An Investigation of the Hospital Management of Acute Scarlatinal Otitis Media with special reference to The Influence of Serum Therapy and to The Value of Zinc Ionisation in the Treatment of Acute Otitis Media complicating Infectious Disease

by

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CONTENTS.

INTRODUCTION.

Probably of all the complications of acute infectious disease, otitis media is the most important on account of its frequency, the difficulty in affecting cure, and the results attributable to it in later life such as the social inconvenience of a discharging ear with defective hearing, and the danger to life of mastoiditis associated with the chronic stage of the disease. It has been pointed out that as many as 5 - 19%[1] of all cases of chronic otitis media and 10%[5] of deaf mutism are due to scarlet fever alone.

The logical solution of the problem would seem to lie in a reduction of the incidence and chronicity rates of the acute stage, and although in the past the discharging ear has been either neglected or inadequately dealt with, in recent years its importance has been recognised and attempts at improvement have been made with varying success in these respects. Ross[2] in 1924 reviewing the Incidence found that it varied between 3.75% and 25% and no decrease could be claimed with the development of modern medicine. With[3] regard to the present treatment of the condition he stated that it was practically identical with the earliest recorded in modern times. Williams[6] made a similar observation in 1933 when he said that the useful principles of treatment today were essentially the same as they were twenty years ago. I have studied the literature and there is no doubt of the truth of these statements but two avenues for investigation have been suggested to me which might lead to improvements and these I have chosen for the main purpose of this work.

The first of my enquiries has been suggested by Logan Turner[10] and T.B.Layton[12] who both thought that the serum therapy of scarlet fever might have a beneficial influence on otitis in that disease. With regard to the second, the

success of Friel,[14] McLaggan[15] and other workers with zinc ionisation in the treatment of chronic otitis media has led me to believe that its efficacy in the acute stage would be worth investigating.

I have been fortunate in being responsible for the treatment and management of all cases of otitis media in the Park Fever Hospital from August, 1933, till January, 1935. The fact that serum treatment of scarlet fever was widely used enabled me, not only to study its effect on the incidence, but also to study its influence on the prognosis of otitis media in cases so treated.[7] [16] Age and additional infectious disease have been shown[19] to influence the incidence in scarlet fever and this has stimulated me to further study the effect of age and the presence of an intercurrent infectious disease on the course of this complication.

Although this work has been mainly concerned with scarlatinal otitis media, I have studied concurrently cases of otitis media complicating measles and diphtheria, mainly to find if my conclusions with regard to the effect of age, intercurrent infectious disease and zinc ionisation in scarlet fever otitis were applicable to the complication in these diseases.

Inasmuch as the removal of tonsils and adenoids was not done in the treatment of the acute stage of the disease in my cases, I have been able to form some opinion with regard to the place of such surgical measures. Even at the present day there seems to be considerable difference of opinion on the efficacy of this procedure, probably due to the fact that the matter has never been properly investigated.

The aspects I have mentioned are only a few of the many which still require investigation but I trust that my conclusions concerning them will be of use in the management of a disease which too frequently enters the chronic stage.

PART II.

Historical Review

and

Commentary.

HISTORICAL REVIEW AND COMMENTARY.

The disease scarlet fever known in France as la scarlatina, in Germany as scarlach and in Spain as escarlatina has a somewhat obscure origin.[21] Suggestive but not complete descriptions were made by the later Greek and Roman physicians. Hippocrates described a disease similar to scarlet fever but no mention was made of the salient feature, namely, the rash. This disease has since been considered to be diphtheria. In the literature little or no mention is made of acute otitis media, one of the most important complications, until the end of the 19th Century, when hospital isolation for the disease became more widespread. With advances in preventive medicine and the activities of Public Health Bodies the condition in recent years has been receiving more attention. The number of sufferers from chronic otitis media following the acute stage complicating infectious disease who attend the ear clinics of the School Medical Services and Out-Patient Departments of General Hospitals, emphasise the importance and need for improvement in the management of otitis cases at the source, namely, in the Infectious Diseases Hospital. Chronic otitis media due to scarlet fever alone has been rated as high as 19%[16] by Harries and Gilhespy, 15.8%[22] by Ker Love and 5 - 15% by Ross[1] whilst May[5] attributes 10% of deaf-mutism to this disease. These figures again stress the need for better treatment of the acute stage.

In recent years consulting otologists have been added to the staffs of these hospitals to aid and advise in the management of such ear complications that arise, with a view to reducing the chronicity rate of such conditions. With this advance our knowledge of this type of otitis is rapidly increasing mainly through hospital reports and the writings of interested observers in the medical journals.

In an analysis of the incidence of many observers over a period of many years Ross[2] in 1924 found it to vary between 3.75% and 25%. A reduction of the Incidence Rate

of the complication has been recognised as the logical solution of the problem and it is interesting to review the facts concerning this aspect of the disease.

Gowen[19] of Philadelphia showed that when scarlet fever was complicated by another infectious disease the Incidence Rate of otitis media increased, e.g.

Scarlet fever and measles	40%	incidence of otitis media.
Scarlet fever, measles and diphtheria	50%	" " " "
Scarlet fever, measles and chickenpox	75%	" " " "

In 1933[7] Williams pointed out the importance of the age period 0 - 5 years in which the greatest number of otitis cases occurred. They were distributed in the following manner:-

Age Group.	Distribution.
0 - 5 years	67.7%
5 - 10 years	30.2%
10 - 15 years	4.2%
15 - 20 years	2.1%
20+ years	1.8%

Likewise Harries[16] and Gilhespy have pointed out the effect of age on incidence and their observations have been borne out by other observers. They found that the younger the patient the greater was the tendency to middle ear complications which their figures clearly show.

Age Group.	Incidence of otitis media.
0 - 5 years	15.4%
5 - 10 years	7.8%
10 - 15 years	3.4%
15 - 20 years	3.6%
20+ years	4.0%

This tendency has been attributable to the relatively greater size of the Eustachian Tubes in the very young a theory supported by otologists in general. However Watson Williams[23] holds that it is possible for a constitutional factor to play a role as recent work has shown young children to have a relative hypovitaminosis which might explain the catarrhal tendency in early life and the vulnerability of the middle ear to bacterial infection. If this is the case he says that the prophylaxis of otitis lies in the hands of the physician during these early years.

In view of the effect of these two factors alone on the Incidence Rate, namely, additional infectious disease and age, it can be readily understood how some observers record high incidences if these factors are not considered. Especially must they be of importance where control cases have been used in assessing the value of any measure in the reduction of this rate.

Attempts in the past to reduce the Incidence Rate have proved useless and Ross[2] in 1924 came to the conclusion that with the development of recent medicine no decrease in the incidence of scarlatinal otitis media had been accomplished. [3] [25] 1909, recommended in all healthy children as a prophylactic of ear disease in case of contracting scarlet fever. The impracticability of this approach to the problem is obvious particularly since present day scarlet fever is of a very mild type. Local applications to the fauces and naso-pharynx have of course been tried for many years but with regard to the prevention of otitis had little effect, being purely symptomatic. In 1920 Potts[27] in the City Hospital, Newcastle, used mixed vaccines in the treatment of the fever itself but could claim no success. As recently as 1931, American[28] workers on the assumption that otitis media, a septic complication of scarlet was due to a state of hypovitaminosis, administered large doses of cod liver oil to correct this. No success in reducing the Incidence Rate was recorded.

It is understandable how such measures have failed when it is considered that the complication occurs with greatest frequency in the first two weeks of the disease as pointed out by Gardiner[30] in his 1922 Report and also by Strachan.[34] Williams[8] agrees in some respects but says that the complication may occur from the first day of the disease till the last day of convalescence. In my own experience the highest frequency is in the first two weeks but not more marked in the first than the second. The falling off in frequency I have noted

after this period and I have seen cases occurring as late as the sixth and seventh weeks. These, however, I have not associated with the original attack of scarlet fever as they are usually associated with secondary tonsillitis which is not uncommon in scarlet fever wards. By the occurrence of the complication is meant the appearance of a discharge in the external meatus, so actually the involvement of the middle ear must have taken place at a still earlier date. Whether the infection is blood borne, air borne by the Eustachian Tubes or takes place by extension in the local lymphatics is not certain. The generally accepted view is that a direct extension of the inflammation in the naso-pharynx mucous membrane takes place up the Eustachian Tube to the middle ear. In my opinion for any measure to be successful in preventing this extension it must act quickly in cutting short the inflammatory process in these parts irrespective of how the infection of the middle ear takes place. Layton[35] in 1921 said that he could not think of any measure, which had not already been tried, directed to decrease this naso-pharyngeal inflammation which would diminish the likelihood of otitis media developing. He felt that for improvements it would be necessary to wait for a serum, analagous to anti-diphtheritic toxin and more specific than the polyvalent anti-streptococcal serum in present use.

Since the introduction of scarlatinal antitoxin the serum therapy of scarlet fever in recent years meets this requirement in varying degree and although the results generally are discouraging as far as otitis is concerned they are worthy of detailed study. The following table which I have compiled mainly from hospital reports gives the facts.

Table I.

Primary Acute Suppurative Otitis Media
complicating Scarlet Fever.
General Incidence Rate on Discharges and Deaths.

Year.	Place	Authority	Scarlet Fever Discharges and Deaths.		Serum Treatment.	Otitis Incidence
			No.	Age 0 -5 yrs		
[30] 1920/22	Edinburgh	Gardner, W.T.	-	-	-	6-10%
[2] 1924	-	Ross, E.L.	-	-	-	3.75-25%
[36] 1923/24	London	Layton, T.B.	3356	?	-	8.6%
[16] 1924	Birmingham	Harries and Gilhespy.	3684	20.6%	-	7.6%
[86] 1926	Philadephia	Gowen, F.V.	10080	?	-	10.0%
[74] *1929	Manchester	Sutherland, D.S.	1873	?	27%	9.9%
[77] *1930	Birmingham	Harries, E.H.R.	1716	20.0%	65%	4.25%
[78] *1930	Leeds	Anderson, J.S.	2223	?	10%	6.3%
[75] *1931	Manchester	Sutherland, D.S.	2643	25.8%	35%	9.7%
[80] *1926/33	Lanarkshire	Reid, J.	2665	?	48%	6.3%
[42] 1924/31	Chicago	Hunt, L.W.	2303	?	38%	10.5%
[76] *1933	Manchester	Sutherland, D.S.	1611	29.2%	35%	9.4%
[79] *1933	Leeds	Anderson, J.S.	1743	?	5%	7.2%
[43] 1933	L.C.C., nine acute fever hospitals	Statistical Department, L.C.C.	19069	28.2%	?20 - 40%	8.0%

* Compiled from data in hospital reports.

From the above table it is noted that the Incidence Rate of otitis media has not materially declined remaining between 6% and 10%. The proportion of cases under 5 years in each series, on account of the high incidence in this age group, and the proportion of cases which have had serum treatment have been included where possible. One noteworthy feature, however, is the Birmingham figure of 4.25% recorded by Harries in 1930,[77] a considerable reduction on his 1924 figure of 7.6%. This was attributable at the time to the use of serum, an assumption which seems reasonable as 65% of the cases were so treated, a remarkably high proportion compared with that of other observers. A low proportion of cases under 5 years in any

series will give a low gross incidence on account of the greater frequency of ear disease in the young child. In this Birmingham series 20% were in the 0 - 5 years group, a low figure compared with the 25 - 30% recorded in other series. The low Birmingham incidence, therefore, can be partly attributable to the rather favourable age grouping as well as to the antitoxin treatment.

The method of administering the serum in the above quoted cases was by the intramuscular route, an inferior method compared with the intravenous route when a maximum effect in the minimum time is desired. As already mentioned the highest frequency of the complication is in the first two weeks of the disease, particularly the first. In view of this fact and since most cases of scarlet fever in our hospitals come under observation on the 2nd or 3rd day of the disease some will have the middle ear already infected whilst in many at least some involvement of the Eustachian Tubes will have taken place. To cut the process short at this stage requires a remedy which will act in a matter of hours and I think most observers will agree that for the serum to have its maximum effect quickly in this respect it must be administered into the blood stream.

Platou[44] demonstrated the superiority of the intravenous route of administering serum when a maximum absorption by the blood stream in the minimum time was desired. The following table demonstrates this point quite clearly where the intravenous, intraperitoneal, intramuscular and subcutaneous methods are compared. The serum absorption of the blood stream is seen to be highest in the shortest time, when given intravenously, the concentration moreover being sustained, and never at any time does it reach the level of the intravenous route when administered in any other way.

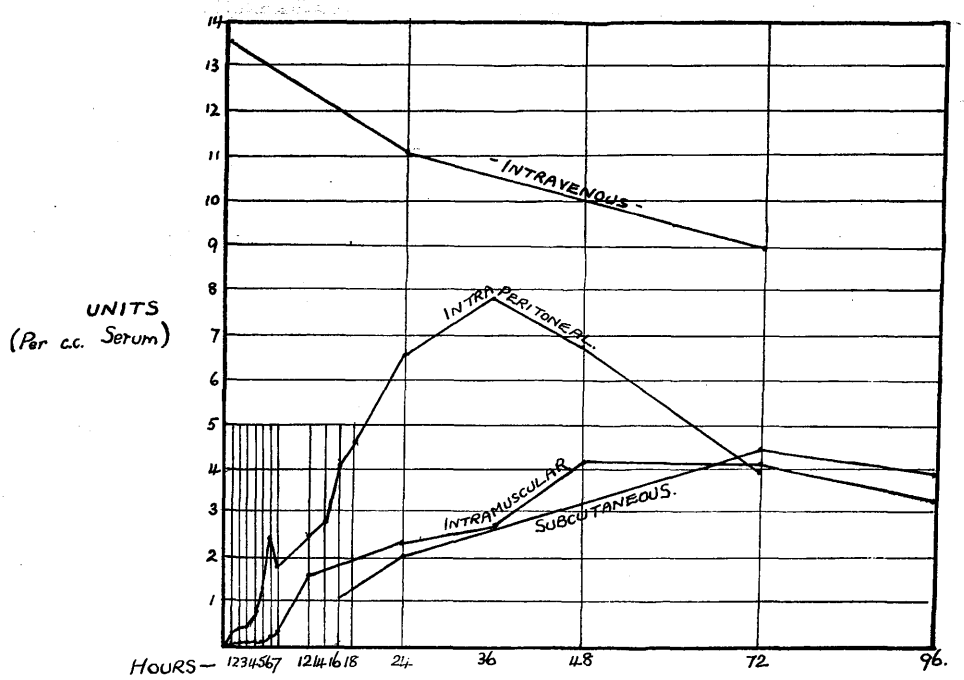

FIG. 1. GRAPHIC REPRESENTATION OF ABSORPTION — UNITS PER C.C. BLOOD-SERUM.

The following table compiled from data in hospital reports shows the effect of serum treatment by the intravenous and intramuscular routes.

Table II.

Primary Acute Suppurative Otitis Media
complicating Scarlet Fever.
Incidence Rate in Serum treated cases.

Year.	Place	Authority	Scarlet Fever Discharges and Deaths.		Serum Treatment.	Otitis Incidence
			No.	Age 0 -5 yrs		
86 1927/28	Ilford	Burton and Balmain	670	28.0%	All intramuscular	6.0%
81 1928	Edinburgh	Craig	478 478	28.2% 30.0%	" No serum	8.4% 11.3%
42 1924/31	Chicago	Hunt, L.W.	882	?	All intramuscular.	5.1%
77 1930.	Birmingham	Harries, E.H.R.	1129	17.8%	"	3.5%
82 1928/32	Leicester	Banks, H.S.	1204	15.0%	All intravenous	0.9%

Although data in the above series is somewhat scanty, results seem to indicate that in scarlet fever treated by serum intramuscularly the incidence of the disease falls between 3.5% and 8.4%, the variations depending largely on the age composition of the series. The outstanding figure .9% recorded by Banks in Leicester in his intravenous treated cases in 1928-32 is by far the lowest in any series. It is noted, however, the low proportion of cases in the 0 - 5 years group, but in spite of this, and as he himself[83] says, the results are due to the serum being used in this way. Unfortunately Banks has no control series and the low incidence credited to the intravenous use of serum is not quite proved. The seasonal and yearly variations in the incidence of scarlatinal otitis media which have been pointed out by Williams[8] necessitates a control series of cases occurring concurrently with those in the serum treated series. If this had been done by Banks and a higher figure had been recorded in the controls his statement would have been proved. However the figure he records is strikingly low and has stimulated me further to investigate his claims in this work.

To proceed to the hospital management of the condition once it has occurred, the literature on the whole is rather inadequate and scanty, but in the case of some observers is worthy of review. Ross[3] in reviewing the treatment of otitis from 1886 to 1922 states that to-day it is practically identical with the earliest recorded in modern times and in general is symptomatic. Williams[6] in 1933 made a similar observation when he stated that the useful principles of treatment to-day were assuredly the same as they were twenty years ago. The aim of all is undoubtedly to secure a healed drum-head with normal hearing in as short a time as possible. Any worker in infectious disease work will readily agree that one of the bugbears is the long period of treatment necessary before cure is affected in ear complications. If this could be accomplished quicker not only would there be less chance of permanent impairment to hearing but there would be a considerable

saving of both time and public funds.

In otitis media, a condition in which there is a natural tendency to cure, it is extremely difficult to assess the values of different forms of treatment. I have concluded that for comparative purposes the average duration of the discharge in the successfully treated cases and the chronicity rate, i.e., the proportion of failures, must be considered, with certain reservations a reduction in both of these is necessary before a method can be said to be superior to another.

Otologists are unanimous in saying, that when a case of acute otitis media is diagnosed early before rupture of the tympanic membrane and paracentesis is performed, the disease is likely to clear up quickly and mastoiditis is rarer. It is interesting to note that Thomson[45] in 1890, Jarecky[3] in 1905 and Yearsley[25] in 1909 all recommended early paracentesis in acute scarlatinal otitis media to facilitate cure by the promotion of drainage of tympanum from the start. The difficulty of course was not in the performance of this simple operation but in the diagnosis of the presence of middle ear involvement before the membrane had ruptured of its own accord.

A rise of temperature, or a complaint of pain or discomfort in the ear, are sufficient to warrant an examination of the drumheads, but unfortunately in the case of acute scarlatinal otitis media these indications are by no means constant and, if relied on solely for the early diagnosis of the condition, would result in most cases of otitis being diagnosed in the discharging stage. Layton[13] in his report of 1920 - 21 to the M.A.B. thought that more could be done in the early diagnosis by otologically examining all cases of scarlet fever in which there was pain in the ear or an unusual rise in temperature. He stated that only a few cases occurred in which these signs were not present. However his 1924 - 25[39] report revealed that, in spite of this otological analysis of pain and temperature, only a relatively small number of otorrhoeas were found before rupture of the drumhead. Only[38] in 56 out of 345 cases was there a complaint of pain preceding the onset of

discharge. Logan Turner[11] found it present only in one-third of his cases, Harries[17] and Gilhespy in one-half, and Gardiner[31] in one-third. Moreover, Harries and Gilhespy point out that in otitis media in children under five years the onset is symptomless on account of the fine texture of the drumhead which ruptures early with no pain or preceding rise in temperature. Gardiner observed that if pain was present it was usually accompanied by a rise in temperature. On the other hand Williams[9] found pain to be usually present and stated that if it occurred in the febrile period of the fever there was usually a further rise in temperature whereas if in the afebrile period this rise was not so constant.

I have made a special investigation of all my cases to prove the value of these signs. With regard to pain I found it present in less than one-fifth and it was usually accompanied by a rise in temperature. In the afebrile period of the fever, however, it was unusual to find an otorrhoea which was not preceded by some indication in the temperature chart. A marked rise was certainly uncommon but a rise of .4°F. to .6°F. was frequently found. In the febrile period I was unable to associate any unusual fluctuation in temperature with otitis media. An analysis of a great number of temperature charts of scarlet fever cases in which this complication did not occur made me conclude that otological investigations would not be rewarded in many cases in which every unusual fluctuation of temperature occurred.

The above and the observations of others simply mean that preceding signs of an otorrhoea in scarlet fever are by no means constant and, even if special otological examinations are carried out when they are, most cases of otitis media will only be diagnosed in the discharging stage. The opportunity of the performance of early paracentesis is therefore rare. Layton[46] points out that when it does occur one of the drawbacks is the delay in obtaining permission for a general anaesthetic. Gardiner[32] also found a general anaesthetic was essential and for the same reason as Layton found the operation

impracticable. I have overcome this difficulty, however, by the use of a local application of Bonain's Solution to the drumhead even in children as young as one year and in nervous patients.

For the early diagnosis the only means of practical value is the daily examination of the drumheads in all scarlet fever cases. This was realised in 1909 by Yearsley[26] who urged such examinations frequently irrespective of the presence of ear disease. In America it was recognised that the early diagnosis of the condition, before perforation of the tympanic membrane and the appearance of a discharge in the meatus, was desirable in order that paracentesis of the drumhead could be performed. A study of the results and methods in the conduct of scarlatinal otitis media at the Los Angeles[47] and the Cook[48] County Hospitals in America are interesting. Efforts were made there to diagnose middle ear involvement before rupture of the drumhead and to perform paracentesis. This entailed the employment of a special staff to examine all cases otologically every four hours at the Cook County Hospital and at least twice weekly at Los Angeles. It is not stated for how long a period this expensive and laborious method was maintained at the Cook County Hospital nor are detailed figures given but it is stated in their series that they had one mastoid operation and dismissed no discharging ear. At Los Angeles Hospital out of 473 cases of scarlet fever, with an incidence rate of otitis media of 12.28% or 58 cases of otitis, 53 were discharged with healed drumheads, that is a chronicity rate of 9%

Another aspect of the early diagnosis of otitis and the performance of paracentesis is worthy of consideration. My observations here are based on the examination of the drumheads of a large number of scarlet fever cases irrespective of the presence of ear disease. The incidence rate as assessed by the presence of a discharge from the tympanum can give quite an erroneous impression of the frequency of involvement of the middle ear cleft. If we use the drumhead as an indicator of the actual condition it is found that in many cases there is a

state varying from a slight injection to a complete dull lustreless appearance with obliteration of all landmarks. A close observation of such cases has shown that the condition does not proceed always to active suppuration but tends to subside rather slowly whether paracentesis has or has not been performed. In view of these facts, detection of this low grade infection presents a practical problem in management. Should paracentesis be performed or should such cases be subjected to a rather long period of hospital observation or should they be discharged? My own opinion is that only when the drumhead is bulging, or when the landmarks are obscured in a very red membrane, should paracentesis be performed. When no tension in the middle ear exists or when the landmarks are present in an injected drumhead, supervision only is necessary until signs of the condition subsiding appear. It is probably from this type of middle ear infection which has left hospital undetected that we get very late cases of suppurative otitis media arising owing to the condition being fanned into the more active state by draughts and colds. My practice at the Park Hospital in recent months has been to examine all drumheads immediately prior to discharge and should such a condition exist, the patient or parent in the case of a child, has been notified of its existence, warned of the danger, and asked to report for further examination.

It is, however, the management of the discharging stage of otitis media that takes the most prominent place and presents problems for most of us.

Treatment in the acute stage is mostly symptomatic and directed to facilitate drainage from the tympanum via the external meatus and to prevent secondary infection by skin organisms. The ways and means employed are many but the fundamental principles are the same, the results depending mainly on the thoroughness and care taken in their application. The rather elaborate method of suction from the Eustachian Tube of a solution in the external meatus, as practised by Gowen[20], is not really practicable and I think not superior to simple suction applied in the external meatus by the use of a Seigle's

speculum. Moreover skin organisms are not drawn into the middle ear as they are by the other method. Secondary paracentesis is undoubtedly indicated where a perforation is such that free drainage is not taking place but in my experience this is seldom necessary in acute scarlatinal otitis media.

When a middle ear in the acute stage of inflammation has failed to show any sign of clearing up after three weeks of conservative treatment, and is entering what might be termed the pre-chronic stage, the question of removal of the tonsils and adenoids arises. With the exception of Layton this is advocated by most observers about the third week in the case of adenoids. Gowen[19] and Williams[6] removed the adenoids but not the tonsils and Gowen, although claiming striking results, admitted that complications did occasionally occur due to adenoidectomy. Strachan,[34] in the conduct of his cases, removed both tonsils and adenoids when the ear had failed to clear up in three weeks. It is interesting to note that opinion is divided about the advisability of removing the tonsils. Watson Williams[23] has gone so far as to say that in his experience he has never seen a case of otitis benefit by their removal.

W. T. Gardiner[33] in 1922, advanced the thesis that the early removal of adenoids in scarlet fever otitis was the surest method of curing the condition and preventing subsequent chronicity. At the Edinburgh Fever Hospital he did this and removed the tonsils as well as soon as the patient was considered fit for the operation. Little statistical proof of this thesis is advanced but he states that the average stay in hospital of otorrhoea cases was reduced from 68 days in 1919, the pre-operative year, to 52 days in 1921, the second of the operative years. Harries and Gilhespy[18] in 1924 generally supported this thesis. They pointed out the high incidence of otitis media and the confinement of mortality in scarlet fever to the age period 0 - 5 years. This they associated with the septic type of scarlet fever and an overwhelming infection of the naso-pharynx in these young children. Their thesis was that if the infection could be eliminated early from the naso-pharynx in the course of

an otitis further infection via the Eustachian Tubes would be prevented and the course of the disease considerably shortened. They removed the adenoids, and tonsils too if septic, generally about the fourth week if by that time the otorrhoea had not cleared up. Although little statistical evidence is advanced the results of such methods appear to be only slightly inferior to those obtained by the American method of early parencetesis in all cases. The average duration of discharge in twenty cases without operation was 32.4 days and in fifty cases with operation 15.8 days. 89% of 122 cases were discharged with dry ears, the chronicity rate being 11%, a slightly higher figure than that obtained in America. Whether the drumheads were examined and dryness recorded by otological methods is not mentioned. In my opinion the dryness of the mucous membrane of the middle ear as observed through the perforation of a completely healed drumhead with lustre returning is essential in the recording of a cure. To rely on what Mr T. B. Layton has called "The Nursological Method" as opposed to the otological method of detecting a discharge in the external meatus can be very fallacious. It would be interesting to know in assessing the value of the work of Harries and Gilhespy if the more accurate method was practised.

T. B. Layton,[40] in 1925, published an exhaustive review of scarlatinal otitis media based on his otological work in the London Fever Hospitals. With regard to the adenoid operation he found one or two cases afforded brilliant results, the ear discharge clearing up immediately after having been present for a considerable time. On the other hand he quoted a number of cases in which no improvement resulted. He stated that by delaying the operation to about the fortieth day there is a natural tendency to cure which would have taken place had no operation been performed.

His general conclusions were:-

1. It was not by any wide system of operative treatment that results in scarlatinal otitis media would be

obtained; and

2. That operations were only of value in certain selected cases.

Although Watson Williams[23] was referring to the treatment of chronic otitis media in general he is to some extent in agreement with Layton when he said that the removal of tonsils seldom benefited an otitis but that, where chronic rhinitis or adenoid hypertrophy was present, surgical treatment in addition to medical was generally necessary and strikingly satisfactory.

My own cases of acute otitis media were specially investigated for the presence of any abnormality in these tissues and since removal was not done whether the otorrhoea was clearing up or not I have been able to form some opinion of my own with regard to their influence on the course of the disease. My conclusions are given in a special section later.

As zinc ionisation, as a therapeutic aid to the conservative methods of treatment of acute otitis media, takes a rather prominent part in this work, I have included at this point a review of some of the literature on this form of treatment.

In the chronic condition its use is of great value in the opinion of most workers. It has been employed by otologists since 1914[49] but dentists have used it for many years prior to this.

Watson Williams,[24] however, casts doubt on its value and states that the results are as good if the electric current is omitted. The treatment, he says, really depends on the cleansing of the meatus and the chemical surface coagulation due to the action of the zinc sulphate. The writer gives no actual data to support this statement but A. R. Friel[52] in replying in the "Lancet" gives definite support for the value of zinc ionisation in that there are now no cases of chronic otorrhoea in the elementary schools of Tottenham since its introduction as a form of treatment.

In spite of many experiments the question, of whether the electric current is necessary or not, is one which has never been quite answered. Lierle[53] and Sage agree with Williams in saying it is of little use, the good effects being due to the action of the zinc sulphate only as the deposit of metallic zinc in living tissue is remote. This statement has never been proved but many experiments carried out with and without the electric current on dead tissue have shown conclusively that the zinc ions are deposited in the tissue and the current is essential for this taking place. Supporters[54] of the treatment in general, as far as the treatment of disease is concerned, are of the opinion that it is necessary for the deposit of the zinc on or underneath the tissues. The clinical evidence, furnished by McLaggan,[55] is in favour of its necessity for the results, quoted by him in the 100 cases of otorrhoea in which the current was used, were infinitely superior to those in the 100 cases in whose treatment it was omitted. In my own opinion since the constant current is used in such small amperage (3 M.A.) it can do no harm. Moreover, I cannot see how zinc ions can be transported to the inflamed tissues in a middle ear covered by discharges without its use. Apart from the action of the current on the zinc sulphate theoretically it is an advantage in treatment since the positive pole is used in the external meatus. The vaso-constrictor effect of this may result in decreasing the congestion in the mucous membrane of the middle ear thus facilitating drainage from the more inaccessible regions where the exudates might possibly be dammed up by the swollen state of this lining. Moreover since the medium surrounding the positive pole is made acid a consequent inhibition of the growth of organisms is produced.

It is interesting to note that E. Watson Williams[24] says that this form of therapy is not recommended for the treatment of the acute condition. He does not say why this is so but I have concluded that it cannot possibly do any harm. Friel[57] although he never tried to treat cases in the

early acute stage found it of benefit after the ear had been discharging for three weeks the commencement of the chronic stage when saprophytes were in the discharge and not in the tissues. From my own experience of acute scarlatinal otitis media I can quite understand the zinc fluid not gaining access to the middle ear in many cases on account of that cavity being already full of pus which would be difficult to displace, and also on account of the minute size of the perforation in the majority of cases. However, I can see good results even in those cases by the sterilization effect on the deep meatus and drumhead, particularly around the site of the perforation, and the consequent prevention of secondary infection.

The report of McLaggan[15] is interesting. He supports Williams[24] in saying that it is not desirable in cases of acute middle ear disease. He used the same technique as recommended by V. B. Jobson[52] and A. R. Friel, i.e. 2 grs to the ounce of zinc sulphate as an ionisation fluid and a current of 1 - 3 milliamperes for 10 - 15 minutes using one application only and examining the drumhead in one week. Although, as he says, the results are difficult to estimate in a condition which tends to spontaneous cure, 25.8% of chronic ears responded when due to measles and scarlet fever as compared with 52.8% of all cases. In other words the treatment was not so favourable if the otitis was due to those acute infections. Stevenson[59] also found chronic scarlatinal otitis media resistant to this treatment although haemolytic streptococcal infections of the ear as a rule were amenable. This, he said, might be explained by the arrangement of the carboxyl groups of a specific protein found in different strains of bacteria which might account for the selective action of some metals combining with them. McLaggan[15] found the treatment most efficacious when a muco-purulent discharge only was present, 19 out of 21 cases in this group responding. He found it only of use when there was no involvement of the bony structures and only the mucous membrane of the middle ear was involved.

Moreover, he found that the size of the perforation did not seem to matter and that tonsils and adenoids and other septic foci did not influence the result. He found the procedure simple with the use of a local anaesthetic in children as young as 4 years. His final conclusion was that it was a therapeutic aid in the treatment of chronic otitis media.

Walker,[60] Norrie,[64] Wells,[58] Friel,[14] Jobson,[56] Tsong[50] and others found the treatment a great improvement on other methods. Walker[61] had 50% better results than with any other known method and many cases which had resisted all treatment frequently cleared up. He found it useful in differentiating between surgical and medical otitis media - in other words, if the case failed to respond it was usually due to deep seated inaccessible sepsis which required operative treatment. Wells points out that failure is usually due to faulty selection of cases or faulty technique and is in agreement with Friel[57] and Jobson[56] in saying that it is only of use in accessible sepsis. Friel[57] and Wells[58] did not find a good response where granulation tissue or polypi were present in the middle ear but on the other hand Norrie[65] had very good results in many cases of simple tympanic sepsis where granulations and polypi were present. These cases, however, I cannot see being permanently benefited by this form of treatment. Norrie[66] is in agreement with others in saying that attic and antrum sepsis were unsuitable. These of course are of the inaccessible type.

With regard to the size of the perforation in the tympanic membrane both Norrie[67] and Wells[58] are of the opinion that size is of no importance but Walker[62] thinks a fairly large hole is necessary. Norrie[67] points out the unsuitability of attic and marginal perforations as they are usually associated with bony disease or involvement of the additus and antrum.

The fact that most observers have found this treatment of great value when the sepsis was accessible with no

bony disease or granulations or polypi present in the chronic stage suggests to me that it would be worthy of trial in the acute stage in primary cases when these contra-indications are not usually present. The marked congestion of the tympanum at this stage moreover might be relieved and drainage improved. Moreover since the infection is superficial and confined to the mucous membrane it is easily accessible to the zinc ions. I can foresee this impregnation of the superficial and deeper tissues acting as a protection from bacterial invasion.

PART III.

General Description of Management

and

Case Recording

of

Acute Scarlatinal Otitis Media.

The work which I now go on to describe was done at the Park Fever Hospital, London, from 4th August, 1933, till 2nd January, 1935. In order to strengthen the figures, and in no way to influence the general deductions formed by myself, the work was continued by Dr Banks, the Medical Superintendent, till 31st March, 1935, and a few cases have been added to my list which were not under my own observation. The material consists of 124 cases of acute scarlatinal otitis media in which 152 ears were treated. Care was taken to include only primary cases, i.e. cases in which no previous history of ear discharge was present. In no case were the tonsils or adenoids removed. Every case in the series was examined otologically (i) at the onset of the discharge, (ii) at intervals throughout the course, and (iii) just prior to leaving hospital when the hearing was tested if the age of the patient permitted. A separate otological record was kept of each case. There was no segregation of the cases in a separate ear ward as it was considered an advantage to distribute the work in order that the toilet of the ear would be carried out thoroughly.

A sound meatal toilet was the basis of treatment in all cases in order that (i) there was free drainage of the discharges from the tympanum via the external auditory meatus, and (ii) secondary infection of the middle ear by skin and other organisms was prevented or minimised. The nursing staff were specially instructed in the art of deep meatal mopping to ensure the cleansing of discharges from that passage as far as the drumhead and the site of the perforation. To merely mop away the overflow at the outer end of the external auditory meatus, leaving that passage as a reservoir for pus, was recognised as useless. The mopping was carried out by using special absorbent wool on orange sticks. In order that the introduction of secondary infection to the deep meatus and site of the perforation was reduced to a minimum, sterile wool was used and the nursing staff were instructed to thoroughly cleanse the hands prior to commencing the toilet. After the meatus was thus cleansed

a combination of glycerine and spirit 50% was instilled into the meatus in order that the hygroscopic action would promote drainage from the middle ear and in addition exert a sterilising effect on the deep meatus and drumhead. The fact that the perforation in the majority of cases of otitis media is minute or invisible in the acute stage makes me conclude that instillations seldom if ever gain access to the tympanum particularly as, in this stage of the inflammation, the middle ear is already full of pus. The frequency of eczematous sores around the pinna and in the external meatus in cases of otorrhoea, particularly in young children, caused me further to complete the toilet by a prophylatic treatment of these parts from the beginning in all cases. The presence of such a condition considerably hampered the mopping away of discharges, owing to the discomfort and even pain, but the smearing of these parts with Unguentium Glycerini Plumbi Subacetatis has eliminated such occurrences completely.

The sisters were instructed in zinc ionisation therapy carried out under my personal supervision. Immediately prior to the treatment the ear was inspected otologically to ensure a clean meatus and free access of the ionisation fluid to the drumhead, deep meatal walls, and possibly the middle ear. The middle ear in suitable cases was evacuated of pus by the application of a negative pressure in the meatus by the use of a Seigle's speculum. This thorough cleansing of the parts is essential for the introduction of the zinc fluid to the infected surfaces and it can be readily understood how useless such a procedure would be if the treatment was carried out in a meatus even partially filled with pus.

The technique was that recommended by Jobson and Friel.[52] A standard ionisation apparatus was used, the positive electrode being carried to the distal end of a vulcanite ear speculum and in this way introduced to the deep parts of the meatus. Zinc sulphate solution (2 grs to 1 ounce) and a current of 3 milliamperes for ten minutes at each application were used. It was found unnecessary to use a local

anaesthetic as recommended by some workers, as children even as young as one year suffered at the worst only slight discomfort. The treatment was commenced on the third or fourth day after the appearance of the discharge and continued, as a rule, every three or four days until cure was affected. In a number of my cases, which by ordinary conservative toilet methods had failed to clear up, this treatment was commenced to find if success could be attained.

The rational of ionisation as pointed out by Friel[52] depends on the combination of the positive zinc ions with the albumen on the infected discharges coating the surfaces forming a coagulum and on their introduction into the superficial cells of the tissues. This form precipitate or coagulum of zinc is a bad culture media for bacteria and the action of the zinc when introduced into the tissues is such that a local antisepsis is produced without subjacent tissues being irritated. The presence of such a coagulum can be noted by inspection of the parts immediately after treatment when the deep meatus, drumhead and walls of the middle ear, if the perforation is large enough, are seen to be coated by a white film.

The cases which I chose for this treatment were not selected in any way and can be sssumed to be a fair sample of the type of scarlatinal otitis media with which I was dealing. The general health of the patient and the size of the perforations in the drumheads were not considered in the selection but patients of the nervous or excitable type were not chosen on account of the difficulty in application of the electric current.

For the purposes of this work I have grouped the cases and tabulated only the data from the records which are essential for my observations and deductions in the following manner.

Groups.

I. Cases occurring in scarlet fever treated by scarlatinal anti-toxin administered intravenously.

II. Cases occurring in scarlet fever treated by scarlatinal anti-toxin administered intramuscularly.

III. Cases occurring in scarlet fever in which serum therapy was not used.

IA. Similar to Group I but in addition ionisation therapy was used.

IIA. Similar to Group II but in addition ionisation therapy was used.

IIIA. Similar to Group III but in addition ionisation therapy was used.

In the tables the following data have been recorded and abbreviations used.

i. Type. Right, Left or Double Otitis Media.
Right = R., Left = L., Double = D.

ii. Age.

iii. Sex. Male = M., Female = F.

iv. Condition of Drumhead at initial examination.
In the tables only the site of the perforation if visible was noted.

No perforation visible = N.V.

A.S. = Perforation in Anterior Superior Quadrant.

A.I. = Perforation in Anterior Inferior Quadrant.

P.S. = Perforation in Posterior Superior Quadrant.

P.I. = Perforation in Posterior Inferior Quadrant.

C. = Central.

Where paracentesis was performed the perforation site was noted in the quadrant of the drumhead where the incision was made.

v. Condition of Drumhead at final inspection.
N = Normal Drumhead, i.e. a drumhead with no perforation visible and in which the landmarks were present and the normal lustre had or had almost returned.

Where a perforation was still present the site was recorded as in iv.

vi. State of Hearing at final examination.
N - Normal Hearing.

D - Defective Hearing.

The tests for hearing defect were carried out by means of the whispered and spoken voice and by the ability to hear the tick of a watch at given distances. In very young infants a rough test by means of attracting the attention of the child by voice sounds was made.

vii. Condition of Tonsils and Adenoids.

N = no abnormality in size or appearance.

The adenoids were presumed to be abnormal if by post-nasal palpation by the finger an unduly large mass was felt.

\+ = slight enlargement or sepsis in tonsils, adenoids or both.

++= marked enlargement or sepsis in tonsils, adenoids or both.

viii. Duration of Treatment.

This was recorded in days from the appearance of discharge till the cessation. Before an ear was considered to be dry a minimum period of one week had to lapse in which there was no reappearance of the discharge.

ix. Final Result.

C = Cure.

P.C.= Partial Cure.

F. = Failure.

The condition was considered either to be cured, partially cured or to have become chronic. For the recording of a cure the drumhead had to be normal in appearance with no perforation and at least a week had to elapse from the last appearance of the discharge. A case was considered to be partially cured if the hearing was normal and a perforation still existed in a drumhead in which the lustre was returning. In addition there had to be no sign of discharge for a minimum period of one week and the mucous membrane of the middle ear, if visible through the perforation, had to be dry. A case was considered to be a failure if the discharge persisted after a period of at least six weeks treatment from the commencement of the discharge.

x. Intercurrent Infections, etc.

In this column any intercurrent infection occurring during the course of treatment of the otitis media was noted.

W.C. = Whooping Cough.

M. = Measles.

R. = Rubella.

N.D. = Nasal Diphtheria.

D. = Diphtheria.

Similarly if mastoid disease occurred as a complication this was likewise noted in this column.

xi. Where ionisation therapy was used, as in groups IA, IIA and IIIa, the record of such treatments was made by noting the total number of treatments and also the lapse in time, in days after the appearance of the discharge, when each treatment was carried out.

PART IV.

Records of Cases

of

Scarlatinal Otitis Media.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP I. SCARLATINAL ANTITOXIN USED INTRAVENOUSLY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
1.	D.	$1\frac{10}{12}$	M.	Rt. N.V. Lt. N.V.	N.V. N.V.	N. N.	N. N.	52 + 53 +	F. F.			
2.	L.	$\frac{9}{12}$	M.	N.V.	N.	N.	N.	34	C.			
3.	R.	$4\frac{7}{12}$	F.	P.I.	N.	N.	N.	6	C.			
4.	R.	6	F.	N.V.	N.	N.	N.	10	C.			
5.	R.	13	F.	N.V.	N.	N.	N.	14	C.			
6.	D.	$2\frac{9}{12}$	F.	Rt. P.I. Lt. P.I.	N. N.	N. N.	N. N.	35 29	C. C.			
7.	L.	$1\frac{1}{2}$	M.	P.I.	P.I.	D.	N.	100 +	F.	Mastoiditis. Scwartz. Oper.		
8.	L.	25	F.	C.	C.	N.	N.	15	P.C.			
9.	L.	6	M.	P.I.	N.	N.	+ +	2	C.			
10.	L.	5	M.	A.S.	N.	N.	N.	12	C.			
11.	R.	$12\frac{1}{2}$	M.	N.V.	N.	N.	N.	12	C.			

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP I (Cont.)

SCARLATINAL ANTITOXIN USED INTRAVENOUSLY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
12.	L.	2	F.	A.I.	N.	N.	N.	16	C.			
13.	L.	5	F.	A.I.	N.	N.	N.	18	C.			
14.	R.	5	M.	P.I.	Small Catricix.	N.	N.	18	C.			
15.	R.	5	M.	A.I.	N.	N.	N.	20	C.			
16.	R.	3½	F.	N.V.	N.	N.	+ +	10	C.			
17.	L.	9	M.	A.I.	N.	N.	+	21	C.			
18.	R.	2½	F.	P.I.	N.	N.	N.	27	C.	Mastoiditis. Wildes. Incision.		
19.	L.	7	M.	P.I.	N.	N.	N.	128 +	F.	Mastoiditis. Scwartz. Oper.		
20.	L.	22	M.	C.	N.	N.	N.	18	C.			
21.	R.	5	F.	A.	A.	N.	N.	25	P.C.	Mastoiditis. Wildes. Incision.		
22.	R.	4	F.	P.I.	P.I.	N.	N.	13	P.C.			
23.	R.	5	M.	P.I.	P.I. minute	N.	N.	17	C.			

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP I A. INTRAVENOUS ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
48.	R.	4	M.	A.	A.	N.	+ +	72 +	F.	N.D., W.C.	7	7th,12th,17th - W.C.,and N.D.developed. 36th,41st,46th,51st.
49.	L.	$1\frac{8}{12}$	M.	C.Large	C.Large	D.	+ +	90 +	F.	M., N.D.	6	M & Broncho-pneumonia N.D.General Health poor. 49th,54th,59th,63rd, 68th,73rd.
50.	D.	6	M.	Rt. P.I. Lt. N.V.	N. N.	N. N.	N. N.	5 16	C. C.		1 4	2nd. 2nd, 5th, 9th, 12th.
51.	R.	5	F.	N.V.	N.	N.	N.	27	C.		2	19th, 24th.
52.	R.	$4\frac{11}{12}$	M.	A.Large	A.Large	N.	N.	7	P.C.		1	4th.
53.	R.	4	F.	A.Large	N.	N.	N.	8	C.		2	3rd, 6th.
54.	L.	2	M.	P.I.	N.	N.	N.	21	C.		2	7th, 12th, Very slight discharge till 21st day.
55.	D.	$4\frac{9}{12}$	M.	Rt. P.I. Lt. P.I.	N. P.I.Smaller	N. N.	+ + + +	32 96	C. P.C.	N.D. N.D., M.	4 6	4th,15th,20th,26th. 4th,15th,20th,26th - Developed Measles - 87th,96th.
56.	R.	29	M.	P.I.	N.	N.	N.	30	C.		2	24th,29th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP IA (Cont.)

INTRAVENOUS ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
57.	R.	5	M.	N.V.	N.	N.	N.	27	C.	M.	1	9th - Measles Developed - Slight discharge till 27th day.
58.	D.	3	F.	Rt. C. Large	C. Large	N.	N.	32	P.C.	M., N.D.	7	4th, 9th, 14th, 19th, 24th, 29th, 32nd.
				Lt. A.I.Small	N.	N.	N.	34	C.	M., N.D.	7	5th, 10th, 15th, 20th, 24th, 29th, 32nd.
59.	D.	4	M.	Rt. A.I.	N.	N.	N.	17	C.	M.	2	13th, 16th.
				Lt. C.	N.	N.	N.	36	C.	M.	2	25th, 29th.
60.	R.	5½	M.	N.V.	N.	N.	N.	3	C.		1	2nd.
61.	L.	3	M.	C. Large	C.Smaller	N.	N.	5	C.		1	2nd.
62.	R.	7	F.	P.I.	N.	N.	N.	11	C.		2	3rd, 7th.
63.	L.	3	M.	P.I.	P.I.	D.	N.	74 +	F.		3	4th, 10th, 18th.
64.	L.	5	M.	P.I.	P.I.	N.	N.	20	C.		3	4th, 8th, 12th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP IA (Cont.) — INTRAVENOUS ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments. Total number	Ionisation Treatments. Day from Commencement of Discharge on which Treatments were carried out.
65.	D.	3 9/12	F.	Rt. A.I.	N.	N.	N.	36	C.		6	11th, 13th, 17th, 23rd, 28th, 32nd.
				Lt. A.I.	Healing.	N.	N.	25	P.C.		5	8th, 11th, 13th, 17th, 23rd.
66.	R.	2	M.	P.I.	P.I.Larger	N.	N.	120 +	F.	N.D.	7	3rd, 8th, 13th, 18th, 24th, 30th, 35th.
67.	L.	6	M.	P.I.Large	P.I.Small	N.	N.	18	P.C.		4	2nd, 6th, 10th, 17th.
68.	R.	5½	M.	A.I.	N.	N.	N.	11	C.		2	3rd, 7th.
69.	D.	4	F.	Rt. P.	N.V.	N.	N.	7	C.		2	2nd, 6th.
				Lt. P.I.	N.	N.	N.	7	C.		2	1st, 5th.
70.	L.	5 9/12	F.	A.I.	N.	N.	N.	23	C.		3	6th, 10th, 15th.
71.	D.	5 9/12	M.	Rt. P.I.	N.	N.	N.	28	C.		5	5th, 10th, 15th, 20th, 25th.
				Lt. A.	N.	N.	N.	22	C.	Secondary Paracentesis	2	8th, 12th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP II

SCARLATINAL ANTITOXIN USED INTRAMUSCULARLY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
24.	R.	3	M.	N.V.	N.	N.	N.	12	C.			
25.	L.	2	M.	C.	N.	N.	N.	7	C.			
26.	R.	2½	M.	P.I.	N.	N.	N.	47	C.	W.C.		
27.	L.	11/12	F.	N.V.	N.	N.	N.	19	C.			
28.	R.	4 9/12	F.	P.I. Paracentesis	P.I.	N.	N.	135	C.	Mastoiditis. Schwartz. Operation.		

GROUP IIA.

INTRAMUSCULAR ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
72.	L.	4	F.	N.V.	N.	N.	N.	30	C.		2	14th, 18th - Very slight moisture till 30th day.
73.	R.	2½	M.	P.I.	P.I.Larger	D.	N.	60 +	F.		8	4th, 8th, 12th, 16th, 20th, 24th, 28th, 32nd.
74.	D.	5	M.	Rt. N.V. Lt. N.V.	N. N.	N. N.	+ + + +	10 11	C. C.		1 1	5th. 6th.
75.	L.	2	M.	C.	N.	N.	N.	34	C.	N.D.	1	10th - Treatment stopped for sore ears.
76.	D.	5	M.	Rt. N.V. Lt. N.V.	N. N.	N. N.	+ +	25 23	C. C.		3 3	5th, 9th - Discharge recurred on 22nd day. Was dry for 7 days - Ion. 22nd. 3rd, 7th - Dry 12th - Recurred 19th day - Ion. 19th.
77.	R.	2½	F.	A.	N.	N.	N.	15	C.		3	6th, 10th, 14th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP III.

NO ANTITOXIN THERAPY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
29.	L.	10	F.	A.	N.	N.	N.	21	C.			
30.	L.	$1\frac{8}{12}$	M.	N.V.	N.	N.	N.	5	C.			
31.	D.	$1\frac{10}{12}$	M.	Rt. N.V. Lt. N.V.	N.V. N.V.	N. N.	N. N.	52 + 53 +	F. F.			
32.	L.	$1\frac{14}{12}$	M.	A.	A.	D.	N.	64 +	F.			
33.	L.	$1\frac{5}{12}$	F.	N.V.	N.	N.	N.	49	C.			
34.	R.	6	M.	P.I.	P.I.	?	N.	100+	F.			
35.	R.	$\frac{6}{12}$	M.	P.I.	N.	N.	N.	14	C.			
36.	L.	11	M.	N.V.	N.	N.	N.	14	C.			
37.	R.	7	M.	I.	N.	N.	N.	42	C.			
38.	R.	$2\frac{8}{12}$	M.	A.I.	A.I.	N.	N.	42	P.C.			

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP III.(Cont.)

NO ANTITOXIN THERAPY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
39.	L.	4	F.	N.V.	N.V	N.	N.	14	C.			
40.	R.	5	M.	N.V.	N.	N.	N.	20	C.			
41.	D.	3	F.	Rt. A.I. Lt. A.I.	N. N.	N. N.	N. N.	21 18	C. C.			
42.	L.	2	M.	I.	I.	N.	N.	42 +	F.			
43.	L.	2½	F.	N.V.	N.	N.	N.	9	C.			
44.	R.	2	F.	P.I.	P.I.	N.	N.	54 +	F.	M., W.C.		
45.	R.	7	F.	A.	N.	N.	N.	20	C.			
46.	L.	5	M.	P.I.	N.	N.	N.	54	C.			
47.	L.	7	F.	P.	N.	N.	N.	11	C.			

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP IIIA.

NO ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
78.	R.	$3\frac{9}{12}$	F.	P.I. Paracentesis	N.	N.	N.	41	C.		1	36th.
79.	R.	$1\frac{11}{12}$	M.	P.I.	P.I.	D.	N.	63 +	F.		7	1st,5th,10th,15th, 20th,25th,30th.
80.	D.	2	F.	Rt. P.I. Lt. N.V.	P.I. N.	N. N.	N. N.	8 18	P.C. C.	N.D. N.D.	2 4	4th,7th. 3rd,6th,10th,14th.
81.	D.	12	M.	Rt. A.S. Lt. A.I.	N. N.	N. N.	N. N.	27 27	C. C.		2 2	16th,21st. 16th,21st.
82.	D.	4	M.	Rt. A.I. Lt. A.I.	N. N.	N. N.	N. N.	36 57	C. C.	S.F. followed M. S.F. followed M.	1 3	30th. 44th,49th,54th.
83.	R.	9	M.	A.I.	N.	N.	N.	63	C.	N.D.	11	14th,17th,20th,24th, 27th,32nd,42nd,47th, 51st,56th,61st.
84.	R.	$1\frac{2}{12}$	M.	I.	I.	D.	N.	42 +	F.	M. Mastoiditis. Scwartz. Operation	2	2nd,8th,- Mastoiditis on 10th day.
85.	R.	$\frac{11}{12}$	M.	C.Large	C.Large	D.	N.	96 +	F.	W.C.C. Pneumonia	6	7th,13th,15th,21st, 34th,39th.
86.	D.	2	F.	Rt. C. Lt. C.	C. N.	N. N.	N. N.	90 + 50	F. C.	N.D. N.D.	8 1	4th,8th,11th - 70th,74th,78th,82nd, 86th. 44th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP III A.(Cont). NO ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments. Total number	Ionisation Treatments. Day from Commencement of Discharge on which Treatments were carried out.
87.	D.	2	F.	Rt. P.I. Lt. P.I.	P.I.Minute N.	N. N.	N. N.	94 102	P.C. C.	N.D. N.D.	1 1	88th. 96th.
88.	D.	4	M.	Rt. P.I. Lt. P.I.	N. N.	N. N.	N. N.	6 51	C. C.	N.D. N.D.	2 4	1st, 5th. 8th,12th -Nephritis Developed-45th,49th
89.	L.	2 1/12	F.	N.V.	N.	N.	N.	26	C.		2	8th - No discharge 9th day - discharged again on 15th day - Ion. 15th.
90.	R.	2 11/12	F.	C.Minute	N.	N.	N.	30	C.		3	6th,10th,14th - slight discharge till 30th day.
91.	D.	2	M.	Rt. P.I. Lt. P.I.Large	N. N.	N. N.	N. N.	59 21	C. C.	M & C Pneumonia M & C "	6 1	30th,34th,38th,42nd 56th,68th. 14th.
92.	D.	5	F.	Rt. N.V. Lt. N.V.	N. N.	N. N.	N. N.	15 18	C. C.	M & C Pneumonia M & C "	3 3	6th,10th,14th. 6th,10th,15th.
93.	D.	4	M.	Rt. P.I. Lt. P.I.	N. P.I.Small	N. N.	N. N.	50 90+	C. F.	M., N.D. M., N.D.	3 3	21st,24th,29th. 7th,10th,15th.
94.	R.	1 5/12	F.	A.Large	N.	N.	+ +	31	C.		3	12th,15th,21st.
95.	L.	7	F.	C.	N.	N.	N.	30	C.		1	13th.Very slight moisture.
96.	R.	3 11/12	M.	A.Large	A.Large	N.	N.	84	P.C.	N.D.	10	21st,26th,31st,36th,42nd. - Dry 44th - Reappeared 50th -50th, 57th, 66th, 71st.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP III A (Cont)

NO ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
97	D.	5	M.	Rt. A.I.	A.I.Large	D.	+ +	90+	F.	N.D.	8	13th,17th,34th,38th, 43rd,51st,59th,63rd.
				Lt. A.I.	N.	N.	+ +	42	C.	N.D.	8	13th,17th,34th,38th, 43rd,51st,59th.
98	R.	2 3/12	M.	A.Large	A.Large	N.	N.	56	P.C.		4	18th,21st,27th,31st.
99	R.	3 11/12	F.	N.V.	N.	N.	+ +	69	C.		10	14th,21st,26th,31st,36th, 42nd - Dry 44th - Discharged 50th - 50th,57th,66th,71st.
100	D.	5	M.	Rt. ANT.I.	A.Large	N.	N.	90+	F.	N.D.	9	3rd,8th,13th,20th,25th, 30th,35th,40th, 45th.
				Lt. N.V.	N.	N.	N.	5	C.	N.D.	1	3rd.
101	D.	5	F.	Rt. P.I.	N.	N.	N.	32	C.		4	4th,10th,14th,18th.
				Lt. P.I.	N.	N.	N.	15	C.		4	2nd,6th,10th, 16th.
102	D.	2 1/2	M.	Rt. P.I.	N.	N.	N.	39	C.	N.D.	3	10th,15th,20th.
				Lt. C.Large	Total Destruction	D.	N.	60+	F.	N.D.	8	12th,17th,20th,27th, 32nd,37th,42nd,47th.
103	R.	6	F.	N.V.	N.	N.	N.	39	C.		6	1st,5th,10th,15th,20th,25th.
104	R.	1 7/12	F.	P.I.	N.	N.	N.	61	C.		7	1st,5th,10th,15th,20th,25th,30th.
105	R.	9	M.	P.I.	N.	N.	N.	4	C.		1	1st.
106	L.	2 1/2	F.	P.I.	N.	N.	N.	21	C.		1	18th.
107	R.	1 7/12	F.	A.I.	A.I.	N.	N.	61	P.C.		5	3rd,7th,16th,21st,26th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP III A (Cont). NO ANTITOXIN THERAPY AND IONISATION THERAPY.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments. Total number	Ionisation Treatments. Day from Commencement of Discharge on which Treatments were carried out.
108.	D.	2	M.	Rt. P. Lt. P.	P. P.	D. D.	N. N.	69+ 35+	68F. F.		9 9	11th,17th,22nd,27th,32nd,37th,42nd,47th, 52nd. 5th,10th,15th,20th,25th,30th,35th,40th,45th.
109.	L.	1 8/12	M.	P.I.	P.I.	D.	N.	60+	F.		3	16th,20th,21st.
110.	D.	2 3/12	F.	Rt. C. Lt. C.	C.Larger C.Larger	D. D.	N. N.	53+ 51+	F. F.	N.D., M. N.D., M.	3 3	1st,15th,19th. 1st,15th,18th.
111.	R.	2	M.	P.I.	P.I.Smaller	N.	N.	9	C.		1	4th.
112.	R.	4 11/12	M.	P.S.	N.	N.	N.	18	C.		2	4th,8th.
113.	L.	4	M.	A.I. Secondary Paracentesis	A.I.	N.	+ +	90+	F.	N.D.	2	14th,18th.
114.	L.	2	M.	P.I.	P.I.Larger	N.	N.	120+	F.	W.C.,N.D.	7	4th,8th,12th,16th,20th,24th,28th.
115.	R.	2 9/12	F.	N.V.	N.	N.	N.	14	C.		3	2nd,7th,12th.
116.	R.	3	F.	P.S.	N.	N.	N.	63	C.	W.C.,M. Mastoiditis Scwartz.Operation	3	24th,29th,34th. Mastoiditis & Scwartz Op.
117.	R.	9 3/12	M.	N.V.	N.	N.	N.	3	C.		1	1st.
118.	R.	5	M.	N.V.	N.	N.	N.	21	C.		1	13th.
119.	L.	1 8/12	M.	P.I.	N.	N.	N.	25	C.		3	7th,11th,15th.
120.	L.	1 1/12	F.	P.I.	N.	N.	N.	51	C.		1	5th.
121.	R.	5	M.	A.I.	N.	N.	N.	36	C.	N.D.	4	10th,15th,20th,25th.

ACUTE SCARLATINAL OTITIS MEDIA.

GROUP IV

SCARLATINAL ANTITOXIN USED INTRAPERITONEALLY IN TREATMENT OF FEVER.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
122	L.	5	F	P.I.	N.	N.	N.	13	C.		3	2nd, 6th, 10th
123	R.	8	M.	A.I.	N.	N.	N.	13	C.		1	12th.
124	R.	$2\frac{8}{12}$	M.	P.I.	N.	N.	N.	20	C.		1	18th

PART V.

Results and Conclusions

in

Scarlatinal Otitis Media.

For assessing the effect of any measure or factor which might influence the incidence and prognosis of otitis media, controls have been used in this work where possible.

When the effect of serum therapy of the fever itself on the incidence was under consideration, an adequate control series was obtained without difficulty. The fact was recognised that the incidence varied in different epidemics depending largely on the severity of the type of scarlet fever prevalent at the time. This variability was eliminated by the use of control cases untreated by serum occurring concurrently with the serum treated cases. Moreover the numerical strengths of the two series were not materially weakened when only simple scarlet fever uncomplicated by another infectious disease studied in age groups. It was essential, in view of the observations of past workers, to eliminate from my series any scarlet fever case in which an additional infectious disease was present, and to study incidence in age groups, as both additional infection and age have been shown to influence the incidence of this complication.

However, when the effect of any factor influencing the course of an otitis media was studied, the obtaining of a series with comparable controls was difficult. There are so many factors both in the individual patient and externally which might have an effect that, for the purpose of proving the effect of one factor, the series and control series studied would require to be very strong numerically in order that the possible effect of other factors might be so minimised as to make the series and control series reasonably comparable. For example, it is said by many that the presence of enlarged or septic tonsils or adenoids tend to prevent an otorrhoea from clearing up. Likewise, in the disease with which we are dealing where there is a natural tendency to cure, the general health of the patient himself must play a role. The healing powers in underfed and poorly nourished children from slums

must be defective and must have an effect on the course of the disease and on the success of any measure adopted in treatment. The difficulty in obtaining enough cases and the necessity of sub-grouping has in some sections of my work made the numerical value of my series and control series deficient for the purposes of comparison and it is realised by me that the findings cannot be said to be proved. I realise that my observations are not proved in all instances but in offering them I do so to show how certain factors tend to influence the course of the disease.

My study of scarlatinal otitis media has been sub-divided into the following sections.

(i) The effect of intravenous scarlatinal antitoxin therapy on the incidence.

(ii) The effect of the presence of enlarged or septic tonsils and adenoids on the prognosis.

(iii) The effect of age on the prognosis.

(iv) The effect of the presence of intercurrent infectious disease on the prognosis.

(v) The effect of intravenous scarlatinal antitoxin on the prognosis.

and (vi) The value of zinc ionisation therapy in treatment.

SECTION I - The Effect of Intravenous Scarlatinal Antitoxin Therapy on the Incidence.

The study of the incidence of this complication of scarlet fever was facilitated by the fact that the practice, at the Park Fever Hospital, was to treat almost half of all the cases admitted by intravenous scarlatinal antitoxin. Separate wards were used for serum treated and untreated cases. No selection of cases for treatment was made but it must be admitted that where a case was more than ordinarily severe that case was given the benefit of serum therapy, with the result that the proportion of sevère cases of scarlet fever was rather higher in the serum treated cases than in the untreated controls.[84] It has been said that bed spacing and ventilation are possible factors influencing incidence in view of the fact that the complication frequently manifests itself in more than one case at a time in a ward and usually in cases situated beside each other. In other words a case of scarlatinal otitis media can infect another case with the middle ear complication. On my own part I cannot see quite how this can be brought about unless indirectly by secondary tonsillitis arising in cases in the same ward. However, the wards and bed-spacing were exactly the same for the series in my study. I am indebted to Dr.S.Banks, the Medical Superintendent, for his help in giving me access to the case records of all admissions, for although I was responsible for the management of all the ear complications arising in the hospital only a proportion of the scarlet fever cases were directly under my care.

The total number of scarlet fever cases treated by scarlatinal antitoxin intravenously was 1877,and in this series 35 developed otitis media, giving an incidence of 1.91%. In the control series of untreated cases, 1429 in number, 97 developed otitis media with an incidence of 6.7%, a figure more than three times that found in the intravenous antitoxin

group. For the purposes of comparison I have obtained and tabulated below the results of serum therapy in the hands of other observers. Although these results are not strictly comparable in the time and type of scarlet fever or in age composition I have used them for a basis of comparison. As only the percentage of cases under 5 years in each group was obtainable a rough correction only for the effect of age was available.

TABLE II - Primary Acute Suppurative Otitis Media complicating Scarlet Fever.

Incidence Rate in Serum treated cases.

Year	Place	Authority	Scarlet Fever Discharges & Deaths.		Serum Treatment.	Otitis Incidence.
			No.	Age 0-5 yrs.		
85 *1927/28	Ilford	Burton & Balmain	670	28%	All intramuscular.	6.0%
81 *1928	Edinburgh	Craig	478	28.2%	"	8.4%
			478	30.0%	No serum.	11.3%
42 1924/31	Chicago	Hunt, L.W.	882	?	All intramuscular.	5.1%
77 *1930	Birmingham	Harries, E.H.R.	1129	17.8%	"	3.5%
82 *1928/32	Leicester	Banks, H.S.	1204	15.0%	All intravenous.	0.9%
1933/34	London, Park Hosp.	-	1429	40%	No serum	6.7%
			1877	25%	All intravenous.	1.91%

* Compiled from Hospital Reports.

It will be seen in the above table that only Banks of Leicester used the serum by the intravenous route in his 1928-32 series, the others relying on the intramuscular route. Only in Craig's series in 1928 was a control series used and although the incidence of the disease is high 8.4% he does record a lower figure than in his untreated cases where an incidence of 11.3% was recorded. His series were comparable in age composition 28.2% and 30% under the age of 5 years and he attributes his better figure to the use of the serum. Harries of Birmingham is 1930 records 3.5% the lowest figure in any series treated by serum intramuscularly but in this case only 17.8% were under the age of 5 years which to some extent must account for the marked difference. It will be seen that the result obtained in my series at the Park Hospital is much lower than in any other series where the serum was used intramuscularly. Even compared with Harries' figure of 3.5% where only 17.8% were under 5 years there is a marked improvement for 25% of the cases were in this age group. The result of intravenous serum therapy at the Park Hospital confirms the improvement in incidence recorded by Banks using the same method in Leicester in 1928-32. His very low figure of .9% can to some extent be accounted for by the low proportion of cases under 5 years, 15%. In my control series of untreated cases of scarlet fever where an incidence of 6.7% was recorded the high figure to some extent is accounted for by 40% of the cases being under 5 years of age.

The table below is composed to show the incidence for the age groups 0 - 5, 5 - 10 and over 10 years in my two series and for the purpose of comparison the age group incidence of other observers have been included. In these latter series a proportion of the cases were treated by serum intramuscularly but full details unfortunately were not available. The American results of Sutcliff in 1933, and those of Harries in 1924 and 1930 are not strictly comparable with mine

as the type of fever prevalent might account for some differences in the incidence of the ear complications. The results recorded in nine London County Council hospitals are comparable, however, inasmuch as the cases were occurring concurrently in the same area from which those at the Park Hospital were drawn.

TABLE III. - Primary Acute Suppurative Otitis Media complicating Scarlet Fever.

Incidence in Age Groups.

Year	Authority	0-5 years			5-10 years			10+ years		
		S.F. cases	Otitis Cases	Otitis %	S.F. cases	Otitis Cases	Otitis %	S.F. cases	Otitis Cases	Otitis %
16 1924	Harries and Gilliespy	758	117	15.4	1686	132	7.8	1140	41	3.6
77 1930	Harries (Birmingham)	343	28	8.1	779	34	4.4	594	11	1.8
29 1933	Sutcliff, W.D. (J.A.M.A.C, 725)	195	48	22.9	331	32	9.7	325	10	3.1
43 1933	L.C.C. nine acute fever hospitals.	5376	715	13.3	7693	573	7.4	6000	244	4.1
1933 -34	Banks, H.S. L.C.C.Park Hospital.									
	non-serum cases.	573	66	11.5	490	25	5.1	366	6	1.6
	intra-venous "	469	18	3.8	755	13	1.7	653	4	0.6

It is seen that at the Park Hospital the incidence in all age groups when intravenous serum therapy was used, is about one-third of that found in the untreated controls, Compared with the figures of the nine London County Council hospitals, where the cases were occurring concurrently, and which might likewise be treated as a control series, the reduction in incidence for all age groups is even greater. The other three series in the table in which higher incidences are recorded likewise suggest that the methods of treatment of scarlet fever, as far as the incidence of otitis media is concerned, are infinitely inferior to the method of treatment by intravenous serum therapy.

Conclusions.

In view of the disappointing results recorded in the past by workers attempting to prevent otitis media arising in scarlet fever, I have come to the conclusion, from my investigations into the incidence of the disease, that in the treatment of the acute stage of the fever itself by intravenous serum therapy, we have a means whereby the incidence of this particular complication can be reduced. The results recorded in this respect, by the use of serum administered intramuscularly, where only a slight reduction in the incidence has been affected, leads me to conclude that the serum alone is not of material value except when its action is immediate and concentrated in the blood stream in the early stages of the fever before the faucial and naso-pharyngeal infection has had time to spread into the Eustachian Tubes to the middle ear. In children under 5 years of age, however, there is still room for further improvement, for although the disease can be said to be rare above the age of 5 and almost unknown in adults when the fever is treated by this means, it cannot be said that the complication is abolished in very young children although the incidence is reduced considerably.

SECTION II - The Effect of Enlarged or Septic Tonsils or Adenoids on the Prognosis in Scarlatinal Otitis Media.

In the early stages of scarlet fever when the fauces and naso-pharynx are inflamed, the tonsils and adenoid tissue in the naso-pharynx are involved.and in some cases appear enlarged or septic. However, in the course of this local inflammation subsiding these tissues return to normal except when permanent enlargement or sepsis is present. In recording enlargement or sepsis in these tissues in my cases, a period of at least 14 days was allowed to lapse from the time the case was admitted to hospital, in order to allow any temporary congestion to subside. An analysis of my cases revealed that only in 12 out of 123 cases developing otitis media were these tissues affected permanently. Of these 12 cases there were 4 with double acute otitis media and 8 with involvement of one side only; in other words disease in 16 middle ears was associated with enlargement or sepsis in the tonsils and adenoids.

Case Numbers.

(a) Single Otitis Media - 9, 16, 17, 48, 49, 94, 99, 113.

(b) Double Otitis Media - 55, 74, 76, 97.

In group (a) 3 cases failed to clear up, Numbers 48, 49 and 113.

In group (b) one side in case 97 failed to clear up.

The average duration of the discharge in the successfully treated cases was 29.3 days. It is interesting to note that in the 3 out of the 4 failures during the course of the otitis media, in cases 48, 49 and 97 intercurrent infectious disease developed. I shall be discussing later the effect on prognosis of intercurrent infectious disease and in view of my findings with regard to this it would be interesting to know to what extent the presence of the intercurrent infections influenced the final issue.

The following table shows the results of treatment

in the ears associated with enlarged or diseased tonsils and adenoids compared with the results in all the ears studied, and also with the results of treatment in those ears not associated with enlarged or septic tonsils and adenoids.

	Total Dry Ears Treated.	Average duration of the discharge.	Number of Failures.	Percentage of Failures.
All ears. 152	122	27.6 days.	30	19.7 %
Number with Tonsils & Adenoids affected. 16.	12	29.3 days.	4	25 %
Number without Tonsils & Adenoids affected. 136.	110	27.4 days.	26	19.1 %
Harpies & Gilhespy. Number in which Tonsils & Adenoids removed. 122	-	-	-	11 %

These figures mean that in only four cases out of 123 suffering from scarlatinal otitis media did the possibility of failure in responding to conservative methods of treatment arise on account of the presence of enlarged or septic tonsils and adenoids. The fact that even in their presence the proportion of failures is only slightly higher in the 16 cases studied, 25% compared with 19.1% in the 136 where they were not, makes one doubt whether the removal of those tissues in the four cases would have resulted in the otorrhoea clearing up.

Conclusions. My results suggest to me that the indications for operative interference are rare and that the decision should not be made until the fourth to the sixth week of the otorrhoea. I am not in agreement with Gardener (see page 18) who states that the early removal of tonsils and adenoids is the surest method of cure. Although he claims a reduction of the period of stay in hospital he does not give any evidence of a reduction in the proportion of failures or in the duration of discharge. Moreover, the

cases which he quotes did not occur concurrently. The practice of Harries and Gilliespy (see page 18) in removing the adenoids and tonsils if septic about the fourth week seems a more reasonable practice and the 11% of failures in 122 cases is certainly a low figure. However, the number subjected to operative treatment is very high indeed and I feel that many of them would have resulted in cure without resort to such measures. I am left with the impression from a study of the results of advocates of this measure that surgery has been resorted to rather too widely and that a more careful choice of the type of case might have been made. I agree that should there be sepsis or enlargement in these tissues they should be removed if the otorrhoea has persisted for longer than four weeks. I regret that this was not done in the four cases in my series already mentioned but these passed from my care as the policy of the hospital was to give such cases a period of convalescent treatment in the country in order to affect cure by building up the general health. This method of management is still in the experimental stage and has been advocated by Mr. T. B. Layton, the consulting otologist of the London County Council Fever Service. The results of this method of handling intractable otorrhoea are not yet available unfortunately. My opinion is that it might be admirable for those cases in which there is no sepsis or enlargement in the tonsils and adenoids and where there is a possibility of mastoid disease keeping up the discharge. At this stage I think a mastoid drainage operation should be considered with and not after adenoidectomy and tonsillectomy. These operative measures are not indicated to the extent they are at present in acute scarlatinal otitis media and should be reserved for the prechronic stage of the disease. A full investigation of their value is long overdue.

I am in agreement with Layton (see page19) who states that (a) many of the successes claimed by adenoidectomy and tonsillectomy are not really due to this measure as there is a natural tendency to cure about the fortieth day of discharge in an otorrhoea and (b) that it it not by any wide system of operative treatment that improved results in acute scarlatinal otitis media can be obtained and (c) that operations are only of value in a few selected cases.

SECTION III - The Effect of Age on Prognosis.

During my experience with the management of otorrhoea cases I was impressed with the difficulty in effecting cure in very young patients. I here tabulate my findings in the table below.

SCARLET FEVER OTITIS MEDIA (1.10.33 to 31.3.35)

Effect of Age on Prognosis.

Age Period.	Number with Dry Ears.	Average Duration of Discharge. In days.	Number with Persistent Otorrhoea.			Layton's 274 cases of Ear Disease 1923-24. Percentage of Failures.
			Number	Percentage of Failures.		
0-2 years.	22	35.8	18	45%	23.3%	0-5 yrs. 56% Failed to become dry in 6 weeks.
2-5 years.	70	28.7	10	12.5%		
5-10 years.	22	18.6	2	8.35%	6.25%	5-10 yrs. 45% Failed to become dry in 6 weeks.
10-15 years.	5	18.8	-	-		
15-20 years.	0	-	-	-		
20 +	3	21.	-	-		
Total	122		30	19.7%		

By far the greatest proportion of failures occurred in the 0 - 5 years group, 23.3%, as compared with 8.3% in the 5 - 10 years group. No failures were recorded above the age of 10 years and over the age of 5 years the percentage of failures was 6.25, one-fourth of that below the age of 5 years. A further analysis of the 0 - 5 years group reveals that above the age of 2 years, i.e. in the 2 - 5 years group, the failures were 12.5%, one-third of that recorded in the 0 - 2 years group, where 45% was recorded. Furthermore, the difficulty in effecting cure as judged by the duration of the discharge is

greatest in the 0 - 2 years group and becomes less so in the 2 - 5 and the groups beyond 5 years.

I have been able to find only one set of figures in the literature with which to compare my results. T.B.Layton[37] analysed 274 cases in 1923-24 in the London Fever Hospitals and although his standards are not quite the same as mine his figures are of some interest. He divided his cases into (1) those which failed to become dry in 6 weeks and (2) those in which cure was effected before this time. He chose only two age groups 0 - 5 years and 5 - 15 years. He found that in the 0 - 5 years group 56% failed to dry up in six weeks and in the 5 - 15 years group 45% failed. Although I allowed a longer period for treatment, usually three months, before failure was recorded in my own cases whereas he allowed six weeks, his figures are high. It is seldom that an otorrhoea which is going to clear up takes longer than six weeks in doing so and I doubt if by allowing a longer period for observation a marked lowering of these figures would have taken place. The outstanding feature in his observations is that he found little difference in his percentage of failures in the 0 - 5 and 5 - 15 years groups, 56% and 45%, as compared with 23.3% and 6.25% in my series. The difference between 56% and 23.3% in the 0 - 5 years group and 45% and 6.25% in the 5 - 15 years group can hardly be accounted for by the six weeks period of observation. I have since discussed these figures with Mr. Layton and he thinks the improvement is due to the better management of such cases in hospital at the present time.

Conclusions. Although my figures are small I have concluded that the older the child the better are the chances of affecting cure quickly and that the real difficulty in affecting this is found in children under 5 years and particularly in infants under 2 years of age.

SECTION IV - The Effect on Prognosis of Intercurrent Infectious Diseases.

In an Infectious Diseases Hospital, particularly at times of pressure, intercurrent infectious disease in cases of scarlet fever is by no means uncommon particularly in otorrhoea cases as these are subjected, as a rule, to a longer stay than usual. It has been shown in scarlet fever complicated by an additional infection that the incidence of otitis media rises and, in my experience of scarlatinal otitis media, I have been impressed with the intractable nature of this complication when another infection has manifested itself in the patient during the course of treatment of this complication.

The table below gives the details of analysis in my cases in which the results of treatment in simple scarlet fever otitis media are compared with cases in which an intercurrent infection or infections have developed. I have recorded the state of the drumhead, whether healed or unhealed in the successes, the average duration of the discharge in the ears which became dry, and the percentage of failures.

TABLE V. SCARLET FEVER OTITIS MEDIA (1.10.33 to 31.3.35)

Effect of Intercurrent Infectious Disease on Prognosis.

	Number of Ears.	Dry Ears.			Persistent Otorrhoea.	
		Number with Healed Drumheads.	Number with Unhealed Drumheads.	Average duration of Otorrhoea.	Number.	Percentage of Failures.
Simple Scarlet Fever.	107	83	9	22.8 days.	15	14 %
Scarlet Fever and Intercurrent Infectious Disease	45	25	5	42.1 days.	15	33.3 %.

It is seen from the table that the average duration of the discharge and the percentage of failures in the ears complicated by intercurrent infecious disease are double that found in uncomplicated cases, 42.1 days compared with 22.8 days and 33.3% compared with 14%. The proportion of unhealed drumheads to healed drumheads is also almost double in the complicated group showing that the damage to the hearing apparatus is more permanent.

The intercurrent infections found were nasal diphtheria, measles or whooping cough or a combination of these and in the table below I have shown their distribution and effect. The following abbreviations have been used:-

N.D. = Nasal Diphtheria. W.C. = Whooping Cough.
M. = Measles.

Table Va. DISTRIBUTION OF INTERCURRENT INFECTIONS WITH RESULTS OF TREATMENT.

	Infectious Disease	Total Number of Ears.	Number which Dried.	Number which Continued to Discharge.	Average Duration of Discharge in Successes.
One Intercurrent Infection.	N. D.	21	15	6	44.2 days.
	M.	9	9	0	34.6 days.
	W.C.	2	1	1	47 days.
Combined Intercurrent Infections.	N.D., + M.	9	4	5	53 days.
	N.D., + W.C.	2	0	2	-
	M., + W.C.	2	1	1	63 days.

The table reveals, that in 6 out of 21 cases in which nasal diphtheria was present, the ear failed to respond to treatment, whereas in the 9 cases complicated by measles no failures occurred. It would seem therefore that measles of itself is not so serious where success or failure is concerned. The combination of two infections reveals that the proportion of failures is greater, in fact 8 failures out of 13 cases were

recorded. It is noticed also that the average duration of the discharge in the successes is longer in each complicating disease than the average recorded for uncomplicated cases. (See table V).

Conclusions. I have concluded that the presence of another infectious disease in the course of a scarlet fever otitis media has a definitely adverse effect, tending to lengthen the duration of treatment and increase the chance of chronicity. Particularly is this the case in nasal diphtheria or a combination of intercurrent infections. The explanation lies probably in the fact that these infections affect the upper respiratory tract and in so doing influence the course of the infection already present in the middle ear by reinfection or keeping it alight. Moreover it is noticeable in such cases of combined infections that the general nutrition and health are unduly below par with the result that any natural tendency to cure on the part of the diseased middle ear is retarded.

SECTION V - The Effect of Serum Treatment in Scarlet Fever on the Prognosis of Otitis Media.

In view of the conclusions reached with regard to the beneficial effect of serum treatment of the fever on the incidence of scarlet fever otitis media, I have made a study of my cases to find if and in what way the course of this complication differed in serum treated and non-serum cases. 72 Ears occurred in serum treated cases and 80 occurred in cases in which serum had not been used. The average duration of the discharge and the percentage of failures have been used for a basis of comparison and in view of the apparent effect of age and intercurrent infectious disease I have recorded beside each group the percentage of cases in the age groups 0 - 2, 2 - 5 and over 5 years, and the percentage of cases in which intercurrent infectious disease was present.

The findings are tabulated below:-

SCARLET FEVER OTITIS MEDIA (1.10.33 to 31.3.35)

Effect of Serum Treatment on Prognosis.

Treatment.	Number of Ears.	Age Distribution.			Percentage with Intercurrent Infections.	Results.				
						Dry Ears.			Persistent Otorrhoea.	
		Years. 0-2	Years. 2-5	Years. 5+		Number with Healed Drumhead	Number with Perforation.	Average duration of Otorrhoea.	Number of Ears.	Percentage of Failures.
Intra-venous Serum.	56					40	8	20.5 days.	8	14.2 %
Intra-Muscular Serum.	13					11	1	13.7 days.	1	7.7 %
Intra-Peritoneal Serum.	3					3	0	15.3 days.	0	-
All Serum	72	18.3%	57.8%	23.9%	16.6 %	54	9	22.2 days.	9	12.5 %
No Serum (Controls).	80	36.2%	47.5%	16.3%	41.2 %	53	6	33.5 days.	21	26.2 %
No Serum (Layton, 1923-24)	283					In six weeks 139 became dry.			In six weeks 144 failed to become dry.	50.9 %

From the above table it is seen that the results in the ears occurring in the serum treated cases are much better than in the non-serum cases. The average duration of the discharge is one-third less and the percentage of failures reduced by more than half. Layton's figure of 49.1% failures in his non-serum treated cases compares very unfavourably with both my series but particularly with the serum treated.

However, the age distribution and the proportion in which intercurrent infectious disease was present, are not quite comparable in my two series and it might be argued that the results in the serum treated cases had been influenced by the relatively low percentage of cases in the 0 - 2 years group and the low percentage suffering from intercurrent infectious disease. The following table shows the results for the age groups and the presence or absence of intercurrent infectious disease.

EFFECT OF SERUM AND NO-SERUM TREATMENT ON PROGNOSIS WITH CORRECTION FOR AGE AND INTERCURRENT INFECTIONS.

TABLE A. SIMPLE SCARLET FEVER.

AGE	SERUM.					NON - SERUM.				
	Number of Ears.	Number of Dry Ears.	Average duration of Discharge.	Number with Persistent Otorrhoea.	Percentage of Failures.	Number of Ears.	Number of Dry Ears.	Average duration of Discharge	Number with Persistent Otorrhoea.	Percentage of Failures.
0-2 years.	8	5	19.4 days	3	37.5%	17	9	34 days	8	47%
2-5 years.	34	32	20.9 days	2	5.9%	18	18	28.9 days	0	-
5 +	18	17	15.8 days	1	5.5%	13	11	21.6 days	1	7.6%

TABLE B. SCARLET FEVER WITH INTERCURRENT INFECTIOUS DISEASE.

AGE.	SERUM.					NON-SERUM.				
	Number of Ears.	Number of Dry Ears	Average duration of Discharge	Number with Persistent Otorrhoea.	Percentage of Failures.	Number of Ears.	Number of Dry Ears.	Average duration of Discharge	Number with Persistent Otorrhoea	Percentage of Failures.
0-2 years	3	1	34 days.	2	67%	12	7	50.2 days	5	41.6%
2-5 years	9	8	40.1 days	1	11.1%	19	12	41.3 days	7	36.8%
5+	-	-	-	-	-	1	1	63 days	-	-

It will be seen that all the groups are not comparable on account of numerical weakness. In table A the average duration of the discharge for the successful cases in all age groups is shorter in the serum treated than in the non-serum cases and likewise this is seen to be the case in table B where intercurrent infectious disease was present. The difference in this respect is particularly noticeable in the age group 0 - 2 years and not so marked in the others.

It is impossible in view of the smallness of the figures to draw conclusions with regard to the percentage of failures. In table A the results for the age groups 0 - 2 and over 5 years are better in the serum treated than in the non-serum series. In the age group 2 - 5 years, however, 2 failures out of 34 cases occurred in the serum treated series whereas out of 18 cases in the non-serum series no failures were recorded. In table B, however, for this age group the percentage of failures is very much higher in the non-serum series 36.8% compared with 11.1% in the serum treated.

Conclusions. Although I realise the deficiencies in the tables I have concluded that serum treatment in scarlet fever tends to influence the course of an otitis media, when it does occur, by shortening the course and lessening the chance of chronicity to a slight extent. This is probably due to the fact that in serum treated cases the middle ear is not so severely infected and the better general condition and nutrition in these cases allows of better healing and of quicker recovery to take place.

SECTION VI - The Effect of Zinc Ionisation on Prognosis in Scarlet Fever Otitis Media.

The cases for treatment by this method were not selected in any way but were as far as possible chosen so that every alternate case of otitis media in the hospital was so treated. In order that the work in any individual ward was not increased too much in this respect, especially where more cases of otitis were occurring than usual, this method of alternate selection was abandoned, and the cases were chosen at random, depending on the pressure of other work in the wards at the time.

Although the practice[52] of most workers with ionisation in cases of chronic otitis media is to carry out the treatment on the ear and not subject it to further interference until the next inspection, I felt that it was desirable to carry out the conservative method of dry mopping combined with drops in the external meatus between treatments in order that such discharges as were present were allowed free exit. In the cases which were not ionised the disease was allowed to run its course being only treated by the conservative methods and in this way these cases acted as a form of control for guaging the effect of the ionisation treatments.

An attempt was made to commence the ionisation treatments as soon as possible after the appearance of the discharge, i.e. in the early acute phase of the disease. However, a number of cases were treated some time after the appearance of the discharge and, for the purpose of analysis of the results, two groups of cases were made.

(1) Those in which ionisation was commenced in the first 14 days of the disease - early ionisation.

(2) Those in which ionisation was carried out after the ear had been discharging for more than 14 days - late ionisation.

(1) A study of the ears treated by ionisation in the early stages of the disease revealed the following facts, shown below in table form, with the corresponding facts in ears not treated by this means.

	Total Number of Ears.	Number of Dry Ears.	Number with Persistent Otorrhoea.	Average Duration of Discharge	Percentage of Failures.
Ionisation	83	65	18	24.6 days.	21.6 %
Non-Ionisation	50	41	9	30.6 days.	18. %

From the above it would seem that there is only a slight advantage in the use of ionisation in the respect that the duration of the disease is shortened a little, 24.2 days compared with 30.6 days in the untreated cases.

Owing to the influence of age, intercurrent infections, and serum therapy of the fever, I have further analysed the two groups in the following tables where those factors have been considered.

Owing to the subdivisions the ionised groups with their corresponding non-ionised groups were rather small in numbers and it was found impossible to study the effects of ionisation in the age groups 0 - 2, 2 - 5 and over 5 years. However, as a rough correction, and in order that the groups could be reasonably comparable in this respect, the percentage composition of the cases under 5 years has been recorded

In the first group of ears studied I have eliminated those in which intercurrent infectious disease was present in order that the results in the groups might be as closely comparable as possible. In view of my previous findings the presence of another infection in a large number of ears in one group would influence the results in that group adversely when comparing them with those in another group in which there were only a few ears where intercurrent

infectious disease was present. Thus in the first table I have compared serum treated and non-serum cases in which ionisation had been used with corresponding cases in which this form of therapy had not been carried out. In this allowance has been made for the three factors, age, intercurrent infectious disease and serum therapy, all of which would have influenced the results.

TABLE A. SIMPLE SCARLET FEVER.

	Ionisation.						Non-Ionisation.					
			Dry Ears.		Persistent Otorrhoea				Dry Ears.		Persistent Otorrhoea.	
	Total Number of Ears.	Percentage under 5 years.	Number with Dry Ears	Average duration of Discharge	Number with Persistent Otorrhoea	Percentage of Failures.	Total Number of Ears.	Percentage under 5 years.	Number with Dry Ears.	Average duration of Discharge	Number with Persistent Otorrhoea	Percentage of Failures.
Intra-venous Serum.	20	55%	19	15 days	1	5%	25	68%	21	18.2 days	4	16%
Intra-peritoneal & Intra-muscular Serum.	10	90%	9	17.7 days	1	10%	4	100%	4	43.2 days	–	–
Total Serum.	30	57.8%	28	15.8 days	2	6.6%	29	69.2%	25	22.2 days	4	14.1%
Non Serum.	21	80.9%	17	27.7 days	4	19%	20	70%	15	23.6 days	5	25%

Where intercurrent infectious disease was not present as in Table A, it is seen that the results, in the serum treated group which had ionisation, are better than in the non-ionised serum treated group. The average duration of the discharge is reduced from 22.2 days to 15.8 days and the percentage of failures from 14.1% to 6.6%. The groups are not quite comparable in age composition, the ionised group being composed more favourably by having 57.8% under 5 years as compared with 69.2% in the non-ionised group.

The slight difference in this respect might have influenced the results a little but I do not think materially .

In the ears which have had intravenous serum therapy, the ionised group shows still better results compared with the corresponding non-ionised group. The average duration of the discharge was 15 days and the percentage of failures 5% compared with 18.2 days and 16%. Here again, however, the age composition is in favour of the ionised group, 55% being under 5 years compared with 68%. The groups where the serum had been used intramuscularly or intraperitoneally are not of much value for comparative purposes. Where serum had not been used in the treatment of the fever the results are not so good as in those where it had been used but the ionised group compares advantageously with the non-ionised group, 27.7 days for the average duration of the discharge and 19% for failures, against 23.6 days and 25%. The percentage of failures is slightly less but the average duration of the discharge is a little more. In these groups, however, it is seen that the ionised series are at a disadvantage in age composition for the percentage of cases under 5 years, 80.9% compared with 70%.

Conclusions. It seems reasonable to conclude from the above that ionisation therapy is an advantage in the treatment of scarlatinal otitis media particularly in cases where serum had been used in the treatment of the fever itself. Although the advantage is not so obvious in the non-serum group I think, in view of the shortening of the duration of the discharge and the reduction of the percentage of failures, it is a measure worthy of trial in every case of otitis media in scarlet fever. My experience of its use has revealed that no untowards effects result. Those who say that it is contraindicated in the acute stage of an otitis media no doubt mean that by its use further complications

such as mastoiditis are more likely to arise or that the condition is prevented in some way from resolving. With regard to mastoiditis complicating the disease, in 83 ears which were ionised only 2 developed mastoiditis, and in the 50 ears which were not 5 developed the complication. I would not care to say that ionisation prevented mastoiditis from these figures, but most certainly the treatment does not predispose to it. E. Watson Williams[24] and McLaggan,[15] who do not publish evidence for saying that ionisation is contraindicated in acute otitis media, would seem to be wrong from my experience with it.

A study of the effect of ionisation in cases in which intercurrent infectious disease developed revealed the following results in serum treated cases.

SCARLET FEVER OTITIS MEDIA
WITH
INTERCURRENT INFECTIOUS DISEASE.

IONISATION THERAPY.

	Total Number of Ears.	Percentage under 5 years.	Number with Dry Ears.	Average duration of Discharge.	Number with Persistent Otorrhoea.	Percentage of Failures.
Intra-venous Serum	10	90%	8	41.6 days	2	20%
Intra-peritoneal Serum	1	-	1	34 days	-	-
Non-serum	21	95%	11	27.3 days.	10	47.6%

Unfortunately I was unable to collect any cases in which ionisation was not carried out and consequently the above table is not of much value in assessing the value of ionisation itself. However, the percentage of failures in the non-serum group is seen to be double that in the serum group, and the results for both groups compare unfavourably with those in the

corresponding ionisation groups where intercurrent infectious disease was not present (se Table A). The results, however, are interesting when we compare the non-ionised groups in Table A. It is found that, in spite of ionisation treatment, the groups compare unfavourably for both the serum and non-serum groups which makes it appear that the presence of intercurrent infection reduced the chances of the ionisation treatment succeeding. Whether it would be of benefit or not in this class of case is difficult to say, without corresponding groups with intercurrent infectious disease where no ionisation was carried out. At the time when this work was being done the effect of intercurrent infectious disease on prognosis was not realised with the result that no controls were instituted. However, from the results in Table A I think it can be presumed that, without this treatment, my results would not have been so good had ionisation not been carried out.

The following 19 remaining cases of my series are those which showed no evidence of the discharge clearing up by the ordinary conservative methods after 14 days and which after that period were treated by ionisation. No doubt many of them would have cleared up in the ordinary course of events and it is difficult, on account of the lack of a control series and the numerical size of the sub-groups, to form any conclusions with regard to the ionisation treatment, but the fact that only 2 ears out of the 19 failed to clear up makes one think that the treatment had some beneficial effect. I have tabulated the results in the table below.

TABLE C. SCARLET FEVER OTITIS MEDIA.

Effect of Late Ionisation Therapy.

	Ionisation.					Non-Ionisation.				
	Total Number of Ears	Dry Ears.		Persistent Otorrhoea		Total Number of Ears.	Dry Ears		Persistent Otorrhoea	
		Number with Dry Ears.	Average duration of Discharge.	Number with Persistent Otorrhoea	Percentage of Failures.		Number with Dry Ears.	Average duration of Discharge	Number with Persistent Otorrhoea.	Percentage of Failures.
Simple Scarlet Fever. Intravenous Serum.	2	2	28.5 days.	-	-	18	14	30.8 days.	4	22.2%
Scarlet Fever Intercurrent Infectious Disease. Intravenous Serum.	2	1	36 days	1	-	1	1	47 days	-	-
Simple Scarlet Fever. Non-serum.	6	5	34.4 days	1	16.6%	14	9	31.9 days.	5	35.7%
Scarlet Fever Intercurrent Infectious Disease. Non-serum.	9	9	66.1 days	-	-	1	-	-	1	-
All Cases.	19	17	50.5 days	2	10.5%	34	24	31.9 days	10	29.4%

In the above table I have used as a rough form of control the cases which in my series had no ionisation treatment and which by the fifteenth day of the disease had not cleared up. The small size of the groups makes a comparison useless but if the gross results are studied it is noticed that 10.5% failed to clear up in the ionised series whereas 29.4% failed in the non-ionised series. There has, of course, been no correction for age, intercurrent infectious disease or serum therapy, but if the ionised group is studied, it will be found to be adversely affected by all these factors, which means that the results would probably have been even better in the ionised group had these factors been reasonably the same in each.

The following gives the composition of the groups for these factors.

TABLE SHOWING COMPOSITION OF AGE, INTERCURRENT INFECTIOUS DISEASE AND SERUM TREATMENT IN "ALL CASES" IN TABLE C.

	Ionised Group	Non-Ionised Group
Age	84.3% under five years	82.9% under five years.
Intercurrent Infectious Disease.	Present in 57.8% (11 out of 19 cases).	Present in 2.9% (1 out of 34 cases).
Serum.	4	19.
Non-serum.	15	16.

Although the percentage of failures is smaller in the ionised group, the average duration of the discharge in the successful cases 50.5 days compares unfavourably with 31.9 days in the non-ionised group. However, the fact that in 11 out of 19 cases intercurrent infectious disease was present compared with 1 out of 34, and 4 out of 19 had serum treatment compared with 19 out of 34, probably accounts for this.

Conclusions. Although the data is scanty and inadequate for positive proof, if such is possible, I think that ionisation treatment started late in the course of an acute otitis media is of value in the respect that success is attained in a number of cases which would not have cleared up by the ordinary methods.

Having come to the conclusion that ionisation therapy is an advantage and an aid in the conservative methods of treatment in scarlatinal otitis media I should like to make a few observations in general concerning its use.

With regard to the choice of case I should say that there are no indications by which we can judge whether the disease will react or not to the treatment. A state of good general condition and nutrition in the patient himself appears to be important for good results, as judged by the results of treatment in the serum treated cases free of intercurrent infections where these are not affected detrimentally. When the middle ear is in the early stages of acute inflammation presumably only the mucous membrane is involved and from my experience, where only primary acute cases were studied, it is impossible to draw any conclusion with regard to its use in cases where the disease had progressed further and involved the bony structures. In only two cases where mastoid disease was present, and in which definite evidence of involvement of bone was present, was the treatment tried. Both cases cleared up in time but the treatments were discontinued at the onset of the mastoid disease. It is difficult to understand how a treatment which acts very superficially can benefit deep seated disease and I am of the same opinion as McLaggan[25] who found it of little use where bony disease was present in chronic cases. With regard to the perforation in the tympanic membrane the site and size give us no indication whether the treatment will be of benefit or not. The size of the perforation is never large in acute scarlatinal otitis media even in severe cases, and I have never seen a case of total or subtotal destruction of the drumhead such as is seen occasionally in acute influenzal or pneumococcal otitis media. In fact in many cases the perforation is minute or invisible, and in what might be termed large ones in this disease they are of such a size as to make it difficult to understand how the zinc fluid penetrates into the middle ear and replaces such discharges as are present. However, only in the large perforation can the mucous membrane of the middle ear be seen to be coated by a white coagulum after treatment. As

for those in which a small perforation is present it is impossible to say if any deposit of zinc ions takes place in the middle ear. In these cases, however, the external surface of the drumhead and the walls of the deep meatus are seen to be coated by the white coagulum. Probably if the ionisation treatments are doing good in such cases it is brought about by a more efficient sterilization of the deep meatus resulting in a more efficient prevention of secondary infection of the middle ear than would take place by merely instilling antiseptic drops. As Friel[52] has said ionisation in ear disease is the only means of antisepsis worthy of the name.

The following details with regard to the number of treatments to which each of my cases were subjected, have enabled me to come to some conclusion about the length of time or rather the number of treatments that should be given before ionisation should be abandoned as useless in a case.

	Total Number of Ears.	Treatments not interrupted								Treatments Interrupted.		
		Total Number of Ears.	Number with Dry Ears	Number of Dry Ears after a given number of Treatments.						Total Number of Ears.	Number of Dry Ears.	Number with Persistent Otorrhoea
				Number of Treatments.								
				1	2	3	4	5	6+			
Serum	43	40	37	10	13	6	3	2	3 F3	3	1	2
Non-serum.	59	51	42	14	6	10	5	1	6 F9	8	1	7
All Cases	102	91	79	24	19	16	8	3	9 F12	11	2	9

The table shows the number of ears which became dry after 1, 2, 3, 4, 5 and 6 or more treatments which were given at 4 day intervals. Where the treatments were abandoned for a particular reason before 6 treatments were given or before

the ear was dry or almost dry the case was included in the special column for "interrupted treatments." Where the ear failed to respond after 6 or more consecutive treatments the case was classed as a failure in the 6+ column.

If the ears included in the "interrupted treatments" column are eliminated certain conclusions can be reached with regard to the effect of ionisation and the continuation of treatment when the ear is not responding. If we consider the figures of all the cases, i.e. line 3 of the table, it is noticed that more success occurs with 1 treatment than with 2 and more with 2 than with 3 and so on. On a percentage basis the facts are

TABLE A.

26.3% of the total responded with 1 Treatment.
20.8% " " " " " 2 Treatments.
17.5% " " " " " 3 "
8.7% " " " " " 4 "
3.3% " " " " " 5 "

or

26.3% of the total became dry after 1 Treatment.
47.1% " " " " " " 2 Treatments.
64.6% " " " " " " 3 "
73.3% " " " " " " 4 "
76.6% " " " " " " 5 "

The percentage of successes with a given number of treatments can be calculated from the table by taking the number of successes out of the total number of ears treated by that number. Thus we find that:-

TABLE B.

In 91 ears subjected to 1 Treatment 26.3% became dry.
" 69 " " " 2 Treatments 28.3% " "
" 48 " " " 3 " 33.3% " "
" 32 " " " 4 " 25% " "
" 24 " " " 5 " 12.5% " "

It can be deduced from the trend of the above figures that the greater the number of treatments required to affect cure the less is the chance of cure being affected. In Table A the relatively small rise in the total successes after 3 and after 4 treatments, 64.6% to 73.3%, and after 4 and 5 treatments, 73.3% to 76.6% is rather suggestive. In Table B the fall in the percentage of successful cases with 3 and with 4 treatments from 33.3% to 25% and with 4 and 5 treatments from 25% to 12.5% likewise points to the treatments becoming less effective.

For 6 or more treatments we notice that the failures exceed the successes, there being 9 ears which responded and 12 which did not. It is very doubtful if the ionisation treatments had any influence in affecting cure at all in this group. The fact that the average case of acute otitis media has a natural tendency to cure as time goes on must be borne in mind and probably, in the 9 successful cases quoted above this has more than likely been affected by natural means.

I have therefore come to the conclusion that, if after 5 or at the most 6 treatments given at 4 or 5 day intervals an otorrhoea has failed to respond to ionisation therapy, it is unlikely that cure will be hastened or success attained by a continuation of the treatments. The figures given are small and are not offered in any was as statistical evidence but are merely offered to show how my conclusions were formed on this point. It is interesting to note that Walker[63] likewise found that, if a chronic otorrhoea failed to respond to 5 or 6 treatments, it was usually useless to continue further with ionisation as success was seldom attained by this means.

Conclusions. Finally with regard to ionisation therapy I should like to say that it is by no means a method of certain cure in the treatment of this complication, and should only be used as an aid to the more important treatment

by free drainage of the discharges and toilet of the external meatus. I do say, however, that, if used in this way in all cases of acute scarlatinal otitis media, cure will be affected more quickly in a number of ears and success will be attained in some which would otherwise have entered the chronic stage. I cannot say that it assisted in any way in preventing destruction of the drumhead or helped the perforation to heal. It can be seen in any of my series that the proportion of healed drumheads to perforated drumheads in the cases which were cured is not materially higher in the ionised groups.

PART VI.

Some Investigations

in

Otitis Media

complicating

Measles and Diphtheria.

INTRODUCTION.

Concurrently with my study of acute otitis media complicating scarlet fever I have carried out a similar but less detailed work with this complication in measles and diphtheria.

My original intention in my cases was to investigate the value of zinc ionisation only, but the opportunity of confirming some of my findings in scarlatinal otitis media has occurred and I have included a study of the effect of age, intercurrent infections, and enlarged or septic tonsils and adenoids on the prognosis.

I have not investigated the incidence of otitis in these diseases. In diphtheria it is certainly low,but in measles on the other hand it rivals scarlet fever in its frequency being about 10%. A reduction of this is long overdue and perhaps, with the wider use of adult measles serum and the production of a mild and fleeting attack of the disease in contacts, the incidence of the complication will be considerably reduced indirectly with the result that the number of chronic otorrhoeas from this disease will be reduced.

The same procedure in examination, treatment,and case recording was carried out as in scarlatinal otitis media care being taken to eliminate cases where there was a history of previous otorrhoea. The salient features of each case I have recorded in the following pages.

In a similar way to that used in scarlatinal otitis media I have made a study of the foregoing cases in the following sections:-

Section I. The Effect of Enlarged or Septic Tonsils and Adenoids in Acute Otitis Media in Measles and Diphtheria.

Section II. The Effect of Age on Prognosis in Acute Otitis Media in Measles.

Section III. The Effect of Intercurrent Infectious Disease on Prognosis in Acute Otitis Media in Measles.

Section IV. The Effect of Zinc Ionisation Therapy on Prognosis in Acute Otitis Media in Measles and Diphtheria.

PART VII.

Records of Cases

of

Otitis Media

in

Measles and Diphtheria.

ACUTE OTITIS MEDIA IN MEASLES.

GROUP I. IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
1.	R.	2 1/12	M.	N.V.	N.	N.	N.	9	C.			
2.	D.	9/12	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	56 43	C. C.			
3.	D.	3	F.	RT. A. LT. N.V.	N. N.	N. N.	N. N.	21 18	C. C.	N.D. N.D.		
4.	R.	2	F.	N.V.	N.	N.	N.	44	C.			
5.	D.	1 6/12	M.	RT. A. LT. A.	N. N.	N. N.	N. N.	28 40	C. C.			
6.	R.	3	M.	A.I.	N.	N.	F.	20	C.			
7.	D.	1 7/12	F.	RT. A.Large LT. N.V.	A. Large. N.	N. N.	N. N.	27 11	P.C. C.			
8.	D.	1 11/12	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	7 16	C. C.			
9.	D.	1 10/12	M.	RT. I.Large LT. A.I.	I. Large. Sub-Total Destruction	- -	- -	- -	F. F.	Mastoiditis Wildes' Incision. Meningitis - died.		
10.	L.	1 1/12	F.	A.I.	A.I.	N.	N.	26	P.C.			

ACUTE OTITIS MEDIA IN MEASLES.

GROUP I (contd). IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
11.	L.	1 7/12	M.	N.V.	N.	N.	N.	13	C.			
12.	R.	2	M.	A.I.	N.	N.	N.	25	C.			
13.	R.	1 10/12	F.	A.I.	N.	N.	N.	37	C.	Broncho-Pneumonia.		
14.	L.	1 11/12	F.	N.V.	N.	N.	N.	13	C.			
15.	R.	4	M.	N.V.	N.	N.	N.	3	C.			
16.	D.	1 11/12	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	48 22	C. C.			
17.	L.	1 11/12	M.	A.	A.	N.	N.	37	P.C.	N.D.		
18.	D.	2	M.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	35 34	C. C.			
19.	L.	11/12	F.	N.V.	N.	N.	N.	29	C.	W.C.		
20.	D.	7/12	M.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	86 89	C. C.	N.D. N.D.		
21.	L.	2 6/12	F.	P.I.	N.	N.	N.	27	C.	W.C.		
22.	D.	7/12	M.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	90 93	C. C.	N.D. N.D.		

GROUP I (contd). IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
23.	L.	1 5/12	F.	P.Large	P. Large	N.	N.	26	P.C.			
24.	L.	3	F.	A.I.	N.	N.	N.	3	C.			
25.	D.	5	F.	RT. N.V. LT. Central	N. Central	N. N.	N. N.	6 11	C. C.			
26.	R.	4	F.	P.	P.	N.	N.	25	P.C.			
27.	D.	1 6/12	M.	RT. A.I. LT. A.I.	N. N.	N. N.	N. N.	70 72	C. C.			
28.	R.	2 4/12	M.	N.V.	N.	N.	N.	15	C.			
29.	D.	1 6/12	M.	RT. A.S. LT. Central	A.S. Central	N. N.	N. N.	90+ 90+	F. F.	N.D. Broncho-Pneumonia, Mastoiditis Wilde's Incision.		
30.	D.	7	M.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	- -	F. F.	Left mastoiditis with Sinus Thrombosis, Broncho-Pneumonia.		
31.	R.	1 11/12	M.	N.V.	N.	N.	N.	30	C.	Broncho-Pneumonia.		
32.	R.	5	F.	A.I.	A.I.	N.	N.	5	P.C.			

GROUP I (contd). IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
33.	D.	5	M.	RT. A.I. LT. P.S.	N. N.	N. N.	N. N.	51 54	C. C.			
34.	L.	2	M.	A.I.	N.	N.	N.	14	C.			
35.	L.	1 3/12	M.	P.Large	P. Large	N.	++	90+	F.			
36.	L.	1 10/12	F.	A.I.	N.	N.	N.	45	C.	Broncho-Pneumonia.		
37.	L.	1 3/12	M.	N.V.	N.	N.	N.	3	C.	Broncho-Pneumonia.		
38.	L.	2	M.	A.I.	A.I.	N.	N.	33	P.C.			
39.	D.	3	M.	RT. A.I. LT. A.I.	A.I. A.I.	N. N.	N. N.	90+ 90+	F. F.			
40.	L.	5	M.	N.V.	N.	N.	N.	25	C.			
41.	L.	1 9/12	M.	N.V.	N.	N.	N.	60	C.			
42.	D.	2	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	13 12	C. C.			
43.	L.	1 11/12	M.	P.I.	P.I.Larger	N.	N.	63+	F.			

GROUP I (contd). IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
44.	R.	5	F.	A.I.	N.	N.	N.	22	C.			
45.	D.	4½	F.	RT. A.I. LT. N.V.	N. N.	N. N.	N. N.	43 13	C. C.			
46.	L.	6½	M.	N.V.	N.	N.	N.	4	C.			
47.	L.	2 6/12	F.	P.I.	N.	N.	N.	27	C.			
48.	R.	4	M.	A.	A.	N.	N.	24	C.			
49.	R.	2	F.	N.V.	N.	N.	N.	17	C.			
50.	D.	4	M.	RT. N.V. LT. N.W.	N. N.	N. N.	N. N.	33 26	C. C.			
51.	D.	1	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	41 43	C. C.			
52.	R.	2	F.	A.I.	N.	N.	N.	21	C.	Broncho-Pneumonia.		
53.	D.	4½	F.	RT. A.I. LT. N.V.	A.I. N.	N. N.	N. N.	34 No Discharge	P.C. C.			
54.	L.	3 11/12	M.	N.V.	N.	N.		60	C.	Mastoiditis Wildes' Incision.		

ACUTE OTITIS MEDIA IN MEASLES.

GROUP II

IONISATION USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
55.	R.	4	F.	P.I.	N.	N.	N.	12	C.		1	4 → Almost Dry 6.
56.	D.	1 5/12	F.	RT. P.I. Large	P. Large	N.	N.	90+	F.		15	3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 51, 55, 59.
				LT. A.S.	A.S.	N.	N.	90+	F.		15	4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60.
57.	D.	4	F.	RT. A.I.	A.I.Smaller	N.	N.	60	F.	S.F. Broncho-Pneumonia	5	8. Stopped S.F. Poor General Health. 38, 45, 47, 50.
				LT. N.V.	N.	N.	N.	16	C.	S.F. Broncho-Pneumonia	1	11.
58.	R.	3	F.	A. Marginal	N.	N.	N.	25	C.		3	4, 9, 14 → Very slight discharge.
59.	R.	5	F.	ANT.I.	N.	N.	N.	10	C.		1	4.
60.	D.	4	F.	RT. A.and P. Large.	A. and P. Large.	N.	N.	9	P.C.		2	4, 7.
				LT. N.V.	N.	N.	N.	9	C.		2	2, 7.

GROUP II (contd)

IONISATION USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
61.	D.	$1\frac{6}{12}$	M.	RT. N.V.	N.	N.	N.	61	C.		10	6, 11, 16, 21, 26, 31, 36, 41, 46, 51.
				LT. N.V.	N.	N.	N.	61	C.		10	7, 12, 17, 22, 27, 32, 37, 42, 47, 52.
62.	L.	$1\frac{4}{12}$	F.	A.	A.	N.	N.	90+	F.	Broncho-Pneumonia	9	37, 45, 49, 54, 59. 63, 70, 75, 79.
63.	D.	$2\frac{1}{2}$	M.	RT. N.V.	N.	N.	N.	50	C.		2	36, 46.
				LT. N.V.	N.	N.	N.	48	C.		5	16, 31, 36, 41, 46.
64.	D.	$1\frac{8}{12}$	F.	RT. P.I. Paracentesis	N.	N.	N.	23	C.		3	4, 12, 18.
				LT. P.N. Paracentesis	SubTotal Destruction	N.	N.	34	P.C.		9	4, 8, 12, 16, 20, 24, 28, 32, 34.
65.	R.	$3\frac{6}{12}$	M.	N.V.	N.	N.	N.	16	C.		2	10, 14.
66.	D.	$2\frac{5}{12}$	M.	RT. Post-Marginal	Larger	N.	N.	31	P.C.		3	13, 18, 22 → Moist
				LT. Central	Central	N.	N.	31	P.C.		3	13, 18, 22 → Moist
67.	D.	$2\frac{5}{12}$	M.	RT. P.I.	P.I.	N.	N.	32	P.C.		3	13, 17, 21 → Moist
				LT. Central	Central	N.	N.	32	P.C.		3	13, 17, 21 → Moist

GROUP II (contd)

IONISATION USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
68.	L.	1 2/12	F.	A.I.	N.	N.	N.	55	C.	N.D., S.F.	3	14, 19, 25 → Moist
69.	D.	1	F.	RT. N.V. LT. N.V.	N. N.	N. N.	N. N.	27 25	C. C.		2 2	18, 23. 23, 26.
70.	D.	2	F.	RT. A.I. LT. A.I.	A.I. A.I.	N. N.	N. N.	44+ 54+	F. F.	N.D.,Broncho-Pneumonia. N.D.,Broncho-Pneumonia.	3 3	15, 19, 23 → Unsuitable. 22, 23, 27 → Unsuitable.
71.	R.	1 4/12	M.	N.V.	N.	N.	N.	7	C.		1	4.
72.	L.	4	M.	A.I.	N.	N.	N.	21	C.		1	3 → Moist
73.	L.	3	M.	N.V.	N.	N.	N.	24	C.		1	4 → Moist
74.	D.	1 4/12	M.	RT. N.V. LT. N.V.	N.V. N.V.	N. N.	N. N.	44+ 44+	F. F.		2 2	16, 22. 16, 22.
75.	D.	4	M.	RT. P.I. LT. P.I.	N. P.I. Smaller	N. N.	N. N.	14 23	C. P.C.		2 2	2, 8. 10, 16.
76.	L.	5	F.	Central Large	Central Large	N.	N.	62	P.C.		3	47, 53, 61.
77.	L.	3	M.	I.	N.	N.	N.	40	C.		4	14, 19, 28, 36.

GROUP II (contd)

IONISATION USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments. Total number	Ionisation Treatments. Day from Commencement of Discharge on which Treatments were carried out.
78.	R.	2 3/12	M.	P.I.	P.I.	AFF.	+ +	53 +	F.		5	3, 8, 11, 17, 26. → Moist, → 36 Discharging.
79.	R.	2 3/12	M.	A.	N.	N.	N.	42	C.		4	2, 7, 17, 25 → Moist
80.	L.	2 1/2	F.	A. Large.	A. Large.	N.	N.	28	P.C.		4	12, 17, 22, 27.
81.	D.	2 8/12	F.	RT. N.V.	N.	N.	N.	Moist. No Discharge	C.		--	---
				LT. P.Large	P. Larger.	N.	N.	33	F.		3	20, 24, 28.
82.	D.	4	M.	RT. A.I.	N.	N.	N.	37	C.	S.F.	1	37.
				LT. A.I.	N.	N.	N.	58	C.	S.F.	3	44, 49, 54.
83.	D.	1 1/2	F.	RT. A.I. Large.	A.I. Large.	N.	N.	135 +	F.	N.D., Broncho-Pneumonia	3	110, 115, 119.
				LT. N.V.	N.	N	N.	14	C.	N.D., Broncho-Pneumonia	--	---
84.	D.	3	F.	RT. A.I. Large.	A.I.Larger	N.	N.	32	C.	S.F., N.D.	7	4, 9, 14, 19, 24, 29, 34.
				LT. A.I.	N.	N.	N.	34	C.	S.F., N.D.	7	5, 10, 15, 20, 25, 30, 32.
85.	D.	2	M.	RT. N.V.	N.	N.	N.	26	C.		1	24.
				LT. N.V.	N.	N.	N.	27	C.		1	23.
86.	D.	4	M.	RT. A.I.	N.	N.	N.	36	C.	S.F.	3	25, 29, 34.
				LT. A.I.	N.	N.	N.	51	C.	S.F.	4	30, 35, 40, 45.

ACUTE OTITIS MEDIA IN DIPHTHERIA.

GROUP I. IONISATION NOT USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
1.	R.	5	M.	N.V.	N.	N.	N.	12	C.			
2.	L.	5½	M.	P.I.	P.I.	N.	N.	39	P.C.			
3.	L.	6	M.	N.V.	N.	N.	N.	14	C.			
4.	D.	7	M.	RT. Paracentesis P.I. LT. Paracentesis P.I.	N. N.	N. N.	N. N.	33 36	C. C.			
5.	L.	18	M.	A.I.	N.	N.	N.	48	C.	Mastoiditis Schwartz Op.		N.D.
6.	L.	6	M.	P.I.	Calatrix	N.	N.	14	C.			
7.	L.	1 5/12	F.	A.I.	N.	N.	N.	17	C.			N.D.
8.	L.	2	F.	I.	N.	N.	N.	20	C.			
9.	R.	5	F.	N.V.	N.	N.	N.	3	C.			
10.	L.	3½	M.	A.I. Paracentesis	N.	N.	N.	2	C.			
11.	D.	2½	F.	RT. P.I. Large LT. P.I. Large	P.I. Smaller N.	N. N.	N. N.	21 20	C. C.			

ACUTE OTITIS MEDIA IN DIPHTHERIA.

GROUP II

IONISATION USED.

No.	Type.	Age	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
12.	L.	9/12	M.	N.V.	N.	N.	N.	13	C.	Posterior Pharyngeal Abscess	1	10. N.D.
13.	L.	2	M.	P.I.	P.I.	N.	N.	9	P.C.		2	2, 6.
14.	L.	9½	M.	A.I.	N.	N.	N.	50	C.		2	40, 45. N.D.
15.	D.	6	M.	RT. P.I. Paracentesis LT. P.I.	N. N.	N. N.	N. N.	16 7	C. C.		1 1	4. Moist. 4.
16.	R.	4 11/12	M.	N.V.	N.	N.	N.	34	C.		4	19, 23, 27, 31.
17.	L.	5½	M.	N.V.	N.	N.	N.	6	C.		2	2, 5.
18.	R.	3½	F.	I. Marginal	N.	N.	N.	13	C.		3	2, 6, 10.
19.	D.	2 11/12	F.	RT. N.V. LT. A.	N. A.	N. N.	N. N.	41 90	C. F.	M. M.	3 4	36, 38, 40. 30, 35, 37, 39.

ACUTE OTITIS MEDIA IN DIPHTHERIA.

GROUP II(contd)

IONISATION USED.

No.	Type.	Age.	Sex	Drumhead Initial Examination	Drumhead Final Examination	Hearing	Tonsils & Adenoids	Duration of Discharge in Days	Result	Intercurrent Infections &c.	Ionisation Treatments.	
											Total number	Day from Commencement of Discharge on which Treatments were carried out.
20.	L.	2 8/12	F.	C.	N.	N.	N.	13	C.	M.	2	3, 5.
21.	L.	6 1/12	F.	A.I.	A.I.	N.	N.	42+	F.	M.	6	2, 7, 12, 17, 22, 27 N.D.
22.	R.	8	F.	A.I.	N.	N.	N.	17	C.		2	4, 8. N.D.
23.	L.	7	F.	P.I.	P.I. Smaller	N.	N.	10	P.C.		2	2, 6.
24.	R.	3	F.	P.I.	N.	N.	N.	7	C.		2	2, 6.
25.	D.	3 1/2	M.	RT. I.Large	N.	N.	N.	44	C.		2	27, 31 Moist. N.D.
				LT. Two P.I.Large A.I.Small	N.	N.	N.	44	C.		2	26, 30 Moist. N.D.
26.	L.	5	F.	A.I.	N.	N.	N.	23	C.		3	8, 13, 18.

PART VIII.

Results and Conclusions

in

Otitis Media

in

Measles and Diphtheria.

SECTION I. The Effect of Enlarged or Septic Tonsils and Adenoids in Acute Otitis Media in Measles and Diphtheria.

In the 26 diphtheria cases with otitis there was not one case in which the tonsils or adenoids were enlarged or septic. In 86 cases in which otitis media occurred following measles, 4 were associated with abnormality in these tissues. The total number of ears involved in the 86 cases was 127, 5 of which occurred in the 4 cases mentioned. It is interesting to note that only one ear out of the 5 cleared up in 60 days whereas the remaining 4 failed to become dry. In 2 out of the 4 cases mastoiditis developed.

Whether the removal of the tonsils and adenoids in these 4 cases would have resulted in the cure of the otitis media is doubtful but it seems reasonable to suppose that the enlargement or sepsis in these tissues must have had some bearing on 4 out of the 5 ears becoming chronic. Since, in the ears not associated with abnormality in these tissues only 18 out of 122 ears failed to clear up, the operative measure of removing enlarged or septic tonsils and adenoids would seem to be justified. Whereas in scarlatinal otitis media it does not seem justified to do this before a fair trial by ordinary means has been given, in otitis media following measles it seems that operation is indicated as soon as possible as the chances of such an ear clearing up by conservative methods is slight. The figures for this conclusion are of course small, but they certainly suggest the above-mentioned procedure. As in scarlatinal otitis media the number of cases for consideration in this respect are few and I cannot visualise the necessity for the measure being adopted except in a very few selected cases.

SECTION II. The Effect of Age on Prognosis in Acute Otitis Media in Measles.

I have been unable to assess the effect of age in otitis media following diphtheria as only 31 ears in 26 cases were collected and studied. Owing to the fact that measles is comparatively rare after the age of 5 I have selected the age groups 0 - 1, 1 - 2, 2 - 3, 3 - 4, 4 - 5, and 5 years and over. I have tabulated the results in 122 ears to show the percentage of failures and the average duration of the discharge at these ages. The one case with double otorrhoea in which death occurred before treatment could be completed and the 3 ears which did not discharge I have excluded from the following table.

Results of Treatment at Different Ages in Acute Otitis Media in Measles.

Age Groups

	Years. 0 - 1	Years. 1 - 2	Years 2 - 3	Years 3 - 4	Years 4 - 5	Years 5 +	Years 0 - 2	Years 2 - 5
Total Ears.	10	54	26	17	14	1	64	57
Number with dry ears.	10	40	22	15	14	1	50	51
Average duration of Discharge.	59.3 days.	30.4 days.	26.8 days.	23.6 days.	28.2 days.	4 days.	32 days.	22.3 days.
Number with Persistent Otorrhoea.	0	14	4	2	0	0	14	6
Percentage of Failures.	0	25.9%	16.6 %	11.8 %	0	0	21.8 %	10.5 %

From the table it is noticed that the average duration of the otorrhoea in the successfully treated cases is about the same except for the 0 - 1 years age group where it is almost double that in the other groups. However, out of 10 ears treated in this group no failures occurred, whereas 25.9%, 16.6% and 11.8% were recorded in the 1 - 2, 2 - 3, and

3 - 4 years age groups respectively. There were no failures in the 4 - 5 years age group in 14 ears and the one ear in the 5 years and over age group was successfully treated. It would therefore seem that the greatest tendency to chronicity occurs between the age of 1 and 2 years and diminishes as the age increases. In infants below 1 year of age there appears to be little tendency to chronicity just as there is after the age of 4 years. This may be explained in the same way mentioned in scarlatinal otitis media by the fact that small infants have a maternal immunity to the streptotoccus which is gradually lost by the age of one year, after which they are not equipped by an acquired immunity to that organism, so accounting for the high percentage of failures between the age of 1 and 2 years. The gradual diminution of the percentage of failures after that age may be explained by the child's acquired immunity increasing gradually as it gets older. So it would seem that between the ages of 1 and 3 years the disease is most difficult to cure.

A study of the age groups 0 - 2 and 2 - 5 years shows that the average duration of the discharge in the successfully treated cases and the percentage of failures are higher in the 0 - 2 years age group, 32 days and 21.8% compared with 22.3 days and 10.5%. These results to some extent resemble those recorded for scarlatinal otitis media where 35.8 days and 45% were recorded for the 0 - 2 years age group and 28.7 days and 23% for the 2 - 5 years age group. I have reinvestigated the results in the scarlet fever ears to find if they resemble those recorded for the measles ears in the age groups 0 - 1, 1 - 2, 2 - 3, 3 - 4, and 4 - 5 years. The following table is compiled to show the points for comparison.

Results of Treatment at Different Ages in Acute Otitis Media in Measles and Scarlet Fever.

Age Groups.

		Years. 0 – 1	Years. 1 – 2	Years. 2 – 3	Years. 3 – 4	Years. 4 – 5	Years 0 – 2	Years. 2 – 5
Measles. Total Ears 121	Number with dry ears.	10	40	22	15	14	50	51
	Average duration of Discharge.	59.3 days.	30.4 days	26.8 days.	23.6 days	28.2 days.	32 days	22.3 days.
	Number with Persistent Otorrhoea	0	14	4	2	0	14	6
	Percentage of Failures.	-	25.9 %	16.6 %	11.8 %	-	21.8 %	10.5 %
Scarlet Fever. Total Ears. 120.	Number with dry ears.	3	19	21	19	30	22	70
	Average duration of Discharge.	22.3 days	38 days.	28.3 days	31 days	27.2 days	35.8 days	28.7 days.
	Number with Persistent Otorrhoea.	1	17	5	3	2	18	10
	Percentage of Failures.	25 %	47.2 %	19.2 %	13.6 %	6.2 %	45 %	12.5 %

A study of the above table reveals a close resemblance between the age group results in scarlet and measles otitis media.

There is little difference in the average duration of the discharge in the successfully treated cases in each age group. In the scarlet fever ears for the 1 - 2 and 2 - 3 years age groups it is a little longer. Although the measles ears became dry in a few days less time, for practical purposes the average duration of the discharge for all the age groups both in measles and scarlet fever otitis seems to be from 3 to 4½ weeks.

The percentage of failures for all the age groups in the scarlet ears is higher than in measles but the same tendency is noted, namely, a low percentage in the 0 - 1 years age group and a high percentage in the 1 - 2 years age

group gradually diminishing in the 2 - 3 and 3 - 4 with the lowest in the 4 - 5 years group. The results in the 0 - 1 years age groups are not quite comparable owing to the fact that in the scarlet fever ears only 4 were treated whereas in the measles ears 10 were treated. However, making allowance for the deficiencies in the table I think the results in the scarlet fever ears confirm my findings for measles otitis media, namely, that it is from the age of 1 to 3 that the greatest difficulty in affecting cure is found. It is possibly again explained by the maternal immunity to the streptococcus in the infant being lost completely about 1 year of age with a low acquired immunity to it in the next two years. To find if this fact is borne out by a study of the incidence rates of scarlatinal otitis media I have further analysed the incidence rates in the 0 - 2 years group in that disease.

For this purpose I have taken all the cases below 3 years of age and divided them into two groups, viz. 0 - $1\frac{11}{12}$ years and 2 - $2\frac{11}{12}$ years. The table shows the incidence of otitis media for serum and non-serum treated scarlet fever for these ages.

In 1933 and 1934 at the Park Hospital.

	Number of Ears. Age 0 - $1\frac{11}{12}$ years.	Percentage Incidence.	Number of Ears Age 2 - $2\frac{11}{12}$ years	Percentage Incidence.
Intravenous Serum.	0 out of 36 cases.	-	7 out of 70 cases.	10%
Non-Serum.	17 out of 124 cases.	13.7%	15 out of 66 cases.	23%

In 1935 Dr Banks of the Park Hospital found that out of 14 cases in the 0 - $1\frac{11}{12}$ years group treated by intravenous scarlatinal antitoxin no cases of otitis media occurred which confirm the findings for 1933 and 1934 above. Therefore for 1933, 1934 and 1935 there were no cases of otitis media in this age group out of 50 cases whereas 7 occurred out of 70 cases in the 2 - $2\frac{11}{12}$ years group for 1933 and 1934. The figures for the cases not treated by serum likewise point

to the fact that below the age of 2 years otitis media is rare whereas at the age of 2 years there is a decided rise. The facts, namely, that (i) in scarlet fever the incidence of otitis is highest between the age of 2 and 3 years and (ii) that the complication is most difficult to cure both in scarlet fever and measles between the age of 1 and 3 years indicate that there must be some element present or lacking in children of these ages to explain this phenomenon. As I have already mentioned this may be expalined by the low immunity to the streptococcus or by the catarrhal tendency due to hypovitaminosis at this time of life. There is no doubt that the work of preventing chronic otitis media must be directed to children at this age period.

SECTION III. The Effect of Intercurrent Infectious Disease on Prognosis in Otitis Media in Measles.

The type of measles admitted to hospital is usually severe and broncho-pneumonia is not infrequently found as a complication. A study of my measles otitis media cases reveals that out of 124 ears 17 occurred where this additional complication was present. The results of these 17 ears justified a special analysis and the following tables show the features.

Table Showing Effect of Intercurrent Infectious Disease on Results of Treatment in Acute Otitis Media in Measles.

	Total Ears.	Number of Dry Ears.	Average Duration of Discharge.	Number with Persistent Otorrhoea.	Percentage of Failures.
Simple Measles.	91	79	22.6 days.	14	15.3 %
Measles & Intercurrent Infectious Disease.	16	16	49.5 days.	-	-
Measles with Broncho-Pneumonia.	9	5	27.2 days.	4	44.4 %
Measles with Broncho-Pneumonia & Intercurrent Infectious Disease.	8	2	15 days.	6	75 %

From the above table it would seem that the duration of the discharge, where intercurrent infectious disease is present, is considerably increased, 49.5 days compared with 22.6 days in the simple measles ears. In the 16 ears so studied no failures were recorded but I would not care to draw any conclusions from so small a series. It would seem, however, that where intercurrent infectious disease alone is present the chance of an ear failing to become dry is not increased. The striking feature of the results where broncho-pneumonia was present is the high proportion of failures, 44.4% where broncho-pneumonia alone was present and 75% where in addition an intercurrent infectious disease was present.

A further analysis of the results for the individual intercurrent infections is shown in the following tables.

TABLE A.

	Total Number of Ears.	Number with Dry Ears.	Average Duration of Discharge.	Number of Failures.	Percentage of Failures.
Measles + Nasal Diphtheria.	7	7	62 days.	0	–
Measles + Scarlet Fever	4	4	45.5 days	0	–
Measles + Whooping Cough.	2	2	28 days.	0	–
Measles + Nasal Diphtheria + Scarlet Fever.	3	3	40.3 days	0	–

TABLE B.

Measles with Broncho-Pneumonia + Nasal Diphtheria	6	1	14 days	5	83.2%
Measles with Broncho-Pneumonia + Scarlet Fever	2	1	16 days	1	50%

Table A shows the average duration of the discharge for the individual intercurrent infections and it is noticed that in the case of nasal diphtheria it is highest. The outstanding feature of Table B, where an intercurrent infection as well as broncho-pneumonia was present in the course of the ear complication, is the exceeding high proportion of failures where nasal diphtheria was present, 83.2% compared with 50% for scarlet fever.

Conclusions.

The conclusions I have reached from my analysis are that intercurrent infectious disease by itself does not influence the chronicity rate in measles otitis media but tends to prolong the duration of the disease. Broncho-pneumonia, however, probably on account of the very low state of nutrition and general health in its presence, has a very marked adverse effect on the course, prolonging the disease and increasing the chances of chronicity. Particularly is this so where an intercurrent infectious disease, especially nasal diphtheria, is present in addition.

SECTION IV. The Effect of Ionisation Therapy on the Prognosis in Otitis Media in Measles and Diphtheria.

I have made a similar study of my cases to that made in scarlatinal otitis media taking into consideration the effect of intercurrent infectious disease, broncho-pneumonia and age.

The results are shown in the following tables.

Tables Showing Effect of Ionisation in Treatment of Acute Otitis Media in Measles.

Table I. Simple Measles Otitis Media.

	Total Number of Ears.	Percentage of Total in 0-2 years Group.	Dry Ears				Persistent Otorrhoea	
			Number with Dry Ears.	Number with Healed Drumheads.	Number with Perforation Present.	Average duration of Discharge.	Number of Failures.	Percentage of Failures.
Early Ionisation	25	28%	22	14	8	26.5 days	3	12%
Non-Ionisation	57	54.3%	50	43	7	27.4 days	7	12.3%
Late Ionisation	7	-	5	5	-	42.6 days	2	28.5%

Table II. Measles Otitis Media, Broncho-Pneumonia or Intercurrent Infectious Disease Present.

	Total Number of Ears	Percentage of Total in 0-2 years Group.	Dry Ears.				Persistent Otorrhoea	
			Number with Dry Ears.	Number with Healed Drumheads.	Number with Perforation Present	Average duration of Discharge	Number of Failures.	Percentage of Failures.
Early Ionisation	5	20%	4	4	-	34.2 days	1	20%
Non Ionisation	17	76.4%	13	12	1	45.8 days	4	23.5%
Late Ionisation	8	-	4	4	-	45.5 days	4	50%

From the above there appears to be little advantage in the use of ionisation in acute otitis media in measles. In Table I the ionised series were at an advantage in age composition, 28% in the 0 - 2 years group compared with 54.3% in the non-ionised group, and it is noticed that the average

duration of the discharge and the percentage of failures are almost the same in both series, 26.5 days and 12% compared with 27.4 days and 12.3%.

Perhaps this lack of success is explained in two ways. The general health and nutrition of hospital measles cases are usually much below par and compare unfavourably with that found in serum treated scarlet fever cases where ionisation appears to be an advantage. Again the type of discharge from the middle ear in measles otitis media is muco-purulent whereas in scarlet fever purulent discharge is the rule suggesting that the infection is more confined to the Eustachian Tubes in measles, parts which certainly cannot be affected by the deposit of zinc ions. Against this argument that a muco-purulent discharge in acute otitis media is unfavourable is the fact that McLaggan[15] found it favourable in his work with chronic otitis media. He succeeded in getting 19 out of 21 cases of otorrhoea of this type dry by its use.

It is worthy of note that no ill effects in the ionised series were recorded. In fact there were no cases of mastoiditis in the 32 cases in which ionisation was done whereas, in the non-ionised cases, 4 developed mastoiditis out of 54 cases. I would not care to conclude that the impregnation of zinc ions in the middle ear prevented the mastoid from being infected in these cases without a considerably extended experiment.

The following table gives the results of ionisation in acute otitis media following diphtheria where intercurrent infectious disease was not present.

Table I. Tables Showing Effect on Treatment of Ionisation. Simple Diphtheria Otitis Media.

	Total number of Ears.	Number of Dry Ears.	Number with Healed Drumheads	Number with Unhealed Drumheads.	Average Duration of Discharge	Number of Failures.
Early Ionisation	10	10	8	2	12.1 days	—
Non Ionisation	13	13	12	1	21.4 days	—
Late Ionisation	4	4	4	0	43 days	—

There were 4 ears in which measles developed as an intercurrent infectious disease in the ionised series. No intercurrent infection developed in the non-ionised series. The results in these 4 ears are shown below.

Table II.

	Total Number of Ears.	Number of Dry Ears	Number with Healed Drumheads	Number with Unhealed Drumheads.	Average Duration of Discharge	Number of Failures
Early Ionisation	2	1	1	–	13 days	1
Late Ionisation	2	1	1	–	41 days	1

Table I reveals that in acute otitis media in simple diphtheria there is little tendency to chronicity and the condition resolves quickly. When ionisation therapy is used this appears to be accelerated considerably for, in the 10 cases ionised, the average duration of the discharge was 12.1 days compared with 21.4 days in the 13 ears which were not. No ill effects seem to result from the treatment. Only one case of mastoiditis occurred in the series and this was in an ear not subjected to ionisation.

The fact, that in the two ears which failed to clear up measles developed, confirms my previous findings with regard to intercurrent infection in acute otitis media in measles and scarlet fever.

I have further analysed the results of treatment in my cases to find if the complication occurring in faucial diphtheria differed in any way from that in the nasal type. I have tabulated the results of treatment in the tables below.

Table A. Acute Otitis Media in Diphtheria unaccompanied by Intercurrent Infectious Disease.

	Number of Ears.	Number Ionised.	Average Duration of Discharge	Number with Persistent Otorrhoea.
Faucial Diphtheria.	17	7	17.2 days	–
Nasal Diphtheria	7	5	33.2 days	–

Table B. Acute Otitis Media in Diphtheria.
Measles occurred as an Intercurrent Infection.

	Number of Ears	Number Ionised.	Average Duration of Discharge	Number with Persistent Otorrhoea.
Faucial Diphtheria	3	-	-	1
Nasal Diphtheria.	1	-	-	1

In Table A it is seen that when there was no intercurrent infectious disease present all the otorrhoeas cleared up but those associated with the nasal type took almost twice as long to become dry as those associated with the disease in the fauces only. In Table B, where measles was present as an intercurrent infection one otorrhoea failed to clear up out of 3 in the faucial type whereas the only one associated with the nasal type became chronic. I cannot say that acute otitis media in nasal diphtheria has the greater tendency to chronicity but I think that the figures indicate that it takes longer to clear up than it does when associated with the faucial disease only.

Conclusions.

Compared with acute otitis media following scarlet fever and measles, the complication in diphtheria is a benign type not tending to chronicity and on the whole running a shorter course. Ionisation therapy appears to be an aid in treatment by affecting cure quicker than by conservative means alone.

PART IX.

A Bacteriological Investigation

of the Middle Ear Discharge

in

Acute Otitis Media

in

Scarlet Fever, Measles and Diphtheria.

INTRODUCTION.

Before bringing this work to a close I should like to include a short series of investigations into the bacteriology of the middle ear discharges in acute otitis media following scarlet fever, measles and diphtheria, which I carried out concurrently with the study of my cases. These investigations were carried out mainly to find if any changes occurred in the bacterial content of the middle ear during the course of the acute stage of the otitis and to find if such changes were related in any way to the condition failing to clear up. Otologists[68] in general are of the opinion that secondary infection of the middle ear by organisms from the skin of the external meatus is one of the main causes of an otorrhoea persisting. It is generally believed that the middle ear is involved in scarlet fever by a direct extension via the Eustachian Tubes of the streptococcal faucial infection. Ross[4] on the other hand is of the opinion that otitis media is primarily a result of scarlet fever in the middle ear, a condition often aggravated by secondary infection by extension from the throat via the Eustachian Tubes. Whether he meant that the original infection was blood borne or was carried by a spread in the local lymphatic channels from the fauces to the middle ear is not quite clear. Valentine[69] found that 53% of scarlatinal otitis media was due to the haemolytic streptococcus of the same seriological species as were present in the throat but did not find any streptococci in the blood stream which rather disproves the theory that the infection of the middle ear took place by this route. Although post-mortem examinations of the Eustachian Tubes in cases of scarlet fever in which otitis media was present have not shown the organism present in these parts, it does not follow that the infection did not originally pass in these structures, as the inflammation may here subside along with the local

faucial lesion by the time the examinations were made. The fact that upper respiratory tract intercurrent infections prolong the course and increase the chance of chronicity suggests that this is brought about by a further secondary infection of the middle ear via the Eustachian Tubes.

In view of this it is not unlikely that secondary infection by faucial organisms may take place but this must be of minor importance compared with the secondary infection from skin organisms in the external meatus.

Torrini[51] and Morandini found the common organisms in aural discharge from different types of otitis media to be the haemolytic streptococcus, non-haemolytic streptococcus, pneumococcus, staphylococcus albus, staphylococcus aureus, bacillus proteus, bacillus pyogenes, and the bacillus of Friedlander. With the exception of the haemolytic streptococcus, pneumococcus and possibly the bacillus mucosus, these organisms are undoubtedly of the secondary infecting type and have not been the cause of the original acute condition. White[73] pointed out that the bacteria causing the acute condition may be the cause of the chronic but this was more likely to be due to mixed infections by the introduction of new organisms during subacute attacks or invasion by saprophytes from the external meatus. Valentine[70] in 1924 published a very full investigation of the bacteriological content of middle ear discharges from acute and chronic otitis media. His work was not confined to otitis media in scarlet fever but included otitis from other causes. He[71] used a similar technique to myself in the obtaining from the middle ear of a sample of pus which was not contaminated by skin organisms in the external meatus. He[69] found as a rule that the haemolytic streptococcus was the causal organism in the acute stage of the disease and it was usually of the same seriological species as was present in the throat. In

the chronic stage it was not present but diphtheroids and staphylococci predominated and he[72] thought that they might be factors responsible for chronicity.

Method of Obtaining Specimens and Recording Findings.

I have decided that the bacteriological examination of a specimen of discharge taken from the external meatus would give a rather inaccurate picture of the bacteriological content of the middle ear inasmuch as this discharge would contain the skin organisms as well as those from the middle ear. In order to eliminate this external meatal contamination, I have used the following technique for the obtaining of specimens of discharge from the middle ear alone. Only ears were chosen in which a perforation of reasonable size was present. The meatus and surrounding parts were thoroughly cleansed of the discharge and treated with repeated washings with 50% spirit. The parts were finally mopped dry by using sterile absorbent ear wool. A fine platinum needle with a very small loop previously sterilized in the flame was then passed under vision with the aid of an operating otoscope, previously sterilized, through the perforation into the middle ear from which a specimen of pus was obtained. Care was taken to see that the platinum loop did not touch the surrounding parts before or after entering the middle ear. The specimens were stained and examined immediately and also cultured on blood agar plates and the cultures examined. The first examination was made immediately after the onset of an otorrhoea, usually within 2 or 3 hours. Specimens were taken and examined at intervals of a week until the otorrhoea cleared up. In the ears which cleared up quickly, at the most only two specimens were available, particularly where the perforation in the drumhead was not very large to begin with and where it was healing rapidly.

I am indebted to Dr. Ash, Bacteriologist of the

Southern Group Laboratory (London County Council) for his assistance and advice in the examination of these specimens. Twenty otorrhoeas following scarlet fever, 17 otorrhoeas following measles and 10 otorrhoeas following diphtheria were investigated in all.

I have arranged my findings into three main groups for simplicity in analysis, e.g.

I Otorrhoeas which cleared up in less than 3 weeks.

II Otorrhoeas which cleared up in more than 3 weeks.

III Otorrhoeas which failed to become dry.

In Group I there were 19 scarlet fever ears, 6 measles ears and 7 diphtheria ears.

In Group II there were 7 scarlet fever ears, 8 measles ears and 2 diphtheria ears.

In Group III there were 4 scarlet fever ears, 2 measles ears and 1 diphtheria ear.

The results are recorded in the tables and the following abbreviations have been used.

H. Streps. = Haemolytic Streptococci.

Streps. = Streptococci.

Staph. Albus = Staphlococcus Albus.

Staph. Aureus = Staphlococcus Aureus.

Bacteriological Examinations of Middle Ear Contents.

Group I — Scarlet Fever

Case Number	Duration of Otorrhoea in days.	Number of specimens examined.	Results of Examinations. First specimen.	Second specimen, after 7 days.	Third specimen, after 14 days.
8	15	1	H. Streps.	–	–
23	17	2	H. Streps.	H. Streps.	–
22	13	2	H. Streps.	H. Streps + few colonies of Staph. Albus.	–
10	12	2	H. Streps.	H. Streps.	–
41	Rt. 21	3	H. Streps.	H. Streps + few colonies of Staph. Albus.	H. Streps. 80% + Skin organisms mainly Staph. Albus.
"	Lt 18	2	H. Streps. 80% + Staph. Albus and Aureus.	H. Streps.	–
61	5	1	H. Streps.	–	–
64	20	3	H. Streps + few colonies of Staph. Albus.	H. Streps.	H. Streps. + few colonies of Staph. Albus and Aureus.
80	8	1	H. Streps	–	–

Group I — Measles.

6	20	2	H. Streps.	H. Streps.	–
25	Rt. 6	1	H. Streps.	–	–
"	Lt. 11	2	H. Streps. + few colonies of Staph. Albus.	H. Streps. 80% + few colonies of Staph. Albus.	–
32	5	1	H. Streps.	–	–
55	12	2	H. Streps. + few colonies of Staph. Albus.	H. Streps. 70% + Staph. Albus Streps.	–
72	21	3	H. Streps.	H. Streps. 60% + Staph. Albus and Aureus.	H. Streps. 50% + Staph. Albus and Aureus.

Group I. — Diphtheria.

1	12	2	H. Streps.	H. Streps. 80% + Staph. Albus.	–
6	14	2	H. Streps. + few colonies of Staph. Albus.	H. Streps. + few colonies of Staph. Albus.	–
8	20	3	H. Streps.	H. Streps. 90% + Staph. Aureus and Diphtheria Bacilli.	H. Streps. 70% + Staph. Aureus.
11	Rt. 21	3	H. Streps.	H. Streps. 70% + Staph. Albus.	H. Streps. 50% + Staphs. Streps. Diphtheroids
"	Lt. 20	3	H. Streps. + few colonies of Staph. Albus.	H. Streps. 80% + Staph. Albus and Aureus.	H. Streps. 60% + Staph. Albus and Aureus.
20	13	2	H. Streps.	H. Streps. 90% + Staph. Albus.	–
23	10	1	H. Streps.	–	–

Bacteriological Examinations of Middle Ear Contents.

Group II. Scarlet Fever.

No. of case.	Duration of Otorrhoea in Days.	No of specimens examined	Results of Examinations. First specimen	Second specimen after 7 days	Third specimen after 14 days	Fourth specimen after 21 days.	Fifth specimen after 28 days.
6	Rt. 35.	4	H. Streps.	H. Streps 80% + Staph. Albus.	H. Streps. 70% + Staph. Albus.	H. Streps. 50% + Staph. Albus. B. Proteus.	–
"	Lt 29	4	H. Streps.	H. Streps. 90% + Staph. Albus + Streps.	H. Streps 70% + Staph. Albus. B. Proteus. Streps.	H. Streps. 60% + Staph. Albus + Streps.	–
26	47	5	H. Streps.	H. Streps.	H. Streps. 90% + Staph. Aureus & Albus.	H. Streps. 70% + Staph. Albus.	H. Streps. 40% + Staph. Albus and Aureus.
37	42	5	Pneumococci 90%	Pneumococci 70% H. Streps. 30%	H. Streps. 80% + Staph. Albus.	H. Streps. 60% + Staph. Albus & Aureus.	H. Streps 50% + Staph. Albus.
58	Rt. 32	4	H. Streps.	H. Streps. 95% + a few Staph. Albus.	H. Streps. 70% + Staph. Albus and Diphtheroids.	H. Streps. 60% + Staph. Albus and Streps.	–
"	Lt. 34	4	H. Streps.	H. Streps. 90% + a few colonies of Staph. Albus.	H. Streps. 80% + Staph. Albus and Diphtheroids.	H. Streps. 60% + Staph. Albus and Diphtheroids.	–
75	34	3	H. Streps + a few colonies of Staph. Albus.	H. Streps. 95% + Staph. Albus and Streps.	H. Streps. 70% + Staph. Albus.		

Group II. Measles.

5	Rt. 28	3	H. Streps.	H. Streps. + a few colonies of Staph. Albus.	H. Streps. 70% + Staph. Albus and Streps.	–	–
"	Lt 40	5	H. Streps.	H. Streps. + a few colonies of Staph. Albus.	H. Streps. 65% + Staph. Albus and Aureus	H. Streps. 30% + Staph. Albus and B. Proteus.	H. Streps. 10% + Staphs., B. Proteus and Streps.
10	26	4	H. Streps	H. Streps. + a few colonies of Staph. Albus	H. Streps. 80% + Staph. Albus and Aureus.	H. Streps 70% + Staph. Albus and Streps.	–
17	37	5	H. Streps + a few Pneumococci.	H. Streps. 90% + Staph. Albus.	H. Streps. 40% + Staph. Albus.	H. Streps 20% + Staph. Albus., Streps., Diphtheroids.	H. Streps. 20% + Staph. Albus and Aureus.
66	Rt. 31	4	H. Streps.	H. Streps. 80% + Staph. Albus and Streps.	H. Streps. 80% + Staph. Albus and Streps.	H. Streps. 70% + Staphs. B. Proteus and Streps.	–
	Lt 31	4	H. Streps.	H. Streps. 80% + Staph. Albus and Streps	H. Streps. 80% + Staph. Albus and Streps.	H. Streps. 70% + Staphs. B. Proteus and Streps.	–
76	62	7	H. Streps. and Micrococci of Catarralis Type.	H. Streps. 80% + Staph. Albus and Streps.	H. Streps. 40% + Staphs., Streps, and B. Proteus.	H. Streps. 10% + Staphs., Streps., B. Proteus, etc.	No Haem. Streps., Staphs. Streps., etc. (6th and 7th exams also).
49	42	5	H. Streps.	H. Streps.	H. Streps. 80% + Staph. Aureus.	H. Streps. 70% + Staph. Albus and Aureus.	H. Streps. 10% + Staphs. Streps. and Diphtheroids.

Group II. Diphtheria.

2	39	4	H. Streps.	H. Streps. 90% + Staph. Albus.	H. Streps. 80% + Staph. Albus.	H. Streps. 70% + Staph. Albus and Diphtheroids.	–
16	34	5	H. Streps.	H. Streps. 95% + Diphtheroids.	H. Streps. 75% + Staph. Albus.	H. Streps 60% + Staphs and Streps.	H. Streps. 50% + Staph. Albus and Streps.

Bacteriological Examinations of Middle Ear Contents.

Group III. Scarlet Fever.

No of case.	Duration of Diarrhoea in Days.	No of specimens examined.	Results of Examinations. 1st Specimen	2nd Specimen after 7 days.	3rd Specimen after 14 days	4th Specimen after 21 days.	5th Specimen after 28 days.	6th Specimen after 35 days.	7th Specimen after 42 days.	8th Specimen after 49 days.
7	100+	8	H. Streps.	H. Streps 80% + skin orgs.	H. Streps. 70% Staphs. Streps.	H. Streps. 20% Staphs. Streps. B. Proteus.	H. Streps. 10% Staphs., etc.	No H. Streps. Staphs., etc.	No H. Streps. Staphs. etc.	No H. Streps. Staphs. etc.
19	128+	8	H. Streps + a few Staph. Albus.	H. Streps. 90% + Staph. Albus.	H. Streps. 60% + Staph. Albus.	H. Streps. 60% Staph. Albus & Aureus, Streps.	H. Streps. 50% Staph. Albus & Aureus, Streps.	H. Streps. 20% Staph. Albus. etc.	H. Streps. 5% Staphs. etc.	No H. Streps. Staphs. etc.
63	74+	6	H. Streps + a few colonies of Staph. Albus	H. Streps.	H. Streps. 70% Staph. Aureus.	H. Streps. 50% Staphs. Streps. B. Proteus.	H. Streps. 20% Staphs. Streps B. Proteus etc.	No H. Streps. Staphs etc.	–	–
113	90+	6	H. Streps.	H. Streps. B. Diphtheriae	H. Streps. 90% Staph. Albus Diphtheroids	H. Streps. 50% Staph. Albus Diphtheroids.	H. Streps. 20% Staphs. Streps. B. Proteus etc.	No H. Streps Staphs etc	–	–

Group III Measles.

35	90+	7	H. Streps.	H. Streps.	H. Streps. 70% Staph. Albus.	H. Streps. 50% Staph. Albus etc.	H. Streps. 20% Staphs. Streps.	No H. Streps Staphs. etc.	No H. Streps. Staphs etc.	–
43	63+	5	H. Streps + a few Staph Albus.	H. Streps + Staph. Albus & Micrococci.	H. Streps. 40% Staphs. Streps.	H. Streps. 20% Staphs. Streps.	H. Streps. 5% Staphs. etc.	–	–	–

Group III Diphtheria.

21	42+	5	H. Streps.	H. Streps., a few Staph Albus, B. Diphtheriae	H. Streps. 70% Staph. Albus Streps.	H. Streps. 40% Staphs. Streps.	H. Streps. 10% Staphs. etc.	–	–	–

RESULTS.

In the foregoing records of the bacteriological examination of specimens it is seen that, in all the initial examinations made, the haemolytic streptococcus was found almost in pure growth in all the cases, measles and diphtheria included. In a small number a few colonies of the staphylococcus albus were grown but these I have concluded to result from contamination of the specimen from the skin of the external meatus in passing the platimun loop into the middle ear. In case 37, Group II, an almost pure growth of pneumococci were grown. It is difficult to understand how a pneumococcal infection of the middle ear occurred in a case of scarlet fever for there was no exceptional history in the case. An examination of the faucial organisms did not reveal the presence of the pneumococcus in these parts and the only explanation I can give is that the infection of the middle ear by that organism was incidental and presumably it was originally in the naso-pharynx and had since disappeared.

It would seem, therefore, that in otitis media complicating acute infectious disease that the haemolytic streptococcus is the casual organism and occurs in pure growth in the early stages of the disease.

An examination of the cases in Group I, where the ears became dry in less than 3 weeks, reveals that there is only a slight secondary infection of the middle ear by skin organisms, mainly by the staphylococcus albus. In the second specimen taken after the ear had been discharging for a week, 60% to 90% of the bacteriological content was found to be the haemolytic streptococcus, the remainder being skin organisms mainly the staphylococcus albus.

In Group II, where the ears became dry in a period of more than 3 weeks, it can be seen that the longer the ear continued to discharge the smaller became the content of haemolytic streptococci and the greater the content of skin organisms. In some at the fourth examination, i.e. 21st day of the discharge, the content

fell to as low as 10% and in one case no haemolytic streptococci were recovered at the seventh examination, i.e. at the 42nd day of discharge. In case 58 a few diphtheria bacilli were found in the discharge at the third examination but were not found at the fourth. This was probably due to faulty technique in the obtaining of the specimen due to the platinum loop touching the skin of the external meatus, and not because the organisms had gained access to the middle ear from the naso-pharynx via the Eustachian Tubes.

In Group III, where the otitis media failed to clear up, it is natural that in the later specimens the content of haemolytic streptococci fell at the expense of skin organisms until at the final examination none were found or only a few.

Two cases, in which nasal diphtheria was present, cases 113 and 21, diphtheria bacilli were recovered from the specimen from the middle ear at the second examination but here again I am of the opinion that external meatal contamination of the specimen had taken place.

Conclusions.

Although the above observations were only made in a limited number of cases it would seem that the haemolytic streptococcus is present in the initial stages of an otitis media alone and is the casual organism. As the disease progresses there is a tendency for the haemolytic streptococcus to disappear at the expense of secondary infection of the middle ear by skin organisms mainly staphylococci and diphtheroids, presumably from the external meatus. This tendency is least marked in those ears which clear up quickly, the haemolytic streptococcus remaining the predominant organism with only slight secondary infection. The longer the ear takes to clear up the more marked is the secondary infection until, in those ears which fail to clear up, the bacterial content of the middle ear is almost entirely secondary with no haemolytic streptococci or only a few present.

The results of my investigation in scarlet fever,

measles and diphtheria are much the same as those found by Valentine[69] in otitis media from other causes.

It is certain that secondary infection of the middle ear by skin organisms is associated with acute otitis media which is difficult to cure or which fails to clear up. Whether this secondary infection is the cause of the disease failing to clear up or merely the result of the disease running a prolonged course is difficult to say, but the prevention of it, as far as possible, should be attempted as a surgical principle in the management of the condition. Potts[27] of Newcastle, in his investigations with autogenous mixed vaccines, composed of staphlococci, streptococci, diphtheroids, pneumococci and micrococci of the catarralis type, in the treatment of the fever itself, had probably this aim in view as it is recognised[41] that, after scarlet fever, patients appear to be more susceptible to pyogenic infections than usual.

PART X.

Final Conclusions.

Final Conclusions.

There is much room for improvement in the hospital management of acute otitis media complicating acute infectious disease. Following diphtheria the complication is not so serious as in scarlet fever and measles as there is little tendency for the disease to become chronic and moreover it reacts to treatment quickly. The real problem lies in the disease in children from 1 to 3 years of age in scarlet fever and measles on account of the high incidence and the greatest tendency to chronicity at this age period in these diseases. Improvements can be got by the adoption of every available measure to prevent or minimise intercurrent infectious disease in hospital, for, upper respiratory tract infections particularly nasal diphtheria, arising in the course of an otitis media considerably lengthen the duration of the disease and increase the chance of chronicity.

The method of frequent deep meatal mopping combined with an aseptic toilet of the pinna and meatus carried out in such a way as to promote free drainage of the discharges from the tympanum and to prevent secondary infection of the middle ear via the external meatus is the basis for success in the management of an acute otitis media. Too frequently however this toilet is not carried out intelligently and often enough by the nursing staffs. A comparison of our present results in otorrhoea with those of previous years at the Park Hospital has shown that the supervision and proper training of nurses in the execution of ear toilet is amply repaid.

Improvements both in incidence and prognosis in scarlatinal otitis media can be best brought about by an extended use of scarlatinal antitoxin in the treatment of the fever itself, even in mild cases and the intravenous route of administration suggests itself as the route of choice on account of the early reduction of faucial congestion and the prevention of naso-pharyngeal sepsis so frequently associated with

intractable otorrhoea. Perhaps in the future a similar treatment in measles will do much to improve the incidence and prognosis of otitis in that disease.

Although it cannot be said that zinc ionisation is of great value in the treatment of acute otitis media following measles it is a valuable aid to the conservative methods of treatment of acute otitis media in scarlet fever and diphtheria. In scarlet fever cases where serum therapy has been used the benefit is most marked. In fact, one can foresee the day when chronic scarlatinal otitis media will become a rarity on account of the very much reduced incidence of the disease in serum treated cases and the very small chronicity rate of the disease when it does arise when ionisation is used in the treatment of such cases.

Contrary to the findings of some workers I do not agree that the solution of the problem lies in a surgical approach. There are a limited number of cases in which this should be done when the tonsils and adenoids are enlarged or septic but at least a period of 4 weeks conservative treatment should be carried out first and the operative treatment should be reserved for selected cases only and not done as a matter of routine where difficulty is found in affecting cure.

There is no doubt that too large a number of cases leave the infectious diseases hospital with a running ear in spite of careful treatment. I feel that for these surgical advice should be sought as soon as possible when perhaps the operation of mastoid drainage might prevent the establishment of the chronic state.

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