ACCESSORY NASAL SINUSITIS IN CHILDHOOD

BY

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WITH A RECORD OF BACTERIOLOGICAL EXAMINATIONS

MADE BY

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Introduction.

Disease of the para-nasal sinuses in childhood has received little recognition in this country. There are some half dozen papers extant upon the subject, notably those by Cleminson and Mollison, together with a small number of case reports. Such literature as there is does not appear to have received the attention it merits from those practising among children. On the other hand, American writing upon the subject is profuse, and makes it clear that nasal accessory sinus suppuration vies with disease of the tonsils and adenoids as a diagnosis in the upper respiratory infections of the children in the United States. Referring to the American writers in his classical work entitled 'Nasal Accessory Sinusitis' Hajek says:

'I have seen a great many children between the ages of seven and twelve with complicated sinus infections. The fantastic reports of some American authors (Dean, Ele, and La Mere) who describe an enormous number of empyemas observed in the earliest years of childhood (Dean speaks of 100 cases), are to be regarded with great scepticism, as their methods of examination give us no assurance of the reliability of their results.'

In this paper the average age of a series of a hundred cases is seven-and-a-half years; the total number of children under seven years is forty-two; the youngest is two-and-a-half, and the oldest twelve. Thus there are obviously great differences of opinion upon the frequency and importance of infections of the para-nasal sinuses in childhood. In view of the prevalence of infections of the ear in children, it seems unreasonable to suppose that disease of the nasal sinuses should be rare in early life: for the middle ear with its Eustachian tube communicating with the pharynx is merely a specialized air sinus.

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Any or all of the accessory air sinuses may be diseased in childhood, for they are all present in early life, as will be demonstrated in the section on development. Authorities differ in their estimates of the relative frequency of disease in the individual sinuses, but the concensus of opinion seems to be that the antra are much the most often involved, then the ethmoids, and more rarely the sphenoid and frontal sinuses. The maxillary antrum offers distinct advantages to the investigator, and indeed the diagnosis apart from x-ray examination, and the treatment of infection in the other sinuses is a matter of difficulty in the young. It is for this reason that nearly all the literature upon the nasal air sinuses in children, and the direct observations in this study, are confined to the antrum.

The investigations which form the basis of this work fall into two groups. The first is a series of twenty-four children in whom the diagnosis of antrum infection was arrived at by the routine exploration of these sinuses in a hundred consecutive children. The second is composed of seventy-six children in whom the diagnosis of antrum disease was made by clinical methods, including x-ray examination.

The study of these hundred children was begun in 1932 and continued into 1933. Since that time up to the early part of 1936 these patients have been re-examined periodically, as far as it was possible to get them to attend. This series forms a useful basis upon which to build with subsequent clinical material, which has not been lacking. During the last two years the presence of antrum disease has been proved by exploratory puncture in over five hundred children attending the Aural Department of The Hospital for Sick Children.

The development of the accessory nasal sinuses.

The antrum. A pouch representing the primitive antrum can be seen on the seventieth day of foetal life. At birth the antrum is always present, but varies in size. It grows steadily, being fully developed at about fifteen years. At the age of three years it measures $22 \times 11 \times 9$ mm. (Schaeffer). At birth the ostium is one-third to one-fifth of adult size (W. Proetz), but the adult size varies from 1 to 22 mm. long by 1 to 6 mm. wide (Schaeffer). At two-and-a-half years the floor of the antrum is as much as 5 mm. above the floor of the nose; at ten years this distance is 2.5 mm. (Findlay).

The frontal sinus. The recessus frontalis of the middle meatus is present at the fourth foetal month. The frontal sinus as such is always demonstrable by the end of the first year of life. At three years its cupula is higher than the nasion, and the cavity measures $5 \times 3.5$ mm. (Schaeffer).

The sphenoidal sinus. This sinus is demonstrable as a constricted part of the nasal fossa by the fourth month of foetal life. By the third year it has become surrounded with bone and measures $5.5 \times 4 \times 2.5$ mm.

The ethmoid cells. These cells are also in evidence in the fourth foetal month, and by birth the ethmoidal labyrinth contains well-developed sinuses.
Scheme of investigation.

Proof of the presence of inflammatory exudate in an air sinus consists of aspirating such fluid from the cavity, and not of washing it out of the nose by the use of a cannula in the sinus. From the point of view of an investigation to show the frequency of antral infection in children it would be useless to examine a given number and subject to puncture only those in whom the clinical picture suggested antral disease, for the pre-conceived clinical picture might be erroneous. It therefore seemed desirable to prove the antral infection first in a number of instances, and then to work backwards to the usual clinical examination, including the use of x-rays: then having abstained from any treatment of the antrum itself to repeat the aspiration after a lapse of time in order to establish the chronicity or otherwise of the infection. This latter point assumed some importance in view of the prevalent opinion that sinus disease in childhood is transitory.

Four reasons led to a decision to aspirate the antra in a series of a hundred children undergoing removal of tonsils. First, they would have some upper respiratory complaint, possibly due to antral infection. Secondly, they could be readily punctured while under the anaesthetic, before the operation. In the third place it had been stated (Dean, Mollison) that removal of tonsils and adenoids usually resulted in the clearing up of antral infection. The fourth consideration was that in these circumstances children would not be included if they had any temporary infection such as a 'cold' which might cause exudate into the antrum.

Any antrum found to contain pathological matter (pus, muco-pus, mucus) was to be subjected to re-aspiration six months later, such a period being allowed for spontaneous recovery, or that due to removal of the tonsils and adenoids. In fact the first aspirations were made in the spring of 1932, and the second in the autumn of that year, thus allowing six good summer months to intervene.

In order to be able to compare the bacteriology of the nose with that of the healthy antrum, and with that of the diseased antrum, it was planned to take nasal swabs in a number of the cases, and to examine the contents of each of the two hundred antra bacteriologically, whether consisting of inflammatory exudate or merely returned saline.

After this preliminary series had been completed it was planned to collect a further number of children upon a clinical basis, and the study of these was to include bacteriological examination on the same lines as before, and repeated x-ray examination. Such detailed observations were stopped when a total number of a hundred cases was reached, and these children have been examined periodically over a period of from three to four years. The results of this study are set out in tables 1, 2, 3, and 4.
The technique of puncture and bacteriological examination of the antra.

The maxillary antrum of a child of any age can be punctured by a straight trocar, through the interior meatus of the nose, but as the floor of the antrum is higher than the floor of the nose, the point of the trocar must pierce the lateral wall of the inferior meatus as high up as possible, just under the root of the inferior turbinate. The trocar should be directed backwards, laterally and upwards, and on piercing the thin plate of bone immediately enters the antrum. It is not necessary to puncture through the middle meatus however young the child may be. If a simple trocar and cannula are used, and the contents of the antrum are aspirated through the cannula, they are contaminated by the inside of this tube, through which the dirty point of the trocar has been withdrawn. Therefore a finer and longer cannula attached to a glass syringe containing a few c.c. of sterile saline was passed through the original cannula left in situ, until its point touched the furthest wall of the antrum. It was then withdrawn one-eighth of an inch and the antrum aspirated. If it contained mucus, muco-pus or pus, this entered the syringe. If only air bubbles appeared it was presumably empty; 2 c.c. of saline were then injected into the antrum and re-aspirated. The saline might come back clear, or with mucus or pus. Sometimes it was impossible to aspirate air or fluid. If the cannula was in the antrum

![Fig. 1.—Puncture-aspiration of the antrum. This position is suitable for either local or general anaesthesia. The cannula reaches the most dependant part of the cavity, and the head is easily held still.](http://adc.bmj.com)
this might be due to it being full of thick pus, or to the point of the cannula being buried in a thick mucosa.

The position of the head is obviously important, for the end of the cannula must reach the most dependent part of the antrum if the contents are not to escape aspiration. Since in a child the cannula must pass upwards as well as backwards, its point reaches the postero-superior part of the antrum, which is most dependent with the child lying on his back with shoulders on a sand pillow, and the head hyper-extended, as in the diagram (fig. 1). In this position, which was used in all aspirations, the ostium lies well up on the medial wall.

The aspirated contents of the antrum were then planted in broth and upon blood agar, and the cultures subsequently examined. In addition, the mucus, muco-pus, or pus obtained was examined directly by the microscope in a sufficient number of cases to check the naked eye observations upon the nature of the aspirated matter.

Analysis of table 1.*

ANTRUM DISEASE FOUND BY ROUTINE PUNCTURE OF A HUNDRED CHILDREN UNDER TWELVE YEARS OF AGE UNDERGOING TONSILLECTOMY.

The main fact which emerges from table 1 is that out of a hundred children having their tonsils removed, twenty-four were found to have mucus, muco-pus, or pus in one or both antra. Secondly, in only nine of these twenty-four were the antra clear of pathological content six months later, after the removal of tonsils and adenoids. Stated differently, 15 per cent. of this series of children had chronically diseased antra. The average age of the twenty-four children was seven years, thirteen were boys and eleven girls. Both antra were involved in six instances, and one only in eighteen.

Of the fifteen children (no. 1, 2, 3, 5, 7, 10, 11, 14, 16, 17, 18, 19, 20, 21, 22) who had chronically diseased antra eight (no. 2, 3, 7, 10, 11, 16, 18, 19) cleared up on antral lavage, four (no. 14, 20, 21, 22) improved, and three (no. 1, 5, 17) remained unchanged. One of these three ceased to attend, and might have improved with longer treatment. The other two have had repeated lavage, followed by antrostomy, without benefit.

That nine (no. 4, 6, 8, 9, 12, 13, 15, 23, 24) of the twenty-four children were found to have clear antra six months after tonsillectomy does not necessarily imply that their recovery was the result of this operation. It may have been; but spontaneous recovery from mild sinusitis is common.

*Tables 1 and 3 will be found at the end of this article following page 306.
### TABLE 2.

**Bacteriological findings in 200 routine antral punctures in 100 children undergoing removal of tonsils and adenoids, with a comparison of the bacteriology of the nasal cavities in 45 of the cases.**

<table>
<thead>
<tr>
<th>Bacteriological findings in</th>
<th>Number of times each type of organism was found</th>
<th>Percentage for comparison (nearest unit)</th>
<th>Number of times each type of organism was found</th>
<th>Percentage for comparison (nearest unit)</th>
<th>Number of times each type of organism was found</th>
<th>Percentage for comparison (nearest unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in 90 nasal swabs taken from 45 children.</td>
<td></td>
<td></td>
<td>170 antra punctured and not found to contain mucus, muco-pus or pus.</td>
<td></td>
<td>30 antra punctured and found to contain mucus, muco-pus or pus.</td>
<td></td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>10</td>
<td>7</td>
<td>94</td>
<td>17</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>B. pfeiffer</td>
<td>8</td>
<td>6</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>B. friedlander</td>
<td>10</td>
<td>7</td>
<td>13</td>
<td>6</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>17</td>
<td>11</td>
<td>40</td>
<td>19</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>42</td>
<td>27</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>M. catarrhalis</td>
<td>25</td>
<td>16</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>B. proteus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>B. hofmann</td>
<td>25</td>
<td>16</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sarcinae</td>
<td>10</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sterile</td>
<td>5 (1)</td>
<td>3 (1)</td>
<td>93</td>
<td>46</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

Each antrum is treated as a separate unit. Mixed infections were common. The figures represent the total number of times each type of organism was present.

(1) As 4 of these 5 swabs were taken on the same day the sterility may be due to a technical error.

To simplify the statements in table 2 the antra and nasal cavities are referred to as units; thus the hundred case gave two hundred antral punctures, and ninety nasal swabs were taken from forty-five of the children.

The first column of figures in each section gives the total number of times the type of organism referred to was present; the second column reduces these figures to percentages to facilitate comparison between the sections. About half of the cultures showed mixed infections; in the table each type of organism present is counted.

**Analysis of table 2.**

**The ninety nasal swabs.** Many of the cultures from the nasal swabs showed mixed infections as was to be expected. Of the five swabs that were sterile four were in series upon one day, a fact strongly suggestive of a technical error. Staphylococcus was by far the most frequent organism.
The hundred and seventy antra negative on aspiration. Ninety-three were sterile, this figure being made up of twenty-eight cases sterile on both sides, and thirty-seven sterile on one side; ten of these having mucus, muco-pus, or pus present in the other antrum. It is thus apparent that over half of the antra which were empty, and possibly healthy, were sterile. It will be shown in the discussion upon the skiagrams that many antra give radiographical evidence of disease and yet are negative on aspiration. It seems reasonable to assume that the great majority of healthy antra are sterile. The remaining seventy-seven antra which were empty, infected the saline which was injected into them and then re-aspirated. The streptococcal was the organism most frequently present, and next to that the pneumococcus. Bacilli of the Pfeiffer and Friedlander types were also numerous.

The thirty antra positive on aspiration. The pneumococcus was much the most frequent organism grown from the mucus, muco-pus, or pus of these diseased sinuses. Next in order was the Pfeiffer type, followed by the Friedlander bacillus. Streptococcus was also responsible for some cases, as were micrococcus catarrhalis, staphylococcus and bacillus proteus. The pneumococcal infections were characterized by thick yellow-green pus, usually present in large quantity.

A comparison of the bacteria found in the nose, the empty antrum, and the antrum containing mucus, muco-pus, or pus reveals a marked difference in the flora of these three. Staphylococcus is frequently present in the nose, rarely enters the antrum, but may cause suppuration there. The same applies to micrococcus catarrhalis. Bacillus hofmann is also common in the nose and rare in the antrum, and in no case was it associated with suppuration. Streptococcus is often found in the nose and in the antrum, and is the cause of inflammation in that sinus in a number of cases. Friedlander bacillus is more frequent in the antrum than it is in the nose, and causes suppuration. Pneumococcus is also more often found in the antrum than in the nasal cavity and is by far the most frequent cause of inflammation of the antrum in childhood. Haemolytic bacilli of the Pfeiffer type are the next most frequent cause of antrum disease although they are also comparatively rare in the nose.

An examination of the bacteriological findings in Table 1 shows that upon second puncture after an interval of six months several of the antra which still contained muco-pus were sterile, whereas they had been infected at the time of the first puncture. It has been observed that organisms may die out in a long standing abscess, such as an empyema of the pleural cavity. A similar condition may presumably account for these sterile but muco-pus-containing antra. The three cases in which the muco-pus was sterile upon first puncture are open to the same explanation.
Analysis of table 3.*

Seventy-six examples of antrum disease in children under twelve years of age.

The average age of these seventy-six children was seven-and-a-half years; thirty-eight were boys and thirty-eight girls; both antra were involved in fifty-five, and one only in twenty-one. The tonsils and adenoids had been completely removed previously in forty-one.

From a clinical point of view they can best be divided into three classes: those who were cured after treatment, those who improved, and those who failed to benefit.

Cured. (No. 26, 29, 31, 32, 33, 34, 36, 38, 39, 40, 42, 43, 44, 48, 49, 50, 52, 54, 55, 56, 58, 65, 68, 70, 71, 72, 75, 77, 78, 79, 80, 82, 84, 86, 89, 96, 100.

Thirty-seven of the seventy-six children could be classified as cured after treatment. In twenty-six of them a final skiogram showed the antra to be clear, not only of fluid content, but of residual mucosal thickening: in three it was doubtful if the x-ray was quite clear: in two it was still positive, showing thickening of the mucous membrane although the children were perfectly well. Final x-rays were not taken in six instances as the children failed to attend.

The antra were clear on final lavage in twenty-four of the thirty-seven: seven were free from symptoms and had negative skiagrams, and repeated puncture did not seem justifiable; six failed to attend, but were reported to be well.

The tonsils and adenoids had been removed previously in eighteen of these thirty-seven children: in five they were removed during the treatment, including two with remnants; in fourteen they were still present at the end of treatment, eight being healthy, three infected, and three remnants.

The surgical treatment of thirty-five of the thirty-seven was antrum lavage, the average number of washes being between two and three. Intra-nasal antrostomy was performed on two.

Improved. (No. 25, 27, 28, 35, 46, 47, 51, 57, 59, 61, 62, 63, 67, 69, 73, 74, 76, 81, 83, 85, 87, 90, 91, 92, 97, 99.)

Twenty-six of the seventy-six children were improved by treatment. They include one with a doubtfully clear skiagram, who still had nasal discharge, thirteen whose x-rays still showed pathological changes in the antra and twelve who had not attended recently for x-ray examination, but were improving clinically when last seen.

Of the twenty-six, seven were clear on final lavage, and six had intra-nasal antrostomy performed. The others were treated by lavage, and improved, but the washes were never clear.

The tonsils and adenoids had been removed previously in seventeen: in three they were removed in the course of treatment, including one with remnants; in five they were still present when last examined, three being healthy, one infected, and two remnants.

*Tables 1 and 3 will be found at the end of this article following page 306.
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NOT IMPROVED. (No. 30, 37, 41, 45, 53, 60, 64, 66, 88, 93, 94, 95, 98.)

Thirteen of the seventy-six children were not improved by treatment. X-ray examination still showed gross pathological changes in nine of the thirteen: the other four failed to attend.

Repeated lavage failed to give any benefit to six: lavage and antrostomy failed in four: one was clear after two washes, but the symptoms have recurred: one improved locally on lavage, but the symptoms were not relieved: one was not improved by one wash and ceased to attend.

The tonsils and adenoids had been removed previously in five of these children, and in four they were removed in the course of treatment. They are still present in four instances, and are unhealthy in three of these.

TABLE 4.

BACTERIOLOGICAL FINDINGS IN 161 ANTRA OF 100 CHILDREN ASPIRATED AND FOUND TO CONTAIN MUCUS, MUCO-PUS OR PUS.

<table>
<thead>
<tr>
<th></th>
<th>Bacteriological findings in 24 children of group 1</th>
<th>Bacteriological findings in 76 children of group 2</th>
<th>Bacteriological findings in antra of children in table 3 arranged according to clinical results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cured.</td>
<td>Improved.</td>
<td>Not improved.</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>12</td>
<td>58</td>
<td>28</td>
</tr>
<tr>
<td>B. pfeiffer</td>
<td>8</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>B. friedlander</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>5</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>M. catarrhalis</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B. proteus</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B. hofmann</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Sarcinae</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sterile</td>
<td>8</td>
<td>39</td>
<td>19</td>
</tr>
</tbody>
</table>

Each antrum is treated as a separate unit. Mixed infections were common. The figures represent the total number of times each type of organism was present.

Analysis of table 4.

Again in this table the figures represent the total number of times each type of organism was found. The infection was often mixed, and there would seem no way of determining the degree of responsibility for inflammation attaching to one or other of, say, three types of organism found in one antrum. It is assumed that the organism most often found in association with antrum infection is the one most likely to cause such an infection.

The bacteriological findings in group 1 of twenty-four children closely resemble those of group 2 of seventy-six children. The pneumococcus was much the most common organism found in the series, but Pfeiffer's bacillus was also frequent. It is interesting to note the presence of the latter bacillus in quite a number of consecutive cases occurring in March, 1933,
as shown in the second half of table 3. In group 1 the Friedlander organism was common, but not in group 2. The streptococcus was common in both groups. The number of sterile cultures was high in group 2, and it is thought that this may have been due to a technical difficulty in planting out the aspirated matter for culture as soon after aspiration as in group 1.

The right hand half of table 4 sets out the bacteriological findings of the seventy-six children of group 2 in sections according to whether the patients were cured, improved, or not improved. As far as can be deduced from the limited figures, streptococcal infection of the antrum would seem to be more resistant to treatment than that due to the pneumococcus or the Pfeiffer bacillus.

Pathology and bacteriology of sinusitis in childhood.

In considering the causation of sinusitis, the primary fact to be kept in mind is that the mucous membrane lining the sinuses is in one piece with that lining the nasal cavity. It is impossible to have inflammation in the latter without some spread to the former. A skiamograph of the sinuses taken during any nasal ‘cold’ will show some thickening of their mucosa. Although the sinuses are more shut off from the stream of air-borne organisms than is the nose, they are at a disadvantage to the nasal cavities in that, once infected, it is more difficult for them to rid themselves of the products of the inflammation. Their ostia are small, and in the antra badly placed for drainage. Since the cilia of the sinuses work towards the ostia dependent drainage is not normally necessary. When they are weakened by inflammation, and have a large mass of muco-pus to move, they may fail to expel it through a small opening, itself reduced in size or closed by surrounding congestion. Retained exudate acts as an irritant, and further mucus or pus is poured forth, a vicious circle of retention being set up.

The health of the lining membrane of the sinuses is also dependent upon proper ventilation. This requires free passage of air through the nose, and the changes of air pressure in the sinuses which result. Should the nasal airway be blocked, for instance by a large pad of adenoids or a deviated septum, the sinuses may cease to drain owing to feeble ciliary action.

These mechanical factors play a large part in the causation of sinusitis, and particularly so in children. The ostia of the cavities in the young are smaller than in the adult, but the mucus or pus produced is of the same consistency. The child’s nose is also smaller, and more easily blocked, and enlargement of the adenoids is more frequent.

The common clinical conditions giving rise to sinusitis are ‘colds,’ influenza, and the infectious fevers, particularly whooping cough. Bathing in infected water is another frequent cause. It has been notable that in a number of children with sinusitis the symptoms have arisen following removal of the tonsils and adenoids. In the writer’s view this is not due to loss of the lymphoid tissue of the throat, but to the sinuses becoming filled with infected blood at the time of operation, from lack of adequate
technique in the control of haemorrhage. The blood clots in the sinus and sets up inflammation there. The child's antrum is free from one of the dangers of infection which beset that of the adult. Infection from the teeth must be rare, for the roots do not project into the floor of the antrum, separated only by a thin plate of bone, as they do in later life.

The bacteriology of antrum infection has been discussed with tables 2 and 4. The pneumococcus was shown to be the organism most frequently present: the muco-pus or pus which it produced was characteristically thick and green-yellow in colour, so that it became possible to suspect its presence by the nature of the matter. Perhaps the thickness of pneumococcal pus is a factor in the prevalence of this coccus in sinus infection: the cilia find it more difficult to extrude than a less viscous fluid. No doubt the bacteriology of sinus inflammation varies with the type of naso-pharyngeal infection prevalent at the time it arises. E. Watson-Williams has recorded observations to this effect. In the present series the Pfeiffer bacillus was next most frequent. The streptococcus took third place, and would seem to affect the prognosis adversely.

Something is known about the mechanical and bacteriological factors in the causation of sinusitis. Of the more important factor, the lack of resistance of the individual to infection, hardly anything is known. Some children seem to be unable to resist any infection of the respiratory tract. The typical example is the child who catches cold almost continuously, has repeated attacks of bronchitis, and by the age of ten years or so has well marked bronchiectasis. An x-ray of the sinuses of such a child will show pathological changes in the antra in almost every case. It has been shown that deficiency in diet of vitamin A results in sinusitis in rats. A like deficiency in the human being is also known to undermine the resistance to infection. That this is not the only factor is obvious.

Sinusitis is likely to be common in those climates where upper respiratory infections are frequent. A cold damp sunless atmosphere is particularly likely to induce nasal infections, and sudden changes of temperature, such as result from entering a centrally-heated room from cold outside air, cause nasal congestion.

Finally the allergic state may lead to sinusitis. The rhinitis which is typical of this condition results in great swelling of the mucous membrane lining the nose and sinuses, and the outpouring of a large quantity of mucus. The ostium of an air sinus is easily occluded temporarily, and the exudate retained: it may become infected secondarily. The muco-pus aspirated from an allergic sinusitis contains a high proportion of eosinophils.

The pathological changes which occur in the lining of the sinuses in childhood range from mild catarrhal oedema to suppuration and destruction.
of the epithelium, as in sinusitis generally. Polypus formation, however, is not common. The bone surrounding the sinuses in the very young is more porous than in later years, and this is reflected clinically in a greater tendency to osteitis due to infection spreading from the air cells.

It must be emphasized that the lining membranes of the sinuses is in reality one of the coverings of the body, and that bacterial infection and the production of pus in a sinus is not comparable, for instance, to infection in a long bone; it is strictly speaking outside the body. In general, it may be stated that the acute manifestations associated with suppuration inside the body do not occur in sinusitis unless there is a lesion in the continuity of the mucous membrane, or blocking of an ostium with accumulation of pus under pressure. On the other hand, chronic sinusitis, even with adequate drainage of discharge, is a common cause of general, and perhaps particularly mental, debility.

The nature of the lymphatic drainage from the sinuses would appear to have a direct bearing upon these observations. Mullin and Ryder⁹ state that there is little absorption from the uninjured mucosa of the sinuses. There is a free anastomosis of the lymphatics of the sinuses and of the nasal mucosa: they drain to the internal jugular and retro-pharyngeal glands, and also to the sub-maxillary group.

The incidence of sinusitis in children.

Observations upon the incidence of sinusitis, or more accurately of antrum infection, by routine antrum puncture of children who are undergoing tonsillectomy have been recorded by various authors; their figures correspond fairly closely with those in table 1. Compared to the 24 per cent. found there Mollison and Kendall² found 22 per cent. of children with muco-pus or pus in their antra. J. W. Carmack¹⁰ examined all patients admitted to a hospital and found muco-pus in the antra in 12 per cent. of ninety-six in 1927: 14·2 per cent. of 328 in 1928. In 1930 he examined only those children who were to have their tonsils and adenoids removed, and he found 30 per cent. positive. Harke¹¹ examined the sinuses of 394 children post mortem, and found sinusitis in sixty-two, fifty-two of them being between nine months and fifteen years of age. The maxillary antrum was involved in forty-seven, the ethmoid labyrinth in three, and the sphenoid in two. His findings are of value in confirming the clinical observation that the antrum is much more frequently diseased than the other sinuses. In the Aural Department of The Hospital for Sick Children, muco-pus or pus has been washed out of the antra in over 500 children during the last two years. There can be no doubt that sinusitis in childhood is common,
The clinical manifestations of sinusitis in children.

Nasal discharge (84 of 100 children). In group 1, twelve of twenty-four children give a history of nasal discharge; and in group 2, seventy-two of seventy-six were found to have either anterior or posterior nasal discharge. The difference in proportion is explained by the different means employed to collect the cases, and by a growing realization that many mothers of the hospital class regard nasal discharge as normal; they even regard otorrhoea a commonplace. In addition anterior nasal discharge is a source of trouble to a child: his mother may attack him with a handkerchief. He therefore frequently prefers to convert it into post-nasal discharge by sniffing, and his mother fails to realize the origin of the throat cough which develops. The discharge is more or less continuous; it may clear up in dry weather, and when the child is above his normal general state. It recurs with each cold, and is then particularly profuse. It persists in quantity for weeks after a cold. The average duration of the discharge in the eighty-four children was two years. If the sinusitis is unilateral it is often possible to get a history of one-sided nasal discharge, but not always. The discharge may be mucoid, muco-purulent, or frankly purulent. It is often accompanied by crusting in the nose and excoriation of the nostrils with consequent nose-bleeding. The infection may spread up the naso-lachrymal ducts and cause conjunctivitis with purulent discharge.

Colds (83 of 100 children). Even in this country an unusual susceptibility to colds is indicated by 88 per cent. of these children suffering from them frequently. The mothers often stated that they were never free from colds. That may be another way of describing continuous nasal discharge. Each fresh cold is accompanied by an exacerbation of the signs and symptoms, such as profuse nasal discharge, barking cough, headache, and nasal obstruction. As each cold causes more inflammation in the sinuses, and chronic sinus infection leads to colds, the vicious circle is complete. It is reasonable to assume that the organisms harbouring in a chronically infected sinus are ever ready to avail themselves of a lowering of the local or general resistance to extend their activities to the nose and throat. A cold, or tonsillitis, is an occasional result of sinus lavage, the bacteria being released from their lair.

Cough (82 of 100 children: 44 had had bronchitis). The cough which is the result of sinus disease without any lesion in the chest must be considered by itself in the first place. It may be simply a throat-clearing cough, or so violent as to simulate the paroxysms of whooping-cough. Sinusitis is one of the causes of 'croup.' Such coughs are the result of pharyngeal irritation and inflammation from infected post-nasal discharge. Secondly,
attention must be drawn to the close relationship between pulmonary inflammation and sinus disease. In most cases of pulmonary fibrosis or bronchiectasis the para-nasal sinuses will be found to be diseased. There are three possible explanations of this. The sinus infection may be primary, and the discharge which results, passing down the respiratory passages to the lungs, chiefly during sleep, may set up inflammation there. There is no lymphatic communication between the sinuses and the lungs. The coughing-up of infected matter from the lungs may infect the sinuses. Lastly, and this seems the most probable, there may be a general inability of the respiratory system to resist infection, whether in the sinuses or in the lungs.

Cough which results from the sinuses alone responds rapidly to treatment of the local condition. Attacks of bronchitis have been observed to be less frequent after such treatment when the patient suffered from both sinusitis and bronchitis. J. P. Findlay reports thirty-six cases of pulmonary inflammation in childhood improved by the operation of antrostomy.

Sore throat (25 out of 100 children). In the first group of twenty-four children, all with tonsils and adenoids present but presumably requiring removal, ten gave a history of sore throats. In the second group of seventy-six children, only thirty-five had not had their tonsils and adenoids completely removed before they were found to have sinusitis. Of these thirty-five, twelve suffered from sore throat. Since many of these sore throats may have been a direct result of tonsillar infection, it would not seem that sinusitis is a common cause of sore throat. It is a cause of an irritable 'dry' throat, but such a complaint is not made by children. Tonsillitis sometimes results from antrum lavage.

Cervical adenitis (37 of 100 children). Of the hundred children fifty-nine had their tonsils and adenoids present when they were found to have sinusitis. Of these, twenty-eight had enlarged anterior cervical glands. The tonsils and adenoids had been completely removed in forty-one, and only nine of these were found to have enlarged glands. The glands into which the sinuses drain are the deep jugular, or retro-pharyngeal glands, and the sub-maxillary glands. Palpation of the sub-maxillary glands, and inspection of the pharyngeal wall has not impressed the writer with the frequency of glandular enlargement in sinusitis. Even in acute inflammatory conditions of the sinuses he has been struck by the absence of corresponding adenitis. This clinical observation is in accord with the conclusion of Mullin and Ryder that there is very little absorption by the lymphatics of the sinuses. Reisman makes contrary clinical observations,
Snoring and mouth breathing (62 out of 100 children). To clarify any conclusions from these figures, those children who still had their tonsils and adenoids present should be excluded. Of forty-one children with sinusitis who had had their tonsils and adenoids completely removed previously, twenty-two still suffered from nasal obstruction. This was the result of congestion and swelling of the nasal mucosa together with the presence of discharge in the nose. The nose is a narrower air-channel than the nasopharynx. It is not common to find adenoids so large that they reduce the size of the naso-pharyngeal air-way to less than that of the inspiratory glottis, a necessary condition if they are to cause respiratory obstruction. It is common to find a nasal air-way reduced to the merest chink as a result of swelling of the mucosa and secretion. The 'adenoid facies' is more often the result of naso-sinusitis than of adenoids.

Headache (44 out of 100 children). Headache is not a common complaint in childhood, and its occurrence should arouse suspicion of sinusitis. It was frequent in the series detailed, and this experience has been supplemented more recently. On a number of occasions a search for the cause of headaches in a child has led to the discovery of sinusitis, with subsequent cure by treatment. The headache is usually frontal, even if the antrum is at fault; is often to one side, and is present on several consecutive days, perhaps following a cold. It may present the characteristic daily periodicity.

Otitis media (44 out of 100 children). Recurrent or chronic otitis media is frequently the result of sinusitis. The infected post-nasal discharge runs down over the orifices of the Eustachian tubes and causes inflammation there, which may spread to the ear. As a cause of otitis media sinusitis is only second to adenoid infection, and should always be suspected if removal of adenoids has not resulted in freedom from such attacks. Catarrhal deafness may be dependent on sinusitis, and a return to normal hearing has been effected by antrum lavage in a number of children.

Systemic manifestations. Although sinusitis may exist with apparently excellent general health, the majority of children suffering from it are in poor condition. This may be the cause or the result of the sinusitis, but there is a clinical picture suggestive of the condition. The child is tired and pale, with dark rings under the eyes: he finds it difficult to concentrate, and loses interest in work and play. Also characteristic is a change for the worse in temperament, and instead of being a happy, sunny child he becomes morose, ill-tempered, and difficult to manage. There was great hope that the sinuses would prove to be a common site of focal infection in those diseases such as arthritis and nephritis, which may depend on such a focus. In few cases has this hope been fulfilled, although of recent years at The Hospital for Sick Children, examination of the sinuses has been extensively carried
out in such conditions. Two examples of haemorhagic nephritis depending upon antrum infection have been observed. They both responded rapidly to lavage. It should be recalled that pus in a sinus is strictly speaking outside the body, and that the lymphatic absorption from the mucous membrane is slight.

The individual sinuses.

The maxillary antrum. This sinus is much more frequently the seat of disease than the other sinuses in childhood. The inflammation is usually of a subacute or chronic type. Rarely does acute suppuration with closure of the ostium, pain, tenderness, swelling of the cheek and eye, and acute toxaemia develop. Commonly there is mucoid exudate as a result of catarrhal inflammation; in more severe examples the discharge is mucopurulent. Sometimes pus is produced, and destruction of the lining epithelium, with fibrosis of the sub-mucosa results. Polypus formation is rare in the young. Osteitis of the maxilla may be due to the spread of acute infection from the mucosa, particularly in the first two or three years of life.

The ethmoidal sinuses. Ethmoiditis is probably second to antrum infection in frequency. The inflammation is usually catarrhal, and such a condition is a not uncommon cause of long-continued mild nasal congestion and discharge. Acute suppuration in the ethmoidal cells in very young children is occasionally encountered. The baby is very ill, with high fever and toxaemia. The corresponding orbit is greatly swollen, and the movements of the eyeball are limited or abolished by external pressure; the eyeball may be proptosed. The swelling extends into the upper part of the side of the nose, and this area is tender on pressure. Such a condition has been mistaken for cavernous sinus thrombosis, and indeed this serious complication may arise with a fatal result.

Frontal sinus. Inflammation of this sinus is not very common in childhood. The development of the frontal air-cell varies greatly, both in the individual, and comparing one side with the other. Headache is a prominent symptom in disease of this sinus. It may be of the vacuum type, due to blocking of the long and narrow sinus duct, or a result of increased pressure from retention of exudate. Suppurative inflammation in the young, requiring surgical interference, is outside the writer's experience.

Sphenoidal sinus. Apart from general naso-sinusitis inflammation in this sinus is rare in childhood. Sphenoid suppuration, which led to cavernous sinus thrombosis, was the cause of death in a child at The Hospital for Sick Children.
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Diagnosis.

The diagnosis of sinusitis depends upon recognition of the clinical manifestations, together with certain special examinations. These are inspection of the nose and throat, x-ray examination, transillumination, and puncture-aspiration.

Examination of the nose and throat. This must of necessity be made with a forehead light and with the use of nasal specula of a suitable size for children. Although surprisingly enough sinusitis may exist with little that is abnormal to be seen in the nose, typically the presence of infected discharge results in congestion and swelling of the mucous membrane of the corresponding side. The antrum, the anterior ethmoids, and the frontal sinus all open into the middle meatus of the nose, and exudate from them runs over the inferior turbinate. Muco-pus or pus may be seen in the middle meatus, or accumulated in the inferior meatus. The inferior turbinate is large and red and moist. Sometimes the discharge forms crusts in the nose, and the mucous membrane may be fiery red but dry. In ethmoiditis the middle turbinate may be swollen, so that it presses on the septum. A swollen pale nasal mucosa will suggest allergic rhinitis, not only as a cause of the nasal condition, but possibly the primary source of the sinusitis. Crowding of the nose due to septal deviation or spurs has been mentioned as a possible cause of sinusitis. Such conditions should be noted, but they have played a very small part in the cases recorded here. If the child will submit, posterior rhinoscopy should be carried out. Examination of the throat may reveal post-nasal discharge, either running down the pharyngeal wall, or hanging in a blob behind the uvula. Hypertrophy of the granular lymphoid follicles of the posterior or lateral pharyngeal wall results from infected post-nasal discharge, and should suggest sinusitis.

X-ray examination of the sinuses. This is the most sensitive of all the diagnostic tests for sinusitis (fig. 2, 3, 4). Not only will it reveal gross pathological changes, but it may show a slight and transitory swelling of the mucous membrane. It is of great value, but equally it can prove misleading if not correctly interpreted and co-related with the clinical condition. It has already been mentioned that a common cold running its uncomplimented course produces 'opaque antra,' and allergic swelling of the mucous membrane will show in an x-ray film. Should there be only slight change in the lining membrane as a result of inflammation, but a free production of muso-pus or pus, a fluid level will be shown. If the mucosa is thickened or fibrosed from inflammation, but there is no retention of exudate, an air-space will be seen in the centre of the shadow cast by the membrane, unless it is so dense as to render the whole area of the sinus opaque. Usually there is a thickening of the lining membrane and retention of some muco-pus, and then the shadows so merge together that the sinus in question shows a more or less uniform opacity in the skiagram. It may be safely stated that if a good skiagram of a sinus is clear there is no disease
Fig. 2a.—Date 11.1.32.

Fig. 2b.—Date 3.10.32.

Fig. 2c.—Date 9.11.35.

No. 54.—Table 3.

Nasal discharge, cough, colds, headaches for one year. Mucopus washed out of right antrum 16.1.32. Since then has been free from symptoms.
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Fig. 3a.—Vertical position.

Muco-pus in the antra of a girl aged 9½, showing fluid level, demonstrated by tilting. This child suffered from 'allergic naso-sinusitis.'

Fig. 3b.—Tilted position.

Fig. 4.—Opacity of the right frontal sinus, right ethmoids, and right antrum in a boy of 9.
present. The writer has never obtained muco-pus from an antrum clear to x-rays, and it may be recalled that many antra which proved so to be were aspirated in the course of collecting the children in table 1. Wasson's assumption that the contrary would prove to be the case can be discounted. On the other hand, it is common to wash out an antrum which is opaque to x-rays, and obtain a clear result. The sinus is diseased none the less, but is draining adequately. Bearing in mind the value of a clear skigram, it was satisfactory to find so many of the children studied in this series negative to x-rays after treatment. Much information may be obtained from one x-ray film taken in the upright position with the head thrown back, so that the nose and the chin lie in the vertical plane. A good view is obtained of the antra and frontal sinuses, and the ethmoids are displayed to some extent. The complete x-ray examination of the nasal sinuses requires exposures in several positions. Dr. Bertram Shires kindly undertook all the radiological work to which reference has been made here.

Transillumination. Transillumination is not so accurate as x-ray examination, and in childhood special difficulties make it even less reliable. Poor transmission of light may be due to pathological changes in the sinus in question, but may also be the result of relatively late development; in the case of the antrum in which transillumination is normally of most value, unerupted teeth may cause opacity. X-rays will differentiate between these conditions: transillumination cannot.

Puncture aspiration. The technique of antrum puncture and aspiration has already been described. Although a positive x-ray will serve to make a certain diagnosis of disease in a sinus, the presence or absence of fluid content can only be proved by puncture-aspiration. In addition an opportunity is afforded of discovering the organisms causing the infection. The antrum is the only sinus which is readily accessible to this investigation. Therapeutic lavage will usually be carried out immediately after aspiration, through a cannula left in situ.

Treatment.

Acute sinusitis. It must be emphasized that some degree of sinusitis occurs with every cold. The vast majority of such inflammations settle spontaneously. When a cold hangs about for several weeks the fault usually lies in failure of drainage of one or more of the sinuses. Even then there will usually be no need to resort to surgical treatment, although in the case of the antrum, lavage may be the most expeditious means to recovery. The proper treatment of the cold itself will go a long way to prevent such sequelae as sinusitis and otitis media. The child should be kept in bed, or in a warm well-ventilated room. Sudden changes in temperature are prone to cause nasal congestion. Blocking of the nasal airway should be prevented
by the use of mild shrinking drops. The nasal antiseptic oils, of which so many proprietary preparations exist, are usually too strong for a child, and cause pain on introduction. They should be diluted with liquid paraffin, and a prescription should not contain more than 1 per cent. of mixed volatile oils, and $\frac{1}{2}$ per cent. of ephedrine. The latter is very irritating to some noses. In addition if possible the child should be made to inhale the vapour of menthol or compound tincture of benzoin. Proper nose blowing is important. The nostrils must not be compressed while blowing out. The increase in intra-nasal pressure which results forces matter into the sinuses. The handkerchief should be held loosely round the nose while the child blows down, and the nose subsequently wiped. If the cold still lingers on after a week or two, a holiday, preferably at the sea-side, should be arranged. If that fails, then the point has been reached where surgical treatment of the sinuses may be necessary.

When an upper respiratory infection is more virulent, acute catarrhal or suppurative sinusitis may arise even in the early days of the illness. Should an ostium become blocked there is retention of the products of inflammation with toxic manifestations, severe headache, localized tenderness and perhaps swelling. Treatment in the first place is conservative, an attempt being made to get the sinus to discharge by the use of nasal drops, inhalations, and the local application under vision of 10 per cent. cocaine and adrenaline to the middle meatus of the nose, to reduce congestion. Fortunately aspirin alone often controls the headache. The warmth of short-wave diathermy applied to the nose is comforting, and often beneficial. Such measures are usually rewarded by a discharge of pus from the sinus, and rapid improvement in the symptoms. If they fail, the next step depends on the particular sinus involved. The antrum should be aspirated, but not washed through until the acute process has settled. Acute suppuration in the ethmoid has been described. It calls for an external operation to drain the cells.

**Chronic sinusitis.** All the children in tables 1 and 3 fall into this category. Should the discharge be mucoid the condition is labelled catarrhal. When pus is produced suppurative sinusitis is present. The two conditions merge into each other. In treating chronic sinusitis the importance of correcting environmental and dietetic errors cannot be over-estimated. Local treatment is on the whole successful, but it should be supplemented by general measures. Lavage may clear up an infected antrum, but if the factors responsible for its origin are not removed there can be small wonder if it recurs. A good diet and a few months at the seaside can establish a cure which could not be made permanent by local treatment only; in some instances they alone will suffice, without surgical interference.

The use of nasal antiseptic oils and inhalations is helpful. The nose is thereby rendered less congested, and the sinuses are given a better oppor-
tunity to drain. It is doubtful if such oils ever reach the sinuses themselves, unless special means such as 'displacement' are adopted.

In the majority of cases the sinus inflammation results in, and depends to some extent upon, the retention of the products of infection in its cavity. That the repeated removal of such exudate frequently leads to resolution of the pathological process has been demonstrated clinically beyond doubt, and is reaffirmed by a study of the results of such treatment of the children in this series. The sinus involved in these examples was the antrum, which lends itself to lavage, and forty-three of the hundred children were cured by this means, and a further twenty-three improved. The average number of washes was between two and three, usually at weekly intervals. They were repeated until the result was clear. Subsequently a number of children have had six, eight or even ten weekly washes, with gradual improvement.

In the Aural Department of the Hospital for Sick Children antrum lavage is carried out under local anaesthesia, even in the youngest patients. Only in exceptional circumstances is it found necessary or advisable to employ a general anaesthetic. Cocaine is used, and no disturbing toxic manifestations have resulted from it on well over a thousand occasions. A wisp of cotton-wool is wound round a thin wooden nasal stick, and dipped in 10 per cent. cocaine and 1 in 1,000 adrenaline, equal parts. Excess of solution is squeezed off. The stick is then inserted below the inferior turbinate under vision. If correctly placed it is firmly gripped, and remains pointing laterally as well as backward. It is left in position for half an hour. The child is then laid on his back with the shoulders on a sand pillow, and the head extended. A nurse holds the head with a hand on each side, and the surgeon sits at the end of the table. Such a position prevents the greatest difficulty in antrum puncture in the young—movement of the head away from the surgeon. The point of the trocar must be well up under the root of the inferior turbinate, and is directed backwards, upwards and laterally. When the cannula is in position the antrum is aspirated, and then the child is sat up for lavage. He leans over a basin, and warm sterile saline is syringed through the cannula. It runs out of the nose into the basin taking with it the contents of the antrum. Finally, the sinus is filled with air, and then the cannula withdrawn. No evil effects have followed this procedure if an occasional cold or sore throat, attributed to the release of virulent organisms from the antrum, are excepted.

Direct lavage of the ethmoids and frontal sinuses in a similar manner to the antrum is not possible. A few years ago Proetz introduced his 'displacement method' of treating sinusitis. It is applicable to all the sinuses, but in the case of the antrum, lavage is easier and more efficient.

Briefly, displacement consists in filling the nose with a therapeutic fluid and then subjecting it to repeated negative pressure. Air bubbles out of the sinuses, and the liquid runs in to take its place. A solution of $\frac{1}{2}$ per cent. ephedrine in normal saline is commonly used. It causes shrinking of the mucosa of the sinuses, and renders their ostia more patent. The method is readily applicable to children, and the results in ethmoiditis are certainly good.

In chronic suppurative sinusitis it may be necessary to make a large artificial ostium at a dependent point so that a sinus may drain into the
nose. This should only be done if repeated lavage or displacement fails. In the hundred cases of antrum disease described previously this procedure intranasal antrostomy was resorted to in eleven instances: of these two made complete recoveries, six were improved, and three remained unchanged.

The operation is performed under general anaesthetic, after shrinking the nose. The inferior turbinate is fractured upwards, and as large an opening as possible is punched out between the inferior meatus and the antrum. Good ventilation of the air cell is attained, and if necessary lavage is easily carried out by a curved blunt cannula.

In advanced suppuration of the antrum with degeneration of the mucous membrane, a Caldwell-Luc operation may be necessary.

Chronic ethmoiditis may demand the opening of the ethmoid labyrinth, but in childhood this should only be done if there is necrosis of bone.

Some success has attended the use of autogenous vaccines prepared from organisms grown from sinus aspiration.

Prognosis.

Of a hundred children, fifty-two were cured, thirty-two improved, and sixteen remained unchanged. The results in these hundred children give a fair picture of the degree of success which has attended the treatment of greater numbers subsequently. In estimating the prognosis, two important factors must be considered; first, the degree of pathological change in the sinuses, and secondly, the general condition and environment of the child. The infecting organism may have a bearing on the question, and it has already been suggested that streptococcal lesions are more resistant to treatment. Anatomical deficiencies, and other pathological states in the nose and throat affect the prognosis. A nose which is unable to function normally owing to the presence of an enlarged or infected pad of adenoids, or of a deviated septum, or because it is itself small and crowded, will make the prognosis less good, if the defect is not rectified. Similarly a sinus which has an unusually small ostium is at a disadvantage.

A complete cure can be anticipated in about half of the children suffering from chronic antrum infection. Many of them will have had symptoms of sinusitis for many months, or even a few years, following upon repeated colds or one severe cold, influenza, whooping cough, or some other infection. On washing out the sinus in question muco-pus or pus is obtained. There is a gradual improvement following each lavage, the result becoming less purulent and more mucoid, until eventually it is clear. In obstinate cases washing may be necessary every week for a month or two. An x-ray taken at the end of treatment will still be opaque. It takes some time for the mucosa to return to normal even after it has ceased to be actively inflamed. Sometimes the result of a single wash is a dramatic cessation of symptoms which may have been present for many months. Probably the explanation
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of such satisfactory cases is that the antrum has harboured a clot of mucus too big to escape normally from its ostium. The presence of the clot keeps up irritation of the mucosa, and discharge. Its removal is followed by immediate recovery of the mucous membrane which was not grossly infected but merely irritated mechanically. Of the fifty-two children who recovered completely, seven belonged to the first group and their antra were clear six months after tonsillectomy, without other local treatment. They represent either spontaneous recovery, or recovery as a result of removal of the tonsils and adenoids. They are not comparable to the second group where the diagnosis was made by clinical observation.

In about one-third of children suffering from antrum infection, improvement but not complete cure is attained. They will generally be found to suffer from one of the disadvantages mentioned previously; poor general condition, bad environment, a virulent or long-standing infection, or some other debilitating factor in the nose or throat. In this category were thirty-two of the hundred children. They were usually well for a week or two after a course of lavage, but their symptoms recurred whenever they caught a cold. Some of them remained quite free from some of their symptoms, while retaining others.

A certain number of children with sinusitis resist every method of treatment which has been adopted. There were sixteen such children in the hundred. This number might have been less had they attended regularly for treatment, but as far as it went it was doing them no good. The degeneration of the mucosa of their antra may have been so advanced that nothing short of its complete removal by the Caldwell-Luc method would suffice. The writer hesitated to resort to this operation in such young subjects, and probably erred on the side of caution. If the opportunity were there they would all be sent to some far-off, dry, sunny climate for a year. They could be no worse, and might be much better.

The relationship between sinusitis and infection of the tonsils and adenoids.

For many years attention has been focussed upon the tonsils and adenoids as the centre of pathology in the nose and throat of children. Probably this is as it should be, and there is no operation of choice in surgery rewarded with such satisfactory results as removal of tonsils and adenoids properly performed for correct indications. On the other hand, there can be no doubt that much illness arising in the nose and throat for which the tonsils and adenoids were not responsible, has been laid at their door. An attempt has been made in this paper to demonstrate the frequency of sinusitis in childhood, and to draw attention to the clinical picture which should arouse suspicion of its presence.

Two questions come to mind. Are infected tonsils and adenoids the usual cause of sinusitis in childhood? If so, it must be as a result of
adenoids so large as to interfere with nasal ventilation, or of surface-spread of infection from the pharynx to the nose, against the normal mucus stream kept up by the cilia. The removal of tonsils and adenoids should result in the cure of sinusitis; and sinusitis should not be common among children whose tonsils and adenoids have previously been removed. It has been shown in table 1 that of twenty-four children with mucus, muco-pus or pus in their antra, only nine cleared up following removal of the tonsils and adenoids, and it is reasonable to suppose, bearing in mind the means of diagnosis of these cases, that some at least would have done so without operation. Table 3 demonstrates that of seventy-six children with sinusitis, forty-one had previously had their tonsils and adenoids completely removed. The broad conclusion is justifiable that infection of the tonsils and adenoids is not the common cause of sinusitis in childhood, and that their removal is neither a preventive or cure of the condition.

Is inflammation of the para-nasal sinuses a common cause of infection of the tonsils and adenoids? As the flow of post-nasal discharge is directed over the adenoids and posterior halves of the tonsils, the mechanical possibility of their infection from the sinuses is evident. If such an infection takes place, children with sinusitis should have diseased tonsils and adenoids. It is very difficult to draw conclusions upon this point from the cases studied here. Of the seventy-six children in table 3, forty-one had already had their tonsils and adenoids removed when sinusitis was diagnosed. Perhaps they were removed for independent disease before the sinusitis was present, perhaps because they were infected from post-nasal discharge from sinusitis; perhaps because of symptoms which should have directed attention to the sinuses rather than to the tonsils and adenoids themselves. It is even possible that the sinusitis originated in some instances as a result of faulty technique during operation. What of the thirty-five children in this group who still had tonsils and adenoids present? There were remnants from unsuccessful operation in nine of them, and they must be discounted. Consider then twenty-six children with sinusitis, and tonsils and adenoids present. In nine of these they were infected and removed in the course of treatment; in six they were infected but not removed for one reason or another; in eleven they remained healthy; eight of these latter being in children with sinusitis that was cured by treatment, and three in those who improved. Arguments for and against sinusitis as a cause of infection of the tonsils and adenoids can be deduced from these figures.

The writer believes that sinusitis is a common cause of inflammation of the adenoids, and to a lesser degree of the tonsils. The first step in the treatment of sinusitis is the treatment of the sinus itself, and not the removal of tonsils and adenoids. If the latter are infected and fail to respond to such treatment they should be removed. If there is a large pad of infected adenoids interfering with respiration, treatment of co-existing sinusitis is not likely to lead to cure until it is removed.
REFERENCES.

It is possible that the adenoids and over the sinuses; therefore, it was decided to remove them at the same time. The adenoids and the tonsils were removed in an eleven-year-old child on September 20, 2023, by guest. Protected by copyright.
REFERENCES.


9. Mullin, W. V., & Ryder, C. T., Laryngoscope, St. Louis, 1921, XXXI, 158.


