THE LARYNGOSCOPE.

VOL. XIII.

ST. LOUIS, MO., MARCH, 1903.

No. 3.

ORIGINAL COMMUNICATIONS.

(Original communications are received with the understanding
that they are contributed exclusively to THE LARYNGOSCOPE.)

THE ANATOMY OF THE SPHENOIDAL SINUS AND THE METHOD OF APPROACHING IT FROM THE ANTRUM.*

BY HARRIS PEYTON MOSHER, M. D., BOSTON, MASS.

Assistant in Anatomy, Harvard University.

Until within a few years the accessory sinuses of the head have been considered as separate and unrelated cavities. Gradually, however, it has become evident that certain of these cavities, notably the frontal sinus and the antrum, are related anatomically and often pathologically; also that the ethmoid cells, the half way station between these two, are related to both. Now it is becoming clear that the sphenoidal sinus, which has been considered so far off and so isolated, is much less so than is supposed. Of late a great deal of work has been done on the sinuses, and many names appear in connection with investigations along these lines, notably the names of Douglas, Cryer, Lothrop, Onodi, Jansen and Furet. There has been published within the last twelve months a book on the nasal fossæ which deserves the word monumental. It is a joint compilation by Sieur and Jacob of Paris. The minuteness with which they have gone over the subject, the beauty of their illustrations and the clearness of their text arouse in the reader the feeling both of wonder and despair. What I have to say is largely a condensation of their chapter on the sphenoidal sinus, supplemented by observations and measurements of my own..

* Read December 23, 1902 at the New York Academy of Medicine, before the Section on Laryngology.

The classical description of the sphenoid bone begins by stating that it consists of a body and three sets of wings. The body is quadrilateral and hollowed by a cavity called the sinus. One large venous sinus—the cavernous—and four small ones, touch this bone, and three chief arteries of the skull touch it or pass through foramina in it, six of the twelve cranial nerves are in relation with it, all the bones of the skull centre round it, and five of the bones of the face articulate with it, and it comes into relation with the cerebellum and the three basal lobes of the brain.

Most of the important structures which are related to the sphenoid bone center upon the sinus. The anatomy of the sinus and the method of approaching it is the subject of this paper.

I shall take the liberty to put in clinical remarks and applications as I go along rather than to group them formally under one head.

Absence of the Sinus.—Absence of the sinus has been reported a few times. (Zuckerkandl-Hertzfeld, 1898). I found it wanting once in one hundred heads.

Size.—The sinus is often larger on one side than on the other, with the difference generally in favor of the left. It may hold only a drop of water or may be large enough to hold 9 c. c. (3 drachms). The average amount is 5-6 c. c. ($1\frac{1}{2}$ drachms).

Form.—In form the sinus is usually a cube, but the regularity of this is broken by the indention in the superior wall caused by the sella turcica and by the pressing in of the cavernous sinus on the two sides.

The Cavity of the Sinus.—The sinus has a median partition. Often this is not symmetrically placed so that one sinus may be much the larger. In such a case the larger and predominating sinus can be in relation with the cavernous sinus on both sides, and in this way a left sinus could give trouble with the right optic nerve. Occasionally the sinus has a partial double partition. In young subjects the septum, between the two halves is very thick. In young subjects also, the sinus does not extend back of the optic foramen, while in the normal adult it reaches the middle of the sella turcica. Like all the other sinuses the sphenoidal sinus enlarges progressively with increasing age. The average antro-posterior diameter is 1-2 c. c., or one-half to three-quarters of an inch.

The cavity of the sinus is narrowed by the optic groove in front and often behind by the ethmoid cells.

It is much more important clinically to know that the sinus is often enlarged. This enlargement is brought about by various prolongations. These are:—

1. A prolongation of the sinus backward by the increase of the absorption of the bony substance of the body of the bone. This, of course, is the commonest method by which the sinus is enlarged.
2. A prolongation into the lesser wing.
3. A prolongation laterally into the great wings of the sphenoid. Combined with this there is often an excavation of the base of the pterygoid plates.
4. A prolongation forward toward the antrum.

Development.—The sphenoidal sinus begins to develop soon after birth, but does not get its complete development until between the 20th and 25th year. It is formed by the sphenoidal turbinate, and by a prolongation of the nasal mucous membrane. The sphenoidal turbinate is a small triangular piece of bone, which is developed in

Fig. I.—Specimen showing the ethmoid cells extending back over the sphenoidal sinus.—Sieur and Jacob.

the posterior superior angle of the ethmoid region. At the end of the first year the sinus consists of a cavity surrounded by a capsule, which belongs entirely to the sphenoidal turbinate. This capsule seems to start from the turbinate as a base and grow backward, like a soap bubble from a pipe. In the anterior part of the capsule there is an opening, which is the ostium. From the second to the third year the cavity is the size of a pea. At four years the sphenoidal turbinate itself begins to be absorbed and the lateral and median parts of the capsule disappear. At ten years, only the anterior and inferior parts of the capsule, which sprung from the sphenoidal turbinate, are left. At nine to twelve years, the role of

the sphenoidal turbinate is over and the bone of the body of the sphenoid itself is invaded. At this time also the sphenoidal turbinates fuse with the face of the sphenoid.

The Mucous Membrane of the Sinus.—The mucous membrane of the sphenoidal sinus is a prolongation from the nasal mucous membrane. It is thin and very lightly attached. If there is a very large ostium it forms a diaphragm over it with an opening in the centre. There are the usual three layers—the mucous, sub-mucous and the periosteal. It is a ciliary membrane, the same as the mucous membrane of the nose. Grouped about the ostium there are many glands. These occasionally degenerate into cysts. Many vessels run in the sub-mucous layer. At the optic foramen these communicate freely with the vessels of the orbit. The lateral wall of the sphenoidal sinus is cribriform with minute foramina, through which vessels run from the sphenoidal sinus into the cavernous

Fig. II.—The sphenoid bone, from above.—Quain.

sinus. There is a venous connection also through the sella turcica and through the anterior face into the posterior ethmoid cells. The arteries which supply the sinus are the sphenopalatine, the pterygo-palatine and Vidian—all branches of the internal maxillary artery in the sphenomaxillary fossa. Branches of the sphenopalatine artery cross the face of the sinus and enter the ostium to supply the inside. The other two arteries lie on the under side of the body and run in bony canals. The elaborate venous anastomoses readily account for the extension of sinus inflammation to the dura and to the optic nerve and the orbit.

Lymphatics.—The lymphatics join both the deep lymphatics of the neck and those at the base of the brain.

The Relations of the Different Faces of the Sinus.—The Upper Surface: This surface is intra-cranial. From before backward it is made up first of a portion of the lesser wing. Then comes the olivary groove and eminence, and next the surface falls sharply in the sella turcica, to rise again into the posterior clinoid processes and the back of the saddle. In a large sinus this face comes into relation anteriorly with the posterior ethmoid cells and posteriorly with the basilar groove. The length in such cases may be 20-31 m. m. ($\frac{3}{4}$ - $1\frac{1}{4}$ inch). A small sinus does not extend back of the optic groove. In young subjects also this line is the limit of the sinus. It is only at about 12-15 years that the sinus reaches the bottom of the sella turcica. Finally, the posterior ethmoidal cells may extend backward and lie under what is usually the superior surface of the sinus.

Structure.—This face is generally thin. In the young, on the other hand, it is generally thick, 3-6 m. m. ($\frac{1}{8}$ to $\frac{1}{4}$ of an inch). In a large sinus especially is the roof very thin. Zuckerkandl has reported the absence of this upper wall. Sieur and Jacob have not observed its absence, but have seen it so thin that the dura could not be removed without bringing this wall with it.

Relations.—The principal relation is, of course, the dura. In front there are the optic nerves and the ophthalmic arteries imprisoned on either side in the optic canal. Back of these on the thicker olivary eminence is the optic chiasma. The fact that this is placed on thicker bone has been given as the reason why the optic nerves are so much oftener affected than the chiasma. Continuing back you find in the cavity of the sella turcica the pituitary gland. Tumors from this occasionally invade the sinus. The upper surface also has a venous sinus in relation with it, the coronary.

The External Wall.—From before backward the following structures are noticed, the optic canal again, the sphenoidal fissure and then the large cavernous sinus and finally the internal carotid artery. Outside of the cavernous sinus, anteriorly, is the foramen rotundum, carrying the superior maxillary nerve, and posteriorly the foramen ovale carrying the inferior maxillary nerve.

The Relations.—A mere mention of the structures near at hand suggests at once how important the relationships are. The relationship to the cavernous sinus is, on the whole, the most important. Within this there are the internal carotid artery, the motor nerves of the eye, and the first branch of the great fifth. Therefore,

when you curette the external surface of the sphenoid as advised by Grünwald you are treading on thin ice. I have one specimen in which both the ophthalmic and the internal carotid arteries project into the sinus, and would be in danger from such curetting.

There is still another small venous sinus, the inferior petrosal, in relation with this wall.

Structure.—The external wall is like the superior fragile. Fractures of the base of the skull by extending through it readily open up the important blood channels which have just been mentioned. This would give profuse epistaxis. Bullet wounds through the mouth for suicidal purposes often do the same thing. Hemorrhage

Fig. III.—Figure showing the relation of the outer wall of the sphenoidal sinus to the cavernous sinus. The contents of the cavernous sinus (the third, fourth and first division of the fifth nerve, the sixth nerve and the internal carotid artery) are also shown.—Sieur and Jacob.

plus eye symptoms would be the diagnostic signs by which a lesion could be localized here. If there is a very irregular sinus, the injury could be on one side and the hemorrhage come from the other. Disease of this wall of the sinus gives progressive ocular troubles, violent pain, epileptiform attacks, crises of vomiting, meningitis, and finally brain abscess.

The Posterior Wall.—This wall is intra-cranial. It is hollowed out by the basilar groove. In this lies the basilar artery and the medulla oblongata and pons. Here again there is another venous sinus, the occipital. There are venous sinuses, therefore, on three sides of the body of the sphenoid, the superior, the external and on the posterior.

A large sphenoidal sinus may extend fully to the posterior wall. Anatomically such a sinus, if diseased, would give the following symptoms: Occipital headache, vertigo, vomiting, epileptiform attacks, involvement of the nerves of the eye and alteration of the fundus. In addition there would be symptoms of involvement of the meninges. Ordinarily, however, the sinus does not extend to the posterior wall so that such an extensive array of signs would be exceptional.

The Inferior Surface.—This surface is in relation with the nose and the pharynx. Through a small foramen in it runs the pterygo-palatine nerve. The width of this surface varies from 20-25 m. m.

Fig. IV.—Figure showing a large sphenoidal sinus which extends to the posterior wall of the body of the bone.—Sieur and Jacob.

($\frac{3}{4}$ to 1 inch.) It is too thick to puncture easily, 3 m. m. 10 ($\frac{1}{8}$ to $\frac{3}{8}$ of an inch). In two-thirds of the cases this surface does not reach the pharynx. The mucous membrane over it is 3-4 m. m. thick ($\frac{1}{8}$ inch). The mucous membrane has much fibrous tissue in it. The membrane thins out as it turns up onto the anterior face of the sphenoid. From this region and from this membrane start the fibromata and the myxomata of the vault. This locality is supplied by the pterygo-palatine and the Vidian arteries. The width of the right choana is 12-13 m. m. ($\frac{1}{2}$ inch) of the left 17 m. m. ($\frac{5}{8}$ +). In a large sinus the length of the inferior surface often is 30 m. m. ($1\frac{1}{4}$ inch). Only in a very large sinus would an attempt to make an opening here be justifiable,

Relations.—The middle lacerated foramen containing the internal carotid artery is in relation with the inferior surface. In a wide sinus the Vidian nerve lies in the floor. This is the motor nerve of the sphenopalatine ganglion. In the pterygoid prolongation of the sinus this nerve is again exposed.

Of the three faces of the sphenoidal sinus so far but one, the inferior, is approachable for therapeutic surgery, and even this one is not generally practicable. There remains, therefore, only the anterior face. Fortunately this can be approached in at least two ways.

The Anterior Face.—This face is divided into two parts, an outer

Fig. V.—The sphenoid bone, from before.—Quain.

which abutts against the posterior ethmoid cells and an inner, which is free and forms the upper and back wall of the nose. To the middle of the free part the septum of the nose is continued back and forms there a median partition. The transverse measurement of this face is from 28-30 m. m. ($1\frac{1}{4}$ inch). In a well developed sinus this face makes a right angle with the cribriform plate, and averages in height 16-18 m. m. ($\frac{3}{4}$ inch).

The Ostium.—The drainage opening of the sinus is placed in this face. The ostium, as the opening is called, is situated nearer the upper border than the lower. Generally it is 4 m. m. ($\frac{1}{8}$ inch) from the top, or 8-10 m. m., ($\frac{1}{4}+$ inch) from the bottom. The opening measures 2-3 m. m. ($\frac{1}{8}$ inch) vertically, and 1-2 m. m.

(1-16 inch) transversely. In a majority of cases the opening cannot be seen unless the middle turbinate is first removed. The distance from the centre of the nasal opening is 5-8 c. c. (2 inch to $3\frac{1}{8}$ inch) and from the nasal spine $6\frac{1}{2}$ to 7 c. c. ($2\frac{1}{2}$ to $2\frac{3}{4}$ inch). The spine is hard to find. The middle of the anterior nares is a variable point. I prefer, therefore, to measure from the lower border of the lateral cartilage, where this turns round to make the posterior boundary of the meatus. So measured, the distance of the ostium is $2\frac{3}{8}$ inches, or 6 c. c. When the ostium is entered, and this is generally told by a feeling resistance overcome as the probe passes through, the examining or curetting instrument has on an average a working distance of 1-2 c. c. ($\frac{3}{8}$ to $\frac{3}{4}$ inch). Owing

Fig. VI.—Method of catheterizing the sphenoidal sinus.—Sieur and Jacob.

to the high position of the ostium the sinus fills with secretion during the night and empties itself in the morning when the patient assumes the upright position.

A word or two here may not be amiss on the method of catheterizing the sinus. According to Sieur and Jacob there always remains a channel back to the sinus along the floor of the cribriform plate. Adhesions, spurs and deflections, they say, never interfere in this region. All will agree that this is a very acceptable condition of affairs. In order to catheterize after their method the head of the patient is tilted a little upward and the catheter introduced to the floor of the cribriform plate and then the handle gradually elevated as the instrument is pushed backward until it meets the top of the anter-

ior face of the sphenoid in the sphenoidal recess. "Then a gentle see-sawing motion is sufficient in the majority of cases to engage the instrument in the opening of the sinus."

The instrument should have the same curve as the Eustachian catheter, but should be of much smaller diameter, 2 m. m. (1-16 + inch) is the measurement recommended by the authors.

I have found that a curve somewhat less than that which is usually employed on the Eustachian catheter to work better. Too much of a curve causes the probe to glide down the face of the sphenoid and not to engage in the anterior superior angle. If, however, the probe is too straight there is danger of its not sliding along

Fig. VII.—The figures on the right and left show the different forms of the ostium of the sphenoid. The central figure shows the space under the cribriform plate, and between the septum and the ethmoid cells, through which the sphenoidal sinus is catheterized after the method advised by Sieur and Jacob.—Mosher.

the cribriform plate but of engaging it and perhaps of perforating it. A straight probe also infringes on the middle turbinate. The probe should be bent 20-30° off the horizontal.

This method of catheterizing in brief is this: Pass the probe to the anterior superior angle of the sphenoid, bring the point downward, still keeping it in contact with the face, and turn slightly outward.

In regard to this procedure I should like to say that I have not found on the cadaver that there is always a clear passage beneath the cribriform plate. In the great majority there has been one. So that if in life the method should be practicable only in one-half of the cases it is of value. Naturally

in those fortunate cases where the ostium is visible no such manipulation is necessary. In 17 subjects at the end of the dissection period, when they were a good deal dried and had in no way been prepared for this procedure, I succeeded easily in finding the ostium in slightly over half the cases.

Measuring from the tip of the nose is measuring from a variable point, but that is about the best that can be done under these circumstances. In a small head I found the distance to the anterior superior angle of the face of the sphenoid to be $2\frac{1}{2}$ inches ($6\frac{1}{2}$ c. c.) and the distance to the posterior wall of the sinus, after the ostium

Fig. VIII.—Prolongation of the sphenoidal sinus into the lesser wings. On the right the optic canal is shown in the roof of the prolongation.—Sieur and Jacob.

was entered, to be 3 inches ($7\frac{1}{2}$ c. c.) The results of the few measurements which I had a chance to make on this point were that if in catheterizing the sphenoidal sinus after this method the probe or catheter rested against the anterior superior angle of the sphenoid the distance was one-quarter of an inch over or under 3 inches, or in the majority of cases 3 inches, and that the probe entered from a half to three-quarters of an inch further before it struck the posterior wall of the sinus.

The Sphenoidal Recess.—Just in front of the anterior face of the sphenoid and separating this from the posterior ethmoid cells, there

is a vertical slit called the sphenoidal recess. The height of the recess is 12 m. m. ($\frac{1}{2}$ inch), and its width, 5-6 m. m. ($\frac{1}{4}$ inch). Some of the posterior ethmoid cells empty into this as does also the sphenoidal sinus. From their nearness the posterior ethmoid cells can be easily infected by pus from a diseased sinus, and *vice-versa*. The mission of this slit is to carry secretion from these cells and from the sinus down into the choanæ. Thus it is that pus seen

Fig. IX.—Prolongation of the sphenoidal sinus into the great wings. The dark marking in the upper wall of the prolongation is the foramen rotundum, and the smaller one in the lower wall is the Vidian canal.—Sieur and Jacob.

by the posterior mirror in the superior meatus and on the upper rim of the choanæ is used as a sign of disease in the sphenoidal sinus. Polypi in this region raise the same suspicion.

Until lately it has been usual to approach the sphenoidal sinus by resecting the middle turbinate and then breaking through the lower part of this anterior face by an instrument introduced through the nose. This is the method of Grünwald and Hajeck.

All these anatomical details have been given in order to clear the way for the discussion of a newer route, namely, the route through

the antrum. There is a little more anatomy, and I am glad to say newer anatomy to take up first, namely, the anatomy of the prolongations.

Prolongations.—Important as the relations of the different faces of the sphenoid are, it is of even greater clinical importance to appreciate that the sphenoidal sinus frequently sends out prolongations which make it less isolated by bringing it into relation with the more accessible sinuses. These prolongations have been mentioned before as the means by which the cavity of the

Fig. X.—(1) The largest figure shows a posterior inferior ethmoid cell between the sphenoid behind and the antrum in front. (2) The upper left hand figure shows the posterior ethmoid cell united to the sphenoid, and making the antrum prolongation of the sphenoidal sinus. (3) The lower left hand figure shows the antrum increased in size by the absorption of this cell.

sinus is often enlarged. I come to them now in order and wish to take them up in some detail.

In rather rare cases prolongations are found running into the posterior clinoid processes or into the break of the sphenoid. These are not common and are not important. There are three varieties, however, which are not only common but very important. These are:—

1. A prolongation into the lesser wings. The importance of this is that it tends to weaken the optic groove, and in cases of

trauma to determine the point of fracture here. It furnishes a better chance for pus from a suppurating sinus to infect the optic nerve. This prolongation occurs once in twelve cases.

2. A prolongation into the great wings of the sphenoid and into the base of the pterygoid plate. This is found once in six subjects, and is seen only in very large sinuses. It is often greater on one side than on the other or even unilateral. It projects outward between the foramen rotundum and the foramen ovale, that is, between the superior and the inferior maxillary nerves. Sometimes

Fig. XI.—Sagittal section of the facial portion of the skull. This section shows the inner wall of the orbit, the inner wall of the antrum and the spheeno-maxillary fossa.—Quain.

the prolongation extends down the side of the chaonæ for 5-6 m. m. ($\frac{1}{4}$ inch). In one case in six, where the prolongation is found, it reaches as far outward as the foramen ovale. Then it would be separated from the two nerves and the two foramina by a thin partition of bone or in some instances only by mucous membrane. This prolongation explains readily the involvement of the two maxillary nerves in affections of the sphenoidal sinus. Where this prolongation is present there is danger in the operation at the foramen rotundum for the resection of the Gasserian ganglion of break-

ing into the sinus. On account of the widening of the floor of the sinus the Vidian nerve is in the floor of the prolongation and so exposed. Whenever the two choanæ are found to be very large it should arouse a suspicion that this prolongation may exist.

3. A prolongation forward at the anterior inferior angle. This is called the palatine prolongation, because it comes into relation with the palate bone. The name maxillary, or antrum prolongation, would suggest better its anatomical and clinical bearings.

This prolongation is the most common of all, as it is found in one-fourth of all the sinuses. I found it twice in the last eighteen subjects in the dissecting room. At the posterior inferior part

Fig. XII.—(1) Shows the division of the inner wall of the antrum into two triangles by the insertion of the inferior turbinate. (2) Drawing to show the point from which measurements were taken. This point is the lower edge of the posterior rim of the nasal opening.

of the ethmoid region there is an ethmoid cell which plays the role of a go-between between the sphenoid behind and the antrum in front. This cell is normally in relation with the outer half of the face of the sphenoid. It corresponds to the anterior inferior angle of the sphenoid and to the posterior superior angle of the antrum. It may be absorbed by the antrum or by the sphenoid. When the cell is absorbed by the sphenoid a cul-de-sac is formed which runs obliquely forward, outward and downward. It may be 4-6 m. m. ($\frac{1}{8}$ - $\frac{1}{4}$ inch) broad and 5-6 m. m. ($\frac{1}{4}$ inch) long. Often the partition which separates this prolongation from the antrum is made of thick bone, but again it is common to have it composed of translucent bone, which could easily be absorbed by pus.

Relations.—Above are the posterior ethmoid cells, of which this prolongation is a derivative. Below and toward the inside is the sphenopalatine foramen, and to the outside, in the sphenomaxillary fossa, is the superior maxillary nerve with the sphenopalatine ganglion hanging from it like a spider; behind is the sphenomaxillary fossa, and directly below a part of the superior meatus. The importance of this prolongation, of course, is that it unites the sphenoid and the antrum. It was proposed to enter the sphenoid through the posterior superior angle of the antrum where this prolongation is so frequent. There were too many important relations, however, and the way too narrow for the procedure to become much used.

Fig. XIII.—Is a horizontal section through the antrum, about one-quarter of an inch behind the ostium. It shows the ethmoid parallelogram nicely, especially the lower outer angle, where it meets the orbit and the antrum. The anterior part of the inner wall of the antrum is also shown. The dark spot in the upper part of this is the ostium. In front of the ostium is the swelling made by the lachrymal duct. From this figure it is plain how an instrument entered at the ostium and pushed diagonally upward at once enters the ethmoid parallelogram.

So much for the anatomy of the sphenoid. I wish now to discuss the method of approaching it.

For this purpose the inner wall of the antrum has an especial importance. This wall is roughly quadrilateral, and is divided into two parts by the insertion of the inferior turbinate. The line of the insertion of the turbinate runs from the anterior superior angle to the middle of the posterior border. The part of the wall above this line belongs to the middle meatus and the part below to the inferior meatus. The part above this line, or the superior triangle, is mostly membranous. It is bounded above by the pos-

terior ethmoid cells, in front by the unciform process of the ethmoid, behind by the vertical plate of the palate bone. The accessory ostium of the antrum (which occurs once in five cases) is simply a further subdivision of this superior triangle by a branching process of the unciform process. Therefore, it is not so often pathological as is ordinarily supposed. The unciform process is very thin and of no operative importance.

The ostium is also in this anterior superior angle of the inner wall of the antrum. It is bounded in front and above by the unciform process, below by the inferior turbinate and behind by the

Fig. XIV.—Right superior maxillary bone; inner view.—Quain.

terminal part of the unciform process. The ostium is hidden under the lip of the hiatus semilunaris.

The inferior triangles corresponds to the inferior meatus. Anteriorly a bit of the nasal process of the superior maxilla comes into this region. Posteriorly a little of the palate bone, and between these two the thin process of the inferior turbinate, which hooks the turbinate into place. In order to enter the antrum by the inferior meatus the puncture should be made at least 2 c. c. ($\frac{3}{4}$ inch) back of the nasal spine, in order to avoid the danger, or rather the annoyance of missing the antrum and coming out in

the cheek in the canine fossa. Higher up in this triangle the lachrymal duct makes a marked swelling.

If the antrum is opened from the canine fossa and the upper part of its inner wall along the line of the junction of the inner wall and the roof of the antrum is examined, the following structures are found: The first quarter of an inch of the wall makes the outer boundary of the lachrymal canal. The position of the canal is gen-

Fig. XV.—Showing the hiatus semilunaris, the ostium and the ethmoid bulla.—Mosher.

erally indicated by a swelling. Just internal to this, or, if there is no swelling present, three-eighths to one-half an inch from the surface, the ostium is placed. One-half of an inch in, however, will usually clear the lachrymal canal. Beyond the ostium the upper part of the inner wall of the antrum is almost entirely membranous, except for the paper-like process of the ethmoid (the uncinata), which projects downward and strengthens it. A knife, therefore, entered at the ostium, inclined toward the horizontal

as much as the opening in the canine fossa permits, and carried directly backward, would cut only the membranous part of the wall, except, of course, this unimportant process of the ethmoid, and would bring up against the maxillary process of the palate bone. In most cases this is extremely thin, so that the knife would penetrate this and be stopped by the ascending process of the palate where it lies against the posterior inner angle

Fig. XVI.—Shows the method of reaching the ethmoid cells from the antrum and the incision in the upper part of its inner wall through which this is accomplished. The anterior end of the incision is at the point where the probe entered. (This corresponds to the ostium.) The crescentic line in front of this is the anterior border of the hiatus semilunaris. From the probe horizontally backward the heavy black line is the incision through which the cells have been reached. Above this the drawing shows how the middle and posterior ethmoid cells have been cleared away, and farther back shows how the front wall of the sphenoidal sinus has been broken down.

of the superior maxilla, like one finger against another, and strengthens it. The lachrymal canal is entirely out of relation to the incision. The incision so made is about one-half of an inch long. No vessels of any size are cut. The inner wall of the antrum hangs like a curtain from the lower part of the inner angle of the orbit. The knife shaves it off much as the mesentery is cut from the small bowel. For practical purposes the inner wall of the antrum can

be regarded as made up much the same as it is in the disarticulated bone, that is, the first quarter of an inch is the outer boundary of the lachrymal canal; then comes the ostium, next one-half inch of membrane, and finally, for three-eighths of an inch, bone again.

A curette entered through the ostium, inclined toward the septum, and carried back in this incision would strike, first, the ethmoid bulla with the rest of the anterior ethmoid cells, then the posterior

Fig. XVII.—The large circle represents the operating opening in the center of the canine fossa; the smaller circle, the ostium of the antrum. The artery in the posterior part of the inner wall of the antrum is the descending branch of the outer branch of the naso-palatine artery. The posterior line drawn from the center of the canine fossa backward represents the distance to the lower border of the anterior face of the sphenoid. The anterior line from the center of the canine fossa passes up through the ostium to the cribriform plate.—Mosher.

cells, and, finally, the anterior wall of the sphenoid. The ethmoid parallelogram is opened from its lower outer angle, and the cells can be removed by working upward and inward, toward the septum and away from the orbit. The height of the working space is the height of the os planum of the ethmoid minus the notch made in the upper wall of the ethmoid parallelogram by the dipping downward of the olfactory groove. This leaves the working space about one-half inch.

Furet abandoned the inner posterior superior angle, where the antrum prolongation of the sphenoidal so often occurs, angle of the antrum as the site for approaching the sphenoid and advised the use of the inner wall. Jansen, some years before, had practiced the same procedure. Furet resects a large part of the inner wall so that he can, by means of a head mirror and good hemostasis, get a view of the anterior face of the sphenoid and the upper part of the choanæ. The sphenoid in this place is very friable, and both sinuses can be opened from here.

Fig. XVIII.—Figure showing the outer wall of the nose and giving operating measurements.—Mosher.

In opening the sphenoid a finger introduced through the mouth into the posterior nares, as advised by St. Clair Thompson, is an additional guide to the lower edge of the anterior surface.

Today we have small electric lamps which can be placed in the antrum to help out the illumination and adrenalin chloride to perfect the hemostasis. Proper retractors for the upper lip are equally important.

I have measured 50 half heads in order to get an idea of the operating distances to the cribriform plate and to the sphenoid. The first measurement is the distance from the centre of the canine fossa back through the posterior part of the membranous area of the inner wall of the antrum to the lower border of the anterior

face of the sphenoid. This is a line through the posterior end of the incision, which was made from the ostium backward. This measurement varied from one inch and a half to two inches. Generally it was two inches (5 c. c.) The angle at which the curette should be carried backward in order to strike this point is 45° . If the curette is not held parallel to the septum there is danger of opening the orbit posteriorly, not otherwise. The distance straight up through the ostium to the cribriform plate ranged be-

Fig. XIX.—Figure showing the sphenopalatine foramen and the branches of the sphenopalatine artery to the sphenoidal sinus and to the antrum.

tween one inch and a half and one inch and seven-eighths. It is not safe to curette toward the cribriform plate further than one and a half inches, 38 m. m., or practically 4 c. c.

Turn now to the inside of this inner wall of the antrum, or what is the same thing, to the outer wall of the nares. The distance from the ostium to the cribriform plate is on the average $\frac{3}{4}$ of an inch (2 c. c.) In one case only did I find it a half of an inch. This distance is the working distance of the curette upward. A half an inch, there-

fore, from the ostium upward is the limit of safety. This measurement also ($\frac{3}{4}$ inch, 2 c. c.), the distance from the ostium to the cribriform plate, is roughly the measurement of the anterior face of the sphenoid.

The ostium in a great majority of cases is on a line with the lower edge of the anterior face of the sphenoid. It may be a little above or a little below, but for surgical purposes the line from the ostium backward can serve as a guide to this point.

Fig. XX.—Cast of the accessory sinuses and the ethmoid cells, showing how they all focus toward the antrum.—Sieur and Jacob.

The only vessel which is in danger of being cut in this incision through the membranous area of the inner wall is the outer and descending branch of the sphenopalatine artery. This, however, runs down on the ascending process of the palate bone and is not in danger if the incision is stopped a quarter of an inch in front of the posterior angle of the antrum, or if the incision is not prolonged beyond the natural stopping place caused by the resistance

this process gives to the knife. Unless the incision is pushed farther back the sphenopalatine ganglion, which is the Gasserian ganglion of the nose, is not in any danger.

The inner wall of the antrum measured between $1\frac{1}{8}$ to $1\frac{5}{8}$ inches (3-4 c. c.)

If the ostium of the antrum should not be found easily, one-half inch (12 m. m.) will, in the majority of cases, clear the swelling of the lachrymal duct. The membranous area varied between one inch and one-half of an inch ($2\frac{1}{2}$ c. c.-4 c. c.) The average measurement was three-quarters of an inch (2 c. c.) I can see no help for wounding the branch of the sphenopalatine artery, which crosses transversely the face of the sinus below the ostium. Cases of fatal bleeding have been reported from injury of this vessel. One wonders, however, if the bleeding was not rather from some larger vessel like the cavernous sinus or the carotid artery, or the ophthalmic.

I have found it very useful in experimenting to work with a measured curette. It is equally reassuring to have a measured curette when you are working in the nose. The distances of $1\frac{1}{2}$, 2 and $2\frac{1}{2}$ inches (4, 5, $6\frac{1}{2}$ c. c.) are marked on the shaft, either by grooves, or what is better, because blood would not obscure them so readily, by slight ferrules. In addition, I must add a word for the warm ether apparatus. This does away with the use of a cone in etherizing, and enables the operator to work uninterruptedly. The dentists have been using this for the last five years in Boston for cleft palate work. I happened upon it this last summer and introduced it into throat work. It has proven a great help.

I have shown, I hope, the importance of these increased relationships of the sphenoidal sinus. When in one-fourth of all cases it comes into relationship with the antrum, it can no longer be regarded as isolated. Since this occurs so often, it would seem natural to approach the sphenoid through the antrum, especially as the inner wall of this offers a large operating space. If this wall is extensively broken down it enables the operator to see the face of the sphenoid. This can be accomplished so well in no other way. Through the nose the lower anterior edge of the face of the sphenoid, measured as I measure, is $2\frac{1}{4}$ inches, and from the middle of the canine fossa, $1\frac{1}{2}$ to 2 inches, or $5\frac{1}{2}$ c. c., and 4 to 5 c. c. According to Sieur and Jacob, this distance measured through the nose, and from the nasal spine, is 7-8 c. c., and measured from the anterior part of the antrum, 5 c. c. The route to the sphenoid by way of the antrum is, therefore, the shortest and

most direct. By it the operator has two guides to the lower edge of the sphenoid, the finger in the mouth at the upper rim of the choanæ and the level given by the incision made from the ostium backward through the membranous area. By this route three of the four accessory sinuses of one side can be opened up. The sphenoidal sinus of the opposite side can also be opened and experimentally on the cadaver, in many cases, the frontal sinus.

In combined empyemata of the antrum, the ethmoid region and the sphenoid, I think that this method is the method of choice.

BIBLIOGRAPHY.

Ankindinow: Empyem und Caries der Keilbeinhöhle. V. Cong. Russ. Aertzte, 1894. Internat. Cent. f. Laryngol., Berl., 1894-95, XI, 498.

Argumosa, J. R.: Caries del ala mayor izquierda del esfenoides; autopsia. *Crón. méd-quir. de la Habana*, 1876, II, 113-116.

Bacon, W. T.: A case of secondary carcinoma of the sphenoidal cavities causing ocular paralysis and destruction of sight. Proc. Connect. M. Soc., Hartford, 1882, n. s., II, 44-47.

Baraldi, G.: Un fatto di atavismo; l'osso sfenotico nell'uomo. Gior. di anat., fisiol. e patol. d. animali, Pisa, 1888, XX, 121-134.

Baratoux, J.: Nécrose des os du nez; expulsion de la partie centrale du sphénoïde. *Prog. méd.*, Paris, 1883, XI, 826.

Barling, G.: Removal of myxo-sarcoma growing from the basic sphenoid by splitting the palate. Tri-State M. J., St. Louis, 1896, III, 238. Am. J. Surg. & Gynec., 195-96., VIII, 84.

Batut, L.: De l'anatomie des sinus de la face et de leurs inflammations suppuratives. *Midi. méd.*, Toulouse, 1893, II, 257-263.

Baumgarten, E.: Affection des Sinus sphenoidalis. Pest. med.-chir. Presse, Budapest, 1891, XXVII, 225.

Bean, C. E.: Suppurative diseases of the sphenoidal sinuses. Northwest. Lancet, St. Paul, 1899, XIX, 446.

Berg, J.: Hydrops sinuses sphenoid. et ethmoid. Rap. f. k. Serafimerlaser, 1886, Stockholm, 1887, 13.

Berger, É.: Les symptômes des maladies du sinus sphénoïdal. Rev. mens. de laryngol., Paris, 1888, VIII, 397-401.

Berger, Émile.: La chirurgie du sinus sphénoïdal. Paris, 1890, 80 p. 4°, No. 102.

Berger (É) & J. Tyrman: Caries und Nekrose des Keilbeinkörpers. Wien. Med. Bl., 1886, IX, 330-333.

Berger (É.) und J. Tyrman: Die Krankheiten der Keilbein-Höhle und des Siebbein-Labyrinthes und ihre Beziehungen zu den Erkrankungen des Sehorgans. Wiesbaden, 1886.

Bertèmes: Étude anatomo-topographique du sinus sphénoïdal. avec applications à la pathologie des sinusites sphénoïdales. Thèse de Nancy, 1900, 119 p.

Betz: Ein Fall von Fremdkörpern in der Keilbeinhöhle. Internat. Cent. f. Laryngol., Berl., 1894-95, XI, 142.

Blair, L. E.: Syphilis of the naso-pharynx, with report of a case of tertiary syphilis of the sphenoid. *Med. Rec.*, N. Y., 1893, XLIII, 459-461.

Bosworth, H. P.: A case of suppurative ethmoid disease followed by invasion of the sphenoidal sinus, abscess of the brain, and death. *N. Y. Med. J.*, 1895, LXII, 450. *Tr. Am. Laryngol. Assoc.*, N. Y., 1896, XVII, 72-74.

Bresgen, M.: Die Eiterungen der Nase und ihrer Nebenhöhlen. *Münch. Med. Woch.*, 1894, XLI, 614; 635.

Brisson, J.: L'œil et les tumeurs des sinus de la face. Étude anatomoclinique et diagnostique. *Arch. prov. de Chir.*, Paris, 1900, IX, 756-789.

Brühl: Méthode de démonstration anatomique des cavités accessoires du nez. *Zeitschr. f. Ohrenh.*, 1899, XXXVI.

Brühl, G.: Zur Anatomie der Nebenhöhlen der Nase. *Berl., klin. Woch.*, 1900, XXXVII, 913-916.

Bryan, J. H.: A further contribution to the study of suppurative diseases of the accessory sinuses, with report of cases. *N. Y. Med. J.*, 1895, LXII, 450-456. *Am. Laryngol. Assoc.*, N. Y., 1896, XVII, 76-94.

Bryan, J. H.: Chronic abscess of the frontal, ethmoidal, and sphenoidal sinuses, followed by meningitis and death. *N. York M. J.*, 1900, LXXI, 77-79. *Tr. Am. Laryngol. Assoc.*, 1899, 193.

Bryan, J. H.: Chronic epyema of the frontal, ethmoidal and both sphenoidal sinuses, with extensive necrosis, complicated with adenoma of the posterior ethmoidal and sphenoidal regions. *Am. J. Med Sci.*, Phila., 1902, n.s., CXXIV, 416-432. *Tr. Am. Laryngol. Assoc.*, New Haven, 1901, 65-85.

Bryan, J. H.: Diseases of the sphenoidal sinuses in relation to diseases of the eye. *J. Am. Med. Assoc.*, Chicago, 1899, XXXIII, 1202.

Bull, C. S.: Some points in the symptomatology, pathology, and treatment of diseases of the sinuses adjacent and secondary to the orbit. *Med. Rec.*, N. Y., 1899, LVI, 73-78.

Caldwell, G. W.: Diseases of the accessory sinuses of the nose, and an improved method of treatment for suppuration of the maxillary antrum. *N. Y. M. J.*, 1893, LVIII, 526-528.

Caldwell, G. W.: Diseases of the pneumatic sinuses of the nose, and their relation to certain affections of the eye. *Med. Rec.*, N. Y., 1893, XLIII, 425-427.

Caubet (H.) et A. Druault: Meningite et phlegmon de l'orbite dus à une polysinusite d'origine dentaire. *Ann. d. Mal. de l'oreille, du larynx, etc.*, Paris, 1899, XXV, 211-217.

Chisholm, J. J.: Two cases of malignant tumor of the sphenoidal, implicating vision. *Arch. Ophth.*, N. Y., 1882, XI, 52-57.

Claoué, R.: Empyème du sinus maxillaire gauche. Infection aiguë secondaire des sinus sus-nasaux gauches. Accidents méningitiques. *Mort. Rev. de laryngol.*, Paris, 1895, XV, 805-810.

Clarke, J. J.: Dilatation of sphenoidal sinus. *Brit. M. J.*, Lond., 1891, II, 1256.

Clarke, J. J.: Dilatation of sphenoidal sinus into which the left internal carotid artery opened. *Lancet*, Lond., 1891, II, 1277.

Coakley, C. G.: The sphenoidal sinus. *Laryngoscope*, St. Louis, 1902, XII, 501-505.

Cobbedick, A. S.: Chronic suppuration in the nasal sinuses; its diagnosis and treatment. *Clin. J.*, Lond., 1901, XVII, 349-352; 363-368.

Coffin, R. A.: A differential diagnosis of empyema of the accessory cavities of the nose by internal examination. Boston M. & S. J., 1898, CXXXVIII, 274.

Coppez und Los; Ueber Neuritis optica mit Sinusitis sphenoidalis. Centralb. f. d. prakt. Augenh., Leipz., 1900, XXIV, 49.

Cordes, H.: Zur Behandlung der Keilbeinhöhlenerkrankungen. Monatsschr. f. Ohrenh., Berl., 1899, XXXIII, 189-194.

Cozzolino, V.: Sulla patologia e sulla chirurgia dei seni etmoidali e sfenoidali. Gazz. clin., Napoli., 1891, II, 153-158.

Craig, R. H.: Some new features of the accessory cavities of the nose. Lancet, Lond., 1898, II, 482-483.

Cryer, M. H.: Anatomic variations of the nasal chamber and associated parts. J. Am. Med. Assoc., Chicago, 1899, XXXIII, 951-958.

Cryer, M. H.: Modes of infection of the maxillary sinus. J. Am. Med. Assoc., Chicago, 1900, XXXV, 1322-1327.

Cryer, M.: Studies of some facial bones. J. Am. Med. Assoc., Chicago, 1898, XXX, 781-789.

Curtis, C. R. S.: Resection of the right superior maxilla, the pterygoid process of the sphenoid of a portion of the body of the sphenoid, and of the vertical plate of the palate bone. St. Louis M. & S. J., 1883, XLIV, 562-565.

Custer, H. J.: Empyema of sphenoidal sinus; special instruments for operating; reports of cases. Columbus M. J., 1900, XXIV, 571-582.

Day, E. W.: Report of a case of caries of the sphenoid bone. J. Am. Med. Assoc., Chicago, 1895, XXV, 890-892.

Discussion on the etiology and diagnosis of ethmoidal and sphenoidal suppurations. Brit. M. J., 1902, II, 595-601.

Dombrowski: A case of primary carcinoma of the sphenoidal sinus. Am. J. Ophth., St. Louis, 1895, XII, 225-237.

Dmochowski, Z.: Beitrag zur pathologischen Anatomie und Aetiologie der entzündlichen Prozesse im Antrum Highmori. Arch. f. Laryngol. u. Rhinol., Berl., 1895, III, 255-353.

Dodd, O.: Abscess of the sphenoidal sinus occurring with acute mastoiditis. Laryngoscope, St. Louis, 1901, X, 334-337.

Douglas, B.: Die Beziehung der Siebbeinzellen zur Keilbeinhöhle, mit besonderer Berücksichtigung des Sinus im kleinen Keilbeinflügel. Monatsschr. f. Ohrenh., Berl., 1901, XXXV., 392-399.

Douglas, B.: The pneumatic sinuses in the sphenoidal wings. Laryngoscope, St. Louis, 1901, X, 93-105.

Drake-Brockman, E. F.: Two cases of disease of the sphenoid bone. Tr. South Indian Branch Brit. Med. Assoc., 1884-6, Madras, 1887, I, no. 5. 4-18.

Dreyfuss, R.: Die Krankheiten des Gehirnes und seiner Adnexa im Gefolge von Naseneiterungen. Jena, 1896.

Dunn, J.: Functions of the ethmoidal, frontal, sphenoidal and maxillary air chambers. Virginia M. Semi-Month., Richmond, 1896-97, I, 281-284.

Durand: Le sinus sphénoïdal. Anatomie. Province méd., No. 32, 1899.

Eckley, W. T.: The intramural sinuses and nasal fossae. Chicago Clin., 1900, XIII, 336-343.

Erichsen: Necrosis of the body of the sphenoid bone; removal of the whole body through the mouth. Med. Times and Gaz., Lond., 1873, I, 7.

Farber, J. H.: Accessory sinuses of the nose; regional anatomy; new suggestions for operation. *Laryngoscope*, St. Louis, 1896, I, 284-289.

Farlow, J. W.: A case of ozaena of probably sphenoidal origin. *Tr. Am. Laryngol. Assoc.*, 1900, 131-134.

Ferreri, G.: Fibro-sarcoma del seno sfenoidale. *Arch. ital. di Otol.*, etc., Torino, 1899, VIII., 445-454.

Ferreri, G.: Sur les néoplasmes du sinus sphénoïdal. *Ann. d. Mal. d. l'oreille, du larynx, etc.*, Paris, 1901, XXVII, 31-42.

Flatau, T. S.: Un caso di carie delle pareti del seno sfenoidale. *Arch. ital. di laringol.*, Napoli, 1893, XIII., 26-28.

Flatau, Rosenberg and others: Discussion on empyema of the sphenoidal sinus. *J. Laryngol.*, Lond., 1895, V, 94-95.

Foucher, A. A.: Nécrose du sphénoïde. *Rev. internat. de rhinol., otol. et laryngol.*, Paris, 1896, VI, 301.

Fraenkel, E.: Beiträge zur Pathologie und Aetiologie der Nasennebenhöhlen-Erkrankungen. *Arch. f. path. Anat.*, Berl., 1896, CXLIII, 42-98.

Furet: Discussion du rapport sur les sinusites sphénoïdales. *Rev. hebdomadaire de Laryngol.*, Paris., 1901, XXII, I, 725-730.

Furet, F.: La sinusite sphénoïdale chronique. *Rev. hebdomadaire de Laryngol.*, Bordeaux, 1901, I, 545-556.

Furet, F.: Le sinusite sphénoïdale chronique. *Paris et Bord.*, 1901, 8°, 84 p.

Furet, F.: Traitement de l'empyème sphénoïdal. Trépanation des deux sinus sphénoïdaux à travers un sinus maxillaire sain. *Presse méd.*, Paris, 1901, I, 61-62. *Abstr. St. Paul M. J.*, 1901, III, 439.

Gallemaertes, E.: Recherches sur la fente sphénoïdale. *Bull. Acad. roy. de méd. de Belge, Brux.*, 1897, 4.s., XI, 200-205. *Policlin.*, Brux., 1897, VI, 365-370.

Gallet: Cas de volumineux ostéome développé aux dépens du sinus sphénoïdal. *Clinique, Brux.*, 1900, XIV, 449-453.

García Solá, E.: Sarcoma de los senos esfenoidales. *Gac. méd. de Granada*, 1895, XIII, 409-421. *Rev. de med. y cirug. pract.*, Madrid, 1895, XXXVII, 241-252.

Gaudier (H.) et Heze: A propos d'un cas de sinusite sphénoïdale. *Écho méd. du Nord.*, Lille, 1901, V, 233-236. *Rev. hebdomadaire de Laryngol.*, Paris, 1901, XXII, I, 701-704.

Gibb, J. S.: Malignant disease of the nose and accessory sinuses. *N. Y. State J. Med.*, N. Y., 1902, II, 24; 56.

Gleitsmann, J. W.: Treatment of diseases of the accessory cavities of the nose. *Ann. Ophth. & Otol.*, St. Louis, 1896, V, 364-374. *N. York Med. Monatsschr.*, 1896, VIII, 123-135.

Grabascher: Caries ossis sphenoidi cum abscessu musculi iliaci interni. *Med. Jahrb.*, d. k. k. oesterr. Staates, Wien, 1845, LI, 67.

Grant, D.: Tables showing the signs of "latent" suppuration in the various sinuses of the nose. *J. Laryngol.*, Lond., 1899, IV, 63-64.

Grant, D.: Disease of the sphenoidal sinus. *J. Laryngol.*, Lond., 1894, VIII, 497-499.

Greene, D. W.: A case of unrecognized empyema of the right sphenoidal sinus; great exophthalmus and divergence of right eyeball; extensive edema of right side of face and neck; death; autopsy. *Ophth. Rec.*, Chicago, 1897, VI, 346-350.

Greift: Un cas d'ethmoidite suppurée avec sinusite frontal maxillaire et sphénoïdale. *Prog. méd., belge*, 1901, Jan.

Grosse, H.: Ueber das Foramen pterygospinosum Civintni und das Foramen crotaphitico-buccinatorium Hyrtl; ein Beitrag zur Anatomie des Keilbeins des Menschen und der Säugetiere. *Anat. Anz. Jena.*, 1892-93, VIII, 321-348.

Grossmann, L.: (Disturbances of vision from diseases of nose and accessory cavities of sinus frontalis and sinus sphenoidalis.) *Gyogyaszat, Budapest*, 1893, XXXV, 111; 122. *Trans. (Abstr.) Pest. med.-chir. Presse, Budapest*, 1894, XXX, 245-247.

Grüber, W.: Ueber Duplicität des Foramen rotundum ossis sphenoidis. *Arch. f. path. Anat. etc., Berl.*, 1888, CXIII, 533.

Grüber, W.: Ungewöhnliche Grube von enormer Grösse an der Wurzel des Processus pterygoidis des Os sphenoidis. *Arch. f. path. Anat., etc., Berl.*, 1877, LXX, 137.

the nose and its accessory sinuses. 355 pp. 8°, New York, 1901.

Grunwald, L.: Pseudobulbarparalyse. Sarkom des Keilbeinkörpers. *Münch. Med. Woch.*, 1895, XLII, 514-515.

Grunwald, L. & H. L. Lack: The etiology and diagnosis of ethmoidal and sphenoidal suppurations. *J. Laryngol., Lond.*, 1902, XVII, 589-619.

Guibert: Anévrisme artériel de la carotide interne au niveau du sinus caveux gauche; communication avec le sinus sphénoïdal gauche, mort; autopsie. *Ann. d'oculist, Paris*, 1895, CXIII, 314-318. Also, N. Y.

Guillemain, A. et A. Terson: Les complications orbitaires et oculaires des infections des sinus frontal, maxillaire, sphénoïdal. *Gaz. d. hôp., Paris*, 1892, LXX, 393-399.

Guisez, J.: Trépanation des cellules ethmoïdales et du sinus sphénoïdal par la voie orbitaire. *Bull. et mem. Soc. anat. de Paris*, 1902, LXXVII, 85-88.

Gussenbauer, K.: Die temporäre Resection des Nasengerüsts zur Freilegung der Sinus frontales, ethmoidales, sphenoidales, und der Orbitalhöhlen. *Wien. klin. Woch.*, 1895, VIII, 377-380. *Rev. internat. de Laryngol., rhinol., et otol., Paris.*, 1895, V, 181-184.

Guye, A. A. G.: Ein Fall von diagnosticirtem Tumor im Sinus sphenoidalis. *Werken van het Genoots., Ser. II, Th. I, Lief 5, Bogen 5 u. 6, Amsterdam*, 1893.

Guye, A. A. G.: Ueber Ausschabung der Keilbeinhöhle anlässlich dreier operirter Fälle. *Monatsschr. f. Ohrenh., Berl.*, 1901, XXXV, 479-480.

Guye, A. A. G.: Vier Fälle von Ausräumung der Keilbeinhöhle bei recidivirenden Nasenpolypen. *Berl. klin. Woch.*, 1902, XXXIX, 157-159. *Ned. Tijdschr. v. Geneesk.*, 1901, II, No. 17.

Hajek, M.: Aetiologie, Diagnose und Therapie der Erkrankungen der Nasennebenhöhlen (exclusive der Oberkieferhöhlen). *XII Cong. internat. de Med.*, 1897, Moscou, 1898, VI, Sect., XII, 130-136.

Hajek, M.: Differentialdiagnose der Höhlenempyeme; kombinierte Empyeme. *Internat. klin. Rundschau, Wien*, 1892, VI, 2113-2118.

Hajek, M.: Ein Fall von Empyem der Keilbeinhöhlen mit bedrohlichen Staunungserscheinungen, endonasale Operation, nebst einigen Bemerkungen über Diagnose und Therapie des Keilbeinhöhlenempyems. *Wien. med. Woch.*, 1895, XLV, 1393; 1430.

Hajek: Pathologie und Therapie der entz. Krankh. der Nebenhöhlen der Nase. *Wien*, 1899.

Hallett, C. H.: Table of measurements of the sphenoid bone in different races of men and in different ages. *Med. Times. Lond.*, 1848, XVIII, 190.

Halstead, T. H.: Epyema of the right maxillary, ethmoidal and sphenoidal sinuses with sudden blindness of the left eye. Operation. Recovery of sight. *Otol., N. Y.*, 1901, XXX.
Otol., N. Y., 1901, XXX.

Hammond, L. J. Surgical treatment of the sinuses accessory to the nose. *Phila. Polyclinic*, 1898, VII, 299-301. *Proc. Phila. Co. Med. Soc.*, 1898, XIX, 112-115.

Hanger, F. M.: Empyema of the sphenoidal sinus. *Atlanta M. & S. J.*, 1898-99, 3.s., XV., 154-155.

Hansberg: Die Sondirung der Nebenhöhlen der Nase. *Monatsschr. f. Ohrenh.*, Berl., 1890, XXIV, 3; 43.

Hansell, H. F.: A case of acute loss of vision from disease of the ethmoid and sphenoid cavities. *Phila. Polyclinic*, 1896, V, 201-205. *Med. and Surg. Rep.*, *Phila.*, 189, LXXXV, 101-105.

Hardie, T. M.: A case of empyema of the sphenoidal sinus and posterior ethmoidal. *Tr. Illinois M. Soc.*, Chicago, 1894, XLIV, 409-419.

Harris, T. J.: Diseases of the accessory sinuses of the nose. *Med. Rev. of Rev's.*, N. Y., 1897, III, 288-293.

Heryng: Traitement de l'empyème de la cavité sphénoïdale. *Cong. internat. d'Otol. et de Laryngol.*, Paris, 1889, 186.

Herzfeld: Ueber Empyem resp. Caries der Keilbeinhöhle. *Berl. klin. Woch.*, 1895, XXXII, 63.

Herzfeld, J.: Zur Pathologie und Therapie der Keilbeinhöhlen-Eiterung. *Arch. f. klin. Chir.*, Berl., 1894, XLVII, 146-161.

Heymann, P.: Die Untersuchung der Nase und des Nasenrachenraumes. *Dent. Med. Ztz.*, Berl., 1884, I, 553-556; 565-568.

Heymann, P.: Handbuch der Laryngologie und Rhinologie. *Wien*, 1900, Vol. III, Nase, 1260 pps.

Hinkel, F. W.: Symptoms and treatment of chronic empyema of the sphenoidal sinus. Twenty-fourth Annual Congress of the Am. Laryngological Assoc., 1902, Boston. *THE LARYNGOSCOPE*, 1902, Vol. XII, No. 10. p. 736.

Hoffman, R.: Ein Fall von Empyem der Keilbeinhöhle mit Betheiligung der Orbita. *Monatsschr. f. Ohren.*, Berl., 1899, XXXIII, 30-32.

Holmes, C. R.: The sphenoidal cavity and its relation to the eye. *Arch. Ophth.*, N. Y., 1896, XXV, 460-477.

Hopman: Defect der unteren Wand der Keilbeinhöhlen. *Deut. Med. Woch.*, Leipz., Wien, 1893, XIX, 1287.

Howard (W. T.) and J. M. Ingersoll: A contribution to our knowledge of the etiology of inflammations of the accessory sinuses of the nose. *Am. J. Med. Sci.*, *Phila.*, 1898, CXV, 520-543. *Trans. Ohio State Med. Soc.*, 1897, 353-359.

Jacob, M. O.: Cathétérisme du sinus sphénoïdal. *Bull. et mem. Soc. anat. de Paris*, 1899, LXXIV, 893-896.

Jacob, O.: Du danger de léser le sinus sphénoïdal dans la résection du ganglion de Gasser. *Presse méd.*, Paris, 1900, II, 3-4.

Jacob, O.: Prolongement du sinus sphénoïdal cause dans les grands ailes du sphénoïde. *Bull. et mém. Soc. anat. de Paris*, 1900, 6s, II, 403-406.

Jacques et Bertèmes: Des tumeurs bénignes des sinus de la face, en particulier du sinus maxillaire. *Rev. de hebdomadaire de laryngologie*, Paris, 1901, XXII, I, 749-750.

Jansen, M. J.: Radicaloperation chronischer combinirter Empyeme der Nebenhöhlen der Nase. XII Cong. internat. de med., 1897, Moscou, 1898, VI, Sect. XII, 154-158.

Jansen, A.: Zur Eröffnung der Nebenhöhlen der Nase bei chronischer Eiterung. *Arch. f. Laryngol. u. Rhinol.*, Berl., 1894, I, 135-157.

Juler (H. E.) and W. J. Harris: Carcinoma of the body of the sphenoid bone; complete blindness of both eyes. *Brit. M. J.*, Lond., 1895, II, 957.

Kaplan: Le sinus sphénoïdal comme voie d'infection intra-cranienne et orbitaire. Paris, 1891.

Kellogg, F. B.: Empyema of the nasal accessory sinuses. *J. Ophth., Otol., Laryn.*, N. Y., 1894, VI, 22-28.

Kicer, G.: Latent empyema of the accessory cavities of the nose. *LARYNGOSCOPE*, St. Louis, 1899, VI, 81-85.

Kirkland, T. S.: The pathological conditions of the cranial sinuses. *J. Laryngol.*, Lond., 1902, XVII, 561-566.

Körner, O.: Escape of cerebro-spinal fluid through the nose, in conjunction with atrophy of the optic nerves, probably caused by the perforation of the wall of the sphenoidal sinus by a tumor of the hypophysis. *Arch. Otol.*, N. Y., 1898, XXVII, 397-403.

Knapp, H.: Mucocoele and empyema of the ethmoidal cells and sphenoidal sinuses causing displacement of eyeball; their operation from the eyeball. *Arch. Otol.*, N. Y., 1893, XXII, 313-328 *Zeitschr. f. Ohrenh.*, Wiesb., 1893-94, XXV, 217-231.

Knox: Importance of the sphenoid bone and its development in man. *Med. Times*, Lond., 1848, XVIII, 190.

Krauss, W. C.: On the close relation between the nasal and cranial cavities and some of the dangers of such relationship. *Charlotte (N. C.) M. J.*, 1900, XVI, 31-35.

Kuchenbecker: Beitrag zur Aetiologie und Therapie des Empyema Antri Highmori. *Monatsschr. f. Ohrenh.*, Berl., 1892, XXVI, 57; 93; 123.

Kuhnt, H.: Ueber die entzündlichen Erkrankungen der Stirnhöhlen und ihre Folgezustände. Eine klinische Studie. Wiesbaden, 1895, 273 p.

Lamb, W.: The diagnosis of suppuration in the accessory cavities of the nose. *Birmingham Med. Rev.*, 1898, XLIV, 327-343, 4 pl.

Lapalle, P.: Tableau statistique de 169 autopsies de sinus de la face, rapports des empyèmes de ces sinus avec les maladies générales. *Arch. internat. de laryngol.*, Paris, 1899, XII, 225-229.

Lapersonne, F. de: On optic neuritis associated with sphenoidal sinusitis and diseases of the posterior parts of the nasal fossae. *L'écho méd. du Nord*, Sept. 17, 1899. *J. Laryng.*, Lond., 1900, XV, 49. *Ophth. Clinique*, 1899, nr. 12. *Arch. d'Ophth.*, Paris, 1899.

Laurens, G.: La chirurgie des sinus de la face dans ses rapports avec la chirurgie de l'orbite. XIIIe Cong. internat. de Méd., Sect. de Laryngol., 1900. Paris, 1901, C. R., 107-113.

Laurens, G.: Relations des maladies du nez et de ses annexes avec les maladies des yeux. *Gaz. d. hôp.*, Paris, 1895, LXVIII, 1021-1031.

Laurent: Catheterization and exploration of the sphenoidal sinus without a speculum. *J. Laryngol.*, Lond., 1894, VIII, 821.

Ledouble: Soudure des apophyses clinoides du sphénoïde et crête sous-épineuse du scapulum dans l'espèce humaine. Bull. Soc. d'anthrop., Paris, 1896, 4.s., VII, 639-642.

Lefferts, G. M.: Diseases and injuries of the nose and its accessory sinuses. Internat. Encycl. Surg. (Ashhurst), N. Y., 1885, V, 359-456.

Lermoyez, M.: Diagnostic et traitement des sinusites aiguës de la face à l'usage des non-rhinologistes. Presse méd., Paris, 1898, I, 85-88.

Lermoyez, M.: Le traitement des sinusites à Vienne. Empyème du sinus sphénoïdal. Ann. d. mals. de l'Oreille, du larynx, etc., Paris, 1894, XX, 74-75.

Lichtwitz, L.: Affections du sinus sphénoïdal. Bull. méd., Paris, 1893, VII, 963-964.

Lichtwitz: Complications des empyèmes des cavités accessoires du nez. Ann. d. Mal. de l'oreille, du larynx, etc., Paris, 1896, XXII, I, 113-125.

Lichtwitz: Disproportion entre la fréquence des empyèmes des cavités accessoires du nez sur le vivant et sur le cadavre. Ann. d. mals. de l'oreille, du larynx, Paris, 1899, XXV, 461-467.

Lichtwitz, L.: Ueber die Erkrankungen der Sinus oder Nebenhöhlen der Nase. Prag. med. Wochenschr., 1894, XIX, 243; 260; 298; 310; 371; 381; 393; (371; 381).

Lodge, Jr., S.: Fatal case of abscess of the sphenoidal sinus. Brit. M. J., Lond., 1899, II, 1423.

Lodge, Jr., S.: A case of fatal sphenoidal suppuration. LARYNGOSCOPE, St. Louis, 1900, VIII, 139-141.

Lommel, E.: Beiträge zur Kenntniss der pathologisch-anatomischen Befunde im Mittelohr und in den Keilbeinhöhlen bei der genuinen Diphtherie. Zeitschr. f. Ohrenh., Wiesb., 1896, XXIX, 301-346.

Lothrop, H. A.: Anatomy and surgery of the frontal sinus and anterior ethmoidal cells. 134 pps. 89 pl. 8°, Boston. Reprint from Ann. Surg.

Luc: Contribution à l'étude des suppurations du sinus frontal et en particulier de son traitement chirurgical. Arch. internat. de laryngol., Paris, 1894, VII, 185-207.

Luc: Leçons sur les suppurations de l'oreille moyenne et des cavités accessoires des fosses nasales. 4° Paris, 1900.

Lütkenmüller, J.: Ein Fall von Keilbeincaries mit Amaurose. Wien. Med. Bl., 1880, III, 1; 38; 57.

Mackenzie, J. N.: Remarks on the surgery of the accessory sinuses. Tr. Cong. Am. Phys. and Surg., N. Haven, 1894, III, 223-227.

McKeown: Chronic sphenoidal suppuration; some observations on operation and cicatrization. Lancet, Lond., 1902, II, 290-291.

Maloney, J. A.: The sphenoid bone; some of its possible functions. N. York M. J., 1888, XLVIII, 144-147.

Martin, J. M. L. F.: De la fréquence de l'empyème des cavités accessoires du nez (recherches anatomo-pathologiques et cliniques. Bordeaux, 1900, 8°, 71 p.

Mermod, C.: Sinusites multiples. Rev. Méd. de la Suisse, Rom., Geneva, 1896, 16; 157.

Milhalkovics, V. von: Anatomie und Entwicklungsgeschichte der Nase und ihrer Nebenhöhlen. Handb. d. Laryngol. u. Rhinol., Wien., 1896, III, 1-86.

Miller, G. V.: Two cases of blindness due to sphenoidal and ethmoidal sinus disease, necropsy. *Brit. M. J.*, Lond., 1900, II, 1776-1777.

Minder: 50 Sectionsbefunde der Nase und deren Nebenhöhlen unter Berücksichtigung der Gesichtsschädelmasse. *Arch. f. Laryngol.*, Berl., 1901-02, XII, 328-362.

Morax, V.: Troubles oculaires observés dans un cas d'épithélioma du sinus sphénoïdal. *Ann. d'ocul.*, Paris, 1896, CXV, 409-418. *Bull. et mém. Soc. franc. d'ophth.*, Paris, 1896, XIV, 415-425.

Mosher, H. P.: Measurements for operating distances in the nose. *Ann. Surg.*, Phila., 1902, XXXVI, 554-559.

Mosher, H. P.: The anatomy of the operation of reaching the ethmoid cells through the antrum. *Am. J. Med. Sci.*, Phila., 1902, n.s., CXXIV, 864-867.

Moure, E. J.: De l'empyème du sinus sphénoïdal. *J. de méd. de Bordeaux*, 1893, XXIII, 405-408. *Rev. de laryngol.*, Paris, 1893, XIII, 817-827.

Moure, E. J.: Traitement des sinusites (maxillaires excepté). XII Cong. internat. de méd., 1897, Moscou, 1898, VI, Sect. XII, 136-153.

Myles, R. C.: Diseases of the accessory nasal sinuses, with suggestions regarding their treatment. *Med. News*, N.Y., 1896, LXVIII, 339-347. *Tr. Am. Laryngol., Rhinol., and Otol. Soc.*, N. Y., 1896, II, 93-106.

Myles, R. C.: Diagnoses of the diseases of the accessory sinuses and their treatment. *N. Y. Polyclinic*, 1895, V, 9-17.

Nemai: Empyema of the sphenoidal and ethmoidal cells. *J. Laryngol.*, Lond., 1896, XXV, 189.

Nichols, J. E. H.: Diseases of the sphenoid bone. *J. Laryngol.*, Lond., 1894, VIII, 755.

Nissle: Die Erkrankungen der Keilbeinhöhle. *Dissert. de Freiburg*, 1899.

Noebel und Lohnberg: Aetiologie und operative Radicalheilung der genuinen Ozaena. *Berl. klin. Woch.*, 1900, XXXVII, 234; 262; 281.

Noquet: Hypertrophie de la muqueuse des cornets inférieurs; cautérisation avec le cautère galvanique latéral de Lœwemberg; guérison; présentation de l'opérée. *Bull. méd. du Nord*, Lille, 1883, XXII, 183-185.

Nouridjan, J.: Cancer de la glande pituitaire et du corps de l'os sphénoïde; symptômes névralgiques variés; mort; autopsie. *Gaz. méd. d'Orient*, Constantinople, 1879, XII, 9; 15.

O'Hara, H. M.: Removal of bony tumour from body of sphenoid bone. *Australas. M. Gaz.*, Sydney, 1897, XVI, 444.

Olivier, P.: Sur les fosses nasales et des sinus de la face. 4° Paris, 1869.

Onodi, A.: Das Verhältniss der Kieferhöhle zur Keilbeinhöhle und zu den vorderen Siebbeinzellen. *Arch. f. Laryngol.*, Berl., 1900, XI, 391-395.

Onodi, A.: Rapports du sinus maxillaire avec le sinus sphénoïdal et les cellules ethmoïdales antérieures. *Rev. hebdom. de laryngol.*, Paris, 1901, XXII, I, 177-182.

Onodi, A.: The anatomy of the nasal cavity and its accessory sinuses; an atlas for practitioners and students. London, 1895, 19 p., 16 pl., 8°. Wien, 1893, 16 p., 12 pl. In library 16 C. 196.

Otto: Ein Fall von medullarem Krebs des Keilbeines. *Cor.-Bl. d. deutsch. Gessellsch. f. Psychiat.*, etc., Neuwied, 1864, XI, 262.

Palmer, A. W.: Diseases of the accessory sinuses of the nose and their treatment. *J. Ophth., Otol. and Laryn.*, N. Y., 1894, VI, 193-210.

Panac, R.: Ein Fall von Kiefer-und Keilbeinhöhlen-Tuberculose mit tödtlichem Ausgang. *Arch. f. Laryngol. u. Rhinol.*, Berl., 1901, XI, 478-479.

Patterson, M. F.: The influences of diseases of the nasal accessory sinuses on the eye. *Tr. Iowa State Med. Soc.*, Cedar Rapids, 1897, XV, 59-70. *Med. Times*, N. Y., 1898, XXVI, 136-138.

Pekostawski, L.: (Caries of the sphenoid bone as cause of purulent meningitis.) *Kron. lek. Warszawa*, 1893, XIV, 364-367.

Pelacz: Rinolito alojado en el recessus naso-etmoidal y en el seno esfenoidal. *Gac. méd. de Granada*, 1897, XV, 528-531.

Poirer, P.: Anatomy of the sphenoid bone. In:—*Traité d'anatomie humaine* par P. Poirier et A. Charpy. Paris, 1899, I, 412-426.

Polyak. Beiderseitiges Stirn-, Keilbein-und Siebbeinzellen-Empyem. *Internat. Cent. f. Laryngol.*, Berl., 1899, XV, 478. *Monatsschr. f. Ohrenh.*, Berl., 1899, XXXIII, 305-308.

Post, G. E.: Fracture of the protuberance of the parietal bone, and of the greater wing of the sphenoid; exophthalmus; hemicrania; removal of bone; recovery. *Lancet*, Lond., 1882, I, 734-735.

Preiswerk, G.: Beiträge zur Corrosionsanatomie der pneumatischen Gesichtshöhlen. *Zeitschr. f. Ohrenh.*, Wiesb., 1899, XXXV, 31-68, 12 pl

Quenu: Carie du sphénoïde; extraction des os malades. *Bull. et mém. Soc. de chir. de Paris*, 1890, n.s., XVI, 632.

Rangé: L'infundibulum et les orifices des sinus. *Ann. d. Mal. de l'oreille, du larynx, etc.*, Paris, 1894, XX, 476-492.

Raymond, P.: Carie de sphénoïde. Méningite de la base. Thirubose des sinus cœnœux, exophtalmie double rapide. *Bull. de la Soc. anat. de Paris*, 1885, LX, 226-228.

Rice, C. C.: Inflammation of the sphenoidal sinus. *Ann. and Analytical Cycl. of Pract. Med.* (Sajous), Phila., 1901, VI, 138.

Rolland, A. J. B.: Chirurgie du sinus sphénoïdal. *Gaz. méd. de Montreal*, 1889, III, 337-341.

Rolland, A. J. B.: Dilatation des sinus sphénoïdaux par accumulation et rétention du liquide; obstruction des arrière-fosses nasales comme conséquence. *Rev. de laryngol.*, Paris, 1889, IX, 401-405.

Röpke: Die Radicaloperation bei chronischen Verschleimungen und Eiterungen der oberen Nasennebenhöhlen. *Arch. f. Laryngol.*, Berl., 1898, VIII, 308-325.

Ruault, A.: Sur un cas d'empyème du sinus sphénoïdal. *Arch. de laryngol., de rhinol.*, etc., Paris, 1890, III, 137-149.

Rudloff: Case of frontal epyema. *J. Laryngol.*, Lond., 1899, XIV, 481.

Sanford, A.: Intracranial abscess arising from caries of the sphenoidal bone. *Brit. M. J.*, Lond., 1894, I, 1023.

Sattler, R.: Surgery of the pneumatic sinuses of the skull, in relation to ophthalmic and aural surgery. *Med. News*, N. Y., 1898, LXXIII, 324-326.

Schadle, J. E.: The aetiology and diagnosis of empyema of the accessory sinuses of the nose. *St. Paul M. J.*, 1899, I, 9-16; 83-89.

Schaeffer, M.: Die Krankheiten der Keilbeinhöhlen. *Handb. f. Laryngol. u. Rhinol.*, Wien, 1900, III, 1173-1199. (Has a good bibliography of the early literature.)

Schaeffer, M.: Ueber acute und chronische Erkrankungen der Keilbeinhöhlen. Deut. med. Wochenschr., Leipz. u. Berl., 1892, XVIII, 1061-1065.

Schech, P.: Diagnose und Therapie der Krankheiten der Nebenhöhlen der Nase. Wien. med. Wochenschr., 1891, XLI, 1891; 1937.

Schech, Ph.: Die Erkrankungen der Nebenhöhlen der Nase und ihre Behandlung. München., 1883, 19 p., 4°.

Schech: Zur Pathologie der Keilbeincaries. Münch. Med. Woch., 1898, XLV, 843-844.

Scheir, M.: Ueber einige Anomalien der Nebenhöhlen der Nase. Arch. f. Laryngol., Berl., 1901-02, XII, 296-302.

Scheir, M.: Contribution à l'étude des anomalies des cavités accessoires des fosses nasales. Arch. internat. de laryngol., Paris, 1901, XIV.

Schmiegelow, E.: (Sounding of accessory nasal fossæ.) Med. Arsskr., Kjöbenhavn., 1893, VII, 183-185.

Scholz: Caries des Keilbeins; Eitersenkung durch die Fossa sphenomaxillaris. Perforation des Sinus cavernosus. Pyämie und Meningitis. Berl. klin. Woch., 1872, IX, 516.

Schwartz, Ed.: Plaies du crâne par balles de revolver. Rabattement du nez et tamponnement des sinus sphénoïdaux, etc. Arch. internat. de laryngol., Paris, 1894, VII, 229-233.

Sedziak, J.: (Diagnosis of an occult form of pyorrhoea (empyema) of lateral sinus of nose, considered as to Highmore's antrum frontal, ethmoidal and sphenoidal relations). Gaz.-lek., Warszaa, 1894, 2.s., XIV, 387; 419; 445.

Serano, J. A.: O sphenoid; excerptos de uma obra inedita. Med. contempor., Lisboa., 1892, X, 409; 1893, XI, 1; 17; 33; 57.

Shambaugh, G. E.: A case of chronic suppuration involving the frontal, maxillary and sphenoidal sinuses on one side of the head, with no complication. Chicago Med. Rec., 1900, XVIII, 368-370.

Shambaugh, G. E.: Chronic empyema of the sphenoid sinus without involvement of the neighboring sinuses. Chicago Med. Rec., 1899, XVI, 511-514.

Sieur et Jacob: Recherches anatomiques, cliniques et opératoires sur les fosses nasales et leurs sinus, 8°, 549 pp., Paris, 1901. Des sinus sphénoïdaux, 282-382.

Siebenmann, F.: Ein Ausguss vom pneumatischen Höhlensystem der Nase. Festschr. z. Jubil. v. Theodor Kocher, Wiesb., 1891, 119-134.

Smith, W. F.: A case of diffuse hyperostosis of the greater wing of the sphenoid; right side. Arch. Ophth., N. Y., 1898, XVII, 9-21. Arch. f. Augenheilk., Wiesb., 1889, XX, 123-132.

Söderbaum, P.: Et Fall af Sarkom. utgaanget fraan sinus sphenoidalis. Gefeb. Dala läk. och apothek. förem. förhandl., 1893, No. 21.

Somers, L. S.: Chronic sphenoid abscess. Penn. M. J., Pittsburg, 1902, VI, 83-89.

Souza-Valladares: Deux observations d'empyème du sinus sphénoïdal gauche. Ann. d. Mal. de l'oreille, du larynx, etc., Paris, 1900, XXVI, 249-251.

Spiess, G.: Zur Chirurgie des Sinus sphenoidalis. Arch. f. Laryngol., Berl., 1897-98, VII, 145-147.

Stacy, H. S.: Bacteriology of the sinuses. J. Laryngol., Lond., 1902, XVII, 566-571.

Staurenghi, C.: Esistenza bilaterale costante di due punti ossei orbito-sfenoidei per ossificazione della parte posteriore della cartilagine di prolungamento dell'orbito-sfenoide (sfenoide anteriore) della hircus L. e del bos taurus, L. *Riforma med.*, Napoli, 1891, VII, pt. 3. 602-603.

Staurenghi, C.: Nuclei complementari costanti del postsfenoide del B. taurus L. non ancora descritti; loro dislocazione nel corso dello sviluppo embrionale, ed omologia cogli ossicini petro-sfeno-basioccipitali umani. *Boll. d. Soc. méd. Chir.*, Pavia, 1900, 173-200.

Sternberg, M.: Ein bisher nicht beschriebener Kanal im Keilbein des Menschen. *Anat. Anz.*, Jena, 1888, III, 784-786.

Sutton, J. B.: On the development and morphology of the human sphenoid bone. *Proc. Zool. Soc.*, Lond., 1885, 577-587. Also reprint.

Sutton, J. B.: On the relation of the orbito-sphenoid to the region pterion in the side wall of the skull. *J. Anat. and Phys.*, Lond., 1883-84, XVIII, 219-222.

Swett, W. M.: Nasal polypi, with affection and maxillary antrum and sphenoidal sinus. *Occidental Med. Times*, San Franc., 1895, IX, 434.

Taptas, N.: Contribution à l'opération radicale des sinusites combinées chroniques. *Ann. d. mals. de l'oreille, du larynx, etc.*, Paris, 1900, XXVI, 244-248.

Testut, L.: Anatomy of the sphenoid bone. In his: *Traité d'anatomie humaine*. Paris, 1899, I, 126-135.

Thirolloix (J.) et Ch. du Pasquier: Coryza. Suppuration des cellules ethmoidales et des sphénoïdales. Lipémie. *Bull. de Soc. anat. de Paris*, 1892, LXVII, 673-677.

Tilley, H.: Empyemata of both frontal, sphenoidal and maxillary sinuses, together with suppurating ear lesions. *J. Laryngol.*, Lond., 1901, XVI, 595-596.

Toubert, J.: Acute sphenoidal sinusitis terminating in fatal suppurative meningitis and diagnosed only at the autopsy. *Med. Bull.*, Phila., 1900, XXII, 367-373. *Rev. hebdomadaire de laryngol.*, Paris, 1900, XXI, pt. 2, 305-317.

Toubert: Contribution à l'étude des complications endocraniennes de la sinusite sphénoïdale. *Arch. gén. de méd.*, Paris, 1890, 9s., IV, 385-423.

Toubert, J.: Un cas de sinusite sphénoïdale à symptômes frustes terminée par méningite suppurée mortelle et diagnostiquée seulement à l'autopsie. *Rev. hebdomadaire de Laryngol.*, Bordeaux, 1900, II, 305-317.

Turner, A. L.: The accessory sinuses of the nose. Their surgical anatomy and the diagnosis and treatment of the inflammatory affections. 212 pps. 8°, New York, 1902.

Vergniaud: Rhinite Catarrhale chronique de la région olfactive; inflammation du sinus sphénoïdal et des cellules ethmoïdales postérieures; anosmie. *Rev. de laryngol.*, Paris, 1894, XIV, 759-763.

Vince: Cas d'un empyème du sinus sphénoïdal avec perforation de l'apophyse basilaire. *Clinique*, Bordeaux, No. 7, 1900.

Vossius: Un cas d'ostéonite du sinus sphénoïdal et de l'ethmoïde avec atrophie optique et un cas d'atrophie papillaire avec polype du naso-pharynx. *Clin. Ophth.*, Paris, 1899, 61. *Ann. d'oculist.*, Paris, 1899.

Weichselbaum, A.: Die phlegmonöse Entzündung der Nebenhöhlen der Nase. *Med. Jahrb.*, Wien., 1881, 227-259.

Wertheim, E.: Beiträge zur Pathologie und Klinik der Erkrankungen der Nasennebenhöhlen. Arch. f. Laryngol. u. Rhin., Berl., 1901, XI, 169-234.

Wheeler, W. J.: Sarcoma of the sphenoid. Med. Press and Circ. Lond., 1898, n.s., LXV, 433. Dublin J. Med. Sci., 1898, CVI, 176-178. Tr. Roy. Acad. Med. of Ireland, Dublin, 1898, XVI, 363.

Wilhelm et Jacques: Traumatisme de la paroi orbitaire interne, sinusite sphénoïdale catarrhale consécutive, opération, guérison. Gaz. d. Hôp, Paris, 1899, LXII, 1334-1335.

Williams, P. W.: Sphenoidal sinusitis. In his Diseases of the upper respiratory tract, the nose, pharynx and larynx. N. Y. and Lond., 1901, 394-398.

Williamson, R. T.: A case of bilateral ophthalmoplegia and neuroparalytic ophthalmia due to sarcoma of the sphenoid bone. Med. Chron., Manchester, 1891, XIV, 417-421.

Winckler, E.: Zur Chirurgie der oberen Nasennebenhöhlen, Arch. f. Laryngol., Berl., 1897-98, VII, 22-33.

Winslow, J.: Rhinite purulente avec étude spéciale de l'empyème chronique des sinus ethmoïdaux et sphénoïdaux. Pratique Méd., 1896, No. 28. Presb. Eye and Throat Charity Hosp. Rep., 1896.

Winslow, J. R.: A contribution to the study of the diseases of the accessory nasal sinuses. Tran. Am. Laryngol., Rhinol. and Otol. Soc., N. Y., 1896, II, 87-92.

Wolff, M.: Die Nebenhöhlen der Nase bei Diphtherie, Masern und Scharlach. Zeitschr. f. Hyg., Leipz., 1895, XIX, 225-262.

Wright, G. A.: Remarks on some affections of the accessory nasal cavities. Med. Chron., Manchester, 1894, n.s., I, 241-246.

Wright, J.: Some personal experiences with cases of suppuration in the accessory nasal cavities. Brooklyn M. J., 1895, IX, 354; 401.

Würdemann, H. V.: Empyema of the maxillary, ethmoidal and sphenoidal sinuses attended by general septicemia following attempted removal of inferior turbinal body; operations; recovery. LARYNGOSCOPE, St. Louis, 1897, III, 18. Ann. Otol., Rhinol. and Laryngol., St. Louis, 1897, VI, 259-261.

Ziem: The operative and dietetic treatment of suppuration in the accessory cavities of the nose. J. Laryngol., Lond., 1895, IX, 725; 783; 855.

Wright, J.: A case of isolated, unilateral, latent empyema of the sphenoidal sinus with delirium and mental symptoms. Recovery. Ann. Otol., Rhinol. and Laryngol., St. Louis, 1902, Feb.

Zeim: Ueber Bedeutung und Behandlung der Nasenciterungen. Monatsschr. f. Ohrenh., Berl., 1886, XX, 33; 79; 137.

Zuckerkindl, E.: Anatomie normale et pathologique des fosses nasales et de leurs annexes pneumatiques. Paris, 1895, 8°, p. 361-377.

Zuckerkindl, E.: Ueber Netzknoorpel am Hamulus pterygoideus. Monatsschr. f. Ohrenh., Berl., 1884, XVIII, 203.

Zuckerkindl, E.: Ueber die normale und pathologische Anatomie der Nasenhöhle und ihrer Nebenhöhlen. Allg. Wien. med. Ztg., 1879, XXIV, 553.

Zuckerkindl, E.: Normale und pathologische Anatomie der Nasenhöhlen und ihrer pneumatischen Anhänge. 8° Wien, 1882, 213 pp. 22 pl.

Zuckerkindl, E.: Zur Muskelfrage. Monatsschr. f. Ohrenh., Berl., 1897, XXXI, 321; 373; 425; 375.

Zuckerkindl, E.: Zur physiologischen und pathologischen Anatomie der Nasenhöhle und ihrer pneumatischen Anhänge. *Med. Jahrb.*, Wien, 1880, 67-102.

Grant, D.: A case of frontal headache depending on sphenoidal sinus disease. *Tr. Brit. Laryngol. and Rhinol. Assoc.*, Lond., 1897, VII.

Addenda—from report of F. W. Hinkel, M. D., Buffalo, N. Y. Published in *THE LARYNGOSCOPE*, Oct., 1902.

Transactions American Laryngological Association, 1895, pages 74, 88, 91, 92.

Transactions American Laryngological Association, 1899, page 193.

Transactions American Laryngological Association, 1900, page 131.

Transactions American Laryngological Association, 1901, page 65.

Annals of Otology, Rhinology and Laryngology, Feb., 1902.

THE LARYNGOSCOPE, May, 1901. . .

Journal of Laryngology, Rhinology and Otology, 1894, page 449.

Journal of Laryngology, Rhinology and Otology, 1895, page 94.

Journal of Laryngology, Rhinology and Otology, 1894, page 497.

Journal of Laryngology, Rhinology and Otology, 1894, page 498.

Journal of Laryngology, Rhinology and Otology (Abstract), 1900, page 610.

Archiv. Intern. de Laryngol. d'Otolog. et de Rhin., 1901, Vol. XIV, pages 1-8.

Archiv. für Laryngologie and Rhinologie, 1900-1901, Vol. XI, pages 391-395.

Medical Bulletin, Oct., 1900.

Journal of Laryngology, Rhinology and Otology, May, 1900, page 244.

Transactions American Laryngological Association, 1895, page 91.

Journal of Laryngology, Rhinology and Otology, 1892, page 75.

Transactions American Laryngological, Rhinological and Otological Society, 1901, page 68.