SOCIETIES' PROCEEDINGS

ROYAL SOCIETY OF MEDICINE—SECTION OF OTOLOGY

May 7th, 1937

President—DOUGLAS GUTHRIE, M.D.

Discussion on Otitis Media in Early Childhood (under 5 years)

DR. J. M. LE MÉE (Paris): *Oto-mastoiditis in infants.*—I use the term "oto-mastoiditis" because there is really no such thing as otitis media in the way in which we generally understand this expression, i.e. as meaning infection of the drum not involving the mastoid. Whereas in the child and the adult there are three compartments of the middle ear, in the infant there is only a single cavity extending from the pharynx to the mastoid. The Eustachian tube is short, and has a larger calibre than in the adult; the isthmus does not exist, therefore the contractions of the muscles of the soft palate have an action on the whole tube; the drum, ossicles, and membrana tympani are the same size as in the adult; the antrum is even larger, its external wall having a thin bony lamella.

Discussion on how the infection can reach and involve this passage would lead us too far, but when this does happen, the sequence is as follows: In the first stage the Eustachian tube is infected and the "oto-salpingitis" is responsible for the fever and pain in the course of rhinopharyngeal infections. The drum is involved and reacts, as is shown by colour and aspect of the tympanum. On paracentesis, one has the impression of a bursting drum. No fluid is found at first, but after from twenty-four to forty-eight hours it usually appears and at the same time the temperature falls and general conditions improve. Such facts may seem paradoxical since, apparently, the discharge seems to be due to the surgical intervention. It is, indeed, merely a mechanical phenomenon; the opening of the tympanum allows the air to rush into the ear, just as when the peg of a barrel is removed. The contents of the Eustachian tube then flow out, the retention ceases, and the general trouble subsides; after a while everything is normal again.

The "primary purulent oto-mastoiditis" is a second type. It might resemble that of the child but for two facts. In the infant, the tympanum is reinforced by a myxomatous lining and, on the

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other hand, the Eustachian tube is wider ; spontaneous perforation is therefore less frequent. This variety was described by André Bloch and ourselves under the term " latent otitis ". I should prefer to call it " overlooked otitis " or " unsuspected otitis " because nothing draws the attention to the ear, the only symptoms being general or systemic. This type of otitis may be suspected : (1) In the presence of a febrile condition, the cause of which is not evident. (2) When, the cause of a febrile condition being known, the general phenomena persist in spite of the subsidence of the local signs (in broncho-pneumonia, for instance). (3) When the treatment of a digestive condition brings only temporary relief. (4) Finally, whenever the infant seems to be in pain and, most important, presents persistent insomnia.

I will merely enumerate other better-known signs, such as : rolling of the head on the pillow ; chewing ; pain on swallowing ; Pins' sign, or contralateral suction ; alternating redness and pallor, Hallé's sign ; pain on pressure over the canal, and certain localized convulsions, especially ocular. In such cases the infant has a staring look ; from time to time, the eyeballs are turned upwards, showing a deviation either to one side, or in convergent strabismus ; this lasts so for a few seconds, and then there is a return to normal.

If the desired result is not attained after several paracenteses, we have to conclude that drainage through the drum is insufficient to clear the oto-mastoiditis and what might be called paracentesis of the antrum must be resorted to, but curetting is useless since only the mucous lining is infected.

The third type, less frequently encountered in the infant than in the child, is " osteitic oto-mastoiditis ", clinically pictured by retro-auricular convexity. Antrum and cells (of which two groups often exist at birth), as Paul Bernard demonstrated radiologically, are separated from the tympanic cavity by obstruction of the aditus ; bone lesion is present, and the consequent suppuration, necrosis, and sometimes sequestration keep up permanent infection. On opening, if the pus seems to be under high pressure, the diseased bone should be curetted, but if only muco-pus is found, one should be content with the curetting necessary for ensuring drainage, since, above all, surgery in infants should always be reduced to the minimum and operations should be as short as possible. In the Hôpital des Enfants Malades we, as a routine, first incise and rugine the periosteum. Two days later we open the mastoid. In such cases, X-rays are very helpful in the diagnosis.

The two other types of oto-mastoiditis cannot be put in the same group with those I have just described.

The type first reported in 1869 by Parrot who, when carrying out autopsies on infants, was surprised to note so often the presence of pus in the cavities of the middle ear, is really a *post mortem*

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empyema, the cavities being only a reservoir for the pus produced in the nasopharynx. It is a principle of elementary physics that the cooling of the air contained in a cavity determines a fall of the pressure, resulting in this case in the penetration of the pharyngeal liquid into the middle ear. It is easy to verify, on the cadaver, that the same principle applies to all other cavities in the cranium; secretions will also be found in the two sinuses existing in the infant —i.e. the maxillary sinus and the ethmoid sinus. Why then is otitis always considered to be the cause of death, not sinusitis, which is just as serious a disease? It is because, when doing an autopsy, one generally does not examine the sinuses. This precaution is also forgotten on examination of the living patient.

The type of oto-mastoiditis described as a cause of athrepsia is not really mastoiditis, and perhaps not even osteomyelitis, since it has been recognized by some authors that few polynuclears are found in these cases.

The reddish-yellow liquid which gushes out through the opening of the mastoid bone and which resembles pus, is also found in the sphenoidal body, in the occipital bone, in the sacrum, and in the sternum. Moreover, it may be found at the autopsy of non-athreptic patients.

In short, the presence of pus in the auricular cavities in the infant has not the same value and significance as in the child, and cannot be treated by standard methods. In the pathology of the infant, the otologist should not content himself with otoscopy and X-ray findings; he should use his own experience in interpreting the facts, and base his decision whether to operate or not on his general impression of the case, in collaboration with the pediatrician, rather than on strictly local signs.

MR. T. RITCHIE RODGER: I have analysed my case-records at the Victoria Hospital for Sick Children in Hull during the nine years since the Ear and Throat Department was instituted. There were 599 cases of otitis media occurring in children under the age of three years.

The large incidence of the bilateral infection is rather striking. Of the 599 cases, no less than 249 (i.e. 40 per cent.) were bilateral. The number of affected ears thus becomes 848. The distribution in the separate year-groups was as follows:—

Age.	No. of cases.	Single.	Bilateral.
Under 1 year ..	185	105	80 (=40%)
1 to 2 years	200	114	86 (=43%)
2 to 3 years	214	131	83 (=38%)

The percentage of bilateral infection in the ages 3 to 4 was 36·5; in the ages 4 to 5 it was 20; so that it would seem that the high frequency of the bilateral condition belongs to the first four years of life.

This observation may be of some importance. In a great many cases the mother draws attention to one ear, which she has noticed to be discharging, or to which the baby seems to refer pain, as for

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example by constantly putting his hand to that side of the head. If we know that of all the cases brought to us probably 40 per cent. are bilateral or are destined to become so, we shall not make the mistake of omitting the examination of the other ear. Further, when we have found on our first examination that only one ear shows anything abnormal, we shall not omit to keep on examining the other ear at subsequent visits or while the patient is under observation in the ward. In a very large number of the cases in this series, the onset of the discharge, or the onset of symptoms demanding myringotomy in one ear was separated from that in the other by an interval of several days—sometimes even of two or three weeks. Occasionally we have not been aware of the imminence of discharge in the second ear. Even when one is watching quite carefully, the appearance of the membrane is sometimes indefinite, and the opportunity of giving relief by myringotomy is missed.

The incidence of mastoiditis requiring operation also proved to be higher than we had expected.

For cases	under	1	year	it was	19%	of all	affected	ears.
,,	,,	1 to 2	years	,,	26%	,,	,,	,,
,,	,,	2 to 3	,,	,,	26%	,,	,,	,,
,,	,,	3 to 4	,,	,,	21%	,,	,,	
,,	,,	4 to 5	,,	,,	21%	,,	,,	,,

In this matter, of course, the personal views of the surgeon come into play. He has no control over the number of cases of otitis media which occur, whether unilateral or bilateral, but the number of cases subjected to operation is to some extent determined by his individual view. Possibly some surgeons would have had a larger proportion of operations in this series, others possibly a smaller. One of the chief aims we set before ourselves is the prevention of chronic otitis. We try to keep every case under observation and carefully treated, until the ear is quite dry. If conservative treatment—including, in a large proportion of cases, the removal of adenoids—is not successful in a reasonable time, we assume that the discharge is being fed from the mastoid antrum and we recommend operation. The " reasonable time " varies with the individual case. If, for instance, the discharge is diminishing gradually and the general condition is good, we are content to wait longer ; on the other hand, if the child continues to look seedy and the discharge remains profuse, three or four weeks is long enough to wait, even with a normal temperature and no mastoid signs. In the presence of continued mastoid tenderness or continued temperature we, as a rule, do not wait at all. Working on these lines we find only very rarely that we have to enter on the case record that operation might have been postponed or avoided, but it is better to run the risk of a mistake of this kind occasionally, than to follow any rule which might swell the ranks of the chronic otorrhœas.

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A further point may be worth noting. It does not appear that the fact of an infection being bilateral indicates an increased virulence. The percentage of mastoid operations among these is not greater than in the series taken as a whole.

In the 80 bilateral cases under 1 year there were 9 bilateral Schwartze operations and 7 unilateral.
In the 86 bilateral cases 1 to 2 years there were 19 bilateral Schwartze operations and 7 unilateral.
In the 83 bilateral cases 2 to 3 years there were 20 bilateral Schwartze operations and 12 unilateral.

The association of otitis media with diarrhœa and vomiting has been a fairly frequent occurrence. Quite frequently also we have had to ask the help of one of the physicians in determining whether the temperature and other constitutional signs were likely to be attributable to a coexisting chest condition rather than to the ear. We have generally put it to him that if he cannot say there is sufficient in the way of pulmonary signs to explain the temperature and malaise, we would propose, with his consent, to explore the mastoid. These are the only cases in which we aim at speed in operating—out of deference to the chest condition.

The incidence of tuberculosis has proved surprisingly small. Members of the Section are acquainted with the figures presented by Dr. Logan Turner and the late J. S. Fraser, when the subject of tuberculosis of the middle-ear cleft was discussed in 1914.* Of the cases of otitis media seen in the Ear and Throat Department of Edinburgh Royal Infirmary during the eight years prior to 1914, 50 per cent. of those under one year, and 27 per cent. of those in the second year of life, were judged to be tuberculous—after pathological examination in about half the cases and on the basis of unequivocal signs in the others. In the hospital from which my figures are taken we have made it our practice to send material from the mastoid operation only in those cases in which tuberculosis was at all suggested by the appearances or signs. Even so, a negative report has been much more frequent than a positive one and when I say that my colleague, Mr. R. R. Simpson, agrees with my impression that not one case in ten has aroused our suspicions, it follows that our estimate of the incidence is something less than 5 per cent.

When I began this analysis a few months ago, we arranged that in every case of mastoid operation on a patient under three years of age, bone tissue and pus should be sent for examination. The number is too small to be of value by itself, but it was the best we could do in the time and the result bears out the above estimate. Of fourteen cases, only one was reported to be positive, and that was in a child of $2\frac{1}{2}$ years who had no history of otitis before three months previously. One in fourteen is a little more than 5 per cent.,

* *Proc. Roy. Soc. Med.*, 1914, iii (Otol. Sect., 15).

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but on the other hand the first and second years—which are the years of the high incidence in Dr. Logan Turner's cases—gave a nil percentage for thirteen cases.

In the paper referred to, Dr. Turner waged war against the insanitary condition of the milk supply in Edinburgh and the surrounding area. He quoted researches by Mitchell and John Fraser on tuberculous gland and tuberculous bone conditions respectively, and referred to their conclusions that in 90 per cent. of the gland cases and 60 per cent. of the bone cases, the bovine type of the tubercle bacillus was proved to be the causative factor. He assumed that in middle-ear tuberculosis the same type of organism is active and that the mode of infection is by the regurgitation of infected milk into the Eustachian tube. In the subsequent discussion all the speakers agreed with this view as to the source and route of infection. Mr. Fraser, in replying to the discussion, as reported in the *Proceedings*, concluded with these words,

"If all tuberculous cows were slaughtered, following a tuberculin test, there would be little or no need for operation on tuberculous otitis media, as the cause would have been eliminated."

If, then, we could accept these two sets of figures—the Edinburgh figures of 1914 and mine of 1937—as exactly comparable, we might claim that within a quarter of a century improvements in sanitation and particularly in the milk supply had achieved all that Fraser in these words had adumbrated—and more than has probably been achieved in the case of any other form of tuberculosis.

There are, however, fallacies in the comparison. In the first place we are comparing conditions in two different cities, whose incidence of tuberculosis in general and of middle-ear tuberculosis in particular may not have been the same in 1914 and may not be the same to-day. I think it was accepted in 1914 that the incidence of tuberculosis in Edinburgh was much higher than in most English towns and cities. Secondly, we have to remember that the *percentage* of tuberculous cases in a series can be lowered quite as well by an increase of the non-tuberculous cases as by a diminution of the tuberculous—and there is no doubt whatever that this has occurred. With increased knowledge, on the part of both parent and practitioner, of the importance of early attention to ear conditions, with child-welfare workers and home nurses and other officials literally hounding the cases to our special clinics, we see, especially in hospitals for children, large numbers of cases of the milder and more transitory type of otitis, such as a generation ago never reached the specialist. Very many of the cases in my series attended within a day or two after the first symptoms began—many others were already on the way to spontaneous cure when first seen. My recollection of working with Turner and Fraser in 1914 is that we saw a comparatively small number of such cases. The persistent

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ones, on the other hand, including all the tuberculous cases, were sure to turn up sooner or later. It may even be the case that the non-tuberculous otitis media not only escapes our attentions less frequently nowadays, but is actually more common. Influenza comes upon us in successive waves. The *Streptococcus hæmolyticus* seems to be always with us.

Still, the difference between 50 per cent. and 5 per cent. is large enough to allow for a generous discount on all these points, while still leaving us with the comforting impression that we have witnessed in our own generation a very great diminution in the incidence of tuberculous otitis. If this is true, we have to accommodate our outlook and our treatment to the altered facts. It was emphasized by Fraser in 1914, and is generally agreed, that the treatment for tuberculous otitis must be radical. If we hold an exaggerated idea of the frequency of the condition, we shall be inclined to sacrifice the hearing in many cases in which a simple Schwartze operation would give a completely successful result, and save the hearing.

DR. J. H. EBBS: I would like to focus attention upon the incidence of acute otitis media, particularly in children suffering from conditions associated with it, or resulting from it. Perhaps the best way to approach the problem from an otological, as well as a pathological and pediatric aspect, will be to show an analysis of the results of the *post mortem* examination of the middle ear and mastoid region in 880 children varying in age from birth to fourteen years. These children have died from a great variety of medical and surgical conditions. The records appear to be of value, since they are those of consecutive examinations of almost 100 per cent. of the children who have died in a children's hospital which receives its patients from a large area in the Midlands. These examinations were begun by my predecessor and senior, the late Dr. R. J. Gittins, and were carried on soon after their commencement by myself and those who have been connected with my department.

During a period of about four years, 880 children have been examined *post mortem*, to determine the presence or absence of infection of the middle ears and mastoid regions. Infection has been recorded as present only when actual purulent material has been found. Serous fluid, clear gelatinous material, and other fluid which was not composed of pus cells have not been recorded as purulent. Of the 880 examinations made, purulent material was found in one or both ears in 52·8 per cent. In other words, more than one-half of the children who have died in this hospital have been found to have a purulent infection in the middle ears and mastoids. A study of Table I shows that 70 per cent. of these children were under one year of age, 80 per cent. were under two years, and almost 90 per cent. were under five years. Infants under one year provide only about one-third of the total admissions to the

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hospital, and yet this age-group is responsible for 70 per cent. of the deaths. This, I believe, indicates clearly the age-group in which the mortality rate is a serious one. A glance at Table II indicates the strong possibility that otology might help in attacking

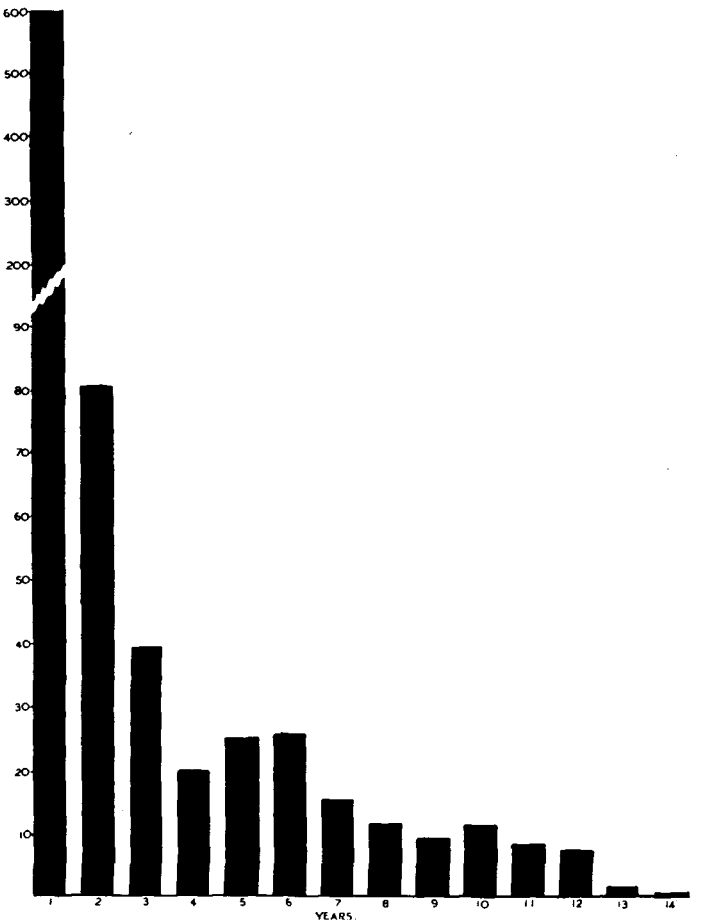


TABLE I.

Age distribution of children examined at autopsy for the presence of otitis media.

this death-rate in infants, since it shows that 61 per cent. or 368 children out of 603 under one year had purulent otitis media when they died. Of children dying during the second year of life, 52 per cent. were found to have otitis media, while of those dying in the other years 30 per cent. or less had the condition. The peak in the curve between five and six years might be attributed to increased

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TABLE II.

Percentage of children in different age-groups found to have otitis media.

incidence when the child first goes to school. Perhaps percentages are misleading, with such small numbers, in the older age-groups, but Table III shows the actual number of cases. Those with

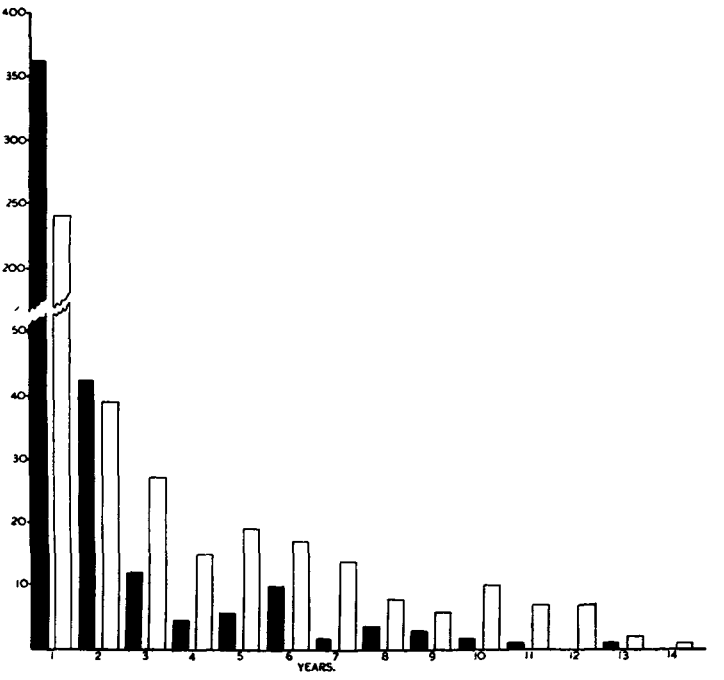


TABLE III.

Number of children found at autopsy to have otitis media indicated in black columns, those without otitis media in white columns.

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infection are indicated in black columns, and those normal in the white columns.

The number found to have otitis media in the first year of life, as well as the total number examined, is so large in proportion to the other years, that in trying to illustrate them graphically the columns extend far beyond the limits of the graphs. For this reason,

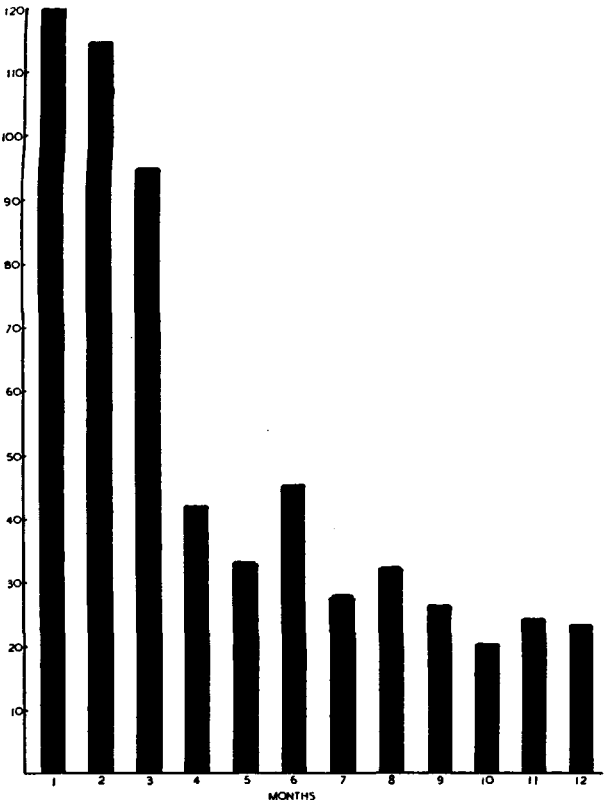


TABLE IV.

Age distribution in months, of infants examined at autopsy who have died during the first year of life.

I have analysed the records of the first year and set them out for the different months. Thus in Table IV it will be seen that the number of infants dying in the first few months of life rapidly decreases, while the incidence of otitis media rapidly increases up to the age of three months, when it remains more or less about 70 per cent. throughout the remaining month periods of the first year (Table V).

The rise to 90 per cent. at ten months is based upon only 20 cases in this age-group, and therefore its significance is open to question (Table VI). Of 120 infants dying during the first month of life,

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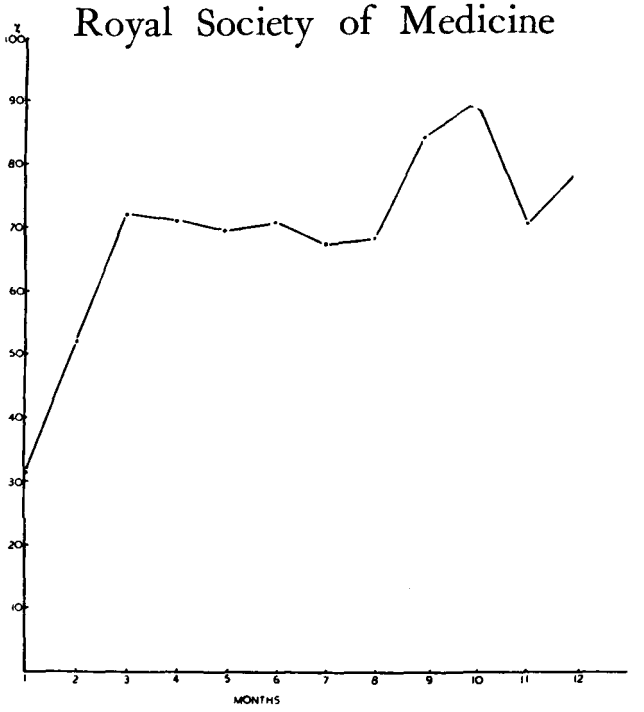


TABLE V.

Percentage of infants in months of first year found to have otitis media.

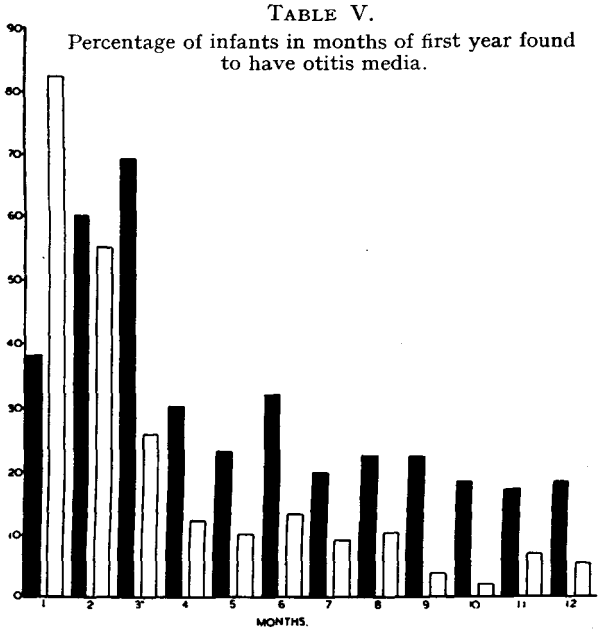


TABLE VI.

Number of infants found at autopsy to have otitis media indicated in black columns; those without otitis media in white columns.

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38 had otitis media and in one of these it had occurred in the first week of life, illustrating the early age at which infection is possible.

A general survey of these charts has brought me to certain conclusions. The incidence of otitis media found, at autopsy, in all infants and children dying in a large children's hospital, is extremely high in those dying during the first year of life, and the incidence decreases as the older age-groups are reached. The incidence of otitis media increases rapidly from birth, when it is not found, until the age of three months, and then remains almost constant through the first year of life.

Perhaps it would be as well to state that I am not implying that those found with otitis media at autopsy have necessarily died as a direct result of this condition. I can only say that purulent infection was present macroscopically; this was confirmed in a large number of cases by microscopical examination of the pus. No attempt has yet been made to study the histological changes in the mucosa and bone of this region. We hope to complete this at some future time.

Associated sinusitis.—While this discussion is confined to otitis media, it might be of interest, in passing, to mention a similar study which has been going on at the same time, in an attempt to determine the incidence of sinusitis in infancy and childhood. There is not time, nor is this the place, to analyse the figures in detail, but the association of sinusitis and otitis media is illustrated by the fact that of 496 children in whom one or more of the accessory nasal sinuses were examined, purulent infection was found in 152, or 30·6 per cent.

TABLE VII.

THE RELATION OF OTITIS MEDIA TO SINUSITIS.

Sinuses.

Total number examined, 496.

One or more sinus infected	152 (30·6%)
Otitis media with associated sinusitis ..	119 (42·5%)
Otitis media without associated sinusitis ..	161 (57·5%)

Table VII shows that while 33 had purulent infection of the sinuses without an associated otitis media, 119 had sinusitis associated with otitis media. In other words, of 496 children of all ages, otitis media was found in 280 or 56·4 per cent., sinusitis in 152 or 30·6 per cent., and both together in 119 (24 per cent.). 42·5 per cent. of the 280 children with otitis media also had sinusitis.

A recent article by Crooks (1937), from the Hospital for Sick Children, Great Ormond Street, revealed the fact that 24 per cent. of 100 children whose antra were examined were infected. These were children in the older age-group, who were having tonsils and adenoids removed. This important clinical study of the disease illustrates the frequency of the condition. Crooks (1937) found that 44 of 100

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children examined for sinusitis had otitis media. In this *post mortem* series 56·4 per cent. had otitis media.

Bacteriology.—A bacteriological study of the pus found in the ears and sinuses at *post mortem* in 200 cases is shown in Table VIII.

TABLE VIII.

THE INCIDENCE OF VARIOUS ORGANISMS FOUND IN 200 CASES OF OTITIS MEDIA.

Total number of organisms found, 275.

Streptococcus	139 (50·5%)
Pneumococcus	49 (17·8%)
Staphylococcus aureus	35 (12·7%)
Staphylococcus albus	24 (8·7%)
H. influenza (Pfeiffer)	15 (5·4%)
Meningococcus	4 (1·4%)
Micrococcus catarrhalis	3 (1·0%)
B. coli	3 (1·0%)
Tubercle bacilli	2 (0·9%)
Diphtheria bacillus	1 (0·3%)

The streptococcus was found in 50 per cent., the pneumococcus being next in frequency, followed by staphylococcus and Pfeiffer's bacillus. It is interesting to note that the meningococcus was found in the ears in four cases of cerebrospinal fever with mastoiditis. The tubercle bacillus was identified in the middle ears in two cases of tuberculous meningitis, and the diphtheria bacillus in one child with otitis media. No attempt has been made to classify the types of the different organisms for the purpose of this communication.

Now I should like to review these statistics from a pediatric point of view, trying to assess the principal causes of death in the group of children studied.

Associated gastro-intestinal disturbances.—The pediatrician devotes a large part of his time and study to the problems of nutrition in infancy and seems to have arrived at what may be described as almost an optimum understanding of nutrition in the normal infant. But it is in certain nutritional disorders of infancy which are associated with infections, that difficulties continue to be a problem. As Marriott (1927) has said, " Otitis media is the most frequent infection responsible for nutritional disturbance." With this in mind, an analysis of these 880 case records revealed the fact that 238 children under the age of two years suffered from gastro-enteritis, characterized by diarrhœa and vomiting, which was either the major complaint or was a complicating factor in the cause of death. Table IX shows that 193 or 81·4 per cent. of these cases had

TABLE IX.

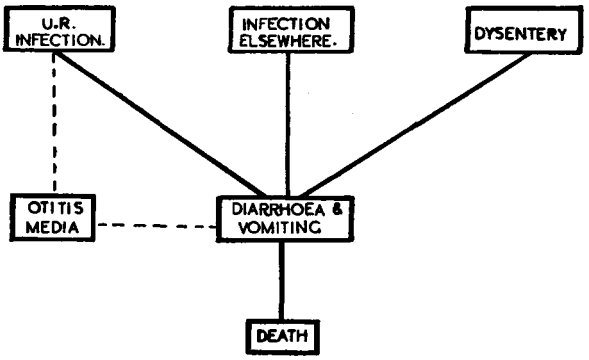
THE INCIDENCE OF INFECTIONS IN GASTRO-ENTERITIS (238 CASES).

With otitis media	193 (81·4%)	91·6%
With other infections	25	
Without demonstrable infection	20	

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purulent otitis media, 25 had a parenteral infection elsewhere, while only 20 showed no evidence of infection. In other words, 91·6 per cent. had an associated parenteral infection, which in most cases was an otitis media. I realize that such statements put me on precarious ground, and yet the importance of the question tempts me to enlarge upon this particular condition, keeping the above figures in mind.

Diarrhœa and vomiting is described under a variety of terms, such as gastro-enteritis, cholera infantum, intestinal intoxication, dyspepsia, etc. It is a condition which has been studied for many years by many investigators and, as a result, various ætiological factors have been put forward. Some of the early investigators found the dysentery bacillus and considered it to be the undoubted



cause. Another early idea was revived by Floyd (1925), Jeans (1926), Marriott (1927), and others, who considered that gastro-intestinal disturbances were related to otitis media. The streptococcus seems to have been the organism found most frequently in the otitis media associated with their cases.

An investigation of summer diarrhœa has been carried on for some years in the Hospital for Sick Children in Toronto, under the direction of Dr. Alan Brown (1930). This investigation has proved that a large number of cases which occurred in summer epidemics were due to dysentery organisms, several different organisms being present. *B. dysenteriæ* Sonne was found fairly frequently in the above series. Otitis media was found in 44 of 171 cases of intestinal intoxication examined upon admission to the above hospital, while 65 other children developed otitis media during the course of their illness. A total of 109 cases (63·7 per cent.) of diarrhœa had otitis media. The Toronto investigators also found that 63·1 per cent. of 84 control cases had otitis media, and there was a higher percentage of streptococcus in these than in the cases with diarrhœa. They came to the definite conclusion that neither otitis media nor the streptococcus was responsible for the diarrhœa-vomiting

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syndrome. I was fortunate enough to be able to observe and take a small part in the above study, and I must confess that the results were most convincing.

After seeing hundreds of cases of diarrhœa and vomiting, I recognize a classification which includes the ætiological factors mentioned above. Carmack (1930) has described a similar classification. I am convinced that they can be divided into three groups, the largest consisting of those cases of diarrhœa and vomiting which are secondary to an upper respiratory infection. This infection might be so slight as to be unrecognized in a young infant. Otitis media usually becomes evident in this group, either at the onset or at a later time, but it is not necessarily present. The second group is also a large one, being those cases beginning with one of a great variety of parenteral infections which develop the diarrhœa-vomiting syndrome during the course of the illness, and sometimes as a terminal event. Examples in this group are pneumonia, abscesses, erysipelas, etc. The third group, and in my experience here, the smallest, is that of cases due to a definite enteral infection, in other words true dysentery. In a large series of stool cultures made in this series, pathogenic organisms were found in only four cases, and two of these were the result of a known epidemic of Sonne dysentery. Blood and mucus are often found in this last group.

It must be remembered that I am quoting *post mortem* figures ; nevertheless they support my impressions from observations of a large number of clinical cases. The above classification recognizes both an enteral-infection group and also a parenteral-infection, or secondary, group. The ætiological factor in the latter group is, in the majority of cases, an infection somewhere in the respiratory tract. I do not consider that the infection is confined to the middle ear and mastoid antrum, as some have tried to show. An infection anywhere in the body of an infant with low powers of resistance is capable of producing the diarrhœa-vomiting syndrome. While otitis media may not in every case be the initiating cause of this condition, it may develop during the course of it, and the toxic effects of a mastoiditis may not only prolong the diarrhœa but be the factor which determines the fatal outcome of the illness.

I am often asked, particularly by new Residents, how they are to diagnose otitis media, mastoiditis, and sinusitis—which I almost invariably find at autopsy—in infants with gastro-enteritis. They tell me that it is simple in those cases which show classical signs and symptoms—such as fever, vomiting, and a red, bulging ear-drum which produces a rapid discharge when a paracentesis is performed, followed by a marked clinical improvement—but unfortunately, these cases are few. The more common finding is either a dull red, or a grey, lustreless drum, which often shows no bulging and when

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incised is boggy, and may or may not produce any discharge. So often, the drums are incised and no pus is found, yet at autopsy the mastoid region is full of thick pus, the whole area showing evidence of marked infection, which obviously was present for some time before death. It is interesting that in some cases of suspected otitis media in which pus does not appear on paracentesis, the ear will begin to discharge profusely when the dehydrated infant has had its fluid balance restored. The temperature charts vary greatly in this condition, as indeed they do in many conditions of infancy. High temperature is associated with acute signs and symptoms of the otitis media, but most cases of the diarrhœa-vomiting syndrome show a low-grade irregular temperature, about 99°-100° F., or else a normal, or even subnormal, temperature. It is perhaps unreasonable to expect anyone to diagnose otitis media in an infant who has a subnormal temperature, apparently normal drums, and who shows none of the signs of otitis media. This occurs very frequently in dehydrated infants who are premature, marasmic, or failing to thrive. I have observed that often such infants will show the presence of their infection by a distinct rise in the pulse-rate from that at which it has been maintained previously. In many such cases there is not any alteration of the temperature.

From these latter remarks it will be seen how difficult it is to mention treatment of such conditions. Dean and others have advocated the drainage of the mastoid antrum, believing that otitis media is a large factor in this disease. Simple cortical mastoidectomy has been performed in several centres. Carmack (1930) has reported 30 cases of diarrhœa and vomiting, in which mastoidectomy was performed ; 22 recovered and 8 died. Wishart (1930) in Toronto performed the operation in a number of cases but came to the conclusion that it was not helpful. Only a few mastoidectomies have been attempted in our hospital, and those only for patients who have been extremely ill—in fact, almost beyond hope—so that the results have not been very successful. Carmack (1930) seems to have the most rational attitude towards the problem of mastoidectomy when he says that—

" Surgical intervention cannot be decided upon intelligently without close co-operation between the pediatrician, the otologist and the radiologist. No mastoid should be opened without clinical evidence of disease in the mastoid space. Adequate pre-operative and post-operative treatment is of vital importance. All infants with marked or continued gastro-intestinal disturbances should have careful ear examinations, and if pathological changes are found, early and free drum incision should be made. If the mastoid is involved and satisfactory improvement does not result from ear drainage, a mastoid operation is indicated. Operation, except in the occasional case, should not be attempted during the violent gastro-intestinal crisis."

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I might add to this that in my opinion indiscriminate operations upon the mastoid antrum in infants with acute gastro-enteritis would be as disastrous as if no form of treatment were instituted. Simple paracentesis should be the first step, followed, if found necessary, by simple drainage of the mastoid antrum. When there are definite indications present this latter procedure should not be reserved until the infant is almost moribund, nor should it be undertaken unless the infant has been prepared for operation, to the satisfaction of the pediatrician.

Pneumonia.—The *post mortem* finding of pneumonia in children is so common that it often becomes difficult for the pathologist to assess its importance in the consideration of the primary cause of death. Sometimes the information which is available is too scanty for an accurate decision to be made on this point. However, in analysing these records, I have attempted to divide pneumonia into two groups. One group I have called " primary ", and this includes all cases admitted to hospital with a confirmed diagnosis of pneumonia which has appeared to be the most important initial condition. The other group is called " secondary " in the sense that all these children have been admitted to the hospital with some other important condition, but have had an associated pneumonia, or have been found to have pneumonia at autopsy. A survey of Table X shows that 71·6 per cent. of 134 so-called " primary "

TABLE X.

THE INCIDENCE OF OTITIS MEDIA AND THE INCIDENCE IN PNEUMONIA.

Age.	Primary Disease.		Secondary to other Disease.		Totals.	
Years.	Otitis Media.	Normal.	Otitis Media.	Normal.	Otitis Media.	Normal.
1 ..	71 (80·7%)	17	130 (70%)	55	201 (75·3%)	72
2 ..	10 (71·4%)	4	14 (70%)	6	24 (70·7%)	10
3 ..	3 (60%)	2	3 (60%)	2	6 (60%)	4
4 ..	1 (20%)	4	3 (60%)	2	4 (40%)	6
5 ..	4 (57%)	3	3 (75%)	1	7 (60%)	4
6 ..	2 (28·5%)	5	2 (66%)	1	4 (40%)	6
7 ..	2 (66%)	1	2 (100%)	0	4 (80%)	1
8 ..	1	0	3	0	4 (100%)	0
9 ..	2	1	0	0	2	1
10 ..	0	0	0	0	0	0
11 ..	0	0	0	0	0	0
12 ..	0	1	0	1	0	2
Totals	96 (71·6%)	38	160 (70·2%)	68	256 (71%)	106
	134		228		362	

pneumonias had an associated otitis media at autopsy, while 70 per cent. of 229 " secondary " pneumonias also had otitis media. It will be seen that pneumonia was an even more frequent finding than gastro-enteritis in these children, and once again the enormous number in the first year of life is quite apalling. Of these children

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71 per cent. were found to have infected middle ears at autopsy. What is the significance of this? Campbell (1934) studied 130 patients with pneumonia, most of them young children, and he found that 70 per cent. of them had otitis media, while 100 per cent. had sinusitis. He suggested that sinusitis was a possible ætiological factor in the production of pneumonia. Cullom (1934) expressed the opinion that infection of the upper respiratory tract is a " menace to all lower lying structures ". Thus it may lead to tonsillitis, bronchitis, bronchiectasis, pneumonia, and severe gastro-intestinal disturbances. Whether otitis media or mastoiditis is a significant factor in the ætiology of pneumonia or not, it is apparent to me that the high percentage of children who die with pneumonia and have an infection of the ear, is very strong evidence in favour of a preceding, concurrent, or secondary upper respiratory infection. The fact that nearly all of these children were found to have broncho-pneumonia rather than lobar pneumonia is further evidence of it being secondary to, or associated with, upper respiratory infection.

Before going on to other diseases and the association of otitis media with them, I should like to mention one or two explanations which have been given for the presence of pus in the middle ears as found at autopsy. It has been said that any infant or child who is suffering from a chronic or lingering, debilitating illness will have a collection of fluid in the middle ear. In other words, it is the result of a terminal infection. This is an explanation which Lierle (1927) discusses and which he names an " agonal event ".

The second explanation is that the pus is of an exogenous nature—i.e. that the condition is not a true otitis media but an empyema of the middle ear, which is a supplementary reservoir for the pus from the nasopharynx. If such were the case one would expect to find milk and other fluids draining into the middle ear. None was found in any of the cases examined in this series.

The third and I believe the most logical explanation is that pus found in the ears *post mortem* is the result of an otitis media which has developed before the onset, or during the course of, the principal disease which led to death. I believe that the otitis media has been an initiating cause in a great many of the diseases found in these children. That the pus found at autopsy is not due to the child lying in a semiconscious, debilitated state is borne out by a study of Table XI, which lists a number of illnesses showing a very low incidence of otitis media, in spite of the fact that some of them are conditions which go on for a considerable time before the child finally dies. Thus rheumatic carditis showed no evidence of infection in the upper respiratory tract in fifteen cases examined. Nine cases of brain tumour were examined and only two had otitis media—but on the other hand in four cases of brain abscess there was gross infection of the ears and sinuses. Appendicitis with

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TABLE XI.

THE LOWER INCIDENCE OF OTITIS MEDIA IN THE UPPER GROUP OF DISEASES ILLUSTRATED.

Diagnosis.	Otitis Media.	Normal.
Rheumatic carditis	0	15
Brain tumour	2	7
Appendicitis	1	8
Intussusception	1	11
Leukæmia	0	5
Bacterial endocarditis ..	0	4
T.B. meningitis	17	44
Cerebral sinus thrombosis ..	17	0
Brain abscess	4	0
Hare-lip and cleft palate ..	11	0
Pink disease	16	1
Meningitis	58	18

general peritonitis, and intussusception are conditions with shorter courses but they also show little evidence of infection in the middle ears. There was no infection in four cases of bacterial endocarditis, and only seventeen out of sixty-one cases of tuberculous meningitis had suppurative otitis media. The tubercle bacillus and tuberculous granulation tissue were found in one of the latter. Everyone is familiar with the lingering semiconscious or unconscious state in which these children lie for many days before their death. If otitis media occurred as an agonal event then I think it only logical to expect a much higher percentage of cases dying from the above conditions, to have otitis media at autopsy.

In the second part of Table XI are listed a few conditions in which otitis media was invariably found and was probably of considerable importance as a factor in the cause of death. Seventeen patients, varying in age from a few months to several years, died of cerebral sinus thrombosis. I have recently made a detailed study of these cases, which have been reported elsewhere, and in every case I have found evidence of an upper respiratory infection. After considering various theories as to the possible cause of this condition, I have come to the conclusion that the majority are the result of infection in the nasopharynx. I am referring here not only to those cases which involve only the lateral sinus in the presence of mastoiditis, but also to those with thrombosis of other sinuses—particularly the superior longitudinal sinus. I think that it is safe to say that nearly every child with hare-lip and cleft palate develops otitis media and sinusitis at some time during its early life. A defective lip, palate and, often, nose predispose to and encourage the entrance of infection to the accessory air passages. It is therefore not surprising that the eleven children who died, having this malformation, were infected.

Pink disease, that curious malady of infants and young children, the ætiology of which is still obscure, makes the child a notoriously

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poor risk in the presence of infection. In fact, children with this disease are so susceptible to infection that many pediatricians avoid admitting them to the general wards of a children's hospital. They do not all die, but in even the best circumstances the mortality is high, and it is interesting to note that those who have died in our hospital have, with one exception, had otitis media.

The diseases listed in the upper half of Table XI, showing a relative freedom from otitis media, are in sharp contrast to those in the lower half of the table, where otitis media is almost the rule. These figures are, I believe, very strong evidence that otitis media is of considerable importance in the group of fatal illnesses.

Associated meningitis.—Meningitis was the principal cause of death in 137 of this group of 880 children. Excluding the sixty-one cases of tuberculous meningitis mentioned above, there were seventy-six children with a purulent meningitis (Table XII). In

TABLE XII.

THE ASSOCIATION OF OTITIS MEDIA WITH PURULENT MENINGITIS.

	Otitis Media.	Normal.
Meningococcal	12 (60%)	8
Streptococcal	22 (95%)	1
Pneumococcal	10 (71%)	4
Influenzal	7 (87·5%)	1
B. coli	6 (60%)	4
Staphylococcus	1	0
	58 (76·3%)	18

meningococcal meningitis twelve had otitis media at autopsy and eight were normal. As mentioned before, the pus from the ears of four cases grew the meningococcus when cultured. It is difficult to say that the organism in the ears had any relation to the meningitis, other than that of infection of the nasopharynx, which is recognized as the first stage of the disease. These findings, however, suggest that we should examine every case of cerebrospinal fever very carefully from an otological point of view, in order to discover otitis media when present, and treat it as indicated. I cannot help feeling that such a focus of meningococcal infection might have been the deciding factor in the fatal result in some of these cases. Careful cultures for the meningococcus should be made in all cases of cerebrospinal fever with otitis media, and treatment with serum should be continued as long as infections are found either in the cerebrospinal fluid or in the ears.

Streptococcal meningitis occurs most frequently as a complication of mastoiditis. It is a condition which is familiar to every ear, nose, and throat surgeon. Twenty-three children in this group have died from streptococcal meningitis, which in twenty-two cases was secondary to mastoiditis and, in one, was a complication of a general

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streptococcal septicæmia. These figures are very common experience and therefore do not require any further comment.

Out of fourteen cases of pneumococcal meningitis an upper respiratory infection was found in all but two. In ten of these there was otitis media, while one case followed removal of tonsils and adenoids. The remaining child had a purulent pneumococcal infection of the sinuses. Seven of the eight cases of influenzal meningitis had an otitis media. Meningitis due to *Bacillus coli* was in each case secondary to spina bifida, while the one caused by staphylococcus was the result of osteomyelitis.

Prophylaxis.—Leaving this appalling list of morbid figures, I will briefly mention one or two points which offer slight hope of reducing the mortality in some of these diseases. Beginning at birth, the first form of prophylaxis is breast-feeding. An analysis of the notes which I have made on all the infants in this large series, reveals the startling fact that of those dying of infections related to otitis media and sinusitis, especially gastro-enteritis and pneumonia, only two had been breast-fed up to the time of the onset of the illness. I am not maintaining that breast-fed infants do not develop otitis media, gastro-enteritis, and other infections, because we all know that they do, but to a much lesser extent. Thus Johnston, Brown, and Tisdall (1930) found that in only five cases of intestinal intoxication the children were breast-fed, while in 141 they were bottle-fed. Dr. J. M. Smellie, in our own hospital, tells me that in only three out of sixty clinical cases of gastro-enteritis the infants were entirely breast-fed. Whether the breast-fed children develop these diseases or not, the point I want to make is that they practically always survive. It is my belief that the best insurance that a mother can adopt for her infant is breast-feeding, whenever it is possible, and particularly during those difficult first few months of life when infections are so dangerous.

My next point is so evident that I hesitate to mention it, but repetition sometimes emphasizes. The case that I have made against upper respiratory infections from which otitis media arises, has wide implications. Everyone admits that such infections are contracted from other persons. It cannot be too strongly emphasized that contact of an adult with an infant, while that adult is suffering from influenza or the common cold, is exposing the infant to one of the gravest risks which it can encounter during its lifetime.

In an attempt to overcome any possibility of infections occurring in these infants while they are in the hospital for other conditions, being aware of the high mortality in the younger age-groups, we are shortly going to erect, in connection with the Birmingham Children's Hospital, an Infant Department which will provide isolation for each child, and facilities for preventing any possible spread of infection by contact or carrier, and will have an adequate

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staff to ensure conditions of attention even better than those afforded in the best of homes.

It must be apparent from the conditions which I have reviewed that there is a great field for co-operation between the pediatrician and the ear, nose, and throat surgeon. A more careful search of the upper respiratory tract of infants and children during examination by pediatricians seems to be indicated, and I think that earlier consultations and treatment by otologists, with careful management by physicians trained in diseases of children, is a possible means of obtaining better results in dealing with this disease.

Otitis media, as found at *post mortem* examinations in this series, has played a very large part as the ætiological, complicating, or final cause of death in a great many of these children. There is not any doubt in my mind, after examining this large number of cases and finally analysing my results, that otitis media is a much more important condition in infancy and childhood than is commonly believed.

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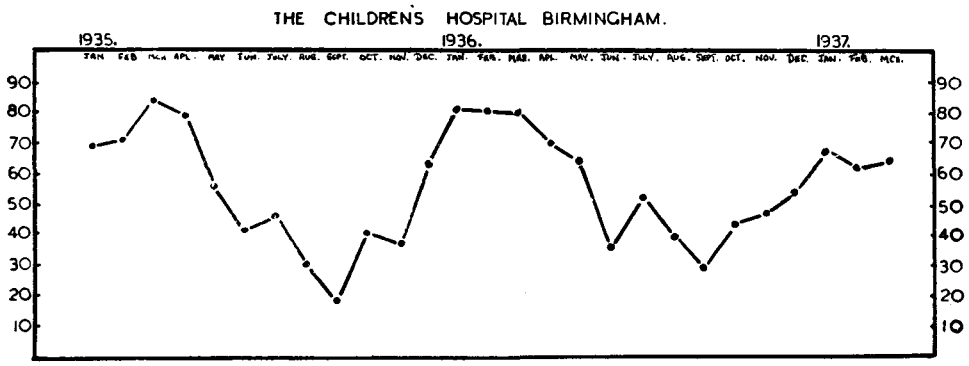
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MR. STIRK ADAMS: I wish to stress Dr. Ebbs' conclusion that the common cold is often the initial cause of a major disaster in infancy. The accompanying chart showing the number of children whose drumheads were incised in each month, month by month, during the years 1935 and 1936 in the Casualty Department at the Children's Hospital, Birmingham, illustrates one aspect of this. These children were not suffering from any infectious disease other than the common cold, and although the figures include children up to the age of twelve years, approximately one-third were under the age of two years.

In the wide field open to us in this discussion I am confining myself to the problem of otitis in infancy, i.e. under the age of two years, when it complicates, or coexists with some other medical condition. I regard otitis and mastoiditis as identical in these children and, while a complete survey of the problem has not proved possible, owing to the difficulty of obtaining records, yet some

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indication of its extent has been obtained by an examination of the records of the fifty cases in which mastoid operations were performed on children under the age of two years, by my colleague, Douglas Marsh, and myself, in the Children's Hospital, in the years 1935 and 1936. They fall into two main groups. The first we can designate primary otitis, in that the only pre-existing illness was a common cold. This includes thirty-five cases, of which twenty-nine were acute and six chronic. In three of these cases diarrhœa and vomiting occurred after operation, and because of the special



NUMBER OF CASES OF PARACENTESIS PERFORMED IN THE OUT-PATIENT DEPT. IN EACH MONTH.

importance of this symptom I have included these cases in a group in which the relation between diarrhœa and otitis will be discussed later in this paper. Most of these infants had a subperiosteal mastoid abscess on admission, and operation was followed by recovery without anxiety in all but two, who died. These were :—

Case I.—M.T., admitted, when 3 days old, *September 11th*, 1936, with spina bifida. This was repaired surgically and healed.

One month later, while the infant was still in hospital, bilateral otitis media developed, and in spite of a double cortical mastoid operation on *December 4th*, death resulted two months from its onset.

Case II.—B.F., aged 10 months. Admitted *October 21st*, 1936. Developed a cold on *October 18th*, on *October 21st* both ears were discharging. *October 27th*. Cortical mastoid operations performed. The infant died on *November 5th*.

Post mortem examination revealed a thrombosis of the superior longitudinal sinus, and lobar pneumonia involving the right lower lobe. Pus was present in the maxillary antra, ethmoidal cells and both middle ears and mastoid antra.

There were also three patients operated on for recurrent otitis and one operated on for tuberculous otitis ; all recovered.

In the group of secondary otitis, or otitis complicating some other illness, there were thirteen patients.

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TABLE I.

	Total.	Result. Cured.	Died.
Primary otitis. Acute ..	27	25	2
Primary otitis. Chronic ..	6	6	0
Recurrent otitis	3	3	0
Tuberculous otitis	1	1	0
Secondary otitis :			
To measles	4	4	0
,, diarrhœa and vomiting ..	6	2	4
,, bronchopneumonia ..	2	0	2
,, meningoccocal meningitis	1	1	0

I would draw particular attention to the diarrhœa-and-vomiting symptom complex in its association with otitis. To make the position clear we have to realize that the prognosis for infants developing diarrhœa and vomiting is that 30 per cent. will die. I am told that this is the proportion in my own hospital, and the figure shows little variation among other hospitals. Dr. Ebbs has pointed out that in all the children who had died from this condition and were examined *post mortem* there was evidence of otitis media. It has been suggested that this latter is a terminal infection, or else the effect of suction after death. I do not think we can accept either of these views, for the majority of these children have had a recognized otitis for weeks before death, and many of them have had a paracentesis performed, releasing exudate under tension. In its clinical course diarrhœa and vomiting in infancy is often acute in onset. Many patients respond rapidly to treatment, although a few children are lost in the first few days from the severity of the toxæmia. Some of these children, however, after an initial improvement, as a result of treatment by salines and blood transfusion, begin to go downhill, and at this stage otitis is recognized and paracentesis is performed. In spite of this and further transfusions the downward progress is not arrested, and a few days later the otologist is asked whether he thinks mastoid drainage should be performed. You will realize that by this time the physician is anxious that no focal infection should remain to prejudice the chances of recovery of his patient, yet the upset of a mastoid exploration may be more than the child is fit for. A difficult decision to make, as it is equally clear that the chances of improvement after a surgical drainage of the mastoid are not good, yet operation offers some hope for the patient. The following table gives the results obtained :—

TABLE II.

		Total.	Cured.	Died.
Group 1.	Acute otitis and D. and V. simultaneously	2	0	2
Group 2.	Broncho-pneumonia ; otitis some weeks later ; D. and V. late	2	0	2
Group 3.	Primary D. and V. without otitis ; otitis ten days later	4	2	2
Group 4.	Primary otitis ; intercurrent D. and V. ..	4	4	0

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Groups 1, 2 and 3 were composed of cases in which the mastoid exploration was being carried out as a last resource, and in assessing the mortality of this group this fact should be borne in mind.

Group 1.—In the first group are two infants who developed acute otitis, and diarrhœa and vomiting simultaneously. In spite of all treatment they both died.

K.K., aged 8 months. Admitted *August 19th*, 1935, for treatment for scurvy. He had been well until four months previously, when he developed an illness which lasted three weeks and was diagnosed as meningismus. He recovered, but was never quite well and three weeks before admission had begun to cry with pain.

August 24th (five days after admission): Diarrhœa and a right ear discharge developed simultaneously.

August 24th, 1935.—Paracentesis.

September 9th.—Paracentesis.

September 12th.—Double cortical mastoid operation.

September 15th.—Patient died.

No treatment appeared to have any effect on the diarrhœa, although the scurvy had been cured biochemically.

B.B., aged 4 months. Admitted *September 19th*, 1935. Had been under treatment at another hospital for the three previous weeks.

September 13th.—Otitis, and diarrhœa and vomiting appeared simultaneously. Double paracentesis.

September 22nd.—Further paracentesis.

September 24th.—A bilateral mastoid operation.

The child survived until *October 6th*, the diarrhœa persisting until the end.

Post mortem findings.—Hæmorrhages present in the small intestine; three active ulcers also present in this region.

In classing these two cases as a group in which diarrhœa and vomiting and otitis developed simultaneously, the decision has been made on apparently clinical grounds. A further investigation, which has not yet been completed, suggests that in all cases in which diarrhœa and vomiting develop, a recognizable upper respiratory infection has been present prior to the development of the diarrhœa and vomiting syndrome.

Group 2.—In Group 2 there are two cases. In each otitis media developed some weeks after broncho-pneumonia; diarrhœa and vomiting occurred as a late manifestation in the illness, and both children died.

D.R., aged 9 months. Admitted *February 24th*, 1935. Had had broncho-pneumonia *February 1st*, 1935; recovered and was well.

February 24th.—Otitis media and meningismus. Double paracentesis.

March 9th.—Child dehydrated. Double paracentesis.

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March 11th.—Double mastoid operation.

March 13th.—Child died thirty-two hours after operation.

Post mortem.—Generalized pleurisy (right). Patchy broncho-pneumonia (both lungs).

G.S., aged 11 months. Admitted *April 4th*, 1935. Had been admitted to another hospital three weeks before, with broncho-pneumonia.

March 15th.—Injection of left drumhead; right membrane thickened (but no paracentesis carried out until *April 1st*, three days after high pyrexia).

March 28th.—Pyrexia. Onset of diarrhœa and vomiting.

April 1st.—Double paracentesis.

April 5th.—Bilateral mastoid operation. Child died twenty-four hours later.

Post mortem findings.—Extensive broncho-pneumonia. Infection of right maxillary antrum.

Group 3.—In the third group there are four cases, in each of which a primary diarrhœa and vomiting developed without otitis. In each, otitis developed about ten days after the onset of diarrhœa and vomiting. Two of these children recovered and two died.

P.B., aged 5 months. Admitted *August 5th*, 1935. History of diarrhœa and vomiting since *August 1st.*

August 13th.—Paracentesis (right and left).

August 23rd.—Right mastoid operation and bilateral antral proof puncture; both antra contained quantities of mucopus. Child collapsed and died a few hours after operation.

Post mortem findings.—Quantity of pus in maxillary antra; broncho-pneumonia in both lower lobes. Pus in left middle ear.

H.S., aged 13 months. Admitted *August 7th*, 1935.

History.—Off food for a fortnight before admission; vomited every day during this time.

August 10th.—Paracentesis (left).

August 11th.—Paracentesis (left).

August 12th.—Paracentesis (right and left).

September 2nd.—Bilateral mastoid operation under gas and oxygen. Slow recovery.

September 26th.—Discharged from hospital.

J.P., aged 8½ months. Admitted *December 16th*, 1934, with ileo-colic intussusception, which was successfully reduced at operation.

On *December 29th* it was noted that he had vomited occasionally for some days and had not taken all his feeds. Hunger stools had been present at first, afterwards, green watery stools. Ears normal.

January 8th, 1935.—Child dehydrated and right drumhead injected.

January 9th.—Diarrhœa and vomiting. Right paracentesis performed.

January 25th.—Profuse discharge from both ears.

February 1st.—Double cortical mastoid operation.

February 28th.—Discharged; well.

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On *January 5th*, *18th*, and *23rd*, positive cultures of *B. dysenteriae* Sonne were recovered from the stools.

D.B., aged 5 months. Admitted *September 17th*, 1936.
History.—Onset of diarrhœa *September 10th*, 1936.
September 21st.—Right otitis diagnosed.
September 22nd.—Paracentesis (right).
October 3rd.—Paracentesis (right).
October 4th.—Right mastoid opened under novocain. Left paracentesis.
October 6th.—Child died, immediately after a 40 c.c. tranfusion of blood intravenously.
Post mortem findings.—Pus in left sphenoid, ethmoid and antrum, left middle ear and mastoid.

Group 4.—In the fourth group are four patients. Here the illness began with an otitis, and diarrhœa and vomiting occurred later. All recovered.

C.P., aged 1 year and 9 months. Admitted *May 22nd*, 1935. A fortnight before admission a nasal discharge had developed.
May 18th.—Spontaneous discharge from left ear.
May 19th.—Paracentesis (left).
May 22nd.—Tender left mastoid. Operation: Left cortical mastoid and right paracentesis.
July 11th to *21st.*—Enteritis.
August 3rd.—Recovered.

F.S., aged 6 months. Admitted *November 23rd*, 1935. History of ear-rubbing (right) for ten days previously and now swelling right mastoid.
November 23rd.—Right cortical mastoid and right paracentesis.
November 30th.—Diarrhœa.
December 6th to *12th.*—Diarrhœa.
December 29th to *January 10th.*—Diarrhœa.
January 25th.—Discharged, cured.

B.G., aged $8\frac{1}{2}$ months. Admitted *April 2nd*, 1936. History of bronchitis a month before and otorrhœa for three weeks before admission. Swelling behind right ear two days.
April 2nd.—Right cortical mastoid.
April 7th.—Diarrhœa.
April 18th.—Left paracentesis.
May 7th.—Readmitted. Further discharge from left ear and right mastoid, and persistent diarrhœa and vomiting.
May 26th.—Finally discharged.

M.H., aged 9 months. Admitted *May 19th*, 1935. Measles had occurred three weeks before and the right ear had discharged for a fortnight. Vomiting occurred during the week before admission, but no diarrhœa.
May 21st.—Cortical mastoid right ear.

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June 6th.—Diarrhœa.
June 14th.—Cortical mastoid left ear.
June 27th.—A note was made that, in spite of repeated blood and and saline transfusions, the child was still very pale and dehydrated.
July 1st.—Diphtheria recognized in nasal swab.
July 5th.—Child better.
July 31st.—Child discharged, recovered.

That a history of measles as a cause of otitis does not justify a serious prognosis is proved by three other cases in which a cortical mastoid operation had been performed for otitis supervening on measles, and in which the patients recovered without the development of diarrhœa and vomiting.

From so small a series as this the conclusions drawn must be tentative. In spite of the fact that in Groups 1, 2 and 3, out of eight patients operated on, six died, I still think we are justified in carrying out operation when the patient is failing to respond to medical treatment and otitis is known to be present, especially when there are symptoms of aural irritation, e.g. ear-rubbing, and head-rolling. Before the operation is carried out the child must be brought to the best possible condition by blood transfusion or subcutaneous salines, as thought necessary. My preference is for operation under local anæsthesia, using a small quantity of 1 per cent. novocain. During the operation the child shows no distress and usually sucks vigorously at a bottle containing sterile glucose and water. In the fourth group, in which diarrhœa and vomiting occur as a late manifestation, treatment is usually successful in arresting it. There is, however, another group not represented in this series, in which a patient has been admitted to hospital with otitis for which paracentesis has been performed. Sometimes diarrhœa and vomiting will occur, while both ears are discharging profusely, and this I regard as an indication for opening one or both mastoids as soon as possible.

In general, an acute otitis media may complicate any medical condition of infancy. It is always important, and treatment of the otitis may be the determining factor in the recovery of the child. As an illustration of this I quote a last case in which a child suffering from meningococcal meningitis—which had been fully controlled by medical treatment—developed a bilateral otitis media which prejudiced his recovery. A double cortical mastoid operation changed the picture entirely and complete recovery ensued.

G.B., aged 13 months. Admitted on *December 5th*, 1935, with meningococcal meningitis of four days' standing. Between *December 5th* and *9th* many lumbar punctures were carried out and large doses of anti-meningococcal serum were given.

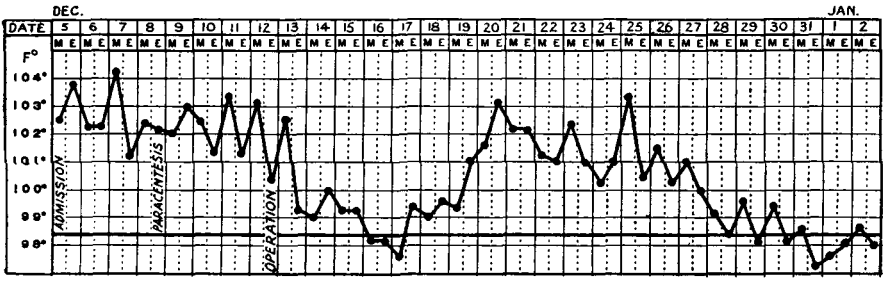
December 9th.—Cerebrospinal fluid had become clear, but the persistence of the temperature suggested the aural infection which was

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diagnosed on examination. A bilateral paracentesis was followed by a profuse discharge but in spite of this the pyrexia still persisted.

December 12th.—Both mastoids were opened, and following this the temperature became normal.

December 17th to *31st.* Suffered from the effects of a generalized serum rash, the ears at this time being perfectly satisfactory.



G.B. Temperature Chart.

Dr. C. E. Scott and Dr. R. B. Lumsden: This paper is based on a consideration of 564 cases of suppurative otitis media occurring in children under five years of age, in the Ear and Throat Department of the Royal Hospital for Sick Children, Edinburgh, during the years 1934 to 1936, inclusive. Of these, 145 occurred in children under one year of age and 419 in children over one year but under five years. We will briefly mention several points which have particularly impressed us in our work with children, and which have been brought out in the analysis of our cases.

Table I shows the number of cases, etc.

Table I.

Royal Edinburgh Hospital for Sick Children.

Cases of Suppurative Otitis Media in Children under 5 years of age. 1934 to 1936 inclusive.

Under 1 year.	1 to 5 years.	Male.	Female.	Right.	Left.	Bilateral.	Total.
145	419	288	276	185	179	200	254

A cause of onset other than acute coryza was assigned and recorded in 46 cases:—

Under 1 year:	Measles	1
	Tonsillitis	1
1 to 5 years:	Tonsillitis	7
	Removal of tonsils and adenoids	4
	Removal of adenoids	2
	Acute bronchitis	1
	Pneumonia	2
	Intranasal antrum operation ..	2
	Measles	17
	Scarlatina	8 (1 "contact")
	Whooping-cough	1
		46

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Ætiology.—Acute coryza was found to be the most common cause and we record only forty-six cases in which a definite cause other than coryza could be stated. At the same time, we have been impressed by the frequent inability of a parent to ascribe any definite cause.

TABLE II.

OPERATION CASES.

Under 1 year	34 cases.
1 to 5 years	120 ,,
Total	154

NUMBER OF OPERATIONS PERFORMED.

	Myringotomy.	Schwartze mastoid.	Modified radical.
Under 1 year ..	10	29	—
1 to 5 years ..	28	107	3
Total ..	38	136	3

Myringotomy followed by Schwartze mastoid operation (included in table above).

Under 1 year	2
1 to 5 years	12
	14

Operation cases.—Of our total of 564 cases, 154 required operation, 34 being under one year of age and 130 over one year but under five years. Considering the two age-groups together, of thirty-eight myringotomies performed, twenty-five ears were dry at the last examination; thirteen failed to report after leaving hospital. 136 Schwartze operations were carried out; 132 recovered, four died, of which three were under one year, and one over one year. Fourteen of these were preceded by myringotomy. A dry ear and a well-healed wound resulted after sixty-six of these operations; in twenty-one the ears were still discharging when last examined, and twenty-eight cases were lost sight of (country patients).

TABLE III.

DURATION OF OTITIS MEDIA AT TIME OF SCHWARTZE OPERATION.

16 cases under 1 year :	Shortest	2 days.
	Longest	300 ,,
	Average duration ..	*46 days.*
74 cases from 1 to 5 years :	Shortest ..	2 days.
	Longest ..	540 ,,
	Average duration	*37 days.*

BACTERIOLOGY.

Schwartze Operations—

Under 1 year (13) :	*Streptococcus hæmolyticus* ..	7
	Str. viridans	1
	Pneumococcus (type not known)	4
	B. influenzae	1
1 to 5 years (29) :	*Str. hæmolyticus*	26
	Pneumococcus (type not known)	2
	B. influenzae	1

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This table shows the duration of otitis media at the time of the Schwartze operation, also the bacteriology in a proportion of cases.

Complications.—Two developed erysipelas; four developed measles; four developed scarlatina; of these four, one, aged over one year, had also an associated retropharyngeal abscess. Two developed kidney trouble.

In one case (under one year) a facial paralysis was present at the time of operation, the auricular glands were enlarged, and the child had been bottle-fed. Clinically this case closely resembled a tuberculous infection, but no bacteriological or histological evidence was found to support this diagnosis. A radical operation was subsequently necessary.

Another case under one year presented interesting features, which we think merit attention. This child was admitted to hospital with marked œdema and tenderness over the mastoid process. The temperature was over 100° F. and a definite bronchitis was present. The tympanic membrane, however, was practically normal in appearance and there was no suggestion of sagging of the posterior meatal wall. At operation, definite infection of the mastoid cells was found, and a swab of pus taken gave a pure culture of *Streptococcus hæmolyticus*. The child died, and at the *post mortem* examination the blood sinuses were found to be healthy but there were multiple pyæmic abscesses in the lungs and abdominal organs. We suggest that this case is one of blood-borne mastoid infection.

TABLE IV.

INTRACRANIAL COMPLICATIONS. LATERAL SINUS THROMBOSIS.

	Cases.	Recovered.	Died.
Under 1 year ..	2	–	2
1 to 5 years	2	1	1
	4	1	3

Intracranial complications.—In respect of these, we appear to have been somewhat fortunate during the period under consideration, thrombosis of the lateral sinus being the only one encountered in these age-periods.

In considering the value of myringotomy, as revealed by our figures, 52 myringotomies were performed. Of these cases, fourteen required a subsequent Schwartze operation. Of the total number of cases, we find that 22 per cent. had a Schwartze operation performed without any previous myringotomy; 21 per cent. of cases in which myringotomy was performed required a subsequent Schwartze operation. This 1 per cent. difference suggests that myringotomy is not an important factor in the avoidance of subsequent mastoid operation in these age-groups. We do not, however,

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interpret this as an argument against the value of myringotomy, as another factor must be considered, namely the period required for ultimate resolution and recovery of hearing.

The value of myringotomy when performed on the intact drumhead in a case of acute otitis media is well established. When performed in the presence of a small perforation, when drainage was considered to be inadequate, we have been disappointed in its efficacy. In connection with this operation, we have been impressed with the deceptive appearances of the infant drumhead in acute otitis. It is so often not the textbook inflamed, bulging drumhead, with perhaps the yellowish tinge typical of imminent perforation. Rather do we find it lustreless and opaque, with little or no apparent bulging ; such cases are frequently seen in medical wards in which no other cause can be found to account for a continued pyrexia. Myringotomy generally reveals pus, and resolution of temperature follows. With regard to the Schwartze operation cases : Many of the operations were performed in the absence of acute mastoid symptoms but discharge was persistently profuse ; the temperature generally settled, but the pulse-rate remained raised.

In just such cases we have not the guidance which is to be derived from hearing tests, which are of such value in older patients. It is all the more important, therefore, that we should keep the preservation of this function constantly before us.

In a small series of cases we have been impressed by the value of skiagrams of the mastoid, even in children under the age of one year, when considered as part of the whole clinical picture. Clouding of the mastoid cells is generally found in all cases of early acute otitis media, but it is later, when definite breaking-down of the cells may be shown, that they prove of assistance.

The value of tonsil and adenoid removal has not been overlooked in our treatment, but we feel that this subject alone would provide material for a discussion.

TABLE V.

TUBERCULOUS OTITIS MEDIA.
(9 cases).

Under 1 year.	1 to 5 years.	Male.	Female.	Right.	Left.	Bilateral.	Total.
7	2	5	4	1	4	4	9

Results.

Under 1 year :	Alive (all discharging)	5	Dead .. 2
1 to 5 years :	Alive	0	Dead .. 2

All proved histologically or bacteriologically.
Definite history of bottle-feeding in 4.
No record in 5.
Facial paralysis in 3—all under 1 year.

We cannot conclude without referring to a particular type of otitis met with in the age-groups under discussion, namely tuberculous infection of the middle ear. This condition was at one time

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fairly common, but is now apparently on the decline. During the years under consideration, we have only been able to collect a series of nine cases and as time is limited, we will only refer to a table giving some particulars of this series.

THE PRESIDENT showed a series of slides, including an otoscopic picture of what Dr. Le Mée called " unsuspected " otitis. The child had been in a medical ward for a fortnight, and had had all his " systems " examined, except the ear ; all with negative results. Then the otologist was called in ; paracentesis was performed, and improvement at once followed. He also showed a chart, prepared more than ten years ago, to show the extraordinary prevalence of otitis ; the frequency in infants dying from all causes varied from 75 per cent. to 96 per cent.

Another chart exhibited showed the age-incidence of otitis media, and he, the President, would point out it strikingly resembled one of the charts shown, earlier in the discussion, by Dr. Ebbs. There was a rise just before school age ; apparently when the child went to school it came under examination by the school medical officers, and otitis was more likely to be discovered.

Why was otitis so common in infants ? One reason was that when the child was born there remained, in very many cases, fragments of embryonic connective tissue, such as that which filled the ear during embryonic life, and which usually became absorbed at or at about the time of birth. Portions of this tissue might remain in the corners of the tympanum, and embryonic tissue was very liable to become infected. A slide shown indicated clearly the malleus and part of the incus embedded in such embryonic tissue.

He had been relieved to hear Dr. Le Mée and Dr. Ebbs say that on incising a suspected tympanic membrane, pus was not always found, because hitherto he had blamed himself when no pus appeared on incision, and when it appeared afterwards it had been considered to be due to infection by the surgeon !

He asked under what conditions Dr. Mée found what he called the " frosted " tympanic membrane, dotted with little white grains. He, the speaker, had seen this appearance in older children, and regarded it as a milder type of infection.

Dr. Le Mée had said that he performed the mastoid operation on infants in two stages and he (the President) would like to know why. He knew that in France there was a fear of the mastoid operation for the very young, and he would like to know whether it was a fear of the anæsthetic, or of the actual operation.

Dr. Ritchie Rodger had said that in the cases of pulmonary infection, speed in operating was essential ; did he consider that a mere incision would suffice, followed, if necessary, by the bone

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operation at a later date? A number of practitioners held that in infants mere incision of the abscess was sufficient to cure mastoiditis.

He agreed with Dr. Ebbs that the mastoid operation was seldom justifiable in cases of gastro-enteritis; he had operated in a number of these, and was not satisfied that the results were better than if the cases had been left alone. A good deal of work remained to be done in order to determine the relationship of otitis to malnutrition, gastro-enteritis, and pulmonary infection.

One of the earliest otoscopic signs of otitis in infants was the disappearance of the cone of light.

He did not think that the X-ray picture was of much value in mastoiditis in children; any value it possessed was only anatomical, showing the position of the lateral sinus and the degree of pneumatization. It was of no value at all unless both sides were radiographed and compared.

MR. E. WATSON-WILLIAMS said that he had devoted special attention to otitis media in the very young ever since 1929[1] when he had analysed a series of cases. He then found that the first year of life provided more cases needing mastoid operation for acute infection than any subsequent year, and that the first two years supplied the great majority of first attacks of otitis media[2, 3].

He had been particularly interested in three of the points Dr. Le Mée had made. First that otitis media meant infection of the whole middle-ear tract including the mastoid antrum and cells[2]; there was no barrier between these and the tympanum and they became infected within a few minutes of infection of the latter. Secondly, his indication for myringotomy—one sleepless night[4]. Thirdly, that the mastoid operation on babies should be short; his (the speaker's) own plan was "a minute a month", i.e. for a seven months' old baby, the operation must be completed in seven minutes from incision to stitches. A twenty-minute operation was a severe test for a young baby.

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[1] WATSON-WILLIAMS, E., *Practitioner*, 1929, 122, 36.
[2] ——— *Brit. M.J.*, 1933 (ii), 329.
[3] ——— in *Modern Treatment in General Practice*, London, 1934, 194.
[4] ——— in Hamilton Bailey's *Emergency Surgery* (1st edition), Bristol, 1931, ii, 103.

DR. MCNAIR SCOTT said it seemed to him that routine examination of the ear in infants with upper respiratory infections often revealed a red and swollen drum. A certain number of these children had obvious symptoms from the ear, such as pain and

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restlessness and, in these, myringotomy was obviously indicated; in others an ear with similar appearance gave rise to no symptoms, and would often quiet down without any treatment. In infants with diarrhœa and vomiting, again, one found in some an obviously bulging drum behind which was pus; in others the drum was reddened, and no pus was released on incision. In the children with diarrhœa and vomiting one felt compelled to incise a drum which, in the absence of these symptoms, one would have been inclined to leave alone.

He would like to ask his surgical colleagues (1) whether any harm ever came of incising a drum unnecessarily, and (2) whether they felt that, otologically speaking, there was anything specific about the otitis in infants with diarrhœa and vomiting which suggested that a different form of therapy from that in otitis without this complication should be employed.

In children with pneumonia it was very common to find that the ear-drum was red and often it might be swollen. In the majority of such cases the ear trouble subsided after the crisis without therapy. However, he had the impression that Type III pneumococcus was particularly liable to cause trouble in the middle ear, and that ears affected with that organism usually had to be opened. He wondered if Dr. Ebbs, in his study of otitis media, had typed out the pneumococcus obtained, and what his results had been.

Dr. Le Mée (in reply) said that he performed the mastoid operation in two stages in these very young patients because he and his colleagues had seen, a few years ago, many cases in which, a few hours after the operation, the patients had high fever and were very pale, so that complication was feared. His colleagues had also published reports of cases in which a high temperature had developed after the mastoid operation, but since the operation had been carried out in two stages such a complication had not been encountered. When first the mastoid was opened limitation of the purulent process occurred, and when the bone was opened it was found to be soft. It was not the general anæsthesic which was feared because, in these very young patients, anæsthesia was produced by applying cold water or ice to the back of the ear for five minutes; opening the bone was then not painful. Shock was a very important matter in the case of infants, and should be avoided as much as possible.

Dr. Ritchie Rodger (in reply) said that when he had spoken of hurrying the operation, he had not been referring to the simple incision; he had really meant that no time should be wasted by the operator. Sometimes the complete operation was carried out in twenty-five minutes.

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