Simultaneous occurrence of very small sphenoid and frontal sinuses.

Because of the uncertainty as to the reason for failure or incompleteness of sinus development, the present almost unique instance of very rudimentary condition of four sinuses merits description. The sphenoid sinuses were symmetrical in form and position. They were about 4 mm. in sagittal and 14 mm. in craniocaudal diameter. A lateral extension of the cavity brought each into series with the corresponding posterior ethmoid cells. The ostium of the left sinus was so far forward and so lateral as to almost justify the interpretation that it was an ethmoid cell. The ostium region on the other side was destroyed. The cavity interpreted as the left frontal sinus was so small that it is not certain that it extended beyond the ethmoid bone. There was no especial condensation of compact bone to warrant the supposition that the sinuses may have been hindered in their development by infantile disease. It is possible that the sphenoid sinuses are to be grouped with others previously described by the writer which were apparently unable to expand through material of the concha-presphenoid fusion plane. No compensation for the loss of these cavities was noticeable in the size of the other sinuses.
SIMULTANEOUS OCCURRENCE OF VERY SMALL SPHENOID AND FRONTAL SINUSES

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TWO FIGURES

A few very small sphenoid sinuses have been recorded, and complete absence has been claimed by several observers. Incomplete development and absence of frontal sinuses are both rather frequent. Only one previous record was found of the slight development of sinuses of two types in the same individual. This also had to do with the frontal and sphenoid cavities. They were described by Wertheim ('01) in an eight-year-old child. The observation was made for a sufficiently early stage of development to admit of the possibility that the deficiency would have been made good to a considerable degree before adult life.

The explanations which have been advanced for the absence and incomplete development of the sinuses are at present supported by little evidence. Information regarding the paranasal region needs to be collected in these cases if any explanation is to become more than a hypothesis. Although it is especially desirable that this be obtained for foetal and infantile specimens, since observations on such material will of necessity be rather infrequent, the conditions surrounding absence or incomplete development of adult sinuses should be examined for whatever information it can afford.

The rudimentary sinuses were found in the course of dissection and were preserved with the mucoperiosteum nearly intact. The subject was an adult male apparently of European parentage. The small spherical cavities were symmetrically developed and extended to the orbit behind the last posterior ethmoid cell (fig. 1). The anteroposterior diameter of the portion lying within the area usually ascribed to the sphenoid was 4 mm. and its height 14 mm. upon the right and 12 mm. upon the left side.
The ostium of the left sinus opened backward, although it was so far lateral as to be little posterior to the nearest ethmoid cell. Were it not for the position of the aperture, the sinus could as well be classified as a posterior ethmoid cell with a recess in the sphenoid bone, because the part of the cavity in series with the ethmoid cells has a position frequently occupied by one of them, and the most posterior ethmoid cell also not rarely invades the supero-anterior part of the sphenoid where the median portions of these sinuses were located.

Fig. 1 Parasagittal diagrammatic drawing through left sphenoid sinus (a). Three posterior ethmoid cells as (b) represented by dash lines. A fourth, the most posterior which had been opened in dissection outlined in an unbroken line. Above it the aperture of the sphenoid sinus also shown by an unbroken line. × ½.

The portion of the wall of the right sphenoid sinus corresponding to the aperture of the left is not perforated and no communication of the sinus on this side with the nasal cavity occurs elsewhere. A saw cut has destroyed that part of the wall lying a little more medially. Either the aperture must have been situated in this region then or the sinus lacked an outlet. There has been considerable discussion as to whether this second alternative ever occurs. Some authors categorically deny that a sinus can originate without an opening, since they believe sinus formation is always by the out-pocketing of the nasal cavity. Zuckerkandl ('93) states that he has seen two sphenoid sinuses
without apertures in their bony walls. No other record of the lack of opening to the osseous wall of a sphenoid sinus was found. Evidently its absence is very rare, although closure of the aperture by the swelling of the mucosa is frequent. For this reason and because the closely similar companion sinus had an opening, it is very probable that its aperture was destroyed by the saw.

Fig. 2 Right frontal sinus (a). × 1.

The more rudimentary of the two frontal sinuses is shown in figure 2. There is a marked difference in the frequencies of absence of the frontal sinus as given by various authors. Onodi (’11) places it as high as 20 per cent, while Boege (’02) finds it to be only 4.9 per cent. Much of this discrepancy is probably due to different conceptions of what constitutes the earliest developmental stage of a frontal sinus as contrasted with a beginning ethmoid cell. The recess (fig. 2, a) is here regarded as a frontal sinus because it is already separated by a ridge from another division of the frontal recess and is in the proper position
to enlarge directly into the frontal bone. It is the passage into the frontal bone upon which the application of the term frontal to a sinus should depend, but it is usually not practicable, even if it is not impossible, to determine whether small out-pocketings of the frontal recess have passed beyond the confines of the ethmoid bone or not.

No peculiarities were observed in the other paranasal sinuses which could aid in finding the reason for the rudimentary condition of the frontal and sphenoid sinuses. The spongy bone surrounding the four sinuses was somewhat more dense than the average. It may be, therefore, that foetal or infantile disease may have brought about a condition which interfered with the enlargement of the sinuses. Onodi ('11) and Wertheim ('01) have brought together some evidence of such an occurrence. The condensation of the spongy bone was not extreme, and, since there was no atrophy of the mucosa, the argument for early disease is not convincing. Furthermore, it would be surprising that sinuses at opposite ends of the nasal cavity should be affected while the maxillary and ethmoid sinuses opening at intermediate positions are normally developed.

The explanation first suggested by Toldt ('83) for the origin of the bony plates in the sphenoid sinus and further elaborated by Cope ('17) and the writer ('19) may possibly be applicable also to the retardation of the sphenoid sinuses. Toldt regarded the planes and ridges as the remnant of material at the plane of fusion of the adjacent ossification centers of the sphenoid sinus which was able to resist the absorptive action of the periosteum during the enlargement of the sinus.

Seven sphenoid sinuses out of two hundred and forty-two were found by the writer ('19) whose posterior walls corresponded in position and direction with the usual plane of fusion of conchal and presphenoid centers. This led to the suggestion that resistant material had prevented the extension of the sinus backward. The two rudimentary sinuses here under discussion have posterior walls lying more anteriorly and somewhat more transversely than the usual position of the plane. It may be that in this instance a plane situated especially far anteriorly put an early stop to the backward extension of the sinuses.
The incomplete development of the two pairs of sinuses in the same individual is suggestive of a correlation between the development of the two types. The interrelation of form and size of adult sinuses seems to show that alternative correlation is a common feature of sinus development when one of two adjacent sinuses succeeds in preempting space originally open to both and thus brings about the underdevelopment of its neighbor. The suggestion has also been made that as an adaptation to keep the total sinus space up to the usual amount the underdevelopment of some sinuses might be correlated with an unusually extensive growth of others through some unknown mechanism. As far as could be found, there is no evidence for the occurrence of a growth response of this nature. If there is a correlation which explains the concurrent retardation of development of the four sinuses in the specimen which has been described, it differs in type from the relationship just referred to in that the sinuses all vary from the norm in the same direction. The retardation or absence of two frontal sinuses is so often bilateral as to be probably correlated. Less data are at hand for sphenoid sinuses, though a certain degree of correlation is probable. The retardation of development of frontal and sphenoid sinuses in the same head is so rare that its coexistence in the two types is probably a matter of chance.

LITERATURE CITED

CONGDON, E. D. 1919 The distribution and significance of septa in the sphenoid sinus.