AN INVESTIGATION WITH OBSERVATIONS ON THE COMPLICATIONS OF SCARLET FEVER IN THREE SERIES OF CASES TREATED UNDER DIFFERENT CONDITIONS OF ISOLATION, WITH SPECIAL REGARD TO THE INCREASE IN THE ISOLATION PERIOD, CAUSED BY SUCH COMPLICATIONS.

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It has for many years been clearly realised that each individual case requiring hospitalisation for one reason or another, runs a definite, and sometimes serious risk of infection by some other strain of the organism causing his own primary disease, or by the organism of some other infection harboured, and produced by one of his fellow patients in the same open ward.

This fact was apparently recognised, though the correct reason or "modus operandi" was not as yet understood, by Greenwell,[1.] who in 1871 at a meeting of the British Medical Association in Plymouth, proposed that all patients should be individually isolated in glass walled chambers, in order to prevent wound infections, which were then so common and so greatly dreaded in all hospitals.

In 1882 Plymouth Corporation[2.] sponsored a plan for all isolation hospitals under their jurisdiction, in which it was proposed to construct wards in the form of small glass partitioned rooms. This rather revolutionary, and as the years have shown, far sighted resolution, was unfortunately rejected by the Local Government Board as they considered that it would not provide sufficient segregation and protection between the sexes, a late, but too often repeated example of false prudery hindering the advancement of preventive medicine.

Granger/[3.]

Granger, Sevestre and Richard,[3] introduced a few years later various methods of isolation in the treatment of patients, particularly in relation to patients in children's wards, which were even then recognised to be pest spots for what is now known to be cross-infection. Goodall[4] in London, carried on the campaign against this scourge, which although prevalent in all hospitals, was of necessity particularly serious in isolation hospitals. More and more did it become apparent that the ever present danger to a patient entering a fever hospital, came from the real danger of a second or cross-infection from one of his fellow patients in the ward, who might well be the carrier of some other organism of some other infectious disease, or of some different strain of the organism affecting our original patient, or having been admitted during the incubation period of another disease be a potential danger to all his fellow patients.

As we have learned from the work of Lancefield[5] and Griffith[6] that there are at least twenty six types of streptococci, many of which are capable of producing clinical scarlet fever, and many others which give rise to the symptons of several of the complications arising during the course of the illness, and although Allison[7] in London, found that over 50% of all scarlet fever cases were caused by types 1-4; it is not/

not surprising that in an open ward, where there are several cases of scarlet, and almost certainly several types of streptococci confined in one room, that there should be as stated in the British Medical Journal April 8th 1944.[8] "a free exchange of bacteria between the patients."

Much extensive and illuminating work has recently been carried out by Cruickshank,[9] Brown and Allison,[10] Godber[11] and Garrod,[12] regarding the mode of cross-infection and its prevention in the open ward, and it is not the purpose of this present paper to discuss, prove, or attempt to disprove, any of the methods presently being practised. Up to the time of writing, one method, and one alone, has proved its value in every instance: that method is the one of complete individual isolation. Unfortunately most of our present isolation hospitals have been in existance for far too many years. They were conceived and erected in the years when our knowledge of infection and cross-infection had not even begun to advance along the paths to those proven facts regarding infection that appear so obvious to-day, consequently the need for individual isolation treatment was neither recognised or pandered to. In addition there was the ever present difficulty of finance, which has always existed but which one hopes will not always remain uppermost and of paramount importance in the minds of hospital/

hospital committees and administrators. In this instance however, as has been shown, there was perhaps some reasonable excuse for avoiding, what must then have been considered unnecessary expense, involved in the erection of many individual isolation units, as opposed to the less expensive open ward. The danger of what we now know as cross-infection had not as yet been clearly realised; it was appreciated as a definite fact, and a most serious one, but the cause was not as yet apparent, and had to be proved beyond doubt, before improvements could be instituted.

There is no doubt that the nursing of patients in individual cells does add materially to the daily cost of the patients upkeep in many and diverse ways, but against this must be offset the curtailment of the isolation period which one is almost certain to achieve in this method of treatment.

It has on several occasions been proved beyond doubt, to what extent complete isolation can reduce the common and all too frequent complications in scarlet fever. Lichtenstein[13]. found that the complications in a series of scarlet fever cases treated in complete isolation were less than one third of those in a control group treated in the open ward. Such a result is indeed excellent, but how many of our present day isolation hospitals could hope to treat all their scarlet cases in complete isolation? Few of them indeed have even individual cells in

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the ratio of one to three of all available beds. This ratio is given by Rolleston[14] as the minimum satisfactory figure while Dr. Begg[15] at a meeting of the Section of Epidemiology of the Royal Society of Medicine 1942 stated that "The principle of structural separation in hospitals had culminated in the construction at the North Eastern Hospital of single or double isolation units in the proportion of 40% of the total accommodation." Even this great advance is not the last word in isolation recommendations, in "The Control of Cross-Infections in Hospitals 1944,"[16] it is stated that "To satisfy present day requirements nearly half the number of beds in a children's or infectious diseases hospital should be composed of individual cells, and the remainder arranged in small units."

It was while bearing this point in mind, that I decided to investigate what difference, if any, the isolation treatment of a series of scarlet fever cases in pairs would have on the incidence of complications, taking as controls a series treated in the open ward, and a series treated in complete isolation. One has been unable to find any reference to such an investigation in recent medical literature, and it was considered that although most fever hospitals cannot at the moment possibly cope with the ideal of complete isolation treatment for all cases of scarlet fever, something might possibly be attempted and achieved, if

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the number of available isolation cells were in this manner doubled, provided the results of this investigation justified such a decision.

The several points to be investigated, and the results compared, and considered, in three series of scarlet fever cases treated under different methods of isolation.

I. To investigate as to whether there is any appreciable disadvantage in the treatment of scarlet fever cases in two bedded cells, as opposed to their treatment in complete isolation in a one bedded cell.

II. To compare the complications arising in this series of cases to two other groups of cases, namely, those treated in single cell isolation, and those treated in the open ward.

III. To determine if there is any difference in the duration of complications arising in each series of cases.

IV. To ascertain if there is any difference in the average day of onset of each individual complication in each series.

V. To compare the average in-patient days in each group of cases.

VI./

VI. To investigate the relative frequency of complications having regard to sex and age group distribution.

It is realised that the number of patients dealt with in each of the three series is rather small; but it is felt that only in large isolation hospitals, and perhaps not in many of these, are there at present sufficient cell-isolation blocks to carry out a similar investigation on a much larger scale, within reasonable time limits, and it is considered that some of the findings on the points to be investigated, may justify the work carried out. When it is realised that it has taken over two years to collect the one hundred and fifty cases treated in isolation, and that, in a small hospital which is relatively well equipped with cell isolation units, it becomes very apparent how far short the present standard of isolation units falls below the desired standard.

Hospital beds available for the investigation.

For the purpose of this investigation use was made of the Scarlet Fever Block and certain isolation cells in the observation Block of the West of Fife Infectious Diseases Hospital, Dunfermline a hospital which has normally accommodation for one hundred and fifty patients.

THE/

THE SCARLET FEVER BLOCK.

This block consists of four small wards; two adult wards, which are also used for older children, and two children's wards. Each ward holds ten beds or cots. The internal measurements of each ward are as follows. Length 44 ft. Breadth 25 ft. Height 15 ft. Total floor space 1,100 sq.ft. Total cubic space 16,500 cu.ft. Bed space is equal to 110 sq.ft. and the Wall length between the centre of adjacent beds is 8 ft. From these figures it will be clearly seen that such a ward is overcrowded when all the beds are occupied; floor space and wall length fall far below the recommended minimum. For infectious diseases hospitals, Currie[17]. gives 144 sq.ft. and 12 linear feet respectively as the ideal for these two important measurements.

Each ward is well ventilated and beds are placed in the orthodox position of one window between each pair of beds, cross ventilation being adequate. Beds are arranged in two rows with the head of each bed in apposition to a section of side wall; leaving a central corridor down the ward, the width of which is 10 ft. It has been found possible to maintain this arrangement of beds during the whole course of this investigation, as there has been no serious out-break of scarlet fever during these two years, and no overcrowding by the introduction of extra beds or cots was found necessary.

Neither/

Neither floors nor bedding were treated with spindle oil, as this method of protection had not come under consideration when the investigation was begun. No barriers of any type were placed between adjacent beds. Normal and routine concurrent and terminal disinfection were carried out.

THE OBSERVATION BLOCK.

This is of the Open Corridor Type, and is of two stories, accommodating in all twenty four cells, which are all capable of being used as single units or double units as circumstances demand. Owing to the multiplicity of conditions which the hospital has been called upon to deal with during the war years, it was only possible to have the use of six cells for the purpose of this investigation. These six cells were taken in the upper-storey, and were all situated in the same wing.

These cells are small rooms, with walls extending from floor to ceiling. There is no connection between adjacent cells except by passage through the one door into the open corridor. The internal measurements of such a cell are as follows. Length 15 ft. Breadth 10 ft. Height 11 ft. Floor Space 150 sq.ft. Cubic Space 1650 cu.ft. When two beds are in position the Wall Length is only 6.5 ft. It will be obvious that when such cells are used as two bedded units, the Floor Space and Wall Length fall badly below the desired/

desired standard, indeed much below the conditions prevailing in the open scarlet ward, which in turn was itself found to be below the advocated minimum.

Each cell is ventilated by a window 6.5 ft.x2.5 ft. and by a fan light above the door. Cross-ventilation is adequate.

Exactly the same precautions regarding concurrent and terminal disinfection were observed in the nursing of patients in these cells.

It was found impossible to have a separate nurse for each individual cell, but as far as possible the same group of nurses attended only to cases of scarlet fever, and to no other cases in the block. As in the open ward no oiling of floors or bed-clothes could be carried out.

SELECTION OF PATIENTS.

There was no selection of patients. All cases of scarlet fever treated in the hospital between June, 1942 and October, 1944, were used in this investigation; with the following proviso. All cases notified as scarlet fever were examined on admission, and a history of the mode of onset was obtained, either from the patient's own doctor, or from the relatives or parents. If there was any doubt as to the authenticity of the case, the patient was seen by a second medical advisor. In some doubtful instances a Schultz-Charlton/

Charlton Test was performed. If there was still doubt as to the diagnosis, the patient was placed under observation and not admitted to this series of cases. No patient suffering from a concomitant disease, or suspected of having been a recent contact with another infectious condition, was admitted to the series. As will be seen later this last proviso has many loop-holes.

Patients when accepted as accredited cases of Scarlatina were allocated to one of three groups. 1. Open Ward. 2. Two bedded cells. 3. Isolation Cells. Owing to the scarcity of cell accommodation, patients could only be admitted to these as the group of six cells reserved for their use fell vacant, so that it was never possible to treat more than six two bedded cells, or six single bedded cells at the same time; but no choice what-so-ever was made between those treated in the open ward or either type of cell isolation. As a cell fell vacant, the next admission to hospital became a cell patient. If no cell were vacant, the patient entered the open ward.

Severity and Type of Disease encountered.

During the course of the investigation which extended a little over two years, there was no serious outbreak of Scarlatina in the districts served by the hospital. From time to time there were sporadic local outbreaks, but in no single instance could the/

the type of disease be designated by any other classification than "Scarlatina Simplex," varying in severity from mild to moderately severe. There were no septic or toxic varieties among the three hundred and fifty cases examined.

TREATMENT.

It was realised at the outset of the investigation, that all cases must receive the identical initial treatment if there was to be any worth-while comparison of results between the three series nursed under different methods of isolation.

On admission, and having been accepted as a genuine case, every patient in all three groups received Antistreptococcal Serum - (Scarlatinal) (Parke-Davis). The amount of serum administered varied with the severity of the case, and depended on the physical findings. Toxicity of the patient, severity of eruption, condition of fauces and cervical glands were all taken into consideration when assessing the dose of serum to be given. The average dose for children under ten years of age was three thousand units, for children above this age, and adults, six to nine thousand units. Local treatment such as gargles, mouth washes, heat to enlarged and painful glands, and inhalations were prescribed as required for each individual case.

In no instance was sulphonamide treatment instituted as a routine measure. If some well defined complication was already evident/

evident on admission, sulphonamide treatment was given where advisable; but in no single instance was any patient placed on this line of therapy with a view to preventing any future possible complication.

It was thought necessary to fix a definite length of stay in bed for all cases, which could only be shortened, if in the observer's opinion, the course of the illness was so satisfactory, that this previously fixed period was unduly long. In this investigation the bed period for all groups was fixed at twenty one days and the mean in-patient period at twenty eight days.

It is realised that in recent years there has been a growing tendency to shorten the bed period quite considerably. Some authorities - Rolleston[18]. "et alia" stating that it is quite legitimate to allow uncomplicated cases to get up after as a short a period as fourteen days, and to spent the ensuing ten days under convalescent conditions, with strict attention to urinary examination in order to detect any signs of incipient nephritis.

In the opinion of the writer this is a thoroughly bad technique, and greatly to be deprecated. My reasons are as follows. During these ten convalescent days, when the patient is up and moving about the open ward and day room, he will be mixing/

mixing, particularly if a child, much more closely with the other convalescents and in-bed patients, and thereby laying himself more open to cross-infection and subsequent complications. This state of affairs of course only applies to patients nursed in the open ward, but here, not even the best of nursing supervision can entirely prevent it from taking place. It is well known that so-called "relapses" or a return of the characteristic symptoms of the disease are most common between the third and fifth week of the disease, that is to say during that period when the patient is out of bed and able to mix with others in the open ward.

Harries and Mitman[19]. state that "although complications may appear at any time, or stage, of the illness, they are most commonly detected at two periods. (1) At the commencement of the illness, while the ordinary manifestations of the disease are still present. (2) At the beginning of the third week, i.e., about the fourteenth to sixteenth day, when the patient in being allowed up for the first time. In such cases an a-pyrexical period intervenes between the initial manifestations and the complication."

It should also be remembered that probably at about this time (fourteenth to sixteenth day) the passive immunity conferred by the administration of serum is commencing to pass off, and the patient/

patient is therefore all the more liable to re-infection by some virulent organism.

Allison and Brown[20] have shown in recent years, that in a series of patients swabbed during the course of their isolation period, a high percentage was found to have become infected with a serological type of organism, additional to that producing the primary disease. In some instances no clinical evidence of re-infection was seen (latent re-infection); in other cases the appearence of such complications as otitis media or rhinitis became obvious (manifest re-infection).

Now most of these re-infections occurred during the third week in hospital, and the fact that most scarlatinal complications have their highest incidence in this period is surely significant.

De Wall[21] also showed that most of the complications of scarlet fever are due to a cross-infection with one or other type of streptococcus, other than the original type causing the primary illness. In his series only 20% of the complicated cases, were caused by the primary infecting streptococcus; 61.5% by streptococci of other types.

It was therefore decided to keep all patients nursed in the open ward, in bed for three weeks, and then to discharge them from hospital at the earliest possible moment, in order to eliminate as far as possible the risk of re-infection, which

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although present at all times in an open ward, is considered by the writer at least, to be greatly increased when convalescent patients are mingling freely with each other in ward or day-room.

This method although considered sound in theory, is rather more difficult to put into practise; for it was found that few patients were sufficiently fit to leave hospital in less than five to six days after arising from bed. This is certainly an improvement on the recommended ten days under observation as an up-patient, but still allows of untold loop-holes for concentrated cross-infection. The ideal which requires to be aimed at in nursing infectious diseases in an open ward - if such requires to be carried out - is to keep the patient in bed until such time as he can be discharged reasonably fit, to a reasonably satisfactory home, where his convalescent up-treatment can be carried a stage further; but many homes being what they are and many more being definitely what they should not be, it is at present incumbent upon the hospital to see that the stage of convalesence is fairly well advanced before returning the patient to his own home, where in all possibility he will be required to fend for himself to a greater or lesser degree. It will be obvious that all this both directly and indirectly increases the in-patient days of all such patients treated in the open ward, and thereby adds appreciably to the expense of running/

running such a ward and hospital.

In the cases treated in isolation cells this difficulty does not arise, and it was considered in order, to allow patients to leave their beds at about the beginning of their third week, unless some complication had set in prior to this date, or their general condition due to the severity of the primary infection did not permit.

These patients were then kept under observation for some six to eight days, during which period they were regaining strength and renewing muscular tone by daily increasing movements about their small cells. They were not permitted to mingle with any other scarlet fever convalescents in the day-room or corridors, isolation being maintained until the hour when they left hospital. In this way it was possible to discharge patients at a much earlier date, as compared to those treated in the open wards, thus cutting down in-patient days, and thereby expense.

The only draw-back may have been the monotony and boredom of confinement in one small cell, but on the whole this is no great tribulation, and the total hospitalisation period was markedly reduced as will be shown. During this investigation there was not one instance of complaint on this score.

Criterion of Complications.

The criterion of all the signs and symptoms listed as

individual/

individual complications within the three groups, was taken as being. "A condition arising during the duration of the illness, but appearing after the initial fever had subsided." If the condition had already shown itself during the first few days of the illness, when pyrexia and initial fever were still present; or if the condition was present on admission; then that condition was not accounted as a complication in this investigation, but was rather taken to be a primary complication of the initial infection.

In this way it will be seen that all the complications dealt with in the present investigation are taken to be secondary complications, or rather complications, which may, or may not be the result of cross-infection. Such complications are described by Allison and Brown[22]. as "manifest" re-infection and in their investigations appeared most commonly during the third week of the illness.

No facilities were available for the typing of the various streptococci obtained from discharges arising out of certain of these complications. The findings of Allison and Brown have been corroborated on several occasions by well known investigators.

Duration of Complications.

This is calculated from the day when the symptoms first become/

become apparent, until such time, as in the opinion of the writer, they had completely disappeared.

Concomitant Infectious Conditions.

Where these occurred in each series of cases, they have been kept separate, and not brought into the various tables, as it was considered that they would unfairly weight the final findings in several ways. They are therefore first considered on their own merits at the conclusion of the observation on each series, before being included in the body proper of the whole investigation.

First Series of Cases.

Two hundred cases of Scarlet Fever treated in an open ward.

Of these two hundred cases, fifteen developed concomitant infections, namely Varicella 11, Measles 4, These cases are therefore not included in several of the findings, although included later. Among the remaining 185 cases treated, there were 147 uncomplicated cases, and 38 complicated.

Table I. shows the sex distribution of these complicated cases having regard to the total number of cases treated of each sex./

TABLE I.

Sex.	Total	No Complications	Complications	% of Complications
Male	94.	79	15	15.96.
Female	91	68	23	25.27
Total	185	147	38	20.54

From this table it will be noted that the total number of patients treated are almost equally divided as to sex; male 94, female 91; and that the total percentage of complications in this series was 20.54%. Also worthy of note is the fact that the percentage of complicated female cases preponderates greatly over the percentage of male complicated cases, in a ratio of approximately 5 to 3.

The accepted complication ratio between male and female cases of scarlet fever, has not been able to be ascertained, but Rolleston[23] states that mortality is quite definitely higher in the male; and as complications are the usual cause of death in this disease, one would rather expect the complication rate to be greater in the male sex also. This was not the case in this series of cases.

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The frequency of complicated cases in each age group is shown in Table II.

TABLE II.

Age Group	Total No. Treated.	No. with no Complications.	%	No. with Complications.	%
0-1.	-	-	-	-	-
1-5.	50	40	80.0	10	20.0
5-10	76	61	80.3	15	19.7
10-15	31	23	74.2	8	25.8
15&over	28	23	82.0	5	18.0
TOTAL.	185	147	79.46	38	20.54

This table shows, as is to be expected, that the greatest number of cases treated, fall into the age group 5-10. This group is one which must of necessity include all children entering upon school life, and thereby becoming exposed perhaps for the first time, to concentrated attacks by many organisms, with which they had heretofore remained unacquainted; but although fifteen of the total thirty eight complications fell in this age group, if the total number of cases treated in each age group are considered, we find that the complication rate is much greater in the/

the higher age group, namely 10-15; the ratio being approximately 25-19. This group indeed, although it had only eight complicated cases, has the highest complication rate of all age groups, viz:- 25.8%, the lowest being in the over fifteen group with 18% complicated cases. One reason for this may well be that in the 5-10 age group, the males preponderate by 41-35, (Table III) while in the 10-15 age group the position is reversed, and the females preponderate by 19-13; now we have already in Table I shown that in this series of cases at least, the complication rate is definitely higher in the female sex.

It is a recognised fact that in early childhood, the incidence of scarlet fever is divided almost equally between the two sexes, but that just before puberty it is higher in the female sex. From Table III it would appear, that, from the corrected total number of cases treated in each age group, the female also predominates in her susceptibility towards complications, not only in the age groups of puberty, but in every single age group. This is an interesting fact and will be considered at a later date in this paper.

TABLE/

TABLE III.

Age Group.		No. Treated.	No. Complications.	Complications.	% Complications.
1-5	M	23	20	3	13.0
	F	27	20	7	25.9
5-10	M	41	33	8	19.5
	F	35	28	7	20.0
10-15	M	13	10	2	16.6
	F	19	13	6	31.5
15 & OVER	M	18	16	2	11.0
	F	10	7	3	30.0

Sex distributions of complications in the five age groups.

DAY OF ONSET OF THE VARIOUS COMPLICATIONS.

TABLE (IV) shows the day of onset of each individual complication.

DAYS.

Complication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Cervical adenitis	-	-	-	-	-	-	-	3	-	3	1	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	9
Otorrhoea	-	-	1	1	-	1	-	1	-	-	-	1	-	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	8
Rhinitis	-	-	1	-	1	1	-	2	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Secondary tonsillitis	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	1	-	-	-	5
Septic Spots	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	4
Rheumatism	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Scarlet fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Jaundice	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TOTAL	-	-	2	2	1	2	1	6	1	6	2	1	1	3	-	1	1	1	1	2	-	1	2	-	1	-	-	-	38
	8							20							6							4							

The twenty eight day period which at the outset was taken as the mean length of hospitalisation in the open ward has been here (Table IV) divided into intervals of one week; and it will be seen that the vast majority of all complications (twenty) occur, or are first observed during the second week in hospital, viz:- between the eighth and fourteenth day of hospitalisation. This is somewhat earlier than the usually accepted period of between the third and fifth week of the illness. As the average duration of illness prior to admission to hospital was three days, the majority of these complications arose between the eleventh and seventeenth day of the illness.

If we examine each complication in turn, we find that:-

Cervical Adenitis:-	Seven out of nine occurred in this period.
Otorrhoea:-	Three out of eight occurred in this period.
Rhinitis:-	Five out of eight occurred in this period.
Secondary Tonsillitis:-	Two out of five occurred in this period.
Septic Spots:-	One out of four occurred in this period.
Rheumatism:-	One out of two occurred in this period.
Jaundice:-	One out of one occurred in this period.

In other words 52.6% of all complications arose between the eighth and fourteenth day of hospitalisation.

The/

The percentage rate for the three other weeks was as follows:-

First Week - 21.05%

Third Week - 15.78%

Fourth Week - 10.52%

Of the total thirty eight complicated cases, thirty four were first observed while the patient was still confined to bed, so that there can be no question of any cross-infection having taken place in the day room or corridors. Any cross-infection which did take place must have occurred within the ward itself. It is a question of just how many more complicated cases might have accrued if these patients had been allowed up at an earlier date, and permitted to mingle with other patients in the day room!

In Table (V) is shown the predilection of the individual complications for the various age groups.

TABLE (V).

Age Group.	No. Treated.	Cervical adenitis	Otorrhoea	Rhinitis	Secondary Tonsillitis	Septic spots	Rheumatism	Secondary Scarlet Fever	Jaundice	TOTAL
0-1	-	-	-	-	-	-	-	-	-	-
1-5	50	1	3	2	-	3	-	1	-	10
5-10	76	6	2	5	-	1	-	-	1	15
10-15	31	1	2	1	3	-	1	-	-	8
15 & over	28	1	1	-	2	-	1	-	-	5
TOTAL	185	9	8	8	5	4	2	1	1	38

The percentage complication rate of each individual complication in each age group having regard to the total number of patients in that age group is perhaps more clearly shown below.

TABLE (VI)

AGE GROUP.	COMPLICATION	%
1 - 5	Otorroea	6%
	Septic Spots	6%
	Rhinitis	4%
	Secondary Scarlet Fever	2%
	Cervical Adenitis	2%
5 - 10	Cervical Adenitis	7.9%
	Rhinitis	6.6%
	Otorrhoea	2.6%
	Septic Spots	1.3%
	Jaundice	1.3%
10 - 15	Secondary Tonsillitis	9.7%
	Otorrhoea	6.5%
	Cervical Adenitis	3.2%
	Rhinitis	3.2%
	Rheumatism	3.2%

TABLE (IV) (Cont.)

AGE GROUP.	COMPLICATION	%
15 & over	Secondary Tonsillitis	7.1%
	Cervical Adenitis	3.6%
	Otorrhoea	3.6%
	Rheumatism	3.6%

Individual Complications.

CERVICAL ADENITIS:-

This complication was found to be most common in the age group 5-10 with a percentage complication rate for all patients treated in this group of 7.9%, and was least frequent in the age group 1-5 with a percentage of 2.0%. As will be seen from Table (VII) in this series of 185 cases, Cervical Adenitis accounted for 4.9% of complications.

TABLE (VII)

Total Number of Cases. 185			
Complications 38.			No Complications 147
Cervical Adenitis	9	4.9%	
Otorrhoea	8	4.3%	
Rhinitis	8	4.3%	
Secondary Tonsillitis	5	2.7%	147
Septic Spots	4	2.2%	
Rheumatism	2	1.1%	
Secondary Scarlet Fever	1	0.54%	
Jaundice	1	0.54%	
	38		147

Total % Complications 20.54%

The complication of cervical adenitis in scarlet fever, after all signs and symptoms of the initial fever have subsided, is well recognised to occur most frequently during the second or third week of the illness, and indeed as has been shown earlier in this paper, seven out of the nine incidents of this particular complication did arise between the eleventh and seventeenth day of the illness.

The reports of the M. A. B. Hospitals London 1900-1909[24]. which deal with 153,607 cases of scarlet fever, give the incidence of this complication as 6.35% with which findings, the results in this series compare not unfavourably.

As will be seen in Table (VIII) the sex ratio of this complication was Female 2, Male 1.

TABLE (VIII)

SEX.	Total Treated	Cervical Adenitis.	Otorrhoea.	Rhinitis.	Secondary Tonsillitis.	Septic Spots.	Rheumatism.	Secondary Scarlet Fever.	Jaundice.
M.	94	3	4	3	2	1	1	-	1
F.	91	6	4	5	3	3	1	1	-

The sex distribution of the separate complications is shown in the previous table. While the female predominates in all the complications, she appears to have a particular affinity towards Cervical Adenitis, Rhinitis and Septic Spots.

OTORRHOEA:-

This complication was most frequently discovered in the 10-15 age group, and almost as frequently in the 1-5 group; and was least common in the 5-10 group. (Table VI).

As shown in Table VII, it accounted for 4.3% of complications.

The South Eastern Hospital Reports for 1936[25] in dealing with a series of 954 cases, all treated in an open ward, and all having received serum on admission; show a percentage rate of 3.8% for this complication.

All cases manifesting this complication in the present series had actual discharge from one or both ears, the bilateral type being the more frequent.

As is shown in Table VIII, the sex ration of this complication was approximately 1:1.

RHINITIS:-

This complication which accounted for 4.3% of complications was most frequently found in the 5-10 age group, with a percentage complication rate of 6.6%; it was also high in the 1-5 age group with 4.0%, and was completely absent in the 15 and over age group.

This/

This complication also showed a marked predilection for the female sex, ratio 5:3. (Table VIII).

Recent figures from London hospitals (1937)[26]. show that Rhinitis was present in 1.1% of all cases of scarlet fever on admission, and in 3.1% at a later date.

SECONDARY TONSILLITIS:-

This complication accounted for 2.7% of complications, and was most frequently discovered in 10-15 age group, where it had a complication percentage of 9.7% of all cases treated within that group. It was also high in the 15 and over age group with 7.1%, but rather unexpectedly completely absent in the two lower age groups; however, Rolleston[27]. states that it is a complication more commonly found in adults and older children, than in the early years of life. This fact would appear to be substantiated by the present findings.

M.A.B. hospital reports[28]. give this complication a frequency of 0.6% to 2.95% for the years 1900-14.

There was an even distribution between the two sexes; the female however, predominating as usual by 3 to 2. In no instance did the condition advance to one of frank suppuration.

SEPTIC SPOTS:-

This condition accounted for 2.2% of complications, and was most frequent in the lower age groups; 6.0% in the 1-5 age group/

group and 1.3% in the 5-10 age group; being completely absent in the two older age groups.

The term "Septic Spots" as here used, includes such conditions as boils, abscesses and spots. It is a well recognised fact that scarlet fever perhaps more so, than the other common exanthemata, reduces the power of the skin tissues to resist secondary infection by organisms which may be normally present on a healthyskin, or may alight on the skin surface by cross-infection.

The site of the secondary skin infection in this series of cases was almost one hundred percent on the buttocks, and upper half of the posterior surface of the thighs.

Females again preponderated in a ratio of 3:1 (Table VIII).

RHEUMATISM:-

This complication which only occurred on two occasions in the present series, was relatively most frequent in the 15 and over age group, where it had an incidence of 3.6%. It was entirely absent from the earlier age groups; and altogether only accounted for 1.1% of complications. Sex distribution as shown in Table VIII was equal 1:1. In neither instance was the complication a severe one; the duration as is shown in Table IX was short.

Joe in the Hospital Reports of Edinburgh City Hospital 1900-09[29] during which period 24,012 cases of scarlet fever were treated, only found this complication to be present in 3.7% of all cases treated.

SECONDARY/

SECONDARY SCARLET FEVER:-

There was only one instance of what is usually taken to be, and described as, secondary scarlet fever, in this series of cases. This gives a percentage of 0.54% for all cases treated. This single case was a female, and occurred in the 1-5 age group.

JAUNDICE:-

One case only occurred, this was a male in the 5-10 age group. This gives a percentage of 0.54% for all cases treated. In this single case, jaundice was very marked, and was accompanied by definite tenderness over the liver on palpation. No hepatic enlargement was detected.

It is realised that it is unusual to encounter jaundice as a complication of scarlet fever; indeed in the reports of the M.A.B. Hospitals, 1903-14[30], the frequency of this complication ranged between 0.13% and 0.41%

DURATION of COMPLICATIONS:

Table IX shows the average duration of the several complications.

TABLE IX/

TABLE IX.

Complication.	Average Duration	Shortest Duration	Longest Duration
Otorrhoea	15.7	5	33
Septic Spots	12.0	4	32
Jaundice	10.0	-	-
Cervical Adenitis	8.8	6	20
Rheumatism	8.0	7	9
Rhinitis	7.0	3	10
Secondary Scarlet Fever	7.0	-	-
Secondary Tonsillitis	5.6	4	7

CERVICAL ADENITIS:-

The average duration was 8.8 days, the longest being 20 days, the shortest 6 days.

OTORRHOEA:-

The average duration was 15.7 days, the longest 33 days, the shortest 5 days.

RHINITIS:-

The average duration was 7 days, the longest 10 days, the shortest 3 days.

SECONDARY/

SECONDARY TONSILLITIS:-

The average duration was 5.6 days, the longest 7 days, the shortest 4 days.

SEPTIC SPOTS:-

The average duration was 12 days, the longest 32 days, the shortest 4 days.

RHEUMATISM:-

The average duration was 8 days, the longest 9 days, the shortest 7 days.

SECONDARY SCARLET FEVER:-

The duration of the one case was 7 days.

JAUNDICE:-

The duration of the only case was 10 days.

It is unfortunate that Otorrhoea and Cervical Adenitis, the complications which occupy first and second places (Table VII) in the frequency of all complications in this series of cases, should also have first and fourth place respectively in the matter of length of duration (Table IX). The duration of an isolated complication such as Jaundice or Secondary Scarlet Fever is not of such serious import when we come to consider the question of increase in In-patient days; but when a common and frequently recurring complication is also a complication of lengthy duration, then this does have a very marked effect on this point.

The/

The short duration of Rheumatism as a complication is pleasing, if a little unexpected.

INCREASE IN IN-PATIENT DAYS:-

In all, the thirty eight complicated cases added 279 days to the total in-patient days of the 185 cases in this series; taking 28 days as the meanfor all cases.

Table X shows the number of additional in-patient days accounted for by each group of complications.

TABLE X.

Complication.	No.	In-patient days 28	Average In-patient days.
Jaundice	1	+ 16	44.0
Otorrhoea	8	+ 122	43.25
Secondary Scarlet Fever	1	+ 12	40.0
Secondary Tonsillitis	5	+ 44	36.8
Septic Spots	4	+ 28	35.0
Cervical Adenitis	9	+ 44	33.0
Rheumatism	2	+ 3	29.5
Rhinitis	8	+ 10	29.25
Total	38	+ 279	35.3
Uncomplicated	147	-53	27.64

In point of fact the average in-patient days for the 147 uncomplicated cases was 27.64 days.

OTORRHOEA:-

Apart from the one isolated case of Jaundice, it will be seen that Otorrhoea is the most grave offender in increasing the average in-patient days of the complicated cases, this despite the fact that otorrhoea in this series of cases, was not a late complication; (Table IV). Six of the total of eight cases occurred within the first fourteen days of hospitalisation. I consider that the reason for this is that the treatment of otorrhoea in an open ward must always be of prolonged duration,

CERVICAL ADENITIS:-

Although the most common complication did not add excessively to the total in-patient days, the duration was relatively short, and the condition appeared to respond exceptionally well to sulphonamide treatment.

RHINITIS:-

Eight cases, all of which, as will be seen in Table IV occurred during the first eleven days in hospital, had little effect on the prolongation of in-patient days; and in a similar manner to Cervical Adenitis, responded well to general and sulphonamide therapy.

SECONDARY TONSILLITIS:-

Five/

Five cases, four of which had a late onset, (Table IV) between the 14th and 25th day in hospital, although not of long duration 5.6 days (Table IX), did have a very marked effect on increasing the total in-patient days.

These four complications which have been dealt with in detail and which comprise 30 of the total 38 complicated cases, accounted for 220 additional in-patient days.

CONCOMITANT INFECTIONS:-

In this series of two hundred cases treated in the open ward, there were 15 instances of concomitant infections. These were varicella 11 cases, measles 4 cases. As has been previously stated, such cases have not up to the present been included in the assessment of the frequency, sex and age distribution, and increase of in-patient days in relation to the various complications; but at this juncture certain observations regarding these infections must be made, since the frequency of these concomitant infections is so well known and dreaded in all open ward treatment.

Unfortunately it is so often completely impossible to exclude the admission of patients who are in the process of incubating some secondary infection, while being admitted on account of their primary notified condition.

It is well known that varicella has a great affinity for scarlet fever cases and should a patient incubating this infection be/

be admitted to an open ward, the infection on developing, will advance through the other members of the ward like wild-fire. F. H. Thomson[31] found that even the strictest barrier nursing in an isolation ward was unable to prevent a rapid dissemination and spread of this infection. The same remarks apply to measles, but to a slightly lesser extent.

In this series, a child was admitted to one of the children's wards who must have been in the process of incubating varicella at the date of admission, as the typical vesicles appeared only on the 9th day after admission. On the 18th day the child in the adjoining bed developed a typical crop of vesicles, and in rapid succession during the next nine days, every other member of the ward developed a typical vesicular eruption. Fortunately the infection remained localised to the one ward in which the original outbreak occurred, but in all, there were eleven cases. Unfortunately the average day of onset was late being 21.9 days, and this had the effect of greatly lengthening the total in-patient days for these eleven cases; it did in fact add 183 days to the total in-patient days, although the duration of the second infection was comparatively short, 11.4 days.

In the case of the concomitant measles infection, it would appear likely that at least three out of the total of four cases affected, on entering hospital were suffering not only from scarlet/

scarlet fever, but were also in the process of incubating measles, as the typical morbilliform rash appeared in these three cases within ten days of admission. The fourth case is doubtful, and might possibly be a true cross-infection, as the rash appeared twelve days after the appearance of the first case, and during the patient's seventeenth day in hospital (TableXI). It is considered probable that a further spread of the infection may have been avoided by the use of Immune Globulin which was administered to every other member of the ward, irrespective as to whether or not the patient was said to have suffered from measles at some previous date.

This concomitant infection did not affect the in-patient days to such a marked extent, as did the outbreak of varicella; chiefly because the second disease (measles) appeared relatively early during the course of the primary infection. In-patient days were however increased by thirty-six.

In all, these two small outbreaks of concomitant infections added 219 days to the mean in-patient days of 11 cases (Table XII)

TABLE XI/

TABLE XI:-

Showing day of onset of concomitant infections.

Day of onset.	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
Varicella	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	2	-	2	-	-	2	2	-	11
Measles	1	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4

TABLE XII:-

Concomitant Disease	Number	28 + or −	Average in-patient days.
Varicella	11	+ 183	44.6
Measles	4	+ 36	37.0
Total	15	+ 219	42.6

This surely is a clear example of the additional expense involved in the treatment of fever cases in the open ward.

One interesting point is, that in not one of the fifteen cases suffering from scarlet fever with an additional concomitant infection, was there a single instance of any of the common complications of scarlet fever. Did the concomitant infection increase the patient's immunity to other organisms of cross-infection within the ward?

Summation of increase in In-patient days.

If we now add the number of In-patient days in excess of 28 (which was taken as the mean) for both complicated cases, and cases with the addition of a concomitant infection, we find that in all, 498 days have been added to the total in-patient days of

200/

200 cases treated in this series within the open ward. This is almost equivalent to the total mean in-patient days of an additional 18 patients.

In other wards for every 100 patients treated in an open ward, we are virtually required to treat 109.

SECOND SERIES OF CASES.

One hundred cases of Scarlet Fever treated in two bedded cell isolation.

Among these one hundred cases there was only one instance of concomitant infection - namely varicella. As in the first series treated within the open ward, this case is not included in several of the tables and findings, although included at the end.

Among the remaining 99 cases, there were 93 uncomplicated cases, and 6 with complications.

Table A shows the sex distribution of the six complicated cases.

TABLE A:-

Sex	Total Treated	No Complications	Complications	% Complications.
Male	51	46	5	9.8
Female	48	47	1	2.08
Total	99	93	6	6.06

It will be seen from this table that as in Series 1, the sex distribution is almost equal; Males 51, Females 48, and that the percentage of complicated cases in this series was 6.06%.

A point to be noted in this table is the fact that the male complicated cases outnumber the female complicated cases by five to one. This is the exact opposite to the findings in the first series of cases, where the female complicated cases predominated by 5 to 3.

An explanation of this rather unexpected reversal can I think be made by the fact that four of the total of five complicated male cases occurred in one age group (15 and over), and were all cases which were admitted during the course of a sharp outbreak of scarlet fever among naval ratings at a near-by training centre. These four cases, without any preference or selection, were being treated in pairs in two bedded cells. All four developed one or other of the listed complications.

The type of infection encountered among these young adult male patients was certainly much more severe than that experienced at any other period of the investigation. It is perhaps a little unfortunate, at least from the point of view of this paper; but not it is felt certain from that of the patients, or their possible ward companions in an open ward, that the majority of these cases were fortunate, though not by selection, in being treated in double bedded/

bedded cell isolation; had it been their misfortune to receive treatment in the open ward, one feels certain that the number of complicated cases in that ward would have risen appreciably.

The frequency of the complicated cases in each age group is shown in Table B.

TABLE B:-

Age Group	Total number treated	Number with no complications.	%	Number with complications	%
0- 1	1	1	100	-	-
1- 5	30	29	96.66	1	3.3
5-10	33	32	97.0	1	3.03
10-15	8	8	100	-	-
15 & over	27	23	85.18	4	14.82
Total	99	93	93.94	6	6.06

It will be seen that as in the first series of cases, the greatest number of cases treated in a single age group is the age group 5-10, yet in this group there is only one complicated case, giving a complication percentage rate of 3.03%. The highest complication rate was found in the 15 and over age group with a percentage complication rate of 14.8%. As has been explained previously this was due to several cases admitted during the course of a sporadic outbreak of scarlet fever of severe type in

a/

a naval establishment. No complications were experienced in either the 0-1 or 10-15 age groups.

Table C shows the sex distribution of the complicated cases in the five age groups.

TABLE C:-

Age Group		Number treated	No complications	Complications	% Complications
0- 1	M	-	-	-	-
	F	1	1	-	-
1- 5	M	13	12	1	7.7
	F	17	17	-	-
5-10	M	16	16	-	-
	F	17	16	1	5.9
10-15	M	4	4	-	-
	F	4	4	-	-
15 & over	M	18	14	4	22.2
	F	9	9	-	-
Total		99	93	6	6.06

Apart from the age group 15 and over, where the male complicated cases preponderate by 4:0, and for which a tentative explanation has been given previously, it would seem unjustifiable to state that there is any sex preference in respect of the few complications/

complications experienced in this second series of cases.

Day of onset of the various complications.

Table D shows the day of onset of the individual complications.

TABLE D:-

Complication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Otorrhoea	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	2
Cervical Adenitis	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	2
Rhinitis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Rheumatism	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Total	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	1	-	-	1	-	-	1	6
				0							2							3					1	6

As in the previous series, a twenty eight day period of hospitalisation has been taken as the mean. This is as before, divided into intervals of one week.

It will be seen that in this series, the complications were somewhat later in materialising than in the cases treated in the open ward. Two occurred during the second week in hospital, three in the third, and one in the fourth. No complications appeared during the first week. Four out of the six complicated cases arose between the eleventh and seventeenth day of hospitalisation, or between the fourteenth and twentieth day of the illness, if we take the average duration of illness prior to admission as three days, as was done in the first series.

In Table E is shown the predilection of the individual complications for the various age groups.

TABLE E:-

Age Group	Number Treated	Cervical Adenitis	Otorrhoea	Rheumatism	Rhinitis	Total
0- 1	1	-	-	-	-	-
1- 5	30	-	-	-	1	1
5-10	33	1	-	-	-	1
10-15	8	-	-	-	-	-
15 & over	27	1	2	1	-	4
Total	99	2	2	1	1	6

The percentage complication rate of each individual complication in each age group, having regard to the total number of patients treated in that group is shown in Table F.

TABLE F:-

AGE GROUP	COMPLICATION	%
0- 1	No complications	
1- 5	Rhinitis	3.3%
	Cervical Adenitis	0%
	Otorrhoea	0%
	Rheumatism	0%
5-10	Cervical Adenitis	3.03%
	Rhinitis	0%
	Otorrhoea	0%
	Rheumatism	0%
10-15	No Complications	
15 & over	Otorrhoea	7.4%
	Cervical Adenitis	3.7%
	Rheumatism	3.7%
	Rhinitis	0%

INDIVIDUAL COMPLICATIONS.

CERVICAL ADENITIS.

This/

This complication was only manifest on two occasions in this series of cases; once in the 5-10 age group and one in the 15 & over age group. As will be seen in Table G this complication accounted for 2.02% of complications occurring in this series of cases. In Table H the sex ratio of this complication was Female 1, Male 1.

TABLE G:-

Total Number of Cases 99.			
Complications	6	% Complications	No Complications.
Cervical Adenitis	2	2.02%	-
Otorrhoea	2	2.02%	93
Rhinitis	1	1.01%	-
Rheumatism	1	1.01%	-
Total	6	-	93
	Total % Complications		6.06%

TABLE H:-

Sex	Total Treated	Cervical Adenitis	Otorrhoea	Rhinitis	Rheumatism
Male	51	1	2	1	1
Female	48	1	-	-	-
Total	99	2	2	1	1

OTORRHOEA.

This condition had a complication rate of 2.02% for all cases treated (Table G). It was found only in the 15 & over age group, and the sex ratio was Male 2, Female 0, (Table H). Both cases were bilateral in nature.

RHINITIS.

There was only one instance of this complication in this series of cases, a male patient in the 15 & over age group; giving a complication rate of 1.01% for all cases treated (Table G).

RHEUMATISM.

There was only one manifestation of this complication. This was a male case in the 15 & over age group. This complication accounted for a complication rate of 1.01% for all cases treated.

Duration of Complications.

Table I shows the duration of the several complications.

TABLE I:-

Complication	Average Duration	Short. Duration	Long. Duration.
Rhinitis	8	8	8
Cervical Adenitis	6	5	7
Otorrhoea	5	5	5
Rheumatism	5	5	5

It/

It will be noted that Cervical Adenitis and Otorrhoea, the two complications which hold first and second place respectively with regard to frequency in this series, hold second and third place with regard to length of duration.

Increase in In-patient days.

In this series the six complicated cases added in all 48 days to the total in-patient days of the 99 cases, taking as before, 28 days as the mean for all cases. Table J shows the number of additional in-patient days accounted for by each complication.

TABLE J:-

Complication.	Number	In-patient days 28 + or −	Average in-patient days
Cervical Adenitis	2	+ 7	31.5
Otorrhoea	2	+ 11	33.5
Rheumatism	1	+ 13	41.0
Rhinitis	1	+ 17	45.0
Total	6	+ 48	37.7
Uncomplicated	93	− 222	25.6

It will be realised that the late onset of any complication has a marked effect on the prolongation of the in-patient day period. This is well illustrated by the cases of Rheumatism and Rhinitis, which/

which did not manifest themselves until the 21st and 17th day of hospitalisation respectively, and thereby added in all 30 days to the total in-patient days; whereas the two cases of Cervical Adenitis which appeared on the 11th and 16th day only added 7 days to the sum total of their in-patient days. Although in this series the two cases of Otorrhoea had a late onset; 23rd and 13th day, the total in-patient days of these two cases were not markedly increased, their average in-patient period being 33.5 days. This condition yielded to treatment in a much more rapid manner, than was achieved in the open ward.

Concomitant Infections.

There was only one instance of concomitant infection in this second series of cases. This was a male child of the 1-5 age group, admitted as an ascertained case of scarlet fever, there being no possible dubiety regarding a prodromal rash such as described by Willan in 1801.[32] The characteristic vesicular eruption appeared on the tenth day after admission to hospital. This is strongly indicative of an extra-mural infection, with admission taking place during the incubation period.

An interesting observation is that neither the other occupant of the patient's cell (who incidentally had never suffered from this infection) nor any of the other patients within the ward succumed to the disease; yet it is almost certain that the fact that/

that the fact that this case was one of those being nursed in isolation, prevented a second outbreak of varicella within the open scarlet fever ward.

This one case of concomitant infection added 12 days to the mean in-patient days of the patient.

Summation of the increase in In-patient days.

If we now add the number of in-patient days in excess of 28 (which was taken as the mean) for both complicated cases, and cases with the addition of a concomitant infection, we find that 60 days have been added to the total in-patient days of 100 cases treated in this series of two bedded cell isolation.

As will be seen from Table J it was found possible in this series to reduce the average in-patient days of uncomplicated cases to 25.6 days.

THIRD SERIES OF CASES.

Fifty cases of Scarlet Fever treated in single bedded cell isolation.

There were two instances of concomitant infection among these fifty cases, one of varicella, and one of Epidemic Parotitis. As in the two previous series these are not included among the severall/

several findings but are incorporated later. The remaining 48 cases were composed of 46 uncomplicated cases and 2 cases with complications.

Table (α) shows the sex distribution of the complicated and uncomplicated cases.

TABLE (α):-

Sex	Total Treated	No Complications	Complications	% Complications
Male	22	22	-	-
Female	26	24	2	7.7
Total	48	46	2	4.16

As in the two previous series, the sex distribution of all cases treated is almost approximately equal. Males 22, Females 26. The percentage of complicated cases for this series is found to be 4.16%

In this series of cases, female complicated cases only, were encountered, there being no single instance of a male complicated case.

The frequency of complicated cases within the various age groups is shown in Table (β).

TABLE (β):-/

TABLE (3):-

Age group	Total Number Treated	Number with no Complications	%	Complications	%
o- 1	2	2	100	-	-
1- 5	5	4	80	1	20
5-10	21	20	95.24	1	4.76
10-15	9	9	100	-	-
15 & over	11	11	100	-	-
Total	48	46	95.84	2	4.16

As in the two previous series, the greatest number of cases treated in any one age group is in the age group 5-10, yet in this age group there was only one complicated case, giving a percentage complication rate of 4.76% for the group. It is worth noting that in this group the number of female cases treated predominates over the male by 13 to 8.

The highest complication rate is found in the 1-5 age group, where although only one complication case is manifested, this among five cases treated within the group gives a percentage complication rate of 20%.

No complications were found in all other age groups.

Table/

Table (Υ) shows the sex distribution of the complicated cases within the five age groups. As has been previously stated, both complicated cases belong to the female sex.

TABLE (Υ):-

Age group		Number treated	No complications	Complications	% Complications
0- 1	M	2	2	-	-
	F	-	-	-	-
1- 5	M	2	2	-	-
	F	3	2	1	33.3
5-10	M	8	8	-	-
	F	13	12	1	7.7
10-15	M	4	4	-	-
	F	5	5	-	-
15 & over	M	6	6	-	-
	F	5	5	-	-
Total		48	46	2	4.16

Day of Onset of the Complications.

The day of onset of both complications fell within the second/

second week of hospitalisation, namely the 9th and 12th day respectively.

Individual Complications.

Both complicated cases in this series were of the nature of Cervical Adenitis, bilateral in type. Both cases were of the female sex, one in the age group 1-5, the other in the age group 5-10.

Duration of Complicated Cases.

The average duration of this complication which was manifested on only two occasions was six days; the longest duration was seven days, the shortest five days.

Increase in In-patient days.

In all, these two complicated cases added 12 days to the total in-patient days of 48 cases, taking as before, 28 days as the mean for all cases. The relatively early onset of the complications in both instances, combined with the short period of duration, accounts for this moderate increase in the in-patient days.

It will be seen from Table (δ) that in this series it has been possible, both by reason of the general condition of the patients, and because of the freedom from risk of infection, to reduce the average in-patient days of the uncomplicated cases to 24.24 days.

TABLE/

TABLE (δ):-

Type of case	Number	In-patient days 28 + or −	Average In-patient days.
Uncomplicated	46	−173	24.24
Complicated	2	+ 12	34.0

Concomitant Infections.

In this series there were as stated two instances of concomitant infection, one of varicella, and one of epidemic parotitis. Both conditions manifested themselves on the tenth day after admission to hospital. This is strongly suggestive of admission during the incubation period of both infections. The case of varicella occurred in a male patient of the 1-5 age group, the epidemic parotitis in a female of the 15 and over age group. Neither of these patients had any further complication, either of their primary disease or concomitant infection. It is clearly realised just what a potential danger both would have been if treated in the open ward - a fact impossible to guard against in our so called "Isolation Hospitals."

The duration of the concomitant infection was of short duration in most cases, and in all only 5 days were added to the mean in-patient days of these two cases.

Summation/

Summation of the increase in In-patient Days.

By adding the number of in-patient days in excess of 28, for both complicated cases, and cases suffering from concomitant infections, we find that 1⅞ days have been added to the total in-patient days of 50 cases treated in complete isolation within single bedded cells.

Summary and comparison, of the various findings in the three series of cases.

At the outset of this investigation it was considered highly probable that there would be a marked difference between the number of complicated cases occurring in the series of cases treated in the open ward, and those treated in complete isolation. Such a finding has been proved beyond question by many investigators among whom Lichtenstein, of whom previous mention has been made, was among the foremost. He it was who found that complications in scarlet fever cases treated in isolation amounted to less than one third of those in cases treated in the open ward. The same great reduction in the complication rate in cases treated in two bedded cell/

cell isolation was considered to be too much to hope for, although a considerable reduction was looked for. Indeed if such were not the case, and there was but slight diminution of the complication rate in this series, then this method of nursing would have little or nothing to recommend it.

Although it was not thought possible to reduce the complication rate in this series to the same level as it was aspired to achieve in the single bedded cell isolation series, one had hopes that it would, at most, be no more than double the figure of that series. Should such prove to be the case, then surely this method of nursing might prove of the greatest value in hospitals with but inadequate and out-dated isolation accommodation.

Table I shows the frequency of complications in each of the three series, with the percentage complication rate for each series.

TABLE I:-

Series	Total Treated	No Complications	Complications	% Complications
Open ward	185	147	38	20.54
Two Bedded Cell	99	93	6	6.06
One Bedded Cell	48	46	2	4.16

From this table it will be apparent to what a great extent

both/

both forms of isolation nursing have reduced the complication rate.

The complication rate in the single cell isolation series is only one fifth of the complication rate in the open ward, while that of the two bedded cell series is less than one-third. Although the complication rate in the open ward appears to be high when compared to the other two series, this is far from being the case, when the figure is compared to findings in other hospitals. George and Gladys Dick[33] state that in a series of 2,303 cases of scarlet fever in the Durand Hospital, Chicago; the percentage of patients with complications was 34.7%.

Although the number of cases treated is unfortunately small, when compared to the rather overwhelming figures of other larger hospitals, of which the above is one example only, still it is gratifying to see how well the present findings in the open ward of this hospital compare. Gratifying, but at the same time highly unsatisfactory and disquieting when it is so clearly seen from the findings of the cases treated in either form of isolation, that in all probability, and allowing for the law of averages, these complicated cases might have been reduced to one third or even one fifth, if suitable isolation accommodation had been available.

It is indeed pleasing to find the great reduction in the complication/

complication rate achieved by the two bedded cell isolation method. The percentage complication rate of 6.06% compares very favourable with the 4.16% for cases treated in complete isolation.

It may well be that chance and good fortune played some part in the pairing of the individual couples, whereby several were possibly infected by the same primary type of streptococcus, and were therefore less liable to the possibility of a potential cross-infection or re-infection. Chance and good fortune indeed may have done much, but again let it be understood that no assistance was given by means of selective pairing or typing of the primary infecting organism. Allowing for all such possibilities, the figures achieved, when compared to the corresponding figures of the open ward, surely speak for themselves as the strongest advocates for the institution of this method of semi-isolation nursing wherever applicable, and wherever complete isolation is meantime impossible.

Concomitant Infections.

The "bête noire" of concomitant infections showed itself all too frequently in all three series. As was to be expected, this was most marked in the open ward, where as has been shown, they caused a serious increase in the in-patient days. In series II, (two bedded cell) although there was only one case, the increase in/

in in-patient days was high. The two cases arising in series III added but little to the in-patient days.

Although these infections are events that must always be looked upon with foreboding, they are only of any real danger and importance when encountered in open ward nursing. Vexatious they certainly are in all forms of nursing, but their teeth indeed are drawn when the outbreak occurs in a case being treated in cell isolation. Here the spread can most definitely be curtailed by nursing technique and care. Such is not the case in the open ward, where the best nursing is quite powerless to prevent a rapid dissemination of the infection by dust and droplet nuclei. Even if in years to come ways and means are found whereby these two potent sources of infection can be combatted successfully - and there are signs - what with the present investigations being carried out with Ultra Violet Irradiation[34] and Aerosols[35] - that this may well be the case, none the less it will still be beyond the powers of man to diagnose a concomitant infection in its early incubation period. Such being the case these patients will continue perforce to enter the open wards of our isolation hospitals, a menace to their fellow ward companion's, and a heartbreak to their medical attendants. One wonders how long such a prehistoric method of treatment will be tolerated by the civilian far less the medical community.

Table/

Table II shows the increase in in-patient days brought about by concomitant infections in the three series.

TABLE II:-

Series	Total Number	Increase In-patient Days.
Open ward	15	219
Two Bedded Cell	1	12
One Bedded Cell	2	5

Individual Complications.

In all three series the first three places for frequency of individual complications were held by Cervical Adenitis, Otorrhoea and Rhinitis, in that order of precedence. Secondary Tonsillitis, Septic Spots, Secondary Scarlet Fever and Jaundice were entirely absent from the two isolation series of cases. It may be, and such findings are strongly suggestive, that these complications are most frequently caused by a true cross-infection. The possibility of cross-infection being so greatly lowered in the two-bedded cells, and completely absent in the one bedded cells, make it impossible for these complications to take place.

Table III shows the frequency of the individual complications in the three series.

TABLE/

TABLE III:-

Open Ward			Two Bed Cell			One Bed Cell		
Cervical Adenitis	9	4.9%	Cervical Adenitis	2	2.02%	Cervical Adenitis	2	4.14%
Otorrhoea	8	4.3%	Otorrhoea	2	2.02%			
Rhinitis	8	4.3%	Rhinitis	1	1.01%			
Secondary Tonsillitis	5	2.7%						
Septic Spots	4	2.2%						
Rheumatism	2	1.1%	Rheumatism	1	1.01%			
Secondary Scarlet Fever	1	0.54%						
Jaundice	1	0.54 %						

Duration of Individual Complications.

It will be observed from the various findings in the three series, that in those complications which are comparable, namely Cervical Adenitis and Otorrhoea, there is a definite shortening of the duration period with the one exception of Rhinitis. This curtailment is strikingly illustrated in the case of Otorrhoea, and as it has previously been noted that this complication holds a high position of frequency in the first two series, it is clear that/

that such a complication which is dominant in these respects, must of necessity have a serious influence on the increase in in-patient days. The reduction of the average duration of this complication, which was 15.7 days in the open ward, to the very reasonable figure of 5 days in the two bedded cell series, bears out the contention made elsewhere that it is never possible to treat a discharging ear in the open ward with any satisfaction, or with hope of a rapid amelioration of the condition.

The duration of Cervical Adenitis as a complication was also reduced in both isolation series, though not to the same degree as was experienced in the case of Otorrhoea; the average duration was similar in both isolation series. This complication was also of high frequency in two of the series, and therefore any abbreviation of the duration, no matter how short it be, has an appreciable effect on the in-patient period.

It is perhaps unfair to compare the duration of Rhinitis in series I and II; as there was only one instance of this complication in the latter series, compared to eight manifestations in series I. Although the average duration in series II was eight days, compared to the seven day average in series I, the longest individual duration in series I was ten days.

TABLE/

TABLE IV:-

Average duration of complications.

Complication	Average Duration.		
	Series I	Series II	Series III
Otorrhoea	15.7	5	-
Septic Spots	12.0	-	-
Jaundice	10.0	-	-
Cervical Adenitis	8.8	6	6
Rheumatism	8.0	5	-
Rhinitis	7.0	8	-
Secondary Scarlet Fever	7.0	-	-
Secondary Tonsillitis	5.6	-	-

Day of onset of Complications.

It will be seen from Table V that taken all over, there is but little difference in the day of onset of the several complications in each series of cases, the great majority of all complications arising during the second week of hospitalisation. In the two bedded cell isolation series, complications were if anything a little later in developing, three out of a total of six appearing during the third week. Apart from this, little is found to comment upon the day of onset.

TABLE/

TABLE V:-

Day of onset of the individual complications in the three series.

Complication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Cervical Adenitis	-	-	-	-	-	-	-	3	½	3	1½	½	-	-	-	½	-	1	-	-	-	-	1	-	-	-	-	-	-
Otorrhoea	-	-	1	1	-	1	-	1	-	-	-	1	½	1	-	-	-	-	1	-	-	-	½1	-	-	-	-	-	-
Rhinitis	-	-	1	-	1	1	-	2	-	2	1	-	-	-	-	-	½	-	-	-	-	-	-	-	-	-	-	-	-
Secondary Tonsillitis	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-
Septic Spots	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Rheumatism	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	½	-	-	-	-	-	-	-	-	-
Secondary Scarlet Fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Jaundice	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				8						20	2.	2.					6	3.						4	½				

Type = Open ward series.
Red = Two bedded cell series.
Green = One bedded cell series.

Increase in In-patient days.

Although there would appear to be little difference in the average in-patient day period of the uncomplicated cases in all three series, the saving of even two to three days in each case treated amounts to quite a formidable figure when a hundred or even fifty cases are being considered. We see from Table VI that it was possible in series II to deduct 222 days from the sum total of the mean in-patient days of ninty three cases, and that in series III 173 days are able to be deducted from forty six uncomplicated cases. What is more striking is that in the open ward thirty eight complicated cases brought about the addition of 279 extra in-patient days to that series of cases, and that in series II six complicated cases only added 48 extra in-patient days.

Any small reduction in the normal in-patient days of uncomplicated cases is welcome, but what is more to be desired is the reduction of complications, which must always, no matter where they be nursed, add an appalling increase to the in-patient days of any series of cases.

Concomitant infections are likewise grave offenders in raising the total of in-patient days. In the small series of cases treated in the open ward (200), fifteen cases of concomitant infection accounted for 219 additional days.

~~TABLE~~/

The age and sex distribution of the complicated cases, in the three series treated.

In all three series the largest number of cases treated in any one age group was to be found in the 5-10 group. With the exception of series II, the greatest number of complications were also placed in this same age group, but if the actual number of cases treated in each age group is taken into consideration, as they needs must, we find that the highest complication rate is not once found in this age group. In series I, it is in the 10-15 group, in series II, in the 15 and over group, and in series III, in the 1-5 group. If we examine these several series in more detail, we see that those age groups have the highest and second highest percentage complication rate in each series, in which the female cases treated predominate over the male cases treated.

A tentative explanation for the reversal of these findings in series II, has already been propounded. Apart from this one instance, there is no doubt in the writer's mind that the female in all age groups is more prone to the complications of scarlet fever, than is the male. This point is clearly substantiated in this investigation when attention is given to the various sex and age group distribution tables.

TABLE/

TABLE VI:-

	Series I			Series II			Series III		
	Number Treated	Increase or decrease from mean	Average In-patient days	Treated	Increase or decrease from mean	Average In-patient days	Number Treated	Increase or decrease from mean	Average In-patient days
Uncomplicated Cases	147	-53	27.64	93	-222	25.6	46	-173	24.2
Complicated Cases	38	+279	35.3	6	+ 48	37.7	2	+ 12	34.0
Concomitant Infections	15	+219	42.6	1	+ 12	40.0	2	+ 5	30.5

Increase in In-patient days.

TABLE VII

Age Group	Series I			Series II			Series III		
	Number Treated	Number with Complications	% Complication	Number Treated	Number with Complications	% Complications	Number Treated	Number with Complications	% Complication
M	-			0			2		
0- 1	-	-	-	1	-	-	2	-	-
F	-			1			0		
M	23			13			2		
1- 5	50	10	20.0	30	1	3.3	5	1	20.0
F	27			17			3		
M	41			16			8		
5-10	76	15	19.7	33	1	3.07	21	1	4.76
F	35			17			13		
M	12			4			4		
10-15	31	8	25.8	8	-	-	9	-	-
F	19			4			5		
M	18			18			6		
15 & over	28	5	18.0	27	4	14.8	11	-	-
F	10			9			5		
	185	38	20.54	99	6	6.06	48	2	4.16

Combined sex and age group distribution of the complicated cases in the three series.

In series I, male cases had a complication rate of 15.96%; female cases 25.27%.

In series II, male cases had a complication rate of 9.8%; female cases 2.08%.

In series III, male cases had a complication rate of nil%; female cases had a complication rate of 7.7%.

Indubitably the female sex is the weaker sex with regard to their propensity towards the common complications of scarlet fever. It is difficult to reconcile this finding with the accepted fact concerning the definite higher mortality rate in male scarlet fever cases.

In view of these findings it is suggested that if isolation accommodation is limited, preference should if possible be given to female cases, whose need for isolation treatment appears to be greater than that of the male.

CONCLUSION.

In this investigation an attempt has been made to combat the all too frequent complications and concomitant infections which occur in all scarlet fever wards with unfailing regularity year after year.

Presupposing that the majority of these complications owe their mode of origin to a cross-infection from one or other member of/

of the open ward, two series of cases were treated in isolation, one series in complete single bedded cell isolation, the other in two bedded cell isolation with a series of patients in the open ward taken as a control.

It was hoped to demonstrate by this double bedded cell isolation method, that it is possible by so using the limited isolation accommodation presently available in most infectious diseases hospitals, to approach somewhere near the standards of excellence achieved in the single cell isolation technique.

This hope has been substantiated and justified by the results achieved in the series of cases examined.

Observations have also been made on the length of the in-patient day period in each series, and comparisons made. The sex and age distribution of the several complications have also been considered and benefit derived therefrom. The day of onset, and duration of the individual complications have also proved illuminating.

The control of cross-infection has of late received much publicity in medical literature. Leading authorities in the epidemiological world of medicine have put forward suggestions regarding ways and means whereby this danger of the open ward may be ameliorated or completely eradicated. Cruichshank[36] considers that much could be done by paying more attention/

attention to the following points.

(1) Attention on admission to hospital.

(2) Full use of up to date laboratory methods.

(3) Control of dust in the wards.

(4) Intelligent co-operation on the part of the nursing staff.

Cooke and Neisser[37] propose the use of separate open wards for different types of infection of the same infecting condition (Type Wards). All such suggestions are excellent, and having been applied in various hospitals have more than proved their worth. It may well be that in the near future by employing the above methods in conjunction with Aerosols, ultra-violet light radiation, spindle oils and yet undiscovered adjuvants to sterility, we may be able to make an open scarlet fever ward a fit place in which to nurse human beings. At the moment such is not the case.

Nursing cases of scarlet fever in the open ward is a very poor substitute for home nursing under conditions where isolation is at all possible, and, in the writer's opinion at least, the risk of home nursing under almost any conditions is preferable to the untold risks which every child must accept on entering an open ward. "Rather bear those ills we have, than fly to others that we know not of." Inconvenient this home/

home nursing may be to many families, but surely it can only be the ignorance of the lay public which permits of such risks being taken. Ignorance in such matters is pardonable in those who do not know the facts, but we of the medical profession who permit of such conditions and complacently consign our scarlet fever cases to the open ward of the local Infectious Diseases Hospital, are indeed proving to the hilt the words of Sir Thomas Sydenham[38] who once stated that Scarlet Fever was a disease seldom fatal except for the excessive zeal of the doctor. Nothing surely is more heart breaking than to admit a child to hospital on account of some simple condition, and for that child to undergo some severe complication, or to contract some concomitant infection, either of which may result in permanent disability or even in fatal results; and to realise that had the child been treated at home, or had adequate isolation accommodation been available, the tragedy might never have happened.

The nursing of scarlet fever cases in the home would not be advocated, if it were considered to the child's advantage to have him nursed in hospital, but at the moment this is not the case, and will not be, until such time as all isolation hospitals are worthy of the name of "Isolation," and are able to provide it where it is most required.

There/

There are already signs that in the post-war medical Utopia to which we look forward with high hopes, and not a little trepidation, steps may be taken to alleviate this problem. The recent memorandum "Control of Cross-Infection in Hospitals"[39] states, "When building is contemplated, the prevention of cross-infection should have an overriding consideration."

In the meantime we must work with whatever available facilities we have to hand, and employ them to the greatest service for the greatest number of patients.

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