

The patient made an uneventful recovery from the operation, but was unlucky enough to develop typhoid fever ten days afterwards, probably from an infection obtained before coming into hospital, as no other case occurred. In the middle of February when his temperature had been normal for a considerable while after the typhoid, he developed cholecystitis and typhlitis, for which an operation was performed on February 19. He succumbed two days later.

Post-mortem examination showed the larynx and trachea perfectly healed, and I am in a position to show both the tumour and its site after healing had taken place.

NASAL THERMOMETRY: A METHOD OF DETERMINING THE INFLUENCE OF THE NOSE ON THE TEMPERATURE OF THE INSPIRED AIR.¹

BY A. BROWN KELLY, D.Sc., M.D.,

Surgeon for Diseases of the Throat and Nose, Victoria Infirmary, Glasgow.

SOME of the most puzzling cases with which the rhinologist has to deal are dependent on disturbances of the respiratory function of the nose. I do not allude to conditions associated with marked nasal obstruction, but to those less obvious varieties in which the patient breathes entirely or almost entirely by the nose. Many of the subjects of the affections to which I refer indignantly deny that they have any nasal trouble.

The principal diseases falling within the class indicated are—intermittent nasal obstruction and deviation of the septum. The symptoms in these affections traceable to defective warming of the inspired air usually manifest themselves as pharyngeal irritation, sometimes exciting cough, and susceptibility to attacks of acute or subacute inflammation in the naso-pharynx, pharynx, larynx or lower air-passages. With the disorders of secretion that may also arise I shall not at present deal.

In the hope of adding to our knowledge of the physiology of nasal respiration and of throwing additional light on the subject I have studied off and on for several years the temperature of the air after it has passed through the nose.

All the experiments have been carried out with extremely delicate mercury thermometers made by Mr. Zeal, London, to

¹ Read at the meeting of the Scottish Otological and Laryngological Society, May, 1913 (see p. 551).

whom I am indebted for the trouble he has taken to meet my requirements.

The thermometer has a twin bulb. Its stem is sufficiently long so that when the instrument is *in situ* the portion with the scale projects beyond the nose or mouth. The scale ranges from 75° or 80° F. to 100° or 105° F., and indicates half degrees. The sensitiveness is such that the mercury immediately responds to the slightest rise or fall in temperature, so that when used for testing the respiratory current in the naso-pharynx the alternate changes

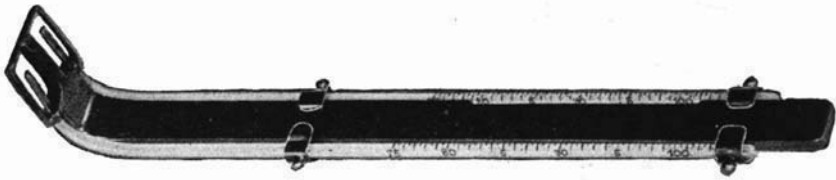


FIG. 1.

produced by the colder inspired air and the warmer expired air are at once evident.

At first I used a straight thermometer. This was introduced along the floor of the nose so that the bulb projected into the naso-pharynx. The chief objection to this instrument was that its presence in the nose cut off a certain amount of the respiratory current and thus altered the normal conditions.

The next step was to employ a thermometer having a long stem

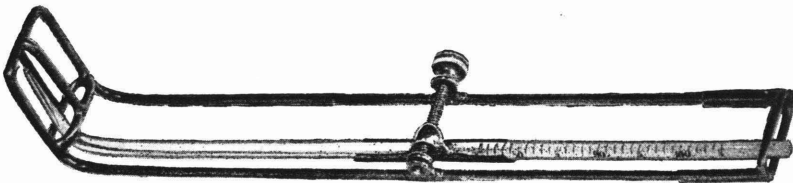


FIG. 2.

with the bulb bent upwards at a right angle. When in position the bulb was in the naso-pharynx and the end of the stem with the scale projected from the mouth. Various difficulties were now encountered: the chief was the uncertainty as to the exact position of the bulb; there was also the danger of the glass breaking.

In order to remove these objections and to allow of the comparison of the temperatures on the two sides of the nose a holder for two thermometers was designed (Fig. 1). This was so constructed that the bulbs could not come into contact with the

mucous membrane, and each was opposite, or nearly opposite, the middle of the corresponding choana.

After many experiments had been made with this double holder and various sets of thermometers, it was found impossible to get a couple exactly alike as to the temperature registered and the amount of excursus.

A single holder consequently was next devised (Fig. 2). It has proved satisfactory, and the results reported in this paper were obtained while it was in use. This pattern allows of the thermometer being moved from side to side of the naso-pharynx as desired. It consists of a rigid wire framework, which, like the thermometer, has its end bent upwards at a right angle to enter the naso-pharynx. A screw forms a bridge between the two sides of the framework, and when the instrument is in position crosses in front of the mouth. On this screw a spring clamp which grips the thermometer travels. The end of the holder which enters the naso-pharynx serves both to protect the thermometer and to prevent it from touching the lining membrane. The other end of the holder can be slipped off and on; the loop encircles the thermometer stem and keeps it in position. The movements of the magnified column of mercury can be easily watched and the scale read by one standing on the patient's right and looking down.

When it is desired to take temperatures the soft palate and posterior wall of the pharynx are painted with cocaine. The thermometer is placed in the middle of the holder so that the bulb is protected in front and behind by the vertical bars of the cage. The instrument is introduced and the vertical bars come to lie behind the posterior edge of the septum. The screw is now turned until the bulb of the thermometer is opposite the middle of one choana. The patient is requested to close his teeth and lips on the instrument and to breathe quietly and regularly through the nose.

The observer stands on the patient's right and gives him a minute or two to accustom himself to the instrument. Meanwhile he watches the movements of the mercury, and as soon as these become fairly uniform, he reads off the highest and lowest points reached during each expiration and inspiration for a period of one minute. A nurse notes the numbers.

If the patient has breathed steadily, and a satisfactory record for one minute of the temperatures of the respiratory current behind one choana has been obtained, the test should be repeated for the other nasal fossa. This is done without removing the

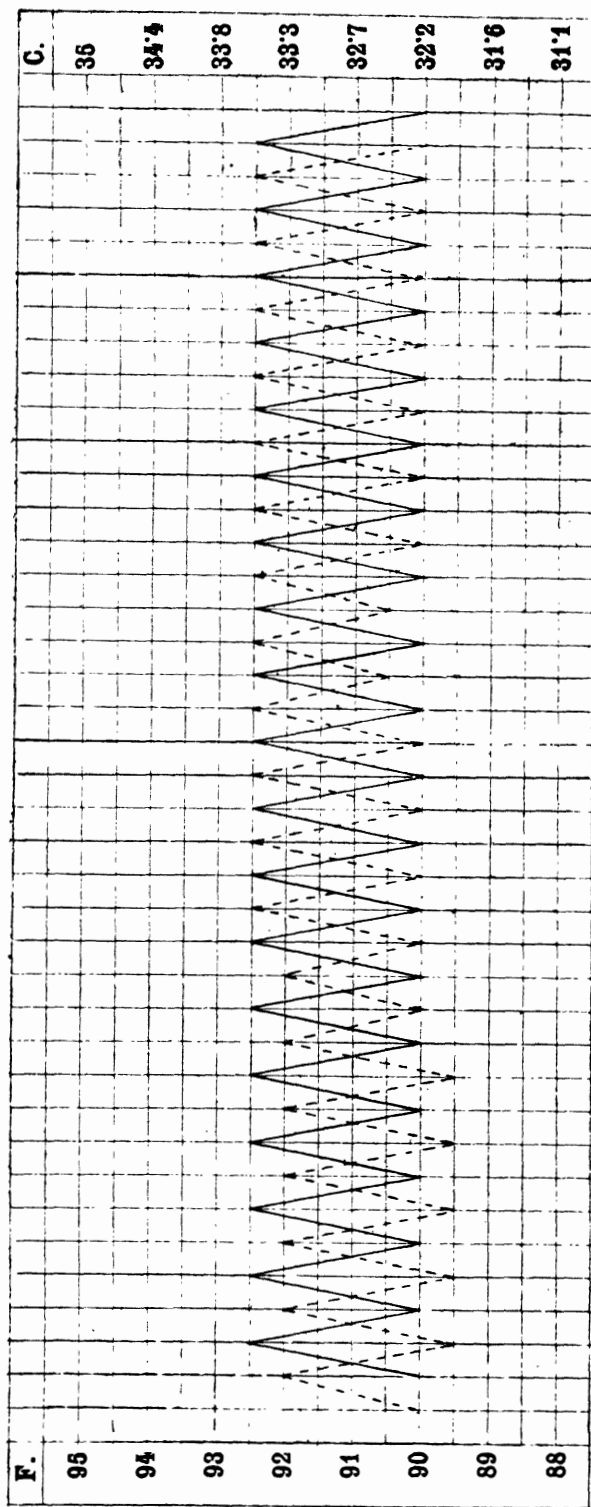


FIG. 3.—Normal nose, 20 respirations per minute. Average on right side (dotted), 90-92.5; excursion, 2.5. Average on left side, 90-92.5; excursion, 2.5.

instrument from the mouth, by merely turning the screw until the bulb is opposite the middle of the other choana, and then noting the temperatures as already described.

The temperatures may be graphically recorded as shown below.

Individuals differ considerably as to their suitability for this test. Some are too irritable and retch, others breathe irregularly from nervousness, and in others too profuse secretion causes

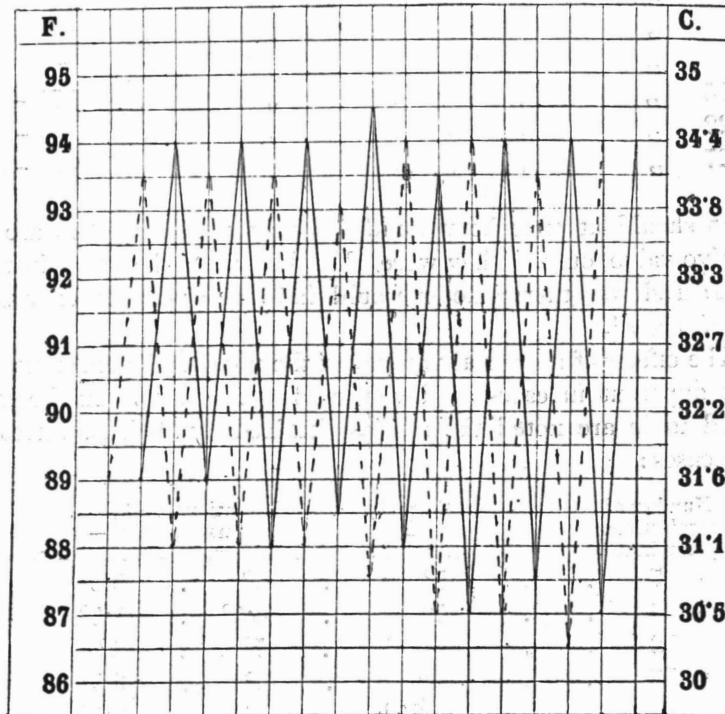


FIG. 4.—Normal nose, 8 respirations per minute. Average on right side (dotted), 87.5° – 93.5° ; excursus, 6° . Average on left side, 88° – 94° ; excursus, 6° .

frequent deglutition. Mucus occasionally envelops the bulb and stretches between it and the cage. Its presence should be suspected if the oscillations seem sluggish. There should be no appreciable interval between the change in direction of the respiratory current and the corresponding change in the movement of the mercury column.

If the movements of the mercury are watched it soon becomes obvious that the amplitude of oscillation bears a direct relation to the depth of the respiration. Shallow rapid breathing produces a

short excursus, while deep, slow breathing produces one of greater amplitude. Thus, 20 respirations per minute are accompanied by oscillations on an average of fully 2° , while 8 respirations per minute may give a variation of 6° (Figs. 3 and 4).

From a large number of observations it has been found that in the normal nose—

8	respirations per minute	give an average excursus of 6° F.
9	”	”
10	”	”
11	”	”
12-15	”	”
16-22	”	”
23-27	”	”

It should at once be pointed out that these numbers are of relative value only. They were all taken with the same instrument; a slower thermometer would indicate a smaller excursus, and *vice versa*.

The effects of abnormal patency of the nose on the excursus are most apparent in cases of deviation of the septum. In the subjoined table are noted the results obtained by testing a series of such cases:

Number of respirations per minute.		Normal average excursus.	Deviation of septum. Excursus behind—			
			Wide fossa.		Narrow fossa.	
7	.	? 7°	.	9°	.	5·5°
9	.	5°	.	4·5°	.	1·5°
12	.	3·75°	.	7°	.	5°
13	.	3·5°	.	6°	.	3·5°
14	.	3·25°	.	4°	.	3·5°
14	.	3·25°	.	4°	.	2°
14	.	3·25°	.	5°	.	4·5°
14	.	3·25°	.	7°	.	1·5°
15	.	3°	.	5·5°	.	2·5°
16	.	2·75°	.	4°	.	1°
17	.	2·5°	.	4°	.	1°
20	.	2·25°	.	2·75°	.	2°

From the above table three facts may be deduced in regard to cases of deviation of the septum: (1) The excursus on the wide side is almost always greater than normal. (2) The excursus on the narrow side is usually less than normal. (3) In every case the

excursus is greater on the wide side than on the narrow side, and occasionally strikingly so (Fig. 5).

A similar but less marked result is obtained when the unequal patency of the nasal fossæ is due to enlargement of one inferior turbinate (Fig. 6).

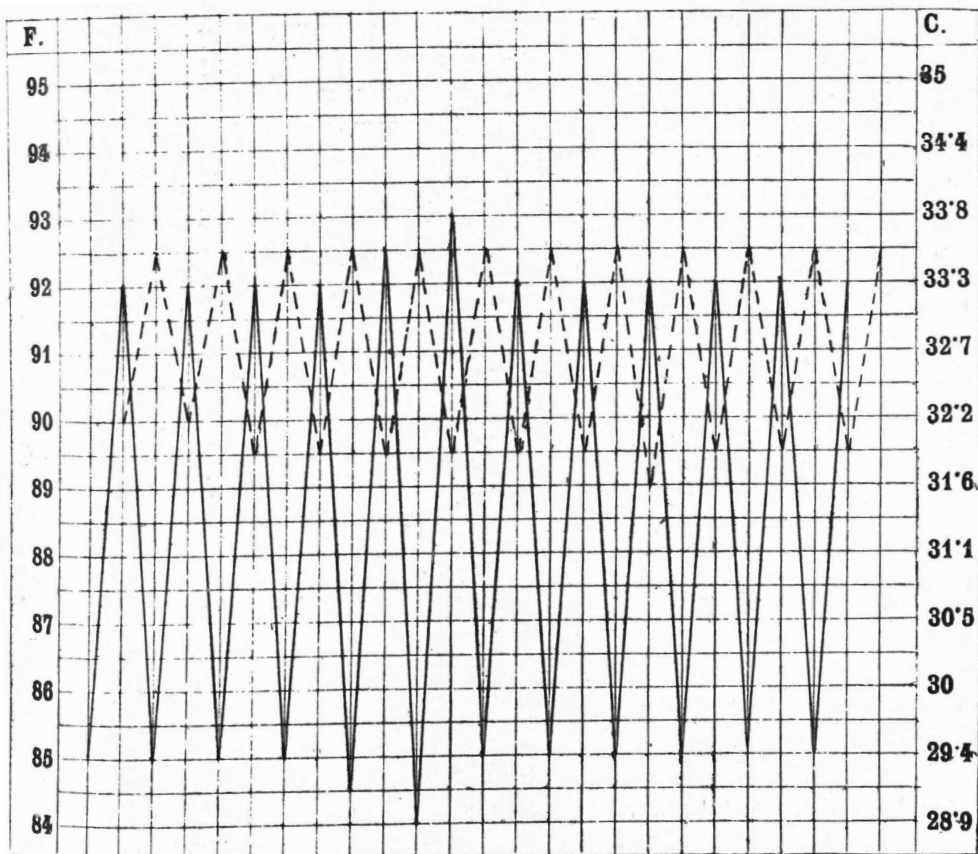


FIG. 5.—Deviation of septum to left, 12 respirations per minute. Average on wide side (right); 85°-92°; excursus, 7°. Average narrow side (left) (dotted), 89.5°-92.5°; excursus, 3°.

The widening of a nasal fossa by cocaine and adrenalin is followed by an increase of $\frac{1}{4}^{\circ}$ to 1° in the excursus.

On the other hand, mere width of the nasal fossæ does not in itself give a large excursus. In atrophic rhinitis the excursus tends to be smaller than normal (Fig. 7), as the following table of cases shows :

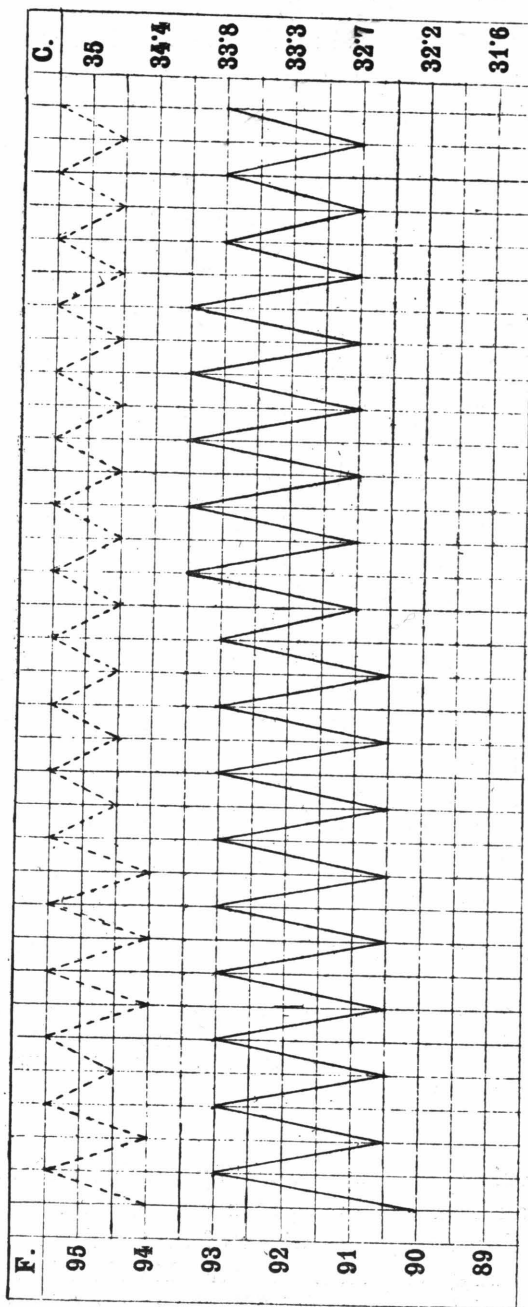


FIG. 6.—Enlarged right inferior tubinal, 17 respirations per minute. Average on normal side (left), 90.75°-93.25°; excursus, 2.5°. Average on obstructed side (right) (dotted), 94.5°-95.5°; excursus, 1°.

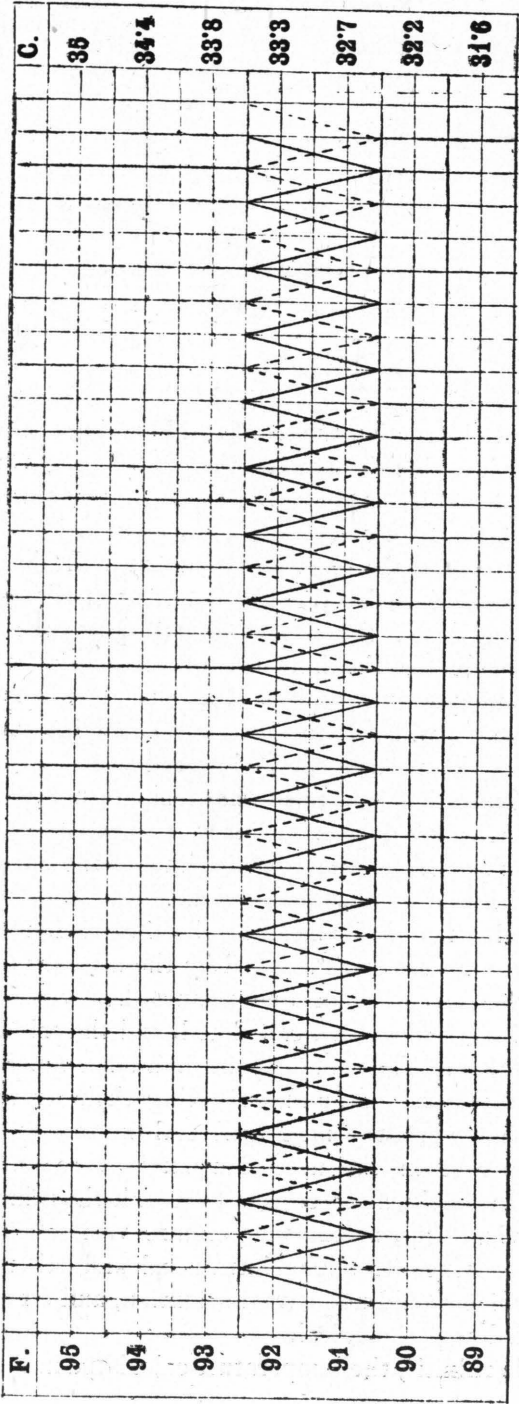


FIG. 7.—Atrophic rhinitis (moderate), nasal fossae equal, 18 respirations per minute. Right and left side, 90°5'–92°5'; excursions, 2°.

Number of respirations per minute.	Normal average excursus.	Excursus in atrophic rhinitis : each side is noted.
13 . .	3.5° . .	3°, 3.5°
15 . .	3° . .	2.5°
16 . .	2.75° . .	2°
17 . .	2.5° . .	2°
18 . .	2.5° . .	2°, 2°, 2°, 2°, 2°
19 . .	2.25° . .	2°
20 . .	2.25° . .	2°, 2°
21 . .	2° . .	2°, 2°, 2°
25 . .	1.5° . .	1.5°
26 . .	1.5° . .	1.5°

In unilateral obstruction the abnormal lowering of the temperature on the wide side is due to the air passing through the corresponding fossa in larger volume per unit of time, and with greater rapidity than normal.

The temperature of the respiratory current in the naso-pharynx, as noted by the method described, is not to be attributed solely to the warming action of the nose and naso-pharynx; allowance must also be made for the influence of the expiratory current. With a room temperature of 60°, if a very deep inspiration be taken the mercury will fall to about 80°; and if a stream of air be blown along the nose it can be lowered to 75°. On the other hand, a full expiration can raise the temperature to 96°. The temperature indicated during ordinary respiration, therefore, is the mean resulting from the commingling of the current of cool inspired air with that of warm expired air.

The determination of this mean has been carried out as follows: The highest and lowest point reached by the mercury during each respiration over a period of one minute has been noted, the average of this series has been calculated, and the middle point of the average taken. The middle point in a large number of cases has been thus worked out, and, on taking their average, it has been found that when the nose is normal the temperature of the respiratory current in the naso-pharynx is between 90.5° and 92.5°. It is probably more correct to state it thus than to give a fixed point, viz. 91.5°, as the temperature varies between these limits in consequence of slight intra-nasal and other variations (*vide infra*) which would not attract attention, and certainly could not be regarded as pathological.

In atrophic rhinitis, the temperature calculated in the same way

is slightly lower, the average being 90.75° . In deviation of the septum the average temperature on the wide side is 89.5° , and on the narrow side 91.5° ; these results were obtained from unselected cases.

I give these figures with some hesitation, for the subject is extremely complex. In proof of this, some of the conditions that influence the temperature of the respiratory current in the naso-pharynx are briefly enumerated :

(1) There appear to be individual differences. Some subjects habitually register lower temperatures than normal, while others register higher temperatures.

(2) The temperature of the external air : All the observations here recorded were made at temperatures between 55° and 65° F.

(3) The depth of the respiration : Increase in the amplitude of the excursus is usually both in an upward and downward direction, but chiefly in the latter when the excursus is great.

(4) With collapse of the inferior turbinate and widening of the inferior meatus there is a fall in the temperature of both the inspiratory and expiratory stream, but especially of the former.

(5) If the inferior meatus is obstructed, but the upper part of the nose is free, the temperature rises above the normal.

(6) If the middle meatus is obstructed, but the inferior is free, the temperature is at, or below, the normal.

(7) The position of the thermometer in the naso-pharynx. The temperature is lower about the middle (*i. e.*, near the septum) than towards the sides of the naso-pharynx; it is also lower on a level with the floor of the nose than towards the roof of the naso-pharynx.

(8) The condition of the other nasal fossa. When the nasal fossæ are unequal, the temperature behind the wide chamber is below normal, while that on the narrow side is at, or usually above, normal.

The method described affords a ready means of testing the influence of the nose on the temperature of the respiratory current. It is evident from what has been stated that one may find slight differences not only between the temperatures taken in a number of apparently normal noses, but even in those noted in the same nose over a period of a few minutes owing to the varying rate of respiration, the changes in bulk of one or other inferior turbinal, etc. The excursus is worthy of attention in that its amplitude,

when taken in conjunction with the number of respirations per minute, seems to be a reliable index of the volume and speed of the air-current passing through the nasal fossa under observation.

WHAT BECOMES OF SINUSES THAT HAVE BEEN OPERATED ON?

By PROF. E. J. MOURE,¹
Bordeaux.

Translated by DAN MCKENZIE.

THE operations which are performed upon the accessory cavities of the face have, during the last few years, passed through several successive phases, particularly interesting from the point of view of their evolution. Thus, in the radical cure of maxillary antrum suppuration a number of partisans have sprung up, who are hotly convinced of the value of endonasal operation (either through the middle or through the inferior meatus), and, in France particularly, drainage of the antrum through the enlarged natural orifices still enjoys a certain amount of favour.

Some practitioners (Mahu, Vacher) have, indeed, added to the simple opening of the antrum of Highmore a more or less incomplete curettage of its cavity by means of bent curettes, but it must be admitted that by this route it is difficult to reach all the nooks, crannies and anfractuosités of a cavity often very roomy, angular, and even septate.

The operation through the canine fossa (Caldwell-Luc), more or less modified in detail by its originators as well as by a considerable number of practitioners, nevertheless still remains the operation of choice, at all events for refractory cases of maxillary sinusitis.

What I am about to say will, I believe, furnish a decisive argument to those who favour the radical cure, now that local anæsthesia by means of cocaine has rendered it so much more simple and easy to perform.

With regard to frontal sinus suppuration, I shall not discuss the methods which consist in treating and even in curing it at times through the natural route. I am convinced that these

¹ Read at the Laryngological Section of the International Congress of Medicine, London, August, 1913.