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In undertaking the work incorporated in this thesis I entertained the hope that any results found might help in the treatment of scarlet fever.

All the tests performed were such that they might easily be introduced as routine measures in the treatment of scarlet fever cases in the isolation hospitals without too great a tax on the resources of the staff.

I wish here to express my thanks to Dr. A.S.M. Macgregor and Dr. T. Archibald for premission to carry out the investigation.

I would like also to express my thanks to Dr. W.R. Snodgrass and Dr. A. MacCrorie for their willing advice and help.

To the sisters, nurses and attendants of Belvidere Hospital, without whose co-operation the investigation could not have been undertaken, my thanks are due.

The section on the post-mortem examinations was made possible by the help of Prof. J. Shaw Dunn and Dr. F.E. Reynolds to whom I wish to record my thanks.

The progress of a case of scarlet fever is often interrupted by complications, and these occur more often after septic attacks. The aetiology, prognosis and treatment of the complications still calls for further investigation. Bauer (1936) in fact, reviewing scarlet fever, considered that a more complete and intimate knowledge of the clinical aspects of the disease was required and that the treatment of the complications required further study.

Here it is proposed to consider particularly the complications affecting the urinary system. The chief among these complications is glomerulo-nephritis.

Nephritis is one of the most frequent and serious complications of scarlet fever. Its frequency varies in different epidemics and in different countries, this complication being apparently commoner in Germnay, Denmark, Norway and Russia than in Great Britain and France. (Rolleston 1929). In this country the incidence of nephritis is at present about 1.5%. (Archibald 1938).

There are cases in which, although no frank nephritis develops, symptoms and signs may point to some involvement of the urinary system. In this connection Fishberg (1934) stated that the tendency to renal implication following scarlet fever was very general, although it was frank in only a decided minority. This was corroborated by Bayart and Elaut (1935), who, after studying the renal function in scarlet fever, came to the conclusion that the great majority of, if not all, cases of

scarlet fever about the third week of illness have a functional renal disturbance of varying intensity. Gram (1936) agreed with the last authors in considering that the majority of scarlatinal patients have a latent nephritis. He also found a degree of renal hyperfunction during the first week of illness in patients with an infectious disease and thought that nephritis was liable to develop in scarlet fever cases not showing this initial hyperfunction.

Albuminuria occurring after the subsidence of the initial toxaemia has given rise to much speculation regarding its relationship to a true nephritis. In this connection Saville (1933) in his book on Clinical Medicine states that: "In scarlet fever albuminuria frequently comes on between the 16th and 26th days, at which time also acute nephritis may supervene. To avoid this risk scarlet fever patients should be kept in bed a month, and the urine kept alkaline". This same doubt as to the true significance of albuminuria has been expressed by Goodall and Washbourn (1928) who consider that albuminuria for a few days at any time from the end of the second week to the fifth week should excite suspicion of nephritis and who state, as a personal opinion, that these cases are actually cases of mild nephritis.

A rise in the blood pressure is often found in cases of nephritis along with the haematuria and albuminuria. The blood pressure curve has therefore come in for attention in the study

of the renal complications of scarlet fever and Fishberg (1934) considered that further investigation to decide the time relation of albuminuria and hypertension in post-scarlatinal glomerulo-nephritis would be highly desirable. An important statement was made by Kylin (1926) who was of the opinion that the blood pressure was raised for three to four days before the onset of post-scarlatinal nephritis. This statement was partly borne out by the work of Bayart (1933) who found that in a number of scarlet fever cases there was a rise in blood pressure during the third week. In 80% of these cases high blood pressure was the only sign. In the other 20%, however, the blood pressure was raised contemporary with or preceding by one to ten days the appearance of albuminuria, haematuria and urinary casts. From this he considered that the finding of albuminuria was not a sufficient criterion to affirm or negative the existence of renal disease.

From the foregoing it can be seen that the importance and significance of the complications of the urinary system in scarlet fever are not fully understood. It also appears that there are many cases, which although never showing the true clinical picture of nephritis, have yet suffered renal damage.

DETAILS of MATERIAL and PLAN of INVESTIGATION.

The material was drawn from cases admitted to Belvidere Isolation Hospital from June 1936 to September 1937 in which a diagnosis of scarlet fever was made. In each case this diagnosis was confirmed by two medical officers.

A history of all previous illnesses was taken and the symptoms of the patient prior to admission ascertained.

A general examination of the systems was made in each case and particular examination was made of the rash, ear, nose, throat, tongue and for glandular enlargement. The severity of illness on admission was assessed under the four following headings: mild, moderate, acute and severe. This classification is of necessity a personal one and was arrived at during the examination of the patient on admission. It is in reality a measure of the toxaemia.

Regular examinations were made and recorded during the patients' stay in hospital.

All cases received the same nursing and the same routine diet, except where the diet was modified as stated later.

Each case was under special investigation for a period of time during which the following examinations were carried out.

1. A blood pressure reading was taken daily about mid-day with the patient in the recumbent position. The same sphygmomanometer was always employed.

2. The following urinary investigations were made in each case.

   a. reading of specific gravity.

   b. qualitative estimation of albumen.

   c. qualitative estimation of chlorides.

   d. qualitative estimation of blood.

   e. percentage estimation of urea.

   f. microscopical examination of the sediment.

3. Separate records of the volume of the output of day and night urine were kept.

4. A Dick test was carried out during the third week of illness.

At this point it has been decided to explain the scheme under which these cases have been studied in order to minimise repetition.

The number of cases examined was 207.

These cases have been divided into four groups depending on the course of the illness. These groups are as follows:-

1. Here we have those cases which developed a true clinical post-scarlatinal glomerulo-nephritis confirmed by the appearance of red blood corpuscles and casts in the urine.

   Number of cases 19.

2. Consists of the cases which clinically aroused the suspicion of nephritis although haematuria and casts were never found in the urine.

   Number of cases 8.

3. Consists of the cases which developed late complications apart from nephritis.

   Number of cases 67.

4. Consists of those cases which were either without complications or with one or more of the early complications (rhinitis, adenitis occurring in the first week or albuminuria in the first week.)

   Number of cases 113.

The cases are also divided intwo two series depending on the manner of their investigation. The two series are as follows:-

1. The cases in this series were all selected as well marked cases of scarlet fever, no mild or atypical cases being included. In these cases the night and day urine was collected separately: the night urine from 6 p.m. till 6 a.m. and the day urine from 6 a.m. till 6 p.m. and both specimens were subjected to the tests already detailed. In these cases this special investigation was carried out from admission until the day on which the patient was allowed up.

Number of cases 63.

2. The cases in this series comprised all cases of scarlet fever admitted to the hospital from March 1937 to June 1937 while this series was being investigated. The cases were examined for four to five days in the third week of illness. In these cases although the night and day urine was collected separately only the combined twenty-four hour specimen was subjected to the various tests.

Number of cases 144.

The 207 cases may thus be tabulated as follows:-

TABLE I.

	GROUPS	NO. OF CASES
SERIES I.	1	12
	2	8
	3	22
	4	21
SERIES II.	1	7
	2	0
	3	45
	4	92

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It was found to be impossible to have any rigid dieting or any accurate measure of the fluid intake, as the patients were in the majority children. Two routine diets were however used and are given in details in the appendix.

1. A routine diet for all patients except as under 2.
2. A diet which was administered to cases of nephritis and the eight cases in group 2 of suspected nephritis.

Blood pressure readings were found to be remarkably stable as even the youngest children soon became accustomed to the manipulation and apparently enjoyed it. The first three readings were always discarded and a variation of 10 mm. above and below the normal for the child's age was allowed. Nizzoli's figures for the blood pressure in children were taken as standards of normal readings (see appendix). In adults figures between 100 mm. and 130 mm. of mercury were taken as being the normal range of the systolic blood pressure.

The diastolic pressure was found to correspond fairly closely with the systolic pressure, but it did not appear to be so reliable. When blood pressure is referred to, it is therefore the systolic blood pressure reading only that is meant.

THE UREA FIGURE.

On examining the figures of the specific gravity estimation and the urea percentage found in the urine in the various cases, it was considered that there was some relationship between the specific gravity figure and the percentage of urea figure in a specimen of urine.

Normally the specific gravity of urine varies with changes in the amount of urea in the urine as a large percentage of the total dissolved solids of the urine is in the form of urea. It was considered that if some equation could be found to express this relationship, it might be of value in assessing the composition of the urine.

The following equation has been suggested and has been used in comparing the results of the cases.

Percentage urea in the urine figure multiplied by 10 minus the last two figures of the specific gravity estimation of the same specimen.

e.g. The figure thus arrived at has been called the Urea Figure of the specimen of urine.

e.g. If in a specimen of urine the specific gravity is 1020 and the percentage of urea 2.0%, the urea figure is found as follows:-

2.0 X 10 - 20 = 0.

This urea figure depends upon the percentage of the urea in the dissolved solids in the urine. This arbitrary figure was found to be normally about zero. A figure below minus 5 was considered as being below the normal limit.

As it was considered that a diet deficient in protein, like a nephritic diet, might influence the urea figure, it was decided to administer to a number of cases a protein poor diet (see apprendix).

The results of the tests obtained in the twelve cases on the above diet were as follows:-

Blood Pressure.

The systolic blood pressure was within normal limits in 10 cases, while a rise was noted in two cases.

Urea Figure.

The urea figure remained within normal limits in 12 cases. Chloride Estimation in the Urine.

The urinary chlorides were within normal limits in 11 cases while the chloride content of the urine was diminished in 1 case.

Volume Ratio.

The volume ratio was normal in 8 cases and reversed in 4 cases.

The urinary tests did not present any unusual difficulties and a description of the methods employed will be found in the appendix.

When the volume of the night urine was compared to that of the day urine, it was found usually to be less. In some cases however the night urine was equal to the day urine and in others the day urine was less than the night urine. The ratio of the volume of the night to the day urine was therefore determined in all cases.

The Dick tests was performed as described in the appendix and no pseudo-reactions were seen.

An intra-dermal test for oedema (see appendix) was tried in the first thirty cases, but its use was discontinued as it did not appear to be of any value.

R E S U L T S.

PREVIOUS ILLNESSES.

An examination of the records of the cases for previous illness showed that three of the infectious diseases had often occurred, namely measles, whooping-cough and chicken-pox. It was rare to find a history of any other illness having preceded the scarlet fever.

The incidence of the illnesses from which the patients had suffered prior to scarlet fever is given below.

Total number of cases	207	cases.
Measles	160	"
Whooping-cough	113	"
Chicken-pox	64	"
Diphtheria	9	"
Pneumonia	4	"
Scarlatina	3	"
Rheumatic Fever	1	"
Bronchitis	1	"
Hirschsprung's Disease	1	
Anterior Poliomyelitis	1	"

SYMPTOMS PRIOR TO ADMISSION.

The incidence of the various symptoms marking the onset of scarlet fever in the 207 cases was assessed from the records of the cases.

It was found that while a rash and sore-throat occurred in the great majority, the other symptoms were less often experienced.

The symptoms in order of their frequency are shown below.

Rash	in	198	cases.
Sore Throat	"	168	"
Nausea	"	70	"
Headache	"	62	"
Vomiting	"	43	"
Shivering	"	36	"
Constipation	"	20	"
Abdominal pain	"	10	"
Diarrhoea	"	7	"
Adenitis	"	7	"
Delirium	"	3	"
Cough	"	2	"
Convulsions	"	1	"

SIGNS on ADMISSION.

The signs of the specific fever were found on admission to a greater or less extent in the 207 cases.

Injection of the faucial pillars was found in all cases. The punctate erythema characteristic of scarlet fever was well marked in the majority of the cases but was fading in a considerable number and absent in a few. While the tongue was more often peeling, it was at the furred stage in some cases. A cervical adenitis was found in about one third of the cases and tonsilitis in about one fifth, exudate being present in twenty eight cases.

The other signs of the disease appeared only in a relatively small number of cases as can be seen from list given below.

Injected fauces	in 207	cases.
Generalised scarlatiniform rash	in 135	cases
Fading scarlatiniform rash	" 62	"
No rash seen	" 5	"
Desquamation started	" 5	"
Peeling tongue	" 116	cases
Furred tongue	" 69	"
Cervical adenitis	" 66	cases

Tonsilitis	in 41	cases.
Exudate on the tonsils	" 28	"
Rhinitis	in 13	cases
Rales in the chest	" 13	"
Albuminuria	" 7	"
Impetigo	" 4	"
Haemic murmur	" 3	"
Cyanosis	" 2	"
Conjunctivitis	" 2	"
Abscess	" 2	"
Otitis media	" 2	"
Stomatitis	" 2	"
Delirium	" 1	"
Irregularity of the pulse	" 1	"
Blepharitis	" 1	"

AGE.

It is considered advisable to record the age of the patients and they may be conveniently tabulated according to the groups.

TABLE 2.

Age in Years	No. of cases				
	Group I	Group 2	Group 3	Group 4	TOTAL
3	2	-	7	9	18
4	2	-	8	10	20
5	4	2	9	17	32
6	2	3	16	7	28
7	1	1	8	11	21
8	1	-	4	9	14
9	-	-	4	8	12
10	2	-	4	9	15
Over 10	5	2	7	33	47

SEX.

In the total of 207 cases 122 were male and 85 female. In the 19 cases of nephritis ten were male and nine female. The distribution in the other groups was likewise fairly equal.

COLOUR.

A general estimation of the colouring of the patient was made. Patients were grouped as being fair or dark. In general the fair cases had blue eyes though not in all.

The total number of cases in which colouring was noted was 158 of which 65% were dark and 35% fair.

In the cases free from late complications the dark cases constituted 68% and the fair 32%, whereas in the cases with late complications 44% were dark and 56% fair. In this group it is interesting to note that out of a total of five cases with arthritis four were fair. In ten cases with nephritis all were dark.

SEVERITY of ILLNESS on ADMISSION.

The severity of illness assessed under the four headings of mild, moderate, acute and severe as previously explained (see page 5) may be conveniently tabulated as below.

TABLE 3:

Series I.	Mild.	Moderate.	Acute.	Severe.
Group 1	0	1	11	0
2	0	0	8	0
3	0	0	20	2
4	0	1	20	0

Series II				
Group 1	0	1	6	0
2	0	0	0	0
3	4	7	33	1
4	9	23	54	6

INITIAL PYREXIA.

The duration of the initial pyrexia was taken as being from the commencement of the illness until the temperature had been normal for twenty-four hours.

The temperature in the majority of cases was found to have returned to normal within the first week.

The duration of the pyrexia is best shown in the following table.

TABLE 4.

Temperature settled in	No. of Cases in Series I			
	Group I	Group 2	Group 3	Group 4
1st week	7	5	10	14
2nd week	4	1	9	6
3rd week	-	2	1	1
Over 3rd Week	1	-	2	-
			Series II	
1st week	3	-	29	71
2nd week	2	-	11	20
3rd week	1	-	2	1
After 3rd week	1	-	3	-

SERUM.

Concentrated streptococcus antitoxic serum (see appendix) was administered to 94 of the 207 cases.

39 of these cases or 52% developed complications, five of them developing nephritis. The percentage of the total 207 cases, which developed complications was 38%.

Serum rashes developed in fifteen cases out of the 94 cases receiving serum.

The following table shows the day of onset of the rash following the injection of the serum and the number of these cases with abnormal urinary signs.

Note: In this thesis a serum rash is not included among the complications of scarlet fever.

TABLE 5.

Day of Onset	0 - 10	11 - 20	Total
Cases developing nephritis	1	-	1
Cases with albuminuria	2	-	2
Cases free	9	3	12

CLASSIFICATION of COMPLICATIONS.

The early complications were found to be more the rule than the exception and may be considered more as part of the natural history of the disease.

Such early complications were as follows:

RHINITIS.

ADENITIS occurring in the first week of illness.

ALBUMINURIA occurring in the first week of illness. This is considered as being a febrile albuminuria.

The late complications which were found were as follows:

CERVICAL ADENITIS commencing after the first week or becoming more marked after the first week.

OTITIS MEDIA commencing during the period of illness but only diagnosed as such if there was an actual discharge from that ear.

ARTHRITIS commencing during the period of the illness and shown by pain in the joints, usually the wrists or ankles, more marked on movement and lasing more than twenty-four hours.

ENTERITIS. By this is meant the appearance of blood and mucus in the faeces at any time during the course of the illness.

CONJUNCTIVITIS commencing during the period of the illness.

SECONDARY INFECTION. By this is meant either a reinfection with scarlet fever or a cross infection with another infectious disease.

ALBUMINURIA noted in any specimen of urine passed after the first week of illness.

NEPHRITIS. To permit the diagnosis of post-scarlatinal glomerulo-nephritis to be made, the appearance of blood cells and casts in the urine was required.

CARDITIS. No instances of this complication were discovered.

The distribution of the various complications was as follows:

1.	Albuminuria after the first week	35 cases.
2.	Cervical adenitis after the first week	22 cases.
3.	Otitis media	16 cases.
4.	Arthritis	6 cases.
5.	Enteritis	3 cases.
6.	Conjunctivitis	1 case.
7.	Secondary infection	6 cases.
8.	Nephritis	3 cases.

Note: In addition there were thirteen cases specially selected because they had nephritis.

DICK TEST.

This test was carried out in the third week in 183 cases and a positive reaction was found in 14 cases.

The following table shows the distribution of the positive cases in the four groups.

TABLE 6.

Positive Cases	Group I	2	3	4
14	1	-	5	8

OEDEMA TEST.

This test was carried out in thirty cases and four cases gave positive results.

The following table shows the distribution of the positive cases in the four groups.

TABLE 7.

Positive Cases	Group I	2	3	4
4	1	1	1	1

MICROSCOPICAL EXAMINATION.

Microscopical examination for the presence of blood in the urine was found to be more delicate than the guaic test.

Microscopical examination of the urinary sediment in the nineteen cases of nephritis showed blood cells both erythrocytes and white cells and numerous casts, granular, blood, epithelial and hyaline.

Examination of the urinary sediment in the other 188 cases showed either amorphous or crystalline deposits and on occasions a few pus cells.

SERIES 1. 63 Cases.

Blood Pressure.

Group 1. 12 cases.

The systolic blood pressure remained within the normal limits in 4 cases. A rise above the normal limits for the systolic blood pressure was found in the other 8 cases.

Group 2. 8 Cases.

The systolic blood pressure remained within the normal limits in 4 cases. A rise above the normal limits was found in the other 4 casesoccurring in the 4th, 5th, 7th or 8th weeks.

Group 3. 22 Cases.

The systolic blood pressure remained within the normal limits in 18 cases. A rise above the normal limits was found in the other 4 cases. In two cases the rise was in the second and third weeks, in one case in the second week only and in the fourth case in the third week only.

Group 4. 21 Cases.

The systolic blood pressure remained within the normal limits in 15 cases. A rise above the normal limits was found in the other 6 cases. In four cases this rise in pressure was in the second week and in two the rise was in the second and third weeks.

SERIES 11.

Blood pressure.

Group 1. 7 Cases.

The systolic blood pressure remained within the normal limits in 3 cases. A rise above the normal limits for the systolic blood pressure was found in the other 4 cases.

Group 3. 45 Cases.

The systolic blood pressure remained within the normal limits in 32 cases. A rise above the normal limits was found in the other 13 cases.

Group 4. 92 cases.

The systolic blood pressure remained within the normal limits in 75 cases. A rise above the normal limits was found in the other 17 cases.

Note: The blood pressure readings in the above cases were taken in the third week.

SERIES 1.

Urea Figure.

Group 1. 12 cases (one case gave no results).

The urea figure remained within normal limits in 1 case. The figure fell below the normal limit in 10 cases.

Group 2. 8 cases.

The urea figure remained within normal limits in 1 case. The figure fell below the normal limit in 7 cases.

Group 3. 22 cases.

The urea figure remained within normal limits in 7 cases. The figure fell below the normal limit in 15 cases. In these 15 cases the low figures were given in the following weeks: One case in the first week, five cases in second week, one case in the third week, one case in the first and second weeks, one case in the first and third weeks, four cases in the second and third weeks and two cases in the first, second and third weeks.

Group 4. 21 cases.

The urea figure remained within normal limits in 12 cases. The figure fell below the normal limit in 9 cases. In these nine cases the low figures were given in the following weeks: Four cases in the second week, three cases in the second and third weeks and two cases in the third week only.

SERIES 11.

Urea Figure.

Group 1. 7 Cases.

The urea figure remained within normal limits in 4 cases. The figure fell below the normal limit in 3 cases.

Group 3. 45 Cases.

The urea figure remained within normal limits in 44 cases. The figure fell below the normal limit in 1 case.

Group 4. 92 Cases.

The urea figure remained within normal limits in 89 cases. The figure fell below the normal limit in 3 cases.

Note: The urea figure readings in the above cases were taken in the third week.

SERIES 1.

Chloride Estimation in the Urine.

Group 1. 12 cases.

The urinary chlorides were within normal limits in 4 cases. The chloride content of the urine was diminished in 8 cases, all being on a nephritic diet.

Group 2. 8 cases.

The urinary chlorides were within normal limits in 4 cases. In two cases the chloride content of the urine was diminished during the initial pyrexia. In three cases the chloride content of the urine was diminished while the patient was on a nephritic diet.

Group 3. 22 cases.

The urinary chlorides were within normal limits in 14 cases. The chloride content of the urine was diminished during the initial pyrexia in 9 cases.

Group 4. 21 cases.

The urinary chlorides were within normal limits in 13 cases. The chloride content of the urine was diminished during the initial pyrexia in 8 cases.

SERIES 11.

Chloride Estimation in the Urine.

Group 1. 7 Cases.

The urinary chlorides were within normal limits in 2 cases. The chloride content of the urine was diminished in 5 cases, all being on a nephritic diet.

Group 3. 45 cases.

The urinary chlorides were within normal limits in 43 cases. The chloride content of the urine was diminished in two cases.

Group 4. 92 Cases.

The urinary chlorides were within normal limits in 92 cases.

Note: The chloride estimation in the above cases were taken in the third week.

SERIES 1.

Volume ratio.

Group 1. 12 cases.

The volume ratio was normal in 10 cases and reversed in 2 cases.

Group 2. 8 cases

The volume ratio was normal in 5 cases and reversed in 3 cases.

Group 3. 22 cases.

The volume ratio was normal in 17 cases and reversed in 3 cases. In two cases the readings of the volume were not sufficiently accurate.

Group 4. 21 cases.

The volume ratio was normal in 21 cases.

SERIES 11.

Volume Ratio.

Group 1. 7 cases.

The volume ratio was normal in 4 cases and reversed in 3 cases.

Group 3. 45 cases.

The volume ratio was normal in 43 cases and reversed in 2 cases.

Group 4. 92 cases.

The volume ratio was normal in 67 cases and reversed in 25 cases.

DISCUSSION.

It is seen that the majority of the patients gave a history of a previous attack of measles. Whooping-cough and chicken-pox are also found fairly frequently in the histories taken from the patients. The frequency of these infectious diseases must be expected as the cases were drawn from an industrial area.

The symptoms of the patients prior to admission in the main consisted of a rash, sore-throat, nausea and headache. Other symptoms of the illness occurred though much less frequently.

The examination on admission showed the characteristic generalised punctate erythema of scarlet fever in nearly all the cases but in many it was commencing to fade. The tongue was more often at the stage of peeling than furred and one wonders if the patients might not with advantage have been admitted earlier to hospital. The fauces showed some degree of injection in all cases and many in addition had tonsilitis with or without exudate. The cervical glands were noticeably enlarged in about one third of the cases while the other signs of the illness were found in a much smaller number of cases.

The average case in this series therefore had the following symptoms and signs:

The patient on admission was seen to have a generalised

punctate erythema and complained of a sore throat, nausea and headache. Examination of the patient showed an injected fauces with a furred or peeling tongue and possibly enlarged cervical glands.

The two cases with cyanosis might be classed as being cases of toxic scarlet fever.

Approximately half of the cases were under seven years of age and the ratio of male to female was as 1.4 - 1.

It is interesting to see that the fair patients were more liable to develop the complications than the dark. Further it is worthy of note that from a total of five cases of arthritis four occurred in fair patients. In contrast to this, nephritis developed in dark patients. The numbers are too small, however to allow any conclusions to be drawn.

The majority of the cases are seen to have been acutely ill on admission and it should be noted that the cases in series 1. were more severely ill than those in series 11. Two of the patients developing nephritis were moderately ill on admission the remainder being acutely ill contrary to the generally accepted opinion.

The table of the duration of the initial pyrexia shows that in the majority the temperature was settled within the first week of illness but that it remained elevated for a longer period in the cases with late complications.

An urticarial rash developed in fifteen of the cases some days after the injection of the serum. This is considered to

be due to a hypersensitiveness of the patient to the serum administered. The cases showing this hypersensitive state did not appear, however, to be especially liable to develop nephritis.

The administration of serum while it was found to make the patient more comfortable, did not prevent the onset of complications which occurred in 52% of the cases.

The incidence of complications developing in this series of cases is interesting as albuminuria is shown to be the commonest, a secondary cervical adenitis occurring less frequently. The percentage of cases developing complications was 38%.

The Dick test was positive in fourteen of the cases and one of these cases developed nephritis. This is of interest as it was considered that a positive Dick test in the third week, presumably indicating deficient antibody formation, might have some bearing on the development of nephritis. It would appear, however, that a positive Dick test in the third week does not indicate any special liability of nephritis developing.

The oedema test was positive in four cases and in only one did nephritis develop. This test to give satisfactory results would have to be repeated frequently in each case.

Microscopical examination of the urinary sediment showed blood cells and casts in the nephritic cases and amorphous or crystalline deposits in the non-nephritic.

The guaiac test was found to be hardly sensitive enough as

blood cells were found in the urine on some occasions before the guaiac test became positive. Again microscopical examination for blood always remained positive for some time after negative guaiac tests were obtained.

By combining the two series of cases it is seen that out of a total of nineteen cases of nephritis twelve had a raised systolic blood pressure i.e. 63.2%. In the group of cases which aroused the suspicion of nephritis (group 2), a rise in the systolic pressure is seen in four cases or 50%.

Combining groups 3 and 4 gives one hundred and eighty cases apparently free from nephritis. In these one hundred and eighty cases the systolic blood pressure was raised in the third week in 35 cases or 19.4%. Taking separately the forty three cases examined throughout the first, second and third weeks of illness (series 1), it is seen that five cases had a rise of the systolic blood pressure in the third week or 11.7% and a further five cases had a raised pressure in the first or second week.

It appears, therefore, that a rise in the systolic blood pressure is a common feature in cases of nephritis. Further, a case of scarlet fever may have a rise in systolic blood pressure at any time in the first three weeks and the percentage of cases showing a raised pressure during the critical period when nephritis most commonly develops is only 19.4%

Turning now to the urea figure and comparing the results in the same manner one sees the following:

In the group of nephritic cases the urea figure was not found in one case leaving a total of eighteen cases. Thirteen of these cases showed a low urea figure or 72.2%. In the group of cases which aroused the suspicion of nephritis a low urea figure was found in seven cases or 87.5%.

In the total of one hundred and eighty non-nephritic cases a low urea figure is seen to have occurred in seventeen or 9.4%. Taking separately the cases in series 1 (43 cases examined in the first, second and third weeks of illness) a low urea figure is seen to have occurred in the third week in thirteen or 30.2% and in the first or second week in eleven or 25.6%.

Here it should be noted that the cases in series 1 were more severely ill than those in series 11.

It appears, therefore, that a low urea figure is a common feature in cases of nephritis. It should be noted however that a moderate percentage of the cases not clinically nephritis showed a low urea figure.

The results of the chloride estimation of the urine when compared in the same manner show the following:

The cases in groups 1 and 2 were all on a nephritic diet and in a total of twenty seven cases the chloride content is seen to have been diminished in sixteen or 59.3%.

The cases in groups 3 and 4 which were all on the routine diet showed a diminution in the chloride content in two cases or 1.1%. Taking separately the forty three cases examined during the early stages of the illness (series 1) there was a diminution in the chloride content of the urine during the initial purexia in seventeen or 39.5%.

It appears, therefore, that the chloride content of the urine is frequently diminished when the patient is on the nephritic diet given in this series (see appendix). Further it is seen that a diminution in the chloride content is a frequent sign in the urine of scarlet fever patients during the initial pyrexia. Two further patients had a diminution in the chloride content of the urine in the third week and in both cases the temperature was elevated when the diminution occurred.

The results of the cases when compared in a similar manner with regard to the volume ratio show the following:

Five cases of nephritis had a reversal of the volume ratio which gives a percentage of 26.8%. In the group of cases which aroused the suspicion of nephritis the volume ratio was reversed in three or 37.5%.

In the groups 3 and 4 the volume was not obtained in two cases leaving a total of one hundred and seventy eight cases and in thirty of this number the volume was reversed i.e. a percentage of 16.8%.

It is seen that, while a reversal of the ratio of the volume of the output of the night urine to the day urine occurred more frequently in the cases of nephritis than in the non-nephritic, the distinction is not very marked. It is suggested that this reversal of the normal ratio is due to some loss of the concentrating power of the kidney.

INTRODUCTION to NEPHRITIS.

Acute Glomerulo-Nephritis in Scarlet Fever.

Nephritis in scarlet fever is normally diagnosed by the appearance of haematuria accompanied by casts in the urine. In addition there is often oedema and oliguria (Price, 1937).

It is very significant that the severity of the primary illness bears little relation to the incidence of nephritis and that the onset is usually delayed till the end of the third week. Nephritis, when it arises as a complication of an acute infection, such as scarlet fever, appears not at the height of infection but as a sequela at a stage when the fever has subsided and convalescence is thought to have begun.

Scarlet fever is the only acute specific fever which, in an uncomplicated form, contributes materially to the incidence of chronic glomerulo-nephritis. (Hadfield and Garrod 1938).

ETIOLOGY.

The etiology of post-scarlatinal nephritis has given rise to much speculation but the explanation which finds most favour at present is that it is related in some way to a hypersensitive state developed during the acquisition of immunity. (Hadfield and Garrod, 1938).

It is of interest to consider some of the experiments which have led up to this view. It was shown by Takenomata (1923-25) that in rabbits immunised against streptococci, but not in those not immunised, glomerulo-nephritis could be produced by the intravenous injection of streptococcus toxin. Then a true glomerulo-nephritis in animals was produced by Masugi (1935) by injecting horse serum into the renal artery in previously sensitised animals. A focal nephritis was caused in non-sensitised animals.

A further interesting observation was made by Friedmann and Deicher (1928) that in cases of scarlet fever complicated by nephritis there is a much more rapid development of bactericidal antibody in the blood. They suggest that this leads to the liberation of an excessive amount of streptococcus endotoxim.

Finally reference may be made to the observation of Veil and Buchholz (1932) who finding the blood complement greatly diminished in acute nephritis argue from the fact, that such a diminution follows an injection of antigen in a sensitised animal, that nephritis is an allergic disease.

PATHOLOGY in acute glomerulo-nephritis.

The work of Lohlein in 1907 established the primary importance of the initial acute inflammatory reaction in the glomerular capillaries and this was confirmed later by Dunn and McNee (1917).

One must visualise the kidney as composed of a number of structural units, each including a vulnerable vascular component the capillary tuft susceptible to damage by toxins of large molecular dimensions which it cannot excrete, and a tubule, which depends for its blood supply on the integrity of its glomerular capillaries.

The typical glomerulus in the acute stage is enlarged, highly cellular, and often almost bloodless owing to swelling and proliferation of the capillary endothelium. Through some the circulation of blood is severely impeded by this process, through others it is completely obstructed, Hadfield and Garrod (1938).

The more severely affected glomeruli progress through the stages of capsular proliferation and post-inflammatory fibrosis to obliteration. On the proportion of the glomeruli so destroyed depends the outcome and duration of the disease, and this process lies at the root of the very large majority of cases of glomerular nephritis ending in renal failure.

Tubular changes do not occur in the first few days of the disease. As the tubule depends on the circulation through the corresponding glomerulus, glomerular destruction must therefore inevitably lead to secondary degeneration and atrophy of the epithelium of the tubule which carries off its filtrate.

This nephritis is a disease from which a few patients, usually children, die in the acute stage, but from which the great majority recover. There remains a proportion of cases in which the disease passes on into a chronic stage. There is also a tendency for the disease to remain latent for long periods.

Onset of Nephritis.

Nephritis commonly develops when the patient has recovered from the initial toxaemia and is convalescent. The complication is ushered in by various symptoms and signs. In the nineteen cases of nephritis in group 1. elevation of temperature accompanied by albuminuria and cervical adenitis with in some cases oedema, was found. These signs were followed by the appearance of haematuria and casts in the urine.

The symptoms and signs found ushering in nephritis in the nineteen cases are now given.

Elevation of temperature	in	15	cases.
Albuminuria	"	12	"
Secondary cervical adenitis	"	10	"
Oedema	"	6	"
Epistaxis	"	2	"
Otitis media	"	2	"
Headache	"	1	"
Tonsilitis	"	1	"

It is seen that the commonest pre-nephritic signs or signs ushering in nephritis were:-

1. Elevation of temperature.
2. Albuminuria.
3. Secondary cervical adenitis.
4. Oedema.

From a consideration of the results it was thought that apart from haematuria three tests were of value in the diagnosis of nephritis. These tests are the following:-

1. Blood pressure.
2. Urea figure.
3. Volume ratio.

The combined series (1 and 11) are now considered for evidence of urinary complications.

The cases are taken by the four groups and the pre-nephritic signs and the nephritic tests enumerated above are considered. The chloride content of the urine is included.

GROUP 1. Cases of Post-scarlatinal Nephritis.

In all 19 cases. One case not fully examined. This group may be divided into three sub-groups.

A. Examination carried out from the day of onset of nephritis or not more than two days later.

B. Examination carried out more than two days after the onset of nephritis.

C. Examination commenced before the onset of nephritis.

Tables are now given of these three sub-groups A. B. C. showing the data - Pre-nephritic signs and Nephritic tests.

For the cases in Series II roman numerals are used.

Sub-group A.

TABLE 8.

	Pre-nephritic Signs				Nephritic Tests.			
Case No.	Elev.	Alb.	Aden.	Oed.	Bl.Pr.	Ur.Fig.	Chl.	Vol.Rat
12	+	-	+	-	+	+	+	-
13	+	-	+	+	+	+	-	-
22	+	-	+	+	+	+	+	-
33	+	+	+	+	+	+	+	+
35	+	+	-	-	-	+	+	-
36	+	+	+	-	+	+	-	+
51	-	+	-	-	-	+	-	-
XX	+	+	+	-	-	-	-	+
XXI	+	+	+	-	-	-	+	-
XXVII	+	+	-	+	+	+	+	+
LXXXIV	-	+	-	-	-	+	-	+
CXVIII	-	+	-	-	-	-	+	-
CXLII	+	-	-	-	+	-	+	-
CXLIV	+	+	-	-	-	-	-	-

Sub-group A. This group comprises fourteen cases, in which the systolic blood pressure, urea figure, chloride content of the urine and volume ratio are considered after the onset of nephritis.

From the table it is seen that the systolic pressure was raised in only seven cases out of fourteen. Of the seven cases without raised pressure two had a rise in pressure before the clinical diagnosis of nephritis (LXXXIV and CXLIV see sub-group C.) but not after, which leaves five cases without any rise in pressure. In two of these the blood pressure readings were taken from two days after the onset; in one case from one day after the onset; in one case from the day of onset and in the last from before the onset. Two of the five cases were of acute nephritis, two were of moderate and one was a mild case of nephritis.

From the table it is seen that the urea figure was low in nine cases out of the fourteen. In the five cases with normal readings one had a low urea before the onset of nephritis (XXI) and one had no readings taken after the onset of nephritis. Considering the other three cases it is seen that two had readings from the day of onset and one had readings commencing before the onset of nephritis. One of the three cases was of acute nephritis and the other two were moderate cases.

The chloride content is seen to be diminished in

eight cases out of the total fourteen. In two of the six cases with a normal chloride content the figure was diminished before the onset of nephritis (36 and CXLIV).

The volume ratio was reversed only in five cases but in one of the nine normal cases (CXLIV) it was reversed before the onset of nephritis.

Sub-group B.

TABLE 9.

	Pre-nephritic Signs				Nephritic Tests.			
Case No.	Elev.	Alb.	Aden.	Oed.	Bl.Pr.	Ur.Fig.	Chl.	Vol.Rat
8	+	-	+	+	+	+	+	-
9	-	+	-	-	-	+	+	-
55	+	-	+	-	+	-	-	-
56	+	+	-	-	+	+	-	-

Sub-group B. This group comprises four cases. These were all cases selected some time after the development of nephritis.

The systolic blood pressure, urea figure, chloride content of the urine and volume ratio are considered only after the onset of nephritis as diagnosed by haematuria.

From the table it is seen that the systolic pressure is raised in three out of the four cases. The urea figure is low in three out of the four cases also. The chloride content is diminished only in the two cases in which the readings were taken within the first fortnight. In none of the four cases was there an alteration in the ratio of the night and day urine.

Sub-group C.

TABLE 10.

	Pre-nephritic Signs				Nephritic Tests.			
Case No.	Elev.	Alb.	Aden.	Oed.	Bl.Pr.	Ur.Fig.	Chl.	Vol.Rat
36	+	+	+	-	-	-	+	-
XXI	+	+	+	-	-	+	-	-
LXXXIV	-	+	-	-	+	-	-	+
CXLII	+	-	-	-	+	-	-	-
CXLIV	+	+	-	-	+	-	+	+

Sub-group C. This group comprises five cases of which three were selected as the onset of nephritis was suspected.

These cases have been included in sub-group A. and here are considered only the systolic blood pressure, urea figure, chloride content of the urine and volume ratio before the onset of nephritis as diagnosed by haematuria.

From the table it is seen that the systolic pressure was raised in three out of the five cases. Of the two cases without raised pressure one was of moderate nephritis and the other case was mild.

From the table it is seen that the urea figure was low in only one case. This was the case of mild nephritis.

From the table it is seen that the chloride content was diminished in only two out of the five cases and that likewise the volume ratio was reversed in two of the cases.

The cases will now be examined for the duration of the various signs.

The onset of nephritis is taken as being the day when blood was first found in the urine by routine examination.

BLOOD PRESSURE.

Not raised in 7 cases.

Raised before only in 2 "

Day on which pressure returned to within normal limits counting from the day of onset of nephritis 4th, 5th, 6th, 10th, 14th, 29th.

Cases with pressure not yet returned to within normal limits on 2nd, 25th, 38th, 48th.

UREA FIGURE.

Not low in 5 cases.

Low before only in 1 case.

Day on which figure returned to normal after onset of nephritis 4th, 6th, 9th, 10th, 12th, 15th, 38th, 44th.

Cases with urea still low on 2nd, 15th, 25th, 40th.

CHLORIDES.

Normal in 7 cases.

Diminished before only in 2 cases.

Day on which returned to normal after onset of nephritis 3rd, 5th, 8th in three cases, 15th in two cases 17th.

Cases with chlorides still diminished on 3rd and 33rd.

VOLUME.

Normal in 12 cases.

Reversed ratio before only in 1 case.

Day on which ratio returned to normal after onset of nephritis 4th, 6th, 15th.

Cases with volume ratio still reversed on 2nd, 7th.

DISCUSSION.

In all the nineteen cases of nephritis microscopical examination of the urinary sediment showed blood cells and casts, granular, epithelial and blood.

The cases examined after the onset of nephritis show that, while the four nephritic tests are commonly positive, none of them are invariably present, even although the case is one of acute nephritis.

The cases examined before the onset of nephritis demonstrate that, while the blood pressure is raised in some cases, the urea figure is only low in one out of the five before nephritis develops.

Three of the cases showed positive results to all the four nephritic tests while one had a raised systolic blood pressure, low urea figure and reversed volume ratio. Seven cases in all had a raised systolic blood pressure with a low urea figure.

The duration of the rise in the systolic blood pressure varied in the different cases, in some it persisted for many weeks. A low urea figure was also found for a variable period up to many weeks in duration. The chloride content of the urine in the cases might be diminished for some time but tended to return to normal sooner than the blood pressure or the urea figure. A reversal of the volume ratio was also seen to remain for several days.

It would appear that in nephritis, while one may expect to find a raised systolic blood pressure, a low urea figure and a reversal of the volume ratio, the absence of one or more of these signs does not rule out a diagnosis of nephritis. The pre-nephritic signs also appear before the onset of nephritis in only a proportion of the cases.

It is considered that while the finding of blood cells and casts in the urine is the only specific sign for the diagnosis of nephritis, the three other tests should be performed and considered together, more value being attached to a rise in the systolic blood pressure and a low urea figure than to a reversal of the volume ratio. A diminution of the chloride content of the urine is considered to be of no value in the diagnosis of nephritis.

SUMMARY.

Four signs are found to commonly usher in post-scarlatinal glomerulo-nephritis namely elevation of temperature, albuminuria, secondary cervical adenitis and oedema.

A rise in the systolic blood pressure frequently occurs at the onset of scarlatinal nephritis and may be detected before the appearance of the other signs.

A low urea figure frequently occurs at the onset of scarlatinal nephritis, but it is unlikely to be found before the appearance of the other signs.

In some cases a reversal of the volume ratio takes place and this may be found before the appearance of other signs of scarlatinal nephritis.

A diminution of the chloride content of the urine may occur but the chloride content returns to normal with the increase in the diet and is thus probably of no prognostic value.

The only specific test for the diagnosis of scarlatinal glomerulo-nephritis is the detection of blood cells and granular, epithelial or blood casts in the urine.

GROUP 2.

Cases clinically arousing suspicion of Nephritis.

In all 8 cases.

These cases are now tabulated like the cases in group 1.

TABLE 11.

	PRE NEPHRITIC SIGNS				NEPHRITIC TESTS.			
Case No.	Elev.	Alb.	Aden.	Oed.	B.Pr.	Ur.Fig.	Chl.	Vol.Bat.
10	+	+	-	-	+	+	+	-
23	-	+	-	-	+	+	-	-
37	+	+	-	-	-	+	+	+
38	+	+	-	+	-	+	+	-
52	+	+	+	-	-	-	-	+
11	+	+	-	-	+	+	-	-
15	-	+	-	-	+	+	-	+
50	+	+	+	-	-	+	-	-

The first two cases came under examination in the first and early part of the second week. The next three cases were brought under special investigation towards the end of the third week, and the remaining three cases after the third week.

Case 10 shows two pre-nephritic signs, but the albuminuria was intermittent in character. This case had a raised systolic blood pressure following a low urea figure but the urea figure was again low after the blood pressure was raised. The chloride content of the urine was diminished. In the second case (23) the urinary symptoms occurred in the second week but the systolic blood pressure was not raised till the third week. The urea figure was intermittently low throughout.

The next three cases all had suspicious pre-nephritic signs occurring at the end of the third week and at the beginning of the fourth. In no case was the systolic blood pressure raised. The urea figure was low at the critical period in the first two cases. In these two cases the chloride content of the urine was diminished. The volume ratio was reversed in the first and third cases.

In the last three cases, examined after the end of the third week, it is seen that two had intermittent albuminuria and raised systolic blood pressure. The raised pressure was

followed by a low urea figure, and in one case the volume ratio was reversed. The last case had three pre-nephritic signs and a low urea figure but no rise in systolic blood pressure.

DISCUSSION.

As none of the cases in this group showed blood in the urine by chemical test or on microscopical examination, no diagnosis of nephritis can be made with certainty without a follow up period of several years.

It is suggested, however, that those cases showing a combination of the pre-nephritic and nephritic signs were cases of mild nephritis.

Four cases had a rise in the systolic blood pressure with a low urea figure and in addition one had a reversal of the volume ratio. As all these cases had albuminuria accompanied in two by an elevation of temperature, it is considered that a diagnosis of mild nephritis is permissable.

Here it is of interest to note that Dunn and Thompson (1921) found out of a total of eight cases, which on post-mortem examination showed an intra-capillary glomerulitis, albuminuria without haematuria in four.

One other case showed a low urea figure accompanied by a reversal of the volume ratio, the pre-nephritic signs being albuminuria and elevation of temperature, and one further showed a low urea figure with the pre-nephritic signs of albuminuria, elevation of temperature and oedema. Both these cases it is suggested should be regarded with suspicion.

Group 3. Cases with late complications.

In all 67 cases.

These cases may be divided into two sub-groups.

A. The cases complicated by albuminuria.

B. The cases without albuminuria.

The cases are shown in the following tables.

Sub-group A.

TABLE 12.

	PRE-NEPHRITIC SIGNS				NEPHRITIS TESTS			
Case No.	Elev.	Alb.	Aden.	Oed.	Bl. Pr. Ur	Fig.	Chl. Vol.	Rat.
7	-	+	-	-	-	-	-	-
40	+	+	-	-	-	-	+	-
54	-	+	-	-	-	-	-	-
58	+	+	-	-	-	-	-	-
65	-	+	-	-	-	-	-	-
XXV111	-	+	-	-	-	-	-	-
XX1X	-	+	-	-	-	-	-	+
XXX1V	-	+	-	-	-	-	-	-
XLV1	-	+	-	-	-	-	-	-
LXXX1X	-	+	-	-	-	-	-	+
XCV111	-	+	-	-	-	-	-	-
CXX	-	+	-	-	-	-	-	-
CXXX1	+	+	-	-	-	-	-	-
CXL111	+	+	-	-	-	-	-	-
57	+	+	+	-	+	-	+	-
CXXV11	+	+	-	-	+	-	+	-
LX1X	+	+	-	-	+	-	-	-
6	+	+	-	-	-	+	-	+
14	-	+	-	-	-	+	-	-
16	-	+	-	-	-	+	+	-
17	-	+	-	-	-	+	-	/
19	-	+	-	-	-	+	+	-
24	-	+	-	-	-	+	-	-
XLV	-	+	-	-	-	+	-	-
28	-	+	-	-	+	+	+	-
32	-	+	-	-	+	+	-	+
39	-	+	+	-	+	+	+	-

Sub-group A.

The first fourteen cases 7 to CXLlll did not have either a raised systolic blood pressure, low urea figure or a reversal of the volume ratio. Cases 40, 58, CXXXl and CXLlll had an elevation of the temperature along with the albumimuria.

Cases 57, CXXVll and LXlX showed a rise in systolic blood pressure and the albuminuria was accompanied by an elevation of temperature, while in 57 there was in addition cervical adenitis and otitis media.

Cases 6 to XLV all had a low urea figure along with the albuminuria. In case 6 the albuminuria was accompanied by an elevation of temperature.

Cases 28, 32 and 39 showed both a rise in systolic blood pressure and a low urea figure accompanying the albuminuria. In the case 28 the urea figure was low for only one day and this was several days before the blood pressure was raised.

Sub-group B.

In this section there are forty cases with late complications but no albuminuria. Eleven of these cases had a rise in systolic blood pressure and in two this was accompanied by an elevation of temperature and cervical adenitis. Six further cases had a low urea figure which was accompanied by an elevation of temperature in two cases.

DISCUSSION.

Here in this group is seen a further series of cases with albuminuria (sub-group A). Three of these cases had a rise in the systolic blood pressure and a low urea figure with in addition in one a reversal of the volume ratio. One of these cases should, however, be disregarded as the urea figure was low for one day only and this occurred some time before the rise in the blood pressure. It is therefore considered that there are two cases of mild nephritis (32 and 39).

One further case had a low urea figure and a reversal of the volume ratio with the pre-nephritic signs of albuminuria and elevation of temperature and should be regarded with suspicion.

The cases in sub-group B. were all free from albuminuria. Some of the cases showed a rise in the systolic blood pressure and others a low urea figure but there was no case with a sufficient combination of pre-nephritic and nephritic signs to suggest nephritis.

Group 4.

Cases with early or no Complications.

In all 113 cases.

Two of these cases had a rise in systolic pressure accompanied by a low urea figure (31 and 21). Twenty one other cases showed a rise in systolic pressure accompanied by a reversal of the volume ratio in three cases (XC, XC11 and XC111). Further ten cases had a low urea figure which in two cases was accompanied by reversal of the volume ratio (11 and X).

DISCUSSION.

In this last group in which there were no late complications and therefore no pre-nephritic signs, two cases are seen to have a rise of the systolic blood pressure accompanied by a low urea figure. It is considered that these two cases should be regarded with suspicion (31 and 21).

Other cases showed a rise in the systolic blood pressure or a low urea figure accompanied by a reversal of the volume ratio but this is not considered to be sufficient evidence to arouse anxiety without the presence of albuminuria.

With regard to the numerous cases with albuminuria occurring in groups 2 and 3 but showing only one of the nephritic signs, it is considered that this is not sufficient evidence to arouse the suspicion of nephritis. The nephritic signs may occur singly in many cases showing none of the pre-nephritic signs. It is suggested that at least two of the nephritic tests must be present to arouse the suspicion of nephritis or if oedema is also present, one nephritic test.

THE UREA FIGURE in SCARLET FEVER.

It was observed that there appeared to be a general fall in the urea figure throughout the first three weeks of the illness and that the figure appeared to be at its lowest at the critical period i.e. at the period when nephritis most commonly occurs: the end of the third week.

A chart of the average urea figure for each day of illness was therefore compiled from the cases in series 1. (67 cases).

A second chart was made of the average urea figure for each day in the series 11. cases (144 cases). The days represented in that chart are necessarily only the 17th to the 21st days.

The cases of nephritis were not excluded from these charts as it would have given a false impression if only typical cases of nephritis were excluded and it would have been impossible to draw a dividing line in the doubtful cases.

A third chart was made with the average urea figures for the cases of nephritis (19 cases). The days in the chart are taken as starting on the day of diagnosis of the nephritis.

Note: It must be remembered that the cases in Series 1. being selected as well marked cases of scarlet fever were rather more severely ill on the average than the cases in series 11. This can be seen in the table showing the severity of illness of the cases on admission (see page 22).

CHART 1. SERIES I. CASES.

This shows that there is a steady fall in the urea figure until the 19th day and that thereafter it rises slightly. The lowest figure reached is minus 2 on the 19th day.

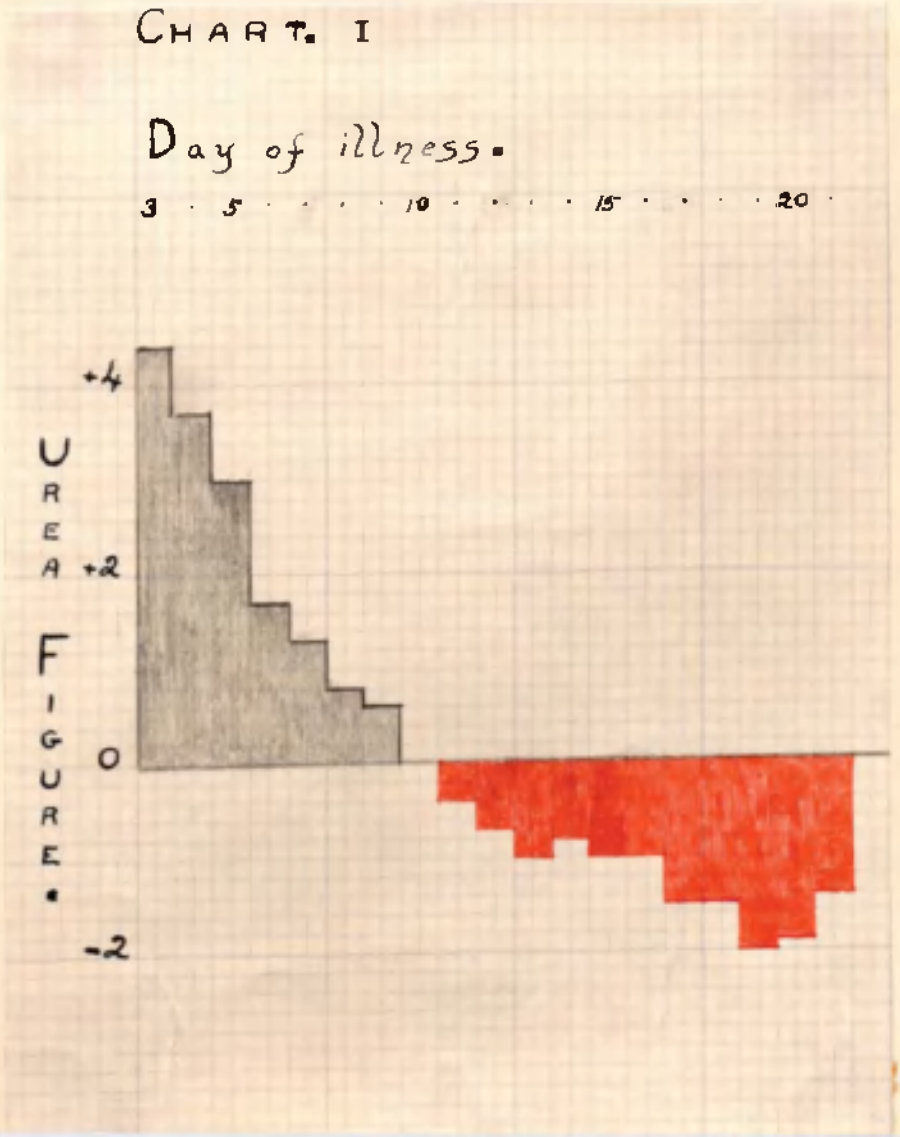


CHART II. SERIES II. CASES.

Here there is a fall from the 17th till the 18th day and then the figure remains almost steady until the 21st day. The lowest figure reached is on the 21st day and is 1.1.

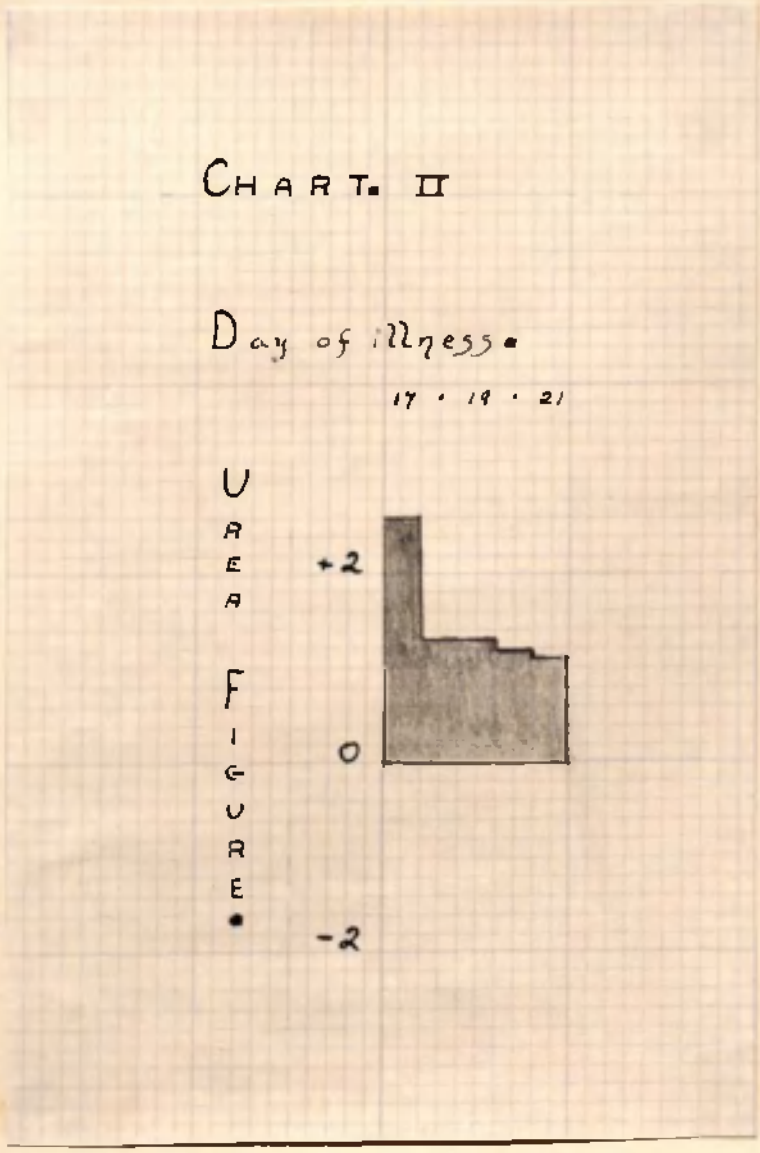
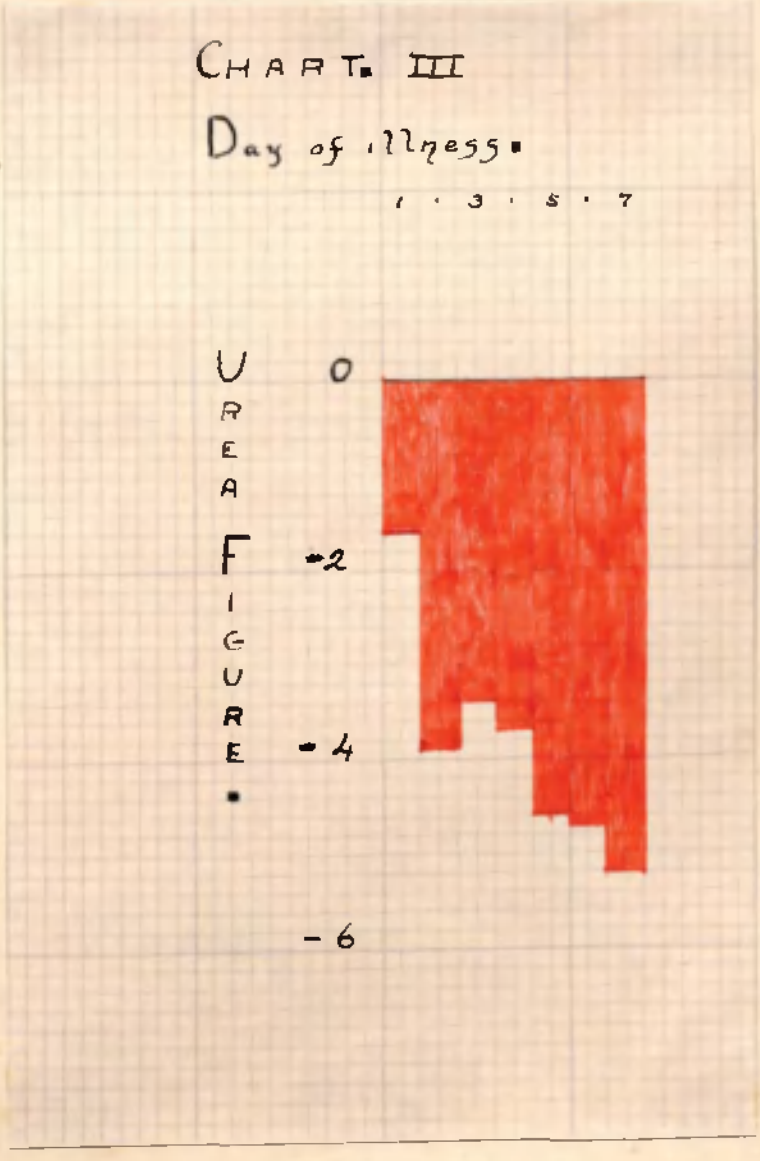


CHART III. NEPHRITIC CASES.

Here the urea figure is much lower than in the other two charts. The lowest figure reached is minus 5.2.



DISCUSSION on the UREA FIGURE.

An interesting point is revealed by the examination of the urea figure. It is found that this figure falls progressively throughout the illness until on the 19th day it reaches the lowest point, possibly tending to rise thereafter.

The urea figure depends on two tests, the determination of the specific gravity of the urine and the percentage of urea in the same specimen of urine.

The specific gravity of water is 1000 while that of urine is normally between 1012 and 1024 (Cole 1919). The difference between the figure for water and that for urine is on account of the dissolved solids in the urine.

The percentage of urea in the urine is the grammes per cent of urea in the urine.

The urea figure is therefore arrived at from a figure derived from the dissolved solids in the urine and a figure derived from the urea in the urine. It is a figure indicating the proportion of the dissolved solids in the urine in the form of urea. A low urea figure signifies that instead of the urea forming approximately 80% of the urinary solids as in the normal (Hutcheson and Rainey 1924), it is forming a much lower percentage and the percentage of some of the other solids must be increased or some other solid introduced. That means that there is either a diminished formation of urea or a diminished excretion of urea with possible the excretion of

another solid in its place.

An increase in the excretion of ammonia in the urine occurs in acidaemia. In the cases in this series there were however no signs or symptoms of acidaemia and no apparent reason why it should occur.

It should be noted here that twelve cases on a diet poor in protein all showed urea figures within the normal limits and that not all cases on a nephritic diet showed low urea figures.

Would a damaged kidney if unable to excrete urea excrete another solid in its place or would the urea which it was unable to excrete be changed and excreted in another form? It is considered that it is more probable that there is a diminished formation of urea and increased excretion of ammonium salts to keep up the elimination of nitrogenous waste products.

With regard to this diminution in the formation of urea, Cole (1919) has shown that on starvation the percentage of urea in the urine falls and that of ammonia and creatinine rises. He further stated that in hepatic disease the percentage of urea also falls, in his opinion, owing to the diminished formation of urea. In hepatic disease also the excretion of ammonia is increased.

That there is some hepatic involvement in scarlet fever is known and attention to this fact has been drawn by

Rolleston (1929) who says that although it is unusual to find any obvious signs of hepatic disturbance a slight involvement of the liver is present in almost every case.

The urea is formed almost exclusively in the liver as far as is known at present. It is therefore quite natural to find that disturbance of liver function gives rise to diminished urea formation. In scarlet fever it is known that there is some hepatic involvement and therefore there is possibly some diminution of urea formation. This would explain the urea figure.

The urea figure is lowest in cases of nephritis and therefore the hepatic disturbance is presumably more marked in these cases. Is it possible that the converse is true and that it is in the cases with the most marked hepatic involvement that nephritis develops?

If the above is true, I would suggest that this gives some explanation of the fact that nephritis is most liable to develop about the end of the third week. It is seen from the urea figure curves that the lowest point is at the end of the third week i.e. the liver function is presumably at its lowest at this time. In some cases it is abnormally low and in these one may expect nephritis to develop.

This diminution of the liver function is not a cause of the nephritis but is a sign which runs parallel with the nephritis and is possibly brought about by the same agent as that which causes the nephritis.

SUMMARY.

The object of this work has been the study of scarlet fever with particular reference to the urinary complications.

The general survey of scarlet fever has brought out some interesting points.

The patients in an industrial area often give a history of a previous infectious disease most commonly measles.

Scarlet fever per se is a mild illness at the present time with mainly only local signs and a toxaemia lasting up to one week but with a fair incidence of complications.

The fair patients appear to be more liable to develop the complications especially arthritis than the dark. This is not seen however in the case of nephritis.

The administration of antitoxic serum did not lessen the incidence of complications and gave rise to a rash in a number of cases. It has been noted (see page) that the theory at present given most credence for the onset of post-scarlatinal glomerulo-nephritis is that it is due to a hypersensitive state developed during the acquisition of immunity. While a serum rash is considered to be due to a hypersensitiveness to the serum injected this state appeared to be specific for the serum as nephritis developed in only one of these cases.

The Dick test was positive in a number of the cases in the third week but reinfection occurred in only one case.

It is seen that the commonest complication in this series was albuminuria occurring at some time after the end of the first week of illness. This occurred in almost 17% of the cases. The number of cases developing a true clinical glomerulo-nephritis was 19 but as some of the cases were selected this does not reveal the true incidence which was 1.4%.

The signs occurring at the onset of the nephritis but before the discovery of haematuria have been given for the nineteen cases of nephritis examined. These signs are of little help in early diagnosis as they may occur in non-nephritic cases and do not occur in all cases of nephritis. The more important of these signs it was found were albuminuria accompanied by an elevation of temperature with oedema and enlarged cervical glands. There are the typical signs seen at the commencement of an attack of acute nephritis and they are followed by the appearance of haematuria with casts in the urinary sediment.

Four further signs were considered, namely the systolic blood pressure, the urea figure, the chloride content of the urine and the volume ratio of the urine.

The systolic blood pressure was found to be more reliable than the diastolic, and as both appeared to be modified in the same way only the systolic was considered in assessing the results.

The systolic pressure was found to be raised in the majority of cases of nephritis and it was also found in some cases to be raised a few days before the onset of nephritis. Therefore it might possibly be considered of importance in the early diagnosis of a case of nephritis. But the pressure was also raised in a number of cases in which there was never any suggestion of nephritis. It has been said by Bayart (1933) that there is a tendency for the pressure to be raised at the critical period i.e. at the end of the third week, but the results show that it is also raised in some cases in the first and second weeks.

A raised systolic blood pressure is therefore an aid to the diagnosis of nephritis and a help in the early diagnosis but too much weight should not be placed upon it and it must be considered along with the other signs.

The urea figure was found to be low in the majority of the cases of post-scarlatinal glomerulo-nephritis but it was also low in some of the cases not developing nephritis. In only one case was the urea figure low before the onset of nephritis. Comparing the urea figure to the systolic blood pressure, it is seen that the urea figure appears to be more reliable than the blood pressure figure as it occurs in more cases of nephritis and in a smaller number of non nephritic cases.

Here we appear to have a further sign of nephritis, which is again not a certain sign in the diagnosis, but an additional sign and must be considered along with the other signs of nephritis.

The estimation of the chloride content of the urine was found to be of no value in the diagnosis of nephritis.

It was found to be often diminished during the initial pyrexia and then later if the patient was put on a nephritic diet. Apart from this it was found to be diminished in two cases with elevation of temperature accompanying late complications.

As a routine test for the diagnosis of nephritis it is therefore useless, depending to such an extent on the chloride intake and other factors.

In some cases the output of night urine was found to be of greater volume than the output of day urine. Normally the night urine is more concentrated and of less volume than the day urine. This disturbance of the normal volume ratio occurred more frequently in nephritic than in non-nephritic cases. It is suggested that this is due to a lack of the concentrating power of the kidney. This sign was not so reliable as the systolic blood pressure; like it however it was seen in some cases before haematuria was noted.

A record of the volume of the output of night urine compared to that of the day urine is therefore an aid to the diagnosis of nephritis but most be considered along with the other signs.

CONCLUSIONS.

207 cases of scarlet fever were examined including nineteen cases of nephritis.

1. Cases of scarlet fever commonly give a history of previous infectious diseases.

2. The commonest symptoms found in scarlet fever are a rash, sore throat, nausea and headache.

3. The commonest signs found in scarlet fever are a punctate erythema, injected fauces and peeling or furred tongue.

4. Fair cases are apparently more liable to develop complications especially arthritis than dark.

5. The initial pyrexia in scarlet fever usually settles within the first week.

6. Antitoxic serum while making the patient more comfortable has no influence on the incidence of complications.

7. A positive Dick test was found in the third week in 14 cases.

8. The guaiac test for blood in the urine was found to be much inferior to microscopic examination of the sediment.

9. The incidence of complications was 38%

10. The incidence of albuminuria was 17%

11. The incidence of nephritis was 1.4%.

12. There is no specific test for the diagnosis of nephritis other than the finding of blood cells and casts in the urine.

13. Albuminuria, elevation of temperature, oedema and enlargement of the cervical glands commonly occur at the onset of nephritis.

14. A rise in the systolic blood pressure is a common sign in post-scarlatinal nephritis but does not always occur and may be found apart from nephritis.

15. A low urea figure is a very common sign in post-scarlatinal nephritis but occasionally it does not occur and it may be present in cases not developing nephritis.

16. The volume of the output of night urine is in some cases greater than the volume of the output of day urine and this occurs more often in the nephritic than in the non-nephritic cases.

17. The chloride content of the urine may be diminished during the initial pyrexia and it is also diminished in cases on a nephritic diet.

18. If one considers together all the symptoms and signs of nephritis, it is suggested that one may diagnose a case of nephritis without the appearance of blood cells or casts in the urine. Six cases were diagnosed as such.

19. The urea figure falls progressively during the illness being lowest towards the end of the third week. This suggests diminished formation of urea by the liver.

20. It is suggested that the liver function is impaired at the end of the third week possibly by the same agent as that causing the nephritis.

APPENDIX.

Diet No. 1.

For the first twenty-four hours the patient was given only fluids, the quantity being at least a pint and a half.

Until the temperature was settled, the patient was kept on fluids including Horlick's food, Benger's food, chicken soup, water, lemon drinks, barley water, orangeade etc. Nourishing drinks were given every three hours.

From the time the temperature settled until the 12th or 14th day, when the patient was allowed to sit up, a light diet was given including eggs, fish and chicken.

After the 12th or 14th day if there were no serious complications, the patient was put on a full diet with meet and potatoes. The patient was also given at this time Parrish's Syrup or Cod Liver Oil emulsion as a tonic.

Diet No. 2.

In the initial stages the diet was fluid not exceeding two pints. It was made up of fruit juice drinks with glucose and a small quantity of milk and weak tea. In moderate cases a thin slice of bread and butter and biscuit or cake might be added.

After the first week, if the patient was improving, the diet was increased by adding the simple farinaceous foods and cooked fruit. The total fluids did not exceed three pints. As the urinary output increased, the diet increased keeping the fat and protein content low.

15 grains of Compound Jalap powder were given initially and then a daily evacuation ensured by the use of salines.

Diet No. 3.

This consisted of a fluid diet made up of fruit juice drinks with glucose and up to half a pint of milk in the twenty-four hours. Nothing else was allowed for the five days during which the patient was under special investigation.

Medicinal Routine Treatment.

All cases were on an alkaline mixture during the fabrile period. It consisted of the following:-

Pot. Cit.		gr. xv
Sod. Bic.		gr. x
Aqua	ad.	3 ii

S. three times a day.

In cases with tonsilitis the following mixture was given:

Tinct. Ferr. Perchlor		m. xx
Glycer.		3 ß.
Aqua	ad.	3 i

s. three times a day in water.

For sleeplessness two preparations were given.

Syrupus Chloralis.

S. 3ß. or 3ī according to age.

Acid. Acetylsal	gr. v
Phenacet.	gr. iii
Codein.	gr. ¼.

S. in adult cases only.

For anaemia during convalescence the following prescription was used:-

Ferr. et Ammon. Cit.		gr. 7½
Tinct. Nuc. Vom.		m. v
Syrup. Aurant.		m. xx
Aqua.	ad.	3 i

S. three times a day.

The Test for Albuminuria.

Heat Test.

A test tube is filled to within two inches of the top, and the upper part of the column of urine is heated in a moderate flame till it boils. Two drops of dilute acetic acid are then added, when any turbidity due to phosphates clears. Turbidity due to protein (albumin and globulin) remains or becomes intensified.

Salicyl-sulphonic Acid Test.

This test is delicate, and if it gives a negative result the absence of protein is certain. It is liable to fallacies when positive, so that positive results should be confirmed. The test is carried out by adding a few drops of 20% aqueous solution of salicyl-sulphonic acid to two inches of urine in a test-tube. The urine should be acidified if necessary with dilute acetic acid before the test is made. Protein gives a turbidity when the reagent is added.

The Test for Chlorides.

The urine is acidified with dilute acetic acid, boiled and filtered to remove the protein. To two inches of the filtrate in a test tube is added 2 to 3 c.c. of nitric acid and a like volume of 10% silver nitrate. The amount of chloride present determines the density of the cloud which forms. When the chloride-content is within normal limits the cloud is a dense white one: when chlorides are reduced, it is less dense and may be imperceptible.

The Chemical Test for Haematuria.

Guaiac Test.

About 5 c.c. of urine are taken in a test tube and to this two drops of tincture of guaiac are added and mixed. Two or three c.c. of ozonic ether are then floated on to the surface. A blue ring at the junction of the fluids indicates the probable presence of blood.

Microscopical Examination of the Urine.

Microscopical examination was carried out on the sediment found after at least three hours standing in a urine glass. A centrifuge was not used.

In nephritic cases blood cells, erythrocytes and white cells, blood casts, epithelial casts, granular casts and hyaline casts were found.

In the other cases microscopic examination gave either amorphous or crystalline deposits and on occasions a few pus cells.

Percentage of Urea in the Urine.

The urea was estimated by MacLean's modification of Gerrard's apparatus.

The following description of the method is given in Finlayson's Clinical Manual (1926).

"The apparatus consists of an ordinary 50 c.c. graduated burette with stop-cock and side branch. The side branch is fitted with a piece of rubber tubing, which is connected to a bottle in which the urine and hypobromite solution are placed. The other end of the burette is attached by rubber tubing to a bell shaped vessel which acts as a reservoir for water in the apparatus (care must be taken that no bubbles of air remain in the rubber tube). A small tube to contain 4 c.c. of urine is also necessary.

To carry out the estimation 25 c.c. of sodium hypobromite solution, freshly prepared, or 23 c.c. of 40% sodium hydroxide solution, and a bulb with 2 c.c. of bromine, are placed in the bottle and the contents mixed. 4 c.c. of urine in the special test tube are then introduced without allowing the two fluids to mix, and the stopper is inserted firmly. The stop-cock is opened and the level of the bell shaped vessel containing the water is adjusted till the water in the burette is at zero level. The tap is closed, the urine and hypobromite solution are then thoroughly mixed, whereupon nitrogen and carbon dioxide are evolved. The latter

is absorbed by the alkaline hypobromite solution, and the former, collecting in the bottle and tube leading to the burette, causes a sinking of the level of the water in the burette. After about half a minute the reservoir of water is altered till the level of water in the burette is the same as that in the bulb.

The number of c.c. of gas in the burette is now read off. Each c.c. of nitrogen equals 0.0625 gramme urea per cent. in the sample of urine examined.

40 c.c. nitrogen = 40 X 0.0625 = 2.5% urea."

Dick Test.

This consists of the intradermal injection of 0.1 c.c. of a 1 in 1000 dilution of toxic broth filtrate in saline solution. Boiled filtrate is used as a control. An erythema at the point of injection, maximal in 24 hours, indicates susceptibility to scarlet fever. (Price 1937).

Intradermal Salt Test for Oedema.

This consists of the intradermal injection of 0.2 c.c. of a 0.8 per cent. solution of sodium chloride. A fine needle is used, and care must be taken that none of the injection gets under the skin. A wheal is formed which persists for at least one hour in normal subjects. Where there is a tendency to oedema the wheal disappears more quickly (e.g. thirty to forty minutes). (Cruickshank 1933).

NIZZOLI'S figures for Blood Pressure in Children.

3 years.	systolic blood pressure	91 mm of mercury.
4 "		100 mm
5 "		104 mm
6 "		97 mm
7 "		100 mm
8 "		106 mm
9 "		110 mm
10 "		116 mm

(Fishberg 1934).

SERUM.

The serum used in the cases in this thesis was:

Concentrated Streptococcus Antitoxin (Scarlatina)

(Burroughs and Welcome).

CASE REPORTS OF TWENTY FIVE CASES OF NEPHRITIS.

Case No. 8.
Name R.D. Age 3 y. Sex - male. Adm. 14.4.36.

Past Illness: None.
Present Illness: The illness commenced with a generalised rash.
On Admission: The case was admitted acutely ill on the 9th day of illness. General examination of the systems revealed nothing abnormal. Local examination gave a peeled tongue, injected fauces with enlarged tonsils and a cervical adenitis.
Progress: 5th day... temperature settled.
22nd " ... a nasal discharge developed.
34th " ... the cervical adenitis more marked.
41st " ... the temperature was elevated and oedema developed. This was followed by haematuria.
47th " ... enteritis developed.
133rd " ... dismissed.

The case was brought under special investigation on the 42nd day of illness.

The Blood Pressure was taken from the 52nd. day and was found to be definitely raised but falling to within normal limits by the 69th day.

On the 42nd day the Urea Figure was low. Difficulty was however found in collecting specimens of urine and a regular record of the urea figure was only obtained from the 58th day. It then tended to remain low until the examination was stopped on the 80th day.

The Volume of the output of night urine tended to be distinctly less than that of the day urine.

The Chloride content of the urine was at first diminished but returned to normal on the 48th day.

Albuminuria was at first marked but gradually became less so and was intermittent after the 60th day. Blood was present to the guaiac test until this time but was becoming progressively less. Microscopical examination revealed casts and blood cells until the 74th day.

The special investigation was stopped on the 80th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 41st day. Blood pressure readings were taken commencing 11 days later, while specimens of urine were collected and specially examined from 1 day after the onset of nephritis.

Case No. 9.
Name P.B. Age 5 y. Sex - female. Adm. 28.4.36.

Past Illness: Measles and whooping-cough.
Present Illness: a rash sore throat and nausea were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fairly bright scarlatiniform rash and enlarged tonsils with exudate.

Progress:
5th day... temperature settled.
15th " ... a cervical adenitis developed.
18th " ... the patient developed pain in the wrist joints.
22nd to 25th day... elevation of temperature.
23rd day... chicken-pox developed.
30th " ... a trace of albumen appeared in the urine.
44th " ... haematuria noted.
54th " ... the urine was free from blood to guaiac test.
81st " ... the patient was dismissed on the request of the parents still with intermittent albuminuria.

The case was brought under special investigation on the 44th day of illness.

The blood Pressure taken from the 56th day was found to remain within normal limits.

The Urea Figure was taken from the 49th day and was intermittently low.

The Volume of the output of night urine was less than the output of day urine.

The Chloride content of the urine was at first diminished but became normal on the 57th day.

Albuminuria was at first marked and became gradually less but was still present on dismissal on the 81st day. Blood was present to the guaiac test from the 44th day till the 54th day becoming progressively less. Microscopical examination revealed casts and blood cells until the 61st day.

The special investigation was stopped on the 81st day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 44th day. Blood pressure readings were taken commencing 12 days later, while specimens of urine were collected and specially examined from 5 days after the onset of nephritis.

Case No. 10.
Name M.B. Age 6 y. Sex - female. Adm. 16/6/36.

Past Illness: Measles and whooping-cough.
Present Illness: a rash, sore throat and sickness noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fading scarlatiniform rash with injected fauces. The tongue was peeling and there was albuminuria.
Progress: 17th day... temperature settled.
10th " ... right ear commenced to discharge.
There was an intermittent albuminuria and the case was dismissed irregularly with albuminuria and a discharging ear.

The case was brought under special investigation on the 8th day of illness.

The Blood Pressure was taken from the 12th day and was raised on the 27th, 29th, 32nd and 34th days.
The Urea Figure taken from the 10th day was low from the 20th till the 22nd day and again on the 27th and 28th day.
The Volume of the output of night urine was less than that of the day urine.
The Chloride content of the urine was diminished on the 9th, 11th, 31st and 32nd days.
There was an intermittent albuminuria throughout the investigation. Microscopical examination was quite normal.

The special investigation was stopped on the 34th day.

Summary.
This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure and a low urea figure.

Case No. 11.
Name L. Age 5 y. Sex - female. Adm. 30/5/36.

Past Illness: whooping-cough.
Present Illness: a rash and shivering were noted before admission.
On Admission: The case was admitted acutely ill on the 2nd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces and enlarged tonsils. The tongue was furred.
Progress: 20th day... temperature settled.
There was intermittent albuminuria from the 34th till the 45th day.
55th day ... patient dismissed.

The case was brought under special investigation on the 34th day of illness.

The Blood Pressure was taken from the 36th day and was raised on the 39th, 40th and 41st days.
The Urea Figure taken from the 34th day was low on the 43rd day.
The Volume of the output of night urine was less than that of the day.
The Chloride content of the urine was normal throughout.
There was a slight albuminuria on the 34th, 36th, 38th, 43rd, 44th and 45th days. Microscopical examination was quite normal.

The special investigation was stopped on the 46th day.

Summary.
This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure and low urea figure.

Case No. 12.
Name B.C. Age 6 y. Sex - female. Adm. 11.6.36

Past illness: measles, pneumonia.
Present illness: a rash, sore throat and shivering were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash and the tongue was furred.

Progress:
3rd day 20 c.c. antitoxic serum administered.
4th " ... temperature settled.
6th " ... elevation of temperature.
12th " ... a serum rash developed.
23rd " ... a cervical adenitis developed and the temperature became elevated.
33rd " ... temperature again settled.
25th " ... haematuria noted.
35th " ... urine clear of blood to guaiac test.
61st " ... urine clear of albumin and patient allowed up.
72nd " ... patient dismissed.

The case was brought under special investigation on the 26th day of illness.

The Blood Pressure was taken from the 26th day and was raised from the 30th till the 33rd day after that remaining within normal limits.

The Urea Figure taken from the 26th day was low between the 32nd and 38th days.

The Volume of the output of night urine was less than that of the day urine.

The Chloride content of the urine was at first diminished but became normal from the 32nd day.

Albuminuria was at first marked and became gradually less so becoming clear on the 61st day when the patient was allowed up. Blood was present to the guaiac test from the 26th day till the 34th day becoming progressively less. Microscopically casts and blood cells were found until the 44th day.

An examination of the blood on the 27th day gave:

R.B.C..... 3,280,000.
W.B.C..... 6,100.
Hb..... 66%

The special investigation was stopped on the 61st day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 25th day. Blood pressure readings were taken commencing 1 day later, while specimens of urine were collected and specially examined from 1 day after the onset of nephritis.

Case No. 13.
Name J.L. Age 5 y. Sex - Female. Adm. 10.6.36.

Past Illness: Measles and whooping-cough.
Present Illness: A rash, sore throat and headache were noted before admission.
On Admission: The case was admitted acutely ill on the 1st day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash and the tongue was lightly coated.

Progress:
4th day ... temperature settled.
21st " ... a cervical adenitis developed and the temperature became elevated.
22nd day ... oedema followed by haematuria noted.
27th " ... temperature again settled.
48th " ... patient allowed up.
62nd " ... patient dismissed.

The case was brought under special investigation on the 22nd day of illness.

The Blood Pressure was taken from the 22nd day and was raised on the 25th day after that remaining within normal limits.

The Urea Figure taken from the 22nd day was low from the 32nd day to the 44th day.

The Volume of the output of the night urine was less than that of the day urine.

The Chloride content of the urine was normal throughout.

Albuminuria was at first moderate and became intermittent from the 32nd day. Blood was present to the guaiac test from the 22nd day till the 28th day becoming progressively less. Microscopically casts and blood cells were found until the 46th day.

The special investigation was stopped on the 61st day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 22nd day. Blood pressure readings were taken from the day of onset, while specimens of urine were collected and specially examined from the day of onset of nephritis.

Case No. 15.
Name M.B. Age 5 y. Sex - Female. Adm. 18.6.36.

Past Illness: measles and whooping-cough.
Present Illness: a rash and sore throat were noted before admission.
On Admission: The case was admitted acutely ill on the 1st day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fading scarlatiniform rash with injected fauces. The tonsils were enlarged and exudate was present. The tongue was peeling.

Progress:
3rd day ... temperature settled.
22nd " ... a nasal discharge developed.
24th " ... reinfection with scarlet fever, albuminuria being present.
32nd day ... temperature settled.
54th " ... 4,000 units antidiphtheritic serum given.
66th " ... 4,000 units antidiphtheritic serum given.
96th " ... patient allowed up.
121st " ... tonsils and adenoids removed.
161st " ... patient dismissed.

The case was brought under special investigation on the 26th day.

The Blood Pressure was taken from the 26th day and was raised on the 32nd day.

The Urea Figure taken from the 27th day was low on the 40th and 50th days.

The Volume of the output of night urine was greater than that of the day urine until the 36th day.

The Chloride content of the urine was normal throughout.

There was an intermittent albuminuria until the 45th day and a trace of albumin on the 51st day. Microscopical examination was quite normal.

The special investigation was stopped on the 52nd day.

Summary.

This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure, low urea figure and reversed volume ratio.

Case No. 22.
Name C.D. Age 3 y. Sex - Female. Adm. 5.8.36.

Past Illness: None.
Present Illness: a rash, shivering and nausea were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash. The fauces were injected and the tongue furred.

Progress:
5th day... temperature settled.
13th " ... slight puffiness noted with elevation of temperature followed by haematuria.
14th day ...a cervical adenitis developed.
34th " ...discharge from right ear.
50th " ...discharge from ear stopped.
66th " ...urine clear of blood to guaiac test.
95th " ...urine clear of albumin.
115th " ...patient allowed up.
122nd " ...patient dismissed.

The case was brought under special investigation on the 14th day of illness.

The Blood Pressure was taken from the 14th day and was raised from the 21st till the 25th day.
The Urea Figure taken from the 15th day was intermittently low.
The Volume of the output of night urine was less than that of theday urine.
The Chloride content of the urine was diminished from the 14th till the 27th day.
Albuminuria was marked while under investigation. Blood was present to the guaiac test and microscopical examination was positive during the investigation.
The Dick and the Oedema tests were both negative.

The special investigation was stopped on the 27th day.

Summary.
This is a case of post-scarlatinal nephritis first diagnosed on the 13th day. Blood pressure readings were taken commencing 1 day later, while specimens of urine were collected and specially examined from 2 days after the onset of nephritis.

Case No. 23.
Name J.E. Age 16 y. Sex - Male. Adm. 20.9.36.

Past Illness: none.
Present Illness: a rash, sore throat, nausea, delirium and constipation were noted before admission.
On Admission: The case was admitted acutely ill on the 4th day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces and exudate on the tonsils. The tongue was furred and a cervical adenitis was present. There was also albuminuria.

Progress: 7th day ... urine clear of albumin.
There was albuminuria on the 10th, 11th and 14th days.
27th day ... patient allowed up.
34th day ... patient dismissed.

The case was brought under special investigation on the 5th day.

The Blood Pressure was taken from the 6th day and was raised from the 23rd till the 26th day.

The Urea Figure taken from the 5th day was intermittently low from the 9th till the 24th day.

The Volume of the output of the night urine was throughout less than that of the day urine.

The Chloride content of the urine was diminished on the 5th day.

There was albuminuria on the 5th, 6th, 10th, 11th and 14th days. Microscopical examination was quite normal.

The Dick test and the Oedema test were negative.

The special investigation was stopped on the 26th day.

Summary.

This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure and a low urea figure.

Case No. 32.
Name R.Y. Age 4 y. Sex - male. Adm. 10.10.36.

Past Illness: measles and whooping-cough.
Present Illness: a rash, shivering, nausea and convulsions were noted before admission.
On Admission: The case was admitted severely ill on the 9th day of illness. General Examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces and enlarged tonsils with exudate. The tongue was peeled and ulcerated. The cervical glands were enlarged.
Progress: 2nd day... 15 c.c. of antitoxic serum administered.
There was albuminuria on the 6th, 13th and 14th days.
25th day... patient allowed up.
33rd " ... patient dismissed.

The case was brought under special investigation on the 5th day of illness.

The Blood Pressure was taken from the 5th day and was raised on the 11th day.
The Urea Figure taken from the 5th day was low on the 14th day.
The Volume of the output of night urine was greater than that of the day urine on the 8th, 9th, 11th and 12th days.
The Chloride content of the urine was normal throughout.
There was albuminuria on the 6th, 13th and 14th days. Microscopical examination was quite normal.
The Dick and Oedema tests were negative.

The special investigation was stopped on the 21st day.

Summary.
This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure, low urea figure and reversed volume ratio.

Case No. 33.
Name J.S. Age 18 y. Sex - female. Adm. 25.9.36.

Past Illness: measles.
Present Illness: a sore throat was noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash, peeling tongue and injected fauces with exudate on the tonsils. There was a left blepharitis marginalis and also albuminuria.

Progress:
3rd day ... 20 c.c. of antitoxic serum administered.
11th day ... temperature settled.
12th " ... a cervical adenitis developed.
15th to 19th. day elevation of temperature.
21st day ... slight oedema and albuminuria noted.
23rd " ... Haematuria noted.
48th " ... urine was clear of blood to the guaiac test.
95th " ... urine was clear of albumin.
106th " ... patient dismissed.

The case was brought under special investigation on the 23rd day of illness.

The Blood Pressure was taken from the 23rd day and was raised except for the 31st, 32nd and 33rd days.

The Urea Figure taken from the 23rd day was low until investigation stopped on the 47th day.

The Volume of the output of the night urine was intermittently greater than that of the day urine.

The Chloride content of the urine was diminished from the 23rd day until the 37th day.

Albuminuria was marked while under investigation and blood was also apparent during this time, stopping on the 48th day. Casts and blood cells were still found microscopically on the 46th day.

The Dick test was negative on the 23rd day while the Oedema test was positive on the same day.

An examination of the blood on the 38th day gave:

R.B.C..... 3,360,000.
W.B.C..... 12,200
Hb..... 60%

The special investigation was stopped on the 47th day.

Summary:/

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 23rd day. Blood pressure readings were taken commencing on the day of onset, while specimens of urine were collected and specially examined from the day of onset.

Case No. 35.
Name R.B. Age 7 y. Sex - female. Adm. 9.10.36.

Past Illness: measles and whooping-cough.
Present Illness: a rash, sore throat, shivering and vomiting were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with a peeling tongue and injected fauces with enlarged tonsils. There was also a right cervical adenitis.

Progress:
10th day ... temperature settled.
13th " ... albuminuria noted with an elevation of temperature.
14th " ... haematuria noted.
17th " ....8,000 units antidiphtheritic serum administered.
29th " ... stye developed in the right eye.
35th " ... septic finger developed.
41st " ... patient allowed up.
57th " ... patient dismissed.

The case was brought under special investigation on the 16th day of illness.

The Blood Pressure was taken from the 16th day and was within normal limits.

The Urea Figure taken from the 16th day was low on the 16th, 19th, 20th and 21st days.

The Volume of the output of the night urine was less than that of the day urine.

The Chloride content of the urine was diminished from the 16th till the 21st day.

Albuminuria was present in a moderate degree until the 19th day. No blood was detected on the 16th day or later by the guaiac test but was present microscopically until the 18th day.

The Dick test and the Oedema test were both negative.

The special investigation was stopped on the 24th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 14th day. Blood pressure readings were taken commencing 2 days later, while specimens of urine were collected and specially examined from 2 days after the onset of nephritis.

Case No. 36.
Name S.L. Age 11 y. Sex - Female. Adm. 23.10.36.

Past Illness: whooping-cough and chicken-pox.
Present Illness: a rash, nausea, shivering and a headache were noted before admission.
On Admission: The case was admitted moderately ill on the 2nd day of illness. General examination of the systems showed nothing abnormal. Local examination showed a scarlatiniform rash with injected fauces, enlarged tonsils and albuminuria.

Progress:
11th day ... temperature settled.
16th " ... an enlargement of the cervical glands with elevation of temperature noted.
13th day ... albuminuria noted.
15th " ... haematuria noted.
44th " ... urine clear of albumin.
49th " ... allowed up.
56th " ... patient dismissed.

The case was brought under special investigation on the 12th day of illness.

The Blood Pressure was taken from the 12th day and was raised on the 17th day only.

The Urea Figure taken from the 13th day was low on the 17th day.

The Volume of the output of the night urine was greater than that of the day urine on the 16th and 17th days.

The Chloride content of the urine was diminished until the 15th day.

Albuminuria was marked while the case was under observation i.e. from the 13th till the 18th day. Blood was present only on the 15th, 16th and 17th days to the guaiac test. Microscopically casts and blood cells were present until the 18th day.

The Dick and Oedema tests were both negative.

The special investigation was stopped on the 18th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 15th day. Blood pressure readings were taken commencing 3 days before, while specimens of urine were collected and specially examined from 2 days before the onset of nephritis.

Case No. 39.
Name W.G. Age 19 y. Sex - male. Adm. 3.1.37.

Past Illness: measles, whooping-cough and chicken-pox.
Present Illness: a rash, sore throat, shivering and headache were noted before admission.
On Admission: The case was admitted severely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces. The tongue was peeling and there was albuminuria.

Progress:
3rd day ... 20 c.c. of antitoxic serum administered.
9th " ... urine clear of albumin.
17th " ... enlargement of the cervical glands noted.
32nd " ... patient allowed up.
40th " ... patient dismissed.

The case was brought under special investigation on the 7th day of illness.

The Blood Pressure was taken from the 8th day and was raised from the 10th till the 24th day.

The Urea Figure taken from the 7th day was low from the 15th till the 25th day.

The Volume of the output of night urine was less than that of the day urine.

The Chloride content of the urine was diminished until the 11th day.

There was albuminuria on the 7th and 8th days. Microscopical examination was quite normal.

The special investigation was stopped on the 26th day.

Summary.

This case although showing neither blood cells nor casts in the urine is considered as a case of mild nephritis. The case had albuminuria with a raised blood pressure and a low urea figure.

Case No. 43.
Name A.M. Age 4 y. Sex - male. Adm. 20.1.37.

Past Illness: pneumonia.
Present Illness: a rash and sore throat were noted before admission.
On Admission: The case was admitted acutely ill on the 2nd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a scarlatiniform rash with injected fauces and a peeling tongue. There was a slight cervical adenitis and rhonchi were present in the chest.

Progress:
8th day ... temperature settled.
23rd " ... an enlargement of the cervical glands with elevation of temperature noted.
24th day ... puffiness of the face with looseness of the bowels and haematuria noted.
26th day ... oedema still moderate.
30th " ... not apparent oedema noted.
33rd " ... a convulsion occurred and lumbar puncture gave 25 c.c. of fluid under moderately increased pressure. The fluid was normal.
34th " ... temperature rose to 103'F.
35th " ... patient died.

The case was brought under special investigation on the 24th day of illness.

The Blood Pressure was taken from the 24th day and remained within normal limits.

No specimens of urine could be obtained until the 27th day and even then not sufficient to ascertain the specific gravity.

The Chloride content of the urine was diminished during the investigation.

Albuminuria and blood were marked during the investigation. Microscopical examination of the sediment showed casts and blood cells.

The Dick and Oedema tests were both negative.

The urea was fairly constant in each specimen of urine and averaged about 1.3%.

The special investigation was stopped on the 35th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 24th day. Blood pressure readings were taken commencing on that day, while specimens of urine were collected and specially examined from 3 days after the onset of nephritis.

Case No. 51.
Name J.S. Age 8 y. Sex - male. Adm. 3.2.37.

Past illness: measles, whooping-cough and chicken-pox.
Present Illness: a rash, sore throat, shivering, constipation and cervical adenitis noted before admission.
On Admission: The case was admitted acutely ill on the 4th day of illness. There was a fading scarlatiniform rash and the fauces were injected. The tongue was peeled.

Progress:
22nd day ... temperature settled.
28th " ... albuminuria noted.
29th " ... haematuria noted.
30th till 39th day temperature elevated.
35th day ... urine clear of blood to guaiac test.
41st " ... urine clear of albumin.
53rd " ... patient allowed up.
61st " ... patient dismissed.

The case was brought under special investigation on the 31st day of illness.

The Blood Pressure was taken from the 31st day and remained within normal limits.

The Urea Figure taken from the 31st day was low from the 32nd until the 37th day.

The Volume of the output of night urine was less than that of day urine.

The Chloride content of the urine was normal throughout.

Albuminuria was present in moderate amount during the investigation while blood was present to the guaiac test until the 35th day. Microscopically casts and blood cells were present until the 38th day.

The Dick and Oedema tests were both negative.

The special investigation was stopped on the 38th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 29th day. Blood pressure readings were taken commencing 2 days later, while specimens of urine were collected and specially examined from 2 days after the onset of nephritis.

Case No. 55.
Name J.M. Age 12 y. Sex - male. Adm. 24.5.37.

Past Illness: measles.
Present Illness: a rash, sore throat, nausea and headache were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fairly bright scarlatiniform rash with injected fauces. The tongue was furred and there was a cervical adenitis.

Progress:
6th day ... temperature settled.
9th " ... cervical adenitis more marked.
21st " ... cervical glands again enlarged.
23rd " ... elevation of temperature and haematuria. noted.
28th " ... temperature again settled.
41st " ... urine clear of blood to guaiac test.
49th " ... urine clear of albumin.
60th " ... patient allowed up.
70th " ... patient dismissed.

The case was brought under special investigation on the 45th day of illness.

The Blood Pressure was taken from the 45th day and was raised until the 51st day.

The Urea Figure taken from the 45th day remained within normal limits.

The Volume of the output of night urine was less than that of the day urine.

The Chloride content of the urine was normal throughout.

Albuminuria was present in moderate amount during the investigation but blood was not present to the guaiac test at this time. Microscopically casts and blood cells were present until the 49th day.

The special investigation was stopped on the 56th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 23rd day. Blood pressure readings were taken commencing 22 days later, while specimens of urine were collected and specially examined from 22 days after the onset of nephritis.

Case No. 56.
Name J.W. Age 10 y. Sex - Male. Adm. 28.4.37.

Past Illness: measles, whooping-cough and chicken-pox.
Present illness: a rash, sore throat and headache were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fading scarlatiniform rash with injection of the fauces. The tongue was peeling and the right cervical glands enlarged.

Progress:
6th day ... temperature settled.
17th " ... a trace of albumin in the urine noted.
21st " ... A slight epistaxis occurred.
25th " ... epistaxis repeated.
29th " ... temperature again elevated.
30th " ... haematuria noted.
40th " ... temperature again settled.
42nd " ... haematuria very marked and pulse poor in quality.
44th " ... patient actively sick.
62nd till 65th day a further elevation of temperature noted.
104th day ... urine clear of blood to guaic test.

The case was brought under special investigation on the 72nd day.

The Blood Pressure was taken from the 72nd day and was raised during the investigation.
The Urea Figure taken from the 72nd day was low on the 72nd day.
The Volume of the output of night urine was less than that of the day urine.
The Chloride content of the urine was normal during the investigation.
There was a marked albuminuria throughout the investigation and blood was present to the guaiac test. Microscopically casts and blood cells were found.

The special investigation was stopped on the 78th day.

Summary.
This is a case of post-scarlatinal nephritis first diagnosed on the 30th day. Blood pressure readings were taken commencing 42 days later, while specimens of urine were collected and specially examined from 42 days after the onset of nephritis.

Case No. XX.
Name C.M. Age 5 y. Sex - male. Adm. 4.3.37.

Past Illness: Measles, chicken-pox and left otitis media.
Present Illness: a rash and vomiting were noted before admission.
On Admission: The case was admitted acutely ill on the 2nd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash and injected fauces.

Progress:
7th day ... temperature settled.
17th till 21st day elevation of temperature.
18th " ... right ear commenced to discharge.
21st " ... a cervical adenitis developed.
26th " ... trace of albumin in the urine noted.
27th " ... haematuria noted.
39th " ... urine clear of albumin.
50th " ... patient allowed up.
70th " ... patient dismissed.

The case was brought under special investigation on the 27th day of illness.

The Blood Pressure was taken from the 28th day and remained within normal limits.

The Urea Figure taken from the 27th day was normal throughout.

The Volume of the output of night urine was generally greater than that of the day urine.

The Chloride content of the urine was normal throughout.

Albuminuria was moderate during the investigation and blood was present to the guaiac test. Microscopically blood cells and casts were found.

The Dick test was negative.

The special investigation was stopped on the 33rd day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 27th day. Blood pressure readings were taken commencing one day later, while specimens of urine were collected and specially examined from the day of onset of nephritis.

Case No. XXl.
Name M.B. Age 11 y. Sex - Male. Adm. 11.3.37.

Past illness: measles.
Present Illness: a rash, sore throat, headache and constipation were noted before admission.
On Admission: The case was admitted moderately ill on the 11th day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fine desquamation and slightly injected fauces. The tongue was peeled and there was a moderate cervical adenitis.

Progress:
21st day ... patient allowed up.
26th " ... patient complained of a headache and pyrexia, cervical adenitis and tonsilitis were found.
27th day ... albuminuria was noted.
32nd " ... haematuria noted.
36th " ... urine clear of blood to guaiac test.
37th " ... temperature settled.
48th " ... patient allowed up again.
55th " ... patient dismissed.

The case was brought under special investigation on the 29th day of illness.

The Blood Pressure was taken from the 29th day and remained within normal limits.

The Urea Figure taken from the 29th day was low on the 31st day only.

The Volume of the output of the night urine was less than that of the day urine.

The Chloride content of the urine was diminished on the 33rd day.

There was a moderate albuminuria while the patient was under the investigation. Blood was present to the guaiac test only on the 32nd day, but was found microscopically from the 29th till the 34th day.

The Dick test was positive.

The special investigation was stopped on the 35th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 29th day. Blood pressure readings were taken commencing on the day of onset, while specimens of urine were collected and specially examined from the day of onset of nephritis.

Case No. XXVII.
Name I. McP. Age 11 y. Sex - Female. Adm. 27.2.37.

Past Illness: Measles, whooping-cough and chicken-pox.
Present Illness: a rash, sore throat and shivering were noted before admission.
On Admission: The case was admitted on the 3rd day of illness acutely ill. General examination of the systems revealed nothing abnormal. Local examination showed a fairly bright scarlatiniform rash with injected fauces. The tongue was peeling and there was a slight nasal discharge. A few rhonchi were heard in the chest.

Progress:
5th day ... the right ear commenced to discharge.
6th " ... 20 c.c. of antitoxic serum were administered.
7th day ... 4,000 units of antidiphtheritic serum were administered.
15th day ... temperature settled.
28th till 30th day temperature elevated again.
34th day ... oedema and albuminuria were noted.
35th " ... haematuria noted.
48th " ... urine clear of albumin.
57th " ... patient allowed up.
66th " ... temperature elevated again.
67th " ... haematuria again noted.
68th " ... temperature finally settled.
69th " ... urine again clear of albumin.
84th " ... Patient allowed up.
87th " ... patient dismissed.

The case was brought under special investigation on the 35th day of illness.

The Blood Pressure was taken from the 36th day and was raised on the 39th day.

The Urea Figure taken from the 35th day was low on the 37th and 39th days.

The Volume ratio was reversed on the 37th, 38th and 39th days.

The Chloride content of the urine was diminished on the 67th day.

There was a moderate albuminuria during the investigation and blood was present to the guaiac test from the 36th day. Microscopical examination showed casts and blood cells.

The Dick test was negative.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 35th day. Blood pressure readings were taken commencing on the day after the onset, while specimens of urine were collected from the day of onset of nephritis and specially examined.

Case No. LXXXIV.
Name K.McN. Age 5 y. Sex - female. Adm. 3.4.37.

Past Illness: measles, whooping-cough and chicken-pox.
Present Illness: a rash, sore throat and vomiting were noted before admission.
On Admission: The case was acutely ill on the 2nd day of illness, when admitted. General examination of the systems revealed nothing abnormal. Local examination showed a faint scarlatiniform rash with injected fauces. The tongue was furred and there was a cervical adenitis.

Progress:
7th day ... the cervical adenitis more marked.
11th " ... temperature settled.
20th " ... albuminuria noted.
26th " ... haematuria noted.
27th till 34th day temperature was again elevated.
29th day ... cervical adenitis again more marked.
38th " ... urine clear of blood to guaiac test
50th " ... urine clear of albumin.
53rd " ... patient allowed up.
57th " ... patient dismissed.

The case was brought under special investigation on the 17th day of illness.

The Blood Pressure was taken from the 17th day and was raised on the 20th day only.

The Urea Figure taken from the 17th day was low on the 27th day only.

The Volume ratio was reversed on the 26th and 27th days.

The Chloride content of the urine was normal throughout.

Albuminuria was present during the investigation from the 18th day onwards. Blood was found by the guaiac test in the urine from the 26th day. Microscopical examination revealed blood cells and casts from the 26th day.

The Dick test was negative.

The Special investigation was stopped on the 27th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 26th day. Blood pressure readings were taken commencing before the onset of nephritis, while specimens of urine were also collected from before the onset of nephritis.

Case No. CXVlll.
Name P.D. Age 4 y. Sex - male. Adm. 7.4.37.

Past Illness: measles and pneumonia.
Present Illness: a rash, sore throat and vomiting were noted before admission.
On Admission: The case was admitted acutely ill on the 3rd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a fading scarlatiniform rash with injected fauces. The tongue was peeling, there was exudate on the left tonsil and the cervical glands were enlarged.

Progress:
3rd day ... 10 c.c. of antitoxic serum administered.
9th day ... temperature settled.
11th " ... a nasal discharge developed.
21st " ... albuminuria and haematuria noted.
22nd " ... temperature elevated.
29th " ... cervical adenitis more marked and temperature again elevated.
30th " ... parotitis developed.
43rd " ... urine clear of blood to the guaiac test.
48th " ... urine clear of albumin.
58th " ... patient allowed up.
67th " ... patient dismissed.

The case was brought under special investigation on the 21st day of illness.

The Blood Pressure was taken from the 21st day and remained within normal limits.

The Urea Figure taken from the 21st day remained within normal limits.

The Volume of the output of night urine was less than that of the day urine.

The Chloride content of the urine was diminished on the 22nd and 24th days.

Albuminuria was marked during the investigation and blood was also present to the guaiac test. Microscopical examination gave blood cells and casts.

The Dick test was negative.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 21st day. The blood pressure was taken from the day of onset, while specimens of urine were collected and specially examined from the day of onset of nephritis.

Case No. CXLll.
Name H.S. Age 6 y. Sex - male. Adm. 16.4.37.

Past Illness: measles, whooping-cough and chicken-pox.
Present Illness: a rash, sore throat and sickness were noted before admission.
On Admission: The case was admitted acutely ill on the 2nd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces. The tongue was peeling.

Progress:
2nd day ... 10 c.c. of antitoxic serum administered.
20th " ... the left ear commenced to discharge.
21st " ... epistaxis occurred.
22nd " ... a sharp elevation occurred and the right ear commenced to discharge. Haematuria was noted.
27th " ... temperature settled again.
30th " ... urine clear of albumin.
63rd " ... patient allowed up.
70th " ... patient dismissed.

The case was brought under special investigation on the 17th day of illness.

The Blood Pressure was taken from the 17th day and was raised throughout the investigation.

The Urea Figure taken from the 17th day was normal throughout.

The Volume of the output of night urine was less than that of the day urine.

The Chloride content of the urine was diminished on the 23rd and 24th days.

There was a moderate albuminuria from the 21st day. Blood was present to the guaiac test only on the 22nd day. Microscopical examination revealed blood cells and casts on the 22nd and 24th days.

The Dick test was negative.

The special investigation was stopped on the 24th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 22nd day. The blood pressure readings were taken from before the onset, while specimens of urine were collected and specially examined from before the onset of nephritis.

Case No.CXLIV.
Name R.S. Age 10 y. Sex - male. Adm. 17.5.37.

Past Illness: None.
Present Illness: a rash, sore throat and nausea were noted before admission.
On Admission: The case was admitted acutely ill on the 2nd day of illness. General examination of the systems revealed nothing abnormal. Local examination showed a bright scarlatiniform rash with injected fauces and exudate on the left tonsil. The tongue was furred and a faint ventricular systolic murmur was heard.

Progress:
6th day ... temperature settled.
21st " ... albuminuria noted.
26th till 32nd day temperature elevated.
28th day ... haematuria noted.
37th " ... urine clear of albumin.
50th " ... patient allowed up.
59th " ... patient dismissed.

The case was brought under special investigation on the 22nd day of illness.

The Blood Pressure was taken from the 22nd day and was raised until the 26th day.

The Urea Figure taken only on the 22nd and 23rd days was within normal limits.

The Volume of the output of night urine was greater than that of the day urine on the 22nd day.

The Chloride content of the urine was diminished on the 23rd day.

A moderate albuminuria was present during the investigation. Blood was first found by guaiac test on the 28th day but microscopical examination revealed blood cells and casts on the 23rd day.

The special investigation was stopped on the 30th day.

Summary.

This is a case of post-scarlatinal nephritis first diagnosed on the 23rd day. The blood pressure readings were taken from before the onset, while specimens of urine were collected and specially examined on the day of onset and the day before.

POST MORTEM EXAMINATIONS.

The post mortem examinations were carried out personally by the author in Belvidere Isolation Hospital.

The sections from the kidney in case No. 1 were cut by Professor J. Shaw Dunn's Department in the Western Infirmary.

The sections in the other five cases were cut in Dr. F.E. Reynolds' Department in Stobhill Hospital. Dr. Reynolds' reports on the sections are included in the case reports.

The Morbid Anatomy of Scarlet Fever.

The naked eye appearances at an outopsy on a scarlet fever patient show nothing characteristic. There is a general congestion of the thoracic and abdominal viscera as well as of the brain and meninges. As a rule the congestion is most marked in the liver, kidneys and lungs (especially at the bases.) The lymphatic glands are swollen, particularly those of the cervical groups. The follicles of the tongue and tonsils are enlarged as are the solitary follicles and Peyer's patches in the intestines.

When death is due to nephritis, the appearance of the kidneys varies according to the duration of the complication. According to Rolleston (1929) in the typical scarlatinal kidney the lesions are those of diffuse glomerulo-nephritis which are not, however, peculiar to scarlet fever, as they may be found in other acute infections.

Case 1.

Complaint scarlatina. age 4y. sex male.

Past Illness: pneumonia on two occasions.
Present Illness: The illness commenced on the 19.1.37 with a sore throat. The rash appeared on the 20th and was bright and generalised.
On Admission: The child was acutely ill with injected throat and peeling tongue. There was a slight cervical adenitis and loud rhonchi were heard all over the chest.
Progress: 8th day - temperature settled.
23rd " - face puffy and temperature sharply elevated.
24th " - the stools were loose and haematuria and albuminura were found. A Dick test was negative.
26th " - child free from obvious oedema.
33rd " - a convulsion occurred and lumbar puncture revealed a cerebro-spinal fluid apparently normal but under considerable pressure.

The temperature remained high and swinging until death on the 35th day of illness when blood and albumin were still present in the urine. Microscopical examination of the urine revealed many blood cells and granular and blood casts.

The blood pressure was never over 100/70 and an average figure was 90/50.

AUTOPSY.

Performed 18 hours after death.

The body was that of a moderately emaciated child. Rigor mortis was moderate as was also post mortem staining. BODY CAVITIES. There were a few c.c. of clear fluid in the pericardial cavity. A few fine adhesions were present in the right pleural cavity.

HEART. Normal.

LUNGS. There was early broncho-pneumonia of the upper lobe of the right lung with bronchitic changes in both lungs.

LIVER. Normal.

SPLEEN. Normal.

INTESTINES. Normal.

ADRENALS. Normal.

PANCREAS. Normal.

LYMPHATIC GLANDS. Normal.

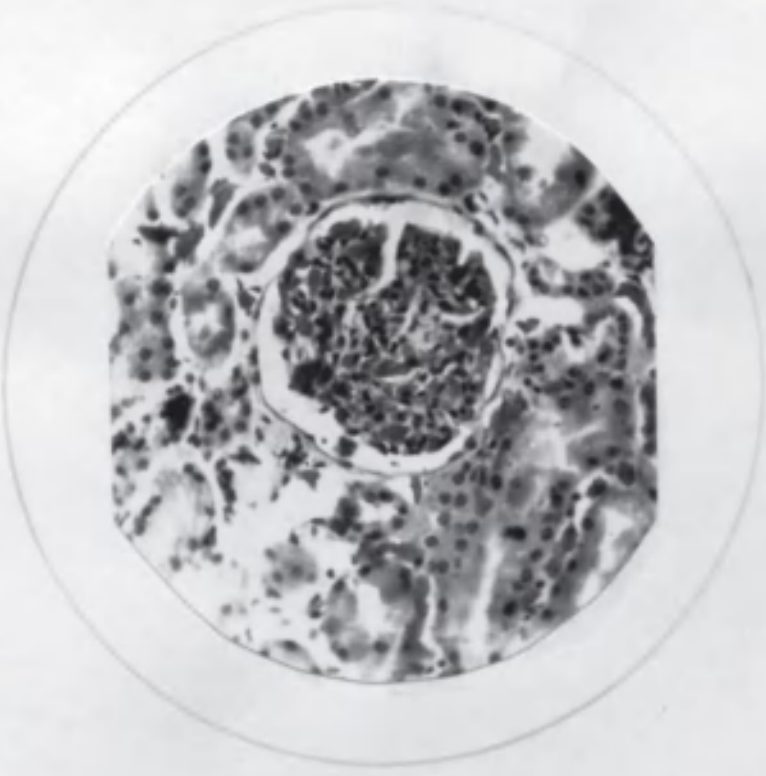
C.N.S. There was marked oedema of the brain with flattening of the convolutions.

KIDNEYS. There was inflammatory reaction in the peri-renal cellular tissues. The capsules stripped easily. The kidneys were injected and the outlines were blurred. Microscopical examination revealed:

There was marked congestion with dilatation of vessels including vessels of glomerular tufts. No apparent increase in cellularity and no thickening of Bowman's capsules was seen. A few round cells were seen in the interstitial spaces. The tubular epithelium was normal.

Case 1.

Microphotograph of kidney section under high power. (×450)



Case 1.

Microphotograph of kidney section under low power.

(x 200)

Case 2.

Complaint scarlatine. age 5y. sex male.

Past Illness: Measles and whooping-cough.
Present Illness: The case was admitted acutely ill on the 4th. Day of Illness: The rash had commenced on the 2nd day and other symptoms were nausea, sore throat and constipation.
On Admission: The patient had a bright generalised rash, injected fauces and a furred tongue.
Progress: 6th day - temperature settled.
20th " - the tonsils were enlarged, the cervical glands enlarged, the pulse rate increased and the temperature elevated.
21st day - generalised joint pains experienced.
28th " - temperature again settled.
33rd " - the pulse became irregular in rate.
39th " - a loud systolic murmur was heard at the apex and an accentuated second sound at the base.
41st day - temperature elevated again.
48th " - the right knee joint was swollen and painful and the patient had a severe epistaxis, 8,000 units of anti-diphtheritic serum being given. The blood culture was negative.
60th day - patient's colour very poor. The apex beat was tumultuous with a long ventricular systolic murmur best heard at the mitral area and softness of the second sound.
The patient died during the night.

AUTOPSY.

Performed 12 hours after death.

The body was that of a moderately emaciated child. Rigor mortis was passing off but post mortem staining was well marked.

BODY CAVITIES. There were a few c.c. of clear fluid in the pericardial cavity. The cavities all appeared normal.

HEART. The heart muscle was pale. White and red clot were present. Minute vegetations were present on the mitral valve.

Microscopical examination of the vegetations gave:

"The nodules consist of fibrous tissue and organisation is not yet absolutely complete. They are probably rheumatic in origin."

LUNGS: Congested but otherwise normal.

LIVER: " " " "

SPLEEN: " " " "

INTESTINES: Agonal intussceptions present.

ADRENALS: Normal.

PANCREAS: Normal.

LYMPHATIC GLANDS: Normal.

C.N.S. Not examined.

KIDNEYS: Congested and with the capsule stripping easily. On section the outlines were well defined.

Microscopical examination:

"In many instances the glomeruli are swollen filling completely the space within Bowman's capsule. There is no thickening of this structure.

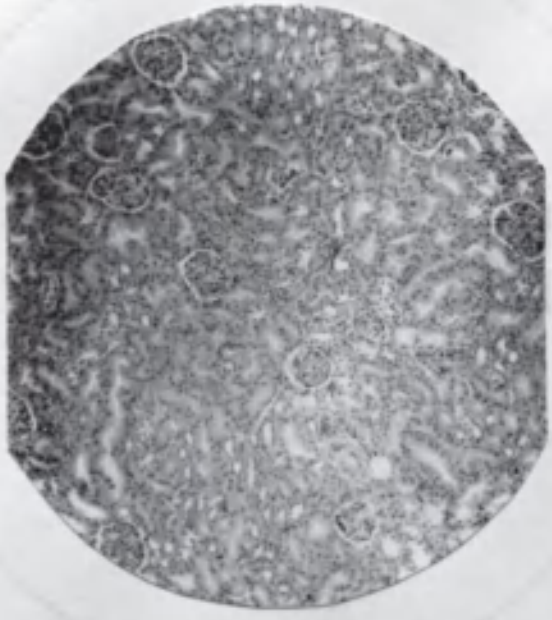
In those cases where a space persists between the glomerulus and Bowman's capsule, no secretion is present within the first portion of the tubule.

Many of the glomeruli are congested; this is probably a terminal change.

The cells lining the convoluted tubules are swollen and their cytoplasm is coarsely granular."

Case 2.

Microphotograph of kidney section under low power. (x 100)



Case 3.

Complaint scarlatina age 2y. sex male.

Past Illness: Whooping-cough and chicken-pox.
Present Illness: The case was admitted acutely ill on the 2nd. Day of Illness: The rash appearing on the first day. The only other symptom was nausea.
On Admission: The patient had a fairly bright generalised rash with injected fauces and a peeled tongue. There were in addition a few crepitations at the bases of the lungs.
Progress: 4th day - there was persistent sickness after drinks and 10 c.c. of antitoxic serum and rectal salines were given.
5th day - a collar of enlarged glands was noted.
7th " - lumbar puncture gave 15 c.c. of clear fluid under normal pressure.
11th day - the temperature was still swinging and the glands were very tender.
12th day - a second lumbar puncture gave 6 c.c. under normal pressure.
13th day - a blood culture was positive for haemolytic streptococci. The Widal test was negative. The left ear commenced to discharge and the breath sounds were still somewhat rough at the bases.
17th day - the glands were incised yielding a blood stained serum and packing was inserted.
22nd day - broncho-pneumonia of the right lung became evident.
24th " - patient died at 1.15 a.m.

AUTOPSY.

Performed 12 hours after death.

The body was that of a fairly well nourished child. Rigor mortis and post mortem staining were marked.

BODY CAVITIES: There were a few c.c. of clear fluid in the pericardial cavity. The cavities all appeared normal.

HEART: Normal but for the fact that the muscle was pale.

LUNGS: Early broncho-pneumonia involving the right lung and general congestion.

LIVER: Congested but otherwise normal.

SPLEEN: Congested but otherwise normal.

INTESTINES: Normal.

ADRENALS: Normal.

PANCREAS: Normal.

LYMPHATIC GLANDS: Normal.

C.N.S. Not examined.

KIDNEYS: Congested and with the capsule stripping easily. On section the outlines were well defined.

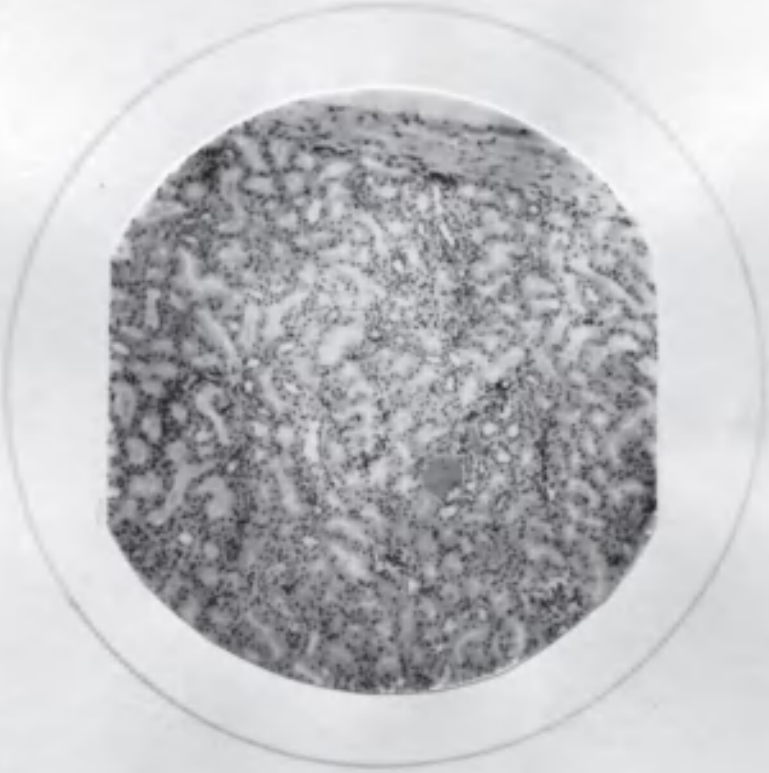
Microscopical examination:

"The glomeruli show no more cellularity than is usual in children of this age and throughout the section no changes outwith the limits of "normal" have been observed."

Blood taken from the heart post mortem yielded streptococci.

Case 3.

Microphotograph of kidney section under low power. (×200).



Case 4.

Complaint scarlatina. age 3y. sex male.

Past Illness: Chicken-pox.
Present Illness: The illness commenced one day prior to admission with a rash and sore throat.
On Admission: The child was moderately ill with a diffuse fading rash and injected fauces. The tongue was furred and the tonsils were enlarged and congested. There was a slight albuminuria.
Progress: 4th day - temperature settled.
7th " - a left cervical adenitis developed.
15th " - a right sided adenitis developed with an elevation of temperature.
16th day - a left sided lobar pneumonia was diagnosed.
17th " - albuminuria developed and this lasted until the termination of the illness.
19th day - the urinary output was very low.
21st " - consolidation of the right apex was noted.
30th " - consolidation more marked on the right side and resolution commencing on the left side.
36th day - patient much weaker and both ears discharging. The patient died on this day.

AUTOPSY.

The body was that of a well nourished child.

BODY CAVITIES: There were a few c.c. of clear fluid in the pericardial cavity. There was some exudate and a few adhesions in the pleural cavities. The abdominal cavity was normal.

HEART: Normal.

LUNGS: The left lung showed a resolving lobar pneumonia. The upper and middle lobes were in a state of grey hepatisation in the right lung.

LIVER: Congested but otherwise normal

SPLEEN: Normal.

INTESTINES: Normal

ADRENALS: Normal.

PANCREAS: Normal.

LYMPHATIC GLANDS: Normal.

C.N.S.: Not examined.

KIDNEYS: Congested and with the capsule stripping easily.

Microscopical examination:

"In certain sections the glomerular capillaries are congested although in other sections no change of this nature is observed. In some of the tubules (loop of Henle) blood is present in the lumen although nowhere has the lining of the tubules been desquamated.

The blood found in the urine and that seen in the tubules in the sections is due to passive congestion of the organ resulting from pneumonia and is of no primary significance.

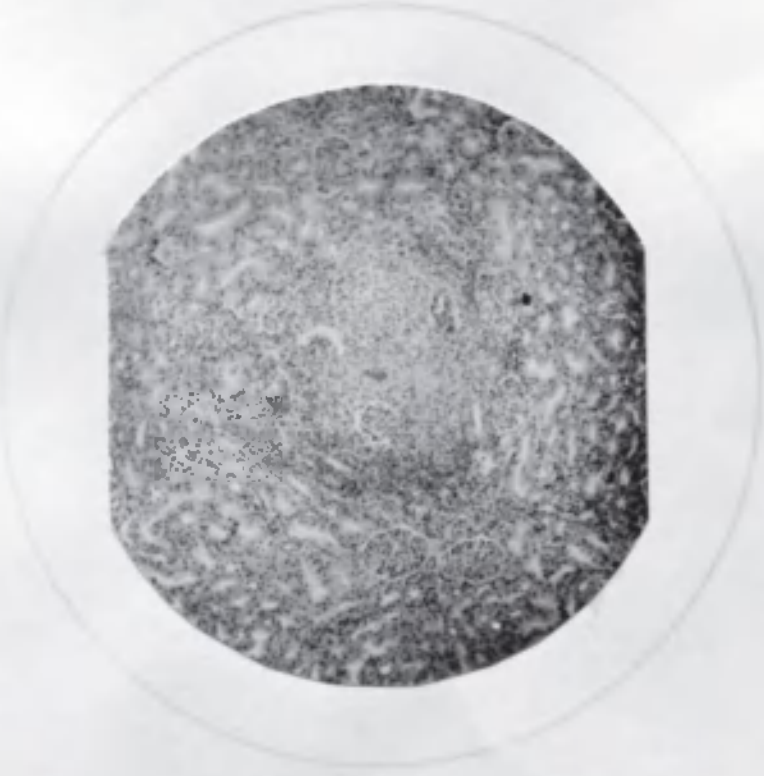
In certain portions of the organ, the glomeruli were swollen filling the whole of the first part of the tubule and they show increased cellularity.

Further, several small areas have been seen in the cortex in which recent formation of fibrous tissue has occurred. These areas show small round celled infiltration. This change is in my opinion to be associated with focal damage occuring in the course of the recent scarlet fever."

A smear from the lung taken post mortem gave pneumococci.

Case 4.

Microphotograph of kidney section under low power. (×200)



Case 5.

Complaint scarlatina age 1y. sex male.

Past Illness: Whooping-cough.
Present Illness: The illness commenced on the day of admission with the appearance of a scarlatiniform rash and nausea.
On Admission: The patient was found to be acutely ill with a fading generalised rash and injected fauces. The tongue was peeling and there was a profuse nasal discharge.
Progress: On the third day of illness the patient collapsed and died.

AUTOPSY:

The body was that of a well nourished child. Rigor mortis was moderate while post mortem staining was well marked.

BODY CAVITIES: There were a few c.c. of clear fluid in the pericardial cavity. The cavities all appeared normal.

HEART: Normal.

LUNGS: Normal.

LIVER: Rather pale in appearance.

Microscopical examination:

"The hepatic parenchymal cells are swollen and their cytoplasm is coarsely granular. The condition is one of albuminous degeneration."

SPLEEN: The Malpighian bodies were well marked.

INTESTINES: Normal.

ADRENALS: Normal.

PANCREAS: Normal.

LYMPHATIC GLANDS and THYMUS: Slightly enlarged.

C.N.S.: Not examined.

KIDNEYS: Congested and with the capsule stripping easily.

Microscopical examination:

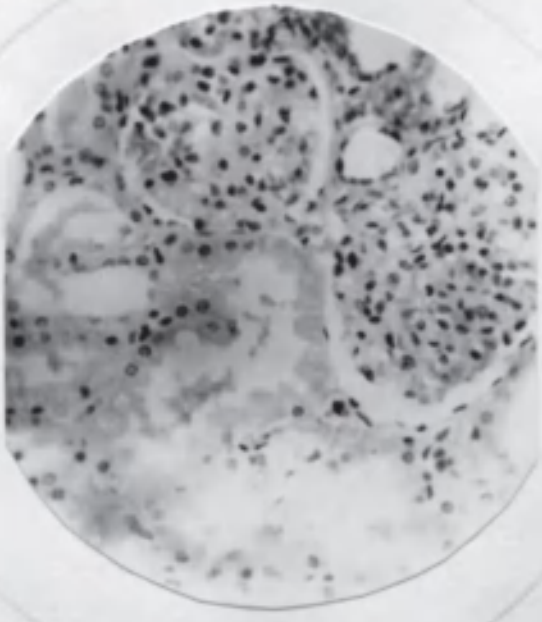
"The glomeruli present numerous nuclei but no more than is usual in infants.

The cells lining the convoluted tubules are somewhat swollen and their cytoplasm is coarsely granular.

The renal condition may come into the category designated "nephroses" but it certainly is not one of nephritis."

Case 5.

Microphotograph of kidney section under high power. (x450)



Case 6.

Complaint scarlatina. age 2y. sex female.

Past Illness: None.
Present Illness: The illness commenced four days prior to admission with vomiting followed by the appearance of a rash.
On Admission: The child was found to be moderately ill with a bright generalised rash and injected fauces. The tongue was peeling.
Progress: The patient appeared comfortable until 24 hours after admission when the breathing became very distressed and the child collapsed and died.

AUTOPSY.

The body was that of a well nourished child. Rigor mortis and post mortem staining were both well marked.

BODY CAVITIES: There were a few c.c. of clear fluid in the pericardial cavity. The cavities all appeared normal.

HEART: Normal.

LUNGS: Congested but otherwise normal.

LIVER: Normal.

SPLEEN: Malpighian bodies well marked.

Microscopical examination:

"The Malpighian bodies are numerous and much increased in size."

INTESTINES: Normal.

ADRENALS: Normal.

PANCREAS: Normal.

LYMPHATIC GLANDS and THYMUS: Slightly enlarged.

C.N.S.: Not examined.

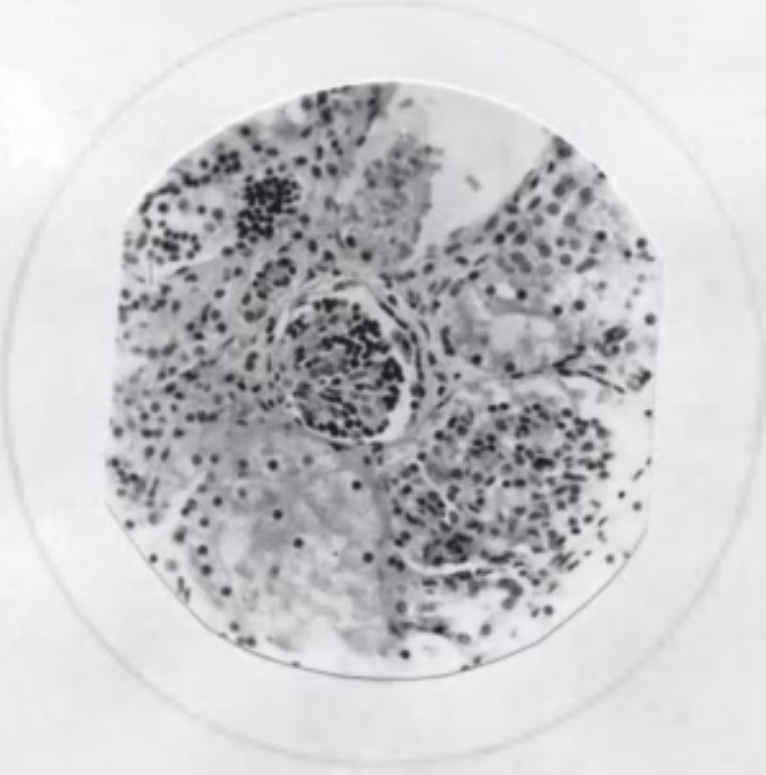
KIDNEYS: Congested and with capsule stripping easily.

Microscopical examination:

"The glomeruli are rich in nuclei but no more so than is usual in children of this patient's age. The cytoplasm of the cells lining the colvoluted tubules is perhaps more coarsely gramular than is usual but the degree is so small that it has no pathological significance."

Case 6.

Microphotograph of kidney section under high power. (×450).



SUMMARY of Post Mortem Cases.

The reports on six cases of scarlet fever which terminated fatally and on which post-mortem examination were carried out have been given. In each case the kidney was examined microscopically.

The first case is one of acute glomerulo-nephritis occurring during scarlet fever and complicated by pneumonia and enteritis. Death occured on the twelfth day after development of the nephritis. Post mortem examination revealed broncho-pneumonia of the right lung. The kidneys showed no increase in cellularity. There was, however, marked congestion with dilatation of vessels including the glomerular capillaries. The other organs were normal except for oedema of the brain.

The second case is one of arthritis with endocarditis developing during scarlet fever. Post mortem examination revealed minute vegetation on the mitral valve probably of rheumatic origin. The kidneys showed many swollen and congested glomeruli. Nothing of importance was seen in the other organs.

The third case is one of septicaemia due to a haemolytic streptococcus occurring during scarlet fever and complicated by broncho-pneumonia and otitis media. Here post mortem examination confirmed the broncho-pneumonia involving the right lung. The kidney in this case showed nothing

abnormal. There were no important changes seen in the other organs.

The fourth case is one of lobar pneumonia accompanied by albuminuria occurring during scarlet fever. Post mortem examination showed a resolving lobar pneumonia on the left side and a state of grey hepatisation on the right side. The kidneys showed in some parts swelling and congestion of the glomeruli with increased cellularity. Several small area of recent fibrosis were also seen and it is considered that this was due to a focal nephritis. The other organs appeared normal.

The last two cases were both cases of collapse and death occurring during the first week of illness. In both the post mortem examination showed enlarge Malpighan bodies in the spleen and some enlargement of the thymus. In one case there was a state of "albuminous degeneration" in the liver. The kidneys in these two cases showed a coarse granularity of the cytoplasm of the cells of the convoluted tubules.

It is seen from the above that there is no apparent change in the kidneys apart from what is to be expected in death following similar complications in the specific infectious diseases. It is remarkable, however, that there was found to be so little evidence of damage to the kidneys in the case of post scarlatinal glomerulo-nephritis considering that the condition was of at least twelve days duration.

CONCLUSIONS on Post Mortem Cases.

1. In fatal cases of scarlet fever no specific pathological changes are found in the kidneys.

2. Post mortem examination of the kidneys of a case of post scarlatinal glomerulo-nephritis revealed only dilatation and congestion of vessels including the glomerular capillaries.

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