maxillary sinus are for the most part simple and easy of diagnosis." We are rather inclined at the present time to voice the statement of Greville Macdonald when he says that the diagnosis of antral diseases is one of the most difficult points in the domain of pathology.

Antral diseases are much more frequent than past clinical observations have led us to believe. Gradenigo has recently given us the result of 103 autopsies, in which he discovered pus in the maxillary sinus in 18 per cent. of the number. Jeanty, of Bordeaux, has made a study of the same subject, under the title of "*Latent Empyema of the Antrum of Highmore*," tending to corroborate the above fact of its greater frequency. He has observed that there are many cases of empyema of the maxillary sinus where the presence of pus provoked no symptoms, and where the only sign was a purulent or muco-purulent nasal secretion in not sufficient quantity to attract special attention.

Differential Diagnosis.—Since the subjective symptoms vary so much, one must necessarily place more, if not full, dependence on a study of the objective signs. The more constant symptom is a purulent discharge, unilateral or bilateral. My statistics show pus in both antræ in 17 per cent. of the cases operated on. The discharge is generally simply purulent, seldom mucous or sanious; is usually of the consistency of cream, sometimes like thickened milk. In chronic cases it may have undergone a caseous degeneration. The odour varies, sometimes being unpleasant to the patient only, and again quite fœtid. The pus is usually found in the middle meatus; generally lying on the anterior and inferior part of the middle turbinal, occasionally between it and the septum. When pus is wiped away with a pledget of cotton it can be made to reappear by Bayer's position, or by pressure on the facial wall of the maxillary sinus.

The above-mentioned objective phenomena, with the possible exception of that obtained by Bayer's position, however, are common to all diseases of the frontal and anterior ethmoidal sinuses. The fœtid odour of the purulent discharge, although more or less characteristic, may be common to that of rhinitis atrophica, rhinitis caseosa, rhinitis syphilitica, hyper-secretion of the naso-pharyngeal lymphoid tissue, caries, necrosis, rhinoliths, foreign bodies, and neoplasms involving the nasal and

accessory cavities. One can differentiate it without much difficulty from the musty, sepulchral odour of atrophic necrosis. In the presence of vague or ill-defined symptoms, the absence of the classical symptoms of distension, and perhaps the purulent discharge in the so-called cases of latent empyema, we must resort to one or all of the following methods to diagnosticate the pathological conditions of the maxillary sinus, viz. :—first, transillumination ; second, sounding ; third, irrigation ; fourth, exploratory puncture. The method of transillumination, which we owe to the erudition of Voltolini, is a ready and quite reliable diagnostic measure in antral disease. It is painless of application, is not repellant to the patient, and as a matter of routine has found favour with rhinologists as a preliminary step to the more thorough surgical methods of exploratory puncture. Although the method of transillumination has proved a disappointment and embarrassment to some, yet it has been found a most useful means in the diagnosis, not only of diseases of the maxillary sinus, but of the ethmoidal and frontal sinuses as well. Although usually a rosy red light suffuses the cheek in transillumination, the diagnostic point of greatest value rests on the pupillary, sub-orbital and intra-nasal appearances.

It is now an accepted fact that the normal tissues in the naso-maxillary region, both in the young and old, are diaphanous, and when they become thickened or infiltrated as a result of inflammatory or other pathological processes the rays of light are not transmitted and umbrae result. In antral disease, therefore, the real cause of the umbrae is more likely to be the infiltration and thickened mucosa, and not necessarily the presence of pus, particularly if the latter be thin. Every sclerosed area of lupus, and infiltration or thickening of the mucosa of the ethmoidal and frontal sinuses, as well as hyperplasia of the middle turbinal, will develop intra-nasal shadows.

Gouguenheim said that transillumination was embarrassing, because it did not resolve the doubt, for on finding a beautiful sub-orbital umbra, and thereupon opening the maxillary sinus, he found no pus. The presence of an umbra, therefore, is no decided indication of pus, but it may be a positive sign of some pathological condition of the antral mucosa. Robertson found that on opening an antrum containing much pus, and which had been a decided and unequivocal umbra on transillumination, after thorough irrigation, gave the same umbra as before. This observation I have repeatedly confirmed.

We sometimes meet with cases of atrophic rhinitis in which slight and occasional pain is complained of over one or the other of the maxillary sinuses, and in which crusts form more abundantly on one side in the upper portion of the nose, near the hiatus semilunare. When these crusts are removed we occasionally see a small quantity of muco-pus, which from its location is thoroughly suggestive of having its origin in the maxillary sinus or anterior ethmoidal cells. I examined one such case with the electric light, and found a well-marked sub-orbital umbra. I opened the sinus by my method, and was very much surprised on finding no pus. The irrigation, however, gave her so much relief that it was repeated every second or third day for three weeks, when the intra-nasal symptoms had ameliorated so much that the openings were

allowed to close. Her condition improved rapidly, and her visits were discontinued in a few more weeks, with an apparent cure.

Since then I have opened the antrum of several patients suffering from a collapse of the inferior turbinals, and formation of thick, foul-smelling crusts, mostly on one side, in all of whom transilluminations showed a sub-orbital umbra, and, on exploratory puncture, no pus was found. In each case the perforation and thorough irrigation gave much relief, and progressed rapidly towards a cure. I have not had the opportunity of opening and exploring the maxillary sinus, as Robertson has done. I believe, however, he has struck a keynote in the pathology of antral disease, and that there exists some correlation between ozaena and antral disease, the exact nature of which I am not prepared to state at present.

In the light of these disclosures the method of transillumination, although not as important a means for diagnostic purposes as was believed by the sanguine Voltolini and Heryng, yet it will not be difficult to convince the more sceptical of its greater value in the diagnosis as well as prognosis of diseases of all the accessory cavities of the nose—the sphenoidal, perhaps, excepted.

These facts do not detract from the value of the measure, since the return to normal illumination in the same case, after treatment, is a ready means of determining the process of repair, and a return of the tissues to their normal transparency. It therefore becomes a most important prognostic and supplementary procedure to proper surgical treatment. Since you are familiar with the *technique* of the method of transillumination, I will call attention to what I believe to be the requisites for a successful application of the same, viz., first, absolutely dark room; second, sufficient light; third, removal of dental plate. The second method, that of sounding, is far from proving satisfactory on account of the anatomical relation of the ostium maxillare to the nasal cavity. It is a decidedly difficult operation, and, according to Schech, succeeds in about 33 per cent. of the cases. If the attempt proves successful, the presence of pus or caries may be determined. The third method, by *irrigation*, is equally difficult as the foregoing. Moldenhauer states that, by means of a syringe with a properly curved nozzle, fluid may be injected not only into, but against the ostium, finding its way into the cavities, displacing pus when present.

In the paper before referred to, which I read before the Illinois State Medical Association on May 9th, 1890, I described my method of using peroxide of hydrogen, which enabled me to satisfactorily differentiate between empyema of the maxillary sinus and other sources of pus discharging into the nose.

My method is as follows: having thoroughly cleansed the nose and cocaineized the nasal mucosa—especially of the middle and inferior turbinals—with a small hypodermic syringe having a long silver canula, bent within a quarter of an inch from the distal end to nearly a right angle, is passed into the semilunar hiatus, and a solution of peroxide of hydrogen (one part to twelve of water) is injected into the antrum. If pus is present it is displaced, and fills the nose with a white foam. That the solution has entered the sinus will be made evident by the patient

complaining of slight pain at the roots of the teeth, and a sense of fulness of the cheek. I know of no test so simple, free from danger, and easy of application, if the mucous membrane of the turbinals is thoroughly collapsed by cocaine.

The fourth method of exploratory puncture may be performed by perforating the outer wall of the nose in the lower meatus, using the stylet of Mickulicz, the trocar of Krause, the trephine of Tornwaldt, the fine trocar and canula of Lichtwitz, the aspirating syringe of Luc, or by perforation of the alveolus in the absence of or on the removal of a tooth (which latter method I will not again mention only to condemn), perforation of the alveolar apophysis, or perforation of the wall of the maxillary sinus in the canine fossa, large enough to admit of digital exploration. By the above methods of exploratory puncture we can determine positively the presence of pus, providing there are no anomalous ridges or septa, which, according to Berger and Tyrman, may divide the sinus into separate compartments.

By the last method, however, which permits of a thorough exploration by the finger as well as an electric light searcher, we can determine positively the exact pathological conditions that obtain, and supplement the same by the proper surgical treatment.

Puncture of the outer wall of the nose, by way of the meatus, has been the favourite method of Mickulicz, Lichtwitz and their followers. If made for diagnostic purposes only, barring the danger of breaking the trocar or needle, and the difficulty of the procedure on account of abnormalities of the inferior turbinal and septum, I see no objection to the method. For therapeutic purposes, however, I believe that the outer wall of the nose is a most undesirable location, for the following reasons: first, the opening does not enter the most dependent part, but from four to eight millimètres above the level of the sinus. Second, that drainage therefore cannot be perfect; third, that the mucous membrane will close the aperture in a few hours after the puncture, and that consequently at each treatment it will be necessary to search for the previous opening, or of necessity make a new one, a procedure which would be objected to by most patients. Hence, if we are to medicate or irrigate through the nose, I much prefer to do it by the natural ostium maxillare. Some writers still advocate extracting a sound tooth and perforating the alveolus from below with a drill, in the absence of the second bicuspid or first molar. Unless the perforation is made at the most dependent part, instead of at the apex of a conical eminence corresponding to the roots of the teeth, the desired object is not attained. Again, the food is much more apt, especially during mastication, to find its way into the sinus, and may prove a source of irritation and cause of persistent suppuration. I much prefer making the perforation at the alveolar apophysis. The drill enters the antrum at its most dependent part, and the cheek will cover the opening or drainage tube that I generally insert, and will prevent food from entering the sinus.

The essential feature of the treatment of diseases of the maxillary sinus, more especially when the presence of pus has been established,

consists in opening the cavity for proper drainage, thorough irrigation, and disinfection. Any other plan involves a long and tedious course of treatment, with exceedingly doubtful results.

My method of exploratory puncture, which serves for diagnostic as well as therapeutic purposes, is that of perforating the alveolar apophysis. The mucous membrane having been cocainized by the local application or submucous injection of a ten per cent. solution of cocaine muriate, a circular piece of mucous membrane is cut out with a tubular knife, below the gingivo-labial fold, between the roots of the second bicuspid and first molar. A drill worked by an electric motor is directed upward, inward and backward at an angle of about forty-five degrees with the plane of the alveolus, the drill entering the sinus at its most dependent part. The opening thus made can be enlarged by a burr of a sufficient diameter to admit of thorough irrigation and disinfection. A gold drainage tube must be so fitted that the distal end will enter just within the sinus, while to the proximal end is properly fitted a collar or clasp, by which it is made fast to a tooth, thus holding it securely in place.

The after treatment consists in daily irrigation of the cavity with an antiseptic solution (preferably a saturated solution of boric acid), and followed by the insufflation of iodoform, iodol, aristol, or europen.

In cases where suppuration persists beyond a reasonable time, I enlarge the opening by a trephine or tubular knife, and explore the cavity with a probe. If there is much thickening of the mucosa, or the exploration discloses caseous pus, I curette thoroughly, following it by irrigation, and packing with iodoform gauze for twenty-four hours, which is then removed, and, after irrigation, one of the above powders (preferably the europen and iodol mixed) is insufflated, and repeated every second day. I am quite favourably impressed with the method of Robertson, of perforating the anterior wall of the maxillary sinus in the canine fossa, of sufficient size to make a digital exploration, and to use an electric light searcher.

Since it seems desirable, in those chronic cases of persistent suppuration, to thoroughly explore the maxillary sinus, the above radical measure will meet the approval of many, because we are thereby enabled to submit the entire field of operation to a searching examination and effective surgical treatment.

34E, Washington Street, Chicago.

ANNOTATION.

ACROMEGALY.

As the name proposed by Pierre Marie, who only so recently as 1886 first clearly isolated the disease, indicates—(ἀκρα, end; μεγάλη, big)—acromegaly is characterized by enormous increase in size of the extremities of the body. The hands and feet undergo a remarkable hypertrophy, which, in the majority of cases, is also well marked in the case of the