

PHASES OF IMMUNITY IN SCARLET FEVER

T H E S I S

for

THE DEGREE OF DOCTOR OF MEDICINE

Presented by

J. MONTGOMERY ANDERSON, M.B., ChB.

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PHASES OF IMMUNITY IN SCARLET FEVER

T H E S I S

by

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During my residence as a physician in the Fever Hospitals of Glasgow, it was suggested to me that some means might be found, by which a doubtful case of Scarlet Fever could be diagnosed. The idea was that perhaps some means of producing an immune serum containing a specific precipitin might be discovered and experiments were undertaken with the view of determining this. Owing, however, to various causes these were found difficult, and during the periods in which the preparation of the immune sera was proceeding, special attention was paid to the curative effects produced in Scarlet Fever by the use of antistreptococcic serum. As the observations made on the latter largely exceed in number those made on the former, they will be first related and the results discussed. Thereafter an account of the experiments conducted, with a view of finding a specific precipitin, will

be briefly detailed.

In the first place the action of the sera used is discussed in its clinical aspect. The effect on the opsonic index of the patient's blood is then described and finally the whole results are reviewed. With regard to the experiments on the precipitins, it is felt that they are not of sufficient number to justify many conclusions, but such results as have been obtained are suggestive and I hope on some future occasion to pursue the matter further.

With regard to the estimation of the opsonic index, Wright's method was used. In a series of fifty-six cases a daily observation of the opsonic power of the patients' serum towards a streptococcus obtained from a case of mastitis was made, and in all 1,400 opsonic indices were calculated.

As Banks² had published his results on the same subject using different strains of streptococci, and as he found practically no variation in the index with any particular strain, the cultural characters of the streptococcus used in my observations were not investigated.

The cases used in the observations are divided into five groups, i. e., Normal Cases, Complicated Cases, those treated with Polyvalent Antistreptococcus Serum (Messrs Parke Davies & Co.), those treated with Aronson's antistreptococcus serum, and those treated with Diphtheria Antitoxin.

The following is a detailed list:-

Group I

16 cases running the normal course of Scarlet Fever.

Group II

5 cases unusual or complicated.

- (a) 1 case of Scarlatina Maligna
- (b) 3 cases of Scarlatinal Nephritis
- (c) 1 case of Scarlatinal Rheumatism

Group III

20 cases treated with P. D. & Co.'s Antistreptococcic Serum, divided into,

- (a) 14 cases normal or uncomplicated
- (b) 4 convalescent cases examined as controls to observe the effect of the serum on a normal index
- (c) 2 cases treated with this serum, after filtration through a Berkefeld filter

Group IV

9 cases treated with Aronson's antistreptococcic serum, of these 8 recovered and one terminated fatally.

Group V

6 cases treated with Diphtheria antitoxin, of which one terminated fatally.

ACTION OF THE SERUM

Clinically:- In the study of the clinical results obtained by serum treatment, the cases must be divided into three separate groups: (a) Those treated with P. D. & Co.'s antistreptococcus serum: (b) Those treated with Aronson's antistreptococcus serum, and (c) Those treated with Diphtheria Antitoxin.

The type of case chosen for treatment was generally that in which there was marked evidence of secondary infection, as shown by purulent discharge from the throat and nose. The serum was always given per rectum in doses of 20 and 10 c.c., with the interval of a day between each, and was always mixed with three times the quantity of normal saline solution, as recommended in the Lancet.

For example, in Group A, the day after administration of 20 c.c. of antistreptococcus serum, there was, in most cases, a very marked diminution in the discharge from the throat, while the condition of the fauces, whether ulcerated and congested, or merely congested, became in about three days pink and healthy. Even when extensive ulceration existed, the discharge and debris disappeared very rapidly, and though the epithelium took a few days to cover the ulcers, the appearance of the fauces was practically normal. In one or two cases where the appearance of the fauces suggested

commencing ulceration, the mucous membrane remained intact.

Much the same results were obtained with Aronson's serum, but the rapidity of the change was not so noticeable, and even after the same dose of serum the pink healthy-looking mucous membrane was not seen as in the first case. In one case in which the throat was intensely congested, ulceration commenced even after the administration of serum, and persisted for more than a week, so that this serum is not so powerful in preventing ulceration as the above.

In the last Group, the clinical results were disappointing, the improvement being tardy. Even here, however, a convalescent stage was reached much more rapidly than in cases not treated with serum.

THE NATURE OF THE SERA

The two antistreptococcic sera are bactericidal in their action. They are both prepared in the same way, viz., by the injection of virulent cultures of streptococci obtained from various sources - puerperal fever, erysipelas, scarlet fever, etc. Each claims to have many good results, but perhaps that of Aronson has been most studied, especially on the Continent. M. Lubowski⁷ discusses Aronson's experiments and shows that his results have been good and numerous in cur-

ative tests with the serum. He found that, even twenty-four hours after inoculation with virulent streptococci, a cure was effected in 50 per cent. of the animals, with large doses of serum. Meyer,¹⁰ in comparing various antistreptococcic sera, found that of them all, Aronson's was the most powerful even in minimum doses. Its special value in cases of Scarlet Fever is enlarged on by Fischer⁵ of New York, and Amheim¹, who describe several severe cases treated with this serum, and in which an almost immediately beneficial effect was obtained. In the cases of the first observer the dose of serum was evidently small, but yet he reports an immediate improvement and in three days a complete disappearance of all necrosis. Amheim's patient required much larger injections - 40 and 50 c.c., but this was followed by a beneficial result. The improvement recorded by these writers is much more rapid than in any of my cases.

P. D. & Co.'s serum has also been investigated in numerous cases, chiefly in septic infections, and on the whole the results are encouraging.

Diphtheria Antitoxin was tried, not in the expectation that brilliant curative results would be obtained, but rather to find out how much of the action of the antistreptococcic sera was due to materials normally present in horse serum. It would have been more satisfactory to have used normal horse serum, but such could not easily be procured.

As for the antidiphtheretic serum, it is a true antitoxic serum, and is used as such. It is not surprising then that the cases treated with this serum should show but a slow improvement since it does not even neutralise any toxin developed by the streptococcus, and it is not bactericidal to that organism. So far as I know there are no published results of the effect of diphtheria antitoxin in Scarlet Fever, though it is claimed that ordinary septic throats are benefited by its use.

A COMPARISON OF THE OPSONIC INDICES IN SERUM
TREATED AND UNTREATED CASES

For purposes of comparison the cases under consideration must be divided into two Groups, (a) the untreated cases, and (b) the serum treated cases, while a sub-division of the latter is necessary for further study of the effects of the various sera on the index.

Taken as a group, normal cases running an uninterrupted course present a low index to begin with, and as convalescence is approached this gradually rises. Many factors have to be taken into account in estimating the clinical significance of this rise - the severity of the attack, the presence or absence of albuminuria and the physique of the patient. On

looking over each chart separately, then, we find that, in the majority of cases, there is a rapid rise to normal with the defervescence of the fever, and the abatement of the symptoms. This level once reached, is more or less maintained and is only disturbed by the presence of complications. This is in general agreement with the results obtained by Banks,² who, however, describes a slight fall in the index about the beginning of the third week of the disease. This I have not found.

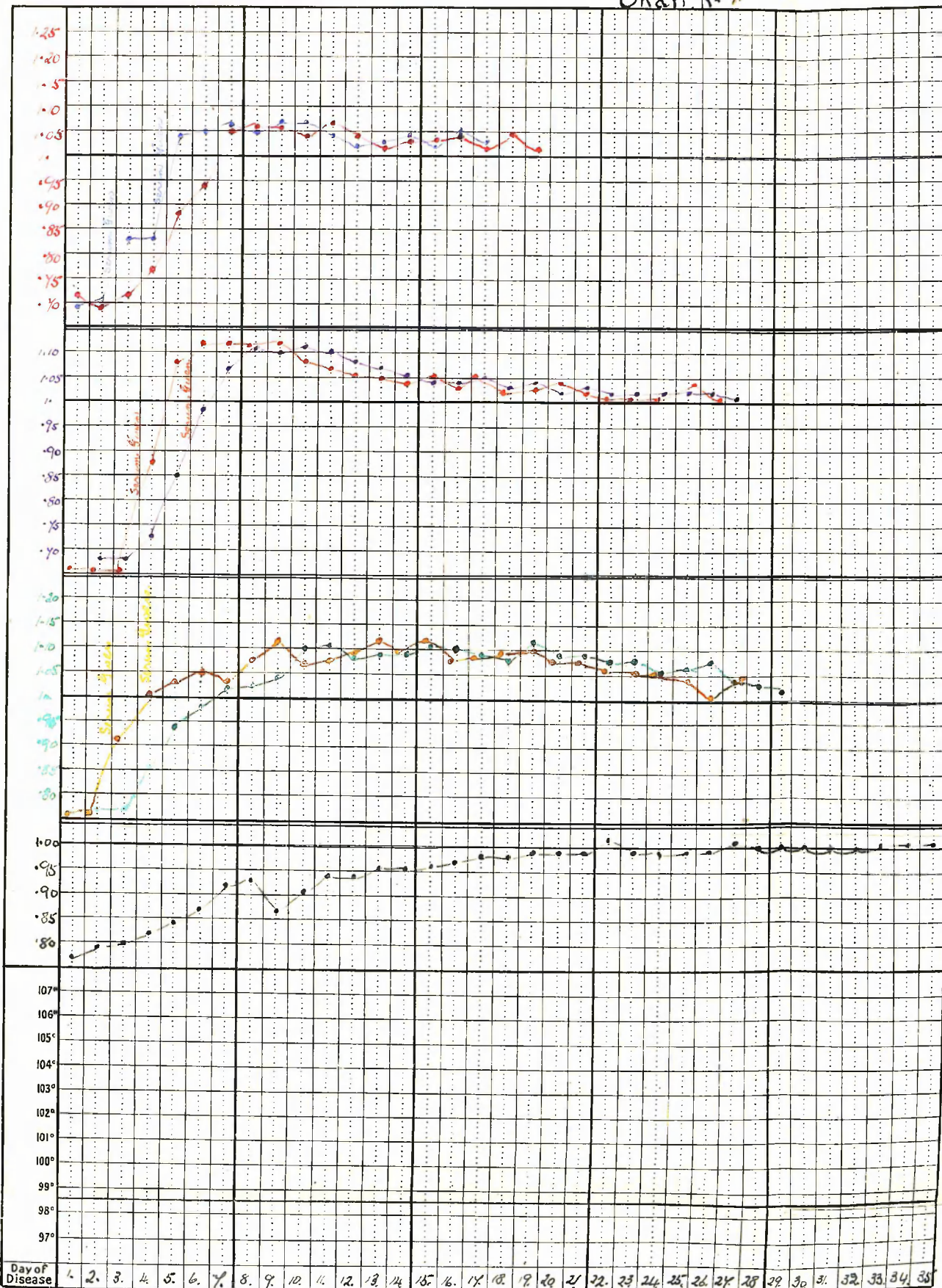
Disregarding for a time the sub-divisions of Group B, the opsonic indices in those cases after the administration of serum will be described first. In all the result is the same. A great increase in the opsonic index, in general to above the normal level, is observed on the day following the giving of serum. This increase is further augmented by the second dose of serum, and the higher figure is maintained for some time, gradually falling to normal as complete convalescence is established. Coming now to the sub-divisions of this group, slight differences are noticed both with regard to the initial rise, and also to the duration of the higher figures. The antistreptococcic sera may be taken together, for while there is a little difference in the initial rise, the serum of P. D. & Co. gives a higher reading throughout the observations. With this serum the index rises so as to attain its maximum on the ninth day after administration.

With Aronson's serum, on the other hand, the rise is much more rapid, the maximum being reached on the sixth day after administration, though the level attained is rather lower than in the other case. With the use of Diphtheria antitoxin there is also an increase in the opsonic power of the blood after the first dose of serum, but a second dose is required to bring the index above unity. The figures obtained, however, are not nearly so high as those after the administration of the antistreptococcic sera. The chart shows the same approach towards the normal line during convalescence. The whole of these results are presented both in tables and in charts for each individual case. In order that the effects of the sera may be more readily appreciated, composite charts have been constructed. By means of a composite chart the individual variations may be eliminated to a certain extent, and a better idea obtained as to the average effect of the remedy. The number of the cases is too small to make a very elaborate differentiation, so in each instance the average has been worked out according to the day of disease and according to the day on which treatment was commenced. This has been done for each of the three remedies employed. For comparison a chart for the average opsonic index for each day of illness, of the untreated cases, is given.

Tables I to VII.

Composite Chart I.

Chart No. 1.



Antidiphtheria Serum I.
Antidiphtheria Serum II.

IV.

Aronsoe's Serum I.
Aronsoe's Serum II.

III.

Parke Davies Serum I.
Parke Davies Serum II.

II.

Normal.
I.

TABLE II

SHOWING THE DAILY OPSONIC INDEX IN SERUM TREATED CASES

Antistreptococcus Serum i

Day of Illness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Malloch		.82	.85	.96	1.06	1.11	1.08	1.01	1.04	.95	.96	.99	1.04	1.02	1.05	1.06	1.03	1.05	1.18	1.08	1.07	1.05	1.05	1.08					
Davidson				.76	.92	.99	1.01	1.01	1.00	1.03	1	1.04	1	.98	1.18	1.07	1.03	1.01	1.07	1.08	1.16	1.13	1.10	1.05	1.02	1.01	.98	1.01	1.04
Grant				.85	.84	.90	.95	.98	.98	1.01	1.01	1.00	1.04	.96	.98	1	1.05	1.13	1.14	1.16	1.17	1.10	1.17	1.11	1.22	1.15	1.08	1.06	
Armichael		.81	.86	.88	.97	1.02	1.03	.98	1	1.12	1.11	1.14	1.2	1.25	1.11	1.08	1.05	1.08	1.15	1.1	1.07	1.04	1.08	1.04	1.06	1.08			
Forseburgh			.84	.85	.95	1.00	1.02	1.00	1.01	1.10	1.17	1.01	1.05	1.15	1.13	1.10	1.10	1.05	1.08	1.05	1	1.03	1.07	1.07	1.08	1.12	1.08		
McBrayrie				.80	.81	.96	1.05	1.02	1.03	1.13	1.04	1.01	1.00	1.06	1.08	1.09	1.08	1.08	1.08	1.03	1.14	1.22	1.15	1.10	1.05	1.06	1.04		
Foreman		.70	.71	.91	1.05	1.05	1.12	1.09	1.19	1.22	1.26	1.26	1.31	1.25	1.23	1.16	1.16	1.16	1.14	1.11	1.05	1.06	1.02	1	1.01				
Good			.74	.79	.91	1.04	1.10	1.07	1.01	1.16	1.13	1.10	1.07	1.05	1.08	1.10	1.19	1.13	1.11	1.11	1.08	1.04	1.06	1.02	1.01	1.03			
McFadden			.70	.71	.96	1.03	1.03	.99	1.00	1.16	1.22	1.03	1.00	1.01	1	1.10	1.1	1.1	1.13	1.13	1.08	1.08	1.1	1.09	1.15	1.15			
Rutherford		.74	.74	.95	1	1	.98	.99	1.03	1.2	1.22	1.10	1.13	1.14	1.15	1.12	1.06	1.02	1.04	1.03	1.12	1.13	1.06	1.07	1.05				
Robertson						.70	.91	1.06	1.09	1.25	1.11	1.17	1.25	1.17	1.21	1.22	1.22	1.14	1.23	1.2	1.13	1.08	1.07	1.05	1.1	1.07	1.04	1.04	1.0
Average		.77	.77	.86	.94	.98	1.02	1.02	1.04	1.10	1.11	1.08	1.09	1.09	1.11	1.10	1.09	1.08	1.12	1.09	1.09	1.08	1.08	1.06	1.07	1.08	1.04	1.03	1.0

TABLE III

TO SHOW THE EFFECT OF SERUM ON THE INDEX ON THE SAME DAY AFTER
ADMINISTRATION

Antistreptococcus Serum ii

Day of Serum	1	2 ^x	3	4 ^x	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Alloch	.82	.82	.95	.96	1	1.11	1.05	1.01	1.04	.95	.96	.99	1.04	1.02	1.05	1.06	1.0	1.05	1.18	1.08	1.07	1.05	1.05	1.08	1.05		
Davidson	.76	.72	.92	.99	1.01	1.01	1.00	1.03	1	1.04	1	.98	1.18	1.07	1.03	1.01	1.07	1.08	1.16	1.13	1.10	1.05	1.02	1.01	.97	1.01	1.04
Grant	.85	.84	.90	.95	.98	.98	1.01	1.01	1.00	1.04	.96	.98	1	1.05	1.13	1.14	1.16	1.17	1.10	1.17	1.11	1.22	1.15	1.08	1.06		
Armichael	.81	.86	.88	.97	1.02	1.03	.98	1	1.12	1.11	1.14	1.2	1.25	1.11	1.08	1.05	1.08	1.15	1.1	1.07	1.04	1.08	1.04	1.06	1.08		
Forseburgh	.84	.85	.95	1.00	1.02	1.00	1.01	1.10	1.17	1.01	1.05	1.15	1.13	1.10	1.10	1.05	1.08	1.05	1	1.03	1.07	1.07	1.08	1.12	1.08		
Brayrie	.80	.81	.96	1.05	1.02	1.03	1.13	1.04	1.01	1.00	1.06	1.08	1.09	1.08	1.08	1.08	1.03	1.14	1.22	1.15	1.1	1.05	1.06	1.04			
Creman	.70	.71	.91	1.05	1.05	1.12	1.09	1.19	1.22	1.26	1.31	1.25	1.23	1.16	1.16	1.16	1.16	1.14	1.11	1.05	1.06	1.02	1	1.01			
God	.74	.79	.91	1.04	1.10	1.07	1.01	1.16	1.13	1.10	1.07	1.05	1.08	1.10	1.19	1.13	1.11	1.11	1.08	1.04	1.06	1.02	1.01	1.03			
Fadden	.70	.71	.96	1.03	1.03	.98	1.00	1.16	1.22	1.03	1.00	1.01	1	1.10	1.1	1.1	1.13	1.13	1.08	1.08	1.1	1.09	1.15	1.15			
Wetherford	.74	.74	.95	1	1	.98	.99	1.03	1.2	1.22	1.10	1.13	1.14	1.15	1.12	1.06	1.02	1.04	1.03	1.12	1.13	1.06	1.07	1.05			
Bertson		.70	.91	1.06	1.09	1.25	1.11	1.17	1.25	1.17	1.21	1.22	1.22	1.14	1.23	1.2	1.13	1.08	1.07	1.05	1.1	1.07	1.04	1.04	1.01		
Average	.76	.77	.92	1.01	1.03	1.05	1.03	1.08	1.12	1.08	1.08	1.09	1.12	1.09	1.12	1.08	1.09	1.09	1.10	1.08	1.08	1.07	1.06	1.06	1.04	1.01	1.04

^xThe days on which serum was given

TABLE IV

Table IV

TO SHOW THE EFFECT OF SERUM ON THE OPSONIC INDEX WITH REGARD TO
THE DAY OF ILLNESS

Aronson's Serum i

Day of Illness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
Hunton														.50	.62	.85	.55	.42															
Walker		.66	.66	.66	.83	1.10	1.15	1.11	1.10	1.08	1.07	1.09	1.07	1.05	1.03	1.1	1.09	1.08	1.12	1.07	1.10	1.03	1.02	1.01	1.02								
Robertson				.64	.66	.63	.81	1.11	1.13	1.13	1.19	1.17	1.1	1.09	1.08	1.04	1.04	1.03	1.01	1.01	1.01	.98	1.05	1.04	1	1.01	1						
Vaughan			.70	.62	.63	.83	1.08	1.13	1.11	1.17	1.13	1.12	1.11	1.06	1.03	1.06	1.1	1.01	1.07	1.05	1.04	1.02	1.02	1.03	1.03	1.02							
Kelly		.70	.70	.83	1.11	1.06	1.15	1.17	1.17	1.14	1.10	1.06	1.03	1.03	1.06	1.05	1.04	1.07	1.03	1.02	1.04	1.06	1.02	1.07	1.03								
Craib		.65	.66	1.06	1.03	1.12	1.09	1.02	1.11	1.06	1.1	1.04	1.1	1.04	1.03	1.02	1.04	1.01	1.03	1.00	1.04	1.02	1.02	1.02	1.02	1.01							
McVicar				.72	.71	.90	1.01	1.1	1.06	1.03	1.12	1.07	1.01	1.03	1.02	1.01	1.07	1.05	1.02	1.01	.98	1.01	1.01	1.02	1.01	1.06	1.01						
E. Stephen			.64	.64	.97	1.11	1.14	1.15	1.10	1.09	1.07	1.05	1.05	1.05	1.05	1.03	1.02	1	1.04	1.01	1.01	1	1.05	1.02	1.04	1.03							
M. Stephen			.66	.66	.84	1.06	1.12	1.14	1.09	1.10	1.05	1.05	1.09	1.12	1.07	1.04	1.03	1.02	1.02	1	1.02	1.04	1	1	1.01	1.01							
Average		.67	.67	.73	.85	.98	1.07	1.11	1.10	1.1	1.10	1.08	1.07	1.06	1.04	1.04	1.05	1.03	1.04	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.01					

TABLE V

TO SHOW THE EFFECT OF THE SERUM ON THE INDEX ON THE SAME DAY
AFTER ADMINISTRATION

Aronson's Serum ii

Day of Illness	1	2	3*	4	5*	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Hunton			.50	.62	.85	.55	.42																									
Walker	.66	.66	.66	.83	1.10	1.15	1.11	1.10	1.08	1.07	1.09	1.07	1.05	1.03	1.1	1.09	1.08	1.12	1.07	1.10	1.03	1.02	1.01	1.02								
Robertson	.64	.66	.63	.81	1.11	1.13	1.13	1.19	1.17	1.1	1.09	1.08	1.04	1.04	1.03	1.01	1.01	1.01	.98	1.05	1.04	1	1.01	1								
Vaughan	.70	.62	.63	.83	1.08	1.13	1.11	1.17	1.13	1.12	1.11	1.06	1.03	1.06	1.1	1.01	1.07	1.05	1.04	1.02	1.02	1.03	1.03	1.02								
Kelly		.70	.70	.83	1.11	1.06	1.15	1.17	1.17	1.14	1.10	1.06	1.03	1.03	1.06	1.05	1.01	1.07	1.03	1.02	1.04	1.06	1.02	1.07	1.03							
Craib		.65	.66	1.06	1.03	1.12	1.09	1.02	1.11	1.06	1.1	1.04	1.1	1.04	1.03	1.02	1.04	1.01	1.03	1.00	1.04	1.02	1.02	1.02	1.01							
McVicar		.72	.71	.90	1.01	1.1	1.06	1.03	1.12	1.07	1.01	1.03	1.02	1.01	1.07	1.05	1.02	1.01	.98	1.01	1.01	1.02	1.01	1.06	1.01							
E. Stephen		.64	.64	.97	1.11	1.14	1.15	1.10	1.09	1.07	1.05	1.05	1.05	1.05	1.03	1.02	1	1.04	1.01	1.01	1	1.05	1.02	1.04	1.03							
M. Stephen		.66	.64	.84	1.06	1.12	1.14	1.09	1.10	1.05	1.05	1.09	1.12	1.07	1.04	1.03	1.02	1.02	1	1.02	1.04	1	1	1.01	1.01							
Average	.66	.66	.66	.88	1.08	1.12	1.12	1.11	1.12	1.08	1.07	1.06	1.05	1.04	1.05	1.03	1.03	1.04	1.02	1.02	1.02	1.02	1.01	1.03	1.01							

*The days on which serum was given

TABLE VII

TO SHOW THE EFFECT OF SERUM ON THE INDEX ON THE SAME DAY AFTER
ADMINISTRATION

Anti-Diphtheria Serum ii

Day of Illness	1	2 ^x	3	4 ^x	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
McLeod		.70	.73	.70	.83	.72	.63	.65	.71	.70	.80	.83	.80	.81	.88	.86	.84	.85	.87	.87	.98	1.04
Steel	.66	.69	.82	.83	1.04	1.05	1.02	1.06	1.10	1.09	1.02	.96	1.01	1.01	1	1.06	1.02					
Breslin	.68	.68	.84	.83	1.04	1.05	1.08	1.09	1.06	1.13	1.12	1.09	1.09	1.06	1.04	1.04	1.04					
Munro	.72	.71	.84	.83	1.06	1.06	1.08	1.05	1.06	1.02	1	1	.98	1.02	1.02							
Macapia	.72	.72	.83	.72	1.04	1.06	1.08	1.03	1.08	1.06	1.02	1.05	1.05	1.06	1.04							
Hunter		.53	.61	.72	.95	.80																
Average	.69	.70	.83	.83	1.04	1.05	1.06	1.05	1.07	1.07	1.04	1.02	1.03	1.04	1.02	1.05	1.03					

^xThe days on which serum was given

The mechanism of this rise in the opsonic index requires some explanation.

Three theories are possible: 1st, that serum contains an opsonin, either of the nature of a complement or immune body: 2nd, that the serum contains some substance changed by the action of the body into an opsonin: 3rd, that serum contains something which stimulates the production of an opsonin.

1st: A careful study of the various sera under consideration shows that there is no free opsonin present. Opsonic counts were prepared with undiluted sera, and with various dilutions up to a hundredfold, and no opsonin was found in any. In one or two instances, however, very large numbers of organisms were present in individual leucocytes, but as has been suggested this was probably due to incomplete washing of the leucocytes. There is neither complement nor immune substance in the serum of the nature of an opsonin.

In the same connection with this possibility, several lines of investigation are open. At first glance it seems at once obvious that the effect of heated antistreptococcus serum should be investigated, but as it was doubtful whether the heating of the serum might not produce some change injurious to the patient, it was not thought proper to try this experiment. Essentially the same results could be obtained in another way. If the opsonin in the blood depended on some body of the nature of an immune body contained in the serum,

the result of heating would obviously be negative. On the other hand, if the body were of the nature of a complement, Muir's¹¹ method seems equally applicable. In his studies in Immunity, this writer has shown that when serum is filtered through fresh unused Berkefeld filters, the immune body passes through while the complement is retained. Certain precautions have to be taken in the filtration as regards the quantity of serum used for each filter, and the rate of filtration. Following his method in every detail, antistreptococcic serum, sufficient for administration to two patients, was passed through fresh filters. In these patients the opsonic index was observed both before and after the administration of the serum, and the results noted. Charts 37 and 38 demonstrate an increase in the opsonic power of the blood after giving serum. It will be noticed, however, that the rise, though quite typical, is not so rapid as in the cases where the serum was unfiltered. These facts would seek to indicate that the immune body is of more importance.

This would seem to show that the substance, which either stimulates the production of an opsonin or is altered by the body fluids into an opsonin, is of the nature of an immune body, though it must be considered possible that a complement derivative, much more easily able to permeate a Berkefeld filter, than the ordinary complement of the blood, might be present in the serum.

Such related bodies are well known to exist as proteids,

and the early digestion products of proteids.

In this connection, the nature of the actual opsonin content of the blood is of very great importance.

As is well known, opsonins are either labile or non-labile. In view of this fact the nature of the opsonin present in excess had to be considered. For this purpose the sera of two patients, to whom the antistreptococcus serum had been given, were taken. One part of these sera was heated while the other was left unheated. The results of this investigation are given in Table VIII, and it is thus seen that the whole opsonin content is destroyed by heat.

As it might be considered possible, though not likely, that fresh blood was able to produce a change in the opsonifying properties of the antistreptococcus serum, the sera of six patients were taken and a part of each sample heated to 55° C. for half an hour.

TABLE VIII

Showing the result of the experiment to determine the exact nature of the opsonin present in excess after administration of serum.

Day of Illness		4	5	6	7	8	9	10
Control	Av. no. of organ per leuc.	3.7 0	4.2 0	4.1 0	4 0	4.6 0	4.6 0	5.2 0
A. M.	(Unheated (Heated	3.3 .1	4.2 .0	4.3 .01	4.3 .03	4.9 .06	5.3 .06	5.6 0
J. D.	(Unheated (Heated	3. 0	3.7 0	3.8 .02	4.1 .04	5. .05	5.8 .02	5.7 .04

TABLE IX

Table showing the effect of heating patients' serum to 55° C. for half an hour, and adding an equal quantity of antistreptococcus serum. In each case a control of unheated and unheated mixed serum was made.

Name	Unheated Serum	Unheated Serum & Antistrept. Serum	Heated Serum	Heated Serum & Antistrep Serum
Control	Av. per leuc. 4.8	Av. per leuc. 5.2	Av. per leuc. .32	Av. per leuc. 0
A. C.	" " " 5.8	" " " 5.2	" " " .32	" " " 0
M. C.	" " " 5.8	" " " 3.6	" " " .3	" " " 0
M. S.	" " " 4.6	" " " 4.2	" " " .52	" " " 0
A. C.	" " " 4.8	" " " 4.5	" " " .0	" " " 0
A. MoD.	" " " 5.8	" " " 4.8	" " " .0	" " " 0
J. R.	" " " 4.7	" " " 4.2	" " " .0	" " " 0

In each case four counts were made, (a) with normal serum, (b) with normal serum plus antistreptococcus serum, (c) with normal heated serum, and (d) with normal heated serum plus antistreptococcus serum.

Table IX, in which the results of this experiment are given, shows that the supposition given above receives little support. This is what would be expected in the light of modern physiology. Bodies which can digest or alter albuminous substances seem for the most part to require time for their production and not to exist primarily in the blood. The latter part of the experiment, C. & D., corroborates the remarks of the preceding paragraph.

CONCLUSIONS

The experiments do not conclusively show whether the substance in the antistreptococcus serum is a stimulant of opsonin, or whether the opsonin found in the blood is formed out of some body existant in the serum. Against the view that it is a stimulant is the fact that it is in general more easy to stimulate the formation of immune bodies in the human organism than of complementary substances. So little is known of the whole subject that too much cannot be made of this. On the other hand equally little is known of the

chemical alterations in the complement group of substances.

On analogy of proteids, as already indicated, however, a certain amount may be surmised. Related groups of proteids with larger and smaller molecules are well known, e.g., albumins and peptones. Associated groups of active and non active ferments are thrown thus, the inactive pepsinogen of the stomach changes into active pepsin, and the inactive trypsin of the pancreas is activated by the entero kinase of the duodenal glands. The fact that a certain amount of the activating substance is withheld by the Berkefeld Filter, suggests the relationship of the soluble and insoluble proteids and of the active and inactive ferments. If this is the case the larger molecule must be associated with more active opsonizing powers. In this respect MacGregor's¹³ observations in cerebro spinal fever on the relationship of bacterio opsonins and erythro opsonins may be recalled, the presence of the one being associated with the diminution of the other, and vice versa.

It is now possible to review the opinions of previous workers in the light of these experiments. Some of the chief views as to the action of such substances as anti-streptococcus serum may be discussed in detail. Besredka³ has fortunately investigated Aronson's serum. He concludes that only traces of immune body ("fixateur") are present in this serum and that only towards Aronson's streptococcus.

If the immune body were the chief factor in the specific action of Aronson's serum then this serum would be without effect on the organism. From various experiments he determines that a serum may be active without containing immune body, and that it may contain immune body without being active. As regards its action he found that after the administration to an inoculated animal there was a very rapid congregation of leucocytes in the neighbourhood of the organisms. This action he attributed to a stimulation of the leucocytes by the serum.

As regards this stimulating action the experiments already detailed agree, but as previously shown, it is improbable that a purely stimulant action is the only one. Of chief importance in connection with the foregoing experiment is the absence of immune body in the serum, as helping to show that the opsono stimulant is of the nature of a complement.

Neufield and Rumpau¹⁵ conclude that in general a serum which is not antitoxic cannot be bactericidal. They found that antistreptococcus serum, both in vitro and in vivo, caused a phagocytosis, and concluded that phagocytosis was not accomplished until the organisms had been sensitized by the serum. They considered that a sensitizing of the organisms alone was not sufficient for phagocytosis, but that the serum must also exert a neutralizing effect on the toxins.

It has in general been found that the serum alone contains no opsonizing substance, and while it is quite probable that part of its action is antitoxic in nature, yet this would seem only a minor part of the reaction. The finding of an opsonin in vitro is contrary to my experience.

Metchnikoff⁹ regards the leucocytes as being the prime factor in connection with the production of immunity. His experiments demonstrate the fact that the leucocytes of an immunised animal are much more active than those of an animal which has not been immunised, and that when an anti-bacterial serum is injected into the latter, phagocytosis becomes more active. This increased action he attributes to a stimulating effect of the serum on the leucocytes.

This theory given in his work on Immunity is of earlier date than that of Besredka, and has already been commented on.

Wright's¹⁷ work on this subject is too well known to demand recapitulation. In place of regarding the essential part of the process as a stimulation of the leucocytes with Metchnikoff, he considers the sensitizing of the organisms the most important factor. The observations given before are in much closer accord with this view. If a stimulant action exist at all it would seem to be a stimulant action of the production of opsonin by the human organism rather than a stimulant action on the leucocytes.

DESCRIPTION OF SPECIAL CASES

Among the cases under consideration there were four in whom a second attack of Scarlet Fever developed within the first three weeks after admission. In three of these cases the resultant effect on the opsonic index was the same, while the fourth requires a special note. In none of the cases was either of the attacks doubtful.

A fall in the opsonic index was noted in each of the first three, and though the second attack was mild, this fall was considerable. This shows that the opsonic index is not a reliable guide to the severity of the attack. It is to be noted (Charts VIII, VII, and IX, J.S., M.T., and M.C.) that during the observations made before the onset of the second attack the index is low and very variable. A certain upward tendency was noted in all, but up to the time of reinfection, the normal was never reached.

Several charts in uncomplicated cases show the same slowness of rise in the index as exhibited by these three cases. In these charts, however, the rise is not accompanied by the same variation.

After the defervescence of the fever and the abatement of the symptoms, a steady increase in the opsonic count was observed as in normal cases.

The fourth case is one of special interest, and though observations on the opsonic index were not continued for any length of time, several points worthy of special note are

suggested.

The facts of the case are the following:-

The patient, D. K. (Chart XLI), was admitted suffering from a moderately severe attack of scarlet fever, the temperature being much elevated, the fauces intensely congested, and the cervical glands enlarged and painful. Under the routine ward treatment the patient made a good recovery and was soon well on the way towards convalescence. In order to examine the effect of antistreptococcus serum on a patient who had just recovered from the disease and whose index was normal, this boy received 20 c.c. of Messrs P. D. & Co.'s antistreptococcus serum, on the 22nd day of his illness. Ten days later the symptoms of a reinfection of scarlet fever developed with a brilliant scarlatini form eruption, slightly elevated temperature and sore throat. Desquamation began twelve days after this and helped to confirm the diagnosis.

The question of this reinfection is interesting in connection with the studies of Neisser,¹⁴ as to the effect of the presence of excess of immune body.

In treating an inoculated animal with the corresponding antiserum, it has been found that there is a medium dose of the serum which will protect the animal, while a larger or smaller dose will not. Many experiments have been made in proof of this theory, but these do not require recapitula-

tion here, and as the opsonic index in this case was not investigated throughout this secondary attack, further discussion as to the probable cause does not seem profitable.

In the series of cases under consideration there were three cases of scarletinal nephritis, while of the others some eighteen showed traces of albumen in their urines on one or more occasions. Taking first of all these three cases of continued albuminuria, the relationship between this condition and the streptococcus will be discussed.

That streptococci are sometimes excreted in the urine has been proved by numerous observers, and these organisms have also been demonstrated in the scarlatinal kidney either in situ or by cultural methods. If scarlatinal nephritis were a localised streptococcic infection a low opsonic index would be expected.

Wright¹⁷ has shown that in many cases of localised infection the index is lowered, and as will be seen presently, this has been borne out by my own observations.

In two of the cases of nephritis a very low index, .5, was recorded at the outset of this complication (Charts X and XI). As the urine cleared, however, a steady but constant rise in the opsonic index was observed, till, when the urine was completely free from albumen, the index was either normal or above normal.

The third case, however, presents some special points of interest. This patient, G. H. Chart XII, was admitted on

the fourteenth day of illness, with unmistakable signs of nephritis - general oedema, dirty tongue, headache, etc., and both blood and albumen in the urine.

The first index recorded was comparatively high, .94, and even this was the lowest found.

In this case a cause of the nephritis other than a streptococcal infection would seem to be required. Had this organism been the direct cause of the nephritis there is a high degree of probability that the indices recorded would have been the same as those of the two previous cases. This is in accord with experimental work on the urine in scarlatinal nephritis in Belvidere Hospital, when cultures from catheter specimens were uniformly negative.

In Banks'² cases, however, the opsonic index was always low.

Having considered the cases of nephritis, those cases which showed at one time or another traces of albumen in their urines without any evidence of extensive nephritis now demand attention.

In six cases treated with P. D. & Co.'s antistreptococcus serum, in all the cases treated with diphtheria anti-toxin, and in one case treated with Aronson's serum, temporary albuminuria was observed. The number of serum treated cases was not sufficiently large to make definite statements as to the protecting power of the various sera. It is a

question, of course, whether initial albuminuria is due to the same cause as that found later, or is only due to the fibrile disturbance. For this paper, initial albuminuria is defined as occurring before the end of the first week of the disease.

The results of this section are given in Table X. Of the seven cases of initial albuminuria not treated with serum, five showed it within the first week of the disease. In two of these the index was unchanged, in two there was a slight fall, and in one a definite fall. In view of the fact that the index is gradually rising towards the end of the first week, this signifies some definite relationship between albuminuria and diminution of opsonin. The cases treated with serum must be mentioned in this connection, but it can only be stated that in all a rise was observed, as would be expected.

TABLE X

CASES WITH ALBUMINURIA

Name & Chart	Day of Illness	Type of Case	Serum	Effect on Index	Average Temp.
J.S.	5	Moderate severity	None	F.	100.6°F.
F.B.	4, 12, 15	Mild	"	S.F., S. F., S.F.	98.4°F.
F.C.	3, 4	"	"	In. Alb., no change	100.2°F.
A.A.	1,7,14,18	"	"	" F., S.F., S.F.	98.2°F.
M.S.	13	"	"	S.F.	98.2°F.
C.K.	6	Moderate	"	S.F.	99.4°F.
T.A.	19, 22	"	"	F., R.	98.2°F.
C.M.	11	"	P.D. & Co.	S.F.	98.2°F.
H.D.	3, 4, 5	"	"	In. Alb. R.	102.4°F.
A.G.	4 till 12				
M.C.	3				
M.McB.	5, 8				
E.M.					
M.McL.					
M.B.					

For the proper study of these cases of albuminuria they are divided into the usual four groups as given above, and these divisions are considered separately as far as possible.

In the matter of albuminuria occurring during the fibrile period of the disease, however, all the cases must be studied at once, for, while in the serum treated patients an increase in the opsonic content of the blood is noted in this period, in those cases in which there was no special treatment the index remained low. It would appear from this that the initial albuminuria is dependent to a great extent on the action of the streptococcus, and is not due to the fibrile disturbance. This fact is further corroborated by several results obtained in Group II. A typical example is shown in Chart XXXIII, A. G. In this patient the albumen persisted in the urine for the first twelve days of illness. After the administration of serum the index, which was low at the beginning, rose quickly till normal was reached. It varied but little from this figure until after the albumen disappeared, when there was a sudden rise from .98 to 1.18. The serum given was quite sufficient to have raised the index above normal, but apparently not large enough to counteract the influence of the albuminuria. Several other charts in this group give similar readings, though not to such a noticeable extent. These are M. McB., H. D., and M. C. Charts

XXXI, XXXIV, and XXXII.

With a few exceptions throughout this class the reading of the index where albuminuria occurs during the illness is much the same for all cases. Leaving these cases, E. M., M. McL., and R. H., for more particular attention the results obtained have to be considered.

As a general rule the appearance of albumen in the urine is reflected on the opsonic chart by a fall in the index. The average amount of this fall is not great, but is sufficiently so to be noticeable.

Variations from this rule occur in each group, and these deserve a passing note.

In Group I (Chart XIII, T. A.) a slight fall is recorded with the appearance of albumen on the nineteenth day of illness, while three days later, with the same complication a rise is noted.

In the other three groups many exceptions to the rule occur. Some of these are reserved for special note while of the others it is probable that the serum given has been more than sufficient to counteract the effect of the albuminuria on the index. This statement is the more likely to be true since in those cases the complication appears comparatively early in the course of the disease.

Among the cases for special note we find that of E. M. Chart XXXVI. This patient was just recovering from an attack of diphtheria when he contracted scarlet fever, and

was very seriously ill. For over a week his temperature was much elevated, his throat badly ulcerated, and his general condition poor. He received in all 100 c.c. of P. D. & Co.'s serum, and his index was taken night and morning. Albuminuria persisted for a week. The index was low for a few days but gradually reached normal with the improvement in the patient's condition. The quantity of serum given was so much larger than in any of the other cases, and the severity of the attack was so great that it is impossible to say definitely how far the low index depended on the presence of albumen in the urine.

Of the two other cases under this heading one had diphtheria antitoxin (M. McL. Chart LVII), and the other (R. H. Chart LI) was treated with Aronson's serum. Both were cases of exceptional severity and both terminated fatally. How far in such cases the low index recorded was due to the albuminuria is doubtful, the other factors being taken into account. A slight rise in each was noted after the serum administration, but on the approach of a fatal result the index again fell. These two cases with their disturbing factors cannot be taken into this group.

Though observations were made on only three cases of nephritis, these, with the results obtained on albuminuria occurring during the course of the disease, are sufficient to suggest the conclusion that a fairly definite relationship

exists in most cases between streptococcus and nephritis.

With the exception of a single case, G. H. Chart XII, the results of these observations are similar to those obtained by Banks in his work on the subject.

The streptococco opsonic index was observed in the three fatal cases of the series. One was a case of malignant scarlet fever, while the other two were cases of scarlatina anginosa treated with diphtheria antitoxin and Aronson's anti-streptococcus serum respectively.

In the case of scarlatina maligna (J. N. Chart XXII, only two observations were made, one on admission and one six hours later, prior to death. The variation in this time is so small that for practical purposes the index must be regarded as having been steady at the low figure .63.

The longer duration of the disease in the other two cases allowed of rather more extended observations. In the first of these, M. McL. Chart LVII, that treated with diphtheria antitoxin, the index was very low at the first observation, but after the administration of serum, an increased opsonic index followed. For several days this rise was maintained, till the index reached .95 on the day before death, but it fell thereafter to .80.

Here then, the serum, though unable to avert a fatal issue, was sufficiently powerful to raise the index from .53 to .95, when the patient was sinking rapidly.

A similar result is recorded in the case treated with

Aronson's antistreptococcus serum. Three days after the administration of serum the index reached its maximum, .85, an increase of .35 over the first observation. During this time a slight improvement in the patient's condition was noted (History, R. H. Chart LI). However, on the day after the maximum figure was obtained, a drop of .30 in the index was recorded and with the onset of cerebral symptoms a further fall, and just before death the index was .42, the lowest figure recorded.

That this rise in the index was not accidental but was really due to the serum is shown by the fact that the single untreated case observed by myself died with a low index, and in the cases observed by Banks a like phenomenon was observed.

Otitis media purulenta complicated five of the cases of the series. Only one of these is of particular value with regard to the opsonic index, though the others are instructive.

This case, W. H. Chart LVI, was one of those treated with diphtheria antitoxin, and was of moderate severity. Up till the twelfth day of illness no observations of the opsonic index were made. During this period, the patient was moderately ill, the fauces were ulcerated, and the temperature chart showed those evening elevations and morning remissions peculiar to sepsis. On the eighth and tenth days of illness pus appeared from the right and left ears respectively.

As there was no improvement in the patient's condition, he received 6,000 and 4,000 units of diphtheria antitoxin on the thirteenth and fifteenth days of illness respectively, the opsonic index being taken before the first dose. A slight rise in the index followed the administration of the serum. This rise was neither great nor of long duration, for on the seventeenth day of illness a decided fall in the index was noted. On this day the tissues behind the right ear became red and oedematous, and three days later this swelling was incised without pus being found. The effect of this incision was marked, for on the following day a rise of .20 in the index was registered. With the healing of the incision the index recorded became higher each day, and soon after the wound had healed the index reached a normal level.

Four other cases remain to be considered. Two of these were fatal cases and can be quickly dismissed. Both were serum treated, and in both a slight rise in the index was noted after the administration of the serum. There can be little doubt that, though the otitis media was of secondary importance in these cases, this complication helped to keep the index low.

This complication in the case of G. H. Chart XII - one of the cases of nephritis discussed above - set in so quietly that the index showed no variation. In this case the disease was possibly due to an organism other than strep-

tococcus.

In the last case of otitis media, that of K. O'D, Chart XVIII, discussed in detail in another part of this paper, the onset of the complication though heralded by some considerable pain in the right ear was not reflected in the opsonic chart as in the other cases. Here, instead of a fall, there was a slight rise in the index, and though this was followed two days later by a fall, the fact is remarkable.

This result naturally raises the question as to the etiology of the complication, and a doubt raised as to the relationship between the disease and the streptococcus. That this organism was probably the direct cause is shown by the fact that a fall in the index occurred so soon. With regard to this case the question has already been raised as to the presence of streptococci in the lungs.

Studying further the complications of scarlet fever and confining attention to these cases in which adenitis of the cervical glands occurred, we can in all these cases establish a relationship between this complication and either the streptococcus or other organisms which lower the opsonic index towards that organism.

In twelve per cent of the cases this complication was observed, though never so severe as to cause abscess formation. These cases must be separated into two groups because in five of them further factors were concerned in the production of opsonic variation. Of these five, one ended fat-

ally, another was further complicated by nephritis, while the last three occurred in serum treated cases.

Examining the opsonic index in those cases which were under routine ward treatment and which had no other complication, we find that the variation in the index depends almost entirely on the amount of pain present in the glands whether these are large or small. The index is low at the outset of the complication, while as the pain and tenderness diminish, a steady rise in the index is observed.

A typical example of this is shown in the case of J. McL. Chart XXI. On admission the index was comparatively high. The glands were neither painful nor palpable. On the seventh day of illness, i. e., the third after admission, the patient began to complain of slight pain in his neck. The temperature rose rapidly to 103.4° F. and the cervical glands became enlarged. The following day the index dropped to .80, and during the next two days a further fall was recorded, the glands during this time having become very painful. For the next week this persisted and was accompanied by an elevated temperature. All this time the index remained practically stationary at .80. With the abatement of the pain and the swelling and the gradual fall of the temperature a slow rise in the opsonic index was recorded, till, when the pain had completely gone the index was practically normal.

An opsonic chart with much the same variation is re-

corded in the case of R. F. Chart XX, in whom, however, the complication was neither so severe nor of such long duration. Another point brought out in this case was the fall in the opsonic index corresponding to the onset of profuse nasal discharge, with a gradual rise as the discharge became less abundant.

In those cases treated with serum A, and which were complicated by adenitis, the typical character of the opsonic curve was considerably altered. This group contains three cases which are illustrated in Charts XXXIV, XXIII and XXIV, H. D., G. H., and A. F. In all these a similarity in the chart was obtained.

The usual effect of the serum on the index was observed, but unlike the uncomplicated serum treated cases, the indices of which increased considerably above unity, the index in these cases after reaching normal remained at that level for several days. That the height of the index depends on the glandular complication is quite evident from the fact that so long as the glands are painful and tender the level of the index is unaltered, while with the abatement of these symptoms an increase in the opsonic index is observed. There can be no doubt that the glandular affection even when improving, exercises a neutralising influence, and prevents the serum having its full effect on the opsonic index. In the last case of this group an increased dose of serum was given and the ef-

fect of this was to raise the index high above normal, in spite of the fact that a moderately severe degree of adenitis complicated the case.

Recovery from the complication was not more rapid in two of these serum treated cases than in those in whom the usual routine treatment was adopted, but in the third serum treated case the pain and tenderness disappeared more quickly, though the swelling did not.

The two cases left for consideration under this heading can scarcely be taken into account in forming conclusions as to the effect of this complication on the opsonic index. One of them treated with diphtheria antitoxin terminated fatally, while the other was further complicated by nephritis and has already been discussed. In neither of these cases was the adenitis of any severity or of long duration.

The opsonic chart recorded in the case of scarlet fever complicated by rheumatic polyarthrititis deserves special consideration.

This patient (C. H. Chart XIX) was admitted suffering from scarlet fever, accompanied by severe pain in all her joints. Under the appropriate treatment the pain and tenderness soon disappeared and the case ran the normal course of scarlet fever.

Three varieties of joint affections are observed in scarlet fever.

- 1st True scarlatinal arthritis, commonly affecting the small joints and occurring during the second week of illness
- 2nd Streptococcic infection of the joints, either acute or subacute
- 3rd True rheumatic fever following scarlet fever, which has its own etiology and should not be regarded as a complication of scarlet fever

Clinically the case under consideration belonged to the first category. The index throughout was comparatively high, a fact which almost negatives the streptococcal origin ascribed by some writers to this affection.

This is in accord with the observations of McClure,¹² who found, on cultivation, the synovial fluid from these joints uniformly sterile. This brings scarletinal arthritis into line with the demonstrably toxic arthritis which follows the administration of horse serum.

Among the abnormal cases met with during the course of these observations, that of K. O'D, Chart XVIII, deserves particular attention.

It will be seen on reference to the history of this patient's illness, that she was a very poorly nourished child, with lateral spinal curvature, and had a tubercular affection of the lungs. Under treatment her condition improved very materially and at her dismissal the only signs of disease in her lungs was the presence of harsh tubular breath sounds at both apices, accompanied by an occasional rale.

The interesting point about this case is the continued low opsonic index.

In tubercular disease of the lungs when there comes to be a mixed infection, streptococcus pyogenes often plays a very important part. This observation has been borne out by the studies of Menzies⁸ in connection with the treatment of mixed infection in phthisis pulmonatis by antistreptococcus serum.

In view of this fact and of our present knowledge of a negative phase after vaccination, the continued low opsonic index may be explained as being the result of an auto-vaccination.

In this patient, while there were signs of acute mischief in the lungs, the opsonic index remained low, but as the chest cleared up a slight but steady rise was noted, disturbed for a short time by otitis media.

While the foregoing offers sufficient explanation of the continuance of the low index, it is necessary to consider another cause discussed in the more recent studies of Muir.¹¹ He has shown that low opsonic indices to tubercle bacillus and streptococcus commonly co-exist, and this may be a quite sufficient explanation in the case under consideration.

The control experiments were four in number. In these 20 c.c. of P. D. & Co.'s antistreptococcic serum were in-

jected rectally, according to the methods before described. The immediate effect of this was to cause a fall in the opsonic index, which lasted about eighteen hours. This was followed by a rapid rise and an opsonic index, considerably in excess of normal, was then registered. The course of this is seen in Charts XXXIX-XLII. It is difficult to satisfactorily explain the initial fall. Various theories might be suggested, but of none is there any proof in light of what has gone before, and it seems therefore useless to speculate. The results of these experiments, however, are in general accord with those already detailed. In previous cases, the rise in the index was commonly observed twenty-four hours after the administration of serum. The fact that no early fall was noticed after the administration of antistreptococcus serum in scarlet fever might be quite easily explained by the lowness of the index at that time.

The following conclusions are drawn from the work done:-

- 1st That the streptococco opsonic index of scarlet fever, varies in a fairly constant and definite manner, gradually rising with the abatement of the symptoms and reaching normal about the beginning of the third week of illness.
- 2nd That in those cases treated with serum, the index rises quickly above normal, and after remaining high for two or three days falls gradually till it reaches normal about the end of the third week.
- 3rd That in fatal cases the index is always low and that even in such cases where serum has been administered and a rise in the index occurs, a

fall takes place before death.

- 4th That in most cases of albuminaria a fall in the index occurs with the presence of albumen, and thus a relationship between this complication and the streptococcus is rendered probable.

One exception is noted under this heading when the opsonic index was high during the whole of the time when albumen was present, and it is considered that in this case the albuminaria was due to an auto-intoxication.

- 5th When such complications as adenitis and otitis media occur, the curve of the opsonic index is altered. With these complications there is usually a diminution in the opsonic power of the blood.

An exception is noted in one case of otitis media, where a rise in the index is obtained.

- 6th That in cases complicated with rheumatic poly-arthritis, this complication is not due to the streptococcus but that it may be due to an auto-intoxication. This theory, however, does not dismiss the streptococcal cause of certain cases of arthritis.

- 7th That in cases of reinfection of scarlet fever a fall in the opsonic index occurs

- 8th That the administration of serum alters the opsonic curve very considerably. Of the three sera used that of Messrs Parke, Davies & Co. raises the index most, while diphtheria antitoxin is least effective in that direction.

- 9th That a beneficial effect is obtained by administration of serum, the serum of P. D. & Co., giving the best results, while that of Aronson comes next.

- 10th That data for prognosis cannot be drawn from the observation of the opsonic index, though sometimes a low index is recorded a day or two before the onset of any complication.

PRECIPITIN REACTION

That a large number of different anti-bodies co-exist in an immune serum has been amply demonstrated by many observers. Normal sera may contain these anti-bodies, but in very small quantities compared to those present in specific antisera. Of these specific products of immunization the most important are the antitoxins, the agglutinins, the precipitins and the opsonins.

The work of this section is concerned chiefly with a study of the precipitins, and was undertaken with the view of finding whether a specific precipitin reaction could be obtained in scarlet fever, which would enable a distinction to be made between very mild cases of this affection and other diseases with similar symptoms.

A short note is also made on the presence of a haem-agglutinin and a haemolysin, which developed in the anti-serum used for the precipitin reaction.

The work was suggested by a study of Nuttall's¹⁶ experiments on Blood Relationships. He has found that when the serum of one animal is injected into a second an antibody is produced which not only acts as a precipitin towards the blood of the first used, but also towards the blood of allied species. In addition he has demonstrated that urine or any serous fluid has the property of producing the same reaction.

After consideration it seemed useless to attempt to

produce a precipitin with blood as this would have given an antibody specific to human blood and not to the small amount of toxin probably circulating in it. Blood, however, was used for inoculation on one occasion, but as this had been obtained from a cadaver and had not been completely sterilized, the animal died.

It was thought most probable that the urine of a person acutely ill from scarlet fever, would contain a specific substance which might react with the blood serum of a convalescent patient. Following Nuttall's procedure, rabbits were given injections of urines from scarlet fever patients. In the experiments urines from three different patients were chosen. As it was necessary to use the same urines throughout the experiments the original specimens were retained. They were sterilized by heating to 52° C. for one hour on three successive days.

It might seem that heated urine would prove ineffective in producing a specific precipitin, as so many toxins are destroyed by heat, but it must be remembered that although such toxins are in many cases so destroyed by heat as regards their specific toxic powers, yet in this inert state they are equally or almost equally able to produce specific antibodies.

From 100 to 120 c.c. of urine were injected, 10 c.c. being given intraperitoneally every fifth day. A fortnight

elapsed between the last injection and the killing of the animal. The different specimens of urine used were obtained as follows:-

- A A urine in the earliest stage of the disease and containing a trace of albumen - febrile albuminaria
- B The urine as in A, but free from albumen
- C Urine from a case of scarlatinal nephritis, and which contained 2% albumen (Esbach) and also a trace of blood.

The antiserum obtained was stored in Pasteur pipettes, and was tested against serum taken from cases of scarlet fever and diphtheria. To observe the reaction a series of small test tubes, each of 1 c.c. capacity, was arranged in racks, each holding a dozen tubes. Into each a certain dilution of blood serum in normal saline solution was placed, and to each a drop of antiserum was added. The dilutions employed were 1-200, 1-100 and 1-50. The immediate result of the addition of the antiserum was noted, half an hour later another observation was made, and the tubes were left overnight, either at room temperature or in the incubator, and the results noted next morning.

In twelve cases of scarlet fever and twelve of diphtheria, the presence or absence of a precipitin reaction was noted after the addition of each of the three antisera obtained.

The results are given in tabular form, Tables XI and XII.

TABLE XI

PRECIPITIN REACTION IN SCARLET FEVER

Name	Day of illness	Anti-serum	Result			Dilution	Complication
			Immediate	In $\frac{1}{2}$ hour	Next Morning		
.L.	51	A	-	Very faint	Faint	1-50	None
		B	-	"	"	1-50	
		C	-	"	"	1-50	
.W.	13	A	-	Faint	Distinct	1-50	None
		B	-	"	"	1-50	
		C	-	"	"	1-50	
.A.	4	A	-	"	"	1-50	None
		B	-	"	"	1-50	
		C	-	"	"	1-50	
.S.	33	A	-	"	"	1-50	None
		B	-	"	"	1-50	
		C	-	"	"	1-50	
.L.	56	A	Faint	Distinct	No change	1-100	None
		B	-	Faint	Distinct	1-100	
		C	Faint	Distinct	No change	1-100	
.B.	44	A	Faint	Faint	"	1-100	None
		B	"	"	"	1-100	
		C	"	"	"	1-100	
.C.	5	A	Marked	Unchanged	Unchanged	1-100	None
		B	"	"	"	1-100	
		C	Faint	More distinct	"	1-100	
.P.	10	A	"	"	"	1-100	None
		B	Marked	Unchanged	"	1-100	
		C	"	"	"	1-100	
.J.	40	A	Distinct	No change	No change	1-200	None
		B	Marked	"	"	1-200	
		C	"	"	"	1-200	
.C.	12	A	-	Faint	More distinct	1-200	None
		B	Distinct	No change	Unchanged	1-200	
		C	Marked	"	"	1-200	
M.F.	5	A	Faint	Distinct	No change	1-200	None
		B	"	"	"	1-200	
		C	Marked	"	"	1-200	
J.G.	21	A	"	Unchanged	Unchanged	1-200	None
		B	Very "	"	"	1-200	
		C	"	"	"	1-200	

TABLE XII

PRECIPITIN IN DIPHTHERIA

Name	Day of Illness	Anti-serum	Result			Dilution	Complication
			Immediate	In $\frac{1}{2}$ hour	Next Morning		
.G.	6	A	-	-	-	1.50	None
		B	-	-	-	1.50	
		C	-	-	-	1.50	
.H.	64	A	-	-	-	1.50	None
		B	-	-	-	1.50	
		C	-	-	-	1.50	
.McK.	5	A	-	-	-	1.50	None
		B	-	-	-	1.50	
		C	-	-	-	1.50	
.McI.	4	A	-	-	-	1.50	None
		B	-	-	-	1.50	
		C	-	-	-	1.50	
.T.	23	A	-	-	-	1.100	None
		B	-	-	-	1.100	
		C	-	-	-	1.100	
.K.	22	A	-	-	-	1.100	None
		B	-	-	-	1.100	
		C	-	-	-	1.100	
.C.	2	A	-	-	-	1.100	None
		B	-	-	-	1.100	
		C	-	-	-	1.100	
.G.	8	A	-	-	-	1.100	None
		B	-	-	-	1.100	
		C	-	-	-	1.100	
.D.	11	A	-	-	-	1.200	None
		B	-	-	-	1.200	
		C	-	-	-	1.200	
.B.	23	A	-	-	-	1.200	None
		B	-	-	-	1.200	
		C	-	-	-	1.200	
L.C.	34	A	-	-	-	1.200	None
		B	-	-	-	1.200	
		C	-	-	-	1.200	
W.L.	8	A	-	-	-	1.200	Paralyses of Palate
		B	-	-	-	1.200	
		C	-	-	-	1.200	

From these tables it is seen that a precipitin reaction has been obtained in scarlet fever sufficient to distinguish that disease from diphtheria. A control was also made with my own serum, and in every case a negative result was obtained.

In examining the tables we find that with greater dilutions the result is more marked. This is in accord with Nuttall's experiments who came to the conclusion that a precipitin is soluble in excess of any blood serum.

If therefore a reaction take place in a highly diluted serum, that reaction should be regarded as specific. From these results, especially those in which the dilution was 1-200, and in which the reaction was well marked, the specificity of the antiserum is rendered probable. A further result ascertained from these experiments is that little difference in the reaction towards the antisera obtained from the three types of urine is observed. The antiserum C, however, viz., that obtained from the urine of scarlatinal nephritis, gives in the higher dilutions a more rapid and denser precipitate than either of the other two. This fact helps to establish a direct relationship between the onset of nephritis and the cause of scarlet fever.

It is now necessary to discuss the potency of the reaction observed. Nuttall considers precipitin formation with a dilution of 1-100 a good reaction. When, however, it was

present in 1-200 dilution, he considered it more specific. In my observations very definite precipitins were never observed, but they were more marked in general in 1-100 and 1-200 than in 1-50 dilutions. They were not tried in dilutions higher than 1-200. Though not in any case very marked they were yet sufficiently typical. I have unfortunately never seen any of Nuttall's reactions as performed by himself, but judging from photographs they are much more definite than mine, but mine were always definitely present when contrasted with normal blood serum, such as my own. In the antisera from all three rabbits precipitins were undoubtedly present. As already remarked, that from scarlatinal nephritis was most powerful. The contrast between a precipitin obtained with blood serum from scarlet fever and diphtheria was most marked, the latter giving no reaction. The blood serum from scarlet fever patients was taken on various days of illness and tested with the various antisera. It is seen that the reaction is present as early as the fourth day of illness and that it becomes more marked between the second and third weeks. After this period, though a reaction is obtained, it is not so well marked as in the earlier weeks of the disease.

Those experiments are too few on which to dogmatise. It would seem clear that a definite reaction can be obtained in patients suffering from scarlet fever in dilutions of

1-100 and 1-200 at all dates from the fourth till the fifty-sixth day of illness. Unfortunately the reaction was not tried in very mild cases, so all that can be suggested is that in cases of moderate severity a distinction can be drawn between the blood of patients suffering from scarlet fever and other diseases. On analogy of enteric fever, where it is frequently found that high agglutinations are found after passing fibricula⁴, it may be surmised that at least in a certain percentage of doubtful cases of scarlet fever some help to diagnosis may be obtained.

As an addendum to these experiments, though not bearing directly on the subject at issue, it may be stated that it was found that the antiserum from the rabbits in all cases contained a certain quantity of agglutinating substance towards the red blood corpuscles, and also a substance which had a certain amount of lytic action. It would hardly have been thought necessary to mention this had not the urines used to inoculate the rabbits been sterilized by heating. As this is so, it renders more probable the fact that some specific toxin is present in the urine and not sufficiently altered by heat to interfere with the truth of the experiment.

The method for observing the agglutination was as follows. Two dilutions of the patient's blood were made with Tournon's fluid, 1-100 and 1-50, and each of these was tested

against the antiserum in the following manner:-

- (a) Equal parts of antiserum and 1-100 blood dilution.
- (b) Equal parts of antiserum and 1-50 blood dilution.
- (c) Equal parts of antiserum, 1-100 blood dilution and serum from scarlet fever patient to test the effect of this last on the antiserum.

Controls were made as above, with the observer's own blood.

Both microscopic and naked eye appearances were noted in all cases at intervals of 10 minutes and half an hour.

In all, twenty cases were used for these observations and a striking similarity in the results was obtained.

These results are given in Table XIII.

TABLE XIII

SHOWING THE RESULT OF THE HAEMAGGLUTININ REACTION

Name	Day of Illness	Dilutions	Microscopic Appearance in 10 minutes	Microscopic Appearance in 30 minutes	Naked-eye Appearance in 30 minutes	Remarks
1 W.W. ^x	6	A B C	Agglut. begun	Large clumps present	Well marked clump	Fairly rapid reaction
2 D.O. ^x	8	"	"	"	Clumps distinct	Very rapid "
3 L.M. ^x	8	"	"	Well marked agglut.	V. distinct clumps	"
4 W.W.	10	"	"	Large clumps	Distinct reaction	Rapid clumping
5 F.A.	14	"	Commenc. agglut.	Clumps distinct	Distinct clumping	Less rapid clumping
6 J.D.	16	"	"	"	"	"
7 A.A.	18	"	"	Fairly distinct clumps	"	"
8 M.C.	19	"	"	"	"	"
9 M.McK.	21	"	Few clumps	Clump small	Not well marked	Agglut. slow
10 A.P.	22	"	"	"	"	"
11 J.S.	24	"	Slow agglut.	Definite but small	Scarcely noticeable clumps	"
12 R.F.	26	"	"	"	"	-
13 M.S.	28	"	"	"	"	-
14 M.C.	48	"	V. slow agglut.	Clump small but distinct	No clumping seen	-
15 G.McG.	54	"	"	"	"	-
16 E.S.	61	"	Prac. no agglut.	Clumps very small	"	-
17 J.S.	61	"	"	"	"	-
18 M.McK.	65	"	"	"	"	-
19 P.E.	88	"	No agglut.	V. few small clumps	"	1 hr. before clumps were at all distinct
20 G.E.	94	"	"	"	"	"

The control done in each case always gave a negative result as did also dilution C

^xHaemolysin present in dilutions A and B

Several points are observed in this study.

- 1st That a haemagglutinin is present in an antiserum produced by inoculation of a rabbit with urine taken from a patient suffering from scarlet fever
- 2nd It is noticed that in the earlier periods of the disease the agglutination of the corpuscles takes place more rapidly than in the later stages, and that in the former the masses of the corpuscles are larger than those of the latter. This is in accord with what is found in enteric fever.⁶

The haemolysin was much less frequently present, and like the agglutinin appeared early.

The results obtained here are not numerous, but are fairly conclusive as far as they go.

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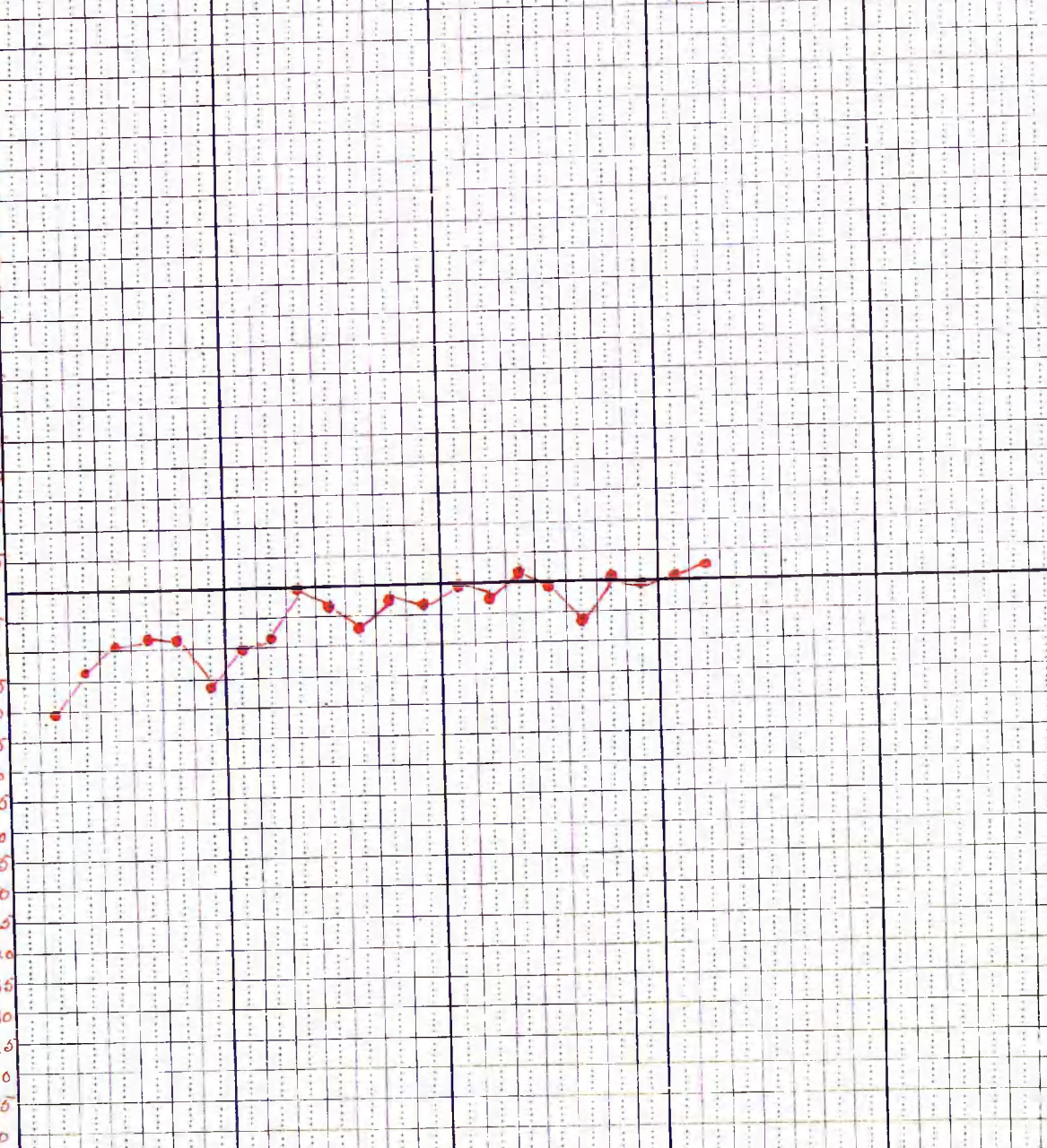
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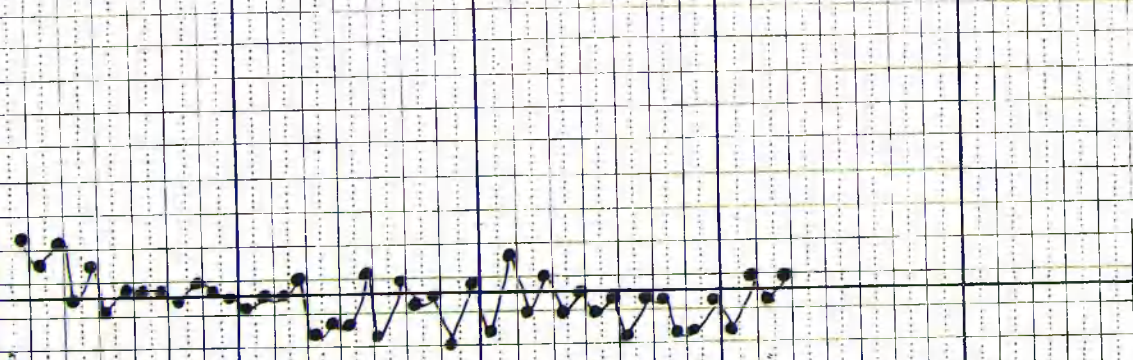
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SD Chart No. 2.

1.95
1.90
1.85
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
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1.15
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95
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107
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98
97



Day of Disease 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

J. D., aet 6 years

Admitted: 21st April, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of headache and sore throat on 20th April. This was followed by a rash which appeared two days later.

Present Condition: On admission Temp. 100.4° F., P. 124, R. 28

The rash has completely disappeared.

The fauces are injected and both tonsils enlarged.

Tongue is coated and the papillae are swollen and congested.

Heart and lungs are both satisfactory.

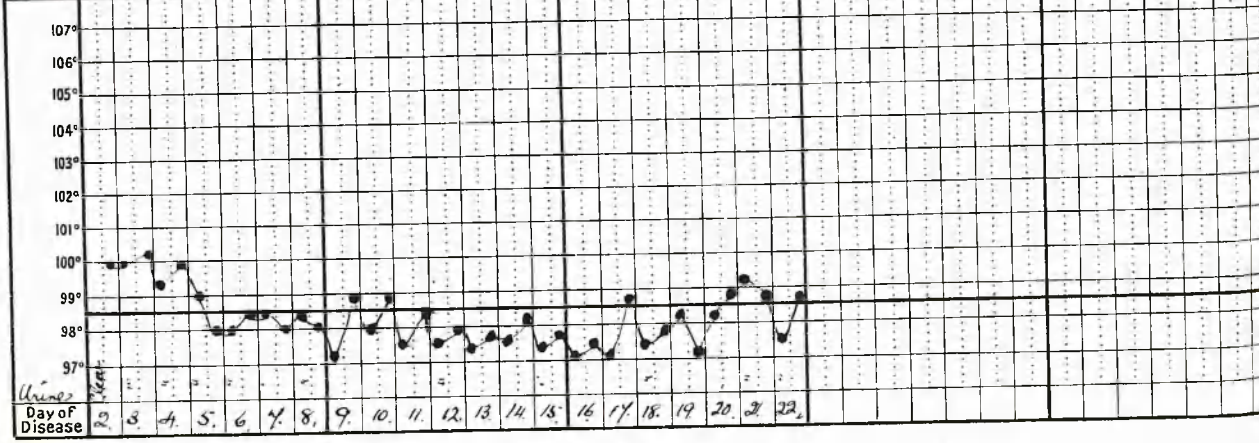
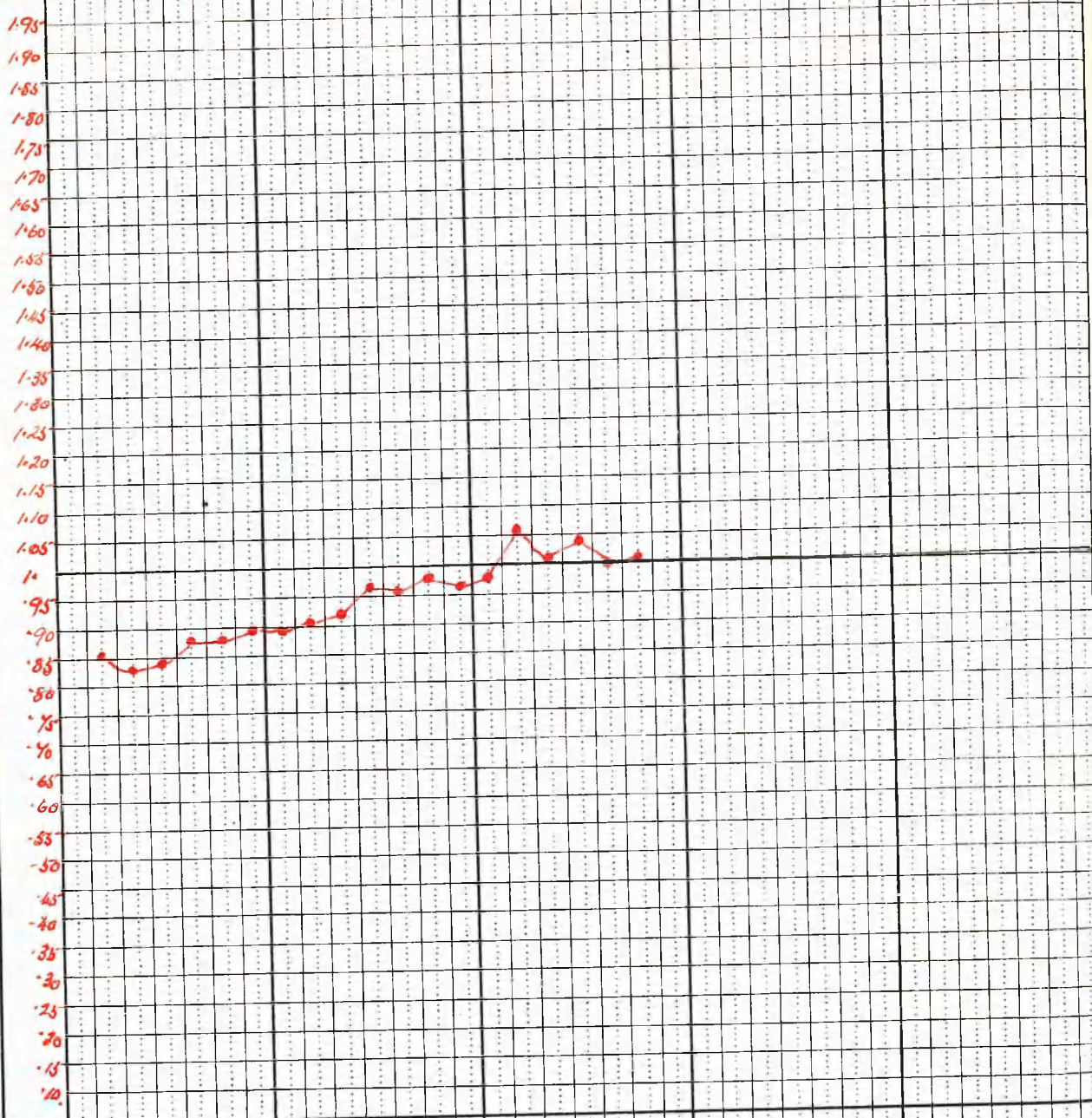
Urine is normal.

Progress: The course of this illness was quite normal.

The throat condition rapidly improving, with an accompanying fall in the temperature.

Desquamation began on 10th day of illness.

Urine remained free from albumen.



Urine:
 Day of Disease: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23

G. D., aet 9 years

Admitted: 30th March, 1909

Previous Infectious Disease: Measles.

History of Present Illness: Patient complained of sore throat and sickness on 29th March. The eruption appeared the following day.

Present Condition: On admission Temp. 99.2° F., P. 128, R. 28

There is a faint erythema present all over the body.

The fauces are slightly congested and the tonsils enlarged.

A thick white fur coats the tongue, which is beginning to peel.

The papillae are enlarged and congested.

Heart sounds satisfactory.

Lungs clear.

Urine is free from albumen.

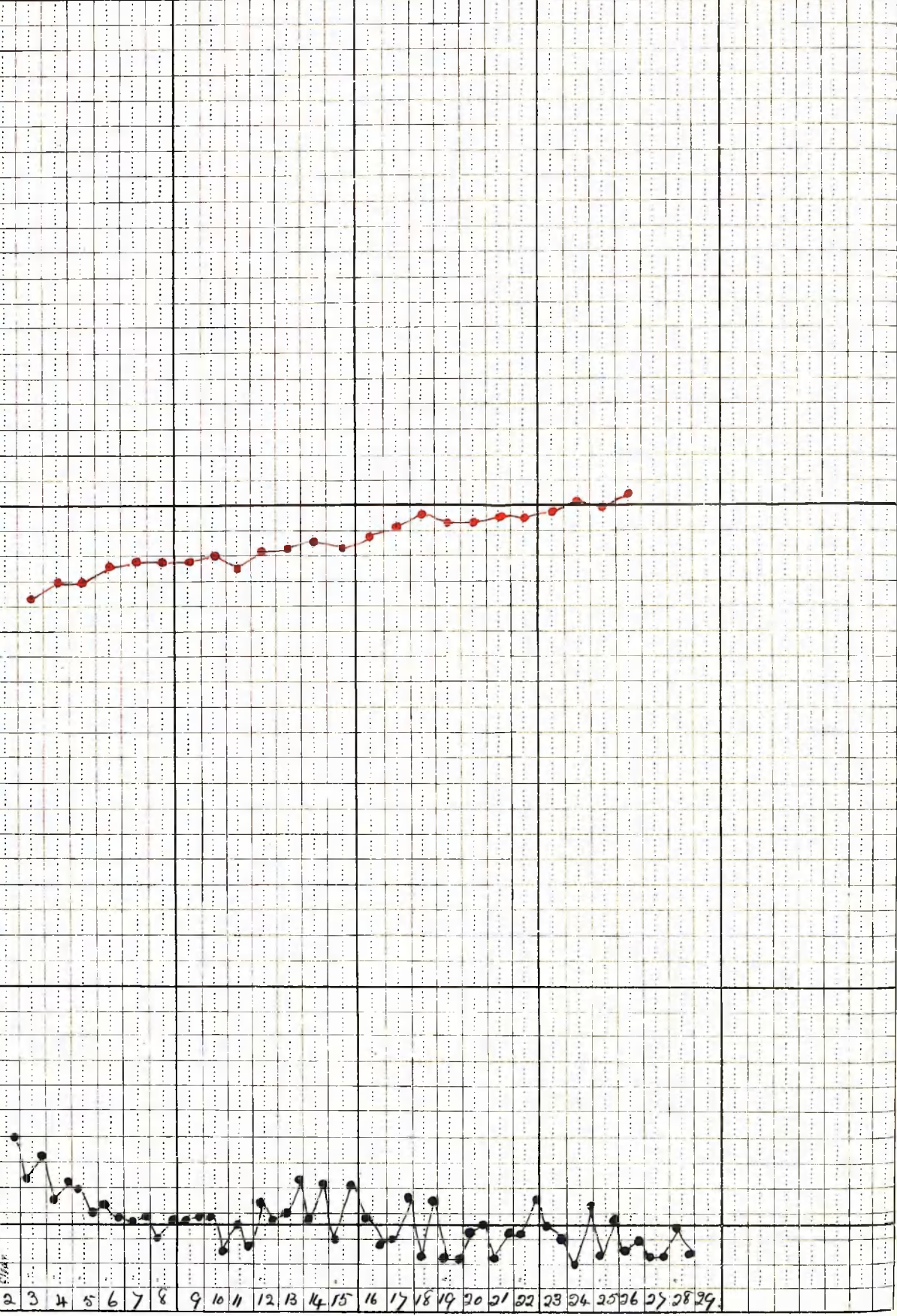
Progress: There is little worthy of note in the progress of this illness.

The local symptoms rapidly disappeared and the patient soon became convalescent.

The urine remained clear.

1.95
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1.85
1.80
1.75
1.70
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1.45
1.40
1.35
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1.25
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0.30
0.25
0.20
0.15
0.10

107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°



Temp. C/F
Day of Disease 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29.

J. McK., aet 9 years

Admitted: 28th March, 1909.

Previous Infectious Diseases: Measles, Chickenpox.

History of Present Illness: Sickness and sore throat were complained of on 27th March. The rash appeared on same day.

Present Condition: On admission Temp. 102° F., P. 146, R. 28

There is a typical rash present all over the body.

The fauces are much congested and are covered with an abundant muco purulent exudate. Both tonsils are ulcerated and slightly enlarged.

The tongue is coated and papillae are prominent.

Heart's sounds are pure.

Lungs are clear.

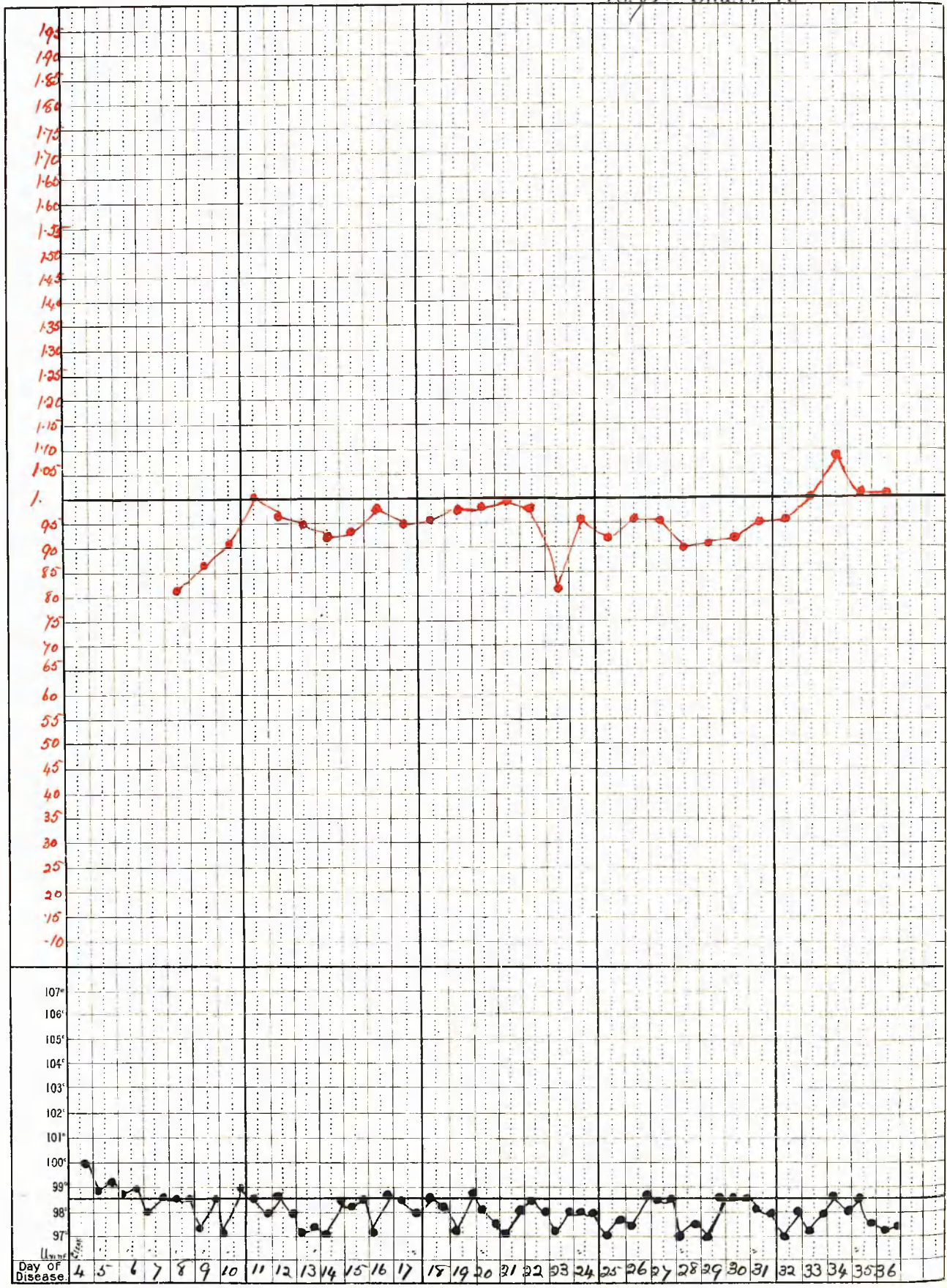
Urine free from albumen.

Progress: Under treatment the symptoms gradually became less severe.

The exudate on the fauces diminished in amount, the ulceration of the tonsils healed up, and soon there was a marked improvement in the patient's condition.

Convalescence established, the patient made an uninterrupted recovery.

The urine was quite normal all through the illness.



R. S., aet 4 years.

Admitted: 15th March, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of sickness and vomiting, headache and sore throat on 12th March. An eruption appeared on his body next morning.

Present Condition: On admission, Temp. 99° F. Pulse 124 beats per minute and respirations 24

A brownish discolouration of the skin suggested the presence of a recent rash.

The fauces were slightly red and congested.

The tongue coated with a brownish white fur, through which the papillae showed red and swollen.

Heart's sounds were rapid but pure.

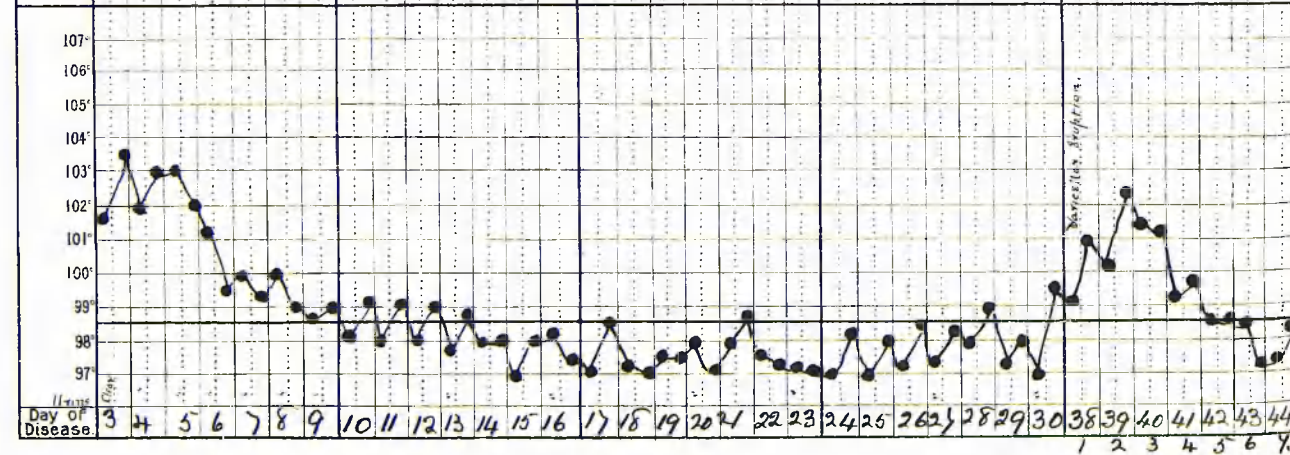
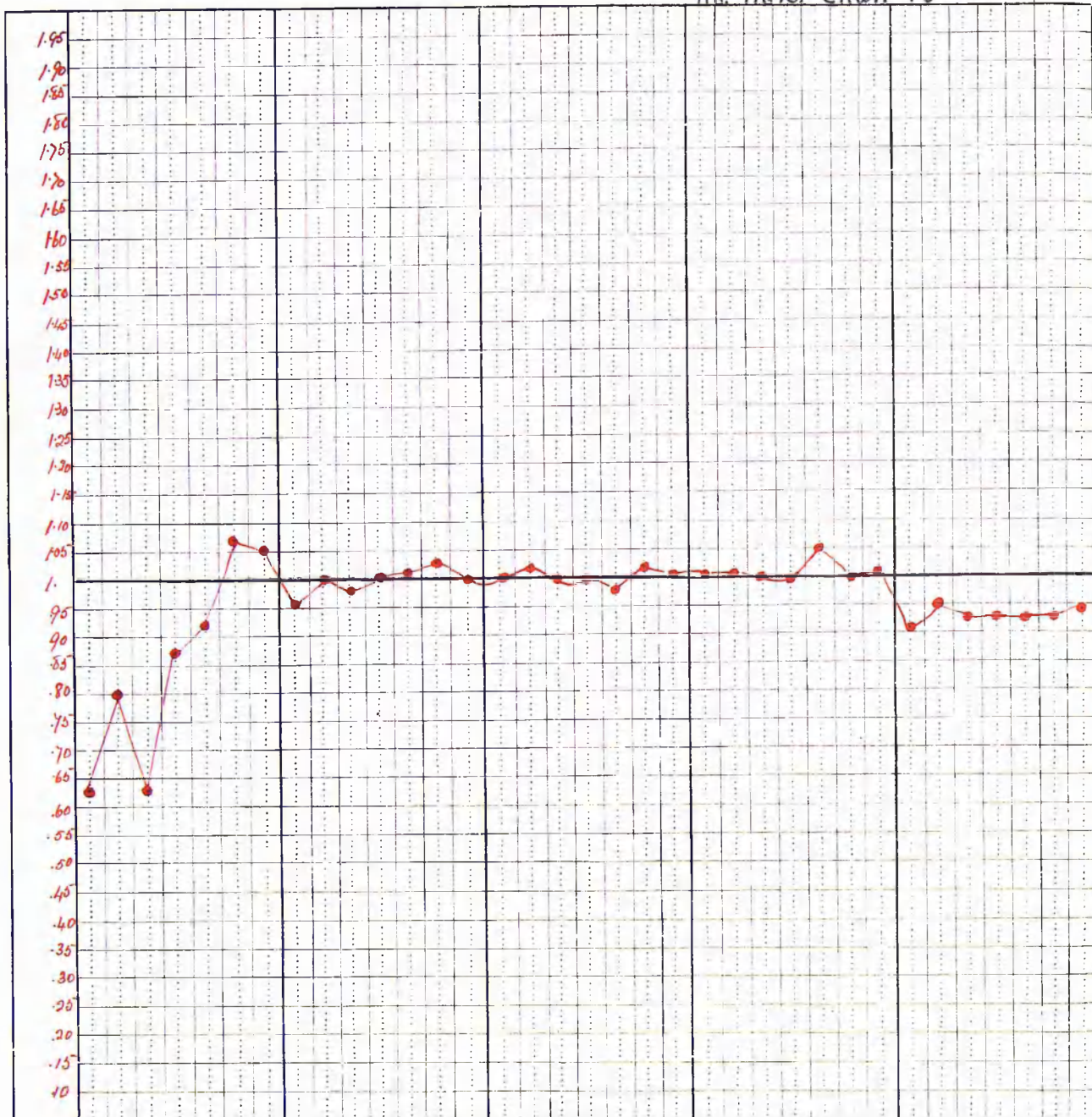
Lungs were free from adventitious sounds.

Urine was quite clear.

Progress: The general condition improved rapidly and the redness of the throat soon disappeared.

Desquamation began on the 12th day, and the patient made an uninterrupted recovery.

The urine was normal throughout the course of the illness.



Paracetamol Injection.

Day of Disease: 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 38 39 40 41 42 43 44

M. McK., aet 5 years

Admitted: 12th February, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of headache, sickness and vomiting and sore throat on 11th February. Rash appeared on 12th.

Present Condition: On admission Temp. 101.6° F. Pulse 136, and Respirations 36 per minute.

Patient is a poorly nourished child and is very pale. He is very ill.

The rash is fading on the body, but is quite typical on the limbs.

Throat is very much congested and oedematous, and the fauces are covered with an abundant mucopurulent discharge.

Tongue is thickly coated and the papillae are prominent.

Anterior chain of cervical glands is quite palpable.

Heart's sounds are rapid and very soft, but are free from adventitious sounds.

Lungs are normal.

Urine free from albumen.

Progress: For two or three days there was very little improvement in the patient's condition either local or general.

The throat remained very much congested and still discharged the mucopus freely.

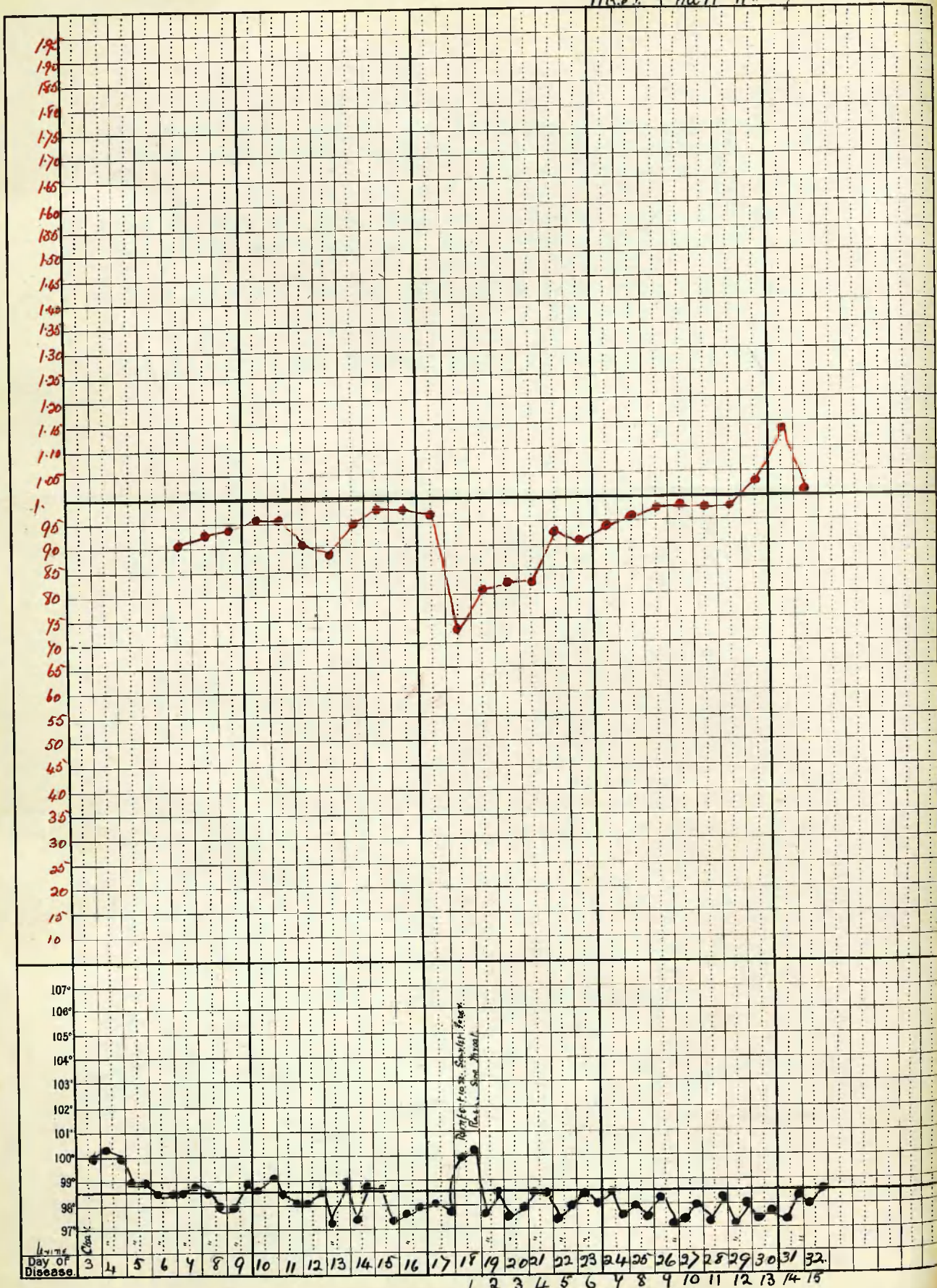
Temperature remained elevated and patient was very ill.

However, an improvement set in and in a short time the congestion had disappeared from the throat, and the temperature became normal.

The cervical glands remained palpable and painful for some considerable time, but they subsided gradually.

Patient developed a typical varicellar eruption on 37th day of illness.

The urine remained clear during the whole of the illness.



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

M. I., aet 6 years

Admitted: 25th March, 1909.

Previous Infectious Disease: Whooping Cough.

History of Present Illness: Patient complained of sore throat and vomiting on 22nd March. Bright red rash appeared on chest on 24th.

Present Condition: On admission Temp. 99.8° F., P. 124, R. 24

There is a bright punctiform erythema all over the body and also a typical varicellar eruption is present.

The congestion of the fauces, and a tongue with enlarged papillae complete the picture of scarlet fever.

Heart's sounds are pure.

Urine is clear.

Progress: The illness followed the usual course, and desquamation began on the 12th day of illness.

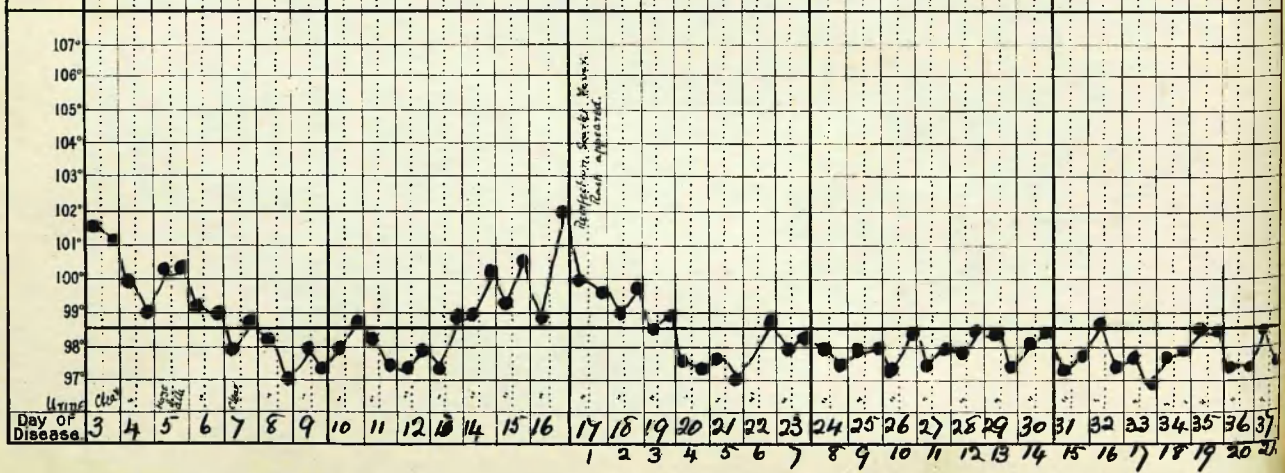
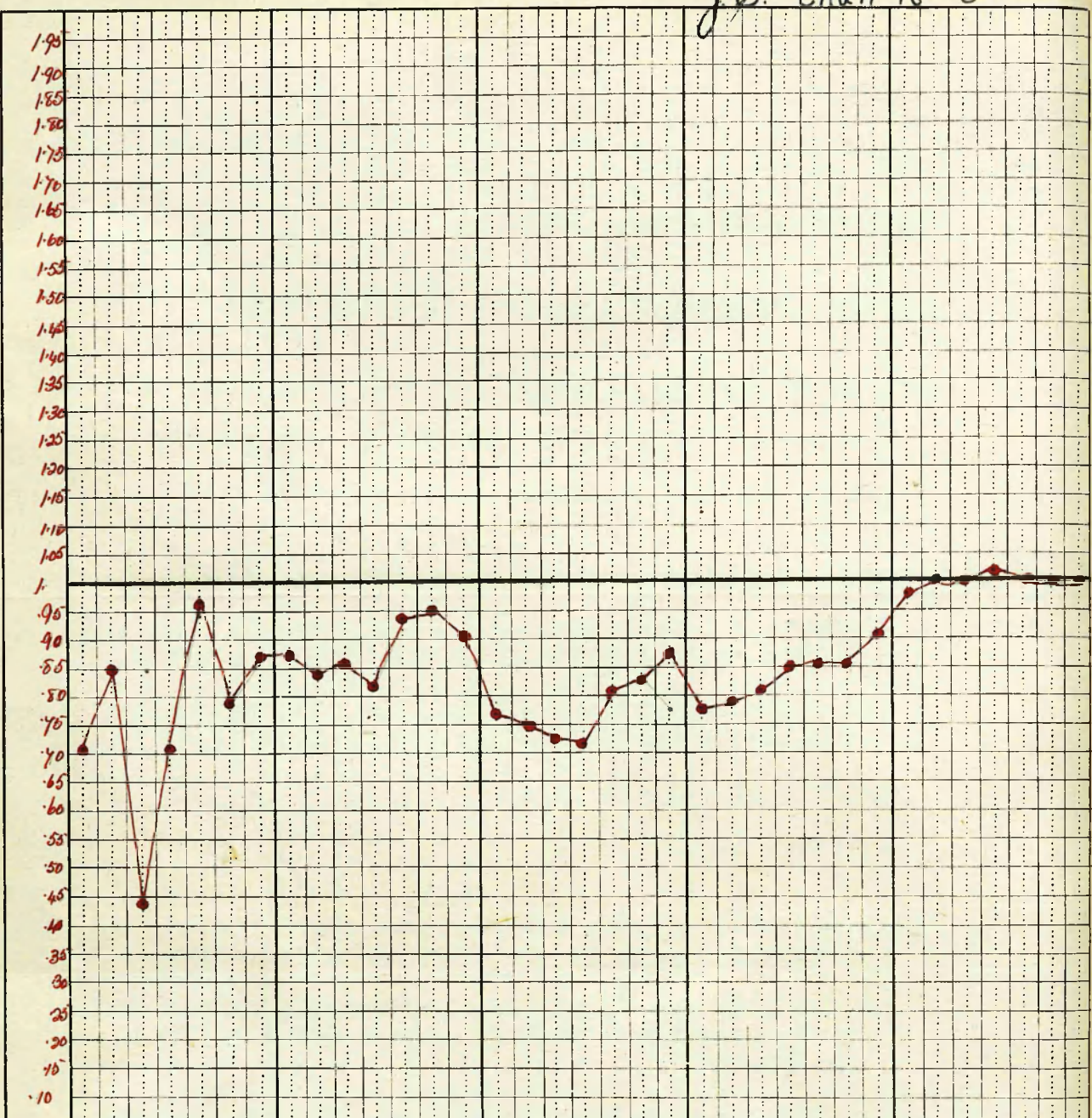
On the 18th day of illness there was a slight elevation of temperature - 100° F., and a faint erythema appeared on the body.

The fauces again became injected, the tongue coated, and the cervical glands enlarged and painful.

These symptoms of a second attack of scarlet fever rapidly subsided and the patient made a good recovery.

The urine remained clear during the whole of the illness.

J.S. Chart No 8.



Day of Disease 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

J. S., aet 2 years

Admitted: 9th February, 1909

Previous Infectious Disease: None

History of Present Illness: Patient complained of sore throat on February 8th. Rash appeared on body on February 9th.

Present Condition: On admission Temp. 101.6° F. Pulse and respirations 140 and 40 per minute respectively.

Patient is a well nourished child but is rather pale.

There is a faint erythema present all over the body.

Pressure dispels the redness momentarily and leaves a yellowish brown colouration.

The throat is typical of scarlet fever, the fauces being much congested and the punctiform rash being present on the soft palate.

A thick white fur coats the tongue, the papillae of which are much enlarged and congested.

Heart's sounds are rapid and rather soft, but are quite pure.

Lungs are free from rales.

Urine is quite normal.

Progress: Under local treatment there was very soon a marked improvement in the condition of the throat. The intensity of the congestion diminished, and the discharge became less, and along with this the temperature and pulse fell to normal.

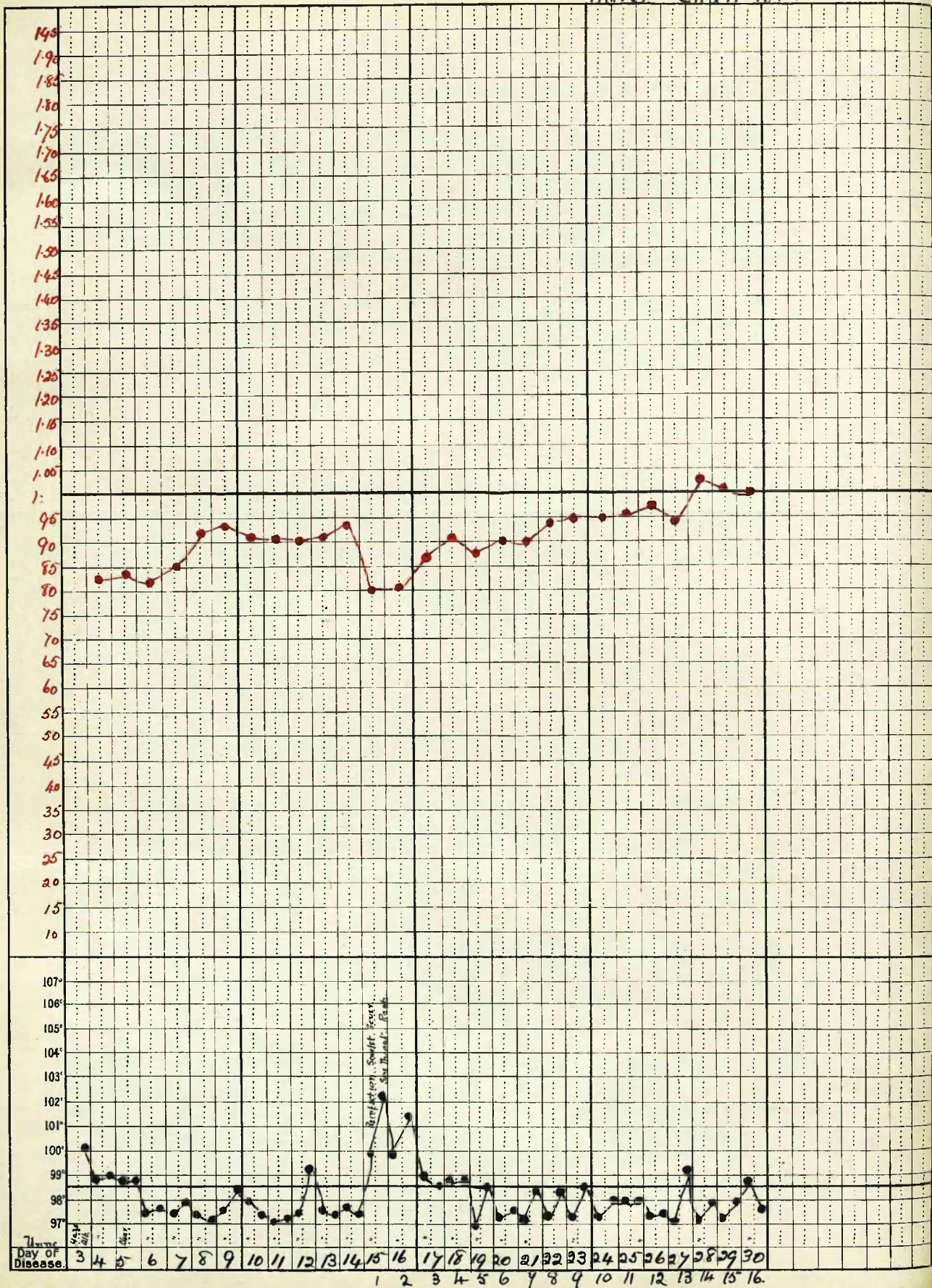
On the 15th day of illness, however, there was a sudden

rise in the temperature to 102° F.

This was due to an exacerbation of the throat condition, which, though there was a faint rash very suggestive of scarlet fever rash, was regarded as follicular tonsillitis from the presence of pus in the tonsillar follicles. This cleared up in a few days and the patient made an uninterrupted recovery.

On two occasions, viz., the 5th and 6th days of illness, did the urine show any trace of albumen, but this was in very small quantity.

*



M. C., aet 7 years.

Admitted; 30th March, 1909.

Previous Infectious Disease: -

History of Present Illness: Patient complained of sore throat on 27th March. A faint rash was noticed next day.

Present Condition: On admission Temp. 100.2° F., p.92, R.22

The rash has disappeared, leaving a brownish discolouration of the skin.

The fauces are slightly congested and the tonsils enlarged.

There is a thin coating of fur on the tongue which is commencing to peel.

The papillae are prominent.

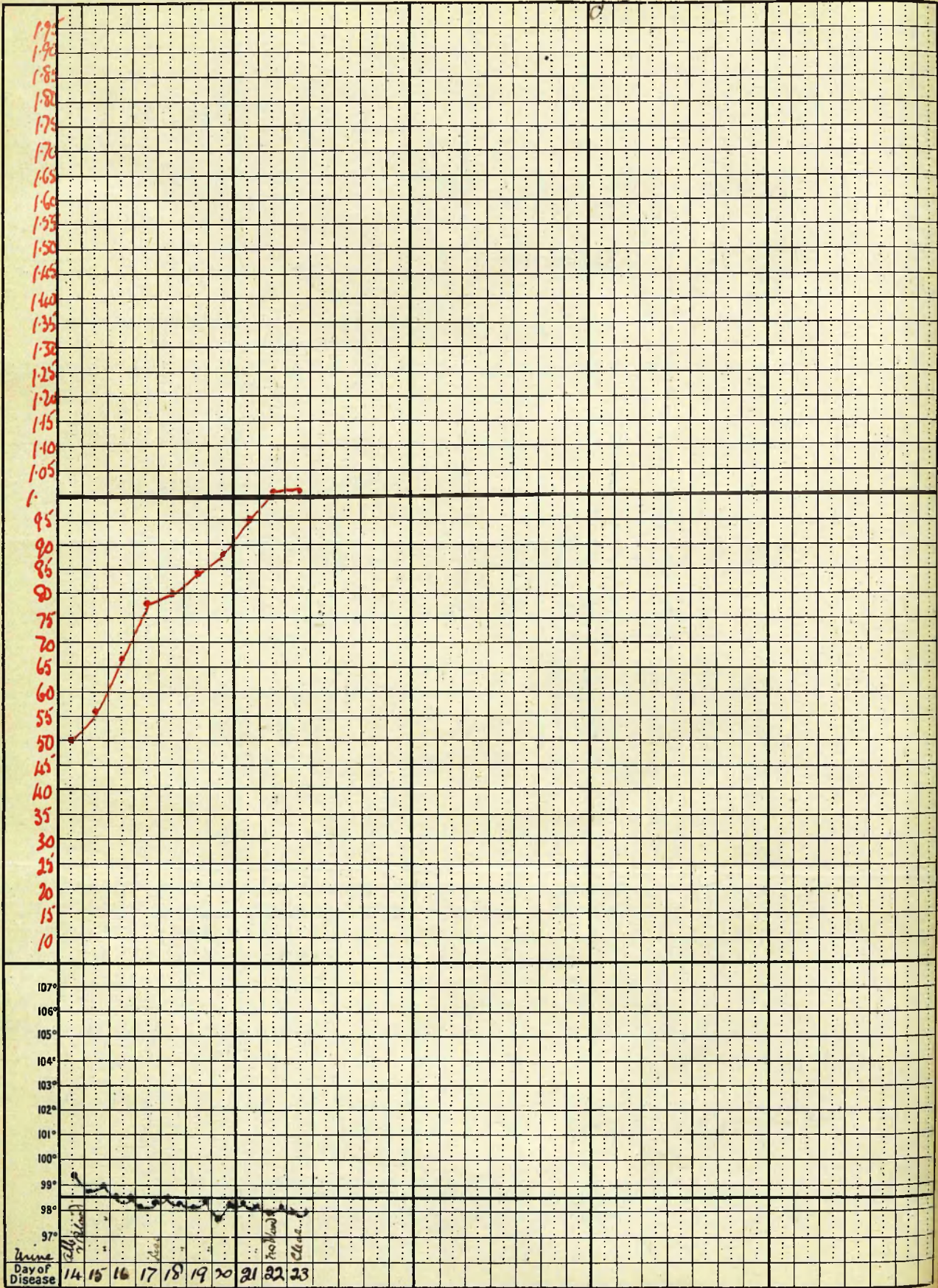
Heart's sounds are pure.

Lungs clear.

Urine contains a trace of albumen.

Progress: The usual course of this illness was interrupted on the 15th day, when, with an elevation of temperature to 102.4° F., and the appearance of a scarlatiniform eruption, there was an evacuation of the throat condition, notably in the tonsils, which showed slight ulceration. In a week, however, these symptoms had disappeared, and convalescence began and continued uninterrupted

Urine contained a trace of albumen on admission, but after this it was quite clear.



J. J., act 5 years

Admitted: 10th September, 1909.

Previous Infectious Disease: None

History of Present Illness: The symptoms developed a fortnight before admission, but were so mild as to attract little attention, and it was not until desquamation was noticed that the nature of the illness was recognised.

Present Condition: On admission Temp. 99.2° F., P. 120, R. 30

Desquamation is proceeding actively on the hands and feet.

The patient is very pale and under the eyes is a certain degree of puffiness.

Oedema of the feet and legs is fairly well marked.

The fauces are a little congested.

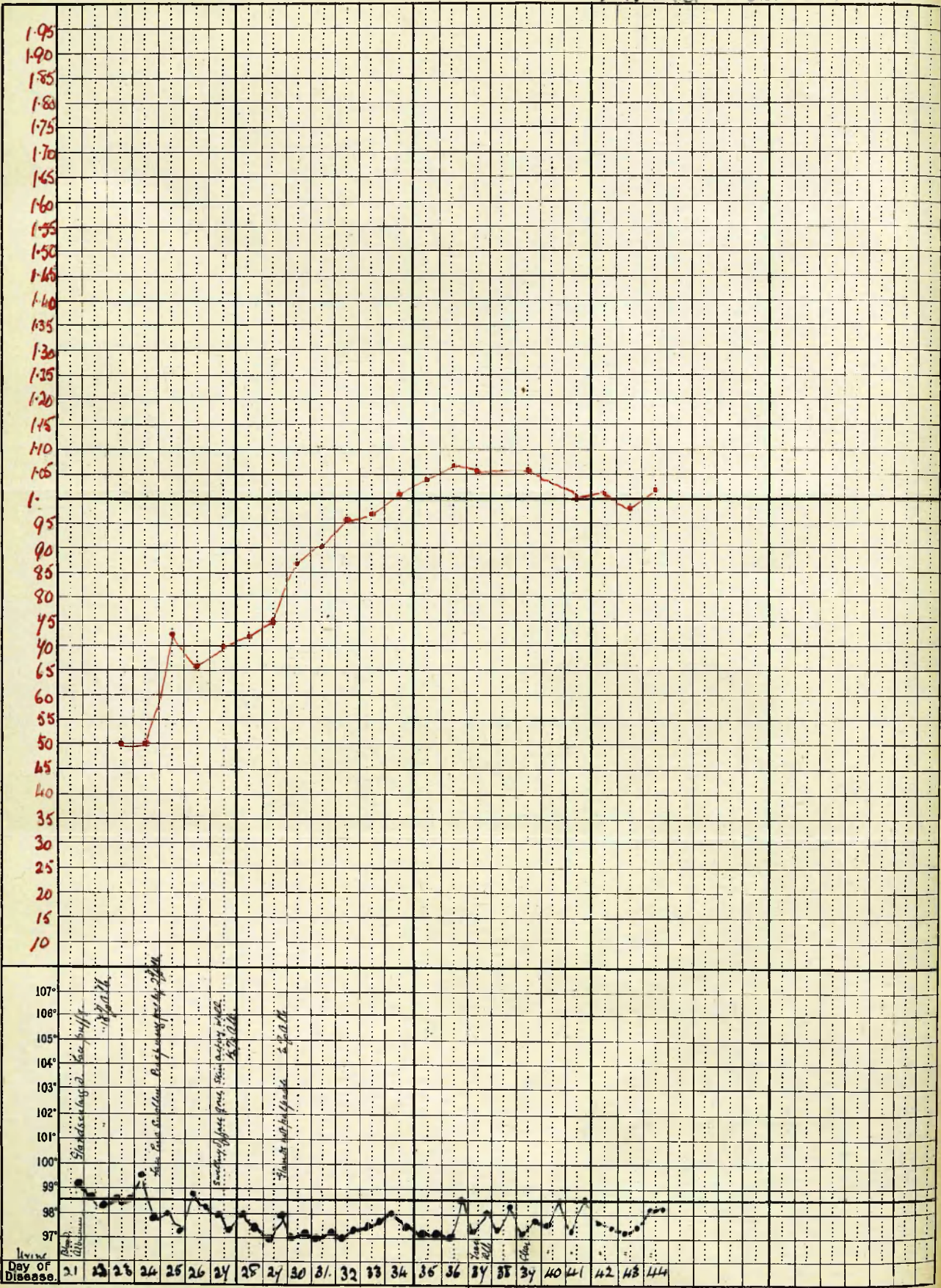
Heart's sounds are pure.

The lungs contain some fine crepitant rales at both bases posteriorly.

Urine: there is a considerable quantity of both blood and albumen in the urine, which is high coloured and has a smokey tint. There is an abundant chocolate coloured sediment, which on microscopic examination is shown to consist of red blood corpuscles, blood casts and epithelial tube casts, some of which have degenerated.

Progress: Under suitable treatment the urine soon cleared up, and at the end of a fortnight was quite free from any abnormal constituents.

The oedema of the legs and feet soon disappeared, and the patient made a complete recovery.



M. McI., aet 12 years

Admitted: 21st July, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Scarlet Fever eight years ago.

History of Present Illness: Symptoms first appeared on 1st July, when patient complained of sore throat, and headache. No rash was noticed.

Present Condition: On admission temp. 99.2° F., P. 72, R. 28

There is no sign of any rash, but desquamation is well marked on hands and feet.

The tongue is very dirty.

Fauces are normal.

Enlargement of the cervical glands on both sides of neck is quite evident.

The heart's sounds are pure.

Lungs clear.

Urine: The urine is small in quantity, is very smoky in colour, and there is a large amount of "chocolate coloured" sediment. Both blood and albumen are present in large quantities.

Microscopic examination shows the sediment to be chiefly red blood corpuscles, blood casts, numerous epithelial tube casts, and a large quantity of epithelial debris. Esbach tube gives 1.75% albumen

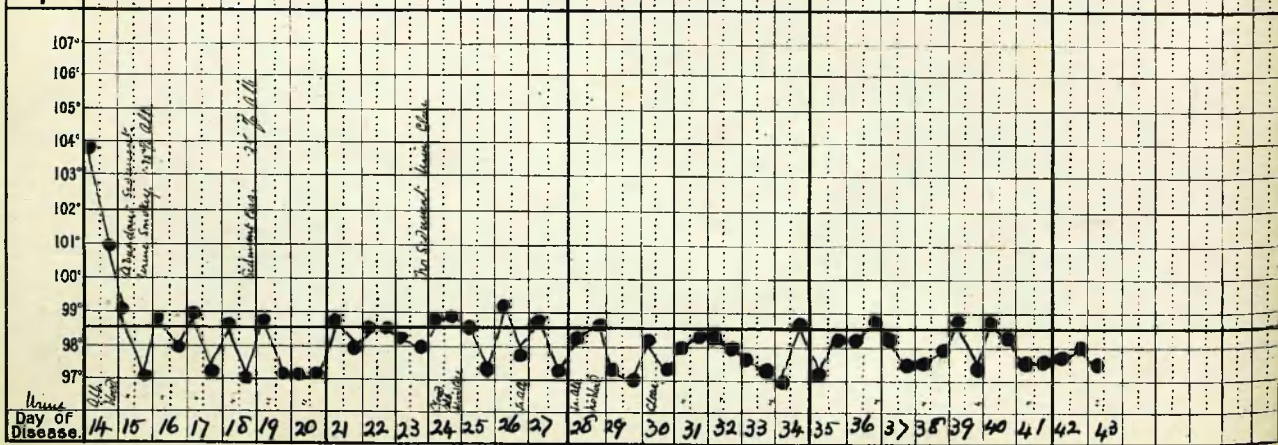
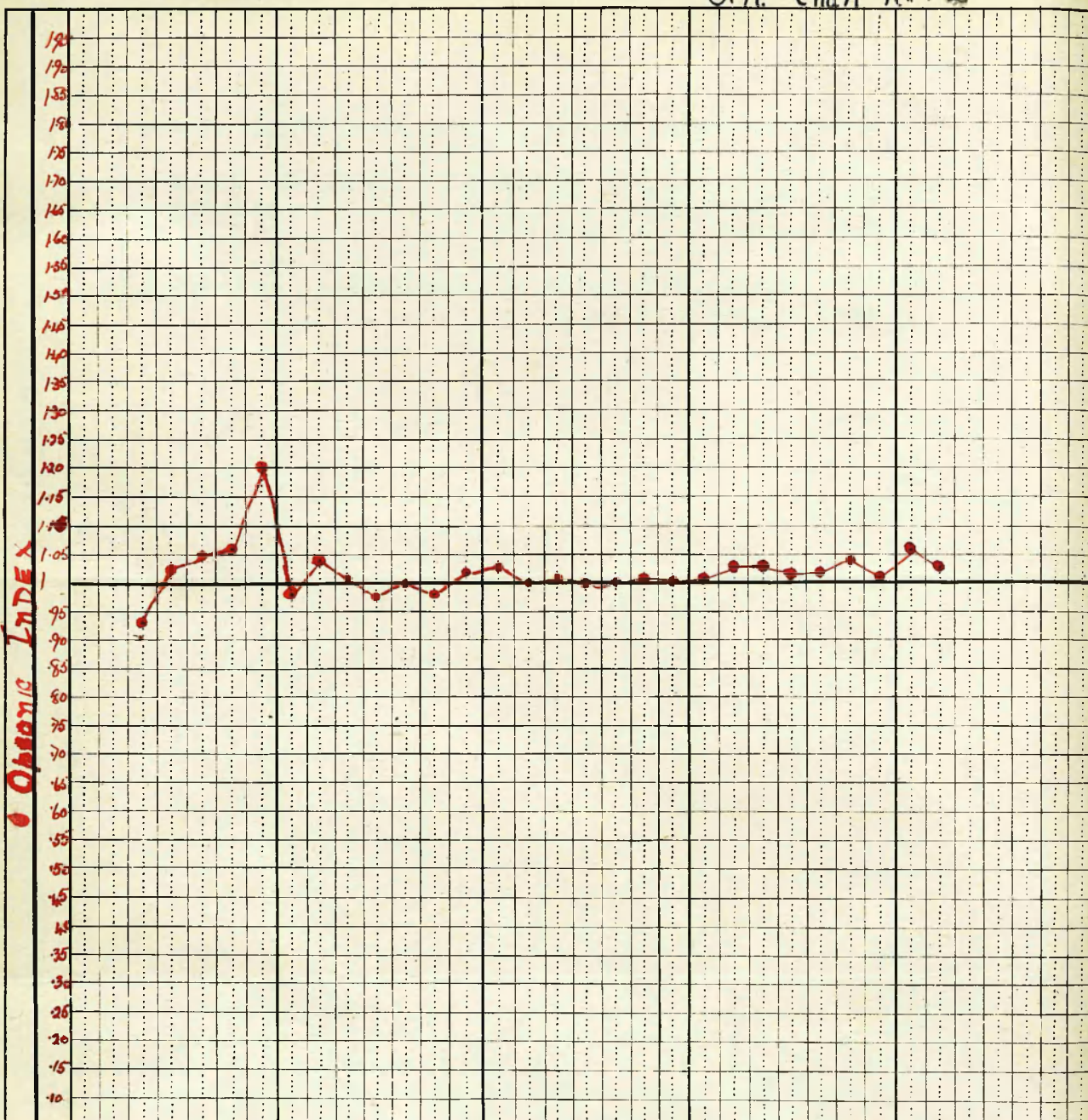
Progress: Under treatment there was a very rapid and progressive improvement in the character of the urine, and in ten days the smoky colour had entirely disappeared. In about the same time, the sediment, which had been

diminishing in quantity, was completely absent.

In a week blood had disappeared from the urine, though the albumen was still present in diminishing quantities for several days after this.

Convalescence was quickly established, and the patient made a good recovery

OBSERVATION INDEX



Time of Day of Disease

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

G. H., aet 5½ years

Admitted: 15th February, 1909

Previous Infectious Disease: None

History of Present Illness: About a fortnight before admission patient was sick and vomiting, and complained of slight sore throat. A few days later a faint blush was seen on his body. This attracted little attention and it was not till desquamation commenced that the true nature of the illness was appreciated. It was noticed at this time that his face, particularly under the eyes, and his legs, were swollen, and that his urine was small in amount and very high coloured.

Present Condition: On admission Temp. 103.8° F. Pulse 120 and respirations 28 per minute

The evidences of scarlet fever are rather indistinct, but quite definite.

Desquamation is active on hands and feet.

The fauces are slightly congested, and the tongue looks as if it had peeled recently.

The general appearance of the patient is very suggestive. He is heavy and dull, complains of severe headache, his breath is foul smelling, and there is very marked oedema all over the body.

The heart's sounds are quite pure but have a slapping quality.

Lungs: Numerous fine crepitant rales are heard all over

the chest.

Urine: Very high coloured and smoky. Large amount of sediment - chocolate coloured - on standing. Constant abundant blood and albumen.

Microscopic examination of the sediment shows abundant blood corpuscles, blood casts, and a few epithelial casts.

Progress: Under treatment the patient's general condition rapidly improved

The urine, from containing 1.5% albumen (Esbach) and abundant blood, rapidly cleared up, till on ninth day after admission only a very faint trace of these were present.

This trace remained for a week longer, getting less every day and ultimately disappearing altogether.

The sediment disappeared in the same way.

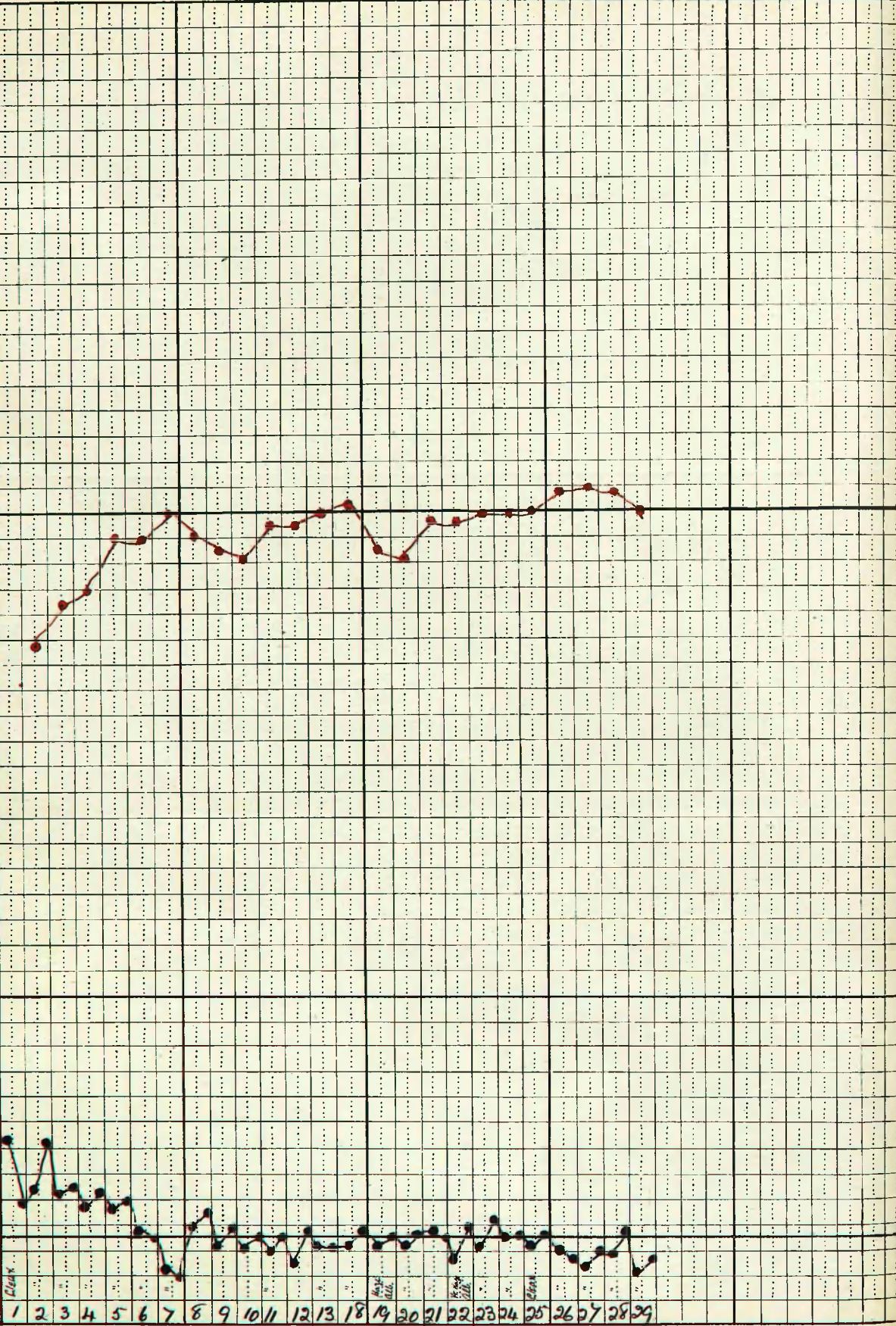
The general condition of the patient improved very rapidly, and soon all signs of oedema disappeared from the chest and legs.

Three days after admission otitis media developed.

There was no particular elevation of temperature and no complaint of pain accompanying this.

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Day of Disease 1 2 3 4 5 6 7 8 9 10 11 12 13 18 19 20 21 22 23 24 25 26 27 28 29

T. A., aet 5 years

Admitted: 11th May, 1909

Previous Infectious Disease: Measles

History of present illness: Patient complained of headache and sore throat on 10th May. The rash appeared on 11th.

Present Condition: On admission Temp. 102.4° F., P. 108, R. 28

All over the body there is a bright rash, which though fading on the chest is still quite typical of scarlet fever on the limbs.

The fauces are much congested and are covered with a very abundant mucopurulent exudate.

The tongue is coated with fur, which is beginning to peel off, leaving that organ red and raw looking.

Heart and lungs are both satisfactory.

Urine is clear.

Progress: For about a week after admission the temperature was elevated, but as the congestion and exudation disappeared from the throat the temperature gradually reached normal.

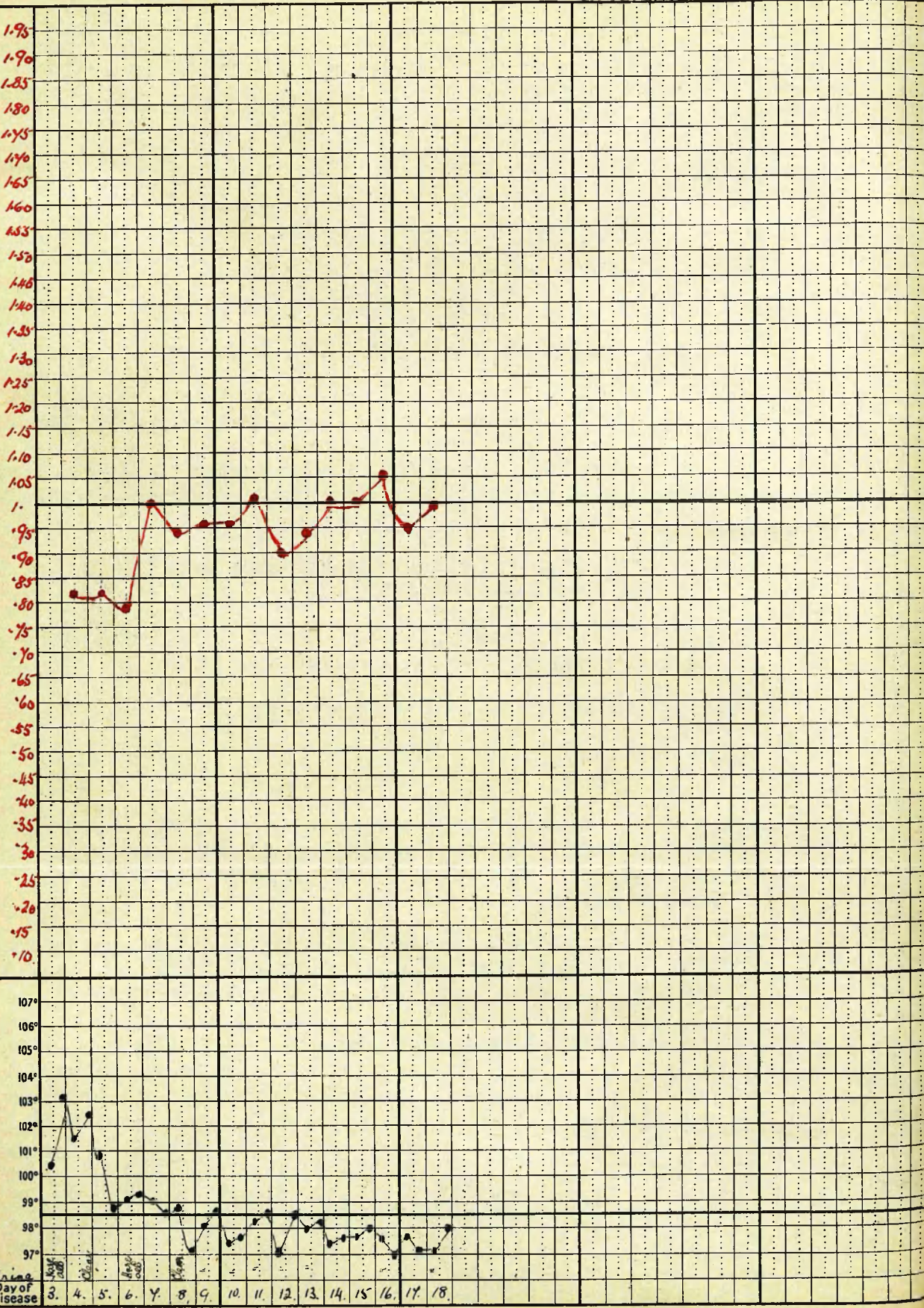
The urine contained a trace of albumen, notably on the 19th, 20th and 21st days of illness. The quantity of albumen was not great, and it disappeared quickly.

Convalescence was uninterrupted.

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Using Day of Disease 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18.



C. K., aet $2\frac{1}{2}$ years

Admitted: 11th May, 1909

Previous Infectious Disease: -

History of present illness: Illness began with sore throat, headache and vomiting on ninth May. No rash was noticed.

Present Condition: On admission Temp. 101.6° F., P. 150, R. 28

There is no rash present, and but little evidence of the recent presence of one.

The fauces are slightly congested and tonsils enlarged.

The tongue is coated and is beginning to peel.

Heart and lungs are satisfactory.

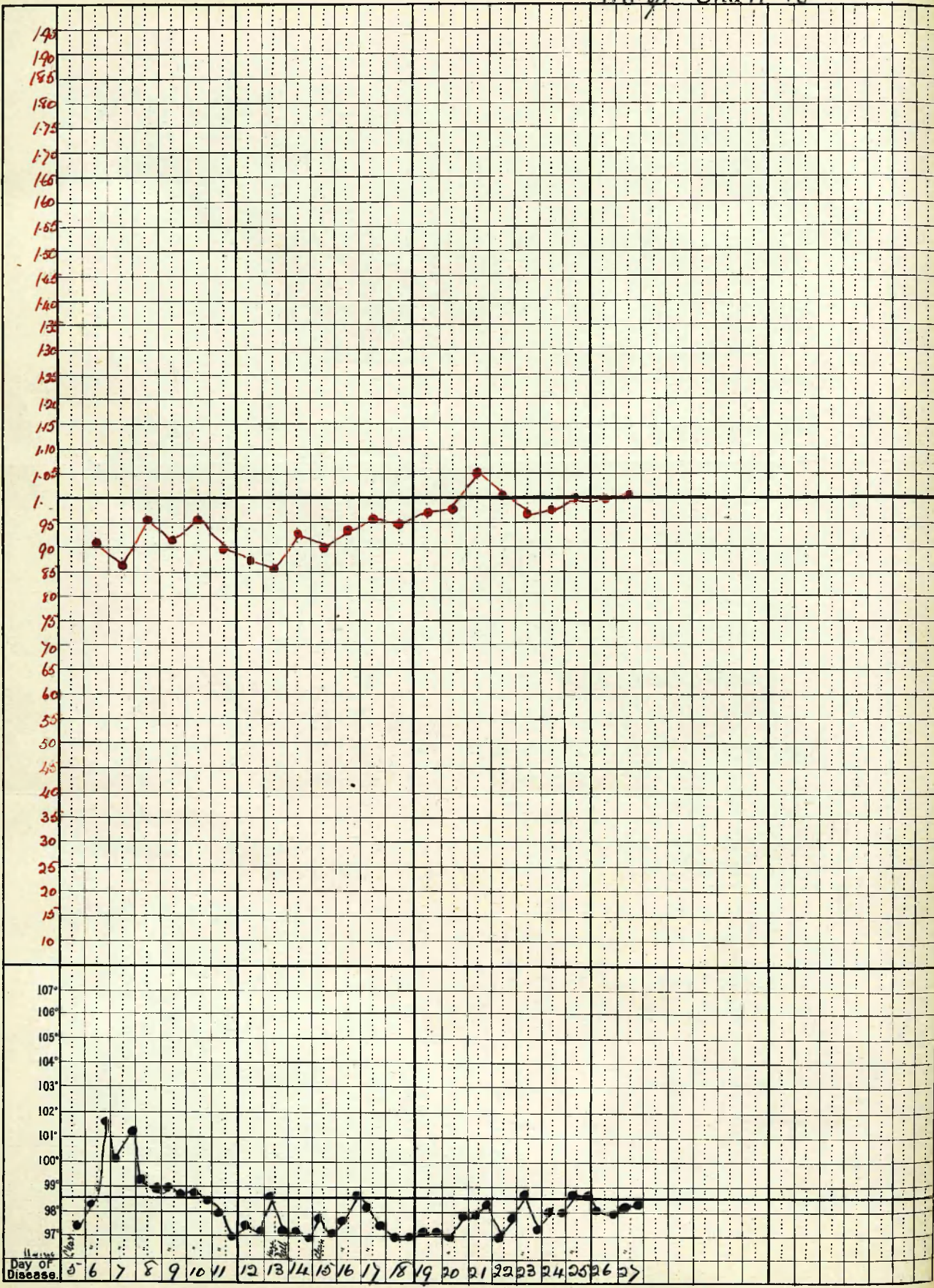
Urine contains a faint haze of albumen.

Progress: The temperature was elevated for two days after admission, reaching 103.2° F. on the evening after admission.

With the rapid improvement in the throat condition the temperature soon became normal.

The urine contained a trace of albumen on 6th day of illness, but otherwise was quite normal.

Convalescence was uninterrupted, and desquamation first began on 12th day of illness



M. S., aet 14 years

Admitted: 21st April, 1909

Previous Infectious Disease:

History of Present Illness: Patient complained of sore throat on 16th April, of headache, sickness and vomiting on 17th, and the scarlet fever eruption appeared on 19th April.

Present Condition: On admission Temp. 97.4° F., P. 136, R. 28

The eruption has disappeared, leaving a brownish staining of the skin.

The fauces are congested, the tonsils red and enlarged.

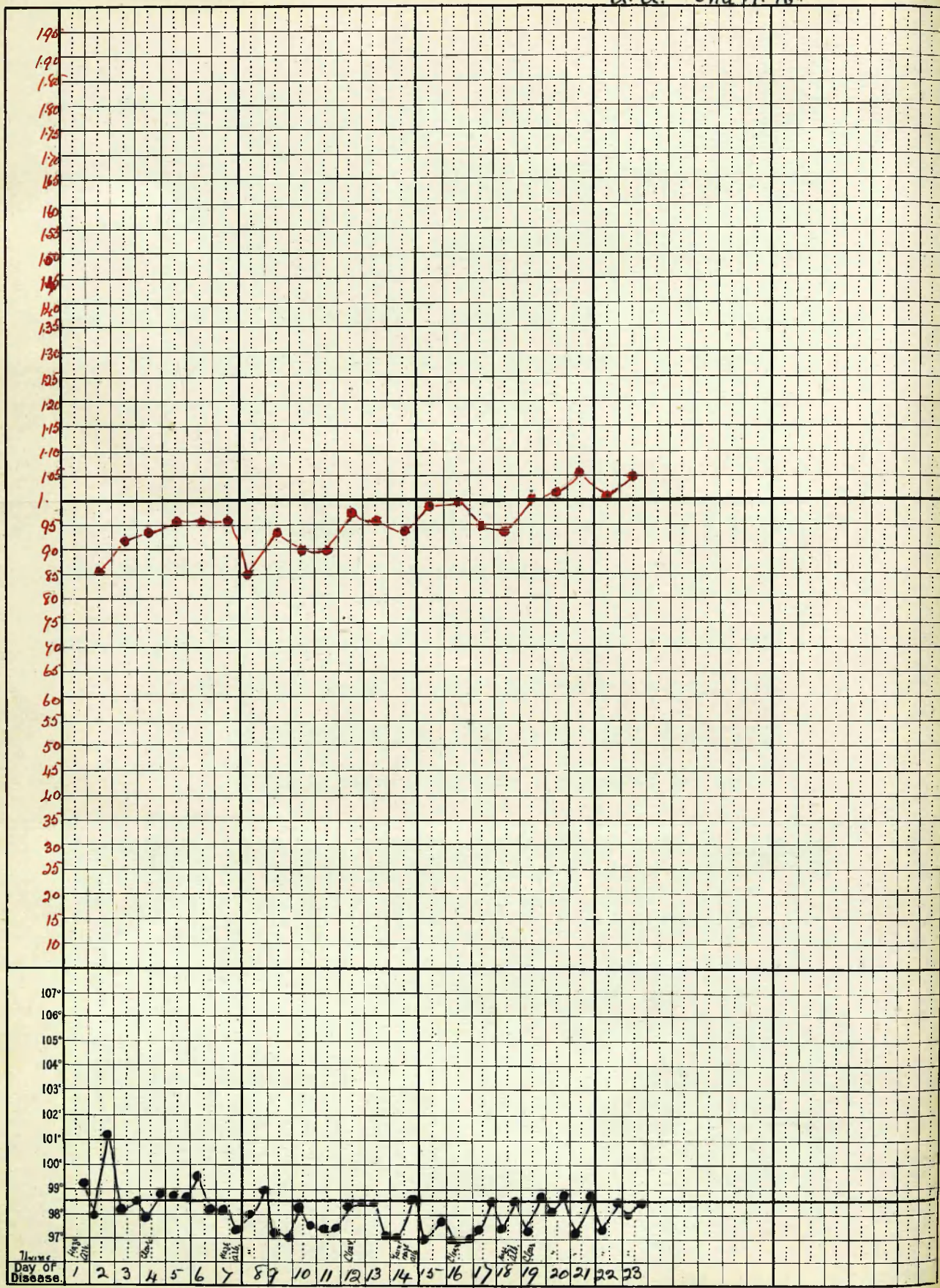
The tongue is coated with a thick white fur.

Heart and lungs are both satisfactory.

Urine is free from abnormal constituents.

Progress: For two days after admission the temperature remained high, but with the abatement of the throat condition it soon became normal, and convalescence was interrupted.

On one occasion the urine contained a trace of albumen, viz., on the 13th day of illness.



Temperature
Day of Disease

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

A. A., aet 2 years

Admitted: 21st April, 1909

Previous Infectious Disease: -

History of Present Illness: A rash was noticed on 20th April.

Present Condition: On admission Temp. 99.2° F., P. 120, R. 40.

There is a very faint erythema present all over the body.

The tonsils are enlarged, fauces congested and covered with a mucopurulent exudate.

A thick white fur coats the tongue, the papillae of which are enlarged and congested.

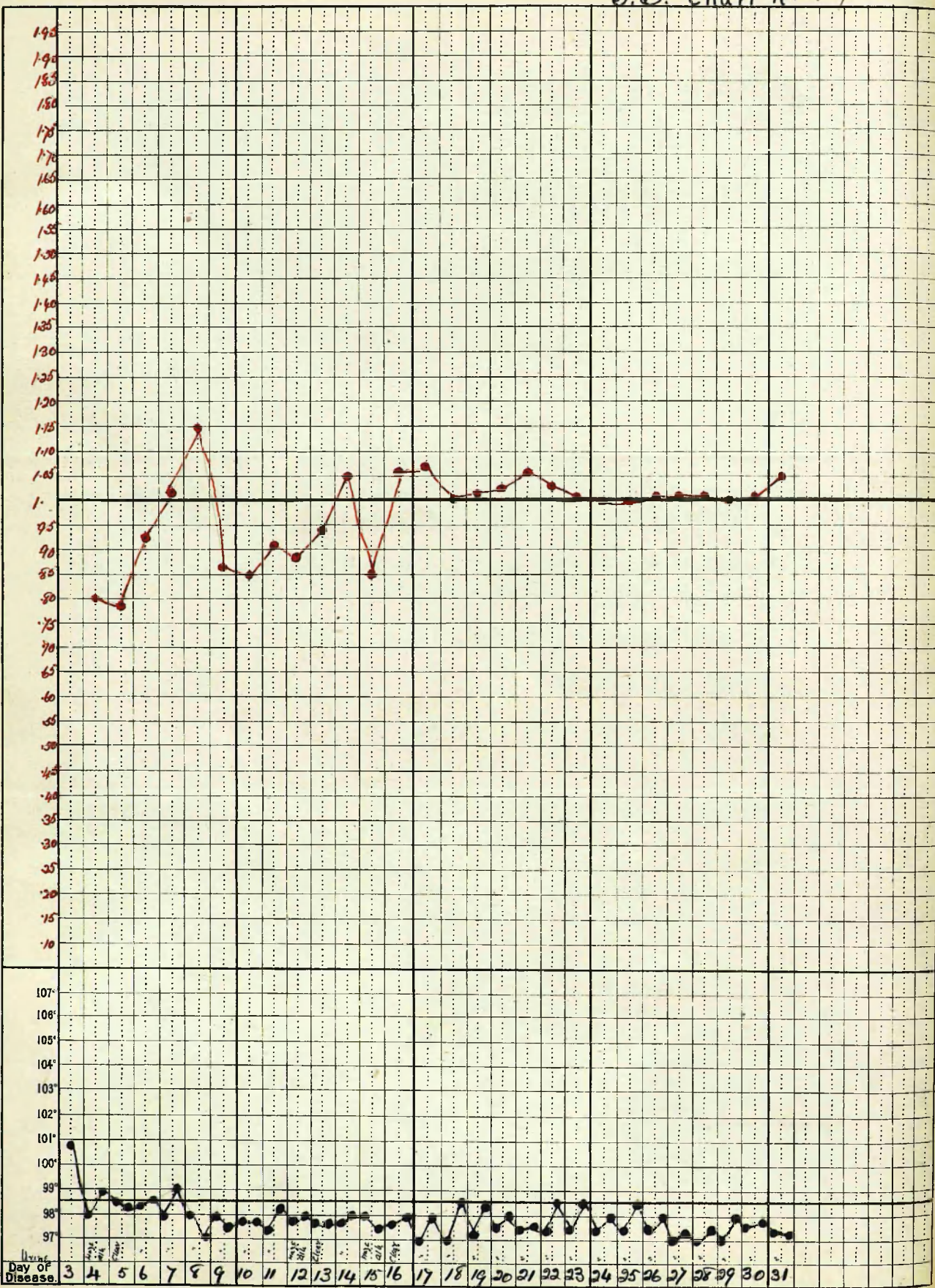
Heart's sounds are rapid but pure.

Lungs are clear.

Urine is free from albumen.

Progress: A very mild attack of scarlet fever, with a rapid amelioration of the symptoms.

There is nothing worthy of note in this case except that on one occasion - the 8th day of illness - there was a faint trace of albumen present in the urine.



G. B., aet 9 years

Admitted: 10th February, 1909

Previous Infectious Diseases: Measles, Whooping Cough

History of Present Illness: Patient complained of sickness and vomiting and sore throat on 8th February. Rash appeared on 9th February.

Present Condition: On admission the temp. was 100.8° F., Pulse 124 beats per minute and respirations 24.

Patient is a very well nourished girl.

On her lower jaw there is a sinus, which has been discharging freely for some months. This developed after toothache. Examination shows that the bone is dead.

The rash has almost faded and has left a brownish discoloration of the skin.

The throat is typical of scarlet fever, being intensely congested, and the fauces covered with a mucopurulent discharge.

Tongue is coated and the papillae are a little enlarged and congested.

Heart's sounds are pure and of good quality.

Lungs are clear.

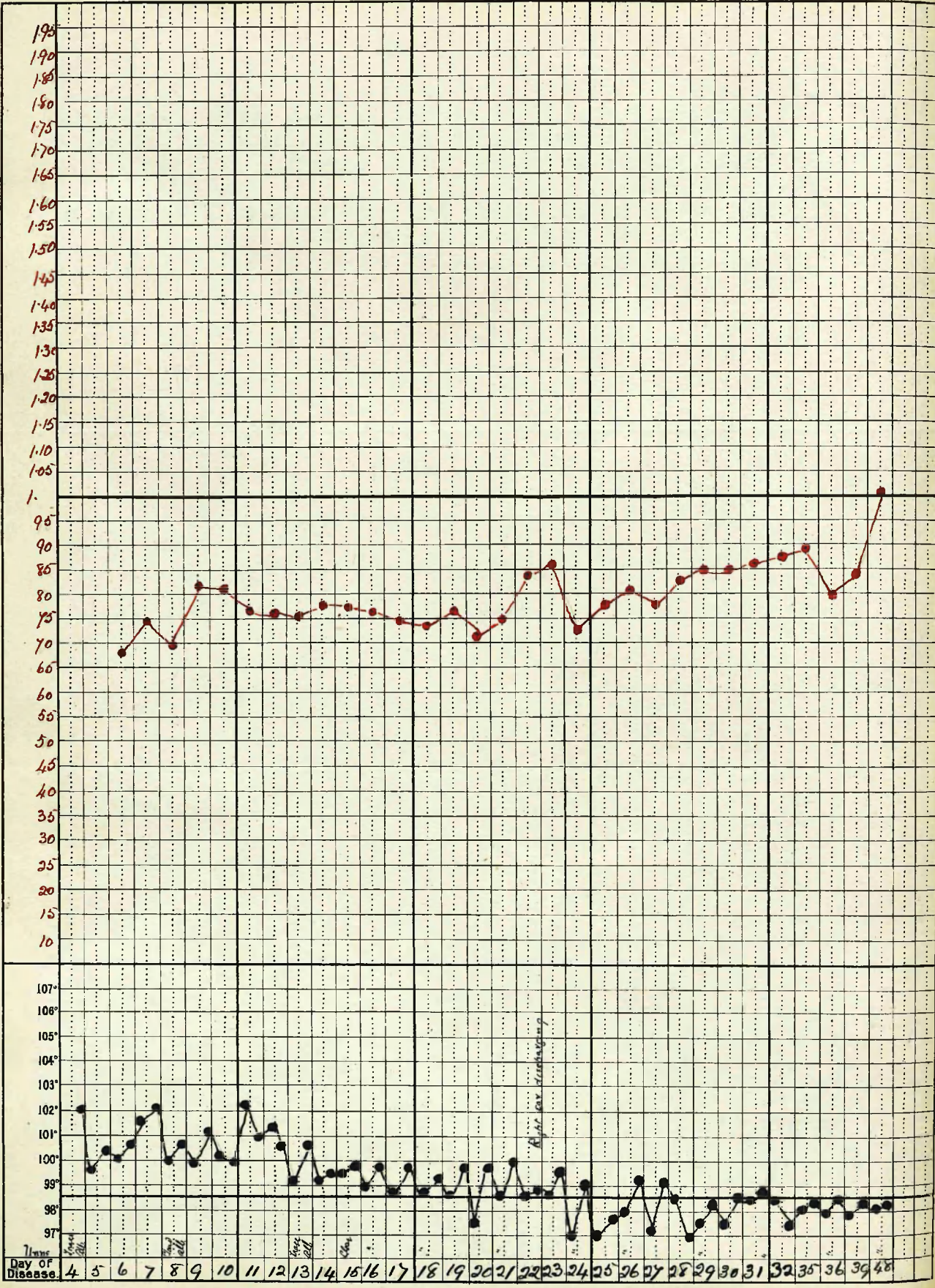
Urine normal.

Progress: There is little to be remarked on with regard to the course of this illness, from which the patient made a very good recovery.

On several occasions, however, her urine contained albumen.

but this was only present in very small quantities, and from the beginning of the fourth week of illness until her dismissal it was quite normal.

The sinus in the lower jaw continued to discharge freely during her residence in hospital.



K. O'D., aet 14 years

Admitted; 25th April, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Enteric Fever

History of Present Illness: Patient complained of headache and sore throat on morning of 23rd April. On the same evening a bright rash was noticed all over the body.

Present Condition: On admission Temp. 102° F., P. 140, R. 40

Patient is a poorly nourished child and looks very ill. She has a lateral curvature of the spine of four years standing.

All over the body there is a brilliant scarlatiniform rash.

The fauces are much injected and on the left tonsil is a large patch of ulceration.

The tongue is very dirty and through the fur are seen the enlarged congested papillae.

There is an abundant nasal discharge, which has led to ulceration of the alae nasi.

Heart's sounds are pure, but soft and rapid.

Lungs: All over the chest numerous rales are heard, and at the right apex posteriorly the R. M. is diminished in intensity and has a tubular quality.

The urine contains a trace of albumen.

Progress: For a week after admission the child was in a very precarious condition. The temperature remained elevated, ranging between 102.2° F. in the evening to 100° F. in the morning.

The throat condition improved but slowly, and though the tonsillar ulceration did not extend, it was a fortnight before it was well.

For ten days the condition of the chest got gradually worse, rales becoming more numerous and harsher, night sweats were common and very profuse.

Though the temperature still was elevated, a little improvement was noticed at the end of a fortnight and by keeping the patient in the open air as much as possible this improvement was maintained and convalescence was established.

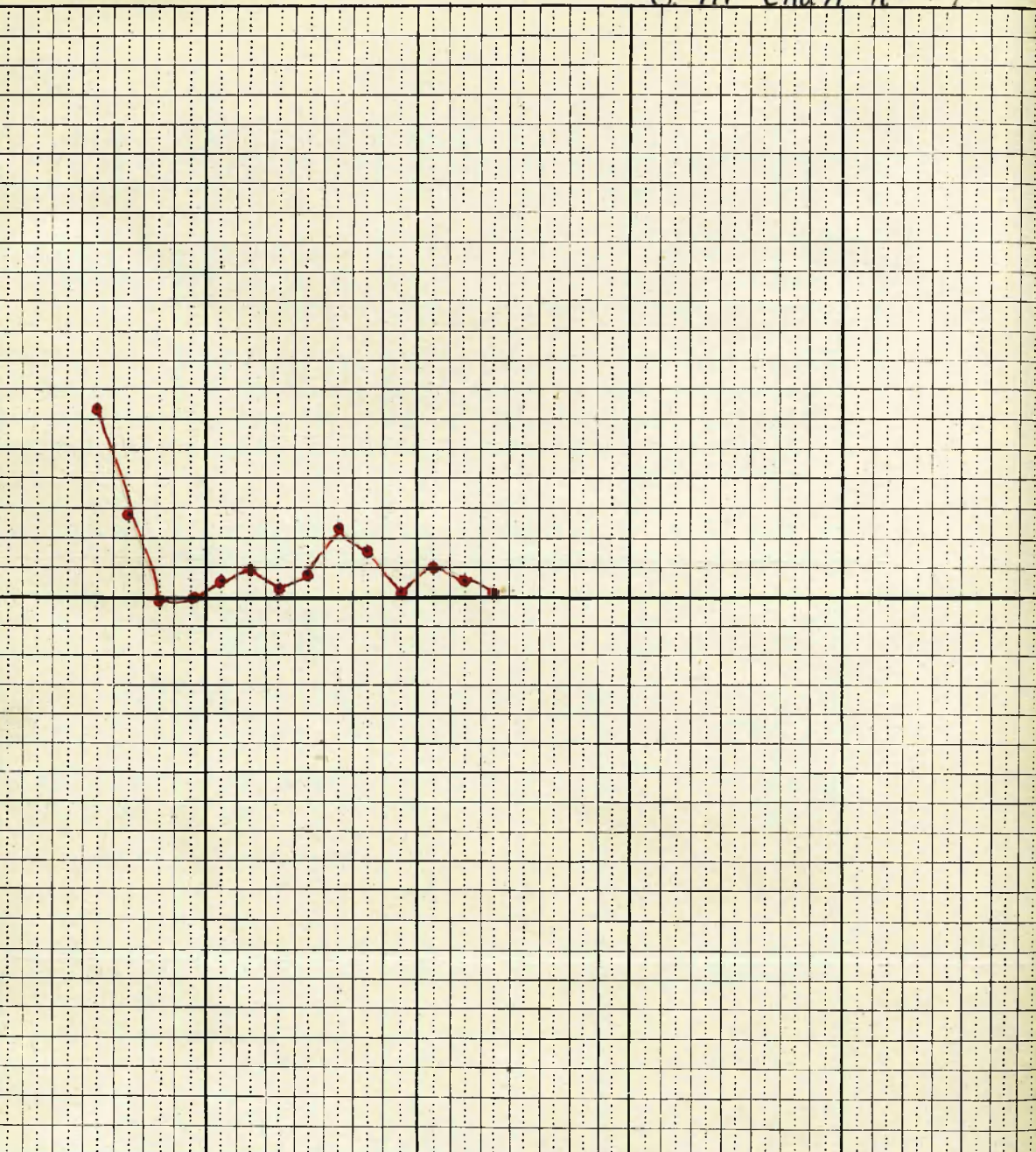
At the time of dismissal there was a very great improvement in the patient's general condition.

The chest was free from rales, but the R. M. was still very harsh and had a tubular quality.

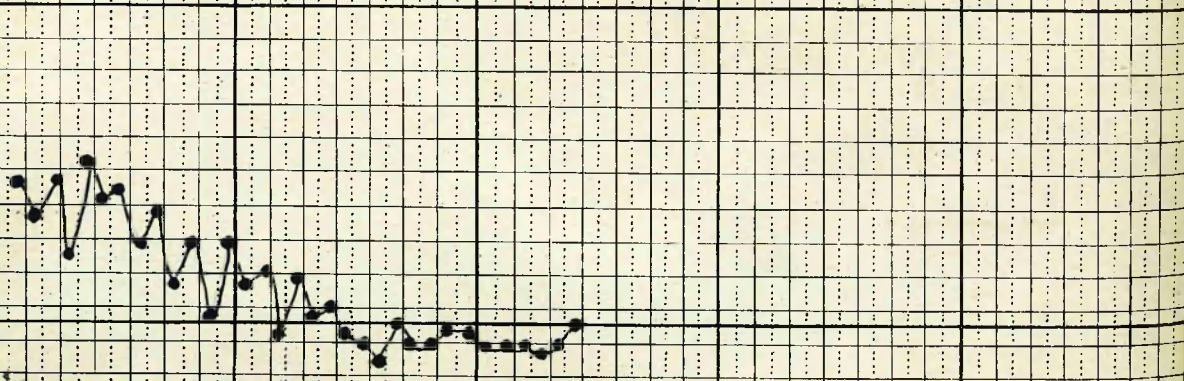
Her right ear began to discharge on twenty-second day of illness.

Urine, contained a trace of albumen for the first fortnight of illness, but after that was quite clear.

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Day of Disease. 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

C. H., aet 13 years

Admitted: 31st May, 1909.

Previous Infectious Diseases: Measles, Whooping Cough, Diphtheria, Chickenpox.

History of Present Illness: Patient has been ill since 27th May, complaining of headache, and sore throat. The rash appeared on 28th May. Two days later her joints became red, swollen and painful.

Present Condition: On admission Temp. 102.6° F., P. 120, R. 32

There is a fairly bright rash present all over the body.

It has partially faded on the chest, where it is replaced by a brownish yellow pigmentation.

The throat is much congested, and a patch of ulceration is seen on the left tonsil.

The tongue is beginning to peel.

All the joints are swollen and red and are very painful on pressure or movement.

Heart and lungs are satisfactory.

Urine contains a faint trace of albumen.

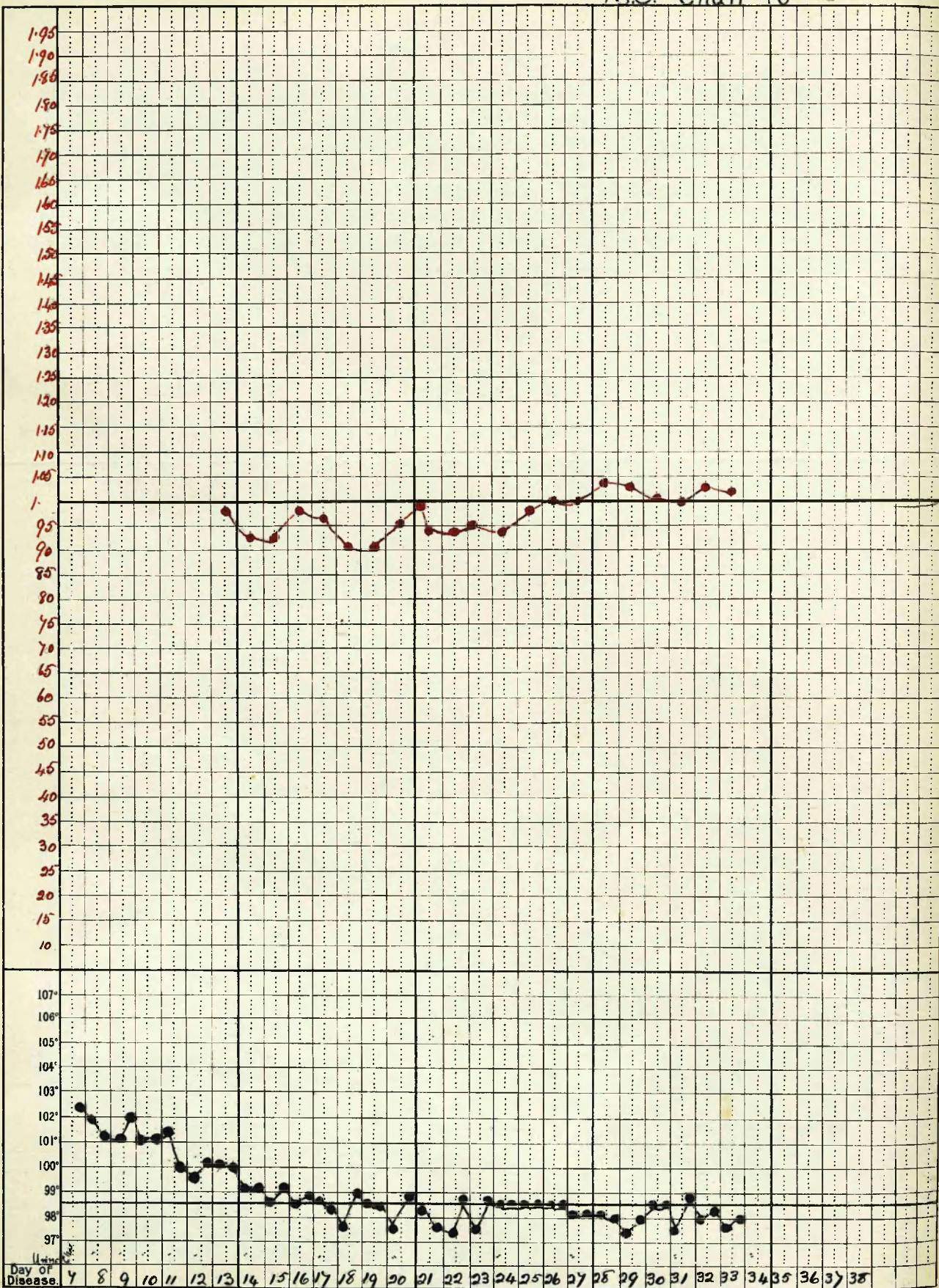
Progress: For the first 24 hours there was no improvement in the patient's condition.

The joints were even more swollen and painful, the throat still congested and the temperature elevated.

Under treatment a distinct improvement was noticed in a few days. The throat was less congested and the ulceration had almost disappeared.

In about a week the pain and swelling of the joints had disappeared and though they remained stiff for some time the patient was more comfortable.

The urine contained a trace of albumen for the first ten days of her illness, but after that it cleared up and remained clear while the patient was under observation



R. F., aet 7 years

Admitted: 23rd March, 1909

Previous Infectious Disease: -

History of Present Illness: The first symptoms of illness appeared on 16th March, when the patient complained of sore throat and headache, sickness and vomiting. On the following day a brilliant rash appeared.

Present Condition: On admission Temp. 102.6° F., pulse 132 beats per minute. He looked very ill.

The rash has faded and desquamation has not begun yet.

The fauces are intensely congested and covered with a mucopurulent discharge.

The tonsils are enlarged and patches of ulceration are showing on their surfaces.

A thick white fur covers the tongue, and the papillae are much enlarged and congested.

The anterior cervical glands are enlarged and tender.

Heart's sounds are rapid and rather soft, but are free from any adventitious sound.

Urine is free from albumen.

Progress: For the first ten days the temperature remained elevated, the throat congested, and the cervical glands enlarged and painful. There was a little daily improvement during this time, but it was slow.

The symptoms gradually became less pronounced, and slowly the glandular enlargement disappeared.

A profuse nasal discharge, which lasted a week, made its

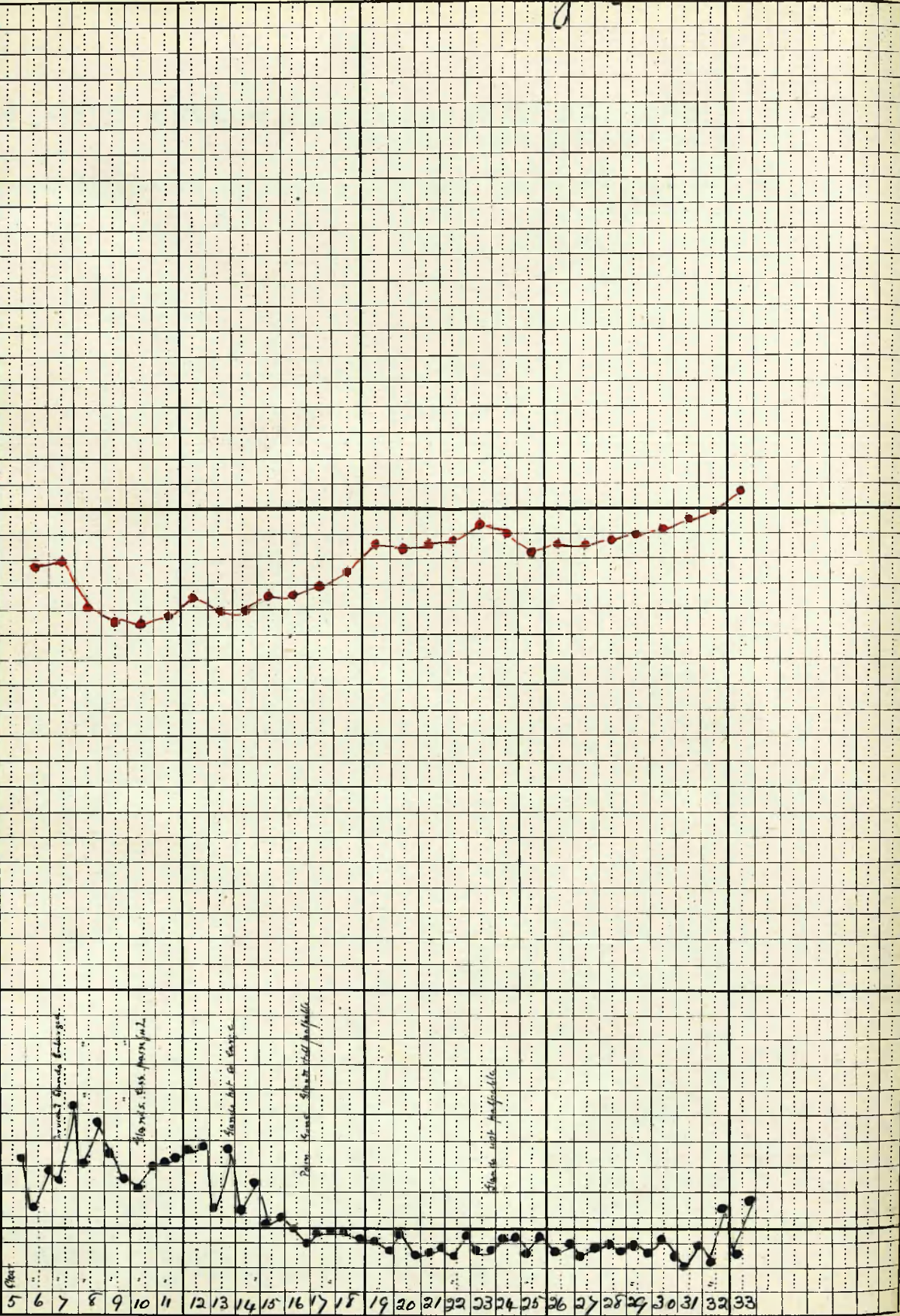
appearance and retarded convalescence a little, but left no bad after effects.

The urine did not show any pathological change during the illness

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J. McL., aet 6 years

Admitted: 30th March, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of headache and sore throat, sickness and vomiting on 25th March. The rash appeared on the same day.

Present Condition: On admission Temp 101.4° F., P. 148, R. 30

The remains of the rash are shown by a faint erythema on the legs and a brown discolouration of the skin.

The fauces are much congested and the tonsils enlarged.

Tongue is coated and the papillae are much swollen and congested.

Heart's sounds are rapid and soft, but free from adventitious sounds.

Lungs are clear.

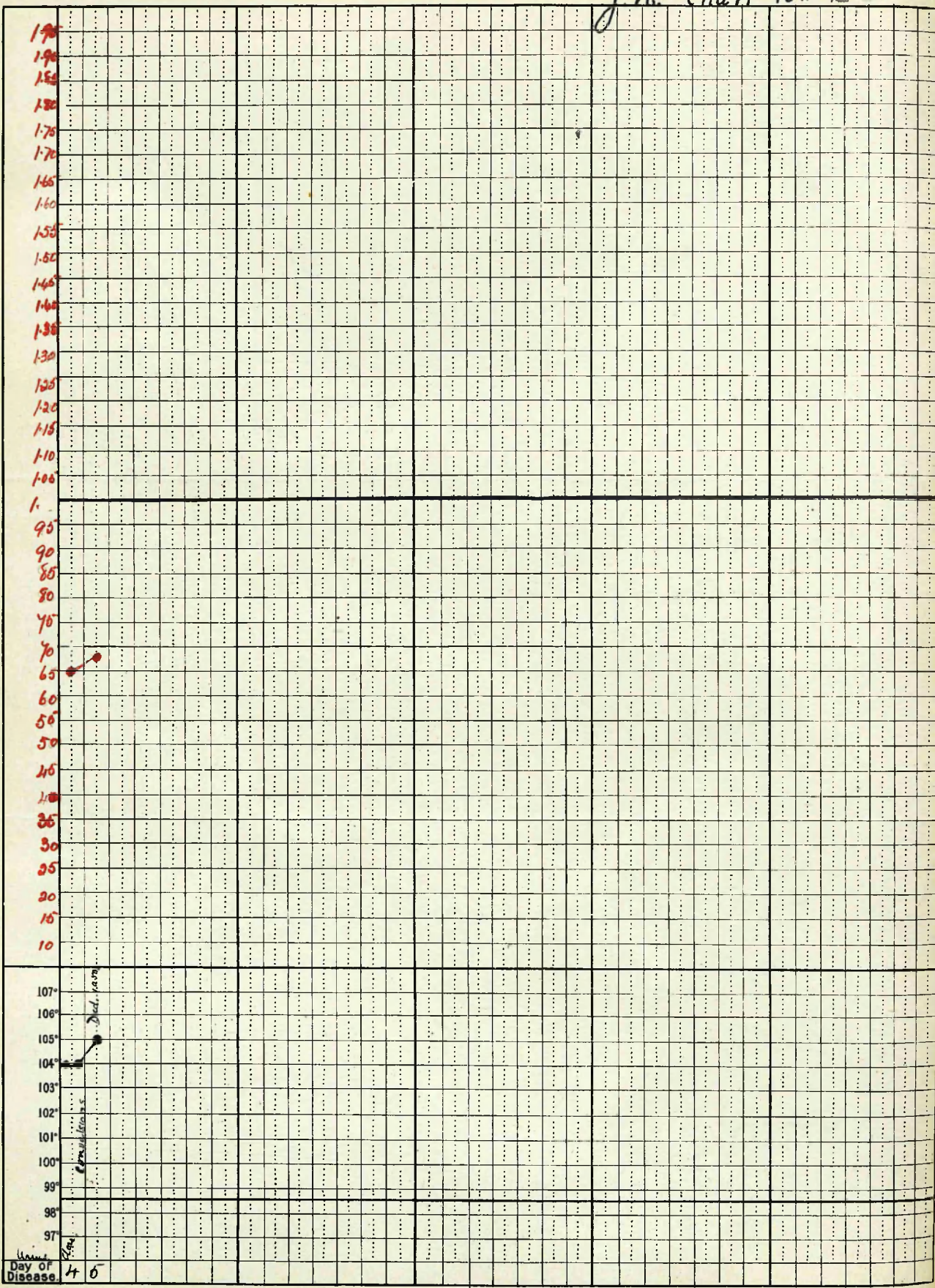
Urine is clear.

Progress: That the disease was very acute is evidenced by the fact that the thermometer registered a fairly high degree of pyrexia. This was at its height on the seventh day of illness, at which time the cervical glands on both sides became enlarged and tender.

A week later a great improvement had shown itself. The temperature had reached normal, the fauces were much healthier looking, and the glandular enlargement had subsided.

Recovery after this was rapid and complete.

Urine remained clear during the whole course of the disease.



Day of Disease 40

J. N., aet 2 years

Admitted: 16th June, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Chickenpox.

History of Present Illness: Symptoms of scarlet fever appeared first on 13th June, when the patient was sick and vomiting and had some difficulty in swallowing. The rash appeared on 14th June.

Present Condition: On admission Temp. 104° F., P. 168, R. 58

A faint erythema is present all over the body.

The fauces were intensely congested and were covered with a very profuse mucopurulent exudation. Both faucial pillars were ulcerated and this ulceration extended to both tonsils, which were much enlarged and congested.

There was a profuse nasal discharge.

The tongue was coated with a thick white fur and the papillae were enlarged and congested.

Heart's sounds were pure, of good quality, but very rapid.

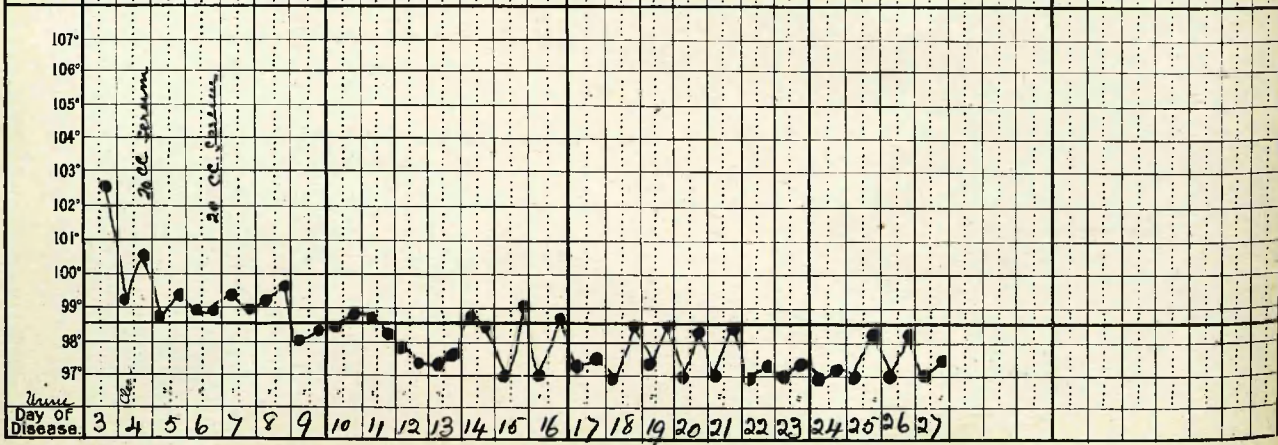
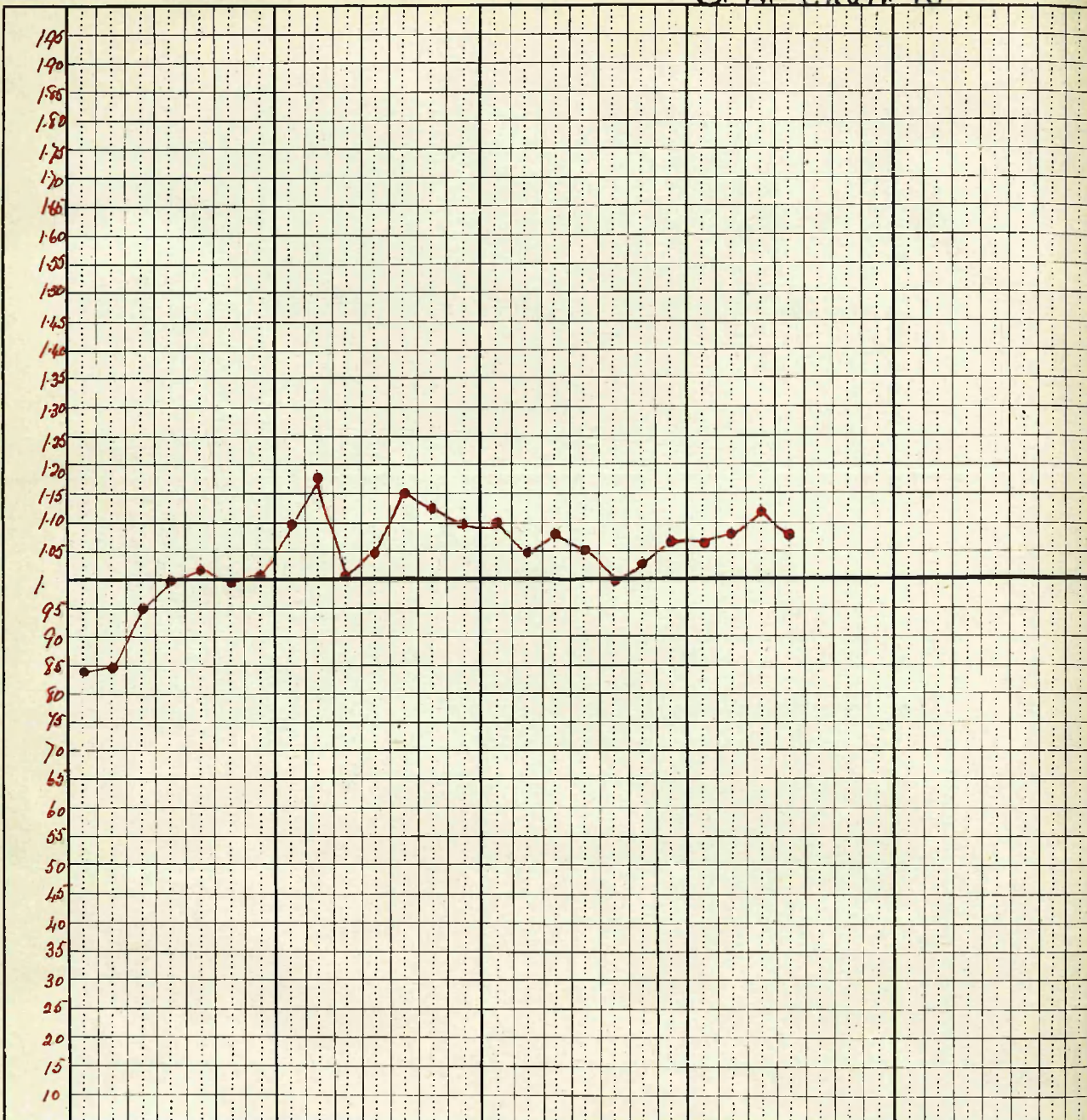
Lungs clear.

Progress: About six hours after admission the patient's condition suddenly became worse.

General convulsions set in and the patient died.

The temperature just at death was 105° F.

CASES TREATED WITH P. D. & CO'S ANTISTREPTOCOCCUS SERUM



Time
Day of Disease

3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

G. H., aet 5 years

Admitted: 18th May, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Chickenpox.

History of Present Illness: First complaints of illness were sickness and vomiting and sore throat on 15th. Rash appeared two days later.

Present Condition: On admission Temp 102.6° F., P. 152, R. 36

The rash has in great part faded, leaving a brownish pigmentation of the skin.

The fauces are congested and oedematous, and both tonsils are enlarged and ulcerated.

The tongue is dirty and papillae are prominent.

Heart and lungs are satisfactory.

Urine is clear.

The anterior cervical glands are palpable.

Progress: Serum treatment as before, two doses of 20 and 10 c.c.

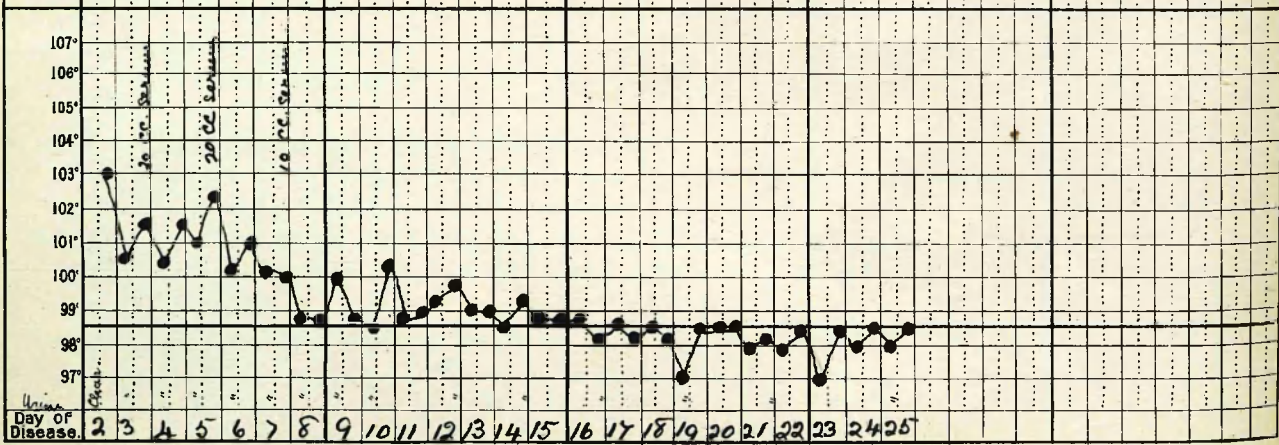
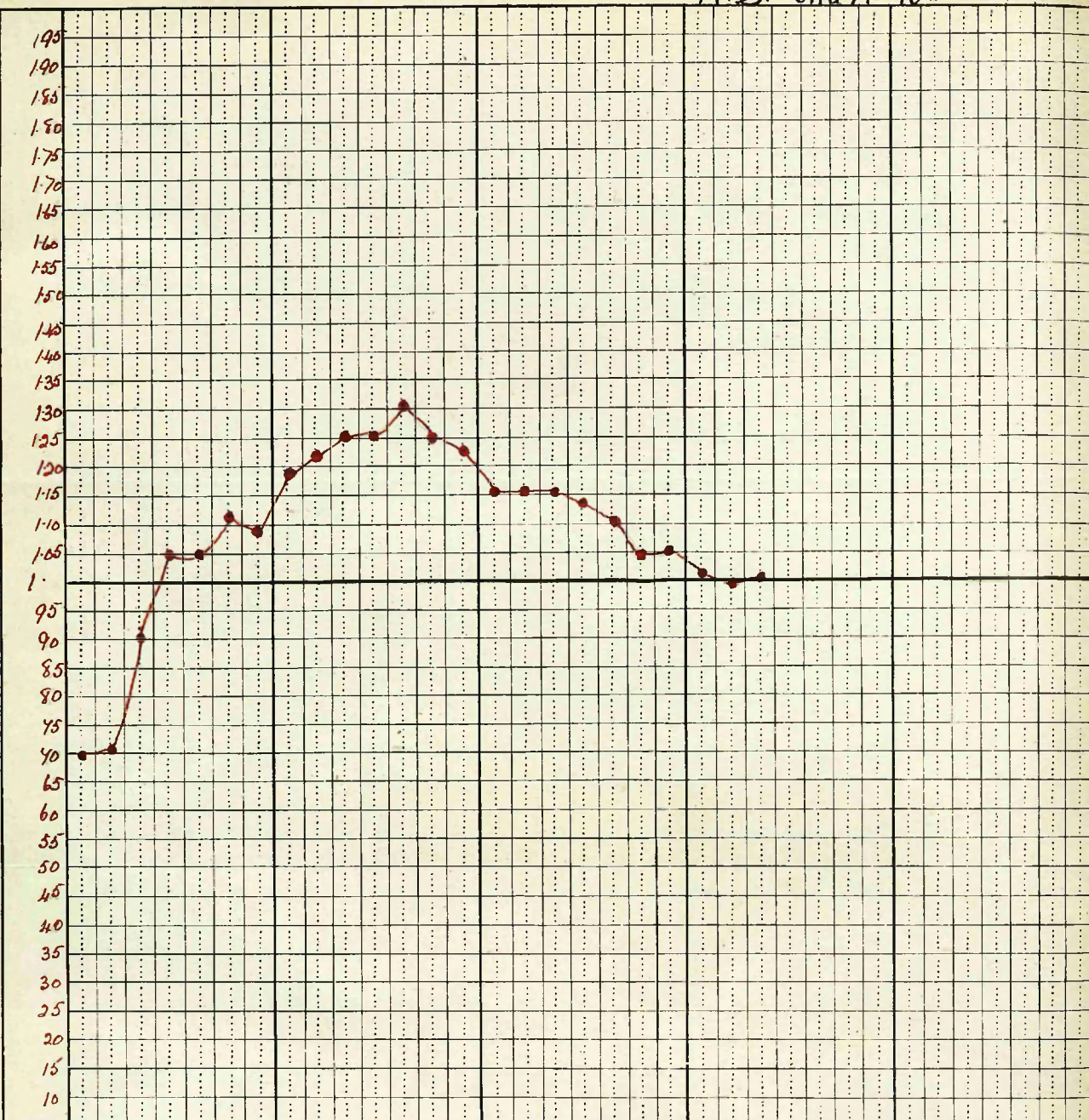
Two days after the first dose of serum there was a very marked improvement in the throat condition.

The dusky congestion was diminished in intensity, and the exudate had disappeared.

The tonsillar ulceration disappeared very quickly, and at the end of a week the throat was quite normal

The enlargement of the cervical glands soon disappeared.

Convalescence was uninterrupted.



Day of Disease: 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

A. F., aet 5 years

Admitted: 22nd May, 1909

Previous Infectious Disease: Whooping cough

History of Present Illness: Illness began on 21st May, when patient complained of sore throat, sickness and vomiting. The rash appeared on the same evening.

Present Condition: On admission Temp. 103° F., P. 160, R. 32

There is a bright scarlet rash present all over the body.

The fauces, which are intensely congested, are covered with a very abundant mucopurulent exudation.

Both tonsils are much enlarged, congested and ulcerated.

The tongue is covered with a thick white fur, through which the red swollen papillae stand out prominently.

Heart and lungs are satisfactory.

The urine is free from albumen.

Progress: Serum treatment as before, two doses of 20 c.c. and one of 10.

For several days there was no improvement and the ulceration of the tonsils extended till both posterior faucial pillars were involved.

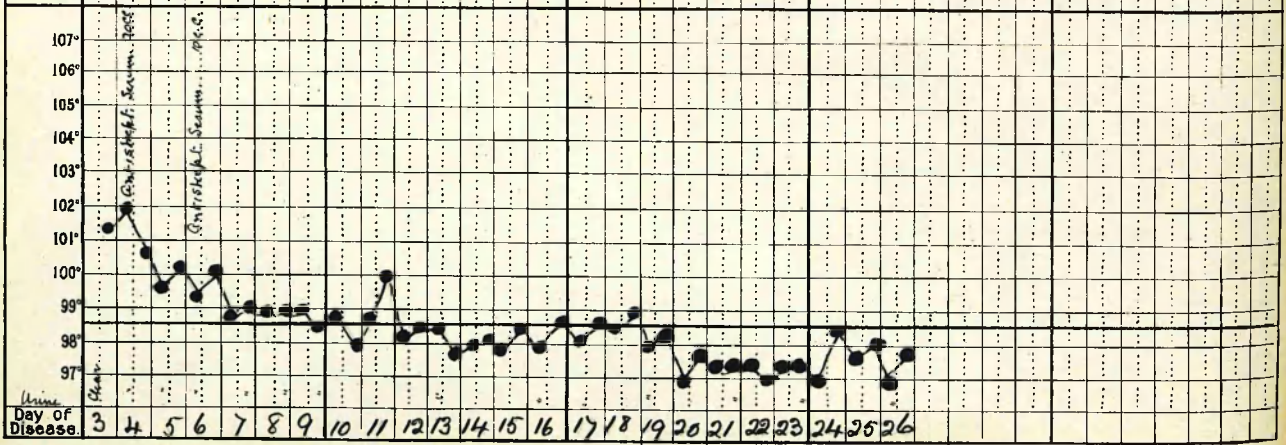
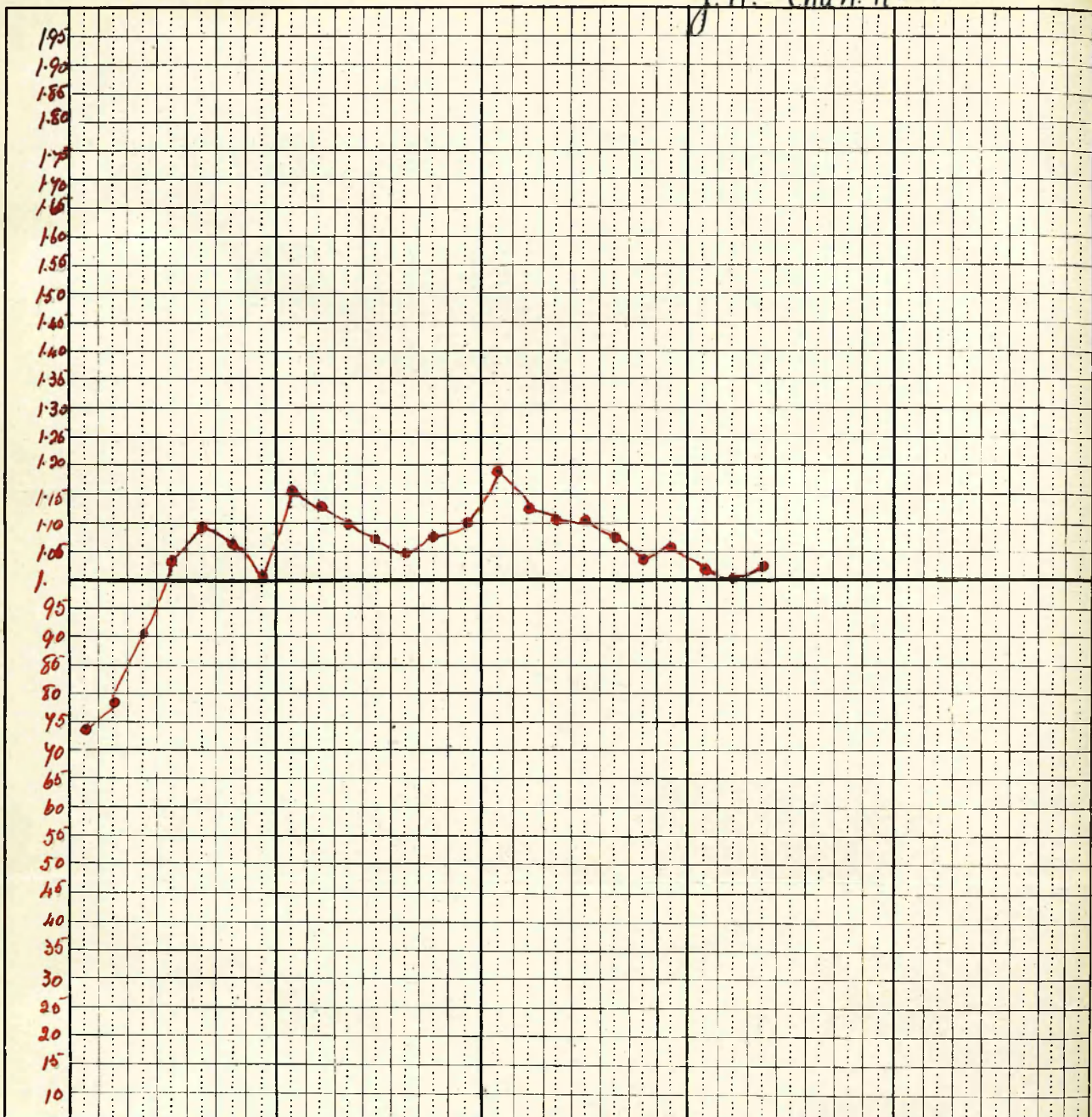
While this progressed, however, there was a noticeable diminution in the amount of exudate and also in the intensity of the congestion.

The ulcers cleared very quickly after the injection of the serum, but it was some time after the congestion had disappeared before they had their mucous membrane covering.

Again the temperature depended on the condition of the throat and it was a fortnight before the normal level was reached.

The cervical glands became very large and tender on pressure, but did not go on to suppuration. They gradually subsided and at dismissal were not palpable.

Convalescence was uninterrupted.



Day of Disease

J. W., aet 2 years

Admitted: 22nd May, 1909

Previous Infectious Disease: Measles, Chickenpox

History of Present Illness: Patient complained of sickness and vomiting on 20th May. Rash appeared on 21st.

Present Condition: On admission Temp. 101° F., P. 152, R. 32

There is a typical scarlet fever rash all over the body.

The throat is much congested and is covered with an abundant exudate.

Both tonsils are enlarged, the right more than the left, which is deeply ulcerated.

The tongue is coated with a thick white fur, through which the papillae are seen large and congested.

Heart and lungs are satisfactory.

Urine is free from albumen.

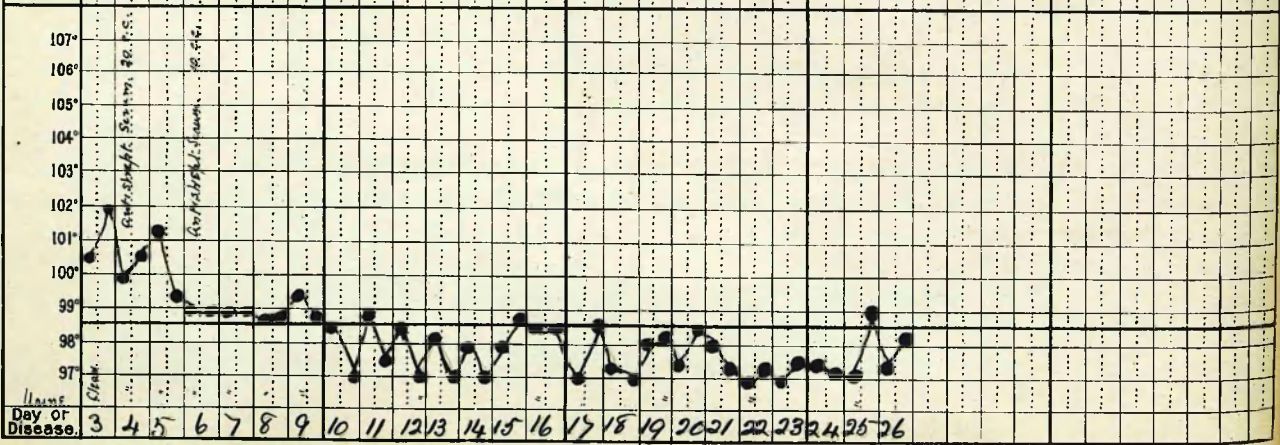
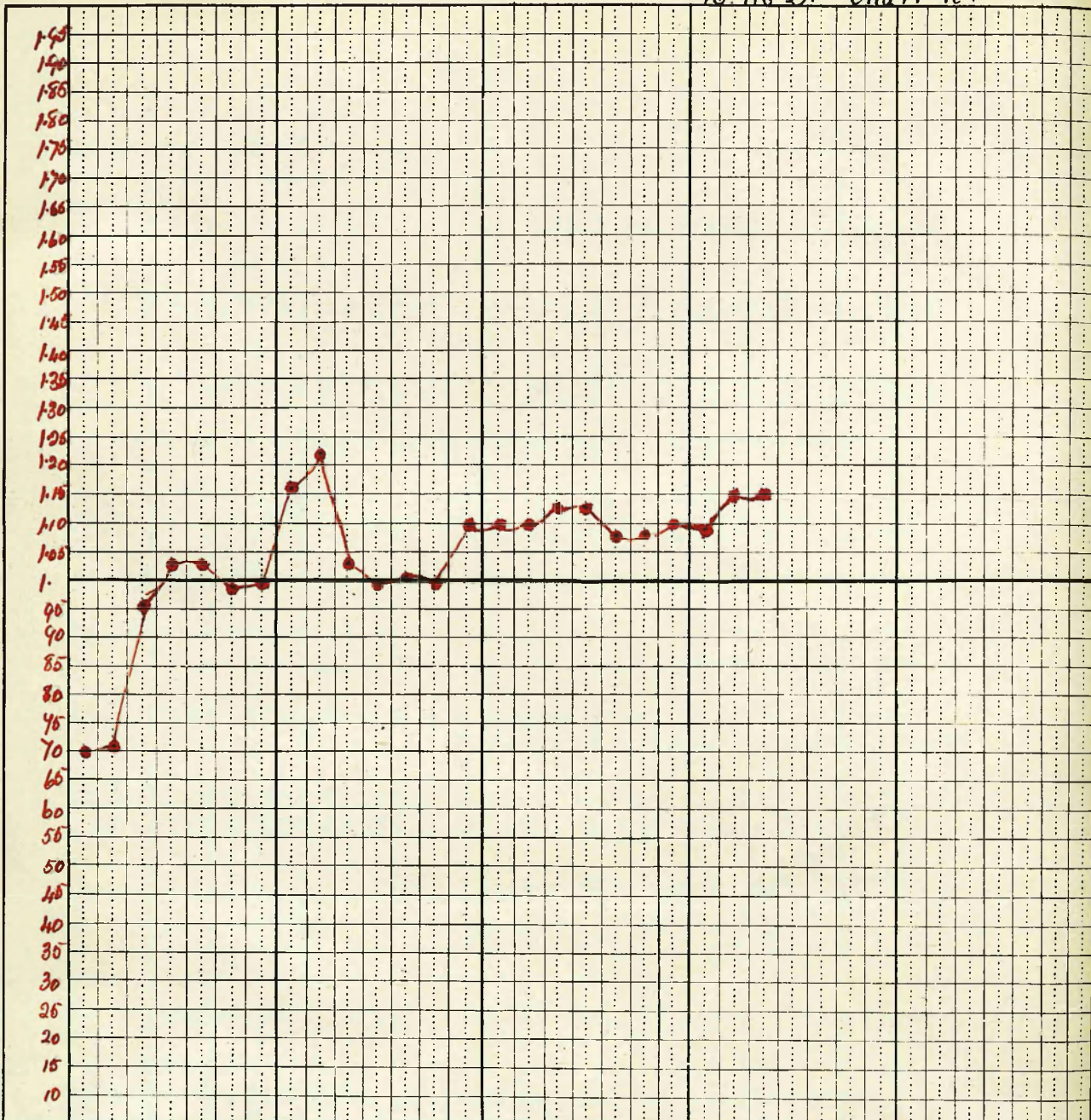
Progress: Serum treatment as before. Two doses of 20 and 10 c.c.

Several days passed without any substantial improvement in the condition of the throat, but when that did begin it progressed rapidly and in a very short time the mucous membrane was quite normal and the tonsillar ulceration had disappeared.

Up till the 7th day of illness an elevated temperature was recorded but after that it remained at the normal level.

The urine was free from albumen throughout the illness.

Convalescence was uninterrupted.



K. McF., aet 3 years

Admitted: 22nd May, 1909Previous Infectious Disease: Measles, Whooping coughHistory of Present Illness: Patient complained of headache and sore throat on 20th May. Rash appeared on 21st.Present Condition: On admission Temp. 100.6° F., P. 148, R. 32

There is a typical scarlet fever eruption present all over the body.

The throat is much congested and the left posterior pillar of the fauces is much ulcerated.

Both tonsils are slightly enlarged and congested.

The tongue is very dirty and the papillae are prominent.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment as before. Two doses, 20 and 10 c.c.

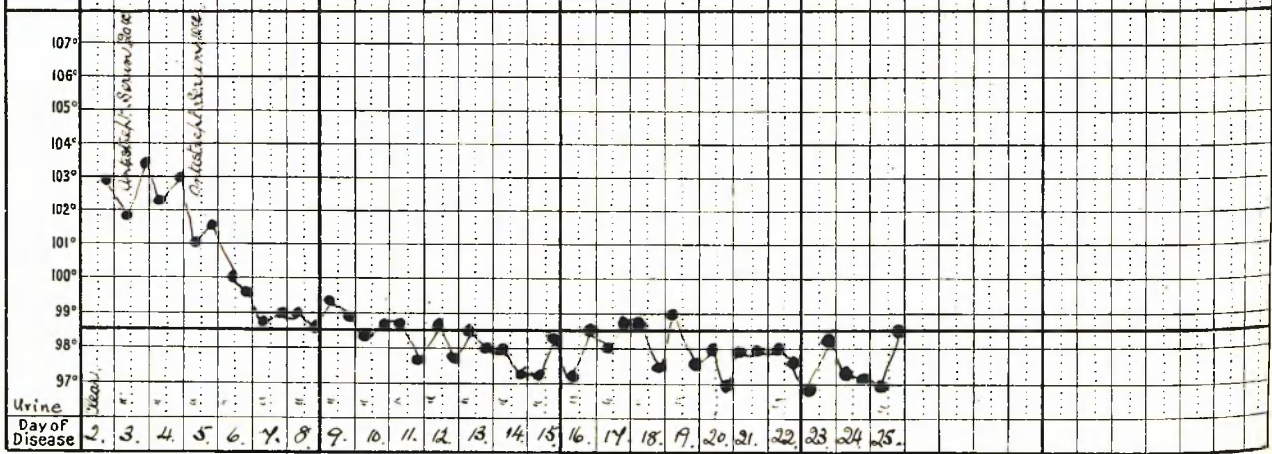
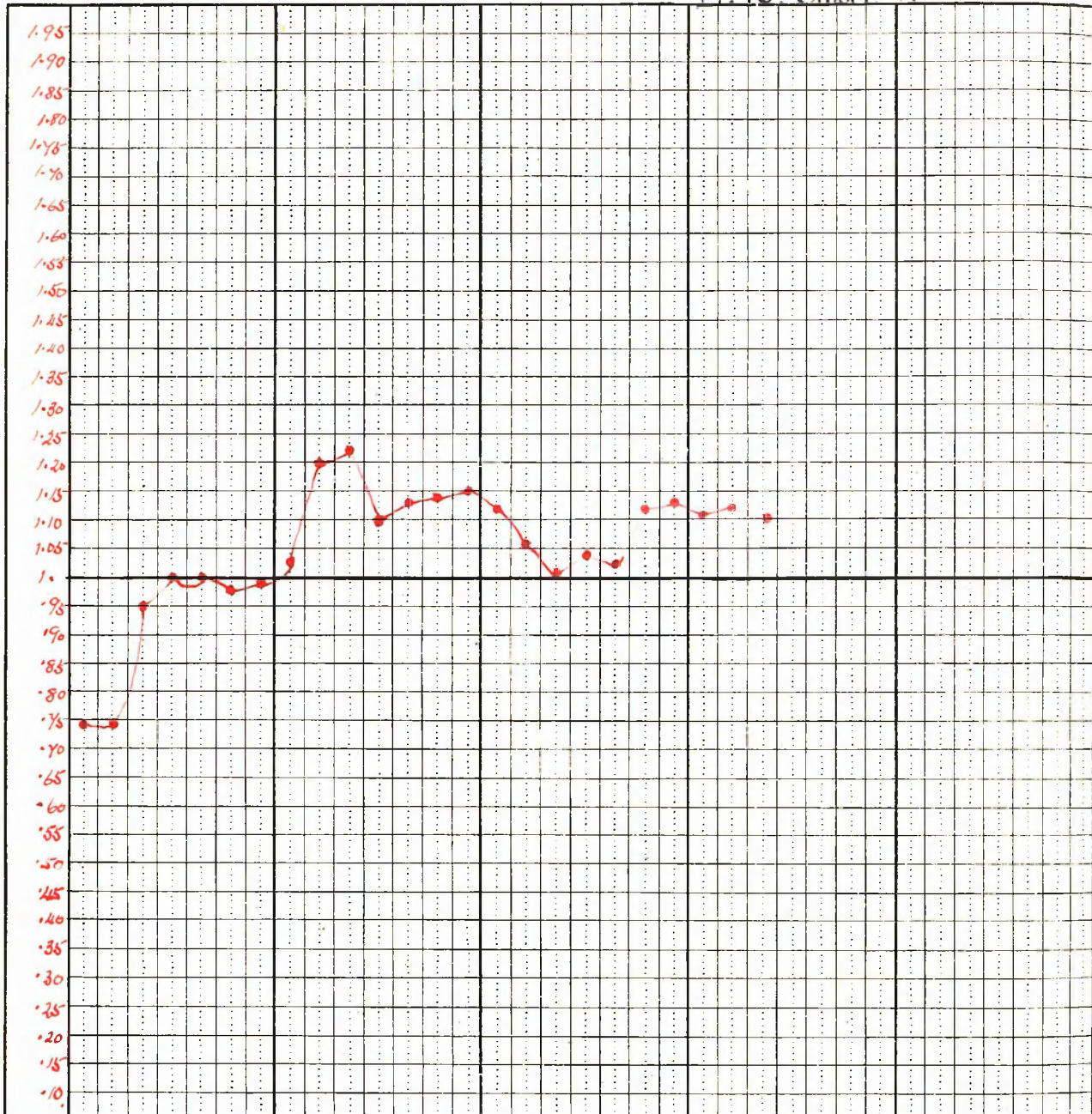
After the administration of the first dose of serum an appreciable improvement was noticed in the condition of the throat, the congestion was not so intense and the exudate had decreased in quantity.

This was the start of a very rapid improvement and soon congestion and ulceration had disappeared entirely and the cervical glands, which had enlarged, gradually became normal.

For a week the temperature remained elevated, ranging from 99 to 102° F. It then became normal and remained so.

The urine contained a haze of albumen on the eleventh day of illness.

Convalescence was uninterrupted.



Urine
Day of Disease

Weakly Positive
Positive

D. R., aet 5 years

Admitted: 22nd May, 1909

Previous Infectious Diseases: Measles, Whooping cough,
Chickenpox.

History of Present Illness: Patient complained of sickness
and vomiting on 21st May. The rash appeared on 22nd.

Present Condition: On admission Temp. 103° F., P. 148, R. 28

There is a bright scarlet fever rash present all over the
body.

The throat is much congested and there is some ulceration
along the edge of the soft palate from the enlarged ul-
cerated tonsils up to and surrounding the uvula.

Tongue is coated and is beginning to peel.

Heart and lungs are satisfactory.

Urine is free from albumen.

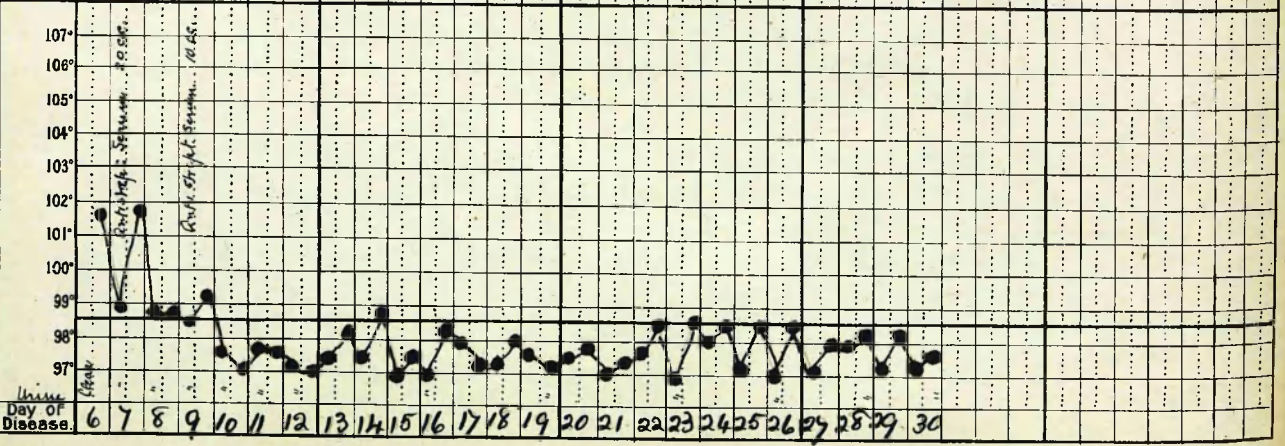
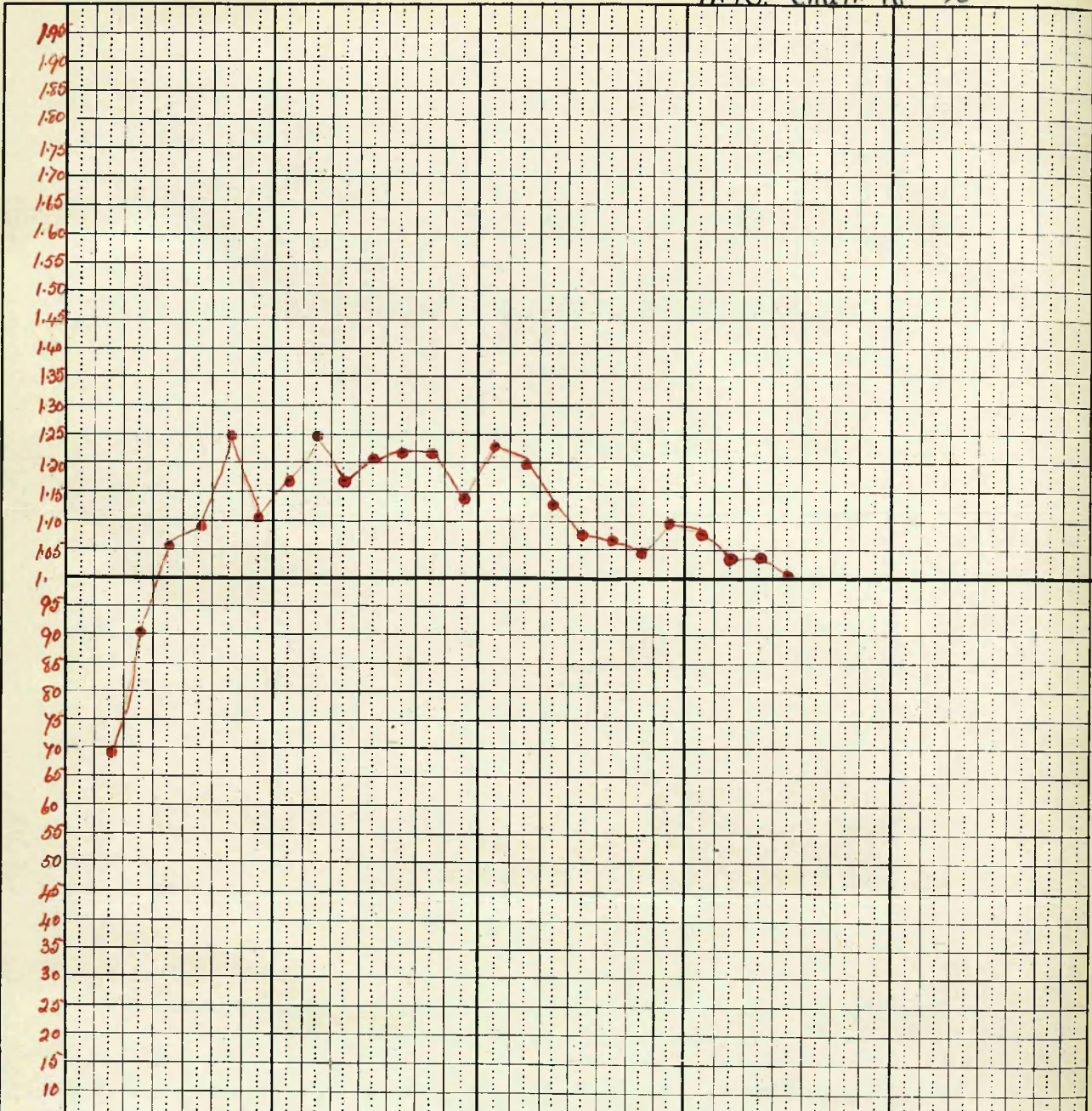
Progress: Serum treatment as before. Two doses of 20 c.c.
each.

There was no improvement in the throat condition until
after the second administration of serum. Then the
general condition of the patient began to improve, the
temperature was less elevated and the condition of the
throat became much better.

A daily improvement was noted and in about ten days the
throat appeared to be normal.

The urine was free from albumen during the illness.

Convalescence was uninterrupted.



Unit
Day of Disease

W. R., aet 3 years

Admitted: 22nd May, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of headache and sore throat on 17th May. Rash appeared on 18th.

Present Condition: On admission Temp. 101.6° F., P. 146, R. 30

There is a coarse punctiform rash present all over the body.

The fauces, which are very deeply injected, are covered with an abundant mucopurulent exudate.

Both tonsils are enlarged and ulcerated.

The tongue is coated and the papillae are swollen and stand out prominently.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment as before. Two doses of 20 and 10 c.c. each.

There is little worthy of note in the course of this illness.

With the rapid and complete recovery of the throat the temperature became normal and convalescence was soon established.

The urine remained free from albumen throughout the illness

A. M., aet 8 years

Admitted: 17th August, 1909.

Previous Infectious Disease: Measles

History of Present Illness: Headache and sore throat, sickness and vomiting were complained of on 15th August. A faint rash was noticed on 16th.

Present Condition: On admission Temp 101.8° F., P. 120, R. 30

The eruption has faded, leaving a brownish staining of the skin.

There is considerable congestion of the throat, which is covered with mucopurulent exudate.

The tongue is beginning to peel, leaving its edges red and raw looking.

Heart and lungs are both satisfactory.

The urine is free from albumen.

Progress: Serum treatment as before. Parke Davis' serum in two doses.

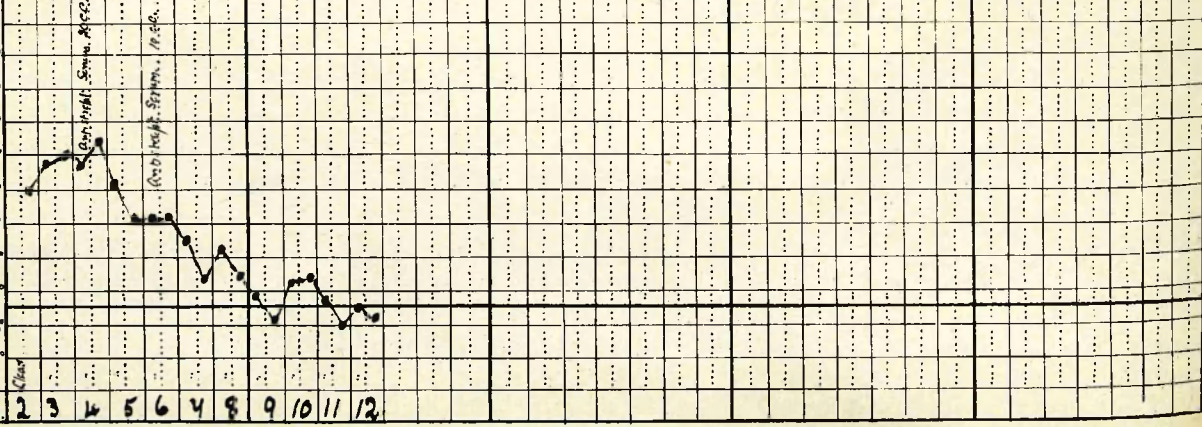
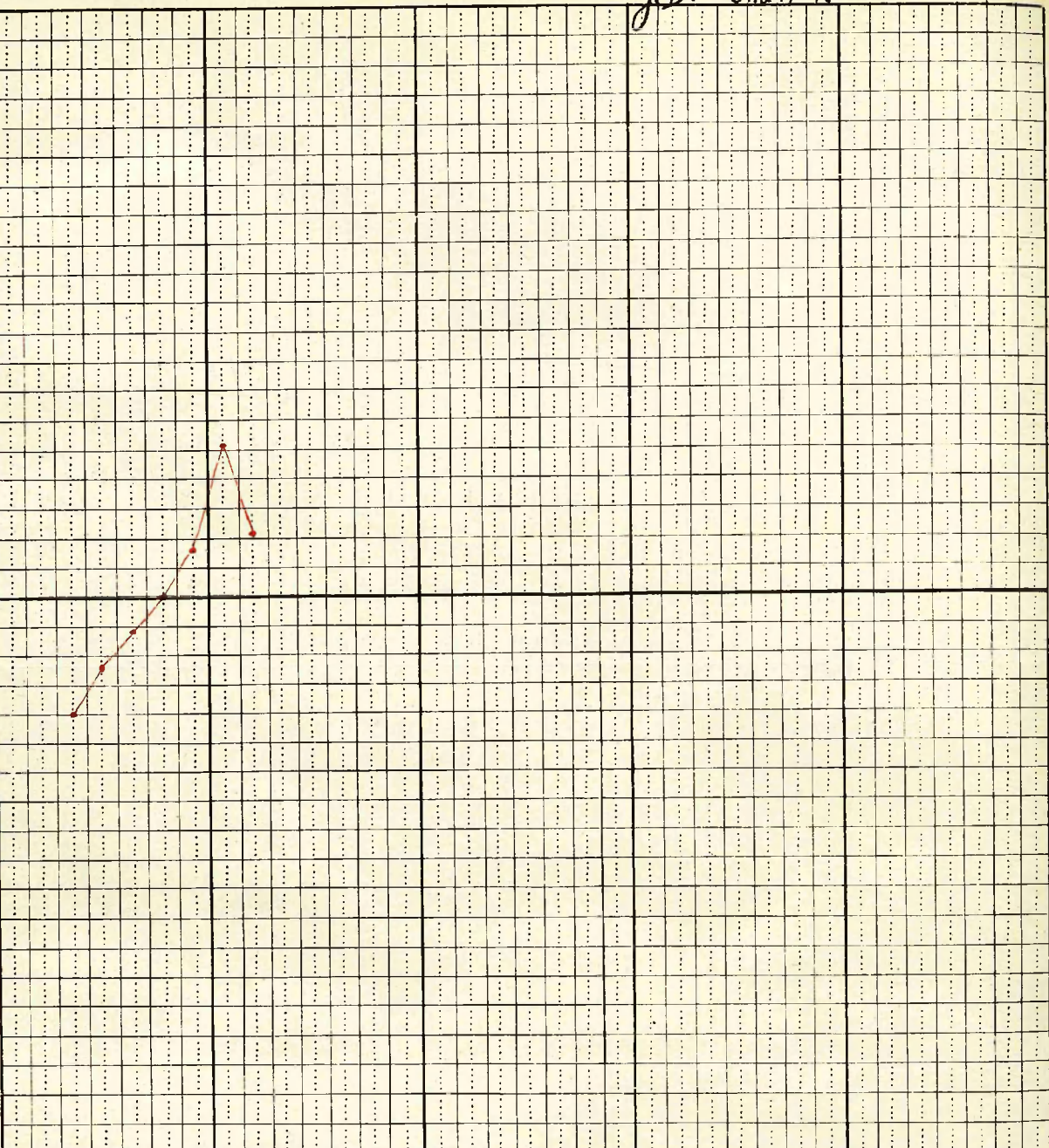
A very rapid return to normal was seen in the throat condition, and at the end of a week the congestion had entirely disappeared.

The temperature, though never excessively high, remained elevated for about a week.

Urine was clear throughout the illness.

1.95
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1.15
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0.65
0.60
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0.40
0.35
0.30
0.25
0.20
0.15
0.10

107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°



Using
Day of Disease

2 3 4 5 6 7 8 9 10 11 12

J. D., aet 7 years.

Admitted: 17th August, 1909

Previous Infectious Disease: Measles, Chickenpox

History of Present Illness: Patient complained of headache and sore throat on 16th August. The rash appeared on 17th

Present Condition: On admission Temp. 102° F., P. 140

The rash has faded from the chest but is still typical on the limbs.

The fauces are much congested and both tonsils are enlarged and covered with a mucopurulent exudate.

Heart and lungs are satisfactory.

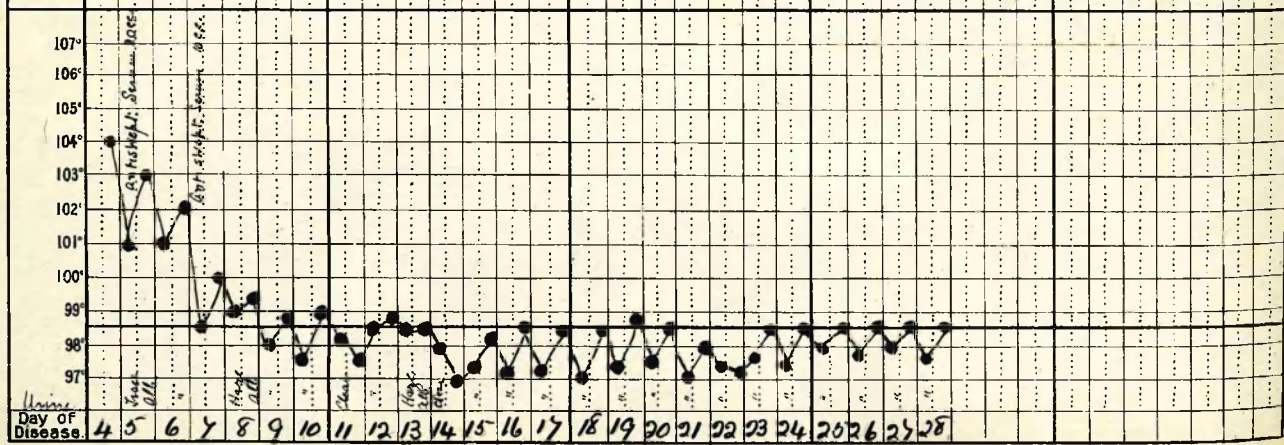
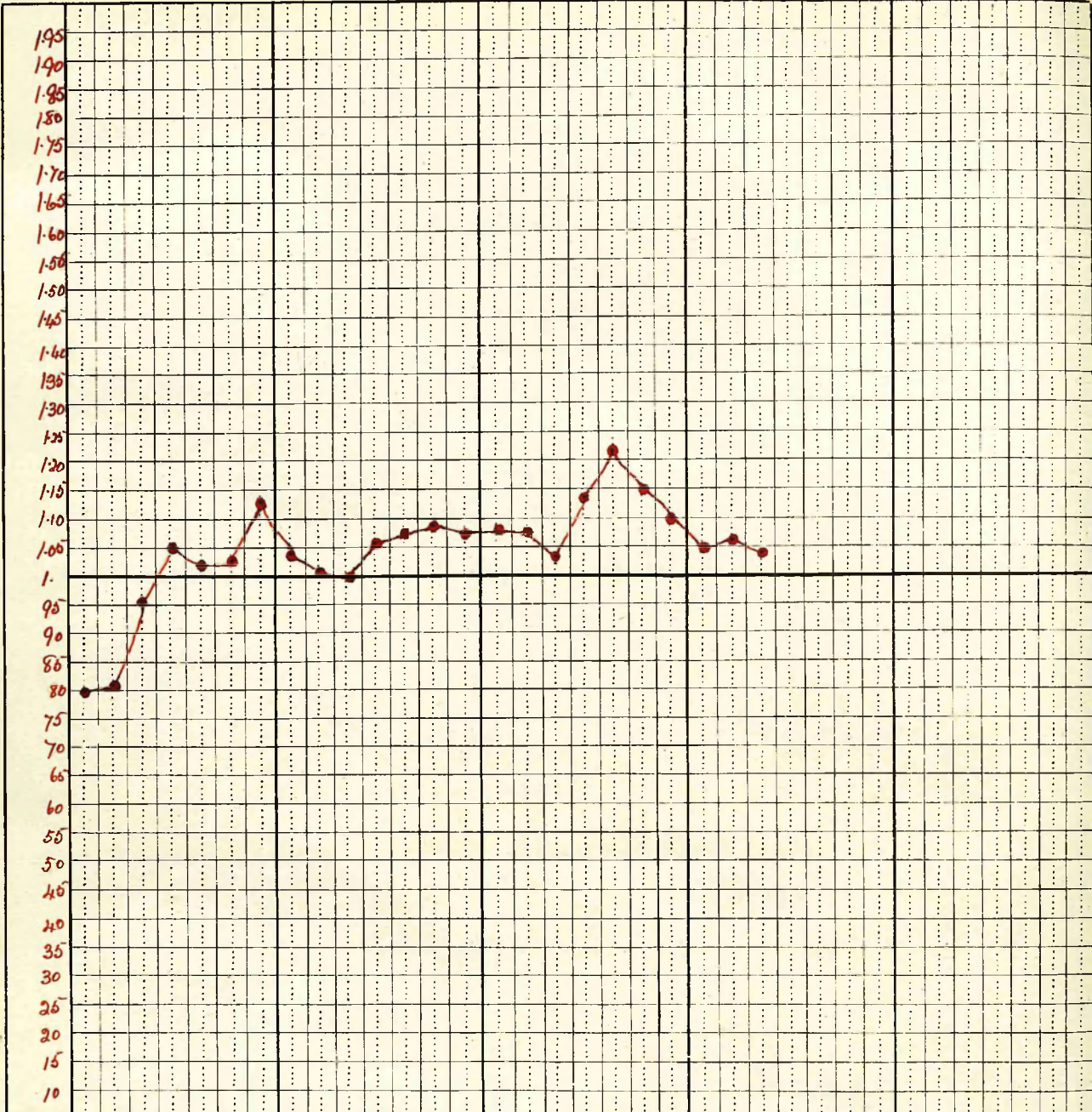
Urine is free from albumen.

Progress: Serum treatment, P. D. & Co.'s serum, in two doses as before.

The improvement in the throat condition did not begin until after the second dose of serum. After that, however, the exudate diminished in quantity, the congestion in intensity, and there was a rapid return to normal.

The temperature was elevated more or less until the 12th day of illness, after which a normal degree was always registered.

Urine was clear throughout illness.



Urine
Day of Disease

4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Notes: Day 4: High pulse, Serum, Rose. Day 5: Urine. Day 6: Urine. Day 7: Urine. Day 8: Urine. Day 10: Urine. Day 12: Urine. Day 13: Urine. Day 14: Urine.

M. McB., aet 27 years

Admitted: 20th May, 1909

Previous Infectious Disease: -

History of Present Illness: Patient complained of sore throat sickness and vomiting on 17th May, and three days later a bright scarlet rash appeared.

Present Condition: On admission Temp. 104° F., P. 144, R. 32

There is a typical scarlet fever rash present all over the body.

The throat is intensely congested and on the fauces the punctiform injection of the mucous membrane is typical.

Both tonsils are much enlarged and ulcerated, and share in the general congestion of the throat.

The tongue is coated and beginning to peel.

Heart and lungs are satisfactory.

Urine contains a trace of albumen.

Progress: Serum treatment as before. Two doses of 20 cc. each

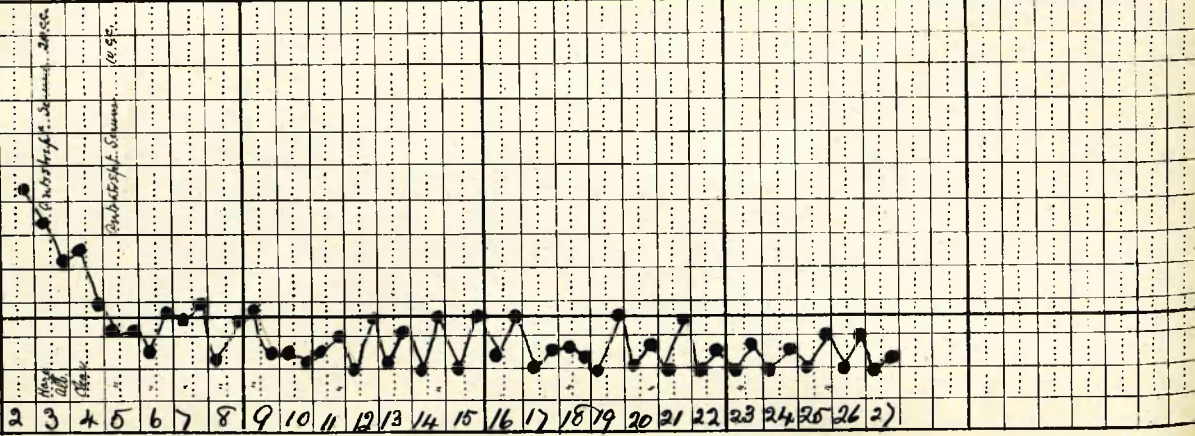
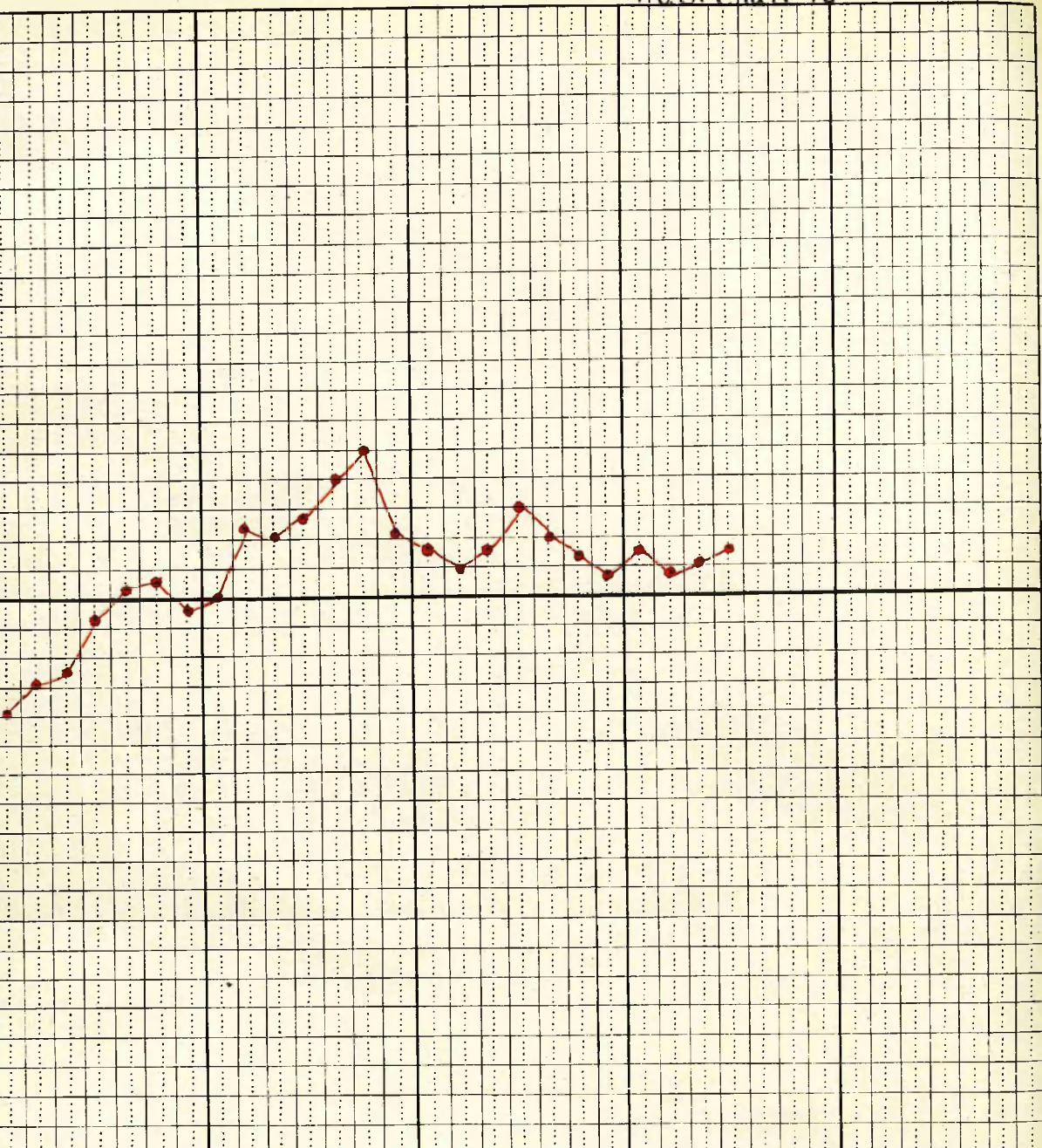
For two days there was little or no improvement in the throat condition, but when the improvement did begin the congestion, ulceration and oedema of the fauces soon disappeared, and at the end of ten days the patient was very well.

As usual the elevation of the temperature depended on the throat condition, and as that cleared up the temperature approached normal, which point was reached on eighth day of illness.

The urine contained a trace of albumen on two occasions, viz: the 8th and 13th days of illness. Thereafter it remained clear. Convalescence was uninterrupted

145
140
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15
10

107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°



Day of Disease: 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

May 21st
Blank

Embryoph. Saurus... (M.S.)

M. C., aet 11 years

Admitted: 18th May, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Chickenpox.

History of Present Illness: The first symptoms of scarlet fever appeared on 17th May, when the patient complained of sore throat. The rash appeared on the evening of the same day.

Present Condition: On admission Temp. 102.8° F., P. 132, R. 36

There is a bright scarlet rash all over the body.

The fauces, which are intensely congested, are covered with an abundant mucopurulent exudate.

A thick white fur coats the tongue, the papillae of which are much enlarged and congested.

Heart and lungs are satisfactory.

The urine contains a trace of albumen.

Progress: Serum treatment as before. Two doses of 20 c.c. each.

For two days the throat condition became gradually worse. The tonsillar crypts contained points of pus and the exudate became more abundant. After the administration of the first dose of serum, a little improvement was noticed and this was accelerated by the injection of the second dose. In a week the congestion of the fauces had almost completely disappeared and the patient was very well.

With the improvement in the condition of the throat the

temperature gradually became less elevated and after the fifth day of illness the normal limit was never exceeded.

The urine was free from albumen except on the first examination.

Convalescence was uninterrupted.

A. G., aet 7½ years

Admitted: 17th May, 1909

Previous Infectious Diseases: Measles, Chickenpox.

History of Present Illness: Symptoms of scarlet fever first appeared on 13th May, when the patient complained of sickness and vomiting and sore throat. Two days later a rash appeared.

Present Condition: On admission Temp. 100° F., P. 126, R. 28

There is a brilliant rash all over the body.

The throat is intensely congested and is covered with a thick mucopurulent exudate.

Tonsils are much enlarged, congested and show deep ulceration.

The tongue is dirty and the papillae are enlarged and congested.

Heart and lungs are satisfactory.

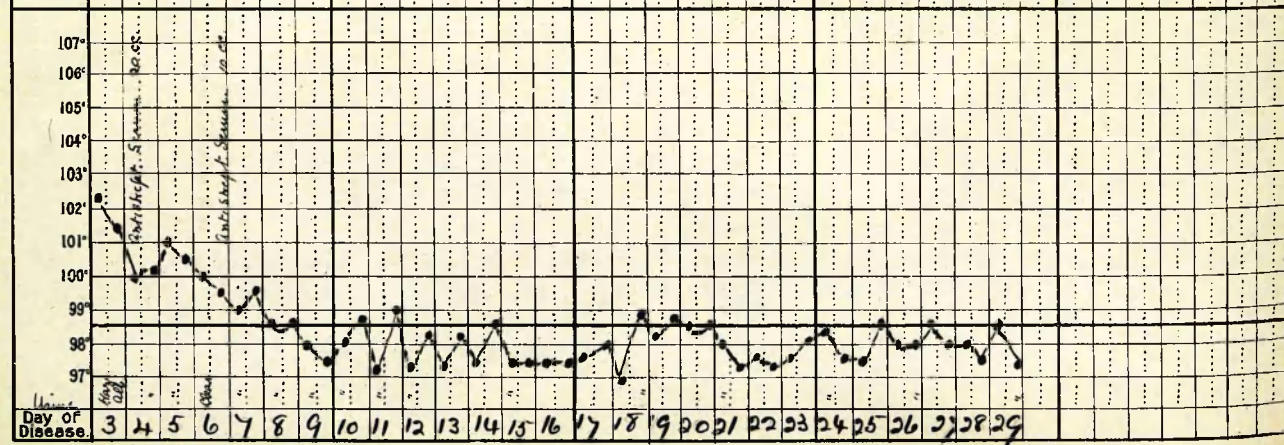
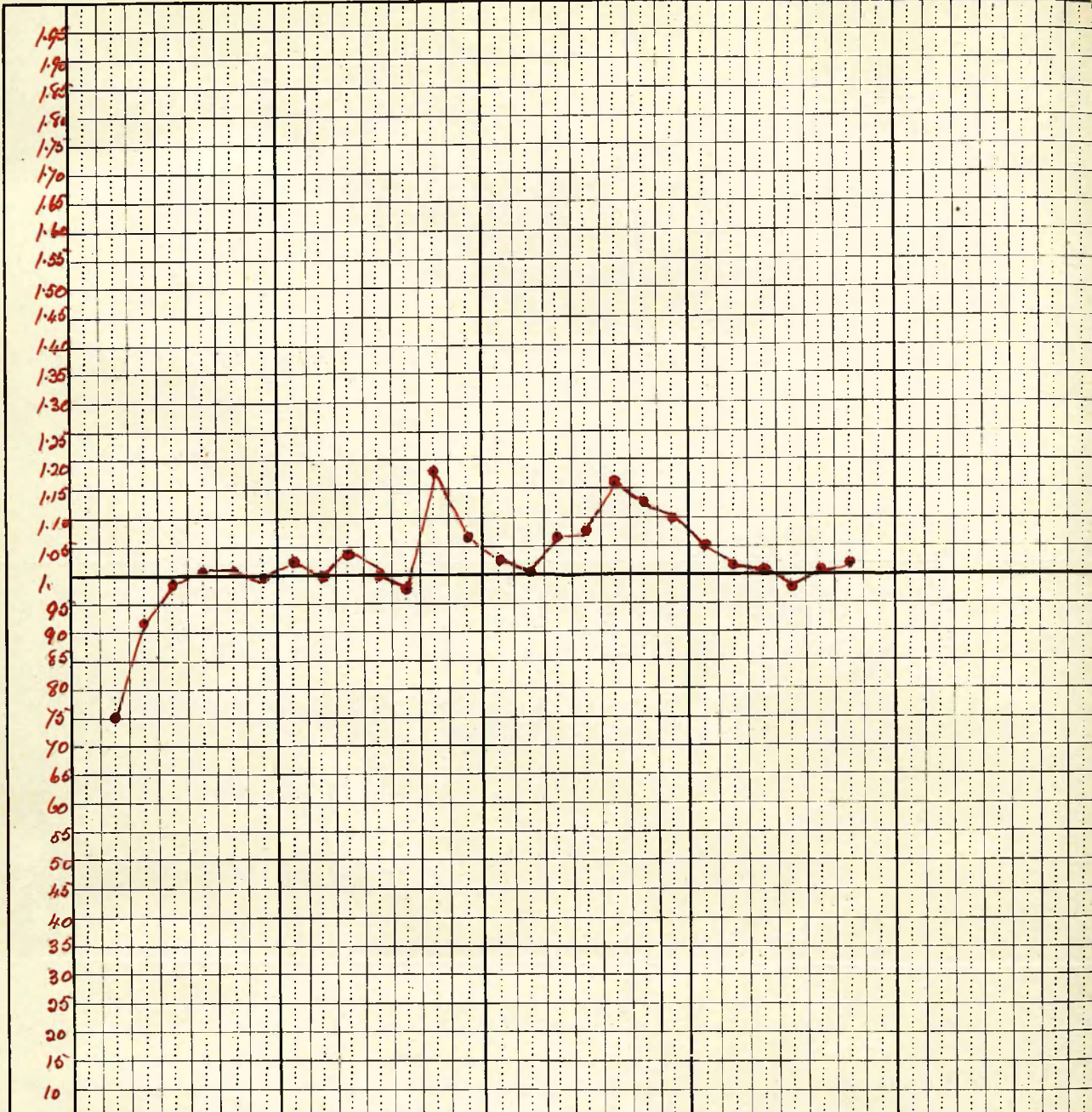
Urine contains a trace of albumen.

Progress: Serum treatment, two doses of 20 and 10 cc. as before.

A marked improvement in the throat condition was seen after the administration of serum. The congestion rapidly diminished, as did the exudation. The ulceration of the tonsils was much longer than usual in clearing, but at the end of 12 days the fauces presented a very healthy appearance.

For ten days the urine showed a trace of albumen, which became less marked each day, and finally disappeared.

Convalescence was uninterrupted.



Day Of Disease: 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

H. D., aet 4½ years

Admitted: 15th May, 1909

Previous Infectious Diseases: Measles, Whooping Cough,
Chickenpox.

History of Present Illness: Patient complained of sore
throat on 12th May. The rash appeared on same evening.

Present Condition: On admission Temp. 102.4° F., P. 146, R. 28

There is a brilliant scarlet fever rash present all over
the body.

The throat is much congested and oedematous and the ton-
sils are enlarged, their follicles filled with pus.

The tongue is coated with a thick fur through which the
enlarged congested papillæ are seen.

Heart and lungs are satisfactory.

Urine contains a trace of albumen.

The anterior cervical glands are enlarged and a little
tender.

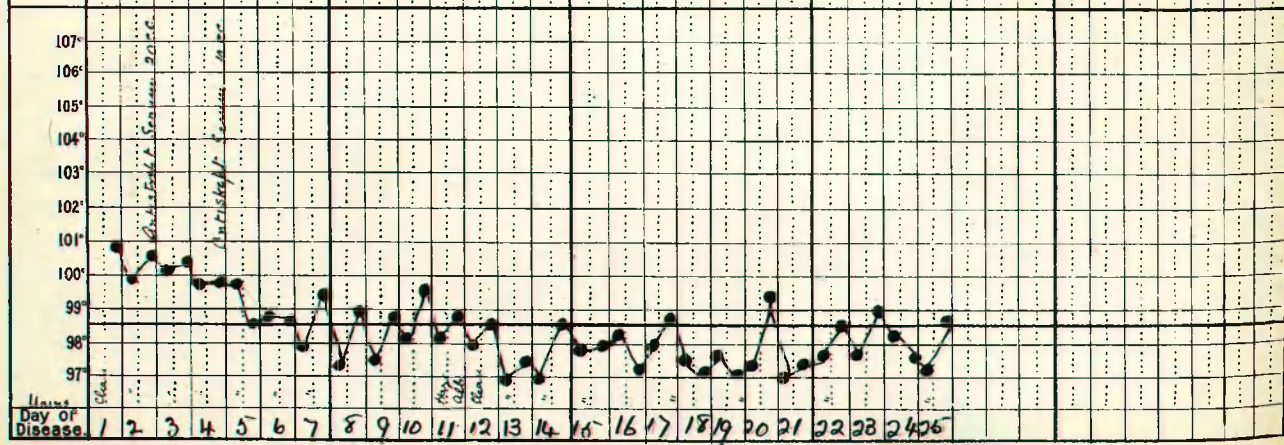
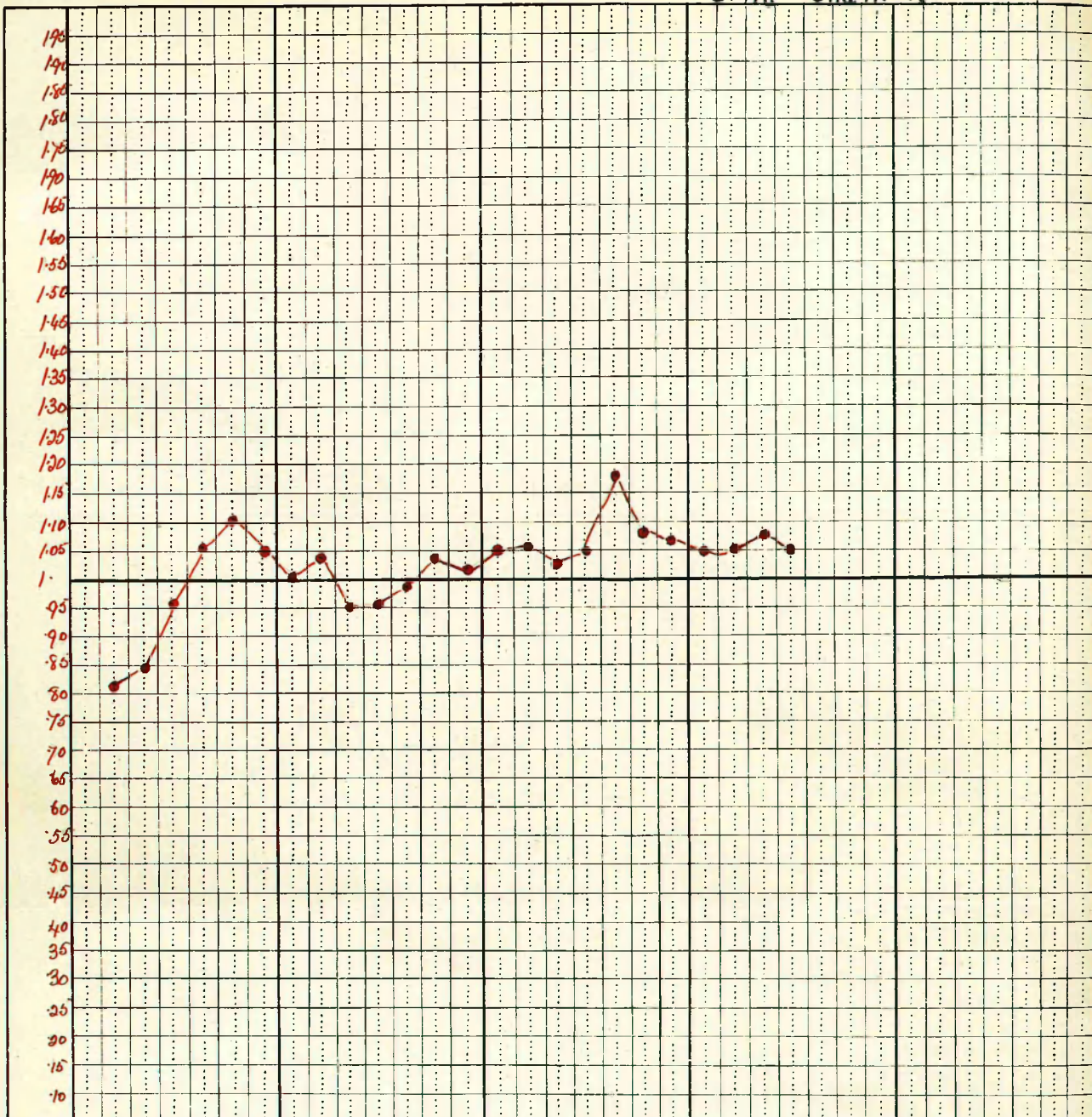
Progress: Patient treated with antistreptococcus serum (P. D.
& Co.), in two doses of 20 and 10 c.c.

There was a very marked improvement in the throat condi-
tion in a few days. The congestion rapidly disappeared
as did the pus in the follicles of the tonsils. These,
however, remained very large during her residence in
hospital.

With the improvement in the throat condition the temper-
ature soon reached the normal level.

Urine contained a faint trace of albumen for the first 3
days, but after that was always normal.

Convalescence was uninterrupted.



Hours Day of Disease 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Quinine 2 grains 20°C

Antipyretic 20°C

100

100

C. M., aet 4 years

Admitted: 11th May, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of sore throat sickness and vomiting on 11th May. The rash appeared on the same evening.

Present Condition: On admission Temp 100.8° F., P. 140, R. 26

There is a brilliant scarlet fever rash present all over the body.

The fauces are intensely congested, and both tonsils are enlarged and ulcerated and the crypts show some points of pus.

The tongue is coated and the papillae are enlarged and red.

Heart and lungs are satisfactory.

Urine contains a trace of albumen.

Progress: Patient treated with (P. D. & Co.) antistreptococcus serum in two doses of 20 and 10 c.c., on 3rd and 5th days of illness respectively.

After the administration of the serum a very marked improvement in the throat condition was noticed.

The dusky congestion had given place to a pink healthy mucous membrane.

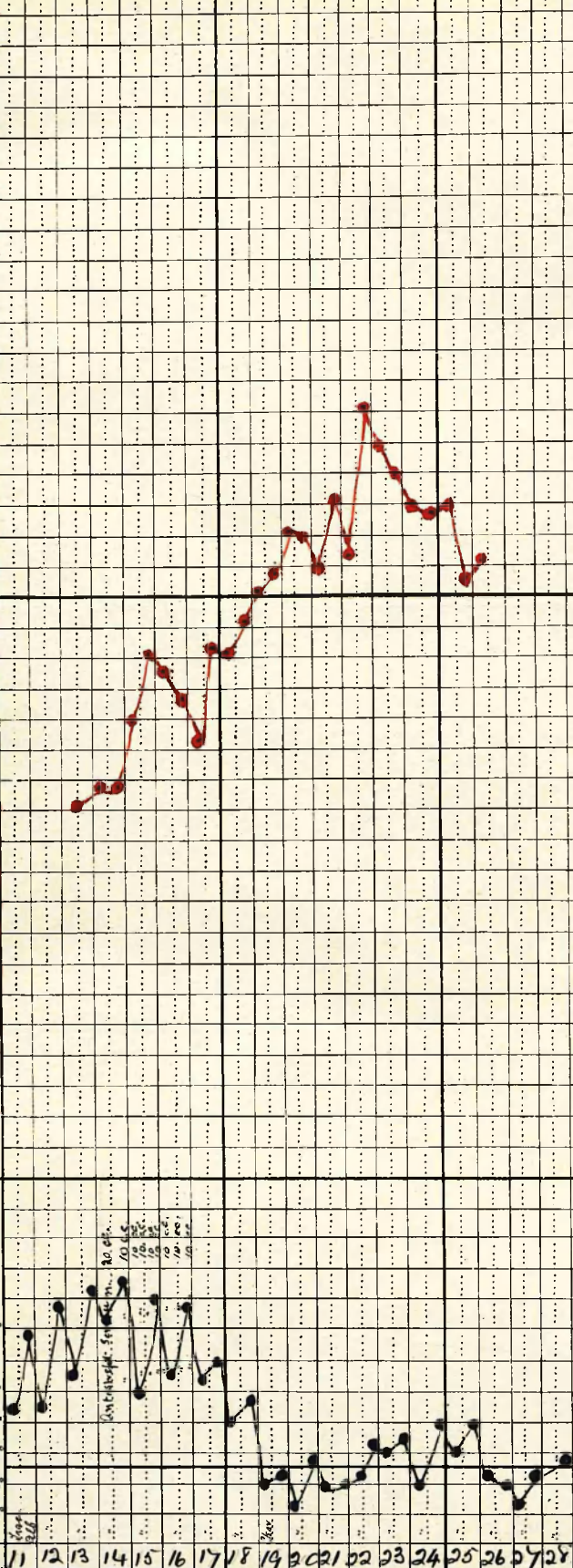
In a week the ulceration of the tonsils had almost disappeared and the throat as a whole was quite normal.

The urine contained a trace of albumen on 11th day of illness.

Convalescence was uninterrupted.

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102°
101°
100°
99°
98°
97°



Day of Disease 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

E. M., aet 10 years

Admitted: 11th May, 1909.

Previous Infectious Disease: Diphtheria

History of Present Illness: Patient was in hospital under treatment for diphtheria when the usual symptoms of scarlet fever appeared.

Present Condition: On admission Temp 100.8° F., P. 128, R. 24

There is a faint erythema present all over his body.

The fauces are intensely congested and the tonsils are slightly enlarged and ulcerated.

The tongue is very dirty and the papillae much enlarged.

Heart and lungs are satisfactory.

The urine is free from albumen.

Progress: Serum treatment, 100 c.c. in all given.

For the first fortnight of the scarlet fever the patient's condition became steadily worse. The ulceration of the tonsils spread rapidly, till the whole of the soft palate and part of the head were involved.

The temperature each day was more elevated than on the previous day and the patient was very ill.

On the evening of the 14th day of illness 20 c.c. anti-streptococcus serum were injected and this dose was given six hourly for three days.

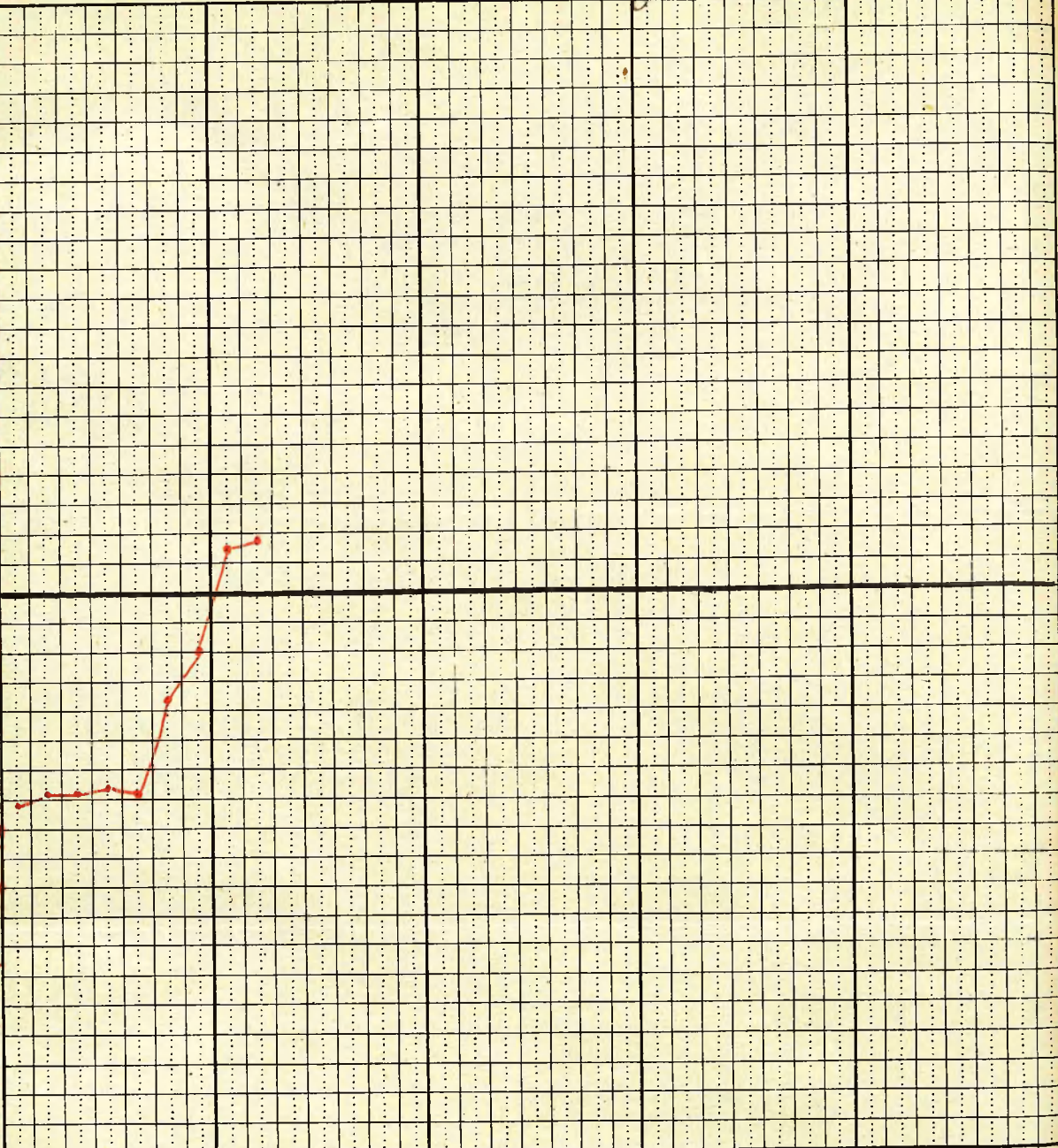
An improvement began but progressed slowly though almost at once the temperature was affected and did not rise so high. Five days after the start of the serum the

temperature was normal and the throat, though not better, was very greatly improved.

The general condition of the patient improved and he soon became convalescent and made an excellent recovery.

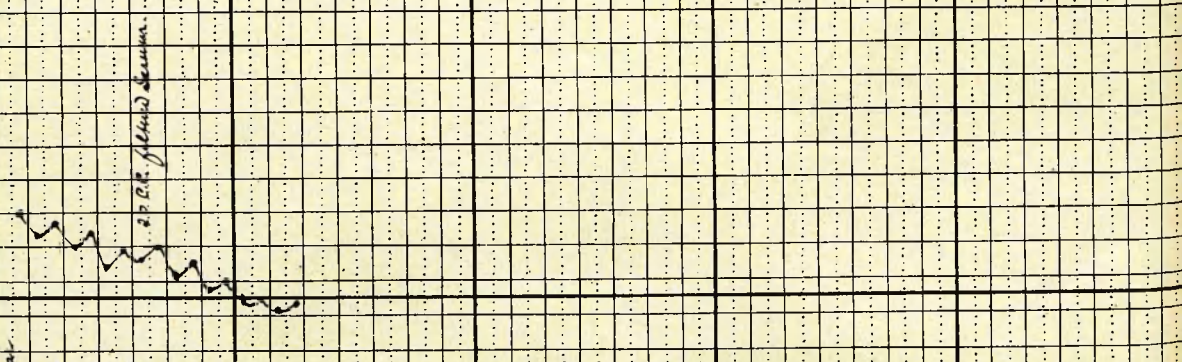
The urine contained albumen each day up till the 19th day of illness, after which it was clear.

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107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°

27 R.R. of blood serum



Time
Day of Disease 4 5 6 7 8 9 10 11 12

J. McD., aet 8 years

Admitted: 4th September, 1909

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of headache and sore throat on September. The rash appeared next day.

Present Condition: On admission Temp. 101° F., P. 132, R. 30
The rash has faded from the chest, but is typical on limbs.
There is some congestion of the fauces which are covered with much exudate.
Tonsils are enlarged and ulcerated.
Heart and lungs are satisfactory.
Urine is free from albumen.

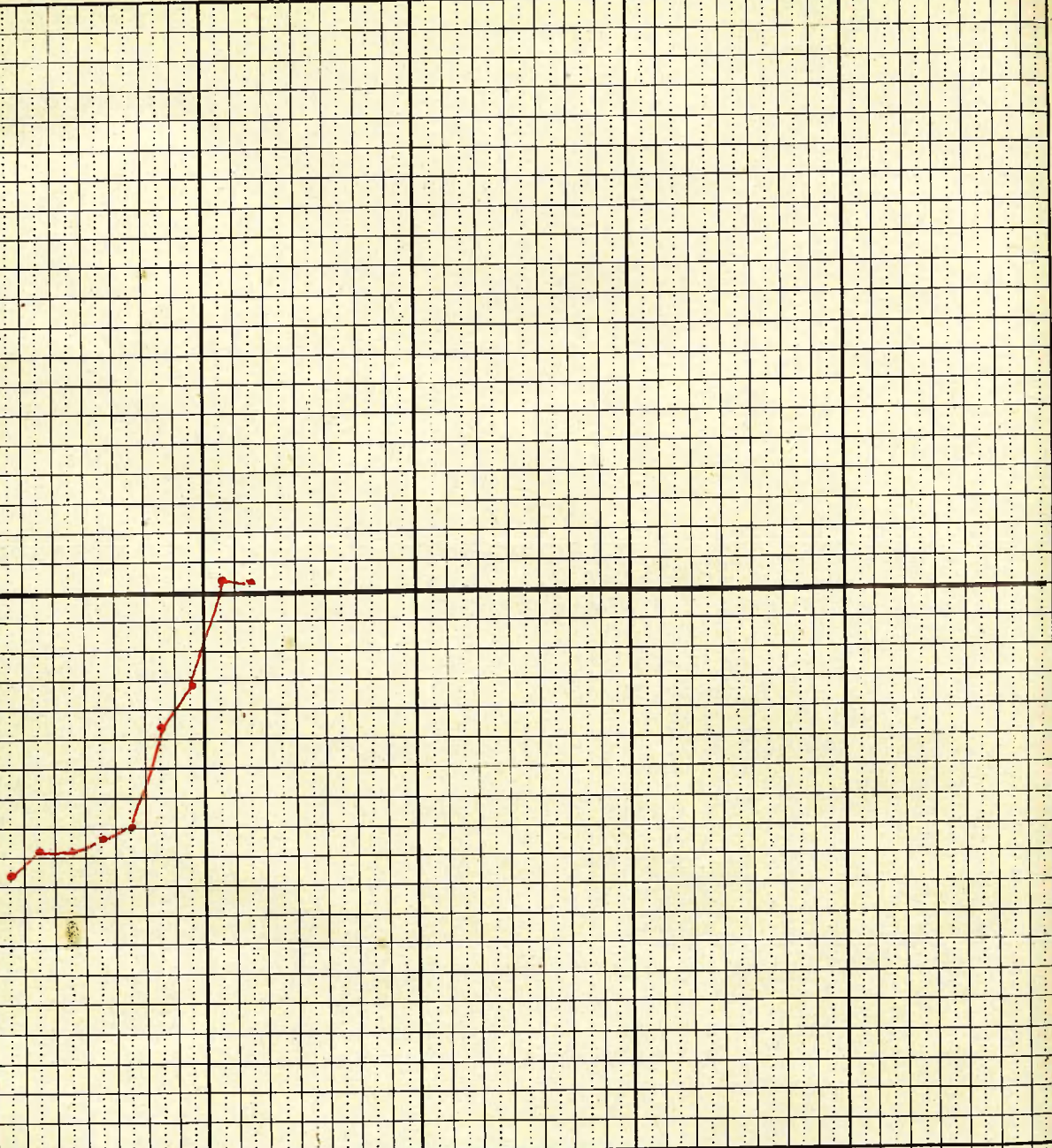
Progress: Serum treatment, two doses of 20 and 10 c.c. respectively of filtered serum (P. D. & Co.).

There was soon a decided improvement in the throat condition, but a fortnight elapsed before it had become quite normal.

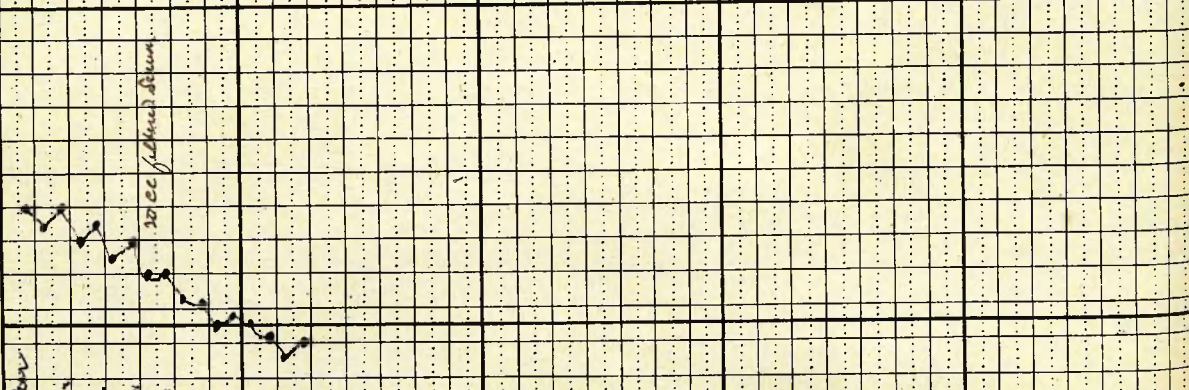
The temperature depending on the throat condition was soon normal and remained so.

Urine was free from albumen.

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15
10



107°
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°



10 cc (4 times) Serum

Time
Day of Disease

5 6 7 8 9 10 11 12 13

S. A., aet 9 years

Admitted: 4th September, 1909.

Previous Infectious Diseases: Measles and Whooping Cough.

History of Present Illness: For several days before admission patient complained of sickness and vomiting, with headache and sore throat. The rash appeared on 3rd Sept.

Present Condition: On admission Temp. 102° F., P. 140, R. 32

There is a bright rash present all over the body.

The fauces are intensely congested and both tonsils are enlarged and ulcerated.

The tongue is coated with a thick white fur through which are seen the congested and oedematous papillae.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment. Two doses of P. D. & Co.'s serum filtered through a Berkefeld filter.

As in other cases the improvement in the throat condition was rapid and very soon the fauces presented a normal appearance.

The temperature which was never very high soon reached normal, at which level it remained.

Convalescence was uninterrupted.

D. P., aet $3\frac{1}{2}$ years

Patient had a very mild attack of scarlet fever, which ran a normal uninterrupted course.

Antistreptococcus serum given on 20th day of illness to test the effect on the opsonic index in normal case.

L. S., aet $8\frac{1}{2}$ years

Mild attack of scarlet fever without complications.

Serum given on 30th day of illness for same purpose as above.

D. K., aet 5 years

Moderately acute attack, with dirty throat and nasal discharge and enlarged cervical glands.

Symptoms cleared up quickly.

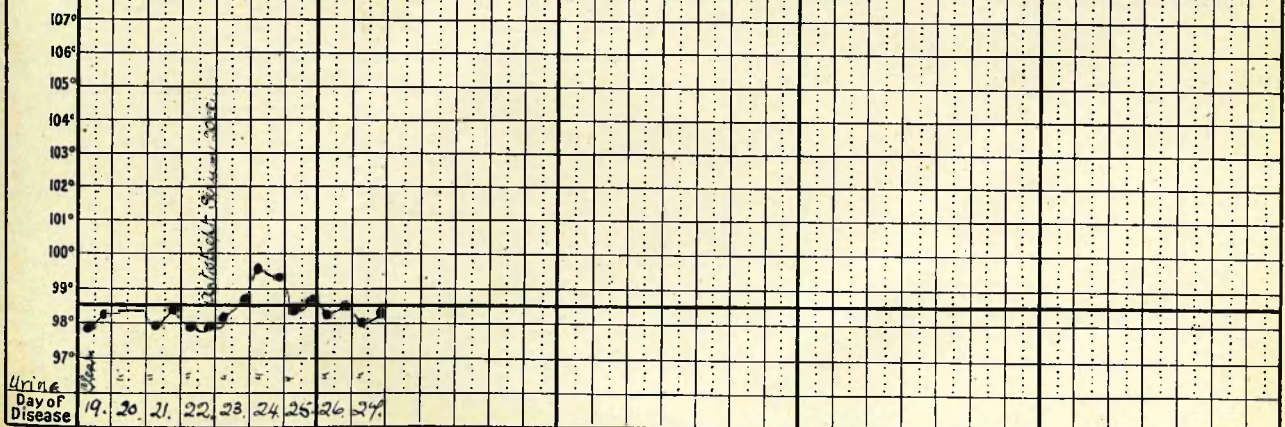
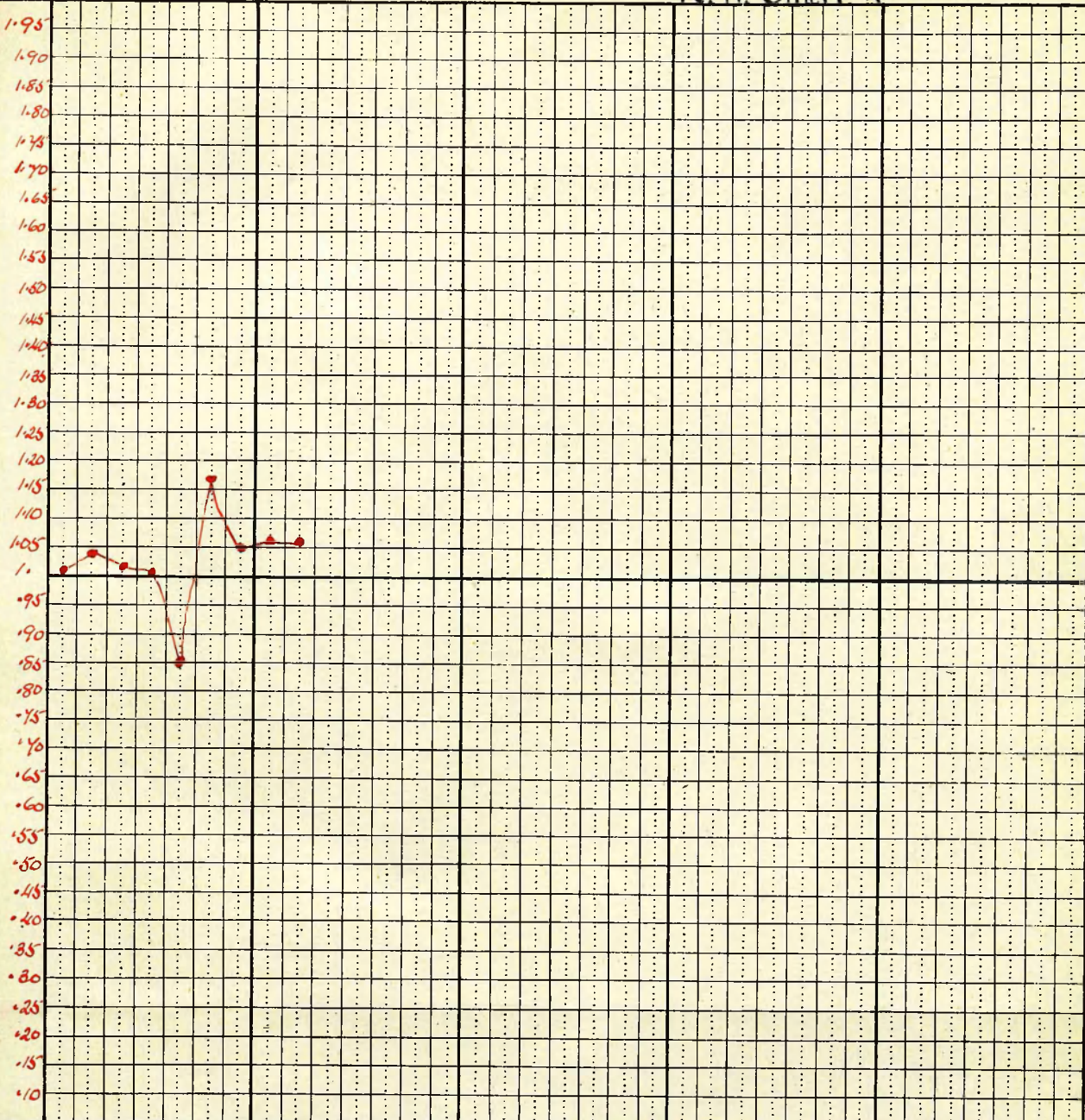
Serum given as in above.

Ten days later this patient developed a mild attack of scarlet fever, diagnosed by rash and sore throat. He recovered quickly.

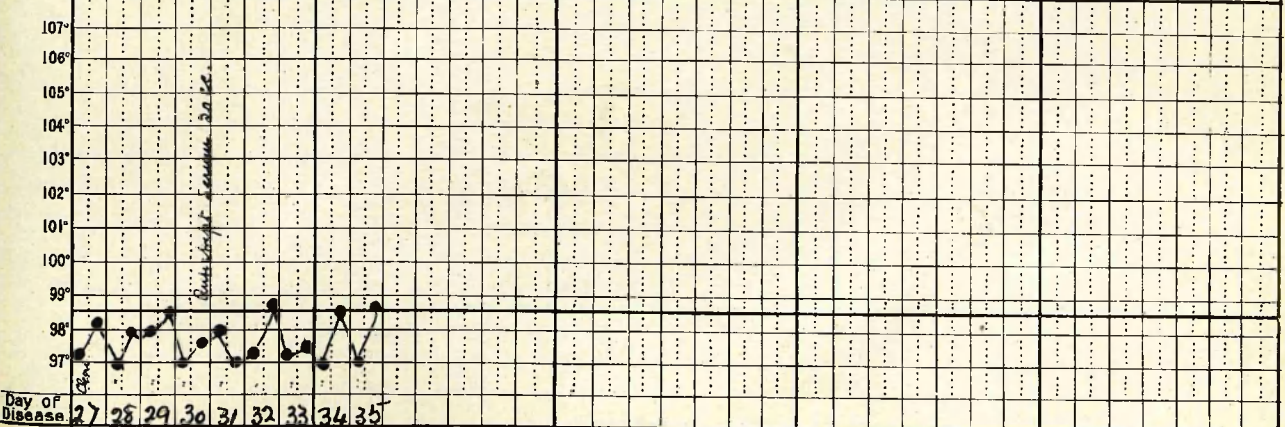
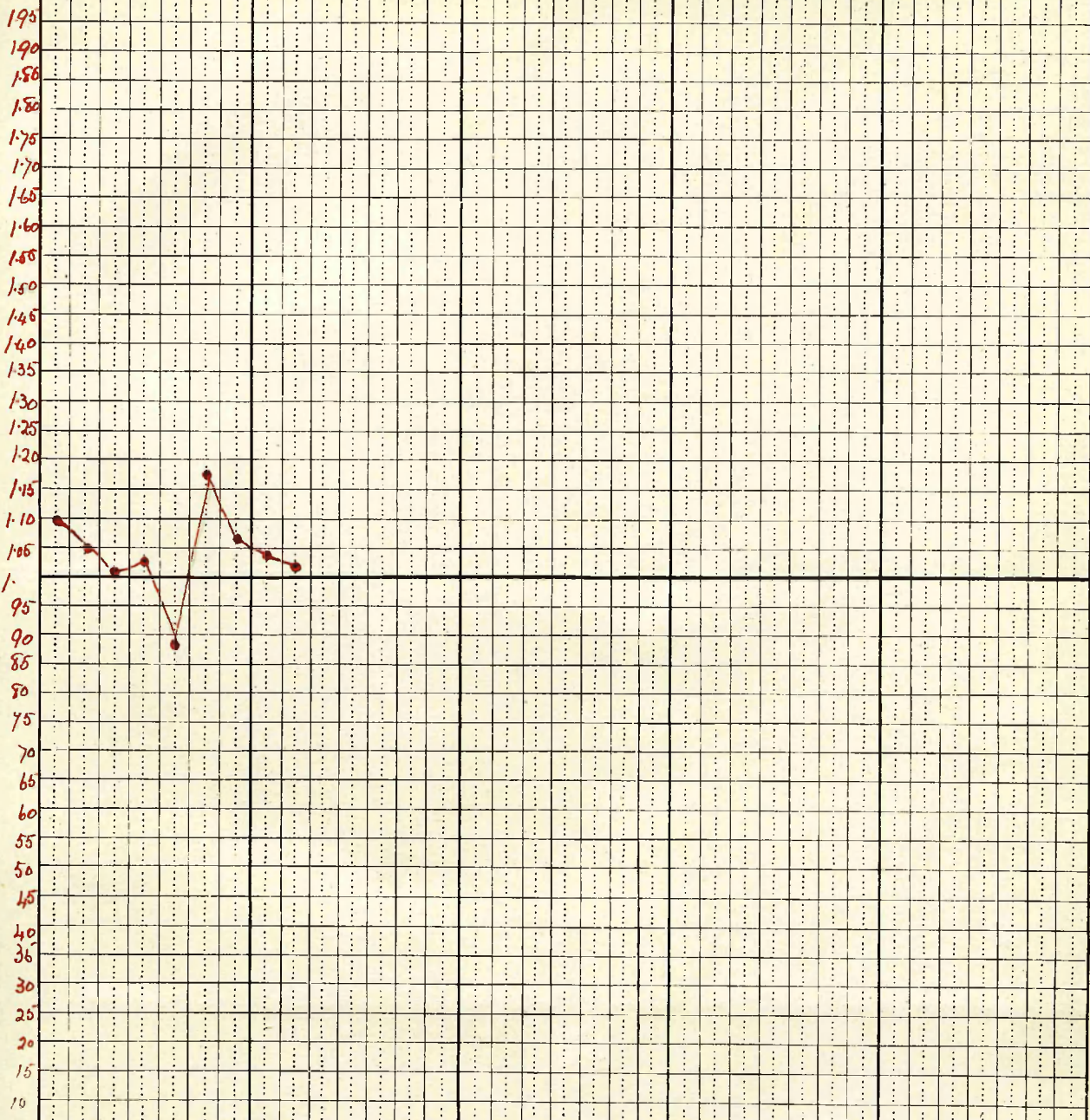
R. W., aet 4 years

Typical attack of scarlet fever of moderate severity, pyrexia lasting four days

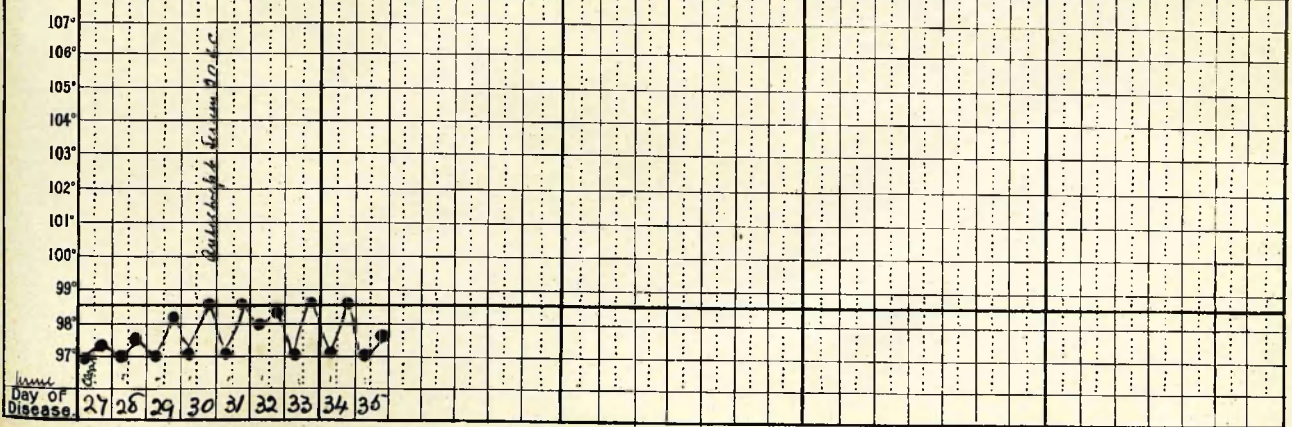
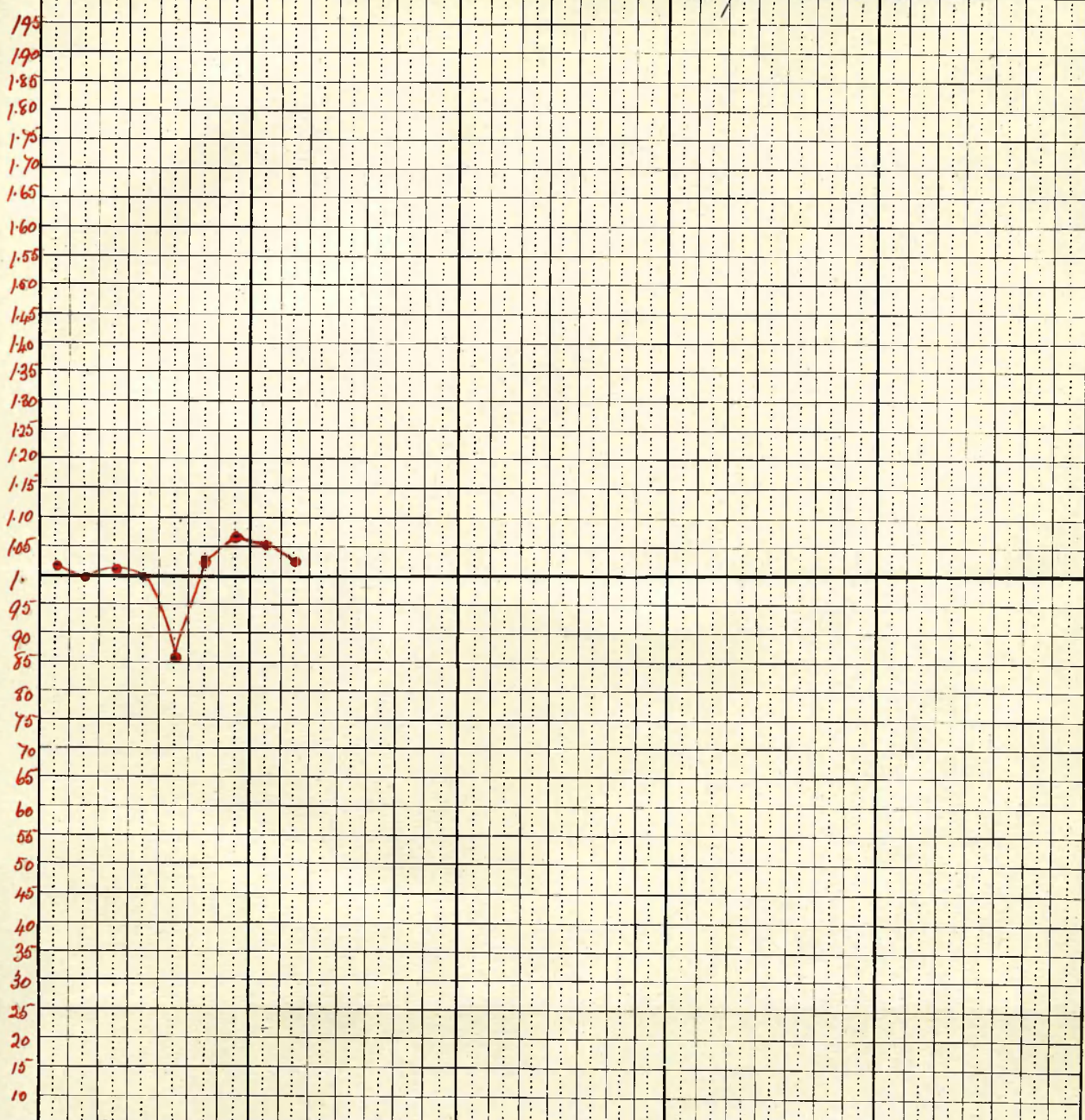
Serum given on 22nd day of illness as in above cases



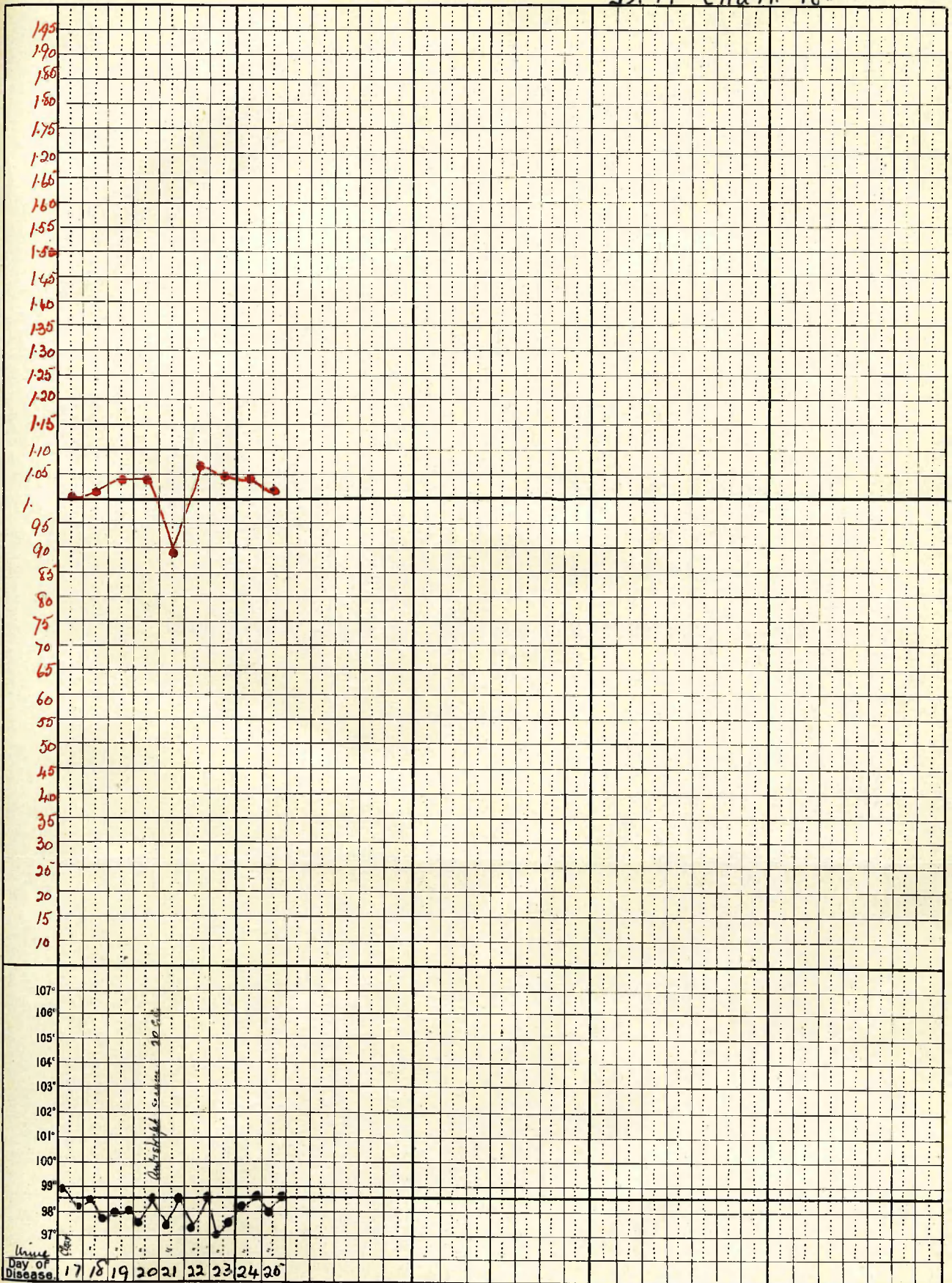
Urine
Day of Disease 19. 20. 21. 22. 23. 24. 25. 26. 27.



Day of Disease 27 28 29 30 31 32 33 34 35



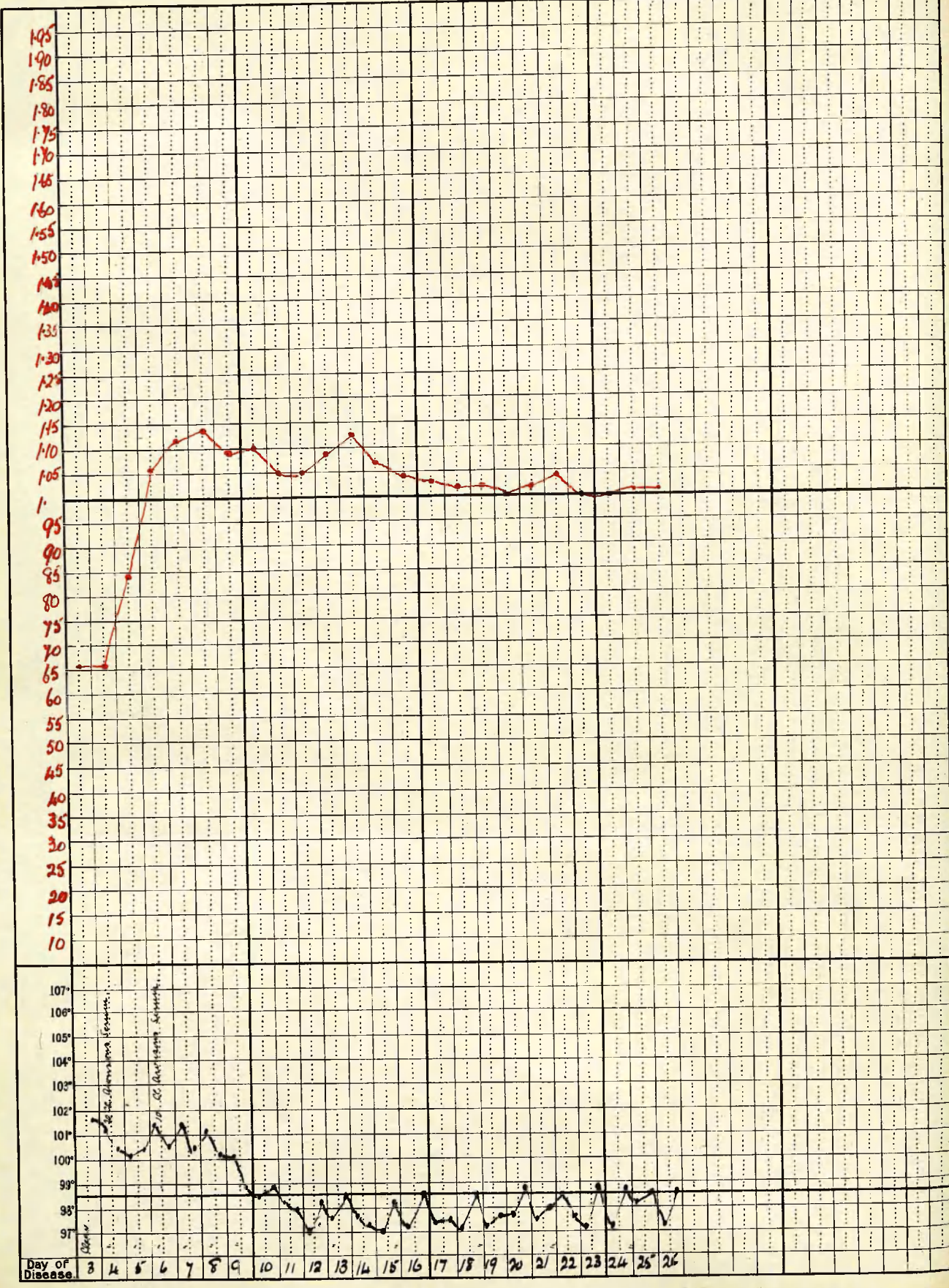
Day of Disease: 27 28 29 30 31 32 33 34 35 36



Diphtheria 10/17/14

Time
Day of Disease

CASES TREATED WITH ARONSON'S ANTISTREPTOCOCCUS SERUM



Day of Disease 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

M. S., aet 5 years

Admitted: 11th August, 1909

Previous Infectious Disease: None

History of Present Illness: Illness began on 9th August with a complaint of headache and sore throat, sickness and vomiting. The rash appeared over the chest on 10th August.

Present Condition: On admission Temp. 101.6° F., E. 140, R. 32

The rash has faded from the chest but is still typical on the lower limbs.

There is considerable congestion of the fauces, the mucous membrane of which is covered with an abundant exudate. Both tonsils are enlarged and congested and show some ulceration.

The tongue is coated with a thick fur through which the papillae stand out much congested and enlarged.

Heart and lungs are both satisfactory.

Urine is free from albumen.

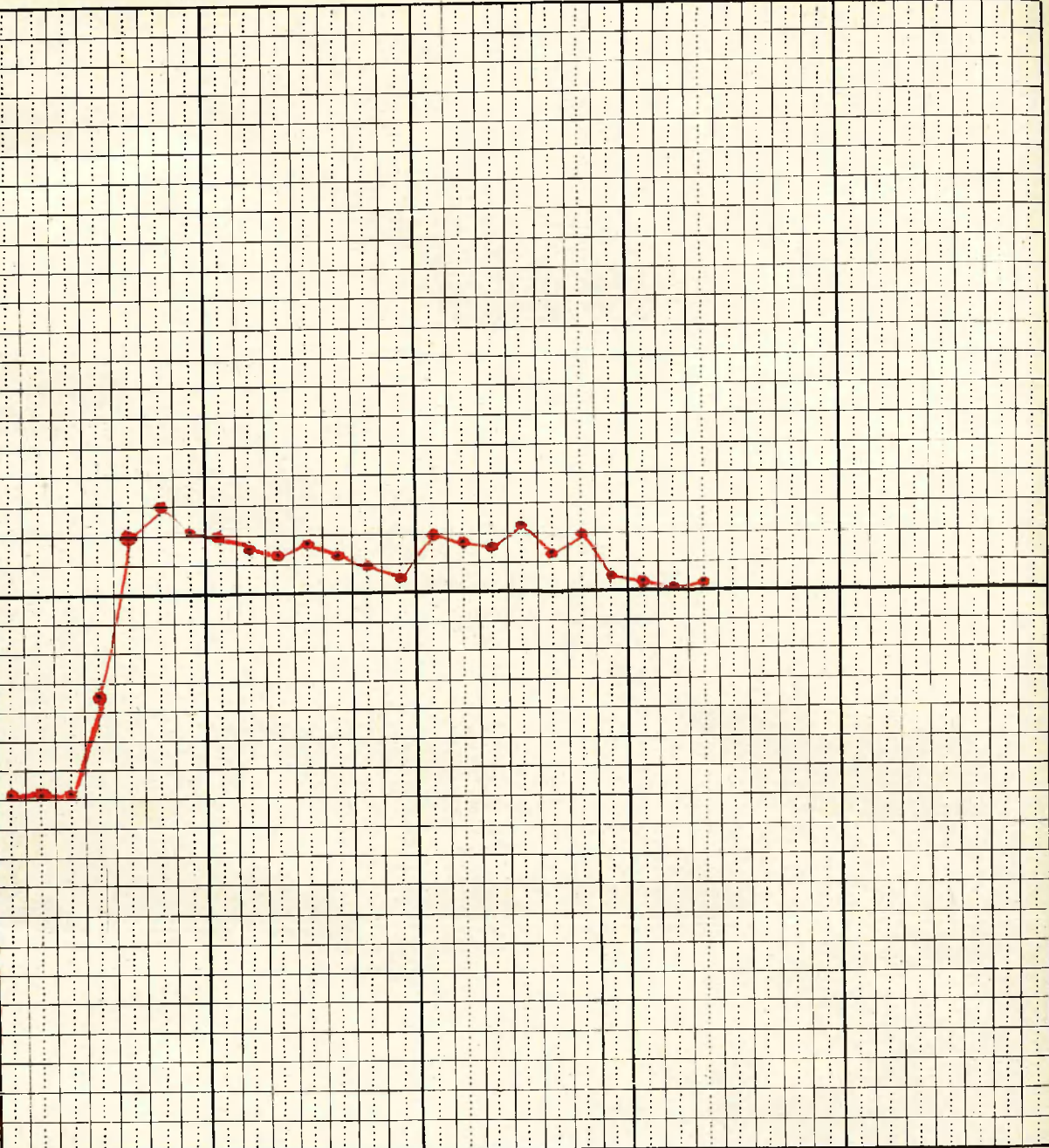
Progress: Serum Treatment. Aronson's serum as before.

The improvement in the throat condition was very rapid to begin with, but though all exudate had disappeared in two days, a week had passed before the ulceration was healed up.

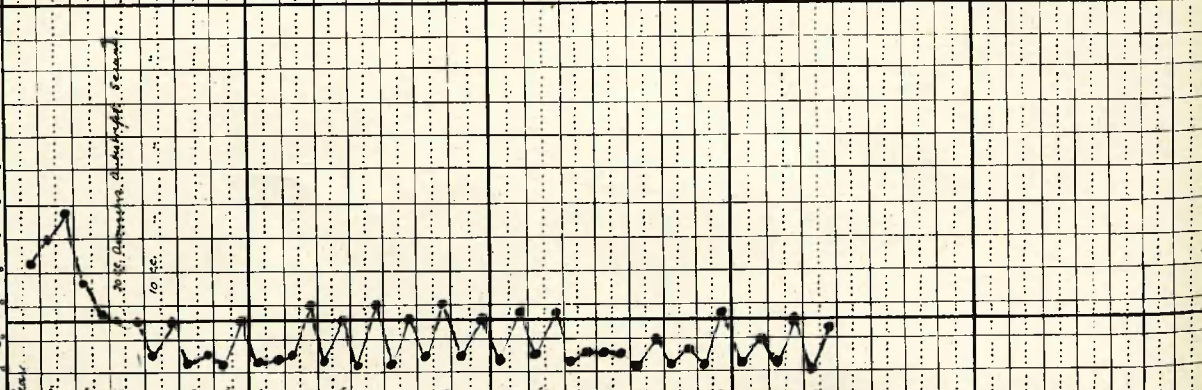
During this week the temperature remained more or less elevated, but it soon reached normal.

The urine was clear during the illness.

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Day of Disease 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

A. W., aet 6 years.

Admitted: 31st July, 1909.

Previous Infectious Disease: Measles, Whooping Cough

History of Present Illness: Headache, sickness and vomiting and sore throat were complained of on 30th July. The rash appeared on same evening.

Present Condition: On admission Temp. 100.4° F., P. 112, R. 24

There is a brilliant scarlet rash present all over the body.

The fauces are much congested and both tonsils are enlarged, and ulcerated.

A thick white fur coats the tongue, which is peeling round the edges.

Heart and lungs are satisfactory.

Urine is free from albumen.

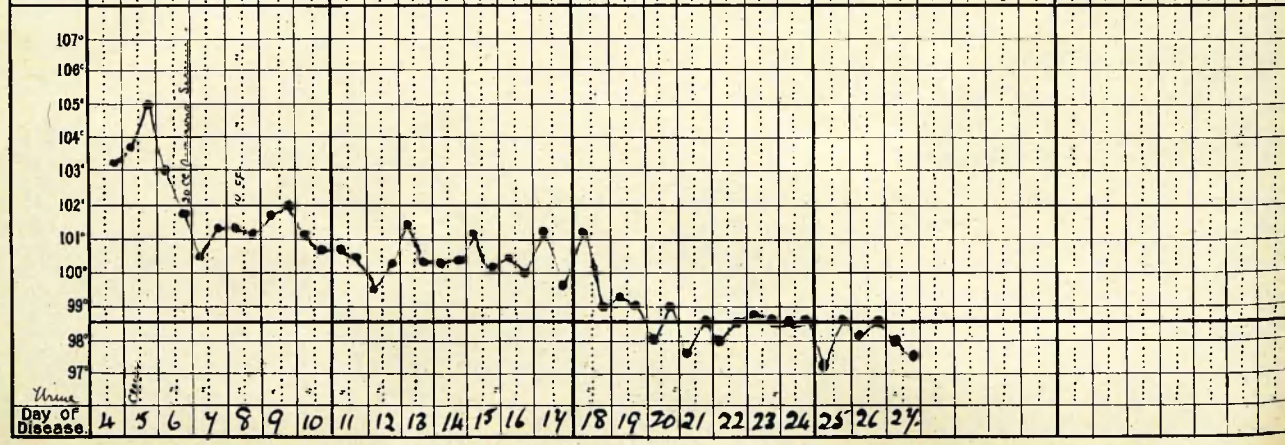
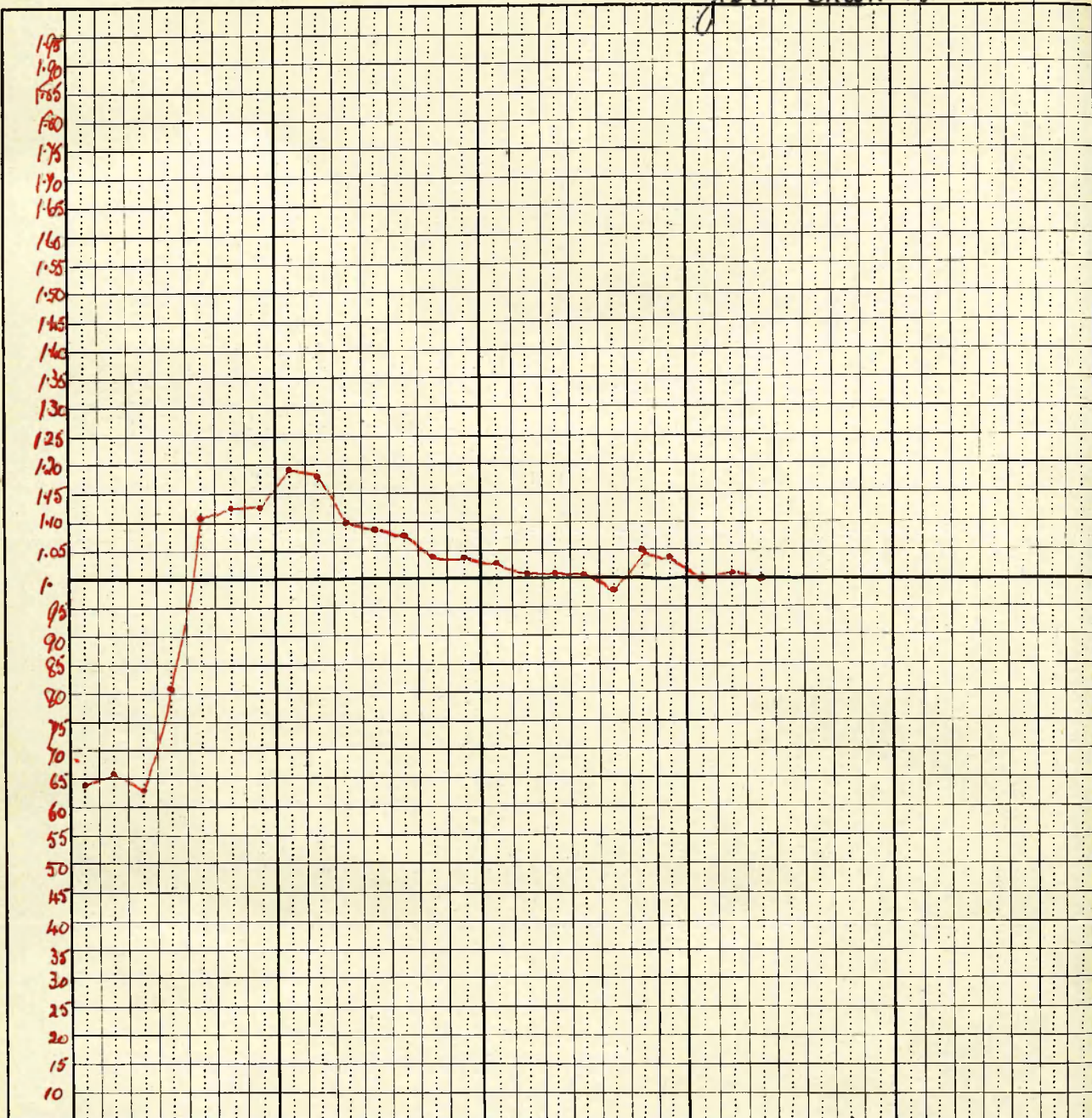
Progress: Serum treatment, Aronson's serum, 20 and 10 c.c.

In a very few days a great improvement was seen in the throat condition and on the eighth day of illness the congestion of the fauces had almost disappeared, and the exudate had diminished.

The tongue peeled rapidly and was soon normal again.

The temperature fell to normal on the fourth day of illness and the patient was very well.

Convalescence was uninterrupted.



Thru
Day of Disease 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

J. R., aet 3 years

Admitted: 31st July, 1909

Previous Infectious Disease: None

History of Present Illness: Patient complained of sickness and sore throat on 26th July. The rash appeared on 29th.

Present Condition: On admission Temp. 103.2° F., P. 128, R. 28

There is a faint erythema present on the chest.

The fauces are much congested and oedematous, but are quite free from ulceration.

Both tonsils are much enlarged.

The tongue is coated and is beginning to peel.

Heart and lungs are satisfactory.

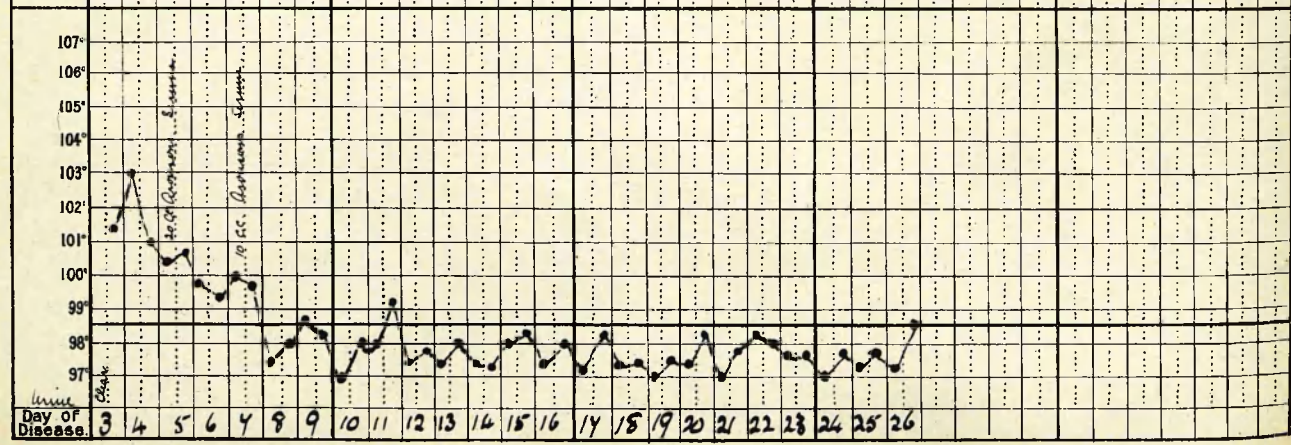
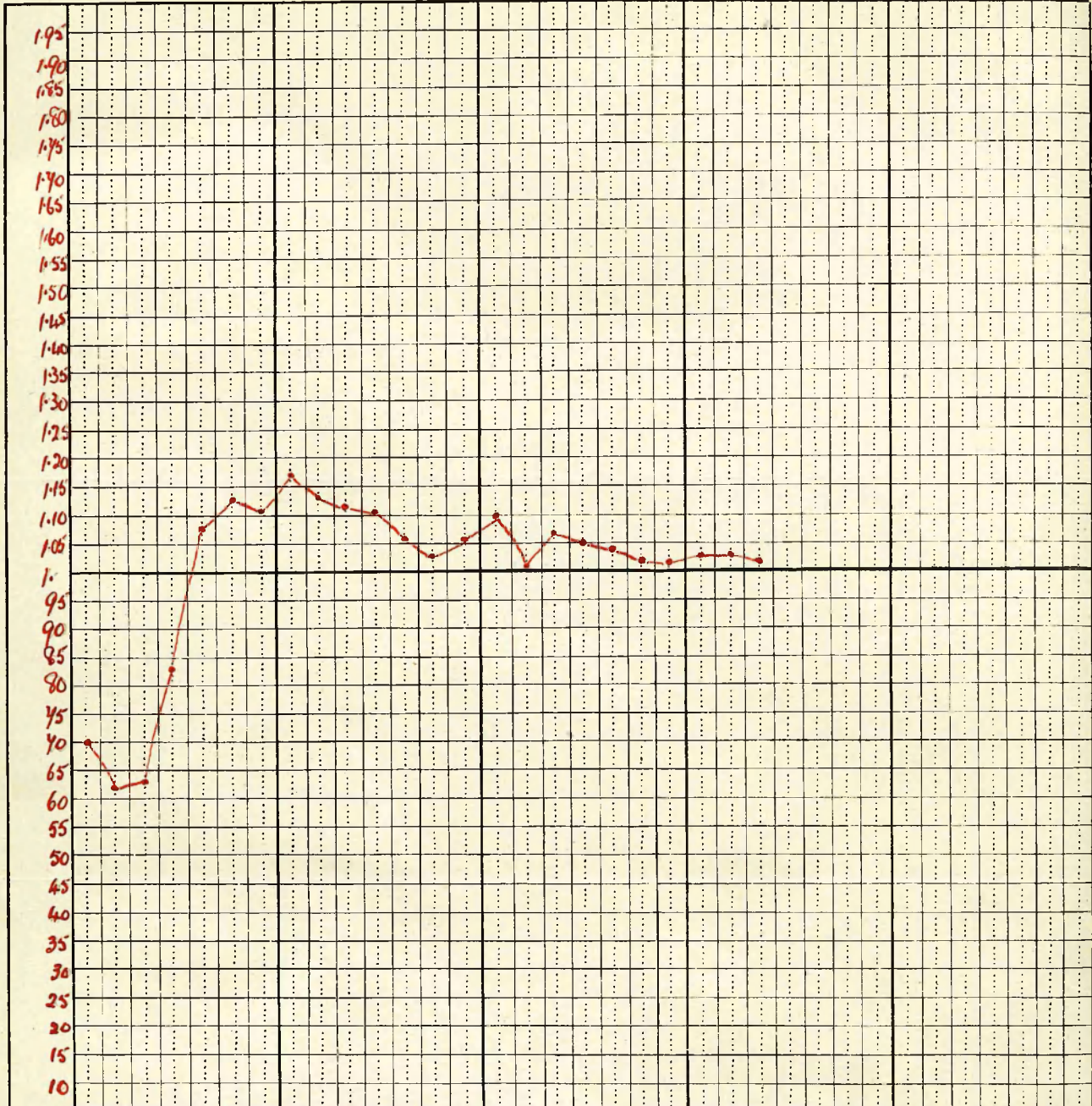
The urine is free from albumen.

Progress: Serum treatment, Aronson's serum as before.

For two days after admission the congestion became more intense and soon the whole of the soft palate was involved in a superficial ulceration. The exudate from this was very abundant and continually flowing over the lips soon caused some deep excoriations. After the second dose of serum the ulceration began to heal up, and in a short time was completely well, though the intense congestion took a much longer time to disappear.

The temperature was elevated more or less for about three weeks, but at the beginning of the fourth week of illness it became and remained normal.

Convalescence was uninterrupted and recovery complete.



Day of Disease: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26

P. V., aet 4 years

Admitted: 31st July, 1909

Previous Infectious Disease: -

History of Present Illness: Patient complained of sickness and vomiting, headache and sore throat, on 28th July. On the following day the rash appeared.

Present Condition: On admission Temp. 101.4° F., P. 140, R. 30

There is a brilliant scarlet rash present over the body.

The congestion of the fauces is intense and both tonsils are greatly enlarged. There is no ulceration.

A thick fur coats the tongue, the papillae of which are much enlarged.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment with Aronson's serum as before.

The intense congestion of the fauces very soon gave place to an extensive ulceration, which, however, was quite superficial.

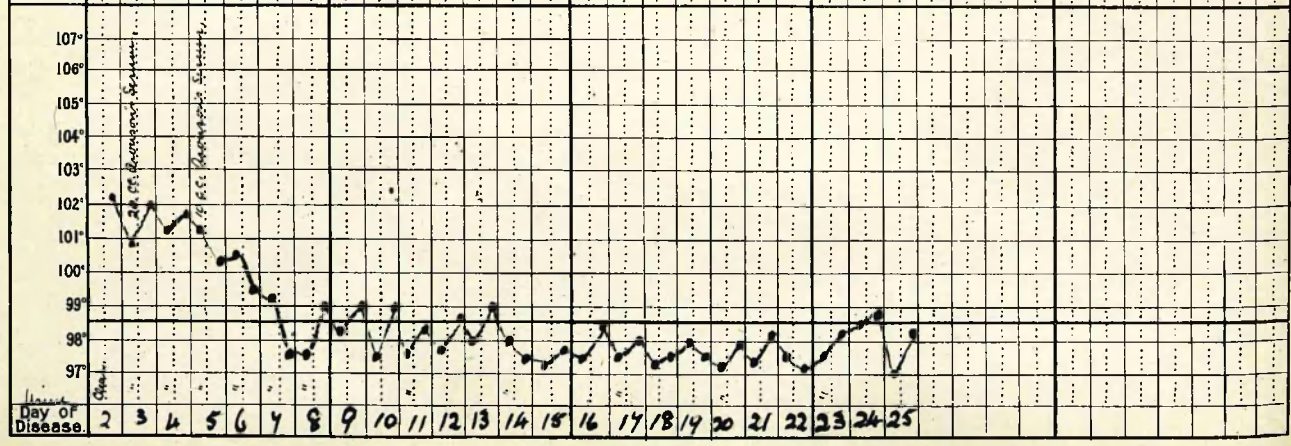
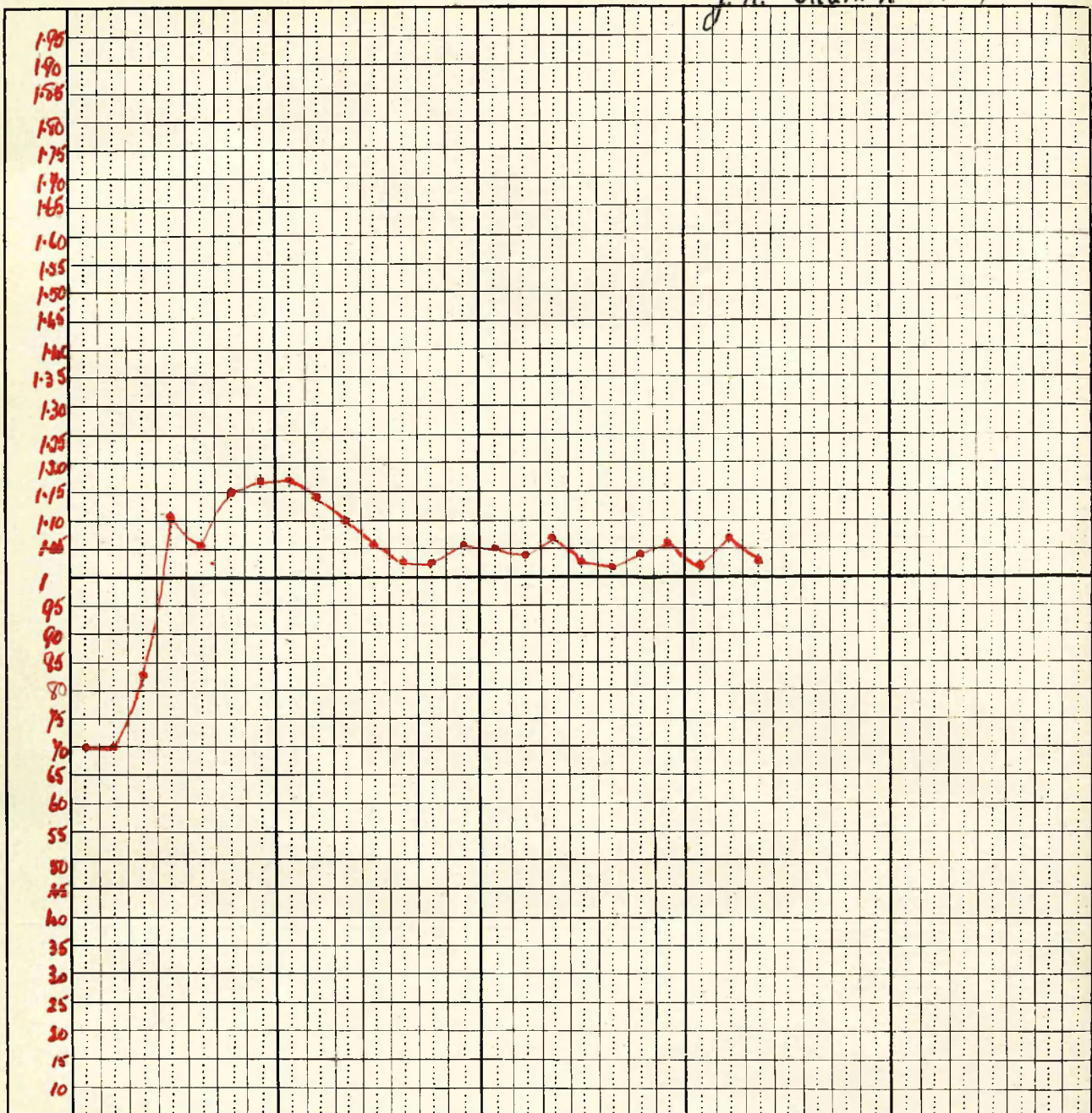
About the sixth day of illness it began to clear up, and by the twelfth day had entirely disappeared.

The deep injection of the fauces had gone completely by this time, and the throat looked quite normal.

There is little to note about the temperature in this case. After the ninth day of illness it became normal.

Convalescence was uninterrupted.

J. K. Chart No. 47.



Day of Disease: 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

J. K., aet 7½ years

Admitted: 2nd August, 1909

Previous Infectious Diseases: Measles and Whooping Cough

History of Present Illness: Patient complained of headache, sickness and vomiting, on 31st July, of sore throat on 1st August, on which day the rash appeared.

Present Condition: On admission Temp 102.4° F., P. 140, R. 36

A bright scarlet rash covers the whole body.

The fauces are much congested, both tonsils are enlarged and the left is deeply ulcerated.

The usual coating of white fur covers the tongue, which is beginning to peel, leaving the edges red and raw looking.

Heart and lungs are satisfactory.

Urine is free from albumen.

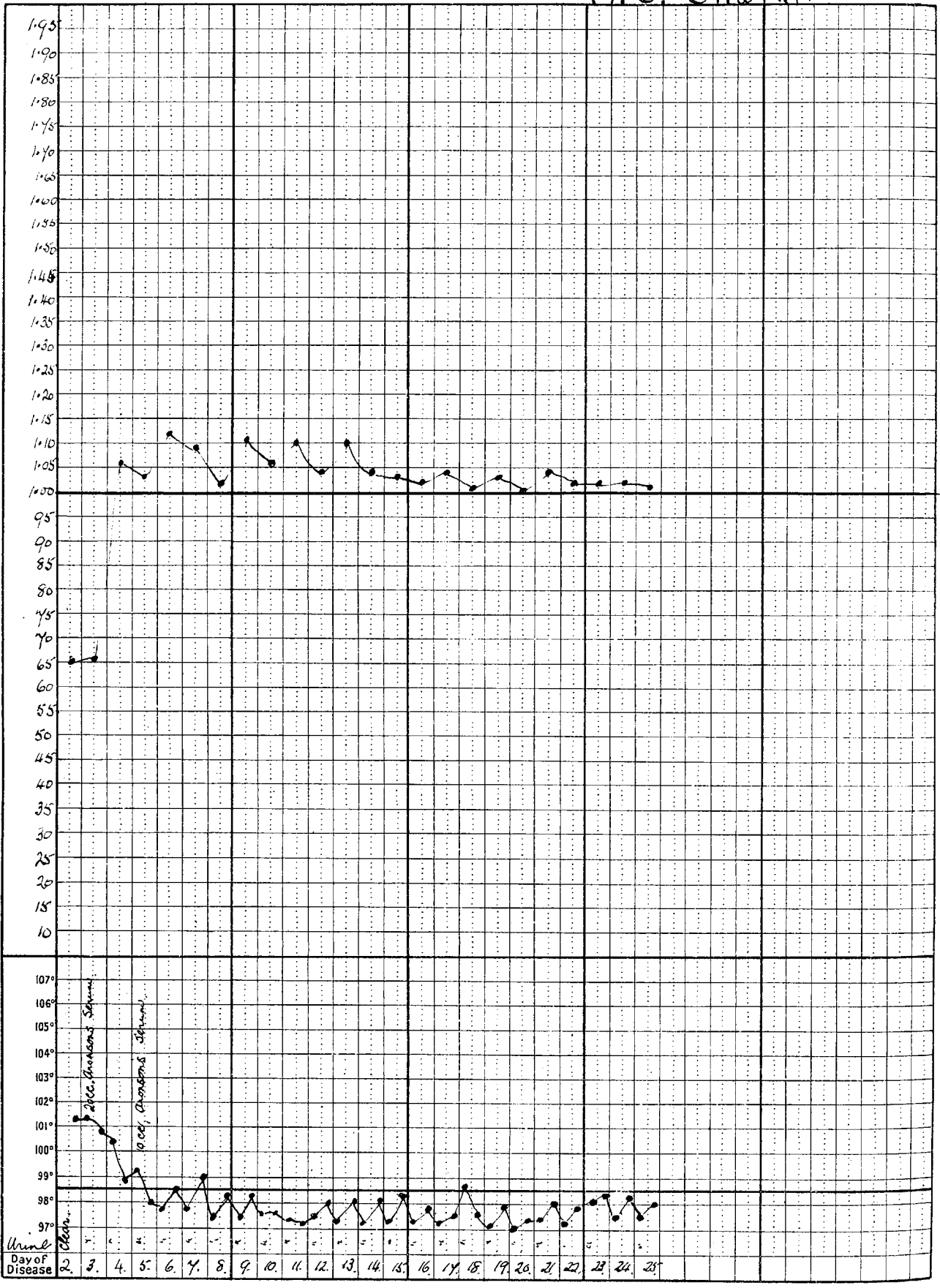
Progress: Serum treatment, Aronson's serum in two doses, 20 and 10 c.c. each.

For several days there was no improvement either general or local, and not until the ninth day of illness was there any great healing of the ulceration.

About this time the patient complained of pain and stiffness in her ankles and knees, wrists and elbows, but with heat this soon passed away.

The temperature was elevated for about a week, but soon reached normal with the improvement in the throat.

The urine was free from albumen throughout the illness.



Wind
Day of Disease

20cc. Anasars Serum
10cc. Anasars Serum

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M. C., aet 2 years

Admitted: 5th August, 1909

Previous Infectious Disease: Measles.

History of Present Illness: Patient complained of sickness and vomiting on the 4th and headache and sore throat on 5th August. The eruption appeared on the evening of 5th.

Present Condition: On admission Temp. 101.2° F., P. 130, R. 30

The rash is brilliant and typical of the disease.

An abundant mucopurulent exudate covers the intensely congested mucous membrane of the fauces.

Both tonsils are much enlarged and show signs of superficial ulceration.

The tongue which is coated with a thick white fur is beginning to peel.

Heart and lungs are satisfactory.

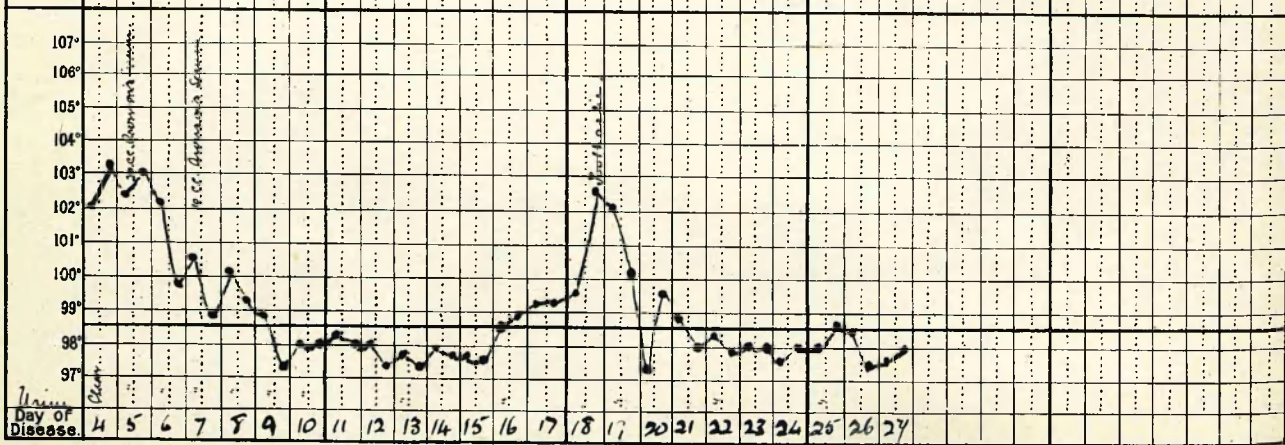
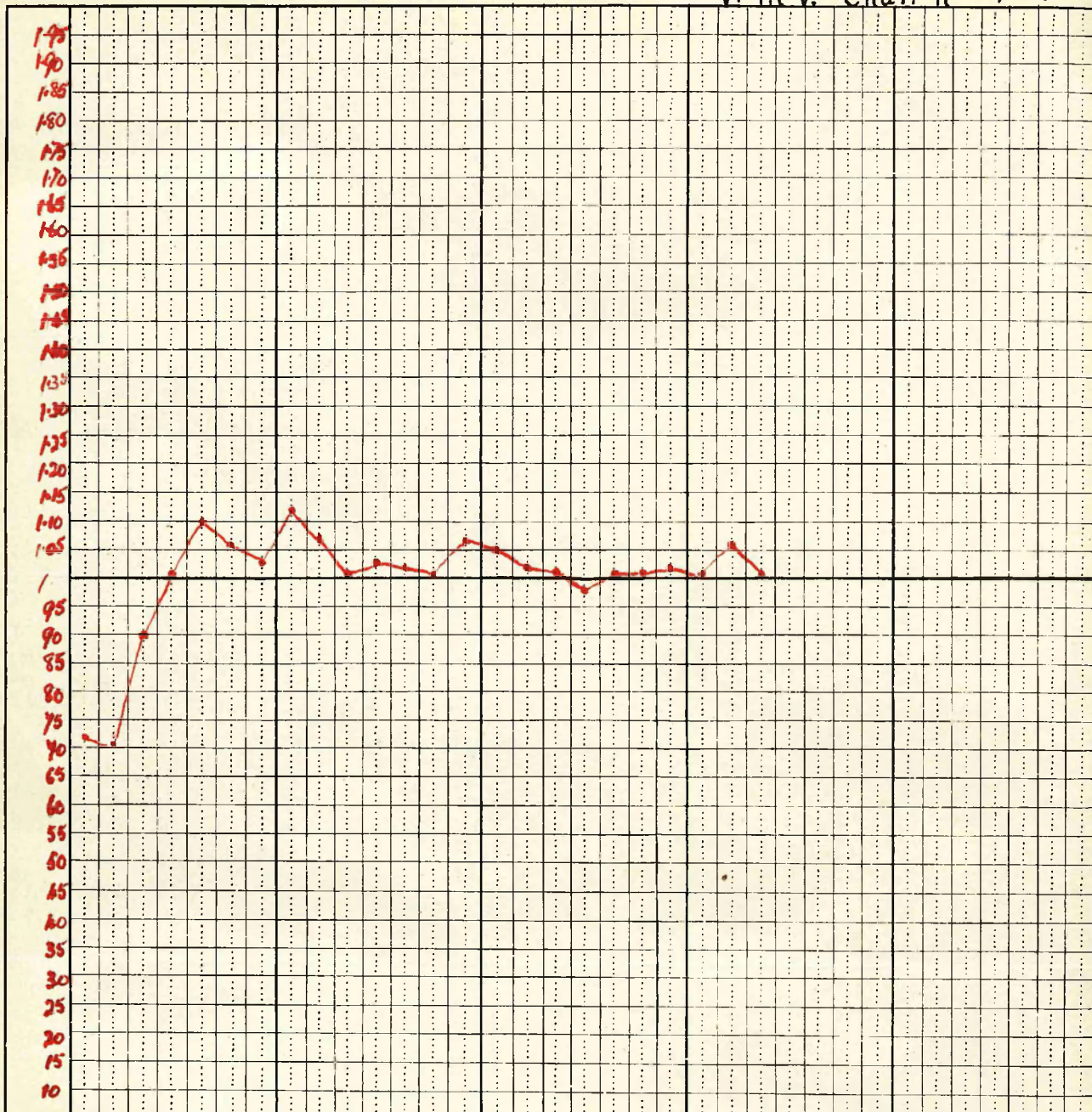
Urine is free from albumen.

Progress: Serum treatment, Aronson's serum in two doses as before.

The usual progressive improvement was noticed in this case. In a few days the congestion had greatly diminished in intensity and the ulceration, though not quite healed up, was free from any exudate. In about ten days the throat was quite normal.

Temperature became normal on fourth day of illness.

Convalescence was uninterrupted.



V. McV., aet 8 years

Admitted: 9th August, 1909

Previous Infectious Disease: None

History of Present Illness: The present illness began on 6th August with a rigor, and on the same day patient had a severe headache, and was sick and vomiting. A day later sore throat developed, and on the 9th the rash made its appearance.

Present Condition: On admission Temp. 103.4° F., P. 136, R. 32

A bright scarlet rash covers the whole body.

The fauces are intensely congested and are covered with an abundant mucopurulent exudate. Both tonsils are enlarged and are slightly ulcerated.

Heart and lungs are both satisfactory.

The urine is free from albumen.

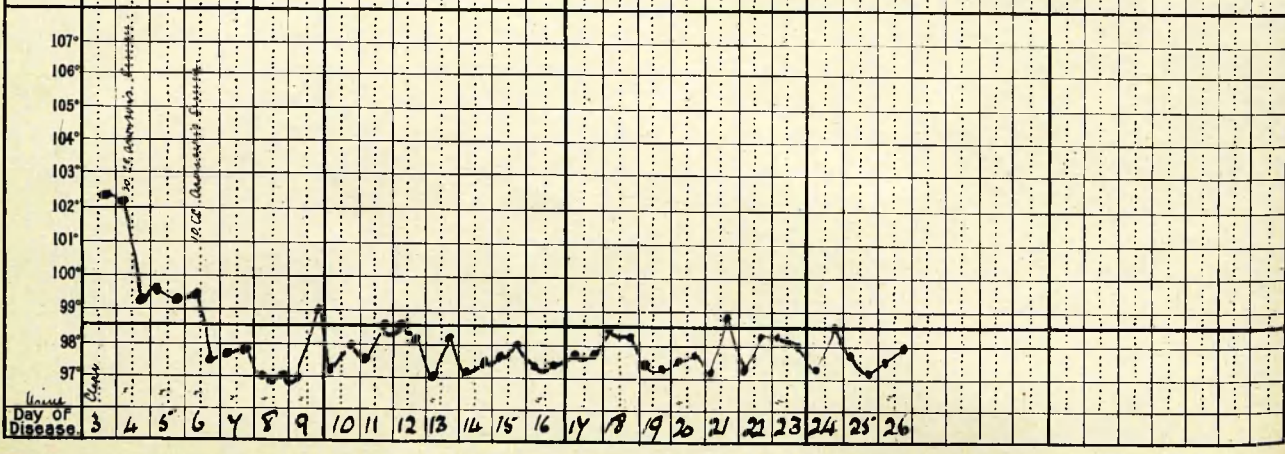
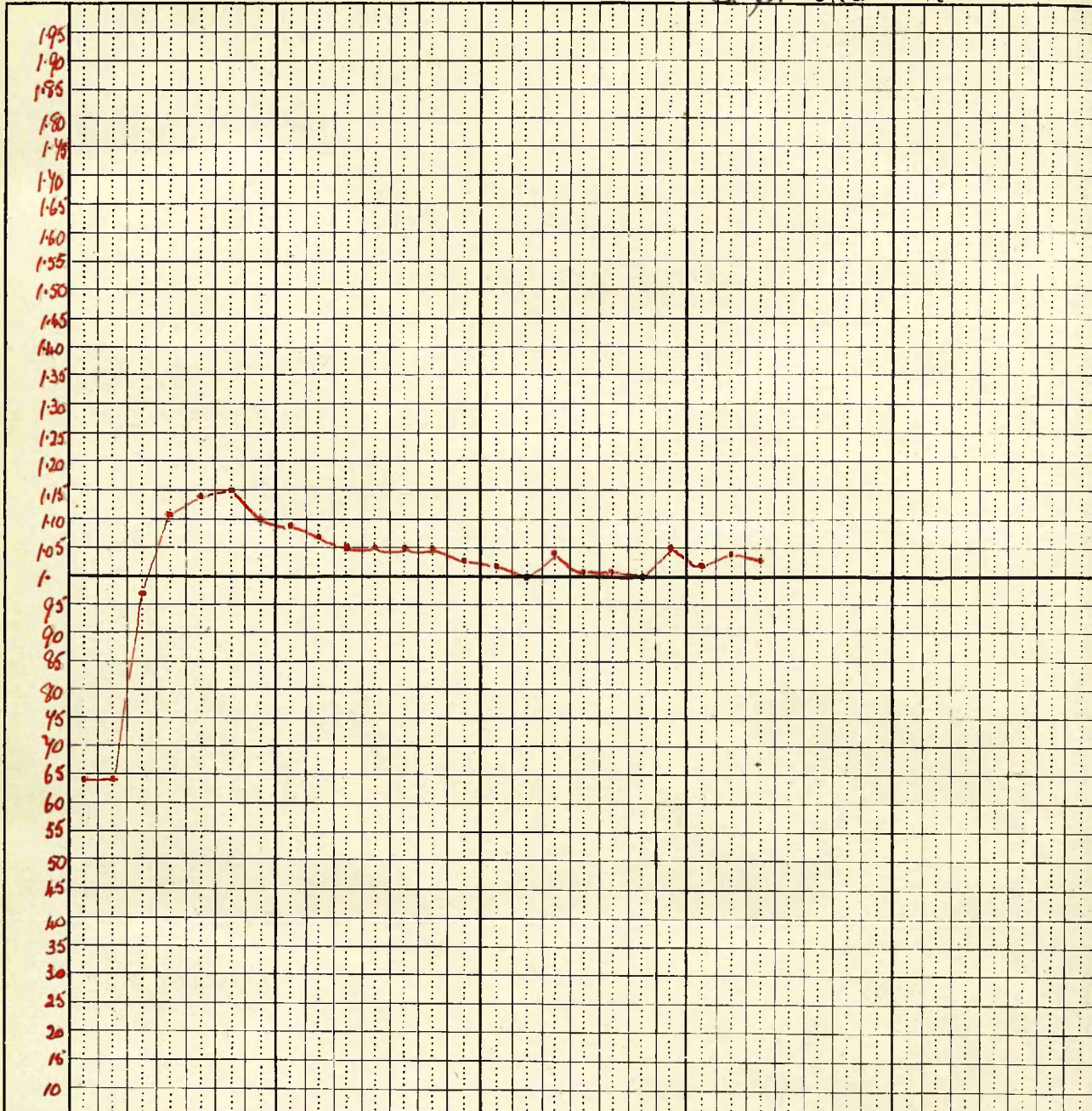
Progress: Serum treatment, Aronson's serum as before.

Three days after admission there was a very decided improvement in the throat condition, the congestion and ulceration both disappearing rapidly, while the exudate had ceased. A few days later the throat was quite normal.

With the improvement in the throat the temperature soon became normal, and remained do. till 17th day of illness, when an alveolar abscess threatened.

This, however, soon subsided, and the temperature again became normal.

The urine remained free from albumen.



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 Day of Disease

E. S., aet 15 years

Admitted: 11th August, 1909

Previous Infectious Disease: None.

History of Present Illness: Patient complained of headache and sore throat on 10th August. The rash appeared on 11th.

Present Condition: On admission Temp. 102.4° F., P. 120, R. 32

A bright rash, typical of the disease, covers the whole body.

The fauces are congested and the mucous membrane is covered with mucopurulent exudation.

Both tonsils are enlarged, congested, and slightly ulcerated.

The tongue is thickly coated and papillae are swollen.

Heart and lungs are satisfactory.

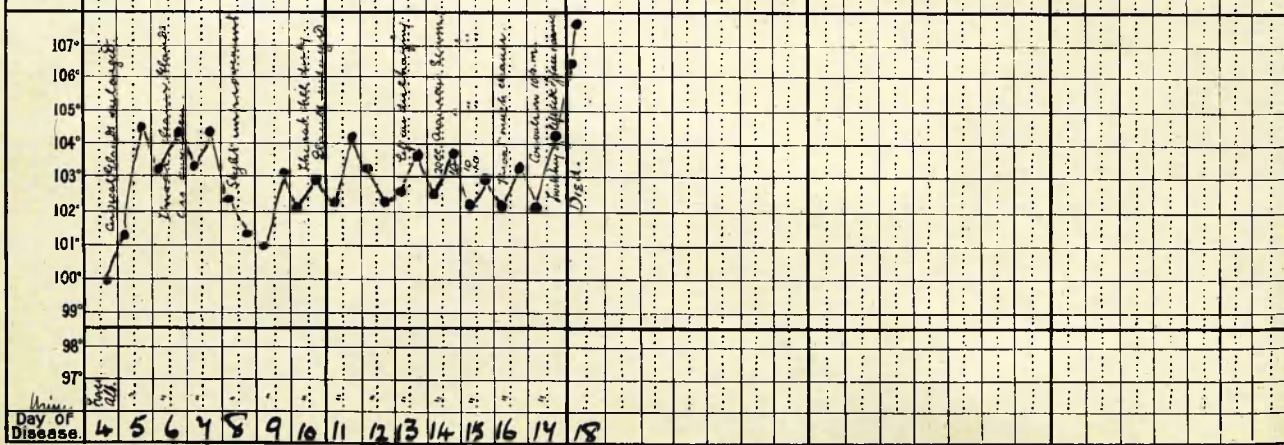
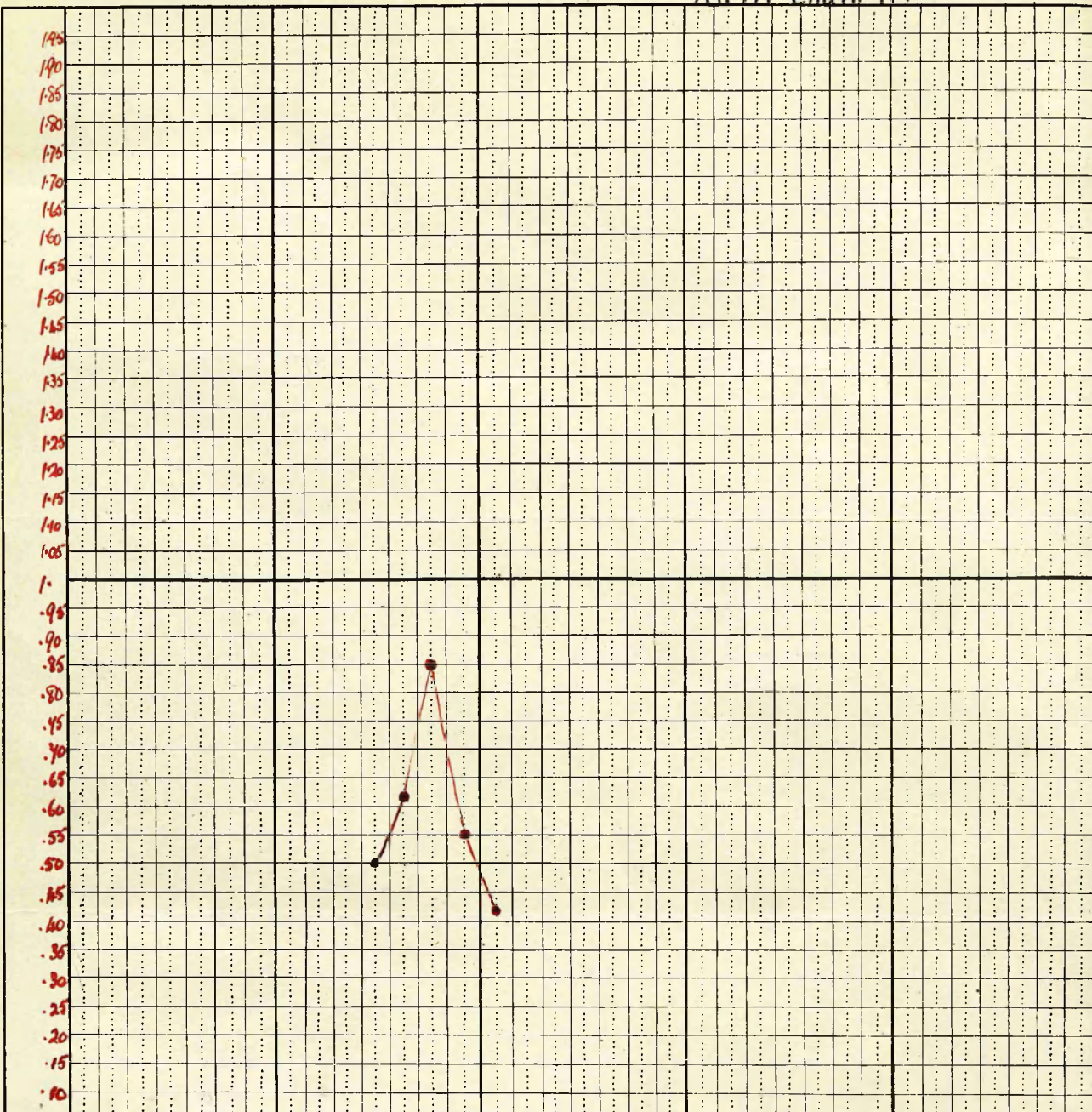
The urine is free from albumen.

Progress: Serum treatment, Aronson's serum as before.

There is nothing worthy of note in the progress of this case. The improvement both in the general and local conditions was very rapid, and within a week the patient had reached the convalescent stage.

Temperature became normal on sixth day of illness.

Urine remained free from albumen.



R. H., aet 2 years

Admitted: 13th July, 1909

Previous Infectious Disease: None

History of Present Illness: Patient complained of sore throat on 10th July, of sickness and vomiting on the 11th and the rash appeared on the 13th.

Present Condition: On admission Temp 101.4° F., P. 148, R. 40

There is a typical scarlatinal eruption present all over the body.

The fauces are deeply congested, and are covered with an abundant exudate.

Both tonsils are enlarged, congested and ulcerated.

Peeling of the tongue has commenced.

The anterior cervical glands are palpable.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment, 20 c.c. Aronson's antistreptococcus serum every six hours.

Instead of improving under treatment the throat condition became gradually worse. The ulceration of the tonsils spread rapidly, till the whole of the soft and part of the hard palate were involved. The abundant discharge from this largely ulcerated surface, combined with a profuse nasal discharge, soon caused ulceration round the mouth and nose.

Very soon the soft palate perforated, and about the same

time some discharge was seen from the left ear.

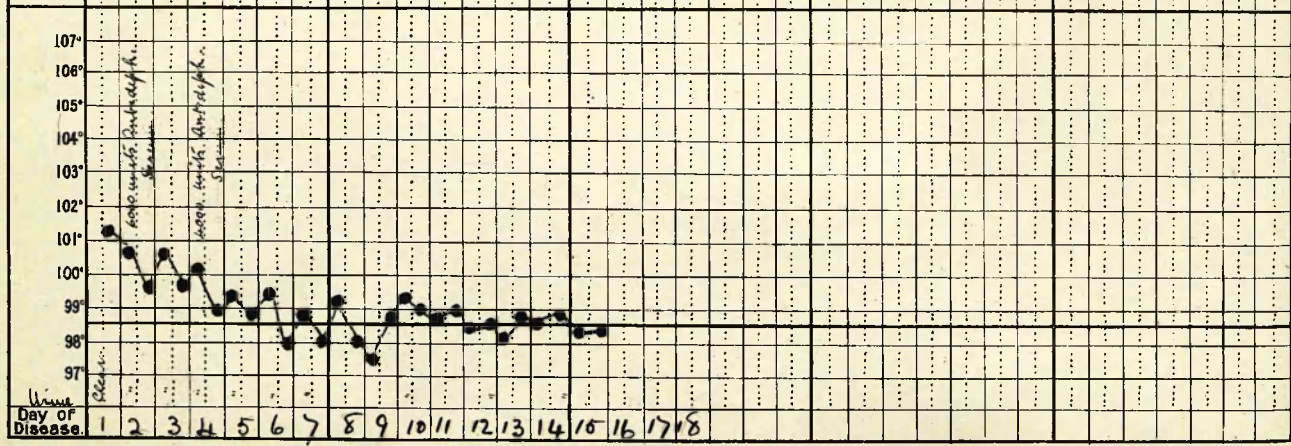
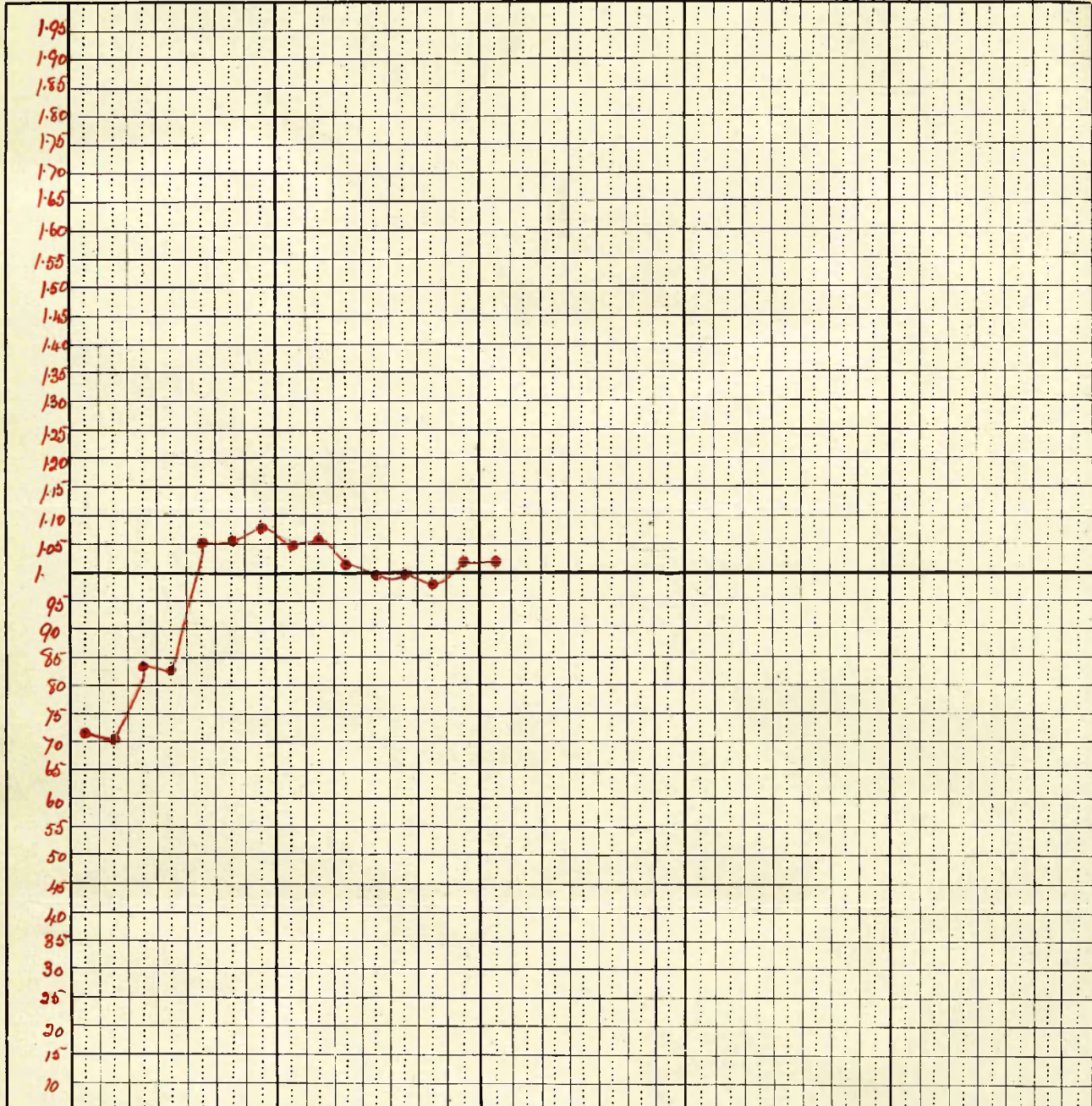
On fourteenth day of illness, serum treatment was begun, and 20 c.c. were given every six hours. The following day showed some improvement in the general condition, but little in the local.

This improvement was maintained, but on the seventeenth day of illness meningeal symptoms set in and patient died.

His temperature chart shows a continual pyrexia, ending in a register of 107.8° F., just after death.

There was no post mortem examination.

CASES TREATED WITH DIPHTHERIA ANTITOXIN



Name _____
 Day of Disease _____
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L. M., aet 8 years

Admitted: 19th June, 1909

Previous Infectious Disease: Measles, Whooping Cough,
Chickenpox.

History of Present Illness: Patient complained of sore
throat on June 18th. The rash appeared on the chest on
19th.

Present Condition: On admission Temp. 101.4° F., P. 102, R. 28

The rash is fading and is leaving a brownish staining of
the skin.

The throat is much congested, both tonsils are enlarged
and are slightly ulcerated.

The tongue is coated and is beginning to peel.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment, Diphtheria antitoxin as before.

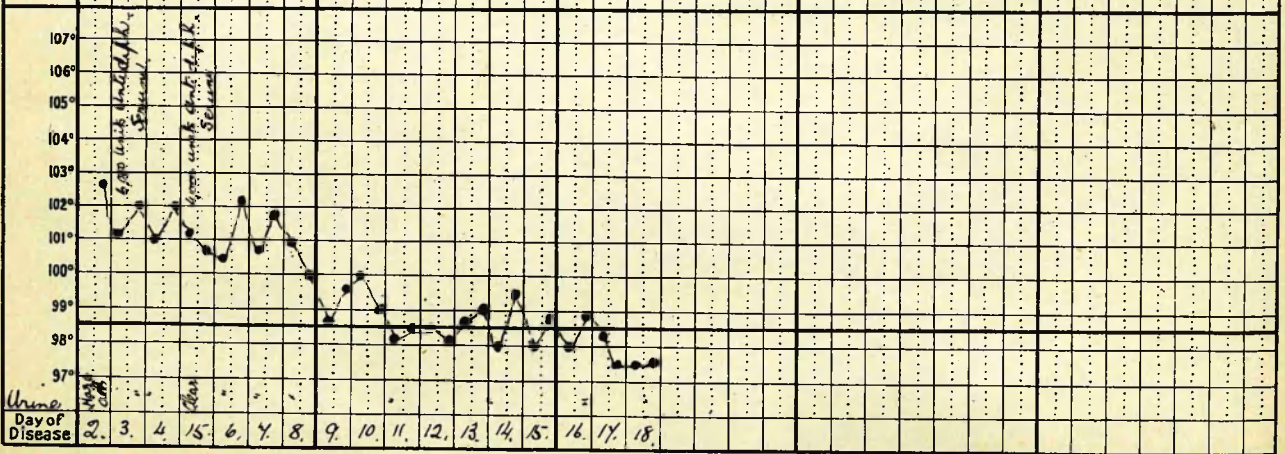
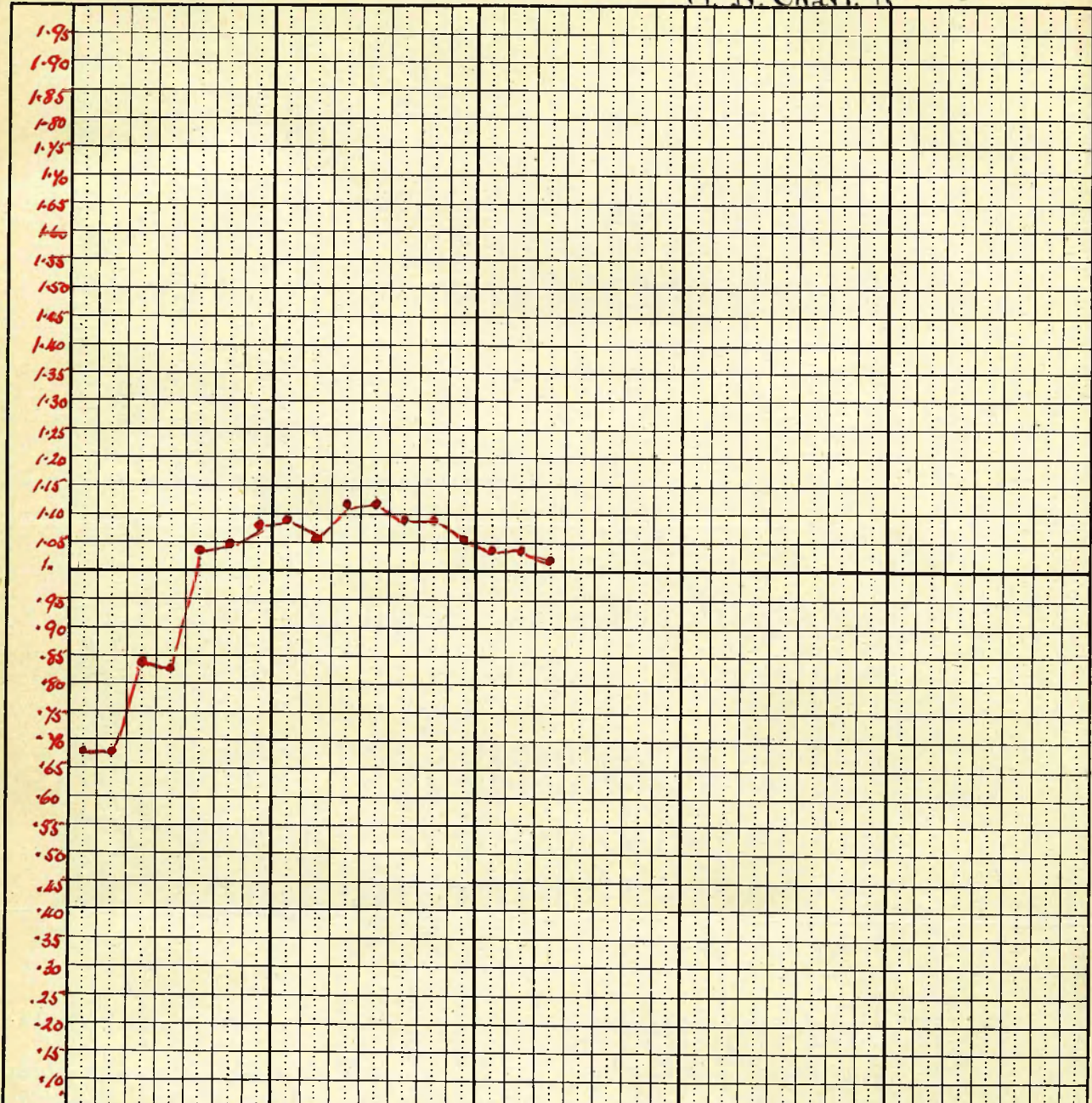
A slight improvement in the throat was noticed after the
first dose of serum, but this progressed very slowly
and it was not till a week had elapsed that any decided
change could be noticed.

In a fortnight the throat had become normal.

The temperature followed the usual course and depending
on the lessened severity of the throat condition came
gradually to normal.

The urine remained free from albumen.

Convalescence was uninterrupted.



M. B., aet 7 years

Admitted: 17th June, 1909

Previous Infectious Diseases: Measles, Whooping Cough

History of Present Illness: Patient complained of headache and sore throat on 14th June. The rash appeared two days later.

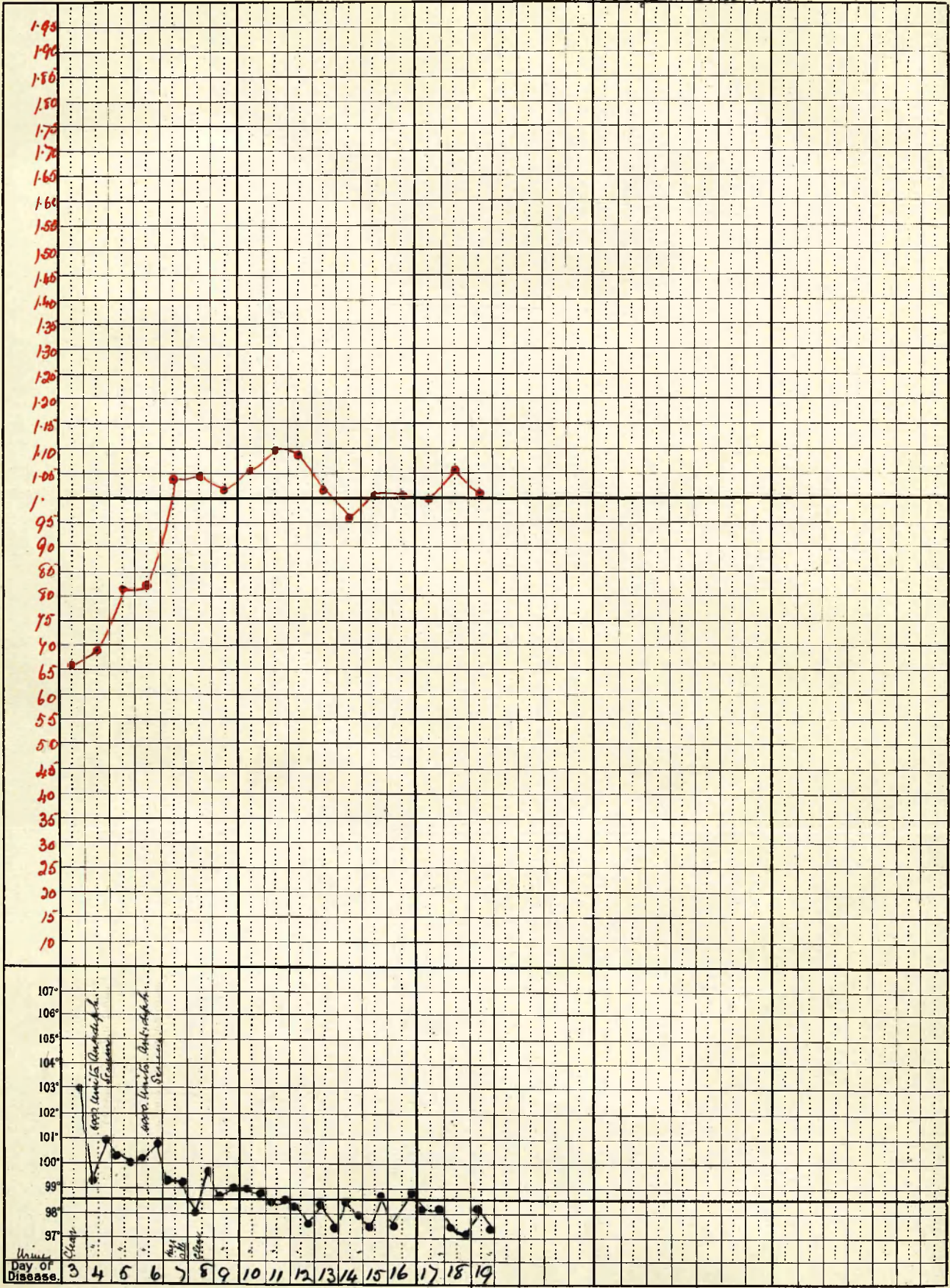
Present Condition: On admission Temp 102.8° F., P. 136, R. 36
All over the body there is a fading scarlet fever eruption.
The fauces are intensely congested and on both tonsils, which are much enlarged, there is some deep ulceration.
The Tongue is beginning to peel and the papillae are enlarged.
Heart and lungs are satisfactory.
Urine contains a haze of albumen.

Progress: Treatment with antidiphtheria serum as before.

The improvement which had commenced after the first dose of serum progressed slowly and even at the end of a week the congestion and ulceration in the throat had not quite disappeared. A week longer was required to clear up the throat condition completely. The very slow improvement in the throat is evidenced by the fact that the temperature did not reach normal until the 11th day of illness.

The urine was free from albumen after the first two examinations.

Convalescence was uninterrupted.



A. S., aet 13 years.

Admitted: 17th June, 1909.

Previous Infectious Disease: Measles

History of Present Illness: Patient complained of sore throat on June 14th. The rash appeared two days later.

Present Condition: On admission Temp. 103° F., P. 124, R. 28

There is a brilliant punctiform rash all over the body.

The fauces are congested and oedematous, and the mucous membrane is covered with mucopurulent exudate.

A patch of ulceration is seen on the right tonsil.

The tongue is beginning to peel.

Heart and lungs are satisfactory.

Urine is free from albumen.

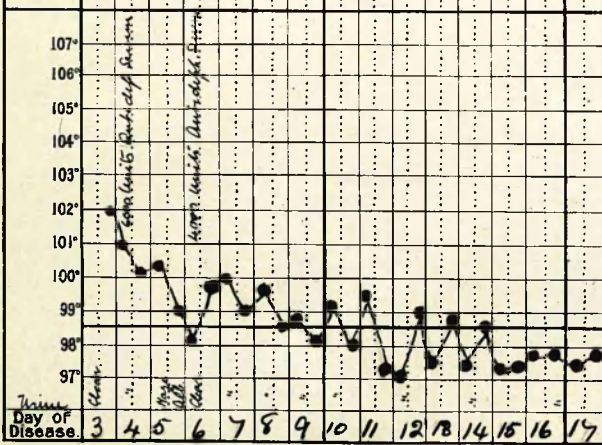
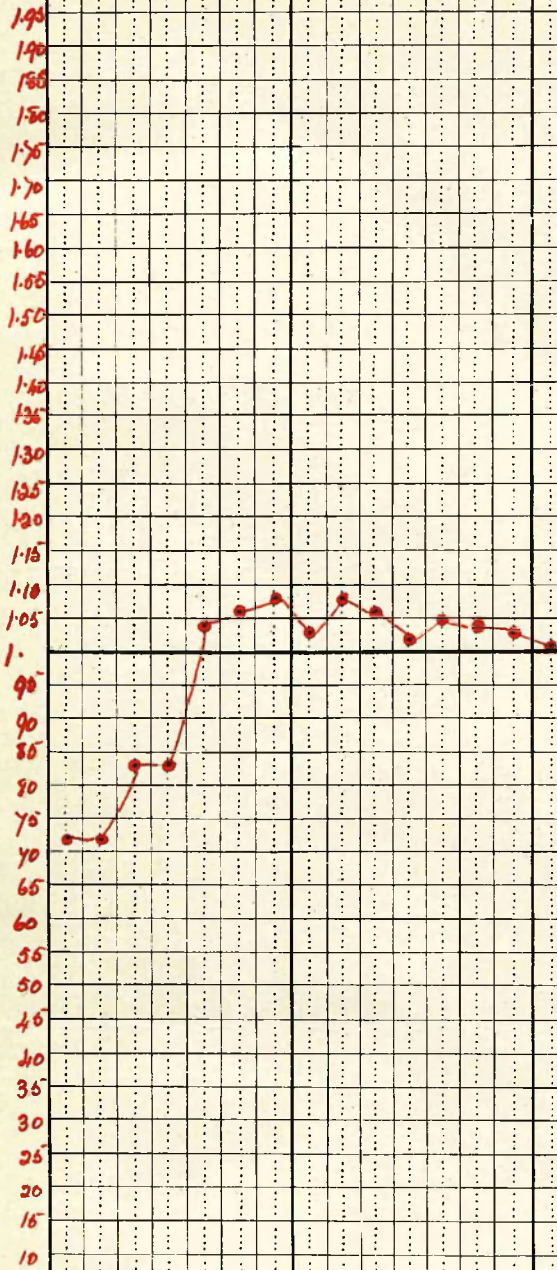
Progress: Serum treatment, Diphtheria antitoxin as before.

Improvement was very slow, and though in a few days the exudation had diminished greatly, the congestion and ulceration took almost a fortnight to disappear.

The temperature gradually approached normal, which was reached on the eleventh day of illness - long before the throat had cleared up.

The urine was free from albumen throughout the whole illness.

Convalescence was uninterrupted.



Time
Day of
Disease

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1000 units, 2000 units
4000 units, 2000 units, 1000 units

C. MacA., aet 3 years

Admitted: 19th June, 1909

Previous Infectious Diseases: Whooping cough, Chickenpox

History of Present Illness: Illness began on 16th June, when the patient complained of sickness and vomiting. The rash appeared on 19th June.

Present Condition: On admission, Temp. 102° F., P. 136, R. 40

The rash has faded from the body but is still quite typical on the lower limbs.

There is considerable oedema and congestion of the fauces and both tonsils are enlarged and ulcerated.

A thick white fur coats the tongue, the papillae of which are enlarged and prominent.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Serum treatment, Diphtheria antitoxin as before.

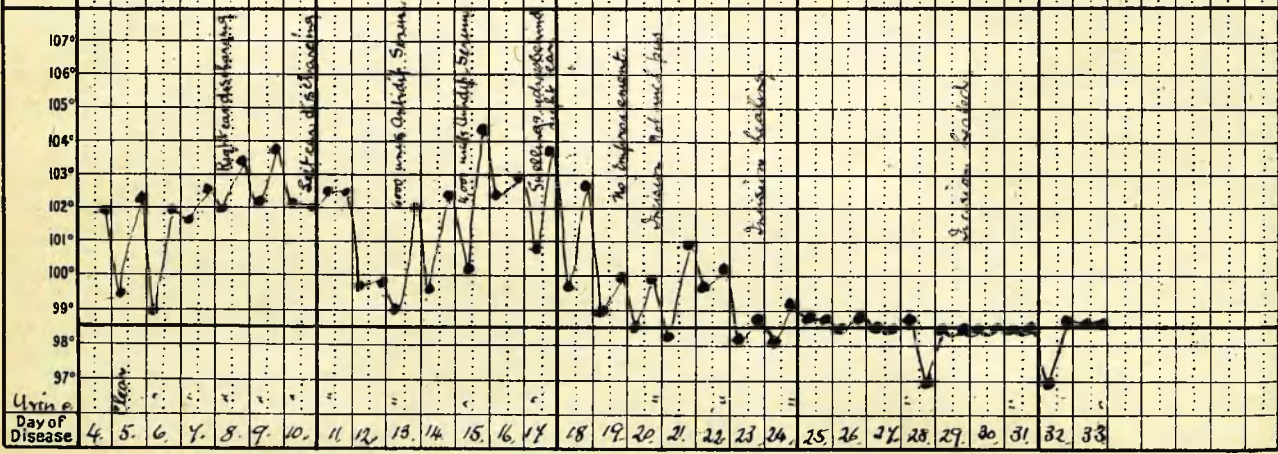
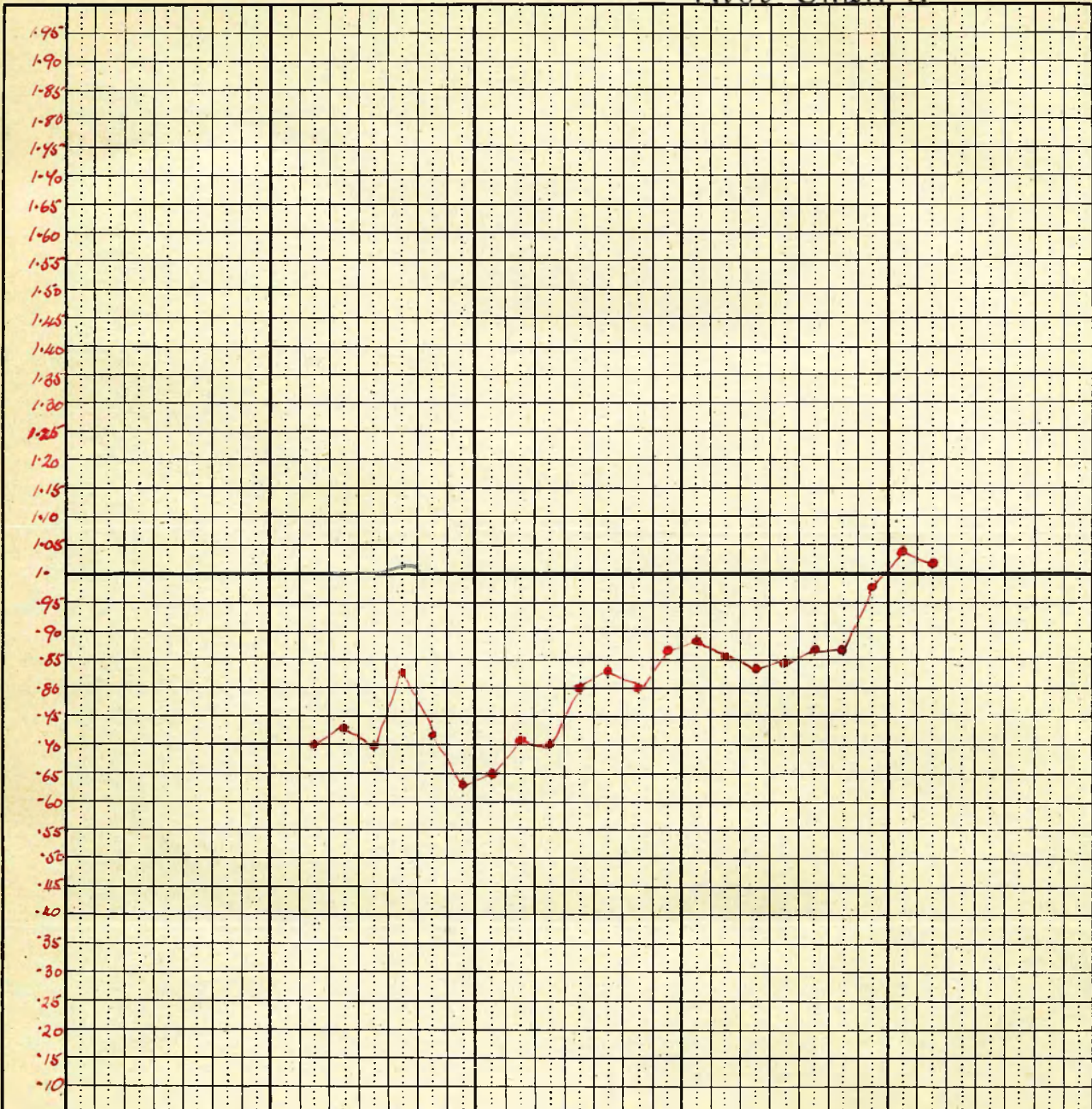
For several days there was very little improvement in the throat condition.

The congestion was as intense as on admission, and the ulceration had even extended a little.

Practically a fortnight elapsed before the faucial condition could be described as being normal.

The temperature fell by lysis and reached normal on 8th day of illness.

The urine was normal throughout the illness.



Urine
Day of Disease

W. H., aet 15 months

Admitted: 4th June, 1909

Previous Infectious Disease: None

History of Present Illness: Patient was sick and vomiting and complained of sore throat on 1st June. Rash appeared on 2nd.

Present Condition: On admission Temp. 102° F., P. 126, R. 36

The remains of a rash can be seen in a yellowish brown pigmentation of the skin.

The throat which is much congested is covered with a very abundant mucopurulent exudate.

Tongue is thickly coated and papillae are prominent.

Heart and lungs are both satisfactory.

Urine is free from albumen.

Progress: Patient was treated with antidiphtheria serum in two doses of 6,000 and 4,000 units respectively.

For a week there was no improvement in the patient's condition. The fauces became more congested and patches of ulceration appeared on both tonsils.

Otitis media purulenta of both ears set in and the temperature remained high.

On the 13th day of illness 6,000 units of diphtheria antitoxin were given and two days later 4,000 units. The throat showed a little improvement after the first dose of serum and this was augmented after the second dose, and in about a fortnight the throat was normal. The temperature, however, still remained elevated and

the cause of this was found in the development of oedema and redness behind the right ear.

With an incision, though little pus was found, there was an improvement and the temperature soon became normal. Both ears continued to show slight discharge till patient was dismissed.

Convalescence established, was uninterrupted.

M. McL., aet $1\frac{1}{2}$ years

Admitted: 4th June, 1909

Previous Infectious Diseases: None

History of Present Illness: All complaints of illness were dated from 1st June, when the patient was sick and vomiting, and complained of pain and swelling on both sides of the neck. The rash appeared that evening.

Present Condition: On admission Temp. 102° F., P. 152, R. 28

There are only faint traces of the rash present on the limbs.

The throat is intensely congested and along the edge of the soft palate there is some ulceration which extends up to and surrounds the uvula.

The mucous membrane is covered with abundant mucopurulent exudate.

Heart and lungs are satisfactory.

Urine is free from albumen.

Progress: Treated with diphtheria antitoxin in two doses of 6,000 and 4,000 units respectively.

For the first week in hospital there was absolutely no change in the patient's condition.

The throat was still congested, the exudate more abundant and the ulceration was extending.

Nasal discharge became very abundant and on the 7th day of illness otitis media began. On 14th and 15th days of illness 6,000 and 4,000 units of diphtheria antitoxin were administered, but this had no beneficial effect, and the patient died on 17th day of illness