Some points in the symptomatology, pathology, and treatment of diseases of the sinuses adjacent and secondary to the orbit / by Charles Stedman Bull.

SOME POINTS IN THE SYMPTOMATOLOGY, PATHOLOGY, AND TREATMENT OF DISEASES OF THE SINUSES ADJACENT AND SECONDARY TO THE ORBIT.[1]

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The subject of this paper may be said briefly to be the "Orbital Symptoms and the Treatment of Sinus Disease." The location and extent of sinus disease adjacent to the orbit, and involving it secondarily, frequently decide not only the question of operative interference, and the nature and extent of the operation itself, but also the point whether any operation is justifiable.

The frontal sinus, the ethmoid cells, the sphenoidal sinus, and the maxillary antrum are often the seat of disease which subsequently extends to the orbit. It is a well-known fact that tumors of the bones of the skull, or of the sinuses contained within these bones, may extend in every direction from one sinus or labyrinth to another, and often exist for a long time and reach a large size before appearing in the orbit. The growth of these tumors is usually slow and insidious, though occasionally very rapid. Extensive disintegration of the ethmoid, sphenoid, and superior maxillary bones, from tumors starting in their respective sinuses, may have already occurred before the presence of such a growth is manifested in the orbit by the usual signs of displacement or protrusion of the

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eyeball, pain on pressure along the orbital walls or directly backward, and the visible or tangible presence of the growth itself within the orbit.

The Frontal Sinus.—With the exception of the true osteoma, the frontal sinus is rarely the seat of tumors primarily. The most frequent diseases met with here are of an inflammatory character, viz., mucocele and empyema, the latter being the more common of the two. Both of these diseases may be acute or chronic, the latter type forming the great majority of the cases. The symptoms are practically the same in both, as a chronic mucocele usually becomes an empyema.

Abscess of the frontal sinus is usually an affection of adult life, and does not occur in childhood, as the sinuses are not developed at this period of life. It is met with oftener among men than among women, probably because the sinuses are more developed in men than in women, the infundibulum is wider, and communicates more directly with the external air through the nasal fossæ, and hence are more exposed to the entrance of infectious agents. The left frontal sinus is more frequently attacked than the right, but the reason for this is unknown. The suppurative process may begin in one sinus, perforate the bony septum between the two sinuses, and involve the other sinus secondarily.

Symptoms: In chronic empyema there may or may not be supra-orbital pain, which is sometimes intense. There are, however, many cases in which there is never any pain during the development of the abscess. In the acute form of the disease there is always severe pain over the eyebrow. If the process is confined to the frontal sinus, there is usually no other symptom until late in the disease. If there is sensitiveness on pressure over the frontal boss, swelling along the lower surface of the supra-orbital margin and inner wall of the orbit, and displacement of the eyeball

downward and outward, it is probable that the disease has extended to the ethmoid cells. If there are coryza, ozæna, and a purulent discharge from the nostril, the nasal meatus has become involved, and the diagnosis is certain. Distention of the frontal sinus can generally be easily recognized by the site of the swelling. It is higher up and farther back than the site of the lacrymal sac, and it has hard, resisting walls. Occasionally a spontaneous opening occurs by absorption of the bony walls, and the symptoms are then those of a cyst. The orbital symptoms usually advance slowly, though occasionally we meet with a very rapid progress. But there are cases in which a sort of intermittence in these symptoms appears. If the swelling of the mucous lining closes the fronto-nasal canal temporarily, a violent supra-orbital pain will be suddenly produced by the accumulation of fluid within the sinus. Sometimes violent neuralgic attacks occur, usually at the same hour in the morning. These attacks are characterized by continuous pain with severe exacerbations, radiating around the orbit and within the zone of distribution of the ophthalmic branch of the trifacial. They are accompanied by injection of the conjunctiva, lacrymation, and photophobia. After several hours the attack subsides. These patients have usually had "grippe" with rhinitis and profuse secretion. At other times I have seen the attack accompanied at its height by paresis of accommodation.

Empyema of the frontal sinus is very frequently preceded or followed by suppuration of the maxillary antrum. The pus from above may flow into the middle nasal meatus, into which opens the "ostium maxillare," and there set up a similar suppurative inflammation, and the flow of pus from the antrum with the attendant symptoms may often be the first signs of disease of the frontal sinus. In rare cases, however, it would seem as if the disease began in the antrum

and extended upward to the frontal sinus. These cases are generally due to an attack of "grippe."

Etiology: The etiology of suppuration of the frontal sinus is somewhat obscure. The predisposing causes are syphilis, tuberculosis, erysipelas, typhoid fever, scarlatina, influenza, inflammatory lesions and polypi of the mucous membrane of the nasal fossæ, and wounds of the superior orbital margin. Both syphilis and tuberculosis may produce an osteo-periostitis of the frontal bone, followed by extensive caries and necrosis and profuse suppuration, and the frontal sinus may be invaded by the pus from without. In erysipelas, the disease process extends through the mucous membrane of the nasal fossæ to the infundibulum, and thence to the frontal sinus. But in order that suppuration should occur in a frontal sinus, there must be an entrance and proliferation of pyogenic microbes in the sinus. The latter may penetrate directly into the sinus through the nasal fossæ, with or without infection of these fossæ, either by way of the infundibulum or by the lymphatics. The mucous membrane of the sinus swells and becomes thicker, and thus the calibre of the infundibulum is narrowed and eventually obliterated, and then the pus collects in the sinus and gives rise to the usual symptoms. When a mucocele becomes an abscess, there must have been present a second element of an infectious nature.

Some assistance in diagnosis is occasionally gained by exploration of the sinus by transillumination with an incandescent lamp, the lamp being applied just beneath the orbital arch. The diagnostic value of this method is, however, *nil*, unless it prove positively the presence of pus in the sinus. If the latter exist, the area corresponding to the extent of the sinus, which should appear illuminated, is in shadow, owing to the presence of pus. Transillumination is of much less value as a means of exploration of the frontal sinus than it is for the maxillary antrum. This

method of examination as an aid to diagnosis is very uncertain. It is well known that the sinuses vary in size and shape in the same individual. One sinus may be completely wanting, or entirely filled by a bony tumor. The dimensions of the frontal sinus are very variable, and they sometimes communicate with each other, or with the ethmoid, or with the orbit. All these facts contribute to the uncertainty of the results obtained by transillumination and to the possibility of a faulty diagnosis.

Treatment: An abscess of the frontal sinus having been recognized, the indications are to open it as soon as possible, drain it carefully, inject bactericidal solutions, and put a stop to the suppurative process. In some rare cases of acute empyema, it may be possible to open the sinus internally by enlarging the infundibulum through the nose with a curette, and thoroughly irrigating the sinus by means of a catheter. But this is an extremely difficult procedure, as every one knows who has tried it, and never entirely satisfactory. Moreover, the opening of the ethmoid cells, which is often necessary in these cases, through the nasal meatus, is a difficult and dangerous undertaking. Hence it seems fair to state that the attempt to cure an empyema of the frontal sinus by enlarging the infundibulum in the nose, and by irrigation of the sinus from the nasal fossa through the fronto-nasal canal, is justifiable only in very recent cases and where the natural conformation of the nose admits of such interference.

In all chronic cases, and in most of the acute cases, the frontal sinus should be opened externally by the Ogston-Luc method. The region of election is at the lowest part of the anterior wall of the sinus, immediately above the root of the nose. The external incision should be from an inch and a half to two inches in length, and should extend far enough toward the opposite side to facilitate an opening into the other sinus, if such a procedure prove to be necessary.

The operation is entirely devoid of danger, and if properly done always succeeds in effecting a cure. Luc prefers to open the sinus by means of the gouge and mallet, and advises that after the removal of the first splinter or scale of bone, the deep or posterior wall of the sinus be protected by a metal shield against any possible danger of injury from the further use of the gouge. I have found it equally easy to use at first a small trephine, half an inch in diameter, and then to enlarge this opening by the gouge. The dimensions of the opening into the sinus depend somewhat upon the extent and chronicity of the lesion, but should always be large enough to admit of free exploration of the entire sinus. After evacuation of the pus, all fungosities and osteophytes should be thoroughly removed by the curette. To this end it is better to take away the entire anterior wall of the sinus. The septum between the sinuses should then be examined, and if found perforated, it should be removed by the gouge, and the cavity of the opposite sinus thoroughly curetted. To do this, it may be necessary to open through the anterior wall of this sinus, which can be done in the same way by extending the external incision beyond the median line.

In view of the somewhat frequent occurrence of abscess of both sinuses, some operators have advised opening the frontal bone in the median line, and extending the opening toward each sinus, and I have done this recently with very satisfactory results in one case.

In most of the chronic cases it will be found necessary to open freely into the ethmoid cells, and in every case a large, free opening must be made through the fronto-ethmoidal canal into the nasal fossa of the corresponding side. The whole cavity is then to be washed out with a solution of mercuric bichloride (1 : 1,000), the irrigation being kept up until the fluid runs freely from the nose. A rubber drainage tube is

then introduced and carried from the nasal cavity well up to the bottom of the frontal sinus, and the irrigation again repeated. The external wound is then to be completely closed by sutures going through the entire thickness of the skin, and the usual antiseptic dressings are to be applied. The immediate closure of the external wound shortens the period of healing and reduces the ultimate cicatricial deformity to a minimum.

In some cases it will be found that nature has caused a fistulous opening, which is usually found just beneath the superior orbital arch, at the supero-internal angle of the orbit. Luc states that the presence of this fistulous tract should not contraindicate the performance of the above operation. After the latter has been done and the sinus completely cleaned out, the fistulous tract may be treated in the usual way by incising the tract throughout its entire length, and then freshening the edges and stitching them together. This seems sound advice, though I have had no experience with fistulous openings into the frontal sinus.

All attempts to relieve or cure chronic empyema of the frontal sinus by intra-nasal treatment alone should be regarded as futile. In view of the frequency with which both frontal sinuses are involved in the process, Moure suggests making a horizontal incision in the usual place, but extending across the glabella to the opposite side, and then making a vertical incision upward in the median line, thus admitting of the dissection of two flaps of skin, and exposing the anterior wall of both frontal sinuses, which may then be opened in the usual way.

Tumors of the Frontal Sinus.—The only tumor originating in the frontal sinus which is encountered with any degree of frequency is the osteoma or ivory exostosis. By its pressure it causes absorption of extensive portions of the bony wall, and eventually an opening not only into the cavity of the orbit, but also

into the anterior fossa of the skull. Its etiology is extremely obscure. It has been attributed to syphilis, gout, rheumatism, and traumatism, but it is well to look for the predisposing cause at least in an abnormal embryonic condition of the bone cells.

Symptoms: Osteomata always grow very slowly and painlessly. They are never sensitive on pressure, and when they cause pain it is either from pressure on some nerve or from some localized inflammation. As the tumor grows, the eyeball is displaced, and there may even be such extreme exophthalmos that the eyelids cannot be closed over the eye, and the cornea ulcerates. There may be marked disturbance of vision, and the usual ophthalmoscopic evidences of neuroretinitis and atrophy of the optic nerve. The diagnosis is made from the location of the tumor, its extreme hardness, its immobility, and its direct connection with the bone. It may be confounded with distention of the frontal sinus or of the ethmoid cells. The prognosis is favorable if the tumor has not encroached upon the anterior fossa of the skull.

Treatment: This consists solely in its operative removal. Owing to the extreme hardness of the tumor, its removal is very tedious and a matter of considerable difficulty. If the tumor is of great size and has probably involved the anterior cerebral fossa, it may be wiser not to attempt its removal, owing to the danger to life. The periosteum must first be incised and carefully stripped from the tumor for some little distance beyond its base in all directions. Then a narrow groove should be cut with a chisel or gouge and mallet around the base, the blows with the mallet being made gently and somewhat rapidly until the tumor is loosened. Then a gentle rocking to and fro will usually suffice to detach it. If the tumor be found of ivory hardness, small holes may be drilled in it by means of a dental engine, and the operation subsequently completed with the chisel and mallet.

The usual antiseptic dressings are then applied, and suppuration rarely occurs.

The Maxillary Antrum.—Diseases of the antrum are by no means so rare as has been supposed, and this is probably due to the fact that the antrum has not always been carefully examined. The inflammatory diseases most frequently met with here are mucocele and empyema, the latter being by far the more common. The subjective symptoms are practically the same in both.

Empyema of the Antrum.—Pus may collect in the antrum as a consequence of inflammation extending from the nose, or of empyema in the sphenoidal antrum, ethmoid cells, or frontal sinus, or it may originate in the antrum itself. If the collection of pus be considerable, it may flow into the nasal meatus through the ostium maxillare, and out through the nostril or back into the pharynx. The most common source of purulent inflammation in the antrum is disease of the teeth or caries of the alveolar arch, especially of the posterior molars, forming first subperiosteal abscess, and then abscess of the antrum.

Symptoms: Pain is the most constant symptom, though, if drainage be free, it may be slight or entirely absent. It is located in the cheek, is frequently periodic in character, and is often accompanied by an unpleasant odor from the decomposition of retained secretions. The escape of pus from the antrum is positive evidence of disease. The orbital symptoms are more or less displacement or protrusion of the eye, orbital cellulitis and chemosis, loss of vision from neuro-retinitis or atrophy, due to pressure on the optic nerve and obstruction to the return circulation, and panophthalmitis from strangulation of the tissues. Many cases of empyema are so slow and insidious in their progress and so slight in their symptoms, that their existence is ignored by the patient, until some violent retro-ocular or orbital inflammation or some grave

cerebral complication demands a careful investigation of the cause. There are other cases in which, in the course of a maxillary empyema of dental origin, are manifested symptoms not due to any visible involvement of the cellular tissue of the orbit, such as narrowing of the visual field, atrophy of the optic disc, and irido-choroiditis with opacities of the vitreous. This makes it necessary to consider how intimately connected are the maxillary antrum, the sphenoid antrum, and the ethmoid cells with each other, and how comparatively near each other in the nose are the openings of these sinuses. Masked by the readily recognizable symptoms of empyema of the maxillary antrum, a similar condition in the sphenoid and ethmoid may be overlooked. Lesions in these sinuses may explain a certain number of orbital complications which have hitherto been attributed to reflex action. It is necessary to exclude disease of the sphenoid or ethmoid sinuses before we can make a positive diagnosis of empyema of the maxillary antrum alone. Owing to the ostium maxillare being the lowest of the three openings, the antrum may frequently become the receptacle for pus coming from the other sinuses, and guided into it by a semilunar fold of mucous membrane in the nose.

The extension of the disease from the antrum to the orbit may take place theoretically in three ways, viz.: (1) By direct propagation through the bony roof of the antrum. (2) By means of the lymphatics. (3) By means of the veins. The first and by far the most frequent channel through the floor of the orbit occurs by osteo-periostitis. The second would affect the eye and orbit by means of a retro-ocular inflammation. The third would cause an orbital cellulitis without any periostitis. In the great majority of the cases the orbital cellulitis is the result of an osteo-periostitis of the orbital floor, which is very thin and often shows openings, through which the infection is propagated

directly from the antrum to the orbit. If the case pursues an acute course, we have a train of symptoms which is easily followed, beginning with dental caries, inflammation of the sinus, closure of the ostium maxillare, symptoms of pus retention, necrotic osteitis of the roof of the antrum, orbital cellulitis, and then, if the case is not radically treated, osteitis of the roof of the orbit, abscess of the brain, and death. If the inflammation is a chronic one, its course is much slower and more insidious, until a marked failure of vision reveals an optic neuritis or atrophy due to retro-bulbar neuritis.

We are sometimes aided in our diagnosis of antrum disease by employing the method of transillumination. This method has very marked limitations, but is more useful and gives more real diagnostic aid in disease of the maxillary antrum than in affections of any of the other sinuses adjacent to the orbit. Certain possibilities should not, however, be forgotten. The typical triangular pyramidal form of the antrum is exceptional. The floor of the sinus may be on a lower plane than the nasal fossa, by excessive absorption of the alveolar border. The antrum of the other side may be higher, and the illumination might lead us to diagnosticate an abscess in the antrum which stood higher. One sinus may be entirely absent or filled by a solid exostosis.

The examination of the antrum by illumination must be made in a dark room. The method devised by Heryng, improved by Vohsen, and still further improved by Luc and Escat, is probably the best. A four—or five—candle-power lamp, connected with a battery and a rheostat by means of ordinary insulated wires covered with rubber tubing is placed in the mouth, the lips are closed over the connecting rubber tubes, and connection is made. If the antrum is normal, the face takes on a ruddy glow, the brightness differing in spots according to the thickness of the

solid parts of the face. The brightest spot will be at the lower margin of the orbit, where the wall is thinnest. If the light encounters pus, or polypi, or solid tumors, there will be more or less darkening of the corresponding side of the face. Burger attaches much importance to the illumination of the eye by the transillumination, the signs of which are a red glow from the pupil. The Heryng method of illumination is valuable only when the corresponding nasal fossa is perfectly healthy, and contains nothing to intercept the luminous rays. The method of Escat, the retro-maxillary illumination, when carefully and properly done, is a much better way of lighting up the maxillary antrum, for it does away with any possible impediment to the passage of the rays through the nose. This illumination "by contact" requires a special lamp of about 3.50 to 4 volts, enclosed in a cylindrical metal capsule, which is open on one of its sides, and fixed at the level of the antrum by a metallic arm. The apparatus in the form of a pipe is fastened to the handle of the galvano-cautery, which connects it with a battery of two accumulators, provided with a rheostat. To illuminate the sinus, the lamp must be carried into the retro-maxillary fossa, the posterior extremity of the superior gingivo-buccal furrow, behind the last molar. The furrow is open below and closed behind by a reflection of the mucous membrane from the maxillary tuberosity to the internal surface of the ascending ramus of the inferior maxilla. To give this retro-maxillary fossa its greatest dilatation the mouth should be half open and the dental arches separated anteriorly about one centimetre. The cheek is pushed away from the jaw by a tongue-depressor, so as to expose the last upper molars, and the lamp is passed along the alveolar arch as far as the last molar, the stem being horizontal and the lamp open upward until beyond the malar prominence. The handle is then raised and the lamp enters the retro-maxillary

fossa. The cheek is then relaxed, the handle of the instrument is lowered about 45°, the mouth is gently closed, and a slight rotation is given to the arm so as to turn the lamp toward the posterior face of the superior maxilla. The current is then turned on and the examination made. If the sinus is normal it is illuminated, which is indicated by two luminous red spots; a crescentic patch corresponding to the lower lid, and a lower, larger, but less brilliant patch corresponding to the "face jugale" of the antrum. If disease of the antrum be present the illuminated patches are absent.

Treatment: The diagnosis of empyema having been made, the only method which promises a cure is to open the antrum, carefully remove its contents, employ frequent irrigation with an antiseptic solution until pus ceases to be secreted, and then endeavor to close the artificial opening. The best method of operating is that suggested by Luc, and consists in making a large opening in the sinus at the level of the canine fossa. The sinus is then curetted and irrigated with a strong solution of zinc chloride. This large opening is, however, only temporary, and is made to serve a double purpose: first, to empty the sinus of its contents and facilitate the curetting, and secondly to allow of the formation of a free opening between the antrum and the nasal fossa for the purpose of drainage. The latter step of the operation is done as follows: The cheek is pulled away from the superior maxilla; a circular perforator, run by a motor, is introduced and directed against the inner or nasal wall of the antrum anteriorly and immediately above the level of the floor of the antrum. This perforator or trephine has a diameter of 9 mm. In some cases the opening is better made with gouge and mallet. The opening having been made in the inner wall, a curette is introduced through this hole into the nasal cavity, so as to clear away any floating folds of

mucous membrane. A short, bulbous-pointed style is then introduced through the same opening, and, its point being guided by the little finger in the nose, it is pushed into the nasal fossa. A strong silk cord is then fastened to the eye of the style, and the instrument is then drawn out in the reverse direction. This pulls the silk cord from the nose into the antrum, and thence out through the buccal opening. To the buccal extremity of this silk cord a drainage tube is attached, and the cord is then again drawn through the antrum and through the opening into the nasal fossa, and out through the nose, and draws the drainage tube after it. This is pulled through until one end of the drainage tube is in the antrum and the other in the nasal fossa. The cavity of the antrum is then wiped dry and powdered with iodoform. The lips of the wound opening into the antrum from the mouth are then closed from behind forward by fine catgut sutures. The antrum should be irrigated several times daily, after the wound in the buccal cavity has throughly healed, with a solution of mercuric bichloride (1 : 2,000), or a saturated solution of boric acid. The drainage tube may be removed from the fourteenth to the twenty-first day. When the patient uses a handkerchief the antrum is generally emptied during the act. All suppuration from the antrum usually ceases in about six weeks. It is easy to irrigate the antrum, even after the withdrawal of the drainage tube, by means of a short curved catheter. Unless the nasal meatus is kept perfectly healthy, empyema of the antrum is obstinate in healing.

Tumors of the Maxillary Antrum.—Pathological neoplasms of the antrum are difficult to recognize if they have not already caused distention of the cavity. The symptoms are pain in the teeth of the upper jaw, a dull ache in the region of the antrum, discharge of pus and blood from the nose in lying down, and more or less epiphora. The pain which may be in the re-

gion of distribution of the infra-orbital nerve, is not apt to appear until the tumor has attained considerable size, and has more or less completely filled the antrum; the distention of the walls of the cavity causing the pain by pressure on the nerve twigs. As the tumor grows, the walls of the antrum are gradually absorbed, and the tumor extends into the nose by extensive enlargement of the ostium maxillare, or through the roof of the antrum into the orbit, or in rare cases through the anterior wall of the antrum into the buccal cavity. When the growth enters the orbit through its floor, the eyeball is displaced upward and outward or upward and inward. These tumors of the antrum gradually extend into all the neighboring cavities. They early involve the nasal meatus, thence extend into the spheno-maxillary and palatine fossæ and pharynx, and finally perforate the base of the skull. They usually involve the orbit later, and sometimes extend into it from the ethmoid cells, even before the floor of the orbit is perforated. In no case is it possible to diagnosticate a tumor of the antrum early in its development.

The treatment of these tumors consists either in extirpation of the growth or in complete resection of the superior maxillary and other bones which may be found diseased.

The Nasal Meatus.—The intricate nature of the nasal meatus, with its many folds of mucous membrane, its spongy bones, its intimate connection with all the adjacent sinuses, and its proximity to the orbit, is sufficient cause for the extension of disease from this region to the orbit, and render necessary a thorough examination into the condition of the meatus in all cases of suspected morbid growths. The most common affection met with here is a purulent rhinitis, either independent in itself or secondary to empyema of the maxillary antrum or of the ethmoid and

sphenoid sinuses. Prompt curetting of the entire nasal meatus, with removal of the spongy bones in whole or in part, is the only treatment which will lead to a cure. Unfortunately a purulent rhinitis is secondary usually to a purulent process in the ethmoid cells or the sphenoid antrum, and the treatment must be primarily directed to these cavities.

Polypoid growths in the nose may extend into the ethmoid cells and produce secondarily many of the symptoms of orbital disease. These growths often possess a partly cartilaginous consistence. It has never been definitely determined whether all the visual defects met with in connection with polypi of the nasal meatus are caused by pressure of the after-growth on the optic canal or in the ethmoid cells, and thence against the inner wall of the orbit. Whatever the cause, the loss of vision is due to pressure on the optic nerve.

Tumors of the Nasal Meatus.—Tumors of the nasal and pterygo-palatine fossæ may enter the orbit through the infra-orbital fissure. They cause neuralgia of the infra-orbital or posterior alveolar nerves. The orbital portion of the tumor may divide into two branches; one involving the orbit, and the other extending into the cranial cavity through the supra-orbital fissure. They eventually extend into all the neighboring cavities.

In the treatment of these growths, it is absolutely necessary that they should be completely extirpated early in their development, together with all the surrounding tissues, including the bony walls of the cavities involved. If a malignant tumor has already invaded the deep bones of the face and base of the skull, including the cavities contained within them, the case may be regarded as hopeless, and while an operation may relieve the patient temporarily, it undoubtedly hastens the fatal termination.

Diseases of the Ethmoid Cells.—The cells of the

ethmoid form a pneumatic labyrinth which increases in width from above downward. The ethmoid anteriorly is connected with the lacrymal bone, and posteriorly often with the orbital portion of the palate bone. The posterior ethmoid cells and the sphenoid antrum open into the superior nasal meatus. In rare cases the ostium maxillare is absent, and the maxillary antrum communicates with the ethmoid cells and sphenoid antrum. Occasionally the lateral ethmoid cells project markedly toward the orbit.

The symptomatology of disease of the ethmoid labyrinth is always perplexing, and a diagnosis is thus rendered extremely difficult. In inflammation of the ethmoid cells, positive subjective symptoms are wanting. In mucocele the symptom is a gradual, painless development of a tumor on the inner wall of the orbit, which later shows signs of fluctuation, and the eyeball is displaced forward, outward, and sometimes downward. Until fluctuation appears, it may be confounded with an osteoma growing from the inner wall of the orbit. Puncture or incision of the tumor will decide the diagnosis. Ectasia of the ethmoid cells occurs mainly in young persons. From a cosmetic standpoint these cases should be treated early in their course, before the ectasia becomes too large; for in the latter case the posterior part of the orbital wall cannot be replaced, and there is more or less deformity. In empyema of the ethmoid cells, whether acute or chronic, the periosteum suffers also, and this may lead to necrosis. In caries of the lamina papyracea, the subjective symptoms are dull pain, increased by pressure in the neighborhood of the diseased bone and vertigo. Redness of the lids at the inner canthus may be present. A hard tumor may be felt at the inner canthus, and later occur fluctation, strabismus, diplopia, exophthalmos and limitations of motility of the eye, and impaired vision. Pus found in the region of the middle turbinated bone must come from the poste-

rior ethmoid cells. If the empyema is of an acute character, symptoms will appear in the nasal fossæ and orbit, such as difficulty of respiration through the corresponding nostril, a nasal tone to the voice, more or less epistaxis, and headache. If no relief is given by way of the nasal fossæ, the disease will invade the orbit and cause the symptoms above mentioned. If the empyema be chronic, the ectasia of the labyrinth may be confounded with a neoplasm in the ethmoid.

The etiology of empyema of the ethmoid is obscure, sex and age seeming to exert no influence. The nasal fossæ contain a large number of microbes, which may easily enter the ethmoid cells and there multiply and set up an inflammatory process. Traumatism of the nasal and orbital bones may also set up an empyema. The primary cause of such inflammation is the presence of some infecting agent, which sets up an irritation, and causes a thickening of the mucous membrane of the labyrinth, which subsequently ulcerates and exposes the bone. This becomes carious, with the formation of sequestra, and the labyrinth is destroyed, or, if the process is not destructive, neoplastic tissue is formed with thickening of the wall of the ethmoid cells and exostosis.

Transillumination as a means of diagnosis in disease of the ethmoid cells is uncertain and perhaps dangerous. It is uncertain because anatomical anomalies exert an effect on the transmission of light. It is dangerous because it may lead to unjustifiable operations. The sinuses may vary both in shape and dimensions, not only in different individuals, but also from one side to the other in the same person. As abnormal sinuses are more numerous than typical cases, transillumination cannot here render any great service. It may help to confirm a diagnosis already made, but it should not be relied upon.

Treatment: In all cases of empyema, the cells should be opened, the pus evacuated, and all frag-

ments of carious bone should be removed. A free opening should be made through the nasal meatus into the ethmoid cells with a curette, and if the swelling has presented in the orbit, it should be freely incised through the conjunctiva, and free irrigation from the orbit through the ethmoid and into the nose should be carried out. A drainage tube should then be introduced from below upward into the ethmoid cavity, and daily irrigation should be kept up until all discharge ceases.

Tumors of the Ethmoid.—Neoplasms of the ethmoid are usually of the sarcomatous or myxo-sarcomatous type, though occasionally other varieties are met with. A morbid growth confined within the ethmoid cells gives rise either to no symptoms at all, or merely to headache, paroxysmal in character. The orbital symptoms are the same as those of tumor of the orbit. The motility of the eyeball is limited. The vision may be slightly affected, or there may be complete blindness. The visual field may not be involved. If the tumor has entered the nasal meatus, the mouth is more or less open, the speech is nasal, and later there is loss of the sense of smell. There may be more or less dropping of clear fluid from the nose, even in the case of solid tumors, owing to a communication between the upper wall or roof of the ethmoid cells and fissures at the base of the skull. There may also be orbito-palpebral emphysema, and hemorrhage from the nostrils on one or both sides.

Enchondroma of the ethmoid is very rare, and always starts from the base of the skull.

Polypi originating in the ethmoid cells and confined within these limits are relatively rare, but nasal polypi usually start from the ethmoid. Polypi of the nasal meatus may conversely penetrate into the ethmoid labyrinth.

Fibroma originating in the ethmoid has been observed but once.

Osteoma of the ethmoid usually begins in some neighboring cavity, and the first objective symptom is a very hard tumor just behind the inner canthus, which is followed by exophthalmos and diplopia. The tumor also usually involves the nasal meatus. The vision may be normal or impaired. There may be papillitis of the optic nerve, and suppuration of the cornea from inability to close the lids completely over the eye. If an osteoma be encapsulated, it may easily be separated from its bony attachments. These osteomata never tend to penetrate the cranial cavity, and their operative removal is not, as a rule, difficult. The only treatment for tumors of the ethmoid bone and cells consists in their radical removal. Further remarks upon the kind of surgical interference and its prognosis will be found at the end of this paper, to which special attention is invited. The surgical attack should always be made through the orbit.

Diseases of the Sphenoid Antrum.—Some curious anomalies are often met with in the sphenoid bone. The anterior, posterior, and lateral walls of the antrum are sometimes very thin. The anterior wall may be entirely wanting, and then the sphenoid antrum opens into the ethmoid cells. The anatomical relations between the ethmoid and the sphenoid are so intimate that any chronic process starting in either bone is almost certain to involve the other at a comparatively early date.

The subjective symptoms of empyema of the sphenoid antrum are the same as those of empyema of other neighboring cavities, though the headache is located at the back of the head, and the ocular lesions are either purely functional or affect the optic nerve back of the eyeball. Disease of the body of the sphenoid, whether ending in caries or not, may cause not only exophthalmos but also disturbance of vision, on account of the close proximity of the optic canal. Pain occurring in the course of disease here may show it-

self in a totally different part of the area of influence of the trifacial nerve, and thus lead to a faulty diagnosis. Attempts have been made to treat the interior of the sphenoid antrum through the nose, but the position of the opening into the nose is so variable, and the use of the rhinoscopic mirror is so unsatisfactory, that such attempts have usually been abandoned. Transillumination is of no practical value here in assisting us in a diagnosis. Inasmuch as the ethmoid cells are usually involved in abscess of the sphenoid antrum, if entrance through the nose proves futile it is better to open the ethmoid through the orbit, clean out the contents, and then penetrate the sphenoid antrum and thoroughly curette its interior.

Tumors of the Sphenoid.—So long as a new growth is limited to the sphenoid antrum, either the subjective symptoms are entirely absent, or there may be severe pain in the head, usually in the occipital region. If the process extends to the adjacent structures, symptoms arise which point to the probability that the sphenoid bone is the seat of the disease, such as blindness due to compression of one or both optic nerves, and the visible or tangible presence of the growth in the nose, ethmoid, orbit, or skull. The entrance of the growth into the cranial cavity may occur without any subjective symptoms, or there may be sudden, severe headache. If the progress of the growth is very rapid, meningitis or cerebral abscess will result. The ophthalmoscopic symptoms are either papillitis or atrophy of the optic nerve due to perineuritis and pressure of the swollen nerve-sheath on the optic nerve fibres. In some cases the pressure is exerted on the nerve in the optic canal. Tumors here may perforate the middle fossa of the skull without causing blindness. If an orbital tumor rapidly causes blindness, and the latter starts from the temporal side of the field and leaves the region of the macula lutea unaffected to the last, and if at the same time a growth

appears in the nose, it is probable that the tumor began in the sphenoid antrum.

Polypi may develop in the antrum independently, and may penetrate the roof and enter the middle fossa of the skull, and even cause meningitis, without giving rise to any disturbance of vision.

Osteomata of the sphenoid are sometimes developed from the embryonic remains of cartilage. They tend to penetrate the cranial cavity, and by compression of the optic nerves in the optic canals early lead to blindness of both eyes. The same symptoms may also be produced by hyperostosis and exostosis of the sphenoid.

Enchondroma and carcinoma of the sphenoid are exceedingly rare diseases.

Sarcoma is by far the most frequent morbid growth met with here. In sarcoma of the base of the skull it is exceedingly difficult to determine the point of origin. The general symptoms are loss of sight, hearing, and smell in the order named; facial paralysis and neuralgia, vertigo, somnolence, vomiting, loss of memory, hemiparesis, and loss or impairment of speech.

A few words in conclusion in regard to neoplasms of the deep sinuses of the face. Extra-orbital tumors originating in the bones or sinuses adjacent to the orbit form a class of cases which are the most serious and desperate of all. The prognosis in these cases must be regarded as absolutely bad from the beginning. No matter where the growth originated, all the deep bones of the face and their communicating sinuses eventually become involved. By emptying the sinuses and extensive exsection of the diseased bones, we do not succeed in arresting the progress of the malady, and subsequent operations become necessary, which sap the strength of the patient and weaken his powers of resistance. The tendency of these malignant tumors is to grow forward or outward rather than inward or backward, and this fact probably explains

why patients afflicted with such tumors live as long as they do, and why they usually die from exhaustion rather than from extension of the growth to the brain. The tendency to extension outward and forward of these tumors may perhaps also explain the increased rapidity of their growth after exenteration of the orbit, or after the more radical operation of exsection of the diseased bones. The empty orbit is a free space toward which there is no resistance to the extension of the neoplasm, while backward or upward its progress is hindered by a bony wall of varying thickness, in which absorption goes on slowly, even when the periosteum has been removed. Three years ago I presented to the American Ophthalmological Society the following conclusions on this branch of the subject, and my experience since has led me still further to emphasize their importance:

1. The prognosis of all forms of malignant orbital tumors is unfavorable; and if the tumor is primarily one of the deep facial bones or their sinuses, the prognosis is positively bad.

2. With the single exception of encapsulated tumors of the orbit, surgical interference is almost invariably followed by a return of the tumor, and the growth of the secondary tumor is more rapid than that of the primary lesion. With each succeeding operation the period of quiescence in the return of the tumor grows shorter and the rapidity of the growth increases.

3. The patient's family, and in certain cases the patient himself, should in the beginning be told of the serious nature of the trouble, and be warned that complete removal of all the diseased parts is a hopeless task. The burden of the decision as to surgical interference must rest upon the shoulders of the patient.

4. Repeated operations in these cases undoubtedly shorten the life of the patient. While it is our duty, therefore, to operate in all cases in order to relieve

severe or unbearable pain, we should be slow to operate merely for the sake of relieving temporarily physical disfigurement or deformity, especially if we are convinced that by so doing we shorten the life of the patient, even if that shortened life is rendered more bearable.