THE VALUE

OF

IMMUNOLOGICAL AND BACTERIOLOGICAL TESTS
IN THE

MANAGEMENT OF SCARLET FEVER

bу

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ProQuest LLC. 789 East Eisenhower Parkway P.O. Box 1346 Ann Arbor, MI 48106 – 1346 PREFACE.

I desire to express my thanks to Dr.William Dow, the Medical Superintendent of Knightswood Hospital, Glasgow, for his permission to embark on the work, for the facilities provided and also for the benefit of his wide experience in the corroboration of the diagnosis of the cases. I am also greatly indebted to him for the kindly encouragement he has at all times shown and without which it is doubtful if the work would have been completed as expeditiously as has been possible.

My thanks are also due to the Nursing Staff for making the necessary preparations for the work performed in the wards; to the Ward Sisters for their kindness in reproducing the various ward charts included in Volume II.; and to my colleagues at Knightswood Hospital for their forbearance and encouragement and for assistance in the reading of the proofs.

H.W.O.F.

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INTRODUCTION.

The following thesis is based on work carried out in the Scarlet Fever Pavilions at Knightswood Hospital, Glasgow, during the two years 1929 and 1930. It is divided into two volumes, the first containing an account of the work performed, the second, the relevant Tables, Graphs and Ward Charts.

Volume I. is divided into two main parts which deal respectively with a critical survey of the reactions to the Dick Test noted on patients suffering from Scarlet Fever in its acute stages and with an investigation into the persistence of Haemolytic Streptococci in the throats of convalescent Scarlet Fever Patients.

Both Sections are further subdivided and each sub-section is prefaced by a short outline of the work under consideration in the section. The sections are illustrated by Tables and Graphs and where possible these have been incorporated in the text. To facilitate reading the larger ones are omitted and are collected for reference in Volume II.

PART I.

The Dick Test in the Acute Stage of Scarlatina.

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- B. The Early Negative Reactors to the Dick Test.
- C. Variations in the Results obtained from the Dick Test.

A. The Dick Test.

Material used for Tests.

Procedure employed in performing the Test.

The Reading of the results to the Test.

The Results obtained from the Test.

Comparison of Results with those obtained by other workers.

Discussion.

THE DICK TEST.

1. The Material.

In the present investigation the reaction to the Dick Test was studied from day to day on 300 consecutive These cases were admitted to hospital certified patients. to be suffering from Scarlet Fever and, in all, the diagnosis was confirmed before they were included in the series. most of the cases the Scarlet Fever encountered was mild or moderately severe in type and in this respect was representative of the usual variety of Scarlatina present in the city. The patients were drawn from all ages, but the great majority lay in the age group 3-15 years. Their social standing too varied, but in most cases they were drawn either from the poorer districts of the city or from the houses of the lower middle class. The object of the work was to study in detail the daily variations of the reaction to the Dick Test in each case, and, to this end, the daily tests were continued as far as possible without interruption, until two consecutive negative results to the test were obtained.

For convenience the cases were divided into three groups each consisting of 100 patients.

Two Hospital Pavilions were available for the treatment of the cases; each pavilion consisting of a ward for male patients and one for female patients. In the case of one of these pavilions (No.10) the accommodation for the different sexes was further divided into two portions each completely separated from the other. These divisions were used, one for acute cases and the other for cases which had been ill for two weeks or more. As the patients passed into convalescence, i.e. after they had passed the 14th.day of their illness, they were transferred from the acute ward into

the convalescent ward and so escaped, as far as was possible, the risk of reinfection by exposure to fresh or acute cases. In the second Hospital Pavilion (No.9), no such sub-division existed and acute and convalescent cases were, perforce, treated in the same ward. Here the acute cases were retained, as far as possible, at one end of the ward and the convalescent ones at the other end. Two of the three groups of cases, Nos.1 and 3 (cases 1-100 and 201-300) were treated in Pavilion 10, while group No.2 (cases 101-200) was accommodated in Pavilion 9.

The Toxins employed in the work were supplied by Messrs.Burroughs, Wellcome & Co. and Messrs.Parke, Davis & Co. Regular supplies of these toxins were arranged for and in every case each supply was used up within three, or, at the most, four days after receipt. At some periods of the work the 5cc of Toxin procured was exhausted on the day of delivery and in this way the toxin was always fresh and was always used up long before the date of expiration as marked on the bottle. All the toxins were stored in the ice chest (4°C.) until required for actual testing. The toxins supplied by Messrs.Burroughs, Wellcome & Co. were used for the tests on the patients in groups 1 and 3, i.e. those cases treated in Pavilion No.10, while the remaining cases, group 2, or those treated in Pavilion No.9, were tested with toxins supplied by Messrs.Parke, Davis & Co.

2. Procedure.

In all, nearly 1500 Dick Tests were performed. While many methods have been described for the carrying out of the Dick Test, the performance of a large number of tests will result in the operator adapting and becoming proficient in a technique suited to his own requirements. The method adapted

in the present inquiry was along the following lines.

Each of the two pavilions maintained a "Dick Tray" on which were kept the various syringes, needles and lotions employed in the work. The syringes used were all glass "Agla" hypodermic syringes of lcc. capacity and were graduated to 0.1 of a cubic centimetre. Two syringes were kept on each tray, one for use with the Dick Test Toxin and the other for the control test. They were so marked that they were easily distinguished one from the other and were kept in small marked bowls containing a l in 20 solution of Carbolic Acid.

This method of sterilisation was preferred to boiling on account of the fact that after being boiled on several occasions the syringe became opaque, thus rendering the reading of the graduations difficult and also, on account of the fact that the component parts of the syringe became slack and did not fit well together, due to differences in the amounts of expansion and contraction of the barrel and piston of the syringe. The syringes were examined periodically to ensure that they were functioning properly. The nozzle of the syringe was occluded by a finger of the left hand and the piston was forced down with pressure from the right hand and if the parts were fitting correctly the piston sprang back to nearly the zero mark when the pressure exerted by the right hand was suddenly relaxed. As considerable force was required for the performance of the Dick Test only syringes which passed this test were employed. The needles used were No.214 stainless steel needles. They were 12 mm. in length and their bore corresponded to No.27 on the standard wire gauge. Both needles and syringes were supplied by Messrs. Burroughs Wellcome & Co. After use, the needles were syringed through with sterile water. boiled in water and finally stored in a small bowl containing methylated spirit. The remaining articles carried on the Tray

were, a bowl of sterile water, a bowl of methylated spirit, a jar of sterile swabs and a skin pencil. The Toxins and Control solutions were procured from the ice chest as required and supplied to the Trays.

The tests were performed, as far as possible, during the forenoon; an exception to this rule was made, however, in the case of a patient who was admitted during the afternoon or evening. Such patients were tested for their reaction to the Dick Test on their admission to hospital. The Dick Test Toxin and the Control solution, toxin heated to 100 degrees C. for at least one hour, were injected into the skin of the flexor aspect of the forearms, the injection with the test toxin being made into the left forearm and that with the control dilution into the right forearm. The syringes were removed from the carbolic solution and all traces of this antiseptic were thoroughly removed by drawing up and forcing out several syringefuls of sterile water. The needles were. thereafter, washed through with sterile water in order to remove all traces of the methylated spirit in which they had been stored. After the forearms of the patient had been swabbed with gauze soaked in methylated spirit, the toxin and control solutions were injected into the proper forearms. great care being taken to ensure that the injection was truly intracuticular and not subcutaneous. The needle was introduced very superficially into a little fold of skin produced by the thumb and forefinger of the left hand and then forced through the cuticle for a distance of about # of an inch. By introducing the needle through this distance it was found that there was little chance of the injected fluid escaping along the needle track on the withdrawal of the needle. After the needle was in place it was possible to observe its outline as a dark line under the skin and to be able to define its

point. Should these two conditions not be fulfilled the assumption was that the needle had been introduced too deeply and in such cases it was withdrawn and reintroduced into the skin. When the needle was properly inserted the piston was forced down, considerable force often being required, and the fluid forced into the cutis. In a well marked, properly performed test, the injection showed up as a white circular wheal with a well marked, raised margin and a definitely foveated surface; the foveation being caused by the presence of hair follicles on the skin.

The Dosage of the different toxins varied: 0.2cc. being the dose recommended for use with the toxin and control solutions prepared by Messrs.Burroughs Wellcome & Co., and 0.1cc. for the toxin supplied by Messrs.Parke Davis & Co.

In work on the Dick or similar Tests the question of the Control injections is always an important point. control solution was, or is at present, supplied by Messrs. Parke Davis & Co., who stated that, on account of its very low protein content, no control injections were required when the Dick Test was performed with their toxins. With regard to the products of Messrs.Burroughs Wellcome & Co., Dr.R.A. O'Brien, in a personal communication, stated that controls were unnecessary when working with Dick Test Toxins prepared by that firm. During the present work a very considerable number of control tests were performed and the results bear out these opinions. In cases 1-100 (Group 1) every individual Test was controlled with control solutions, in cases 201-300 (Group 3) each patient received one control injection, while in Group 2 (Cases 101-200) no control tests were performed.

3. Readings.

The results were read and recorded 24 hours after

the performance of the test. In practically all of the cases the readings were made in the forenoon and in no instance was a reading made in artificial light. The cases were observed after the first 12 hours and in those which later proved to be positive reactors a faint flush was already present over the site of injection. The intensity of this flush varied in degree according to whether the case proved to be a strong positive or a weak positive reactor. In some cases, however, this state of progression did not follow on the usual lines: in those instances little or no reaction was noted during the first 12 hours but rapidly developed in the following 12 hours. After 24 hours the majority of the reactions began to fade and in a large number of cases was practically invisible after 48 hours. In some cases the site of injection was marked by a dull bluish-purple staining which tended to persist for as long as a week. This mottling seemed to occur more readily in certain individuals and in these patients as many as seven or eight marks were discernible after a fortnight of daily tests. In a very small number of the cases (less than 1% of the series) "pin point" or scarlatinal desquamation was observed over the injection site.

A point of interest which may be referred to briefly is the fact that it was noted that the skin developed a local insusceptibility to the Dick Toxin while the body as a whole remained susceptible. If two Dick Tests were performed, one on the site of a former test and the other to the side of this one, the reactions when read 24 hours later showed striking differences. The reaction to the test on the site of the old injection was usually of smaller area and of a lesser degree of intensity than that of the test performed on the normal skin. Such results point to the formation of a cutaneous insusceptibility to the Dick Test Toxin by the skin. This cutaneous insusceptibility or immunity has also

been noted by Zingher in New York. It appears to be due to the action of the toxin on the tissues of the skin themselves and is developed long before the body tissue has become immune as shown by a negative result to the Dick Test.

Results which demonstrate this point are shown on Table 1.

TABLE 1.

THE LOCAL INSUSCEPTIBILITY DEVELOPED BY THE SKIN
TO THE DICK TEST TOXIN.

	TEST	1.	TEST 2.				TEST 3.			
			Contr	ol.	Super:		Cont	rol	Super:	
Patient	Area	Inten-	Area	Inten-	Area	ryfey.	Area	Inten-	Area	Inten-
	Sq.cm		Sq.cm.		Sq.cm		Sq.cm		Sq.cm	
RB	2.98	6	3.6	6	3.5	4	3.3	5	2.3	3
MB	3.9	6	4.9	7	4.9	5	8.0	6	4.9	3
DW	2.4	5	3.6	5	2.9	3	3.8	5	1.9	2
TB	5.5	4	7.2	4	5.3	3	5.9	4	3.3	2

The Degree of Intensity of the Reactions was assessed according to the values noted on the Scale reproduced on the following page.

It will be noted, from a study of the above figures that in most cases the value of the "Superimposed" Test was smaller, both with regard to its area and also its intensity, than that of the Control Test. Attempts were made to carry this work on to the 4th. and 5th. Tests but owing to the staining produced at the site of the superimposed injections the readings made after these tests were difficult to assess and therefore unsatisfactory and for this reason the tests were not carried out beyond the 3rd.Test.

Each result was noted with regard to its area and

and to its intensity. Two diameters were measured and recorded in millimeters, the area being calculated from the formula, Area = \tilde{n} r² where \tilde{n} = 3.14; while the intensity of the reaction was noted by means of the following scale.

SCALE BY WHICH DEGREE OF INTENSITY OF REACTION TO DICK TEST WAS RECORDED.

, 0	1	2	3	4	5	6	7
Neg.	Flush.	Very faint.	Faint.	Ord.	+	+ +	+++

The different degrees of intensity were differentiated in the following manner.

- O. Negative.
- 1. Very faint but definite positive. A flush was present but it was not possible to measure it accurately.
- 2. This reaction was pink in colour and was quite measurable.
- 3. The "Faint" reaction was definitely marked and readily measured. Its colour was deep pink.
- 4. This was the ordinary type of reaction. Its borders were well marked, often sharply demarcated, but there was an entire absence of oedema of the tissues. In colour it was a well marked red.
- 5. This reaction resembled No.4. In this case the colour was bright red and in some patients the area of the reaction was slightly oedematous.
- 6. In the "two plus" reaction the colour was very intense.
 There was marked oedema of the skin.
- 7. In this group, of which very few members were met, were included those reactions which, by reason of their exceptionally bright colour, large area and marked oedema, appeared to exceed the limits of Group No.6.

In employing such a scale it was recognised that the readings could only be regarded as arbitrary. In many cases the readings were borderline examples and it was difficult to decide to which class they should be assessed. However, as all the readings were made by the same observer, as all the cases were consecutive ones and as the manner of

performance of the test and conditions of lighting at the readings were the same throughout the entire series, the readings may be considered as comparable one with the other.

The Results obtained from the Dick Tests on the 300 patients are recorded in Table 2 which is reproduced in Volume II. of this work.

4. Results.

When the results of the Dick Tests performed on patients on the day of their admission to hospital were considered, it was evident that the results could be divided into three main groups, namely:-

- A. Positive Results.
- B. Irregular Results.
- C. Negative Results.

The allocation of cases to Groups A and C was quite obvious: the patient being either definitely positive or giving a totally negative result which was followed, in the latter cases, by a second negative result when the patient was re-tested on the following day. Group B, however, was rather In this group the patients gave a negative result to the first Dick Test but, on being re-tested on the following day, were found to have become positive reactors to the test. Several variations in the results were noted in this group of patients, varying from the simple -+-, to -++-, -++--, -++-.-+ and even to alterations on the following lines -+-++-. puzzling type of result is dealt with more fully in a later section and, while no reference to such a variation in the results has been found in the literature, its occurrence has been noted by various workers. Zingher, in 1924, published a table of results to the Dick Test, performed on patients suffering from Scarlatina, in which he has recorded instances of cases in which was noted an alteration from a positive

reaction to a negative one and then back to a positive result. These variations, however, occurred during the period of convalescence. Reid, recording the results obtained from work on the Dick Test carried out at Motherwell, has also published a table in which he showed that when a series of patients, suffering from Scarlet Fever, was subjected to the Dick Test at intervals of one week, the percentage of positive reactors obtained in the series varied from week to week and, in one week, the fifth week of residence in hospital, showed a marked rise.

The results obtained from the Dick Tests performed on the 300 patients on the day of their admission to hospital may be summarised in the following tables.

TABLE 3.

In this Table only those cases which gave a positive result after their first test were recorded as Positive Reactors, the Negative and Irregular Cases being combined as Negative Reactors.

No. of Cases.	No. of Positive Results.	% Positive.
300	142	47.3%

The Irregular Group consisted of 30 patients which amounted to 10% of the total number of cases under review. If these cases, all of which gave a positive result to their second Dick Test, were classed as positive results, the number and percentage of positive reactors was increased and has been shown in Table 4.

TABLE 4.

No.of Cases.	No.of Positive and Irregular Results.	% Positive.
300	172	57.3%

It has already been noted that the toxins used for the Dick Tests performed on the 300 patients were supplied by Messrs.Burroughs Wellcome & Co. and Messrs.Parke, Davis & Co., the former being used for cases 1-100 and 201-300 and the latter for cases 101-200. It is interesting to compare the results obtained in each of these groups of patients both with regard to the bearing they have on the results recorded in Tables 3 and 4 and also for comparison with each other.

TABLE 5.

		React	ion to Dick	Test.
Source of Toxin.	Nos.	Positive.	Irregular.	Negative.
B.W.& Co.	1-100	40	8	52
P.D.& Co.	101-200	59	9	32
B.W.& Co.	201-300	43	13	44

Messrs.Parke Davis & Co. give one the impression of being more powerful than the products of Messrs.Burroughs Wellcome & Co. The type of patient was practically the same throughout the whole series so that we must look for some other explanation for the greater incidence of Positive reactors among the patients tested with the Parke Davis & Co. Toxin.

A further experiment was undertaken in which the same patient received two Dick Tests simultaneously one with each brand of toxin. A considerable number of tests were made and Table 6 has been constructed to illustrate the type of result which was obtained. While Table 5 showed that the Parke Davis & Co. brand of Dick Toxin yielded a higher percentage of positive reactors than the Burroughs Wellcome & Co. variety, the results exemplified in Table 6 showed clearly

that the latter Dick Toxin not only gave larger and more intense reactions but, in most cases, gave Positive reactions for some days after the Parke Davis toxin had ceased to produce positive results. This fact complicated rather than simplified the problem of effecting any accurate comparison between the two brands of commercial Dick Toxin. This question will be discussed in a fuller manner in the sections dealing with the effect of "Age" and "Days Ill" on the reaction to the Dick Test.

COMPARISON OF RESULTS WITH THOSE OBTAINED BY OTHER WORKERS.

It has thus been shown, Table 3 and 4, that, of the 300 cases tested with the Dick Test on admission to hospital, only 47.3% were found to give a positive result. If we included, as positive reactors, those cases, 30 in number, which though having given a negative result to their first test were found to react in a positive manner to the second test which was performed on their second day of residence in hospital, the total percentage of positive reactors among the 300 cases was raised to 57.3%. This figure fell far short of the results claimed for the test by workers in America.

Zingher performed the Dick Test on 190 patients suffering from Scarlet Fever during the early days of their illness and found that they gave the following reactions.

TABLE 7.

Number of Days ill before Dick Test.	Number.	Dick Positive.	% Dick Positive.
1 - 5 6 and over.	141 49	141 8	100% 16.5%
Total,	190	149	78.4

The same worker recorded the results which were

obtained when the Dick Test was applied to a further series of Scarlet Fever patients at the time of their admission to hospital. These results have been appended in Table 8.

TABLE 8.

Number of days ill before Dick Test.	Number.	Dick Positive.	% Dick Positive.
1 - 5 6 and over.	201 80	197 16	98% 20%
Total,	281	213	78.8%

Results which gave percentages that approximated closely to the results obtained by Zingher were obtained by Benson and Simpson during work on the Dick Test performed in Edinburgh. They tested 50 cases of Scarlet Fever, admitted to hospital during the first three days of illness, with toxins supplied by Dr.R.A.O'Brien of the Wellcome Physiological Research Laboratories and also with toxins prepared by Professor T.J.Mackie of Edinburgh from haemolytic Streptococci obtained from throat swabs taken from patients suffering from Scarlet Fever in its early stages. With the London Toxin they obtained positive reactions in 100% of the cases while with the Edinburgh Toxin 98% of the patients were found to give positive results.

It will be noted that the percentage of Positive Reactions obtained in the present work was on a much lower scale than such figures. In none of the three groups, which were investigated, did we obtain figures which approximated to the results obtained by these workers.

It is interesting to observe that other workers have also recorded results which fall short of the claims originally made for the Dick Test. Ker of Edinburgh in his series of tests was unable to obtain figures as high as those recorded by American workers. W.A.Horne, working in Knightswood

Hospital during the years 1925-1926-1927, examined the reactions to the Dick Test on a series of 483 patients. results were on a much lower level than those already cited and may be summarised in the following manner. Of the patients tested, those in the first three days of their illness yielded positive results in 52% of the cases, those tested during the "Days ill" Group 4 - 7 days 56%, those tested from the 7th. to the 10th day of illness 40.4%, while if the cases were arranged in one series the percentage of positive results obtained during the first ten days of illness was 50.5%. Reid, working in Motherwell during 1925, examined the Dick Reaction on 75 cases of Scarlet Fever admitted to hospital on the 1st. to 14th. day of illness. In this series he obtained positive results in 29.3% of the cases, but if only those cases which were admitted on the 1st. to 5th. day of their illness were considered the percentage rose to 39.5%.

Further work by Brown in Motherwell and reported by Reid yielded somewhat different figures.

Day of Disease over 1 2 4 7-14 3 5 6 14 Number Positive 9 21 51 47 36 8 9 4 Number Negative 6 18 17 17 15 7 3 5 Total 15 69 64 53 36 11 16 9 % Positive 60% | 73.9% | 73.4% | 67.9% | 58.3% | 72.7% | 56.2% | 44.4%

TABLE 9.

It is evident, from a study of these figures, that very varied results have been noted by the different observers, and it is difficult to determine the real degree of variation from the above figures as, in order to ensure that they would be comparable, it would be necessary to compare them with regard to definite "days ill" groupings. The sex and age of

the patient together with their social standing is also of importance as the degree of partial immunity which it is customary to attribute to all patients will vary with these factors. While recent work on the Schick Test amongst the population of Iceland may cast doubt on such a state of affairs it has been noted by many observers that children of the poorer classes develop a greater and more rapidly formed immunity to the zymotic diseases of childhood than those of the more fortunate classes. When investigating the value of the Schick Test, Zingher found that this factor was one of importance and he also maintained that race and hereditary tendency had a considerable influence on the reaction to the Schick Test. A similar state of affairs has been observed in connection with the Dick Test. Dyer, Caton and Sockrider and Nesbit have shown that immunity to Scarlet Fever as assessed by the Dick Test is developed more rapidly in the male than in the female. The sex, age and social standing of patients admitted to Infectious Diseases Hospitals remains fairly constant and thus if the results of the Dick Test on these patients are considered according to the stage of the disease at which the individual tests were performed, the results will be comparable.

COMPARISON OF RESULTS WHEN ARRANGED ACCORDING TO "DAYS ILL".

The results obtained from the Dick Tests on the 300 patients were arranged according to the "Days Ill" at which the tests were performed. Unless the total number of cases tested on each day is sufficiently large it is difficult, if not almost impossible, to place too much reliance on the percentage of positive results obtained among them. For this reason only those cases which were tested during the first

five days of their illness were considered suitable for comparison with the results obtained by other investigators. During these first five days the Dick Test was found to yield positive results in 55.14% of the 243 patients who were included in this group.

TABLE NO.10

tested.	Positive	Positive.
243	134	55.14
57	3 8	66.6
	243	243 134

The percentages were calculated for each day and the results are shown in Table 11.

TABLE 11.

Day of Illness on which tested.	lst.	2nd.	3rd.	4th.	5th.
Number tested.	14	66	72	64	27
% Positive,	35.7%	54.5%	51.39%	57.8%	70.4%

In two of these days, namely the first and fifth, the total number tested were only 14 and 27 respectively and, for this reason, too much stress cannot be placed on the percentages arrived at from them. It is interesting to note the close approximation of the resultant percentages obtained on the 2nd., 3rd. and 4th.days, viz:-

TABLE 12.

Day of Illness.						
2nd.	2nd. 3rd. 4th.					
54.5%	51.39%	57.8%				
Percentage Dick Positive.						

This group of cases included 110 positive reactors among 202 cases and the average percentage of positive reactors was found to be 54.45%. The percentage of positive results obtained from the other "Days Ill" groups were all on a higher level, but owing to the much smaller number of cases tested in these groups it was not possible to draw any inference from them.

The results obtained in the present work and arranged according to the number of days which the patients had been ill before receiving the test are shown on Table 13.

COMPARISON WITH RESULTS OBTAINED BY W.A.HORNE.

It is interesting to compare these results with those obtained by W.A.Horne from work on the Dick Test performed in this hospital and recorded in his Glasgow Thesis in 1927. His figures are recorded in Tables 13 and 14 and, for convenience in comparing them with other figures, the results obtained by ourselves and other workers are also included in these tables. If we consider Table 11, it will be noted that there is a close agreement between the percentage of positive results obtained during the first three days of illness in the present investigation and those recorded by Horne. This similarity is well shown in the following Table.

TABLE 15.

Da y s Ill.	y s Ill. 1		3	_		
Present Figures,	35.7%	54.5%	51.39%	Percentage Positive.		
Horne's Figures,	33.3%	53.3%	52.5%			

In other words, out of 152 cases of Scarlet Fever tested on admission to hospital on the first, second and

third day of illness, during the present work, 78 or 51.31% gave a positive result, while out of 73 cases tested by

Horne during the same period of illness 38 or 52% were found to be positive reactors. Cases tested by me on the 4th.day of illness yielded positive results in 57.8% of the cases, while Horne obtained 75% in his similar group. During the present investigation 64 cases fell into this group - 37 of them being positive reactors - while in Horne's corresponding group only 28 cases were included and of these 21 were found to give positive results. The fewness of patients in Horne's group prevented one from laying too much stress on his high percentage (75%) while the numbers (64) in this group in the present work made it possible to compare the percentage obtained (57.8%) with the corresponding figures for the previous "Days Ill" groups.

This question is clarified by Table 16 which has been compiled from figures obtained during the present work.

TABLE 16.

Days Ill	2	3	4
Number of Cases	66	72	64
Number Positive	36	37	37
% Positive,	54.5%	51.39%	57.8%

The results obtained from patients admitted with Scarlet Fever on the 4th.day of illness - 57.8% positive reactors - although lower than Horne's percentage (75%) is probably a more correct result as it corresponds closely with the other results obtained in the "Days Ill" groups 2 and 3, with the average percentage of positive reactors in the groups 1 - 3 and 2 - 4 days ill and with the figures recorded by Horne for similar groups. Comparison with the same worker's figures for the group 4 - 6 days ill showed that, out of 99

cases in the present series, 62 or 62.6% gave positive Dick Reactions, while Horne working with 66 cases obtained 37 or 56% positive reactors to the test.

In the groups in which the patients had been ill for a longer period before receiving the test the percentages in the two investigations did not correspond.

TABLE 17.

Worker	Days Ill	7-10	11-20	21-30	30 +	Total Cases.
FREW.	Number Tested	50	24	5	Nil	49
1	% Positive	60	75	40	Nil	
	Number Tested	47	101	59	137	344
HORNE.	% Positive	40.4	27.6	35.6	13.1	

The table shows that the two investigations contained in these "Days Ill" groups 49 and 344 cases respectively and on this account the percentages drawn from them are quite incomparable.

In the series of cases recorded by Horne many of the tests recorded in the 11-20, 20-30 and 30 + days ill groupings were repeat tests on patients whose reactions to the Dick Test had already been ascertained, while in the present work the figures represented in every case the result to the first Dick Test performed on the patient.

The comparison of the results obtained by two observers, working at different periods in the same hospital is of interest on account of the fact that the type of patient treated will remain similar in both cases and because both investigations were carried out in the same wards. In the work of Horne and in the present work a close similarity was noted in the percentage of positive results which were obtained from the Dick Test when performed in the early days of the illness from Scarlet Fever. This close approximation

in results is of very great interest when we come to consider
the very divergent results which have been obtained by other
workers and particularly those recorded by American investigators.

COMPARISON OF KNIGHTSWOOD RESULTS WITH THOSE OBTAINED IN OTHER HOSPITALS.

In his annual reports on the work performed in the County of Lanark (Middle Ward) Hospital at Motherwell, Reid quoted the results of two investigations on the Dick Test. In the first, published in the report of 1925, he gave the figures shown in Table 18, while the corresponding figures obtained by Brown in the second piece of work and quoted by Reid in his report for 1926 are also shown in Table 18.

TABLE 18.

A! Reid (1925). B: Brown (1926).

	Days Ill														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	14+
A	-	33.3	54.5	33.3	33.3	50	14.28	0	0	33	0	20	0	0	
В	60	73.9	73.4	67.9	58.3	72.7			7 56	2.2	4				44.4
	Percentage Positive Results.														

The result's obtained from tests performed in the same hospital at Motherwell in consecutive years showed marked differences. While it must be noted that the total number of cases included in Reid's series was small it is obvious that the percentage of positive reactions obtained in 1926 was much greater than in 1925. These figures, demonstrated on Table 14, are classified there according to "Days Ill" groups and show how they differ from the Knightswood series. Reviewed as a whole, the results of these four investigations bear out the fact that, in a series of Dick Tests performed on patients in the acute stage of Scarlet Fever the Dick Test only yielded positive results in 50% to

75% of the cases. In both the Knightswood series the average was approximately 50% while in the Motherwell Tests 30% of one and 75% of the other series were Dick Positive. Probably owing to the fewness of cases in the 1925 work the results from this year should be discarded and only those obtained in 1926 retained and considered accurate for purposes of comparison with other percentages.

The results obtained at Motherwell and Knightswood do not bear any comparison with those obtained by Benson and Simpson in Edinburgh. In their investigation 50 cases of Scarlet Fever, all of which were either one, two or three days ill, were tested with two varieties of Dick Toxin, one of which had been prepared in Edinburgh and the other obtained from London. Benson and Simpson obtained positive reactions with the London Toxin in 100% of the cases, while 98% of the 50 cases tested gave positive reactions with the Edinburgh Toxin. In their report of the work they stated that "The London filtrate was apparently of higher toxin content than the Edinburgh filtrate". Zingher, of New York, reported a series of cases in which 190 patients suffering from Scarlet Fever were examined for their reaction to the test. Of 141 cases, who were tested during the first five days of their illness 141 or 100% gave positive results, while 49 cases were admitted to hospital having been ill for six days or more and in these latter cases the Dick Test gave positive results in 8 or 16.5%. The same worker published a subsequent table of Results to the Dick Test in which he showed that during the first five days of illness 197 out of 201 cases, or 98% of the patients gave positive reactions to the Dick Test and that 16 or 20% of the 80 cases admitted after their 6th. day of illness also gave positive results.

The results obtained in New York by Zingher or in

Edinburgh by Benson and Simpson do not show any agreement with those obtained in Motherwell by Reid and Brown or at Knightswood by Horne or myself. Benson and Simpson's figures of 100% of positive reactors with the London Toxin or 98% with the Edinburgh Toxin during the first three days of illness are very much higher than the 52% of positives obtained by Horne, the 51.31% obtained by myself, the 50% noted by Reid or the 72.3% recorded by Brown, all from patients suffering from Scarlet Fever and at the same stage of their illness as those in the Edinburgh series. Comparison with Zingher's American results also showed great discrepancies in the reaction to the In the first series noted by Zingher 100% of those tested during the first five days of their illness yielded positive results while 16.5% of the remaining patients, who were not admitted until after their fifth day of illness. gave positive results. In his second series 98% of the patients tested during their first five days of illness were found to be positive reactors, while 20% of the remainder, who had already been ill for more than five days gave positive results to the test. It is interesting to compare these figures with those obtained during the present work. patients were tested, 243 being admitted during the first five days of illness and the remaining 57 cases at later periods. 134 or 55.14% of the 243 cases were found to be Dick Positive on their admission to Hospital, while 38 or 66.6% of the 57 later admissions gave positive results. we calculate out Horne's figures on the same lines we find that he tested, on admission, 119 cases of Scarlet Fever during the first five days of illness in each case and obtained positive results in 67 cases or in 56.3%. 364 cases at periods later than the fifth day of illness and found that 25.8% or 94 of these patients gave positive

However, 137 of these 364 cases were not tested results. until they had been ill for 30 days or more and only 18 or 13.1% of them were found to be Dick Positive. If these 137 cases are deducted from the 364 who were tested at periods after the fifth day of illness it will be found that of the remaining 227 patients, 76 or 33.48% gave positive reactions to the Dick Test. In the cases reported by Brown 237 patients were tested on admission, all being in the first five days of illness and of these 164 or 69.2% were found to give positive results, while 21 or 58.3% of the 36 cases admitted after the fifth day of illness were positive to the test. The corresponding figures for Reid's cases are of less value owing to the small number of cases examined. Of 38 cases admitted to hospital during the first five days of illness and tested with the Dick Test during this period, 15 or 39.5% gave positive results while 7 or 19% of 37 patients admitted after the fifth day of illness were found to be positive reactors.

It will be seen that the test gave very varied results in the hands of different operators. The differences were not only noted when dealing with the aggregate results but were also present when the cases were divided up into various groups which varied with the stage of the disease. Our results bore close resemblance to those obtained by W.A. Horne in Knightswood Hospital during the years 1924-1927 and approximated fairly closely to the Motherwell percentages. They did not, however, compare at all with the figures set forth by Zingher, from his work in New York, or with those obtained by Benson and Simpson in Edinburgh. At no time during the present work was I able to obtain groups of patients who gave positive Dick Reactions in 100% or 90% or even 80% of the cases. Even in early cases it was found that nearly as many real instances of Scarlet Fever gave negative results to

the Dick Test applied on their admission to hospital as were found to be positive reactors.

THE PERCENTAGE OF POSITIVE RESULTS IN THE EARLIEST DAYS OF ILLNESS.

When the results of the tests performed on admission were examined, according to the number of days during which the patients had been ill before testing, it was noted that the results obtained on the first day of illness were on a lower scale than those noted on the succeeding two or three days. This surprising fact was recorded in the Knightswood and Motherwell series and is shown in the following table.

TABLE 19.

Days Ill	1	2	3	4	
Present Work	35.7	54.5	51.39	57.8	Percentage
W.A.Horne,	33.3	53.3	52.5	75.0	Positive
Brown,	60	73.9	73.4	67.9	Results.
Reid,		33.3	54.5	33.3	

It is difficult to explain such results.

provides a method for assessing the susceptibility of a patient to Scarlet Fever then we would expect to find that patients tested on the first day of their illness would yield positive results to the test. During Horne's work the precentage of patients yielding a positive result was 33.3% while during the present work it was noted as 35.7%. If a person contracts Scarlet Fever the assumption is that he is susceptible to the infective agent of Scarlatina and if tested with the Dick Test should yield a positive result. If, on the other hand, the patient yields a negative result to the Dick Test we can explain such a reaction by the presence in his blood stream of antibodies to the Scarlet Fever streptococcus.

Following up such a line of argument we find that we would be dealing with patients whose blood contained antibodies to Scarlet Fever virus and yet who contracted the disease. Such a state of affairs is difficult to conceive when we bear in mind the period of time which usually elapses between the infection of a person with some particular micro-organism, and the development of immunity to that organism.

A series of experiments, in which the serum of Scarlet Fever patients in the early days of their illness was investigated for the possible presence of antitoxin, was undertaken in an attempt to explain this difficulty. The results of this work are noted later in Section B.

THE PERSISTENT POSITIVE REACTORS TO THE DICK TEST.

The majority of workers appear to agree that in every series of Dick Tests we always find a certain number of patients who remain positive to the Dick Test throughout their illness and if re-tested prior to dismissal are still found to be positive reactors. The Dicks, in the early work on the test, found that the injection of the toxin prepared from the haemolytic streptococcus which they claimed to have proved to be the causal organism of Scarlet Fever gave "negative, or only slightly positive, skin tests in all the convalescent Scarlet Fever patients tested".

Zingher tested 170 convalescent cases of Scarlet Fever with the Dick Test and found that 158 or 93% gave positive results on admission to hospital and became negative during convalescence. Twelve patients, or 7% of his total cases remained positive to the test throughout their illness. These twelve cases appear to have been admitted and accepted as genuine instances of Scarlet Fever. In two of them the Schultz Charlton Reaction was noted as having been positive,

both with commercial antitoxin and with Dochez Serum. In other two, desquamation was stated to have occurred, well marked in one case and poor in the other. No desquamation was observed in the remainder of the patients.

The inference, however, seems to be that, out of his 170 cases twelve, or 7% were found to remain positive reactors to the Dick Test throughout their illness.

In another report, the same worker found that 19 out of 232 patients who gave a positive reaction to the Dick Test on admission to hospital, failed to give negative results when retested during convalescence. In this series, therefore, 8.7% of the cases continued to be positive reactors to the Dick Test during convalescence. In a note on the cases, Zingher stated that he was of the opinion that 2 of the 19 cases did not suffer from Scarlet Fever while, of the remaining 17 patients, no desquamation was observed in twelve. Six of these twelve cases were found to give + + reactions to the test and yet none of them developed another attack of Scarlet Fever while patients in the hospital.

Benson and Simpson performed the Dick Test on a series of 50 cases of Scarlet Fever in the acute stages of the disease and also in the convalescent period. As has been already noted they used two varieties of toxins for their work and their results are shown on Table 20.

TABLE 20.

Source of Toxin.	lst 3 of Ill		14th 33rd.Day of Illness.			
	D +	D -	D +	D -		
Edinburgh,	49	1	14	36(72%)		
London (x18) (B1962)	50	0	24	26(52%)		

In this series we have an example of the differences in results which occur from time to time. The tests were

made in duplicate and in those performed during the first three days of illness the results were in very close agreement - the London toxin producing positive reactions in all of the 50 cases while the Edinburgh toxin failed to do so in only The results obtained with the same toxins on one instance. the same patients at a later stage of the illness (from the 14th. to the 33rd. day) did not, however, agree with one The London toxin produced positive results in 48% another. of the convalescent patients while the Edinburgh filtrate was found to give rise to positive reactions in only 28% of these patients. This difference of fully 20% is difficult to explain. The toxins were used in proper dilutions and one would expect them to give results which would correspond with each other. The reason for the discrepancy might be due to a deterioration of the toxin content of one of the solutions. If this were so, the strengths of the dilutions would not coincide and the two results would not be really comparable.

It is of vital importance that the toxin dilutions should be standardised properly before use for it is possible that we could obtain a positive result in most patients if we employed a strong enough toxin dilution. Another possible source of fallacy is that the commercial toxins may have deteriorated, and so lost part of their toxin content, before receipt and use. While we are unable to prove this point in the present work we were forced to suspect some deterioration of the toxin dilution on at least one occasion when a fresh supply of Dick Toxin, used immediately on delivery, was found to give rise to negative reactions in all the cases for which it was used.

THE PERSISTENT POSITIVE REACTORS IN THE PRESENT WORK.

Tests was examined it was noted that the majority of those cases which were found to be positive reactors on admission to hospital gave negative results when re-tested during convalescence. This change from positive to negative reaction occurred usually during the first ten days of the illness and few cases were ill for more than three weeks before giving negative results to the test. These facts hold when either the "Positive" group or the "Positive + Irregular" group of cases is considered. Of the 300 cases tested with the Dick Test 142 or 47.3% were noted as positive reactors, while 172 or 57.3% were recorded as positive plus irregular positive reactors. When considering the question of the numbers of cases in each of these groups which became negative reactors during convalescence each group was treated separately.

Positive (Regular) Group.

In this group 142 or 47.3% of the 300 cases tested gave positive results to the Dick Test and of these 131 or 92.6% became negative during their period of treatment in hospital, leaving 11 or 7.74% who remained positive throughout. When these figures were considered according to the individual groups of one hundred cases to which they belonged it was noted that, while small differences did exist, they agreed fairly closely with those arrived at from an examination of the entire series.

TABLE 21.

Group.	% becoming Negative during Convalescence.	% remaining Positive throughout illness.
1 - 100	87.5	12.5
101 - 200	93.3	6.7
201 - 300	95 .35	4.65
1 - 300	92.26	7.74

from Groups 101-200 and 201-300 correspond closely with those obtained from the whole series, while in the cases in Group 1-100 the difference noted is on a higher scale. This difference, however, is not too great to invalidate its comparison with those already mentioned. Furthermore, the majority of those cases which became negative reactors to the test during convalescence did so during their first ten days of illness. Fully 50% of the 142 cases fell into this category while the percentage varied from 52.5% in one group to 67.5% in another. The number of cases which did not become negative until after their 20th.day of illness was small, the average being 10.5% and its limits 5% and 18.6%. The figures and percentages are set forth in Table 22.

TABLE 22.

	Total	Number bec		ive during oupings.	the various					
Group.	No. Posi-	Days Ill.								
tive	1 - 10	11 - 15	16 - 20	21 +						
1-100	40	27 (67.5%)	3 (7.5%)	3 (7.5%)	2 (5%)					
101-200	59	31 (52.5%)	12 (20.3%)	7 (11.8%)	5 (8.47%)					
201-300	43	27 (62.79%)	2(4.65%)	4 (9.3%)	8 (18.6%)					
1-300	142	85 (59.85%)	17 (11.97%)	14 (9.85%)	15 (10.56%)					

Positive and Irregular Group.

This group consists of those patients who, in the early days of their illness, were noted as having given positive reactions to the Dick Test. Although 30 of the cases gave a preliminary negative result before giving positive ones, the figures from this group were regarded as representing more closely the true number of positive reactors than the Positive (Regular) Group and for this reason were used in all the final calculations in the work. 172 or 57.3% of the cases gave positive results to the test and 161 or 93.6% of

these were found to become negative during convalescence, while 11 or 6.4% remained positive throughout their illness. Reviewed as a whole, and in separate groups, the results appear as is shown in Table 23 and closely resemble those obtained in the Positive (Regular) Group.

TABLE 23.

Group.	% becoming Negative during Convalescence.	% remaining Positive throughout Illness.
1-100	89.6	10.4
101-200	94.12	5.88
201-300	96.25	3.75
1-300	93.6	6.4

As in the case of the Regular group the majority of cases beceme negative during the first 10 days of illness while few remained positive after the third week. Taking the cases as a whole, 63.37% became negative during the first ten days, the percentage for the individual hundreds being 72.9%, 64.28% and 55.88%, while the percentage of those remaining positive after the third week and yet giving negative results before dismissal from hospital were 19.64%, 7.35% and 4.16%, the average percentage for the entire 300 cases being 10.46%.

These figures are shown in Table 24 for comparison with those already noted in Table 22.

TABLE 24.

	Total	Number becoming Negative during the various Day Groupings.								
Group Posi	No. Posi-	Days Ill.								
	tive.	1 - 10	11 - 15	16 - 20	21 +					
1-100	48	35 (72.9%)	3 (6.25%)	3 (6.25%)	2 (4.16%)					
101-200	6 8	38 (55.88%)	14 (20.58%)	7 (10.29%)	5 (7.35%)					
201-300	56	36 (64.28%)	2 (3.75%)	5 (8.92%)	11 (19.64%)					
1-300	172	109 (63.37%)	19 (11.04%)	15 (8.72%)	18 (10.46%)					

Rate at which the Positive Reactors became Negative Reactors.

Further examination of the time which elapsed before the positive reactors became negative ones revealed the fact that the cases in the three separate groups did not yield negative reactions to the test at the same rate as Group 1 and 3 (Cases 1-100 and 201-300) which. one another. as was already noted, were tested with the Burroughs Wellcome & Co. Toxin, were found to differ in certain respects from Group 2 (Cases 201-300) for whose tests the Toxin supplied by Messrs. Parke Davis & Co. was employed. The chief difference lay in the fact that in Groups 1 and 3 a larger percentage of positive reactors became negative during the first ten days of illness than occurred in Group 2. Furthermore. in the second ten days of illness the process was reversed: the percentage of positive reactors giving negative results being much higher in Group 2 than in Groups 1 and 3. This variation really only applied to the first three weeks of illness and during this period the percentage of cases becoming negative was practically the same in all the groups.

This question is illustrated in Tables 25 and 26 and in Graph 1.

TABLE 25.

PERCENTAGE OF POSITIVE REACTORS BECOMING NEGATIVE DURING CONVALESCENCE.

	Days Ill.							
Group.	1-10	11-15	16-20	21 +	1-21			
1-100	67.5	7.5	7.5	5	82.5			
101-200	52.5	20.3	11.8	8.47	84.83			
201-300	62.79	4.65	9.3	18.6	76.75			
1-300	59.85	11.97	9.85	10.56	81.7			

The above figures and accompanying graph demonstrate that the percentage of positive reactors becoming negative ones

is smaller in Group 2 than in Groups 1 and 3 during the first ten days of illness, but much greater from the 11th. to the 15th.day. It is difficult to ascertain if this variation is of any significance and, if so, what factors are responsible for its occurrence. The toxins employed for Groups 1 and 3 were supplied by Messrs.Burroughs Wellcome & Co. while Messrs.Parke Davis & Co. supplied those which were used for In other words, the percentage of patients whose reaction to the Dick Test changed from Positive to Negative was smaller in those tested with the Parke Davis & Co. Toxin than in those cases which were tested with the Burroughs Wellcome Toxin during the first ten days of illness but greater during the next five days (11th. - 15th.days). This fact suggests that the Parke Davis Toxin was of greater concentration than the Burroughs Wellcome Toxin. This suggestion is supported by the fact that when the reaction of patients to the test on admission to hospital was ascertained it was found that the Parke Davis Toxin gave higher results than the Burroughs Wellcome Toxin. Both brands of toxin, however, are issued by the makers with the statement that the dose recommended for the test: (0.2cc. with the B.W.& Co. Toxin and O.lcc. with the P.D. & Co. Toxin) contains one skin test dose of toxin and if this be correct some other factors must be responsible for the differences noted. While, of course, the toxin producing properties of the strains of haemolytic streptococci used in the two laboratories may vary sufficiently to produce in one brand of toxin a toxin which has a closer affinity for the skin than the toxin produced by the other strain of haemolytic streptococcus the probable explanation to the question was sought along another line.

The patients in each of the three groups were arranged according to their ages and the curves reproduced in

Graph 2 were constructed. From a study of these three curves it was noted that the number of cases aged 1-10 years and 11-15 years occurring in each group was as follows.

TABLE 27.

	roup.	1	2	3
1	(1-10 years	64	73	62
of Cases	(11-15 years	20	14	14

Taken year by year during the first ten years the cases can be arranged as in Table 28.

TABLE 28.

Age in Years	-1	1+	2+	3+	4+	5+	6+	7+	8+	9+	10-
Group 1		3	3	6	4	10	13	6	7	9	3
" 2	1	1	7	8	9	4	8	10	11	9	5
n 3			11	8	5	8	5	7	8	8	2

These figures were then added together year by year and the resultant table (Table 29) shows the total number of cases in each group in any age group from 1-10 years.

TABLE 29.

Age in Ye	ars	-1	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
Group	1		3	6	12	16	26	39	45	52	61	64
	2	1	2	9	17	26	30	38	48	59	68	73
77	3			11	19	24	32	37	44	52	60	62

The results are shown on Graph 3. They will be found in Curve A which demonstrates that, at practically all ages in the first ten years the number of patients in Group 2 exceeded those in the other groups.

In a similar manner the percentage of positive reactors who became negative during the first ten days of illness was calculated and plotted out. These results are represented in Curves B and C of Graph 3; C being the curve

obtained from "Positive" Reactors while B represents the reaction of the "Positive and Irregular" group. In both cases it will be noted that the total percentages obtained in Group 2 were, at practically all the days, lower then those obtained from Groups 1 and 3. Furthermore the curves constructed from the results obtained from Groups 1 and 3 follow one another fairly closely. It is interesting to note that, while there is a larger percentage of cases of ages one to ten years in Group 2 than in the other groups, the percentage of positive cases becoming negative reactors is always correspondingly lower in this group than in the other two groups. From the curves it would appear that, in a group of cases, the percentage of patients who, on admission to hospital, are found to be positive reactors to the Dick Test and who become negative reactors during the first ten days of illness, varies inversely with the ages of the patients in the group.

NUMBER OF TESTS REQUIRED BEFORE POSITIVE REACTOR BECOMES NEGATIVE REACTOR.

While the question of the number of days which elapsed before a patient who, on admission to hospital, was found to give a positive result to the Dick Test became a negative reactor was being considered a further point of interest was noted. When the number of Dick Tests which were performed on any patient before the patient was found to yield permanently negative reactions to the test was considered in relation to the age of the patient it was found that the younger patients gave negative reactions after fewer tests than the older patients. This fact was elicited by taking the average age of all patients becoming permanently negative to the test after the second, third, fourth and fifth tests. Owing to fewness in numbers it was not possible to proceed with the investigation beyond the fifth test. The average ages were

calculated with regard to these tests in each of the three groups of cases with the following results.

TABLE 30.

Number of Dick Tests performed on patients before First Permanent Negative Reactions were obtained compared with the Age of the Patients.

	Number of Dick Tests Performed.						
Group.	2	3	4	5			
1 (1-100)	6.3	8.8	13.2	31.5			
2 (101-200)	9.2	13.9	12.1	8.9			
3 (201-300)	11.3	12.3	12.75	16.5			
	Average age in Years.						

These figures demonstrate that in Groups 1 and 3 the average age shows a definite increase in each of the four divisions. The toxins used for the tests on patients in these groups was supplied by Messrs. Burroughs Wellcome & Co. Group 2 we find that the average for the patients in the divisions 2 Dick Tests and 3 Dick Tests follows the same trend, but that in subsequent divisions it becomes irregular. In the 4 Dick Test division it does not show much deviation from the courses taken by Divisions 1 and 2 but the average age of these patients becoming negative after five Dick Tests falls far short of the corresponding ages in Groups 1 and 3. The tests in Group 2 were performed with Messrs. Parke Davis & Co. Toxin. Further, it will be noted that the average ages of the patients in each division in Group 1 increase by larger amounts than those in Group 3. As the toxin used in these groups was supplied by the same laboratory the reason for this difference probably lies in the fact that while the ages of 72.5% of the positive reactors in Group 1 lay between one and ten years and only 7.5% were over 20 years of age only 53.5% of Group 3 were of the ages one to ten years and 11.6% were over 20 years of age.

The 300 cases were then reviewed as a whole and

the average ages for each "Number of Dick Tests Divisions" was calculated with the following results.

TABLE 31.

Number of Dick Tests performed on patients before First Permanent Negative Reactions were obtained with the Age of Patients.

	Numb	er of Di	ck Tests	Performed.
Cases	2	3	4	5
1-300	8.9	11.9	11.3	13.9
		Average	Age in	Years.

Such results correspond with those already obtained from the individual Groups. Although the average age of those patients who did not give negative reactions to the Dick Test until they had received four tests is less, by 0.3 years, than that of patients becoming negative after three tests the series as a whole demonstrated that the younger patients tend to react in a negative manner after a fewer number of tests than the older patients.

Zingher published a table which showed the number of days taken by a series of cases to give negative results to the Dick Test and it was possible to calculate from it the average age of the patients becoming negative after the second and third consecutive tests. The average ages for these two groups is shown in Table 32.

TABLE 32.

Number of Dick Tests performed on patients before

First Permanent Negative Reactions were obtained compared with

Age of Patients.

Number of Dick	Tests Performed.		
2	3		
11.7	12.6		
Average Age of P	atients in Years.		

These results resemble the figures obtained from my own work and in particular they agree closely with the averages arrived at in Group 3.

The results of this aspect of the work are illustrated by Graph 4. It would appear that, within limits, the number of Dick Tests (the patient being tested every day) performed before a patient becomes a negative reactor to the test varies according to the age of the case. Furthermore, the younger patients become negative, that is, develop immunity to Scarlet Fever in a shorter period than the older ones. This proposition is surprising and appears to be contrary to the usual ideas concerning the production of immunity. It is accepted on all hands that among normal children we find more positive Dick Reactors than among normal adults. Further, the percentage of children giving positive Dick reactions varies inversely with the age of It appears, however, that younger children develop immunity more rapidly than do older ones. This fact seems to suggest that the younger children appear to be able to accelerate the production of antibodies to Scarlet Fever which had been progressing slowly before they became infected but had not, and would not normally have, reached a point which would protect the child against Scarlet Fever. held by many that this gradual formation of immunity is due to the child receiving many small sub-infective doses of the infection and its occurrence and progressive development is shown by the following tables prepared by Zingher.

TABLE 33.

Results with Dick Test at Public School No.4 Bronx.

Age.	% Dick Positive.
5-6 years	62.5
6 - 7 "	51.35
7 - 8 **	33.33
8 - 9 "	35.29
9-10 "	20.00
10-15 "	12.85

TABLE 34.

The Dick Test at different age groups.

Age.	Percentage D	ick Positive.	
0 - 6 months	44.8	44. 8	
6 - 12 months	64.2	65.3	
1 - 2 years	70.7	71.6	
2 - 3 **	67.8	64.2	
3 - 4 "	59.4	60.5	
4 - 5	46.4	48.4	
5 - 10 **	35.4	33.6	
10 - 15 *	25.4	22.8	
15 - 20 "	26.3	16.8	
20 + *	17.9	14.4	

^{*} Partial immunity due to placental transmission of maternal immunity.

The older patient, by reason of his having contracted Scarlet Fever and also by giving a positive reaction to the Dick Test, has evidently failed to produce sufficient immunity to protect him against the infection and once he has contracted the disease his immunity forming abilities are not increased to the same extent as in younger patients.

NUMBER OF DAYS TAKEN FOR POSITIVE REACTORS TO GIVE NEGATIVE REACTIONS TO THE DICK TEST.

When the number of Dick Tests, which were performed on any particular patient before the first permanent Negative result was obtained, was considered, it was noted that, in the majority of cases, seven or eight tests were required to produce this reaction. A number of cases were found to give negative results after the second test and an increasing number of negative results were noted on the succeeding days. This finding holds good for both the "Regular" and "Regular plus Irregular" groups of cases and the relevant figures for each are shown in Table 35.

TABLE 35.

Percentage of Positive Reactors becoming Negative on each Test. Test on which first Permanent Negative Result was noted.

Dick Test	2	3	4	5	6	7	8	9	10
Regular Group,	25.4	39.4	54.2	64.8	69.7	74.6	78.9	81.7	84.5
Regular plus Irregular Group,	20.9	39.5	54.1	66.9	72.1	76.7	80.2	83.1	86.6

Dick Test	11	12	13 •	15	17	18	19		Never Nega- tive.
Regular Group,	85.2	86.6	88	-	89.4	90.8	91.5	92.2	7.7
Regular plus Irr.Group,	87.2	88.4	89.5	90.1	91.3	92.4	93	93.6	6.4

It will be noted that the figures for each group correspond closely with each other and no real points of difference can be demonstrated.

The only point at which any divergence is present is found in the percentage of negative results obtained after the second Dick Tests. Here we find that there is a difference of nearly 5% between the two groups, but when it is recalled that all the irregularly positive cases were negative after the first test and then positive after the second one, it will

be seen that the difference is due to their inclusion and has no bearing on the percentage of cases becoming negative after certain definite tests which are shown on the table (Table 35). The graphs reproduced, Graphs 5 and 6, were obtained by plotting out the above percentages. They show a close similarity one with the other and illustrate that the majority of the cases became negative after seven to ten tests. Curves obtained from the percentages calculated from the results obtained in Groups 1, 2 and 3 of the Dick Tests were superimposed on those already constructed and revealed the interesting fact that, in all three groups, whether we consider the "Regular" or the "Regular plus Irregular" series, the results correspond with one another.

The Persistent Positive Reactors.

An examination of the results obtained in the present series of cases showed that, as in results obtained by other workers, a small number of patients remained positive reactors to the Dick Test throughout their illness. In all, ll of the 300 patients tested were found to belong to this class; this figure giving an average of 3.66% which is considerably lower than the corresponding percentages recorded by Zingher, namely 7% and 8.7%. It has, however, already been noted that in several of the cases noted by Zingher in both of his series, the correctness of the diagnosis of Scarlet Fever was open to question.

The incidence of Persistent Positive Reactors in the three Groups of patients in the present work was as follows:-

TABLE 36.

Grou	ρ.	Number of Persistent Positive Reactors.
l (Cases l	- 100)	5
2 (Cases 1	01 - 200)	4
3 (Cases 20	01 - 300)	2

If these cases are arranged according to the brand of Dick Toxin employed for the tests it will be seen that the results can be arranged as in Table 37.

TABLE 37.

Brand of Dick Toxin.	Persistant Positive Reactors.
B.W. & Co.	7 (3.5%)
P.D. & Co.	4 (4.0%)

As the number of cases under review was small it was not possible to compare the number of persistent Positive Reactors which occurred in Pavilion No.10, which, as we have already noted, contained acute and convalescent Wards, with those which were noted in Pavilion No.9 in which the acute and convalescent patients were nursed in the same wards.

The 11 cases which gave positive results to the test during convalescence were noted on their admission to Hospital to be suffering from definite attacks of Scarlet Fever and the course of their illness together with the complications which occurred in some of them confirmed this diagnosis. Their ages varied from 5 years to 18 years and nine of the eleven cases were males, the remaining two being females.

TABLE 38.

Sex	Females	Males			·		
Number	2	2	1	1	3	1	1
Age in Years	5	6	7	8	9	13	18

In eight of the cases the facies of the patient, the bright punctate rash and the typical tongue allowed no disbelief of the original diagnosis. In two of the remaining cases the rash was punctate in type and the character of the tongue and the occurrence of Otorrhoea, Rhinorrhoea and Cervical Adenitis in one and Otorrhoea and Rheumatism in the other helped to confirm the original diagnosis of Scarlet Fever.

The last case was admitted to hospital with typical "Pin Point" desquamation on his hands and feet one day after his younger sister had been admitted to hospital suffering from Scarlet Fever and during his convalescence developed a degree of Cervical Adenitis: this complication helping to confirm the diagnosis of Scarlet Fever.

It is interesting to note that with only two exceptions, one a boy and the other a girl, all the Persistent Positive Reactors suffered from one or more complication during their convalescence. Six of them developed Cervical Adenitis, three Otorrhoea, two Rheumatism, two Tonsillitis and one of them contracted Diphtheria after having been a patient in a Scarlet Fever Ward for five weeks. The question of the occurrence of complications among the patients who were either found to be negative reactors to the Dick Test throughout their illness or who gave negative reactions in their convalescence after having given positive ones on their admission to hospital will be discussed in a later section and it will suffice to note at this point that, in these patients, complications did not occur in more than 50% of the cases. It is thus evident that cases which remain persistently positive to the Dick Test throughout their illness are more susceptible to the development of complications than are those patients who become negative reactors in the usual manner.

During convalescence one of these cases suffered from a relapse while, up to the present time, we have been able to discover that another of the patients has contracted a second attack of Scarlet Fever within five months of his dismissal from hospital. This apparent liability to relapse on the part of the Persistent Positive reactors is one which may cause considerable administrative difficulty and we have on several occasions considered the advisability of administering

scarlatinae antitoxin. The administration of 5cc. of this antitoxic serum will produce a passive immunity and is said to protect the patients for periods of from two to three weeks. While our limited experience on this point, based on observations made on all classes of fevers, is favourable, a note on the following case is not without interest.

A case of Scarlet Fever having occurred in a Diphtheria Ward, all the patients who had not previously suffered from the second disease were tested with the Dick Test and all those who yielded positive reactions received 5cc. of Scarlet Fever antitoxin. M.V., a girl aged 5 years and awaiting dismissal from the ward, was noted as having given a positive reaction to the Dick Test and consequently received a prophylactic (5cc.) dose of the serum. Five days later she was dismissed from hospital and, twelve days or seventeen days after receiving the antiscarlet fever serum. was re-admitted to hospital suffering from a typical attack of Scarlet Fever. This case appears to demonstrate that while the prophylactic use of the serum is of great service in dealing with "cross infected" wards its effect is of short duration and is perhaps not to be relied on for periods exceeding ten to fourteen days.

While eleven cases were recorded as Persistent
Positive Reactors it should be noted that it was only in
those cases which had failed to give negative results to the
test that were tested into convalescence. It is possible that,
if all the 300 cases included in the series had been re-tested
prior to dismissal, a much larger percentage of Positive
Reactors might have been obtained. Again, while eleven cases
did remain positive two of them had given a first negative
reaction before dismissal and one of them would probably have

become permanently negative if it had been possible to detain him longer in hospital for another test.

Although the number of cases is too small to allow of reliable figures being drawn from them they seem to suggest that a larger number of males are found among those giving persistently positive reactions to the Dick Test than females, and also that those cases which fail to become negative reactors are frequently characterised by the development of one or more of the common complications of the illness.

SUMMARY AND CONCLUSION.

- The Dick Test was performed daily on a series of 300 patients suffering from Scarlet Fever.
- The consecutive daily tests were performed until the patients were noted as having given "Persistent Negative" reactions.
- The term "Persistent Negative" was applied to the occurrence of negative results to two consecutive Dick Tests.
- In the present work the percentage of Positive Reactions obtained was 57.3%. This result does not compare with the very high percentage of positive results obtained by some workers, particularly those working in America, but it agrees closely with results published in the West of Scotland and very closely with those obtained by Horne from work performed in Knightswood Hospital during 1924-1927.
- The great differences in the published results may be due to there being a different type of Scarlet Fever prevalent in this country when compared with that present in America, to differences in the manner in which the readings were made and also to the varieties and qualities of the toxin solutions employed for the test.
- Contrary to the opinion expressed by some workers, including Zingher, we do not consider that the Dick Test has any great diagnostic value. We have examined many typical cases of Scarlatina from which we have obtained Negative results to the Dick Test. This opinion is supported by Horne, in a personal communication.
- When the percentage of positive results obtained on each day of the illness was considered it was found that the percentage obtained on the first day was lower than that noted on the second and third days. This finding was also noted by Horne, Reid and Brown.
- It was noted that the majority of the cases became negative within the first ten days of illness, that they did so after seven to ten tests and that the younger patients appeared to become negative reactors after fewer tests than did the older patients.

In every investigation into the course of the Dick Test on patients suffering from Scarlet Fever a small percentage (3.66% in the present work) of cases remain persistently positive to the test. If anything, males seem to be more liable than females to be included in the group of Persistent Positives. The persistent Positive Reactors are more liable to suffer from relapses than are the Normal Reactors and they are also more susceptible to complications than are these latter cases.

B. The Early Negative Reactors to the Dick Test.

The Early Negative reactors to the Dick Test.

Experiments with the Blood Serum of the Early Negative Reactors.

The Reading of the Results.

Comparison of the Results obtained from the use of Control Sera, Serum from Patients in the Acute stage of the illness and Serum from Convalescent patients.

Conclusion.

Scope of the blanching, or Schultz Charlton, method of testing the Blood Serum for the presence of Antitoxin.

THE EARLY NEGATIVE REACTORS TO THE DICK TEST.

When the results obtained from the Dick Tests performed on the 300 patients were reviewed it was noted that a considerable number of negative results had been obtained from newly admitted patients. This failure to react to the test was present in early cases as well as in those whose admission to hospital had been postponed until the 5th. or 6th. or even later day of illness.

The occurrence of a Dick Positive reaction was taken to indicate the absence in the body fluids of the antibody to the streptococcus Scarlatinae. The fact that an individual contracted Scarlatina may be taken as evidence that such antibodies were absent or deficient in his blood, and if the Dick Test was applied early in his illness, he should be found to give a positive result. The occurrence of a Dick negative result in such cases suggested that a supply of antibody, sufficient to neutralise the amount of Dick Test Toxin injected into the skin of the forearm, was present in the capillaries of the skin and had either (a) been present in the tissues normally, i.e. prior to infection and presumably did not act as a protection against the Scarlatinal infection. (b) been liberated from some foci in the body or (c) been produced in the body tissues between the time of infection and the performance of the Dick Test. The presence of antitoxin in the body fluids would explain the occurrence of a Dick negative result in the early cases of Scarlet Fever and efforts were made to attempt to demonstrate its presence or absence in the blood serum of these patients. It must also be considered that, perhaps owing to some individual idiosyncrasy, patients, whose blood serum does not contain Scarlet Fever antibodies, may, in some unknown manner, give negative reactions to the Dick Test.

EXPERIMENTS WITH BLOOD SERUM OF THE EARLY NEGATIVE REACTORS.

Materials and Patients.

The patients selected for this experiment were those suffering from undoubted Scarlatinal infection, in its first few days, who gave a negative result to the Dick Test on both the first and second days after admission to hospital. was taken to exclude any patient who might suffer from Tuberculosis, Mental Diseases or any protozoal infection such as Malaria. The skin of the arm at the elbow was swabbed with gauze soaked in methylated spirit and thereafter with iodine and, after the application of a tourniquet, a sterile exploring needle was introduced into the Median Basilic Vein in the direction of venous circulation. The blood obtained was collected in two tubes. These tubes (25 x 8) had been sterilised by dry heat (170 degrees C for one hour) and were stoppered with rubber corks which had been rendered sterile by boiling. 0.5 cc of blood was collected in the first tube and 10-15 cc. in the second one. The contents of tube No.1 were examined for the Wassermann reaction. No.2 tube was left standing upright in the ice chest overnight in order that the serum might separate from the other constituents of the blood. The serum was then removed with a 10 cc. Record syringe, which had been previously sterilised by boiling, and the serum then transferred to a sterilised centrifuge tube. It was then spun for 20 minutes (2000 revs. per minute) in order that the resultant fluid might be free from blood cells and after centrifugalisation the supernatant fluid was removed and bottled in 5 cc. bottles (rubber corked). The sediment obtained from the centrifuge tube was then used to inoculate an Agar slope (P.H. 7.5) which was subsequently incubated at 37 degrees C.

for 24-36 hours in order to ascertain if the serum was sterile. The bottled serum was stored in the ice chest (4°C.) and if the Agar slope revealed absence of organism and the Wassermann reaction was negative the serum was passed as fit for use and was retained in the ice chest until a suitable case was available for testing purposes.

Procedure.

The cases selected for the purposes of testing the sera were those exhibiting bright early typical rashes. of the serum under consideration was injected into the skin at a point where the rash was intense. The skin over the abdominal wall was the site most favoured, but in some cases the tests were made on the thighs as the rash was better developed at that area than on the abdominal wall. Care was taken to ensure that the injection was intracutaneous, not subcutaneous. A successful injection was noted to show definite swelling, white coloration, sharply defined border and foveation. Should any of the injections fail to give these characters, or if the injection was made subcutaneously, it was repeated, and only the injection which gave the typical characters was considered. Each experiment was controlled by the injection of 0.2 cc. of the Schultz-Charlton Product prepared by Messrs. Burroughs Wellcome & Co. and 0.2 cc. of the Scarlet Fever Antitoxin. issued by Messrs.Parke Davis & Co. This latter preparation is identical with the Parke Davis Schultz-Charlton product. Two or sometimes three different sera were tested on the same patient at the same time and the results were read in 12 hours, 18 hours and 24 hours. Thereafter they were read every 24 hours until the rash had disappeared. Measurements of the results were taken at the 24th. hour and the 48th. hour and recorded on separate lists prepared for each patient and each serum.

The Reading of the Results.

When reading and recording each Schultz-Charlton reaction the size was noted by measuring and recording its two diameters in millimetres and an attempt was made to assess the value of the individual tests by a consideration of the intensity of the blanching produced in the Scarlatinal rash. In order to allocate each result to its proper value the following scale was adapted.

3 0 1 4 6 8 10 2 5 9 ordinary very in-Negative very faint Reaction. faint tense blanching.

It will be seen that those tests which produced the usual moderate blanching met with in the routine application of the Schultz-Charlton test were allotted to class 5 while the extremes were class 0 which included the negative results and class 10 in which were grouped those reactions which were marked by the very intense blanching which they produced. In assessing the values of those reactions which were grouped in the higher classes the chief consideration was the intensity of the reaction, but some regard was also paid to the area of The results, then, were allotted values between 0 blanching. and 10 and an endeavour was made to appreciate and record as small differences in the results as was possible. Class 3 included those reactions which were faint in character, while Class 2 comprised the very faint reactions. Those results which were very dim and hazy were noted in Class 1 while those which were at the best "Shadows" were allotted to even smaller In this manner we attempted to place each reaction. values. no matter how poor its blanching, into its proper class.

Without doubt this scale of values is arbitrary, but, as the tests were all performed during the same period

of the work, by the same person, on patients whose rashes were at the same stage of development, and as the reactions were read under identical conditions by one observer, the grading of these results may be taken as being comparable.

The testing of the serum from cases of acute
Scarlatina, who gave two negative results to the Dick Test on
their admission to hospital was carried out on a series of
53 patients in all of whom the rash was bright and of a
typical punctate character. Eleven such sera were available
and 124 blanchings tests were performed with them, while for
the purpose of comparison the blanching properties of four
convalescent sera were ascertained by 44 tests. Each test
was controlled with Schultz-Charlton tests performed with
the Burroughs Wellcome & Co. product and Parke Davis & Co.
product and in all 274 tests were performed in the entire
series.

COMPARISON OF THE RESULTS OBTAINED FROM THE USE OF CONTROL SERA.

It is interesting to note, in the first place, the reactions obtained from the two control or standard tests, namely those reactions to the B.W. & Co. product and those to the P.D. & Co. antitoxin. Viewed as a whole, it was noted that the reactions produced by the P.D. & Co. antitoxin gave better results, both with regard to the intensity of the reaction and to the area of blanching, than did the B.W. & Co. Schultz-Charlton Product. These two products are retailed by their manufacturers as being identical and, as the dosage recommended in each case is the same, one would expect that, if their potencies were equal they would give results which would compare equally with one another. These results are illustrated in Graphs 7 and 8. In Graph 7 the results obtained from the Parke

Davis & Co. product are arranged in descending values and the curve indicated by the black line constructed, while the corresponding values of the tests performed on the same patients with the Burroughs Wellcome product are shown by the red line. It will be observed that, generally speaking, the graphs indicate that the Parke Davis product is of greater potency than that produced by Messrs.Burroughs Wellcome. In order to eliminate any fallacy which might arise in the construction and reading of the graphs the values were plotted out again, taking, this time, the Burroughs Wellcome results as the standard and fitting in the corresponding Parke Davis results. This is shown in Graph 8 and once again it will be noted that in the main the curve representing the results obtained from the use of the Parke Davis antitoxin is on a higher level than that constructed from the values allotted to the reaction noted by using the Burroughs Wellcome Schultz-Charlton Product.

examined and it was noted that the already noted superiority of the Parke Davis product over that of Messrs.Burroughs Wellcome was again apparent. Not only were the reactions obtained by use of the first mentioned of greater intensity than those noted after tests with the latter but a smaller number of completely negative results were observed to follow the tests performed with the Parke Davis antitoxin than with the Burroughs Wellcome product. This question is illustrated by Graphs 9 and 10 which, together with the following table (Table 37), make it clear that better results were obtained from the use of Parke Davis antitoxin than from the Burroughs Wellcome Schultz-Charlton product.

TABLE 39.

Intensity of Reaction	10	9	8	7	6	5	4	3	2	ઢ	1	-1	0	Total
P.D. & Co.,	3	2	5	-	2	2	1	6	4	1	3	9	15	53
B.W. & Co.,	-	1	6	1	1	1	4	_	3	3	3	12	18	53

Summed up briefly from another point of view we note that out of the 106 tests only 29 were classed as belonging to class 4 and upwards, i.e. their reactions varied from "fairly good" to "very intense". The remaining 77 reactions were all classed as being faint or belonging to an even lower classification; and, while 60 of them, which belonged to classes 1, -1 and 0 might, as far as practical value went. be considered negative, as many as 33 were definitely, totally These considerations bring out the fact that, out negative. of 106 Schultz-Charlton Tests performed on genuine and early Scarlet Fever rashes, only 29 clearly positive results were obtained. Furthermore, 33 definitely negative reactions were noted and of the remaining 44 tests only 13 were classed as "fairly positive" or "very faintly positive". Thus, while the test may be of value when positive reactions are observed it is of little use as a diagnostic agent in the routine work of a Scarlet Fever Ward, especially when it is recalled that these cases, in whom the diagnosis is doubtful, are usually noted for their faint and often atypical rashes.

RESULTS FROM WORK WITH SERUM FROM PATIENTS IN ACUTE STAGES OF ILLNESS.

Turning now to the results obtained from the use of serum obtained from either patients suffering from the acute stages of Scarlet Fever or from patients during their convalescence from the disease, it should be noted that no attempt was made to estimate the amount of Scarlet Fever antitoxin which was present in the blood tested. Obviously

it would not be possible to compare the antitoxic content of patients' serum with that of highly concentrated commercial sera which contain enough antitoxin per cubic centimetre to neutralise at least 20,000 skin test doses of toxin. All that was attempted in this work was to ascertain the presence or absence of antitoxin to the Scarlet Fever Toxin in the patients blood. The results obtained from the use of each serum were examined separately and, in order to facilitate examination, were plotted out on graphs in the manner adapted for the comparison of the Parke Davis & Co. antitoxin and the Burroughs Wellcome & Co. Schultz-Charlton product. The standard which was adapted in these graphs was the value of the reactions to the Parke Davis & Co. serum. If we examine the results obtained from the tests, in which the sera obtained from patients in the acute stage of their illness, we find that, while some degree of reaction is noted in a considerable number of the cases, it is only in three instances that this value approaches to reliable dimensions. In one case the intensity of the reaction is classed as 7, while in the other two it is 2 or "very faint". However, as was mentioned above, too much stress must not be placed on these values owing to the much greater potency of the standard sera used and, when we note that the curves obtained from the reactions to the patients' sera follow fairly accurately the curves obtained from the control injections, though at a much lower level, we can agree that the sera obtained from the patients' blood does contain a certain amount of antitoxin.

An examination of Graphs 11 to 22 will bear out this point. In 11, 12, 13, 14, 15 and 18 we note that the red curve which represents the reactions to the sera from patients in the early days of their illness follows fairly accurately the course taken by the green and black curves which represent

respectively the reactions obtained to the Parke Davis & Co. and Burroughs Wellcome & Co. product, though at a much lower level. This state of affairs is not seen to the same extent in the other graphs. In Nos.16, 17, 20 and 22 it would appear that the sera did cause some small degree of blanching, but that the degree of this reaction did not follow the curves drawn from the results obtained from the control tests. The serum used for the tests illustrated by Graph 19 did not appear to cause any definite blanching.

RESULTS OF WORK WITH SERUM FROM CONVALESCENT PATIENTS.

Turning now to the results of the Schultz-Charlton tests performed with the serum from patients convalescing from Scarlatina and illustrated by Graphs 23, 24, 25 and 26, it will be noted at once that the results obtained from such tests are on a higher level than those obtained from the use of acute sera. Three of the four convalescent sera used for the tests, namely those whose actions are recorded on Graphs 24, 25 and 26, produced reactions of definite value and once again, the graphs constructed from their values followed, though again at a lower level, the curves representing the control sera. In the remaining serum, No.12, the results, which are shown on Graph 23, were poor but seemed to indicate the presence of antitoxin in the blood. It is interesting to note that in this case tests were also made with the patient's serum when he was suffering from the disease in its early stage the results were also noted as being poor.

Conclusions.

Certain patients, suffering from genuine attacks of Scarlet Fever, give negative results to the Dick Test when tested on admission to hospital.

Some of these patients, who are found to be persistently negative to the Dick Test, seem to have small amounts of antitoxin in their blood stream and this antitoxin, while it may possibly be in sufficient concentration to inhibit their reaction to the Dick Test and so render them Dick Negative Reactors, has not protected them from Scarlatinal infection.

The presence of this antitoxin in the blood stream is of such concentration that it may produce faint blanching when injected into typical early Scarlet Fever rashes.

Whether this antitoxin is present in sufficient quantities to inhibit the patients reaction to the Dick Test is very doubtful and this all the more so when we recall, as was noted above, that the occurrence of a positive or negative reaction to the Dick Test seems to depend more on a cutaneous immunity situated in the skin itself than on the development of a general body immunity. If this surmise be correct it follows that the antitoxic content of the blood serum is of much less importance than the local immunity possessed by the skin itself, when we are considering the reaction of any patient to the Dick Test.

The work seems to indicate that the amount of antitoxin present in the blood increases during the course of the disease.

SCOPE OF THE BLANCHING, OR SCHULTZ-CHARLTON, METHOD OF TESTING THE BLOOD SERUM FOR PRESENCE OF ANTITOXIN.

While this method of comparing the antitoxic content of different sera is a very useful and simple one it can only be carried out on patients with bright typical Scarlatiniform rashes and, on this account, only on a small percentage of the total number of patients admitted to hospital. This is a very real

difficulty for usually the supply of such patients is not constant enough for purposes of the standardisation of the various sera. Another drawback to this method is the time which is lost while the Wassermann Reaction of the serum is being ascertained and while the customary tests for its sterility are being conducted. Apart from these objections this test is of service and is fairly reliable for the testing of sera for the presence or absence of antitoxin. Cruickshank agrees with such opinions and states that the method gives results which are "fairly uniform and delicate".

Again O'Brien, Okell and Parish confirm this view and state that "the Schultz-Charlton method could probably be used as a rough method of titration, if great care were taken in the choice of rash and the area injected".

It is interesting to note that, while other workers obtain positive reactions with the test in 4, 8 or 12 hours we have frequently found them to be completely negative after 24 hours and yet show good areas of blanching in 48 hours' time. This phenomenon has been frequently noted in cases showing very intense Scarlatinal rashes who were tested immediately after admission to hospital.

C. Variations in the Results obtained from the Dick Tests.

Construction of Graphs to demonstrate the variations in the Dick Test Results.

Survey of the complications.

The Study of the Graphs.

The Value of Serum Treatment in Persistent Negative Reactors.

The Use of Streptococcus Scarlatinae Antitoxin.

CONSTRUCTION OF GRAPHS TO DEMONSTRATE VARIATIONS IN THE RESULTS OBTAINED FROM THE DICK TEST.

The reactions obtained from the Dick Test on the series of 300 patients were now studied in greater detail in an endeavour to ascertain whether or not the successive reactions in the different patients, followed the same course as one another. To this end two graphs were constructed, one representing the area of the reaction and the other its intensity, in all those patients who gave positive results to the test in the early days of hospital residence. 172 cases were classed in this group and, in most cases the early days of hospital residence coincided with the early days of illness. relevant graphs are reproduced in Volume 11 of this work and will be found there as Graph 27. In the construction of the graphs the fluctuations from day to day in the area of the reaction are recorded by the red line, while the variations in the intensity of the reaction are noted by the broken black In each case the stage of illness was taken into consideration and is shown on each graph. After the various figures had been completed the course of illness in each case was considered and the occurrence of any complications noted. These complications were recorded on the appropriate graph, being inserted at the proper day of illness. In these cases which ran an uncomplicated course this fact was recorded by adding "No Comp." to the chart. This additional work was undertaken to discover if any special type of variation of results to the Dick Test had any bearing on the development or non-development of complications in any particular case under review. Put in another way this work was performed with a view to ascertaining whether or not the Dick Test Reactions followed any definite trend: whether it would be possible to suspect the development of complications in any particular case from a study of the Dick Test reactions noted in that case

and, generally, to discover whether the Dick Test could be employed as an aid in the diagnosis of Scarlatina and whether a study of its course would be of assistance when considering the prognosis of the case.

SURVEY OF COMPLICATIONS.

It will be convenient to make comment, in the first place, on the complications which occurred in the 300 cases under consideration and, thereafter, to revert to the study of the various curves constructed from the daily variations obtained in the Dick Test observations.

The 300 cases were studied with a view to discovering whether those cases, which were Dick Positive on admission to hospital, were more susceptible to the development of complications during their period of convalescence than those who were persistently Dick Negative reactors or vice versa. Before such a survey could be carried out it became necessary to decide what precisely constituted the complications which were alleged to have been caused by the Scarlatinal infection. the development of Measles in nine children in the Scarlet Fever Wards could not be said to be a complication of the original disease. Two such small outbreaks were noted in the wards during the present work; each being caused by the admission of a case of Scarlet Fever who was, at the same time. incubating Measles and who developed the second disease after having been in the Ward for a week or longer. For the same reason the occurrence of Varicella in one child and Mumps in three others could, in no way, be considered as a complication of Scarlet Fever. The development of Septic sores of the fingers and toes, and boils, while no doubt having some relationship to the intensity of the Scarlatinal rash, were not included among the complications of Scarlet Fever. The presence of chronic discharge, such as cases of Otorrhoea, which had been present for several years, or a previous illness such as a case of Nephritis of several months; standing who, while undergoing treatment for this condition in the medical wards of one of the General Infirmaries of the City, contracted Scarlet Fever could not, for reasons similar to those given above, be considered as complications of Scarlet Fever.

of Scarlet Fever were Cervical Adenitis, Secondary Sore Throat, Otorrhoea, Rhinorrhoea with which was included the presence of Post Nasal Discharge, Rheumatism and the occurrence of relapses. It is a well recognised fact that during convalescence a certain percentage of the cases develop Diphtheria. The percentages recorded by different workers vary, but all are agreed that patients convalescing from Scarlet Fever are definitely susceptible to Diphtheria, on account of the weakened resistance of the mucosa of the pharyngeal wall, and, for this reason, the occurrence of Diphtheria in the cases under review was looked upon as a complication of the original infection.

Nephritis, which is included as one of the common complications of Scarlatina, was present in one case only, that of a boy admitted with typical desquamation on the arms and legs, with blood and albumin in the urine and marked oedema of the face and extremities. In a few other cases a transitory albuminuria was noted but, as this cleared up in 24 - 48 hours, the present series of cases is lacking in instances of Nephritis occurring as a complication during the treatment of the patients in hospital. This fortunate state of affairs must not be taken as representative of the occurrence of Nephritis during the convalescence from Scarlet Fever. During the Autumn of 1930 its incidence was found to be much higher and approached the figure calculated by Rolleston from the statistics of the M.A.B. Hospitals, London.

Other but rarer complications, such as pneumonia, in one case followed by empyema, erythema nodosum which occurred in one case on his 33rd.day, facial erysipelas, endocarditis, gastritis and appendicitis are not considered as they occurred in only one or in some instances, two patients. It is interesting to note that haemolytic streptococci were recovered from the pus obtained from the case of empyema and that a toxin was prepared from these organisms. This toxin was used for Dick Tests in dilutions of 1:1000 and 1:500, each test being controlled by injections of the Parke Davis Dick Test Toxin, and was found to yield positive results which, if not of as large an area or of as bright an intensity as those produced by the control injections, were noted as being quite definite positive results.

It will be recalled that, of the 300 cases tested, 172 were recorded as positive reactors, while the remaining 128 were noted as being persistently negative to the test. These two groups of cases were reviewed with regard to their complications and the following table was constructed.

TABLE 40.

POSITIVE		NEGATIVE							
Number of Case	s: 172	Number of Cases: 1							
With complications.	Nil	With complications.	Nil						
77	95	. 65	63						
44.8% 55.2%		50.8%	49.2%						

A study of the figures obtained from the table reveals the remarkable fact that the greater percentage of cases developing complications during convalescence occurred among the group of Negative Reactors and not, as one might expect, among the Positive Reactors. It might naturally be expected that those cases which were supposed to possess some degree of immunity to the Scarlet Fever infection, as

demonstrated by their absence of reaction to the Dick Test, would be much freer from the development of complications than those which, by reason of their reaction to the Dick Test Toxin, showed their susceptibility to the Scarlatinal infection and the fact that this was not the case, in this series of cases at any rate, makes it difficult to see in what way the Dick Test demonstrates the presence or absence, in any particular case, of resistance to the Scarlet Fever toxin or at any rate to utilise the test when attempting to prognose the course of the illness. No doubt the smallness of the numbers of patients in the series under review makes it impossible to be too dogmatic but there would appear to be a definite indication that those cases which failed to give any reaction to the Dick Test when tested on their admission to hospital did not show any immunity to the occurrence of complications, but rather appeared to suffer in this respect more heavily than those which were found to be Dick Positive Reactors when tested at the same period of their illness.

Probably a more important point lies in the fact that, while in the group of positive cases those patients who went through their illness without any complications exceeded, by fully 10%, those suffering from complications, those classed in the group of negative reactors who developed complications exceeded those who did not by nearly 2%. This further point, then, amplifies the statement that the table (Table 40) suggests that the positive reactors possess as great, if not greater, immunity to complications than do negative reactors.

If we examine the number of each individual complication which occurs in each group it will be noted that the position as suggested above is corroborated to a large extent. The numbers of these complications and the relevant percentages are shown in the following table.

TABLE 41.

Complication		l Cases		tives 72	Negatives 128		
	No.	%	No.	%	No.	%	
Cervical Adenitis	92	30.7%	45	26.2%	47	36.7%	
Secondary Sore Throat	39	13%	21	12.2%	18	14.1%	
Otorrhoea,	27	9%	17	9.9%	10	7.8%	
Rhinorrhoea (& Post Nasal Discharge),	37	12.3%	17	9.9%	20	15.6%	
Rheumatism,	23	7.7%	13	7.6%	10	7.8%	
Relapse,	11	3.7%	7	4.1%	4	3.1%	
Diphtheria,	5	1.7%	3	1.7%	2	1.6%	

The above figures demonstrate that the negative reactors are more prone to suffer from such complications as Cervical Adenitis, Secondary Sore Throat and Rhinorrhoea than those cases which gave positive reactions to the test. The incidence of Rheumatism would appear to fall practically equally on each group while the negative reactors escape the occurrence of Otorrhoea to a greater extent than do the positive cases.

Il or 3.7% of the 300 cases were noted to suffer from relapses during their convalescence. In most cases the symptoms of the relapse were of the typical type: sore throat, headache, punctate rash, furred tongue which on peeling revealed enlarged papillae and a rise of temperature. In one, however, all the above symptoms were present, with the exception of the rash, but the case was so clearly marked that the diagnosis of "Scarlatina - sine - eruptione" was applied. The incidence of this complication was noted to fall rather more heavily on the positive reactors than on those cases which were found to give negative reactions to the Dick Test on their admission to hospital.

Lastly, the question of Diphtheria falls to be examined and, in doing so, it should be noted that only those cases, from whose throats the Klebs-Loeffler bacillus was

recovered, were recorded as cases of Diphtheria. Several other cases were observed in which patching of the pharyngeal wall, tonsils and uvula was noted and who received large doses of diphtheria antitoxin, but whose throat swabs were persistently returned "Negative", were not included among the cases of Diphtheria. 5 of the 300 cases, of 1.7%, developed this complication during convalescence: the incidence being 3 cases or 1.7% in the group of positive reactors and 2 cases or 1.6% in the negative cases. The five patients all recovered: four doing so without any further complication developing, but in the fifth case, a positive reactor to the Dick Test on admission to hospital, continuously so throughout his convalescence and right up to his dismissal from the Scarlet Fever Ward, severe pharyngeal paralysis supervened despite the early administration of diphtheria antitoxin and markedly delayed his ultimate complete recovery.

This survey of the individual complications occurring during the period of convalescence from Scarlet Fever strengthens the opinion, already suggested, that those patients who are said to possess a degree of immunity to the Scarlatinal infection on admission to hospital, as shown by their absence of reaction to the Dick Test at that time, do not appear to escape the onset of complications to any greater extent than those cases who, by being Dick positive reactors on admission to hospital, exhibit their susceptibility to the Scarlatinal infection and in fact the figures seem to suggest that the negative reactors are, if anything, more prone to develop most of these complications than are the positive cases.

The Study of the Graphs.

The construction and study of graphs drawn to represent the daily fluctuations of the results obtained from the Dick Test on the 300 patients was undertaken in an attempt

to ascertain whether or not these daily variations followed any standard course and whether this course was influenced by the mildness or severity of the attack of Scarlet Fever. reactions obtained from the entire series of positive cases, i.e. the regular and irregular groups, numbering 172 in all, were considered and graphs were drawn to represent the area of the reaction, and secondly, its intensity. When the result to the Dick Test was read in any particular case its size was noted by measuring its two diameters. From these figures the average diameter was ascertained and the area was calculated from the formula, Area = π r² where π = 3.14. The area of each of the daily tests was obtained and the red curve drawn to represent its daily fluctuations. The corresponding degrees of intensity, as decided by the scale described on page 15 were plotted out and the variations thereby obtained shown by the broken black line.

The relevant graphs are appended, as Graph 27 in Volume 2, for reference.

When the curves were examined it was at once noted that they showed great degrees of variation. Some reached the negative line by values which became progressively smaller: others seemed to undergo marked fluctuation before reaching this point while, in a third set, the curves followed such irregular routes that it was impossible to designate their course. In most cases, however, the two curves appeared to follow one another fairly closely, the various rises and falls in one being noted in the other.

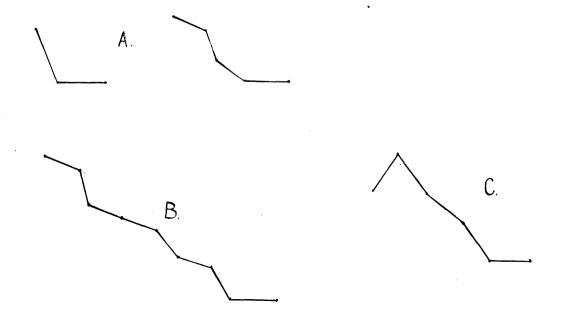
In order to assist in the classification of the results the curves representing the areas were arranged in five groups, viz:-

Group.	Type of Curve.						
1	Straight curves.						
2	Irregular curves.						
3	Spiked curves.						
4	Prolonged curves.						
5	Prolonged and Persistently Positive curves.						

In group 1 the succeeding values of the reactions were seen to become smaller and smaller until the negative line was reached. The group was further sub-divided in three sub-divisions on the following lines.

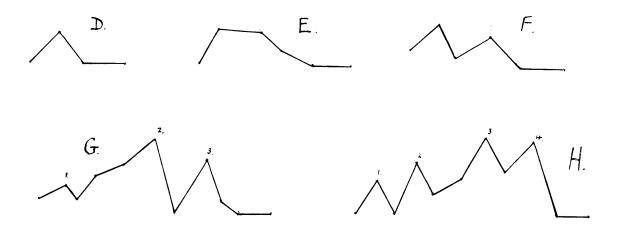
- A. Simple. In this sub-division the red curve reached the negative line on the second to the fifth test and thereafter remained at this level.
- B. Complex. In sub-division B the number of tests required before the negative results were obtained was larger than in A. In B, however, as in A each succeeding test gave a smaller area of reaction than preceding one.
- C. Toothed. In sub-division C the curve showed an increase in the area on the second test but thereafter followed the course taken by Sub-division A.

These sub-divisions are illustrated by the following diagrams.



Group 2 consisted of those cases which were included in the Irregularly Positive series of cases mentioned when the results to the Dick Test were considered. It was sub-divided into the two sub-divisions D and E for the following reason.

- D. In this sub-division were included those cases which, after giving a negative reaction to the test on the first day of hospital treatment, gave a positive one on the second day and finally became permanently negative on the third day.
- E. In sub-division E the decline from the positive result noted on the second day of hospital treatment was more prolonged: two or sometimes three positive results being noted before the patient actually became negative. This state of affairs is noted below.



Group 3 contained those results which underwent marked fluctuation before becoming negative. Here the areas noted increased and decreased in an apparently reasonless manner: at some times even touching the negative line only to rise again from it. Group 3 is sub-divided into three sub-divisions namely F., G. and H., according to the number of maxima noted in each curve. Thus two curves representing two peaks were placed in sub-division F, those with three in G, while sub-division H contained those curves which showed four peaks.

The position in each case is represented above.

Groups 4 and 5 contain those cases whose curves were noted to follow a course of prolonged fluctuation.

Those which finally became negative were included in Group 4 while those which were found to remain positive throughout their illness were classed as Group 5.

The various graphs were examined and after they had been allotted to their respective groups the following table was compiled.

TABLE 42.

		1		2	3		3		4	5
	A	В	O	Ð	E	F	G	Н		
1 - 100	13	3	6	5	_	9	3	3	4	2
101 - 200	25	-	3	2	2	21	7	1	3	4
201 - 300	19	1	2	3	3	12	6	4	4	2
1 - 300	57	4	11	10	5	42	16	8	11	8
		72		15		66			11	8
	4	41.9	%	8.7%		38.4%		6.4%	4.6%	

Perhaps the first point which will attract attention is that the above results do not follow what might be called the popular conception of the course which one would expect the reactions to successive Dick Tests to follow. It is commonly held that when a person contracts Scarlet Fever he will be found to give a large Dick reaction of bright intensity: in fact, his ability to do so is said to be one reason for his having contracted the disease. Furthermore, it is said that, as the patient passes onwards towards convalescence, he manufactures a supply of antitoxin and, as this increases in amount, so does his reaction to the Dick Test become proportionately smaller until, when he has reached the middle of his second week of illness, he fails to give any reaction to the Whilst working among Scarlet Fever patients it is quite Test.

common to observe cases who do not conform to those ideas. In the present series of cases 128 out of 300 patients suffering from Scarlatina in its early stages were found to be negative reactors to the Dick Test and, as has been noted above, like results have been obtained by other workers. including Horne, who, during work performed in this hospital during 1924 and 1927 obtained results which approximate closely to our own. Again, one frequently meets with cases which give a positive Dick Reaction and, although in close contact with Scarlatinal infection for prolonged periods do not contract the disease. We have also observed two cases both nurses in this hospital - who, after having been noted as being "Dick Negative" were put on duty in the Scarlet Fever Wards and who later contracted Scarlet Fever. In one of these cases the attack of Scarlet Fever was mild while in the other it was of a moderately severe character. Furthermore. only 41.9% of the positive reactors in the present series were found to follow the "Normal", if it may be so called, course of the reaction, that is, to show a gradual but constant diminution in their degree of reaction to the Dick Test.

Another point which may be discussed lies in the fact that 66 or 38.4% of the positive cases are represented by curves which are classed in group 3. Here we find marked fluctuation in the course of the Dick Reactions: they may be of low value one day, high value on the next day and perhaps smaller value on the following day. In some cases this type of variation was carried on for 10 or more days. At the commencement of the work the question arose as to whether the daily injection of Dick Toxin would tend to create a degree of immunity in the patients. However, when we remember that the toxin used for the purposes of immunisation against Scarlet Fever contains 2,500 skin test doses in every cubic

centimetre and that the series of injections must be carried on over a period of several weeks before immunisation is accomplished it was apparent that even twenty consecutive Dick Tests or, in other words, the injection of 20 skin test doses of toxin dilution spread over a period of three weeks, could have little effect, as far as immunisation of the patient was concerned, and the results obtained have, I think, justified this opinion.

When we remember that in any infectious disease, i.e. in diseases caused by micro-organisms, the development of antibodies to the infective agent is a gradual process, it is reasonable to suppose that, instead of being a constant progressive phenomenon, it is one which, while progressing onwards towards recovery, is marked by fluctuations caused no doubt by slight increases in bacterial proliferation. state of affairs is quite commonly illustrated by the exacerbations of the original disease which are met with in patients suffering from erysipelas, enteric fever or even pneumonia. Again this gradual but fluctuating development of immunity is instanced by a study of the Widal Reaction in patients suffering from Enteric Fever. Here the development of immunity progresses until recovery takes place but, as Rolleston states, quoting Widal, the course of the reaction is very capricious. Indeed the mere fact that, while an ordinary attack of Scarlet Fever tends to subside by lysis and one which had received serum treatment by crisis, seems to suggest a gradual auto-immunisation which is subject to degrees of fluctuation. This suggestion, then, may explain, to some extent, the spiked type of curve found in Group 3. This theory if developed still further will perhaps explain the fact that in some curves we find a case becoming negative and then once more becoming positive to the test. This state of affairs has

been noted in not a few of the cases and, while no definite record of such an occurrence can be found in the literature, Zingher, in 1926, published a table of results to the Dick Test in which an example of this change was noted. In some of my own cases, which had become negative during convalescence in the usual manner, a positive reaction was obtained on re-testing them prior to dismissal and, in one other case, a positive result was noted when the patient suffered from a relapse on his 23rd.day of illness (Case 53). Thus, although it may not agree with the preconceived idea of the course which should be taken by the Dick Test in cases of Scarlet Fever, it has been noted that in certain cases the patient becomes negative only to become positive again before finally giving negative reactions to the test.

A study of the Graphs will demonstrate that a certain percentage of the cases failed to become negative to the test in spite of the fact that the tests were performed right up until the time of dismissal. Similarly a number of cases did not become negative reactors until their convalescence was well advanced. In both of these groups of cases the curves adopt the spiked contour and the fact that they do not become negative at all or do so only after prolonged periods of testing does not appear to have any relationship to the severity of the initial attack of the fever or to the subsequent course of the disease. This statement appears to hold good for the entire series for, reviewed as a whole, the type of illness and the course taken during convalescence did not seem to have any relationship to the type of curves obtained from the Dick Tests. The graphs were re-examined in an attempt to discover if. by their study, it would be possible to forecast the occurrence of complications but, once again, no evidence of relationship could be discerned. Even in the question of relapses they

were of little value as not a few cases exhibited very marked increase in reaction to the test late in their convalescence and yet did not suffer from this complication.

The relationship of the patients reaction to the Dick Test and to the therapeutic value of Scarlet Fever antitoxin is one of importance for, if it were possible to determine in advance that serum treatment would prove beneficial in any particular case, the question of serum treatment could be stabilised and all those cases which would benefit from its use would be treated accordingly. By so doing the maximum value would be obtained from the use of serum, the length of hospitalisation of Scarlet Fever cases would be diminished and the expense incurred in their treatment reduced. Preliminary work on the relationship of the Dick Test and this point is not very convincing. It would appear, however, that those cases which are Dick Negative Reactors on admission to hospital do not seem to derive much benefit from the administration of Scarlet Fever antitoxin.

In a few instances the serum was withheld on this account and, in all, the patients made a normal recovery. In another case, Dick Negative on admission to hospital on the third day of illness, serum treatment was instituted as the patient appeared to be rather severely ill. 300,000 units were injected intramuscularly on the 3rd.day and this dose was repeated on the following day. The child appeared to derive no benefit from the administration of serum and died after having given evidence of the development of a pulmonary and an abdominal condition. Post mortem examination revealed the presence of a plastic pleurisy of one side and a plastic peritonitis. Haemolytic streptococci were recovered from the exudate obtained from each of these sites and also from the heart blood and a toxin prepared from these organisms and used

in dilutions of 1:1000 and 1:500 gave typical skin reactions in patients who were at the same time tested with a commercial Dick Test Toxin.

While it is not possible to compare too closely the cases cited, the evidence which we have collected seems to suggest that Dick Negative Reactors do not derive much benefit from serum treatment.

The last mentioned case brings out the point that "Septic" cases do not appear to react well to the Scarlet Fever antitoxin. This is not surprising as the serum is essentially "Antitoxic" although its makers claim for it definite antibacterial powers. In our hands it does not appear to have reduced the number of septic complications, such as Otorrhoea and Rhinorrhoea, in cases so treated. Wylie, when discussing work performed in Ruchill Fever Hospital, Glasgow, during 1926 and 1927 is also of the opinion that the administration of Scarlet Fever antitoxin has no effect on the occurrence, date of onset or duration of septic complications.

We have recently observed excellent results from the use of serum in a case of Toxic Scarlet Fever which was admitted early in its illness in a very grave condition. The child was markedly dazed, practically moribund, the rash was dusky, bluish and very poorly developed and the eyes were dull and lustreless. After the possibility of pneumonia had been excluded the patient received 300,000 units of Scarlet Fever antitoxin intravenously which was followed at twelve hourly intervals by three similar doses given intramuscularly. In all 1,200,000 units of antitoxin were given and the results noted were remarkable. The rash became much more evident and assumed a scarlatiniform colour, the eyes resumed their normal brightness and the physical and mental change in the patient

were, indeed, striking. Her convalescence went on without interruption, with the exception of the development of slight Rhinorrhoea, and all who had observed the course of her illness were quite definitely convinced that, without the administration of the serum, the case would have progressed rapidly to a fatal termination.

This case has led me to adopt the theory that, if one is to obtain the best results from the use of Scarlet Fever Antitoxin, and more recent work has confirmed this opinion, the antitoxin should be administered by the intravenous route and the first, at any rate, of any subsequent doses should be given in the same manner.

A collection of Ward Charts from the various Scarlet Fever Wards has been included in Volume 2. Charts demonstrating the effect of intravenous or intramuscular injection of Scarlet Fever Antitoxin are exhibited and for purposes of comparison we have included a series of charts which demonstrate the course of the illness in "Non-Serum" treated cases. Owing to the relatively small number of cases illustrated it is not possible to draw any definite conclusions from a study of the charts. A brief note precedes each group of charts in Volume 2.

PART II.

THE EXAMINATION OF THROAT SWABS FROM

SCARLET FEVER PATIENTS

DURING

THEIR CONVALESCENCE.

A. The examination of Throat Swabs from Convalescent cases of Scarlatina with special reference to the occurrence of Return Cases.

B. An Investigation into the Toxin Forming Properties of Haemolytic Streptococci recovered from the throats of Scarlet Fever Patients during their Convalescence.

A. The Examination of Throat Swabs from Convalescent

Cases of Scarlatina with special reference to

the occurrence of Return Cases.

Introduction.

The Materials used in the Work.

The Procedure.

The Reading and Recording of the Results.

The Results.

The Return Cases.

Conclusions.

The haemolytic streptococcus is now accepted by many workers as the causal organism of Scarlet Fever. Loeffler, in 1884, demonstrated the frequency of haemolytic streptococci in the throats of Scarlet Fever patients and investigations by Klein in 1887, Moser in 1902, Savchenko in 1905, Pirquet and Gabritchewsky in 1907, Dochez and Sherman in 1919 and onwards and Mervyn Gordon in 1921 supported the hypothesis that Scarlet Fever was produced by a definite strain of streptococcus. The great difficulty encountered by all the workers was their failure to produce Scarlet Fever in animals. However, in 1923, George F. and Gladys H.Dick advanced their work to the stage where they were able to produce clinical Scarlet Fever in human volunteers and since then other workers both in Britain and America, among whom Zingher and Tunnicliff were prominent investigators, have produced evidence in support of the streptococcal theory of the etiology of Scarlet Fever. several strains of the organism may be responsible for the apparently slightly different varieties of Scarlet Fever observed is probable and such an explanation would go far to explain the anomalies met with in the results to the Dick and Schultz Charlton Tests. Pursuing this line of work Griffth succeeded in isolating four chief types of the streptococcus scarlatinae. These types are all closely related, one to the other, but they may produce toxins which may differ from one another sufficiently to affect the results obtained, when they are used for the Dick Test. Their existence would also go far to explain the occurrence of relapses in a Scarlet Fever Ward and also the development of second or third or even more attacks of Scarlet Fever in the same person.

The common localisation of the haemolytic streptococci is undoubtedly the fauces. The organisms are also present in the morbid discharges from the nose or ears and are found in

the pus obtained from abscesses in Scarlet Fever patients. In some cases they may be recovered from the blood and in others have been noted in the urine and stools. Moody and Irons noted their presence in the stools of 30% out of 85 patients suffering from Scarlet Fever and quote that Tunnicliff (J.A.M.A. 74:1386) found that in 6 out of 11 cases haemolytic streptococci were obtained from the stools and resembled those obtained from the throat of an early case of Scarlet Fever.

The importance of the relationship of the haemolytic streptococcus as the causal organisms of Scarlet Fever and the administration of a Scarlet Fever Ward is obvious. Such questions as the number of cases which may be treated in each ward, the length of hospitalisation of each case, the liability of relapses, return cases and complications are all closely related to the organism and its possible types.

OBJECT OF WORK.

In the present investigation the frequency of the haemolytic streptococcus in the throats of patients convalescing from Scarlet Fever was studied in an attempt to discover whether or not more "Return Cases" could be traced to those patients who, on their dismissal from hospital, were noted to harbour in their throats strains of haemolytic streptococci, than to those patients whose cultures did not reveal haemolytic streptococci. If such a state of affairs existed the obtaining of negative cultures before dismissal might help in the control of the infection in Scarlet Fever. The influence, if any, of complications, especially septic ones and more especially those connected with the naso-pharynx or ears, on the persistence of haemolytic streptococci in the throat was also studied.

THE WORK.

The work was performed on a series of 300 consecutive cases of Scarlet Fever. These cases were, in every respect, representative of the type of Scarlet Fever met with in the city at the present time. Three swabs were obtained, at intervals of a few days, from the throat of each patient and examined for haemolytic streptococci. The swabs were taken as far as possible during the last ten days of hospital treatment in each case.

MATERIALS USED.

MEDIA.

Meat Extract.

The Meat Extract was prepared in the manner recommended by Muir and Ritchie in their "Manual of Bacteriology". Finely minced rump steak, as free from fat as possible, was used throughout the work. 1 lb. of this mince was added to 1000 cc. of distilled water in a flat shallow basin (18" x 12" x 3") and allowed to stand for 24 hours. The fat, which had collected on the surface of the fluid, was removed by stroking the surface of the fluid with filter paper and the mixture was then filtered through white lint. After filtration had ceased the bag was removed and as much as possible of the fluid still remaining in the meat was expressed by firm pressure. As a meat press was not available this operation had, perforce, to be done by hand but it was found that the volume of extract obtained was nearly 1000 cc. Thus apart from the extra time required for the manual expression the method proved quite satisfactory. The extra was then steamed in the Koch for two hours in order to coagulate all the protein content and the mixture was then filtered through Swedish filter paper. The resultant filtrate

was clear yellow in colour and after the volume of the extract had been made up to 1000 cc. with distilled water the flask was plugged with non-absorbent cotton wool and then sterilised in the steam in the Koch for $1\frac{1}{4}$ hours. The resultant Meat Extract was then stored against future use.

Peptone Broth.

The Peptone Broth used in the work was made up from the Meat Extract already prepared. "Lab.Lemce" was tried but Meat Extract, as prepared above, was favoured and used throughout the work. The ingredients were used in the following proportions.

Meat Extract. ... 200 cc.

Sodium Chloride, ... l gram.

Peptone Albumin, ... 2 grams.

The Peptone Albumin was supplied by Messrs. Parke Davis & Co. and was tested by them to ensure absence of fermentable sugars. The mixture was heated in the Koch at steam for 30 minutes, being shaken at frequent intervals, until all the peptone albumin had dissolved. The reaction of the mixture was strongly acid and alkalinisation was proceeded with. object of this step was to render the mixture slightly, but distinctly, alkaline. In the first stages of the work this was done by adding $\frac{N}{1}$ NaOH and, after thorough mixing, testing the resultant reaction with Litmus Paper. The papers - blue and red - were introduced into the bulk of the broth: a drop of broth was now removed with a glass rod and placed on the Difficulty was experienced in deciding when the reaction of the mixture changed from acid to alkaline and it was impossible to ensure that each batch of broth was rendered as alkaline as the others. For this reason, and also because of the saving of time, the peptone broth used in the succeeding parts of the work was alkalinised by the Hydrogen Ion Concentration method. The P.H. decided on was 7.3. The broth, after having been brought to this reaction, was filtered and its volume made up to 200 cc. with distilled water.

It was tubed in tubes, $5^n \times \frac{5}{8}$, which had previously been sterilised at 170 degrees C. for one hour. They were sterilised in this manner as it was found that, by so doing, less chance of contamination occurred and also because after sterilisation the wool stoppers fitted the mouth of the tubes much better. 2 cc. of broth were run into each tube from a flask and the charged tubes were then sterilised in the Koch at steam for $1\frac{1}{4}$ hours.

Agar.

The ingredients employed in preparing the Agar were used in the following proportions.

Meat Extract, ... 1000 cc.

Peptone, ... 10 grams.

Sodium Chloride, ... 5 grams.

Agar, ... 15 grams.

During the first stages of the work "ordinary" agar was employed and was torn up into small portions before being used but in the greater part of the work powdered agar was used as, owing to its being more easily handled, much time was saved. The different ingredients were mixed together in a 2000 cc. flask and allowed to stand for a short time. They were then boiled in the Koch for low to 2 hours in order that the agar might be thoroughly melted. Steps were then taken to clear the mixture as perfectly as possible. This was accomplished by cooling the mixture to between 60 and 70 degrees C. and then adding the white of two eggs, moderately well beaten up, to each litre of medium and then rapidly heating up and boiling the mixture in the Koch for 30 minutes: the flask being thoroughly shaken several times during this latter

process. At the commencement of the work the white of one egg was added to each litre of medium but it was soon found that better results were obtained when the white of two eggs was used for this purpose. The mixture was then filtered through Chardin's paper. This filtration was carried out in the Koch the whole apparatus being kept at boiling point and the mouth of the filter funnel being covered with a glass plate in order to prevent water of condensation dripping from the lid of the Koch into the The reaction of the medium was then adjusted by the hydrogen ion concentration method to P.H. 7.5. This operation occasionally caused difficulties as it was necessary to carry out the entire procedure before the agar had time to solidify. When the reaction had been adjusted the agar was distributed in tubes containing 12-15 cc. or in flasks containing 80-100 cc. and then sterilised in the Koch for one hour. As the work proceeded it was found that more satisfactory results were obtained when 20 grams of powdered agar were used per litre of meat extract instead of the 15 grams already noted and this alteration in the amount of agar used was adopted for the greater part of the work.

The filtration of the agar proceeded slowly and, with a view to quickening this and so saving time, various methods were employed. In one of these the orifice of a large filter funnel was occluded with a rubber stopper. The filter funnel was then placed upright in the Koch and heated up to boiling point. The molten unfiltered agar mixture was then poured into the funnel and reheated for twenty minutes. The funnel was then removed from the Koch and allowed to cool after which a solid cone of agar could be removed from the funnel. During the heating in the Koch the agar had become as liquid as possible and when transferred to the filter funnel the solid materials

brought down by the coagulated egg albumin fell to the bottom of the funnel and, collecting there, formed a thick layer of debris. When the solid cone of the cooled agar had been removed from the funnel this layer of debris was cut off and the remaining frustum was found to consist of clear agar which was remelted, and after its reaction had been adjusted to P.H. 7.5 it was distributed in tubes or flasks and sterilised before being stored until required for use in the work. While this method worked fairly satisfactorily in our hands it was found that the volume of agar obtained from the 1000 cc. of meat extract was much smaller than that obtained when it was filtered in the usual manner and for this reason the greater quantity of agar used in the work was prepared by filtration through Chardin's paper.

Blood Agar.

The medium employed for the cultivation of the organisms obtained from the throat swabs was 5% Blood Agar. The blood was obtained from the marginal vein of the rabbit's ear in the following manner. The ear, in the vicinity of the vein, was shaved and thoroughly cleansed with alcohol and ether and then allowed to dry. An opaque electric reading lamp was placed at a short distance from the ear such being that the lamp produced a pleasant warmth. When the root of the ear had been firmly grasped between the first finger and thumb of the left hand and the vein rendered prominent, a small transverse incision was made through the marginal vein and approximately 10 cc. of blood collected. The blood was collected in test tubes and defibrinated by being beaten up In some parts of the work the blood was by a glass rod. collected in a thick glass test tube of the Ogilvie pattern, in which had been placed a glass rod, the tube and its bead being sterilised before use. By using such a tube it was

possible to carry on defibrination while the blood was being collected and in this way the possibility of the blood clotting was much lessened. The Ogilvie tubes were preferred for this stage of the work because, owing to their greater thickness and strength, there was less chance of their being broken by the glass rod or bead than existed when the ordinary test tubes were used.

After defibrination had been completed the blood was warmed up to 45 degrees C. and added, in the correct proportions, to the agar which had been allowed to cool to a like temperature. It was important to ensure that the agar was cooled down to this temperature because if the blood was added to agar at a higher temperature there was a great liability that changes would be produced in the haemoglobin of the blood. The blood was added to the molten agar either in test tubes or in small flasks and thorough mixing was ensured by rapid rotary movements of these vessels. In the case of the former one tube of agar was used for each Petri plate but when the agar was contained in small flasks it was possible to pour several plates from each flask, and, as this latter method lent itself more to speed and economy in blood agar and also afforded less chance for contamination to occur, it was preferred and used throughout most of the work.

While every care was taken to ensure complete sterility at each stage of the work the blood agar plates were incubated for 24 hours in order to ensure that no contamination had taken place. During the present work blood agar plates were poured twice or thrice weekly and in this way fresh plates were always available and they were never stored for more than two days before being used.

Petri Plates.

The blood agar used for the growth of the organisms

obtained from the throat swabs was plated out in Petri plates. Before being used these plates were wrapped in grease paper and sterilised in the Hot Air Oven at 170 degrees C. for one If placed on the bottom shelf of the oven it was hour. found that the paper was readily charred but, if they were placed on the upper shelf, sterilisation went on without any adverse effect on the wrapping paper. If the plates were intended for use immediately after sterilisation it was found quite satisfactory to sterilise them without any wrapping. Further, no evidence of contamination was noted in plates which were sterilised without any paper covering and which were stored for a few days before being used provided that the plates had been wrapped up in paper immediately after steril-Three sizes of plates were used, viz. $3\frac{1}{2}$, 4 and isation. $4\frac{1}{2}$ in diameter. The plates were divided into 2, 3 and 4 portions respectively with blue skin pencil markings and each portion was inoculated with the washings from one throat swab.

Swab Sticks.

The swab sticks used were of the usual type. A small portion of non-absorbent cotton wool was fixed securely, by twisting on to the free end of the aluminium stick and after the sticks had been fitted into the containing tubes, $5^n \times \frac{1}{4}^n$, they were sterilised by dry heat at 170 degrees C. for $1\frac{1}{4}$ hours.

PROCEDURE .

The Throat Swabs.

Swabs were taken from the throats of a series of 300 consecutive cases of Scarlet Fever, the throats being swabbed on three occasions during the patients' last ten days of convalescence in hospital. For purposes of comparison throat swabs were also obtained from patients suffering from

Scarlet Fever in its early stages and also from early cases of Measles. In all, upwards of 1000 throat swabs were obtained and examined in the present investigation.

The tonsillar region was the site to which attention was directed and no gargles or other antiseptic measures were applied to the throats for at least one day previous to the swabbing. When taking the throat swabs both tonsils were rubbed thoroughly and the swab stick was then transmitted to the laboratory with as little delay as possible. An emulsion of the contents of the swab was then made in peptone broth by vigorously massaging the swab on the side of the tube containing the medium. A loopful of this emulsion was then removed with a platinum loop and placed on a plate of blood agar. It was then distributed evenly over the surface of the medium with a glass spreader. As has been noted above two. three or sometimes four throat swabs were plated out on the same blood agar plate and in all cases a portion of the plate was left uninoculated and served as a control against possible contamination of the plate. The plates were incubated at 37 degrees C. for 18 hours and then examined for haemolytic It was found that incubation for 18 hours gave colonies. the most satisfactory results. If the plates were removed from the incubator after 12 hours the growth was scanty and haemolysis was poorly marked while, on the other hand, if left for 24 hours the growth was often so luxurious that it was difficult to distinguish separate colonies one from the other.

EXAMINATION OF PLATES INOCULATED WITH WASHINGS FROM THROAT SWABS OF CONVALESCENT SCARLATINA PATIENTS.

Naked Eye Examination.

When the plates were examined, after 18 hours incubation, it was at once noted that they contained numerous

varieties of organisms. In only a very few cases did we observe plates which contained pure cultures of haemolytic streptococci and, indeed, in the majority of plates, these organisms, if they were present at all, were noted as being in the minority. The typical haemolytic streptococcal colony was noted as being small in size, circular in outline, and disc like in appearance. When examined under the low power of the microscope its outline was seen to be slightly wavy or woolly. It was greyish white in colour, of a semi-translucent appearance and was surrounded by a narrow, but clearly marked, area of haemolysis. These colonies could be distinguished readily by the naked eye from the whiter and much larger staphylococcal colonies which were observed to have a wavy or oil appearance. However, many other organisms, such as cocci, including micrococci and pneumococci and various forms of bacilli, such as bacillus diphtheriae, and cocco-bacilli also occurred as small almost translucent or greyish colonies surrounded by a narrow ring of haemolysis that it was only after examination of a stained smear from each colony that its character could be stated definitely.

Microscopic Examination of Smears from Colonies of Haemolytic Streptococci.

Smears were prepared from every plate on which were observed any haemolytic colonies which were suspected of being streptococcal in type. These films were stained for ten seconds with dilute Carbol Fuchsin and examined for Streptococci If any of these smears were found to consist of streptococci further specimens were prepared and stained by Gram's method.

The haemolytic streptococcus was observed to be stained deeply with the dilute Carbol Fuchsin stain and was not decolorised by Gram's method. The chains were noted as being of varying lengths: in some cases they consisted of half a dozen or so cocci while in other cases they were of

considerable length. The size of the individual cocci was also noted to vary. In most chains the individual cocci were of normal appearance but in others they were much enlarged and appeared to be swollen and in some instances seemed to be as much as twice their normal diameter. Examination of the films revealed the interesting point that some chains of streptococci took on the appearance of chains of diplococci or by coccobacilli. These appearances were due to the fact that division was about to take place or had taken place in the individual colonies of the chain and demonstrate that the multiplication of streptococci is brought about by transverse fissure.

THE RECORDING OF THE RESULTS.

The results of the examination of the organisms isolated from the blood agar plates were recorded in Table 43 which is reproduced in Volume II. of this work. In the swabs obtained from cases 1 - 100 the results were noted simply as "Positive" or "Negative". While this point was noted in Cases 101 - 300 an attempt was also made to estimate the proportion of colonies of haemolytic streptococci present on each plate. In these cases the number of such colonies was determined, as accurately as possible, and the result expressed as a fraction of the total number of colonies present on the plate. These results are recorded on the table of results mentioned above and reproduced in Volume II.

THE RESULTS.

When the results obtained from the 900 swabs under consideration were examined, three swabs having been taken from each of the 300 cases, it was found that very varied results had been obtained. The three swabs from some patients

were Negative for haemolytic streptococci: were Positive from others: in some cases the first swab was Positive and the later ones Negative, and vice versa, while, in others, the variation was still more irregular.

When the results of the examination of the 900 swabs, that is the swabs from the entire series, were examined, it was found that 167 patients, or 55.66%, had yielded negative swabs on all three occasions, and, in only 6, or 2%, was it possible to demonstrate haemolytic streptococci in each of their three throat swabs. Furthermore, 243 or 81% of the 300 cases were noted as being "Negative" on their dismissal from hospital and only 57 or 19% as being "Positive" at the same time. This question is clarified by an examination of Table 44.

TABLE 44.

RESULTS OF THE EXAMINATION OF THROAT SWABS FROM CONVALESCENT CASES OF SCARLET FEVER.

	CASES 1 - 300 STATE ON DISMISSAL							
	Negativ	re •	Positive.					
Result	No.	%	Result	No.	76			
	167	55.66%	+ + +	6	2%			
+	35)		-++	16)	•			
+ + -	12)	76 (25.33%)	+	24)	51 (17%)			
- + -	29)		+ - +	11)				
	243	81%		57	19%			

A study of the above table will reveal the fact that only a small minority of the cases, 19%, were noted as harbouring haemolytic streptococci in their throats at the time of their dismissal from hospital while the great majority, namely 81%, were recorded as being Negative on dismissal and, with very few exceptions, were found to have been so on two out of the three occasions on which tested.

It is interesting to compare these figures with those obtained by Gunn and Griffth. These observers demonstrated that, of 100 patients whose throats were swabbed on the day prior to their discharge from hospital after Scarlet Fever, 50 carried haemolytic streptococci. They also recorded that none of these 50 cases gave rise to "return" cases.

The results recorded on Table 44 were studied in greater detail with a view to discovering whether those patients who were treated in Pavilion 9 were more prone to retain the haemolytic streptococci in their throats than those who were treated in Pavilion 10. It will be recalled that Pavilion 10 was divided into "Acute" and "Convalescent" Wards, while in Pavilion 9 both acute and convalescent patients were nursed in the same ward. In order to facilitate this comparison Graphs 28 and 29 were constructed, the former representing Pavilion 10 and the latter Pavilion 9. In each case the black curve, or curve B, represents the daily variation in the number of patients treated in each Ward. Curve C, the broken red curve, represents the number of throat swabs examined on any particular day while curve D, or the solid red line, indicates the number of "Positive Swabs" obtained on any of these days. After these six curves had been completed the two Graphs were examined. was found that, in each Graph, the variations of the black line, which indicated the total number of patients present in the Ward, were reflected in corresponding variations in curves C and No apparent difference, however, could be discerned between the Graphs representing the two Hospital Pavilions. A further curve, curve A, dotted red line, was therefore added to each Graph to represent the percentage of positive results obtained on each day on which throat swabs were examined. additional curves were then considered, and it was noted that the fluctuations recorded in one closely resembled those noted

in the other. The percentage of positive results obtained from either pavilion varied from 0% up to 50% with occasional rises to 100% on days on which the total number of throat swabs examined was small. We were, therefore, forced to the conclusion that, in this investigation at any rate, the type of ward in which the patients were treated had little effect, if any, on the persistence of haemolytic streptococci in the throats of convalescent patients.

The age or sex of the patient, or the presence or absence of septic or other complications did not appear to have any influence on the persistence of haemolytic streptococci in their throats during convalescence.

THE RETURN CASES.

The after histories of the 300 cases were followed up and examined in order to ascertain the number of return cases which were noted to arise from these patients on their return to home. At the same time attention was also directed to the incidence of Scarlet Fever in the closes and properties in which these cases resided and in the schools which they attended; to the size of their homes, the number of occupants and the number of occupants per apartment in the house, the domestic arrangements in the house, the position of the W.C. whether in the house, stair or close - and the number of susceptible contacts at home. The greater number of the 300 cases were drawn from the Central Division of the city which is the area served by the hospital, and the investigation into the after histories of the cases was made possible by the kindness of Dr.R.J.Peters, until recently Division Medical Officer of the Central Division of Glasgow, in allowing me access to the records compiled by his department during 1929.

In all, seven patients were discovered to have

infected further patients on their return to home; in six cases one return case being noted in each household while, in the seventh family, two secondary return cases were recorded. The total number of return cases was therefore 8 which, when compared with the 300 cases dismissed well, gives a return case rate of 2.66%. Chalmers notes that, from 1894 till 1925, the return case rate for the city has varied from 1.5% to 3%. Dr. A.S.M.Macgregor, the present Medical Officer of Health, states that, for the past ten years, it has remained at 2% and was 2.4% for the city in 1929 and 3.1% for Knightswood Hospital during the same period. The figure obtained from the present 300 cases, namely 2.66%, is therefore in keeping with that for the entire city.

Glover and Griffth, in a note on an outbreak of Scarlet Fever at an English Preparatory School, state that 8 of their 34 cases (or 23%) gave rise to return cases in spite of the good diagnosis and isolation which was available and the favourable surroundings in which they were treated. The causal organism of these cases was found to belong to type 2 of the streptococcus scarlatinae and the surprisingly high Return Case Rate demonstrates that this type of organism may retain its infectiousness for prolonged periods.

The particulars noted with regard to the eight return cases may be summarised as in Table 45.

TABLE 45.

1	ime ase	•	Dismissal Date.	Period of Treatm ^t	Case.		Case. Date.		Inter- val.		nta	
	Sex	Age		Days.		Sex	Age			Apts	Ad.	Ch
SG	F	8	27/6/29	60	IG	M	22	2/7/29	5	5	2_	2
MMcK	F	6	14/11/29	33	TMcK	M	3	19/11/29	5	2	3	3
AM	F	5	30/11/29	31	MM	F	8	8/12/29	8	1	2	3
MMcI	F	8	30/11/29	36	NMcD	M	30	11/12/29	11	2	2	3
11	11	11	30/11/29	36	AMcD	F	6	16/12/29	16	2	2	3
NC	F	10	26/12/29	37	JC	P	4	14/1/30	19	3	3	2
ΓĐ	M	13	11/1/30	62	MD	F	2	20/1/30	9	2	3	1
RG	F	3 1	20/1/30	84	MG	M	2	30/1/30	11	2	2	3

The investigation was carried on for a period of over 11 months, namely from April 1929 until March 1930, and during this period throat swabs were obtained and examined from every case of Scarlet Fever dismissed from hospital. It should, however, be noted that those cases of Scarlet Fever who developed a second disease such as Diphtheria or Measles and were removed to Isolation Wards for that reason were not included in the series. It will, therefore, be seen that the cases were in no way selected, and that the series is representative of the type of Scarlet Fever encountered in the city at the present time.

The Incubation Interval between the return of the convalescent primary case hospital to home and the sickening of the second or return case was studied and is illustrated by Table 46.

Return Cases.			<u>;</u>	PABLE (ubation	Interve	al ·
	Days	5	8	9	11	16	19	
	Cases.	2	ז	1	2	,	7]

It will be seen that, with two exceptions, the incubation interval exceeded one week and that, in two cases, the date of sickening of the return case lay in the third week. In one of these latter cases, however, namely A.McD., the question was complicated by the fact that this child's father sickened, as a return case, five days before the onset of her illness and, although this incubation period would be rather longer than that most commonly met with in children of her age she might be regarded as a Secondary Case of Scarlet Fever. The table seems to suggest that, while the incubation interval before the sickening of the return case may be short, that is under one week, it may also be considerably longer and the infection may persist for nearly three weeks before giving rise to fresh cases.

Table 45 will also demonstrate that, although the work extended over a period of fully eleven months, seven of the eight return cases were noted to occur during the winter months, December and January being the period when these cases were most frequent. The months of November and December are stated by the Medical Officer of Health to be the most frequent period for the sickening of the second case in other parts of the city, and it will be seen that our figures are in agreement with this statement. It should also be noted, and reference to Graphs 28 and 29 will bear out this point, that the months of December and January followed closely the period when the hospital accommodation for cases of Scarlet Fever was taxed to its greatest. It may follow that, if the wards are filled beyond a certain limit, the possibility of return cases arising will be much accentuated.

Table 45 will also demonstrate that, in this investigation, six cases out of the seven giving rise to return cases were noted to be females, while the incidence of the return cases fell equally on the two sexes. The length of the hospitalisation of patients causing return cases varied, but exceeded one month in all cases and this factor does not appear to have much influence on the question of these return cases provided the patient is free from discharges at the time of dismissal from hospital. The Age Distribution of the Return Cases was of the usual type: seven of the eight cases being of eight years of age and under.

The study of the conditions in the patients' homes was disappointing. While secondary cases of Scarlet Fever could be traced in schools and properties the incidence of return cases was not noted. Again such factors as the position of the W.C. did not have any appreciable effect on the incidence of Scarlet Fever. Five of the eight return cases were noted to

live in houses of two apartments but no instance of real overcrowding was noted. In this part of the work the number of cases under review was relatively small and for this reason it was not possible to place too much reliance on the results obtained.

THE RESULTS OF THE THROAT SWABS IN THOSE CASES
GIVING RISE TO RETURN CASES.

The results of the examination of the throat swabs from those patients who, on their return home, infected further, or return, cases have been shown in Table 47.

TABLE 47	

No.	Name.	Result
13	SG	+ + +
86	MMcK	+ - +
104	MMcD	
113	AM	+(few
128	RG	++
154	LD	
174	NC	÷

It will be observed that the above results show marked variations and that in two of the cases, who accounted for three of the eight return cases, the throat swabs were said to be persistently negative. Again in four of the seven cases the swabs on dismissal were returned as "Negative". Although quite free from any such discharge on dismissal from hospital several of the cases giving rise to return cases were said to have developed Rhinitis on their return home and such an occurrence would, in some cases, explain the source of infection. In others again, however, no such discharges were noted, either while they were in hospital or on their return home, and as their final throat swab was returned as "Negative"

the exact source of the infection cannot be stated. In such cases we must consider that the organism had been present in the crypts of the tonsils or some similar region in the nasopharynx and that, on the patient's return home, the infection had once more become active and thus been able to give rise to further cases.

The relationship of Relapses and the presence of haemolytic streptococci in the throats of those patients who suffered from Relapses was considered but, owing to the small number of such cases under review, it was not possible to arrive at any definite decision on the question. The following case note is, however, of interest. A.D., a girl aet.5 years, was noted as being a Persistent Positive Reactor to the Dick Test and, when tested on the 33rd.day of illness, was found to yield a definite positive result. Her throat swab was examined two days later with positive results and on the following day, 36th.day of illness, she was noted to suffer from a Relapse. In this case the combination of a positive Dick Reaction and the positive result obtained from the throat swab appeared to bear some relation to the occurrence of this It should also be noted, however, that several other cases, in which either positive Dick reactions were recorded or from whose throats haemolytic streptococci were recovered on more than one occasion did not suffer from Relapse.

SUMMARY AND CONCLUSIONS.

The Throats of 300 patients convalescing from Scarlet Fever were swabbed, each on three occasions, and examined for haemolytic streptococci.

The results obtained from this work varied but it was found that 55.66% of the patients gave "Negative" results to each of the three examinations and, in only 2% of the cases, were we able to demonstrate the haemolytic streptococcus in each of the three throat swabs.

When the condition of the patient on dismissal from hospital was considered it was found that, in 81% of the cases, the final swab was negative for haemolytic streptococci and

- that positive results were only obtained in 19% of the cases.
- The type of ward in which the patients were treated, the age and sex of the patients and the presence or absence of complications appeared to have no influence on the persistence of haemolytic streptococci in the throats of convalescent Scarlet Fever patients.
- In the latter two thirds of the work the proportion of colonies of haemolytic streptococci was estimated. It appeared to vary within wide limits and probably is of little importance.
- The presence of positive results from the throat appears to have little effect on the production of return cases. Examination of throat swabs would also appear to have little value in the prevention of relapses.
- The routine swabbing of the throat in convalescent cases of Scarlatina and the examination of the swabs for the presence of haemolytic streptococci does not appear to have any great value in the prevention and control of return cases.

B. An Investigation into the Toxin Forming Properties of Haemolytic Streptococci recovered from the Throats of Scarlet Fever patients during their convalescence.

Preparation of the Toxins.

The Testing of the Toxins.

Summary and Conclusions.

During the work in the examination of the Throat
Swabs obtained from the Convalescent Scarlet Fever patients
we were able to isolate over thirty cultures of haemolytic
streptococci. At the same time we also obtained eight further
cultures of haemolytic streptococci from lesions which occurred
in cases of Septic Scarlet Fever. One of these was obtained
from blood culture in a case which succumbed to an attack of
Septic Scarlet Fever in its acute stage. Toxins were prepared
from these organisms and an attempt was made to compare them
by using them, in varying dilutions, for Dick Tests.

MEDIUM EMPLOYED.

The medium used for the preparation of these toxins was Hartley's Broth prepared in the manner laid down by Muir and Ritchie in their "Manual of Bacteriology". 150 grms. of minced horse muscle was added to 250 cc. of tap water and the mixture heated to 80° C. in the Koch. 250 cc. of 0.8% solution of sodium carbonate was then added and the mixture allowed to cool to 45°C. When this temperature had been reached 5 cc. each of chloroform and pancreatic extract were added and the mixture incubated at 37°C for six hours, being shaken at frequent intervals; 40 cc. $\frac{N}{1}$ HCl were then added and the whole steamed for half an hour in the Koch. The reaction of the medium was then adjusted to P.H. 8 and, after filtration, it was distributed into sterilised test tubes. 10 cc. of the medium was run into each tube and, after sterilisation by steam for one hour, the tubes were stored for future use. pancreatic extract recommended for use in this work was that prepared on lines laid down by Cole and Onslow. Even after filtration a slight degree of sedimentation was noted in the tubes but, unless this was marked its presence was ignored.

PREPARATION OF TOXINS.

Tubes of Hartley's Broth were inoculated with the various cultures of streptococci. They were incubated at 370 C. for four days after which they were removed from the incubator and allowed to stand for two days. In this way a considerable amount of the solid material present in the tubes fell to the bottom. About 5 cc. of the supernatant fluid was drawn off with a sterilised 10 cc. Record Syringe and transferred to a sterilised centrifuge tube. A smear was made from the fluid remaining in the tube and stained with dilute carbol fuchsin. The film was examined and streptococci demonstrated on each slide. This was done in order to prove that the organism from which the toxin was prepared, was of streptococcal The fluid which had been removed from the tube of Hartley's Broth was then centrifuged at high speed (2000 revolutions per minute) for fifteen to twenty minutes after which the clean upper portion (4cc.) was removed with a sterile syringe. The fluid was then transferred to a sterile tube and placed in the vaccine bath at 56° C. for one hour. During this time any organisms which might have remained in the fluid after centrifugalisation were killed off while no change occurred in the toxin. The toxin was incubated at 370 C. for 24 hours in order to ensure that it was sterile. If it remained clear after this period it was passed as sterile and fit for use but if it became cloudy it was rejected. The toxins which had been passed as suitable for use were transferred by a sterile Record Syringe to 5 cc. glass bottles, which had been sterilised by dry heat at 170° C. for $1\frac{1}{4}$ hours and which were stoppered with rubber corks rendered sterile by boiling.

Steps were now taken to render the various "toxins" as free from protein as possible and this was accomplished in the manner suggested by Mackie. 1 cc. of unpurified toxin was

was observed to form and this was separated out by centrifing the mixture for about ten minutes. The supernatant fluid was then removed and the residual precipitate re-dissolved in 1 cc. normal saline. This toxin solution was retained as concentrated toxin. Dilutions of 1:10, 1:100, 1:500 and 1:1000 in normal saline were prepared for testing purposes. 1 cc. of the 1:100 dilutions was transferred to rubber capped bottles and heated at boiling point in the Koch for two hours. This latter dilution was employed for Control Tests.

The various toxins and their dilutions were stored in the ice chest until required for actual testing but it should be noted that the dilutions were not prepared until suitable patients were available for testing purposes. In this way all our dilutions were fresh when used for Dick Tests.

THE TESTING OF THE TOXINS.

The patients selected for the testing of the toxins, which had been prepared in the above manner, were those who were convalescing from Diphtheria or Pneumonia. Their reaction to the Dick Test was ascertained by the injection of 0.2 cc. Burroughs Wellcome & Co. Dick Test Toxin and only those patients, who were noted as having given a strong, well marked, reaction to this toxin, were used in the tests. The most suitable patients were those of three to eight years of age and considerable difficulty was experienced in maintaining a sufficient supply of such patients for this work. Owing to patients, suffering from definite attacks of Diphtheria developing Scarlet Fever soon after their admission to the Diphtheria Ward, all patients admitted to this ward over a considerable period received a prophylactic dose of anti-streptococcus scarlatinae serum and, for this reason, were not

available for testing purposes. Furthermore, as the Pneumonia patients admitted to hospital during the latter part of 1930 were, in most cases, very young, often being under one year, only a small number of them were suitable for the purposes of our work. A large number of Dick Tests were performed with commercial Dick Test Toxin and, only those patients whose reaction to the test was marked, were retained for the testing of our own toxins.

The toxins were employed in dilutions of 1:10, 1:100, 1:500 and 1:1000. Each test was controlled by the injection of the corresponding control solution which consisted of toxin which had been steamed in the Koch for two hours. The dosage employed in this work was 0.2 cc.

The results of the tests were read and recorded twenty-four hours later. They are reproduced in Table 48. This table shows that, of the 33 toxins tested, 25 had been prepared from haemolytic streptococci recovered from throat swabs obtained from convalescent Scarlet Fever patients and, of the remaining eight, seven were obtained from pus in cases of Septic Scarlet Fever and the remaining one from the heart blood of a case which died in the early days of the illness. Various dilutions were employed for testing purposes and it was noted that, in practically all the cases, no reactions were obtained after the use of the higher dilutions. point has been noted by other workers. Horne required to dilute his toxins to 1:250 in order to obtain reasonably constant results but, during an account of his work on this question, stated that other workers were able to use higher dilutions.

During the present work we employed dilutions of 1:10, 1:100, 1:500 and 1:1000, all the dilutions of one toxin being tested out on the same patient. As the investigation

progressed it became evident that the majority of the toxins, which gave rise to reactions at all, did so in dilutions which lay from 1:100 to 1:500 and, for this reason, it would have been informative if a dilution lying between these two had been available for purposes of comparison. However, owing to a considerable number of the patients who were used for the tests being either dismissed or awaiting dismissal from hospital and to the difficulties experienced in obtaining a sufficient number of suitable cases for further tests, it was not found possible to corroborate those tests.

A considerable number of tests were made with 1:10 dilutions but as this dilution was considered to be too low the results obtained were not considered when the final calculations were made. When the results were examined it was noted that the toxins prepared from the streptococci recovered from the septic lesions were more potent than those prepared from the organisms obtained from the throat swabs. This is illustrated by Table 49.

TABLE 49.

No.	Source.	1:1	.000	1:	500	1:	100
		+	-	+	′	+	-
8	Septic Lesions.	1	7	7	1	8	
25	Throat Swabs.	2	23	7	18	13	12

These results include, as positive results, all the reactions noticed, no matter how small and faint and, as these poor reactions were observed chiefly in the case of toxins prepared from throat swabs, the table brings out the superiority of the toxins prepared from the organisms of the septic complications over those prepared from throat swabs. This point is further emphasised by the fact that the individual reactions obtained from the toxins prepared from the organisms

recovered from the septic complications were larger and brighter than those noted to arise from the injection of toxin prepared from throat swabs.

A further point of interest was noted in the fact that in the case of several toxins the area and intensity of the reaction did not appear to be influenced to any great extent by the dilutions in which it was employed. Toxins 2, 18 and 32 may be cited, among others, as examples of this point.

SUMMARY AND CONCLUSIONS.

- In this work nearly 40 toxins were prepared from various cultures of Haemolytic Streptococci and, of these, 33 were tested for their toxic content.
- The toxins, in their proper dilutions and with their corresponding control solutions, were injected into a series of patients all of whom gave strong, well-marked reactions to the standard toxin, in this case the product of Messrs.Burroughs Wellcome & Co. Each toxin was tested on one patient. Results obtained in this way are open to doubt. We, however, consider that, if the "Knightswood toxin" is unable to produce positive reactions in cases which react in a positive manner to the standard toxin, even in very low dilutions, then that "toxin" is very deficient or is totally lacking in toxin.
- The reactions noted in Table 48 demonstrate that the results obtained are, in practically every case, of much lower value than those obtained by use of the Standard Toxin.
- We were able to obtain positive reactions in only approximately 50% of the toxins prepared from cultures from throat swabs but the percentage was much higher in the case of toxins prepared from the other cultures of haemolytic streptococci.
- It should be recognised that no attempt was made to endeavour to prove that the toxins prepared in the present work were identical with the true Dick Toxin or to establish, in this way, the identity of the streptococci used. To accomplish this we would require to perform neutralisation tests which, even in the most suitable cases, are difficult to interpret and are often unsatisfactory.
- All that was attempted in the present work was to investigate the toxin forming properties of certain streptococci which were recovered from Scarlet Fever patients. We find that some of these organisms do produce toxins in quite definite amounts while others completely fail to do so.

This method of assessing the toxin production of different haemolytic streptococci is long and often difficult and we do not consider it of sufficient value to be carried out as part of the routine work in the examination of Throat Swabs from convalescent Scarlet Fever patients.

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THE VALUE

of

IMMUNOLOGICAL AND BACTERIOLOGICAL TESTS

in the

MANAGEMENT OF SCARLET FEVER.

VOLUME II.

I N D E X.

THE TABLES.

THE GRAPHS.

THE WARD CHARTS.

INTRODUCTION.

A complete collection of the Tables which are referred to in Volume 1 have been included in this volume. By this arrangement the larger of the Tables have been omitted from Volume 1 in order that, by causing as few interruptions as possible in the text, the reading of the volume might be facilitated.

In most cases the graphs bear descriptive titles but in some instances they are prefaced by explanatory notes.

The Ward Charts are arranged in three groups according to the treatment which they received. Each group is prefaced by a brief introductory note.

T A B L E S.

TABLE I.

THE LOCAL INSUSCEPTIBILITY DEVELOPED BY THE SKIN TO THE DICK TEST TOXIN.

	TEST 1	•		T	EST 2.			7	rest 3.	
			Contr	ol.	Superi posed No.1	on	Control	•	Superimp on No.	
Patient.	AREA.	Intensity	AREA.	Intensity	AREA.	Interestty	AREA.	Intensity	AREA.	Intensity
R.B.	Sq.cm. 2.98	6	Sq.cm.	6	Sq.cm.	4	Sq.cm.	5	Sq.cm. 2.3	3
M.B.	3.9	6	4.9	7	4.9	5	8.0	6	4.9	3
D.W.	2.4	5	3.6	5.	2.9	3	3.8	5	1.9	2
T.B.	5.5	4	7.2	4	5.3	3	5.9	4	3.3	2

The Degree of Intensity of the Reactions was assessed according to the values noted on the Scale reproduced on page 15 of Volume 1.

TABLE 2.

THE DICK TEST.

THE RESULTS OF DICK TESTS PERFORMED

ON A SERIES OF 300 PATIENTS.

The series of cases was divided into three groups, each consisting of 100 cases, and the following table has also been sub-divided into three parts corresponding to these groups.

The size of each reaction was noted by measuring its two diameters and these readings have been recorded in the following tables in Black: the figures in each case being given in millimetres.

The values of the intensity of the reactions, as noted by the Scale described on page 15 of Volume 1, have been recorded on line 3 by the Red figures.

The brand of Dick Test Toxin employed has been noted for each group.

		DICK	T	est .	RESULTS	š .			
	,	***************************************							
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DICK TEST RESULTS.

GROUP 3 (CASES 201 - 300).

TOXIN SUPPLIED BY MESSRS BURROUGHS WELLCOME & CO.

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TABLE 3.

Results of the Dick Tests performed during the present work.

In this table only those cases which gave a positive result after their first test were recorded as Positive Reactors, the Negative and Irregular cases being combined as Negative Reactors.

Number of Cases.	Number of Positive Results.	% Positive.
300	. 142	47.3%

TABLE 4.

Results of the Dick Tests performed during the present work.

In this table the positive and Irregular cases are included as Positive Reactors.

Number of Cases.	Number of Positive and Irregular Results.	% Positive.
300	172	57.3%

TABLE 5.

Comparison of Results of Dick Tests performed during the present work when arranged according to brand of Dick Test Toxin employed.

		React	ion to Dick	Test.
Source of Toxin.	Nos.	Positive	Irregular	Negative.
Burroughs Wellcome & Co.,	1-100	40	8	52
Parke Davis & Co.,	101-200	59	9	32
Burroughs Wellcome & Co.,	201-300	43	13	44

Comparison of Results obtained from Tests performed with Dick Toxin supplied by Messrs. Burroughs Wellcome & Co. and Messrs. Parke Davis & Co., the two tests being performed simultaneously on the same patient. (The area of each reaction is noted in sq.cm. in Column 1 (black figures) while the intensity of the re-action will be found in Column 2 (red figures)

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M.I.	B.W.& Co.		3.8	8 4	3.3	3 2.3	3 3	1	1								_								_
8 yrs.	P.D.& Co.		0.5	5 4	ı	1	•	1	•	_							_								
M.D.	B.W.& Co.				8.0	5 2.3	3	1.9	3 2.5	5 1	1.5	8	1.4	- 2	1		<u></u>					_			
7 yrs.	P.D.& Co.		_		6.0	5 1.3	3	9.0	3 -	1	•	-	1	•	-	-	-	_							<u>_</u>
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5g yrs.	P.D.& Co.	0.5 2	3	-													_								_
J.B.	B.W.& Co.		6.	9 9	8.9	6 3.8	3	4.7	3 3.6	6 1	2.5	Н	4.2	2 2.5	П	8.0	22	8		6.2 3	1.8	2 7	7.8 1		<u>.</u>
10 Yrs.	P.D.& Co.		4.	4.2 5	1.5	4 1.8	3 1	1	1	1	1	1	1	1	-	-	-	•			1	1	1		<u> </u>
D.R.	B.W.& Co.	8.0 1	-	1					\vdash	_															
7g yrs.	P.D.& Co.	•	-	•										_			_	_			L				
J.Y.	B.W.& Co.				8.8	6 4.9	9	3.5	8.29	8 8	Ŀ	•						_							
16 yrs.	P.D.& Co.				4.0	4 2.3	4	0.5	1 -	1	•	•													_
H.McP.	B.W.& Co.		8.8	5	8.8	5 3.3	5 5		1.2	2 3			1	_		1	Ļ	-			_				<u> </u>
3g yrs.	P.D.& Co.		1.0	3	1.3	4 2.8	3 4		0.4	7 7		Ĭ	0.4	3									-		
M.McM.	B.W.& Co.		2.7	5	2.5	6 3.8	5	0.8	2 1.5	5 3	•	-													
10 yrs.	P.D.& Co.		2.3	5	1.3	5 2.3	5 5	1	•	1	1.8	2	•												

<u>Dick Test Results Recorded by Zingher.</u>
(J.A.M.A. Vol.86 No.6 p.432.)

Number of Days Ill before Dick Test.	Number.	Dick Positive.	% Dick Positive.
1 - 5	141	141	100%
6 and over.	49	8	16.5%
Total,	190	149	78.4%

TABLE 8.

Dick Test Results Recorded by Zingher. (Amer. Jour. Public Health. Vol.14 No.11) (Nov. 1924).

Number of Days Ill before Dick Test.	Number.	Dick Positive.	% Dick Positive.
1 - 5	201	197	98%
6 and over.	80	16	20%
Total,	281	213	78.8%

TABLE 9.

Dick Test Results Recorded by Brown and Reported by Reid.

(Annual Report. County of Lanark. (Middle Ward) Hospital 1925).

Day of Disease.	1	2	3	4	5	6	7-14	over 14
Number Positive,	9	51	47	36	21	8	9	4
Number Negative,	6	18	17	17	15	3	7	5
Total,	15	69	64	53	36	11	16	9
% Positive,	60%	73.9%	73.4%	69.9%	58.3%	72.7%	56.2%	44.4%

TABLE 10.

Results of Dick Tests performed during the present work arranged according to "Days Ill".

Days Ill.	Number of Patients Tested.	Number Positive	% Dick Positive
1 - 5	243	134	55.14
6 and over	. 57	38	66.6

TABLE 11.

Results of Dick Tests performed during the present work arranged according to Days of Testing.

Day of Illness on which Tested.	lst.	2nd.	3rd.	4th.	5th
Number Tested,	14	66	72	64	27
$% \mathcal{F}_{n}^{\prime }$ Positive,	35.7%	54.5%	51.39%	57.8%	70.4%

TABLE 12.

Table to illustrate the close approximation of the Results obtained from Dick Tests performed during the present work on the 2nd, 3rd, and 4th. days of illness.

I	ay of Illne	89.	
2nd.	3rd.	4th.	
54.5%	51.39%	57.8%	
Pe	ercentage Po	sitive.	

TABLE 13.

Analysis of Results of Dick Tests performed during present work. (Arranged according to Days of Testing). Results obtained by other workers are included for purposes of comparison.

			-											1				-					
Day of Illness.		82	ဗ	4	2	9	7	8	10	11	12	13	14	15	16	17	18	19	20	230	31+	Tot-	
No. done,	8	28	23	23	9	7	3	2 1		,	1	7	T	7	1	П	•		•	1	ŧ	100	1
No. positive,	-	11	11	10	4	4	ю	<u> </u>		<u>۔</u>		•	ŧ	Н	•	гH	1		1	ı	1	48	-
No. negative,	~	17	18	13	Q		Q	<u>-</u>		! 	•	ч	٦	•	Н	8	1	1	•	•	1	25	10
% positive.		39,36	47.83	43.48	66.67	100	60 5	50 hoo	0	100	•	•	1	100		100	•		•	-	_	48%	0
	11	16	22	19	14	-	3	1 1	2	-	Ľ	8	3	,	3	٦	•	,	1	7	•	100	1.0
No. positive,		13	12	14	6	,	Q	<u>ا</u>			•	Q	ю	1	ю	٦	•	1	Н	1	1	89)1
No. negative,	9	 	10	ည	ည	1	٦	-		ا ــــــــــــــــــــــــــــــــــــ	•	1	1	ı	1	1	•	1	•	٦	•	32	- 20
% positive,	45.5	5% 81.3	54.5	73.6	64.3		66.6 1	001 001	0 50	_		100	100		100	100			100	•	1	68	00
No. done,		22	27	22	4	4	4	1	-	<u> </u>	•	•	82	Н	CQ2	٦	•	7	п	4		100	20:
No. positive,	-	12	14	13	9	Q	_	<u>.</u>		·	1	1	٦		Q	1	1	Н		Q	1	56	1 -
No. negative,		01	13	00	٦	Q	10	1		1	1	ı	Н	٦	1	п	1	1	1	Q	•	44	. 3
% positive,	·	54.5	51.8	59.1	85.7	50	25 L	91		-	1	1	20	•	100	•	-	00	100	50	1	56	300
Total Done,	14	99 1	72	64	27	ω	12	4	2	7	<u>'</u>	3	ဖ	ત્ર	9	ဗ	ļ .	-1	22	ည	•	300	1
Total Positive		36	37	37	18	9	9	8 8	<u></u>	7		Q	4	Н	ß	Q	•	Н	03	03	•	172	-
Total Negative,	 -	30	35	27	ω	C\2	9	<u>-</u>		1		٦	Q	٦	~	_	•	t	1	ю	1	128	3(
%(Total)Positive	ve, 35.7	.7 54.5	51.39	57.8	70.4	75	50 7	75 100	0 50	100	•	9.99	66.6	20	98.0	66.6	다	100	100	40	1	57.3	00
% Positive (Ho	(Horne) 33.3	.5 53.3	52.5	75.0	44.4	0.0	28.57 4	10	400 F7.14 33.3	3 37.5													
Do. (Br	Brown) 6	60 73.9	73.4	67.9	58.3	72.7	56.2	4.4		·													
						<u></u>		3 (4)						-									
Do. (Reid)	1d)	0 33.3	54.5	33.3	33.3	50	14.28	8	0%	80 80	8	8	8										
							-			-													

TABLE 14.

Analysis of Results of Dick Tests performed during the present work. (Arranged according to "Days Ill" Groupings). Results obtained by other workers are included for purposes of comparison.

		Frew.					norne's rigures.				Reid's Figures.	,		Brown's Figures.			
+	1	-			25		119	86.9	ĺ		<u>, , , , , , , , , , , , , , , , , , , </u>			an and	Carrier 1	TF - 12	
30		+			137	+	18	13.1									
30		-	2	90	59	1	38	64.4									
- 12	5	+	82	40	S	+	21	35.6									
- 20	24	ı	9	25	τοί	1	73	72.4					14		သ	55.6	
11 -	CV	+	18	75	[+	28	27.6 72.4					Over 9	+	4	44.4	
10		•	8	40	47	•	88	59.6	15	1	13	86.7	14	1	7	43.8	
7 - 10	80	+	12	09	4	+	18	40.4	- h	+	23	13.3	- 7 36	+	6	56.2	
9		١	37	37.4		ı	88	44	လ	1	02	62.5	100	•	35	35	
4 -	66	+	29	62.6	99	+	37	99	38	+	12	37.5	7	+	65	65	
ည	ଷ୍ଟ	•	74	48.69	73	ı	35	48	14	ı	7	20	148	ı	41	27.7	
- T	152	+	78 .	51.31	7	+	38	25		+	7	20		+	101	72.3	
Grouping of Days of Disease.	No.in each Group.	Reaction.	No.under each sign.	% in each Group.	No.in each Group.	Reaction.	No.under each aign.	% in each Group.									

TABLE 15.

Table to illustrate similarity between results obtained from the Dick Tests during the present work and those recorded by Horne.

Days Ill.	1	2	3	
Present Figures,	35.7%	54.5%	51.39%	Percentage.
Horne's Figures,	33.3%	53.3%	52.5%	Positive.

TABLE 16.

Table to illustrate the close approximation of results obtained during the present work from Dick Tests performed on the 2nd. 3rd. and 4th. days of illness.

Days Ill.	2	3	4	
Number of Cases,	66 36	72 37	6 4 37	
$% \frac{1}{2} = \frac{1}{2} \left(\frac{1}{2} - \frac{1}{2} \right)$	54.5%	51.39%	57.8%	

TABLE 17.

Results of Dick Tests obtained in the present work when performed 7 days or later after the onset of illness. The results are arranged according to "Days Ill" groupings and are compared with the corresponding figures obtained by Horne.

Worker.	Days Ill.	7-10	11-20	21-30	30+	Total Cases.
Frew.	Number Tested. % Positive.	20 60	24 75	5 4 0	Nil Nil	49
Horne.	Number Tested. % Positive.	47 40.4	101 27.6	59 35.6	137 13.1	344

TABLE 18.

Results of Dick Tests performed at Motherwell by Reid (1925) and Brown (1926) and arranged according to "Days Ill" when tested.

(Annual Reports. County of Lanark (Middle Ward) Hospital 1925 and 1926).

A - Reid, 1925.

B - Brown, 1926.

					DAYS	3 ILL	•									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	+
A	-	33.3	54.5	33.3	33.3	50	14.28	0	0	33	0	20	0	0		
В	60	73.9	73.4	67.9	58.3	72.7				7 - 56					44.	4
			<u> </u>		% I	Posit	ive Res	u]	Lts			***********				

TABLE 19.

The results of the Dick Tests performed in the early days of illness during the present work compared with results obtained by other workers during the same period of illness.

Days Ill.	1	2	3	4	
Present Work.	35.7	54.5	51.39	57.8	Percentage.
W.A.Horne.	33.3	53.3	52.5	75.0	Positive.
Brown,	60	73.9	73.4	67.9	Results.
Reid.		33.3	54.5	33.3	
! !					

TABLE 20.

Dick Test Results obtained by Benson and Simpson in Edinburgh. (Lancet 5/2/27. p.282).

Source of Toxin.	lst3rd. Day of Illness.	14th33rd. Day of Illness.
	D + D -	D + D -
Edinburgh,	49 1	14 36(72%)
London (x 18) (B 1962)	50 0	24 26(52%)

TABLE 21.

Table to show percentages of cases in Positive (Regular) Group of Reactors which failed to give Negative Reactions to the Dick Test during Convalescence.

Group.	% Becoming Negative during Convalescence.	% Remaining Positive throughout illness.
1 - 100	87.5	12.5
101 - 200	93.3	6.7
201 - 300 1 - 300	95.35 92.26	4.65 7.74

TABLE 22.

Table to demonstrate the rate at which these Positive Reactors in the Positive (Regular) Group of Cases, who were noted as giving Negative Reactions to the Dick Test during Convalescence, became Negative Reactors.

G	Total Number	Number becom	ning Negativ Day Group Days Il	ings.	the various
Group.	Positive	1-10	11-15	16-20	21 🛧
1-100	40	27 (67.5%)	3 (7.5%)	3 (7.5%)	2 (5%).
101-200	59	31 (52.5%)	12(20.3%)	7 (11.8%)	5 (8.47%)
201-300	43	27 (62.79%)	2 (4.65%)	4 (9.3%)	8 (18.6%)
1-300	142	85 (59.85%)	17 (11.97%)	14(9.85%)	15(10.56%)

TABLE 23.

Table to show percentage of cases in Positive and Irregular Group of Reactors which failed to give Negative Reactions to the Dick Test during Convalescence.

Group.	% Becoming Negative Dur- ing Convalescence.	<pre>% Remaining Positive throughout Illness.</pre>
1-100	89.6	10.4
101-200	94.12	5.88
201-300	96.25	3.75
1-300	93.6	6.4

TABLE 24.

Table to demonstrate the rate at which these Positive Reactors in the Positive and Irregular Group of Cases, who were noted as giving Negative Reactions to the Dick Test during Convalescence, became Negative Reactors.

Group.	Total Number Positive.	Nun	Number becoming Negative during the various Day Groupings.					
			Days Ill.					
		1	- 10	11 - 15	16 - 20	21 🛊		
1-100	48	35	(72.9%)	3 (6.25%)	3 (6.25%)	2 (4.16%)		
101-200	68	38	(55.88%)	14(20.58%)	7(10.29%)	5 (7.35%)		
201-300	56	36	(64.28%)	2(3.75%)	5 (8.92%)	11(19.64%)		
1-300	172	109	(63.37%)	19(11.04%)	15(8.72%)	18(10.46%)		

TABLE 25.

Percentage of Positive Reactors becoming negative during Convalescence.

Brand of Toxin Employed.

Group.	Toxin.
1 - 100	Burroughs Wellcome & Co.
101 - 200	Parke Davis & Co.
201 - 300	Burroughs Wellcome & Co.

GROUP.	DAYS ILL.					
	1 - 10	11 - 15	16 - 21	21 +	1 - 25	
1 - 100 101 - 200 201 - 300 1 - 300	67.5 52.5 62.79 59.85	7.5 20.3 4.65 11.97	7.5 11.8 9.3 9.85	5 8.47 18.6 10.56	82.5 84.83 76.75 81.7	

Percentage of Positive Reactors becoming Negative during Convalescence.

To Show Number of Cases becoming Dick Negative on each day of Illness

TABLE 26.

	28 30 1 1	2(4.16%)	5 29	5(7.35%)		64%	never 11	46%
		2(4.	24 25 1 3	5(7.	11	11(19.64% e.	(n 18(18(10.46%
	0 21	7 6				(%) 1 negative	-	J • 1
	9 10 11 12 13 14 15 16 17 18 19 20 21 2 4 1 1 1 1 1 1 1	(6.25%)	Q	(%)	જ	%) nega	2 4	15(8.72%) become negative
	18			7(10.29% negative.		5(8.92%) become ne	3	15(8.72%) come nega
	6 17	S	7	d	63	ام :	82	15(ecom
IRREGULARS.	15.1	to become	ю	3%) became	-	d to	5 4	to p
REGU	14		ii io	58%) r be		5%) failed	œ	
+	2 13 1 1	48 3(6.25%) falled	3 1	4(20.58%)	56	7	50 1	19(11.04% 6.4% failed
VES	11 1		II i	14		2(3 (3.75%	9 3	19
POSITIVES +	10	3 (10, 4%)	-	(5.88 %)	4	or (9	a o
PO	ထမာ	9%)	6 4	.88%) Cases	ည		7 36	63.37) 11 Cases
	6 5	35(72.9%) 5 Case		38(55.88%) 4 Cases	2 7	36(64.28%) 2 Cases	151	109(63.37 11 Ca
	4 B	35(3 7	38(189275	36(9 14 21 15 17 16	109(
	ය හ	ا 	80	ا	7		02	
Day of Illness	28 30		25 29	7%)		(%9	(never (11	56%)
f 11	j	2(5%)	24 2	5(8.47%	8	8(18.6%	15(15(10.56%
ay o	12 0	٠ ١ ١		ا. ا	٦ ا	• 7	-	15
Ã	19 2	.5%)	Q2	7(11.8%) become negative	Q	4(9.3%) to become negative	4	17(11.97%) 14(9.85%) or 7.74% falled to become negative
	18	3(7.5%)	4	7(11.8%) me negat		4(9.3%) ome nee	ro.	14(9.85%) come nega
	6 17 1 1	3(7.	1	7(4 (α α	14(
ES.	15 1	15 to	ы	~ 0	r	to	4	to
POSITIVES.	14	5%)	4	INO I		(4.65%) failed	4	17(11.97% feiled
Pos	2 13	3(7.5%) or 12.5% failed	2 1	12(20. failed	1 43	2.4 fa	4 C	7(1) fai
	11 1	25.	83	78.		4.65%	က	.74
	3 3] เ	1	or 6.7%	~	or 4	9	or 7
	4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 2 4 5 3 3 2 3 1 1 1 1 1 1 1	(S 80 80 80 80 80 80 80 80 80 80 80 80 80	5 6 4	%) 1863	4	1868	0.136	35%) 1808
	5 3	27 (67.5%) 5 Cases	200 5 5 3	31(52.5%) 4 Cases	- 300 6 9 1 4	27 (62.79%) 2 Cases	1118	85(59.85%) 11 Cases
100		27(1 10	31(1)	27(tal 8 11 18 11 10 13 6	85
	S 10	,	101		102 L		Tota] 2 8 1	No.26

TABLE 27.

Age Distribution of the Patients in each of the three Groups of Cases.

Group.	1	2	3
Number (1 - 10 years. of (Cases. (11 - 15 years.	6 4	73	62
	20	14	14

TABLE 28.

Age Distribution of the Patients in each of the three Groups of Cases taken year by year during the first ten years.

Age in Years.	-1	1+	2‡	3∔	4∔	5∔	6‡	7‡	8‡	9‡	10‡
Group 1		3	3	6	4	10	13	6	7	9	3
* 2	1	1	7	8	9	4	8	10	11	9	5
* 3			11	8	5	8	5	7	8	8	2

TABLE 29.

Table to show total number of cases in any age group from 1-10 years in each of the three groups of cases.

Age in Years.	-1	1+	2+	3∔	4+	54	6‡	74	84	94	10‡
Group 1		3	6	12	16	26	39	45	52	61	64
* 2	1	2	9	17	26	30	38	48	59	68	73
n 3			11	19	24	32	37	44	52	60	62

TABLE 30.

Number of Dick Tests performed on patients before First Permanent Negative Reactions were obtained compared with the Age of the Patients.

Group.	Number of Dick Tests Performed.					
	2	3	4	5		
1 (1 - 100)	6.3	8.8	13.2	31.5		
2 (101 - 200)	9.2	13.9	12.1	8.9		
3 (201 - 300)	11.3	12.3	12.75	16.5		
	Ave	rage Ag	ge in Y	ears.		

TABLE 31.

Number of Dick Tests performed on patients before First Permanent Negative Reactions were obtained compared with the Age of the Patients.

	Number of	Dick T	Cests Pe	rformed.
CASES.	2	3	4	5
1-300.	8.9	11.9	11.3	13.9
	Avei	age Age	in Yea	rs.

TABLE 32.

Number of Dick Tests performed on patients before First Permanent Negative Reactions were obtained compared with the Age of the Patients.

The figures were calculated from data published by Zingher in 1926. (J.A.M.A. Vol.86. No.6. p. 432).

Number of Dick	Tests Performed				
2	3				
11.7	12.6				
Average Age of P	atients in years				

TABLE 33. Results with the Dick Test at Public School No.4 Bronx. (Zingher, J.A.M.A. Vol.86. No.6. p.432).

Age.	% Dick Positive.
5 - 6 years.	62.5
6 - 7 **	51.35
7 - 8 H	33.33
8 - 9 W	35.29
9 - 10 "	20.00
10 - 15 *	12.85

TABLE 34. The Dick Tests at different age groups.

Age.	% Dick	Positive.	
0 - 6 Months.	(1) 44.8	(2) 44.8)
6 - 12 "	64.2	65.3)弄完
1 - 2 Years.	70.7	71.6	
2 - 3 "	67.8	64.2	
34 "	59.4	60.5	
4 - 5 "	46.4	48.4	
5 - 10 *	35.4	33.6	
10 - 15 *	25.4	22.8	
15 - 20 *	26.3	16.8	
20 +	17.9	14.4	

ER Partial immunity due to placental trans-

mission of maternal immunity.

(1) Zingher: J.A.M.A. Vol.86. No.6. p.432.

(2) Zingher: Amer.Jour.Public Health. Vol.14

No.11 (Nov.1924).

TABLE 35.

Percentage of Positive Reactors becoming Negative on each Test. Test on which first Permanent Negative Result was noted.

Dick Test.	2	3	4	5	6	7	8	9	10
Regular Group,	25.4	39.4	54.2	64.8	69.7	74.6	78.9	81.7	84.5
Regular Plus Irregular Group,	20.9	39.5	54.1	66.9	72.1	76.7	80.2	83.1	86.6
Dick Test.	11	12	13	15	17	18	19	24	Never Neg- ative.
Regular Group,	85.2	86.6	88	-	89.4	90.8	91.5	92.2	7.7
Regular Plus									

TABLE 36.

The incidence of Persistent Positive Reactors in the three Groups of patients.

		Group	No.of Persis- tent Positive Reactors.			
1	(Cases	1	-	100	5
2	(Cases	101	-	200	4
3	(Cases	201	-	300	2

TABLE 37.

The number of Persistent Positive Reactors compared with the Brand of Dick Test Toxin employed.

Brand of Dick Toxin.	Persistent Positive Reactors.
Burroughs Wellcome & Co.,	7 (3.5%)
Parke Davis & Co.,	4 (4.0%)

TABLE 38.

The age and sex incidence of the Persistent Positive Reactors.

Age in Years.	5	6	.7	8	9	13	18
Number,	2	2	1	1	3	1	1
Sex,	Female	s	~ ~ ~ ~ .	M s	les		

TABLE 39.

Results of Schultz-Charlton Tests Performed with Parke Davis & Co. Antitoxin and Burroughs Wellcome & Co. Schultz-Charlton Product.

Intensity of Reaction.	10	9	8	7	6	5	4	3	2	ᆙ	1	-1	0	Tot- al.
Parke Davis & Co.	3	2	5	-	2	2	1	6	4	1	3	9	15	53
Burroughs Well- come & Co.,	-	1	6	1	1	1	4	-	3	3	3	12	18	53

TABLE 40.

The Incidence of Complications in the groups of Positive and Negative Reactors to the Dick Test.

Positive	·	Negative.					
Number of Case	es: 172	Number of Cases: 128					
With Complications,	Nil	With Complications,	Nil				
77	95	65	63				
44.8%	55.2%	50.8%	49.2%				

TABLE 41.

The Incidence of the Individual Complications in the present series of cases together with their incidence in the groups of Positive and Negative Reactors to the Dick Test.

Complication.	Total Cas	es 300	Positive	s = 172	Negatives = 128		
	Number.	%	Number	%	Number	%	
Cenvical Adenitis,	, 92	30.7%	45	26.2%	47	36.7%	
Secondary Sore Throat,	39	13%	21	12.2%	18	14.1%	
Otorrhoea,	27	9%	17	9.9%	10	7.8%	
Rhinorrhoea & Post Nasal Discharge,	37	12.3%	17	9.9%	20	15.6%	
Rheumatism,	23	7.7%	13	7.6%	10	7.8%	
Relapse,	11	3.7%	7	4.1%	4	3.1%	
Diphtheria,	5	1.7%	3	1.7%	2	1.6%	

TABLE 42.

The Dick Test Curves arranged in their respective groups.

			TY	PE	OF	CURVE.				
		1		2		3			4	5
	A	В	С	D	E	F	G	H		
1 - 100	13	3	6	5	-	9	3	3	4	2
101 - 200	25	-	3	2	2	21	7	1	3	4
201 - 300	19	1	2	3	3	12	6	4	4	2
1 - 300	57	4	11	10	5	42	16	8	11	8
		72		15	5	66			11	8
	4	1.9%	8	8.7	8.7%		8.4%		6.4%	4.6%
									,	

TABLE 43.

The Result of the Examination of Throat Swabs for the presence of Haemolytic Streptococci in a series of 300 convalescent cases of Scarlet Fever.

The columns 1, 2 and 3 represent the three throat swabs examined from each patient.

The figures indicate the day of illness on which the swabs were taken: black figures representing Negative Results and red ones Positive Results.

In the case of Swabs 101 - 300 an attempt was made to estimate the proportion of haemolytic streptococci present on the plate. The results obtained are indicated by the fractions in the extra columns.

The complications which developed in the cases together with the day of illness on which they occurred is noted in the last column.

(Rare complications and others, such as septic fingers and toes, are omitted).

When dealing with this point the following abbreviations were employed:-

CA - Cervical Adenitis.

T - Tonsillitis.

R - Rheumatism.

ND - Nasal Discharge.

0 - Otorrhoea.

Q - Quinsy.

T & A - Removal of Tonsils and Adenoids.

S.S. - Relapse.

FE - Facial Erysipelas.

N - Nephritis.

Alb. - Albumin in urine but not Nephritis.

SC + - Positive Result to Schultz-Charlton Test.

i i	1						
No.	Name.	Sex.	Age.	1	2	3	Complications.
ı	A.G.	F	13	26	38	40	CA: 16; T: 17.
2	J.C.	F	8	38	40	66	-
3	Mrs.R.	F	32	23	35	37	R: on adm.
4	A.K.	F	4	69	71	73	CA: 8.
5	A.McI.	F	12	37	41	42	•
6	M.D.	F	17	37	41	43	-
7	R.R.	M	5	40	43	44	CA: 18.
8	J.L.	F	16	37	39	41	•
8	I.McD.	M	3	40	44	46	ND: on adm.
10	K.R.	M	7물	76	79	81	R: 22; S.S: 44; SC+ 45
11	J.S.	F	19	37	39	40	ND: on adm; R: 8.
12	A.E.	F	7	45	47	48	CA: 7; M: 13; Q: 25.
13	s.g.	F	8	40	42	43	CA: 7.
14	M.C.	F	4 2	39	47	49	CA: 14.
15	G.K.	M	5	40	42	43	CA: 6; ND: 15; CA: 33.
16	H.M.	F	5	28	35	45	CA: 40.
17	H.C.	F	6	39	41	43	CA: 20.
18	M.P.	F	8	28	33	41	-
19	I.P.	F	5	29	34	42	•
20	M.McW.	F	30	27	34	35	-
21	J.M.	F	16	30	37	39	•
22	J.B.	M	4호	33	40	42	ND: 16.
23	н.в.	M	17	31	33	34	R: 6.
24	I.W.	F	6	34	36	37	-
25	R.W.	M	28/12	35	37	38	ND: 25.
26	R.McK.	M	2 1	31	33	36	ND: 5; CA: 7; 0: 19.
27	M.R.	F	4	35	41	42	-
88	A.R.	F	6	37	43	44	ND: 4; CA: 9; ND: 22.
59	I.G.	M	2 1	25	35	39	ND: 13.
30	M.F.	F	16	25	38	39	•

No.	Name.	Sex.	Age.	1	oat Si		Complications.					
	J.B.				J.B. F.H.			wge.	1	2	3	Complications.
	J.B.	M	7	34	40	41	R: 7; ND: 25.					
32	F.H.	M	6	79	85	86	ND: 3; CA: 8; S.S: 48 CA: 63.					
33	J.McD.	F	13	36	43	44	. •					
34	J.McG.	F	7	36	40	42	•					
35	M.C.	F	16	31	35	38	-					
36	M.McD.	F	15	32	35	38	-					
37	C.McD.	F	7	29	35	38	-					
38	E.R.	M	28	31	34	35	•					
39	N.McD.	F	18	31	34	35	•					
40	J.McI.	M	20	30	34	38	0: 10.					
41	C.G.	F	7	36	38	42	-					
42	J.McP.	F	13	38	39	42	-					
43	C.McP.	F	17	37	38	41	-					
44	H.S.	M	30	23	28	32	-					
45	M.S.	F	4	36	41	44	-					
46	M.McN.	F	9	34	39	42	•					
47	P.McN.	M	4	43	48	52	N: on adm.					
48	M.B.	F	14	35	40	44	S.S: 22.					
49	J.McD.	F	7	39	44	48	CA: 8; ND: 27.					
50	B.M.	F	5 ≩	31	32	36	•					
51	A.S.	F	5	30	33	34	-					
52	M.O.	F	6	32	33	37	-					
53	I.McC.	M	4	35	38	39	ND: on adm.					
54	A.R.	X	6	41	47	50	0: 40.					
55	M.S.	F	18/12	36	38	41	CA: 30.					
56	M.McD.	F	9	34	36	39	-					
57	J.D.	М	13	32	34	37	-					
58	H.J.	M	15.	28	31	33	•					
59	R.McK.	M	5	23	26	28	•					
60	J.C.	M	5 }	24	27	30	-					

							•
				Thre	oat S	wabs.	
No.	Name.	Sex.	Age.	1	2	3	Complications.
61	E.W.	M	8	24	27	30	-
62	T.D.	M	12	27	30	33	-
63	J.M.	M	23	24	27	30	T: 26.
64	R.S.	M	3 2	33	36	39	CA: 19.
65	B.S.	F	13	23	26	29	•
66	S.R.	M	8	28	31	34	-
67	M.P.	F	13	26	29	33	ND: on adm.
68	J.D.	F	5	35	38	41	ND: 15.
69	Mrs. Mc V	F	5 6	26	29	32	T: 19.
70	E.McC.	F	7	24	27	30	-
71	A.A.	F	18	27	30	33	0: 7; R: 32.
72	H.K.	M	9	25	27	28	CA: 17; (Scarlet Fever 5 months later).
73	A.W.	M	6 ≩	35	38	39	-
74	R.M.	M	4호	34	37	38	CA: 23.
75	M.W.	F	11	32	35	36	-
76	J.P.	M	$1.\frac{11}{12}$	26	29	30	
77	W.G.	M	7	33	36	37	ND: 5.
78	G.D.	M	6	36	39	40	•
79	H.B.	F	11	33	36	37	•
80	A.W.	F	7출	34	37	38	-
81	J.G.	M	14	27	29	32	ND: 6.
82	B.N.	F	5	26	28	31	GA: 30.
83	B.F.	F	9	31	33	36	T: 17; CA: 20; ND: 20.
84	D.L.	M	8	27	29	32 4 6	0: 28; CA: 28; T & A:45
85	M.S.	F	2	27	29	32	
86	M.McK.	F	6	27	29	32	•
87	M.D.	F	9	32	34	37	CA: 20.
88	J.M.	M	6 ≩	28	30	33	•
89	С.Н.	F	30	28	30	33	R: 23.
90	B.C.	F	10	27	29	32	•

,

				Thre	oat S	wabs.	
No.	Name.	Sex.	Age.	1	2	3	Complications.
91	A.S.	F	5	28	30	33	, •
92	w.w.	M	24	24	37	39	CA: 29.
93	A.L.	M	11	27	30	37	-
94	A.O.	F	12	31	38	40	•
95	w.c.	F	13 ½	26	33	35	ND: 7.
96	H.D.	M	6	33	40	42	-
97	W.H.	M	5	21	44	52	CA: 17; Alb: 22.
98	J.S.	F	19	20	31	34	T: 19.
99	A.W.	M	4	19	30	33	CA: 10.
00	J.B.	M	9	26	37	40	•

,		·			Thro	oat S	wahe.			
No.	Name.	Sex.	Age.	1		2		3		Complications
101	С.В.	. F	5	22		33	2	36	1 3	•
102	P.S.	M	9	23		34	喜	37		N.D: 11
103	W.McC.	M	14	33		44	1	47		~
104	M.McD.	F	8	24		35		38		ND: 18.
105	G.R.	F	9	20		31		34		CA: 10.
106	J.M.	F	24	21	ì	32	V. few.	35	1/3	-
107	M.S.	F	15	22		33		36	<u>\$</u>	-
108	R.T.	F	12	20		31	1	34		-
109	P.McK.	F	1	32	효	34	<u>‡</u>	36		0: 5.
110	D.K.	M	3	39		41	효	43		-
111	A.McD.	M	6	26		28		30	i.	ND: 17; CA: 32.
112	M.G.	F	12	26	$\frac{1}{1}$	28		30	34	-
113	A.M.	F	5	26		28		30	few	-
114	в.в.	F	5	31	few	33		35	3	CA: 4.
115	B.W.	M	9 <mark>군</mark>	33		35		37	<u> 5</u>	-
116	J.McI.	F	9	26		28		30	2 3	MD: 26.
117	M.McK.	F	9	29	1	31		33	_	-
118	J.A.	M	13	28	1	31	효	33	<u>1</u>	-
119	S.W.	M	6	30		33	4	37		R: 8; CA: 15; MD: 16.
120	J.C.	M	9	30		33		35	:	-
121	M.McL.	F	14	29		32		36	<u>3</u>	CA: 25.
122	T.W.	M	6 <mark>호</mark>	29	효	32	2 3	36		CA: 7.
123	M.W.	F	11	35	효	38		40		-
124	J.McG.	K	5	34		39	ł	44		CA: 10.
125	E.L.	F	9	28		31		35		-
126	A.P.	F	8	25		29	1	34		-
127	J.C.	F	10	32		36	-	38		-
128	R.G.	F	3]	35	2/3	40		60		CA: 8; 0: 14.
129	S.B.	M	2 1	33		37		42	효	•
130	M.V.	F	9	30		34		36		•

					m re	oat S	wohe			
No.	Name.	Sex.	Age.	1	TIII	2	MAUS	3		Complications
131	V.McD.	F	14	35	1 2	39		40		-
132	A.T.	M	9	30		34		39		-
133	F.O.	M	4	33		38	효	43		-
134	H.R.	F	13	34	$\frac{2}{3}$	38	1	39	2 3	-
135	R.F.	F	8	31	夏	35	•	37	1	-
136	E.O.	F	9	34	1	38		43	•	- '
137	M.C.	M	7=	33	\$	38		41		0: 7; & 10; MD: 34.
138	J.McK.	F	21	31		35	1	40	ł	CA: 5; ND: 8.
139	A.T.	M	8	26		35		42	ł	CA: 18; ND: 24.
140	J.T.	M	9	27	ŧ	31		36		0: 10.
141	A.McL.	F	7	34		38	효	39	7	-
142	D.C.	M	6	32		36		41	2 3	-
143	J.A.	M	6	35		40		42		-
144	D.W.	M	7	34		39	1	41		-
145	S.McN.	M	7	28		33		38		-
146	M.W.	F	15	26		31		36		CA: 7; R: 9.
147	A.C.	M	42	33		34		36	l I	R.22.
148	J.McA.	M	33	22		25		29		•
149	R.D.	M	6	35		43		55		0: 24.
150	H.C.	F	8	41		49	3	57		R: 6
151	C.T.	F	4	5 4	14	57		62		ND: 5; 0: 21.
152	P.S.	F	3	29	1	38		49	1	CA: 23.
153	I.H.	F	3	33	효	41		49		CA: 7.
154	L.D.	M	13	29		37		49		-
155	M.F.	F	7	33	1/3	38		40		CA: 11.
156	A.P.	M	34	26		31		33	효	-
157	J.S.	F	8	25		30	*	34		-
158	M.T.	F	9	27		32		39		-
159	A.M.	F	4	31		36	78	40	1/3	CA: 7; 0.7; T & A.51.

No.	Name.	Ser.	Age.	1	Thros	at S	wabs	. 3		Complications
-					3		3			
160	J.C.	M	11	30	34	34	<u>3</u>	37		CA: 22.
161	J.A.	M	49	27	효	31		34	!	CA: 6.
162	R.P.	M	7	29	훈	33		36		CA: 10; 0: 15.
163	H.T.	F	5	29		33		3 6		-
164	I.McG.	F	6	29		33		36	1	-
165	E.H.	F	3	28	t	40		43	34	-
166	M.W.	F	. 8	20	4	35		43	i	0: 31.
167	C.McP.	F	15	30		42		4 5		-
168	T.McK.	M	3	28		31		34	1	-
169	T.G.	M	11	37		42		46	:	-
170	A.I.	M	5	51		5 4	<u>후</u>	58		0: 24.
171	A.L.	F	5	31	14	34		37		CA: 27.
172	C.McL.	F	13	30		33		36	!	-
173	G.T.	F	8	30	7 8	33		36		CA: 20.
174	N.C.	F	10	30	<u>3</u>	33		36	:	R.6.
175	B.McK.	M	7	30	2 3	33		36	1	•
176	N.C.	M	13	28		31		34		-
177	J.McG.	F	2	29	2 3	32		35		ND: & CA.7;
178	A.N.	F	10	31		34		37		-
179	A.G.	F	6	30		33		36		R.8.
180	H.N.	M	4	31		34		37		CA: 20.
181	J.P.	M	17	27		32		35		CA: 7; T.17.
182	J.J.	F	21	27		30		34	1	_
183	C.W.	F	8	32	1 6	35		39	1	-
184	S.McC.	F	6	35	0	38		42		CA: 8.
185	H.C.	F	8	35	34	38		42		0: 20.
186	J.R.	M	29	36		42		47		ND: 4. R: 6.
187	L.N.	F	12	27		30		33		-
188	M.R.	F	9	27		40		50		-
189	M.McG.	F	3	40		43		47		-

					Thro	at S	wabs			
No.	Name.	Sex.	Age.	1		2	i	3		Complications
190	W.P.	M	6	34		37		41		-
191	J.S.	F	5	30		33		41		-
192	Mrs.W.	F	29	29		32		36	78	T: 19.
193	M.W.	F	22	31		34		38		-
194	D.F.	M	37	57		63		70		R: 11; CA: 16; FE: 23.
195	E.M.	F	13	30		34		42		TA: 30.
196	R.M.	M	3	33		41		44		ND: 34.
197	в.в.	F	14	28		32	11 11 11 11	40		R: 7; T.& A.28; CA: 31.
198	S.McM.	F	10	25		29	78	37		T.& A.26.
199	N.E.	F	24	23	3 4	27		31		R: <u>6</u> .
200	N.McC.	F	22	23	-	27		31		CA: 5.
201	E.S.	F	18	27		35		39		-
202	T.S.	M	3 ខ ្	44		52		59		CA: 14; ND: 26.
203	M.B.	F	7	33		37		41		R: 6.
204	J.P.	F	18	66		74		77	•	Pneumonia 10; Empyema 14:
205	D.C.	M	3	38		46		50		CA: 7; ND: 24; T.& A. 37.
206	F.C.	F	9	30		34		41		-
207	T.H.	M	13	47		50		54		CA: 22.
208	J.F.	M	15	56		63		66		N: on adm.
209	B.McC.	F	18	25		32		35		-
210	A.K.	M	11	44		47		51	1 2	-
211	N.McG.	F	4	4.0		43	1	44		FE: 13 & 26.
212	P.F.	F	6	24		37	1	41	i	CA: 27.
213	J.S.	M	8	33		43	few	46		-
214	J.McL.	M	9 1	32		39		42		-
215	M.T.	F	21	27		58	1 5	62		ND:7; CA:31.
216	A.B.	M	13	30		33		40	· E	CA: 8.
217	J.McG.	M	3	44		51		54		CA: 10 & 42.
-]				1	

No.	Name.	Sex.	Age.	1	Thro	at S	wabs	3		Complications
	<u> </u>	: 	-							
218	C.L.	F	1.2 T2	33		36		39		-
219	G.McL.	M	15	30		33		36		-
220	J.B.	M	5	40		43		46		ND: 9.
221	A.J.	M	8	27		30	효		few	-
222	M.T.	F	8	33		38		43		T.26.
223	E.M.	F	21	31		34		38		CA: 12.
224	A.M.	F	16	29		33		36		-
225	Y.H.	F	10	33		37		40		-
226	T.McM.	M	8	34		3 8		41		-
227	J.McC.	M	3	36		40		43		CA: 8; 0.13;
228	W.B.	F	21/2	36		40		43		-
229	M.D.	F	11	33		37		40		-
230	I.W.	F	4	33		40		41		CA: 14.
231	I.W.	F	6	33		40		41		-
232	R.W.	F	4	24		35		39		•
233	I.S.	F	3	38		39		43		ND: 14.
234	R.H.	M	18	40	few	42		44	few	CA: 9; T: 19.
235	F.F.	F	28	34		41		42		CA: 13.
236	J.K.	M	17	27		34		35		. -
237	M.W.	F	5	33		36		40		CA: 15.
238	K.A.	M	5	35		39		42		-
239	B.A.	F	$2\frac{10}{12}$	31		34		38		ND: 2.
240	A.M.	F	59	36	few	39		41		R: 6; FE: 16.
241	A.T.	F	4	41		49		61		CA: 20; T:33; ND: 37:
242	J.C.	M	12	31		32		35		-
243	A.J.	M	12	27		28		35		-
244	M.T.	F	41	28		46		50		0.26.
245	E.Y.	F	6	41		42		49		CA: 22; T: 28 ND: 29.
246	M.McN.	F	11	31		32		39		ND: 7.

No.	Name.	Sex.	Age.	ı	Thr	oat :	Swabs	3	:	Complications
						 			<u> </u>	
247	M.M.	F	7	26		44		4 8		CA:12.
845	V.M.	F	2	25		26		33		-
249	G.M.	F	4	27		45		49		CA:11.
250	F.D.	M	2 1	27		28		35		-
251	A.McK.	F	6	30		31		38		-
252	M.C.	F	4	30		31		38	:	-
253	M.S.	F	31	24		25		29	•	-
254	J.M.	M	7	27		28		35	: 	CA: 3.
255	W.C.	M	13	27		28		35		R:18; 0:24.
256	M.M.	F	5	41		45		49	•	ND: 27; CA: 29 0: 55.
257	J.H.	F	41	34		3 8		39	1 5	CA: 3; ND: 9;
258	C.McC.	F	18	26		30		34		-
259	s.w.	F	15	31		37		41		-
260	E.G.	F	7	31	1 I	37		41		-
261	J.R.	M	3	40		46	3	50		-
2 62	M.C.	M	13	39	few	43		47		CA: 21.
263	C.W.	F	8	38		42	효	43		CA: 7.
264	W.C.	M	13	40		45		52	효	R: 18; CA: 23 0: 29.
265	M.McK.	F	8	24	효	28		32		CA: 45.
2 6 6	F.P.	F	10	38	23	46		49		CA: 13.
2 67	D.M.	M	7호	34		38	3 4	42		0: 21.
868	Mrs.W.	F	28	23	효	27	34	31		CA: 4.
26 9	J.M.	M	2	43		47		51		•
2 7 0	1.H.	F	30	25		29	1 1	33		•
271	E.S.	M	5	24		28	1	32	1 5	-
272	T.H.	M	9	32		36	few	40		-
2 73	B.M.	F	7	38		41		44		-
274	W.H.	M	7	41	78	45		48		CA: 12; ND: 1
275	A.B.	F	27	29		33		36		R: 10.
		1	1		1 1					

					Thre	oat :	Swab	8.		
No.	Name.	Sex.	Age.	1		2		3		Complications.
276	J.R.	F	14	28		32		35		
277	J.M.	F	2	46	훓	50		6 4		0: 18.
278	J.D.	M	11	50		54		55		-
279	W.S.	M	5	46		50		64		(Septic Scarlatina) 0: 4; ND: 4; CA: 4.
280	J.B.	M	2 1	31		34		45		ND: 9; CA: 9.
281	M.C.	F	8	31		39	23	48	f	T: 26.
282	S.D.	F	12	29		33		37		R: 8.
283	M.C.	F	24	30	훒	31		35		-
284	G.S.	F	22	28		32	효	36	2 3	-
285	E.K.	F	6	27		35		38		-
286	M.B.	F	9	31		34	POTENTIAL CAMBOLIC CAPT OF	35	2 3	-
287	A.H.	F	6	31		34	효	35	효	-
288	A.D.	F	16	.33		36	1	37		-
289	в.в.	F	11	33		36		37		-
290	N.M.	F	21	29		32	$\frac{9}{10}$	33	few	-
291	A.McA.	F	18	26		30		34		-
292	M.W.	F	12	32		36		40		R: 8.
293	M.M.	F	8	38		46		48		R: 8.
294	W.S.	M	6	39		47		49		CA: 19.
295	J.M.	M	10	31	<u>3</u>	39		41		CA: 10.
296	D.H.	F	9	45		53		5 5	<u>3</u>	CA: 9.
297	J.C.	F	5	38	$\frac{1}{3}$	41	2	46		ND.11.
298	C.M.	F	14	45		48		50		-
299	A.L.	M	2 1	56		58	ł	60		•
300	D.McL.	M	7	36	2 3	38		40	34	CA: 22; ND: 22.

TABLE 44.

Results of Examination of Throat Swabs from Convalescent Cases of Scarlet Fever.

		CASES	1 - 300											
	STATE ON DISMISSAL.													
N	egative	.		Posit	ive.									
Result.	No.	%	Result.	No.	%									
	167	55.66%	+ + +	6	2%									
+	35)	76	-++	16)	51									
+ + -	12)	(25.33%)	+	24	(17%)									
- + -	29)		+ - +	11)										
	243	81%		57	19%									

TABLE 45.

F 3\frac{1}{20}/1/30

l.G.

.G.	ex F	Age 8		Days.	Name	_	1				Home	3 •
i.McK.	F	8	:		-10110	Sex	Age		Days.	Apts.	Ad.	Ch.
		_	27/6/29	60	I.G.	M	21	2/7/29	5	5	2	2
.M.	F	6	14/11/29	33	T.McK.	M	3	19/11/29	5	2	3	3
	F	5	30/11/29	31	M.M.	F	8	8/12/29	8	1	2	3
.McD.	F	8	30/11/29	36	N.McD.	M	30	11/12/29	11	2	2	3
1	*	**	30/11/29	36	A.McD.	F	6	16/12/29	16	2	2	3
.c.	F	10	26/12/29	37	J.C.	F	4	14/1/30	19	3	3	2
.D.	M	13	11/1/30	62	M.D.	F	2	20/1/30	9	2	3	1

M.G. M 2

84

RETURN

CASES.

31/1/30

11

2

2

THE

TABLE 46.

RETURN CASES:

INCUBATION INTERVAL:

Days.	5	8	9	11	16	19
Cases.	2	1	1	2	1	1

TABLE 47.

Result of Examination of Throat Swabs from Convalescent Scarlet Fever Patients who, on their return home gave rise to Return Cases.

Throat Swab Number	Name	Result.
13	S.G.	+ + +
86	M.McK.	+ - +
104	M.McD.	
113	A.M.	+(few)
128	R.G.	++
154	L.D.	~ ~ ~
174	N.C.	t

TABLE 48.

The Results obtained from the Skin Tests performed with the Toxins prepared from Haemolytic Streptococci recovered in Knightswood Hospital from Scarlet Fever Patients.

No.	Source.	1:1000	1:500	1:100	1: 10	Control	B.W.& Co.
1	Peritoneum(P.M)	-	faint	+	+ +	-	+ + +
2	Pleura (P.M.)	-	+ +	+ +	+ + +	-	+ +
3	Heart Blood(P.M)	-	+	+ +	+ + +	-	+ +
4	Throat Swab	-	.	-	-	-	+ + +
5	Empyema Pus,	•	+	+ + +	+ + +	-	+ +
6	Pus,	?	+	+ +	+ + +	_	+ +
8	Throat Swab,	-		-	flush	-	+ + +
9	Throat Swab,	-	?	faint	+	_	+ +
10	Throat Swab,	-	?	small& faint	+	-	+ + +
11	Throat Swab,		-	+	+	-	+++
13	Throat Swab,	-	-	-	+	-	+ +
14	Throat Swab,	-		-	-	-	+++
15	Throat Swab,	-	-	-	-	-	+ +
17	Throat Swab,		-	+	+ +	-	+ + +
18	Throat Swab,	-		+ +	+ +	-	+ + +
19	Pus,	-	?	+		-	+ +
20	Pus,	•	faint	+ +		-	+ +
21	Throat Swab,		ven void	-	-	-	+ +
22	Throat Swab,	faint	+	+		?-	+ +
23	Throat Swab,			-	+	-	+ + +
24	Throat Swab,			-		-	+ +
25	Pus,		-	†		-	+ +
26	Throat Swab,			-		-	+ +
27	Throat Swab,			-	-	-	+++

No.	Source.	1-1000	1-500	1-100	1-10	Control	B.W.& Co.
29	Throat Swab,	-	+	+ +		-	+ +
30	Throat Swab,			-		_	+ +
31	Throat Swab,			-		-	+ +
32	Throat Swab,	?	+	+ + +	+ + +	-	+ + +
33	Throat Swab,	•	+	+ +	+ +	-	+ + +
34	Throat Swab		-	+		-	+ +
35	Throat Swab,	-	?	ŧ,	+	-	+ + +
36	Throat Swab,		-	-	+	-	+ + +
37	Throat Swab,			-	+	-	+ + +

TABLE 49.

The Results obtained from the Skin Tests performed with the "Knightswood Toxins" arranged according to the source of the Haemolytic Streptococci.used in their preparation.

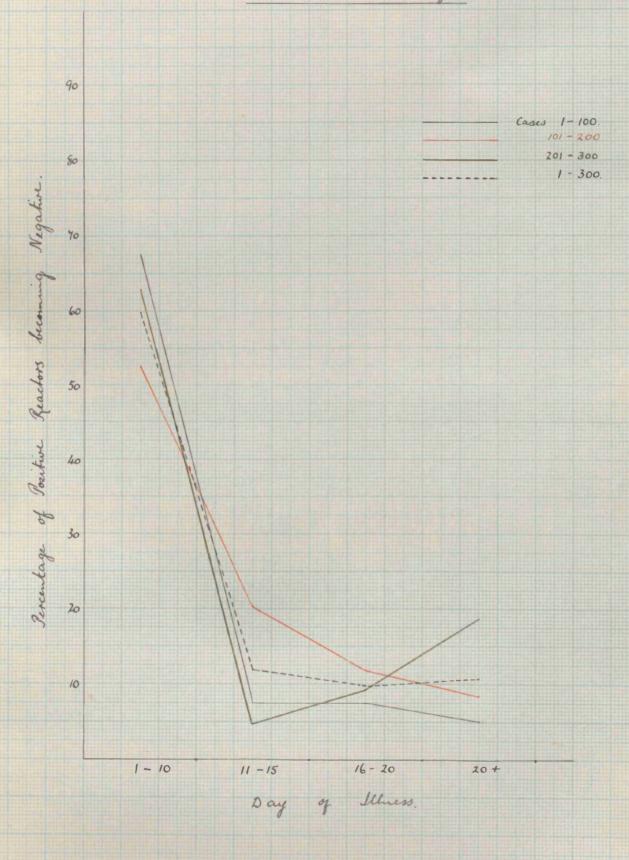
No.	Source.	1:1000		1:500		1:100		
		+	-	+	-	+	. •	
8	Septic Lesions	1	7	7	1	8		
25	Throat Swabs.	2	23	7	18	13	12	

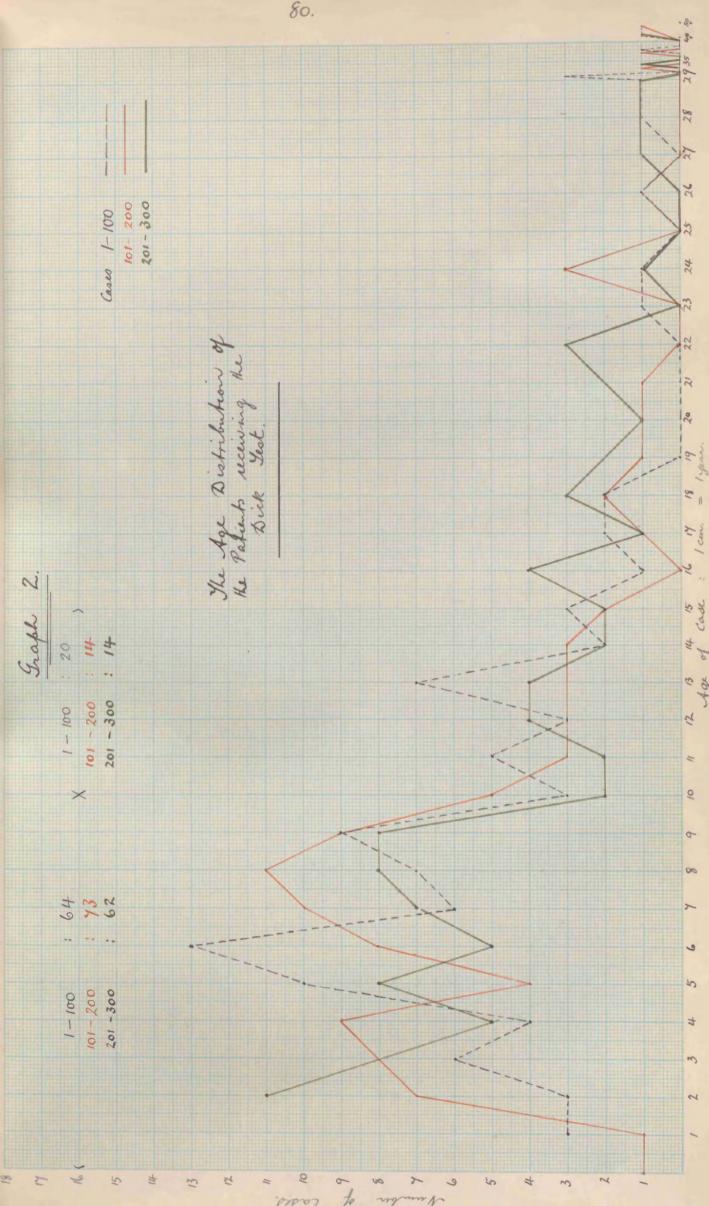
THE GRAPHS.

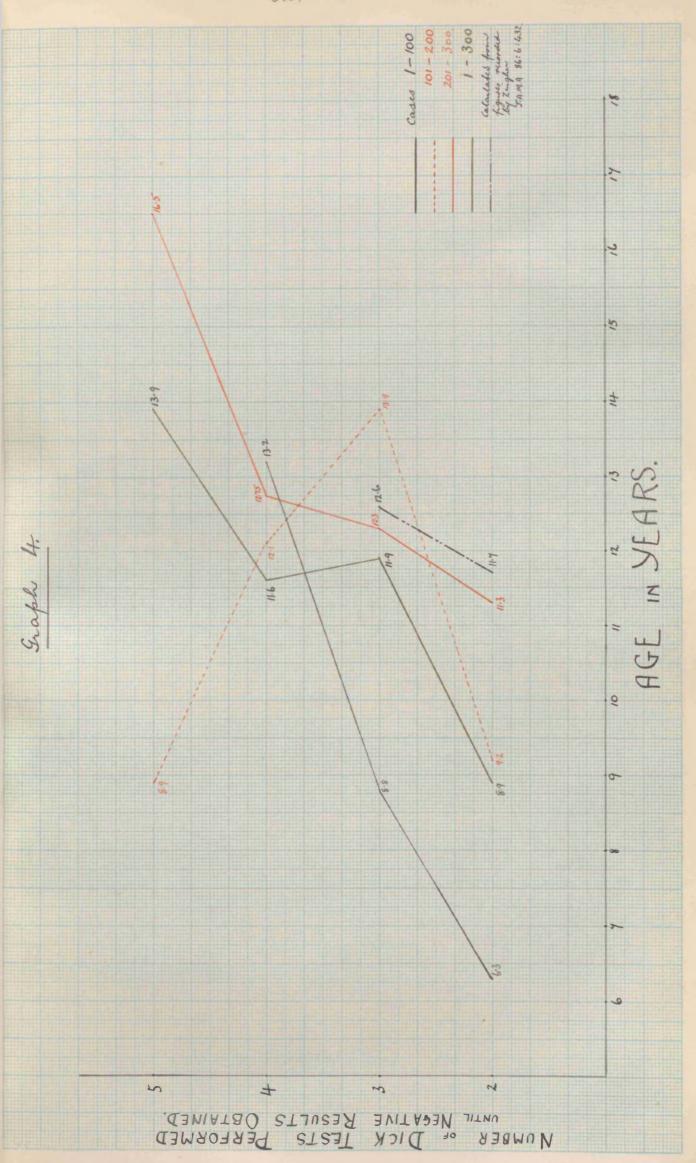
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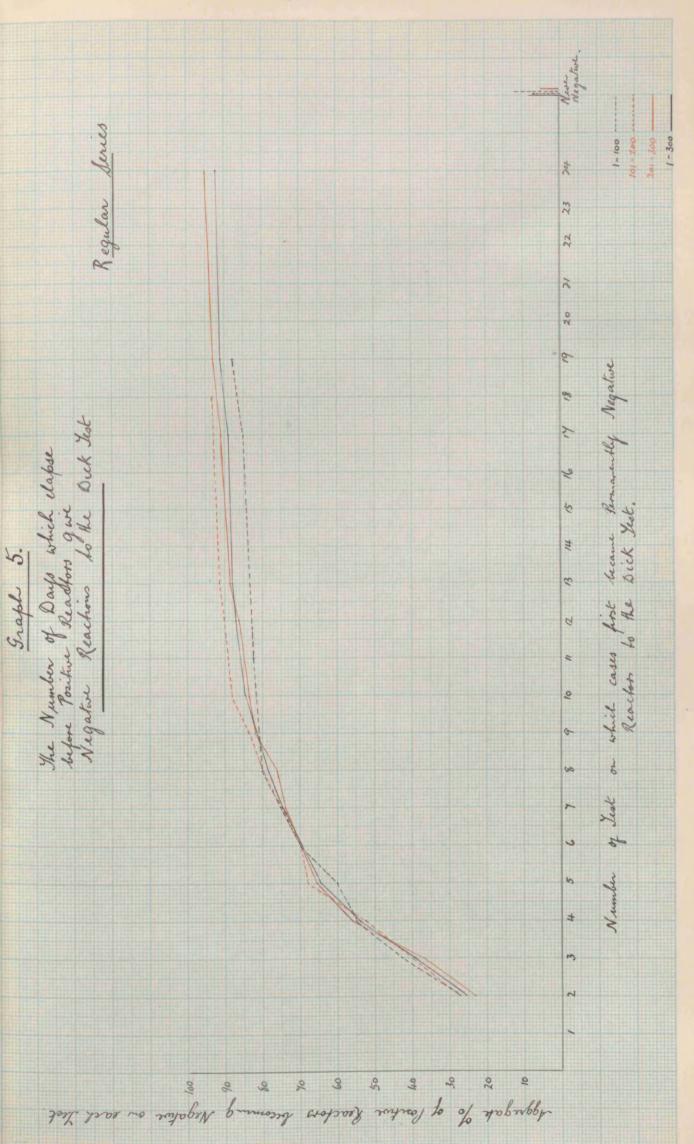
Graph 1.

Graph to Demonstrate the Rate at which the Positive Reactors to the Dick Yest became Negative Reactors.

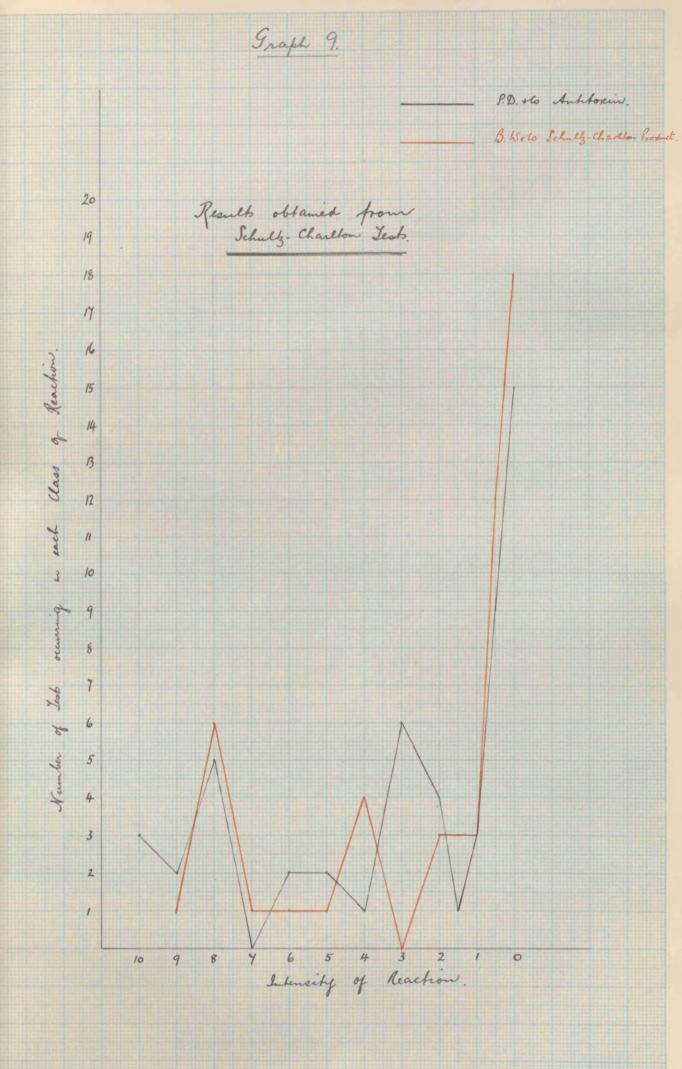


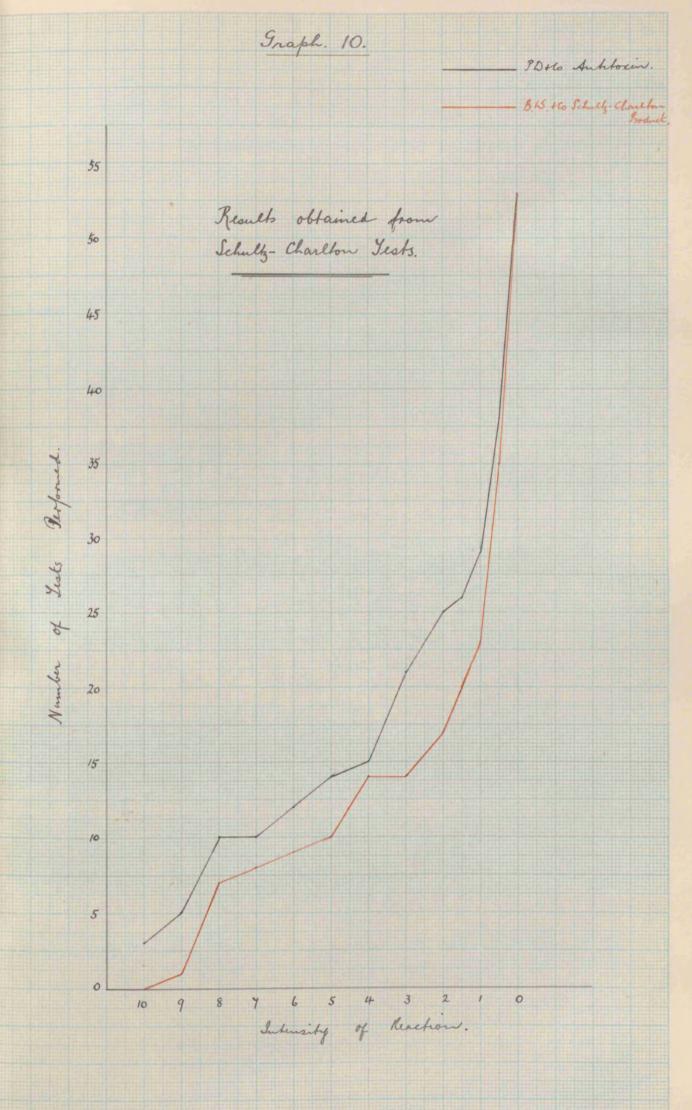






BK + to St. Goduck P.D. 16 autilosais Alleng & Lillian I low is A Captul 4 Kan stall Ferra 3 y bious In Wer fuction 4 Dougles E Shields the Carret lote hoose Jumphy hi yulon hetonon per churchan thouse Schully- Charleon Yests. he houtelk 100/ I he of som growth from De Comon Gaple 7. ל מת כלני שיפור Jhanery 5 Duncon a Jackson for North I hich ela Sugmon thouthead a hisanda. E Beyth for he Lowa of Dodath hut House Har Scott C Kilithon of your L huntely a Bald hat tickes a Eggest has this of headlow Value

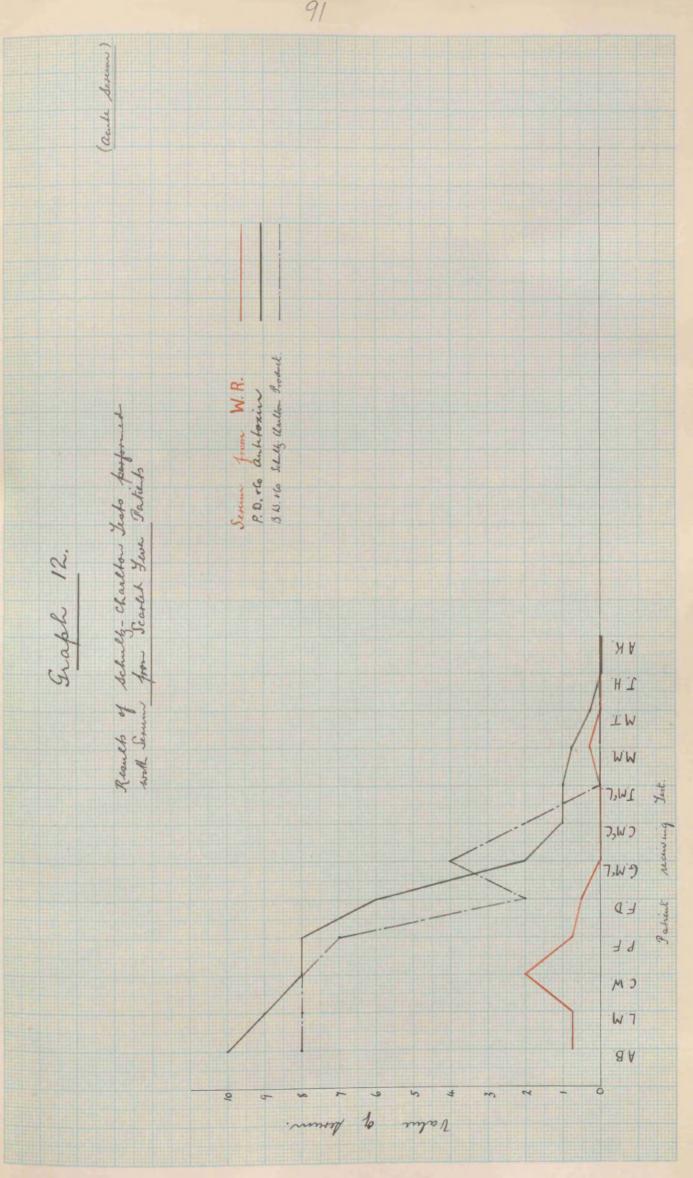


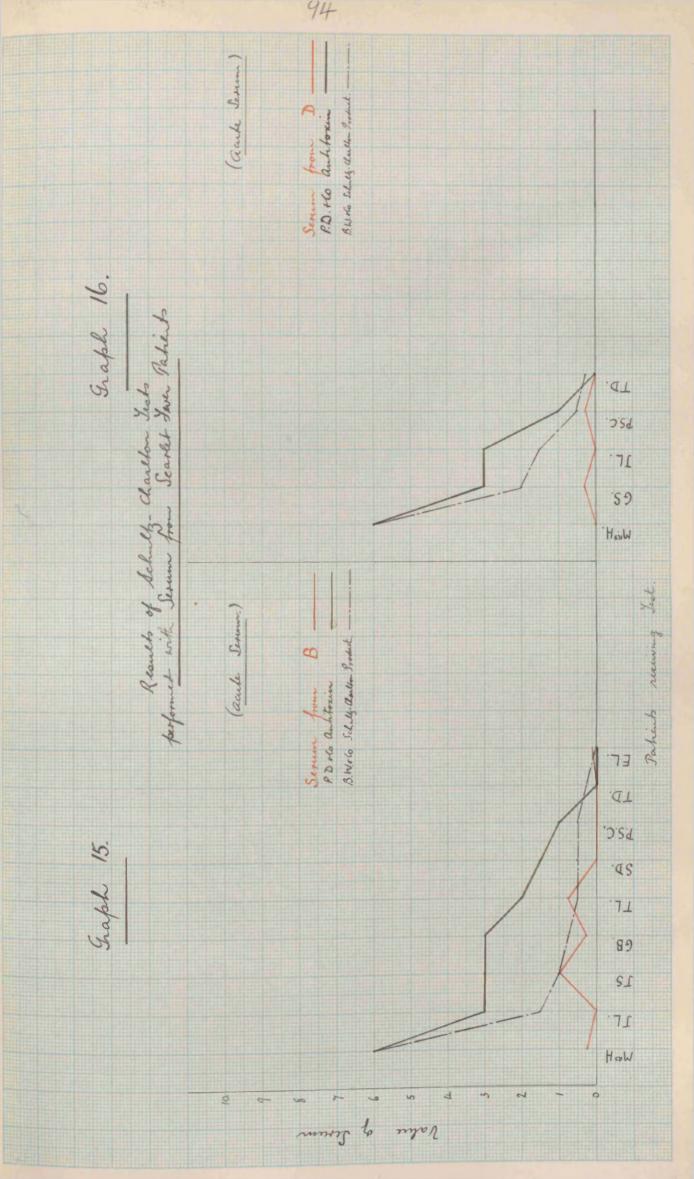


RESULTS FROM SCHULTZ - CHARLTON REACTIONS PERFORMED WITH SERUM FROM SCARLET FEVER PATIENTS.

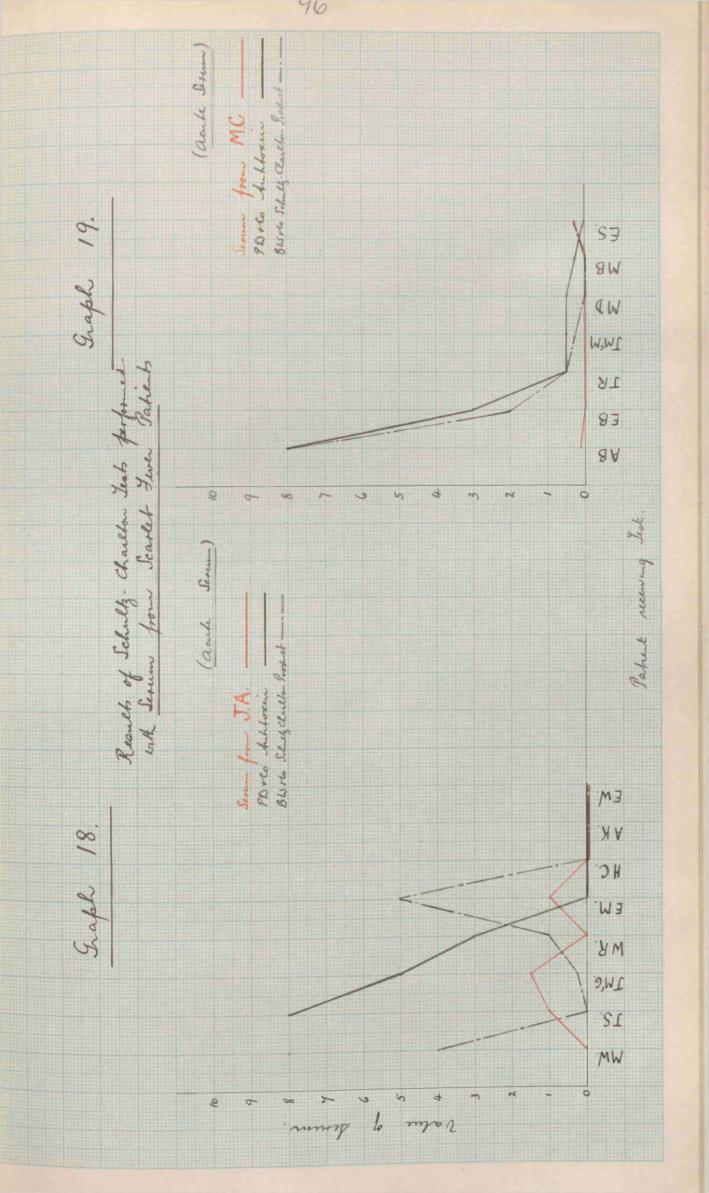
Graphs 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, and 22 were performed with serum obtained, during the early days of their illness, from patients who yielded Persistently Negative Reactions to the Dick Test, at that time.

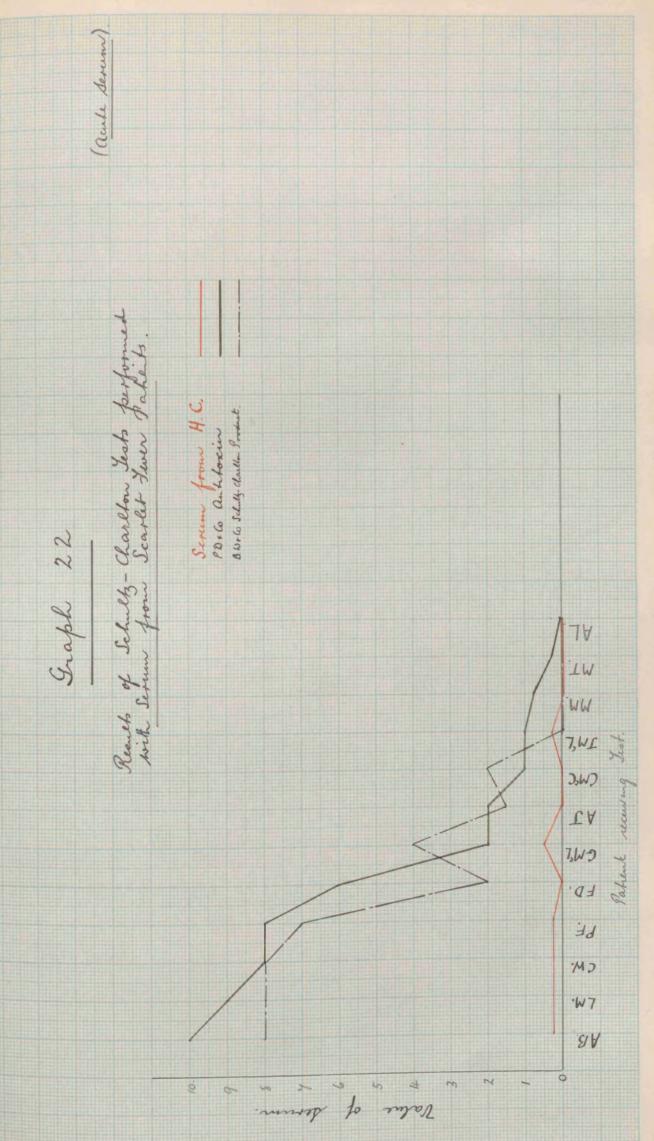
Graphs 23, 24, 25, and 26, were performed with serum obtained from Convalescent Scarlet Fever Patients.

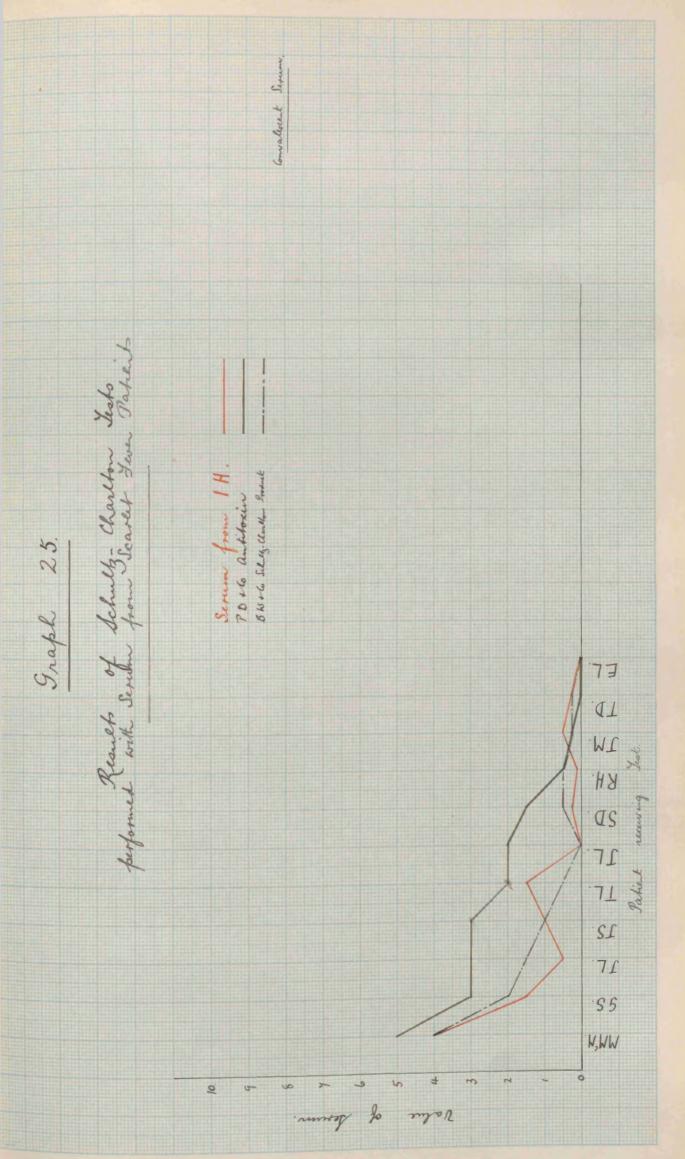


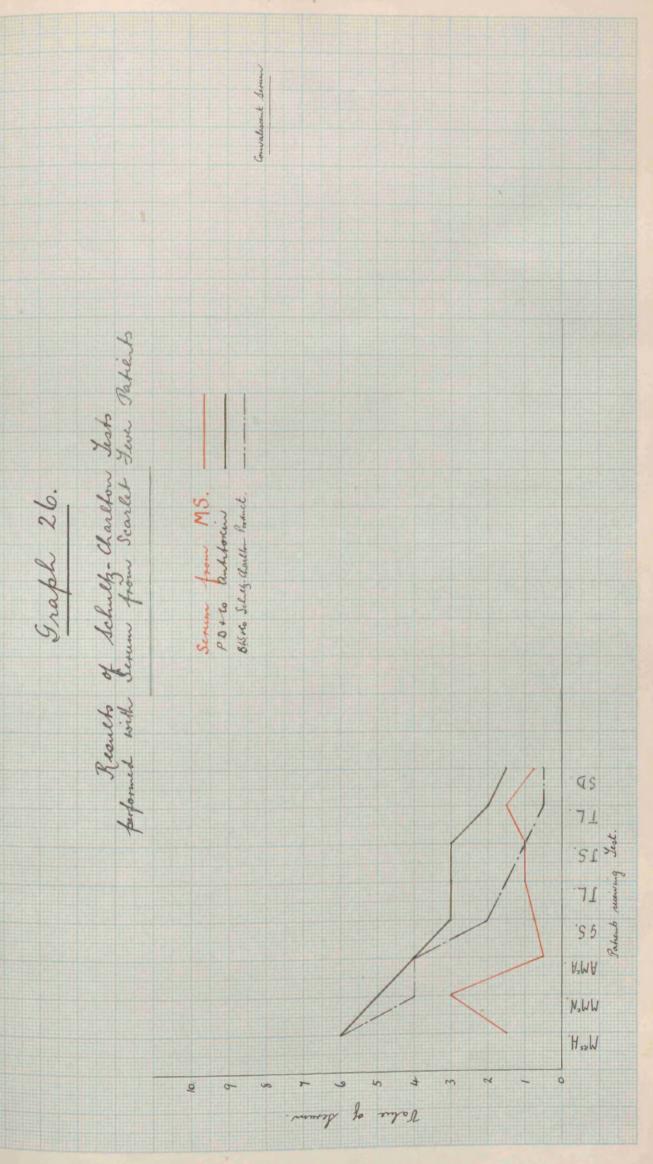


45









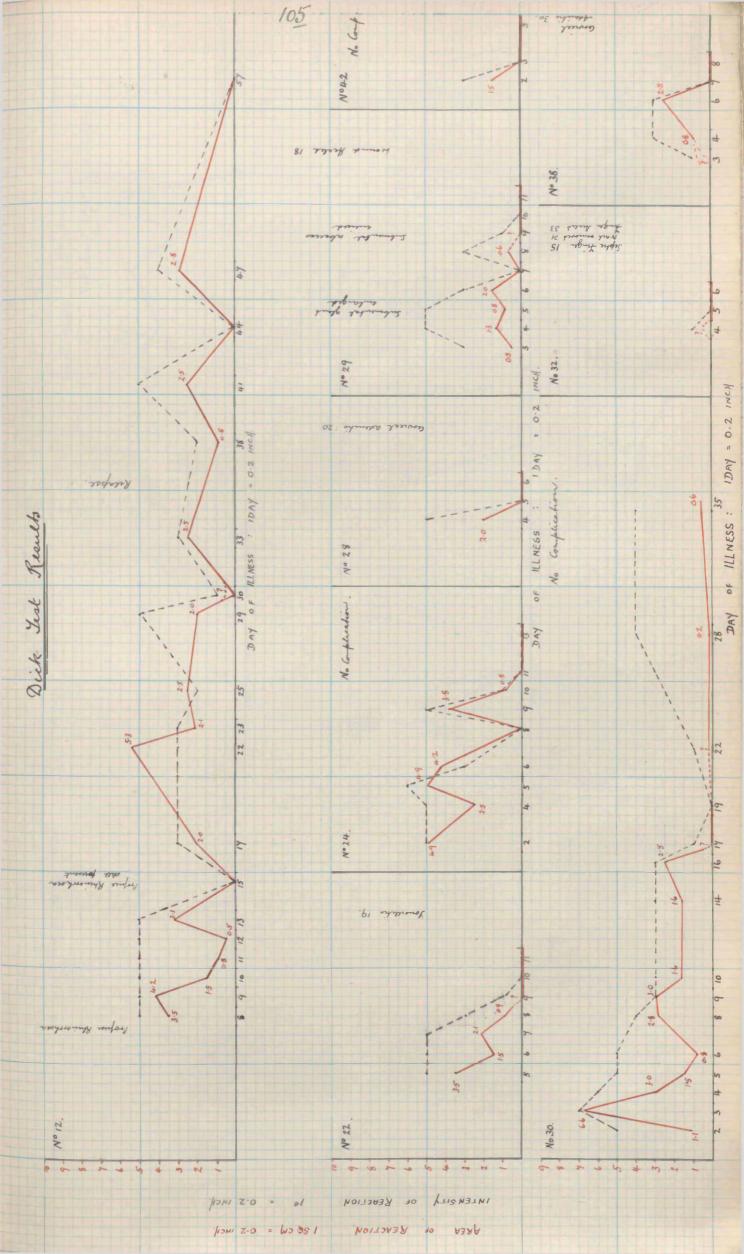
GRAPH 27.

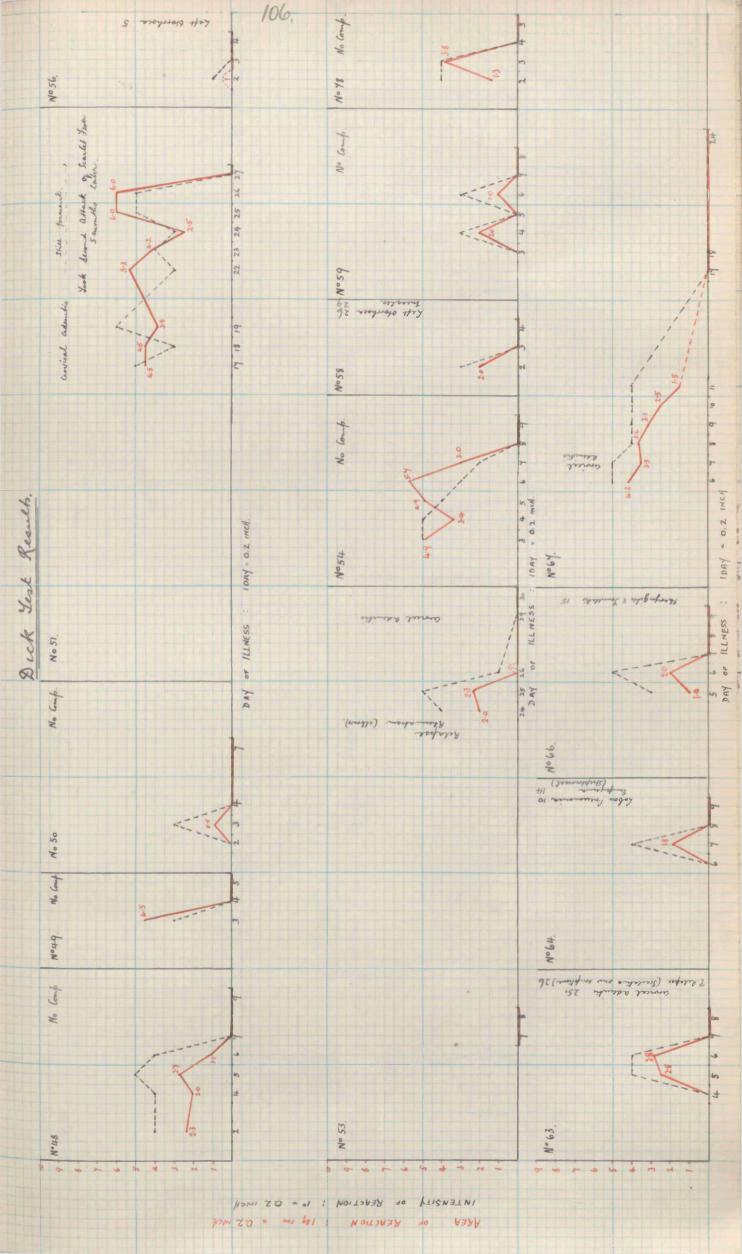
GRAPHS TO DEMONSTRATE THE COURSE FOLLOWED BY THE DICK TEST IN PATIENTS SUFFERING FROM SCARLET FEVER.

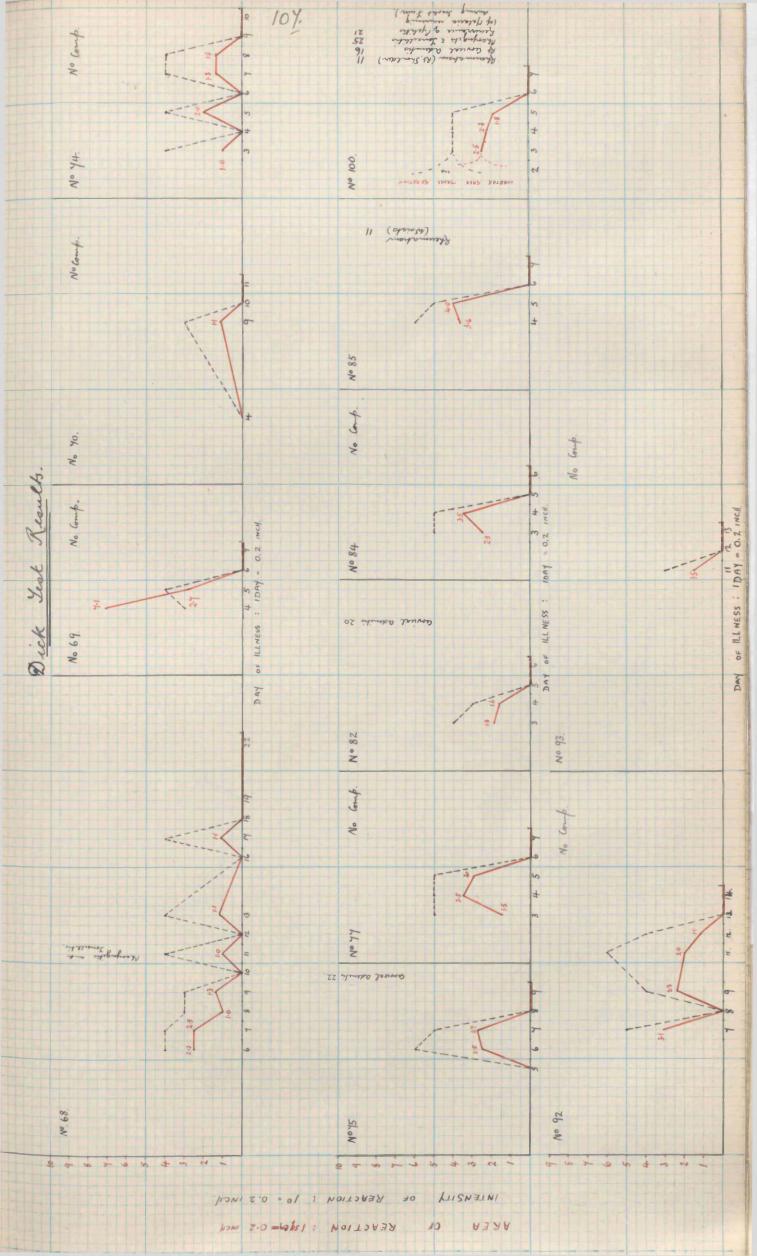
The course followed by the Dick Reactions in each of the 172 Positive Reactors is illustrated by the following graphs, the number attached to each graph indicating the patient from whom the results were obtained.

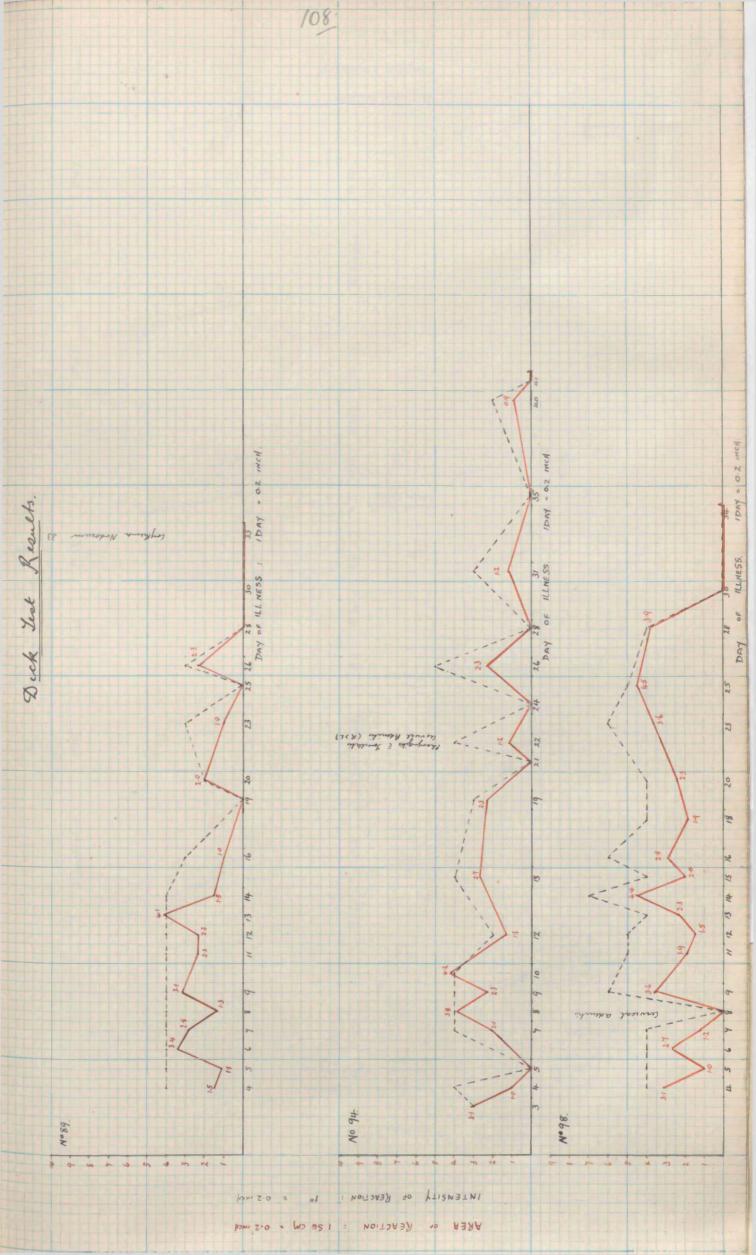
The area of the reaction, expressed in sq.cm. is noted by the red line while the intensity of each reaction, as assessed by the scale noted on page 15 of Volume 1, is indicated by the black line.

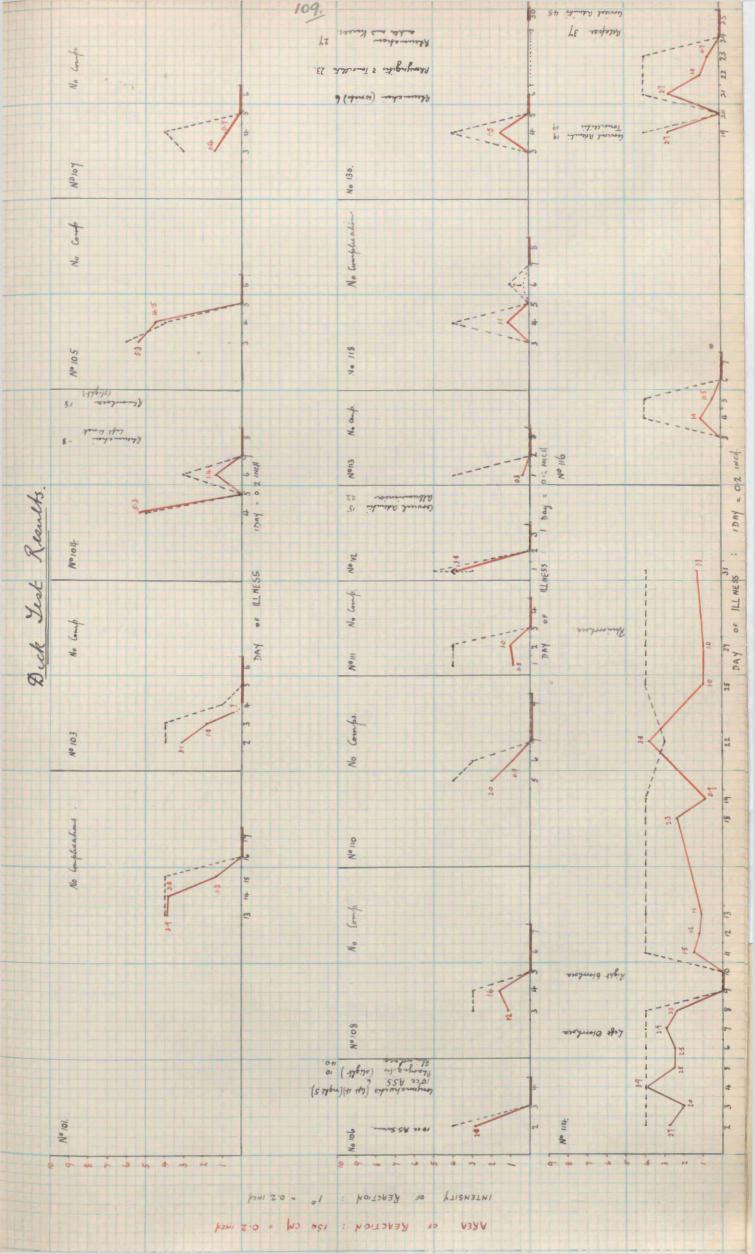
The reactions noted in patients 1 - 200 are recorded on 1^n graph paper while those obtained from patients 201 - 300 are reproduced on 1 cm. graph paper.

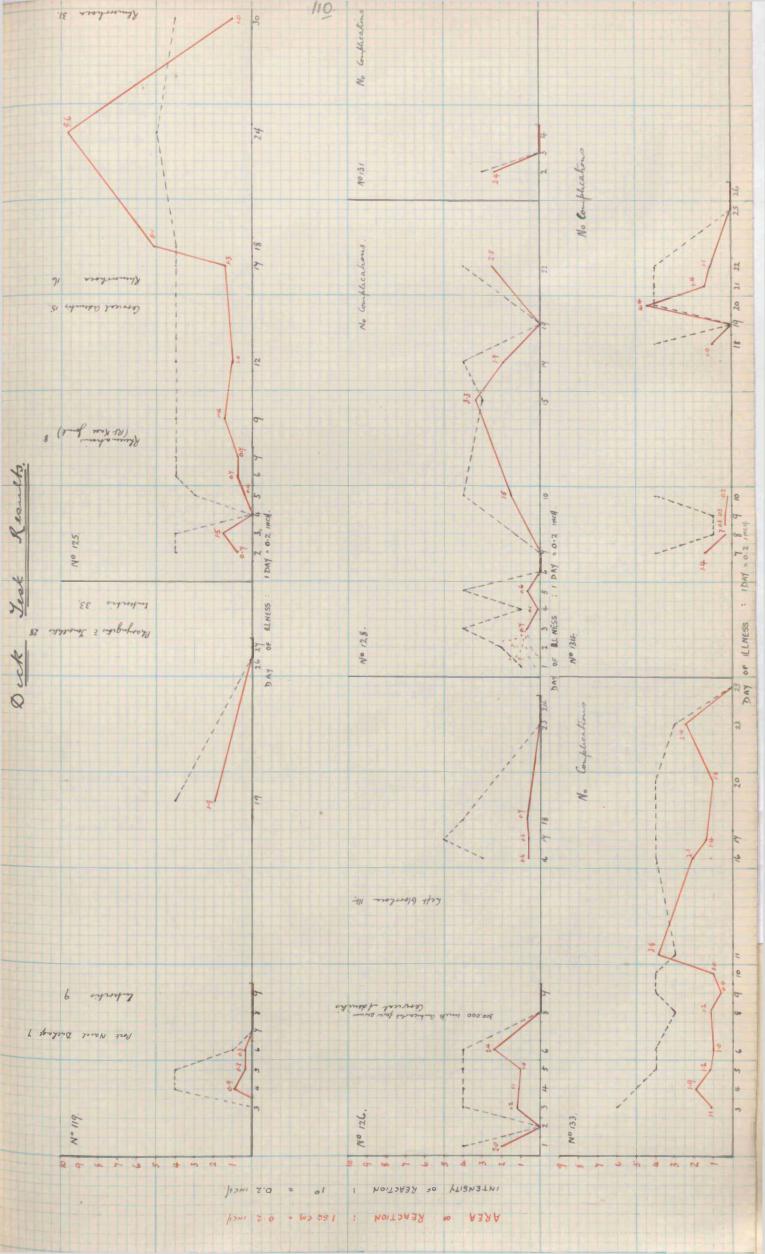


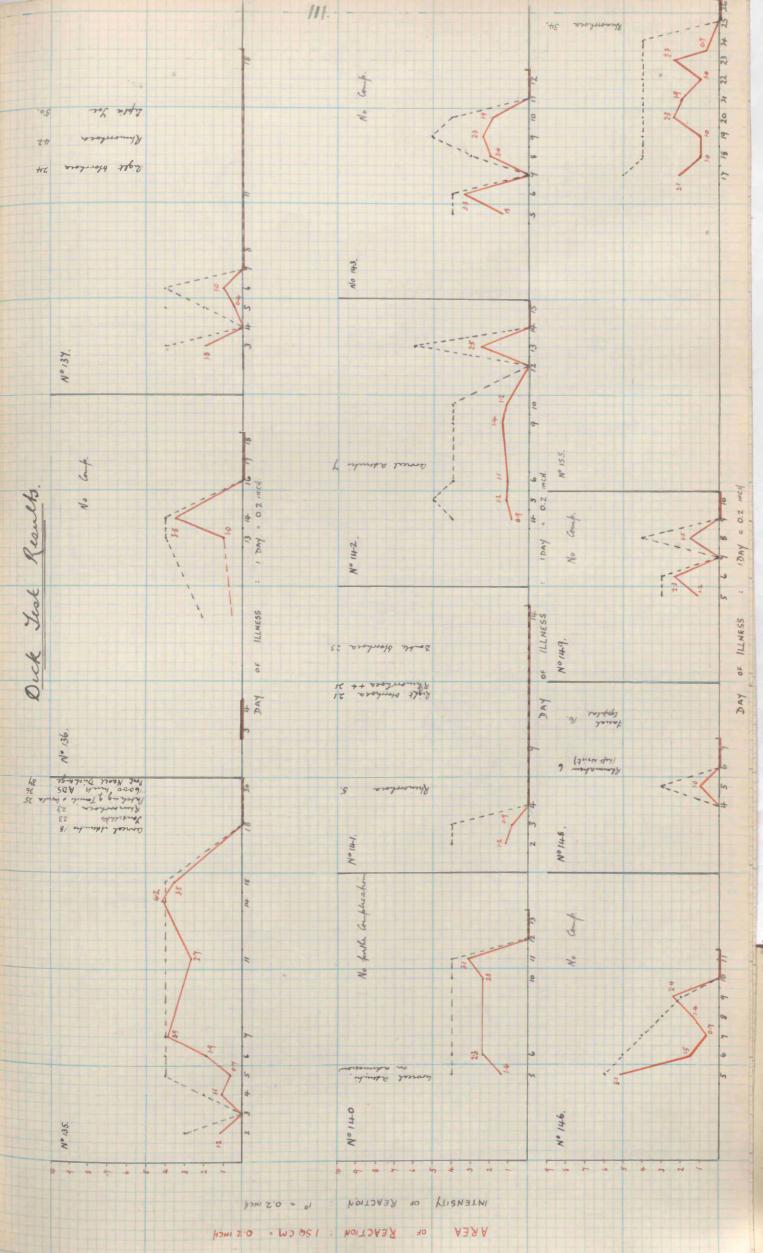


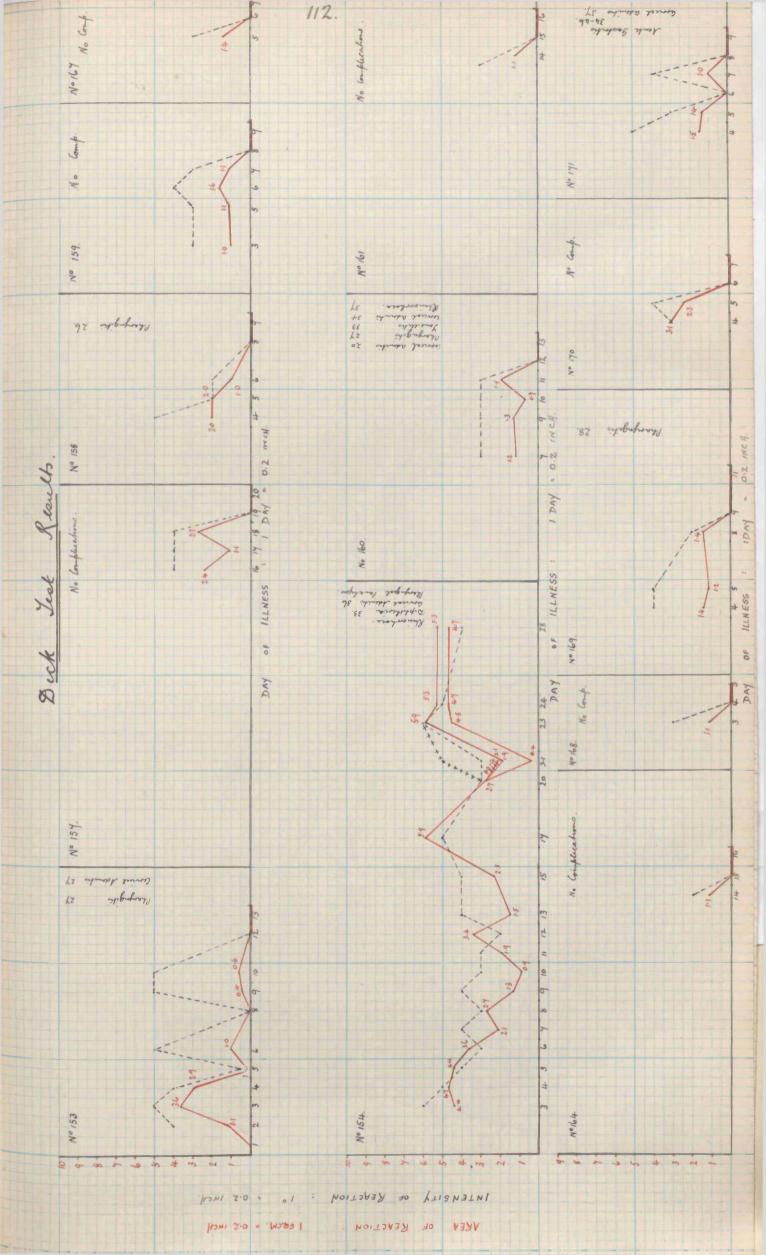


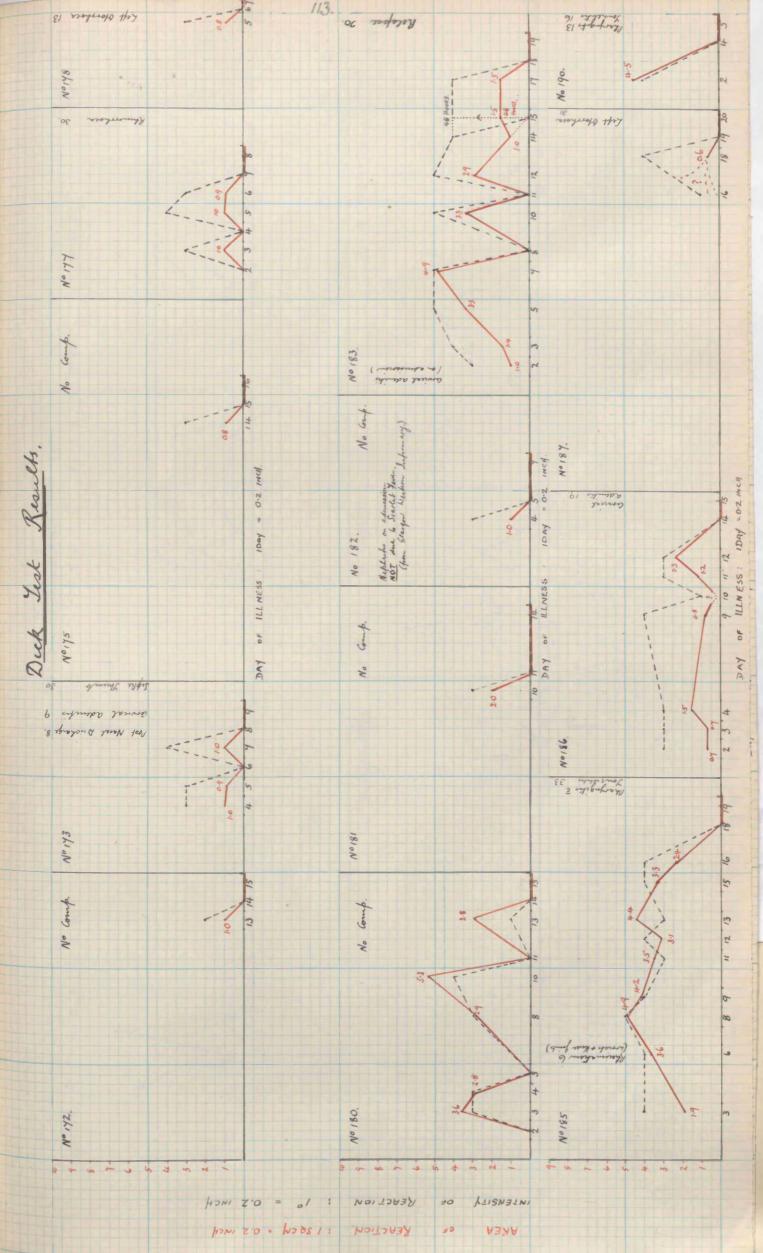


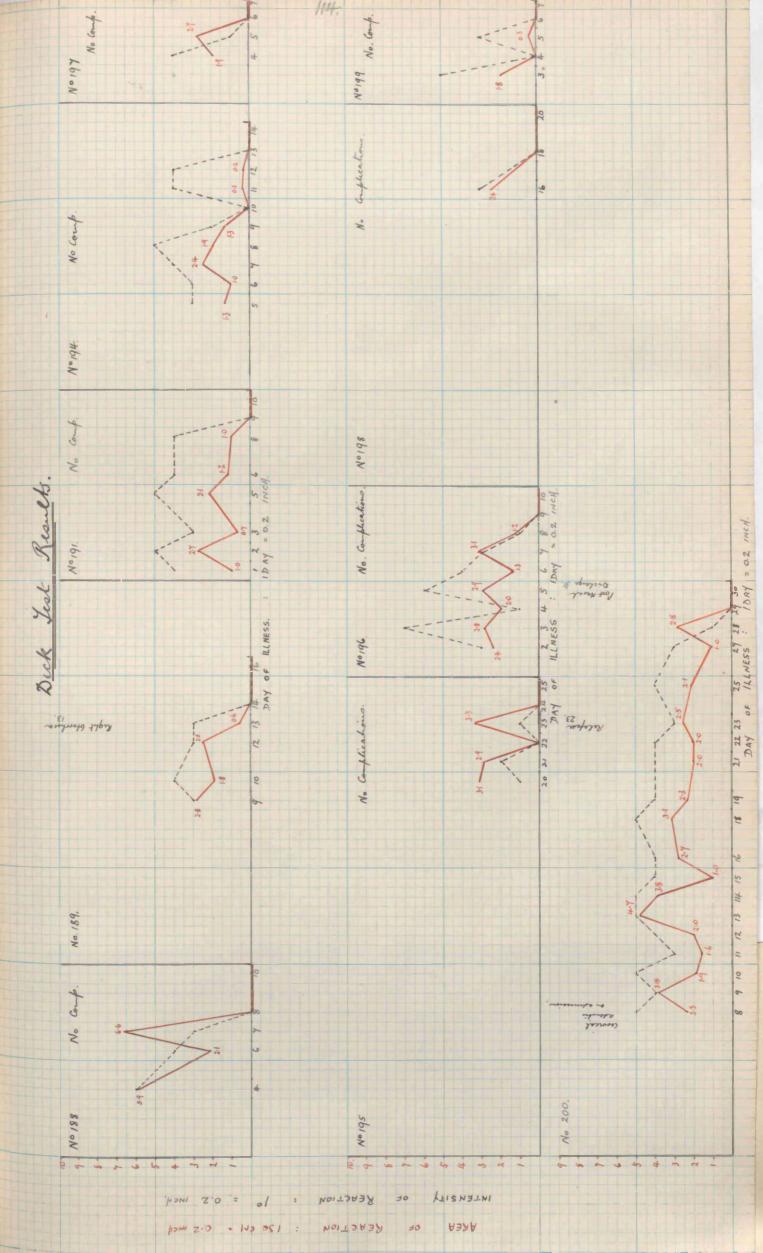


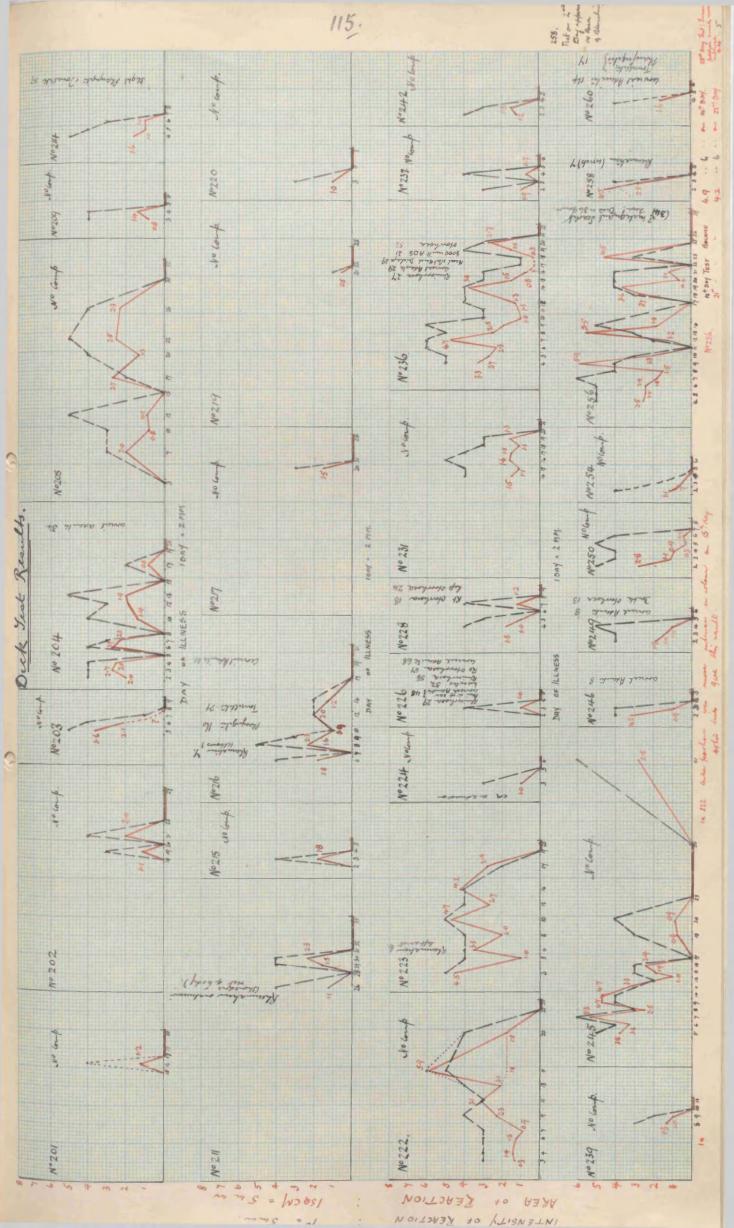


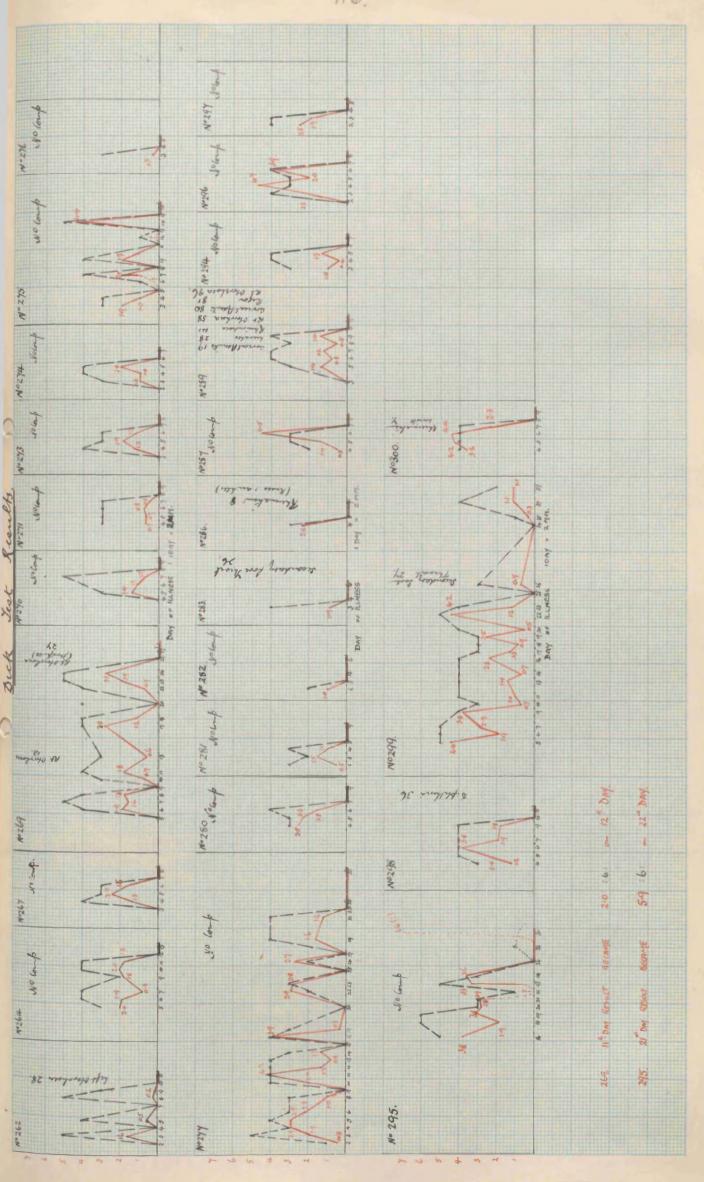




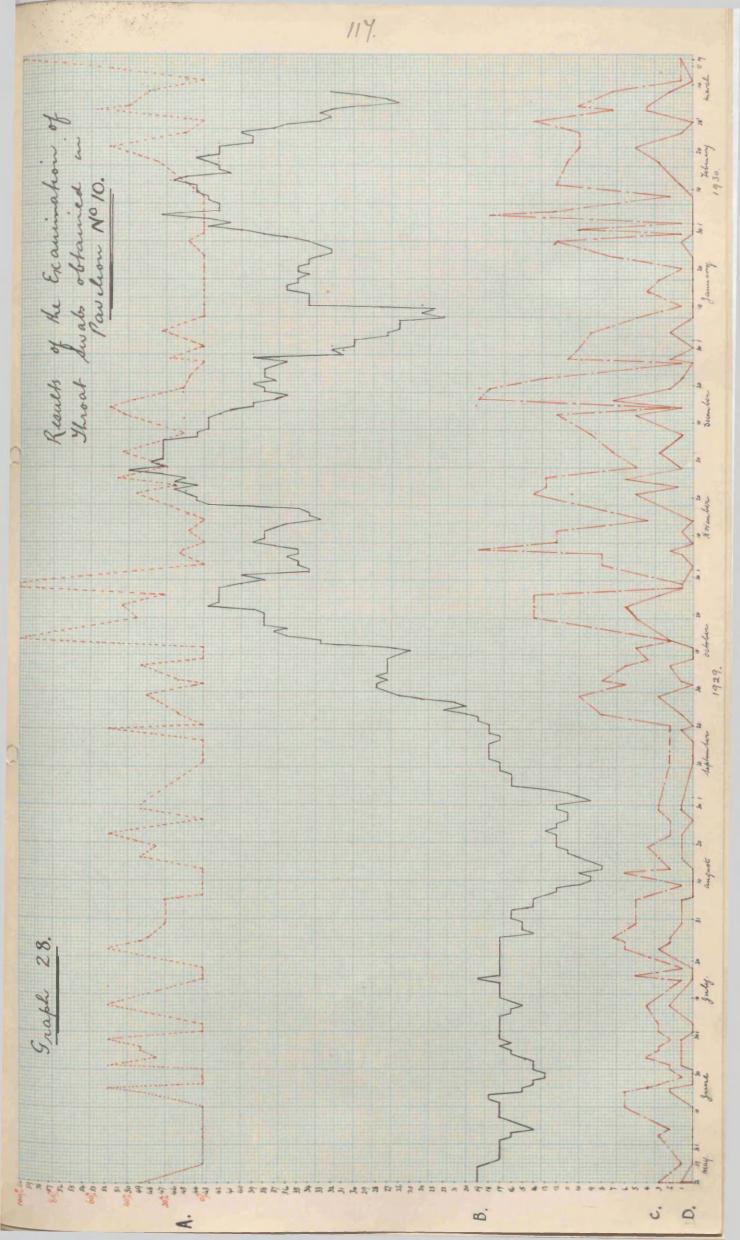








10



THE WARD CHARTS.

SERUM TREATED CASES:

Intravenous Route, ... Charts 1 - 14.

Intramuscular Route, ... Charts 15 - 40.

NON SERUM TREATED CASES: ... Charts 41 - 58.

Two types of Streptococcus scarlatinae Antitoxin were employed namely those supplied by Messrs.Parke Davis & Co., and by Messrs.Burroughs Wellcome & Co. In the case of the former the therapeutic dose is 300,000 units while, in the latter, it is loc.c. At the commencement of the work the dosage for the Parke Davis & Co. antitoxin was stated to be 16.8 c.c.

A brief note precedes each group of Ward Charts.

In the following charts the temperature is shown in black, the pulse in red, and the respirations in black.

The administration of serum is indicated by the vertical green line.

INTRAVENOUS SERUM.

14 charts demonstrating the effect of the administration of antitoxin by the intravenous route are appended. Chart 1 illustrates the action of the serum in the case of Toxic Scarlet Fever noted on page 81 of Volume 1.

In all the other cases the administration of serum into the blood stream was followed by a rapid improvement in the general condition of the patient. Signs of toxaemia disappeared and the patient felt much more comfortable.

The temperature and pulse rate were markedly lowered and in some of the charts, namely 2, 3, 4, and 5, the fall was by crisis while in charts 6 - 11 it took the form of a rapid lysis. In the remaining charts 12, 13, and 14, the temperature, though lowered, did not regain the normal line for some time.

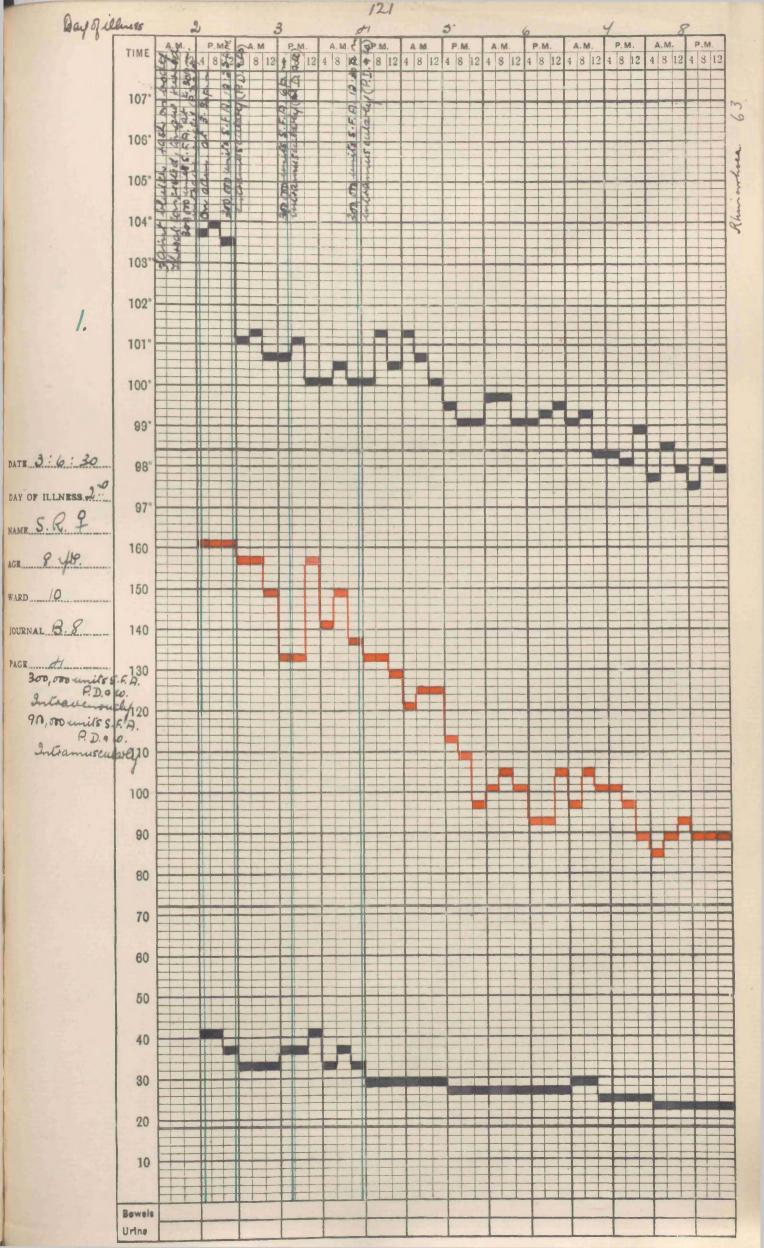
The administration of serum, by any route, has been noted to be followed by a rapid blanching of the rash. This point has been recorded by different workers and we have noted it on numerous occasions. In the present series of patients, however, blanching of the rash was not observed to follow the intravenous injection of serum. In only one instance did the rash disappear within twelve hours, in only two cases within 18 hours and in only one case within 36 hours. In the remaining nine cases the rash did not fade until 48 hours or more had elapsed after the administration of the serum. This failure of the serum to blanch the rash when administered into the blood stream is all the more interesting when we recall the considerable number of cases in which it followed the intramuscular injection of serum. It was observed that the time taken for the temperature to regain the normal level seemed to be in direct proportion to the time which elapsed before the rash completely disappeared.

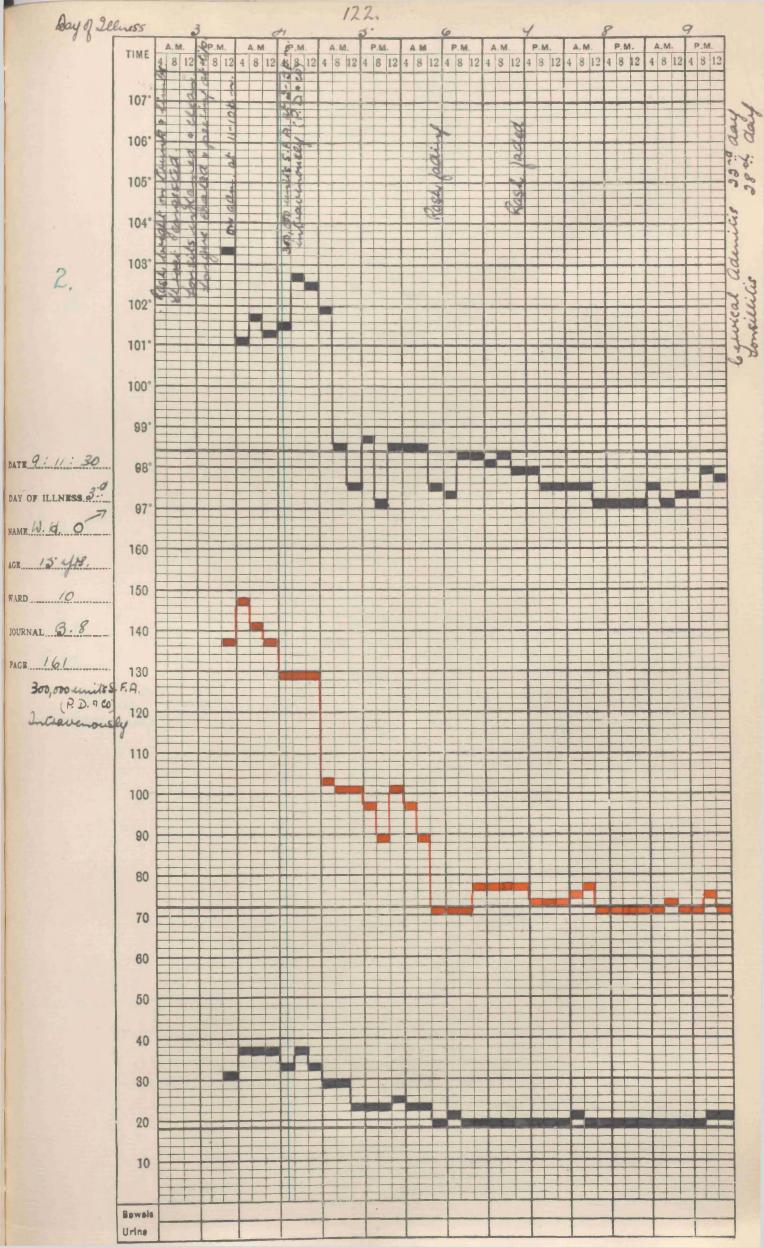
Wylie noted that Gordon reported that the administration of serum was followed by a rise of the temperature and states that such an elevation occurred in 53% of her cases. This preliminary rise of temperature was observed in the majority of the cases treated by me during the present work.

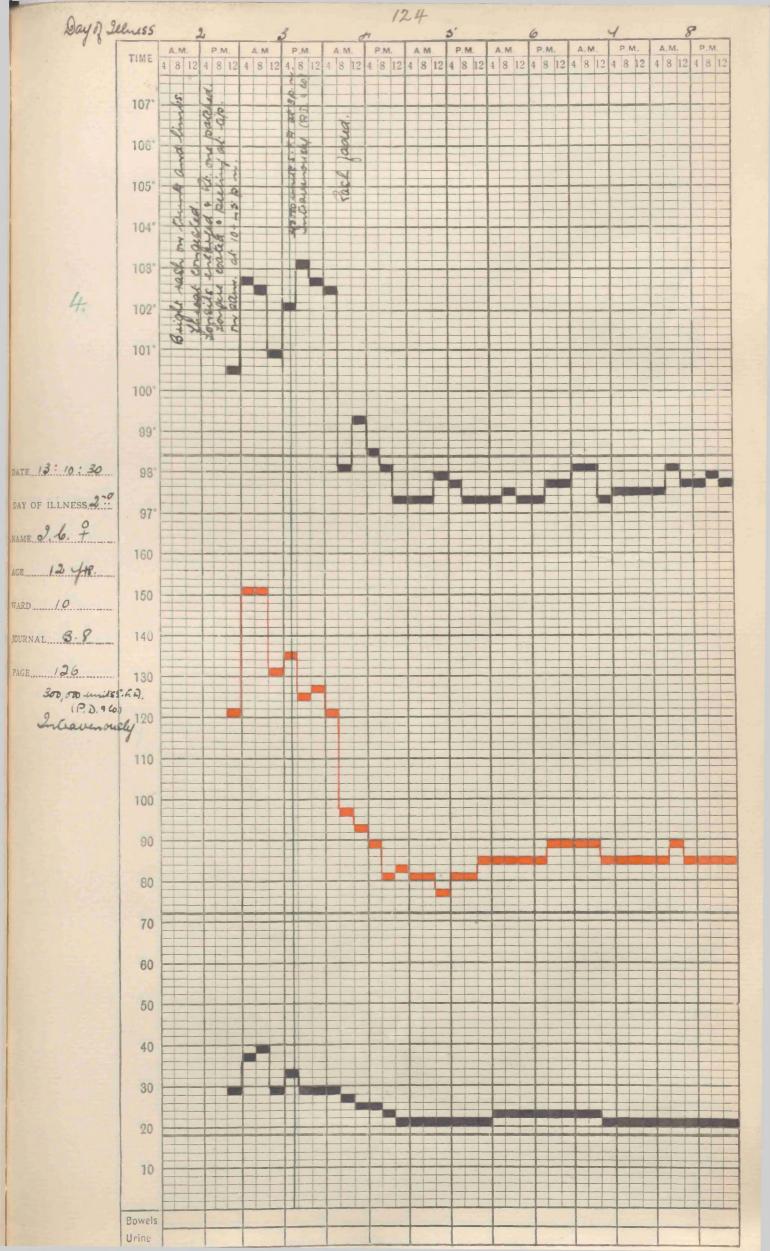
In five of the cases treated with serum by the intravenous method complications were observed.

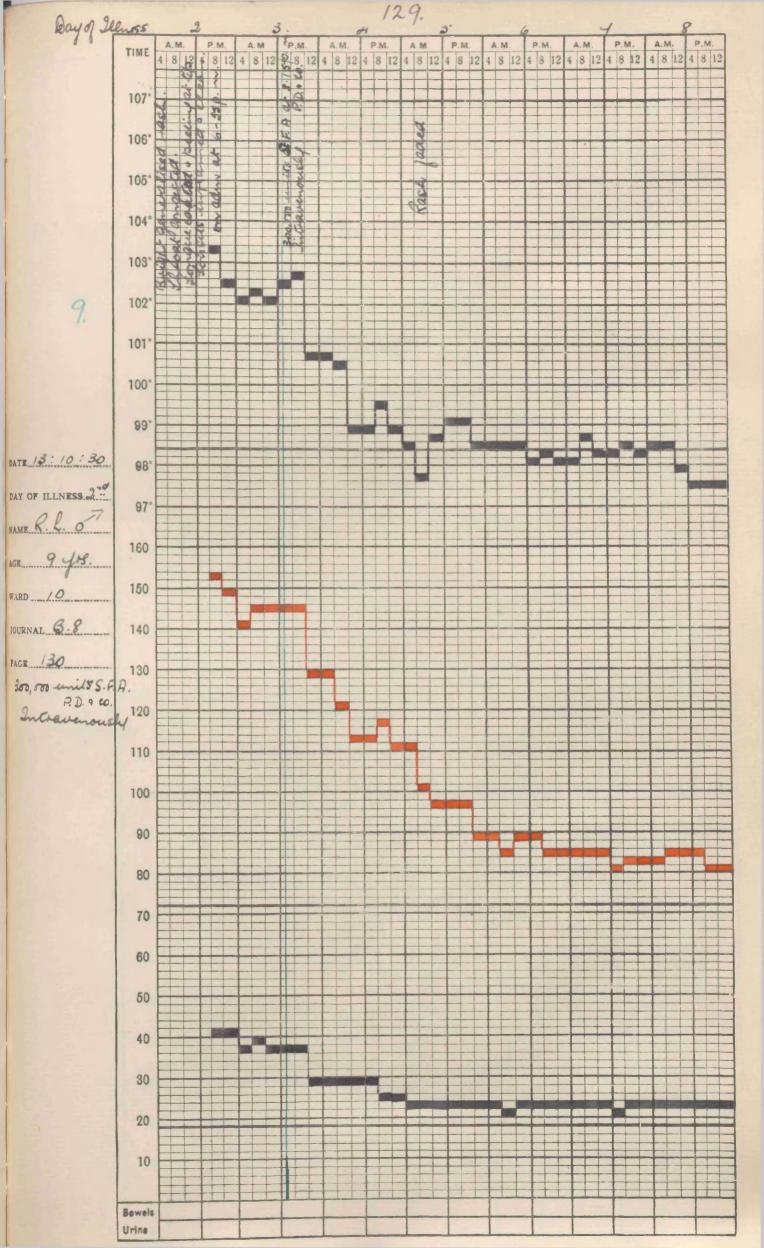
We have observed one example of severe anaphylaxis following the intravenous administration of Scarlet Fever Antitoxin and, for this reason, consider that all cases receiving the serum in this manner, should be highly desensitised. Our practice is to inject 5 minims, 10 minims, and a further 15 minims of the serum intramuscularly at intervals of 15-30 minutes before injecting the therapeutic dose into the blood stream.

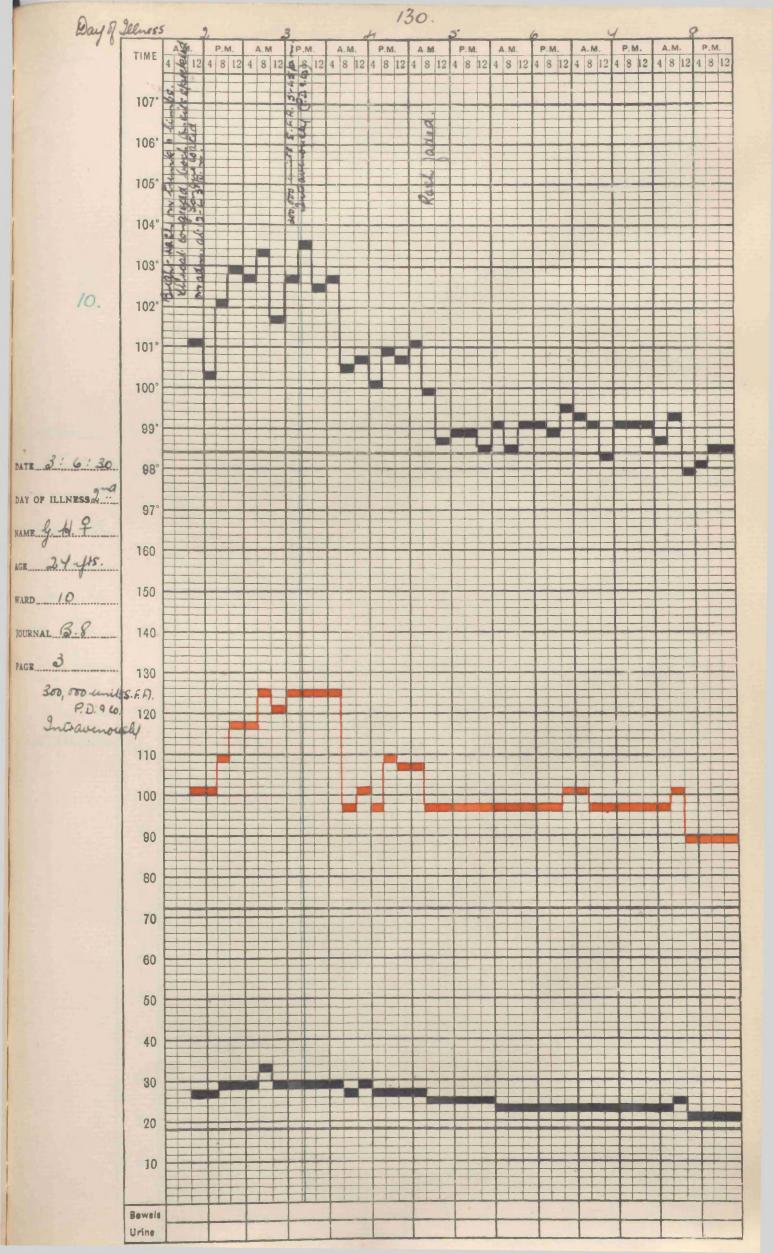
A consideration of the clinical improvement noted after the intravenous administration of Scarlet Fever Antitoxin especially in severe cases, the rapid return of the temperature and pulse rate to normal and the striking results obtained in the case illustrated by Chart 1 has caused me to form the opinion that, in order to obtain the maximum benefit from the treatment the antitoxin should be administered by the intravenous route in at least the first instance.











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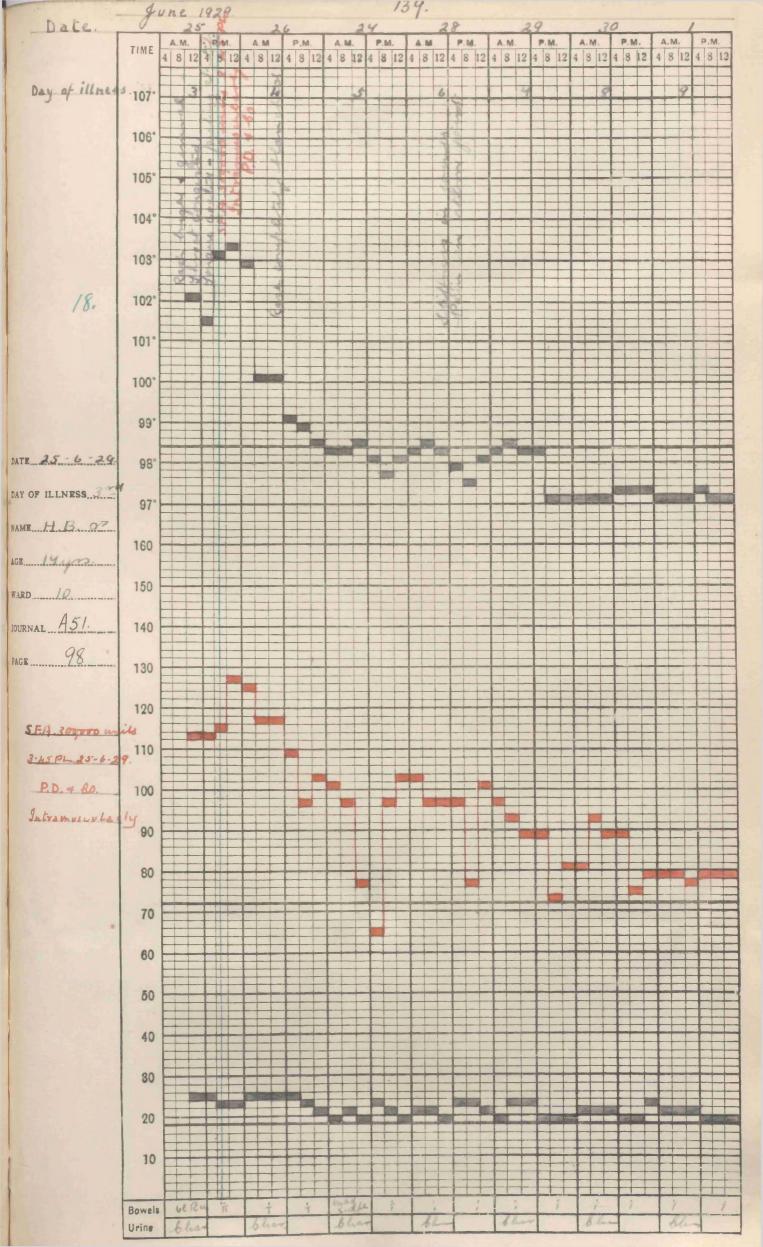
INTRAMUSCULAR SERUM.

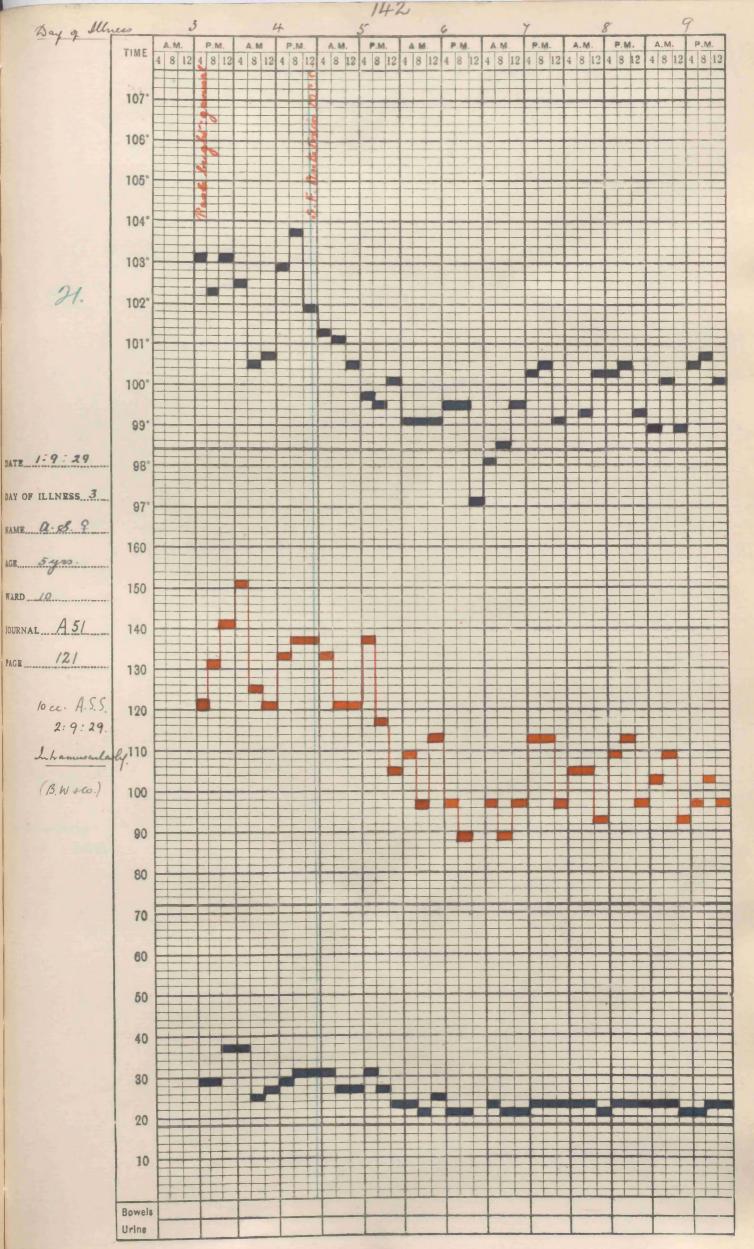
A series of 26 charts illustrating the action of Scarlet Fever Antitoxin when administered by the intramuscular route has been appended.

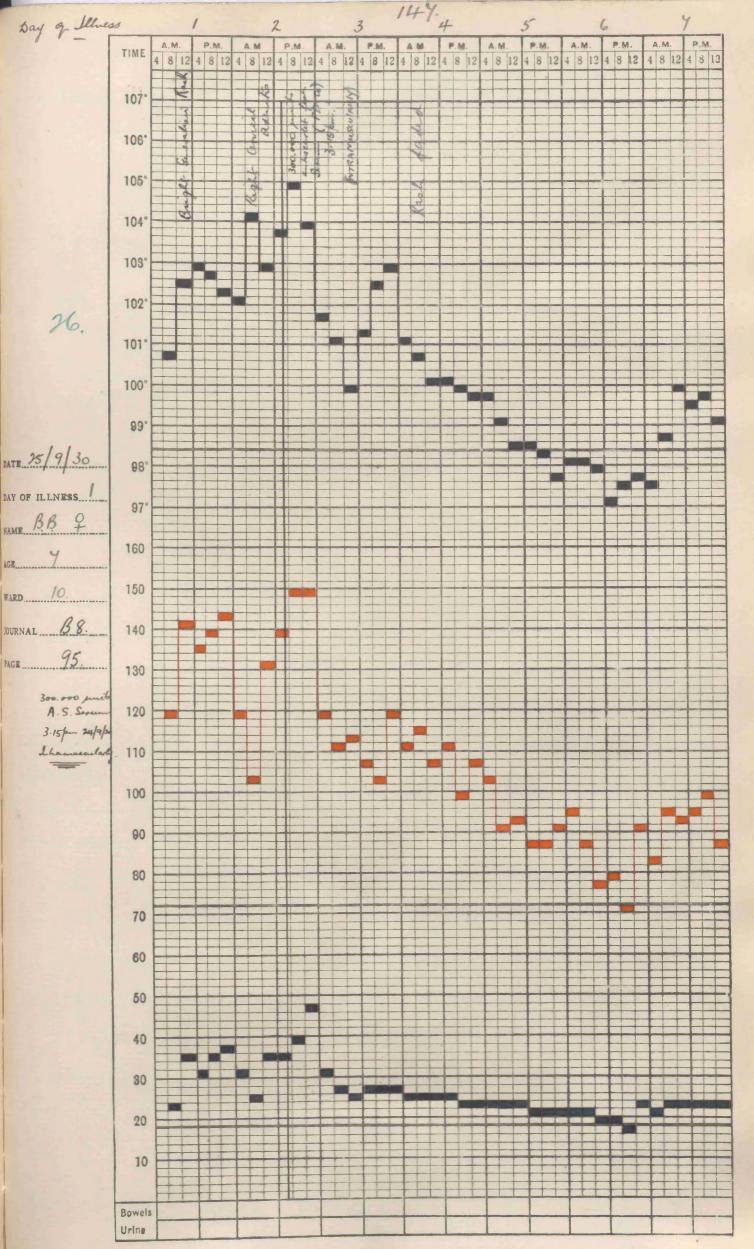
In these cases the administration of serum was observed to be followed by considerable clinical improvement in the patients. This result of the serum treatment, however, did not develop so rapidly as was observed to follow the intravenous injection of serum. The temperature and pulse rates were both observed to be decreased but, in only two cases, 15 and 16, did the temperature fall by crisis. In cases 17-23 and 24-27 the fall was by rapid lysis, in 28-34 by prolonged lysis and in 35-40 the administration of serum did not have much effect on the course of the temperature.

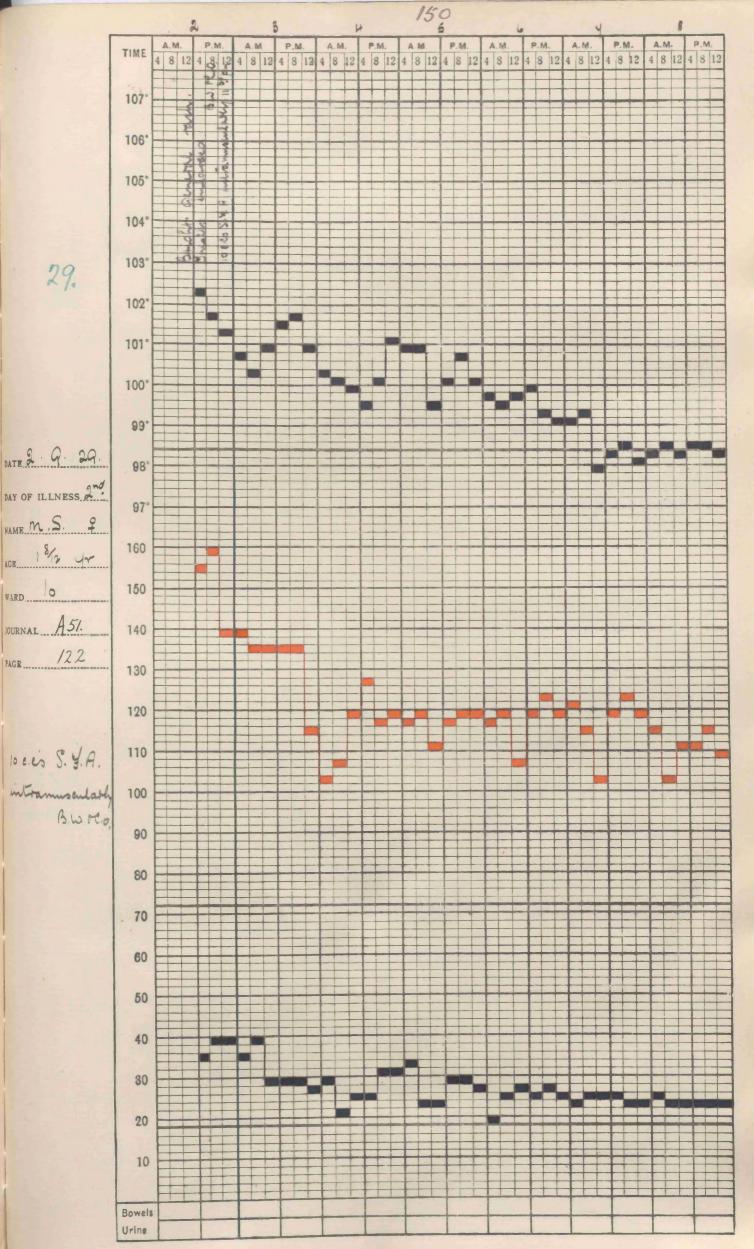
It is interesting to note, in contrast with what has been noted in the case of intravenous injection of serum, that, in a considerable number of cases the rash was rapidly blanched by the intramuscular administration of serum.

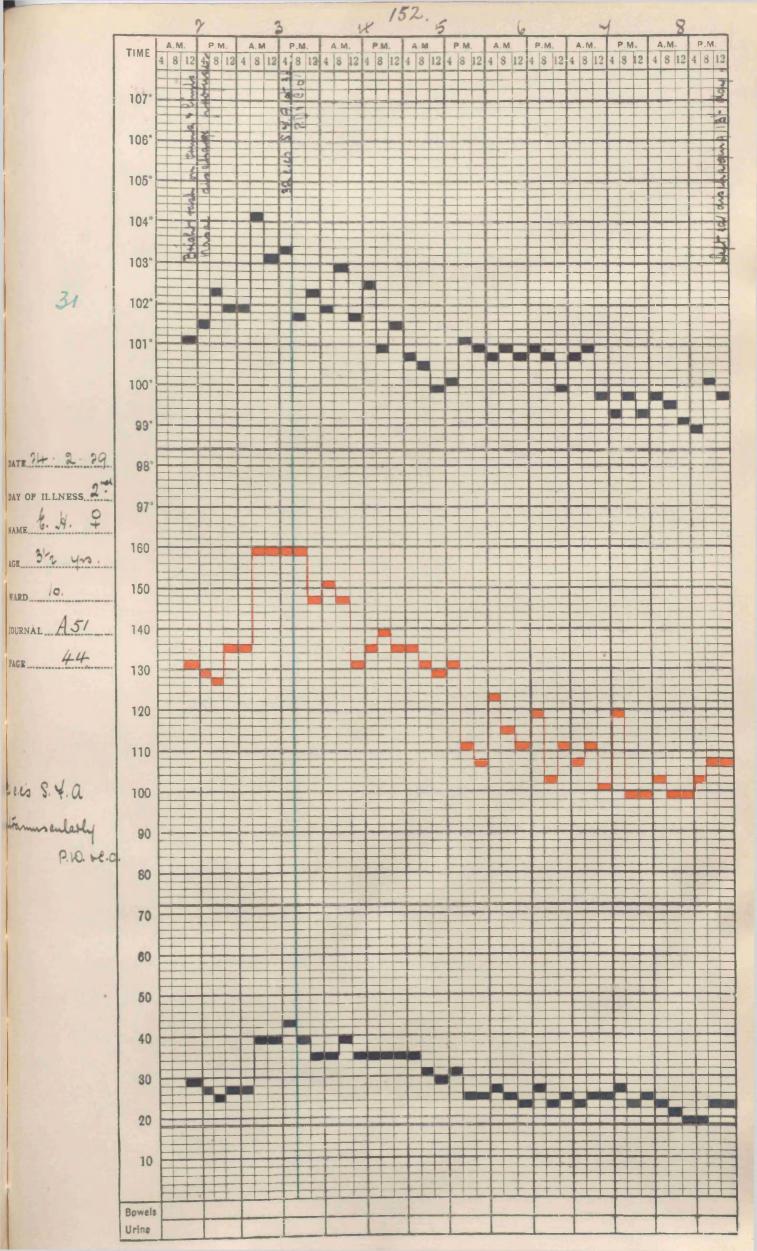
Complications were observed to occur in 11 of the 26 cases. While the number of our cases is too small to allow of definite conclusions being made, it would appear that fewer complications develop after the intravenous administration of serum than after treatment by serum injected intramuscularly. This suggestion is strengthened by the fact that the intravenous method of serum administration was applied chiefly to the most severe cases.

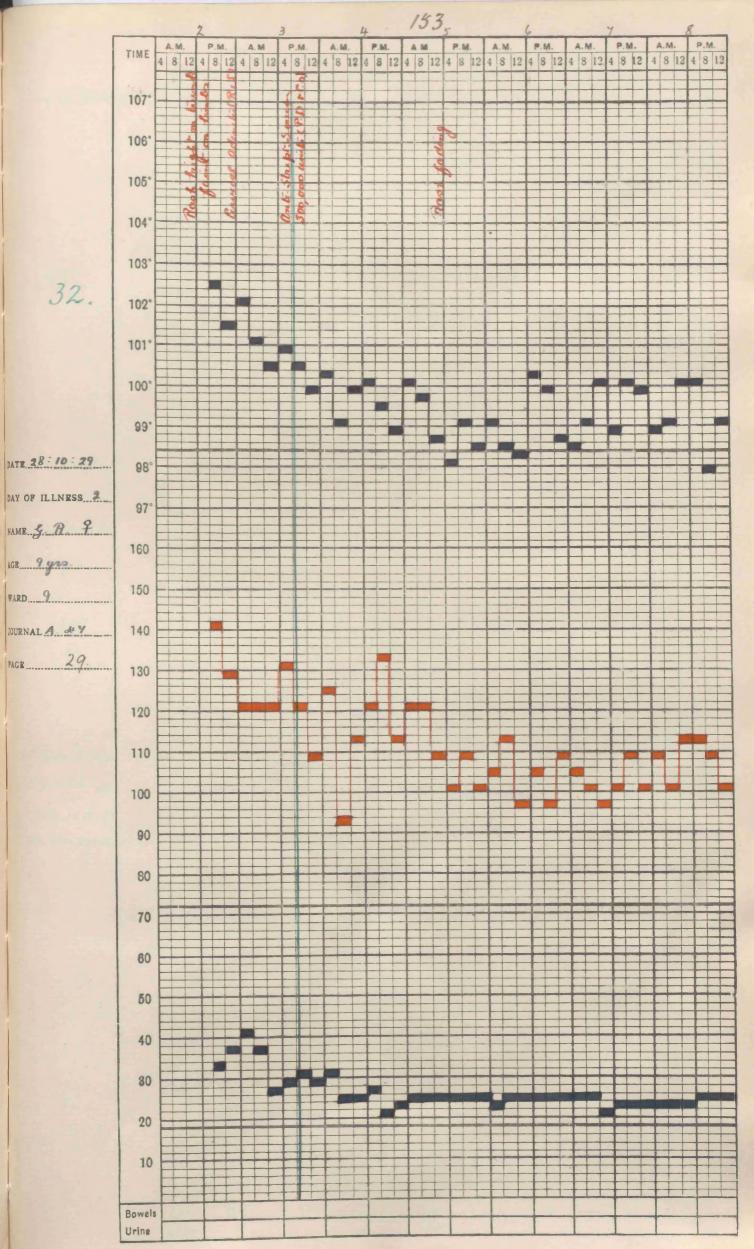


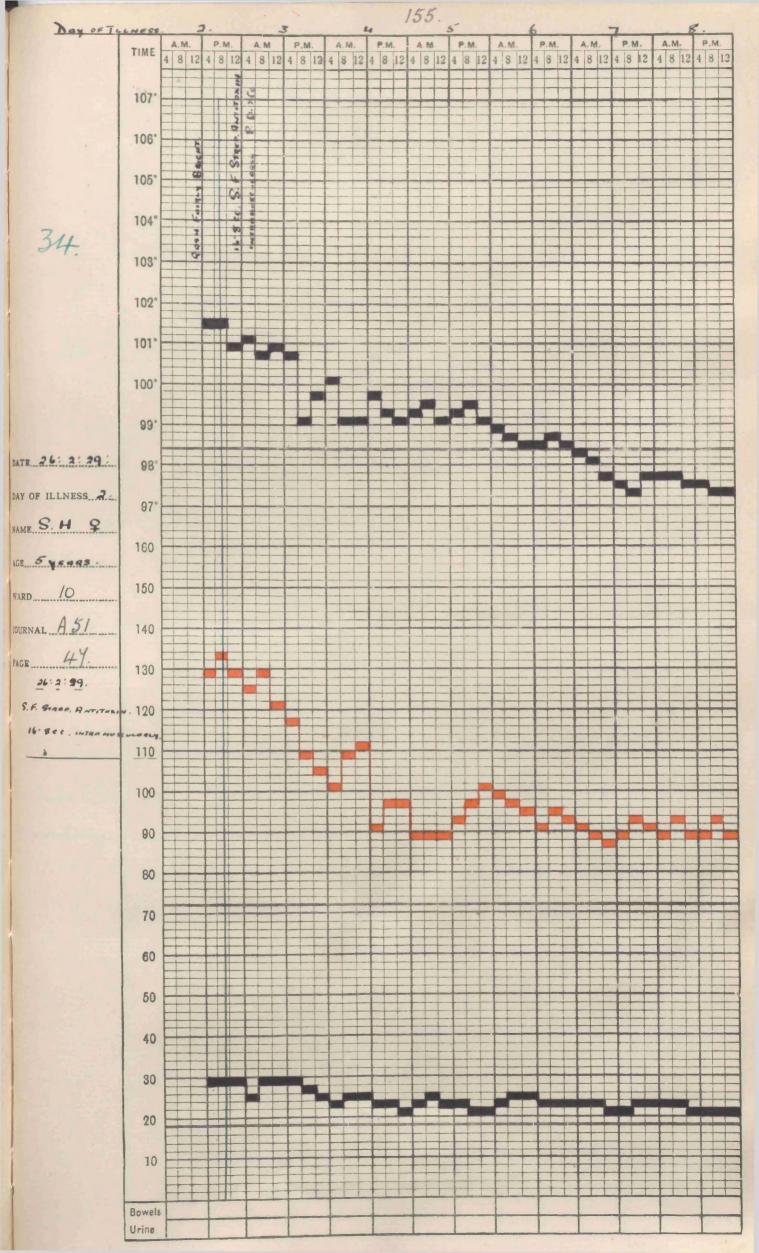


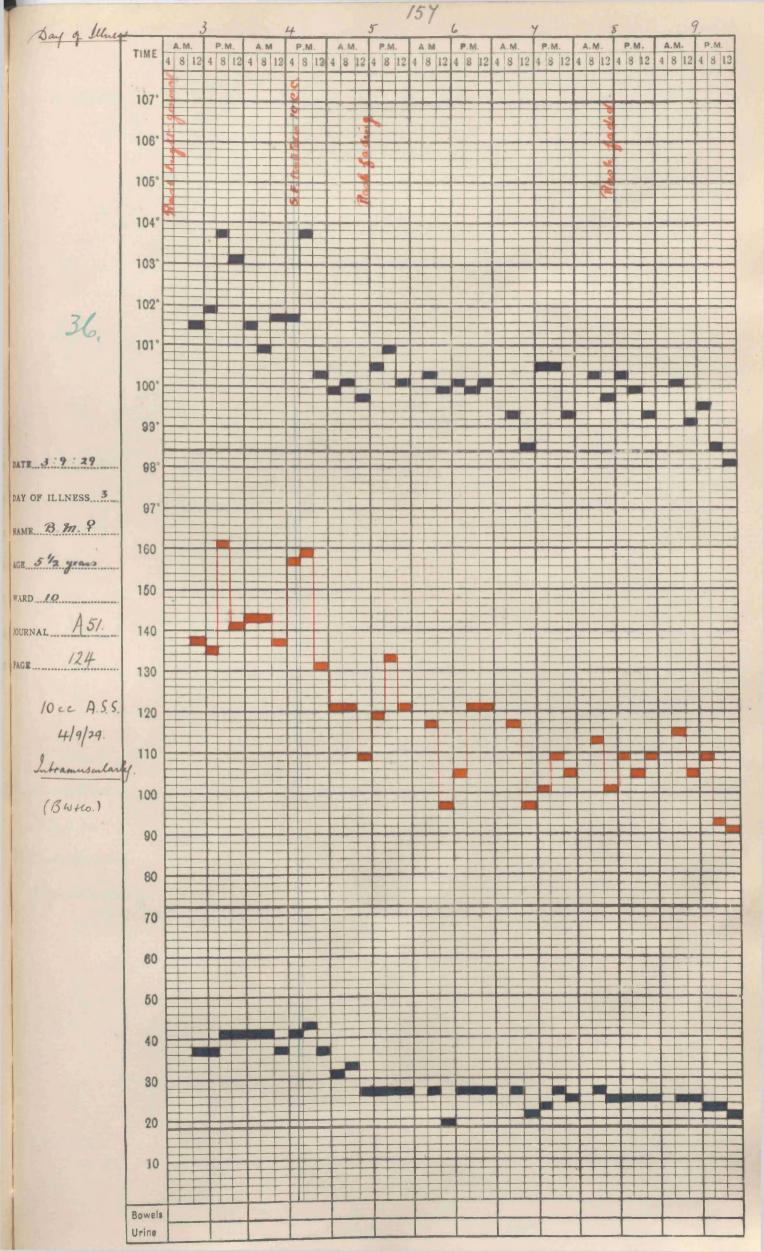


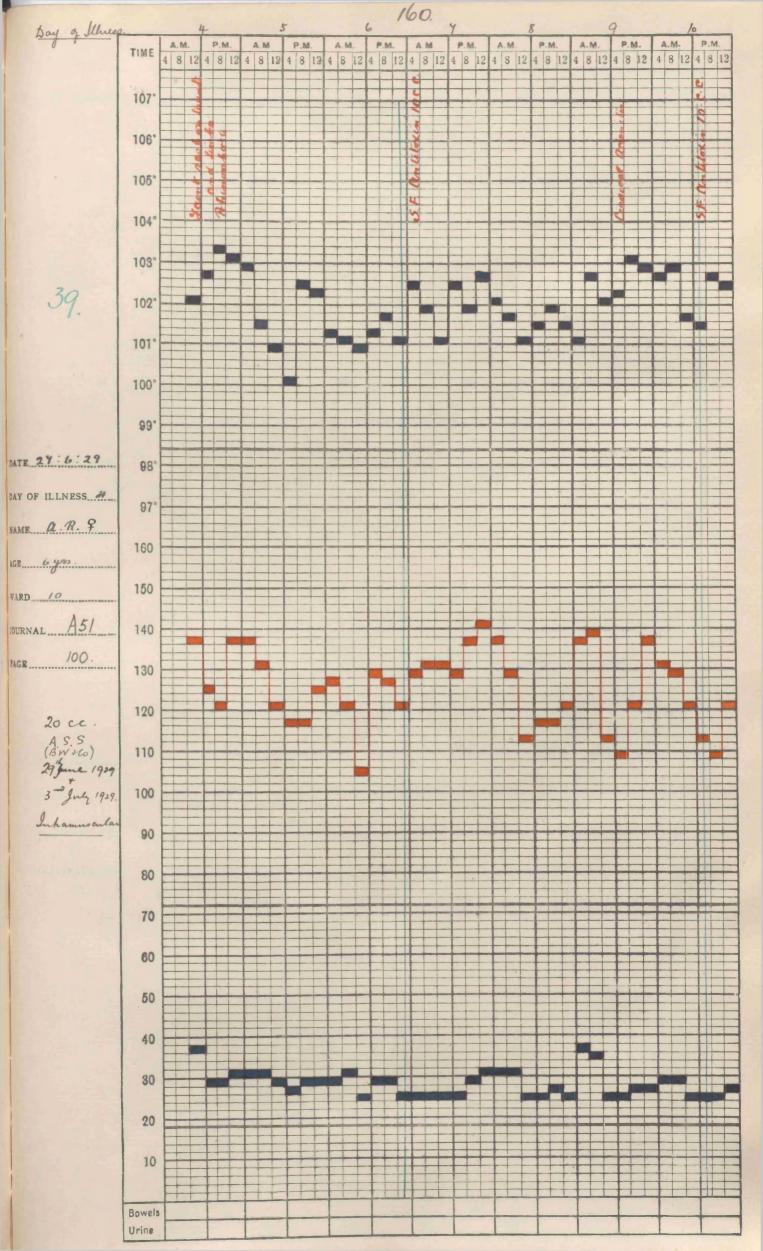


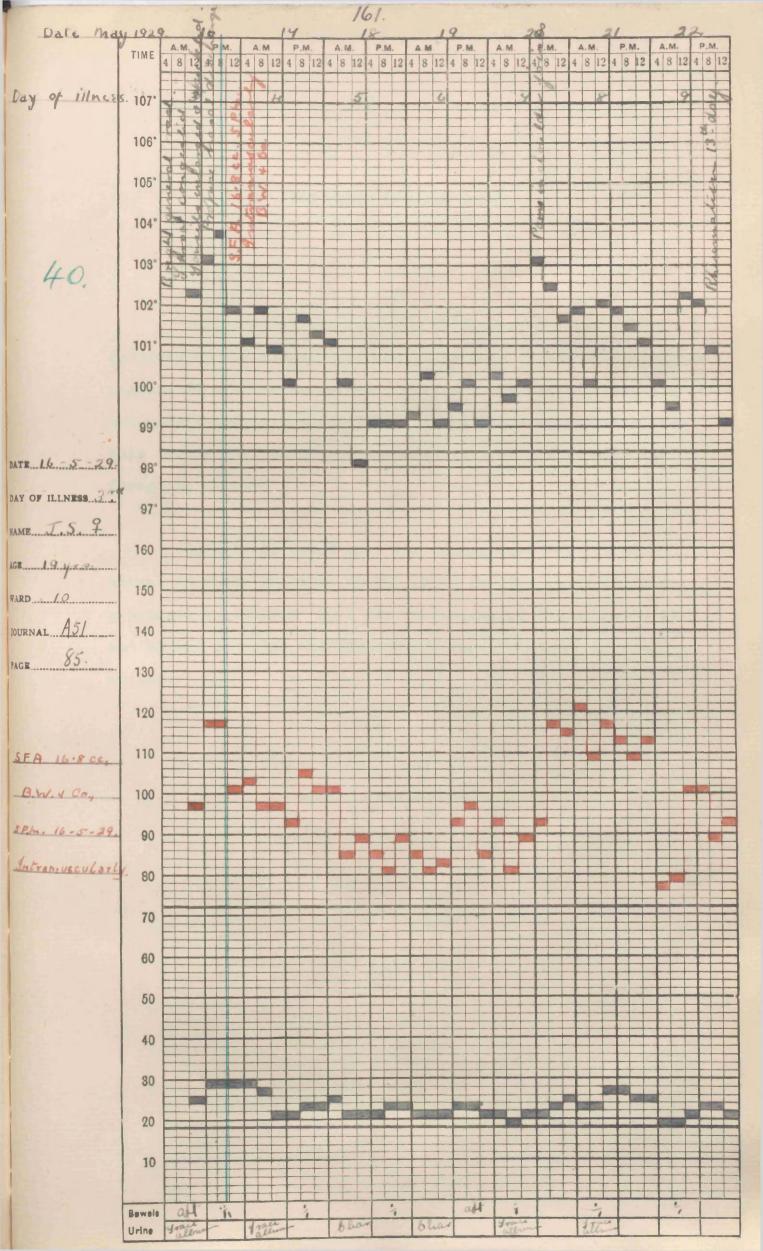












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NON SERUM TREATED CASES.

Charts 41-58 are included to demonstrate the course followed by the temperature and pulse rate in Non Serum Treated cases. It must be remembered, however, that these cases did not receive serum treatment because of their mildness and for this reason they cannot be compared too critically with the foregoing charts.

It will be noted that the temperature returns to normal in these cases by lysis, rapid in some cases and more prolonged in others. In a few instances, of which Charts 41 and 42 are examples, the temperature regains normal levels by crisis.

