THE TONSILS AND NASOPHARYNGEAL EPIDEMICS *

BY

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In a paper on nasopharyngeal epidemics presented to the Section of Epidemiology and State Medicine of the Royal Society of Medicine on 22nd June, 1928, J. A. Glover suggested an investigation into the 'relative incidence of droplet infections upon children whose tonsils have been enucleated and whose adenoids have been removed, compared with children who have not been operated on.'

I have attempted this investigation, and by reference to a small part of the literature on the subject, to discuss my observations.

The material observed is a public school for boys. A preparatory school is included, so that the ages of the boys under observation range from ten to eighteen years.

The enquiry resolved itself into two parts :—

Part 1. The condition of the throat in health.

Part 2. The incidence of catarrhal disease.

1.—A sample of the school, 289 boys in good health, was examined during the second half of July, 1929, and data relative to the tonsil, the oral pharynx, the buccal mucosa and the cervical glands noted. The figures obtained are compared with the results found in Part 2.

2.—An analysis was made of my records of the acute, non-notifiable, upper air-passage infections occurring in the same boys during the four preceding school terms. A period of approximately one year of actual observation, but including two summer terms, is therefore dealt with. Ill health during vacations is not considered.

Whereas the figures given in Part 1 may be taken as fairly typical of this class of community, those in Part 2 can in no way be looked upon as constant. They are dependent on the epidemic constitution at the time, and in the locality of the observation. Any conclusions drawn from this comparison can relate only to these particular circumstances. The setting during this period was one of epidemic sore throat, but apart from the fact that an epidemic of streptococcal tonsillitis might be expected to bias the figures against the much maligned tonsil, the writer believes his conclusions are reasonably true for all acute catarrhal upper air-passage infections.

It must be remembered that this semi-isolated community provides an environment favouring the spread of what, in the present state of our knowledge, appear to be droplet infections. As Glover says 'A school seems to be designed for epidemiological study'¹, and Sydenham advises 'To fish out the species of a continued fever choose for your field of observation some large and

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populous place.' One can 'fish out' very little in the small household, and yet my impression is that, broadly speaking, I find my conclusions applicable to my general practice outside School.

PART 1.

Condition of the throat in health.

Material investigated.—The 289 boys examined represent only a part of the School. They were all in good health at the time, boys sick or recently sick being excluded so that the figures in Part 1 should be of value as a normal standard. Of these boys 60, or 20 per cent., had had no illnesses during the previous four terms; 50 have been selected as 'habituals.' The latter boys were admitted to the school infirmary at least thrice during the period under survey, and are those who lost most time as the result of catarrhal infections. The 'habituals' are not necessarily bad material. On the whole they are up to the usual standard of physical development, and I think it would have been impossible for an outside observer to pick them out as 'habituals' at the time of this examination. Naturally they show signs of disease for a while after each attack, and may become seriously debilitated after a recurrence, but at midsummer they were as healthy as the rest of the school.

The time of this examination is important. Upper air-passage infections are least frequent at the end of the summer term, and these throats were seen under optimum conditions for health. Other observers have failed to distinguish between the appearance of throats in summer and winter. It is not unusual to find as many as 80 per cent. hyperæmic throats in a batch of boys seen in the winter, and a large tonsil in the winter may be one of normal size during the summer.

The main findings are shown in the following Table 1 :—

TABLE 1.
CONDITION OF THE THROAT IN HEALTH (289 BOYS).

	All cases		Never ill		Habituals	
	No.	%	No.	%	No.	%
Total numbers	289	—	60	21	50	18
Tonsils :						
present	122	42	22	37	21	42
large	59	22	8	13	11	22
removed	167	58	38	63	29	58
Remnants :						
present	120	42	23	38	18	36
large	66	23	14	23	8	16
Pharyngeal granulations	101	35	21	35	20	40
Cervical glands :						
palpable	123	43	29	48	18	36
large	82	28	18	30	11	22
Unhealthy throats	23	8	6	10	5	10

Definition of groups.

TONSILS PRESENT.—This includes all cases not operated upon, and one or two instances where a boy was uncertain whether he had been operated upon or not. I did not find a case with a natural absence of tonsil.

TONSILS LARGE.—I hesitate to speak of 'enlarged' tonsils because the term would seem to imply a pathological process. In point of fact nine of these cases showed some pathological sign and are discussed later. It is difficult to define a standard for the measurement of enlargement. In this analysis a tonsil extending beyond the posterior pillar of the fauces is said to be large. These are certainly cases in which tonsillectomy would be performed were enlargement per se considered to be an indication for removal.

TONSILS REMOVED.—This includes all cases operated upon. No attempt has been made to distinguish between dissection, guillotine enucleation and simple cutting. The age at operation was noted but has no apparent effect upon the occurrence of remnants.

REMNANTS PRESENT.—This disregards size and includes nineteen in which the remnant amounted to nothing more than a few granulations under half a cubic centimetre in size, in all probability grown since operation.

REMNANTS LARGE.—More than one cubic centimetre of tonsil substance remaining in the throat has been assessed a large remnant. In 11 per cent. of the total cases remnants exceeded two cubic centimetres and occurred twice as frequently in 'habituals' as in the 'never ill' group. Appreciable lingual remnants were seen in 10 per cent. of all cases. These are less easily observed than faucial tissue, and the figure given is, therefore, probably insufficient. They were equally distributed between 'healthy' and 'habituals' and in 4 per cent. of all cases occurred in the complete absence of faucial tonsil.

PHARYNGEAL GRANULATIONS—as seen by direct observation through the mouth with soft palate lifted. The material examined does not include boys with obvious nasal obstruction or gross adenoids—conditions thought to require curettage and treated accordingly. The granulations observed are those on the posterior pharyngeal wall which are, I believe, sometimes the cause of the diagnosis 'granular pharyngitis.' The presence of these lymphoid nodules in the pharynx is suggestive of their presence higher up in the nasopharynx, in a position where, if enlarged, they could be called adenoids. Lateral 'granulations,' those masses of loose mucous membrane immediately behind the posterior pillars of the fauces, are not included because in the presence of large tonsils it is almost impossible to observe them, a circumstance which precludes them from statistical investigation. Large lymphoid nodules are frequently seen in this region and sometimes, when the pharyngeal constrictors and the pharyngo-palatine muscles are contracted, these masses appear to be as large as tonsils. They deserve particular attention, and may be of great importance in nasopharyngeal infections. It is across this area of mucosa that the main stream of discharge from the post-nasal space passes. I should like to repeat Lowndes Yeate's experiment with indigo carmine injections into the nasal sinuses which would, I believe, show particularly active cilia along this track. In disease they are the parts most constantly inflamed. Anatomically they

are intimately related to the tonsil and it is probable that they have an equally close physiological association, acting as the catchment areas drained by the tonsils. They are so very much under cover of the tonsil that careless observation of the throat does not reveal their presence and the text-books seldom mention them. Paton⁶ in his clinical notes on influenza, makes special reference to them and looks upon their involvement as peculiar to influenza. In this he is certainly wrong, for in most common colds these folds of mucosa will be seen to be red and covered with a stream of muco-pus. In tonsillitis and in all upper air-passage infections they appear more hyperæmic than the surrounding tissues, and exudate is frequently seen on them. A peep round the posterior pillar of the fauces will frequently show an extensive area of membrane in this region in faucial or nasal diphtheria.

CERVICAL GLANDS PALPABLE.—Observations on the anterior cervical glands are recorded. The posterior triangle was not examined. Some anatomical text-books teach that the posterior groups drain the adenoids and posterior pharyngeal wall. This is probably true but rubella is the only nasopharyngitis in which I have found any constant enlargement of this group. I have always associated the deep sub-sternomastoid glands with acute pharyngeal infections, and this group is included in my observations. Glands were palpable in 43 per cent. of the cases examined, and were enlarged in 28 per cent. of the same group. This fraction is dealt with in the next paragraph.

CERVICAL GLANDS LARGE.—Again there is difficulty in defining enlargement. The 28 per cent. in this category were easily felt, and many of them were sufficiently enlarged to make one anxious to exclude chronic infection. The boys were examined at midsummer and acute infections played no obvious part in the enlargement. I am satisfied that the enlargements included in this series are within physiological limits, although in one or two cases the family doctor had instituted special treatment. In three boys glands had been incised or removed, and in two of these cases large glands have survived the operation, are freely moveable, and have been so long quiescent that anxiety is no longer felt about them.

UNHEALTHY THROATS.—Under this heading pathological appearances in the throat are tabulated. It includes the following conditions :—

Cheesy matter and exudate in the crypts	3
'Specks' (typical of the streptococcal sore throat discussed later) on tonsil or pharyngeal granulations ..	6
Bloodstained pus in the nasopharynx	2
Relaxed sore throat, i.e., faucitis	3
Otherwise unhealthy appearance	9

Mucus or mucopus in the nasopharynx is not included, but was very seldom seen in July.

OTHER OBSERVATIONS.—Figures were also collected with regard to the appearance of the wall of the mouth. Oedema of the buccal mucosa was seen in 6 per cent. of the cases examined and appeared to be more frequent in boys frequently ill. A boggy mucous membrane is very commonly seen in naso-

pharyngeal disease and is most obvious along the line of junction of the teeth when the jaws are closed. There is sometimes a marked ridge in this region, and desquamation occurs along the crest of this ridge. This desquamation is very similar to that seen in the region of old Koplik's spots. Minute petechiæ are also fairly common in the normal mouth but occur in the region of the back molars, a little behind the usual location for Koplik's spots. They are surprisingly constant in this position although they may occasionally be seen on the fauces and soft palate. Sometimes they desquamate and may then be confused with Koplik's spots, but they are never bluish in colour neither have they an areola. These petechiæ were seen in 9 per cent. of the boys examined and were evenly distributed among the groups discussed. They are mentioned here because it is believed that they greatly increase in incidence in the presence of certain naso-pharyngeal infections, and figures are quoted for purpose of control. Hill^{1a} mentions a relationship between permanent turgidity and overgrowth of the nasal and buccal mucosa and sexual development. I find no evidence of such a connection.

Discussion.

It was hoped that this investigation would permit conclusions to be drawn as to the value of tonsillectomy in the control of the common naso-pharyngeal infections. The data in Table 1 suggests that some benefit is to be obtained from removal of tonsils for, whereas the figures for tonsillectomy are the same for 'habituals' as for the mean of the School, operation has been performed a little more frequently in those cases tabulated as 'never ill.' The advantage is, however, small—but 5 per cent.—and may have been gained by the provision of adequate airway or by the removal of chronically infected tissue. It is almost negligible and not outside the limits of possible statistical error. Further discussion of this subject will be postponed until the incidence of sickness in the presence or absence of tonsils has been considered.

Of 167 operations, 60 (36 per cent.) are considered as being surgically successful; 11 cases of lingual remains and 19 cases in which the remnants were very small are included among the successful cases so that in only 30 (18 per cent.) was complete eradication performed. Paton⁴ found no tonsil visible in 46 per cent. of operated cases. In no part of his paper does he mention lingual tonsil. Coues² found 30 per cent. of tonsillectomized children suffering from chronic tonsillar hypertrophy whereas in 12 per cent. of my operated cases the remnants amounted to normal or large tonsils in size. Although there is considerable variation in these figures, the general conclusion must be that in the majority of cases operation has failed to eradicate tonsillar tissue.

Can it be that in the 'never ill' group operation has been more complete than in the 'habitual' group? The proportion of operations considered to be successful was found to be the same in both groups; remnants, particularly large remnants, being less frequent in the sick than in the healthy, to an extent which cancels the excess of operations in the 'never ill' group.

Over 50 per cent. of 122 unoperated cases showed large tonsils. Coues² reports 72 per cent. with 'marked chronic tonsillar hypertrophy' but he found no case of acute tonsillitis among 212 children at the time of

examination, and he appears to have been dealing with a healthy community. But Coues' operation rate was only 20 per cent. against my 58 per cent. I take it that the majority of the operations in this 58 per cent. were performed for enlargement, and had my material been less well cared for my figures for enlargement might well have approached his. It appears, therefore, that large tonsils are the rule rather than the exception, and it is not easy to find an indication for surgical alteration of this rule on account of size only. Operation for simple enlargement continues to be a common practice in spite of considerable clinical evidence demonstrating its uselessness.

Kaiser³ examined 5,000 cases and found that, in the absence of obstruction or obvious infection, there was no change in the patient's condition a year after operation.

Paton⁴ has made a careful analysis of 424 cases, and, writing on the same subject in the reports of the St. Andrews Institute for Clinical Research⁵, says 'it is difficult to believe that there is justification for so widespread an attack upon a normal structure of the body.'

Coues, however, puts a different interpretation on his results. He writes:— 'these figures show the need for keeping up and increasing this work' (of tonsillectomy).

TABLE 1A.
COMPENSATORY HYPERTROPHY OF OTHER LYMPHOID TISSUE AFTER TONSILLECTOMY.

	No operation		Operation	
	No.	%	No.	%
Total numbers	122	42	167	58
Pharyngeal granulations	35	35	66	65
Glands :				
palpable	49	40	74	60
enlarged	32	39	50	61
Unhealthy appearance	16	70	7	30

Large tonsils are much less frequent in the healthy than in the 'habituals.' At first sight this observation suggests an argument in favour of tonsillectomy, but it must be remembered that the tonsillar enlargement is post hoc and not propter hoc to disease and is probably physiological and not pathological. This remark also applies to pharyngeal granulations which are most obvious in the habitually ill and in operated cases (vide Table 1A). Paton⁴ found that granular pharyngitis was present in 24·8 per cent. of unoperated cases and that this figure rose to 30·7 per cent. in operated cases with remnants and 38·1 per cent. in those in whom eradication of the tonsil was complete. He concludes 'it is evident then that the tonsil adenoid operation is followed by compensatory hypertrophy of the lymphoid tissue of the pharynx.' My figures appear to justify the addition of the words 'in the presence of acute U.A.P.I.* for these granulations can be seen to 'grow' during catarrhal infections in

* U.A.P.I.—Upper Air-Passage Infections.

THE TONSILS AND NASOPHARYNGEAL EPIDEMICS 341

the same way as remnants become apparent in the presence of acute inflammations. Moreover they were found to be scarcest—but 20 per cent.—in the clean operation cases of my ‘never ill’ group. Table 1A shows some further evidence of compensatory hypertrophy in the figures for cervical glands.

Returning to Table 1, it will be seen that there is little difference in distribution between palpable and easily felt glands in the various groups. Those cases in which enlargement was sufficient to give suspicion of disease were associated as follows :—

Small tonsils..	..	..	2
Large tonsils	..	..	1
Remnants ..	..	..	3
Large remnants	..	..	1
Clean	..	..	1

figures too small to permit conclusion, but certainly not associating adenopathy with tonsillar enlargement in health. Glands above suspicion are slightly more numerous in boys not subject to U.A.P.I. and in boys upon whom tonsillectomy has been performed. This even distribution of glands is unexpected. It contradicts the traditional text-book teaching, and seriously challenges the statements of many writers, including Pentecost⁷, who found improvement in the cervical glands and common colds in 800 children examined after tonsillectomy. Davis⁸ anticipates my conclusion when he states that tonsillectomy offers no diminution in the liability to glands in the neck.

It must be remembered that the anterior cervical glands drain the mouth as well as the fauces and pharynx. Glandular enlargement is common during the eruption of the teeth and George H. Wright⁹ has pointed out that enlargement of tonsil may be physiological and of a temporary character dependent on the stimulation accompanying the four periods of molar eruption. He might have mentioned the submaxillary and tonsillar glands with the tonsil.

Perhaps the greatest interest is centred round the high percentage of glands in the ‘never ill’ group and reference to Table 2A will show that large glands were not found in any boy who had suffered from a complication.

Ledingham and Arkwright¹⁰ refer to Goppert’s work on meningococcal infections, which showed that glands were more frequently found in healthy contacts than in meningitic patients. Busse¹¹ confirms the suggestion that lymphoid hyperplasia protects from, rather than predisposes to, nasopharyngeal infections.

I believe the position is much the same in the presence of acute upper air-passageway infections. Adenitis is frequently more obvious in the absence of tonsil than when the tonsils are present and acutely inflamed. I have not yet met an epidemic of glandular fever or the pseudo-glandular fever in which adenitis is a marked feature of a naso-pharyngeal infection, and I hesitate to make this statement in unequivocal terms.

Paton⁵ writes : ‘Tonsillar disease sufficient to induce *glandular enlargement may be present without enlargement of the tonsil*’ in relation to the examination of a number of healthy school-girls. I suggest that there is no

justification for mentioning disease, and that the statement in italics (which are mine) is sufficient in itself. The same writer⁴ gives figures from 428 girls, and concludes that the 'completeness or incompleteness of the enucleation does not affect the incidence of enlarged glands.'

Pathological appearances were observed as frequently in the 'never ill' group as in 'habituals' but 70 per cent. of them occurred in boys not operated upon. This is what would be expected and, since lymphoid tissue is the only nasopharyngeal tissue demonstrating easily observed signs of inflammation, the percentages shown in Table 1A for unhealthy throats are really meaningless. In no case was the unhealthy appearance associated with ill health at the time of examination, and the history of the boys concerned was good. Four were 'habituals,' six are included in the 'never ill' group, the same number had remnants and one had no tonsils but an oedematous uvula. The morbidity amongst these boys was 74 per cent. and the average number of admissions 1.26, both figures below the average for the school. Three only gave evidence of chronic tonsillitis, and have since been operated upon, but one cannot help fearing that some of the others—particularly the 'never ill'—are immune carriers in whom a surgical spring-clean is indicated for the good of the community. And yet how difficult it is to bring home the charge against them, until our knowledge of the bacteriology of the nasopharyngeal infections has emerged from its present chaotic state, and until the importance of the immune carrier in droplet infections becomes more fully appreciated by the profession and public at large.

Conclusions.

A survey of the throat appearances of healthy school boys shows that tonsillectomy fails to eradicate tonsillar tissue in the bulk of cases. Reduction, by operation, of the amount of tonsillar material is followed by a compensatory hypertrophy of other lymphoid tissue in the neck. This hypertrophy appears to be stimulated by catarrhal infections but is least marked in boys frequently attacked by nasopharyngeal disease and those suffering from complications.

In cases still possessing tonsils hypertrophy of the tonsil is more the rule than the exception and is most frequent in boys habitually ill.

These findings suggest that there is an optimum amount of lymphoid tissue necessary for the protection of the body from nasopharyngeal diseases and their complications. Removal of part of this tissue by operation is followed by a physiological replacement in the same or other regions of the neck. Until this compensation has occurred there is increased liability to catarrhs in susceptibles.

PART 2.

The incidence of catarrhal disease in relation to throat appearances in health.

Before proceeding to discuss my figures under this heading I must emphasize the fact that my observations are limited to a period of four school terms. The epidemic state of affairs in a semi-isolated community is constantly changing and for this reason I must weary my readers with descriptions of the conditions met during the period under survey.

Recent history of nasopharyngeal infections in the school.

The period dealt with in this paper—May 1928 to July 1929—was unusually healthy. It was preceded by a Lent term in which a typical influenzoid epidemic with a steeple-like incidence curve involved 30 per cent. of the school. The zenith was reached on February 14th, when fifty-six of three hundred and thirty boys were ill. The infection appeared to have exhausted itself in five weeks but was followed by a slowly descending curve of trailers. Pneumococci predominated and an indefinite Type IV organism was found in almost pure culture in post-nasal swabs taken from nine boys in adjacent beds at the same time. The disease increased in virulence with passage and six cases of Type I pneumonia (one fatal) resulted about March 1st. To my mind there is very definite evidence of mutation of coccal type in vivo in pneumococcal fever. Two undoubted cases of 'influenzal' jaundice occurred. Schroder and Cooper³⁶ have described a similar explosive epidemic in a childrens' home—a Type V pneumococcus being causal. Streptococcal sore throat next appeared, otitis media was unusually common and three mastoids (all streptococcal), resulted, the first of them on March 19th.

The Summer term of 1928, with which the period here discussed begins, was very healthy. Febricula and coryza recurred sporadically and were associated with a few other cases of streptococcal sore throat. Some mild gastro-enteritis occurred in a short epidemic without signs in the upper air-passages. It was attributed to pollution of an open-air swimming bath in which faecal organisms had become concentrated.

Michaelmas term opened in much the same way. Streptococcal sore throat was constantly present, and one severe acute nephritis of the hydræmic type was detected. At the beginning of December the speckled sore throats increased in severity and prevalence, and otitis media again became frequent. Lent term 1929 was peculiar. Influenzoid was sporadic only, although in other schools and in the outside community there was a marked and serious wave. Freedom of a school in the presence of an epidemic outside is by no means an unusual phenomenon, and examples of it have been observed at King's College School, Cambridge²³ and at Rugby School in November 1928¹⁴. This immunity was not due to any attempt at prophylactic vaccination. The weather was particularly bad with long frosts, and visiting football and hockey games were cancelled. A pneumococcus was, however, with us and a steeple-like wave of apyrexial and often symptomless catarrh spread over the school, giving rise to 'pink-eye,' which incomplete and not absolutely convincing investigation proved to be pneumococcal of low mouse virulence. Koch-Weeks bacillus was not found. The catarrh persisted for some weeks in a few cases and was most troublesome in the adults of the community. Two adults contracted pneumococcal pneumonia of low virulence at the end of the wave, and one died after a relapse due to an unidentified diphtheroid. Of these pink-eye cases twelve were pyrexial and were admitted to the infirmary. They are included in my figures as febricula and coryza. The immunity of the school from influenza may be attributed to the fact that the general epidemic outside did not commence until mid-January, soon before the school had started¹⁹ and

very little contact with the outside world was allowed owing to the hard weather. On the other hand the conjunctivitis, as soon as it became evident that an extensive epidemic was imminent, was met by a universal dropping into the eyes of 1 per cent. mercurio-chrome, a process which was repeated three or four times. The instillation of antiseptics into the conjunctival sac in the prophylaxis and treatment of nasopharyngeal infections is no new idea, but I doubt if the school's freedom from influenza can be attributed to it, although I think the method is worth a further test. Our immunity coincided with the administrations of a vitamin B preparation to the whole school, and it appeared that while this preparation was being used the health of the school improved. I have since had cause seriously to doubt this association.

TABLE 2.
INCIDENCE OF ACUTE NASOPHARYNGEAL DISEASE.

	All cases		Habituals		Tonsils							
					No op.		Large		Op.		Remnants	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Population at risk ..	289	—	50	—	122	—	59	—	167	—	107	—
Totals :												
Boys sick ..	238	82	50	100	99	81	52	88	139	83	96	90
Admissions ..	441	156	174	348	188	154	98	166	253	151	166	155
Details :												
§A. Boys sick :												
Sore throat ..	171	59	41	82	85	70	46	78	86	51	61	57
Coryza and febricula	105	36	35	70	35	28	18	30	70	42	39	27
Gastro-enteritis ..	30	11	11	30	13	11	7	12	17	11	11	12
§B. Admissions :												
Sore throat ..	233	81	84	168	118	97	64	108	115	68	80	75
Coryza and febricula	149	52	67	134	52	43	26	44	97	58	53	50
Gastro-enteritis ..	33	11	15	30	14	11	7	12	19	11	13	12
Influenzoid (trailers)	14	5	6	12	4	3	1	2	10	6	8	7
P.U.O., etc. ..	13	5	2	4	—	—	—	—	13	8	5	10
Total		156		348		154		166		151		155
§C. Morbidity of												
Susceptibles :												
Sore throat ..	—	136	—	249	—	127	—	139	—	134	—	131
Coryza and febricula	—	142	—	191	—	148	—	144	—	138	—	140

Speckled tonsils became more frequent about the end of February, and continued in a scattered incidence throughout the rest of the term and the following summer term. It was accompanied as usual by febricula and common cold. There was evidence of the usual seasonal decline in U.A.P.I., but summer failed to give us absolute freedom, doubtless on account of the endemic streptococcal parasitism which shows no marked seasonal variation

Rubella produced a widespread epidemic during this summer term. The first few cases were isolated but the extension of the disease was not controlled. Isolation was, therefore, discontinued and the disease was treated in the school, except when symptoms were marked and malaise incapacitated boys. No other notifiable diseases occurred.

Definition of terms.—The material examined in this section is the same as that described in Part I and the definitions of Table 1 apply to the headings in Table 2. Certain items in the left hand column of Table 2 require extensive consideration and are dealt with later under 'discussion of diagnosis.'

The percentages in section A—'Boys Sick' and section B—'Total Admissions' are percentages of the population at risk shown at the head of the columns. The reader may find it easier to multiply these figures by ten when they represent morbidity per 1,000. In section C, which records morbidity of susceptibles, the divisor is the number of boys sick with either sore throat or coryza, i.e., section A. This figure represents the number of known susceptibles to either of these conditions. Thus:—

$$\left. \begin{array}{l} \text{Morbidity of sore throat} \\ \text{susceptibles with large} \\ \text{tonsils} \end{array} \right\} = \frac{\text{Admissions for sore throat of boys with large tonsils}}{\text{Boys with large tonsils sick with sore throat}}$$

$$= \frac{64 \times 100}{46} = 139 \text{ per cent.}$$

BOYS SICK AND TOTAL ADMISSIONS.—This includes all cases admitted to the infirmary for pyrexial catarrh of any type, rubella excepted. The mildest indisposition was excluded from school for observation and any temperature over 99.4 is recorded as a pyrexia. It will be clear that the total of boys sick is not the aggregate of figures for boys sick from the several conditions. A boy susceptible to both coryza and sore throat will figure as one case in the total but as two in the aggregate—one in each of the coryza and sore throat groups.

SORE THROAT.—This term is used here to represent a specific disease and not a symptom. The type of disease is described and discussed later and inclusion in this group depended upon the observation of characteristic exudate on the patient's throat.

CORYZA AND FEBRICULA.—This group contains those catarrhs which could not be placed into the other groups. It is the pool into which cases of nasopharyngeal infection showing no distinctive sign have been put and therefore contains many cases which should appear in other sections.

GASTRO-ENTERITIS.—Epidemic diarrhoea and vomiting are the criteria for inclusion in these sections. Pyrexial acidotic vomiting and feverish dyspepsia occur occasionally but are not included in this paper as I am not sure where to put them. They probably come into this group.

INFLUENZOID.—These cases are most probably sporadic trailers of what I prefer to call pneumococcal fever. Although the bacteriology was not investigated they were typical of the epidemic cases of Lent term 1928 and

resemble Simey's second type of febricula¹⁴. They differ from the febricula of my period in many ways but most definitely in that:—

1. At the onset the temperature is sub-normal and the pulse temperature ratio very high—temperature 95·6, pulse 120 is a common ratio. Within six hours this ratio is reversed and becomes low.
2. The 'grip' is obvious and the onset particularly sudden. Unbearable malaise is, as a rule, the only symptom at onset.
3. The skin reaction is marked; a moist, flushed skin with profuse sweating is usual.
4. Apart from slight generalized oedema of the nose, throat and mouth, anginal signs are absent.
5. Prostration is marked. These boys curl up under the bedclothes. They will neither eat nor attempt to read, talk or move. A case of febricula, even with a high temperature, is still a boy. Influenza takes away all his boyishness, and a ward full of influenza is silent and motionless.
6. Pyrexia is high, shows a fastigium, and falls by crisis. The plateau-like chart is easily distinguished from the irregular curve given in streptococcal infections.

PYREXIA OF UNKNOWN ORIGIN, ETC.—The bulk of these cases had pyrexia without signs. The upper air-passages appeared to be healthy and no cause for the fever was found elsewhere. They should in all probability be included under febricula and coryza. It is interesting to note that tonsillar tissue in the form of remnants was present in most cases but showed no signs of disease.

Discussion of diagnosis.

General epidemiological considerations.—The embryo epidemiologist fears that it may be a grave presumption on his part to attempt to discuss a subject at present sub judice in the hands of his peers, the Committee of investigation into epidemics in schools. He feels that certain fundamental points occur to the school medical officer as the result of his intensive clinical observations, which are missed in investigations based mainly on notifications and sickness returns. The main difficulty is in diagnosis and the definition of separate clinical entities. The notifiable and common infectious diseases of childhood present little difficulty. The febricula-like forme fruste of the notifiables can, as a rule, be classified in the presence of an epidemic, unless the forme fruste outnumbers the typical manifestation of the disease, as instanced in Glover's investigation into dropping cases of scarlet fever¹.

Febricula and some cases of pyrexia of uncertain origin are, I believe, mainly forme fruste of other U.A.P.I. I have seen a family of nine children with common colds in which a persistent rhinitis in one case has led to the discovery that the Klebs-Löffler bacillus was the cause of all the catarrhs. Osler¹³ writes 'It is not very unusual, during an epidemic of typhoid, scarlet fever, or measles, to see cases with some of the prodromal symptoms and slight fever, which persist for two or three days without any distinctive features. I have already spoken of these in connection with the abortive type of typhoid

fever. Possibly, as Kahler suggests, some of the cases of transient fever are due to the rheumatic poison.'

The steeple-like epidemics of influenzal type are easily recognized when once established, but the first cases and the trailers to the epidemics are identified with less certainty. The same must be admitted of the many different forms of tonsillitis and sore throat. Coryza is most typical in the absence of pyrexia: then it appears to be a well defined and distinct disease. But when the cold is a feverish one its differentiation from the other catarrhs becomes so difficult that Simey¹⁴ writes 'It seems highly probable that coryza, febricula and influenza are an inseparable group of diseases beginning in the upper respiratory tract.'

The question 'Are these sub-divisions separate clinical entities?' must be answered. Paton⁵ in an admirable discussion of a series of cases conventionally diagnosed

1. Febricula or P.U.O.,
2. Vomiting or gastro-intestinal catarrh,
3. Sore throat or pharyngitis,
4. Follicular tonsillitis,
5. Bronchial catarrh,

shows how much alike are these conditions, and using as an analogy the signs and complications of measles and scarlet fever concludes 'The facts suggest strongly that some common factor underlay all the cases whose variations were determined by the activity of secondary complicating organisms. Symptoms common to all cases in all groups suggest that the common factor may have been *B. pneumosintes*¹⁵ and that the epidemic was influenzal in character.' Sir William Hamer¹⁶ would, I feel, have us think the same without mentioning *B. pneumosintes*.

This single pathology is a suggestion worthy of most careful consideration. It is a very attractive solution to the acute U.A.P.I. problem, but as a working hypothesis in clinical school medicine it is, in my opinion, dangerous. Only by attempting to split the atom shall we prove it whole, and I would suggest for practical purposes the opposite hypothesis, namely, that the local and general reactions to simple parasitic invasion of the upper air-passages are similar, no matter what the cause. There are, however, fine differences both epidemiologically and clinically enabling recognition of separate fevers referable to specific causes, microbic or otherwise.

Pyrexia, coryza, urgent lymphoid hyperplasia and œdema of mucous membranes are common factors. Varying types of exudate, visible coccal colonies, false membrane, local hæmolysis and hæmorrhagic oozing, typical pyrexias, vasomotor disturbances, rashes, herpes and complications may be pathognomonic of specific infections having separate identities and showing definite epidemiological characters.

Clinical observations on these lines, coupled with careful bacteriological investigations, should offer a more satisfactory solution. The subject will become complicated but when we have grown a good beard let us apply William

of Occam's razor 'Entia non sunt multiplicanda præter necessitatem,' if we dislike the growth, and can hope to find the fair face of truth underneath it.

I have remarked that an attempt to associate all acute upper air-passage infections under one pathology is dangerous. There appears to be such definite evidence that many different infections are at play, and although these may be due to secondary invasion as postulated by Paton, I am inclined to believe that such is not the case. One frequently finds two distinct catarrhs summated in the same patient, or one patient suffering from two apparently distinct diseases within a few days. This super-imposed infection may be the explanation of Paton's cases already referred to⁵, in which gastro-enteritis was followed by tonsillitis and influenza by septic sore throat.

Bloomfield and Felty¹⁷ report a carefully observed case (No. 31) in which influenza commenced on January 27th and was complicated by the onset of 'Beta' streptococcal tonsillitis on February 1st, at a time when it is probable that both conditions were epidemic and almost certain that the attack of tonsillitis could not be the result of an auto-infection. It thus becomes clear that these conditions must be nursed separately if cross infection amongst ward boys is to be avoided.

Clement Dukes¹⁸ remarks 'When asked, as I frequently have been, what is the matter with the throat, I am only able to plead ignorance, but I strive to impress the fact on my inquisitors that when I am able to diagnose the case at first sight I have secured it far too late for the welfare of the individual and for the protection of the other members of the school. Moreover . . . an early exact diagnosis is not necessary so long as the sufferer is transferred to a quarantine ward immediately.' Since the influenza pandemic of 1918 matters have changed. In Dukes' time influenza attacked only 8 per cent. per annum of the school in an average of the years 1871-1904, reaching its zenith in 1893 with about 25 per cent. per annum. Sir George Newman quotes¹⁹ for a public school the following attack rate of influenza :—

1919 Lent	..	..	32 per cent.	} Per term only.
1920 „	..	..	46 „	
1925 „	..	..	59 „	
1926 „	..	..	12 „	
1927 „	..	..	19 „	
1928 Summer	..	..	18 „	

This experience of influenza is by no means unusual and these figures are not high.

I believe there has been a corresponding increase in the non-influenzoid catarrhs since the war. Such infections are apparently less frequent during influenza epidemics or else are summated by influenza. Simey¹⁴ demonstrates with figures from Rugby School the same fact, and Glover¹ produces conclusive graphs. It is this increase which makes it no longer possible to observe individual cases of catarrhs in quarantine rooms and early clinical diagnostic signs must be looked for in order that cross infection in sick wards shall be avoided. Furthermore Dukes' most formidable enemies were the notifiable diseases. The present generation of school medical officers are equally, if not

more, anxious to control the serious complications of the more indefinite acute upper air-passage infections :

Pneumonia, etc.

Sinusitis.

Otitis media, mastoid, etc.

Peritonitis.

Carditis.

Lowered exercise tolerance, depression and mental inertia ; and almost certainly acute rheumatism and acute nephritis²⁰.

Roseneau's dictum²¹ ' Man is the source and fountain head of these infections, each case is a focus for their spread. Isolation and disinfection of the discharges are the first indications ' was said of the common cold and must be applied. Isolation is, however, not the whole solution to the problem. Dudley²² writes ' It should be clear that isolation has failed to control the spread of infectious diseases, because it is impossible to control all the infected hosts,' and has shown that one of the many things which will reduce the carrier menace is the proper spacing of beds in dormitories and careful ventilation.

At this point it is well to remember that epidemiological curves of influenza show a high incidence of trailers after the main epidemic. We are at present on the swing back of a pandemic wave, and the possibility of the shock attack of influenza lowering the resistance of the host to secondary invaders may account for the present increase in catarrhal disease. It is improbable that the secondary invaders give any increased immunity against a second shock attack, but they may immunize against themselves.

Bloomfield and Felty¹⁷ report a wide dissemination of other common inhabitants of the throat after influenza. In the case of the epidemic observed by them they conclude that since there was no alteration in the streptococcal parasitism they were studying that other hæmolytic streptococci disseminated were saprophytes. This is doubtful. It may be that these organisms are only apparently saprophytic and fail to attain an epidemic potential for some time after dissemination. When an effective potential matures, the standard organisms are overgrown and a new epidemic flora appears. Such was Glover's¹ experience when investigating sore throat attributed to Dochez's hæmolytic streptococcus. The original streptococcus was lost but sore throats continued with another flora. I suggest that some change in the clinical signs in the throat may have marked the disappearance of Dochez's organism, and that observation of these signs may have prevented relapses, the new disease being isolated from the old.

Streptococcal sore throat.

The standard fever of the school during the period dealt with in this paper was a ' viridans ' sore throat producing characteristic signs in the nasopharynx. Diagnosis depended on the observation of exudate, translucent and pearly in appearance, in the throat. The exudate resembled a colony on a culture plate and varied in size from a pin head to a split pea. It was generally disc-like and circular in shape. It was most easily observed on the tonsil, but both in the presence and absence of tonsillar tissue it appeared on the post-pharyngeal

granulations and was occasionally seen upon the mucosa of the fauces or soft palate. The little specks of exudate occurred on the mounds of tissue between the crypts rather than over the crypt mouths, and in the pharynx they sat like small caps on the top of the lymphoid nodules. In this respect and also in shape and colour the exudate differed from that observed in lacunar tonsillitis. The smaller specks are likely to be confused with the tiny scars occasionally seen on the surface of the tonsil. These scars are seldom circular and are of a yellowish colour. They cannot be wiped off with a swab. In a few cases the growth gave place to a definite follicular tonsillitis; yellowish cheesy matter appearing in the tonsillar crypts. I formed the opinion that the exudation of debris from the crypts was mechanical and secondary to oedema of the tonsil produced by infection with the surface organism. One was reminded of the picture produced when a volsellum is applied to a large tonsil before dissection.

The pyrexial reaction lasted from three to five days and was irregular, with a variation of about two degrees between morning and evening readings. Growth seldom appeared until the second day and was marked on the third. Sore throat was not a marked feature unless the fauces were involved. I think it was a more common symptom in boys whose tonsils had been removed. Pain in the throat was commonly absent, headache being the main symptom. Swabs were taken from many cases and sent by post for examination. They helped to exclude diphtheria but were otherwise of little value. *Streptococcus viridans* predominated and was associated with hæmolytic and non-hæmolytic streptococci of two or three strains in each culture. *M. catarrhalis* appeared occasionally but the absence of pneumococci was conspicuous. It is obvious to the writer that the bacteriology of these conditions must be worked out at the bedside. Exudate should be 'picked off' from the throat and planted direct on to the medium with a platinum loop. The swab is not an instrument of precision and long postal journeys are not good for microbes.

In this connection I should like to emphasize the difference between surface and tonsil-puncture cultures which has been demonstrated by other workers^{29, 30} and to suggest that bacteriologists investigating the tonsils arrange for the collection of material with more care than that offered by a swab jabbed deep into a tonsillar crypt.

The specific condition described appeared to be endemic during the period dealt with in this paper, but it is not always present in the school. It was probably carrier borne, and the case incidence was similar to that charted by Bloomfield and Felty¹⁷ showing no marked seasonal preponderance. I do not suggest that the causal organism in these cases was the beta-hæmolytic streptococcus of these writers for I have, I believe, observed two other distinct clinical forms of streptococcal sore throat. One is best described as a 'glairy tonsillitis' in which the tissues look as though they had been smeared with white vaseline. In the other the growth is not disc-like but conforms to that lacunar tonsillitis described by Fraenkel²⁶.

Bloomfield and Felty¹⁷ state: 'It was shown that either tonsillectomy or carriage of beta-hæmolytic streptococcus protected against infection' but in a later paper²⁷ they admit the development of acute streptococcal infection

of lymphoid tissue of the throat, equivalent to tonsillitis in people whose tonsils have been removed.

There are probably many strains of epidemic tonsillitis apart from milk-borne outbreaks. Haig-Brown²⁸ watched his cases at Charterhouse with great care and describes the exudate observed as varying from 'little green dots studding the tonsil surface' and sometimes extending to a greenish or yellowish green mass spreading on the fauces. His cases appeared to occur in more definite epidemics of a shorter wave length, although they had no obvious seasonal relationship. Haig-Brown reports, out of 345 sore throats, eight cases of endocarditis with chronic valvular disease. Three boys had pericarditis and ten mitral regurgitation of a transient character. His acute rheumatism rate was proportionately high.

Drs. Griffith and Scott¹ found Dochez hæmolytic streptococcus present in an epidemic of sore throats in a school during one term, and Dr. Glover tells me that this organism produced a plum coloured tonsil without exudate. As already mentioned, in the following term the sore throats continued but Dochez disappeared. It appears to be amply demonstrated that many strains of streptococcus can produce sore throat, that of scarlet fever amongst them : that in any one epidemic one strain will predominate and may give rise to a distinctive clinical appearance in the majority of persons affected.

I have mentioned cryptic or follicular tonsillitis and suggested that it is produced mechanically in acute surface infections, given tonsils with deep crypts which will naturally retain débris. In other words there is a type of follicular tonsillitis which will only occur in tonsils from which débris can be expressed in health. The débris appears to mean little more than wax in an ear or smegma behind a prepuce and the appearance of beads of pus-like débris in the crypts during an attack of sore throat does not mean a more severe illness, and the surface organisms are more likely to be causal than those found in the débris. These latter are probably saprophytes in the healthy subject and play no part in epidemic sore throat. Simey¹⁴ writing on febricula, says 'In some epidemics cases of true follicular tonsillitis occur but this is not the rule.' Follicular tonsillitis of this type must be distinguished from the definitely infectious 'lacunar' tonsillitis so ably described by Prof. Fraenkel²⁶ in which a white exudate appears over the entrance to the crypts and usually conforms to the shape of the crypt mouth. This mechanical cause of follicular tonsillitis is most probably the explanation of the occurrence of 'traumatic angina' after cautery of the nose or other intra-nasal manipulations which produce a diffuse oedema of the upper air-passages in the same way as the common cold.

Coryza, febricula.—An attempt will be made in another section to prove the contention already put forward that coryza and febricula are 'formes frustes' of the stationary fevers of a community. It appears that this conception is generally accepted. Wells³¹ says : 'The consensus of the best opinions is that there is no specific cause of this troublesome infection.' I would rather say with Osler¹³ 'There are a variety of causes'—a probable reason for the relapses which are so frequently observed and in which subsequent attacks may differ from each other ætiologically and bacteriologically.

I suggest that the chief ætiological factor in the cases met during the period under survey in this paper was the streptococcus, producing at the same time sore throat. To a less extent the cases of gastro-enteritis, pink-eye, pneumococcal fever, etc., brought in their train further cases of coryza and febricula, produced by their respective causal organisms. This group of coryza and febricula is therefore a polygenic collection of cases of nasopharyngitis of unknown origin in which a diagnosis on physical signs has been impossible.

Gastro-enteritis.—The thirty cases observed occurred in short bouts and appear to deserve recognition as a separate entity. The largest wave produced sixteen pyrexial attacks. They were undoubtedly nasopharyngeal infections and were occasionally associated with definite symptoms of coryza. In all cases there was an acutely unhealthy appearance of the throat, but the presence or absence of tonsils had no influence on the case incidence. Pyrexia occurred in only a small proportion of the total morbidity and these figures represent not more than a third of the total cases of 'tank trouble' as it is called in the school. These trivial epidemics are steeple-like in form and in this the common name of 'gastric influenza' is fitting. Food poisoning, polluted water from drinking and bathing, and infected milk are possible causes. Food poisoning would not have given cases over a period of a fortnight. There is a common supply of water and milk to the school and to people resident outside the school who are also under my care, and who did not suffer from the disease. The most probable source of the trouble is a droplet infection, and a slight but definite increase in febricula and coryza at the time of the gastro-intestinal epidemic supports this suggestion.

A point of great interest is the occurrence of two cases of appendicitis (one confirmed at operation) on the two days immediately preceding a wave of diarrhoea and vomiting. The total number of tender appendices in the four terms recorded was five. Recently there has been much correspondence on the association of appendicitis and sore throat or tonsillitis, and the literature makes frequent mention of measles complicated by appendicitis. Those who work in small hospitals serving, say, a market town or group of villages with fairly fixed population, may confirm my observations that appendicitis tends to occur in batches. I draw no conclusions from these notes, but suggest that the possible association between the acute appendix and acute U.A.P.I. is worth further investigation. Bowen³² elaborates this suggestion. Poynton's³⁷ classical experiments with the diplococcus rheumaticus should be remembered and Cope³⁸ has recently emphasized the importance of blood stream infection from nasopharyngeal foci in the ætiology of the acute abdomen, although he omits to mention the common origin of these foci, the droplet infection.

'Influenzoid' pneumococcal fever.—Simey⁴ believes influenza to be inseparable from the febriculæ. To my mind it is difficult to associate the two at all closely. The distinctive clinical appearance and remarkable constancy of the epidemic curve appear to identify it without doubt from the ever present common cold group. Of course there are abortive forms indistinguishable from febricula and inseparable in this sense. It is also probable

that the mode of transmission of influenza is unlike that easily demonstrated droplet route of the stationary endemic fevers and associated coryzas. Hill^{1,2} cites M. J. Roseneau's observation that it was found impossible to transmit 'flu from a bedridden case to another subject by a face to face talk, whereas 'sore throat' can be transmitted in this way.'

I do not suggest that influenza in all its forms is the result of invasion by one organism only. It is the influence of a particular type of epidemic invasion, each mass attack having an individuality depending upon a specific parasitism. The parasitism may vary with succeeding waves, and the many organisms described as causal may easily have been causal in the place and at the time of observation. The cases collected in this series were most probably pneumococcal fever.

Results obtained.—82 per cent. of the boys investigated suffered from nasopharyngeal disease and averaged 1.85 admissions to the infirmary per boy, the morbidity of the whole 289 examined being 1.56 per boy, (see Table 2).

These figures at first sight would appear to be high, but upon investigation they are not out of proportion with the findings of other schools, neither are they much more grave than in the general population. Slight fever and malaise is seldom reported to the general practitioner, and in some households we do not look upon a feverish cold or two per child per annum as excessive. It cannot, however, be denied that schools are, for many reasons, good incubators, and in the school under discussion about 400 people live in one building, sometimes at dangerously close quarters.

Consideration of the actual numbers in Table 2 produces little of interest. Sore throat was the predominant disease and, if my diagnostic methods are reasonably safe, one attack failed to produce more than a transitory immunity. It has been suggested that this sore throat was, for the most part, of a specific type and that the coryza and febricula associated with it was produced by the same micro-organism. If this is true, diagnosis of this particular type of viridans fever has been possible in about two-thirds of the cases involved.

The percentages are more instructive, and when the totals are considered one is impressed by an unexpected uniformity in the distribution of disease in the various columns, the differences being so small that one doubts their significance and hesitates to draw conclusions from them. Thus, with a mean susceptibility of 82 per cent., operated cases are most susceptible (83 per cent.) and of them boys with remnants stand the greatest chance of being ill (90 per cent.). Next to them boys with large tonsils show the highest attack rate (88 per cent.). There is, therefore, a definite association between morbidity and an increased amount of lymphoid tissue. A more searching analysis than is possible here has shown that the 18 per cent. of operated cases in which complete eradication of lymphoid tissue has been accomplished is the healthiest in the school. This is not because successful operations have been performed on them, but because they are healthy. A few bouts of nasopharyngitis would have caused lymphoid tissue to appear, and they would have swollen the most susceptible group, those with remnants. The greatest morbidity is, however;

in the large tonsil group (1.66 per boy) and is 6 per cent. above the mean of the school. In other words, while boys with remnants are least immune to catarrhal attack, recurrence of attack is most common in those with large tonsils—an observation possibly associated with autogenous infection and discussed later.

So far only the aggregates of all diseases have been considered. When we come to the detailed figures we find that in both sections A and B sore throat is most common in the presence of large tonsils and least common in operated cases with little or no remnants. The reverse is true of coryza and febricula, which occurs most frequently in the absence of tonsil. The less the lymphoid tissue the more uncertain the diagnosis.

Gastro-enteritis is evenly distributed in the different tonsil columns but almost half the cases—15 of 33—occurred in ‘habituals.’ This either brings to light a source of statistical error and shows this group to be inflated, or suggests that habitually catarrhal children are more susceptible to gastro-enteritis. I believe the former explanation to be the true one.

Influenzoid.—My figures under this section are small and hardly worthy of consideration, particularly as it is almost certain that typical influenza will appear again in epidemic form when data can more easily be collected. It is, however, obvious that what figures I have produced exonerate the large tonsil from blame, and show the incidence of influenza to be highest in the operated cases.

Discussion.

I am conscious of the limits of my investigation. My findings are true of a community of about 350 young males, observed for the comparatively short period of sixteen months and living in an environment in which risks of infection are great but types of infection few, so few that the bulk of sickness during the period was produced by one type of organism. Under these circumstances I hesitate to apply the following conclusions to all epidemics of sore throat. Some strains may have a predilection for the tonsil so that tonsillectomy may protect against infection, but in the type of infection dealt with in this paper there is little evidence to show that tonsillectomy either protects or has any obvious effect on the incidence of acute anginal conditions.

The ætiology of the common cold.—It has been stated that the pathognomonic sign of sore throat was the detection of specks of exudate. Exudate occurs on lymphoid tissue but may rarely be seen on mucous membrane. It follows that where there is no lymphoid tissue exudate is unlikely to be detected. Hence many cases which should be included as sore throat are scheduled as feverish colds. This shift is obvious in sections A and B of Table 2, and there is no real suggestion that tonsil-free cases are twice as susceptible to febricula as those with some tonsil. The coryza group has also received undiagnosed cases of gastro-enteritis, influenzoid, and probably some rubella. An estimate of the extent of this shift can be made.

I have postulated that tonsillectomy has no appreciable effect on the incidence of U.A.P.I., provided compensatory hypertrophy has occurred to replace the lost lymphoid tissue, and have shown that the catarrhs are dis-

tributed evenly irrespective of the state of the tonsil. In the epidemic condition discussed diagnosis of typical sore throat has been proportionate to the amount of lymphoid tissue present. The ratios of sore throats to coryzas are as follows :

Operation	1·17	} Mean of all cases 1·56.
Remnants present	1·50	
No operation	2·26	
Large tonsils	2·46	

If these premises are true and the ratios of sore throat to coryza are corrected to 2·5 in all groups, there is but a small residue of febricula left. Similar corrections for coryzas related to gastro-enteritis, pyrexial pink-eye, rubella and influenzoid fevers will dissolve the residue for pyrexial coryza as a separate entity. William of Occam's razor will have been applied to part of the growth, and a single pathology for the endemic-epidemic febriculæ of the community under consideration established, relating them to the epidemic flora present at the time.

I have said in my general epidemiological consideration that the single pathology hypothesis is a dangerous one until proved. I repeat this warning for I have not attempted to extend this discussion beyond the limits of my own small investigation. With change of time or place other micro-organisms or other circumstances may produce similar results, and I merely contend that febricula and coryza are 'formes frustes' of the stationary fevers of a community.

Such is my tentative conclusion arrived at by a process of speculation upon insufficient figures. I think, however, the method is worth further test and I commend it to other investigators.

The influence of the chronic tonsil on the incidence of acute nasopharyngitis and tonsillitis.—It has been pointed out that the morbidity of boys with large tonsils was 6 per cent. above the mean for the school. It is possible that part of this excess is due to recurrent auto-infection in boys with chronic tonsillitis. The presence of such cases is also suggested by the relatively higher percentage of large tonsils amongst 'habituals' compared with healthy boys (Table 1). Three such cases are mentioned in the discussion on 'Unhealthy appearances in the throat in health' (Part 1), but they total no more than 1 per cent. of the school. Given chronic septic tonsils and adenoids, particularly if there is nasal obstruction, tonsillectomy is definitely indicated and certainly improves the children operated upon. In this I agree with the generally accepted opinion and the conclusions of Pentecost⁷ and Sington²⁴, but tonsillectomy does not reduce the risk of heterogenous and epidemic infection, an assertion in keeping with the findings of Kaiser³ already mentioned.

I have found no evidence that the boy with chronic infected tonsils acts as a carrier, but a school medical officer in reply to a questionnaire circulated by the Association of School Medical Officers²⁵ writes 'In three years treatment of adenoids, rhinitis and septic tonsils in boys acting as sources of infection has reduced the incidence of colds.'

The school under consideration is surprisingly free from the chronic tonsil, but I take it that probably the most potent source of chronic infection is the

acute catarrh, and under these circumstances the chronic tonsil is a potential carrier. Even so, the total of such cases must be a very small part of the carrier rate required to produce an epidemic, and in my mind the chronic tonsil, although it requires attention, plays but a minor role in the spread of infection.

I have stated that not more than one per cent. of the boys investigated require tonsil operation, and I feel that a great number have already been unnecessarily deprived of some useful lymphoid tissue. I am, of course, unable to estimate the number of those cases operated upon in which operation was essential. Perhaps in no other subject is there such a great difference in the personal judgement of the surgeon and in the criteria of operability. It is possible that a further one per cent. will acquire chronic tonsillar infection during their school lives. The best way to avoid this is to protect them from droplet infections.

TABLE 2A.

CONDITIONS OF THROAT IN HEALTH OF BOYS SUFFERING FROM COMPLICATIONS TO A PRIMARY NASOPHARYNGITIS.

					All compli- cations		Otitis media		Mean of school	Relative defi- ciency of total lymphoid tissue in complicated cases	
					No.	%	No.	%	%		
Total numbers	..	..	..	..	31	11	20	7	—	Less	More
Habituals	..	..	..	..	8	26	3	15	18		
Tonsils :											
Present	..	..	..	..	11	35	7	35	43	— 8	
Large	..	..	..	..	4	13	1	5	22	— 9	
Removed	..	..	..	..	20	65	13	65	58	— 7	
Remnants :											
Present	..	..	..	..	14	45	9	45	42		+ 3
Large	..	..	..	..	12	39	5	25	23		+16
Pharyngeal granulations	..	..	..	..	10	32	7	35	35	— 3	
Cervical glands :											
Present	..	..	..	..	9	29	8	40	43	—14	
Large	..	..	..	..	0	0	0	0	28	—28	
Total										—69	+19

Complications.—Fortunately complications to the catarrhs discussed in this paper were, with the exception of otitis media, infrequent so that the figures presented in Table 2A may be too small to be significant. They are, however, suggestive and will therefore be discussed.

Although many cases of otitis media were mild and showed nothing more than carache and a flushed drum head, the other complications are those in which appreciable disease was present causing some anxiety as to ultimate prognosis. They occurred as follows :—

THE TONSILS AND NASOPHARYNGEAL EPIDEMICS 357

Acute otitis media (including three cases with grave							
toxæmia	..	..	..	..	..	..	20
Bronchitis, large tube	..	..	..	..	..	..	4
Bronchitis, small tube	..	..	..	..	..	..	1
Congestion with phantom consolidation	..	..	..	..	..	..	3
Congestion with pleurisy	..	..	..	..	..	..	1
Established lobar pneumonia	..	..	..	..	..	..	1
Acute rheumatism	..	..	..	..	..	..	1

I have said that in conditions other than otitis media only severe complications are included in my figures. Infection of the paranasal sinuses is, of course, very common in association with all nasopharyngeal disease, and a serous sinusitis is probably present in a large number of the catarrhs seen. Diagnosis is, however, uncertain except in well developed cases, and without special apparatus diagnosis sufficiently exact to allow statistical investigation is unattainable.

A few râles or rhonchi in the chest of a coughing boy are not included as appreciable complications, but they were seldom met during the period discussed in this paper, the predominating infection having a much greater affinity for the ears than for the chest.

Discussion.

The results obtained show that complications occur most frequently in operated cases, particularly in those in whom complete or almost complete eradication has been performed. Serious disease is infrequent in the presence of large tonsils. Habituals, who number but one-sixth of the boys examined, score one-quarter of the complications, and although, as previously pointed out, the morbidity figures in the 'habitual' column are inflated, I am satisfied that the 'habitual' stands in greater danger of contracting a complication merely because he is more frequently involved in a catarrhal fever.

The most interesting observation to be made from Table 2A is the marked deficiency of total lymphoid tissue. This deficiency is represented in the right hand column of the table, the figures in which are merely relative and have no statistical value. Large tonsils and palpable cervical glands are below the mean, clean operation cases produce the greatest proportion of serious disease and large cervical glands are entirely absent. On these grounds it is difficult to avoid the conclusion made in Part I of this paper that there is an optimum amount of lymphoid tissue in the throat and neck, the artificial reduction of which exposes the person to increased dangers.

Only two of the complicated cases had an unhealthy throat appearance in health and I feel that the chronic tonsil had little to do with the incidence of serious disease in the school. The figures produced from the twenty cases of acute otitis media examined hardly confirm Paton's⁴ observation that the tonsil-adenoid operation results in an increased incidence of otorrhœa, for it will be seen that tonsils had been removed in about the same proportion as in the group 'never ill.' There is, however, ample evidence that tonsillectomy has not protected against otitis media. Fowler³³ does not give comparative figures, but 53 per cent. of his cases of otitis media had had tonsillectomy

performed, and Wright³⁹ surveying the experience of sixteen years, shows marked increase of this disease in spite of the increased practice of tonsillectomy. On the other hand his figures show some improvement with regard to chronic ear-disease as the result of operation.

Otitis media is the complication of the common nasopharyngeal infections which appears best to demonstrate the mixed origin of these infections. Separate waves of otitis occur, each wave appearing to have definite differences from the preceding wave: One wave, frequently when a pneumococcus is about, will produce fulminating mastoids; another probably associated with a staphylococcus aureus throat infection will show more signs of otitis externa than of otitis media, the drum-head and meatus being constantly obscured by a white membrane. In a third, pain will be intense and spontaneous perforation occur before paracentesis can be performed. In a fourth, the otitis will be of a low grade and insidious in onset, but will give a high percentage of chronic mastoids. Streptococcus mucosus will be producing common colds at this time. E. Watson-Williams³⁴ notes how some cases of mastoid disease without otorrhœa tended to occur in groups, and the almost constant appearance of a vesicular eruption on a dusky drumhead during the last influenzal epidemic will be remembered by many. The otitis of scarlet fever is produced by the scarlet streptococci and not by secondary invaders.

I have little doubt that these phenomena are the cause of such conflicting reports on investigations of the bacteriology of otitis media³⁵, and I look upon them as being strong evidence against the relation of all coryza, febricula and influenza to a single causal organism.

The importance of simple nasopharyngeal infections in the ætiology of the majority of serious acute illness is not always appreciated. Only in the case of acute rheumatism will the direct association between the appreciable diseases mentioned above and the simple acute U.A.P.I. be challenged, and a discussion of the ætiology of acute rheumatism is out of place here. It may, however, be opportune to suggest that there is evidence that some cases of many apparently unrelated and so called idiopathic conditions, for example:—essential hæmaturia, cystitis and pyelitis, cholecystitis and catarrhal jaundice, gastric and duodenal ulcer; and even some dermatoses, namely, pityriasis rosea, certain urticariæ, and other allergic manifestations may originate in acute U.A.P.I. in the same way as erythema nodosum shows relation to an epidemic sore throat.

These sweeping assertions are, of course, put forward in the most tentative sense, but since observations on the common cold must necessarily be made by the general practitioner and satisfactory material will seldom present itself to the expert investigator, I feel it is for a general practitioner to redirect attention to the possibility of such an association.

Conclusions.

A comparison between the incidence of disease in, and the normal throat appearances of, healthy school boys answers the question asked by Glover¹, and taken as the text of reference for this enquiry. The figures produced admit of one certain conclusion:—

In the mass the tonsil has no obvious effect upon the incidence of acute anginal conditions, and uncomplicated nasopharyngitis occurs irrespective of the presence or absence of tonsil.

Cases of chronic tonsillitis subject to recurrent auto-infection are rare and their number is insufficient to alter this conclusion, the bulk of disease being due to transitory surface infection. The quality of lymphoid tissue is at present beyond investigation. There is, however, considerable evidence that an optimum quantity exists in the healthy throat and that this optimum quantity is greatest in the presence of nasopharyngeal infection. Reduction of this quantity by operation increases the patient's risks to invasion by an infecting organism, not only so far as simple catarrh is concerned but to a greater extent with regard to complications.

My figures give strong support to Paton's⁴ conclusion that 'it is evident that those subjected to the operation were not only no better than the rest, but were actually worse in practically every particular with the exception of enlarged cervical glands.' Palpable cervical glands, even when enlarged, are seldom pathological but are most frequently physiological, and Paton could justly erase this one blot from the tonsil's escutcheon. Such physiological enlargement results from the presence of infection in the nasopharynx which also stimulates increased growth of the nasopharyngeal lymphoid tissue, the tonsil or the tonsillar remnant. The increased risk to invasion after operation is in some way mitigated by this compensatory hypertrophy of the remaining lymphoid tissue, and the absence of such hypertrophy appears to conduce to complications. The distinction between infection and invasion should be noted. When a pathological flora attacks a closed community almost every member becomes infected and the carrier rate is said to be very high. Comparatively few of the infected hosts respond with a local and general reaction sufficiently violent to constitute disease. These latter are said to be invaded. It has also been suggested that the common cold is the expression of an abortive reaction to infection, no matter what the infecting organism. The continued search for a specific cause of the common cold is not likely to establish a single pathology for this condition.

That most extensive and ubiquitous group of diseases, the droplet infections, has little to do with the tonsil or its removal. Except in the relatively rare instance where auto-infection from a chronic focus produces recurrent inflammation, acute tonsillitis is a symptom and not a disease. Tonsillectomy is symptomatic treatment in its most elementary form and its extensive application has produced no obvious beneficial result in the control of acute nasopharyngeal infections. It is a red herring which must be removed from the deep waters covering the secrets of the prophylaxis and treatment of the common cold and its many malicious relatives.

Summary.

1. An attempt has been made to assess the value of the tonsil-adenoid operation in the prevention of epidemic nasopharyngeal infections. The operation was found to be of no appreciable value, but some evidence is produced to show that it is followed by compensatory

- hypertrophy of other lymphoid tissue in the presence of acute upper air-passage disease. The findings suggest that, until the loss of lymphoid tissue is made good, the operated cases are more susceptible to the common catarrhs and more frequently attacked by complications.
2. Chronic tonsillitis is a complication of acute nasopharyngitis. Auto-genous reinfection from septic tonsils is not common. It is discussed and the necessity for operation in these circumstances emphasized.
 3. A distinctive type of epidemic sore throat is described.
 4. A tentative statistical proof that coryza and febricula are "formes frustes" of the stationary fevers of a community is presented.

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