

**T H E S I S**

**PRESENTED FOR THE DEGREE OF DOCTOR OF MEDICINE**

**by**

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**SUBJECT**

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**The Variation in the Amount of Complement present in  
the Blood in Acute Infectious Diseases and its  
Relation to the Clinical Features; with a short  
note upon the Serum Treatment of Cerebro-Spinal  
Meningitis**

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## INTRODUCTION

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This investigation upon the quantitative variations of the complement in the serum of patients suffering from various acute infectious diseases has been carried out during the past year in the laboratory of Ruchill Hospital. It has been suggested by the great importance of as full a knowledge as possible of all the immunity phenomena existing in such diseases, and by the possibility that the observations made might bring to light something that would be of practical value in treatment.

Such substances as toxins, antitoxins, agglutinins, immune-bodies, and opsonins have all received considerable attention, and the literature on all is very abundant. Modern treatment turns largely upon the practical application of the knowledge acquired about these, but it can be said that the success of the antitoxin treatment of diphtheria has not been repeated. All are aware of the comparative failure of many anti-bacterial sera. It is also known that such sera when administered under certain circumstances seem to be harmful.

As far as can be ascertained by the writer, the literature upon investigations of the serum complement, made throughout the whole course of acute infectious diseases, is

scanty. Longcope<sup>(1)</sup> has described the behaviour of the bacteriolytic complement in the terminal infections of some chronic diseases, using the bacteriolytic effect of the serum of these cases on the bacillus typhosus and bacillus coli, as an indirect measure of the total bacteriolytic complement content. The same observer also estimated the bacteriolytic properties of the blood of three cases of enteric fever against the bacillus typhosus, but this was not done throughout the whole course of the disease. In the present investigation the variation of the complement has been followed up as far as the opportunities of the writer have permitted.

In dealing with patients certain difficulties necessarily arise. There are times when to disturb them unnecessarily is to their disadvantage, and the result is that many gaps occur in the work; but in all a very large number of observations have been made, and the lacunae in one case may be filled up from the whole course of another case if the observations made at various times show a general concordance. In this paper the facts and theories concerning complement are specially considered in their relation to the phenomena observed in the specific infectious diseases, and the different points are discussed in the following order:-

(1) The different conceptions of complement

(2) The methods by which the amount of complement in the blood has been investigated

(3) A consideration of some special points.

- (A) Complement and age
- (B) Complement in the individual
- (C) The amount of credence to be attached to the experimental results

(4) An Account and a Discussion of the results of the investigations in:-

- |          |   |                                  |
|----------|---|----------------------------------|
| Sections | A | Enteric Fever                    |
|          | B | Erysipelas                       |
|          | C | Diphtheria                       |
|          | D | Scarlet Fever                    |
|          | E | Measles                          |
|          | F | Typhus fever and Lobar Pneumonia |

(5) Note on the serum treatment of cerebro-spinal meningitis.

#### Appendix

In this are included a brief account of the clinical aspects of the cases investigated, with tables of the numerical results of the observations, and charts illustrating the course of the cases and the variations of the serum complement at the time of the different observations. The numbering of the Charts corresponds to that of the Cases given in the text. They are arranged in the order in which the diseases are discussed.

The Charts, for convenience, have been bound in a separate volume.

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## DIFFERENT CONCEPTIONS OF COMPLEMENT

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- 1       As is well known, there are two classes of substances concerned in the production of immunity in an organism. One of these, the immune body, is definitely recognised by all authorities as being specific. The other is of a much less definite character and has been termed the complement or alexin by different observers.
- 2       The presence of this substance is absolutely essential to the production of immunity; but with regard to its specificity some difference of opinion exists.
- 3       Muir and Browning<sup>(2)</sup> define complement as, that labile substance of normal serum which is taken up by the combination of an antigen and its anti-substance.
- 4       Bordet,<sup>(3)</sup> as is well known, believes in the functional unity of complement or alexin.
- 5       Ehrlich,<sup>(4)</sup> as is also well known, believes in a pluralistic conception of complement.
- 6       By adopting appropriate experimental conditions he demonstrated the presence of at least five different kinds of complement in the serum of the goat, heating goat's serum, which

is normally haemolytic to guinea pigs' and rabbits' red corpuscles, with papain, soda solution, and heat, he found that each of these methods had the power of altering only certain of the complements, leaving the others intact.

7 Further absorption methods led to the conclusion that this difference did not depend only on a variety of zymotoxic groups in each complement, but that also the haptophore group differed with each type.

8 Muir and Browning<sup>(5)</sup> have demonstrated that this difference in the molecules of complement exists and that it depends upon a number of gradations in their affinities and action; but that there is also a certain community in the combining relationships of the complement molecules. As far as combining affinity of the different complement molecules is concerned, it is rather one of degree than of quality, because if sufficient bacteria be used along with a suitable immune body in the presence of fresh serum, the haemolytic as well as the bacteriolytic or bacteriophilic complement is absorbed in the reaction.

9 In all diseases, especially acute infectious diseases, it may be assumed as probable, that at the most active stage of the disease the number of organisms present in the body fulfils the above conditions, and that such different types

of complement as exist, may be used up by the antigen and its specific immune body in establishing immunity.

- 10        Of the adoption of the haemolytic test, in vitro, as a means of estimating the total complement-content of the serum of patients suffering from acute diseases, the criticism might be made that only the haemolytic portion is estimated in the reaction, were it not that, as has just been mentioned, bacteriolytic and haemolytic complements display a common action in the presence of sufficient antigen. This condition, with reference to the bacteriolytic complement, always exists in the test tube experiments.
- 11        The haemolytic properties of the serum may therefore be taken as a measure of the total complement-content.

## METHOD BY WHICH THE SERUM HAS BEEN INVESTIGATED

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- 1        The haemolytic effect of fresh serum from patients upon ox corpuscles in the presence of a suitable immune body (rabbit & ox), has been used as an index of the amount of complement present.

## THE PATIENT'S SERUM

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- 2        The blood of the patients was withdrawn from one of the veins in front of the elbow by means of a 10 c.c. serum syringe fitted with a suitable needle. After the skin had been sterilized the veins were rendered turgid by the application of an elastic bandage round the upper arm, and the most prominent vein selected. In many of the young patients this could be felt but not seen; no great difficulty, however, was experienced in obtaining sufficient blood.
- 3        From 8 c.c. to 10 c.c. supplied the necessary amount of serum for each examination, namely 4 c.c. to 5 c.c. This restricted the total number of examinations which could be made in each case.
- 4        To prevent any accidental haemolysis, the syringe, needles, and test tubes for receiving the blood were all



taken out of sterile .85% saline solution. The blood was allowed to stand for several hours, usually six, at the temperature of the laboratory and the serum pipetted off. The latter was then centrifugalized to clear it completely of red corpuscles, as the presence of even a small quantity of the latter obscures the reading, since they are not lysed during the test.

5 In practically every case the estimation of the haemolytic power of the serum was made on the day upon which the blood was withdrawn from the patient.

6 The specimens of blood were taken before the mid-day meal, and in this way the serum was obtained clear or nearly so in most cases, but when this was not possible, and the serum was opalescent or turbid from the presence of chyle, the reading of the result did not appear to be materially affected, as the complete stage of haemolysis could readily be seen in spite of the cloudiness of the solution. In most cases however the serum was obtained quite clear.

#### OX CORPUSCLES

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7 Ox corpuscles were used throughout as the antigen, and a fresh supply of defibrinated ox blood was procured from the slaughter-house twice weekly. The writer has not in-

investigated the possibility of different samples of ox corpuscles being more readily lysed than others under the same conditions. The ox blood which has been used during the course of this work was obtained from a receptacle in which the defibrinated blood of several animals had been pooled, and if a difference in susceptibility to the haemolytic action of human sera does exist, this has probably been reduced to a minimum by the mixing.

#### IMMUNE BODY

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8           The method adopted in the production of a suitable immune-body and the estimation of its dosage was that advised by Muir.<sup>(6)</sup>

9           Rabbits were inoculated intraperitoneally with injections of 5 c.c., 10 c.c., and 15 c.c. of washed ox corpuscles, with an interval of ten days between each inoculation. The corpuscles which were obtained aseptically from the ox were washed three times by centrifugalizing with .85% sterile saline solution before the rabbits were inoculated.

10          In this way the animals yielded serum containing a large amount of immune-body ten days after the last injection. This was stored in sealed quill tubes with a capacity

of 1 c.c. These were sterilized and the complement destroyed by heating on three consecutive days to 57° C. for one hour. At the end of six days the minimum haemolytic dose of the immune serum was estimated, using as complement guinea pig's serum which had been treated first with ox corpuscles for two hours in an ice chamber to remove the natural immune-body.

- 11           The minimum dose of the several haemolytic sera used throughout this work was .001 c.c. for 1 c.c. of a 5% suspension of ox corpuscles in .85% saline solution.

#### TECHNIQUE

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- 12           All the test tubes and pipettes used were taken from saline solution.
- 13           A 5% suspension of washed ox corpuscles in .85% saline solution was used in all the tests.
- 14           The red corpuscles in 5 c.c. of defibrinated ox blood were washed three times by centrifugalizing, and sufficient saline solution added to the corpuscles obtained to make up a bulk of 100 c.c.
- 15           To each cubic centimeter of this suspension five times

the minimum haemolytic dose of the immune-body (rabbit v ox) was added to sensitize the corpuscles, and the mixture was placed in the incubator at 37° C. for thirty minutes or more before use.

16 It was found, owing to the considerable differences in the haemolytic power of the various fresh sera, that a series of twenty-four test tubes was necessary for each examination.

17 Into each of a series of test tubes 1 c.c. of this sensitized suspension of ox corpuscles was measured, and the following quantities of the patient's serum were then added, namely:-

.02, .04, .06, .08, .09, .10 .11, .12, .13, .14, .15, .16, .17, .18, .19, .20 .21, .22, .23, .24, .25, .26, .27, .28 c.c. respectively.

18 In the case of sera which were found to be very inactive the quantities were suitably modified.

19 After the addition of this complement containing serum the test tubes were placed in an incubator at 37° C. for one hour, being shaken at intervals of fifteen minutes. The reading was then taken. At first a second reading was also taken next day, but as the differences between the two were small this was discontinued. The hour limit was adopted

throughout.

20           The complement content of the serum was determined by the presence of complete haemolysis, as indicated by the absolute disappearance of turbidity.

21           As a source of error the presence of a natural immune-body in human serum against ox corpuscles was investigated.

Numerous estimations were made of the natural haemolytic power of fresh human serum, and this was always found to be relatively slight.

22           For example the following tests may be quoted. In order that the conditions might be comparable eleven specimens of blood taken on the same day were examined, some of which were known to be rich in haemolytic complement as tested with the sensitized ox corpuscles.

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TABLE I

| Fresh Serum                      |               | .05 cc.     | .1 cc.      | .15 cc.     | .2 cc.      | .25 cc.     | .3 cc.      | .4 cc.      | .5 cc.      | .6 cc.      |
|----------------------------------|---------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Convalescent (facial erysipelas) | No haemolysis | faint trace | faint trace | faint trace | faint trace | faint trace | faint trace | faint trace | faint trace | faint trace |
| Acute erysipelas                 | "             | no haemo.   | no haemo.   | no haemo.   | "           | "           | "           | "           | "           | "           |
| Acute "                          | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Erysipelas migrans               | "             | faint trace | faint trace | faint trace | "           | "           | "           | "           | "           | "           |
| Suppuration of scalp             | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Recurrent erysipelas of face     | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Normal                           | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Normal                           | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Normal                           | "             | "           | "           | "           | "           | more marked | more marked | more marked | more marked | more marked |
| Normal                           | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |
| Senile gangrene of foot          | "             | "           | "           | "           | "           | "           | "           | "           | "           | "           |

1 c.c. of sensitized ox corpuscles used in each test tube

23       The degree of haemolysis which was observed in all, even with the three most active sera, was very far below what constituted a complete result in the estimations recorded in this paper.

24       In about thirty other examples similarly examined the result was the same. The amount of natural immune-body found was so small that the removal of it from the sera by previous treatment at 0° C. with fresh ox corpuscles was not considered necessary.

25       It has not been possible, because of the rate of deterioration of the complement, to store all the samples of serum obtained from the patients during the whole period of illness when the estimations were being made, in order that all might be tested under exactly the same conditions; but the precautions observed, namely the time of collection and examination of the blood, the constant amount of immune-body used for sensitizing the ox corpuscles, the fact that the ox corpuscles were from several animals, and the fixed period of incubation for the test series, tend to a uniformity of results. Sometimes in certain cases of diphtheria, when estimations of the amount of complement present in the serum before and after the administration of antitoxin-serum were made, it was necessary to keep the first specimen of blood overnight if the patient arrived late in the day, and there

may have been some falling off in the amount of complement by the time it was tested next day, although estimation of guinea pig's complement under the same conditions does not show any marked deterioration during the first twentyfour hours.

This is shown by the results in Table II.

TABLE II

Deterioration of Guinea Pig's Complement Day by Day

| Day       | 1st      | 2nd      | 3rd     | 4th      | 5th      | 6th     | 7th    |
|-----------|----------|----------|---------|----------|----------|---------|--------|
| Serum (a) | .015 cc. | .015 cc. | .02 cc. | .025 cc. | .035 cc. | .08 cc. | .3 cc. |
| " (b)     | .015 "   | .02 "    | .04 "   | .07 "    | .17 "    | -       | -      |
| " (c)     | .015 "   | .015 "   | .02 "   | .025 "   | .04 "    | .08 "   | .35 "  |
| " (d)     | .015 "   | .015 "   | .02 "   | .03 "    | .035 "   | .07 "   | .1 "   |
| " (e)     | .015 "   | .02 "    | .025 "  | .035 "   | .05 "    | .09 "   | .3 "   |

1 c.c. sensitized ox blood used. The quantities of serum represent the minimum haemolytic dose on the different days after the serum was obtained

METHOD OF RECORDING THE RESULTS

In taking the observations the amount of serum required to effect complete haemolysis was recorded, but as this is



evidently proportional to the reciprocal of the amount of complement contained in the serum, the results as charted have been calculated on the latter basis.

27        Thus if two sera be taken and if of one the amount required to produce complete haemolysis is .2 c.c. and of the other .05 c.c., then the amounts of complement present in the two sera ~~are~~<sup>is</sup> evidently in the proportion of 5 to 20. The reciprocal for each amount of serum used has been calculated.

28        A scale of these reciprocal proportions is given in the vertical column on the left margin of each chart. All the points on the charts obtained from the observations are joined, to give a rough idea of the course of what may be called the complement curve. In this way the fluctuations from time to time in the quantity of available haemolytic complement present throughout the period of illness and of convalescence, in each case where continuous examinations have been possible, can be easily followed.

The charts also contain a record of most of the salient features of each case, especially temperature, complications, pulse and respirations.

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# COMPLEMENT IN NORMAL SERUM -----

29        As a standard of comparison between the amount of complement in the serum in health and disease, about forty examinations were made by the methods described.

30        In the first place the writer's serum was examined for daily variations in relation to meals, and the following results were obtained.

TABLE III

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| Hour                       | Complete haemolysis<br>produced by | Reciprocal for<br>Complement |
|----------------------------|------------------------------------|------------------------------|
| 10 a.m.<br>Serum clear     | .25 c.c.                           | 4.00                         |
| 1 p.m.<br>Serum opalescent | .23 "                              | 4.34                         |
| 5.30 p.m.<br>Serum Turbid  | .23 "                              | 4.34                         |
| 8.30 p.m.<br>Serum Turbid  | .23 "                              | 4.34                         |

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31        It was not possible to make a similar investigation of the haemolytic power of the complement in any other individual's serum, as from 8-10 c.c. of blood were required to

furnish sufficient serum for each examination.

32 From the results obtained (Table III) it seems reasonable to infer that variations in the amount of complement in the serum from hour to hour are not marked, nor does the presence of the products of absorption of meals appear to influence to any great extent the complement value, nor turbidity of the serum from this cause to interfere with the reading of results.

33 On another occasion the writer examined his serum at intervals of two days throughout a period of six days, with the following results:-

TABLE IV

|                 |     |      |       |          |         | Reciprocal<br>representing<br>Complement |
|-----------------|-----|------|-------|----------|---------|------------------------------------------|
| 1st examination | .23 | c.c. | prod. | complete | haemol. | 4.34                                     |
| 2nd "           | .18 | "    | "     | "        | "       | 5.55                                     |
| 3rd "           | .23 | "    | "     | "        | "       | 4.34                                     |

Again a fairly uniform result was obtained. In this instance the variation, though somewhat marked, is much smaller than that observed during the course of some acute diseases.

34            Similar examinations were made of the serum of some healthy adults and of others who had been long convalescent. The results are given in the following table.

TABLE V

| Healthy Adults |                           |                      |      | Convalescents          |                      |  |
|----------------|---------------------------|----------------------|------|------------------------|----------------------|--|
| Case           | S.                        | Complement           | Case | S.                     | Complement           |  |
| 1              | (a) .18 c.c.<br>(b) .17 " | (a) 5.55<br>(b) 5.88 | 1    | .24 c.c.               | 4.16                 |  |
| 2              | .17 "                     | 5.88                 | 2    | .19 "                  | 5.26                 |  |
| 3              | .18 "                     | 5.55                 | 4    | .18 "                  | 5.55                 |  |
| 4              | .23 "                     | 4.34                 | 5    | .22 "                  | 4.54                 |  |
| 5              | .28 "                     | 3.57                 | 6    | .28 "                  | 3.57                 |  |
| 6              | .20 "                     | 5.00                 | 7    | (a) .20 "<br>(b) .20 " | (a) 5.00<br>(b) 5.00 |  |
| 7              | .30 "                     | 3.33                 | 8    | .20 "                  | 5.00                 |  |
| 8              | (a) .22 "<br>(b) .28 "    | (a) 4.54<br>(b) 3.57 | 9    | .20 "                  | 5.00                 |  |
| 9              | .21 "                     | 4.76                 | 10   | .20 "                  | 5.00                 |  |
| 10             | .17 "                     | 5.88                 |      |                        |                      |  |
| 11             | .18 "                     | 5.55                 |      |                        |                      |  |
| 12             | .21 "                     | 4.76                 |      |                        |                      |  |

S = Amount of Serum required to produce complete haemolysis of 1 c.c. sensitized ox corpuscles

Complement = Represented by the reciprocal of the amount of serum required to produce complete haemolysis of the test amount of sensitized ox corpuscles

NOTE: In all other tables the letter S and the word Complement have this meaning

35

It is clear from these results that the amount of fresh normal serum which is capable of completely haemolysing 1 c.c. of sensitized ox corpuscles in one hour varied between .17 c.c. and .28 c.c., giving complement figures between 5.88 and 3.57 units.

36

The mean of all the complement figures obtained from these examinations of the serum of healthy adults and convalescents is 4.84, and in subsequent sections this is referred to as the normal average amount of complement.

\*Attention is drawn in this connection to the average values in the amount of complement obtained in the different diseases at the end of convalescence. Table IX. These results are in close accord with the value given here

## CONSIDERATION OF SOME SPECIAL POINTS

## A COMPLEMENT AND AGE

- 1 In the sections which follow dealing with the acute infectious diseases in which investigations have been made it is to be noted that various ages are represented. The influence of the latter upon the quantity of complement present in the serum, and upon the variations in its amount during the course of disease, has consequently to be considered.
- 2 The figures which have been chosen as most likely to throw light upon this point are those representing the greatest amount of complement present during the acute stage of the various diseases, and the amount present towards the end of convalescence. The latter may be taken as probably approaching most nearly the normal of each.
- 3 These figures are given in the accompanying table.

TABLE VI

| Age of Patient | Greatest number of complement units observed during the acute stage of illness | The number of complement units present at the time of the final observation in convalescence |
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

## (1) ENTERIC FEVER

|          |       |       |
|----------|-------|-------|
| 13 years | 16.66 | 5.26  |
| 15 "     | 10.00 | 3.57  |
| 15 "     | 6.66  | 4.54  |
| 16 "     | 12.50 | 5.88  |
| 19 "     | 12.42 | 7.14  |
| 20 "     | 6.66  | 3.57  |
| 20 "     | 25.00 | 5.00  |
| 21 "     | 6.66  | 5.12  |
| 22 "     | 9.09  | 5.40  |
| 23 "     | 16.66 | 5.26  |
| 23 "     | 8.33  | 3.57  |
| 24 "     | 10.00 | 5.26  |
| 25 "     | 5.26  | 4.34  |
| 25 "     | 22.22 | 4.76  |
| 27 "     | 5.00  | 16.66 |
| 28 "     | 8.33  | 3.57  |
| 31 "     | 20.00 | 3.70  |
| 32 "     | 6.66  | 4.00  |
| 33 "     | 11.76 | 4.16  |

| Age of Patient | Greatest number of complement units observed during the acute stage of illness | The number of complement units present at the time of the final observation in convalescence |
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

## (1) ENTERIC FEVER (Contd.)

|          |       |       |
|----------|-------|-------|
| 33 years | 5.00  | 3.57  |
| 35 "     | 12.50 | 4.54  |
| 35 "     | 7.69  | 3.57  |
| 36 "     | 10.00 | 4.00  |
| 52 "     | 6.25  | 11.11 |

## (2) ERYSIPELAS

|          |       |      |
|----------|-------|------|
| 16 years | 7.69  | 4.34 |
| 20 "     | 14.28 | 5.55 |
| 25 "     | 8.33  | 4.00 |
| 25 "     | 12.50 | 2.94 |
| 26 "     | 5.55  | 3.57 |
| 29 "     | 9.09  | 4.16 |
| 30 "     | 6.25  | 7.14 |
| 31 "     | 11.11 | 4.34 |
| 33 "     | 6.25  | 2.85 |
| 40 "     | 8.33  | 8.33 |
| 40 "     | 8.33  | 4.34 |
| 43 "     | 5.26  | 3.57 |
| 45 "     | 8.69  | 6.66 |
| 45 "     | 3.70  | 6.25 |



| Age of Patient | Greatest number of complement units observed during the acute stage of illness | The number of complement units present at the time of the final observations in convalescence |
|----------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
|----------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|

## (2) ERYSIPELAS (Contd.)

|          |       |       |
|----------|-------|-------|
| 46 years | 7.69  | 7.14  |
| 48 "     | 8.33  | 5.55  |
| 50 "     | 11.76 | 5.00  |
| 51 "     | 16.66 | 4.76  |
| 58 "     | 6.25  | 7.14  |
| 62 "     | 6.25  | 10.00 |
| 69 "     | 5.55  | 5.26  |
| 70 "     | 9.09  | 8.33  |

## (3) DIPHTHERIA

|         |       |      |
|---------|-------|------|
| 5 years | 2.17  | 3.33 |
| 6 "     | 6.66  | 8.33 |
| 7 "     | 16.66 | 4.00 |
| 7 "     | 7.69  | 4.54 |
| 9 "     | 5.88  | 2.63 |
| 10 "    | 0.00  | 0.00 |
| 13 "    | 10.00 | 3.84 |
| 13 "    | 4.00  | 7.14 |
| 16 "    | 7.69  | 4.00 |
| 25 "    | 4.00  | 3.03 |

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| Age of Patient | Greatest number of complement units observed during the acute stage of illness | The number of complement units present at the time of the final observation in convalescence |
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

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## (3) DIPHTHERIA (Contd.)

|          |       |      |
|----------|-------|------|
| 29 years | 10.00 | 3.22 |
| 31 "     | 8.00  | 4.76 |
| 33 "     | 16.66 | 6.66 |

## (4) SCARLET FEVER

|         |       |      |
|---------|-------|------|
| 5 years | 5.00  | 4.00 |
| 6 "     | 4.54  | 5.00 |
| 6 "     | 3.70  | 5.00 |
| 7 "     | 4.34  | 3.57 |
| 8 "     | 3.70  | 4.76 |
| 9 "     | 4.16  | 2.94 |
| 9 "     | 8.33  | 4.76 |
| 10 "    | 6.21  | 3.17 |
| 10 "    | 4.34  | 7.14 |
| 12 "    | 7.09  | 5.00 |
| 24 "    | 3.57  | 6.21 |
| 27 "    | 10.00 | 8.33 |
| 43 "    | 6.25  | 8.33 |

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| Age of Patient | Greatest number of complement units observed during the acute stage of illness | The number of complement units present at the time of the final observation in convalescence |
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|----------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

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## (5) MEASLES

|          |       |      |
|----------|-------|------|
| 18 years | 3.57  | 3.57 |
| 19 "     | 7.69  | 5.88 |
| 20 "     | 12.50 | 5.55 |
| 25 "     | 5.88  | 3.57 |
| 28 "     | 4.65  | 5.26 |
| 30 "     | 6.25  | 6.25 |

## (6) TYPHUS FEVER

|          |      |      |
|----------|------|------|
| 22 years | 7.14 | 8.33 |
| 23 "     | 4.54 | 6.66 |

## (7) LOBAR PNEUMONIA

|          |       |      |
|----------|-------|------|
| 13 years | 5.88  | 3.84 |
| 15 "     | 12.50 | 4.76 |
| 29 "     | 4.76  | 3.57 |
| 32 "     | 7.14  | 4.76 |

4        It may be stated, from a careful analysis of these figures both by inspection and by the calculation of the correlation coefficient, that no definite relation has been found to exist between age and the amount of complement ob-

served at any of the periods selected except in two instances. This is illustrated in the subjoined table in which the means in certain age groups are given.

TABLE VII

| Age Period        | Number of Cases | The mean of the greatest amount of complement present during the acute stage of illness | The mean of the amount of complement present during convalescence |
|-------------------|-----------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| (1) ENTERIC FEVER |                 |                                                                                         |                                                                   |
| 13-21 years       | 8               | 12.0 units                                                                              | 5.0 units                                                         |
| 22-28 "           | 8               | 10.6 "                                                                                  | 6.1 "                                                             |
| 28-52 "           | 8               | 9.9 "                                                                                   | 4.8 "                                                             |
| (2) ERYSIPELAS    |                 |                                                                                         |                                                                   |
| 16-31 years       | 8               | 9.3 units                                                                               | 4.5 units                                                         |
| 33-48 "           | 8               | 7.0 "                                                                                   | 5.5 "                                                             |
| 50-70 "           | 6               | 9.2 "                                                                                   | 6.7 "                                                             |

5 In the acute cases of enteric fever a steady decline with advancing years in the average highest amount of complement is observed, but the difference is not sufficient to allow a conclusion to be drawn, and when it is taken in conjunction with the fact that the opposite variation is observed during convalescence after erysipelas, it is probable

that both can be explained by the ordinary theory of errors.<sup>x</sup>

## B COMPLEMENT IN THE INDIVIDUAL

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6 Table VI also shows that here are very considerable differences in the amount of complement present in the individuals examined, both in the acute stage of the illness and in convalescence. An analysis of the complete observations shows much the same result. These differences are much more marked in the acute stage of the fever. Like differences of varying degrees exist during convalescence, yet the majority of the figures are fairly close together and show much less variation from the mean. There has been found in some cases however, a very considerable departure from this, both in excess and deficit, but the number of individuals showing a large departure from the mean form only a small proportion of the whole. In determining the meaning of the observations each case must therefore be taken to afford its own criterion. In some, in which a small amount of complement was found during the course of the illness, a

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<sup>x</sup> The correlation coefficients and also the probable errors referred to in this section were kindly evaluated by Dr Brownlee

like deficiency continued during convalescence; in others the amount was large throughout.

7 Illustrative cases of each of these may be given here.

TABLE VIII  
-----

| Disease                  | Greatest amount of complement during fever | Amount of complement in convalescence |
|--------------------------|--------------------------------------------|---------------------------------------|
| Enteric Fever<br>Case 16 | 12.42 units                                | 7.14                                  |
| Scarlet fever<br>Case 10 | 10.00 "                                    | 8.33                                  |
| Diphtheria<br>Case 17    | 2.17 "                                     | 3.33                                  |
| Diphtheria<br>Case 12    | 0.00 "                                     | 0.00                                  |

(c) THE AMOUNT OF CREDENCE TO BE ATTACHED TO THE EXPERIMENTAL RESULTS  
-----

Experimental Error:

8 Blood corpuscles vary in their susceptibility to lysis. Small variations take place in the activity of the immune-body from day to day. The room temperature, the rate of manipulation, and the temperature of incubation, are not always precisely the same. Yet a consideration of the obser-

vations made from day to day suggests that the experimental error in the present investigation is rarely more than two complement units in the region of the mean value; that is to say, that the mean value five will very rarely be read as high as seven or as low as three. Of course, when the serum is very actively haemolytic and only a very small quantity is required to produce complete haemolysis, the error in this is considerable, and in the region of ten complement units may perhaps amount to plus or minus three, though these are probably extreme values. In like manner the experimental error of the small numbers will have a much less degree of variation. When means, however, come to be calculated, these errors tend to cancel one another, and the error of the means of a number of observations is very much less than the error of each individual examination.

9        A table, Table IX, is here given showing the mean values of the two sets of observations already given in Table VI.

TABLE IX

| Disease         | Number of Cases | Mean greatest amount of complement observed during the acute stage | Mean amount of complement present at the end of convalescence |
|-----------------|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------|
| Enteric Fever   | 24              | 10.88 $\pm$ .73                                                    | 5.31 $\pm$ .39                                                |
| Erysipelas      | 22              | 8.15 $\pm$ .51                                                     | 5.28 $\pm$ .26                                                |
| Diphtheria      | 13              | 6.98                                                               | 4.25                                                          |
| Scarlat Fever   | 13              | 5.49                                                               | 5.25                                                          |
| Measles         | 6               | 6.76                                                               | 5.01                                                          |
| Typhus Fever    | 2               | 5.84                                                               | 7.50                                                          |
| Lobar Pneumonia | 4               | 7.57                                                               | 4.23                                                          |
| All Diseases    | 84              | -                                                                  | 5.1                                                           |

Probable Error:

- 10      The probable errors of these means have been calculated for enteric fever and erysipelas. As a general rule three times the probable error is taken as the standard of significant difference between observations. In the case of enteric fever the difference is more than seven times the probable error, and in the case of erysipelas more than five times, so that these differences are far beyond those which might be assumed as due either to experimental error, or to the error due to random selection. The observations





SECTION A - ENTERIC FEVER  
-----

- 1        This disease seems to afford very favourable opportunities for the study of the variations in the amount of the serum complement, and the correlation of such with the clinical appearances illustrated by the different types of case.
- 2        The severity or mildness of the attack, the prolonged nature of the fever, the occurrence of relapses and other complications, such as thrombosis and pneumonia, are all reflections more or less of the working of the immunizing machinery in combating the typhoid bacillus and its products.
- 3        It may reasonably be inferred that immune-body is probably smaller in amount when prostration and toxæmia are most marked than when recovery is taking place. This, as is well known, cannot be measured by the agglutinating power of a typhoid serum, because agglutination may be well marked during the worst period of the disease or even prior to death.
- 4        Agglutinin alone does not bring about the establishment of immunity in Enteric Fever, for an organism may show most evident clumping and yet retain its virulence unimpaired.<sup>(7)</sup>
- 5        Specific immune-body or bodies requiring the presence

of complement are necessary for the complete destruction of the typhoid bacillus. The more immune-body present the greater will be the amount of complement required in order that the former may be used to greatest advantage. The presence of the infecting agent in the body stimulates the production of both antibody and complement, but the response in each case is not the same. The intermediary body and complement are independent of one another.

- 6 Immune body seems to be more slowly produced, as is demonstrated indirectly by the results which have been obtained throughout this investigation. Almost invariably there is abundance of available complement early in the course of the fever, when the clinical appearances of the patient, the symptoms and the temperature negative the presence of a sufficient amount of immune-body. The latter seems to be produced later, and its appearance to be coincident with a reduction in the complement content. Failure of complement production in the acute stage of favourable cases does not seem to be common.

- 7 When compared with the normal average, complement in the acute stage of enteric fever is greater in amount. The increase is variable, but is almost uniformly present. Thus during the period of pyrexia in this disease sera have fre-

quently been obtained of which an amount of .12 c.c., .11 c.c., .1 c.c. or less produced complete haemolysis of the test amount of sensitized ox corpuscles, where at least twice the amount of normal serum was required.

8           In a favourable case, when the infection is being successfully overcome as shown by the improvement in the patient's general condition, complement decreases in amount (Charts I, II and III). This suggests that when immune body is produced the complement is being fixed, and so there is less available for the haemolytic test. As already remarked, though complement may be diverse in character, yet it is none the less true that the fall in the amount of complement is probably explained by the appearance of immune-bodies.

9           The presence of much complement in a serum during the acute stage of the disease may mean that there is an insufficient amount of immune-body present in the organism at that time.

10          Again in mild cases the immunity factors seem to be more equally balanced during the greater part of the illness. An early production of immune-body sufficient to mitigate the symptoms, but not great enough to end the attack may by continually fixing the complement account for a

comparatively small amount of the latter in the serum. On the other hand a low complement content may have quite a different meaning. It may mean that along with a slow rate or absence of production of immune-body, complement may be similarly affected, or only a weak complement may be present. Such a condition might be expected in some patients who are extremely ill, or it might account for some of the prolonged severe attacks of enteric fever.

11

When the disease is proceeding to a fatal issue everything points to failure in the production of immune-bodies. Two possibilities suggest themselves; either a great deficiency of both immune-body and complement exists, or a deficiency of immune-body, associated with even an excess of complement, may give rise to the same result. Such variations of the complement have been observed. In this connection an old observation made by Bordet and Gengou,<sup>(8)</sup> that death can hardly be due to defect of the alexin, may be cited. These authorities found that *B. pestis*, *B. typhosus* and *B. proteris vulgaris* did not absorb complement to any great extent except in the presence of a suitable immune-body, and the organisms had to be abundant to do so. Consequently in patients suffering from an invasion of pathogenic organisms, even supposing protection by complement to be the essential factor in immunisation, death would not be due to a lack of complement, but rather to an insufficiency

of immune-body to utilize or absorb it.

- 12 Relapses in enteric fever are comparatively frequent, and vary markedly in severity. In general the relapse is milder than the primary attack, although if the primary attack be mild a severe relapse may follow. It is obvious then that the immunity established during and after the primary attack is insufficient in these cases. It would seem that virulent bacteria remain, to again multiply when the immune substances have become exhausted and it is to be expected that complement and immune-body will behave in a similar manner, to that seen in the primary stage of the disease

How far these more or less theoretical views are substantiated will be discussed in the following review.

- 13 Forty cases of enteric fever were investigated. In thirty-two of these, examinations of the serum were made at varying intervals throughout the period during which the patients were in hospital.

- 14 In the remaining eight cases the complement estimations were unavoidably interrupted, but the results are included because they afford confirmation of what has been found generally in the study of the disease.

The cases are divided into the following groups:-

(a) Uncomplicated cases

(b) Cases complicated with relapses, thrombosis, and secondary infections

(c) Fatal cases

GROUP (a)

- 15 Clinically the patients in this group resembled one another in that the appearances of enteric fever as manifested by all were typical; marked differences in the degree of illness however existed.
- 16 The diagnosis in each case was made from the clinical evidences, and corroborated by the Widal reaction, while in many cases the bacillus typhosus was isolated from the blood, faeces, or urine.
- 17 It will make for an easier understanding of the matter if the variations in the amount of complement are described in reference to a special case which seems to supply the type.
- Case I, Chart I, fulfils this condition.
- 18 This patient was admitted to hospital on the eighth day of illness, suffering from a severe attack of enteric fever. The temperature remained constantly about 102° F. until the twentieth day of illness, when it became remittent, reaching normal on the twenty-seventh day. The patient was markedly

prostrate. Improvement began when the temperature became remittent. Convalescence was uninterrupted. The complement, or that amount of it estimated by the haemolytic test, was found to be most abundant during the period of fever. What changes may have taken place during the intervals between the examinations cannot of course be stated, but the general course of the curve shows that there was a steady decline in the amount from the end of the period of pyrexia until shortly before the patient was dismissed well.

19        Sixteen cases, including that just recorded (Cases and Charts I to XVI) show the same phenomenon. It seems from this reasonable to draw the conclusion that the immune-body was lacking during the period of fever. As soon as this was produced in sufficient quantity, as evidenced by the course of the fever, the complement content diminished in amount.

20        The complement curves in the various cases however do not agree in all particulars. The diminution in the amount of complement did not always happen at the same period. It occurred sometimes almost immediately after the temperature became normal, in two cases (Cases and Charts V and XVI). In three cases the diminution was most apparent a week after the disappearance of the fever (Cases and Charts II, IV and XV)



In six cases the diminution was most marked at the end of the second week (Cases and Charts I, III, VI, VII, X and XI); in two (Cases and Charts VIII and XIV), at the end of the third week, and in the remaining three (Cases and Charts IX, XII, and XIII) about the end of the fourth or fifth weeks. This is more clearly seen from the subjoined table:-

TABLE VI <sup>i</sup>  
-----

| Case | Approximate period at which<br>diminution in complement<br>was observed |   |   |   |   | Case | Approximate period at which<br>diminution in complement<br>was observed |   |   |   |   |
|------|-------------------------------------------------------------------------|---|---|---|---|------|-------------------------------------------------------------------------|---|---|---|---|
| 5    | End of fever                                                            |   |   |   |   | 7    | 14 days after end of fever                                              |   |   |   |   |
| 16   | "                                                                       | " | " |   |   | 10   | "                                                                       | " | " | " | " |
| 2    | 9 days after end of fever                                               |   |   |   |   | 11   | 18                                                                      | " | " | " | " |
| 4    | "                                                                       | " | " | " | " | 8    | 21                                                                      | " | " | " | " |
| 15   | "                                                                       | " | " | " | " | 14   | 22                                                                      | " | " | " | " |
| 1    | 16                                                                      | " | " | " | " | 9    | 28                                                                      | " | " | " | " |
| 3    | "                                                                       | " | " | " | " | 12   | 28                                                                      | " | " | " | " |
| 6    | 18                                                                      | " | " | " | " | 13   | 34                                                                      | " | " | " | " |

21        These figures are only approximate, as the intervals at which the examinations of the serum were carried out varied in length. There is sufficient variation however to show that the completion of immunity does not take place at

any fixed time. This is in accordance with what is known clinically regarding the appearance of the tongue during convalescence, and also with the manner in which typical rose spots appear within the first fortnight after the temperature is normal.

TABLE VII--II

| Case | Type of illness | Approximate duration of fever | Approximate period after end of fever at which complement is diminished | 16 days after end of fever | 26 days | 10.00 units on the 11th day | Greatest amount of complement during fever, and day upon which observation was made |
|------|-----------------|-------------------------------|-------------------------------------------------------------------------|----------------------------|---------|-----------------------------|-------------------------------------------------------------------------------------|
| 1    | Severe          |                               |                                                                         |                            |         |                             |                                                                                     |
| 2    | "               | 27                            | "                                                                       | 9                          | "       | "                           | 8.33 " 12th "                                                                       |
| 3    | "               | 28                            | "                                                                       | 16                         | "       | "                           | 8.33 " 21st "                                                                       |
| 4    | Moderate        | 22                            | "                                                                       | 9                          | "       | "                           | 6.66 " 21st "                                                                       |
| 5    | Severe          | 23                            | "                                                                       | End of fever               |         |                             | 16.66 " 13th "                                                                      |
| 6    | "               | 26                            | "                                                                       | 18 days after end of fever |         |                             | 16.66 " 23rd "                                                                      |
| 7    | "               | 17                            | "                                                                       | 14                         | "       | "                           | 7.69 " 18th "                                                                       |
| 8    | Very severe     | 52                            | "                                                                       | 21                         | "       | "                           | 6.66 " 41st "                                                                       |
| 9    | Severe          | 34                            | "                                                                       | 28                         | "       | "                           | 9.09 " 24th "                                                                       |
| 10   | "               | 39                            | "                                                                       | 14                         | "       | "                           | 12.50 " 28th "                                                                      |
| 11   | "               | 28                            | "                                                                       | 18                         | "       | "                           | 8.33 " 28th "                                                                       |
| 12   | "               | 52                            | "                                                                       | 28                         | "       | "                           | 12.50 " 20th "                                                                      |
| 13   | Moderate        | 25                            | "                                                                       | 34                         | "       | "                           | 5.26 " 12th "                                                                       |
| 14   | "               | 39                            | "                                                                       | 22                         | "       | "                           | 5.00 " 20th "                                                                       |
| 15   | "               | 13                            | "                                                                       | 9                          | "       | "                           | 6.66 " 10th "                                                                       |
| 16   | Severe          | 17                            | "                                                                       | End of fever               |         |                             | 12.42 " 14th "                                                                      |

- 22           The questions arise as to whether the mildness or the severity of the attack and the length of the fever have any relation to the time at which the complement shows a diminution in amount.

THE RELATION BETWEEN THE TYPE OF ATTACK  
AND THE PERIOD AT WHICH THE COMPLEMENT FALLS IN AMOUNT  
-----

- 23           In four moderately ill patients (Cases and Charts IV, XV, XIV and XIII) the fall in complement was most apparent one week, one week, three weeks, and five weeks, respectively, after the temperature settled (Table <sup>II</sup>~~III~~). In the other twelve cases of this group, all of whom were acutely ill, this occurred between the end of the fever and five weeks afterwards.

- 24           No definite statement therefore can be made from this analysis as to the time at which complement is distinctly diminished, and indirectly it follows that the period at which an optimum amount of immune-body is present probably varies irrespective of the severity of the attack.

DIMINUTION OF COMPLEMENT IN RELATION TO THE LENGTH OF THE FEVER  
-----

- 25           The period of fever differed very markedly in the sixteen cases which are being considered. It will be seen from

the Charts and Table <sup>II</sup>~~VII~~ that between an abortive attack lasting thirteen days (Case and Chart XV) and an attack which was prolonged to the fifty-second day (Case and Chart VIII) various periods of fever are represented.

In five cases (Cases and Charts XV, XVI, IV, V and II) in which the fever lasted thirteen days, seventeen days, three weeks, three weeks and four weeks respectively, a marked fall in complement was observed either at the end of the fever or sometime during the first week of convalescence.

In the other eleven cases, most of whom suffered from a fever lasting four weeks or more, the diminution in complement, as far as is shown by the examinations made, occurred at times varying between two and four or perhaps five weeks after the temperature had subsided.

26

From this observation it might be deduced that the shorter the period of the fever the earlier is a distinct fall in the amount of complement noted, and the longer the fever the longer after its termination is complete immunity established.

#### THE QUANTITY OF THE COMPLEMENT DURING THE FEVER IN RELATION TO THE SEVERITY OF THE ATTACK -----

27

It will be seen from the Charts of these sixteen cases and also from Table <sup>II</sup>~~VII~~ that the greatest quantity of com-

plement present during the pyrexia varied between 5 units and 16.

28           The clinical histories of all those cases in which the highest complement figure lies between 8 units and 16 show that they were all acutely ill. In one, however (Case and Chart VIII) who was extremely ill, and at one period in the typhoid state, the complement figure at its highest was only 7 units, which represents a comparatively inactive type of serum, and this when taken in conjunction with the clinical facts seems to indicate that in addition to a failure or slow production of immune-body, complement was similarly affected, or that only a weak type of complement was present.

29           The four other cases (Cases and Charts IV, XIII, XIV and XV) in which complement even when greatest in amount was only between 7 units and 5, were all moderately ill. The low complement figure and the comparative mildness of the attack in each, even although the fever was prolonged in one of them (Case XIV) to thirty-nine days, seem to indicate that in these cases a considerable amount of immune-body was produced fairly early in the fever, and was probably sufficient to mitigate the symptoms, but not great enough to end the fever. In other words the immunity factors were nearly balanced throughout the illness.

- 30 From these observations it would appear that the quantity of complement present in certain cases of enteric fever bears some relation to the type of illness.

#### IRREGULARITIES IN THE PRODUCTION OF THE COMPLEMENT -----

- 31 Irregularity of the complement curve was seen in some cases, particularly in four (Cases and Charts IX, X, XI, and XII). In these cases, which resembled each other clinically, the fever lasted four weeks or longer. The temperature curve in the first three of these showed a break, as if it were falling about the twenty-first day, indicated by a blue line drawn on each Chart at this point. A recrudescence, however, occurred, lasting for a week or longer. In the remaining case (Case and Chart XII) the temperature curve shows no interruption. In the first three the complement was less in amount before or at the period of the break and increased during the final part of the fever.

- 32 The relatively low complement figure observed at these times, when compared with what has been found in preceding cases, and also during the final phase of the fever in the cases under consideration, may mean that immune-body was present fixing complement but not in sufficient amount to end the fever at that time.

33 In the remaining case (Case and Chart XII) something of the same kind seemed to have occurred, although there was no break in the temperature or other clinical indication that the end of the fever was approaching.

34 The variation of the complement in these cases suggests that there may be two phases of the primary fever represented, and that the part corresponding to the secondary increase in the complement must be regarded in the nature of an exacerbation or recrudescence of the primary fever. If this be so then these cases form a link between uncomplicated enteric fever and that associated with relapses.

Similar cases will be referred to under the next section.

35 The two remaining cases of Group (a) (Cases and Charts XVII and XVIII) are exceptional in that complement was much greater in amount during convalescence than at the time of the fever. In one of the cases already considered (Case and Chart XVI) something of the same kind regarding complement occurred during convalescence but not nearly so markedly as in the former two cases. No explanation is offered for this difference.

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GROUP (b)  
-----ENTERIC FEVER WITH COMPLICATIONS,  
RELAPSES, THROMBOSIS AND SECONDARY INFECTIONS  
-----

- 36           Eleven cases constitute this group. Of these seven suffered from relapse, two from thrombosis of the saphenous vein, and two were associated with different types of infection, namely erysipelas and pneumonia.
- 37           Before discussing the special phenomena of relapse it is to be noted that in five of these (Cases and Charts XX, XXI, XXII, XXV and XXVI) complement behaved during the primary fever in a similar manner to that described regarding the first four of the last six cases in the previous group.
- As in the previous Charts a blue line has been drawn where a distinct break in the fever occurred. As before suggested the break probably indicates an unsuccessful attempt at this point to establish immunity. The differentiation between the two phases was best seen in the first three cases of this series (Charts XX, XXI, and XXII) while an overlapping is more marked in the remaining two (Charts XXV and XXVI). If taken in the reverse order these temperature curves demonstrate the gradation of a true relapse from the recrudescence which overlaps or is tacked on to the

primary fever in some cases.

38        The complement estimations are not sufficiently complete to throw further light on this hypothesis, although the nature of the complement curves obtained in two of the cases (Cases and Charts XXI and XXVI) points to the probable presence of a considerable amount of immune-body at the period at which the lysis was interrupted.

#### RELAPSES

-----

39        With special regard now to the cases in which relapses occurred, it may be stated that the phenomena follow a course such as would be expected from what has already been said.

40        A review of the behaviour of the complement in all of this group of cases in which examinations were made at sufficient intervals, shows that this substance was more abundant during the relapse than during the afebrile interval or convalescence. This agrees in general with the results obtained in the uncomplicated cases.

41        In one case (Case and Chart XIX) where there is a fairly complete record of the amount of complement in the primary fever and the relapse, the complement curve followed

closely the course of the fever in both stages of the disease, there being a reduction during the apyretic interval and a uniformly small amount of complement present throughout convalescence.

42           In all except two cases (Cases and Charts XXIV and XXV) in which the record is incomplete, the fall in the amount of complement occurred within a week after the relapse, thus differing to some extent from what has already been found in uncomplicated cases.

43           This seems to indicate that immune-body is produced more rapidly in relapses, and that recovery takes place sooner than from an initial fever, as is indeed also noted clinically.

44           The highest complement figure obtained in the individual cases during the relapse varied between 7 units and 24. The two patients who were most severely ill (Cases and Charts XIX and XXII) yielded the least haemolytic serum, which fact might be explained in the same way as adopted already in connection with one of the cases of Group (a) which was very severely ill (see paragraph 28 of this section)

45           In another exceptional case (Case and Chart XXIII), also acutely ill during the relapse, the serum was very actively haemolytic, and therefore that explanation does not hold in

this instance. In other three cases of this group (Cases and Charts XX, XXI and XXIV) in which the relapse was of a mild type, a high complement figure was obtained.

46 In general the course of the relapse is associated with a considerable amount of complement, and this holds in some cases even when the patients are acutely ill, but as in all other immunity phenomena, variations in the amount of antibodies occur in this class of cases. This variation is represented by those cases who had what might be called acute relapses. In one the amount of complement present was very considerable, in the other two, though considerably higher than in the apyretic stage, yet it never reached much above twice the amount normally present in the serum of these patients.

47 In the other case contained in this group (Case and Chart XXV) complete observations were not made, but the record as far as it goes is in agreement with what has been said.

#### ENTERIC FEVER ASSOCIATED WITH A SECONDARY INFECTION -----

Two cases were observed (Cases and Charts XXVI and XXVII).

48 As can be seen from the clinical history of the first

case (Case and Chart XXVI) the illness was severe and prolonged. It was complicated by erysipelas of the face, and subsequent suppuration of the scalp, neck and thigh.

49       The complement curve as a whole shows a decline from the time of the primary fever until convalescence was completely established, thus conforming to what has already been found in the majority of the cases examined. Closer analysis of the curve shows that it is possibly made up of three elements, the first coinciding with the first twenty-two days of the fever, the second with what has in other cases already described been looked upon as a recrudescence, and the third with the period of suppuration.

50       From the results obtained in erysipelas (see Section B) an increase in the amount of complement was to be expected when this complication arose in the present case, but such did not occur until much later, when suppuration was in progress. Thereafter, associated with healing of the abscesses and the gradual recovery of the patient, a steady diminution in the amount of complement was observed.

51       The second case (Case and Chart XXVII) was admitted to hospital suffering from lobar pneumonia. Enteric fever developed fourteen days later. Although complement was relatively low in amount throughout the illness, it was a

little more abundant during the attack of enteric fever than at the time of complete convalescence. No observations were made during the attack of pneumonia.

52           These two patients resemble each other in that they suffered from two types of infection, and that the power of production of complement appeared to be impaired at the time the second infection began. Müller<sup>(9)</sup> quotes experiments made by Schütze and Scheller, and Wassermann, who found that after one type of infection in which complement has been used up this substance is not rapidly regenerated if a secondary infection with another type of organism occurs.

53           This explanation may be applied to the two cases under consideration regarding the relative failure of complement production at the beginning of the attack of erysipelas in the one and of enteric fever in the other.

#### ENTERIC FEVER COMPLICATED WITH THROMBOSIS -----

54           Two cases complicated with thrombosis of the saphenous vein were observed (Cases and Charts XXVIII and XXIX). The complement curve as a whole in both conforms with that found in the earlier cases described in this section, but as far as the observations show no marked variation in the amount of complement occurred during the time thrombosis was present.

55 In the first of these two cases (Case and Chart XXVIII) however a considerable increase in the amount of complement was present when the clinical evidence showed that separation of sloughs from the intestine was in progress. This was associated with a notable accession of toxæmia. A disturbance in the rate of production of immune-body seems to have been indicated at this period, possibly due to an increase in the amount of toxic substances absorbed from the bowel.

#### A CASE COMPLICATED BY PLEURISY AND PNEUMONIA -----

56 The outstanding feature in this case (Case and Chart XXX) was the very marked rise in the amount of complement between the first two examinations. It corresponds with the beginning of pleurisy and pneumonia. During this period complement remained relatively increased. Cystitis was also present, though the date of origin was somewhat obscure. There may also have been a recrudescence of the enteric fever.

When convalescence was established the quantity of complement decreased.

57 The statement already made (paragraph 52 of this section) regarding the cause of the low amount of complement

found in the two cases which showed a double infection does not hold in the present instance. It may be noted, however, that the pleurisy and pneumonia differed clinically from a pneumococcal infection, and the condition was clinically considered at the time as probably due to the typhoid infection. The behaviour of the complement at this time was somewhat similar to that observed in the other cases showing a recrudescence.

#### GROUP (c)

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#### FATAL CASES OF ENTERIC FEVER

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58        Ten cases have been included in this group. In five of them (Cases and Charts XXXI, XXXII, XXXIII, XXXIX, and XL) several examinations of the serum were made, and in the others (Cases and Charts XXXIV, XXXV, XXXVI, XXXVII and XXXVIII) only single examinations were possible.

59        It was found in all of these cases except one (Case XXXIX) that, even where the complement was present in small amount, the lowest figure was something higher than the mean obtained from examinations of normal sera already noted, namely 4.84 units. In none of them was there any absence of complement. A very notable increase in the amount of com-



plement was found immediately prior to death in four cases (Cases XXXI, XXXII, XXXIII and XXXIV).

60 In the first three of these the difference in the amount of complement at this time, compared with what it was several days before death, was very great. Death cannot be ascribed therefore to a lack of complement in these four cases particularly, but rather to the lack of sufficient immune-bodies. This has already been referred to in the introduction to this section of the paper, (paragraph 11).

61 In other five cases, where only single examinations were made (Cases and Charts XXXV, XXXVI, XXXVII, XXXVIII and XL) the amount of complement, although more or less small in comparison with the previous cases, is also in accordance with this view to some extent.

62 In four of the cases (Cases XXXV, XXXVI, XXXVII and XXXVIII) several days elapsed between the time of the examination of the serum and the occurrence of death. The results nearly correspond with those obtained at an almost similar period in the first three cases of this group, in which the very marked final increase in complement was observed.

63 In a single instance (Case and Chart XXXIX) however the amount of complement was small even at the time of death,

and this seems to signify a failure in the production of both immune-body and complement, or the production of a very weakly acting complement.

64 In another case (Case and Chart XL) the amount of complement fluctuated. It was very great four days and relatively small one day before death. This again seems to show, when taken in conjunction with the clinical evidence, that complement and immune-body are produced quite independently of one another.

#### N O T E

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A Note on Haemolysis occurring in the presence of an excessive Amount of Fibrin in a Serum which caused complete coagulation of the whole Content of each Tube in the Test Series

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65 In one fatal case (Case XXXIV) when the serum was being examined great difficulty was experienced in obtaining it free from fibrin, of which an excessive amount was present. Coagulation of the serum occurred several times after each removal of the coagulum. During an interval between coagulations, when the serum could be drawn into a pipette, it was added to the series of test tubes containing 1 c.c. of the

suspension of sensitized ox corpuscles, in quantities varying from .02 c.c. to .28 c.c. as already described in connection with the technique of this work. The amount of serum in each of the twenty-four test tubes was therefore very small. Five minutes after the tubes had been placed in the incubator complete coagulation of their contents occurred, which formed a solid mass at the bottom of each.

66           This however did not interfere with the progress of haemolysis, which proceeded in the usual way.

67           At the end of an hour the haemolytic power of the serum could be readily observed by the presence of complete haemolysis.

68           This phenomenon was only present in this instance, although an excessive amount of fibrin was frequently observed in the blood of patients who were very ill.

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SUMMARY OF THE RESULTS OBTAINED IN ENTERIC FEVER  
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- 1            Complement is always present during enteric fever, and is more abundant throughout the period of pyrexia than during convalescence.
- 2            Diminution in the amount of complement in favourable cases seems to coincide with the production of immune-body as shown by the condition of the patient.
- 3            Complete immunity is not established in all cases at any definite time after the temperature has settled, and it does not seem to bear any definite relation to the degree of severity of the attack, but it would appear to depend to some extent on the length of the period of illness; immunity being established sooner after a brief than after a prolonged illness.
- 4            Severity of the attack bears some relation to the amount of complement present during the fever. In patients who are very ill complement as well as immune-body may be produced slowly; or only a weak type of complement may be produced. On the other hand in patients who are moderately ill a relatively small amount of complement seems to indicate the presence of a considerable amount of immune-body,

but not sufficient to terminate the attack. In the intermediate type of illness, which is the most common, a large amount of complement is found.

5           Two cases showing an increase in the amount of complement throughout convalescence have been observed.

6           The variation in the amount of complement during some prolonged types of primary fever seems to indicate that the terminal portion of such may be of the nature of a recrudescence.

7           Complement is increased in amount during relapses and diminished when recovery is taking place. The diminution appears to occur sooner after a relapse than after a primary attack. This might mean that immune-body is produced earlier than in the original attack. The extent of the variation of the complement does not bear any definite relation to the severity of the relapses which have been observed.

8           In cases of enteric fever associated with a pyogenic infection, or vice versa, regeneration of complement seems to be impaired during the secondary illness.

9           No variations in complement have been found associated with thrombosis in enteric fever.

10          Death from enteric fever is due chiefly to absence of

immune-body. Complement is sometimes very abundant in fatal cases, and at other times only a weak type of complement may be present.

- 11 All the results show that complement and immune-body are not produced in any fixed ratio to one another.

It was also found that the amount of complement and immune-body produced in the early part of the disease is not necessarily proportional to the amount of complement and immune-body produced in the late part of the disease. In fact, the amount of complement and immune-body produced in the late part of the disease is usually much greater than the amount produced in the early part of the disease. This is especially true in the case of the acute stage of the disease. In the acute stage of the disease, the amount of complement and immune-body produced is usually much greater than the amount produced in the early part of the disease.

This brief outline of the clinical course of the disease shows that the immunity phenomenon does indeed develop in the acute stage of the disease. Immune substances are equally rapidly produced in the acute stage of the disease.

Experiments have been carried out for the purpose of determining the effect of the acute stage of the disease on the immunity phenomenon. In these experiments, it was found that the amount of complement and immune-body produced in the acute stage of the disease is usually much greater than the amount produced in the early part of the disease. This is especially true in the case of the acute stage of the disease. In the acute stage of the disease, the amount of complement and immune-body produced is usually much greater than the amount produced in the early part of the disease.

SECTION B - ERYSIPELAS  
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1           This disease is characterized by an acute onset, a moderately short period of high pyrexia, and a critical termination.

2           In most cases the attack ends in the first or in the early part of the second week, but occasionally it may continue for a longer period, as for example in the migrating type of the disease. There is usually considerable pyrexia and general disturbance in the condition of the patient during the acute stage of the illness. Relapses are common.

3           This brief outline of the clinical facts indicates that the immunity phenomena once begun develop rapidly, and that the immune substances are equally rapidly produced.

4           McCririck<sup>(10)</sup> has observed for instance that the opsonic index in erysipelas, at first relatively low, reaches normal between the fourth and eighth days from the onset of the infection, and that during a relapse the normal index is restored between the second and fourth days.

5           Thus opsonin seems to play an important part in terminating an attack.

That true bactericidal substances are also produced in the course of erysipelas can hardly be doubted, although this has not been investigated by the writer.

6 Altogether thirty cases of erysipelas have been investigated, and the estimations of the complement have been made as frequently as was practicable.

7 The cases have been arranged in the following manner:-

Group (a) Uncomplicated cases and a case of erysipelas  
migrans

Group (b) Cases complicated with relapse and suppuration

Group (c) Fatal cases

#### GROUP (a)

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8 As certain similarities were found in the variations of the amount of the complement present in the twenty patients included in this group, special reference is made here to a particular case which seems to be the type with which the others may be compared.

9 (Case I, Chart I) The patient was admitted to hospital on the fourth day of illness, suffering from a sharp attack of erysipelas involving the upper part of the face and the



scalp. The infection originated in a septic wound of the scalp. The temperature fluctuated between 100° F. and 104° F. for seven days and reached normal by rapid lysis on the tenth day of illness. The inflammatory process spread over the face during the period the temperature was elevated and subsided on the eighth day, two days before the temperature reached normal. A rapid recovery was made.

- 10           The complement was found to be greatest in amount during the acute stage of the illness, reaching its highest point, 8.33, on the seventh day. Four days after recovery it diminished to 5.88, and when the patient was dismissed on the twentieth day the figure obtained was 5.55. Thus quite an appreciable diminution in the amount of complement was present during convalescence. This phenomenon was equally well marked in other eleven cases (Cases and Charts II to XII).

- 11           The remarks made regarding enteric fever, namely that the fall in the amount of complement is associated with the production of immune substances, apply here and accord equally with the clinical appearances. The extent of the variations in the amount of complement present during an attack of erysipelas however cannot be expected to be so marked as in enteric fever, in which the reaction shown by the patient is much more gradual.

THE RELATION BETWEEN THE PERIOD OF THE DIMINUTION IN THE AMOUNT OF  
THE COMPLEMENT AND THE SEVERITY AND DURATION OF THE ILLNESS  
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TABLE I  
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| Case | Period of diminution in<br>complement |   |   |   | Type of attack and extent                    | Duration<br>of attack |   |
|------|---------------------------------------|---|---|---|----------------------------------------------|-----------------------|---|
| 2    | End of fever                          |   |   |   | Severe - face and scalp                      | 4 days                |   |
| 11   | "                                     | " | " | " | Very severe, arms, face<br>body and left leg | 26                    | " |
| 12   | "                                     | " | " | " | Severe - face and scalp                      | 10                    | " |
| 3    | 3 days after temp.<br>reached normal  |   |   |   | Severe - face and part of<br>scalp           | 7                     | " |
| 8    | "                                     | " | " | " | " " " "                                      | 9                     | " |
| 1    | 4                                     | " | " | " | Severe - face and scalp                      | 10                    | " |
| 6    | "                                     | " | " | " | Severe - face and part of<br>scalp           | 7                     | " |
| 7    | "                                     | " | " | " | Moderate - face                              | 7                     | " |
| 4    | 5                                     | " | " | " | Severe - face and scalp                      | 10                    | " |
| 9    | 9                                     | " | " | " | " " " "                                      | 7                     | " |
| 10   | 10                                    | " | " | " | " " " "                                      | 18                    | " |
| 5    | 12                                    | " | " | " | " " " "                                      | 7                     | " |

12 It will be seen from Table I that the period at which  
the complement is distinctly diminished after the temperature  
has reached normal is not the same in all cases.

The figures however are only approximate, as the intervals at which the serum was examined varied.

13        Of the patients one (Case VII) was moderately ill, and the others severely or very severely ill. In the former the fall in the amount of complement was observed four days after the termination of the fever, and in the latter group the time varied between the end of the fever and the subsequent twelve days. As will be seen from these observations no definite relationship can be traced between the severity of the illness and the establishment of complete immunity, although it may be inferred from the results obtained that the latter occurs within a few days after the inflammatory process has subsided. This is also in accord with the clinical observation that all these patients made a rapid recovery.

14        This table also tends to show that the duration of the illness bears no relation to the period of fall in the amount of complement. In three instances for example (Cases II, XII and XI) the fall in the amount of complement was closely associated with the termination of the fever which occurred in four, ten, and twenty-six days respectively after the onset of illness.

15        Thus the establishment of complete immunity does not seem to bear any definite relation to the duration of the

illness. This observation is also substantiated by the rapidity of the recovery of practically all of these patients.

THE QUANTITY OF COMPLEMENT PRESENT DURING THE FEVER IN RELATION  
TO THE SEVERITY AND THE DURATION OF THE ATTACK  
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16 This will be seen from the points noted in the sub-joined table.

TABLE II  
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| Case | Type of Attack | Duration of fever | Greatest quantity of complement present during the fever |
|------|----------------|-------------------|----------------------------------------------------------|
| 1    | Severe         | 10 days           | 8.33 complement units                                    |
| 2    | "              | 4 "               | 6.25 "                                                   |
| 3    | "              | 7 "               | 5.26 "                                                   |
| 4    | "              | 10 "              | 6.89 "                                                   |
| 5    | "              | 7 "               | 8.33 "                                                   |
| 6    | "              | 7 "               | 7.69 "                                                   |
| 7    | Moderate       | 7 "               | 9.09 "                                                   |
| 8    | Severe         | 9 "               | 5.55 "                                                   |
| 9    | "              | 7 "               | 8.69 "                                                   |
| 10   | "              | 18 "              | 8.33 "                                                   |
| 11   | Very severe    | 26 "              | 12.50 "                                                  |
| 12   | Severe         | 10 "              | 14.28 "                                                  |

17 The definite conclusions can be drawn from these results so far as they go, that no relation exists between the greatest complement content of the serum during the acute stage

of the disease and the severity of the illness or its duration.

- 18        The average amount of complement present is considerably less than that observed in enteric fever and this seems to indicate that the production of the immune substances occurs comparatively soon in erysipelas.
- 19        In the remaining eight cases of uncomplicated erysipelas (Cases and Charts XIII to XX) results were obtained which differ somewhat from those just described.
- 20        In the first three of these (Cases and Charts XIII, XIV and XV) only slight variations in the amount of the complement were observed during both the period of erysipelas and the convalescence. All were mildly ill, and only one of them (Case XIV) showed any marked pyrexia.
- 21        The fact that the disease was not very acute in these cases seems to indicate that the production of immune substances was comparatively constant, and caused a balancing of the immunity factors, or that the stimulus of the infection was not powerful enough to call forth a marked reaction in the complement producing organs. It may be noted in this latter connection that in the single case (Case XV) which showed an increase in the amount of complement at one stage, that the erysipelas was most marked at this time.

22 In the remaining five cases (Cases and Charts XVI, XVII, XVIII, XIX and XX) an increase in the amount of complement after the erysipelas had subsided is the chief point to be noted; they differ in this respect from the first twelve cases of this Group (a). In three of them (Cases XVI, XVII and XVIII) however a temporary diminution was observed towards the end of the period of pyrexia.

23 In the absence of special knowledge as to the behaviour of the other immunity factors it seems unsafe to venture any special hypothesis regarding these variations in the amount of complement.

#### A CASE OF ERYSIPELAS MIGRANS

24 (Case and Chart XXVII) In this case the erysipelas began on the face, and at different times throughout the course of the illness it affected the body, arms, and one leg. The patient was most acutely ill during the first seven days, and from that time onwards the inflammatory became less and less acute.

25 The amount of complement present during the first seven days was relatively small, only varying between 4 and 5 complement units. The patient's general condition at this time, indicated a weak degree of reaction. During the less

acute stage of the disease however, when recurrences of a progressively less severe type were appearing on different parts of the body, marked fluctuations in the amount of complement were observed.

26        This irregular behaviour of the complement as well as the clinical evidence, indicates a certain instability in the degree of immunity at different stages of the illness in this case. An increase in the amount of complement was also observed during convalescence. The only further examination of the serum which was possible was made on the fifty-fourth day of illness, when the patient was perfectly well and about to be dismissed from hospital. The complement content was then observed to be 4.34 units.

27        During the interval between the two final observations, made on the thirty-second day and the fifty-fourth respectively, a slight recurrence of the facial erysipelas lasting three days occurred. This is of some interest, as it tends to corroborate the remarks just made regarding the instability of immunity in this case.

-----  
Iodipin was administered subcutaneously in this case on the seventh, eighth, ninth, tenth and eleventh days of illness in doses of 90 minims. A marked rise in the amount of complement from 4.76 units on the seventh day to 11.11 on the ninth does not seem to depend on the action of this drug, since the doses which were given on the ninth, tenth and eleventh days were associated with a diminution of complement to 4.00 units

GROUP (b)  
-----CASES COMPLICATED WITH RELAPSE AND SUPPURATION  
-----

- 28 Before discussing these cases it is to be noted that in four of them (Cases and Charts XXI, XXII, XXIII and XXIV) the complement curve obtained during the initial attack corresponds to that described in the first twelve cases of Group (a).
- 29 Six cases are included in this Group (Cases and Charts XXI to XXVI). All of these recovered except one (Case XXV), which finally became septicaemic. Two relapses were observed in the last mentioned case.
- 30 Five of these patients suffered from a relapse of the erysipelas, one (Case XXII) on the eighth day after the termination of the preceding attack, one (Case XXV) on the tenth day, two (Cases XXIII and XXIV) on the fifteenth day, and one (Case XXI) on the nineteenth day.
- 31 Two cases in this Group (Cases XXIV and XXVI) were complicated by suppuration during the course of the illness.
- During the relapse in the first three cases the amount of complement as far as the observations show was smaller than during the primary attack.



32           In the first two cases (Cases and Charts XXI and XXII) the secondary attack was very mild, of very short duration, and unaccompanied by any notable disturbance in the patient's condition. The local reaction was also comparatively slight. This seems to show that the disturbance of the immunity balance was soon readjusted.

33           In the third case (Case and Chart XXIII) the first estimation during the relapse was made when the crisis was in progress, seven days after the onset of the secondary fever. A fairly rapid fall in the amount of complement two days after the end of the primary attack had been previously observed.

34           In the absence of a sufficient number of estimations during the acute stage of the relapse, it can be surmised either that the small amount of complement observed at the time mentioned may have been preceded by a greater amount or that as in the two previous cases a smaller amount of free complement existed in the blood than during the primary attack.

35           The relatively high complement figures observed during convalescence in three of these cases (Cases XXIII, XXIV and XXV) is in accord with what has been noted in five cases of the previous Group, and the remarks previously made would

seem to apply equally here. In the case which developed a secondary septicaemia the complement always remained relatively high, and this possibly had some relation to the inability to maintain an immunity, but what relationship is not clear.

#### ERYSIPELAS ASSOCIATED WITH SUPPURATION

-----

36        The record of one of the two cases showing this Complication (Case and Chart XXIV) is incomplete and is not discussed, but in the other (Case and Chart XXVI) an unusually large number of observations were made, fourteen in all.

37        This patient suffered from erysipelas of the face and scalp arising from a septic scalp wound. There was extensive suppuration of the scalp and forehead, followed by sloughing of the subcutaneous tissue. At no time after the eleventh day was the inflammatory process nearly so acute as during the preceding period. The patient was delirious on the sixth, seventh and eighth days. His general condition improved about the tenth day, although pus began to accumulate under the scalp at this time. Numerous incisions were made and much pus evacuated. Between the seventeenth and the twenty-first days of illness pus again accumulated under the scalp, and in addition a large abscess formed in the forehead,

both requiring incisions. Improvement followed, and by the thirtieth day all the sloughs had separated. From that time the scalp healed very slowly, and the inflammatory condition of the forehead persisted, rendering further incisions necessary on the forty-third day. The patient was still in hospital on the seventy-second day, when the final estimation of the complement was made. The scalp and forehead at that period had not quite healed, although the patient was very well.

38         The complement curve in this case shows three phases, the first corresponding to the attack of erysipelas with abscess formation under the scalp, the second to the abscess formation in the forehead and the reaccumulation of pus under the scalp, and the third to the recurrence of the abscess in the forehead.

39         The course of the complement curve points to a deficiency of immune substances during most of the time the observations were made, except for a few days after the delirium had subsided and the first collection of pus had been evacuated. The indirect evidence supplied by the amount of complement regarding the presence of immune substances points to a considerable deficiency of the latter during the worst period of the erysipelas and at such times as reaccumulation of pus was taking place in the scalp and the forehead.

GROUP (c)  
-----FATAL CASES OF ERYSIPELAS  
-----

- 40 In addition to the fatal relapsing case (XXV) already mentioned in the previous group, three others have been investigated.
- 41 In two (Cases and Charts XXVIII and XXIX) an increase in the amount of complement was noted at the time of death. In the third (Case and Chart XXX) a single examination was made when the patient was dying, and although the amount of the complement found was not so high as in the other fatal cases, yet it is a little above the normal average.
- 42 The fatal issue in these cases cannot be ascribed to absence of complement, but rather to the dearth of immune substances.
-

## SUMMARY OF THE RESULTS OBTAINED IN ERYSIPELAS

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- 1        In the majority of the cases examined complement was present in greater amount during the acute stage of the illness than during convalescence. The clinical evidence supports the view that the diminution coincides with the production of immune substances.
- 2        The period at which the complement is distinctly diminished is not the same in all cases.
- 3        No definite relationship has been found to exist between the severity or the duration of the illness and the period at which immunity in the primary attack is established, although this seems to occur within a few days after the inflammatory process has subsided, as is also shown by the rapid recovery made by most of the patients.
- 4        The greatest amount of complement present in any case has no relation to the severity or the duration of the illness.
- 5        This amount is considerably less than already observed in enteric fever, which fact suggests that the production of immune substances occurs comparatively early in erysipelas.
- 6        In some mild cases only slight variations in the amount

of complement present have been observed.

- 7           An increase in the amount of complement has been observed in some instances during convalescence, and is possibly due to an early diminution in the amount of immune substances present. It is well known in this connection that the immunity established by an attack of erysipelas is in many cases of short duration.
- 8           On account of the comparatively small number of observations which it has been possible to make during relapses no definite conclusion has been drawn from the results obtained during this phase of the disease.
- 9           Complement is increased in amount during prolonged suppuration complicating erysipelas.
- 10           Irregularity in the amount of complement present during illness indicates a certain degree of instability in the immunizing mechanism, as is shown by the clinical course of a case of erysipelas migrans.
- 11           The amount of complement present in fatal cases has been found to be above the normal average.
-

SECTION C - DIPHTHERIA  
-----

- 1        Diphtheria, unlike the two preceding diseases which have been considered, is not associated with any definite period of pyrexia, and it is practically impossible to state even approximately a limit to the duration of the illness.
- 2        The local manifestations of the disease vary in the different patients to a very marked extent. Between simple catarrhal diphtheria, and the malignant type, associated with copious haemorrhage and affecting the whole of the fauces, palate, larynx and trachea, all degrees of severity of illness are met with.
- 3        The toxaemia, which is one of the most striking features of the early stage of diphtheria, likewise varies within extreme limits, but is usually proportionate to the extent of the local infection; in mild cases it may be absent, and in the severe type it is often profound. Except perhaps in the case of the mild type of infection, recovery is gradual and certainly does not coincide with the disappearance of the membrane from the affected part. This only represents the

end of the first stage of the disease.

- 4           Convalescence varies in duration, and may be prolonged even when the case is uncomplicated by paralysis or cardiac symptoms. When these complications have arisen the period of convalescence may extend through weeks or even months, especially when marked trophic changes have occurred in the muscles.
- 5           After the administration of antitoxin a rapid improvement in the local and general conditions takes place, and the diphtheritic membrane usually disappears within a week; but the extent of the damage brought about by the toxæmia is only seen later, when the complications due to secondary degenerative changes in the affected nerves and muscles already indicated have appeared.
- 6           In profoundly toxæmic cases these complications may appear during the first few days of the illness. In the less severe types they occur most frequently in the third week, but may be as early as the second or as late as the sixth. Love<sup>(11)</sup> has found from his experience and analysis of eighty-five cases that paralysis occurs within the first two weeks in severe cases, and during the third week or later in the milder types.

- 7           The serum disease is another accidental feature of



many cases of diphtheria.

- 8 Most of these phenomena which have been briefly outlined are presented in the twenty-two cases included in this section, and investigations of the complement were made as far as was possible during all stages of the disease. The cases have been arranged in three groups, according to the site of the disease.

Group (a) Faucial diphtheria - thirteen cases

" (b) Faucial and nasal diphtheria - seven cases

" (c) Laryngeal diphtheria - two cases

#### GROUP (a)

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- 9 This group includes cases which presented various degrees in the extent of the membrane and in the severity of the disease, the latter feature being determined by the amount of toxæmia present in each instance.

The subjoined table gives a brief account of each case:-

-----

TABLE I

| Case | Distribution of membrane and condition of the lymphatic glands | Degree of toxaemia | Amount of anti-diphtheritic serum given |            |             |
|------|----------------------------------------------------------------|--------------------|-----------------------------------------|------------|-------------|
| 1    | Whole of fauces. Cervical glands swollen                       | Severe             | 14,000                                  | units sub- | cutaneously |
| 2    | Both tonsils and uvula. Cervical glands swollen                | "                  | 12,000                                  | "          | "           |
| 3    | Both tonsils and uvula. Cervical glands swollen                | "                  | 20,000                                  | "          | "           |
| 4    | Both tonsils                                                   | "                  | 14,000                                  | "          | "           |
| 5    | Tonsils and soft palate                                        | "                  | 6,000                                   | "          | "           |
| 6    | Both tonsils                                                   | "                  | 10,000                                  | "          | "           |
| 7    | Both tonsils. Cervical glands swollen                          | "                  | 6,000                                   | "          | "           |
| 8    | One tonsil and soft palate. Right cervical glands swollen      | "                  | 10,000                                  | "          | "           |
| 9    | Whole of fauces and soft palate. Cervical glands swollen       | Very severe        | 40,000                                  | "          | "           |
| 10   | Both tonsils and uvula in patches. Cervical glands swollen     | Moderate           | 4,000                                   | "          | "           |
| 11   | Both tonsils                                                   | "                  | 8,000                                   | "          | "           |
| 12   | " "                                                            | "                  | 8,000                                   | "          | "           |
| 13   | " "                                                            | "                  | 8,000                                   | "          | "           |

10 In all of these cases except two (Cases XII and XIII) the amount of complement varied. These two cases are spec-

ially considered later on (paragraph 16).

In seven of the other eleven cases similarities were observed in the variations of the complement (Cases and Charts I to VII).

11 The following case (Case I) may be taken as the type.

This patient was admitted to hospital on the sixth day of illness. The greater part of the fauces was covered with diphtheritic membrane, and the cervical glands were considerably swollen. The patient was sharply ill, and the toxæmia was severe.

The temperature which on admission was  $98.4^{\circ}$  F. rose during the course of the evening to  $101.6^{\circ}$  F. and returned to normal next day. Fourteen thousand units of anti-diphtheritic serum were administered subcutaneously. The pulse rate at this time varied between 76 and 98 per minute. A faint mitral-systolic murmur was present, which continued throughout convalescence.

During convalescence the pulse rate varied between 80 and 110 per minute.

The membrane quickly disappeared from the throat, and was completely absent five days after the administration of the antitoxin. At the same time the swelling of the fauces and cervical glands became rapidly less, and the symptoms of toxæmia gradually abated.

During convalescence the patient frequently suffered

from moderate pain in both shoulders and in the back, which was ascribed to a rheumatic condition to which he had previously been subject. There were no sequelae due to diphtheria.

- 12 In this case the amount of complement present was greatest on the day upon which the patient was admitted to hospital, and was represented by 10.00 complement units. Three days later a marked diminution was observed, the serum then possessing only half the activity found on the previous examination. An almost similar amount was present ten days later. During the remaining part of convalescence a further diminution to 3.00 units was observed.

- 13 In the other six cases here considered, all of them severely ill, the amount of complement present was also greater during the acute stage of the illness than during convalescence.

- 14 With regard to the remaining four, in one, a severe case (Case and Chart VIII), a decrease in the amount of complement was observed at the end of the first week of the illness. Ten days later a slight increase occurred, but at the end of convalescence the amount of complement present was less than at any other period. Thus the behaviour of the complement in this instance has a general resemblance to that in the preceding cases.

15           In the other three cases (Cases IX, X, and XI), in the first of which the illness was severe and in the other two only moderate, the amount of complement present at the time of the last observation in convalescence was greater than or at least as great as during the acute stage of the illness. It may however be noted that in the second of these cases a slight diminution in the amount of complement was observed towards the end of the first week of the illness, and in this respect it agrees with what has already been described in the preceding cases.

16           Two cases (Cases and Charts XII and XIII) already referred to, both moderately ill, were quite exceptional.

          In the first of these complement seemed to be practically absent from the serum during the whole period of the patient's residence in hospital, complete haemolysis not even being produced by such a large amount of serum as .54 c.c. In the second this absence of complement was observed during the acute stage of the illness and until the fourth week of convalescence, when a slight return of the complement content was observed. The complement figure, 3.84, was obtained at this time, which represents .26 c.c. of serum.

-----

GROUP (b)  
-----FAUCIAL AND NASAL DIPHTHERIA  
-----

- 17 Observations were carried out in seven cases of faucial and nasal diphtheria (Cases and Charts XIV to XX). Of these five recovered and two died. One of the latter, an haemorrhagic case, succumbed to the toxæmia and haemorrhage, and the other to primary heart failure. In both the illness only lasted five days.
- 18 The following table (Table II) includes a short account of these cases.

TABLE II

| Case | Distribution of membrane and condition of the lymphatic glands            | Degree of toxæmia | Amount of anti-diphtheritic serum given |
|------|---------------------------------------------------------------------------|-------------------|-----------------------------------------|
| 14   | Both tonsils and nose. Cervical glands swollen                            | Severe            | 8,000 units intravenously               |
| 15   | Both tonsils, soft palate, and nose. Cervical glands swollen              | "                 | 40,000 units subcutaneously             |
| 16   | Whole of fauces and nose. Cervical glands much swollen                    | "                 | 40,000 " "                              |
| 17   | Both tonsils, part of soft palate and nose                                | "                 | 12,000 units intravenously              |
| 18   | " " " "                                                                   | "                 | 14,000 units subcutaneously             |
| 19   | Fauces, palate, and nose. Haemorrhagic. Cervical glands very much swollen | Profound          | 22,000 units intravenously              |
| 20   | Both tonsils and nose                                                     | Severe            | 16,000 units subcutaneously             |

The complement curves obtained from the results of the observations in the first three cases (Cases and Charts XIV, XV and XVI) are very much the same as those already described in relation to the first seven cases of the preceding group (a). In all the complement, as far as the number of observations made indicates, was greater in amount during the acute period of the illness than throughout convalescence.

19 Complement in the next two cases (Cases and Charts XVII and XVIII) was small in amount during the whole period of residence, and this deficiency was most marked in the first case during the first two days, and in the second case during the first eleven days of illness.

During convalescence however a slight diminution was observed in both cases, in the first from the end of the second week, and in the second from the beginning of the third week. Convalescence in both cases was prolonged by the occurrence of palatal paralysis.

20 In both the fatal cases (Cases and Charts XIX and XX) the serum was fairly active two days prior to death, the complement figure being 7.69 units and 6.25 respectively. In the former of these (Case XIX) the serum when first examined, on the day upon which the patient was admitted, was found to be twice as rich in complement as at the date of the second observation.

It would appear that complement is not absent about the time of death from diphtheria.

#### GROUP (c)

-----

21 Some observations were made in two cases of laryngeal diphtheria, but they were not extensive. In both cases (Cases and Charts XXI and XXII) however a large amount of



complement was observed during the acute stage of the illness.

22            Immediate tracheotomy was necessary in the first, and three days after this, when the patient was recovering, an unusually large amount of complement was present, being more than twice that observed at the time of the first examination of the serum.

23            In the second case complement, in accordance with what has already been described, was markedly diminished in amount at the beginning of convalescence, when the second and final observation was made.

24            Attention is here drawn to the fact that the amount of complement was below the normal average    Complement figure during the acute stage of the disease in four cases (Cases XII, XIII, XVII and XVIII), and during part of convalescence in ten (Cases I, II, III, IV, V, VI, VII, XIV, XVII and XVIII).

-----

RELATION OF THE DIMINUTION IN THE AMOUNT OF COMPLEMENT TO THE DISAPPEARANCE OF THE  
MEMBRANE AND TOXAEMIA IN THE THREE GROUPS OF CASES

TABLE III

| Case | Number of days after antitoxin required for disappearance of membrane and toxæmia | Increase or decrease in the amount of complement during this period | Case | Number of days after antitoxin required for disappearance of membrane and toxæmia | Increase or decrease in the amount of complement during this period |
|------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------|
|      |                                                                                   |                                                                     |      |                                                                                   |                                                                     |
| 1    | 5 days                                                                            | Decrease                                                            | 14   | 6 days                                                                            | Marked decrease                                                     |
| 2    | 9 "                                                                               | "                                                                   | 15   | 6 "                                                                               | Marked decrease at first. Increase later                            |
| 3    | 7 "                                                                               | "                                                                   | 16   | 8 "                                                                               | Slight decrease                                                     |
| 4    | 6 "                                                                               | "                                                                   | 17   | 7 "                                                                               | Increase                                                            |
| 5    | 3 "                                                                               | Marked decrease                                                     | 18   | 7 "                                                                               | Slight decrease; complement small in amount                         |
| 6    | 4 "                                                                               | Very little change                                                  | 19   | Both present at time of death                                                     |                                                                     |
| 7    | 4 "                                                                               | Slight decrease                                                     | 20   | " "                                                                               | "                                                                   |
| 8    | 6 "                                                                               | "                                                                   |      |                                                                                   |                                                                     |
| 9    | 5 "                                                                               | " increase                                                          |      | Group (c)                                                                         |                                                                     |
| 10   | 3 "                                                                               | " decrease                                                          |      |                                                                                   |                                                                     |
| 11   | 3 "                                                                               | Increase                                                            | 21   | ?                                                                                 | Marked increase                                                     |
| 12   | 3 "                                                                               | Complement absent                                                   | 22   | ?                                                                                 | Decrease                                                            |
| 13   | 4 "                                                                               | "                                                                   |      |                                                                                   |                                                                     |

- 25           It will be seen from Table III that the throat was clean or almost so, and that the toxaemia had almost gone, or at least was much diminished, at periods which vary between three and nine days.
- 26           In thirteen of the cases a decrease of varying degree in the amount of complement was observed during this phase of the illness.
- 27           In four others a varying degree of increase was noted; in one, complement scarcely varied; and in two it was found to be practically absent. The remaining two cases, which proved fatal, showed persistent membrane and toxaemia at the time of death, and therefore the presence of an increase or decrease in the amount of complement has not been noted in this table.

-----  
 Extremely severe  
 Severe

Very severe  
 Severe

THE RELATION OF THE GREATEST AMOUNT OF COMPLEMENT OBSERVED IN EACH  
CASE DURING THE ACUTE STAGE TO THE SEVERITY OF THE ILLNESS

-----

This will be best seen from the subjoined table.

TABLE IV

-----

|           |    | Severity of attack as measured by extent of membrane and the toxaemia | The greatest amount of complement present in the acute stage of disease |       |
|-----------|----|-----------------------------------------------------------------------|-------------------------------------------------------------------------|-------|
| Group (a) | 1  | Severe                                                                | 10.00                                                                   | units |
|           | 2  | "                                                                     | 7.69                                                                    | "     |
|           | 3  | "                                                                     | 5.88                                                                    | "     |
|           | 4  | "                                                                     | 5.88                                                                    | "     |
|           | 5  | "                                                                     | 16.66                                                                   | "     |
|           | 6  | "                                                                     | 7.69                                                                    | " (a) |
|           | 7  | "                                                                     | 4.54                                                                    | "     |
|           | 8  | "                                                                     | 6.25                                                                    | "     |
|           | 9  | Very Severe                                                           | 4.54                                                                    | "     |
|           | 10 | Moderate                                                              | 5.55                                                                    | "     |
|           | 11 | Mild                                                                  | 9.09                                                                    | "     |
|           | 12 | Moderate                                                              | 0.                                                                      | "     |
|           | 13 | "                                                                     | 0.                                                                      | "     |
| Group (b) | 14 | Severe                                                                | 10.00                                                                   | "     |
|           | 15 | "                                                                     | 16.66                                                                   | "     |
|           | 16 | "                                                                     | 8.00                                                                    | "     |
|           | 17 | "                                                                     | 4.16                                                                    | " (b) |
|           | 18 | "                                                                     | 3.57                                                                    | "     |
|           | 19 | Extremely severe                                                      | 16.66                                                                   | "     |
|           | 20 | Severe                                                                | 6.25                                                                    | "     |
| Group (c) | 21 | Very severe                                                           | 20.00                                                                   | " (c) |
|           | 22 | Severe                                                                | 11.11                                                                   | "     |

28 It will be seen from this Table (IV), and from the summary of the clinical reports on each case included in the

appendix to Section C, that most of the cases of diphtheria included were of the severe type. In four instances only (Cases X, XI, XII and XIII) was the attack comparatively mild.

29           The former class of case may be subdivided according to whether the attack was severe or very severe, the latter including fatal cases.

30           In the first type of this subdivision the highest complement figures varied between 3.57 units and 16.66, and in the second type between 4.54 units and 20.00.

31           In the mild type the highest figure obtained in any case was 9.09 units, while in two it was almost zero.

32           From this it can be seen that the upper limit is highest in the very severe class, somewhat lower in the severe class, and lowest in the mild class.

33           This relation however is not definite enough in all cases to allow a conclusion to be drawn.

#### THE RELATION OF COMPLEMENT TO THE OCCURRENCE OF PARALYSIS -----

34           In three instances (Cases and Charts XIII, XVII, and XVIII) palatal paralysis of a mild type developed, and while it was present a single estimation of the complement

was made in each case.

35 It has already been observed, when these cases were considered with the others, that the amount of complement present in all was relatively small throughout the whole course of the illness; in one (Case XIII) it was practically absent until the fifth week (Paragraphs 16 and 19).

36 As far as the single examinations here indicate there was a slight decrease in the amount of complement at the period the paralysis occurred, but the evidence is incomplete.

37 The following table (Table V) shows the comparison between the greatest quantities of complement observed during the acute stage or convalescence and the amount present when paralysis occurred.

TABLE V

| Case | Amount of Complement present<br>at the time of paralysis | Greatest amount of Complement<br>present during acute stage<br>and convalescence |            |
|------|----------------------------------------------------------|----------------------------------------------------------------------------------|------------|
| 13   | 0.00 units                                               | 0.00 units                                                                       | 3.84 units |
| 17   | 3.33 "                                                   | 4.34 "                                                                           | 4.34 "     |
| 18   | 2.38 "                                                   | 3.57 "                                                                           | 5.00 "     |

THE AMOUNT OF COMPLEMENT PRESENT  
BEFORE AND AFTER THE ADMINISTRATION OF ANTI-DIPHTHERITIC SERUM  
-----

38 In ten cases (Cases and Charts IV, VI, VII, VIII, XI, XIV,<sup>\*</sup> XV, XVI, XVII and XIX) the amount of complement was observed before the administration of anti-diphtheritic serum and again within twenty four hours after, with the results which are given in the subjoined Table VI.

TABLE VI  
-----

| Case | Amount of antitoxin and<br>method of administration |                | Units of complement<br>before and after in-<br>jection |       | Interval<br>between ex-<br>aminations |
|------|-----------------------------------------------------|----------------|--------------------------------------------------------|-------|---------------------------------------|
|      |                                                     |                | Before                                                 | After |                                       |
| 4    | 14,000 units                                        | subcutaneously | 4.00                                                   | 5.88  | 24 hours                              |
| 6    | 10,000                                              | "              | 7.14                                                   | 7.69  | 16 "                                  |
| 7    | 6,000                                               | "              | 4.00                                                   | 4.54  | 14 "                                  |
| 8    | 10,000                                              | "              | 6.25                                                   | 5.71  | 24 "                                  |
| 11   | 8,000                                               | "              | 6.66                                                   | 9.09  | 12 "                                  |
| 14   | 8,000                                               | intravenously  | 10.00                                                  | 6.89  | 24 "                                  |
| *15  | 40,000                                              | subcutaneously | 16.66                                                  | 7.69  | " "                                   |
| 16   | 40,000                                              | "              | 8.00                                                   | 7.14  | " "                                   |
| 17   | 12,000                                              | intravenously  | 2.17                                                   | 2.17  | " "                                   |
| 19   | 22,000                                              | subcutaneously | 16.66                                                  | 7.69  | 12 "                                  |

39 An increase in the amount of complement was observed in four cases (Cases and Charts IV, VI, VII and XI) and a de-

<sup>\*</sup>In this case the first specimen of blood was withdrawn three hours after the administration of antitoxin

crease in five (Cases and Charts VIII, XIV, XV, XVI and XIX). In the remaining case (XVII), in which the amount of complement was small no change was observed.

40           The greatest increase observed was 2.43 complement units in one case (Case XI), and the smallest .54 in another (Case VII).

41           On the other hand the greatest decrease observed was 8.97 units in two cases (Cases and Charts XV and XIX), and the smallest .54 units in one case (Case and Chart VIII). This is shown in Table VII.

TABLE VII

| Cases showing decrease |                                        |                   |       |         | Cases showing increase |                                        |                   |       |         |
|------------------------|----------------------------------------|-------------------|-------|---------|------------------------|----------------------------------------|-------------------|-------|---------|
| -----                  |                                        |                   |       |         | -----                  |                                        |                   |       |         |
| Case                   | Extent of decrease in complement units | Dose of antitoxin |       |         | Case                   | Extent of increase in complement units | Dose of antitoxin |       |         |
| -----                  |                                        |                   |       |         | -----                  |                                        |                   |       |         |
| 8                      | .54                                    | 10,000            | units | subcut. | 4                      | 1.88                                   | 4,000             | units | subcut. |
| 14                     | 3.11                                   | 8,000             | "     | intrav. | 6                      | .55                                    | 10,000            | "     | "       |
| 15                     | 8.97                                   | 40,000            | "     | subcut. | 7                      | .54                                    | 6,000             | "     | "       |
| 16                     | .86                                    | 40,000            | "     | "       | 11                     | 2.43                                   | 8,000             | "     | "       |
| 19                     | 8.97                                   | 22,000            | "     | "       |                        |                                        |                   |       |         |
| -----                  |                                        |                   |       |         | -----                  |                                        |                   |       |         |

Case XVII  
Complement 2.17 before and after  
12,000 units of antitoxin intravenously

42           It is also to be noted that the greatest decrease in the amount of complement occurred in two cases (Cases XV and



XVI) in which 40,000 units and 20,000 units of antitoxin respectively were used.

43 Although the degree of diminution is not certainly proportional to the amount of antitoxin administered, yet there is a presumption that a greater diminution occurs after the injection of large amounts of serum.

#### COMPLEMENT AND SERUM RASHES

-----

Complement estimations were made during the occurrence of a serum rash in six cases (Cases and Charts IV, V, IX, XIII, XIV and XV). The results are included in the following table.

TABLE VIII

-----

|      |                                         |                                | Quantity of complement |                                   |
|------|-----------------------------------------|--------------------------------|------------------------|-----------------------------------|
| Case | Day of illness upon which rash appeared | and day of illness before rash | at time of rash        | and day of illness after the rash |
| 4    | 8th day                                 | No immediate observation made  | 3.70 units             | 2.63 units on 9th day             |
| 5    | 11th "                                  | " "                            | 4.76 "                 | No immediate observation made     |
| 9    | 10th "                                  | 4.34 units on 8th day          | No observation made    | " "                               |
| 13   | 11th "                                  | 0.00 " " 9th "                 | 0.00 units             | 0.00 units on 12th day            |
| 14   | 15th "                                  | No immediate observation made  | 3.57 "                 | 3.57 " " 16th day                 |
| 15   | 19th "                                  | " "                            | 6.25 "                 | No immediate observation made     |

44

These observations included in the above table are not extensive, but no marked disturbance in the amount of complement was noted in any, as can also be seen from an examination of the complement curve in the Charts.

... ..  
 ... ..  
 ... ..  
 ... ..

In the case of ~~.....~~ ...  
 ... ..  
 ... ..  
 ... ..  
 ... ..

On three cases of severe febrile ...  
 ... ..  
 ... ..  
 ... ..

The complement in the severe cases of  
 ... ..  
 ... ..  
 ... ..

SUMMARY OF THE RESULTS OBTAINED IN DIPHTHERIA  
-----

- 1           In seven cases of severe faucial diphtheria, there was a greater amount of complement present during the acute stage of the illness than during convalescence.
- 2           In three cases of faucial diphtheria, one of which was very severely and the other two moderately ill, complement was greater in amount during convalescence than during the acute stage of the illness.
- 3           In two cases of faucial diphtheria, both moderately ill, complement was practically absent during the acute stage in both, and only present in small amount during the convalescence in one.
- 4           In three cases of severe faucial and nasal diphtheria, a greater amount of complement was present during the acute stage of illness than during convalescence.
- 5           The complement in two severe cases of faucial and nasal diphtheria was small in amount during the whole illness, and more especially so during the acute stage than at any other time.
- 6           In two fatal cases of severe faucial and nasal diphtheria, one haemorrhagic, the complement content was relative-

ly great two days before death.

7           A large amount of complement was found during the acute stage of illness in two cases of laryngeal and tracheal diphtheria.

8           During the acute stage of illness in four cases, two of which were mild faucial, and two severe faucial and nasal in type, the amount of complement which was found present was below the normal.

9           A similar observation was made during convalescence in seven cases of severe faucial diphtheria; and in three cases of severe faucial and nasal diphtheria, the amount of complement was also below the average.

10           In thirteen of the cases of diphtheria investigated, the diminution in the amount of complement occurred during the period at which the throat was healing and the toxæmia disappearing.

11           In four others a varying degree of increase in the amount of complement was observed at this period.

12           The observations made during the occurrence of post-diphtheritic paralysis are insufficient, only single examinations being made in three cases. Complement was a little less in amount at this period than during the acute stage of the illness in two of the cases and less than the amount

present during convalescence in all.

- 13           The amount of complement shows a tendency to lessen in some instances within twenty-four hours after the administration of antitoxin, but this does not always occur. Although the degree of diminution is not definitely related to the amount of antitoxin administered, yet there is a tendency for a greater diminution to occur after the injection of a very large dose.
- 14           No variation in the amount of complement was observed during the presence of serum rashes.

## SECTION D - SCARLET FEVER

-----

1        These observations on the serum complement in scarlet fever have been carried out in the same way as that already described, with this difference, that in all the cases except four .5 c.c. of sensitized ox corpuscles were used instead of 1 c.c. This measure was adopted because of the occasional difficulty met with in obtaining sufficient blood from the younger patients, to yield a quantity of serum large enough for the series of test tubes containing 1 c.c. of sensitized ox corpuscles.

2        In recording and charting the results however, the reciprocal of twice the amount of serum, which was found to produce complete haemolysis of .5 c.c. of the sensitized ox corpuscles was taken to represent the amount of complement present, and in this way the results have been made comparable with those in the other sections.

3        Twenty-two cases have been investigated. These have been arranged in three groups according to the degree of severity of the illness:-

Group (a) Cases which were mildly or moderately ill.

Group (b) Cases which were severely ill

" (c) Cases which were very severely ill or fatal

#### GROUP (a)

-----

- 4        Six cases are included in this group (Cases and Charts I, II, III, IV, V, and VI). The degree and period of fever varied. The inflammatory condition of the throat was in no case severe, and none of the patients showed any marked prostration. In two of the cases (Cases I and V) the rash was faint, while in the others it was well marked.
  
- 5        No very definite variations in the amount of complement were observed in the cases which comprise this group either during the acute stage of the illness or during convalescence. In none of them was complement found to be markedly increased at any period of the disease, the amount of variation throughout being no greater than three complement units. This was present in three of the cases (Cases I, V, and VI), while in only one of these (Case I) was there a distinct diminution in the amount of complement during convalescence.
  
- 6        On the other hand, in two of the cases (Cases V and VI) an increase to the extent of three complement units occurred

between the end of the fever and the first ten days of convalescence.

GROUP (b)  
-----

- 7 This group of ten cases (Cases and Charts VII to XVI) comprises those in which considerable inflammation of the throat was present; and in which the degree of prostration was more or less severe. A well developed rash was present in each case. The period of fever varied between seven and fourteen days, and the highest temperature registered was between  $101^{\circ}$  F. and  $103.8^{\circ}$  F. All recovered.

The subjoined table contains the chief points in each case.

-----



TABLE I

| Case              | Day of illness<br>on admission | Period<br>of fever | Highest<br>temperat-<br>ure reg-<br>istered | Throat<br>condi-<br>tion | Complications                                                                                  |
|-------------------|--------------------------------|--------------------|---------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------|
| 7<br>Age 43 yrs.  | 5th                            | 10 days            | 102.8° F.                                   | Much in-<br>flamed       | Scarlatinal ar-<br>thritis on 10th<br>day of illness                                           |
| 8<br>Age 10 yrs.  | 3rd                            | 7 "                | 102.4 "                                     | "                        | None                                                                                           |
| 9<br>Age 12 yrs.  | 1st                            | 14 "               | 103.8 "                                     | "                        | Scarlatinal ar-<br>thritis on 12th<br>day of illness.<br>Tubercular dis-<br>ease of ilium.     |
| 10<br>Age 27 yrs. | 3rd                            | 10 "               | 102                                         | With ul-<br>ceration     | Peritonsillar<br>abscess 3rd week<br>of illness                                                |
| 11<br>Age 12 yrs. | 2nd                            | 6 "                | 102.8 "                                     | Much in-<br>flamed       | None                                                                                           |
| 12<br>Age 24 yrs. | "                              | 6 "                | 101.6 "                                     | "                        | Scarlatinal ar-<br>thritis on 7th<br>day. Chronic<br>nephritis and<br>albuminuric<br>retinitis |
| 13<br>Age 8 yrs.  | 3rd                            | 6 "                | 102.                                        | "                        | None                                                                                           |
| 14<br>Age 10 yrs  | 4th                            | 14 "               | 101.                                        | "                        | "                                                                                              |
| 15<br>Age 9 yrs.  | 3rd                            | 6 "                | 101.4 "                                     | "                        | "                                                                                              |
| 16<br>Age 5 yrs.  | "                              | 12 "               | 103.8 "                                     | "                        | "                                                                                              |

8           The amount of complement found present varied considerably in four of these cases; (Cases and Charts VII, VIII, IX, and X).

In the first (Case VII) in which eight observations were made, a steady diminution from 6.25 to 3.12 complement units occurred between the sixth and the twentieth days of illness, but on the thirtieth day, when the patient was perfectly well, complement was present to the extent of 8.33 units.

9           In the second (Case VIII), the smallest amount of complement observed, namely 2.94 units, was present on the tenth day of illness, three days after the temperature had become normal; and on the twentieth day, when convalescence was well established, an increase in amount to 7.14 units was observed. The amount was also small during the terminal part of the pyretic period.

10           In the third (Case IX), a case complicated by tubercular disease of the ilium, with suppuration from secondary pyogenic infection, an increase was observed on the twenty-sixth day after the commencement of scarlet fever.

11           In the fourth case (Case X) there was only a slight difference, of less than two complement units, between the first estimation made on the fourth day and the final estimation fifty-five days afterwards, when the patient was about to be

dismissed quite well.

The amount of complement fluctuated between 9.09 and 3.44 units during the period of fever, but on the eleventh day, one day after the temperature had reached normal, it was relatively small, representing 4.54 complement units.

12        It will thus be seen from the analysis of these four cases, that complement tended to diminish towards the end of the pyrexia and to increase during convalescence.

13        In two other cases (Cases XI and XII) somewhat similar differences to those just mentioned were observed, though not so markedly.

During the acute stage of the illness in the first of these a fluctuation between 3.57 units and 7.09 was observed. At the end of the fever the amount again decreased, to 4.16. The result of the final observation was practically the same, though the complement was slightly increased.

During convalescence in the second case a slight but steady increase was also noted, but again the differences were too slight to warrant a definite opinion.

14        Of the remaining four cases of this Group (Cases and Charts XIII, XIV, XV and XVI) one (Case XVI) showed a comparatively small decrease in the amount of complement during convalescence. In a second case (Case XIII) except for a

slight increase of less than two units on the fourth day of convalescence, complement, as far as the observations show, remained practically unaltered throughout the whole period of the patient's residence in hospital.

In a third case (Case XIV) a considerable diminution of complement was observed two days before the end of the fever. A very slight increase was however present a week later.

In the remaining case (Case XV) only two estimations were possible. Both were made during the febrile period, and the complement was found on both occasions to be a little greater than normal.

15 From a review of the cases of Group (b) no definite opinion can be expressed regarding the behaviour of the serum complement.

The most outstanding feature of five of the cases was an increase in the amount of complement during some period of convalescence; and during the pyrexia, also in five cases, the average trend of the fluctuations observed was towards a diminution in the amount of complement.

#### GROUP (c)

-----

16 This group comprises six cases (Cases and Charts XVII, XVIII, XIX, XX, XXI and XXII) three of which died (Cases XX,

XXI, and XXII).

The following table contains the chief points in these cases.

TABLE II

| Case               | Day of illness on admission | Period of fever | Highest temperature registered | Condition of throat                      | Complications                                               | Result   |
|--------------------|-----------------------------|-----------------|--------------------------------|------------------------------------------|-------------------------------------------------------------|----------|
| 17<br>Age 6 yrs.   | 3rd day                     | 13 days         | 104° F.                        | Much inflamed and ulcerated. Septic type | Relapse of Diphtheria on the 7th day of scarlet fever       | Recovery |
| 18<br>Age 6 yrs.   | 3rd "                       | 37 "            | 105 "                          | Much inflamed and ulcerated. Septic type | Suppurative parotitis on 9th day. Empyema on 12th day       | "        |
| *19<br>Age 9½ yrs. | -                           | -               | 105 "                          | -                                        | Scarlatinal nephritis on 18th day and pneumonia on 20th day | "        |
| 20<br>Age 4 yrs.   | 2nd day                     | 12 days         | 104.8 "                        | -                                        | Scarlatinal nephritis on 17th day                           | Death    |
| 21<br>Age 1½ yrs.  | 5th "                       | 7 "             | 103 "                          | Extensively ulcerated (malignant)        | -                                                           | "        |
| 22<br>Age 2 yrs.   | 2nd "                       | 6 "             | 104.4 "                        | Extensively ulcerated (malignant)        | -                                                           | "        |

\* This case only came under observation at the time the complications occurred

17        The first case of this Group (Case XVII) was of a septic type. The patient was convalescing from diphtheria when scarlet fever began. During the first seven days of the latter illness the patient was extremely ill; a bright rash was present; the throat was extensively ulcerated; the cervical glands were much swollen, and there was profuse nasal discharge. The temperature fluctuated between  $100.6^{\circ}$  F. and  $103.8^{\circ}$  F., and the pulse rate between 114 and 148 per minute. Antistreptococcic serum, in doses of 10 c.c. was given per rectum six hourly during the fourth, fifth, and sixth days of illness. A relapse of the diphtheria occurred on the seventh day, and 8,000 units of anti-diphtheritic serum were administered subcutaneously. From that time onwards the patient improved, and ultimately recovered.

18        Between the fifth and seventh days the amount of complement diminished from 8.33 to 2.38 units, and from the latter period onwards a steady increase was observed, until the figure 4.76 was reached on the thirtieth day of illness.

      The Complement curve obtained in this instance conforms to a certain extent to that just described in connection with five cases of the preceding Group (b) paragraph 15.

19        As this was the only case in which observations were made during the period of administration of anti-streptococcic serum, no opinion can be expressed regarding the causal

agency of the latter in bringing about a change in the amount of complement present in scarlet fever.

- 20 In the second case (Case XVIII) also of a septic type, which was complicated by suppurative parotitis on the ninth day of illness and by empyema on the twelfth day, complement was practically absent during the periods at which observations were possible, except for a small amount observed on the ninth day of illness, when 2.00 units were present.

During all this time the patient emaciated very markedly and when the final observation was made on the thirty-first day he was still very ill.

- 21 The almost complete absence of complement in this case cannot be ascribed to its fixation by immune substances, the presence of which was negatived by the clinical evidence, and although no opinion was expressed when a similar observation was made in two cases of diphtheria (paragraph 16, Section c), yet in this instance the phenomenon seemed to be due to a failure in the production of complement itself.

#### SCARLATINAL NEPHRITIS

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- 22 In the two cases which were complicated by scarlatinal nephritis (Cases and Charts XIX and XX) complement was practically absent in one (Case XIX) and very markedly deficient

in the other (Case XX). Death occurred in the latter case. Complement, at the time of death, was found present to the extent of 4.00 units. In the former case .46 c.c. of serum only produced slight haemolysis of .5 c.c. of the sensitized ox corpuscles

23           Somewhat similar results were obtained by an independent observer in this hospital in other two cases of scarlatinal nephritis, the records of which are as follows:-

(Case A) In this case, at a period when the patient, a child, was very ill, and the urine markedly suppressed, .37 c.c. of the serum was required to produce complete haemolysis of 1 c.c. of sensitized ox corpuscles, which gives the reciprocal 2.70 complement units.

(Case B) In this case also the illness was very acute. Extensive oedema was present, and the urine contained much blood and albumen.

The result of the observations made at this period showed that .34 c.c. of the patient's serum produced practically no haemolysis. No greater amount of serum was used. A second observation was made some time later, when the oedema had almost gone, and the albumen and blood were diminished. On this occasion 4 c.c. of the patient's serum was found to produce distinct but not nearly complete haemolysis.



24

The results of these investigations in scarlatinal nephritis agree with those obtained by Longcope,<sup>(1)</sup> whose investigations on the complement content in certain cases of uraemia following chronic nephritis were carried out by a bacteriolytic method.

No explanation can be given for this marked reduction of the complement content of the serum of these cases of scarlatinal nephritis.

The effect of urea on the haemolytic property of an active serum was observed.

To 3 c.c. of fresh guinea pig's serum .25 gms. of urea was added, and this mixture was allowed to stand at room temperature for one hour.

The minimum haemolytic dose of the untreated guinea pig's serum for 1 c.c. sensitized ox corpuscles was .015 c.c.

A similar result was obtained with the same serum after treatment with urea.

25

In both the final cases of this Group (Cases and Charts XXI and XXII), which were of a malignant type of scarlet fever, only one examination was possible before death occurred. Complement was present to the extent of 16.66 units in the first on the day preceding death, and to the extent of 8.00 units in the second on the day of death.

26

This observation is in accord with the results already

referred to in some of the fatal cases of enteric fever, erysipelas and diphtheria.

SUMMARY OF THE RESULTS OBTAINED IN SCARLET FEVER  
-----

- 1        In six mild cases of scarlet fever no very definite type of variation in the amount of complement was observed. A diminution however, though relatively small, occurred in one case, and an increase in two cases during convalescence. Complement in the other three cases was nearly constant in amount throughout the illness and convalescence.
- 2        In ten cases of a more severe type of scarlet fever a diminution in the complement content occurred during the period of pyrexia, and a subsequent increase during convalescence was observed in four, and in two a somewhat similar though less well marked variation occurred. Of the remaining four cases, one showed a decrease in the amount of complement at the end of the pyrexia and a very slight increase during the first week of convalescence; the second a small diminution during convalescence; and in the other two complement remained practically unchanged in amount.
- 3        No definite conclusion can be drawn from these results, although there seems to be a tendency for the amount of complement to diminish towards the end of the fever and to increase during convalescence.

- 4            In a septic case of scarlet fever, complicated by diphtheria, complement diminished in amount during the first seven days, and increased during the remaining five days of the fever and during convalescence.
- 5            In another septic case, complicated by suppurative parotitis and empyema, complement was almost absent during the whole period of illness. No observations were possible during convalescence, which was very prolonged.
- 6            In four cases of scarlatinal nephritis complement was almost absent, or only present in very small amount.
- 7            In two fatal cases of malignant scarlet fever a large amount of complement was present at the time of death.
-

## SECTION E - MEASLES

-----

- 1        Observations on the amount of complement present during the course of measles were carried out in six adults.
- 2        All the patients were sharply ill, the catarrhal symptoms and the distribution and characters of the eruption being typical in each. The duration of the illness varied between five and ten days, and no complications occurred in any of the cases.
- 3        In one case (Case and Chart I) variations in the amount of complement were observed, but in the others (Cases and Charts II to VI) there were no notable fluctuations.
- 4        The first patient was sharply ill, and the temperature, which varied between 99° F. and 103° F., became normal on the fifth day of the attack. Between the fourth and sixth days of illness there was an increase in the amount of complement from 6.66 units to 12.50, which was followed two days later by a diminution to 5.88 units; thereafter very little variation was observed, the amount present at the final examination being 5.55 units. In the second case a diminution from 5.88 units to 3.57 was observed between the

sixth day, on which the fever ended, and the eighteenth day of illness.

In the third case an even smaller decrease was observed between the ninth and the nineteenth days of illness.

Practically no variations were observed in the remaining three cases (Cases and Charts IV, V and VI). In one of these the complement figure remained only a little above 3 units, while in the others it was a little higher than normal, being between 4 units and 6.

- 5        These observations only show that complement is present in slightly varying quantities in the serum of adults suffering from measles, and that such variations as do occur have not been proved to follow any definite rule.

## SECTION F

- (a) Typhus fever and
  - (b) Lobar pneumonia
- 

TYPHUS FEVER  
-----

- 1        Only three cases of this disease came under observation, two during the acute stage and the third when the temperature had reached normal and the typical appearances had almost gone. Two of the cases recovered and one died.
- 2        In the first case (Case and Chart I), in which six observations were made, complement was found to be smaller in amount during the fever than during convalescence.
- 3        In the second case (Case and Chart II) a somewhat similar behaviour of the complement was observed, but in this case the first examination was only made when the temperature had newly reached normal.
- 4        In the third case (Case and Chart III) a more complete series of observations was possible. The complement content was relatively small, though slightly above normal, during the acute stage of the fever, but after the fourteenth day

of the patient's illness, when the crisis had occurred, it increased in quantity, and it continued doing so until death ensued on the thirtieth day. This patient had recovered from the attack of typhus fever, and death was due to a secondary pyogenic infection of the urinary tract, which condition was also present during the fever.

- 5           The results obtained in the two complete cases (Cases I and III) indicate that there may be no definite variations in the amount of complement during the pyretic period. That there may be a certain amount of increase during convalescence is shown by the course of the complement curve obtained in these two cases.

Further observations are necessary before a definite opinion can be expressed on the subject.

- 6           The amount of complement present in the fatal case prior to death is in accord with some of the results already noted in connection with fatal cases in the previous sections.
-



LOBAR PNEUMONIA  
-----

1        Observations were made on the quantitative variations of the complement content in four cases of Lobar Pneumonia.

2        The first case (Case and Chart I), a boy aged 13 years, was admitted to hospital on the third day of illness. The left lower lobe was completely involved. The temperature remained between  $103^{\circ}$  F. and  $104^{\circ}$  F. until the fifth day of illness, and reached normal by crisis on the seventh. During the illness the respirations varied between 28 and 36, and the pulse rate between 108 and 128 per minute.

3        On the fourth day of illness there were 5.88 units of complement present in the serum, and on the ninth day, two days after the crisis, an almost similar quantity was observed, namely 5.55 units. A diminution to 3.84 units occurred during convalescence.

4        Three observations were made in the second case (Case and Chart II) in which a very notable diminution in the amount of complement occurred between the fifth and the twenty-third days of illness.

The whole of the right lower lobe in this patient was affected. The pyrexia fluctuated between  $100^{\circ}$  F. and  $103^{\circ}$  F., and terminated by crisis on the seventh day.

Convalescence was only interrupted, during the twenty-fifth and twenty-sixth days, by the occurrence of tonsillitis

5       The first examination of the patient's serum was made on the fifth day of illness, when 12.50 units of complement were found present; the second on the twelfth day, at which period there was a diminution to 6.25 units, and the last on the twenty-fifth day when a further diminution to 4.76 units was observed.

6       In the third case of pneumonia (Case and Chart III) three observations were made.

The amount of complement present was relatively small throughout, being 4.76 units on the fourth day of illness, 3.70 units on the eighth, and 3.57 units on the twelfth. A diminution, though slight, occurred between the acute stage of the illness and convalescence. This patient was admitted on the fourth day of illness, supposed to be suffering from cerebro-spinal meningitis because of the delirium which was present. The cerebro-spinal fluid was normal. The greater part of the left lung was affected. The temperature was  $103^{\circ}$  on the fourth day of illness, falling to  $100.8^{\circ}$  on the following evening, and reaching normal by crisis on the seventh day. The respirations were about 36 during the acute stage of the illness, and the pulse rate varied between 102 and 118 per minute at this period.

- 7        The fourth case of pneumonia (Case and Chart IV), in which seventeen observations were made, differs very markedly from the preceding three with regard both to the clinical course of the illness and to the variations in the complement content of the serum.
- 8        The attack of pneumonia was extremely severe, and continued for ten days, during which period practically the whole of the left lung became involved. The patient was sharply ill during the first seven days of the illness, and from this date until the ninth day he was delirious, and seemed as if he were about to die. The respirations during the former period steadily increased from 28 to 36 per minute, and as the patient became rapidly worse they increased to 56. The pulse rate also increased, from 132 to 144. The temperature showed a fall from  $104.2^{\circ}$  F. to  $102.6^{\circ}$  F. within the first three days of the patient's residence in hospital, but with the exacerbation of the symptoms and spread of the pneumonic process it again rose, to  $104.6^{\circ}$  F. on the eighth day of illness. A rapid improvement was observed on the ninth day, and the attack terminated on the tenth day by a typical crisis.
- 9        During the sixth, seventh and eighth days of illness the amount of complement steadily diminished from 7.14 units to 4.76, the latter being observed when the symptoms were most

urgent. On the ninth day it increased to 6.66, and it again decreased to 5.12 on the day of the crisis.

10           The pneumonia resolved after this, and the patient's condition improved until the sixteenth day of illness, although the temperature, pulse and respirations remained above normal.

11           During this period the amount of complement steadily increased from the 5.12 units already mentioned to 10 units. There was no apparent reason for the unsettled condition of the temperature, pulse and respirations, though pleurisy was suspected. On the sixteenth day definite symptoms of this were observed. These were accompanied by a large effusion into the left pleural sac, which was aspirated on the twenty-ninth day, twenty-three ounces of fluid being removed.

From that period until the forty-seventh day convalescence from the pleurisy was satisfactory, but even at that time the chest was not clear.

The temperature varied considerably at times, between 99° F. and 101.6° F., and the pulse and respirations continued above normal.

12           The amount of complement during the period at which the pleurisy with effusion was present remained increased, being 11.11, 7.14, 9.09 and 7.69 units on the nineteenth,

twenty-fifth, thirty-first, and forty-fourth days of illness respectively.

13        The case was further complicated by the occurrence of a sharp attack of scarlet fever on the forty-eighth day, which continued for six days, the highest temperature,  $104.6^{\circ}$  F., being registered on the second day of this illness. The angina was severe and the rash very bright. The temperature reached normal on the sixth day by a steady lysis, which began on the second day of the attack.

14        Three observations were made regarding the amount of complement present during the scarlet fever period. On the first day the amount present was 7.69 units; on the fourth, 5.88 units; and on the tenth, four days after the termination of the attack, 7.14 units.

The variation therefore during the scarlet fever was comparatively slight, which observation agrees with some of the results already discussed in Section D.

15        A final observation, made on the eighty-fifth day after the onset of the initial pneumonia, when the patient was perfectly well, showed a diminution in the amount of complement to 4.76 units, which is the normal mean.

At no time then, even when the patient was extremely ill, was the amount of complement less than normal.

16

The results in uncomplicated pneumonia indicate that complement was present in greater amount during the acute stage of the illness than during the period of convalescence. In a case complicated by pleurisy and subsequently by Scarlet fever, an increase occurred during the onset of the former and continued until convalescence was established, when the amount present was normal.

## NOTE ON THE SERUM TREATMENT OF CEREBRO-SPINAL MENINGITIS

-----

1           During the past few years cerebro-spinal meningitis has become more and more sporadic and the number of cases admitted annually to this hospital has been comparatively small. There have been no cases during the past seven months, and within the last two years it has been exceptional to find a convalescent and an acute case in the hospital together. In consequence, the treatment of sporadic cases has been modified and the following pages contain a record of ten cases, eight of which were meningococcic in nature and two pneumococcal. As is well known, Mackenzie and Martin<sup>(1)</sup> during the epidemic period of cerebro-spinal meningitis made extensive observations on the cerebro-spinal fluid and serum of cases of this disease. They found that the former was practically wanting in complement and bactericidal substances, but that the latter in convalescent cases had strong bactericidal properties. This was also observed to a less well marked degree in normal human serum and that of cases acutely ill from the disease.

2           Similar results regarding complement in the cerebro spinal fluid of patients who have come under observation dur-

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(1) Journal Path. and Bact., Vol. XII, 1908 p. 539

ing the present post epidemic period have been obtained by the writer. For example, 2 c.c. of the cerebro-spinal fluid from Case V, to be described, only produced slight haemolysis of 1 c.c. of sensitized ox corpuscles. Other observations gave similar results. As a result of their investigations, Mackenzie and Martin adopted a treatment of epidemic cerebro-spinal meningitis with intraspinal injections of the serum of patients recently convalescent from this disease. Other patients were treated with their own serum, and both methods were successful.

3       As already mentioned, the facilities for these methods of treatment do not exist at present owing firstly to the fact that a convalescent patient is rarely in hospital along with an acute case, and secondly to the age of some of the patients, which makes bleeding to a sufficient extent quite impracticable.

4       Consequently, a modification in the method has been employed in the treatment of the sporadic cases.

5       The anti-meningococcic serum of Flexner has been used in four cases, and the polyvalent anti-meningococcic serum issued from the Lister Institute by Allen and Hanbury in three. One other chronic case was treated with his own serum. On account of the absence of complement from the cerebro-spinal fluid the anti-meningococcic serum has been



reactivated at the time of each injection by the addition to it of fresh normal human serum, a healthy individual always being selected to supply the latter. Of the four cases treated with Flexner's serum, obtained from New York, three recovered and one died. The three cases, all of the chronic type, treated with the Lister Institute serum died.

6        The patient treated with his own serum, also a chronic case, recovered after a prolonged illness.

7        It may be noted here, although a record is also given along with the summary of the clinical reports of the cases, that owing to the absence of progress made in three of the fatal cases, fresh guinea-pigs serum was substituted for the human serum without making any apparent difference, and certainly no ill effects were observed.

#### TECHNIQUE

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8        Ten cubic centimeters of blood were withdrawn from the median basilic vein of a healthy individual and allowed to stand for a few hours until the serum had separated. This quantity of blood yielded about 5 c.c. of serum in four hours; separation was hastened in some instances by placing the blood in an incubator at 37° C.

9           The serum was then added to the amount of anti-meningococcal serum which was to be injected. The dosage varied with the age of the patients.

10           Lumbar puncture was then performed, and a quantity of cerebro-spinal fluid, a little in excess of the volume of the serum to be injected, was removed.

11           The subdural injections have always been performed with the patient under a general anaesthetic, but not deeply so. The serum was heated to 98° F. before being injected. The injection was made slowly and after it was completed the foot of the patient's bed was elevated for an hour to allow the serum to gravitate throughout the cerebro-spinal system.

12           Severe headache and backache were complained of in some cases, and practically all of them were restless for some hours afterwards. The breathing was sometimes observed to become shallow for a short time but no other untoward results were noted. The injections were repeated at intervals of one, two, three or four days and sometimes longer, depending upon the stage of the disease, the character of the cerebro-spinal fluid, and the clinical appearances of the patients.

13           The quantity of the growth of the meningococcus obtained from a loopful of the deposit yielded by centrifugal-

izing 10 c.c. of the cerebro-spinal fluid was also taken as an index of the progress of the patient, and also as a guide to the frequency of the injections. Thus as the fluid cleared and the colonies became more scanty the interval between the injections was lengthened.

14 In favourable cases two or three doses sufficed.

15 In the record of Case IV a complete account is given of the treatment by the patient's own serum. This was a chronic case and the recovery is all the more worthy of note.

16 The diagnosis in all these cases was confirmed by the presence of the meningococcus in the cerebro-spinal fluid and by cultures made from the latter on serum agar, the latter being prepared by smearing the surface of an agar slope with a few drops of fresh human serum which had been heated to 57° C. for one hour.

17 Two cases of pneumococcal meningitis were treated on the same principle as the other cases but both died. Anti-pneumococcal serum combined with fresh complement was used in these two cases without effect.

18 The following is a table of the cases of meningococcal meningitis treated:-

-----

| Case  | Age      | Type of case and<br>period of fever | Result                     |
|-------|----------|-------------------------------------|----------------------------|
| 1     | 6½ years | Acute - 14 days                     | Complete recovery          |
| 2     | 5 "      | " 7 "                               | Recovery - totally<br>deaf |
| 3     | 8 months | " 14 "                              | Complete recovery          |
| (1) 4 | 15 years | Chronic - 45 "                      | "                          |
| 5     | 5 months | " 14 "                              | Death                      |
| (2) 6 | 6 years  | " 23 "                              | "                          |
| (2) 7 | 8 months | " 44 "                              | "                          |
| (2) 8 | 2 years  | " 28 "                              | "                          |

(1) Treated with his own serum

(2) Treated with Allen and Hanbury (Lister Institute) Anti-meningococcic serum

The others were treated with Flexner's serum.

SUMMARY OF THE CLINICAL REPORTS  
ON THE CASES OF CEREBRO-SPINAL MENINGITIS

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CASE 1: H. McA., Age 6½ years

Admitted on the fifth day of illness.

Onset with severe headache and vomiting.

Delirium on the second day of illness.

Symptoms typical; squint, retraction of head, rigidity of limbs, and hypersensitiveness of skin. Petechiae over the body. Herpes on back of hand. Deafness between the eighth and twelfth days. C.S. fluid turbid. Meningococci abundant. Many of the organisms extracellular. Exudate polymorphonuclear.

Temperature varied between 101° F. and 104° F. until the eleventh day of illness and reached normal by crisis on the twelfth. It afterwards varied between normal and 99° F. until the thirtieth day of illness.

The patient made a complete recovery.

TREATMENT:

- 15 c.c. Flexner's serum + 5 c.c. fresh human serum on the sixth day
- 25 c.c. Flexner's serum + 5 c.c. fresh human serum on the ninth day
- 25 c.c. Flexner's serum + 5 c.c. " " " " twelfth day

**CASE 2: B. R., Age 5 years**

Admitted on the sixth day of illness.

Onset with sickness and vomiting, and pain in the head and back.

Symptoms of meningitis typical.

Retraction of head, rigidity of muscles of neck. Well marked Kernig's sign. Squint, reaction of pupils normal.

C.S. fluid turbid. Meningococci present; chiefly intracellular. Exudate polymorpho-nuclear with many lymphocytes. On the eighth day the fluid was opalescent and only a fine cobweb coagulum separated out from it. Several films were stained for tubercle bacilli and in one a few acid-fast bacilli with the morphological characters of tubercle bacilli were observed.

On the twelfth day the C.S. fluid was still opalescent and the exudate almost entirely lymphocytic. No organisms could be found. A guinea pig, which was inoculated with 2 c.c. of this specimen, showed no evidence of tubercular disease four weeks later. The patient recovered but was quite deaf.

**TREATMENT:**

|    |      |                 |   |   |      |                   |            |
|----|------|-----------------|---|---|------|-------------------|------------|
| 15 | c.c. | Flexner's serum | + | 5 | c.c. | fresh human serum | on 7th day |
| 15 | "    | "               | " | + | "    | "                 | "10th "    |
| 15 | "    | "               | " | + | "    | "                 | 12th "     |

## CASE 3: M. S., Age 8 months

Admitted to hospital on the thirteenth day of illness.

Illness began with vomiting.

Symptoms of meningitis fairly typical.

Head a little retracted, knees drawn up, Kernig's sign present.

C.S. fluid opalescent. Exudate polymorpho-nuclear. Large number of lymphocytes also present. Meningococci abundant.

Fever in this case ended by crisis on the fourteenth day of illness, and the symptoms of meningitis disappeared by the twentieth day.

The child recovered completely.

## TREATMENT:

15 c.c. Flexner's serum + 4 c.c. fresh human serum on 13th day

15 " " " + 4 " " " " 16th "

15 " " " + 4 " " " " 19th "

## CASE 4: A. McG., Age 15½ years

Patient admitted to hospital on the tenth day of illness.

Symptoms and signs of cerebro-spinal meningitis typical

Meningococci present in the C.S. fluid.

Fever varied between 100° F. and 103° F. until the thirtieth day of illness, and during this period the patient emaciated to an extreme degree without abatement of the meningitis. The C.S. fluid at the end of this time was turbid and meningococci, though scanty, were present.

## CASE 4 (Contd.)

The patient came under the writer's observation at this time.

Previously to this no serum treatment had been adopted.

On the thirty-third day venesection was performed, and 70 c.c. of blood obtained.

20 c.c. of the serum from this were injected subdurally next day, and the remainder, 15 c.c., on the thirty-second <sup>next</sup> day. Considerable improvement was observed a few days afterwards. Venesection was repeated on the forty-second day, and 20 c.c. of serum obtained from the blood were injected subdurally next day.

The patient continued to improve until the sixty-fifth day when he had what appeared to be a recrudescence of the meningitis although the cerebro-spinal fluid remained clear. This lasted for ten days. It was never severe, and no further serum treatment was adopted.

The patient ultimately recovered completely without showing any sequelae.

## CASE 5: F. McL., Age 5 months

Admitted to hospital on the fifth day of illness.

Very poorly nourished, only weighing about seven pounds.

Symptoms of meningitis typical.

Cerebro spinal fluid turbid.

Abundant meningococci present. Exudate chiefly polymorpho-nuclear.



## CASE 5 (Contd.)

The illness lasted thirty days when death occurred.

The temperature varied between normal and 102° F. until the twenty-third day. Hydrocephalus developed during the course of the illness and this seemed to be the cause of death. At this time the child only weighed six pounds.

## TREATMENT:

|    |      |           |       |   |   |      |       |       |       |    |      |     |
|----|------|-----------|-------|---|---|------|-------|-------|-------|----|------|-----|
| 4  | c.c. | Flexner's | serum | - | 2 | c.c. | fresh | human | serum | on | 5th  | day |
| 12 | "    | "         | "     | - | 3 | "    | "     | "     | "     | "  | 9th  | "   |
| 15 | "    | "         | "     | - | 3 | "    | "     | "     | "     | "  | 11th | "   |
| 12 | "    | "         | "     | - | 4 | "    | "     | "     | "     | "  | 15th | "   |
| 12 | "    | "         | "     | - | 3 | "    | "     | "     | "     | "  | 19th | "   |
| 12 | "    | "         | "     | - | 4 | "    | "     | "     | "     | "  | 25th | "   |

Lumbar puncture was performed frequently to relieve the intracranial pressure, but the effect was only of short duration.

As the disease advanced the cerebro-spinal fluid was observed to become gradually less turbid and the organisms much reduced in number, as judged from the appearance of films and the number of colonies grown on serum agar, although at no time were they completely absent.

P.M. Examination: Lateral ventricles very much dilated.

Thick green pus in the right. Convolutions of the brain markedly flattened. Base of brain and cord covered with thick inflammatory exudate.

## CASE 5 (Contd.)

The right kidney showed extensive necrosis of the cortex.

The necrotic areas were yellow and opaque, with considerable congestion at the margins. Thrombi were found in some of the renal vessels, which condition appeared to be marantic in origin.

## CASE 6: A. McO., Age 6 years

Admitted to hospital on the sixth day of illness.

Symptoms of meningitis typical.

Head markedly retracted. Rigidity of muscles of neck, back, and legs. Skin hypersensitive. Right ear covered with an herpetic eruption. Respirations shallow and quiet. Kernig's sign present to a marked degree.

Cerebro-spinal fluid turbid. Considerable fibrinous coagulum separated out after fluid had stood for an hour. Exudate polymorpho-nuclear. Meningococci abundant. Hydrocephalus developed about the thirtieth day. Death occurred on the fortieth day. The temperature varied considerably during the whole period of illness.

## TREATMENT:

Subdural injections of 20 c.c. of anti-meningococcic serum (Allen and Hanbury, Lister Institute) plus 4 c.c. fresh human serum on the sixth, eighth, tenth and thirteenth days without effect. Similar injections were repeated on the nineteenth and thirty-first days with 4 c.c. of fresh

## CASE 6 (Contd.)

guinea pig's serum substituted for human serum, also without effect.

No post mortem examination.

## CASE 7: G. B., Age 8 months

Well nourished child. Admitted on tenth day of illness.

Frequent convulsions.

Symptoms of meningitis fairly typical.

Cerebro-spinal fluid opalescent.

Meningococci abundant, chiefly extracellular. Condition steadily grew worse and death occurred on the forty-fourth day. Temperature fluctuated between normal and 104° F. during the illness.

## TREATMENT:

Subdural injections of 10 c.c. of anti-meningococcic serum (Allen and Hanbury, Lister Institute) plus 4 c.c. fresh guinea pig's serum, on the eleventh and fourteenth days without effect.

On the twenty-eighth, thirty-third and thirty-eighth days, subdural injections of 6 c.c. of Flexner's serum plus 4 c.c. fresh human serum were given, also without effect.

No post-mortem examination.

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CASE 8: J. H., Age 2 years

Admitted on the sixth day of illness.

Symptoms of cerebro-spinal meningitis typical. Retraction of head not very marked. Considerable rigidity of the muscles of the neck. Kernig's sign present. Squint. Pupils sluggish.

Cerebro-spinal fluid opalescent.

Meningococci abundant.

Illness lasted twenty-eight days when death occurred. Temperature during the first four days of illness gradually fell to normal, but from that time onwards it fluctuated between  $101^{\circ}$  F. and  $104^{\circ}$  F., and finally reached  $105.8^{\circ}$  F.

#### TREATMENT:

On the sixth, eighth and eleventh days, subdural injections of 20 c.c. antimeningococcic serum (Allen and Hanbury, Lister Institute), plus 5 c.c. fresh human serum were administered, but without effect.

On the seventeenth day a similar injection was given, substituting fresh guinea pig's serum for human serum, also without effect.

No Post Mortem examination.

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TWO CASES OF PNEUMOCOCCAL MENINGITIS  
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## CASE 9: H. W., Age 16 years

Admitted on the fifth day of illness.

Extremely ill. Unconscious. Delirious. Marked symptoms of meningitis.

C.S. fluid turbid; turbidity chiefly due to the extreme abundance of pneumococci.

Death occurred on the eighth day.

## TREATMENT:

Subdural injections of 25 c.c. antipneumococcic serum, (Meister, Lucius and Bruning) plus 5 c.c. fresh human serum on the fifth and seventh days without effect.

P.M. Examination: Whole of brain and cord covered with thick pus. No primary lesion found in ears, lungs or heart.

## CASE 10: D. C., Age 4½ years

Admitted on the fifth day of illness. Extremely ill.

Delirious and unconscious. Symptoms of meningitis typical.

Fluid turbid. Turbidity almost entirely due to the presence of pneumococci.

Death occurred on the eighth day of illness.

## CASE 10 (Contd.)

Two subdural injections of 25 c.c. anti-pneumococcic serum (Meister, Lucius and Bruning) plus 5 c.c. of fresh human serum were given on the fifth and seventh days of illness. On the sixth day, 25 c.c. of the antipneumococcic serum were administered subcutaneously. No effect was noted after any of the injections.

P.M. Examination: Vessels of the meninges deeply congested.

Surface of the brain pink in colour.

Thick purulent exudate in all the sulci, most marked at the base and over the surface of the cerebellum. Cord also thickly coated with exudate.

All other viscera seemed healthy.

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## APPENDIX A

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Summary of the Clinical Reports on the Cases of Enteric Fever, together with the Results of the Series of Complement Estimations in each Case

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808

## SUMMARY OF THE CLINICAL HISTORIES OF THE CASES OF ENTERIC FEVER

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## CASE 1: W. C., Age 23 years

Admitted on the 18th day of illness. Severely ill.

Most prostrate between 8th and 20th days of illness. Steady improvement after temperature became more remittent.

Fever lasted approximately 28 days.

Convalescence uninterrupted. Patient rapidly gained in weight.

Urine gave positive diazo-reaction during the fever.

Widal reaction positive.

B. typhosus grown from blood.

## CASE 2: Mrs T., Age 28 years

Admitted on 10th day of illness. Severely ill.

The fever ran a typical course and ended on the 28th day.

Steady improvement during the third week.

Convalescence uninterrupted.

Widal reaction positive.

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The Cases are numbered according to the order in which they have been discussed



| Case  | Day of illness | S        | Complement |
|-------|----------------|----------|------------|
| 1     | 11th           | .1 c.c.  | 10.00      |
|       | 15th           | .11 "    | 9.09       |
|       | 32nd           | .13 "    | 7.69       |
|       | 42nd           | .23 "    | 4.34       |
|       | 63rd           | .28 "    | 3.57       |
| ----- |                |          |            |
| 2     | 12th           | .12 c.c. | 8.33       |
|       | 29th           | .18 "    | 5.55       |
|       | 37th           | .28 " +  | 3.75 -     |
|       | 47th           | .26 "    | 3.84       |
|       | 64th           | .28 " +  | 3.57 -     |

S = Amount of patient's serum required to produce complete haemolysis of 1 c.c. sensitized ox corpuscles

Complement - Represented by the reciprocal of the amount of the patient's serum required to produce complete haemolysis of 1 c.c. sensitized ox corpuscles. The figure 1 has been taken as the complement unit

**CASE 3: Mrs E., Age 31 years**

Duration of illness before patient's admission indefinite;  
probably 18 days. Severely ill.

Semi-conscious and very prostrate. Muttering delirium.

Condition improved a few days later. Fever terminated about  
the 28th day. Good recovery.

Urine gave positive diazo-reaction. Widal reaction positive.

**CASE 4: J. R., Age 15 years**

Admitted on the 14th day of illness. Moderately ill.

The symptoms and clinical appearances were typical.

Fever lasted 22 days.

Urine: negative diazo-reaction.

Widal reaction positive.

Convalescence uninterrupted.

**CASE 5: S. R., Age 13 years**

Admitted on the 12th day of illness. Severely ill.

Appearances of enteric fever typical. Eruption of rose  
spots. Tongue swollen and dry. Spleen much enlarged.

Fever lasted 23 days.

Improvement began about the 18th day and progress from that  
time until completion of convalescence was uninterrupted.

Urine gave positive diazo-reaction. Widal reaction positive.

B. typhosus grown from faeces.

| Case | Day of illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|   |      |          |      |
|---|------|----------|------|
| 3 | 21st | .12 c.c. | 8.33 |
|   | 27th | .18 "    | 5.55 |
|   | 36th | .28 "    | 3.57 |
|   | 46th | .26 "    | 3.84 |
|   | 64th | .28 "    | 3.57 |

|   |      |          |      |
|---|------|----------|------|
| 4 | 21st | .15 c.c. | 6.66 |
|   | 32nd | .22 "    | 4.54 |
|   | 62nd | .2 "     | 5.00 |

|   |      |          |       |
|---|------|----------|-------|
| 5 | 13th | .06 c.c. | 16.66 |
|   | 24th | .15 "    | 6.66  |
|   | 52nd | .18 "    | 5.55  |
|   | 70th | .19 "    | 5.26  |

**CASE 6: R. R. Age 23 years**

Admitted to hospital on the 11th day. Severely ill.

Eruption of rose spots. Tongue dry and brown.

Abdomen much distended. Spleen enlarged.

Bronchitis.

Fever lasted 26 days. Patient remained very ill until the end of the third week. Improved steadily afterwards.

Good recovery.

Diazo-reaction negative. Widal reaction positive.

B. typhosus grown from blood.

**CASE 7: J. H., Age 35 years**

Admitted to hospital in third week of illness. Severely ill.

Marked deafness. Tongue dry, peeled and tremulous. Spleen enlarged. Rose spots present on body.

Fever lasted approximately three weeks.

Convalescence was good.

Widal reaction positive.

**CASE 8: A. T., Age 22 years**

Admitted about the 23rd day of illness. Very severely ill.

Very deaf. Tongue dry, swollen, and could not be protruded.

Typical eruption present. Abdomen distended. Spleen en-

larged. Extreme prostration. A few days after admission the patient was in almost the 'typhoid state'. Retention

| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 6    | 23rd           | .06 o.c. | 16.66      |
|      | 25th           | .08 "    | 12.50      |
|      | 30th           | .08 "    | 12.50      |
|      | 45th           | .18 "    | 5.55       |
|      | 69th           | .21 "    | 4.76       |

|   |      |          |        |
|---|------|----------|--------|
| 7 | 9th  | .19 o.c. | 5.26   |
|   | 11th | .21 "    | 4.76   |
|   | 18th | .13 "    | 7.69   |
|   | 32nd | .22 "    | 4.54   |
|   | 60th | .28 " +  | 3.57 - |

|   |      |          |      |
|---|------|----------|------|
| 8 | 25th | .18 o.c. | 5.55 |
|   | 26th | .22 "    | 4.54 |
|   | 30th | .18 "    | 5.55 |
|   | 36th | .17 "    | 5.88 |
|   | 41st | .15 "    | 6.66 |

## CASE 8 (Contd.)

of urine.

Improvement began about the 33rd day. Tremor and subsultus tendinum still present at that period.

Fever lasted 52 days.

Rapid progress was made afterwards.

Convalescence was uninterrupted.

Urine gave positive diazo-reaction. Widal reaction positive.

## CASE 9: W. P., Age 23 years

Admitted on the 14th day of illness. Severely ill.

Rose spots present on abdomen and chest. Abdomen distended.

Spleen enlarged. Symptoms became more pronounced as fever advanced. Improvement began about the 18th day.

Fever lasted 34 days.

Urine gave a faintly positive diazo-reaction. Widal reaction positive.

B. typhosus grown from urine.

## CASE 10: D. M., Age 20 years

Admitted on the 14th day of illness. Severely ill.

Patient a little delirious on admission. Abundant crop of rose spots on the body. Tongue sticky and thickly furred. Spleen enlarged.

Improvement began on 20th day. This steadily continued until the temperature was normal.

| Case          | Day of Illness | S        | Complement |
|---------------|----------------|----------|------------|
| 8<br>(Contd.) | 51st           | .18 c.c. | 5.55       |
|               | 64th           | .25 "    | 4.00       |
|               | 78th           | .24 "    | 4.16       |
| -----         |                |          |            |
| 9             | 10th           | .14 c.c. | 7.14       |
|               | 24th           | .11 "    | 9.09       |
|               | 35th           | .12 "    | 8.33       |
|               | 47th           | .12 "    | 8.33       |
|               | 64th           | .185 "   | 5.40       |
| -----         |                |          |            |
| 10            | 20th           | .17 c.c. | 5.88       |
|               | 25th           | .15 "    | 6.66       |
|               | 28th           | .08 "    | 12.50      |
|               | 36th           | .13 "    | 7.69       |
|               | 47th           | .16 "    | 6.25       |
|               | 61st           | .21 "    | 4.76       |

## CASE 10 (Contd.)

Fever lasted 39 days.

Urine gave a positive diazo-reaction. Widal reaction positive.

*B. typhosus* grown from the blood.

Convalescence uninterrupted.

## CASE 11: W. B., Age 35 years

Admitted on the 13th day of illness. Severely ill.

Numerous rose spots present. Tongue furred, sticky, peeled at edges. Considerable doughy resistance over abdomen. Spleen enlarged.

Diazo-reaction positive. Widal reaction positive. *Bacillus typhosus* grown from the blood. Patient remained very ill until 20th day, after which his condition steadily improved.

Period of fever lasted 28 days.

He made an uninterrupted recovery.

## CASE 12: L. P., Age 25 years

Admitted on the 12th day of illness. Moderately ill on admission.

Some rose spots present on the body. Tongue thinly furred.

Abdomen flaccid. Spleen enlarged. Diarrhoea severe.

Negative diazo-reaction. Widal reaction positive.

Patient remained moderately ill until the end of the third week, after which he became more prostrate. Eruption



| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |        |
|----|------|----------|--------|
| 11 | 20th | .18 c.c. | 5.55   |
|    | 28th | .12 "    | 8.33   |
|    | 34th | .17 "    | 5.88   |
|    | 47th | .28 " +  | 3.57 - |

|    |      |          |       |
|----|------|----------|-------|
| 12 | 20th | .08 c.c. | 12.50 |
|    | 23rd | .135 "   | 7.40  |
|    | 36th | .13 "    | 7.69  |
|    | 44th | .09 "    | 11.11 |
|    | 52nd | .14 "    | 7.14  |
|    | 80th | .17 "    | 5.88  |
|    | 93rd | .22 "    | 4.54  |

## CASE 12 (Contd.)

more abundant at this time. During the following two weeks he remained very ill and lost flesh rapidly. Improvement began with lysis, about the 33rd day, and continued throughout convalescence. A doubtful typhoid bacillus was isolated from the urine.

During convalescence the patient gained rapidly in weight.

## CASE 13: J. T., Age 33 years

Admitted on the 7th day of illness. Moderately ill on admission.

Rose spots present on the abdomen and chest. Tongue dry and furred. Some resistance in right side of abdomen. Spleen not palpably enlarged.

Negative diazo-reaction.

Bacillus typhosus grown from the blood and faeces.

During the following week the patient was more ill but not acutely so. He improved with the progress of lysis, and made a good recovery.

Fever lasted 25 days.

## CASE 14: T. K., Age 20 years

Admitted to hospital on 15th day of illness. Moderately ill.

Tongue thinly furred. Rose spots on chest and abdomen.

Slight distension of abdomen. Spleen just palpable.

Heart and lungs normal.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 13 | 12th | .19 o.c. | 5.26 |
|    | 18th | .27 "    | 3.70 |
|    | 26th | .18 "    | 5.55 |
|    | 61st | .23 "    | 4.34 |

-----

|    |      |         |      |
|----|------|---------|------|
| 14 | 20th | .2 o.c. | 5.00 |
|    | 27th | .23 "   | 4.34 |
|    | 43rd | .19 "   | 5.26 |
|    | 61st | .22 "   | 4.54 |
|    | 82nd | .28 "   | 3.57 |

## CASE 14 (Contd.)

Doubtfully positive diazo-reaction. Widal reaction positive. Bacillus Typhosus grown from faeces and rose spots. Patient continued moderately ill throughout, and the temperature only varied on two occasions, during convalescence when a vaccine of his own bacillus was administered. Fever lasted 39 days.

## CASE 15: E. M., Age 19 years

Patient was admitted on the 8th day of illness. Sharply ill on admission.

Typical eruption of rose spots. Abdomen flaccid. Spleen not palpably enlarged.

Urine gave a positive diazo-reaction. Hearing impaired.

Patient remained fairly sharply ill until the 14th day, after which she rapidly improved. Convalescence was uninterrupted.

Bacillus typhosus grown from the faeces on the 11th day, and three days later the widal reaction was positive, agglutination being present in a 1-11,000 dilution.

Fever lasted 13 days.

## CASE 16: E. McL., Age 22 years

Admitted on the 8th day of illness. Acutely ill on admission. Severe generalized bronchitis, causing frequent coughing, and cyanosis. Tongue peeled, fissured and tremulous.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 15 | 10th | .15 c.c. | 6.66 |
|    | 20th | .25 "    | 4.00 |
|    | 29th | .17 "    | 5.88 |
|    | 47th | .28 "    | 3.57 |

|    |      |         |       |
|----|------|---------|-------|
| 16 | 11th | .1 c.c. | 10.00 |
|    | 14th | .085 "  | 12.42 |
|    | 18th | .14 "   | 7.14  |
|    | 25th | .22 "   | 4.54  |

## CASE 16 (Contd.)

Hearing much impaired. Abdomen resistant, no distension. Spleen not palpably enlarged. Rose spots present on the body.

Diazo-reaction positive. Widal reaction positive.

Patient remained very ill until the temperature began to fall about the 13th day, after which steady improvement took place. She made a good recovery and convalescence was only interrupted for two days, 51st and 52nd, by a "cold". There was no evidence of a recurrence of the enteric fever then.

The fever lasted 17 days.

## CASE 17: A. R., Age 52 years

Admitted on the 14th day of illness. Patient moderately ill on admission.

Rose spots present on body. Tongue dry and furred. Abdomen soft, spleen not palpably enlarged. Cardiac condition normal. Evidence of bronchitis throughout both lungs. Positive diazo-reaction. Widal reaction positive.

B. Typhosus isolated from urine.

Patient remained moderately ill throughout the period of fever, which lasted 32 days.

Convalescence was uninterrupted.

-----

| Case           | Day of Illness | S        | Complement |
|----------------|----------------|----------|------------|
| 16<br>(Contd.) | 46th           | .17 c.c. | 5.88       |
|                | 59th           | .15 "    | 6.66       |
|                | 65th           | .14 "    | 7.14       |

|    |      |          |      |
|----|------|----------|------|
| 17 | 20th | .18 c.c. | 5.55 |
|    | 31st | .16 "    | 6.25 |
|    | 38th | .12 "    | 8.33 |
|    | 55th | .11 "    | 9.09 |

CASE 18: Mrs R., Age 23 years

Admitted about the 15th day of illness. Thin and pale, but mildly ill.

Tongue furred and moist, abdomen flaccid. Spleen not palpable. Heart and lungs normal.

Widal reaction positive. Diazo reaction negative.

Rapid progress was made with the fall of the temperature on the 18th day, and patient made a good recovery.

CASE 19: M. F., Age 24 years.

Admitted on the 8th day of illness. Sharply ill on admission.

Tongue dry, furred and swollen. Abundant crop of rose spots over the body. Abdomen a little distended, spleen palpable. Extensive bronchitis. Heart normal.

Diazo reaction positive. Widal reaction positive. Bacillus typhosus grown from the faeces on the day after admission. The fever ran an acute course for 4 weeks, during the last of which the patient improved and remained well until the 35th day, when a relapse began.

A fresh eruption of rose spots appeared and the clinical appearances were similar to those manifested during the primary fever. Improvement began on the 50th day and continued during the period of lysis.

Convalescence was not again interrupted and the patient made a good recovery. Primary fever lasted 31 days and the relapse 29 days.



| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 18   | 20th           | .16 c.c. | 6.25       |
|      | 26th           | .17 "    | 5.88       |
|      | 66th           | .09 "    | 11.11      |

|    |       |          |        |
|----|-------|----------|--------|
| 19 | 13th  | .12 c.c. | 8.33   |
|    | 19th  | .18 "    | 5.55   |
|    | 33rd  | .29 " +  | 3.44 - |
|    | 38th  | .23 "    | 4.34   |
|    | 48th  | .14 "    | 7.14   |
|    | 55th  | .17 "    | 5.88   |
|    | 66th  | .28 " +  | 3.57 - |
|    | 87th  | .28 " +  | 3.57 - |
|    | 102nd | .28 " +  | 3.57 - |

CASE 20: Mrs D., Age 33 years

Admitted on the 18th day of illness. Symptoms on admission were mild.

Tongue was furred and moist. Examination of the abdomen was practically negative, and there was no eruption of rose spots. Spleen not enlarged.

Widal reaction positive.

Two days after admission patient was much better, having got rid of an extraordinary store of gooseberry skins, currants and pieces of fat. A few days later the patient had abdominal pain associated with diarrhoea and the temperature again rose. The patient during the remainder of the primary fever was never very ill. About the 47th day of illness, the temperature after having been settled for more than a week, again began to fluctuate, and a mild relapse took place, lasting little more than a week. Convalescence was not again disturbed and the patient was dismissed well.

CASE 21: E. B., Age 20 years.

Patient was admitted on the 7th day of a sharp attack of enteric fever.

Eruption of rose spots on the abdomen and back. Tongue furred and a little moist. Abdomen distended but not tender. Spleen enlarged but not palpable. Heart and lungs normal. Diazo reaction positive. Widal reaction positive.

| Case | Day of Illness | S       | Complement |
|------|----------------|---------|------------|
| 20   | 65th           | .1 c.c. | 10.00      |
|      | 71st           | .17 "   | 5.88       |
|      | 86th           | .19 "   | 5.26       |
|      | 109th          | .19 "   | 5.26       |

|    |      |          |       |
|----|------|----------|-------|
| 21 | 20th | .18 c.c. | 5.55  |
|    | 22nd | .09 "    | 11.11 |
|    | 27th | .085 "   | 11.76 |
|    | 41st | .14 "    | 7.14  |
|    | 50th | .06 "    | 16.66 |

## CASE 21 (Contd.)

*Bacillus typhosus* grown from the blood.

Patient rapidly became more ill. Distension of the abdomen increased and severe diarrhoea began. He also became delirious. From the 19th day until the 22nd an improvement took place, but the temperature remained elevated for two weeks more.

Patient received a vaccine of his own organism (200,000,000) on the 24th day, a second dose of 750,000,000 on the 34th day, and another dose, 1,000,000,000 on the 44th day.

Temperature remained elevated after the first two doses, and the third was administered at the beginning of a relapse. Patient was not very ill during the latter period.

Recovery was not again interrupted.

The primary fever lasted 38 days and the relapse 9 days.

## CASE 22: L. H., Age 20 years

Patient was admitted on the 12th day of a severe attack of enteric fever. Markedly toxic appearance on admission.

Tongue furred and dry. Rose spots present on the abdomen.

Abdomen distended. Spleen enlarged. Extensive bronchitis.

Severe diarrhoea.

Widal reaction positive.

Improvement noted on the 19th day of illness, diarrhoea being less troublesome and bronchitis less marked.

An accession of the symptoms took place between the 23rd and

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|                |      |          |      |
|----------------|------|----------|------|
| 21<br>(Contd.) | 58th | .19 c.o. | 5.26 |
|                | 76th | .24 "    | 4.16 |
|                | 86th | .24 "    | 4.16 |

|    |       |          |          |
|----|-------|----------|----------|
| 22 | 52nd  | .15 c.o. | 6.66     |
|    | 60th  | .15 "    | 6.66     |
|    | 65th  | .16 " +  | 6.25 - . |
|    | 76th  | .24 "    | 4.16     |
|    | 104th | .17 "    | 5.88     |
|    | 130th | .22 "    | 4.54     |

## CASE 22 (Contd.)

28th days, and the abdomen remained distended. A copious haemorrhage occurred on the 32nd day. Patient began to improve afterwards, and temperature fell to normal on 39th day. A relapse began a week later, and lasted for three weeks, during which time the patient emaciated rapidly, although the symptoms were at no time so urgent as during the primary fever. A second relapse occurred on the 92nd day of illness. This was of a mild nature, and in two weeks the temperature settled completely. A good recovery was made.

## CASE 23: B. C., Age 16 years

Admitted to Hospital on the 11th day of illness. Sharply ill.

Tongue furred but moist. Abdomen soft. Spleen enlarged. Rose spots present on the body. Heart normal. Lungs congested at both bases.

Widal reaction positive. On the evening of the 14th day the patient had a severe attack of abdominal pain, associated with vomiting, but was well again next day. Temperature reached normal on the 19th day.

Good progress was made until the 29th day, when a relapse began and lasted three weeks, during which the patient was sharply ill. There was a recurrence of the typical enteric symptoms. Nothing further of note occurred, and the patient was dismissed well.

-----  
Case            Day of Illness            S            Complement  
-----

23            36th            .04 c.c.            25.00  
             42nd            .1    "            10.00  
             57th            .145 "            6.89  
             96th            .2    "            5.00

-----

**CASE 24: Mrs M., Age 25 years**

Patient was admitted on the 10th day of illness suffering from a severe attack of enteric fever.

Tongue dry and cracked. Pregnancy of three months. Abdomen distended, spleen palpable. No eruption. Heart and lungs normal. Rose spots appeared three days after admission. Symptoms of abortion began on the 10th day, and a three months' foetus was discharged. This was associated with a marked fall in temperature. Two days later the temperature again rose and remained elevated until the 20th day. On the day following the abortion the patient showed marked hysterical symptoms, and at one time became semi-comatose. This was followed by aphonia, which continued until the beginning of a relapse on the 31st day. The relapse lasted two weeks. Patient was mildly ill during this period.

Convalescence was not again disturbed.

**CASE 25: E. C., 15 years**

Admitted to hospital on 7th day of illness. Acutely ill, very deaf, and quite irrational.

Numerous rose spots present. No abdominal distension.

Spleen enlarged. Tongue dry, peeled and cracking. Heart and lungs satisfactory.

Urine: positive diazo reaction. Widal reaction positive.

Patient remained very ill during the whole course of the



| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 24   | 44th           | .06 c.e. | 16.66      |
|      | 46th           | .05 "    | 18.18      |
|      | 76th           | .19 "    | 5.26       |
|      | 88th           | .19 "    | 5.26       |

|    |      |          |       |
|----|------|----------|-------|
| 25 | 13th | .05 c.e. | 20.00 |
|    | 23rd | .045 "   | 22.22 |
|    | 30th | .075 "   | 13.33 |
|    | 92nd | .21 "    | 4.76  |

## CASE 25 (Contd.)

fever. There was no abatement of the symptoms until the temperature showed bigger remissions, about the 25th or 26th days. The primary fever lasted 38 days. The patient became much emaciated. A relapse occurred on the 43rd day, but this lasted less than a fortnight. The patient was fairly well during this period.

Convalescence was uninterrupted.

## CASE 26: R. S., Age 21 years.

Admitted on the 16th day of illness. Sharply ill.

A few rose spots present on abdomen. Tongue dry and furred.

Throat sticky. Slight distension of abdomen. Spleen not palpable. Heart normal. Lungs clear. Diazo reaction positive. Widal reaction positive.

B. Typhosus isolated from urine.

The abdominal distension soon increased and the patient rapidly became worse, and by the 21st day he was very ill. On the 22nd and 23rd days a decided improvement was noted. Although the patient remained ill for some time, the improvement was continued, but when the temperature settled on the 32nd day he was not quite sensible, and at times was almost crazy. Facial erysipelas began on the 39th day, and this ultimately spread over the whole face, scalp, and neck. Suppuration of the eyelids occurred. Abscesses appeared in the scalp. The bacillus typhosus

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |       |         |        |
|----|-------|---------|--------|
| 26 | 18th  | .1 o.c. | 10.00  |
|    | 21st  | .12 "   | 8.33   |
|    | 31st  | .09 "   | 11.11  |
|    | 42nd  | .2 "    | 5.00   |
|    | 55th  | .15 "   | 6.66   |
|    | 71st  | .11 "   | 9.09   |
|    | 84th  | .14 "   | 7.14   |
|    | 100th | .16 "   | 6.25   |
|    | 133nd | .28 " + | 3.57 - |

## CASE 26 (Contd.)

was not present in the pus. Abscesses also appeared periodically in the neck. All had to be incised at various times. About the 75th day an inflammatory swelling began in the right thigh, which ultimately suppurated, and continued discharging even after the temperature had finally settled about the 100th day.

Convalescence was not again interrupted and the patient made a good recovery.

## CASE 27: H. McL., Age 16 years

Admitted on the 8th day of an attack of pneumonia. No definite evidence of enteric fever.

Heart normal. Lungs: evidences of pneumonia involving right lower lobe.

Urine: diazo reaction positive. Leucocytes 16,000. Widal reaction positive.

Temperature fell to normal by crisis on the 12th day and the patient improved during the following week. Temperature rose rapidly on the 23rd day, and a typical attack of enteric fever followed. Rose spots began to appear on the 7th day of the fever, and the spleen became palpable two days later. Improvement began on the 14th day of fever and continued into convalescence. The attack of enteric was moderately severe and lasted 3 weeks. The bacillus typhosus was isolated from the urine at the end of the fever.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 27 | 31st | .15 c.c. | 6.66 |
|    | 58th | .28 "    | 3.57 |
|    | 67th | .15 "    | 6.66 |
|    | 84th | .195 "   | 5.12 |

CASE 28: J. L., Age 36 years

Admitted on the 8th day of illness. Acutely ill.

Deafness, abundant crop of rose spots over the body. Tongue thickly furred. Spleen palpable. Abdomen resistant in the right side. Heart normal. Evidence of bronchitis in both sides of chest.

Diazo reaction faintly positive. Widal positive.

Bacillus typhosus grown from the urine.

Symptoms of enteric rapidly grew worse and the patient became delirious three days after admission. On the 14th day a rigor occurred, associated with pain in right iliac fossa. Leucocytes 5,000 per c.m.m. Next day there was slight improvement.

On the 16th day abdomen became more distended and resistance increased. Leucocytes 3,000 per c.m.m. Temperature which was subnormal could not be registered by the thermometer. Hiccough present at this time. Bowels moved frequently.

Blood appeared in the stools next day and the collapse during the previous day was ascribed to separation of sloughs.

Improvement began after this and continued till the 27th day.

At this time the left thigh became swollen and tender.

No pitting on pressure. Swelling increased for a few days and spread below the knee. Vaccine given on 29th day, 100,000,000 of B. Typhosus isolated from patient's urine.

| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 28   | 11th           | .13 c.c. | 7.69       |
|      | 16th           | .08 "    | 12.50      |
|      | 21st           | .2 "     | 5.00       |
|      | 35th           | .17 "    | 5.88       |
|      | 42nd           | .17 "    | 5.88       |
|      | 55th           | .17 "    | 5.88       |

## CASE 28 (Contd.)

The temperature rose again on the 28th day and a relapse which lasted two weeks followed.

Thrombosis still continued and the leg remained swollen during convalescence.

## CASE 29: J. M., Age 31 years

Admitted on the 9th day of a severe attack of enteric fever. Bright crop of rose spots present on the body. Tongue, dry, furred and fissured. Abdomen distended. Spleen enlarged but not palpable. Heart normal. R. M. deficient over base of both lungs.

*B. typhosus* grown from faeces and urine.

Widal reaction positive.

Fever continued till the end of the 4th week. During the 4th week fluid appeared in right side of chest. It was blood stained. No typhoid bacilli found in it. Spit also blood stained at this time. Condition improved during the 5th week, but at the end of that period left groin became painful. This spread to the leg, and the foot became colder than the other. Distension of superficial veins of this limb was present. Tenderness along internal saphenus vein was very marked. Swelling gradually subsided and had almost disappeared by the 50th day of illness.

After patient was allowed up out of bed on the 60th day, the



| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |         |       |
|----|------|---------|-------|
| 29 | 12th | .1 c.c. | 10.00 |
|    | 21st | .1 "    | 10.00 |
|    | 26th | .13 "   | 7.69  |
|    | 37th | .21 "   | 4.76  |
|    | 49th | .14 "   | 7.14  |
|    | 60th | .25 "   | 4.00  |

## CASE 29 (Contd.)

swelling returned, but not so markedly, and it was still present when he left the hospital against advice.

NOTE: Two months later the patient came back to the hospital to report himself. The leg was still swollen.

## CASE 30: K. A., Age 23 years

Admitted to hospital on the 3rd day of illness. Sharply ill. Tongue moist and furred. General appearance suggested illness of fully a week's duration. Rose spots present on abdomen. Spleen enlarged. Abdomen fairly flaccid. Slightly distended. Diazo reaction positive. Three days after admission the patient became much worse. Delirium set in, also retention of urine. Condition remained serious until lysis began on the 15th day. Severe bronchitis was present during the whole time of fever. On the 22nd day severe pain present in the right side of chest. Marked pleural friction. R.M. became tubular and the greater part of the right lower lobe showed evidence of solidification. At this time there was pus and blood in the urine. Widal reaction positive.

By the 33rd day the pulmonary condition had cleared up and the general condition of the patient improved. Temperature was again elevated on the 49th day, but no evidence of enteric fever was present.

Convalescence was afterwards uninterrupted.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |             |        |
|----|------|-------------|--------|
| 30 | 17th | .145 c.c. + | 6.89 - |
|    | 20th | .05 "       | 20.00  |
|    | 27th | .085 "      | 12.42  |
|    | 35th | .08 "       | 12.50  |
|    | 51st | .19 "       | 5.26   |
|    | 80th | .27 "       | 3.70   |

CASE 31: Mrs C., Age 27 years

Admitted to Hospital on the 28th day, acutely ill.

Tongue dry and brown. Rose spots present over abdomen and back. Spleen palpable. Abdomen soft. No distension. Pulse very rapid and dicrotic. Heart sounds soft. Bronchitis present.

Six days after admission haemorrhages from the bowel began and continued intermittently for 4 days, during which time the patient became much paler. Toxaemia became more and more intense, and the patient ultimately died on the 39th day of the disease.

Widal reaction positive.

CASE 32: Mrs D., 27 years.

Admitted on the 6th day of illness. Probably ill longer than this. Acutely ill.

Tongue dry and swollen. Some doubtful rose spots on the abdominal wall. Abdomen distended. Spleen palpable. Hypostatic congestion at bases of both lungs. Heart: sounds distant and soft.

B. Typhosus isolated from faeces on the day following admission. Widal positive. Patient rapidly became more and more prostrate, and on the 11th day was practically unconscious. Gangrene of the labia majora began at this time. Death occurred on the 16th day of illness.

| Case | Day of Illness | S         | Complement |
|------|----------------|-----------|------------|
| 31   | 34th           | .125 o.c. | 8.00       |
|      | 37th           | .055 "    | 19.80      |
|      | 39th           | .04 "     | 25.00      |

|    |      |         |       |
|----|------|---------|-------|
| 32 | 6th  | .2 o.c. | 5.00  |
|    | 11th | .21 "   | 4.76  |
|    | 16th | .06 "   | 16.66 |

## CASE 33: K. McJ., 11 years

Admitted to hospital on the 10th day of illness. Practical unconscious when admitted. Breathing quiet and shallow. Pulse poor and irregular.

Tongue furred and sticky. Head retracted. Pupils sluggish but equal. No evidence of paresis. Muscles of neck not rigid. Indefinite Kernig's sign present. Cerebro spinal fluid perfectly clear. Lungs normal. Heart irregular; sounds pure but soft. Abdomen showed no distension and was quite flaccid. Spleen enlarged and palpable.

Widal reaction doubtful. Diazo reaction positive. Patient remained in this very markedly typhoid condition until death occurred on the 17th day.

Post Mortem. Enteric ulcers in small and large intestine in various stages of sloughing. Brain and spinal cord normal in appearance.

## CASE 34: Mrs G., 25 years.

Admitted to hospital on the 13th day of a severe attack of enteric fever. Four months pregnant.

Tongue furred and dry. No eruption. Spleen enlarged.

Slight abdominal distension. Marked degree of toxæmia. Diarrhoea.

Diazo reaction positive. Widal positive. Agglutination (to 1 in 15,000). Lungs normal.

| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 33   | 10th           | .18 c.c. | 5.55       |
|      | 12th           | .13 "    | 7.69       |
|      | 15th           | .13 "    | 7.69       |
|      | 17th           | .06 "    | 16.66      |

-----

|    |      |          |       |
|----|------|----------|-------|
| 34 | 27th | .07 c.c. | 14.28 |
|----|------|----------|-------|

-----

## CASE 34 (Contd.)

By the 22nd day the abdomen was markedly distended, and from this time the patient rapidly became worse. Death occurred on the 28th day.

Post Mortem: Enteric ulcers in small and large intestine.

## CASE 35: Mrs T., Age 35 years

Admitted to hospital on the 8th day of illness. Symptoms and appearances typical of enteric fever. Acutely ill. Tongue furred and dry. No eruption. Abdomen a little distended, but flaccid. Retention of urine. Diazo reaction positive. Widal positive.

After admission the patient became rapidly worse. Marked hypostatic congestion of both lungs took place, and the patient died on the 15th day.

## CASE 36: Mrs M., Age 33 years

Admitted on the 12th day of a severe attack of enteric fever. Marked anaemia. Very deaf.

Tongue dry and brown. Heart weak. Lungs clear. Abdomen soft. Spleen palpable. Widal reaction positive.

On the 15th day pleural friction was present in the right side of chest. Next day the lower part of right side of chest became dull. Patient died on the 17th day of illness.



| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |     |          |      |
|----|-----|----------|------|
| 35 | 9th | .13 c.c. | 7.69 |
|----|-----|----------|------|

|    |      |          |      |
|----|------|----------|------|
| 36 | 15th | .14 c.c. | 7.14 |
|----|------|----------|------|

**CASE 37: Mrs McD., Age 37 years**

Admitted on the 20th day of illness. Anaemic, marked deafness. Tongue very dry, pale and swollen.

Abdomen not distended. Spleen enlarged. A few rose spots present in abdomen. Heart: sounds very soft.

B. typhosus grown from faeces. Widal reaction positive.

Agglutination up to 1-15,000 dilution.

Patient became delirious on the 24th day and death occurred on the 28th day.

**CASE 38: M. J., 37 years**

Day of illness when admitted to hospital was doubtful.

Very ill and exhausted on admission.

Tongue red, dry and fissured. Abdomen soft. Spleen not enlarged. Heart: sounds soft, regular. Lungs: dullness at both bases. Tubularity over both bases but most marked on the left side.

Diazo reaction negative. Widal reaction positive.

Agglutination up to 1-800 dilution.

Leucocytes 4,000 per c.m.m.

B. Typhosus grown from urine.

Patient steadily became worse and ultimately died two weeks after admission to hospital.

-----

| Case | Day of illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 37 | 25th | .17 c.c. | 5.88 |
|----|------|----------|------|

|    |        |          |      |
|----|--------|----------|------|
| 38 | 43rd ? | .16 c.c. | 6.25 |
|----|--------|----------|------|

## CASE 39: B. E., Age 21 years

Admitted on the 8th day of illness. Acutely ill and very prostrate.

Hands and tongue tremulous and lower jaw almost clonic. Numerous rose spots present on the body. Tongue swollen, furred, and dry. Could not be protruded. Abdomen distended. Spleen enlarged. Lungs clear.

B. Typhosus grown from faeces. Widal reaction positive. Agglutination up to 1-6,000 dilution.

Two days after admission the patient became delirious.

Toxaemia became more pronounced. Death occurred on the 13th day.

## CASE 40: J. P., Age 24 years

Admitted to hospital probably at the end of the first week of illness. Acutely ill. A few small rose spots on abdomen. Tongue dry and brown.

Abdomen slightly distended, and resistant. Spleen enlarged. Heart in good condition. Lungs clear. Positive diazo reaction. Widal reaction positive. Leucocytes 6,000 per c.m.m.

During the next few days the eruption of rose spots increased, and the diazo reaction became more marked.

Hypostatic congestion occurred as patient became more toxæmic. Death occurred 11 days after patient's admission to hospital. P.M. Enteric fever. B. Typhosus grown from spleen.

| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 39   | 9th            | .21 c.o. | 4.76       |
|      | 13th           | .2 " +   | 5.00 -     |

# ADDITIONAL

of the Clinical Reports on the Cases of

|    |      |          |       |
|----|------|----------|-------|
| 40 | 11th | .08 c.o. | 12.50 |
|    | 14th | .04 " +  | 25.00 |
|    | 17th | .13 " +  | 7.69  |

**APPENDIX B**  
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**Summary of the Clinical Reports on the Cases of Ery-  
sipelas, together with the Results of the Series  
of Complement estimations in each Case**

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## SUMMARY OF CASES OF ERYSIPELAS

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## CASE 1: W. W., Age 48 years

Admitted on 4th day of illness. Sharply ill.

Erysipelas involved the upper part of face and scalp, and originated in a septic wound of scalp.

Sharply ill. Disease spread for 4 more days and then subsided rapidly with the fall in temperature.

Fever lasted 9 days.

## CASE 2: A. H., Age 33 years.

Admitted to hospital on the 1st day of illness. Sharply ill.

Erysipelas of the forehead: spread rapidly over whole of face and scalp. Patient sharply ill for three days.

Rapid recovery.

Fever lasted 4 days.

## CASE 3: W. C., Age 43 years

Admitted on 2nd day of illness.

Erysipelas of face. Confined to right cheek at first.

Spread within the next 3 days over whole face and front of scalp. Sharply ill at this time. Recovery good.

Fever lasted 6 days.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|   |      |          |      |
|---|------|----------|------|
| 1 | 5th  | .13 o.o. | 7.69 |
|   | 7th  | .12 "    | 8.33 |
|   | 11th | .13 "    | 7.69 |
|   | 14th | .17 "    | 5.88 |
|   | 20th | .18 "    | 5.55 |

|   |      |          |        |
|---|------|----------|--------|
| 2 | 3rd  | .16 o.o. | 6.25   |
|   | 5th  | .21 "    | 4.76   |
|   | 10th | .35 " +  | 2.85 - |

|   |      |          |        |
|---|------|----------|--------|
| 3 | 3rd  | .21 o.o. | 4.76   |
|   | 6th  | .19 "    | 5.26   |
|   | 10th | .28 " +  | 3.57 - |



CASE 4: C. S., Age 45 years

Admitted on 3rd day of illness. Sharply ill.

Whole face affected by erysipelas. Slightly delirious.

Erysipelas spread over scalp within a short time. Recovery on the 11th day.

CASE 5: J. F., Age 30 years

Admitted on the 3rd day of illness. Whole face affected.

Sharply ill.

Spread into scalp. Attack lasted 7 days. Recovered rapidly.

CASE 6: P. McM., Age 16 years

Admitted on 4th day of illness. Sharply ill.

Erysipelas affected whole face and front of scalp. Recovery on the 7th day. Convalescence rapid.

CASE 7: A. McD., Age 29 years.

Admitted on 3rd day of illness. Facial Erysipelas.

Whole face affected. Moderately ill. Attack lasted 7 days.

Good recovery.

CASE 8: J. M., Age 26 years

Admitted on the 5th day of illness. Sharply ill. Slightly irrational.

Erysipelas affected face and part of scalp.

Attack lasted 9 days. Good recovery.

| Case | Day of Illness | S           | Complement |
|------|----------------|-------------|------------|
| 4    | 5th            | .145 c.c.   | 6.89       |
|      | 9th            | .21 "       | 4.76       |
|      | 15th           | .28 "       | 3.57       |
|      | 22nd           | .28 " +     | 3.57 -     |
| 5    | 3rd            | .12 c.c.    | 8.33       |
|      | 5th            | .17 "       | 5.88       |
|      | 9th            | .17 "       | 5.88       |
|      | 19th           | .27 "       | 3.70       |
| 6    | 5th            | .13 c.c.    | 7.69       |
|      | 7th            | .17 "       | 5.88       |
|      | 11th           | .23 "       | 4.34       |
| 7    | 4th            | .145 c.c. + | 6.89 -     |
|      | 6th            | .11 "       | 9.09       |
|      | 11th           | .24 "       | 4.16       |
| 8    | 7th            | .18 "       | 5.55       |
|      | 12th           | .28 " +     | 3.57 -     |

CASE 9: P. McA., Age 45 years

Admitted on the 1st day of illness. Sharply ill.

Erysipelas spread all over face and into scalp. Attack ended on the 7th day. Good convalescence.

CASE 10: J. H., Age 25 years

Admitted on the 5th day of illness. Sharply ill.

Whole of face affected. Spread within the course of two or three days through scalp. During the last four days of attack erysipelas recurred for short intervals in places that had already healed. Terminated on 17th day. Good recovery.

CASE 11: A. McL., Age 25 years

Admitted about the 4th day of illness. Acutely ill. Marked prostration. Cellulitis of whole of right arm and erysipelas of the greater part of the back of body.

Greater part of skin on inside of upper arm sloughed. Multiple incisions made in upper arm. Improvement noted 3 days after admission. Erysipelas spread during the following 20 days over the greater part of body, face, left arm and leg. The recurrences gradually became less marked as time went on. Practically no healing in wounds during this time. After temperature became normal healing began, and a skin grafting operation was done on the inner aspect of the upper arm during the seventh week of

| Case  | Day of Illness | S         | Complement |
|-------|----------------|-----------|------------|
| 9     | 5th            | .115 c.o. | 8.69       |
|       | 15th           | .15 " +   | 6.66 -     |
| ----- |                |           |            |
| 10    | 6th            | .14 c.o.  | 7.14       |
|       | 9th            | .12 "     | 8.33       |
|       | 11th           | .18 "     | 5.55       |
|       | 14th           | .17 "     | 5.88       |
|       | 27th           | .25 "     | 4.00       |
| ----- |                |           |            |
| 11    | 5th            | .08 c.o.  | 12.50      |
|       | 7th            | .2 "      | 5.00       |
|       | 11th           | .15 "     | 6.66       |
|       | 14th           | .2 "      | 5.00       |
|       | 25th           | .24 "     | 4.16       |
|       | 55th           | .26 "     | 3.84       |
|       | 3 months later | .34 "     | 2.94       |
| ----- |                |           |            |

## CASE 11 (Contd.)

illness.

Good convalescence. Dismissed well at end of 10 weeks.

NOTE: Patient reported himself at the hospital 4 months later. He was perfectly well then.

## CASE 12: P. McC., Age 20 years

Admitted on 3rd day of illness. Sharply ill.

Erysipelas involved whole of face and scalp.

Improvement began on the 8th day and continued throughout convalescence.

Fever lasted 10 days.

## CASE 13: S. M., Age 47 years

Admitted on the 3rd day of a mild attack of facial erysipelas.

No general disturbance.

Upper part of face affected. Attack lasted 5 days.

## CASE 14: A. G., Age 45 years

Admitted to hospital on the 4th day of a fairly sharp attack of facial erysipelas. Whole face affected.

Attack ended on the 6th day.

## CASE 15: W. M., Age 69 years

Admitted on the 6th day of illness. Erysipelas in patches over face and scalp.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |        |
|----|------|----------|--------|
| 12 | 4th  | .07 c.c. | 14.28  |
|    | 6th  | .28 " +  | 3.57 - |
|    | 9th  | .28 "    | 3.57   |
|    | 16th | .18 "    | 5.55   |

-----

|    |      |          |        |
|----|------|----------|--------|
| 13 | 4th  | .27 c.c. | 3.70   |
|    | 8th  | .28 " +  | 3.57 - |
|    | 12th | .29 "    | 3.44   |

-----

|    |      |          |      |
|----|------|----------|------|
| 14 | 4th  | .16 c.c. | 6.25 |
|    | 10th | .15 "    | 6.66 |

-----

|    |      |       |      |
|----|------|-------|------|
| 15 | 7th  | .18 " | 5.55 |
|    | 9th  | .19 " | 5.26 |
|    | 11th | .14 " | 7.14 |
|    | 21st | .19 " | 5.26 |

## CASE 15 (Contd.)

This condition, although never very acute nor associated with fever, continued until the end of the 2nd week and was worst about the 12th day. Patient was moderately ill during that time.

Good recovery.

## CASE 16: J. L., Age 43 years

Admitted on 2nd day of illness. Sharply ill.

Face and scalp affected.

Attack lasted 6 days. Patient had chronic albuminuria.

## CASE 17: J. C., Age 45 years.

Admitted on 2nd day of illness. Patient suffered from a sharp attack of erysipelas which spread over the right side of face and through the whole of scalp. Lasted 10 days.

Bronchitis as well during the period of residence.

Good convalescence.

## CASE 18: R. A., Age 40 years

Admitted on 3rd day of illness. Erysipelas began on forehead and spread rapidly over the face and scalp within the first 6 days. Patient slightly delirious. Attack ended on 7th day by crisis, and in a few days more the swelling of the face had quite gone. Good recovery.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 16 | 3rd  | .16 c.c. | 6.25 |
|    | 5th  | .18 "    | 5.55 |
|    | 7th  | .28 "    | 3.57 |
|    | 11th | .19 "    | 5.26 |
|    | 15th | .17 "    | 5.88 |

|    |      |          |      |
|----|------|----------|------|
| 17 | 5th  | .27 c.c. | 3.70 |
|    | 12th | .28 " +  | 3.57 |
|    | 22nd | .16 "    | 6.25 |

|    |      |         |      |
|----|------|---------|------|
| 18 | 4th  | .2 c.c. | 4.00 |
|    | 6th  | .12 "   | 8.33 |
|    | 8th  | .19 "   | 5.26 |
|    | 14th | .12 "   | 8.33 |



**CASE 19: J. R., Age 30 years**

Admitted on 2nd day of a moderate attack of erysipelas.

Cheeks and nose affected.

Attack ended on the 5th day by crisis.

**CASE 20: W. H., Age 62 years**

Admitted on the 3rd day of illness. Typical attack of facial erysipelas.

Greater part of the face and part of scalp involved. By the 6th day patient was quite delirious, and very difficult to control. Erysipelas lasted until the 9th day. Practically no fever. Patient was still erratic in his manner when he went home a week later.

**CASE 21: A. T., Age 40 years.**

Admitted on 1st day of a fairly sharp attack of facial erysipelas, which extended next day into the scalp.

Fever ended on the 4th day and inflammation had practically gone on the 8th day. Slight redness of cheeks and nose remained until a few days before dismissal, on the 23rd day.

A mild recurrence took place 4 weeks later. Erysipelas confined to nose and cheeks. No general disturbance. Rapid recovery from this secondary attack.

-----

| Case  | Day of Illness | S             | Complement   |
|-------|----------------|---------------|--------------|
| 19    | 2nd            | .16 c.o.      | 6.25         |
|       | 4th            | .17 "         | 5.88         |
|       | 6th            | .14 "         | 7.14         |
| ----- |                |               |              |
| 20    | 4th            | .16 c.o.      | 6.25         |
|       | 14th           | .1 "          | 10.00        |
| ----- |                |               |              |
| 21    | 3rd            | .14 c.o.      | 7.14         |
|       | 6th            | .12 "         | 8.33         |
|       | 11th           | .18 "         | 5.55         |
|       | 22nd           | .24 "         | 4.16         |
|       | Relapse 3rd    | Relapse .21 " | Relapse 4.76 |
|       | 14th           | .25 "         | 4.00         |
|       | 25th           | .23 "         | 4.34         |
| ----- |                |               |              |

CASE 22: D. McL., Age 50 years

Admitted on 5th day of a sharp attack of erysipelas. Spread rapidly over whole of face and scalp. Terminated on the 11th day.

Remained very well for a week. Recurrence on the 19th day. Mild, lasted 4 days. No general disturbance at this time. Good recovery.

CASE 23: J. J., Age 70 years

Admitted on 3rd day of facial erysipelas. Severely ill.

Whole face affected. Oedema of conjunctiva.

Improved rapidly after fall of temperature on 8th day.

Sharp recurrence took place 15 days later, as severe as the primary attack. Also lasted 9 days. Rapid recovery.

CASE 24: D. G., Age 46 years

Admitted on the 3rd day of erysipelas. Moderate attack.

Lasted 6 days. Little general disturbance.

Boil formed on back of neck on 8th day and a large abscess in connection with this had to be opened on the 11th day.

Large abscess under right jaw in region of submaxillary glands formed on the 29th day and this also had to be

opened. Wounds still discharging when a recurrence occurred on the 21st day. This was much more severe than

the primary attack, and lasted 10 days.

Recovery took place rather slowly.

| Case  | Day of Illness | S          | Complement |
|-------|----------------|------------|------------|
| 22    | 5th            | .15 o.c.   | 6.66       |
|       | 8th            | .085 "     | 11.76      |
|       | 12th           | .125 "     | 8.00       |
|       | 21st           | .15 "      | 6.66       |
|       | 25th           | .2 " +     | 5.00 -     |
| ----- |                |            |            |
| 23    | 4th            | .27 o.c. + | 3.70 -     |
|       | 6th            | .11 "      | 9.09       |
|       | 10th           | .23 "      | 4.34       |
|       | 19th           | .28 " +    | 3.57 -     |
|       | Recurrence     | Recurrence | Recurrence |
|       | 8th            | .27 o.c.   | 3.70       |
|       | 18th           | .12 "      | 8.33       |
| ----- |                |            |            |
| 24    | 4th            | .24 o.c.   | 4.16       |
|       | 6th            | .13 "      | 7.69       |
|       | 8th            | .17 "      | 5.88       |
|       | 24th           | .14 "      | 7.14       |
|       | 37th           | .14 "      | 7.14       |
| ----- |                |            |            |

CASE 25: J. M., Age 58 years.

Patient admitted somewhere near the end of an attack of pneumonia, with the history of facial erysipelas about 4 weeks before. No evidence of erysipelas present.

Pneumonia involved whole of left lower lobe. Fever ended on 10th day. Good recovery from this illness. Dismissed well two weeks after temperature had become normal. Re-admitted 17 days after dismissal with facial erysipelas on the 3rd day. No fever. Erysipelas confined to region of right eye and left ear. Was dismissed apparently well in two weeks.

Returned to hospital a week later very severely ill. Erysipelas had recurred and involved greater part of the face. Evidence of septicaemia. Left leg hard, much swollen, and very tender. Oedematous swelling of right elbow. Patient rapidly became worse. Several rigors. Death occurred suddenly on the 7th day of this attack.

CASE 26: A. J., Age 51 years

Admitted to hospital on the 5th day of illness.

Septic wound of scalp, with erysipelas extending over whole scalp and face. Patient sharply ill.

Delirious on the 6th day and during the three days following. Erysipelas began to subside on the 8th day, and continued to improve, but pus accumulated under the scalp, forming large swellings over both temporo-parietal regions. Sever

| Case | Day of Illness        |      | S        | Complement |
|------|-----------------------|------|----------|------------|
| 25   | Pneumonia             | 6th  | .18 o.o. | 5.55       |
|      |                       | 7th  | .17 "    | 5.88       |
|      |                       | 9th  | .16 "    | 6.25       |
|      |                       | 13th | .14 "    | 7.14       |
|      | Recurrence            | 20th | .16 "    | 6.25       |
|      | Erysipelas            | 3rd  | .12 "    | 8.33       |
|      |                       | 10th | .14 "    | 7.14       |
|      | Further<br>Recurrence | 6th  | .14 "    | 7.14       |

|    |      |          |       |
|----|------|----------|-------|
| 26 | 6th  | .12 o.o. | 8.33  |
|    | 7th  | .06 "    | 16.66 |
|    | 9th  | .14 "    | 7.14  |
|    | 11th | .21 "    | 4.76  |
|    | 13th | .28 " +  | 3.57  |
|    | 15th | .3 "     | 3.33  |
|    | 17th | .3 "     | 3.33  |
|    | 19th | .16 "    | 6.25  |

## CASE 26 (Contd.)

incisions were made into the abscess on the 12th day, and the pus evacuated. Patient's general condition improved until the 17th day. The fascia of the scalp sloughed at this time.

On the 19th day a further accumulation of pus occurred on the back of the head and in the brow, extending over the bridge of the nose, but not associated with acute inflammatory reaction. Further incisions were necessary, and a further improvement took place. All the sloughs were removed by the 30th day of illness. Good progress was made until about the 40th day, when there was a recurrence of the abscess of the forehead, requiring a further operation. Although patient had not completely recovered at the time the last examination, his condition was very good.

At no time after the subsidence of the erysipelas was there more than a slight disturbance of temperature. The patient remained fairly well, but showed very moderate healing powers throughout.

## CASE 27: R. R., Age 31 years

Admitted on the second day of a severe attack of facial erysipelas. Whole of face involved. Persistent hiccough present during the first six days. Face healed about the seventh day, but the erysipelas migrated over the back, both arms, and left leg, between that day and the twenty-

| Case           | Day of Illness | S        | Complement |
|----------------|----------------|----------|------------|
| 26<br>(Contd.) | 21st           | .11 o.o. | 9.09       |
|                | 23rd           | .11 "    | 9.09       |
|                | 29th           | .17 "    | 5.88       |
|                | 39th           | .09 "    | 11.11      |
|                | 50th           | .12 "    | 8.33       |
|                | 72nd           | .22 "    | 4.76       |

-----

|    |      |          |       |
|----|------|----------|-------|
| 27 | 2nd  | .21 o.o. | 4.76  |
|    | 3rd  | .24 "    | 4.16  |
|    | 5th  | .23 "    | 4.34  |
|    | 7th  | .21 "    | 4.76  |
|    | 9th  | .09 "    | 11.11 |
|    | 11th | .2 "     | 5.00  |



## CASE 27 (Contd.)

first day of illness, when it subsided.

Patient recovered rapidly. Fever lasted twenty days. After the erysipelas disappeared from the face, as it spread over the body and limbs it gradually became less and less acute. Its last appearance, on the leg, was slight. This patient was treated with subcutaneous injections of Iodipin in doses of 90 minims on the eighth, ninth, tenth and eleventh days, with no effect.

## CASE 28: T. A., Age 50 years

Admitted to hospital on the 1st day of erysipelas. Erysipelas associated with an extensive laceration of the ear. Patient also suffering from pneumonia, extremely ill. Died five days after admission.

## CASE 29: H. H., Age 37 years

Admitted to hospital on the 7th day of illness.

Erysipelaz was associated with carbuncular condition of the upper lip. Extreme swelling of the face. Hard palate affected, and covered with a pseudo-membrane, almost identical with diphtheritic membrane. Examination of the membrane both histologically and by culture showed that there were no diphtheric bacilli present, but pyogenic cocci were extremely abundant. Only staphylococcus pyogenes aureus was grown. Patient died from septicaemia on the 12th day of disease.

| Case           | Day of Illness | S        | Complement |
|----------------|----------------|----------|------------|
| 27<br>(Contd.) | 12th           | .25 o.c. | 4.00       |
|                | 21st           | .1 "     | 10.00      |
|                | 26th           | .2 "     | 5.00       |
|                | 32nd           | .12 "    | 8.33       |
|                | 54th           | .23 "    | 4.34       |

-----

|    |     |          |      |
|----|-----|----------|------|
| 28 | 3rd | .14 o.c. | 7.14 |
|    | 5th | .12 "    | 8.33 |

-----

|    |      |          |      |
|----|------|----------|------|
| 29 | 9th  | .21 o.c. | 4.76 |
|    | 12th | .13 "    | 7.69 |

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CASE 30: H. McC., Age 85 years

Frail old man.

Admitted on the 1st day of illness.

Facial erysipelas.

Rapidly grew worse and died on the 6th day of illness.

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| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 30   | 5th            | .18 c.c. | 5.55       |

APPENDIX C

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Summary of the Clinical Findings on the Cases of

Syphilis together with the Results of the

Series of Examinations of Complement of the

sera in each

**APPENDIX C**  
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**Summary of the Clinical Reports on the Cases of**  
**Diphtheria together with the Results of the**  
**Series of Examinations of Complement of the Serum**  
**made in each**

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## SUMMARY OF CLINICAL REPORTS ON CASES OF DIPHTHERIA

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## CASE 1: J. O'D., Age 29 years

Admitted on 6th day of illness. Faucial diphtheria. Sharply ill.

Membrane covering fauces, severe toxæmia. Cervical glands swollen. 14,000 units antitoxin subcutaneously.

Throat cleaned rapidly. Membrane gone in five days. During convalescence the patient suffered from painful joints ascribed to rheumatism, to which he was subject.

There were no complications due to diphtheria. A faint V.S. murmur with rapidity of the pulse was present throughout illness.

## CASE 2: R. McL., Age 16 years

Admitted on 4th day of illness. Faucial diphtheria. Severely ill.

Membrane covering both tonsils and uvula. Cervical glands swollen. Toxæmia severe.

12,000 units antitoxin on admission.

Throat quite clean and patient well by 12th day.

Convalescence was good.

-----

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|   |      |         |       |
|---|------|---------|-------|
| 1 | 6th  | .1 c.c. | 10.00 |
|   | 9th  | .2 "    | 5.00  |
|   | 19th | .18 "   | 5.55  |
|   | 24th | .27 "   | 3.70  |
|   | 40th | .31 "   | 3.22  |

|   |      |          |      |
|---|------|----------|------|
| 2 | 5th  | .13 c.c. | 7.69 |
|   | 12th | .27 "    | 3.70 |
|   | 17th | .33 "    | 3.03 |
|   | 31st | .24 "    | 4.16 |
|   | 38th | .215 "   | 4.65 |

**CASE 3: D. H., 9 years**

Admitted on 2nd day of illness. Very ill. Faucial diphtheritic membrane covering both tonsils and uvula. Cervical gland swollen. Toxaemia severe.

20,000 units antitoxin on admission.

Improvement began on the following day, and continued throughout. Convalescence was good except for sickness on 15th day, which may have been a manifestation of serum disease. No rash.

Throat clean on the 9th day of illness.

**CASE 4: W. McB., 9 years**

Admitted on 2nd day of illness.

Diphtheritic membrane covering both tonsils. Toxaemia fairly severe.

14,000 units antitoxin subcutaneously on admission.

Improvement noted on the following day, after which recovery rapidly took place. Throat clean on 8th day.

Serum rash 6 days after administration of serum.

Good convalescence.

**CASE 5: J. McD., 7 years**

Admitted on 2nd day of illness. Severely ill.

Diphtheritic membrane on tonsils and soft palate. Toxaemia severe.

6,000 units antitoxin.



| Case  | Day of Illness | S        | Complement |
|-------|----------------|----------|------------|
| 3     | 3rd            | .19 o.o. | 5.26       |
|       | 4th            | .17 "    | 5.88       |
|       | 7th            | .21 "    | 5.00       |
|       | 9th            | .21 "    | 4.76       |
|       | 16th           | .28 "    | 3.57       |
|       | 27th           | .28 "    | 3.57       |
|       | 36th           | .24 "    | 4.16       |
| ----- |                |          |            |
| 4     | 2nd            | .25 o.o. | 4.00       |
|       | 3rd            | .17 "    | 5.88       |
|       | 8th            | .27 "    | 3.70       |
|       | 11th           | .38 "    | 2.63       |
|       | 25th           | .38 "    | 2.63       |
| ----- |                |          |            |
| 5     | 3rd            | .06 o.o. | 16.66      |
|       | 5th            | .17 "    | 5.88       |
|       | 11th           | .21 "    | 4.76       |
|       | 19th           | .25 "    | 4.00       |

## CASE 5 (Contd.)

Marked improvement two days later. Throat almost clean on 5th day of illness.

Serum rash 9 days after administration of antitoxin.

Convalescence satisfactory.

## CASE 6: G. B., Age 7 years

Admitted on 2nd day of illness. Sharply ill.

Membrane covering both tonsils. Toxaemia moderately severe.

10,000 units antitoxin subcutaneously on admission.

Throat clean by 6th day.

Convalescence uninterrupted.

## CASE 7: A. S., Age 25 years

Admitted on 2nd day of illness. Sharply ill.

Faucial diphtheria.

Membrane on both tonsils. Toxaemia moderate. Fauces much swollen and inflamed.

Cervical glands enlarged and tender.

6,000 units antitoxin subcutaneously on admission.

Throat clean by 6th day.

Rapid recovery.

## CASE 8: N. C., Age 9 years

Admitted on 2nd day of illness. Sharply ill. Severe toxaemia

Diphtheritic membrane covering right side of throat and

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|   |      |          |      |
|---|------|----------|------|
| 6 | 2nd  | .14 o.c. | 7.14 |
|   | 3rd  | .13 "    | 7.69 |
|   | 6th  | .13 "    | 7.69 |
|   | 8th  | .18 "    | 5.55 |
|   | 26th | .21 "    | 4.76 |
|   | 36th | .22 "    | 4.54 |

|   |      |          |      |
|---|------|----------|------|
| 7 | 2nd  | .25 o.c. | 4.00 |
|   | 3rd  | .22 "    | 4.54 |
|   | 6th  | .28 "    | 3.57 |
|   | 15th | .33 "    | 3.03 |

|   |     |          |      |
|---|-----|----------|------|
| 8 | 2nd | .16 o.c. | 6.25 |
|   | 3rd | .175 "   | 5.71 |
|   | 8th | .22 "    | 4.54 |

## CASE 8 (Contd.)

uvula. Right cervical glands swollen.

10,000 units antitoxin given subcutaneously on admission.

After the 3rd day throat improved rapidly, and was quite clean by the 8th day.

Good convalescence.

## CASE 9: A. T., 13 years

Admitted on 3rd day of illness. Acutely ill.

Membrane covering whole of fauces. Cervical glands much swollen. Severe toxæmia.

16,000 units antitoxin on admission.

24,000 " " next day.

Improved steadily after this. Throat almost clean on 8th day of illness. Serum rash on 10th day.

Otorrhoea on 15th day and palatal paralysis on the 35th day.

The latter was slight and did not last long.

Convalescence was good afterwards.

## CASE 10: J. C., Age 6 years

Admitted to Hospital on 1st day of illness. Faucial diphtheria. Moderately ill.

Diphtheritic membrane in patches on both tonsils and uvula.

Cervical glands a little swollen.

4,000 units antitoxin subcutaneously. Throat quite clean on the 4th day of illness.

Convalescence uninterrupted.

| Case          | Day of Illness | S        | Complement |
|---------------|----------------|----------|------------|
| 8<br>(Contd.) | 18th           | .28 c.c. | 5.55       |
|               | 51st           | .26 "    | 3.84       |

|   |      |          |      |
|---|------|----------|------|
| 9 | 3rd  | .25 c.c. | 4.00 |
|   | 8th  | .22 "    | 4.54 |
|   | 24th | .14 "    | 7.14 |

|    |      |          |       |
|----|------|----------|-------|
| 10 | 2nd  | .18 c.c. | 5.55  |
|    | 4th  | .22 "    | 4.54  |
|    | 7th  | .22 "    | 4.54  |
|    | 25th | .08 "    | 12.50 |

## CASE 11: E. D., Age 6 years

Admitted on 3rd day of illness. Diphtheritic membrane covering both tonsils. Mild toxaemia. Left tonsil ulcerated.

Membrane gone by the 6th day, but an ulcer remained on the tonsil even as late as the 36th day.

8,000 units antitoxin subcutaneously on admission.

## CASE 12: G. B., Age 10 years

Admitted on 4th day of illness. Sharply ill. Diphtheritic membrane covering greater part of both tonsils. Toxaemia moderately severe.

8,000 units antitoxin given subcutaneously. Throat clean on 7th day after illness.

Patient made a good recovery.

## CASE 13: J. H., Age 7 years

Admitted on 4th day of illness.

Patches of membrane on both tonsils. Moderate degree of toxaemia.

8,000 units antitoxin subcutaneously on admission. Had 4,000 units 4 days before admission.

Serum rash on 11th day of illness. Palatal paralysis on 16th day.

Convalescence slow but not further interrupted.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |          |      |
|----|------|----------|------|
| 11 | 3rd  | .15 c.c. | 6.66 |
|    | 4th  | .11 "    | 9.09 |
|    | 36th | .12 "    | 8.33 |

|    |      |                                      |                                     |
|----|------|--------------------------------------|-------------------------------------|
| 12 | 5th  | .36 c.c. <sup>K</sup>                | 2.77 -                              |
|    | 7th  | .34 " <sup>K</sup>                   | 2.94 -                              |
|    | 12th | .46 " <sup>K</sup>                   | 2.17 -                              |
|    | 15th | .44 " <sup>K</sup>                   | 2.27 -                              |
|    | 33rd | .54 " <sup>K</sup>                   | 1.85 -                              |
|    |      | <sup>K</sup> Haemolysis not complete | - Complement figure lower than this |

|    |      |                                      |                                     |
|----|------|--------------------------------------|-------------------------------------|
| 13 | 6th  | .36 c.c. <sup>K</sup>                | 2.77 -                              |
|    | 9th  | .36 " <sup>K</sup>                   | 2.77 -                              |
|    | 11th | .40 " <sup>K-</sup>                  | 2.50 -                              |
|    | 13th | .44 " <sup>K</sup>                   | 2.17 -                              |
|    | 20th | .43 " <sup>K</sup>                   | 2.32 -                              |
|    | 37th | .26 "                                | 3.84                                |
|    |      | <sup>K</sup> Haemolysis not complete | - Complement figure lower than this |

**CASE 14: M. B., Age 13 years**

Admitted on 4th day of illness. Diphtheritic membrane covering both tonsils. Fauces and cervical glands much swollen. Nasal discharge. Toxaemia severe  
8,000 units antitoxin intravenously. Condition much the same next day.

Steady improvement afterwards. Throat clean by 10th day. Serum rash appeared over body on 10th day after the antitoxin was given. Serum arthritis three days later. Convalescence was good.

**CASE 15: Mrs G., Age 33 years**

Admitted on 4th day of illness. Faucial and nasal diphtheria. Diphtheritic membrane covering tonsils completely and extending over the soft palate. Nasal discharge. Marked facial pallor.

Severe toxaemia. Cervical glands enlarged.

20,000 units antitoxin on admission.

20,000 units more on the following day.

Throat and nose steadily improved, and membrane had completely gone by the 10th day.

Serum rash appeared 14 days after antitoxin was given. Little general disturbance at this time.

Convalescence was uninterrupted, although slow



| Case | Day of Illness | S       | Complement |
|------|----------------|---------|------------|
| 14   | 4th            | .1 c.c. | 10.00      |
|      | 5th            | .145 "  | 6.89       |
|      | 8th            | .2 "    | 5.00       |
|      | 15th           | .28 "   | 3.57       |
|      | 17th           | .28 "   | 3.57       |
|      | 22nd           | .36 "   | 2.77       |
|      | 38th           | .26 "   | 3.84       |

|    |      |          |       |
|----|------|----------|-------|
| 15 | 4th  | .06 c.c. | 16.66 |
|    | 5th  | .13 "    | 7.69  |
|    | 7th  | .14 "    | 7.14  |
|    | 10th | .09 "    | 11.11 |
|    | 19th | .16 "    | 6.25  |
|    | 38th | .15 "    | 6.66  |

## CASE 16: J. A., Age 31 years

Admitted on 4th day of illness.

Faucial and nasal diphtheria. Severe toxæmia. Whole of fauces covered with foul diphtheritic membrane. Cervical glands much enlarged.

|                                                        |   |                |
|--------------------------------------------------------|---|----------------|
| 20,000 units antitoxin on admission                    | ) |                |
| 20,000     "             "             " following day | ) | subcutaneously |

Condition steadily improved after this, and membrane had entirely gone by 12th day of illness.

Convalescence was prolonged because of a mild degree of palatal paralysis, which began on the 36th day.

## CASE 17: J. S., Age 6 years

Admitted on 5th day of illness.

Faucial and nasal diphtheria. Sharply ill.

Severe toxæmia.

Membrane covering both tonsils and part of soft palate.

Nasal discharge.

12,000 units antitoxin intravenously.

Throat quite clean by 12th day.

Slight palatal paralysis developed on the 45th day.

Rapidly disappeared.

Good convalescence afterwards.

-----

| Case | Day of Illness | S         | Complement |
|------|----------------|-----------|------------|
| 16   | 4th            | .125 c.c. | 8.00       |
|      | 5th            | .14 "     | 7.14       |
|      | 8th            | .15 "     | 6.66       |
|      | 11th           | .16 "     | 6.25       |
|      | 19th           | .21 "     | 4.76       |

|    |      |          |      |
|----|------|----------|------|
| 17 | 5th  | .46 c.c. | 2.17 |
|    | 6th  | .46 "    | 2.17 |
|    | 9th  | .24 "    | 4.16 |
|    | 12th | .23 "    | 4.34 |
|    | 18th | .25 "    | 4.34 |
|    | 45th | .30 "    | 3.33 |

## CASE 18: D. G., Age 7 years

Admitted on 2nd day of illness. Acutely ill.

Faucial and nasal diphtheria. Severe toxæmia.

Membrane covering both tonsils. Fauces swollen. Nasal discharge. Cervical glands swollen.

14,000 units antitoxin given subcutaneously on admission.

Throat quite clean on 9th day of illness.

Condition steadily improved, and patient was quite well on the 12th day.

Slight palatal paralysis on 42nd day of illness.

Convalescence afterwards was good.

## CASE 19: M. W., Age 3 years

Admitted on 3rd day of illness. Malignant diphtheria.

Fauces completely covered, and nose blocked with diphtheritic membrane.

Throat and nose bleeding. Neck very much swollen.

Toxæmia profound.

22,000 units antitoxin given intravenously.

No improvement followed. Haemorrhage continued. Death on 6th day.

## CASE 20: J. C., Age 6 years.

Admitted on 3rd day of illness. Severe faucial and nasal diphtheria.

Membrane covering tonsils and also present in nose. Severe

| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 18   | 2nd            | .28 c.c. | 3.57       |
|      | 12th           | .46 "    | 2.17       |
|      | 18th           | .2 "     | 5.00       |
|      | 45th           | .41 "    | 2.38       |
|      | 58th           | .38 "    | 2.8        |

|    |     |          |       |
|----|-----|----------|-------|
| 19 | 3rd | .06 c.c. | 16.66 |
|    | 4th | .13 "    | 7.69  |

|    |     |          |      |
|----|-----|----------|------|
| 20 | 4th | .16 c.c. | 6.25 |
|----|-----|----------|------|

## CASE 20 (Contd.)

toxaemia.

16,000 units antitoxin subcutaneously.

Throat improved steadily.

Death from cardiac failure occurred on the 6th day of illness.

## CASE 21: E. C., Age 6 years.

Admitted on 4th day of illness.

Laryngeal and tracheal diphtheria.

Tracheotomy on admission.

20,000 units antitoxin subcutaneously. Improved rapidly.

Tracheal tube removed on 7th day.

Convalescence uninterrupted.

## CASE 22: J. S., Age 5½ years

Admitted on 7th day of illness.

Faucial and laryngeal diphtheria. Membrane on tonsils.

Moderate degree of toxaemia.

4,000 units antitoxin.

Recovered rapidly. Quite well by the 18th day.

Good convalescence.

-----

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |     |          |       |
|----|-----|----------|-------|
| 21 | 4th | .12 c.c. | 8.33  |
|    | 7th | .05 "    | 20.00 |

Summary of the Clinical Report on the Cases of

Scarlet Fever, together with the Results of

the Series of Examinations of the Blood, made

in each

|    |      |          |       |
|----|------|----------|-------|
| 22 | 8th  | .09 c.c. | 11.11 |
|    | 18th | .165 "   | 6.06  |

**APPENDIX D**  
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**Summary of the Clinical Reports on the Cases of  
Scarlet Fever, together with the Results of  
the Series of Examinations of Complement made  
in each**

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SCARLET FEVER - CLINICAL NOTES ON CASES  
-----

## CASE 1: L. T., Age 10 years

Admitted to hospital on 2nd day of illness.

Mild attack of scarlet fever. Faint rash. Throat moderately inflamed. Fever lasted 10 days.

No complications. Convalescence good.

## CASE 2: E. D., Age 9 years

Admitted on 3rd day of scarlet fever. Moderately ill.

Bright rash. Throat mildly inflamed.

Fever lasted 8 days. No complications.

## CASE 3: J. K., Age 7 years

Admitted on 5th day of illness. Fever almost gone at this period.

Mildly ill. Fairly bright rash.

Throat a little red and swollen.

Practically no fever from the time of admission.

No complications

  
-----

| Case  | Day of Illness | S         | <sup>*</sup> Complement |
|-------|----------------|-----------|-------------------------|
| 1     | 3rd            | .115 c.c. | 4.34                    |
|       | 6th            | .135 "    | 3.70                    |
|       | 8th            | .105 "    | 4.76                    |
|       | 11th           | .155 "    | 3.22                    |
|       | 14th           | .2 " +    | 2.50 -                  |
|       | 30th           | .24 "     | 2.08                    |
| ----- |                |           |                         |
| 2     | 3rd            | .12 c.c.  | 4.16                    |
|       | 6th            | .135 "    | 3.70                    |
|       | 8th            | .15 "     | 3.33                    |
|       | 12th           | .13 "     | 3.84                    |
|       | 29th           | .17 "     | 2.94                    |
| ----- |                |           |                         |
| 3     | 5th            | .115 c.c. | 4.34                    |
|       | 9th            | .135 "    | 3.70                    |
|       | 11th           | .15 "     | 3.33                    |
|       | 15th           | .14 "     | 3.57                    |

<sup>\*</sup>As the amount of serum used in scarlet fever was tested against .5 c.c. sensitized ox corpuscles, the reciprocal of twice this amount of serum represents the amount of complement necessary to haemolyse 1 c.c. sensitized ox corpuscles. In this way the results have been made uniform with those of the other sections of this paper

**CASE 4: J. H., Age 5 years**

Admitted on 5th day of mild attack of scarlet fever.

Rash well marked. Throat congested. Fever lasted 9 days.

Mild cervical adenitis on 12th day.

Good recovery.

**CASE 5: D. M., Age 9 years**

Admitted on 1st day of illness. Mildly ill.

Faint rash, very little affection of throat.

Fever lasted 5 days.

No complications. Good convalescence.

**CASE 6: J. H., Age 6 years**

Admitted on 3rd day of illness. Moderately ill.

Bright rash. Tonsils swollen and inflamed.

Fever lasted 5 days. Good recovery.

No complications.

**CASE 7: D. D., Age 43 years**

Admitted on 5th day of illness. Sharply ill.

Dirty and much inflamed throat. No ulceration. Bright rash.

Fever lasted 10 days.

Arthritis of wrists on 10th day.

Otherwise convalescence was good.

| Case  | Day of Illness | S        | Complement |
|-------|----------------|----------|------------|
| 4     | 8th            | .1 c.c.  | 5.00       |
|       | 12th           | .11 "    | 4.54       |
|       | 14th           | .125 "   | 4.00       |
| ----- |                |          |            |
| 5     | 2nd            | .13 c.c. | 3.84       |
|       | 4th            | .17 " +  | 2.99 -     |
|       | 14th           | .085 "   | 6.22       |
| ----- |                |          |            |
| 6     | 3rd            | .11 c.c. | 4.54       |
|       | 6th            | .2 " +   | 2.50 -     |
|       | 16th           | .10 "    | 5.00       |
| ----- |                |          |            |
| 7     | 6th            | .08 c.c. | 6.25       |
|       | 7th            | .095 "   | 5.52       |
|       | 8th            | .095 "   | 5.52       |
|       | 10th           | .09 "    | 5.55       |
|       | 13th           | .12 "    | 4.16       |
|       | 15th           | .12 "    | 4.16       |
|       | 20th           | .16 "    | 3.12       |
|       | 32nd           | .06 "    | 8.33       |

**CASE 8: J. A., Age 10 years**

Admitted on 3rd day of illness. Sharply ill.

Bright rash. Throat much inflamed.

Fever lasted 7 days. Good convalescence. No complications.

**CASE 9: D. Q., Age 12 years**

Admitted on 1st day of scarlet fever.

Chronic tubercular diseases of ilium with discharging sin-  
uses present.

Sharply ill from the scarlet fever.

Throat much inflamed.

Bright rash present. Scarlet fever lasted 14 days.

Tubercular condition remained unchanged.

No scarlatinal complications.

**CASE 10: C. D., Age 27 years**

Admitted on 3rd day of illness. Sharply ill.

Bright rash. Throat much inflamed. Ulceration of left  
tonsil.

Fever lasted 10 days.

Peritonsillar abscess developed during 3rd week. Conval-  
escence afterwards was good.

**CASE 11: M. F., Age 12 years**

Admitted on 2nd day of sharp attack of scarlet fever.

Bright rash. Throat much inflamed. Fauces much swollen.

Fever lasted 6 days. Good recovery. Uncomplicated.

| Case                                                    | Day of Illness | S         | Complement |
|---------------------------------------------------------|----------------|-----------|------------|
| 8                                                       | 6th            | .135 c.c. | 3.70       |
|                                                         | 8th            | .115 "    | 4.34       |
|                                                         | 10th           | .17 "     | 2.94       |
|                                                         | 20th           | .07 "     | 7.14       |
| -----                                                   |                |           |            |
| 9                                                       | 3rd            | .14 c.c.  | 3.57       |
|                                                         | 5th            | .15 "     | 3.33       |
|                                                         | 8th            | .135 "    | 3.70       |
|                                                         | 10th           | .125 "    | 4.00       |
|                                                         | 27th           | .085 "    | 6.21       |
| -----                                                   |                |           |            |
| 10                                                      | 4th            | .055 c.c. | 9.90       |
|                                                         | 7th            | .145 "    | 3.44       |
|                                                         | 9th            | .05 "     | 10.00      |
|                                                         | 11th           | .11 "     | 4.54       |
|                                                         | 25th           | .065 "    | 8.76       |
|                                                         | 59th           | .06 "     | 8.33       |
| -----                                                   |                |           |            |
| 11                                                      | 3rd            | .14 c.c.  | 3.57       |
|                                                         | 5th            | .075 "    | 7.09       |
|                                                         | 7th            | .12 "     | 4.16       |
|                                                         | 10th           | .1 "      | x 5.00     |
| *1 c.c. sensitized ox cor-<br>puscles used in this case |                |           |            |

CASE 12: Mrs McN., Age 24 years

Chronic nephritis with albuminuric retinitis.

Recovering from diphtheria when scarlet fever began.

Moderately severe attack of the latter. Throat considerably inflamed and swollen. Rash well marked.

Fever lasted 6 days.

Scarlatinal arthritis of wrists on the 7th day of illness.

Kidney condition remained unchanged during convalescence from scarlet fever.

CASE 13: M. E., Age 8 years

Admitted on 3rd day of illness. Moderately severe scarlet fever.

Bright rash. Throat much inflamed.

Fever lasted 6 days.

Good recovery. No complications.

CASE 14: J. R., Age 10 years

Admitted on 4th day of illness. Sharply ill. Bright rash.

Throat much inflamed, swollen and covered with soft exudate

Temperature elevated until 14th day.

Good recovery. No complications.

CASE 15: S. W., Age 9 years

Admitted on 3rd day of scarlet fever. Sharply ill.

Tonsils much swollen and inflamed. Bright rash.

Fever lasted 6 days. No complications.

| Case  | Day of Illness | S         | Complement        |
|-------|----------------|-----------|-------------------|
| 12    | 2nd            | .135 c.c. | 3.70              |
|       | 4th            | .17 "     | 2.94              |
|       | 7th            | .21 " +   | 2.38              |
|       | 13th           | .14 "     | 3.57              |
|       | 28th           | .12 "     | 4.16              |
|       | 46th           | .1 "      | 5.00              |
| ----- |                |           |                   |
| 13    | 4th            | .135 c.c. | 3.70              |
|       | 7th            | .135 "    | 3.70              |
|       | 9th            | .095 "    | 5.52              |
|       | 12th           | .11 "     | 4.54              |
|       | 26th           | .105 "    | 4.76              |
| ----- |                |           |                   |
| 14    | 5th            | .115 c.c. | 4.34              |
|       | 8th            | .12 "     | 4.16              |
|       | 10th           | .085 "    | 6.21              |
|       | 12th           | .2 "      | 2.50              |
|       | 18th           | .16 "     | 3.17              |
| ----- |                |           |                   |
| 15    | 3rd            | .19 c.c.  | <sup>x</sup> 5.26 |
|       | 7th            | .16 "     | 6.25              |

<sup>x</sup>1 c.c. sensitized ox corpuscles  
used in this case



## CASE 16: C. McS., Age 8 years

Admitted on 3rd day of scarlet fever. Sharply ill.  
Bright rash. Throat considerably inflamed and swollen.  
Fever lasted 12 days.  
No complications.

## CASE 17: M. McI., Age 6 years

Convalescing from diphtheria when scarlet fever began.  
Acutely ill. Septic type of scarlet fever. Bright rash.  
Throat much swollen and ulcerated. Much nasal discharge.  
Patient received 10 c.c. antistreptococcic serum 6 hourly,  
per rectum, during the 4th, 5th and 6th days of illness.  
Recrudescence of diphtheria occurred, and 8,000 units of  
diphtheria antitoxin were given on the 7th day of illness.  
Improved afterwards. Convalescence good. Fever lasted 13  
days. No complications.

## CASE 18: J. H., Age 6 years

Septic scarlet fever. Severely ill.  
Admitted on 3rd day of illness. Bright rash present. Dirty  
mouth and throat.  
Suppurative parotitis, with otorrhoea, began on 9th day of  
illness. Empyema developed on the 12th day. Thoracotomy  
performed. Patient emaciated very much afterwards.  
Very slow recovery.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |      |           |      |
|----|------|-----------|------|
| 16 | 4th  | .125 c.c. | 4.00 |
|    | 6th  | .14 "     | 3.57 |
|    | 9th  | .16 "     | 3.62 |
|    | 23rd | .22 "     | 2.27 |

|    |      |          |      |
|----|------|----------|------|
| 17 | 5th  | .06 c.c. | 8.33 |
|    | 7th  | .21 "    | 2.38 |
|    | 10th | .16 "    | 3.12 |
|    | 16th | .12 "    | 4.16 |
|    | 30th | .105 "   | 4.76 |

|    |      |                                     |      |
|----|------|-------------------------------------|------|
| 18 | 4th  | Slight haemolysis with<br>.27 c.c.  | -    |
|    | 6th  | .33 "                               | -    |
|    | 9th  | Complete haemolysis ♂<br>.25 c.c.   | 2.00 |
|    | 31st | Incomplete haemolysis ♂<br>.26 c.c. | -    |

**CASE 19: J. D., Age 9½ years**

Scarlet fever. Severely ill on admission.

Nephritis began on 18th day of illness. Blood and albumen abundant.

Uraemic convulsions at this time.

First specimen of blood withdrawn 2 hours after convulsions began.

On the 21st day, i.e., the 3rd day of nephritis, pneumonia developed.

The temperature, which had been at 100° F. before rose to 104.8. Pulse was 156 and respirations 50.

Another specimen of blood was obtained on that day, but no other could be got subsequently. The patient ultimately recovered.

**CASE 20: K. McC., Age 4 years**

Very ill.

Nephritis began on 17th day of illness.

Death occurred on 32nd day.

Suppression of urine during 4 days preceding death.

**CASE 21: R. H., Age 1½ years**

Admitted on 5th day of illness.

Malignant scarlet fever. No rash except numerous small papules on the front of legs.

Extensive ulceration of throat. Copious nasal discharge.

Profound toxæmia. Death on 7th day.

| Case | Day of Illness | S | Complement |
|------|----------------|---|------------|
|------|----------------|---|------------|

|    |     |                                         |   |
|----|-----|-----------------------------------------|---|
| 19 | 1st | Very slight haemolysis<br>with .27 c.c. | - |
|    | 3rd | " " .46 "                               | - |

|    |      |                                                     |                                                      |
|----|------|-----------------------------------------------------|------------------------------------------------------|
| 20 | 30th | Very slight degree of<br>haemolysis with<br>.2 c.c. | Very small<br>amount of com-<br>plement pres-<br>ent |
|    | 32nd | .125 "                                              | 4.00                                                 |

|    |     |          |       |
|----|-----|----------|-------|
| 21 | 6th | .06 c.c. | 16.66 |
|----|-----|----------|-------|

\*1 c.c. sensitized ox  
corpuscles used in  
this case

CASE 22: E. M., Age 2 years

Malignant Scarlet fever

Admitted on 2nd day of illness.

Extensive ulceration of throat, with much enlargement of  
cervical glands.

Scarlet rash present.

Death occurred on 5th day.

-----

| Case | Day of Illness | S         | Complement |
|------|----------------|-----------|------------|
| 22   | 5th            | .125 o.o. | 8.00       |

\*1 o.o. sensitized ox cor-  
puscles used in this case

APPENDIX E

Summary of the Clinical Reports on the Cases of

Scarlet, together with the Results of the

Series of Examinations of Complement made in

each

**APPENDIX E**  
-----

**Summary of the Clinical Reports on the Cases of  
Measles, together with the Results of the  
Series of Examinations of Complement made in  
each**

-----

SUMMARY OF CLINICAL REPORTS ON THE CASES OF MEASLES  
-----

## CASE 1: M. MoI., Age 20 years

Admitted on the second day of illness. Sharply ill.

Catarrhal symptoms moderately severe.

Moderately bright rash present - typical.

Fever lasted five days.

Temperature varied between 99° F. and 103° F.

Terminated by crisis.

## CASE 2: E. K., Age 25 years

Admitted on the fifth day of illness. Sharply ill.

Catarrhal symptoms almost absent.

Rash in fading stage.

Temperature 101.6° on admission. Normal on the 6th day of illness.

## CASE 3: Mrs S., Age 28 years

Admitted on the seventh day of illness. Sharply ill.

Bright and typical rash present. Catarrhal symptoms moderately severe.

Temperature 102° F. on admission; 103.4° F. on the following day; reached normal by crisis on the 10th day of illness.



| Case | Day of Illness | S        | Complement |
|------|----------------|----------|------------|
| 1    | 4th            | .15 c.o. | 6.66       |
|      | 6th            | .08 "    | 12.50      |
|      | 8th            | .17 "    | 5.80       |
|      | 10th           | .16 "    | 6.25       |
|      | 12th           | .18 "    | 5.55       |

|   |      |          |      |
|---|------|----------|------|
| 2 | 6th  | .17 c.o. | 5.88 |
|   | 9th  | .23 "    | 4.34 |
|   | 12th | .2 "     | 5.00 |
|   | 18th | .28 "    | 3.57 |

|   |      |          |      |
|---|------|----------|------|
| 3 | 9th  | .13 c.o. | 7.69 |
|   | 11th | .14 "    | 7.14 |
|   | 13th | .18 "    | 5.55 |
|   | 15th | .17 "    | 5.88 |
|   | 19th | .17 "    | 5.88 |

CASE 4: L. McK., Age 30 years

Admitted on the fifth day of illness. Sharply ill.

Rash developing; typical on the following day.

Catarrhal symptoms moderately severe.

Temperature  $102.4^{\circ}$  F. on admission; reached normal by crisis on the seventh day.

CASE 5: N. L., Age 19 years

Admitted on the eighth day of illness. Sharply ill.

Catarrhal symptoms moderate.

Bright rash present; typical distribution.

Temperature  $100^{\circ}$  F. on admission. Reached normal on the same day.

CASE 6: D. W., Age 18 years

Admitted on the fourth day of illness. Sharply ill.

Catarrhal symptoms moderately severe.

Rash bright and typical.

Temperature rose from  $102^{\circ}$  F. to  $103^{\circ}$  F. on the day of admission; reached normal by crisis on the 6th day of illness. Slight tonsillitis on the 28th day.

-----

| Case  | Day of Illness | S         | Complement |
|-------|----------------|-----------|------------|
| 4     | 5th            | .16 o.o.  | 6.25       |
|       | 7th            | .2 "      | 5.00       |
|       | 9th            | .19 "     | 5.26       |
|       | 11th           | .20 "     | 5.00       |
|       | 15th           | .16 "     | 6.25       |
| ----- |                |           |            |
| 5     | 8th            | .215 o.o. | 4.65       |
|       | 10th           | .20 "     | 5.00       |
|       | 14th           | .19 "     | 5.26       |
| ----- |                |           |            |
| 6     | 5th            | .28 o.o.  | 3.57       |
|       | 6th            | .3 "      | 3.33       |
|       | 8th            | .28 "     | 3.57       |
| ----- |                |           |            |

APPENDIX F

(a) Typhus Fever

(b) Lobar Pneumonia

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Summary of the Clinical Reports on the Cases of

Typhus Fever and Lobar Pneumonia, together

with the Results of the Series of Examinations

of Complement made in each

-----

## (a) TYPHUS FEVER

-----

## CASE 1: H. McG., Age 23 years

Admitted on 5th day of illness. Sharply ill.

Typical rash over body. Slightly delirious. Remained ill until temperature began to fall.

Rapid convalescence. Fever lasted fourteen days.

## CASE 2: M. McC., Age 22 years

Patient had a sharp attack of Typhus fever. No complications.

Fever lasted 12 days.

Good convalescence.

## CASE 3: H. B., Age 39 years

Admitted to hospital on 8th day of illness. Very ill.

Delirious. Retention of urine. Bright fixed typhus rash.

Improved until 14th day, when temperature fell to normal by crisis.

Cystitis developed about this time. This became progressively worse. Rigors occurred on the 28th, 29th and 30th days of illness. Patient died on 30th day.

Post Mortem: extensive cystitis, pyelitis and periurethral suppuration.

-----

| Case  | Day of Illness | S        | Complement |
|-------|----------------|----------|------------|
| 1     | 7th            | .22 o.o. | 4.54       |
|       | 9th            | .25 "    | 4.00       |
|       | 12th           | .17 "    | 5.88       |
|       | 16th           | .27 "    | 3.70       |
|       | 19th           | .26 "    | 3.84       |
|       | 23rd           | .15 "    | 6.66       |
| ----- |                |          |            |
| 2     | 14th           | .14 o.o. | 7.14       |
|       | 22nd           | .2 "     | 5.00       |
|       | 38th           | .12 "    | 8.33       |
| ----- |                |          |            |
| 3     | 8th            | .19 o.o. | 5.26       |
|       | 9th            | .21 "    | 4.76       |
|       | 10th           | .19 "    | 5.26       |
|       | 12th           | .21 "    | 4.76       |
|       | 14th           | .22 "    | 4.54       |
|       | 16th           | .22 "    | 4.54       |
|       | 24th           | .14 "    | 7.14       |
|       | 29th           | .15 "    | 6.66       |
| ----- |                |          |            |

(b) LOBAR PNEUMONIA  
-----

## CASE 1: J. B., Age 13 years

Admitted on the 3rd day of illness.

Sharply ill. Typical appearances. Crisis on 7th day.

Recovery rapid.

## CASE 2: G. L., Age 15 years

Admitted on 3rd day of illness. Sharply ill.

Left lung extensively affected. Delirious. Symptoms typical.

Remained sharply ill until crisis occurred on 7th day.

Convalescence uninterrupted.

## CASE 3: M. McL., Age 29 years

Admitted on the 4th day of illness. Moderately ill.

Symptoms typical. Right lower lobe affected. Crisis on 7th day. Convalescence was good, with the exception of illness from tonsillitis on the twenty-fifth day.

## CASE 4: T. S., Age 32 years

Admitted on 5th day of illness. Very ill. Left lung involved.

Was extremely ill on 8th day. Delirious.

Rapid improvement with the occurrence of a crisis on 10th day.

| Case  | Day of Illness | S        | Complement |
|-------|----------------|----------|------------|
| 1     | 4th            | .17 c.c. | 5.88       |
|       | 9th            | .18 "    | 5.55       |
|       | 14th           | .27 "    | 3.70       |
|       | 23rd           | .26 "    | 3.84       |
| ----- |                |          |            |
| 2     | 5th            | .08 c.c. | 12.50      |
|       | 12th           | .16 "    | 6.25       |
|       | 25th           | .21 "    | 4.76       |
| ----- |                |          |            |
| 3     | 4th            | .21 c.c. | 4.76       |
|       | 8th            | .27 "    | 3.70       |
|       | 12th           | .28 "    | 3.57       |
| ----- |                |          |            |
| 4     | 6th            | .14 c.c. | 7.14       |
|       | 7th            | .18 "    | 5.55       |
|       | 8th            | .21 "    | 4.76       |
|       | 9th            | .15      | 6.66       |



## CASE 4 (Contd.)

Temperature never settled for the following five weeks, because of pleurisy with effusion, although the patient's general condition steadily improved.

On the 49th day Scarlet fever developed. Sharply ill at this time. Bright rash present and also a fairly severe angina.

Temperature had not quite settled on the 58th day but the patient had quite recovered at this time. Dullness over the base of the left lung persisted.

Lung condition steadily improved after this.

-----

| Case          | Day of Illness | S         | Complement |
|---------------|----------------|-----------|------------|
| 4<br>(Contd.) | 10th           | .195 c.c. | 5.12       |
|               | 11th           | .15 "     | 6.66       |
|               | 12th           | .12 "     | 8.33       |
|               | 14th           | .11 "     | 9.09       |
|               | 16th           | .1 "      | 10.00      |
|               | 19th           | .09 "     | 11.11      |
|               | 25th           | .14 "     | 7.14       |
|               | 31st           | .11 "     | 9.09       |
|               | 44th           | .13 "     | 7.69       |
|               | 48th           | .13 "     | 7.69       |
|               | 51st           | .17 "     | 5.88       |
|               | 58th           | .14 "     | 7.14       |
|               | 85th           | .21 "     | 4.76       |

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- (1) LONGCOPE Jour. Hygiene. Vol. 3, 1903. p. 28
- (2) MUIR AND BROWNING, Jour. Path. and Bact. Vol. XIII, 1908, p. 76
- (3) BORDET, "Studies in immunity", translated by Gay, John Wiley and Sons, p. 186
- (4) EHRLICH AND SACHS, "Studies on Immunity". Ehrlich translated by Boldann. John Wiley and Sons, p. 195
- (5) MUIR AND BROWNING, Loc. cit.
- (6) MUIR, "Studies on immunity", 1909, p. 3
- (7) BORDET Loc. cit., p. 99
- (8) BORDET AND GENGOU, " p. 226
- (9) MULLER, Vorlesung uber infektion und immunität, pp. 315-316
- (10) MCCRIRICK, Jour. Path and Bact. 1911, Vol. XVI, p. 16
- (11) LOVE, Glasgow Medical Journal, 1911. Vol. LXVI, p. 247

## C H A R T S

Illustrating the Course of the Cases and the Variations of the Serum Complement at the time of the different Observations. The numbering of the Charts corresponds to that of the Cases given in the text. They are arranged in the order in which the Diseases are discussed

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## T H E S I S

PRESENTED FOR THE DEGREE OF DOCTOR OF MEDICINE

by

WILLIAM COOPER GUNN, M.B., Ch.B.

June, 1912

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SUBJECT

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The Variation in the Amount of Complement present in the Blood in Acute Infectious Diseases and its Relation to the Clinical Features; with a short note upon the Serum Treatment of Cerebro-Spinal Meningitis

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**SECTION A - ENTERIC FEVER**

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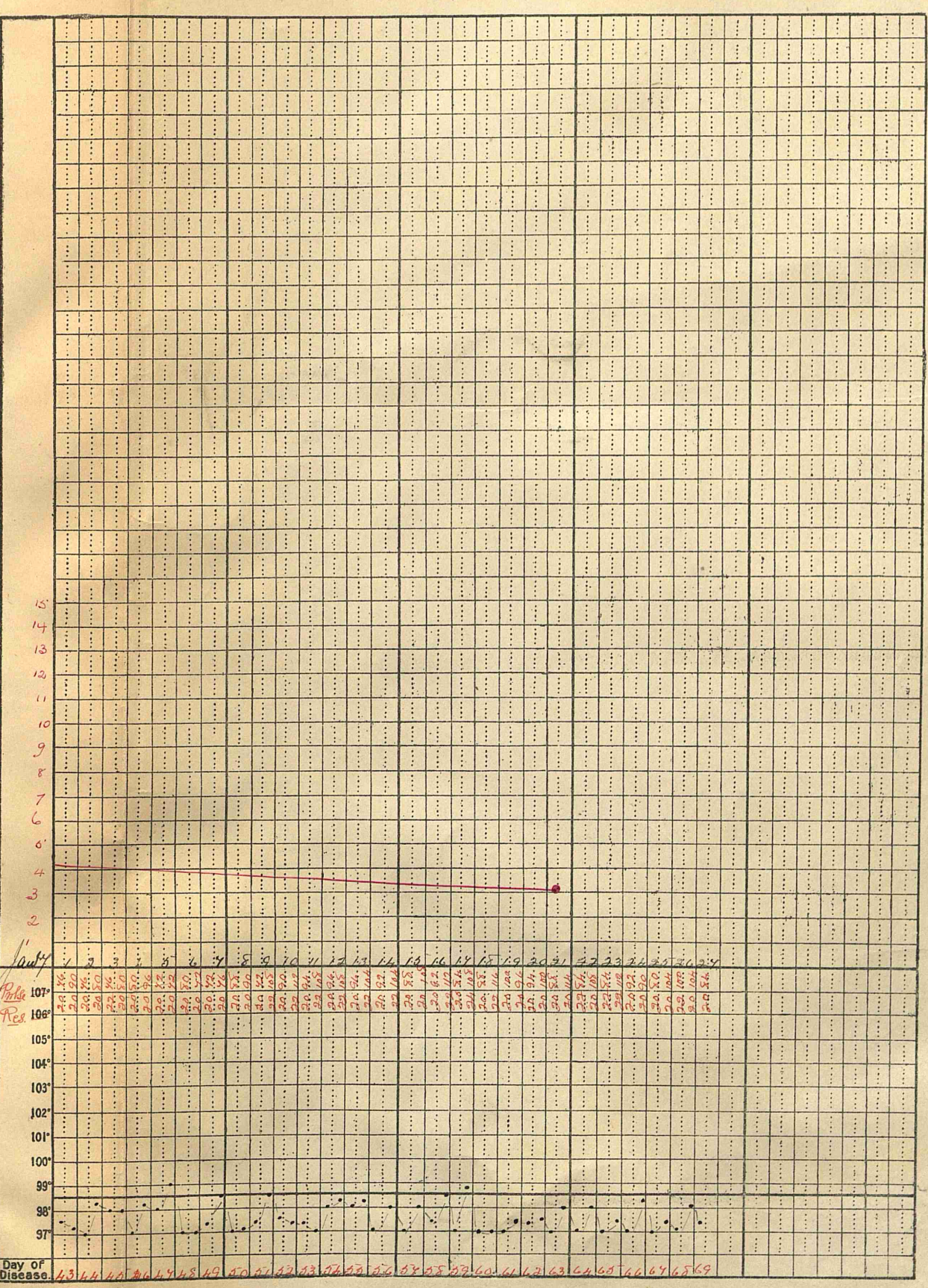
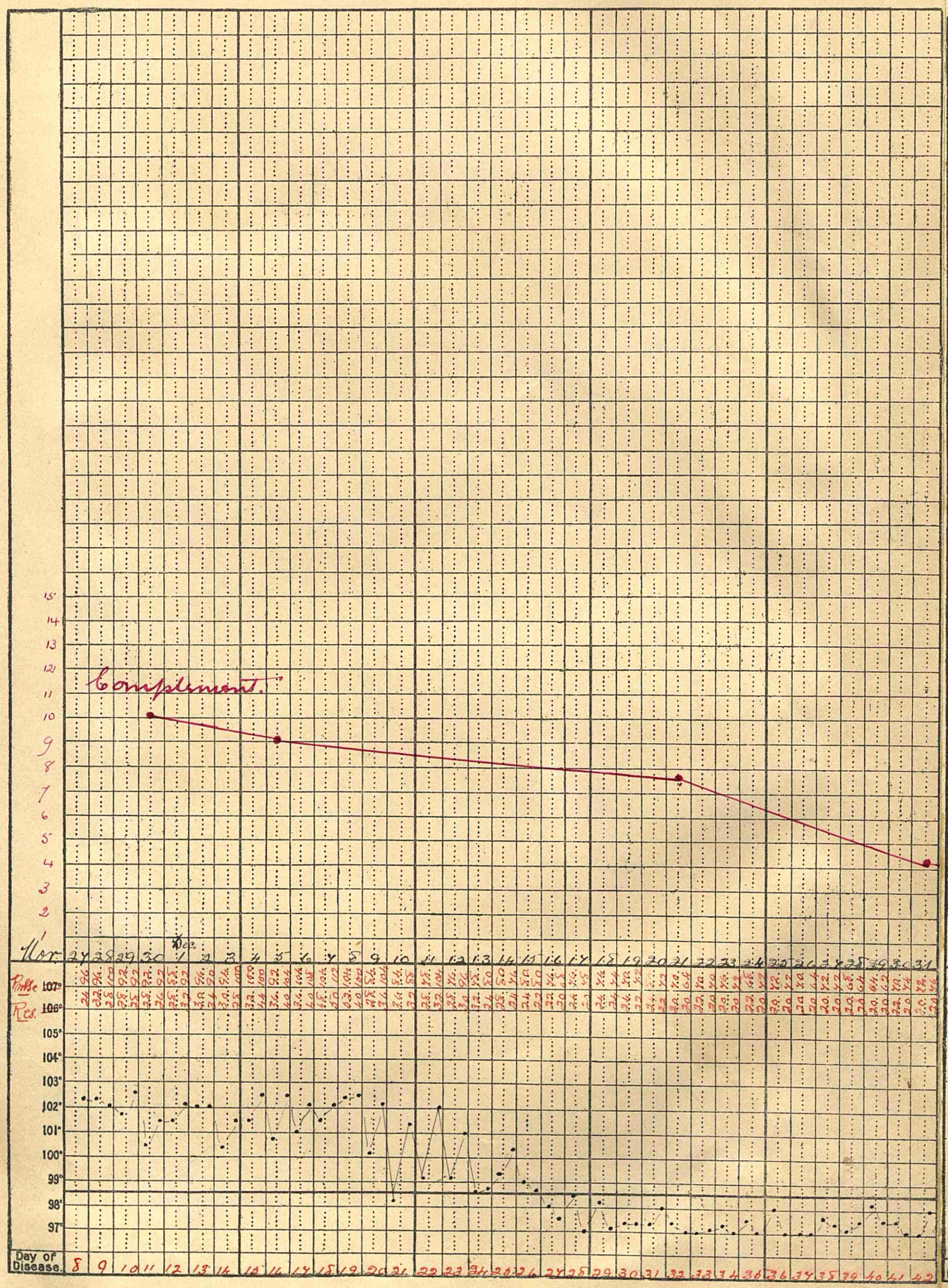
William Cooper  
Age 23 years  
Adm. 24. 11. 11

Chart I

1st. Cont.

1a

Entire  
Fever.



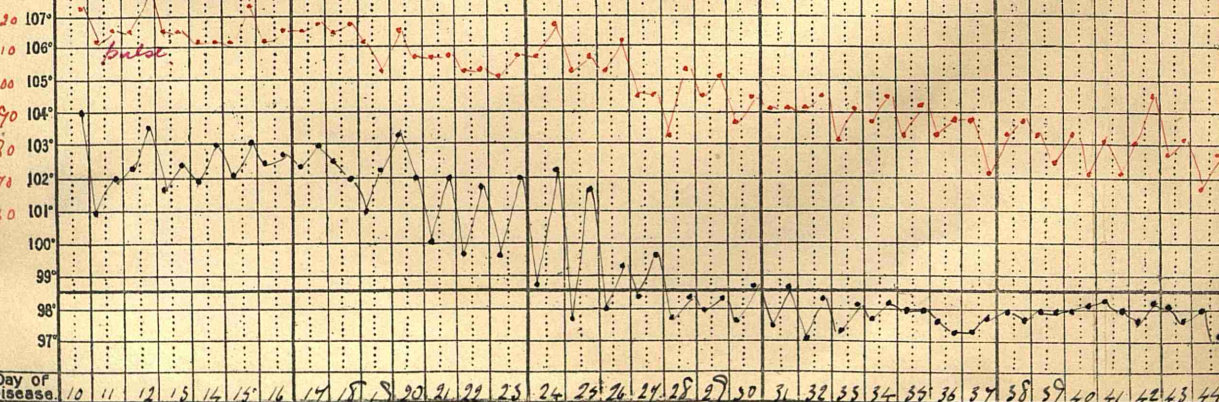


File

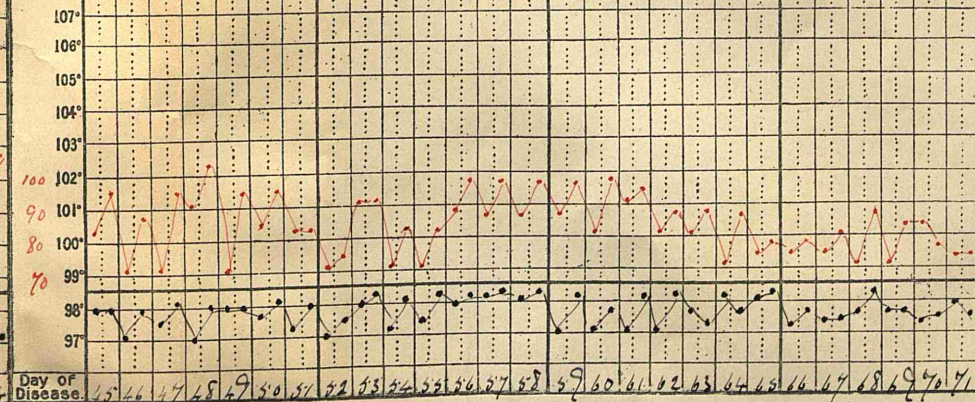
November 24 25 26 27 28 29 30 December 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

December 29 30 31 January 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Complement



Complement



Free  
- ves.

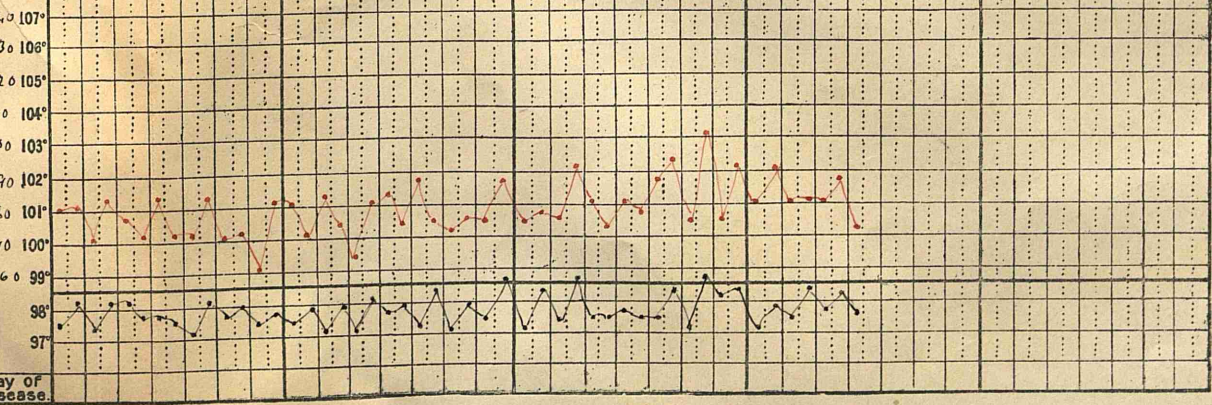
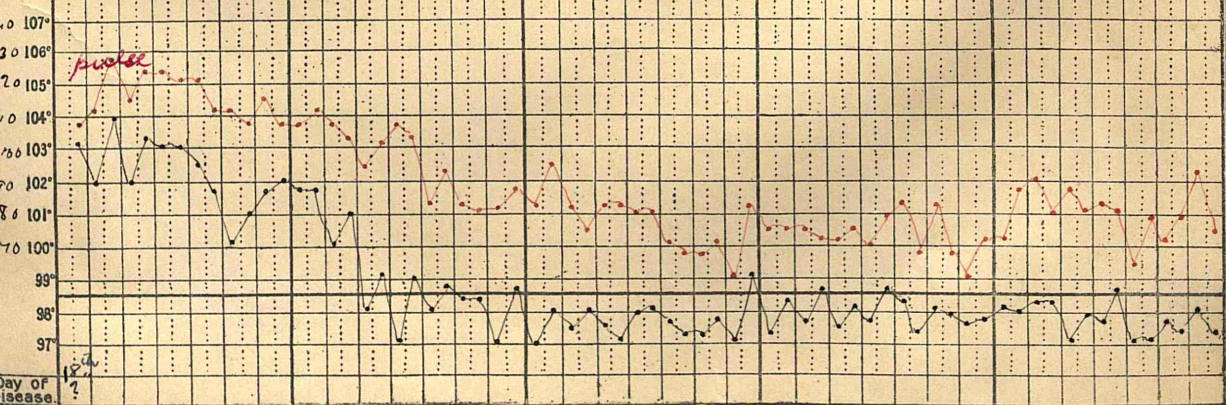
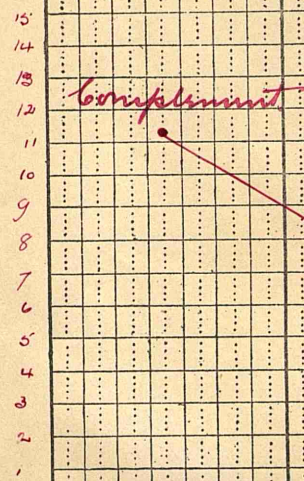
1/2 m 50u  
100u  
24. 9.11



January

December 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 1 2 3 4 5

January 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



Antoni  
Frost.

A. Elliot  
31 years  
under 2nd 1911

Day of  
Disease

Day of  
Disease



u Reid

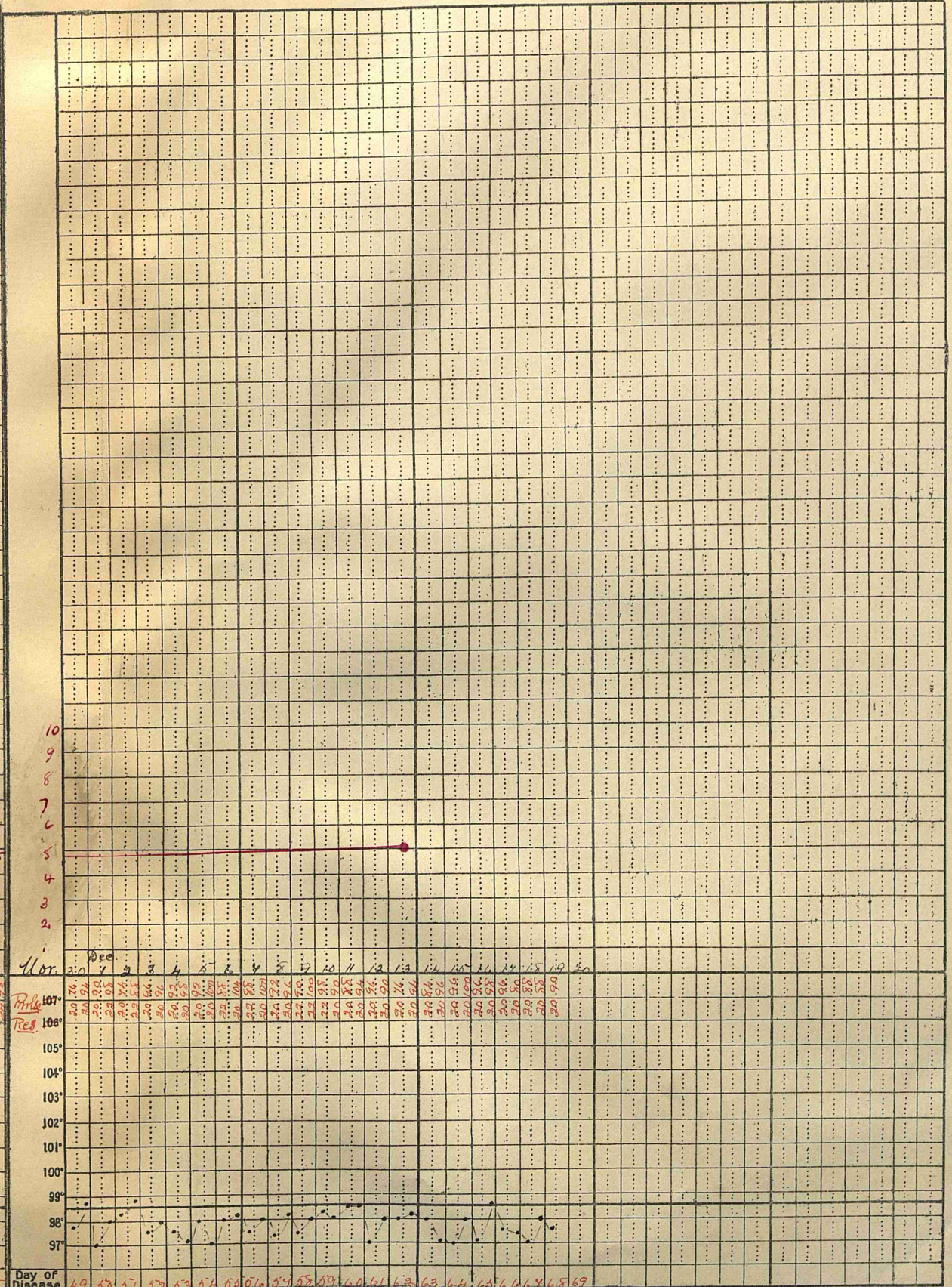
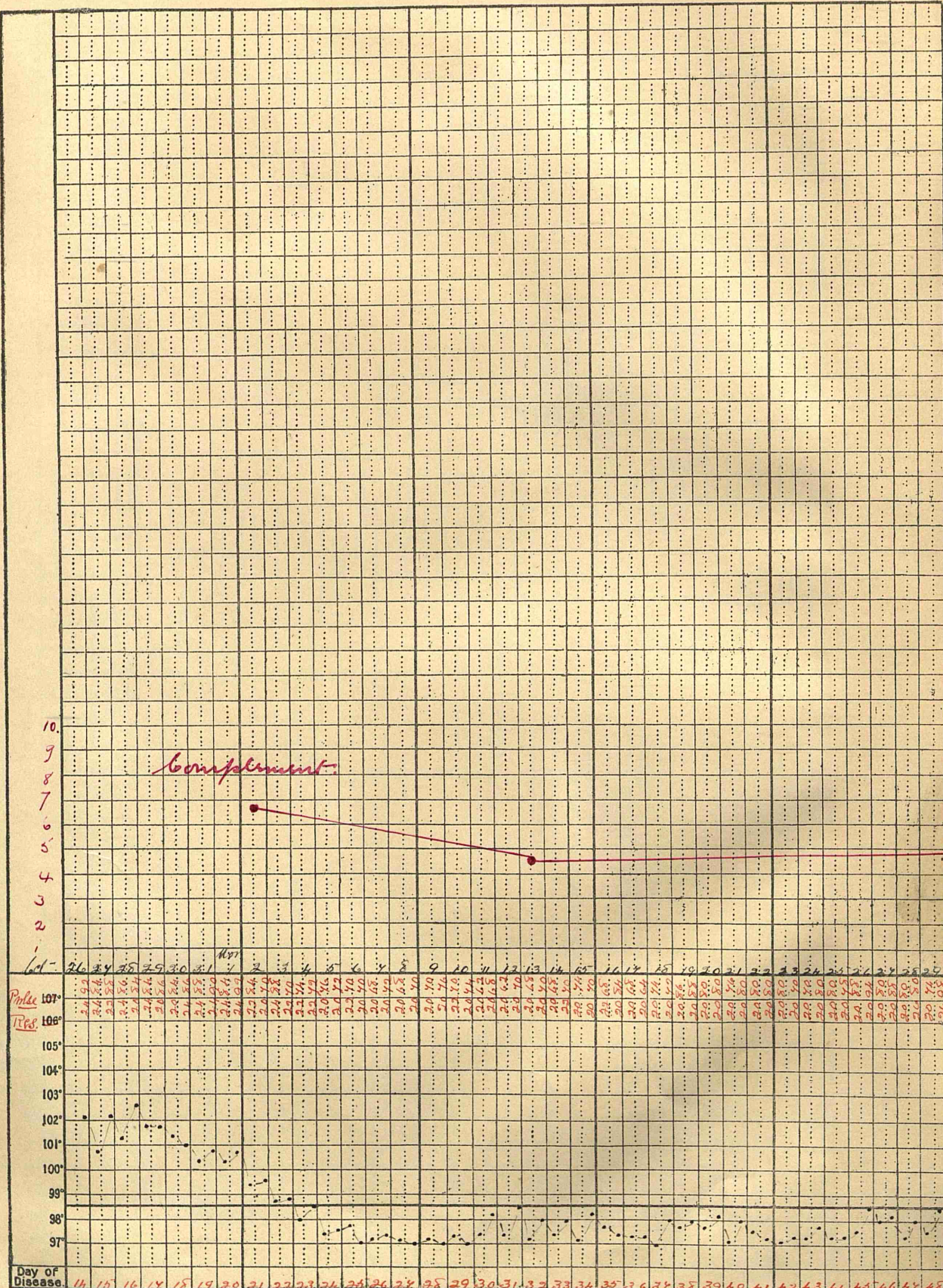
chart  
IV

4 2

4a

Age 10 years.  
26.10.11

clinical  
fever

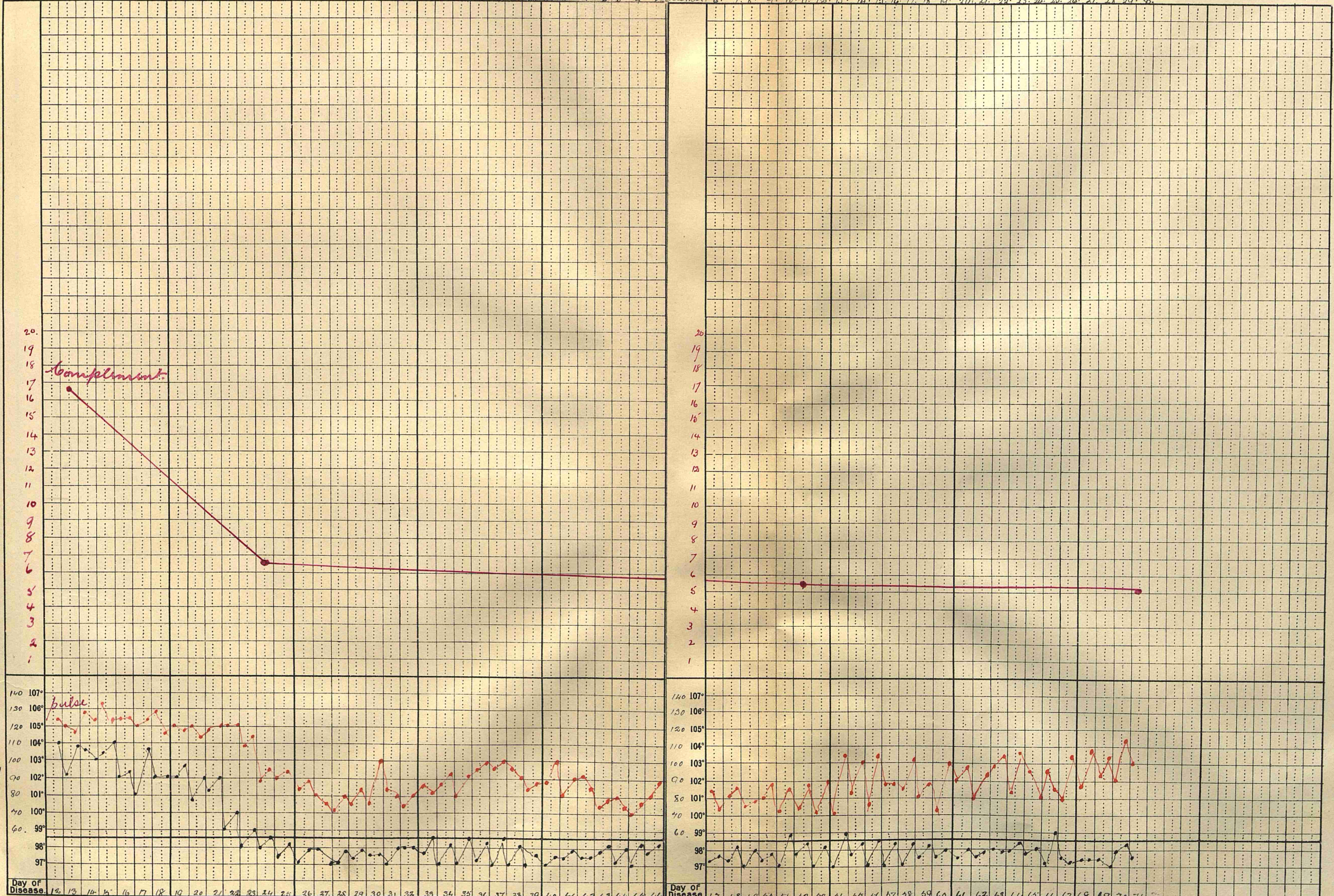




November. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 December. 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

ntani  
wv.

Lilled  
yours  
11/9/11





Dr. T. G. ...  
Age 23 years  
Date 12.9.11

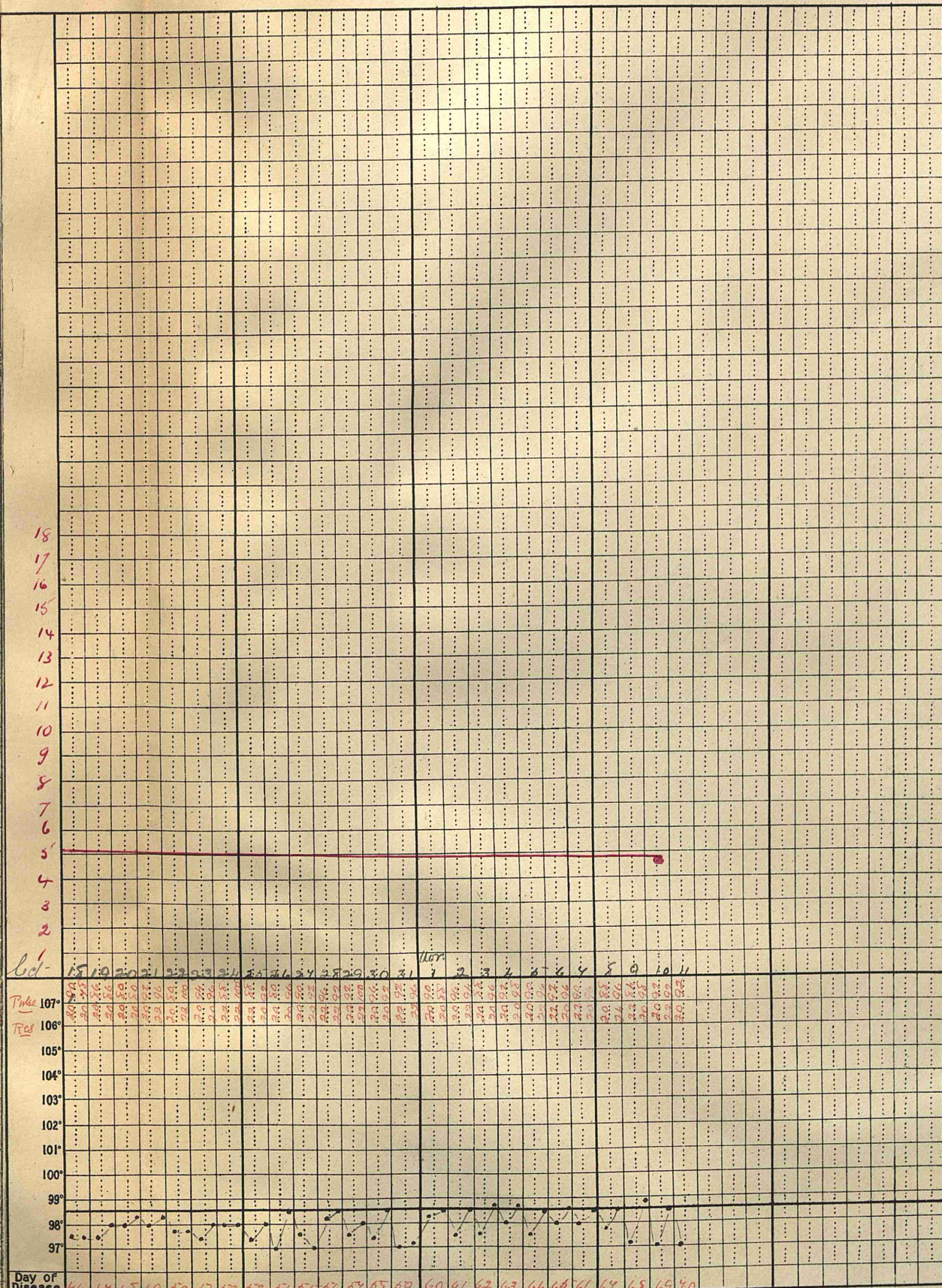
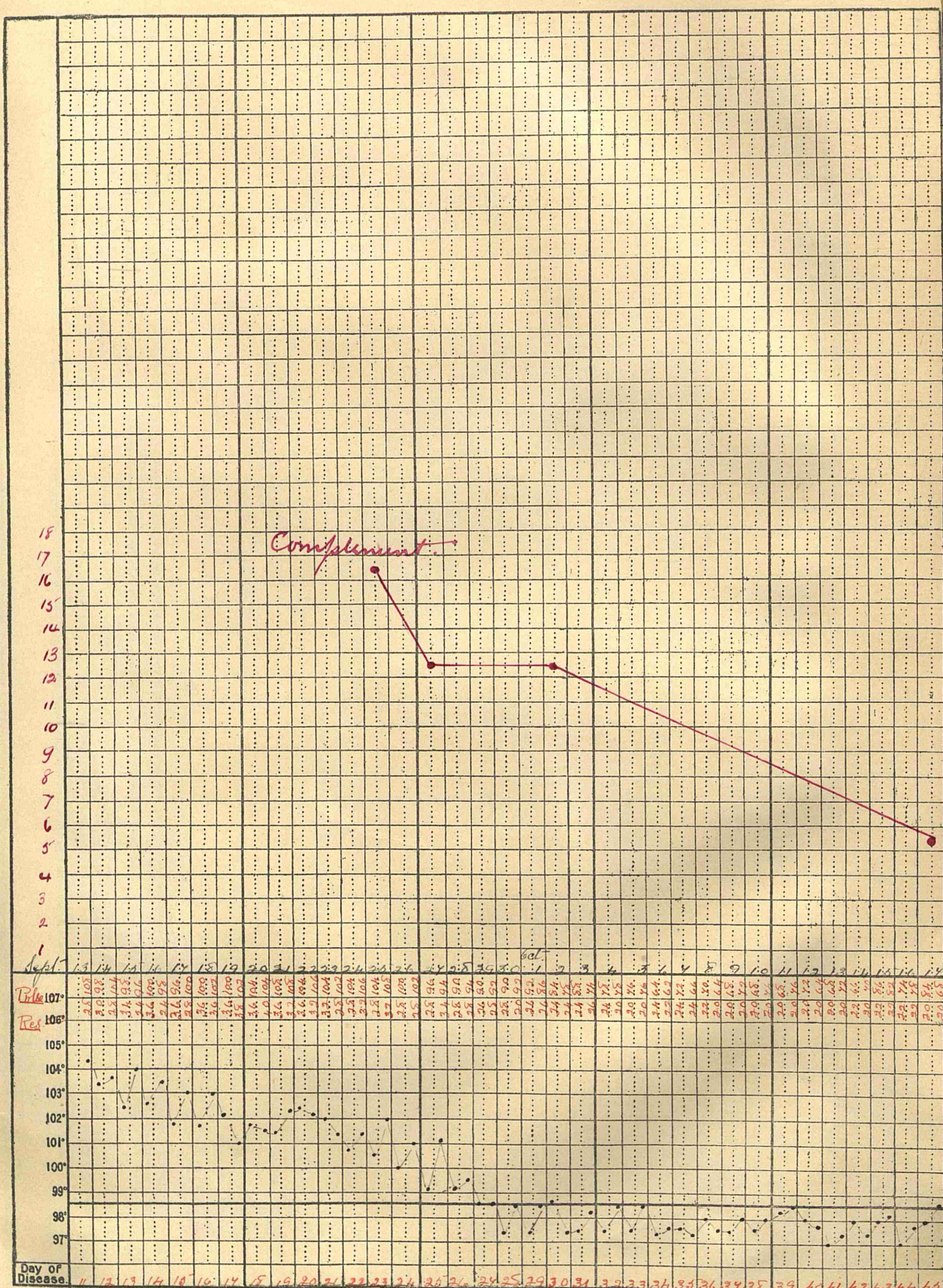
Chart VI

6

Cell

6a

Time  
Temp.





October 20 21 22 23 24 25 26 27 28 29 30 31 November 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

December 24 25 26 27 28 29 30 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

tonic  
lower

Hawthorn  
leaves  
20<sup>th</sup> 1911

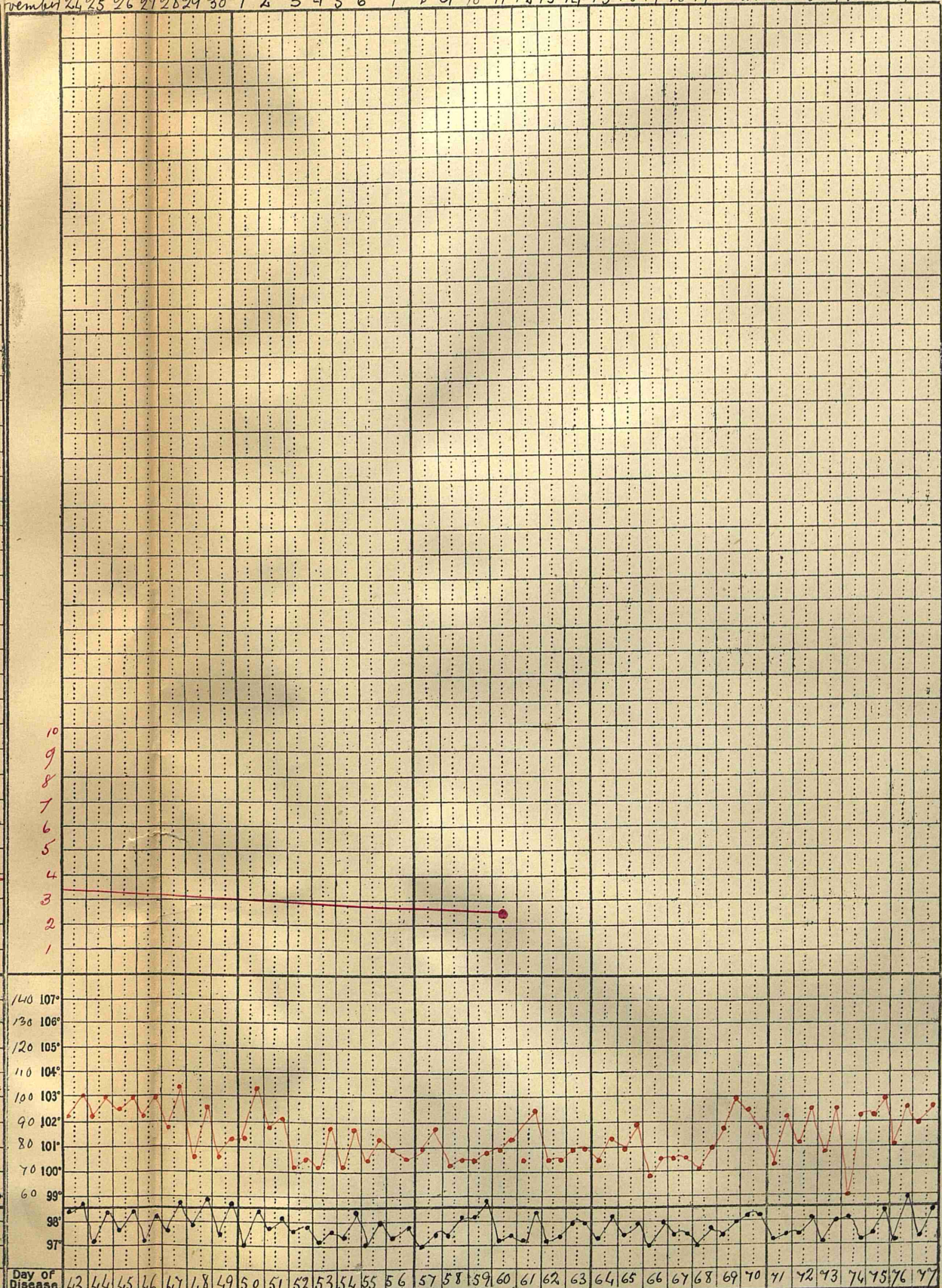
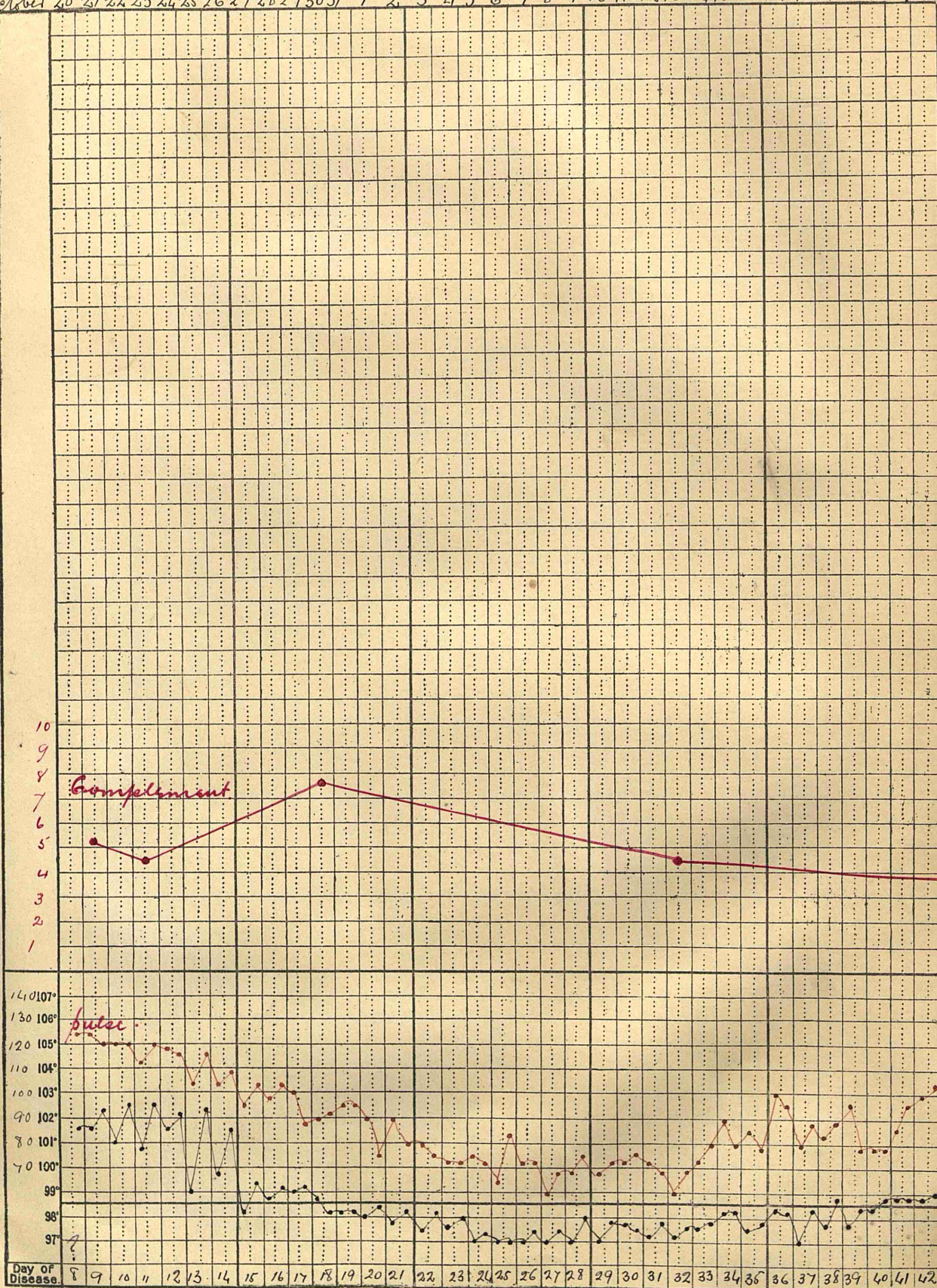




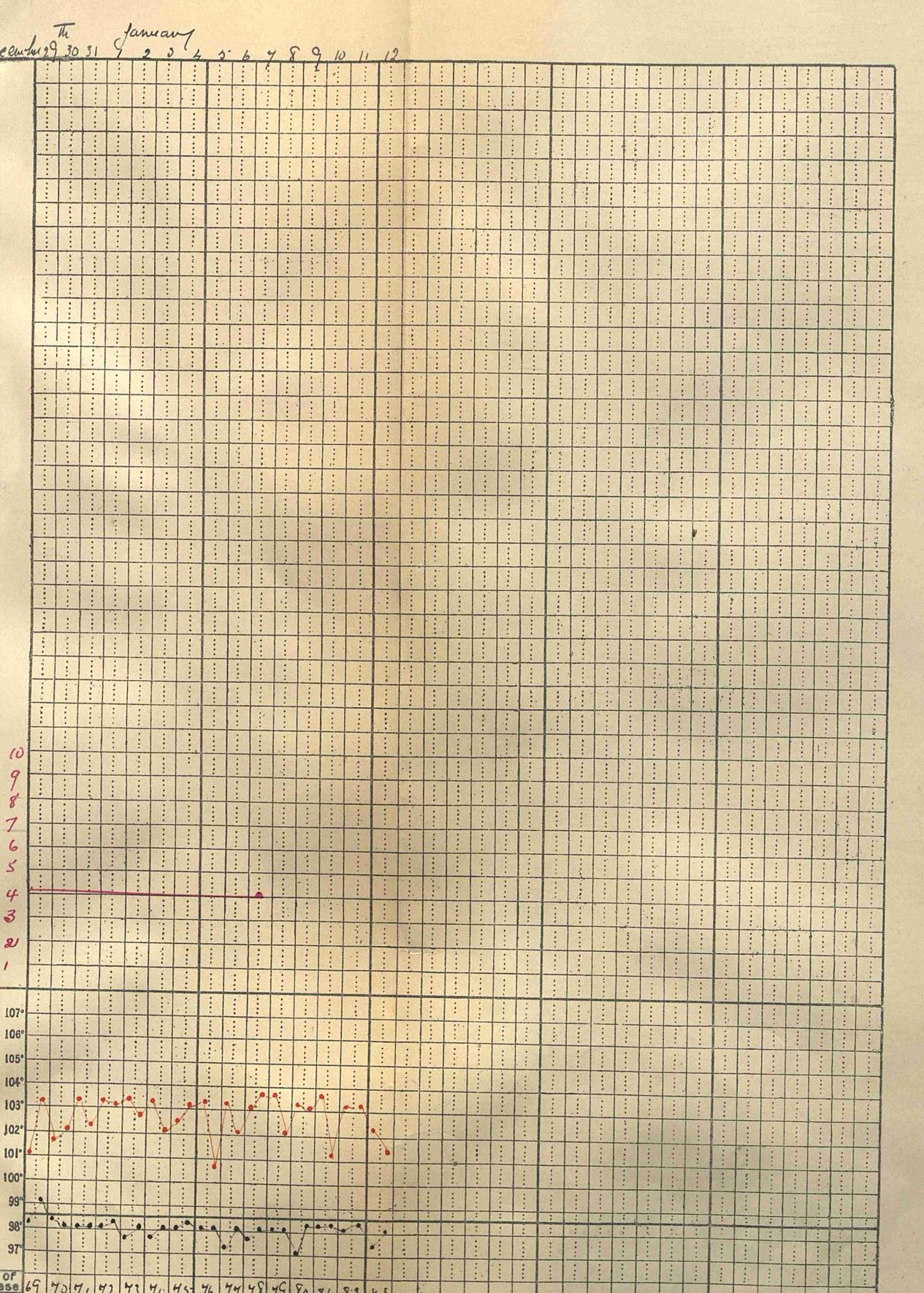
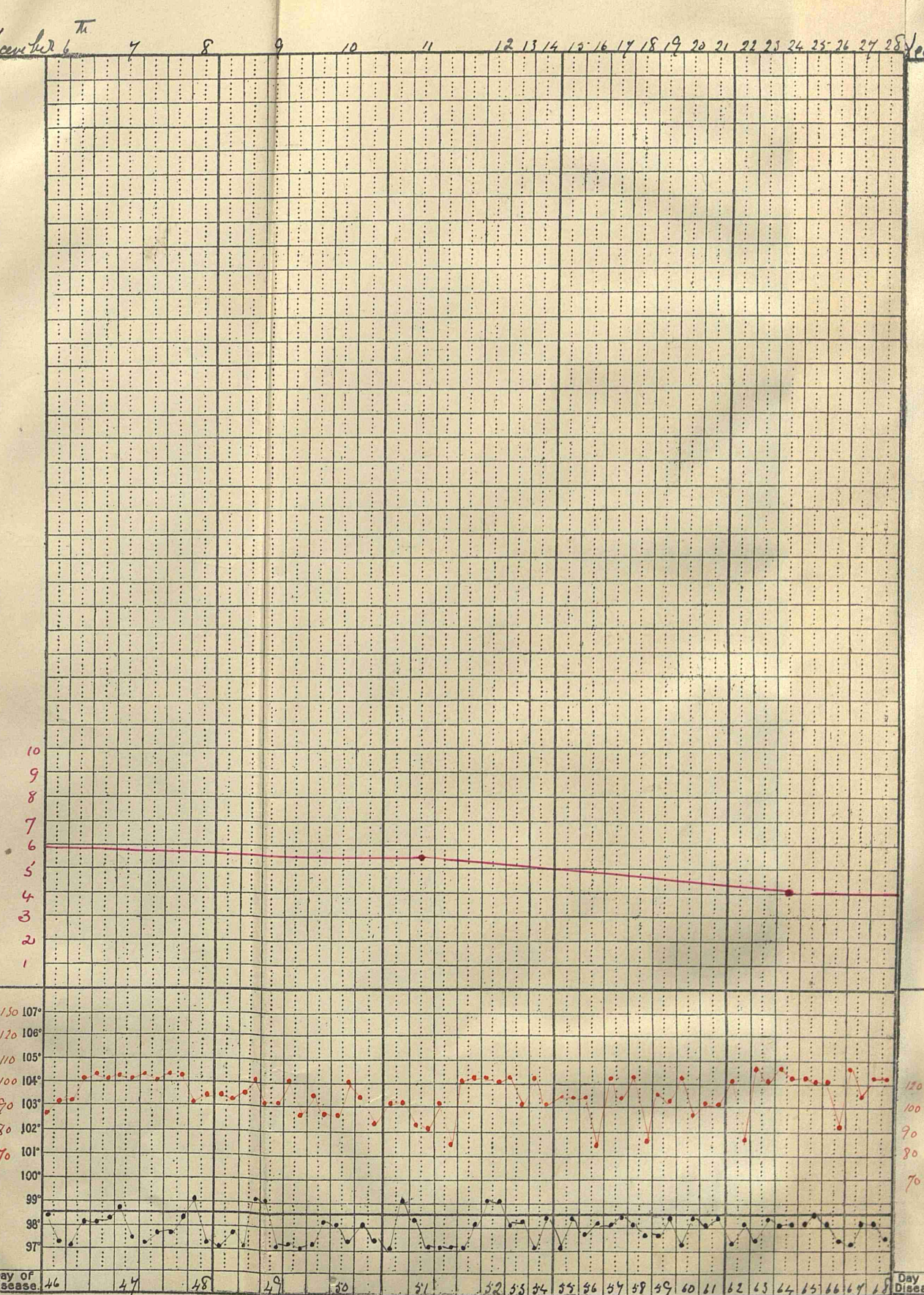
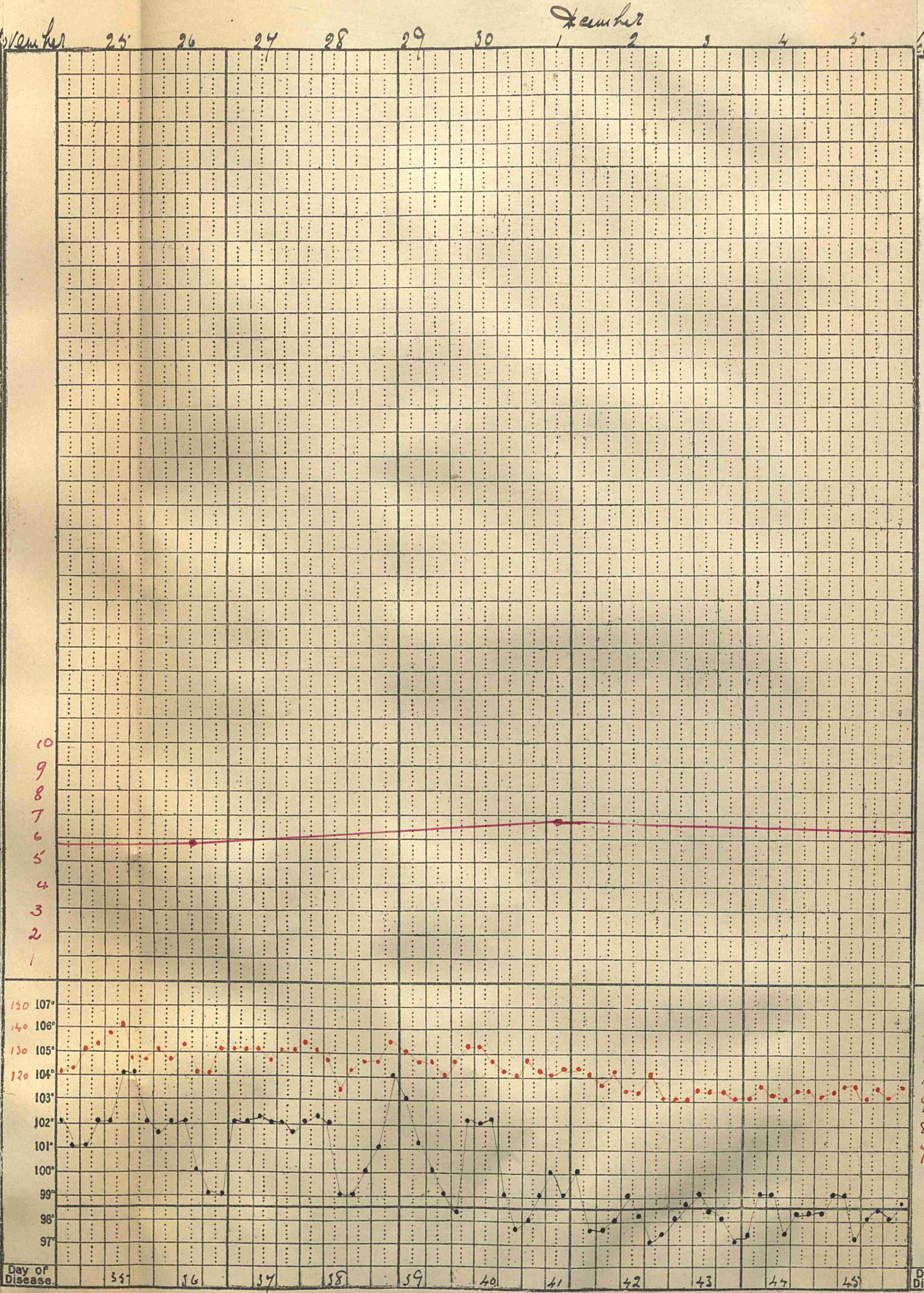
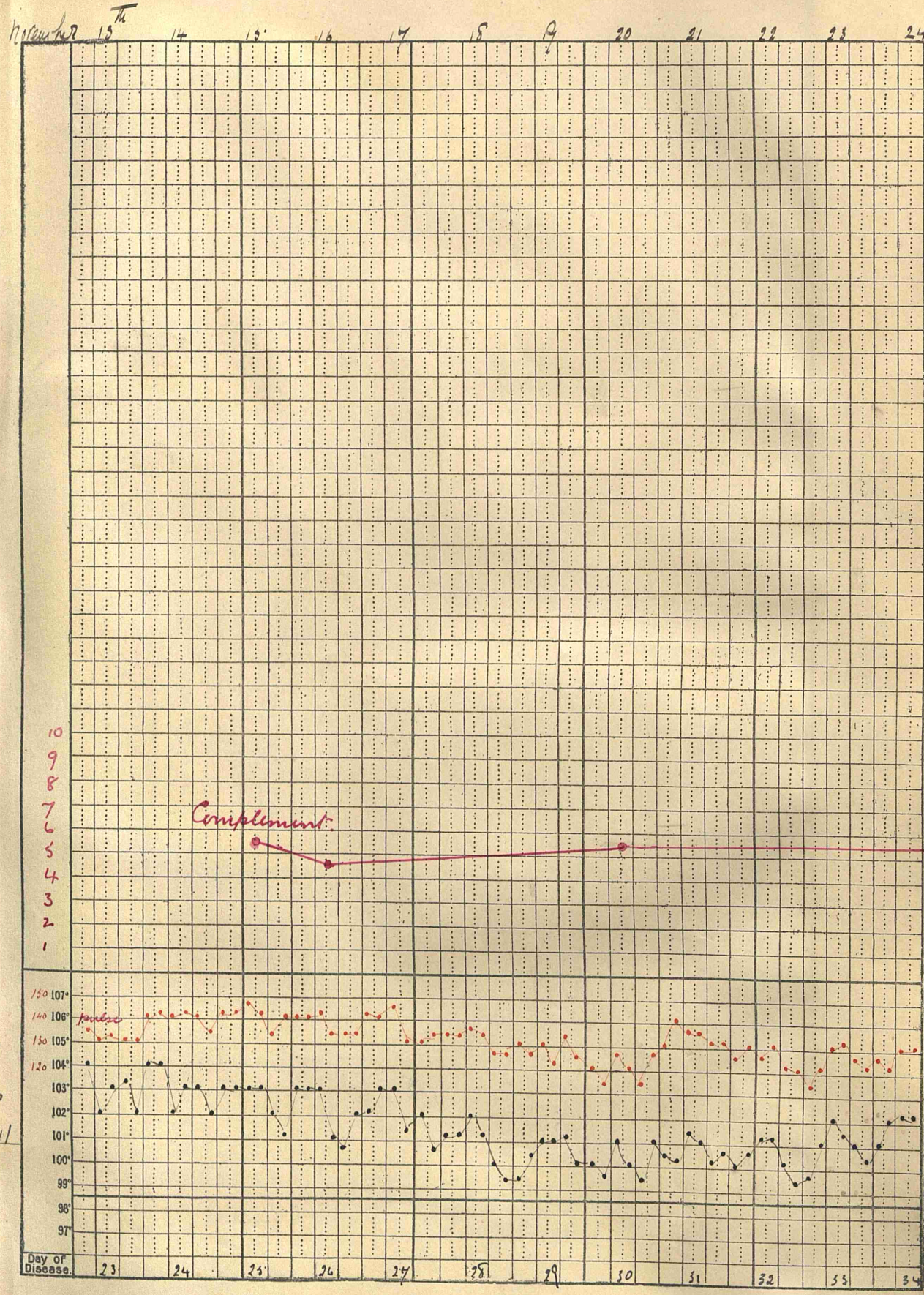
Chart VIII

8

8a

8b

8c



line  
over

Trend  
Focus  
12.15.91



Pa





old Martin  
Age 20 years  
11.11.11

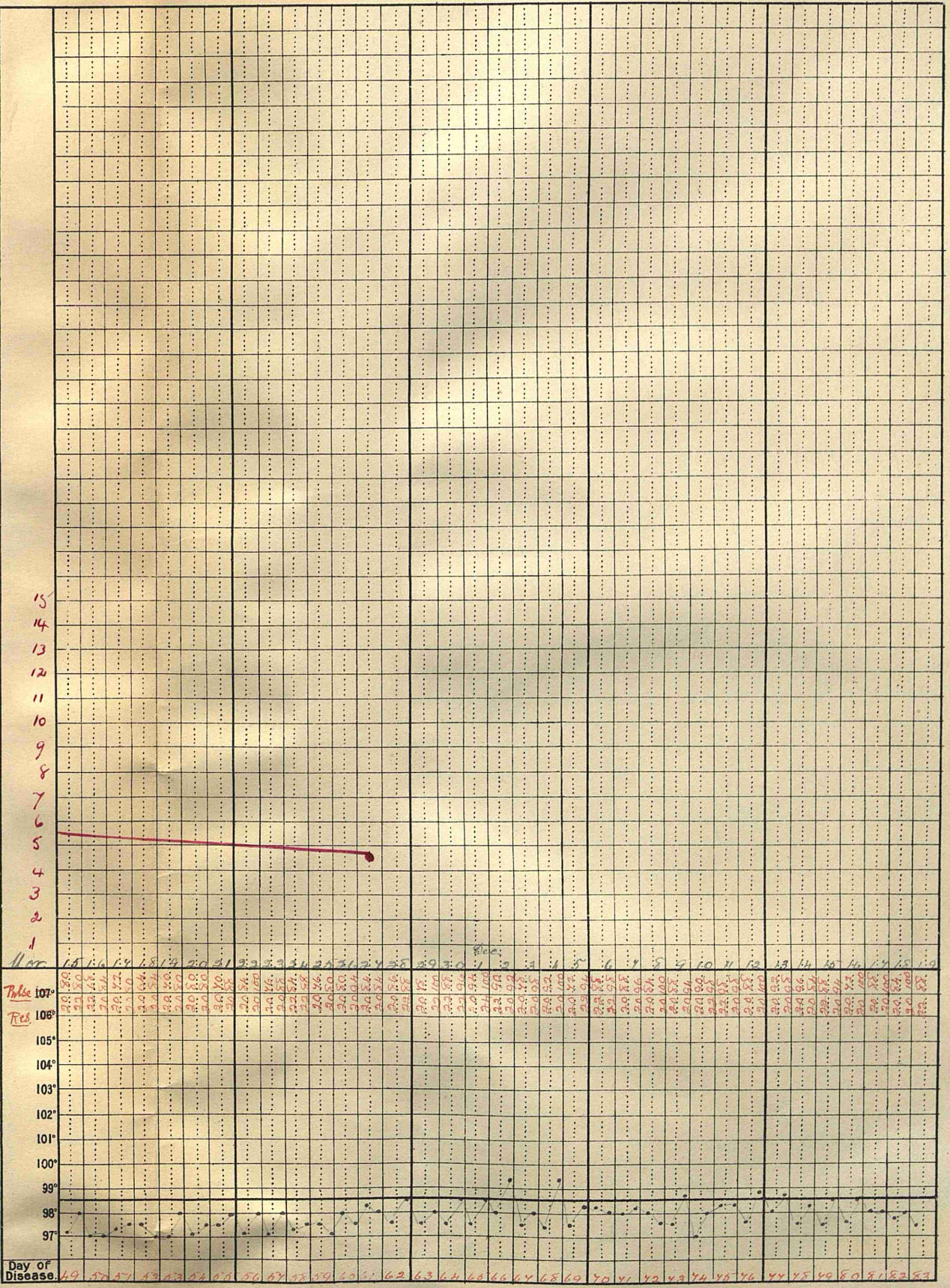
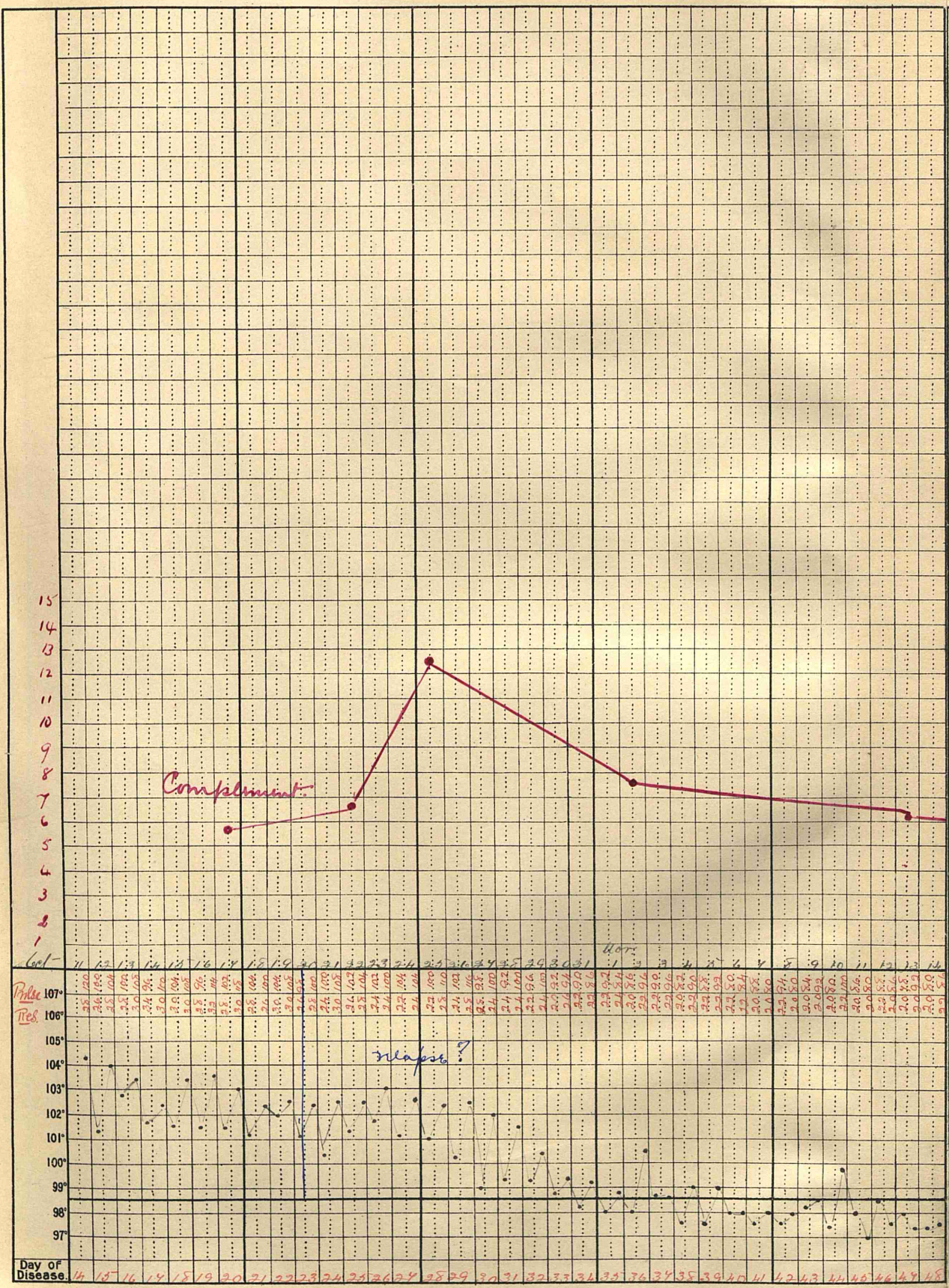
chart X

10

the Cont-

10a

nic  
er.



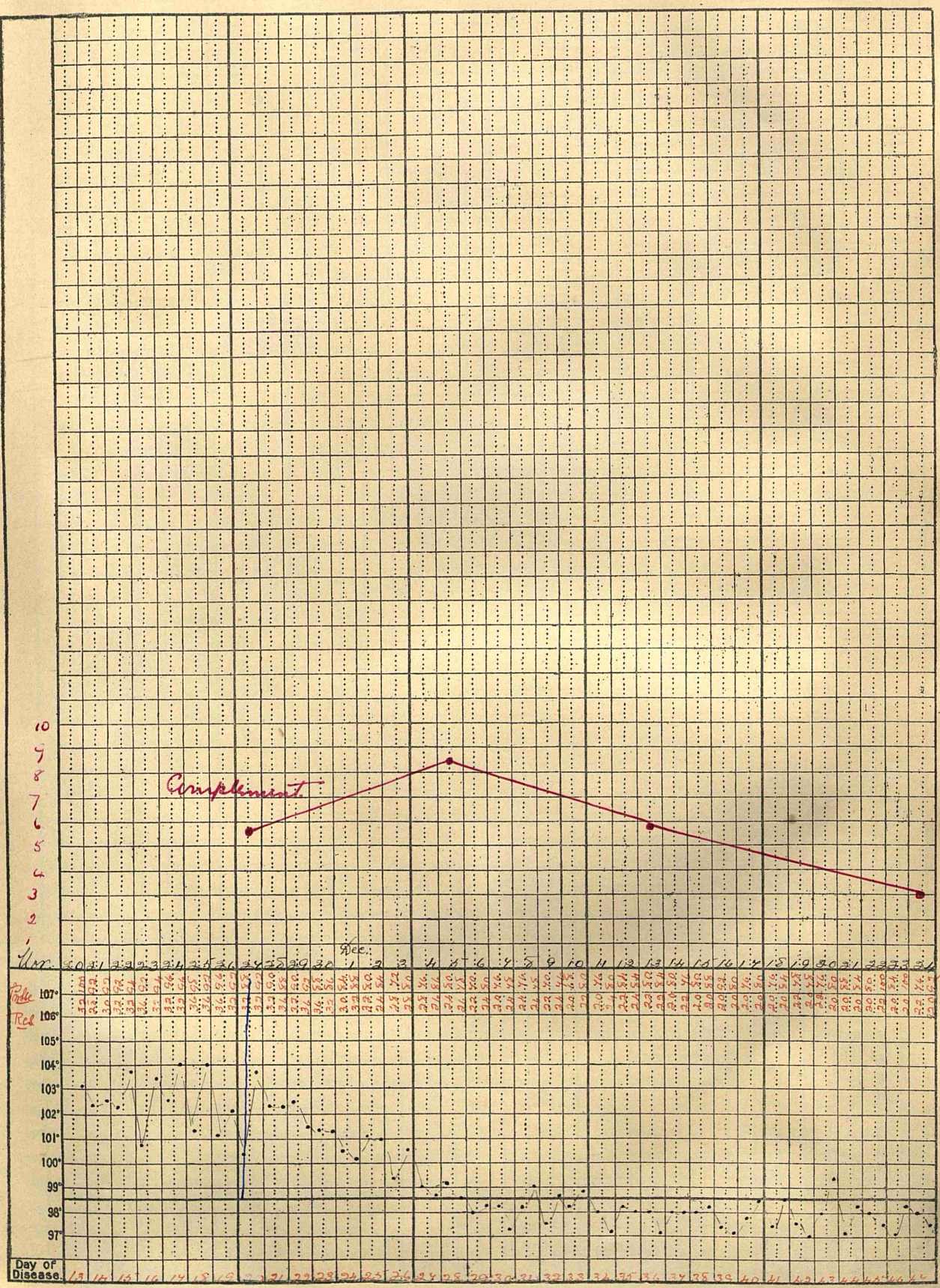


Philip Barnes  
 Age 35 years.  
 Dec. 20. 11. 11

Chart XI

11

tonic  
 over.





Staff  
225 years  
23.9.11

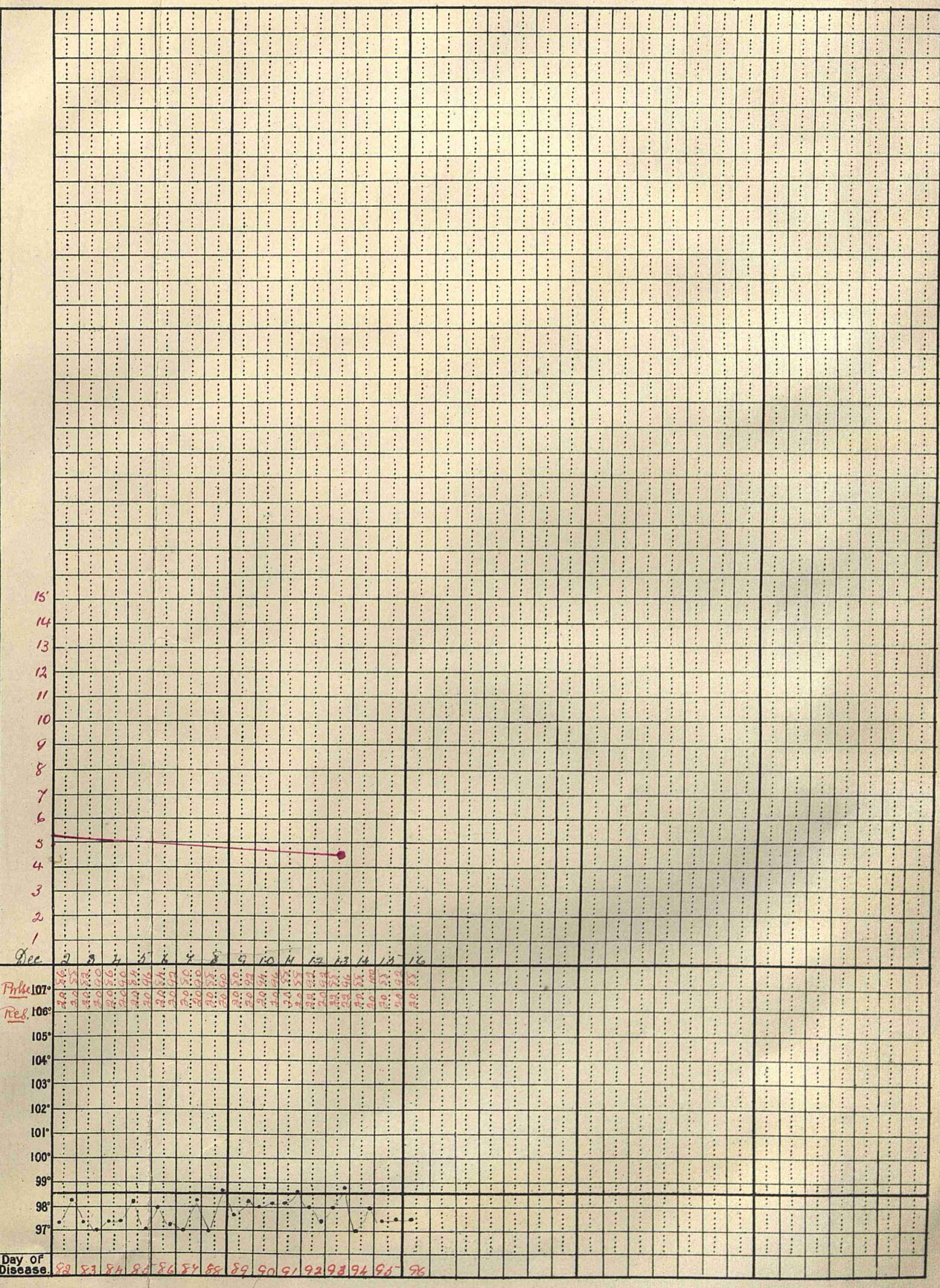
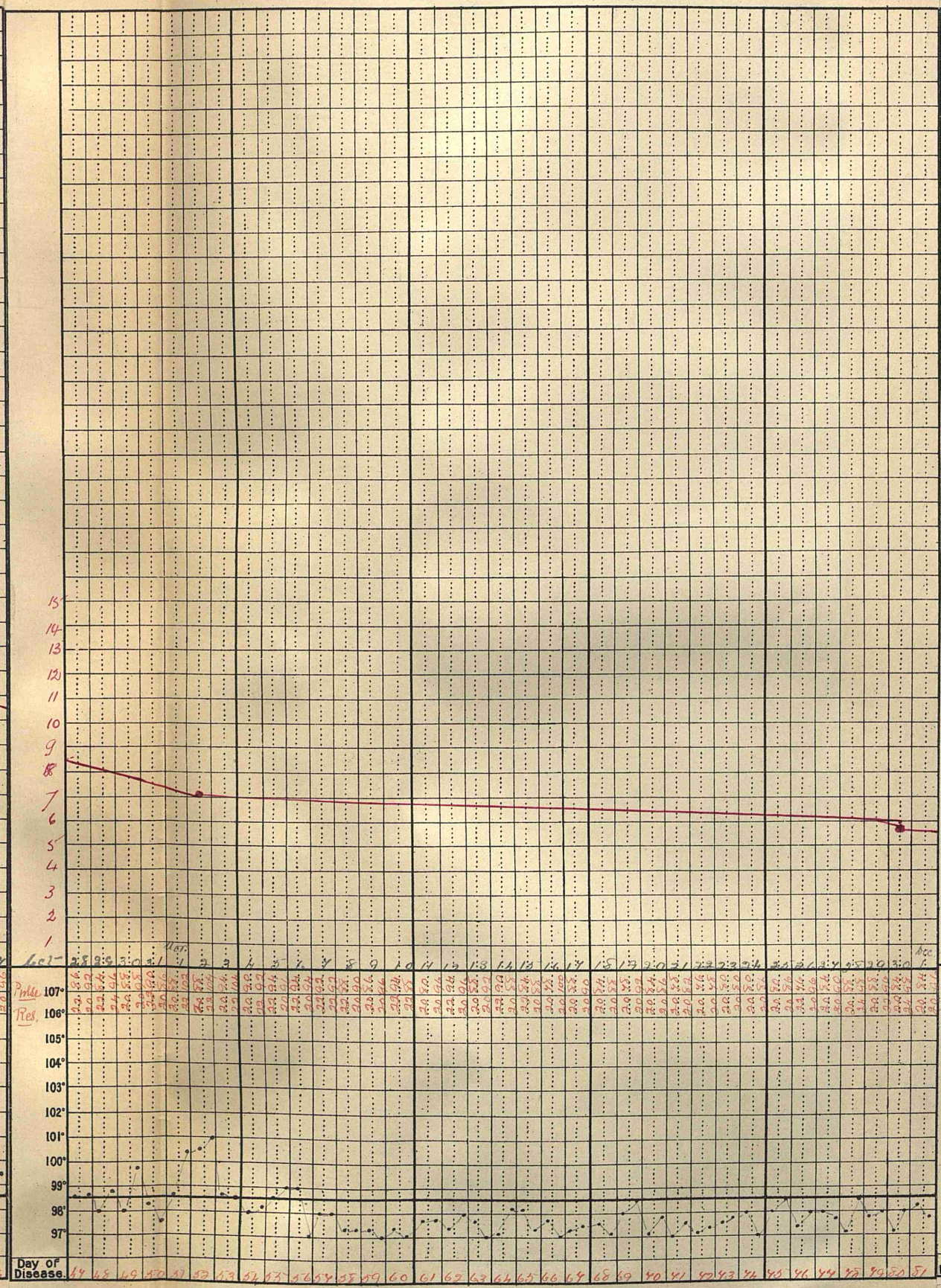
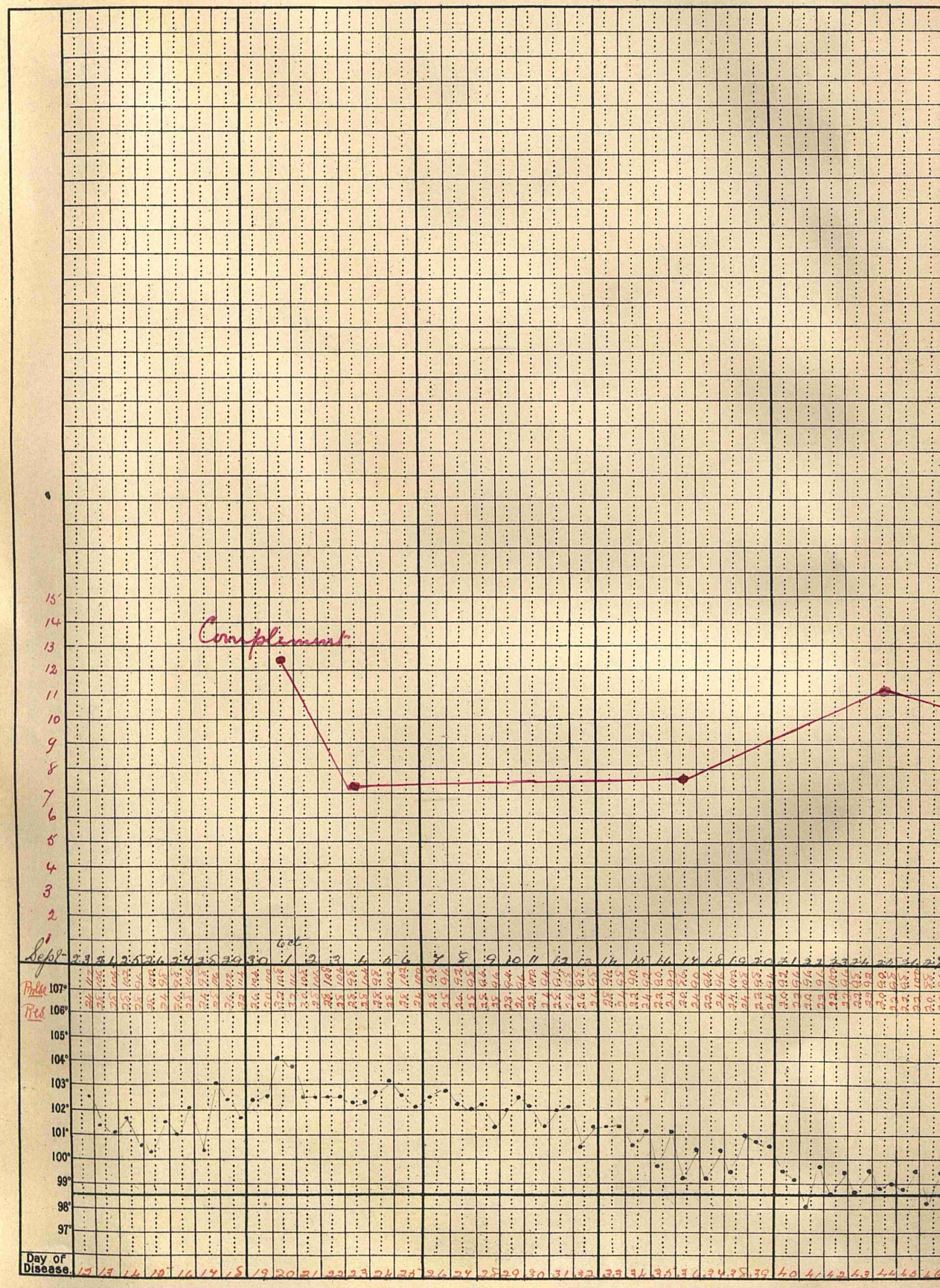
Chart XII

12a

12a

12b

time  
was





es Thomsen  
Age 33 years  
19. 11

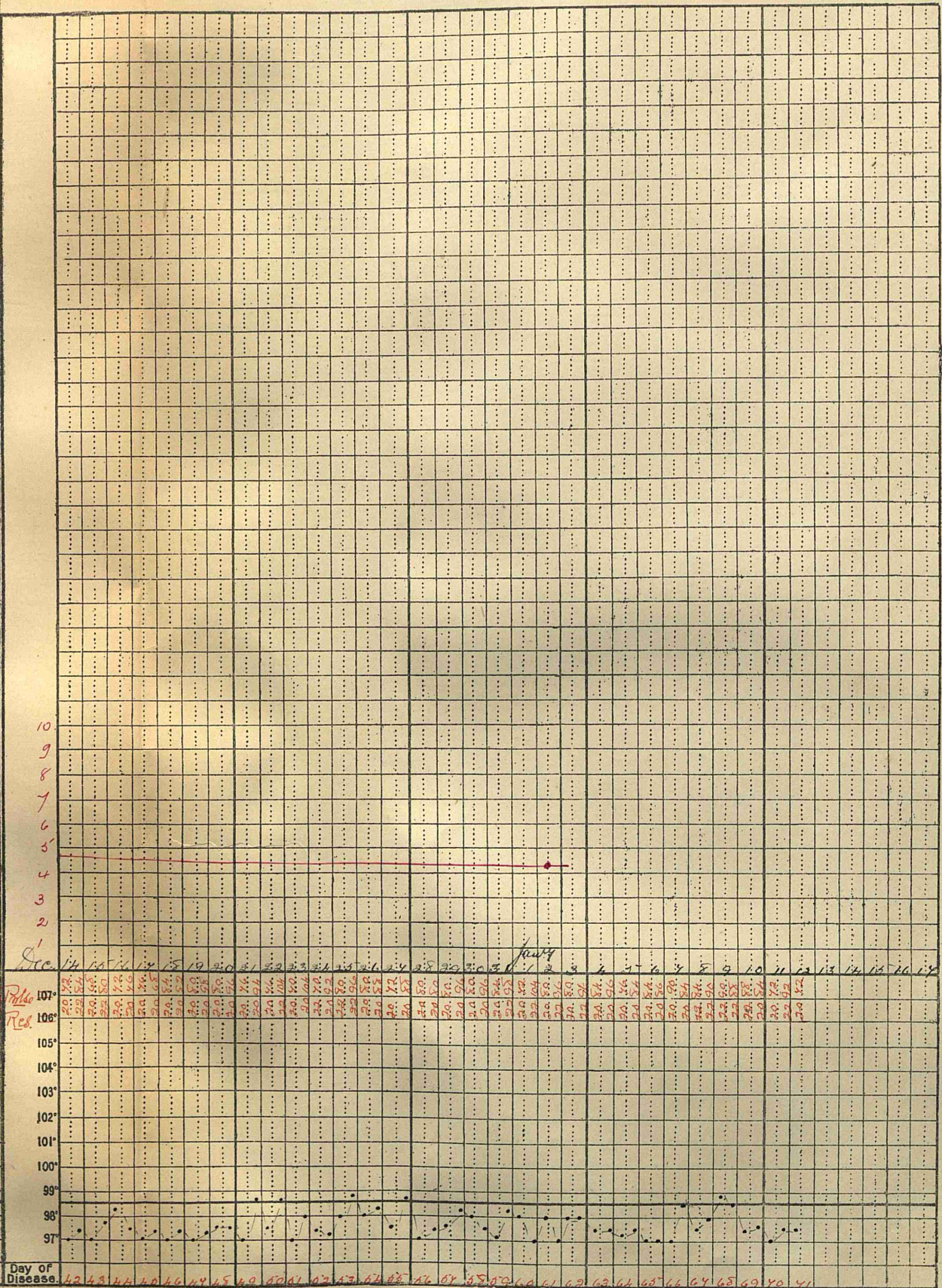
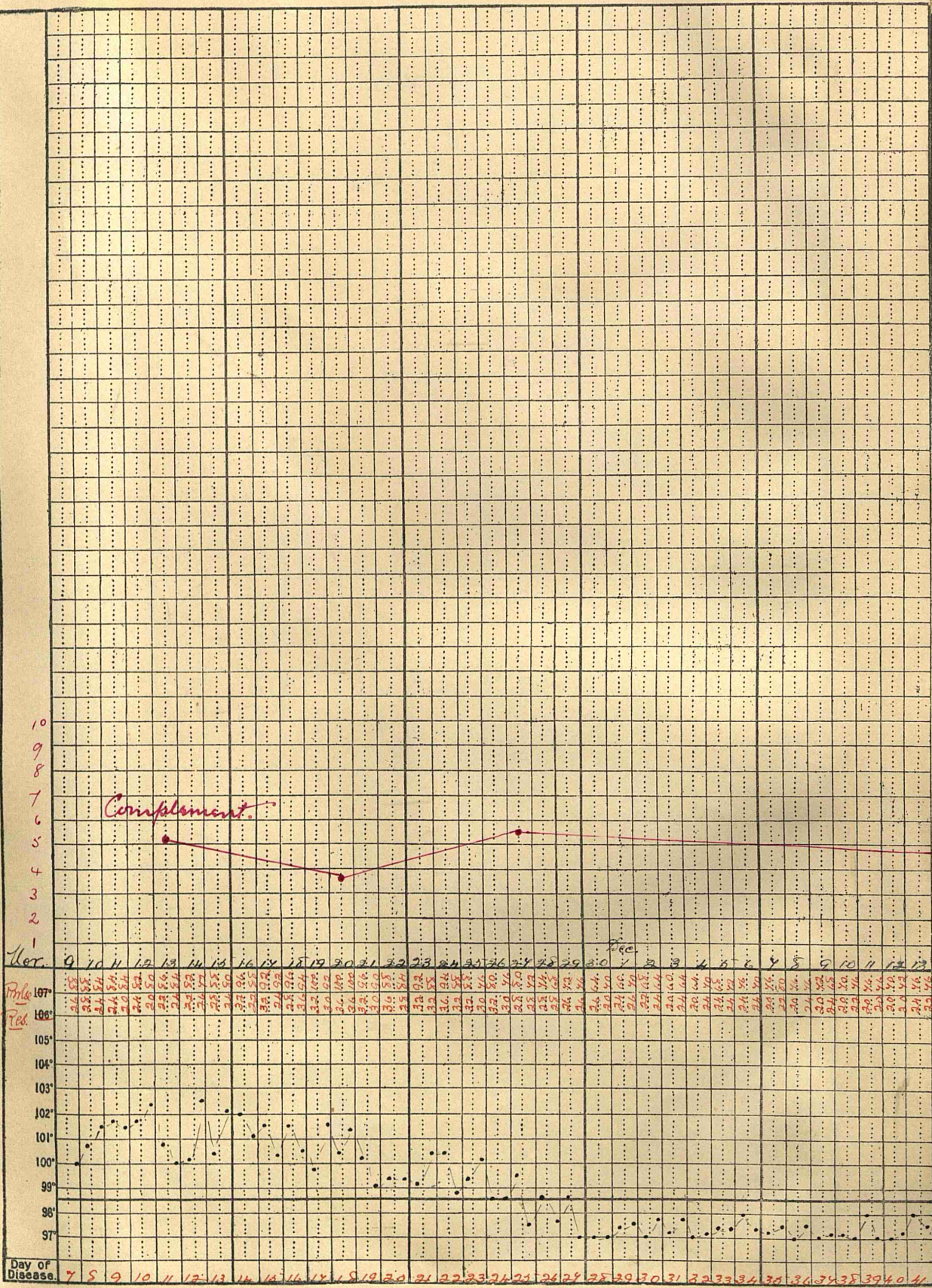
Chart x  $\frac{111}{111}$

13

msoul-Cont-

13a

nter  
Fuer





as Kirkwood  
Age 20 years  
180 " "

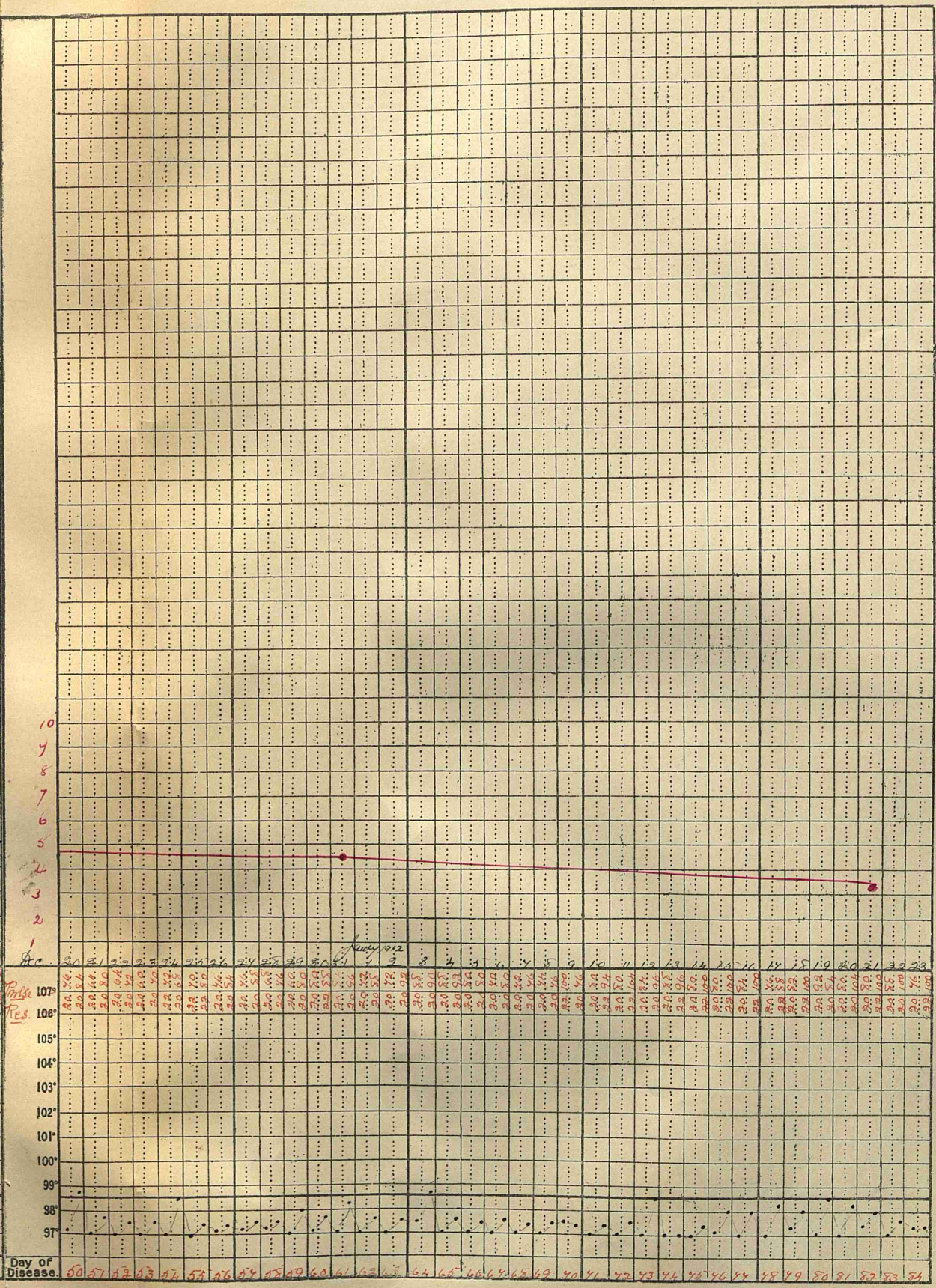
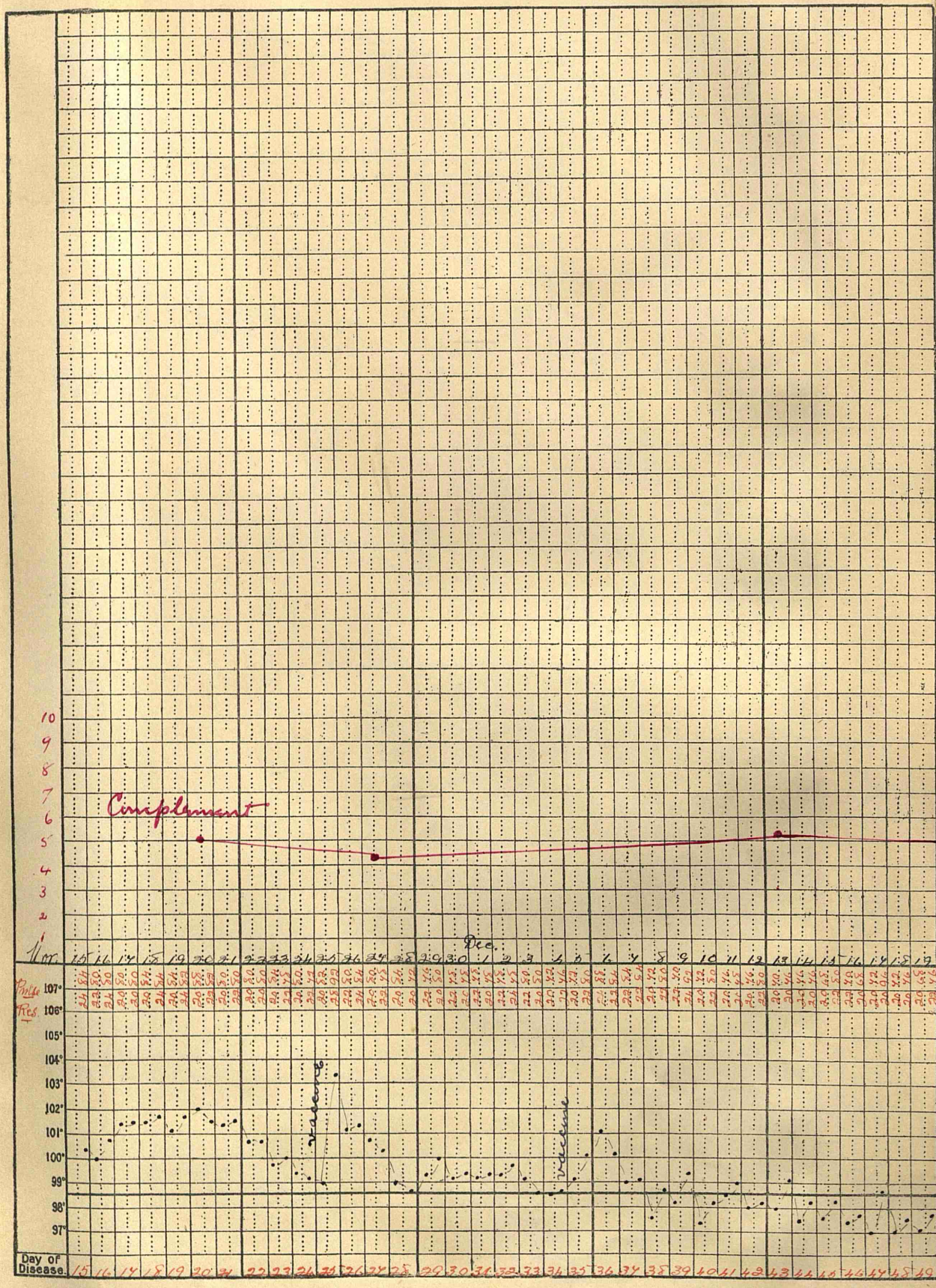
Chart Kiv

14

Kirkwood Cont.

14a

Inter-  
twined



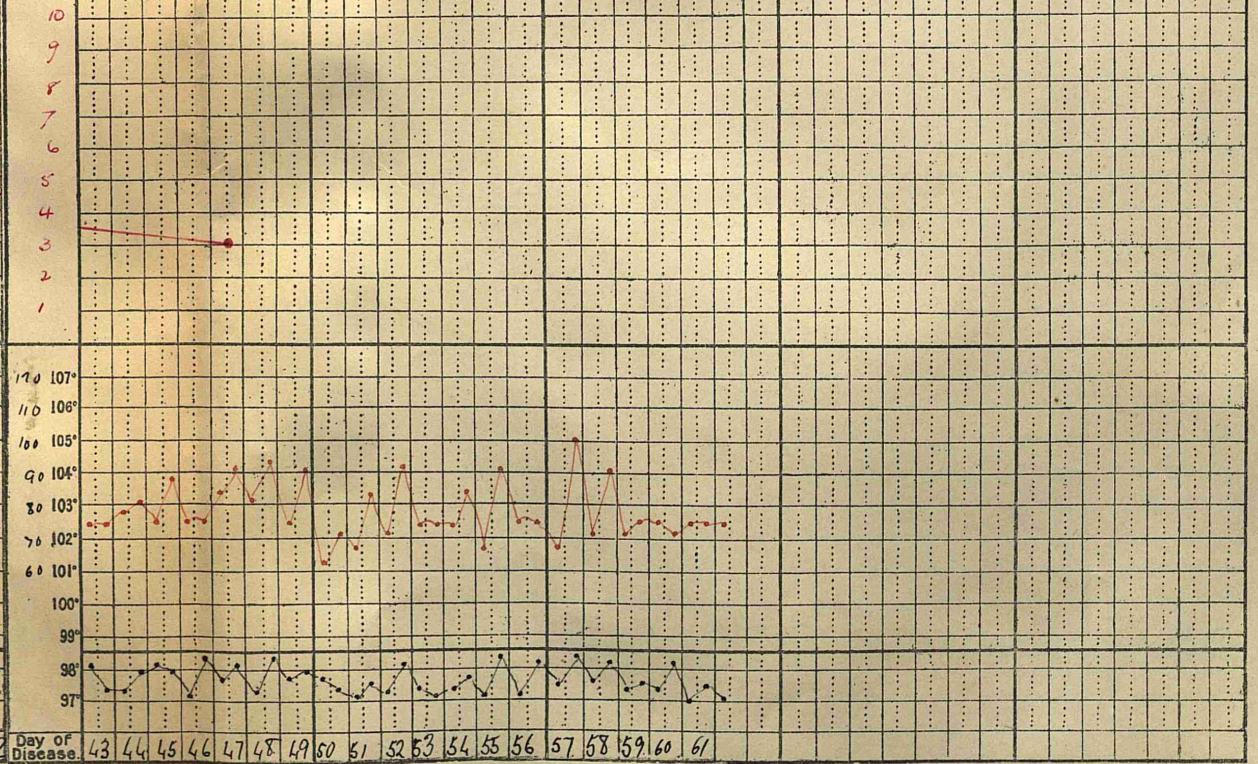
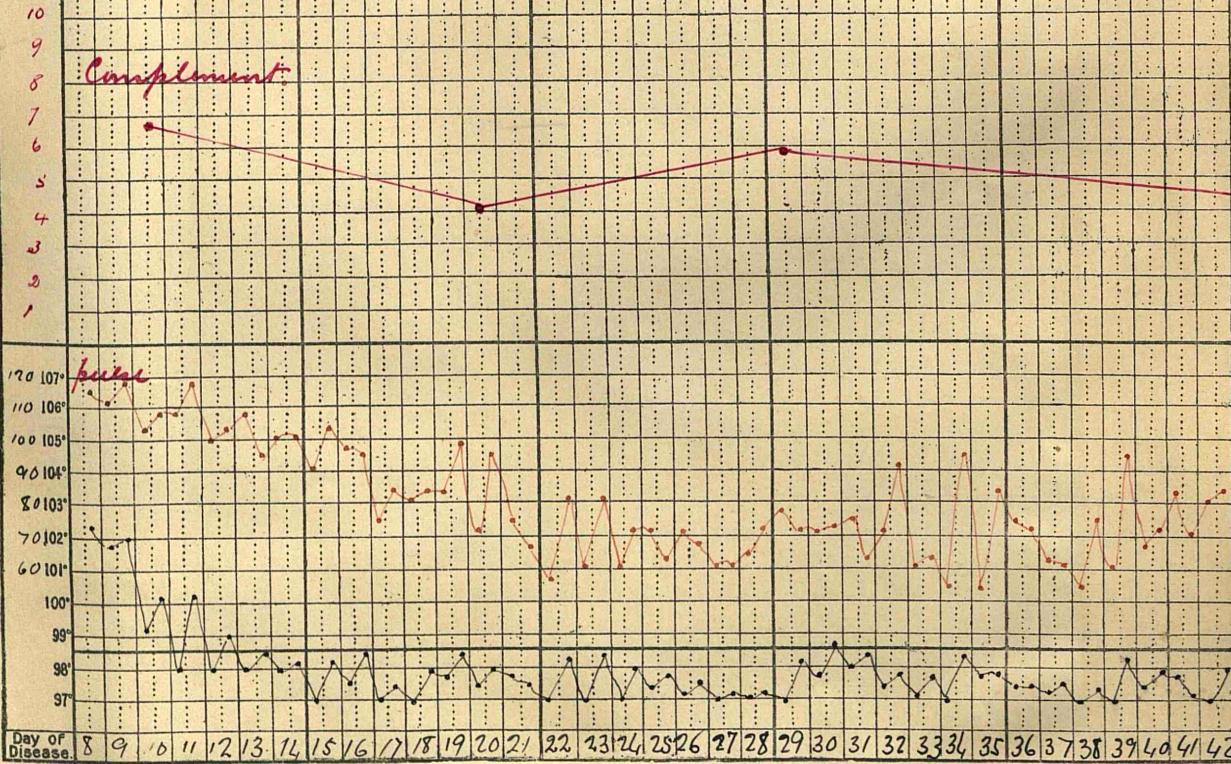


January

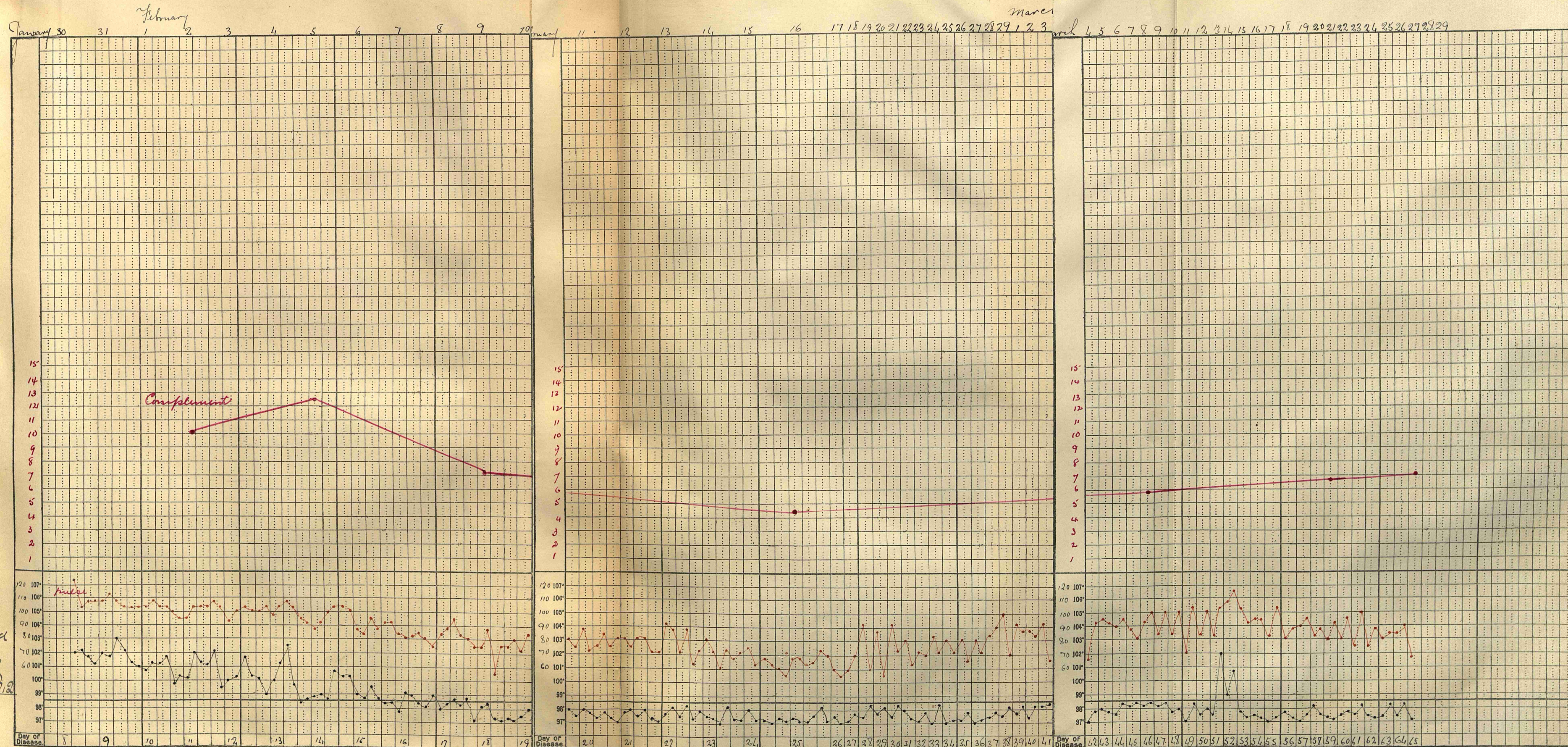
December 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 January 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

relative  
linear  
water

Millar  
Leans  
49th 1911









Ryder Reed  
Age 22 years  
24.10.11

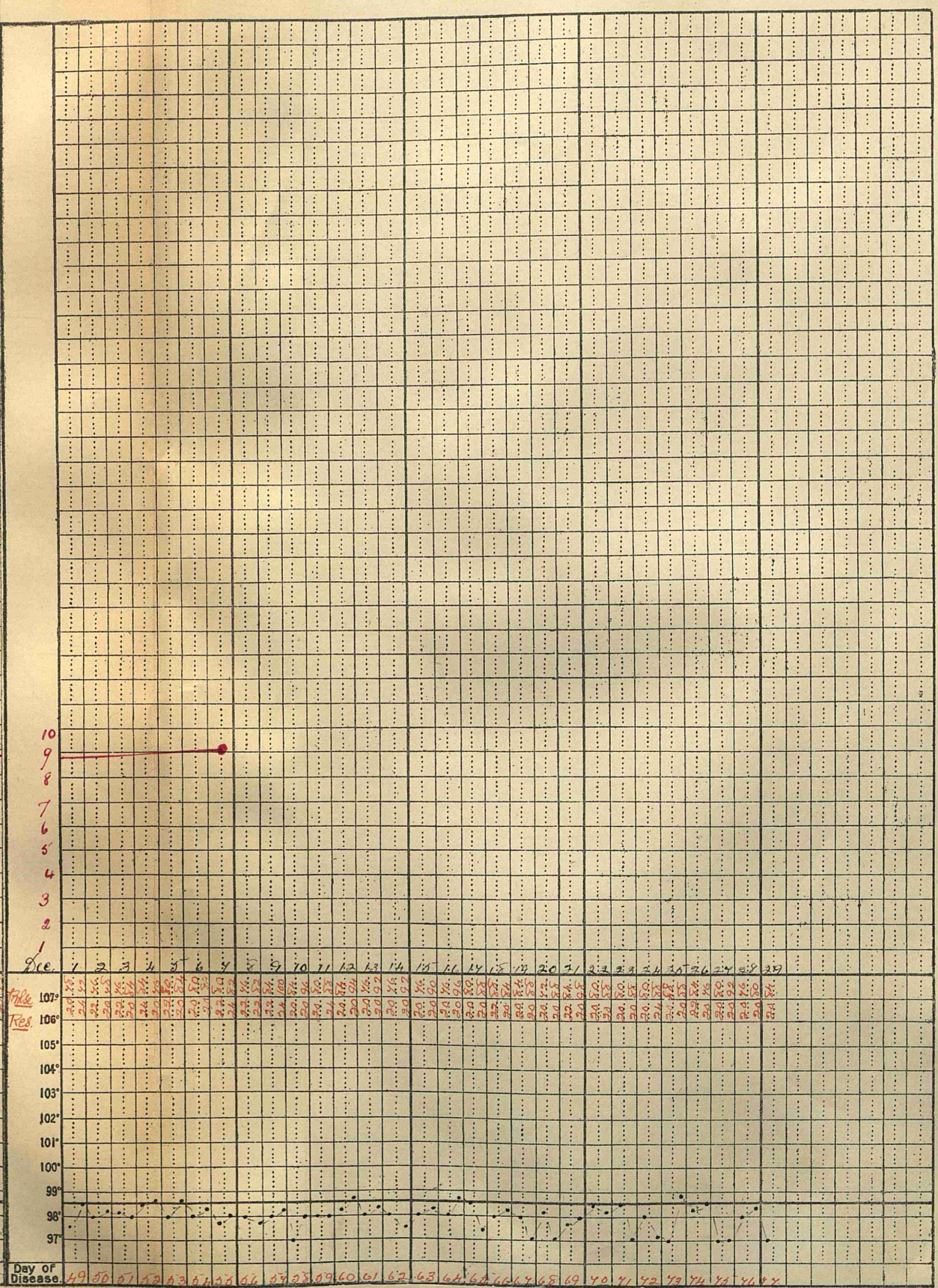
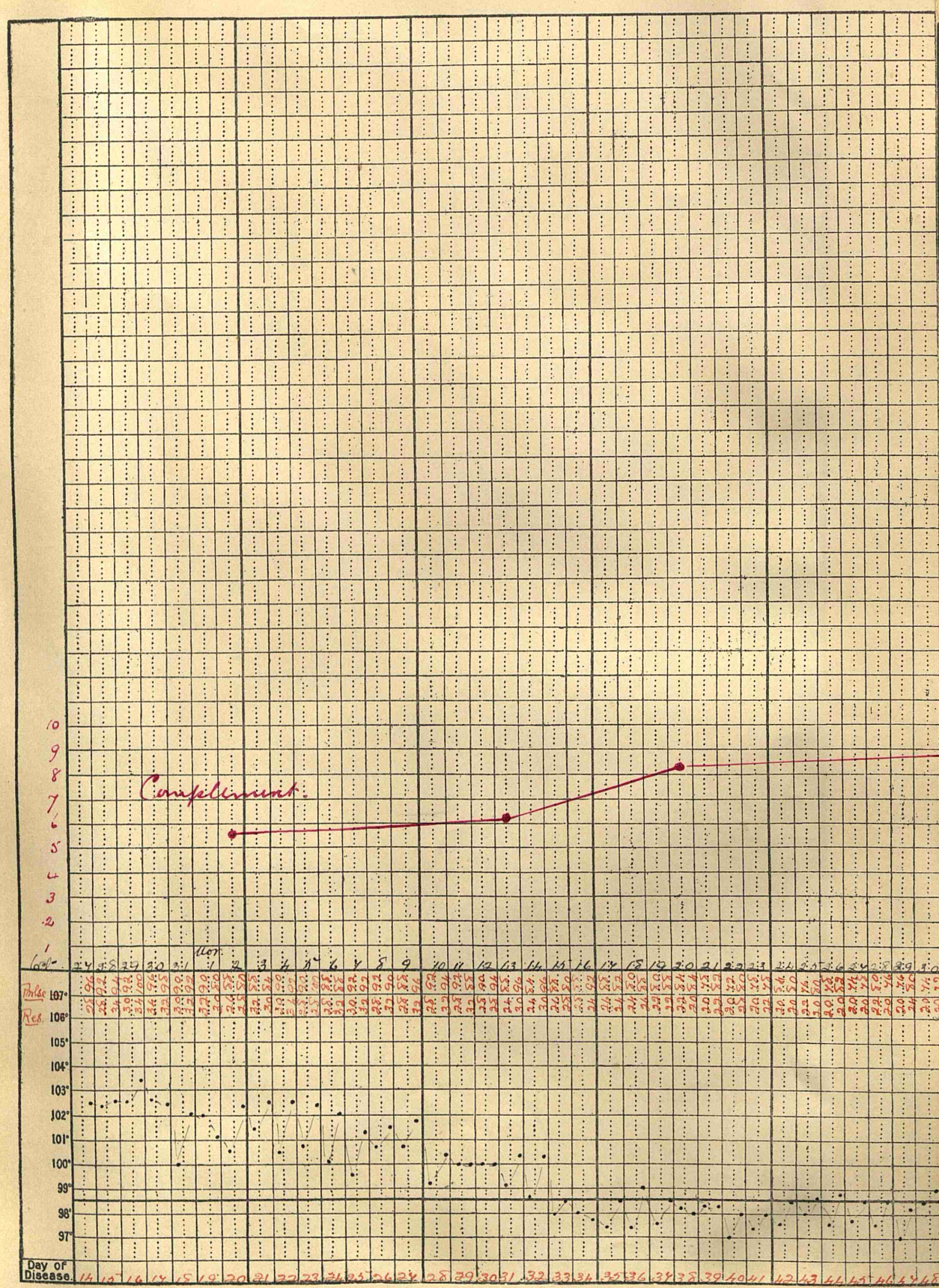
Chart XVII.

17

id Cont

17a

tonic  
lower.





November

December

October 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14

November 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2

12  
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Complement

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11  
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5  
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1

Ryan  
Leaves  
11 1911

140 107°  
130 106°  
120 105°  
110 104°  
100 103°  
90 102°  
80 101°  
70 100°  
60 99°  
50 98°  
40 97°

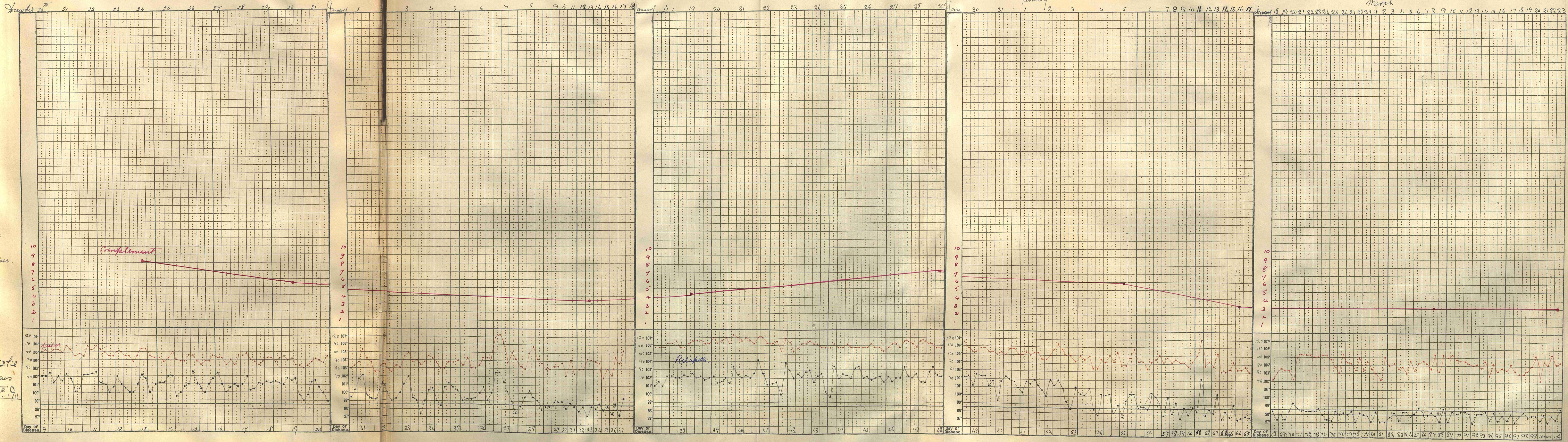
Pulse

140 107°  
130 106°  
120 105°  
110 104°  
100 103°  
90 102°  
80 101°  
70 100°  
60 99°  
50 98°  
40 97°

Day of Disease 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 44 45 46 47 48 49

Day of Disease 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67





one  
or  
with  
refuse.

Laidie  
focus  
2 20 1/11

Relapse



Aug. July 31 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  
Sept. 1 2 3

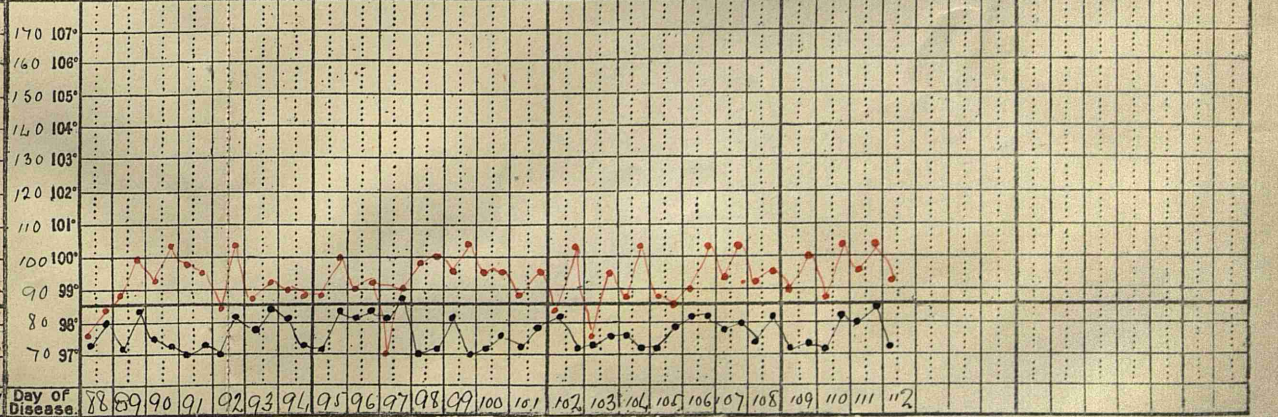
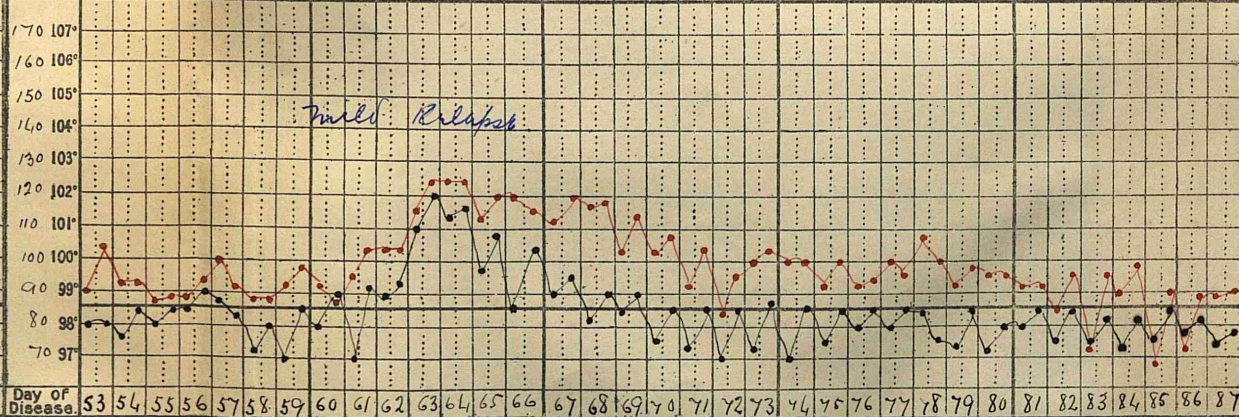
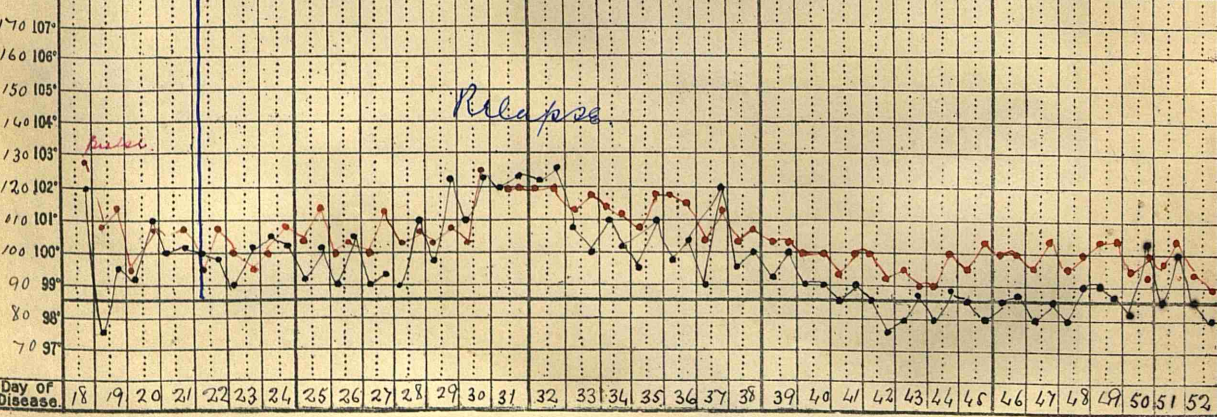
October 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8

November 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3

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1



Complement

Mild Relapse

Relapse



Black  
e 20 years  
2-9-11

Chart Xx1

21

Black Cont-

21a

Black Cont-

21b

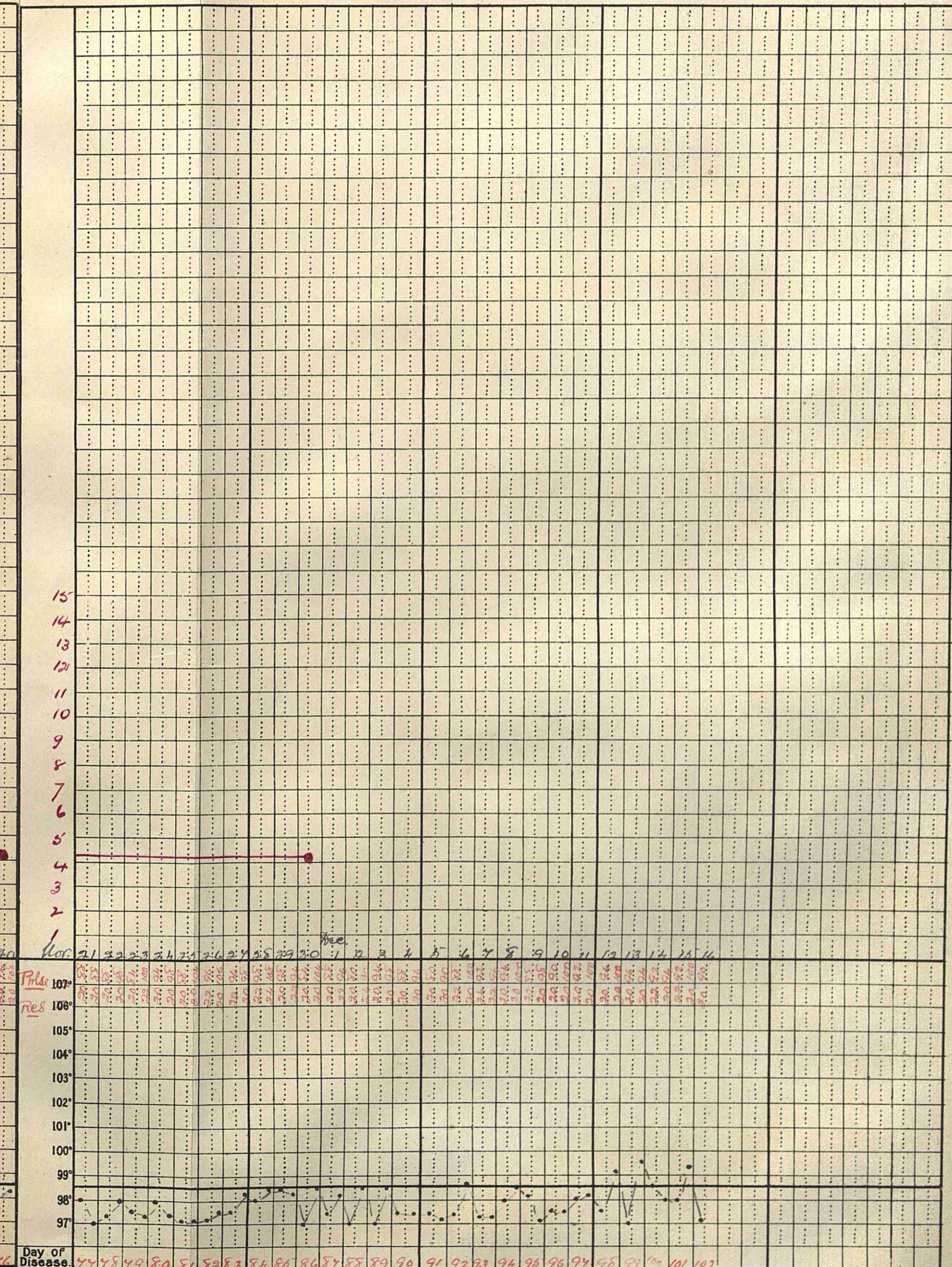
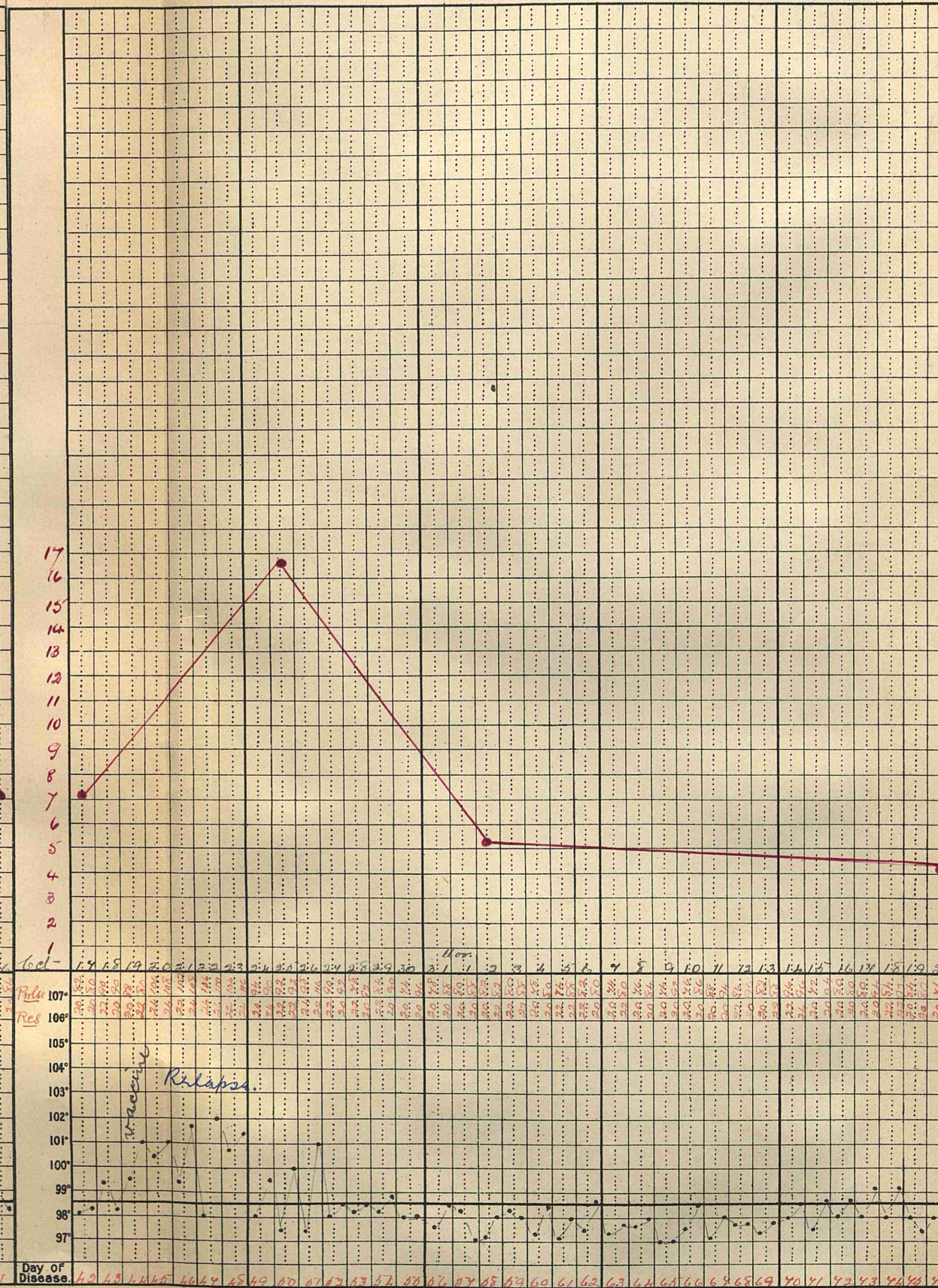
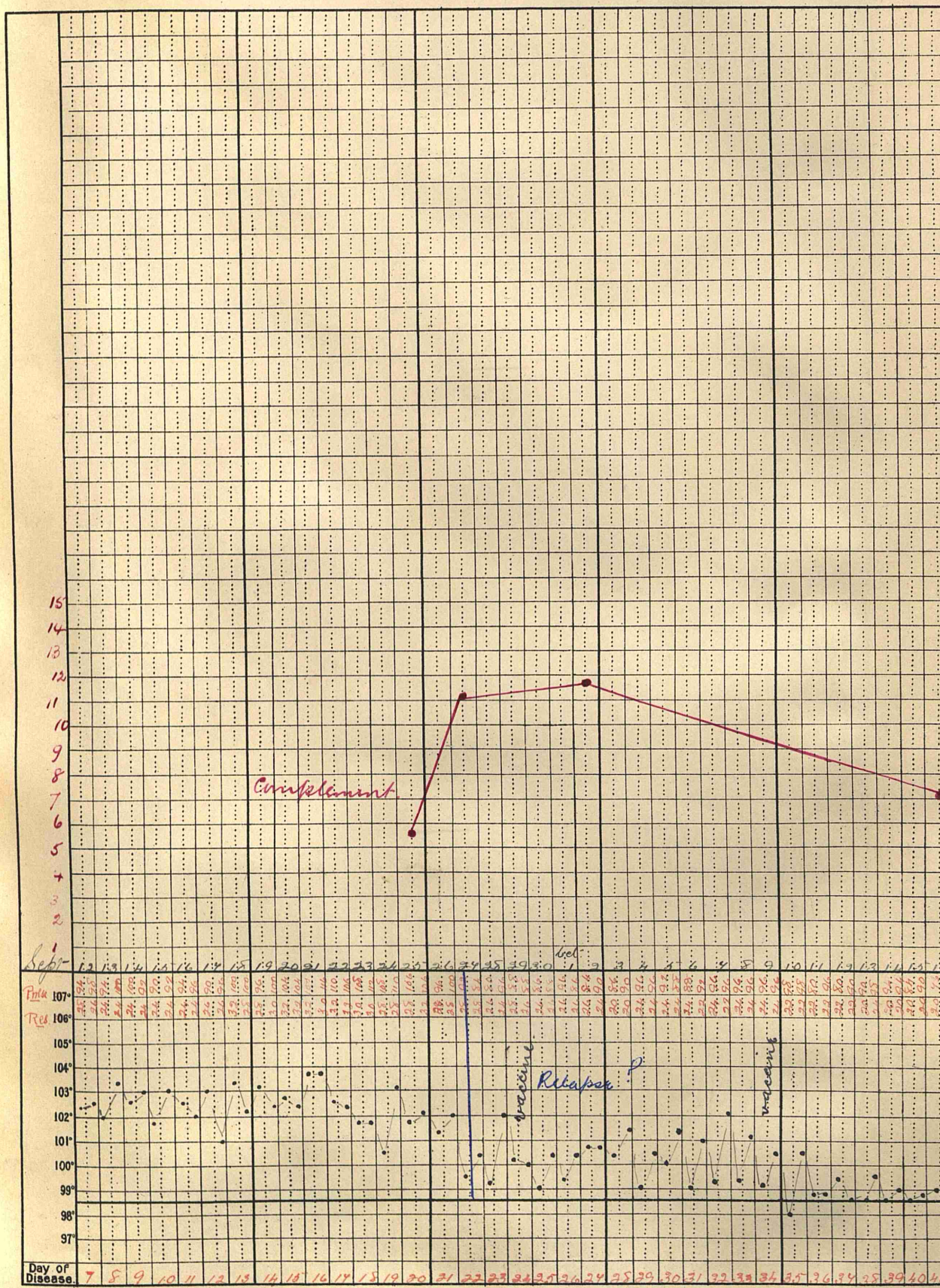




Chart XXII

22a

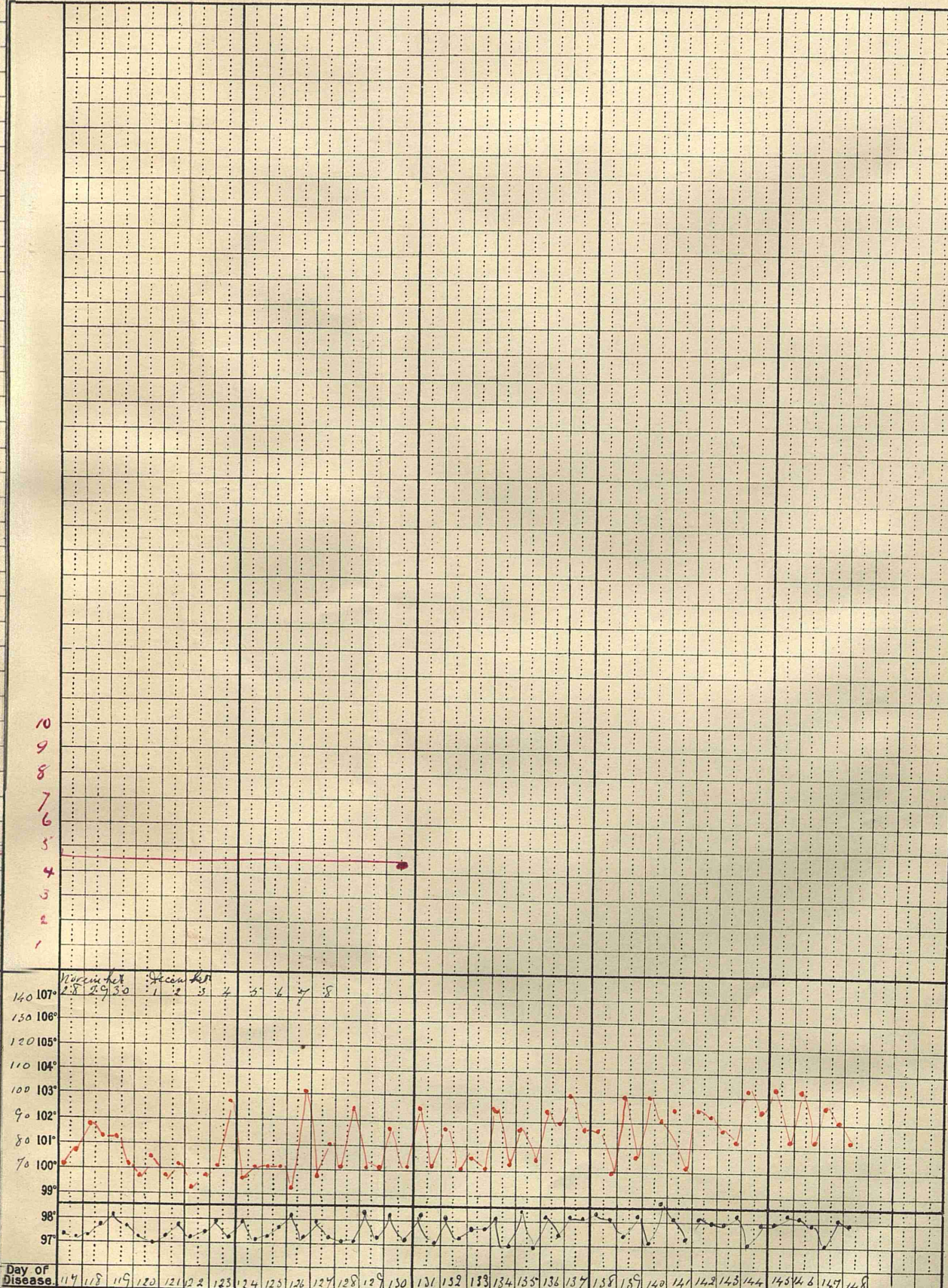
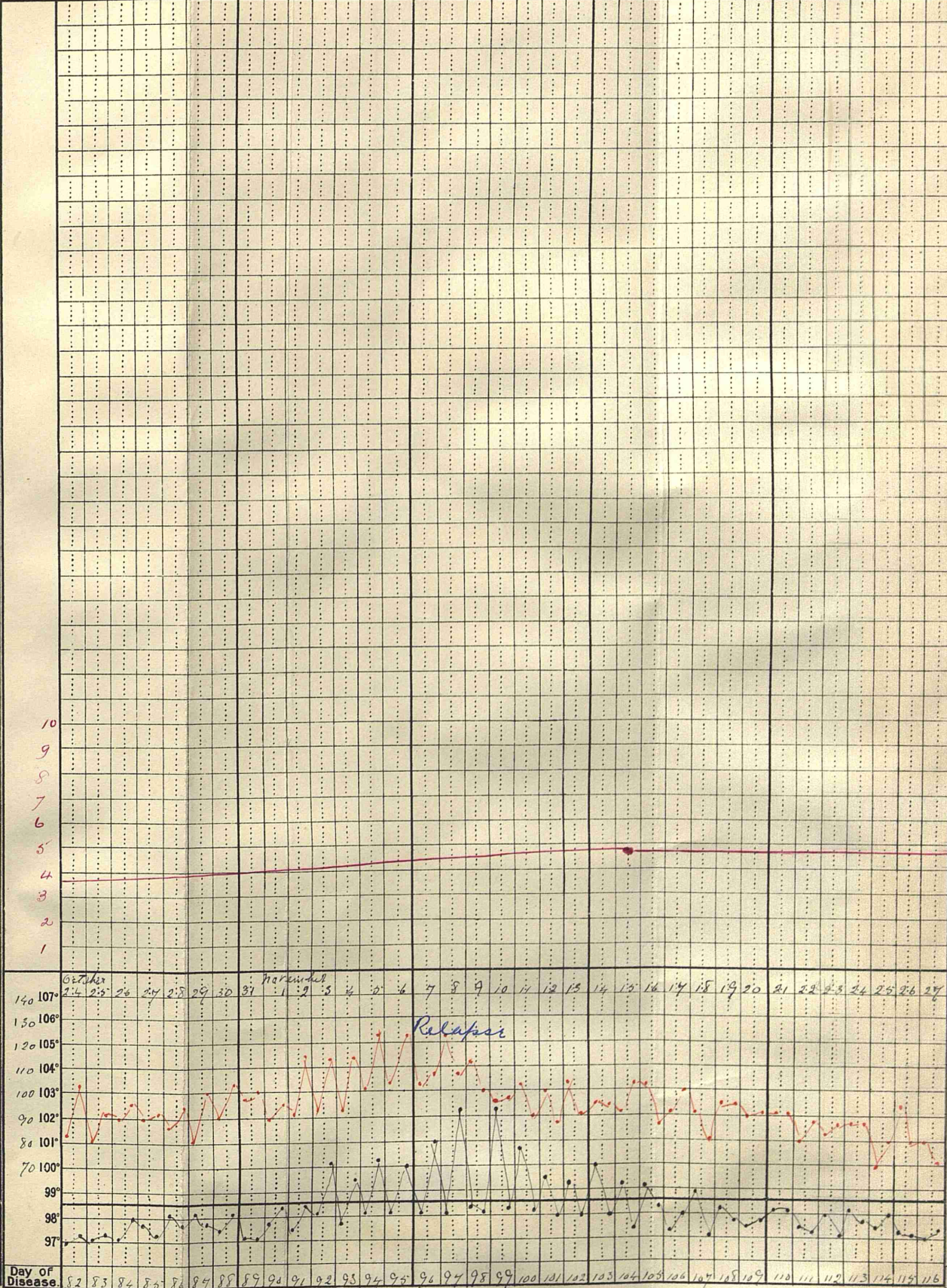
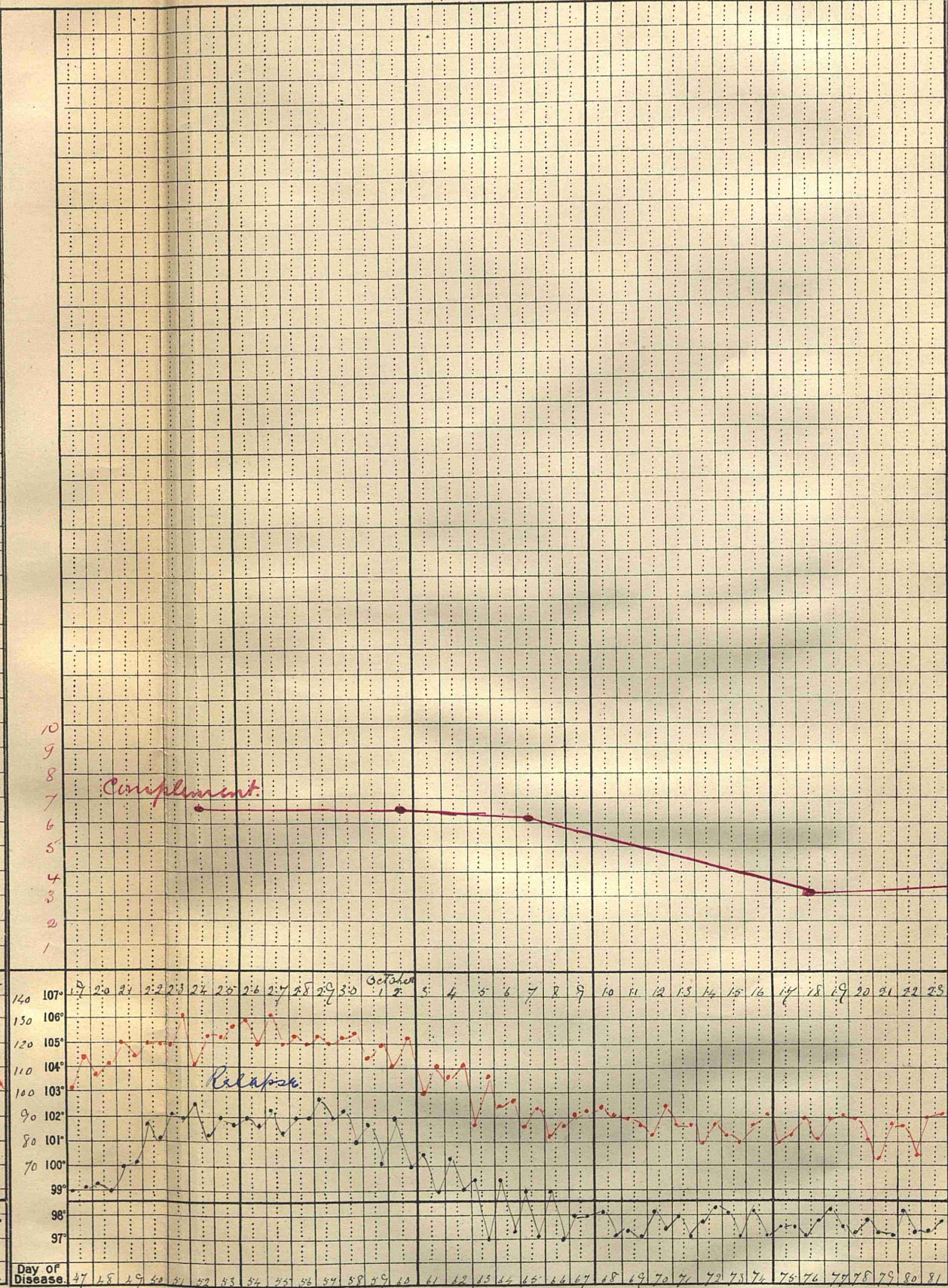
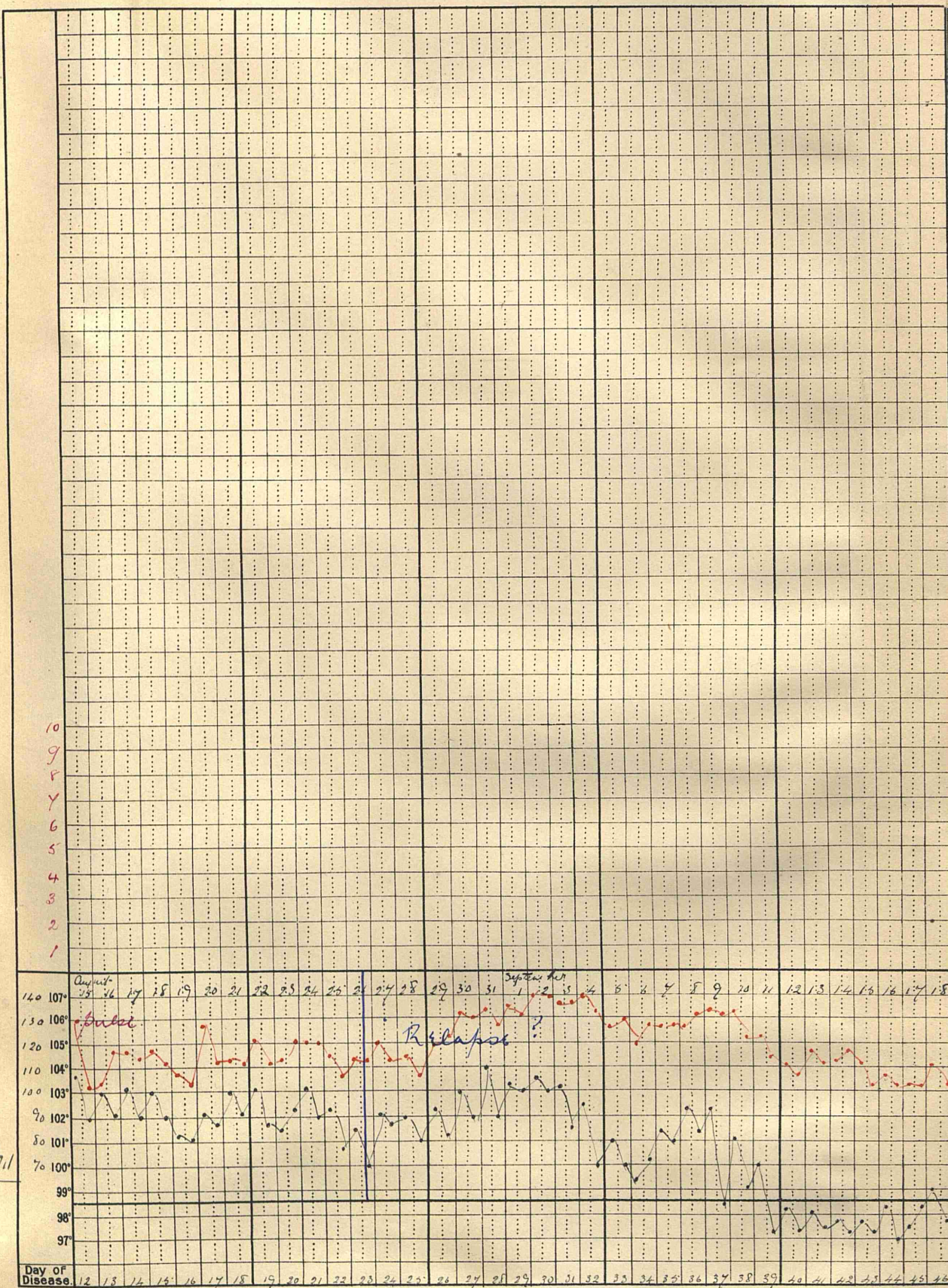
22a

22b

22c

Scale

Chart  
years  
15<sup>th</sup> 9<sup>th</sup>





August 22 23 24 25 26 27 28 29 30 31 September 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

October 26 27 28 29 30 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

November 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

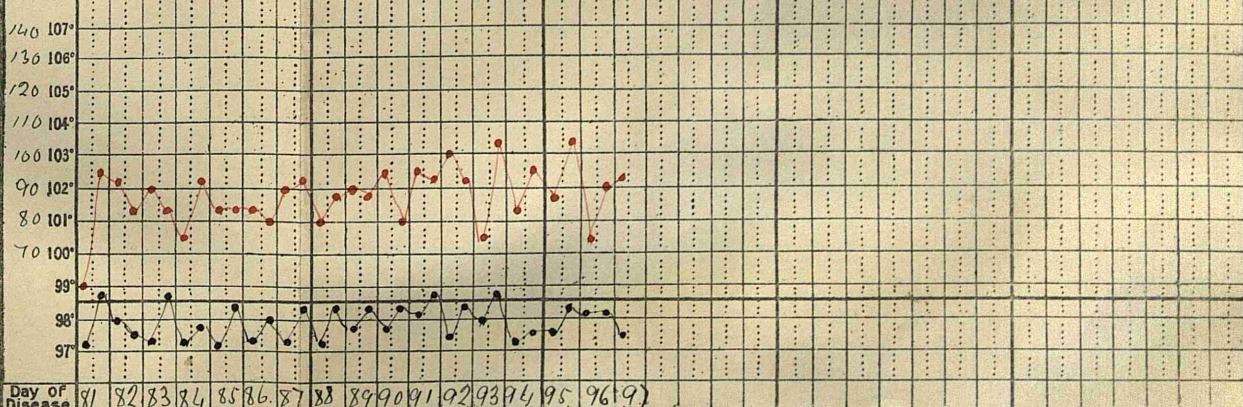
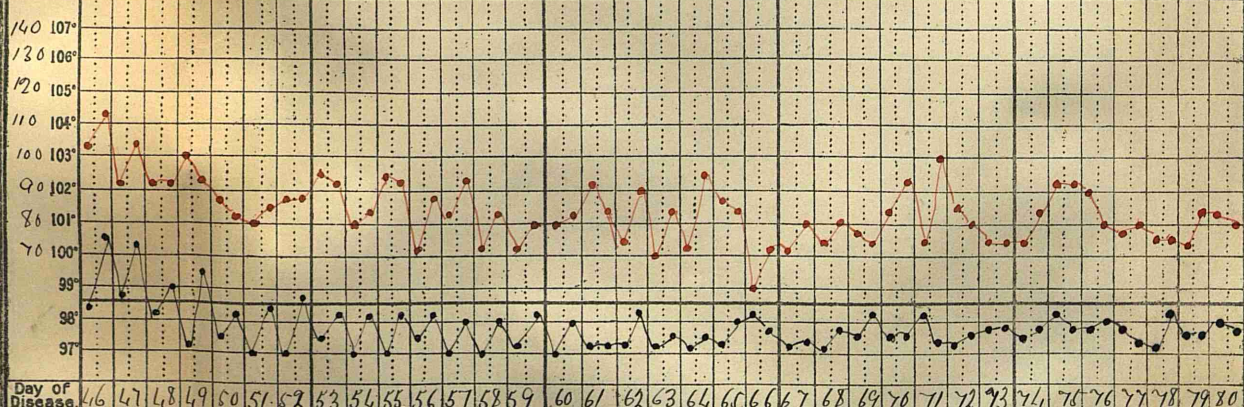
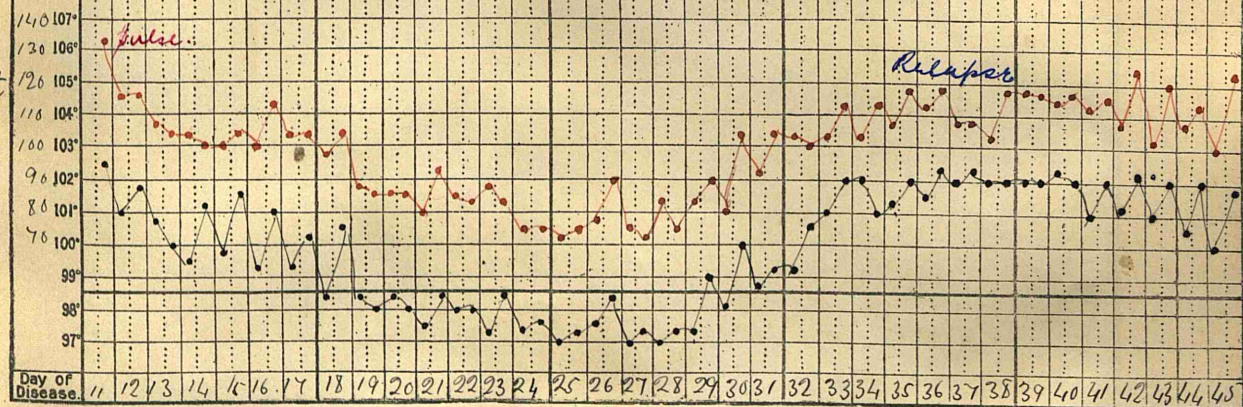
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3  
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Complement

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2  
1

Chestnut  
Leaves  
Aug 22 1911





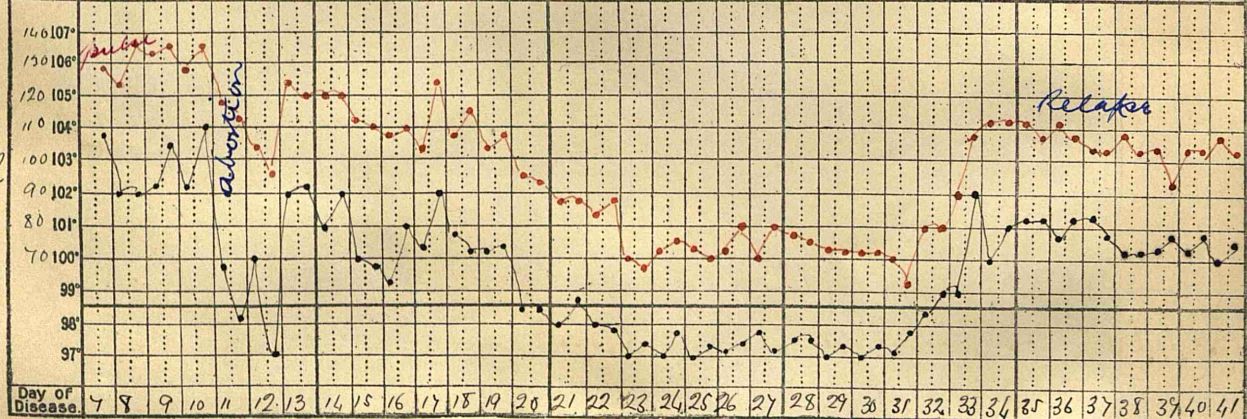
# Chart XXIV

24

September

August 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31  
September 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

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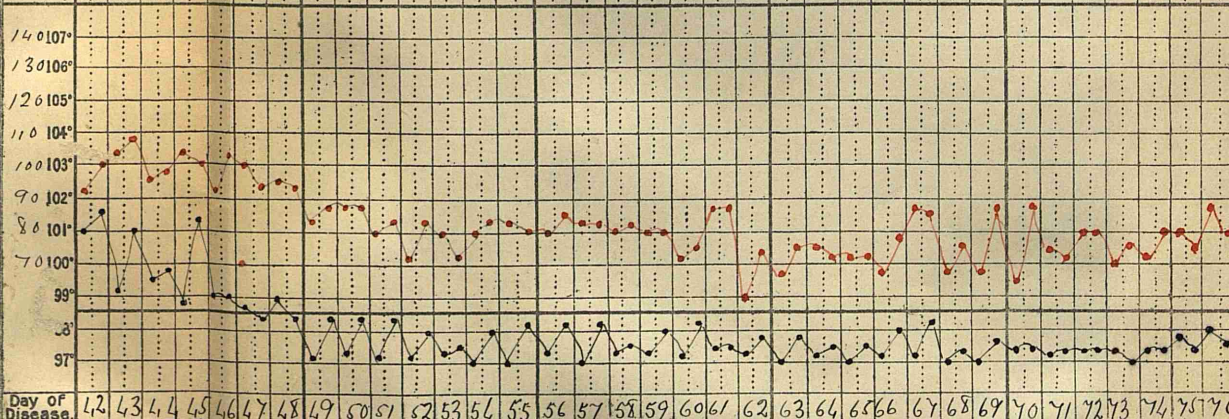


October

September 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
October 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

complement

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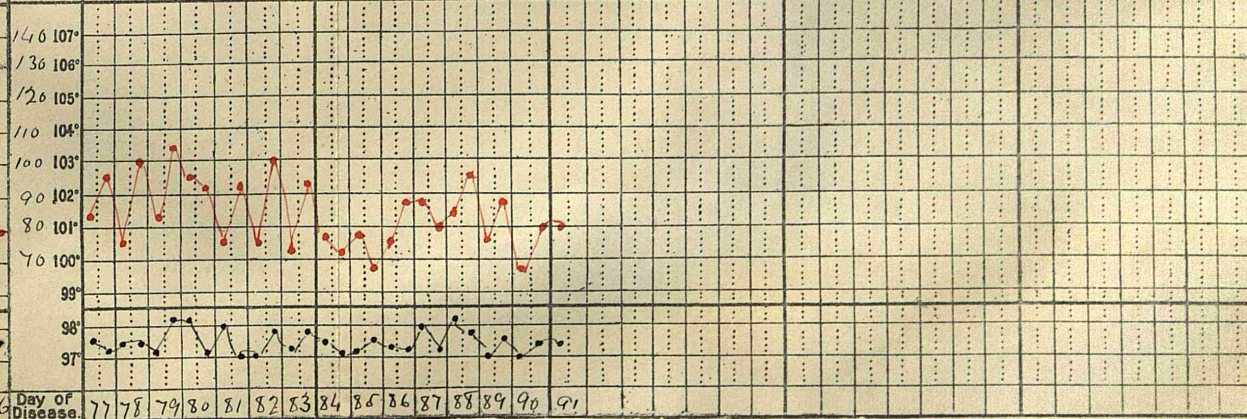


24

November

October 19 20 21 22 23 24 25 26 27 28 29 30 31  
November 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 1 2

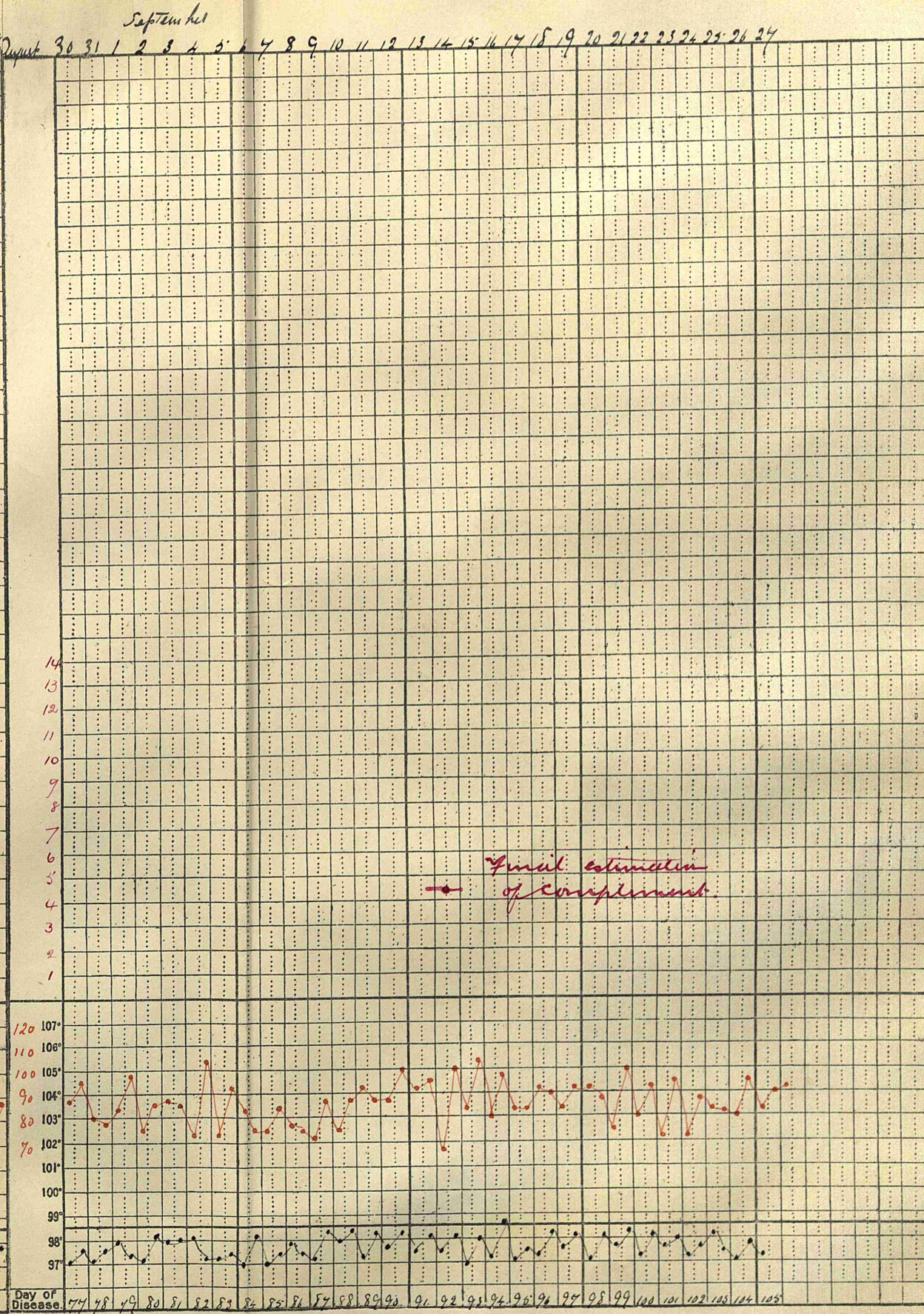
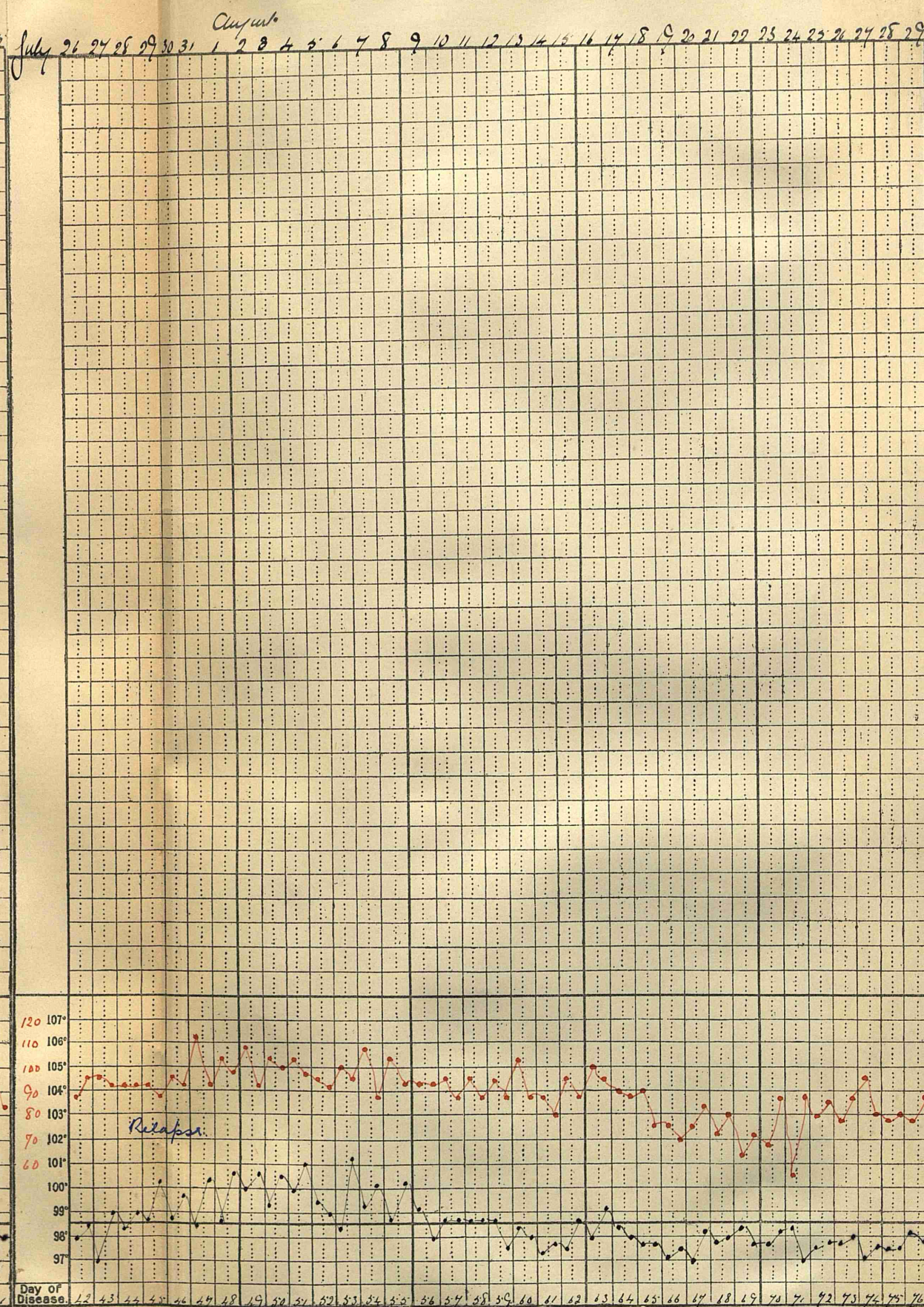
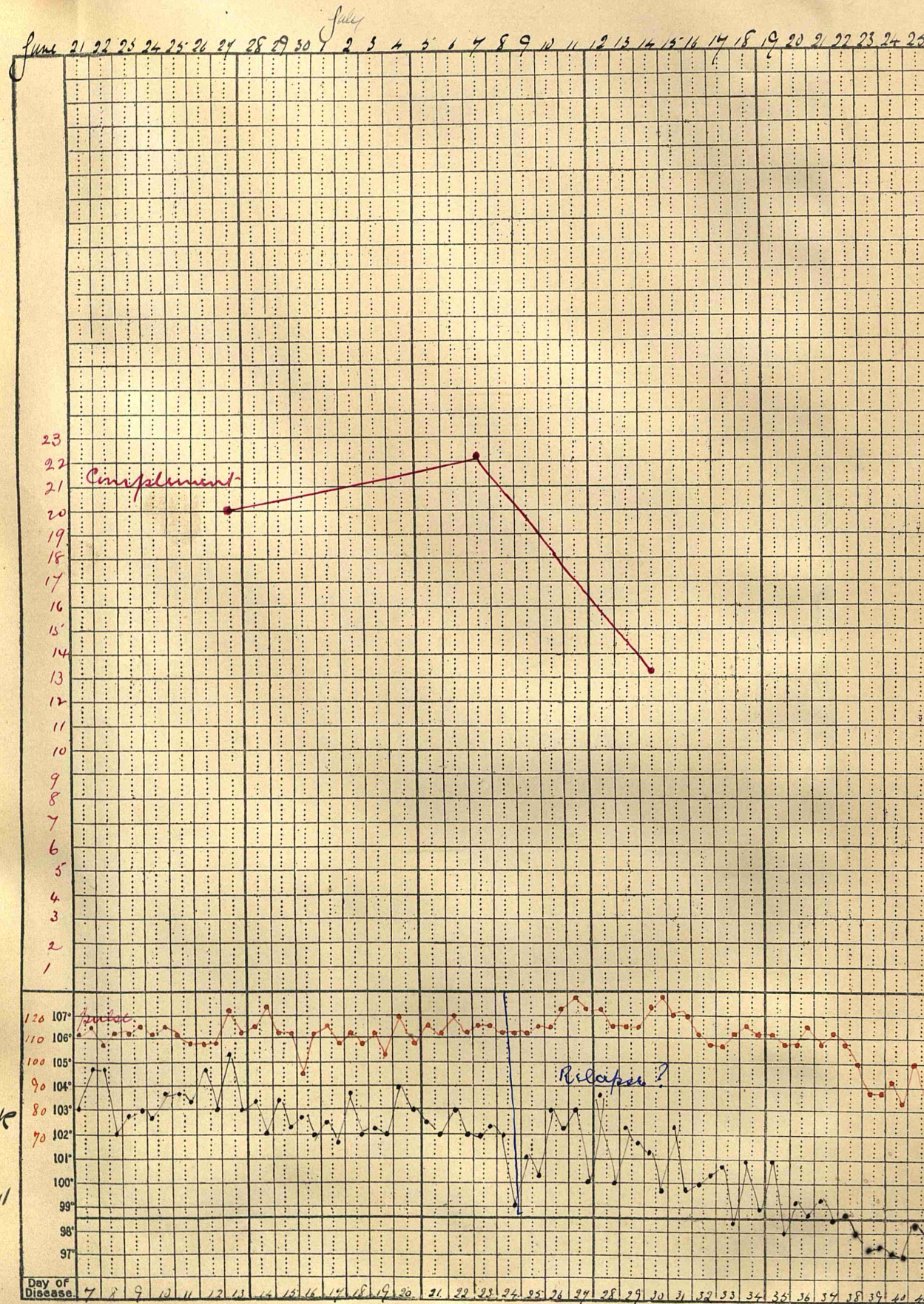
6  
5  
4  
3  
2  
1



246

Mitchell  
ears  
10th 1911







Stewart  
age 24 years  
5. 12. 11

Chart XXVI.

26

Carl Coul-

26a

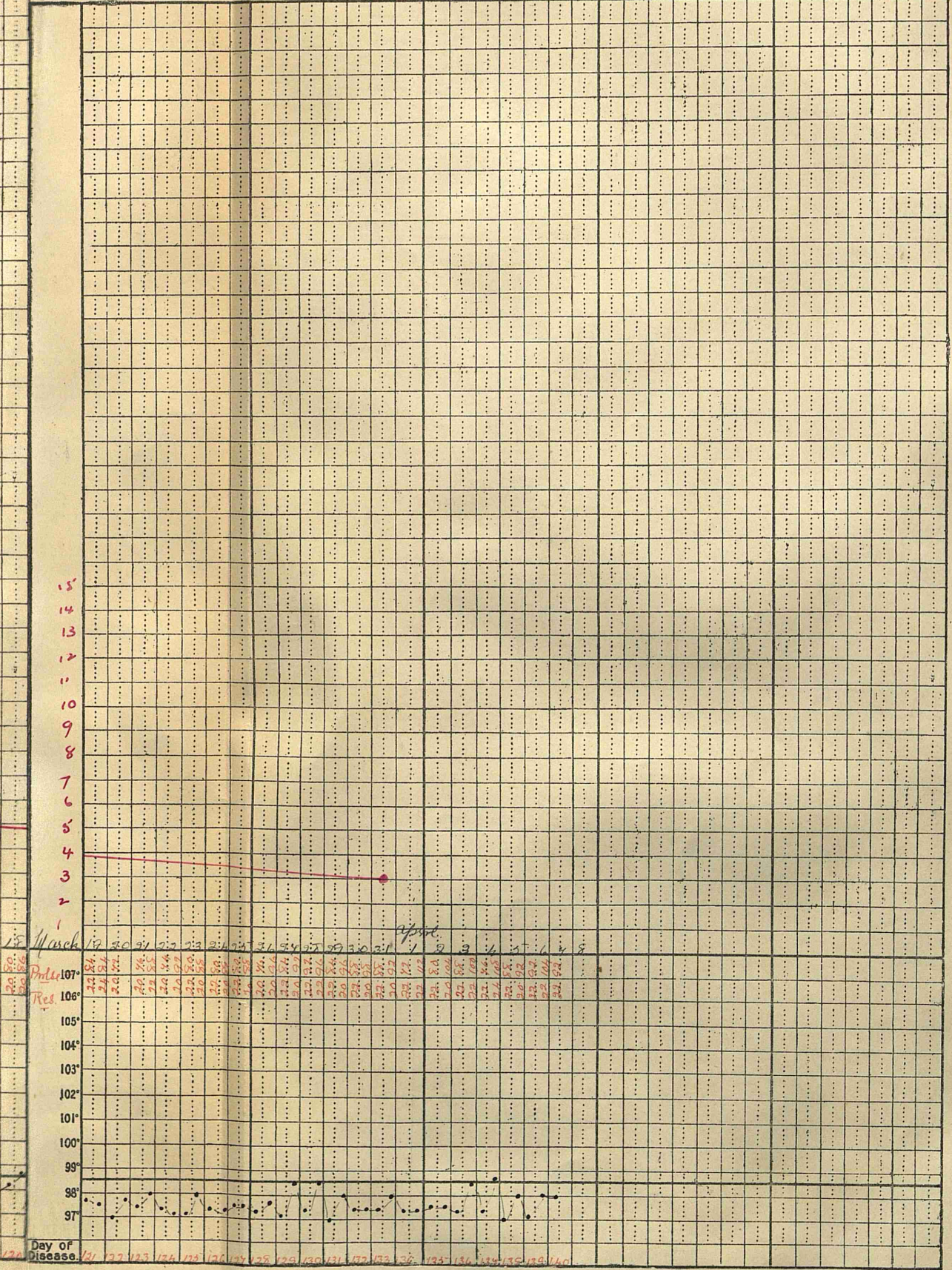
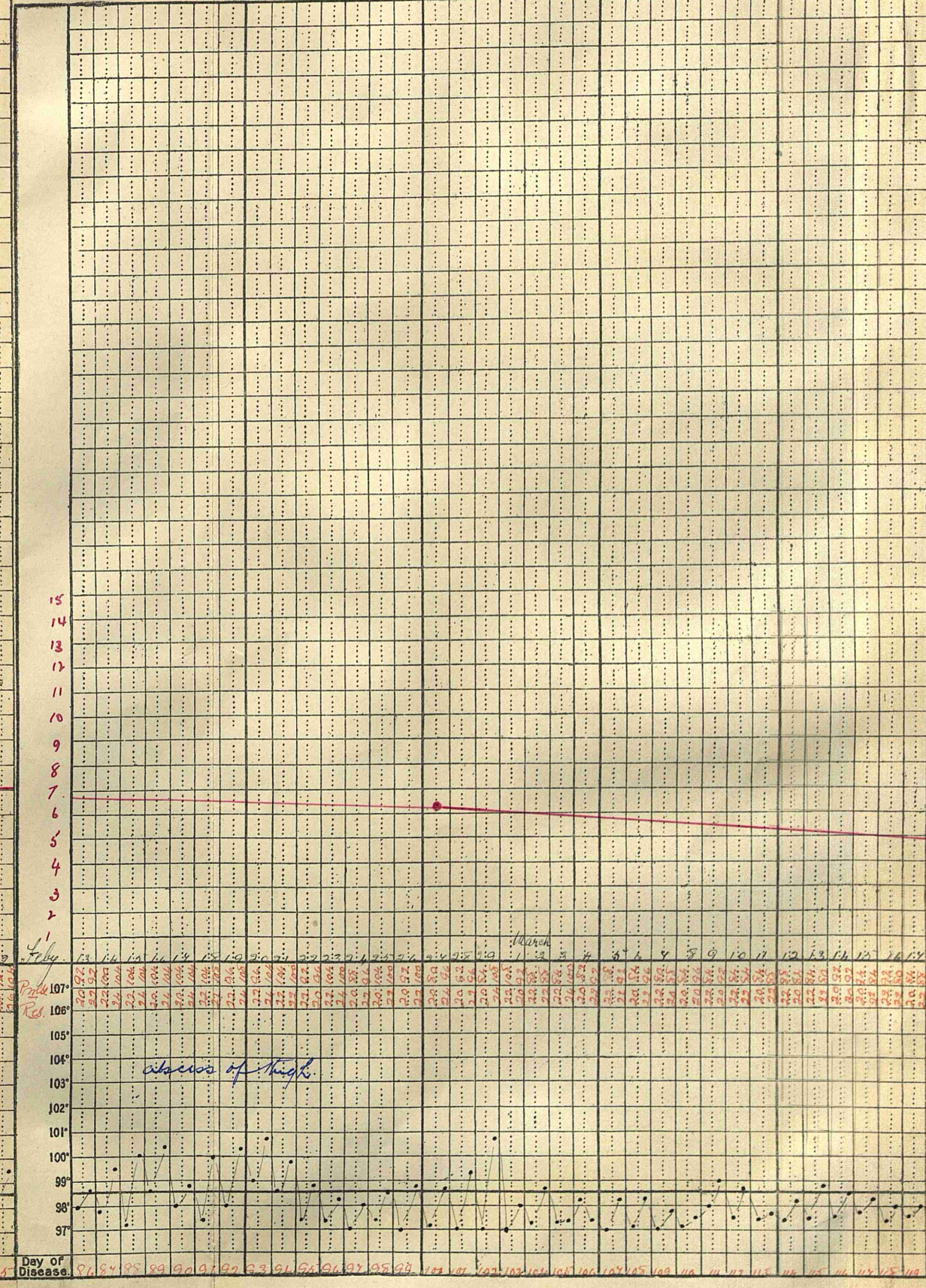
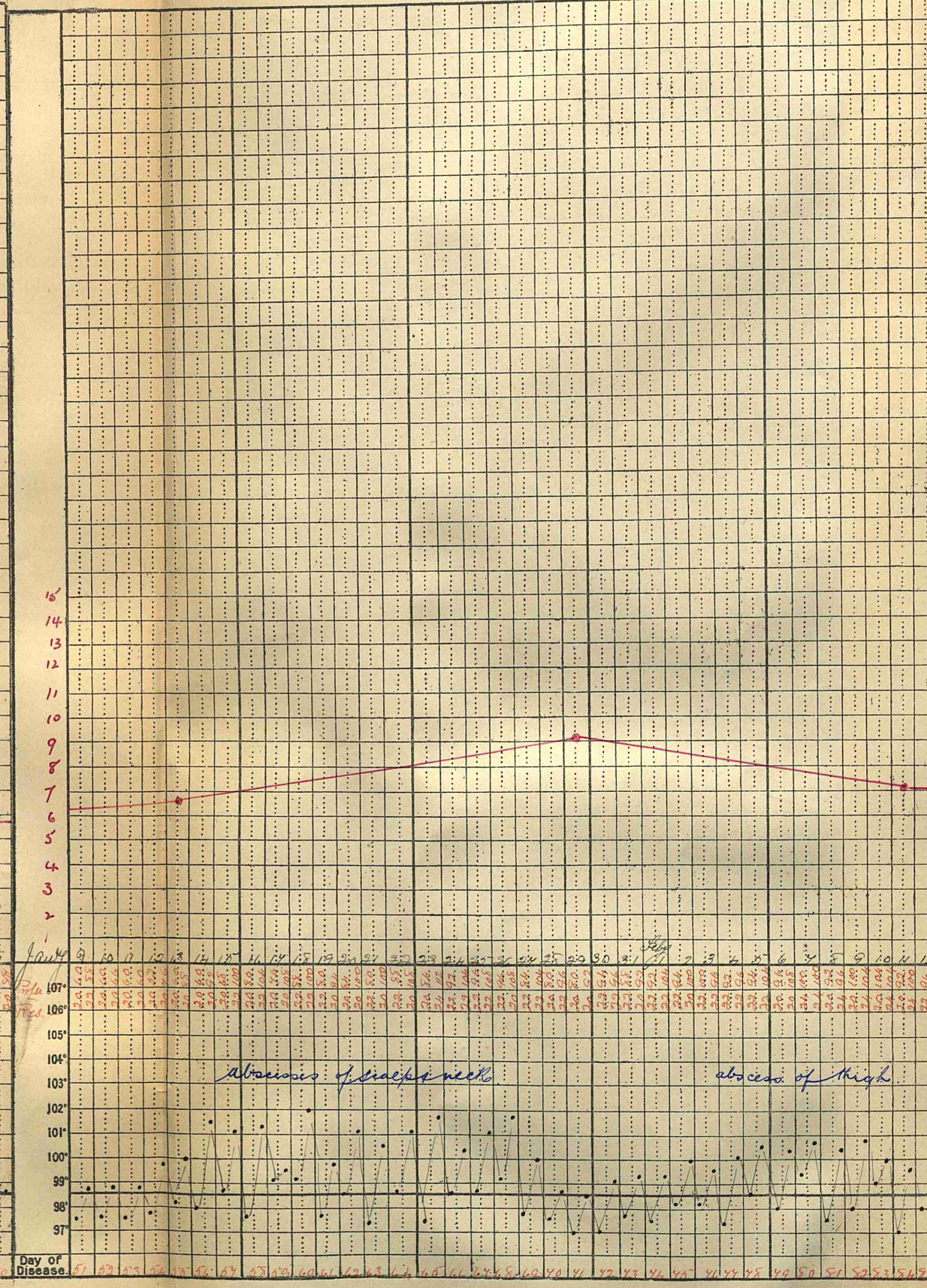
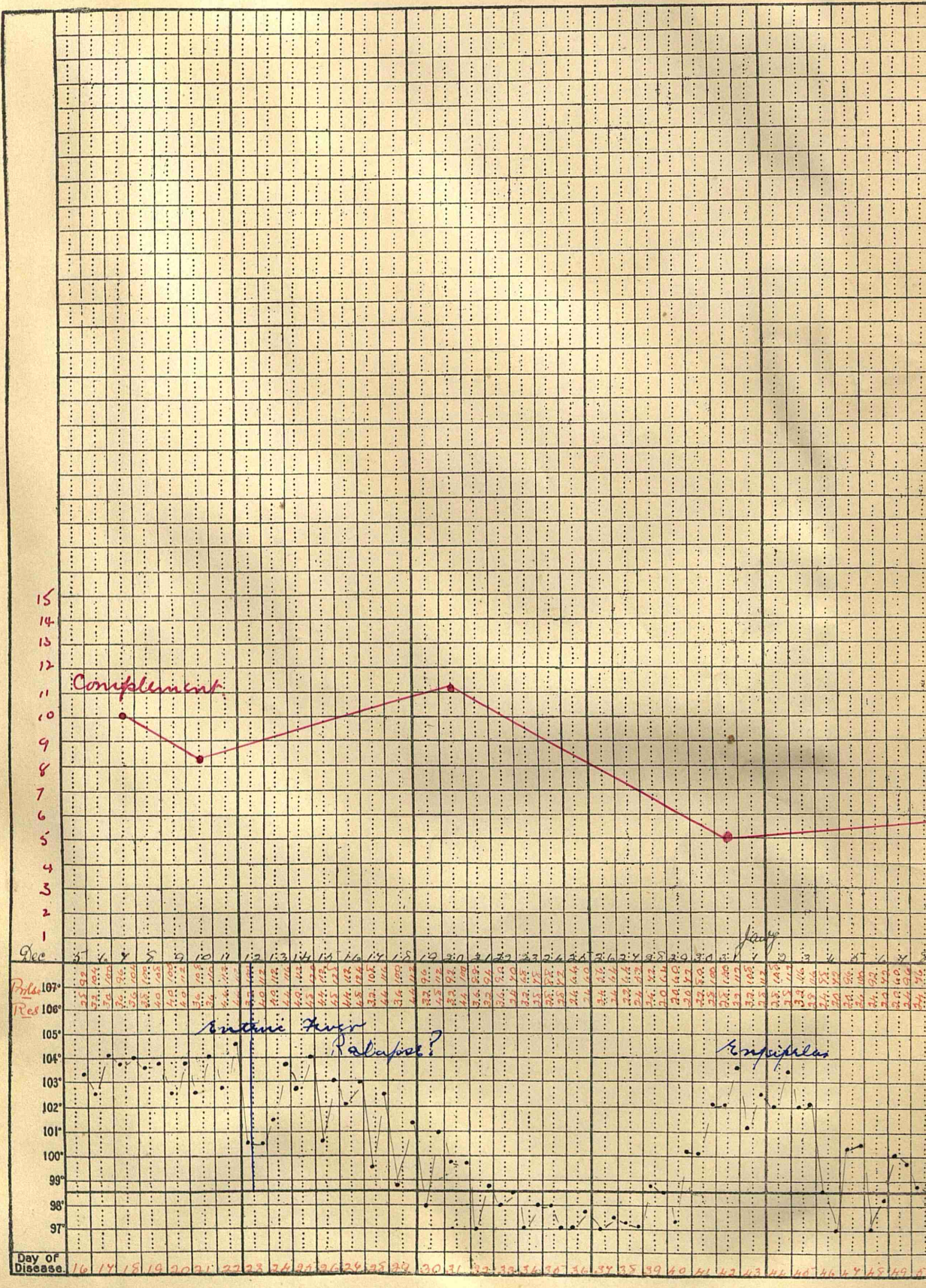
Carl Coul-

26b

Carl Coul-

26c

re  
s  
day  
unc  
ation





Loughlan  
46 years  
8.11.11

Chart XXVII

27

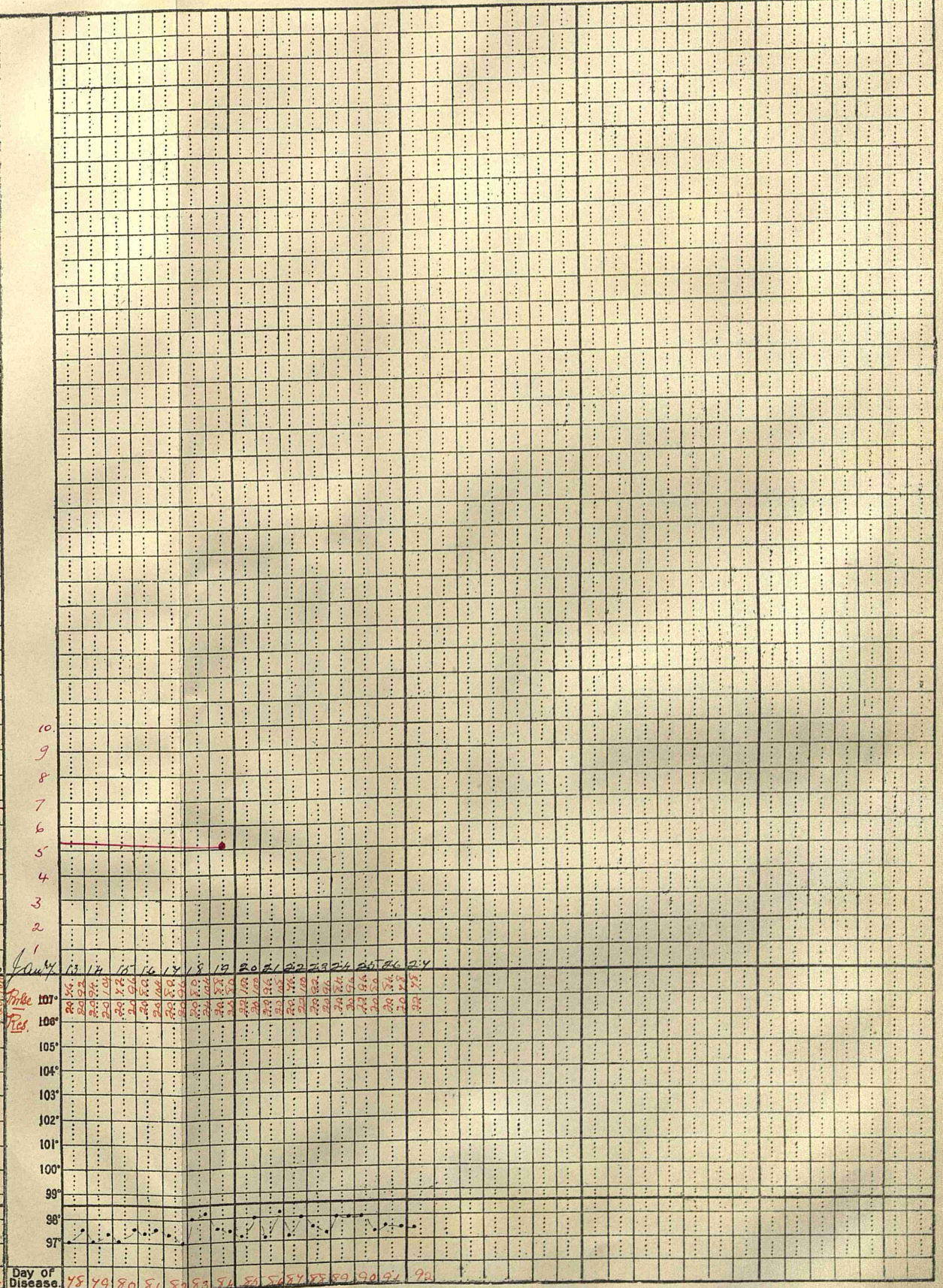
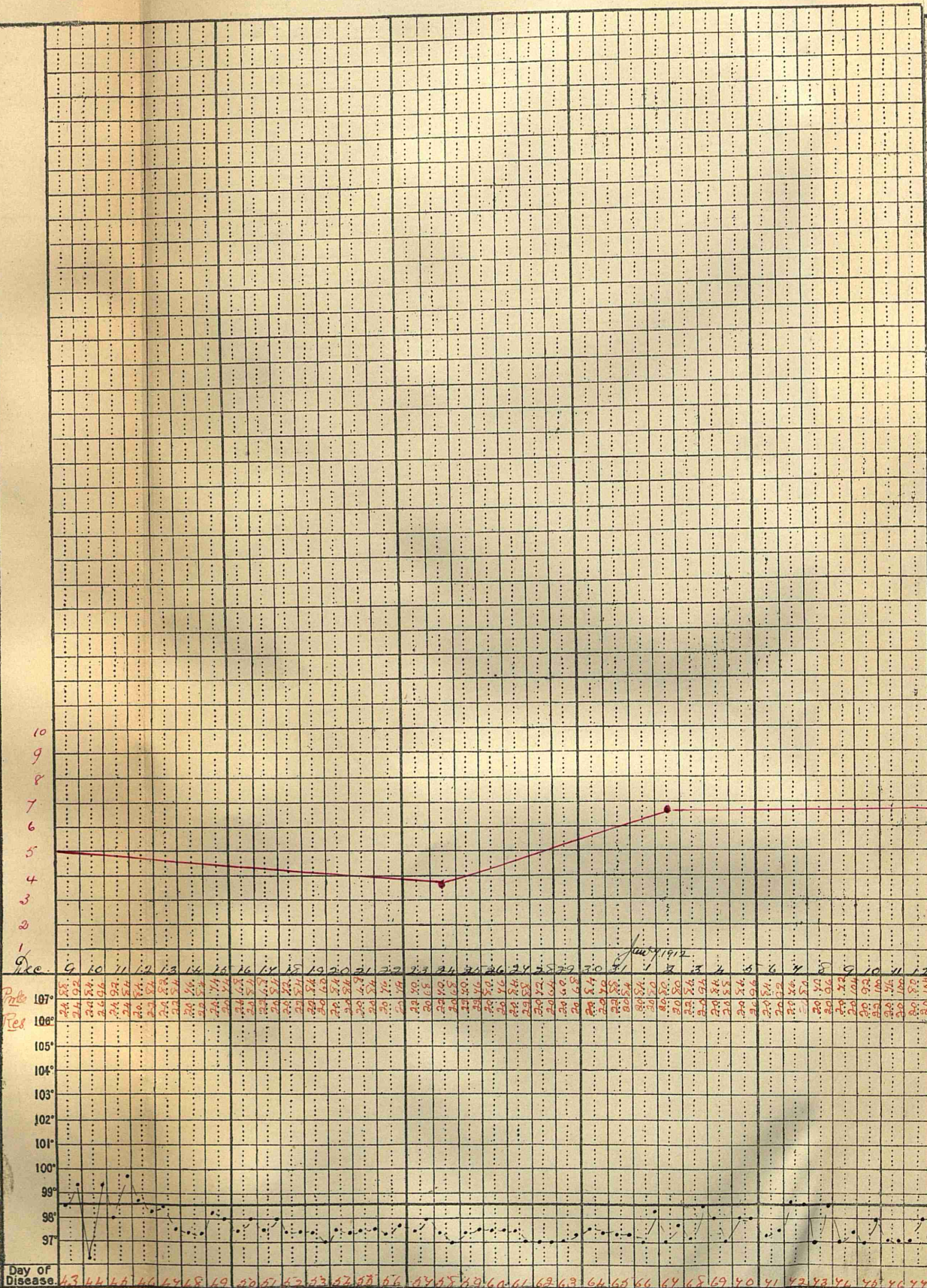
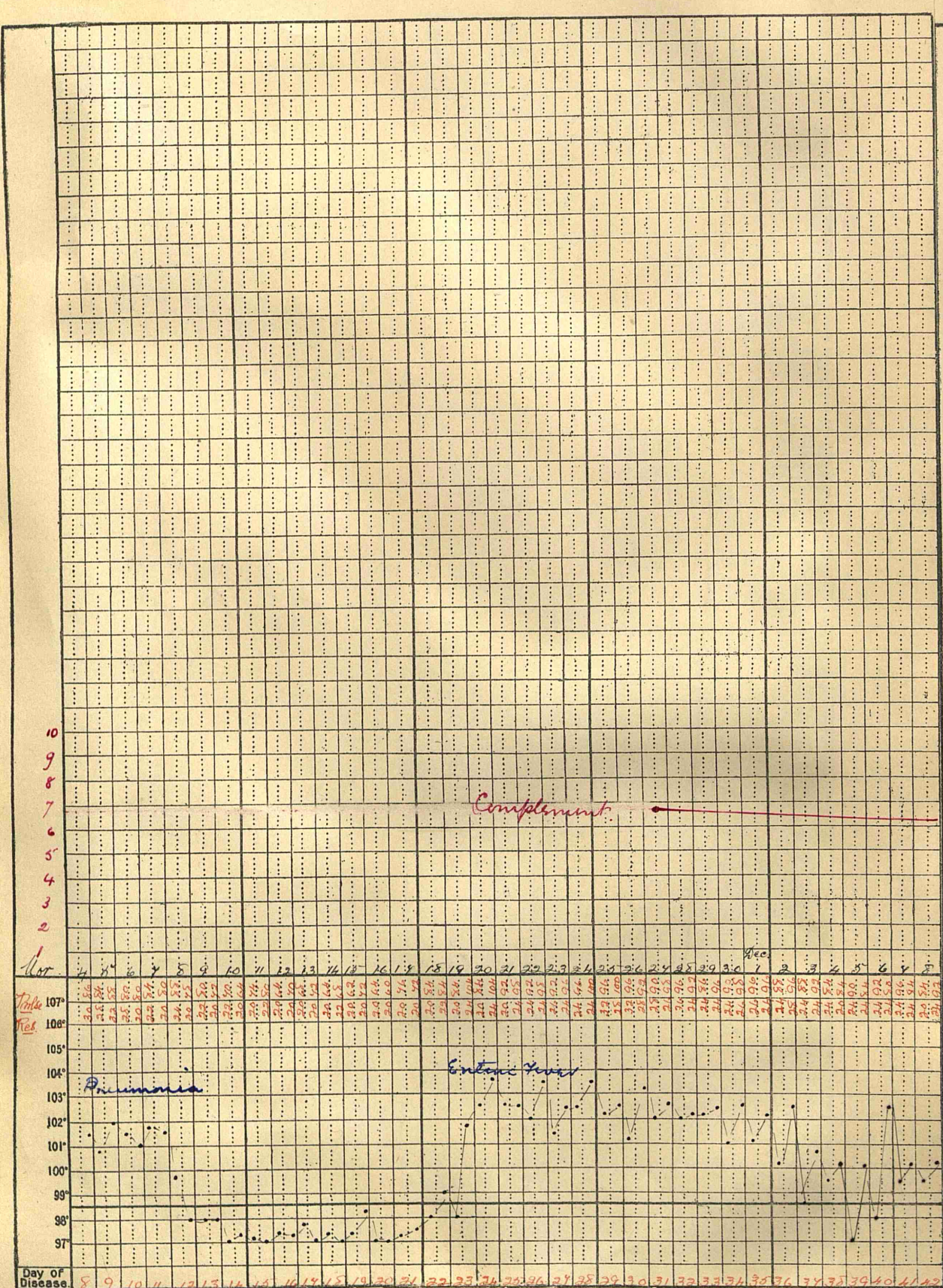
Plan Cont.

27a

Plan Cont.

27b

nona  
in  
fever





2nd Low  
 Age 36 years  
 Dec. 27. 11. 11

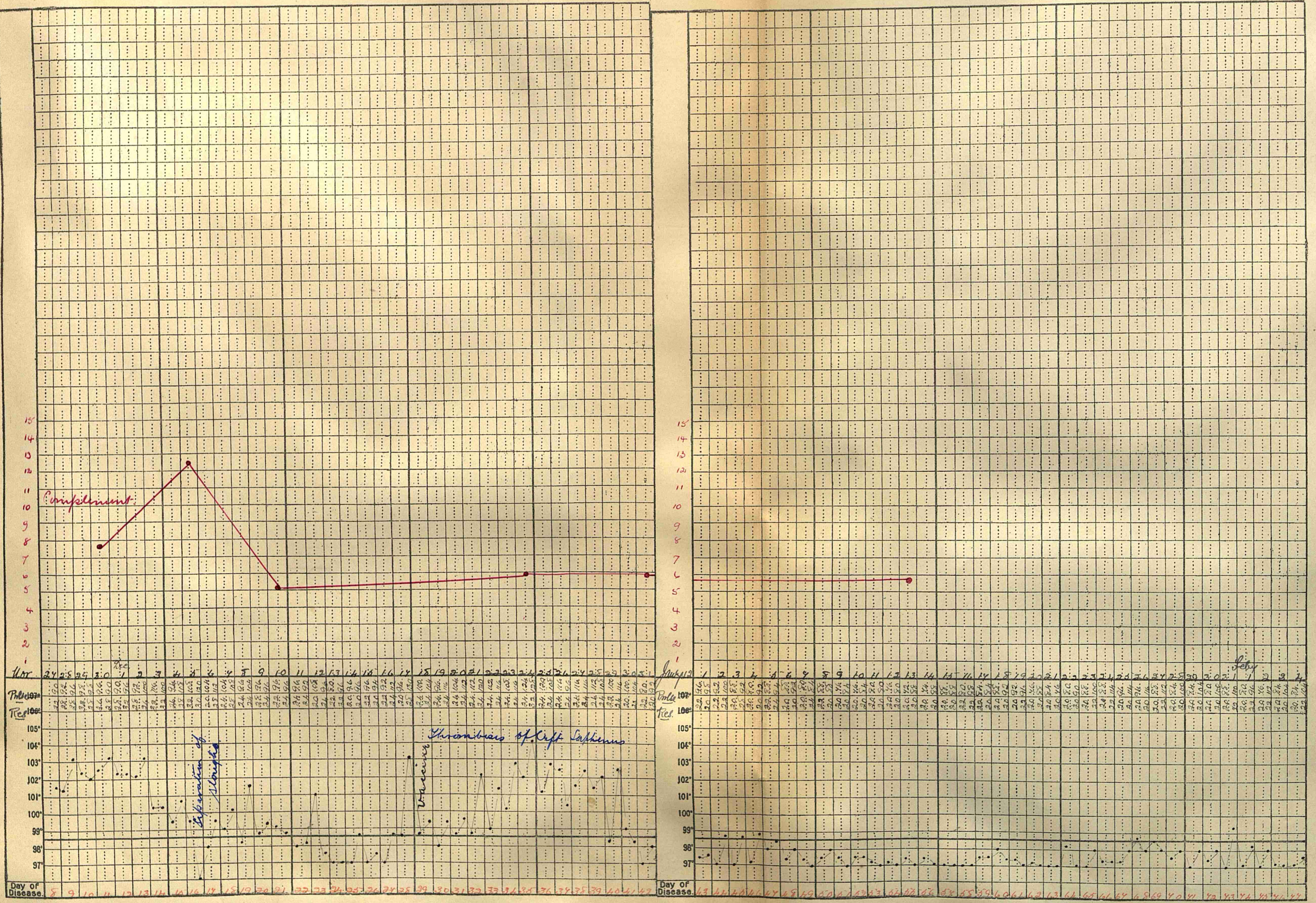
Chart x x VIII

28

2nd Cont.

282

teni  
 loss  
 with  
 umbrae





Matheson  
23.11.11

Chart XXIX

29

Cont.

29a

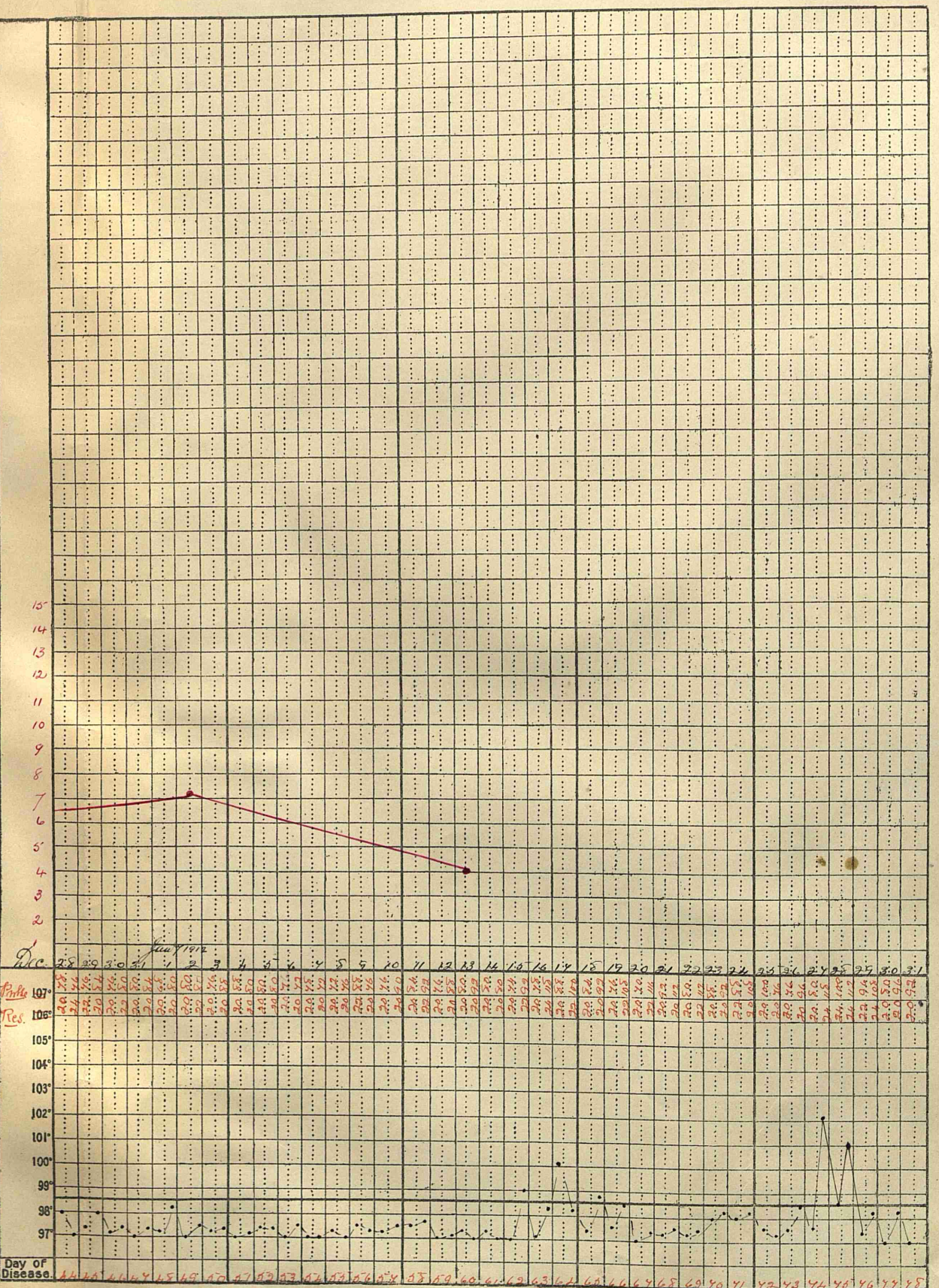
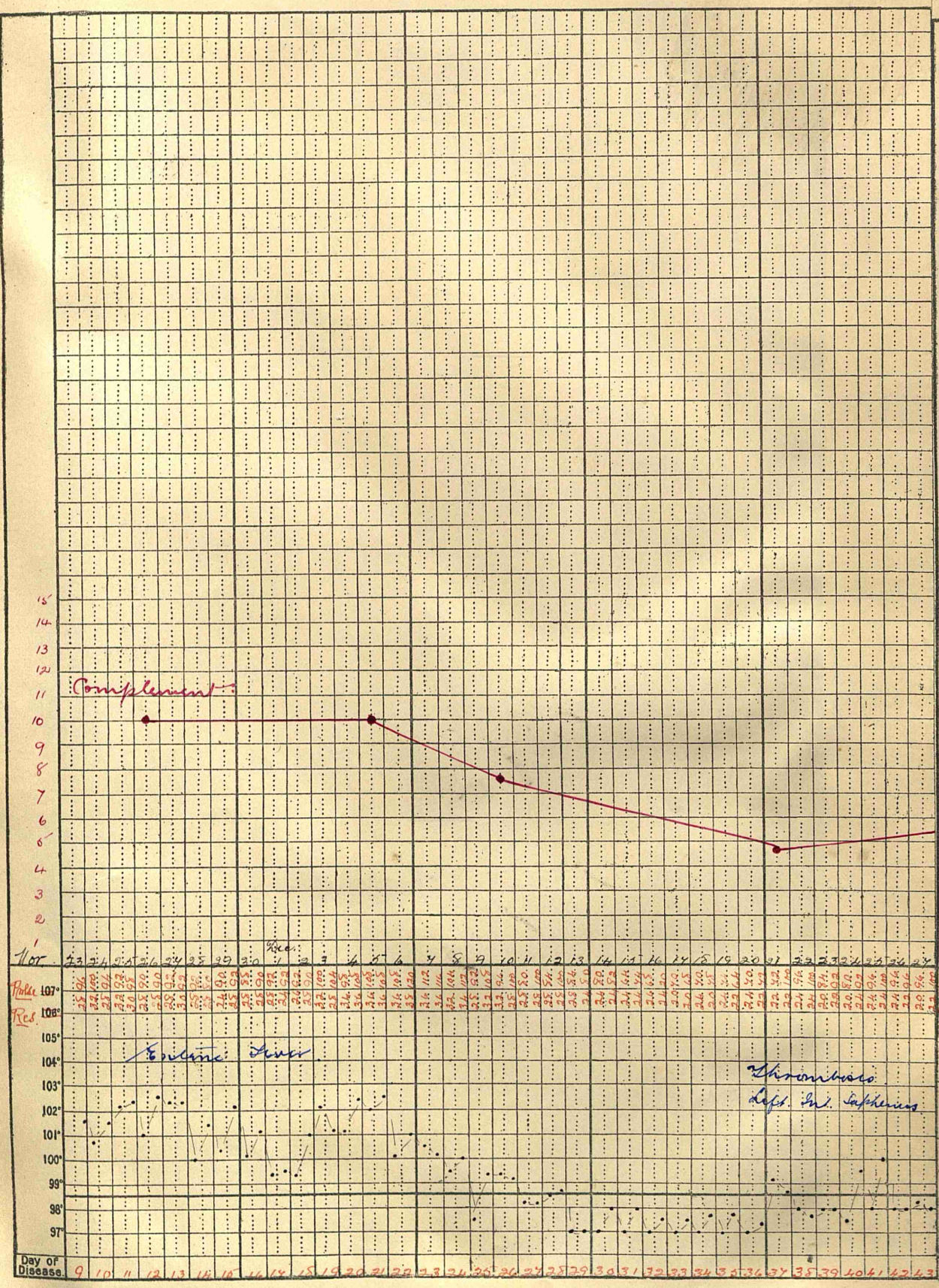




Chart XXX.

30

30a

30b

me  
ves  
ing.

Allan  
years  
51. 1911

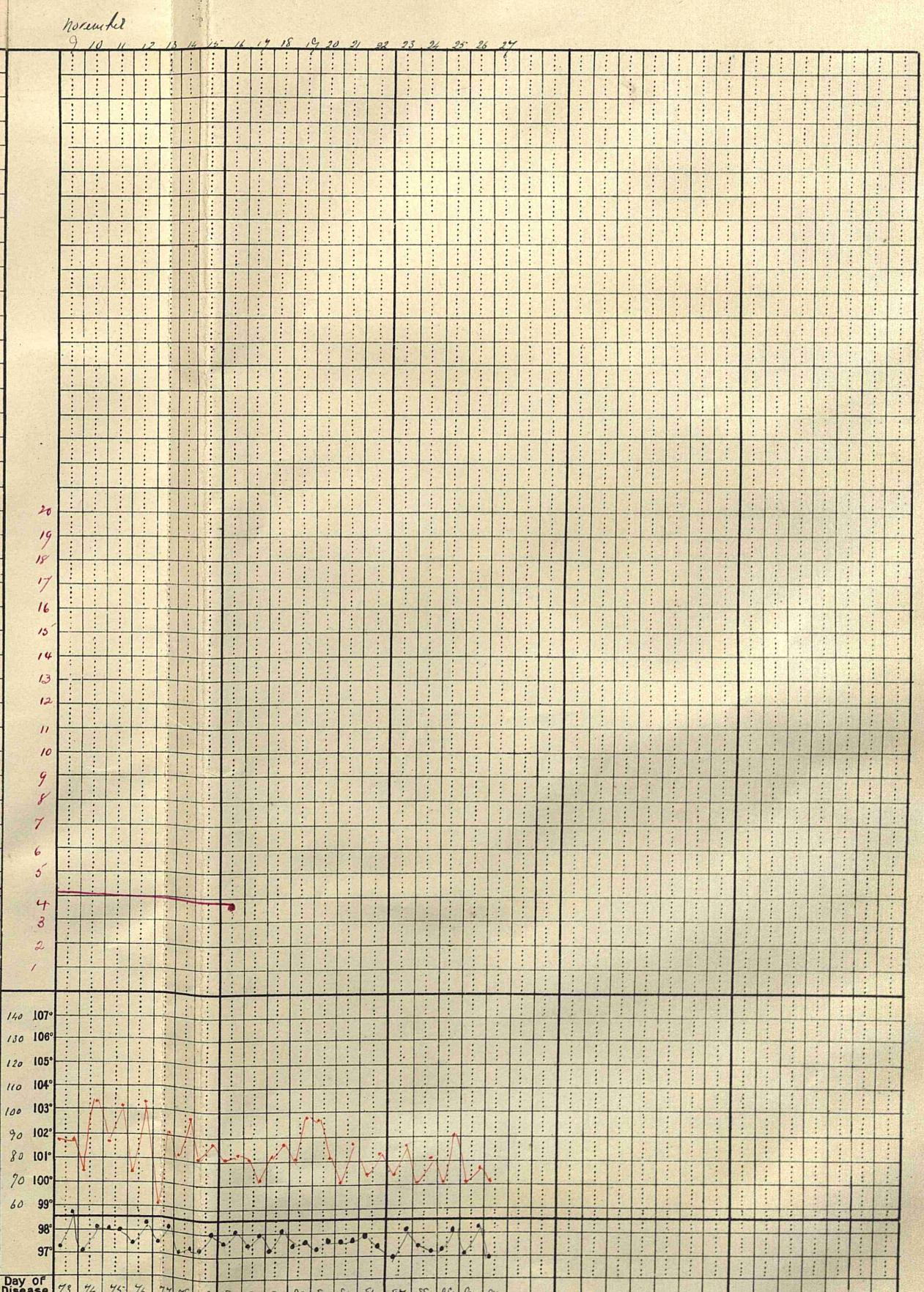
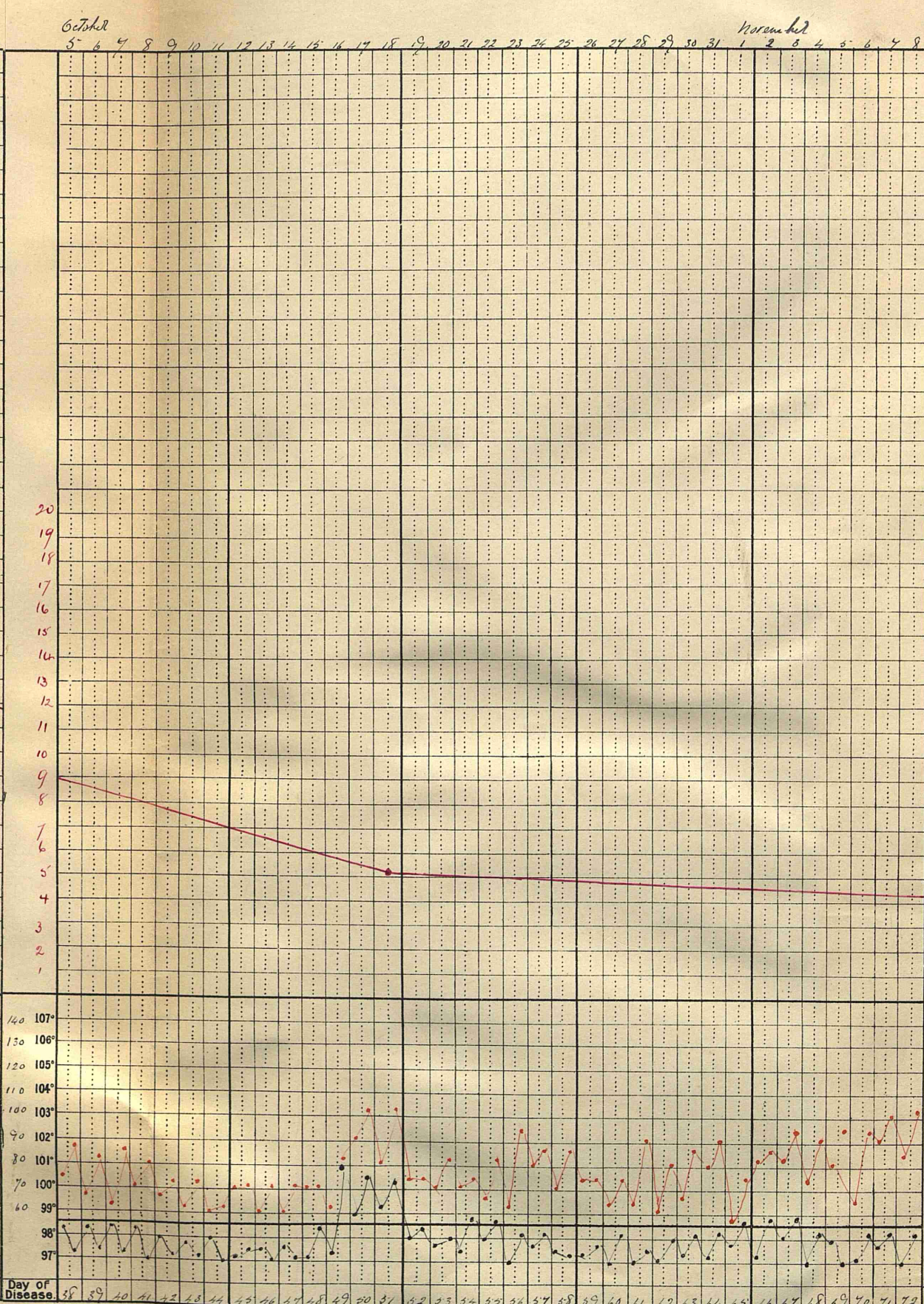
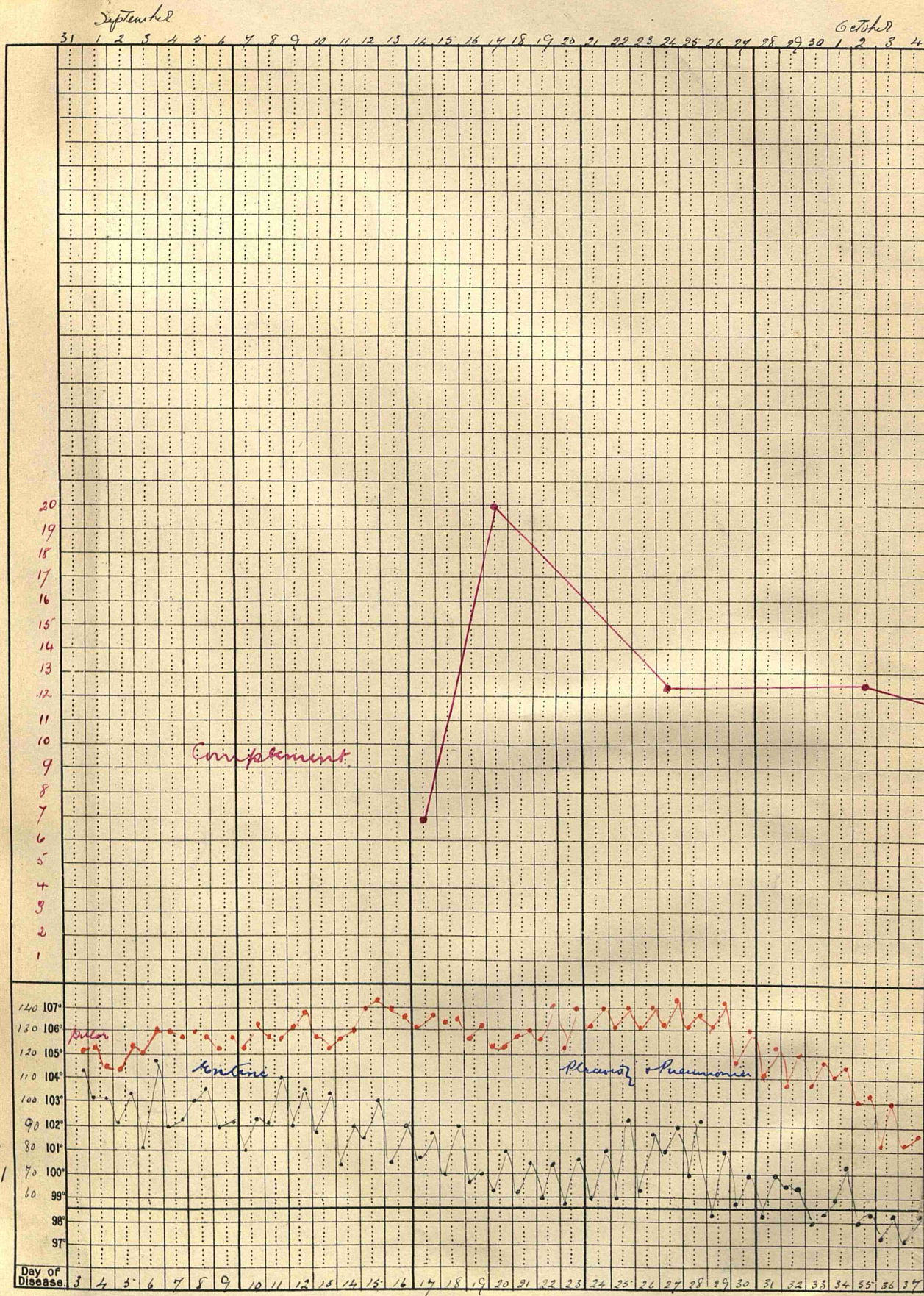
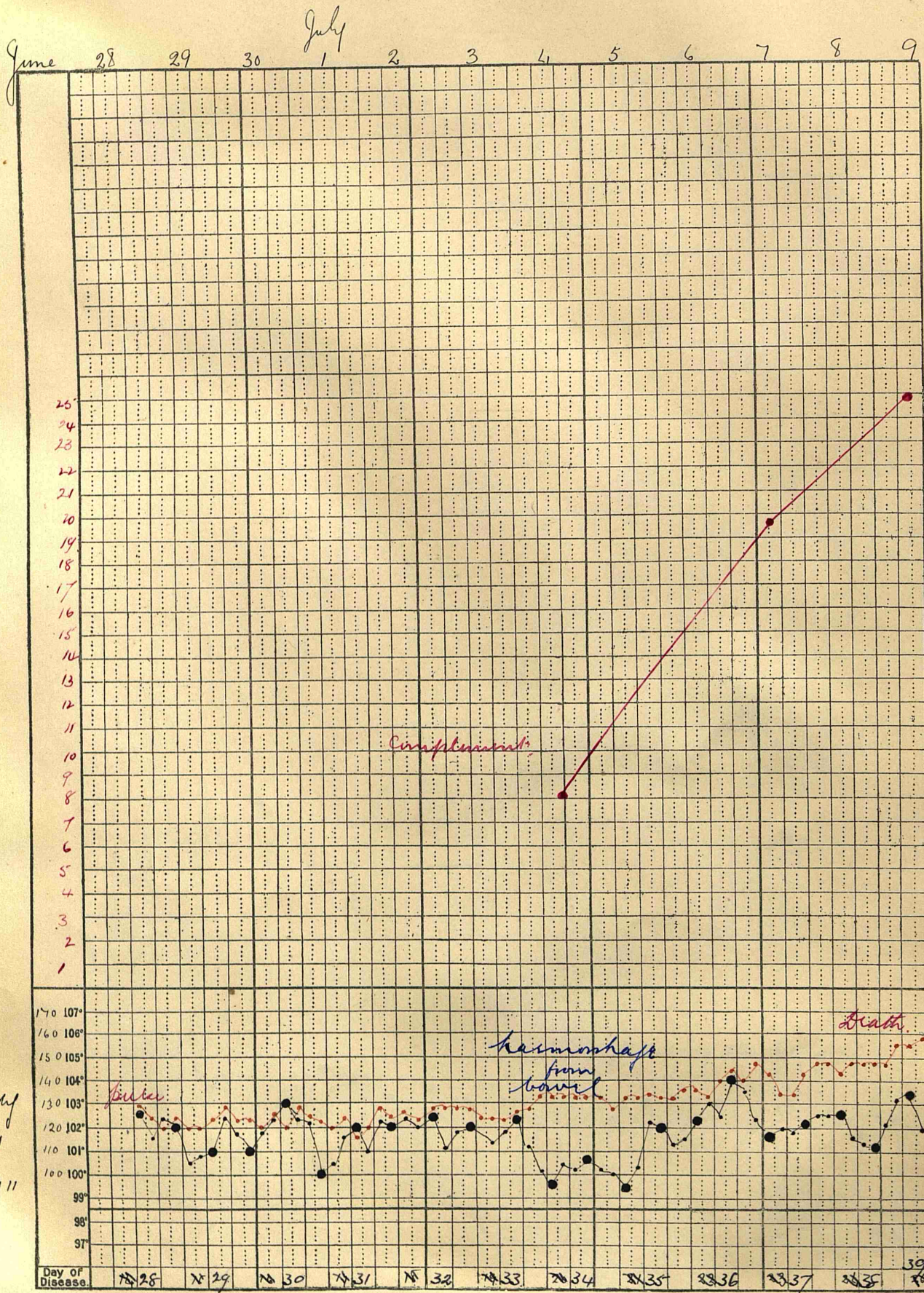




Chart XXXI

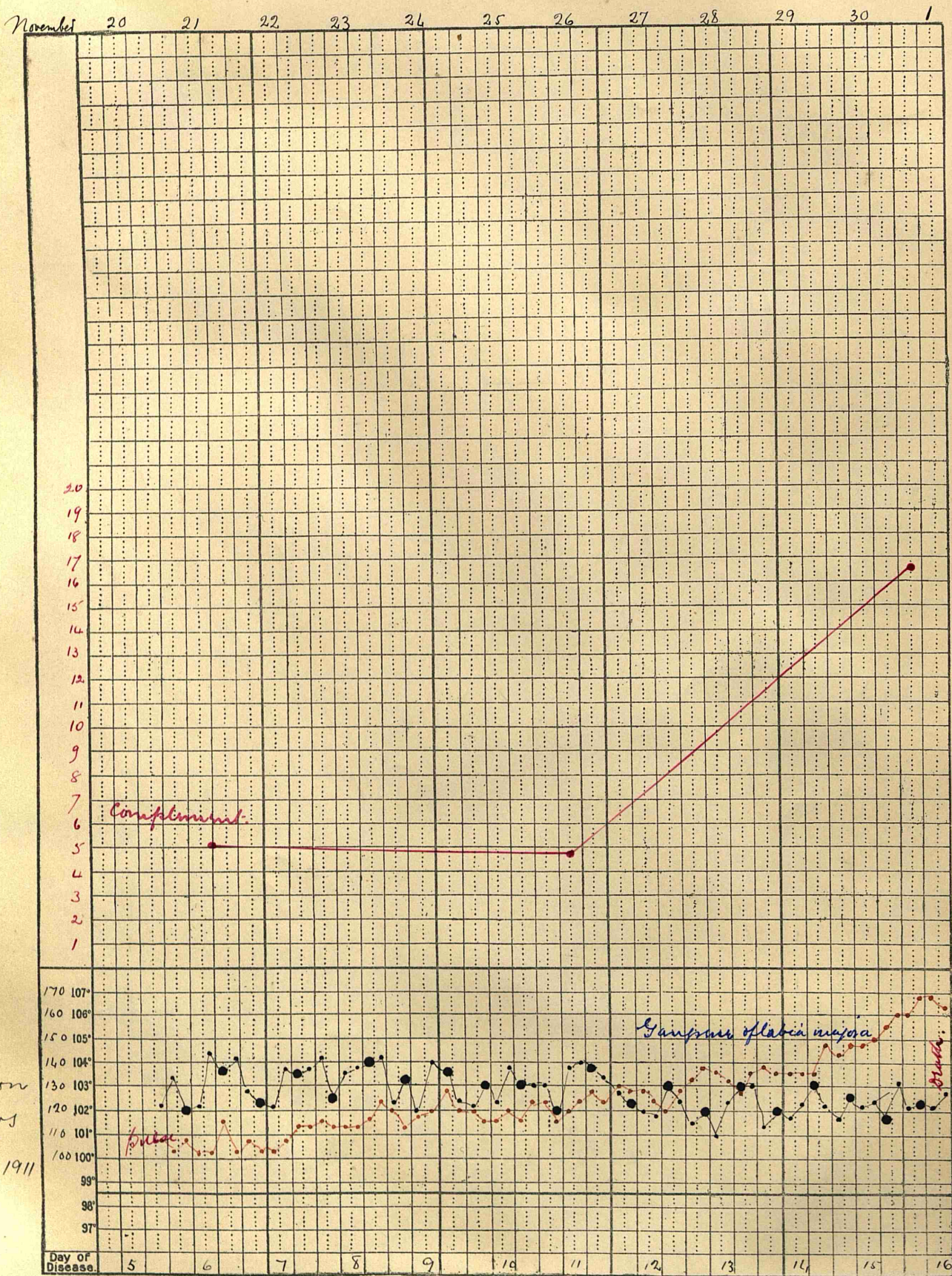
31



Bassidy fears  
28th 1911

25





Ami  
er

Dawson  
1 Year  
at  
bet 20" 1911



October 16 17 18 19 20 21 22 23

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

Enteric  
Fever

Temperature

170 107°  
160 106°  
150 105°  
140 104°  
130 103°  
120 102°  
110 101°  
100 100°  
99°  
98°  
97°

John McIntosh  
11 years  
October 16<sup>th</sup> 1911

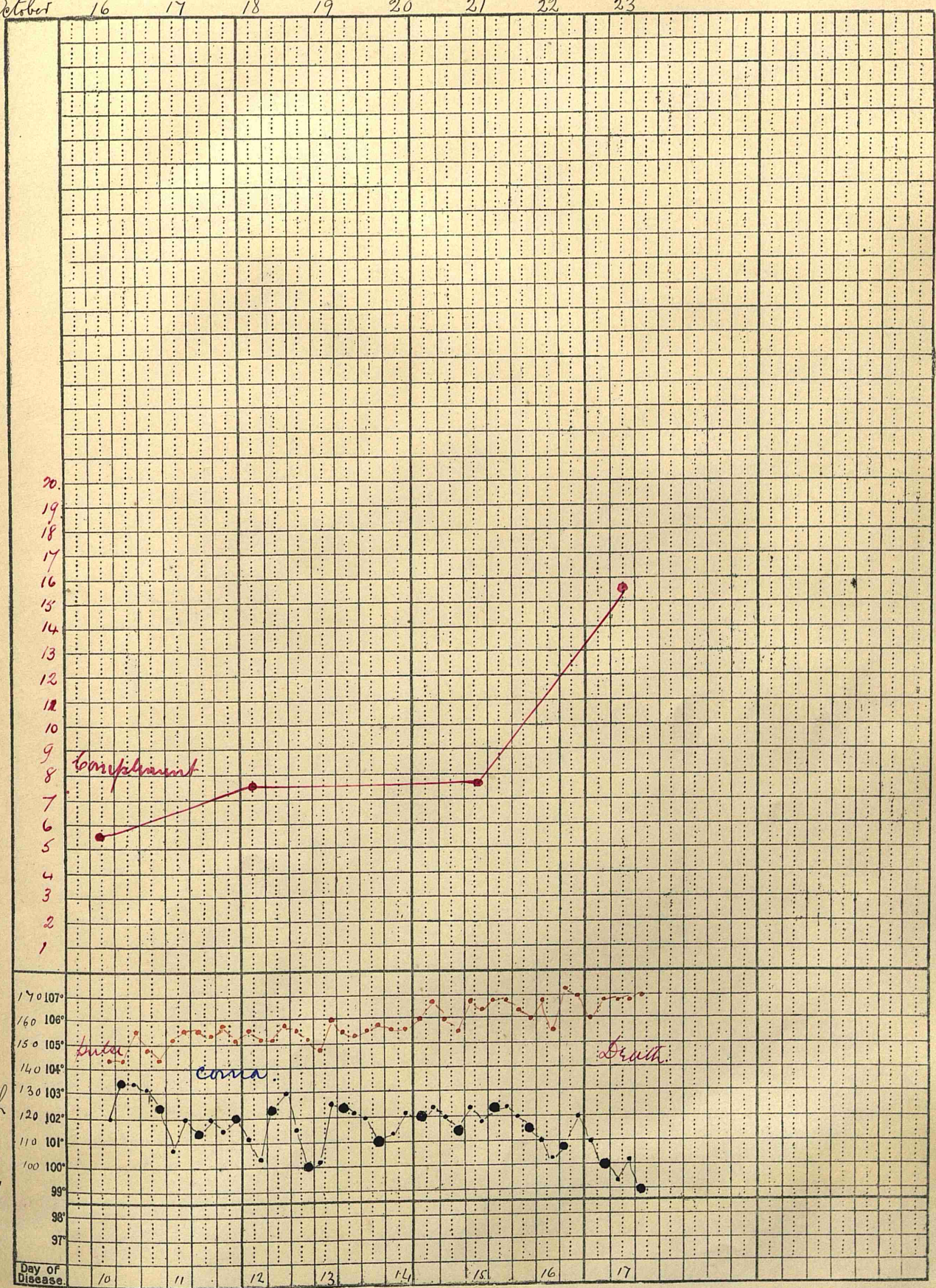
Intake

Coma

Death

Day of  
Disease

10 11 12 13 14 15 16 17



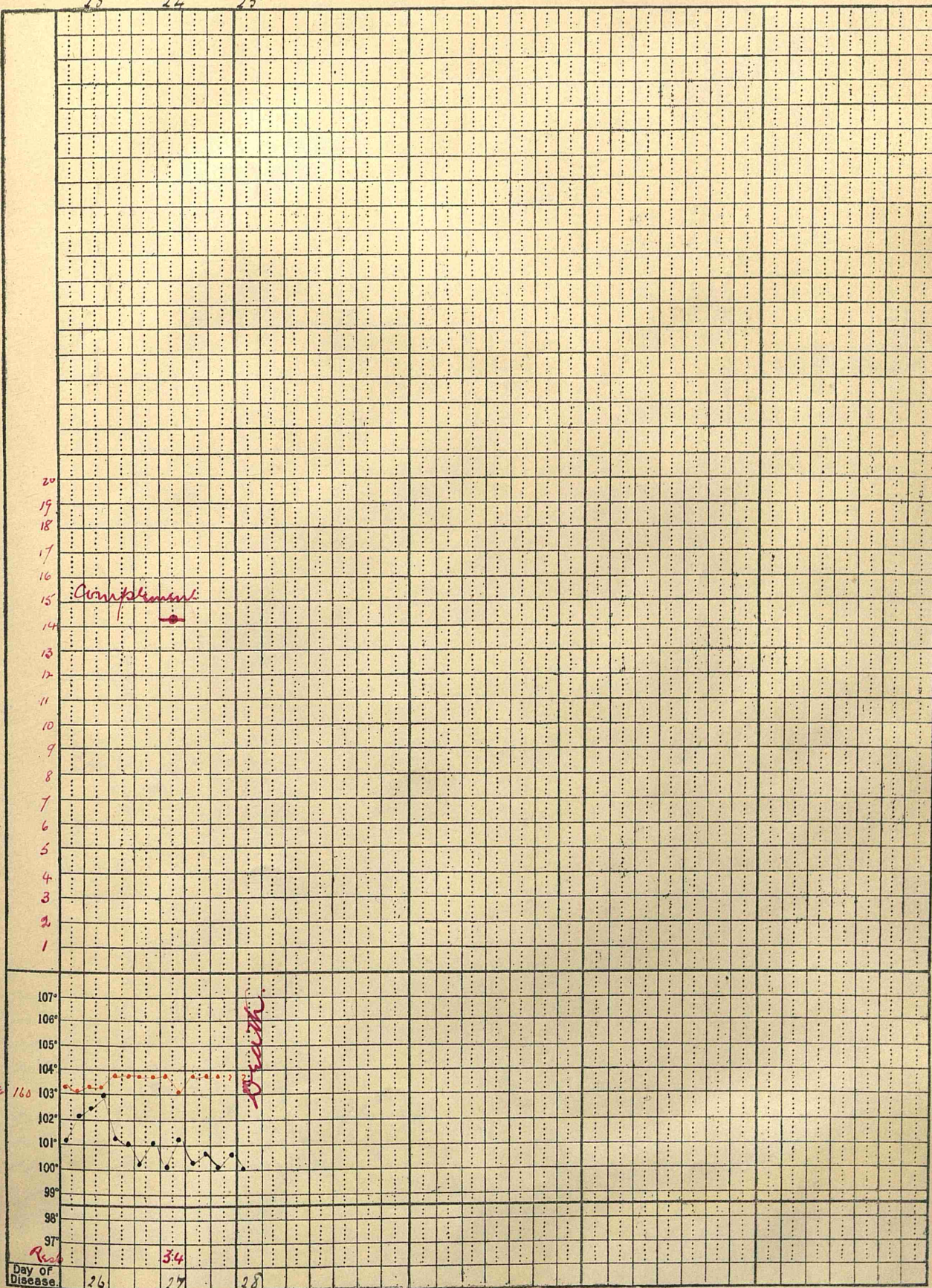


# Chart XXX IV

34

January

23 24 25



Paul  
Asyos  
Nino Fuen

Paul 160

Res



# Chart xxxv

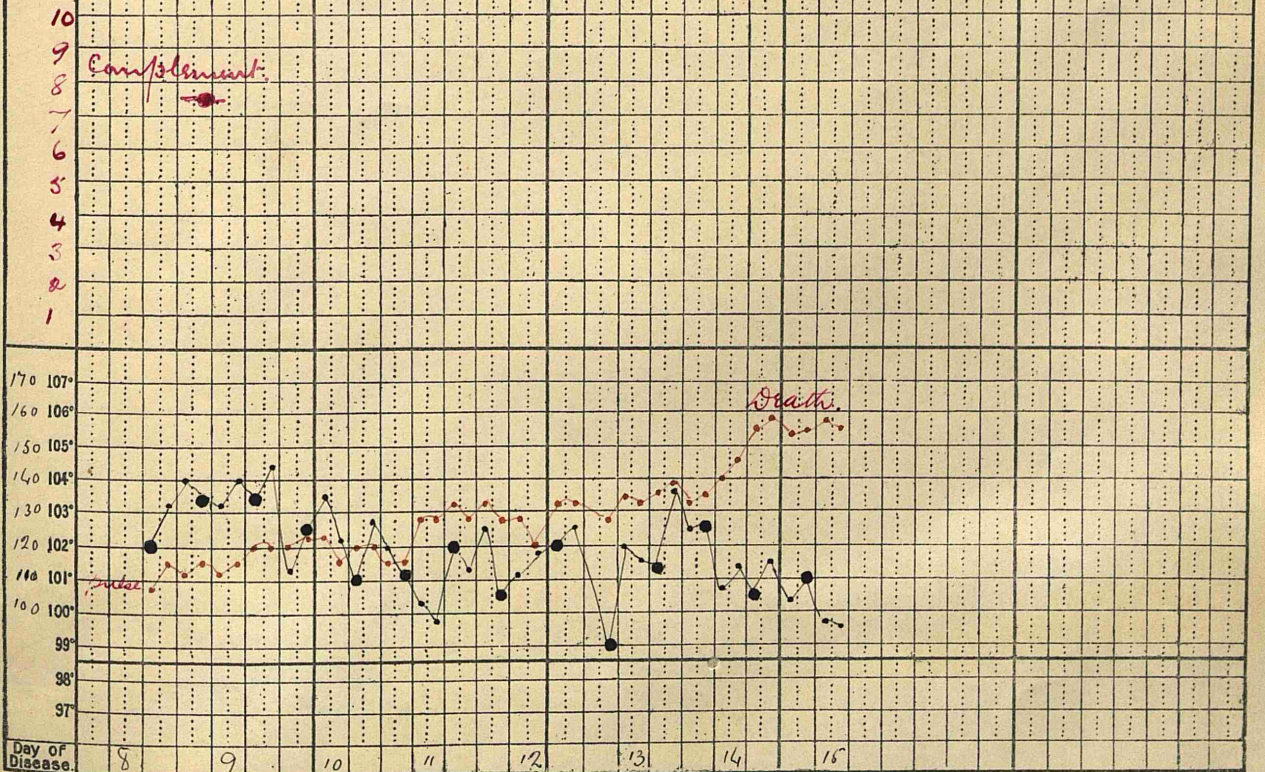
35

July 22 23 24 25 26 27 28 29

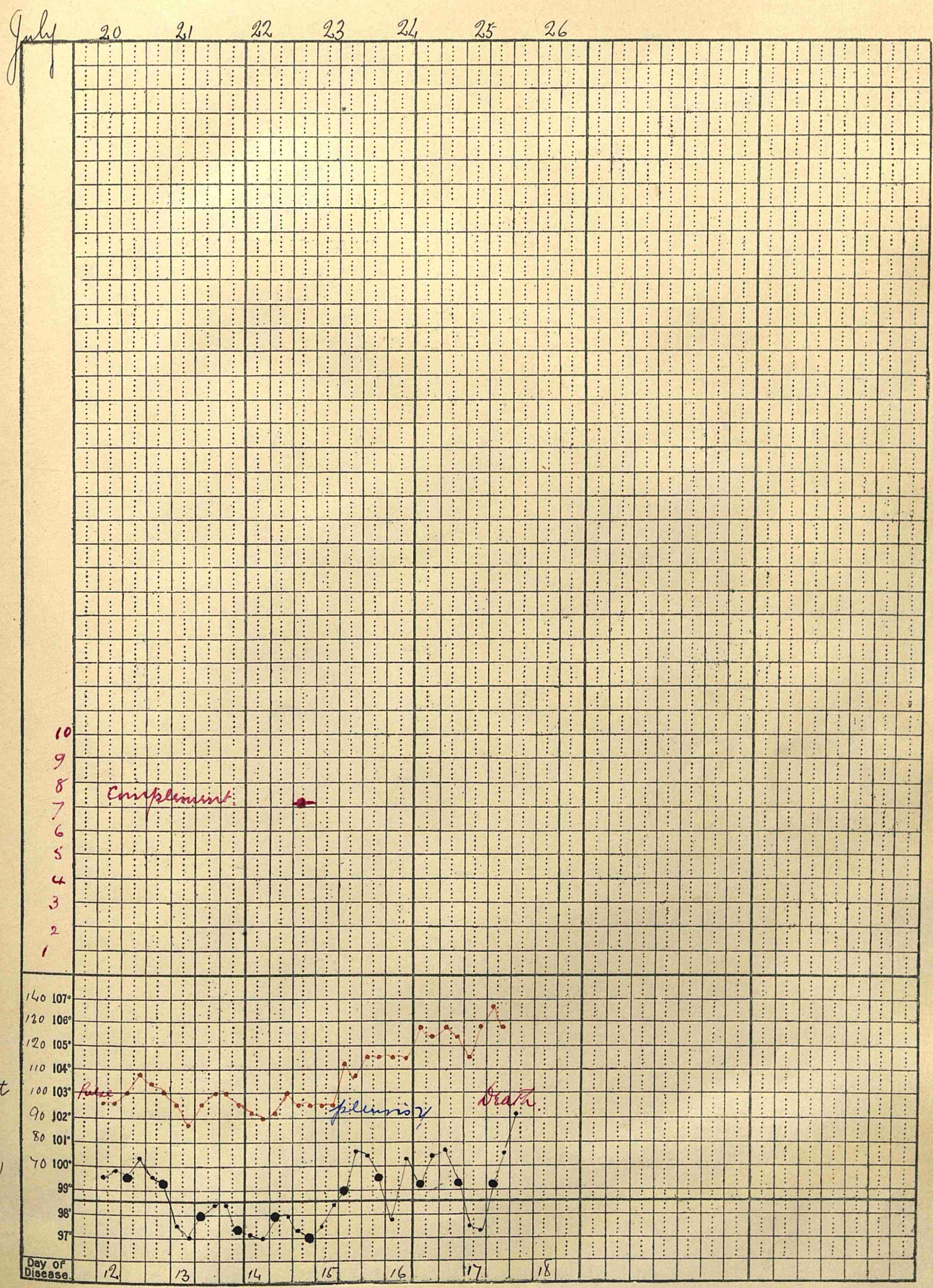
Entire  
Fever

and

Mrs Thomson  
35 years  
July 22nd 1911







Electric  
Power

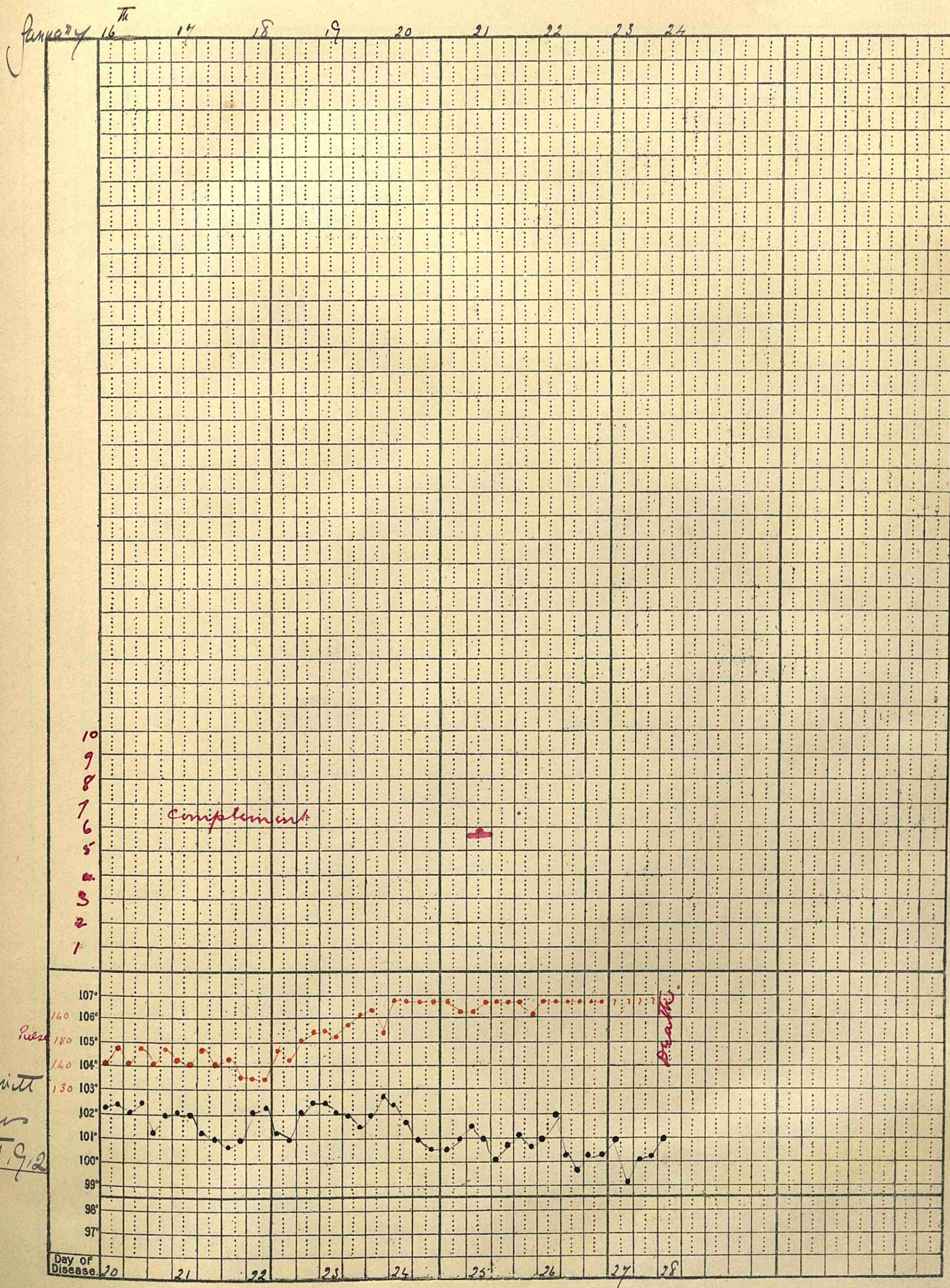
Dis.

Mrs. Meggatt  
33 years  
July 20 1911



Chart XXXVII

37



ntine  
Fever

Pres. 160  
150  
140  
130

Practic.

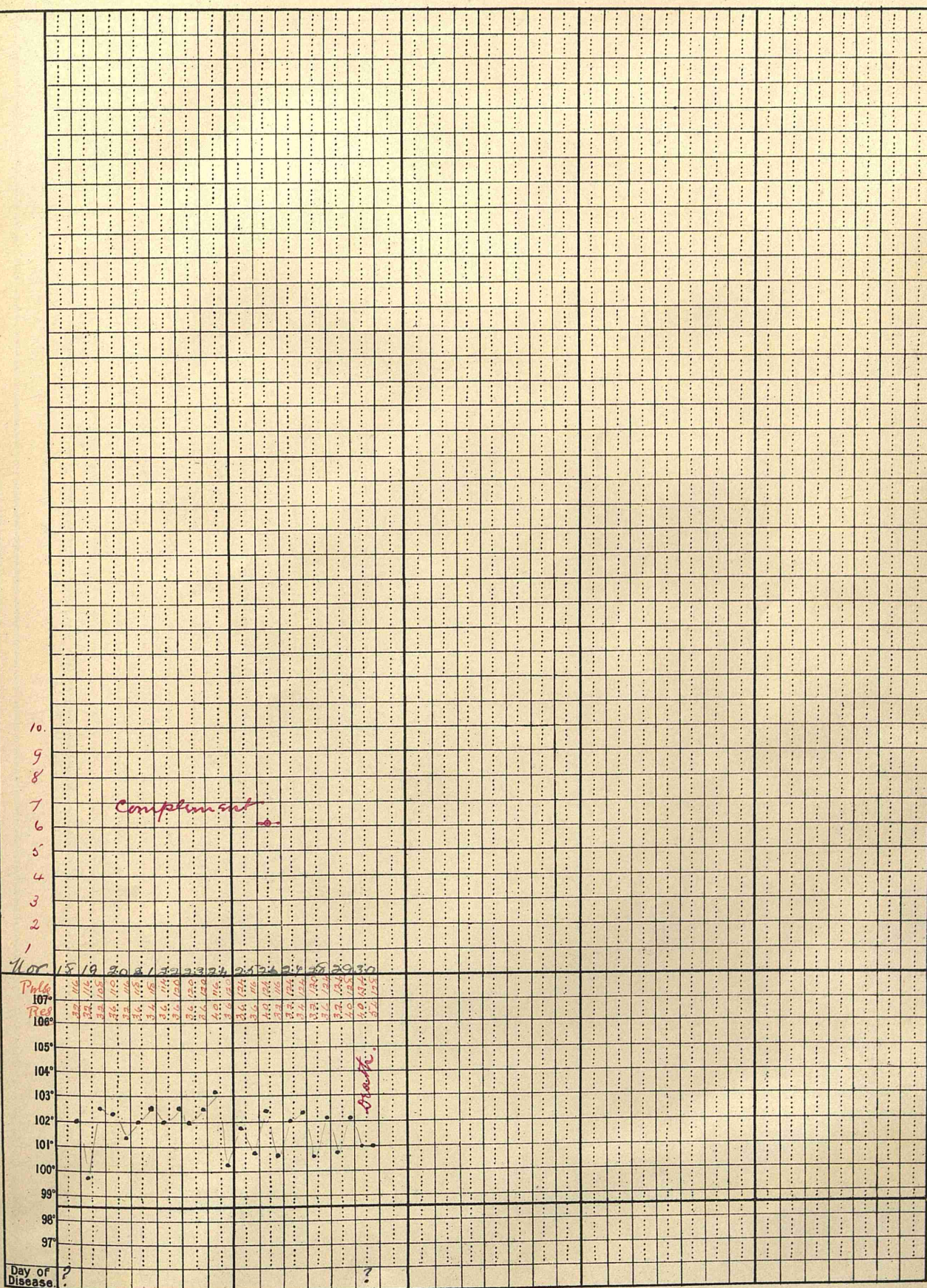
Day of Disease 20 21 22 23 24 25 26 27 28



New Stone  
 Age 34 years  
 11-11

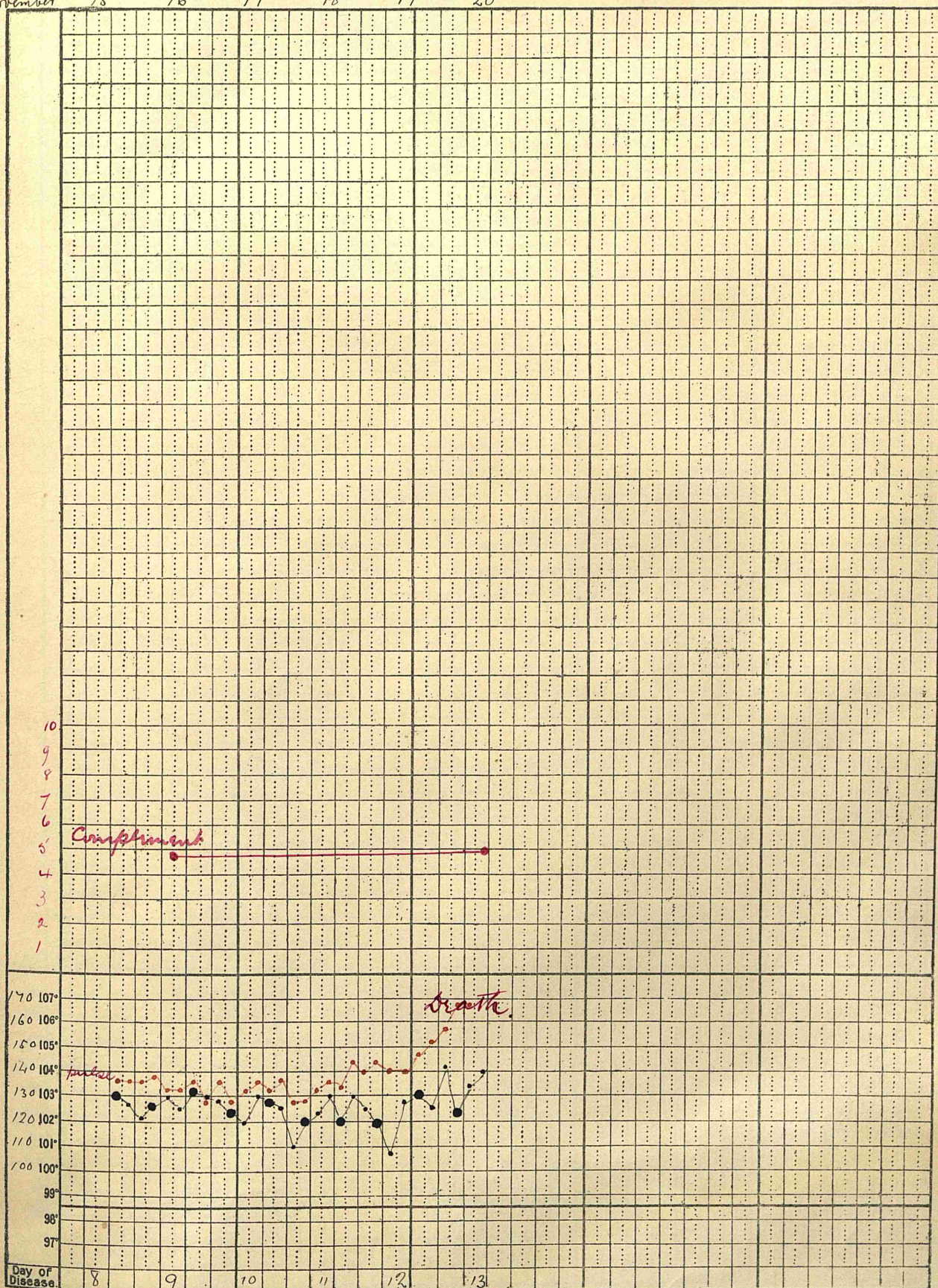
Chart XXXVIII

Intine  
 Fever





November 15 16 17 18 19 20



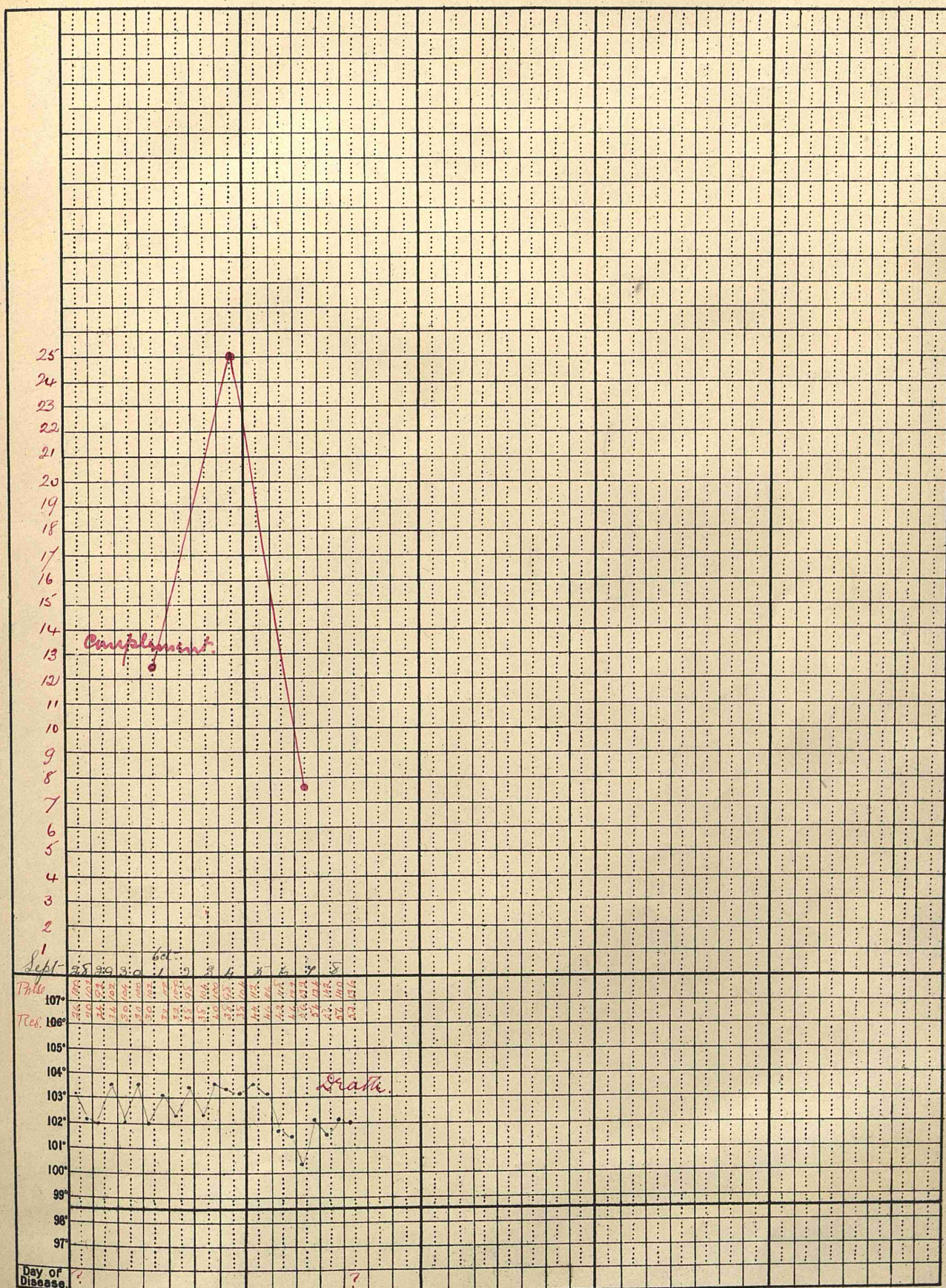
stenic  
fever

ella Elliot  
21 years  
November 15, 1911



Age 24 Years

Jul 28 - 9 - 11



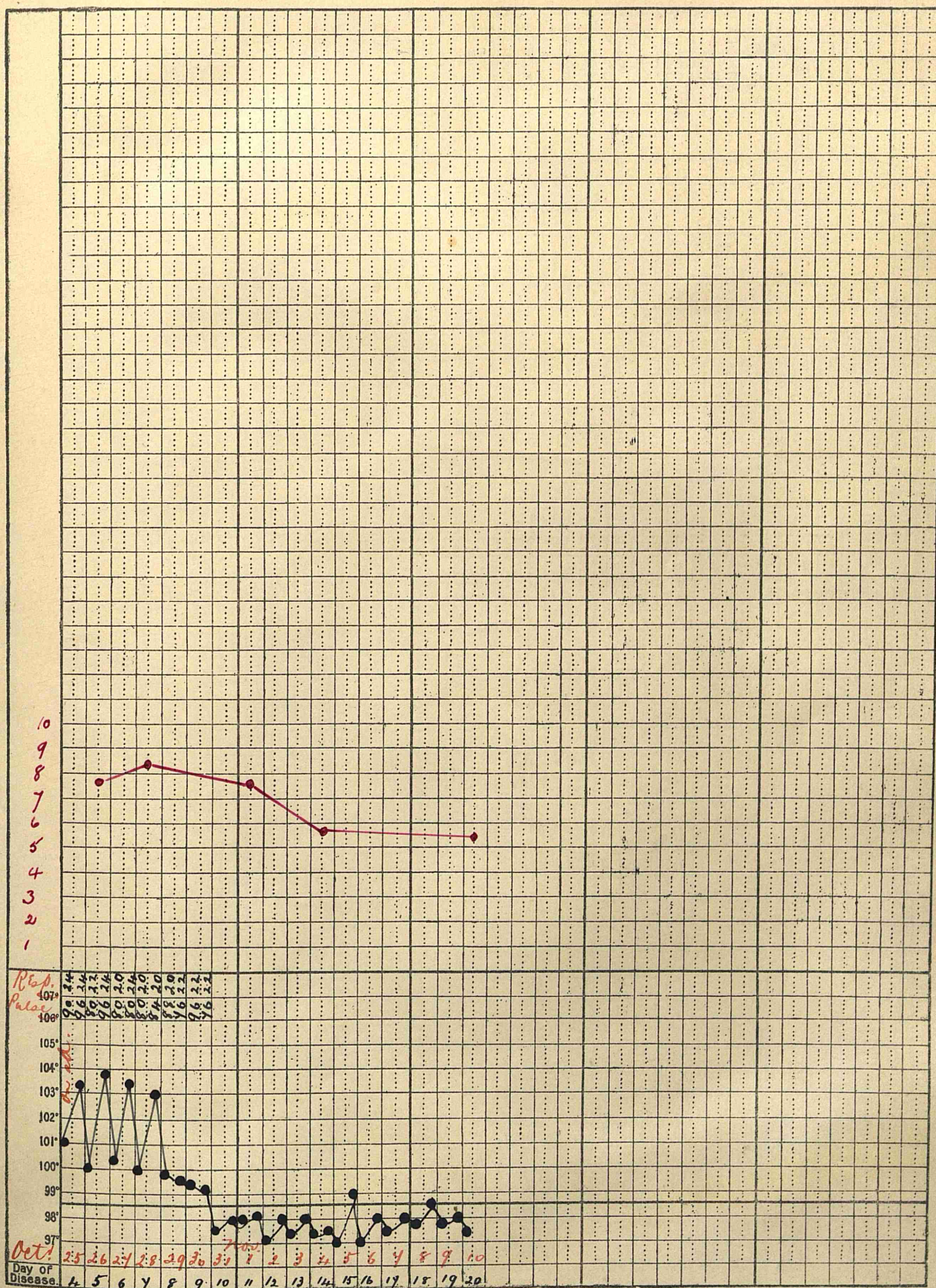


**SECTION B - ERYSIPELAS**

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War R. Agv. 48  
 Facial Erysipelas. Chart I.

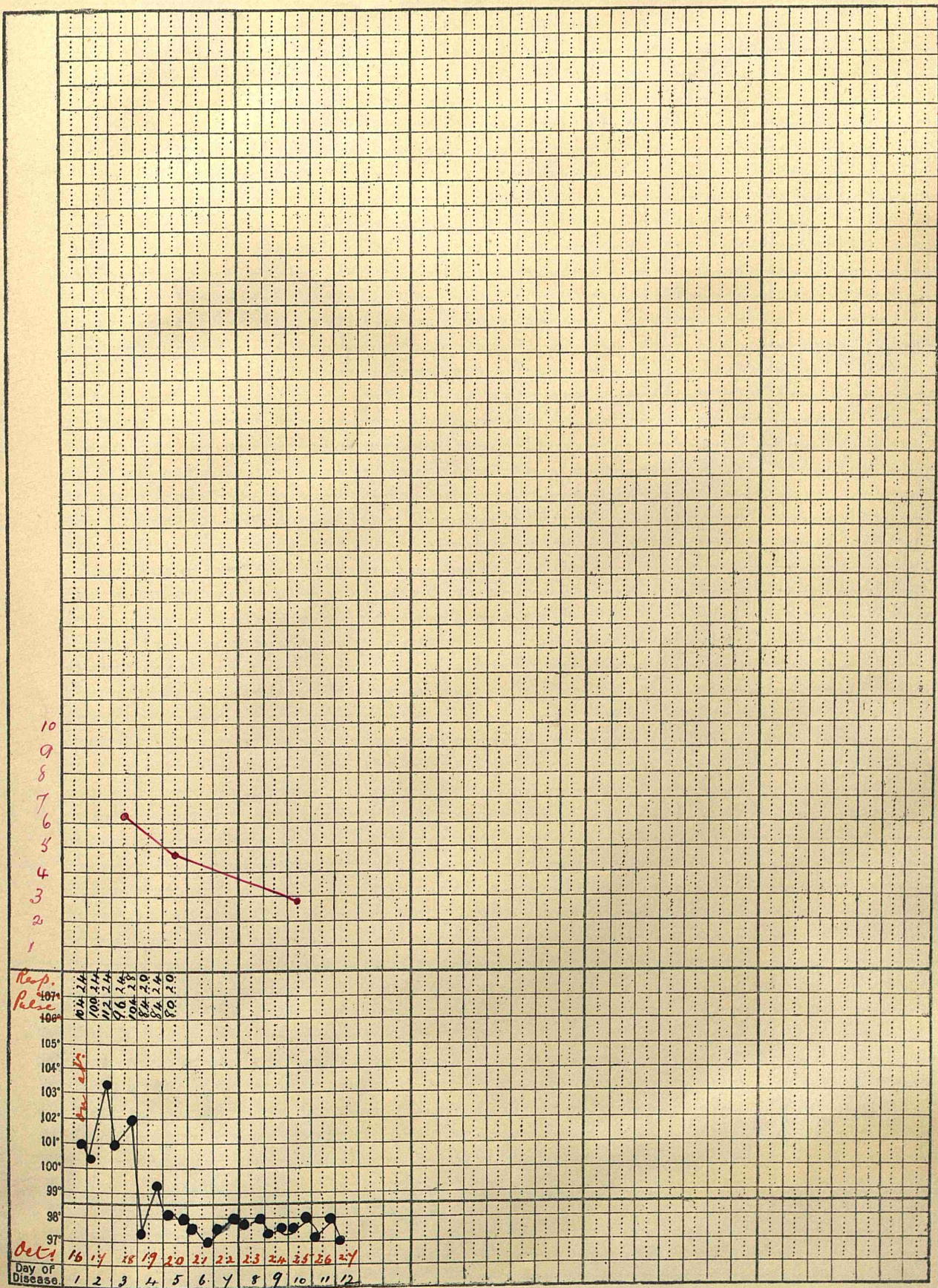




Arthur Holloway, Ag. 33.

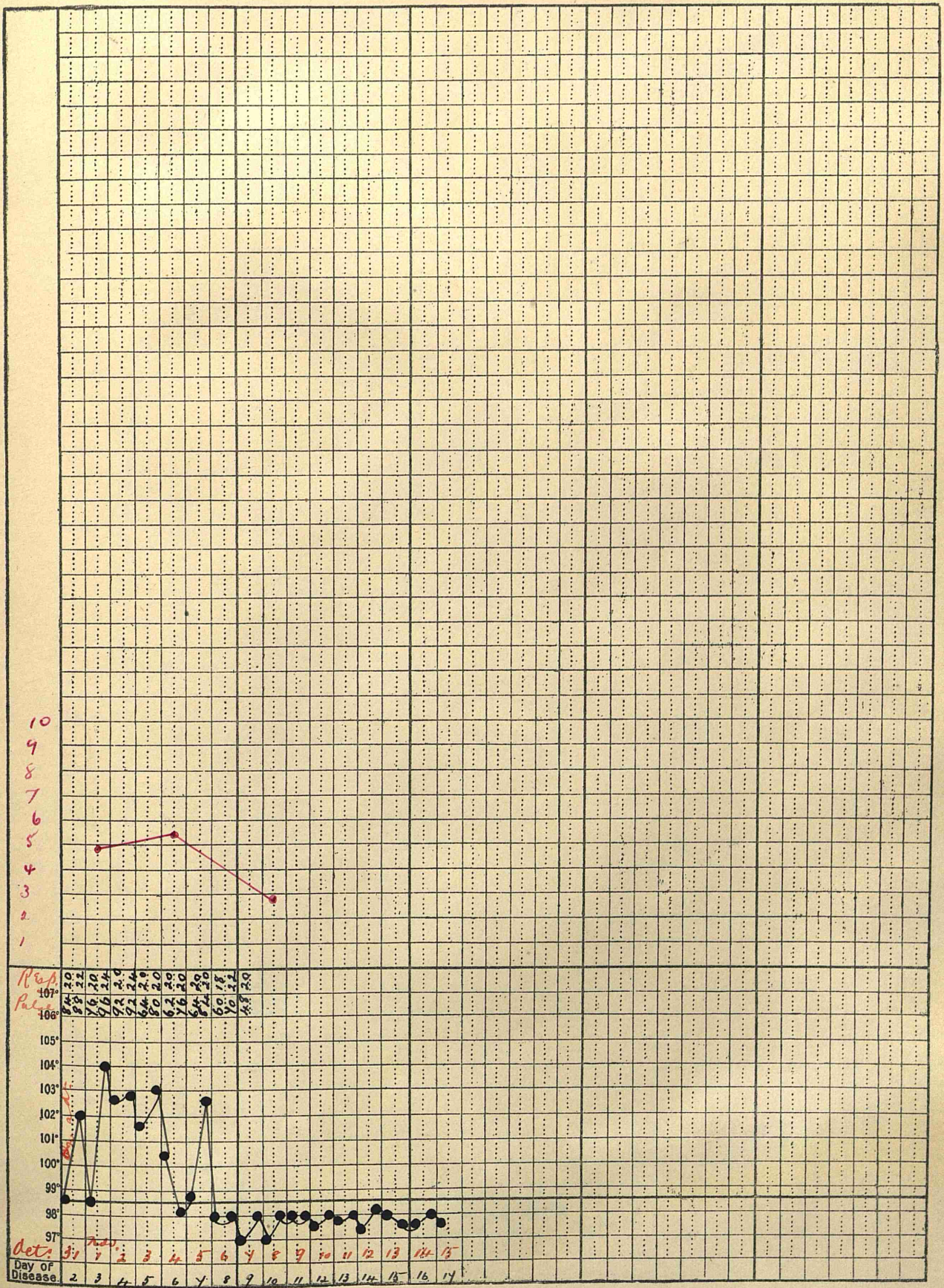
Facial Erysipelas.

Chart II



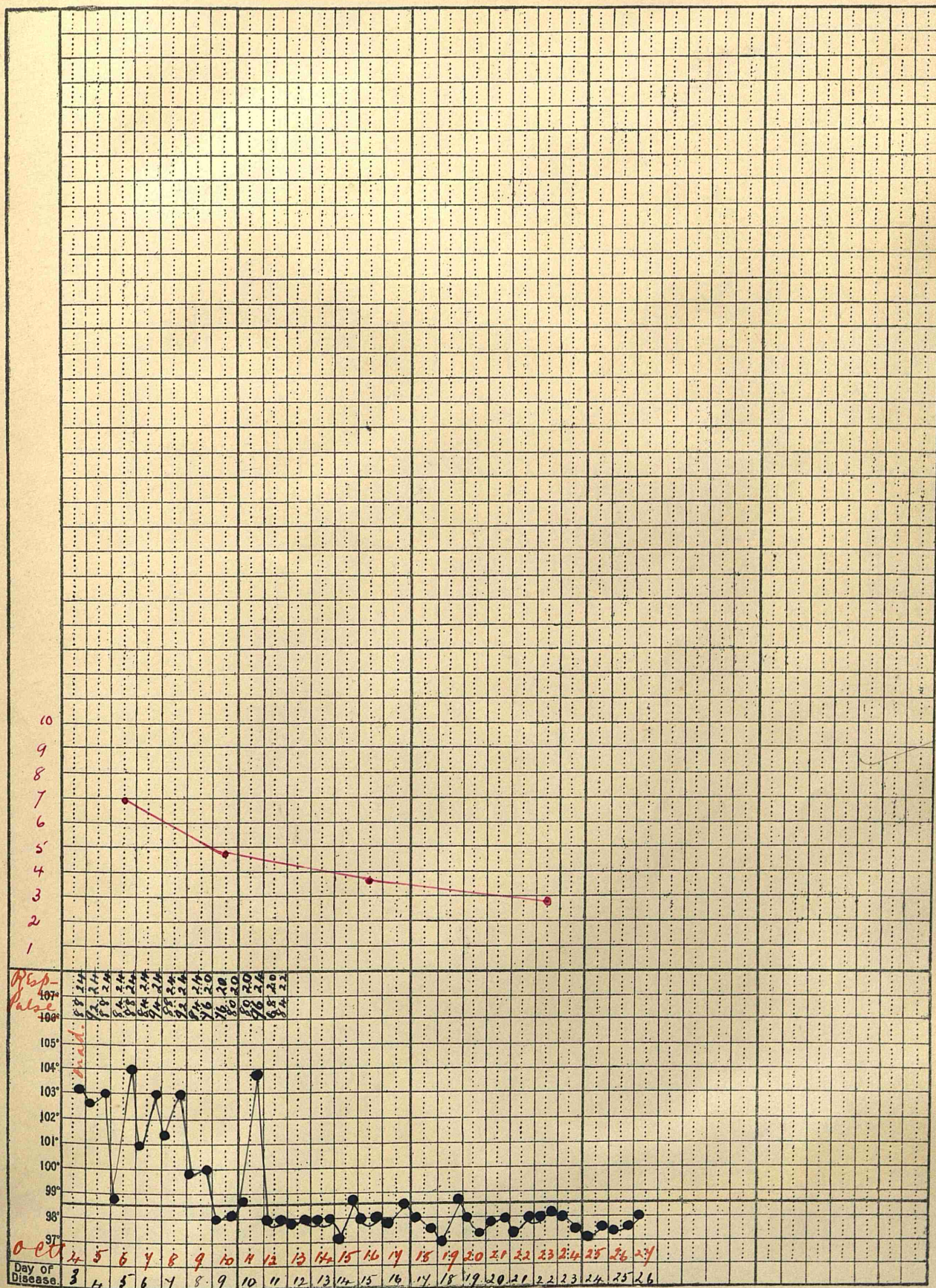


Wm. Cassidy, Agt. 43.  
 Facial Erysipelas. Chart iii



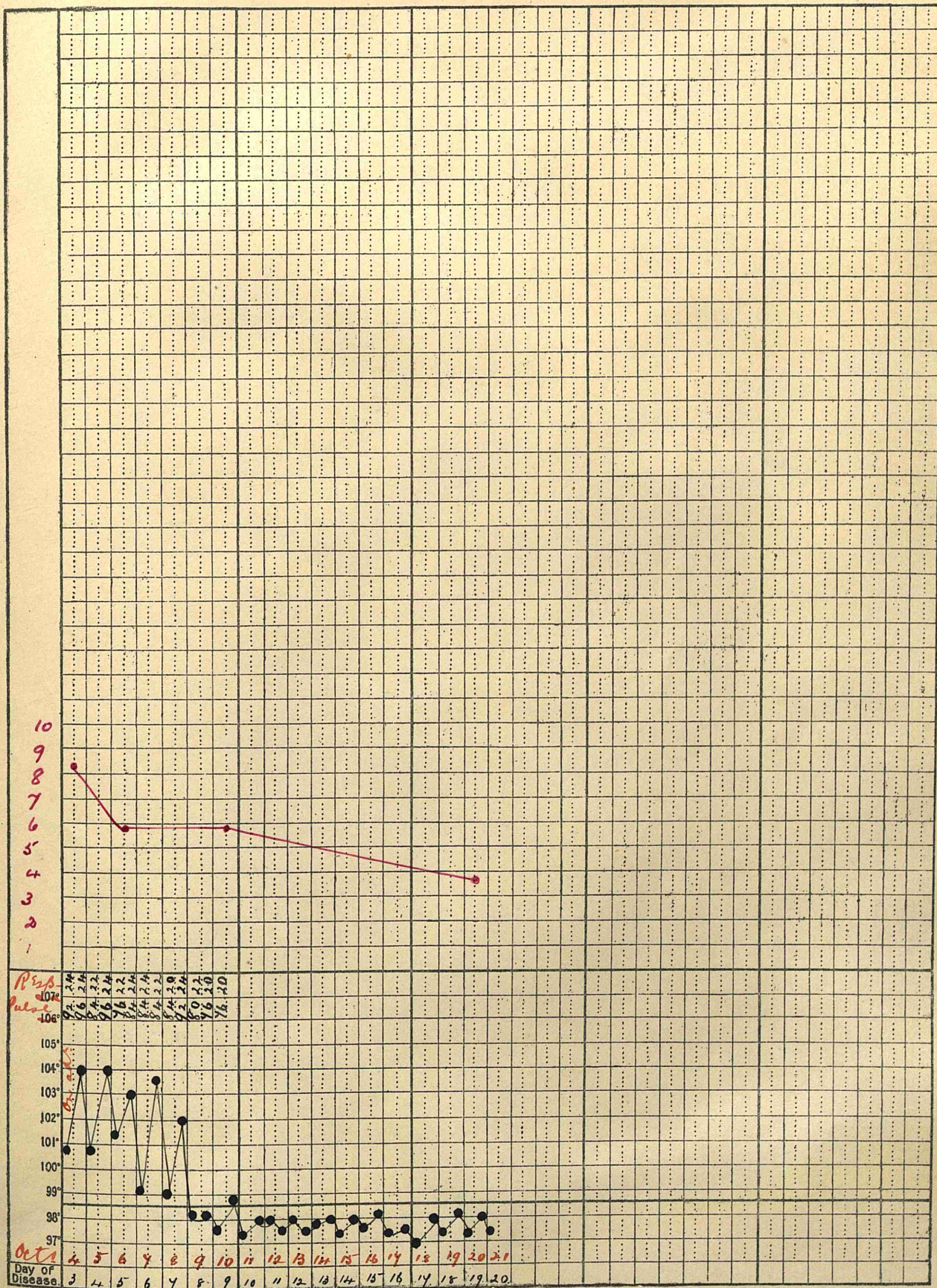


Othello Shields, Age 45.  
 Facial Erysipelas. Chart IV





Joseph Falconer. age 30 1/2.  
 Facial Erysipela. Chart V.

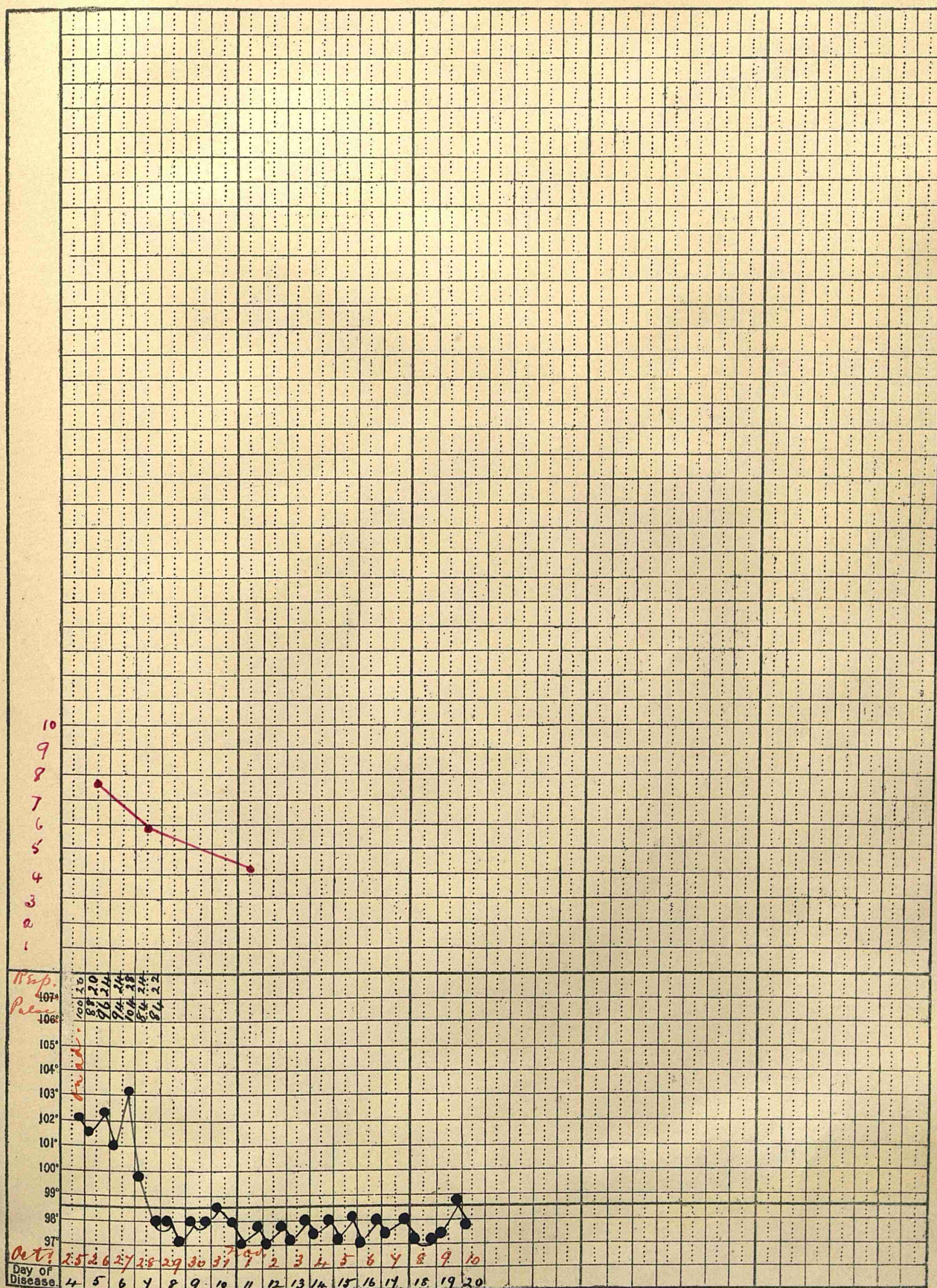




Peter M. Mahon, age 16.

Facial Erysipelas.

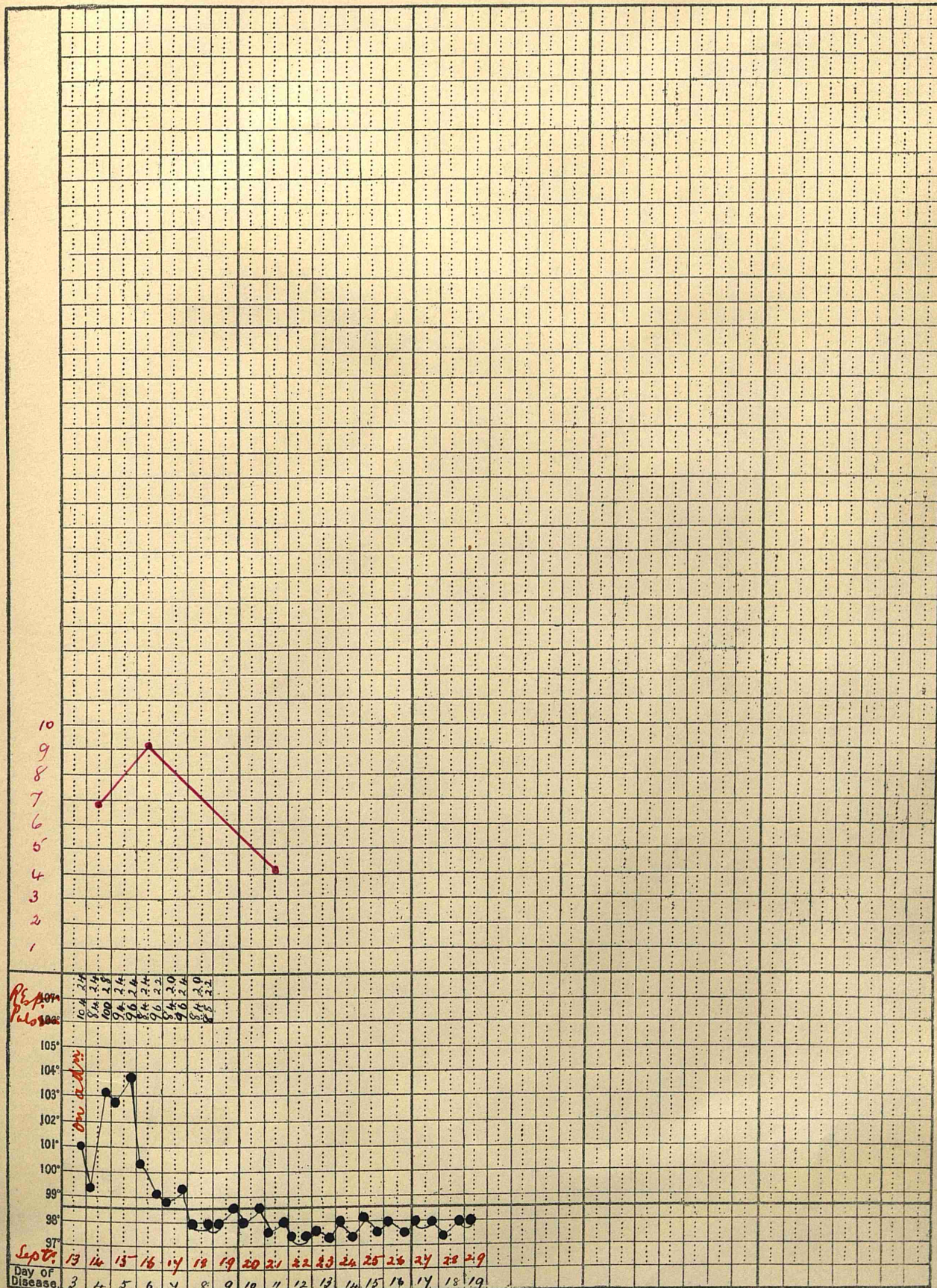
Chart VI.





Ally. Mac Donald. age 29.  
Facial Erysipelas.

Chart VII.

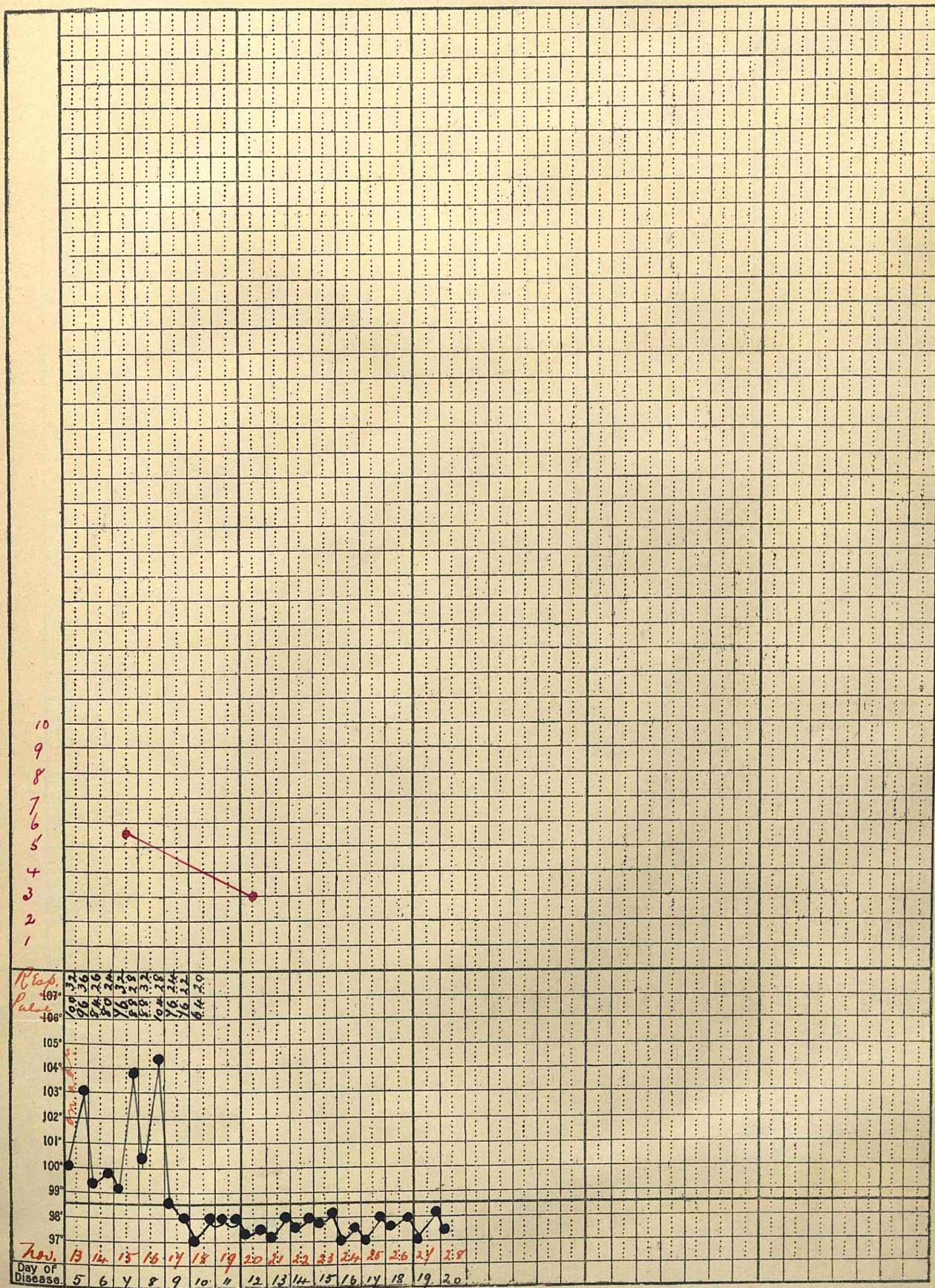




James Miles age 26.

Facial Erysipelas.

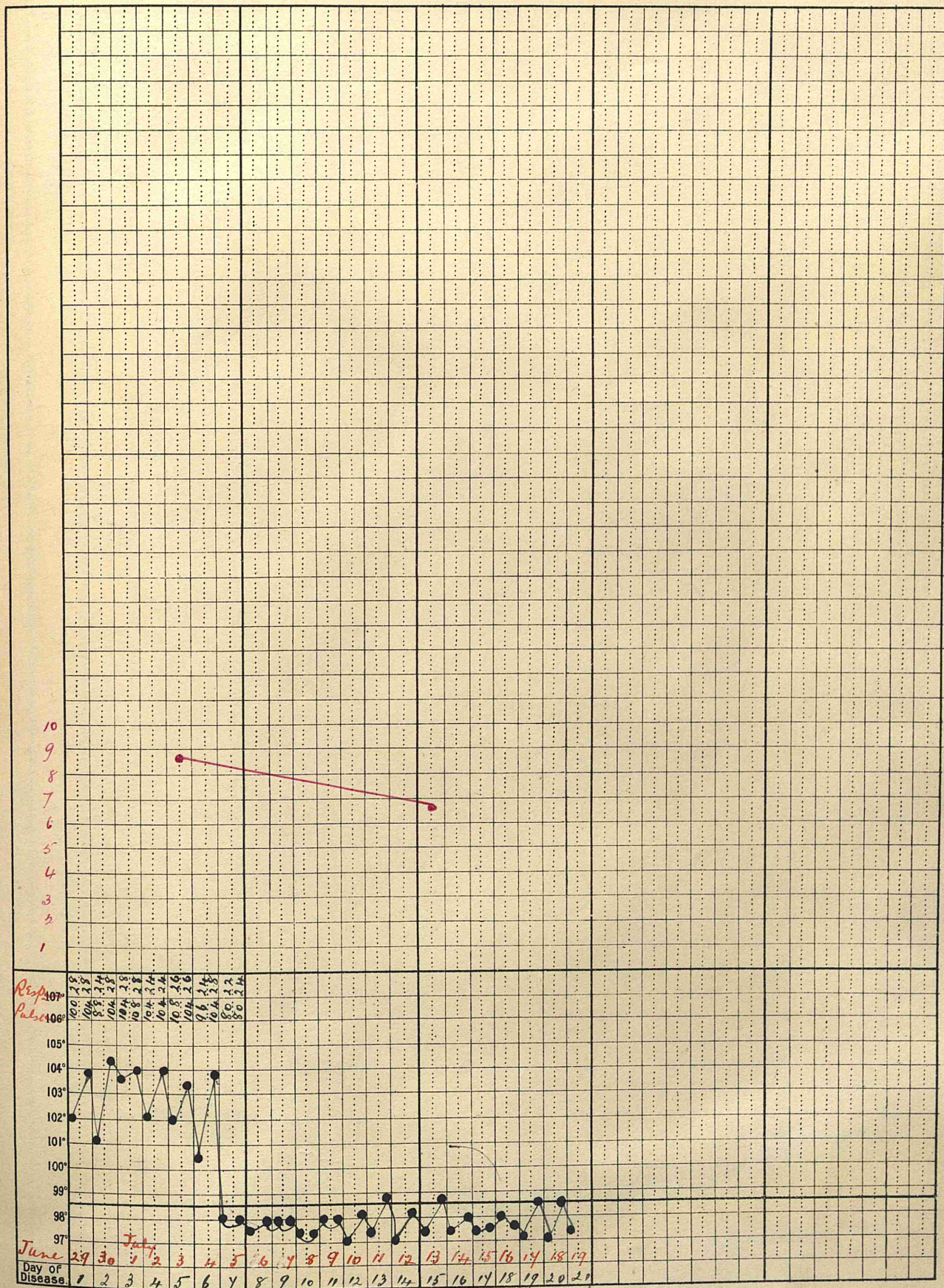
Chart VIII.





Pat. N. Leade. Age. 45.  
 Facial Erysipelas.

Chart IX

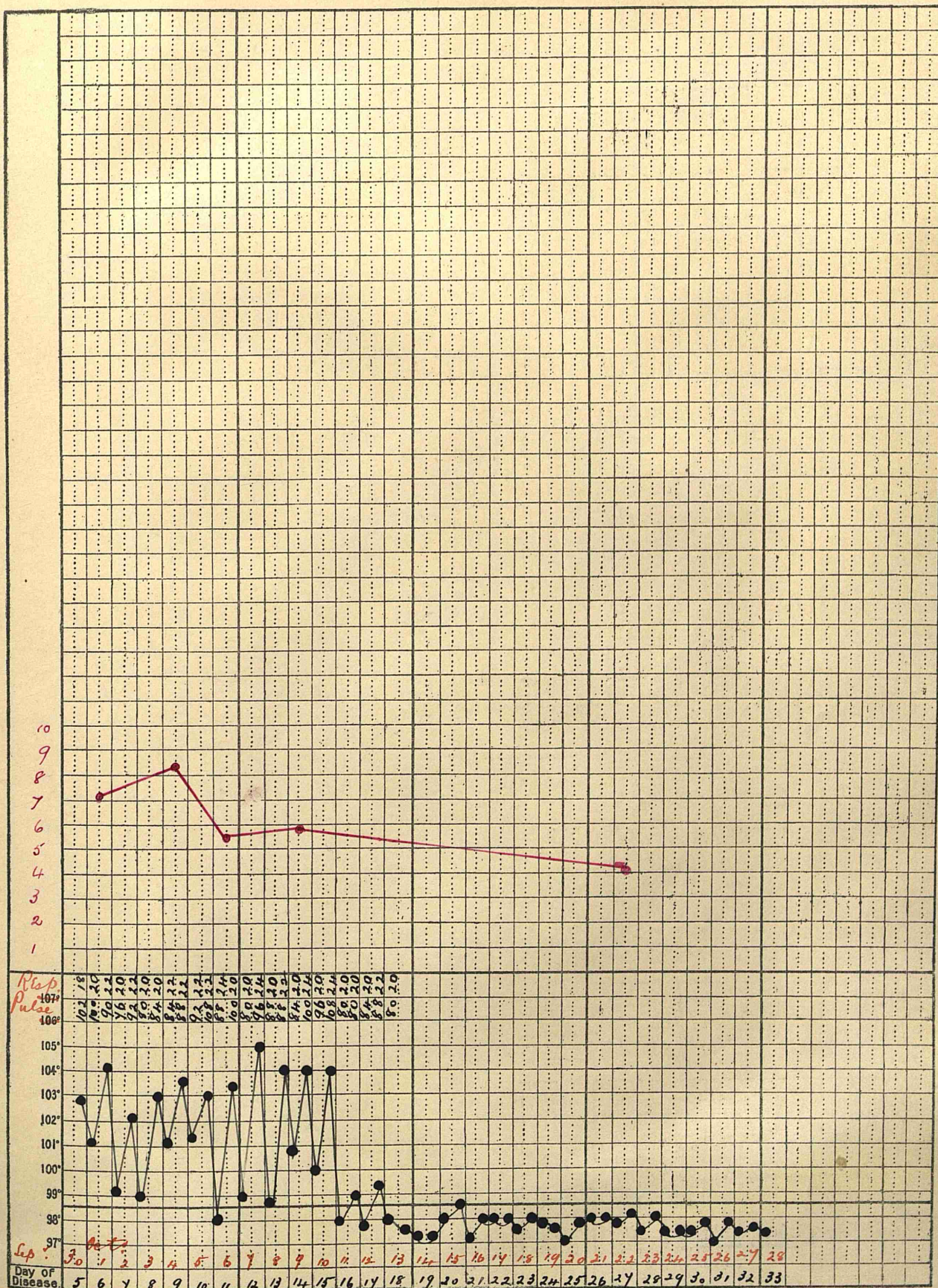




James Stevenson. Aug. 25-

Facial Erysipelas.

Chart X.

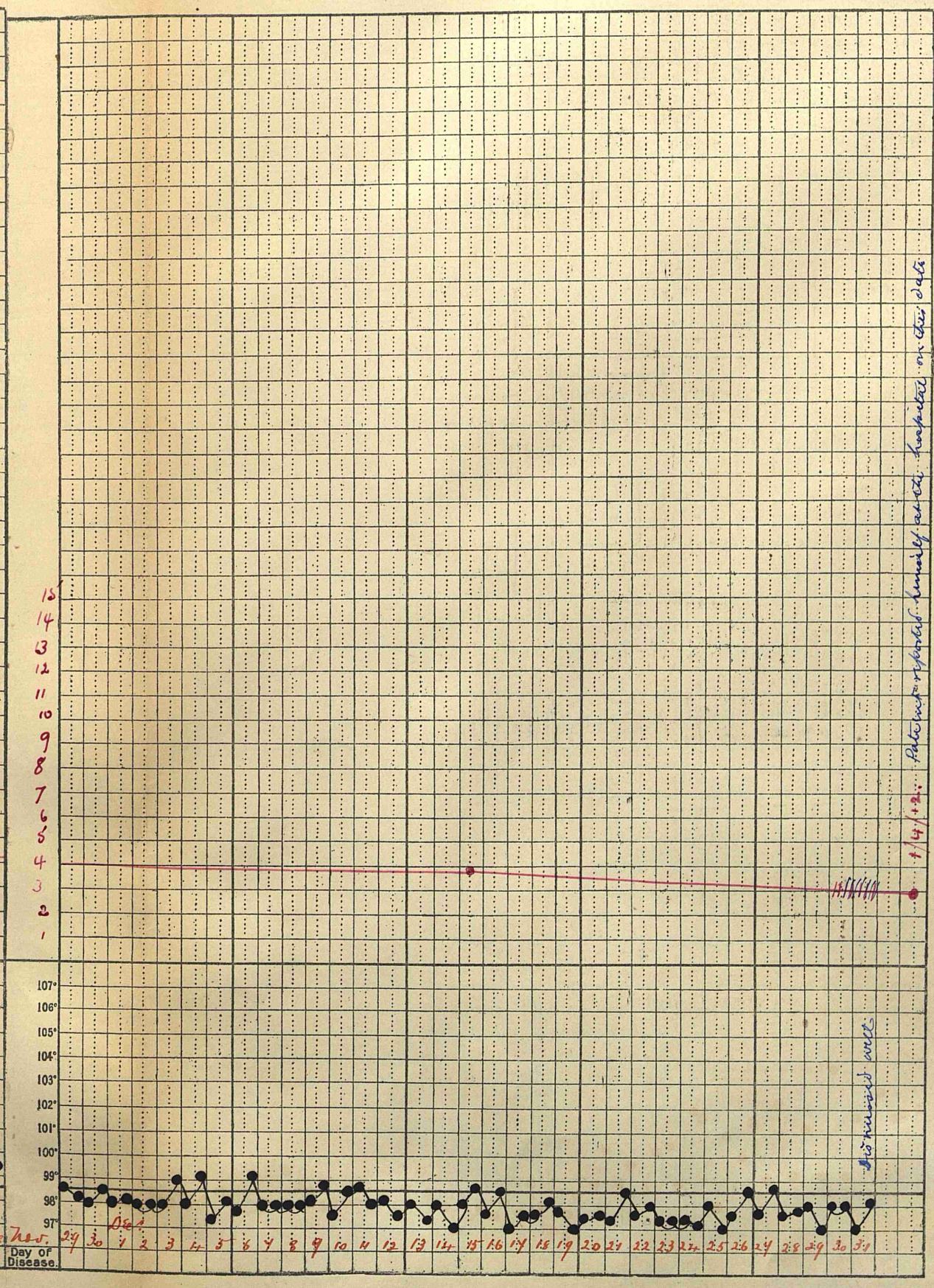
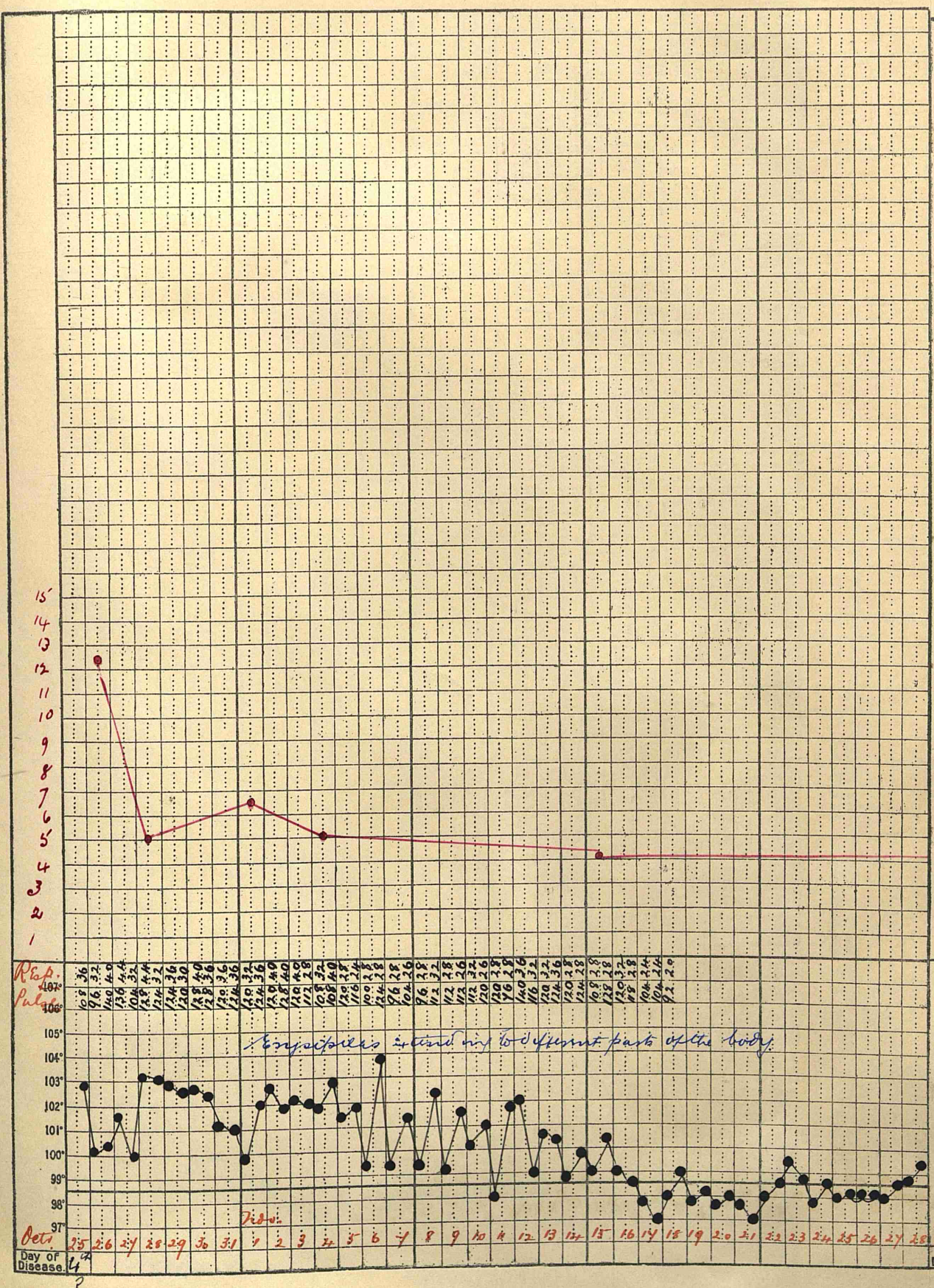




Angus McLean, Aug. 25.  
 Cellulitis of arm.  
 Erysipelas. Chart XI.

McLean, Aug. 25.

11a

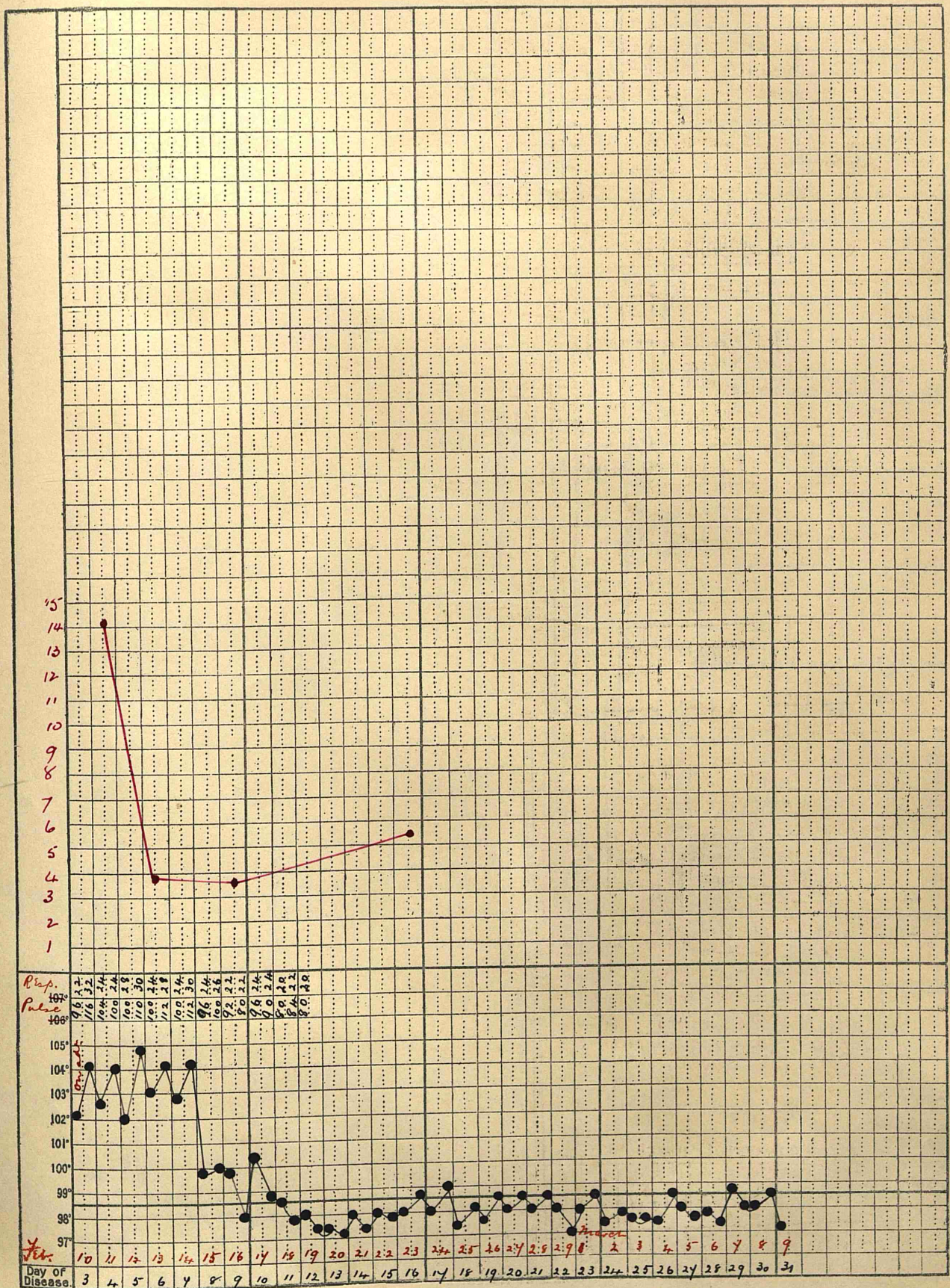




Peter H. Callum, Aug. 20.

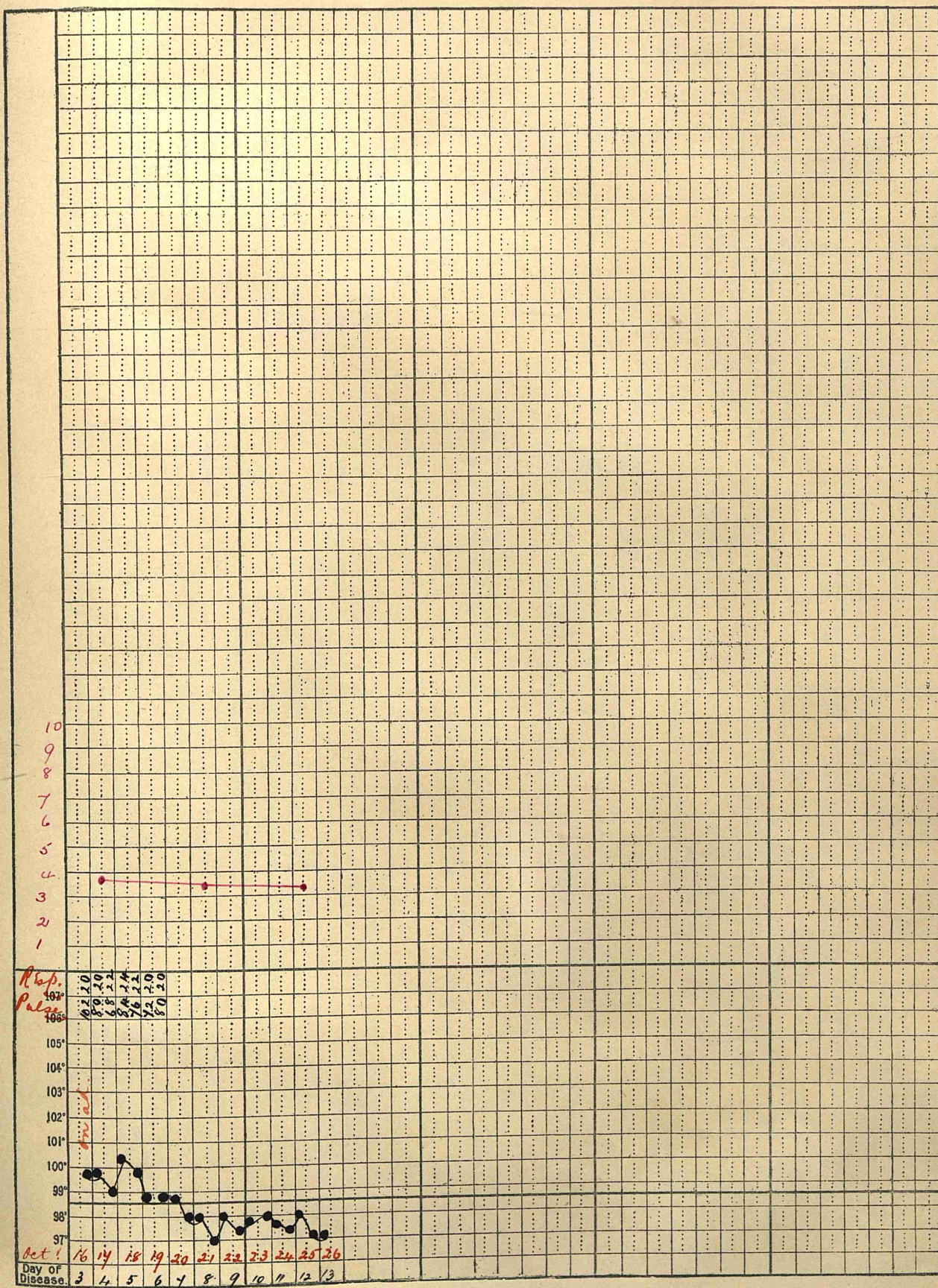
Facial Erysipelas.

Chart XII.



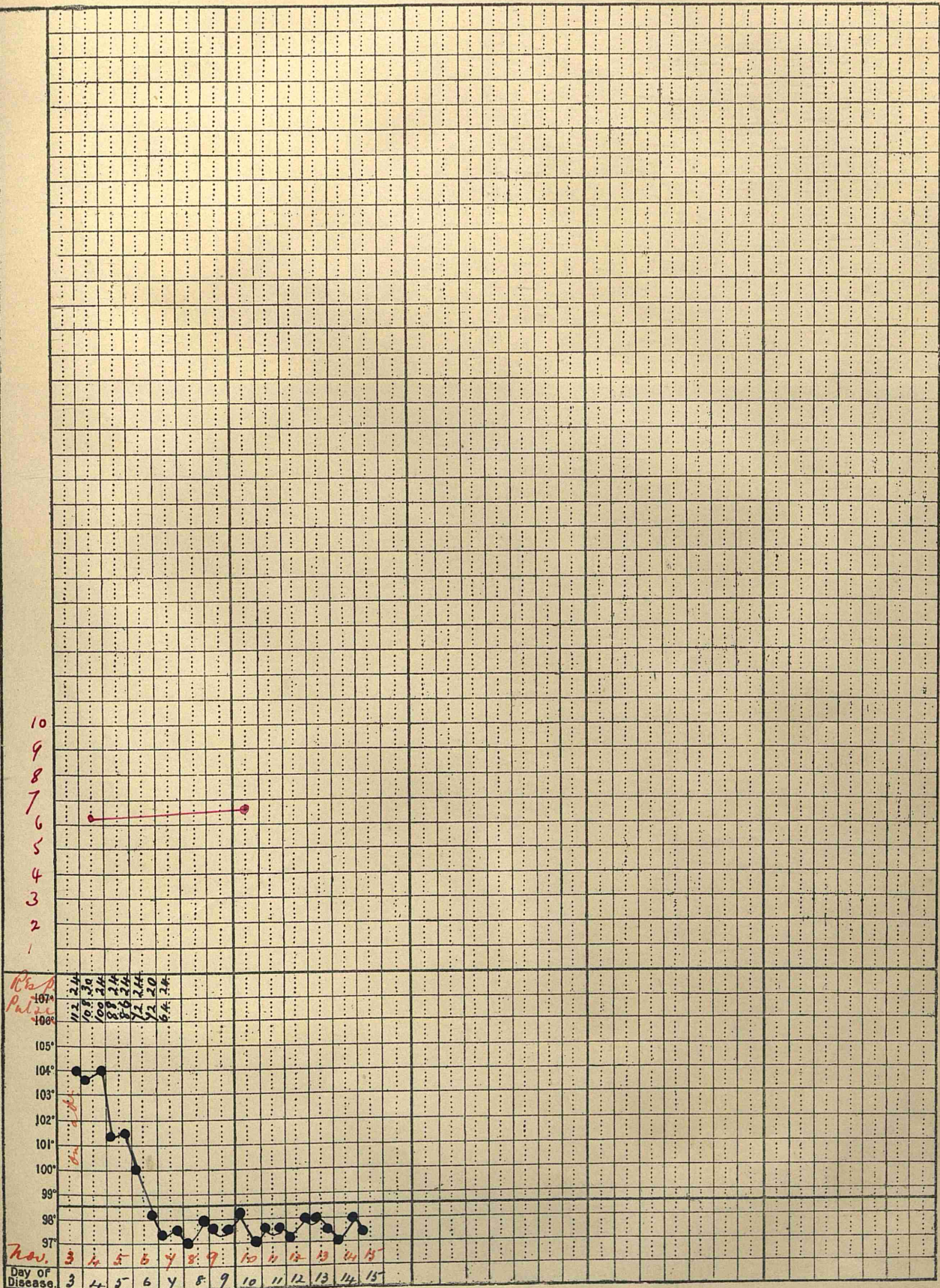


*San. Massey. Agg. 47.*  
*Facial Erysipelas.*  
*Chart XIII.*





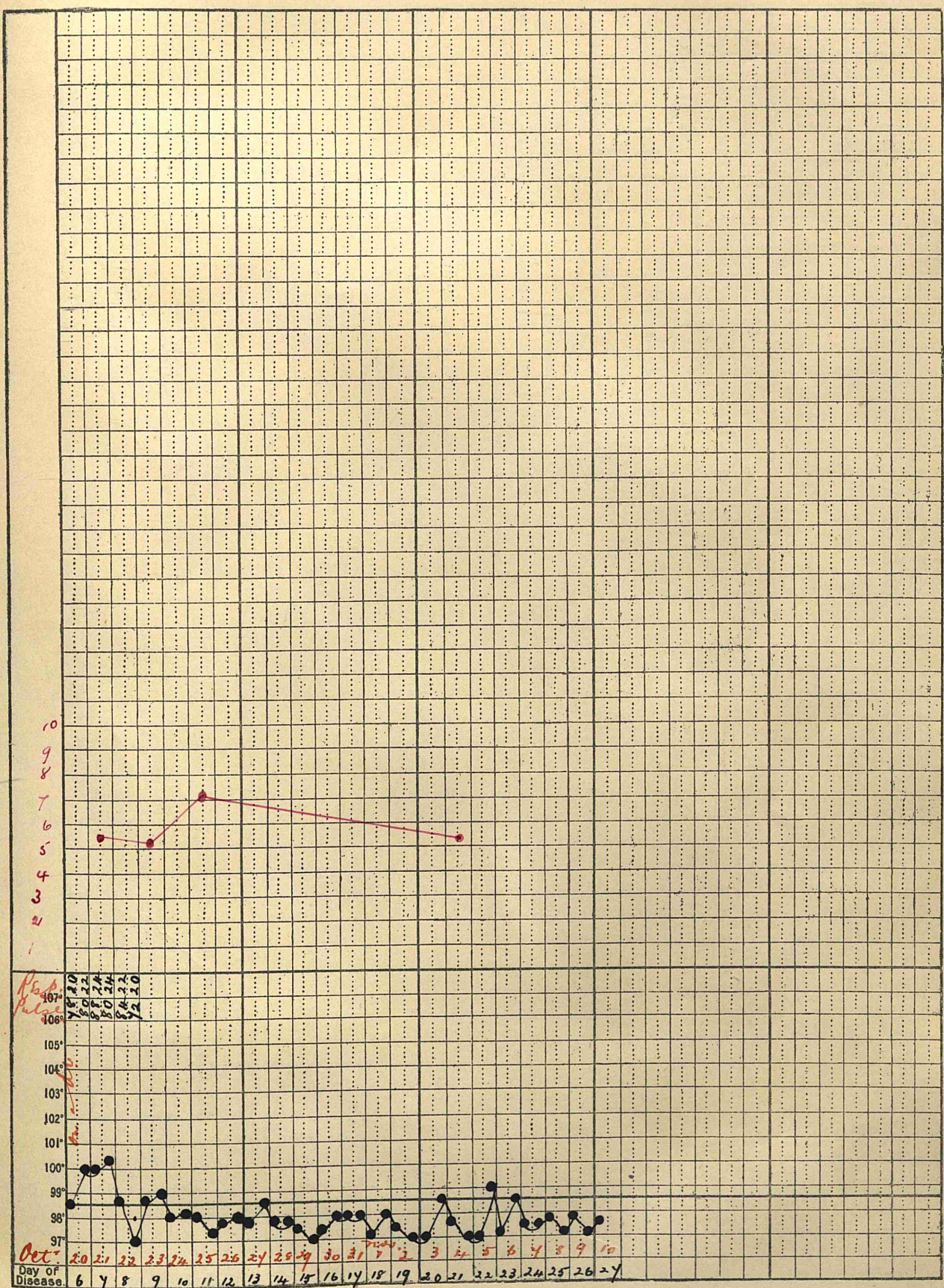
Alex. Gibbie, age 45  
 Facial Erysipelas.  
 Chart XIV.





Wm Marshall age 69 Y.

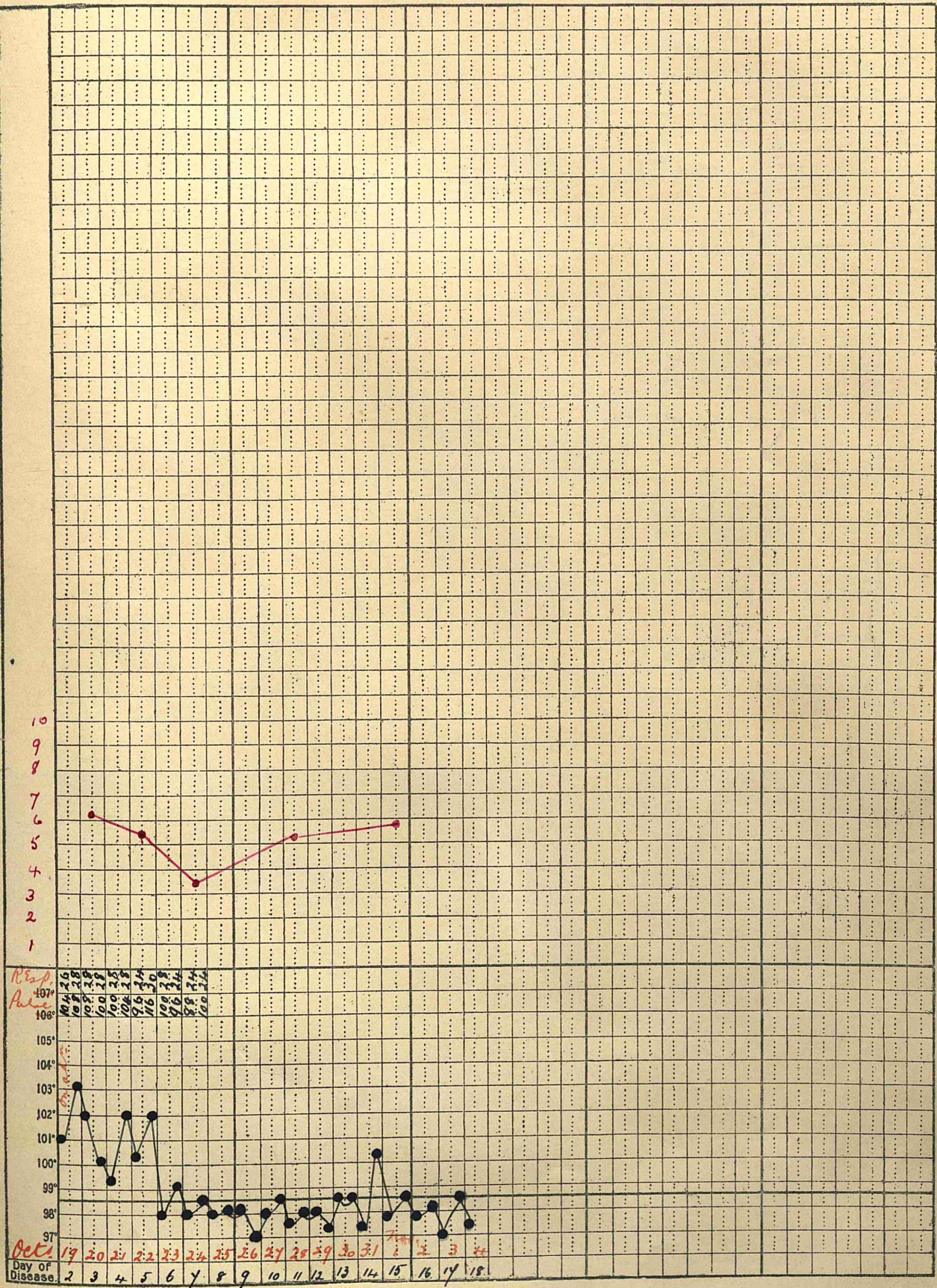
Facial Erysipelas.  
Chart XV.





John Lewis' Apr. 43.  
 Facial Erysipelas.

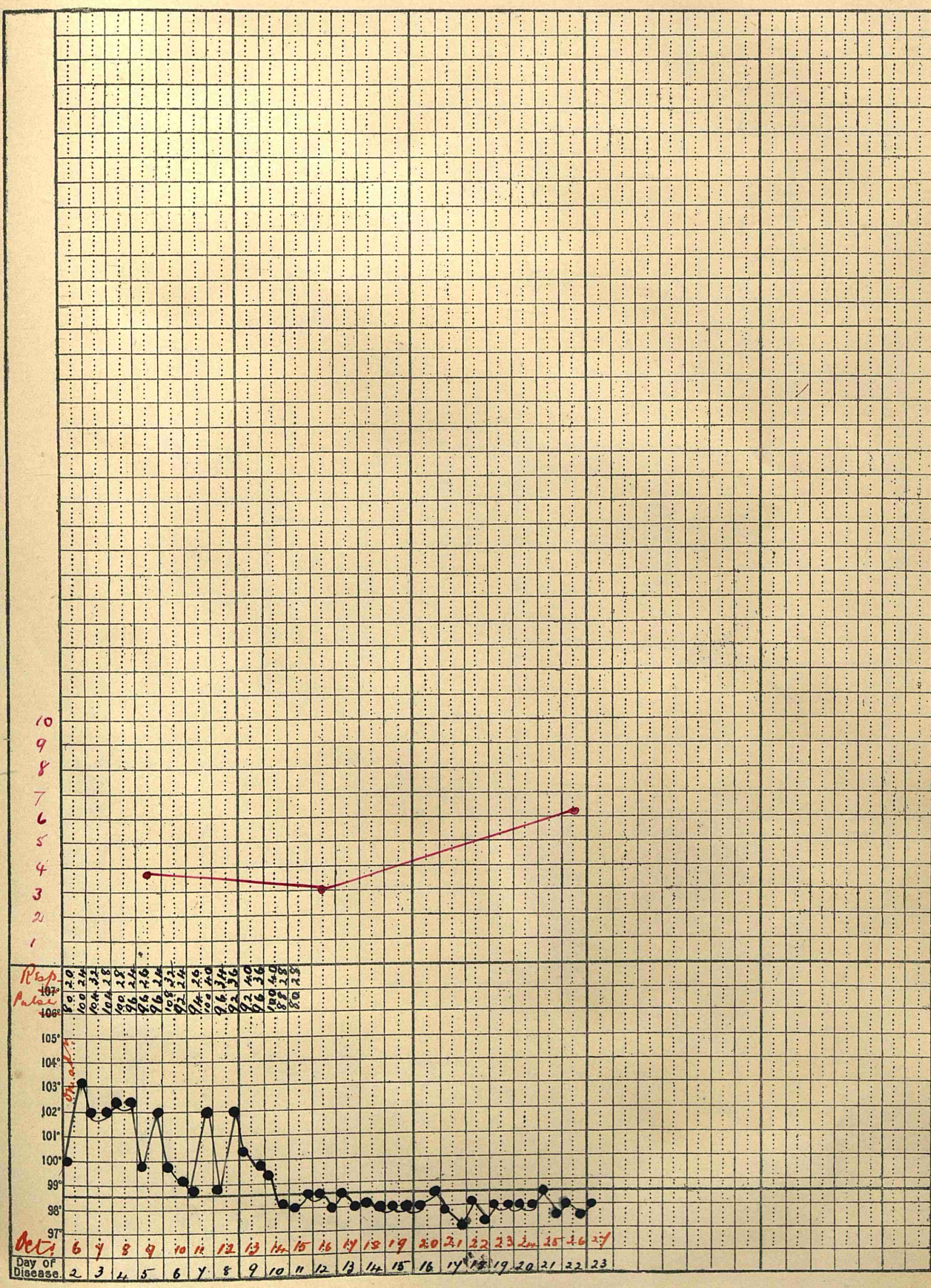
Chart XVI





Jane Connor. Age 45.  
 Yacine Encephalus.

Chart XVII.

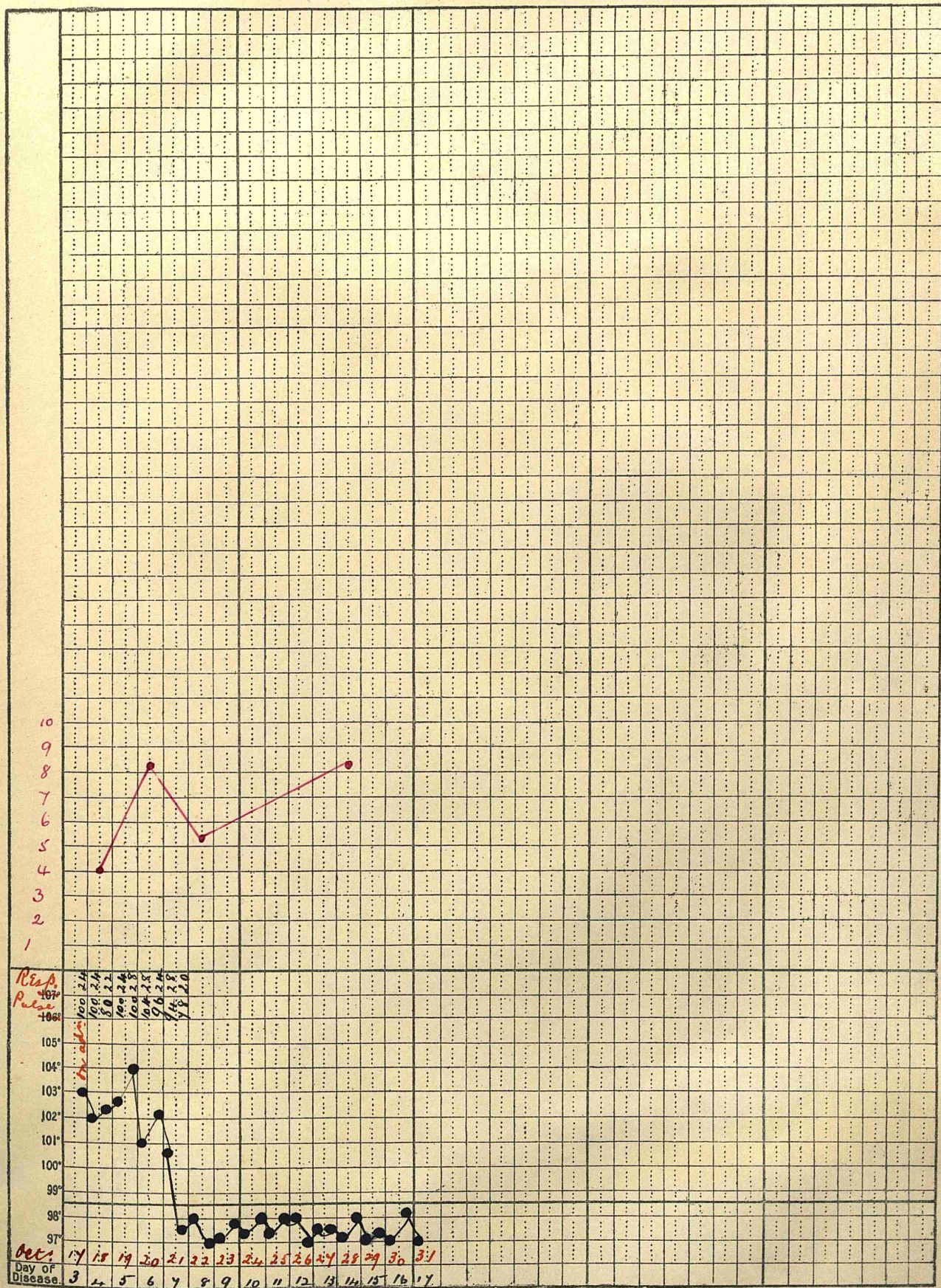




Robert Adams, age 40 yrs.

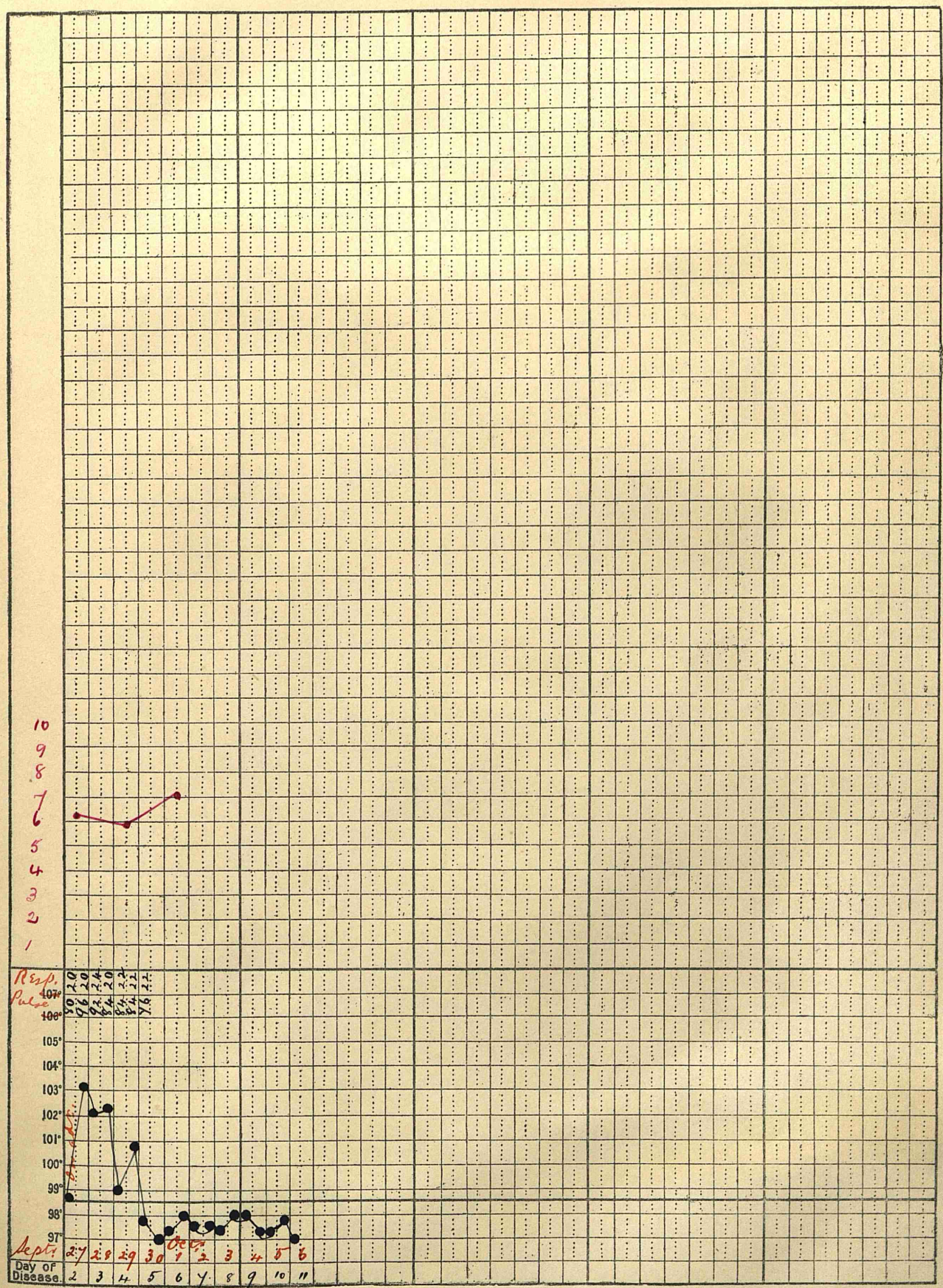
Facial Erythema

Chart XVIII.



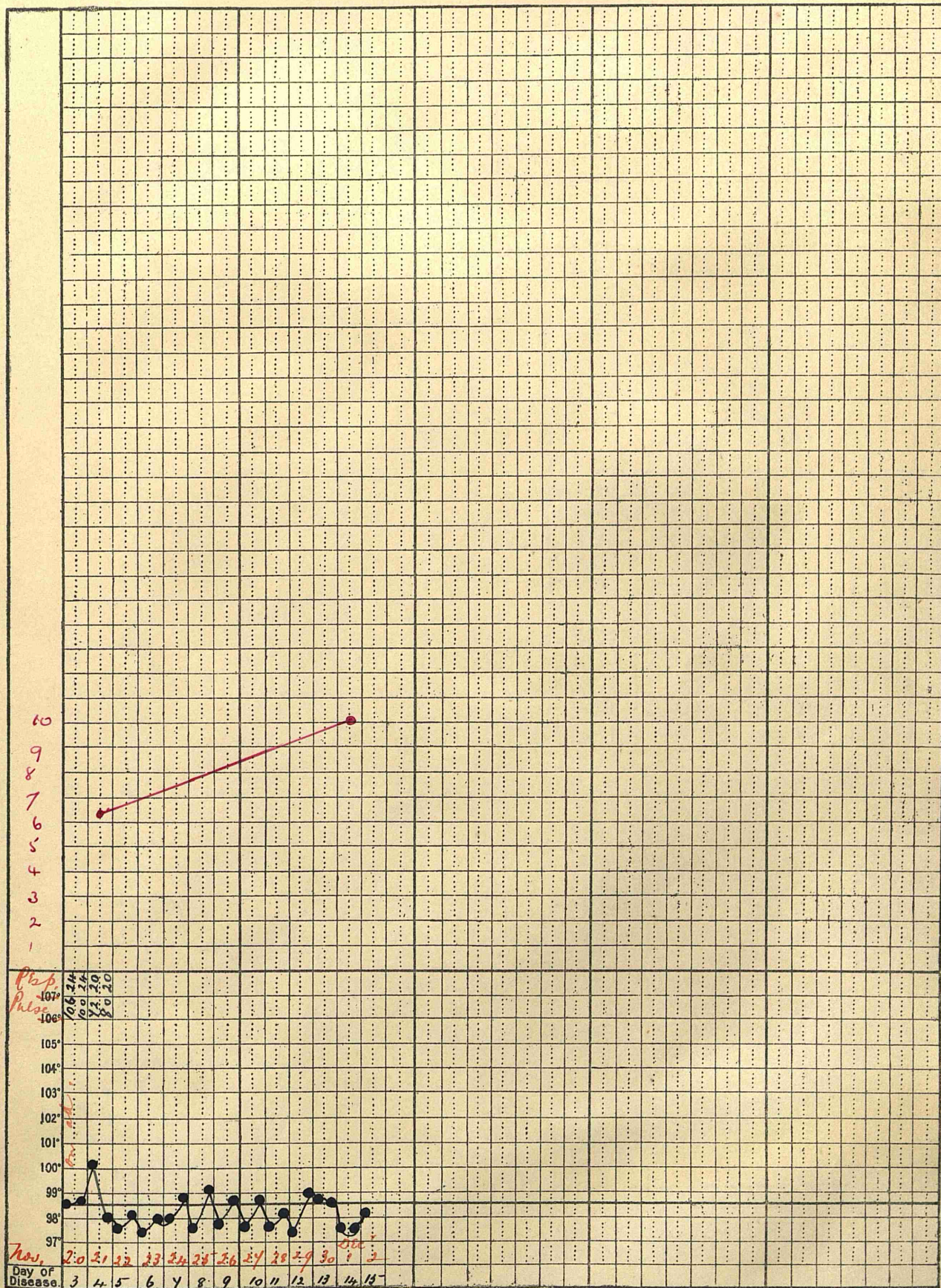


Joseph Rigley age 3 1/2.  
*Yacine Erysipelas.*  
 Chart XIX





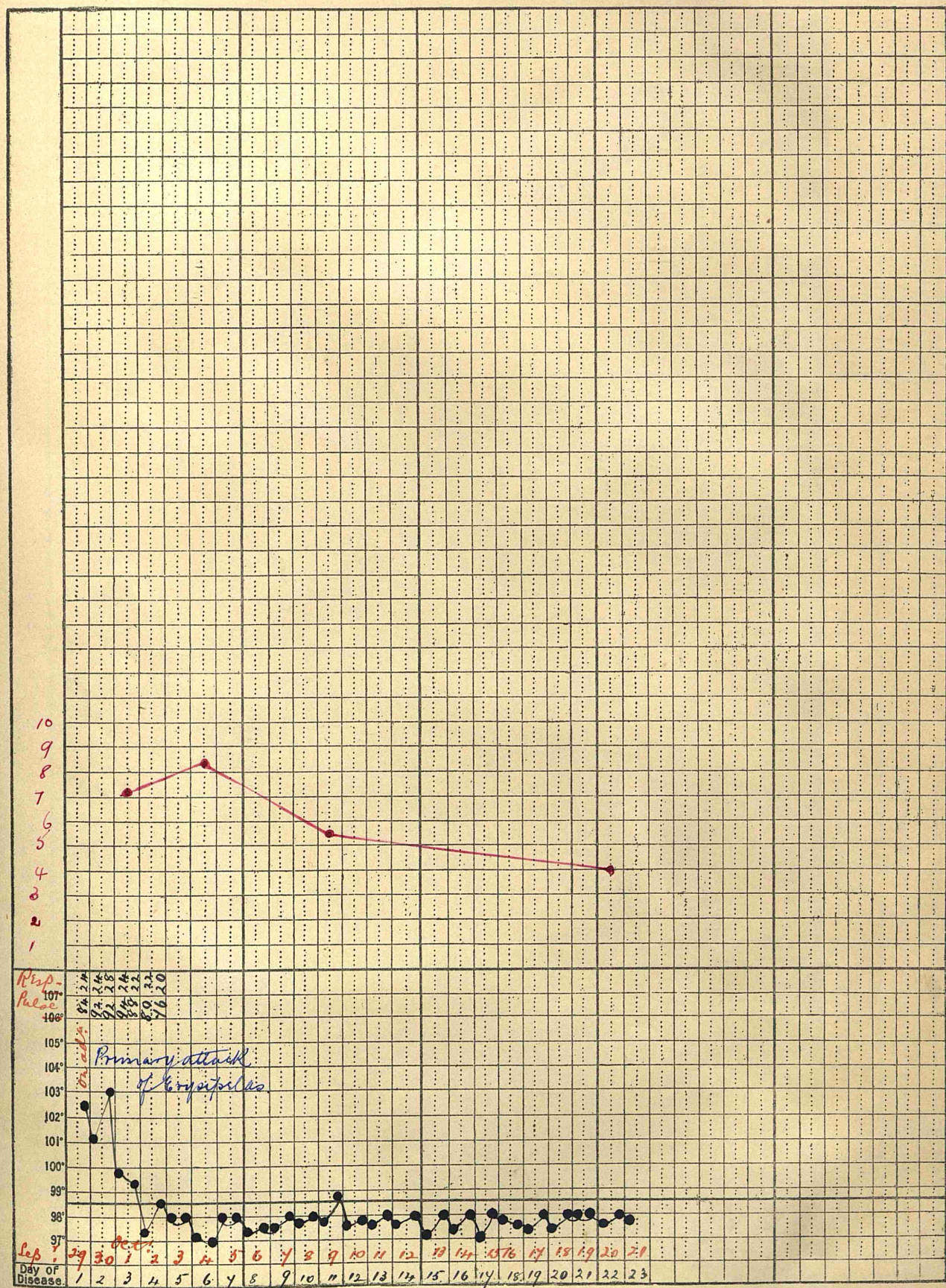
from "Thyloph. agv. 62.  
*Tachia Erysiptila*.  
 Chart XX.





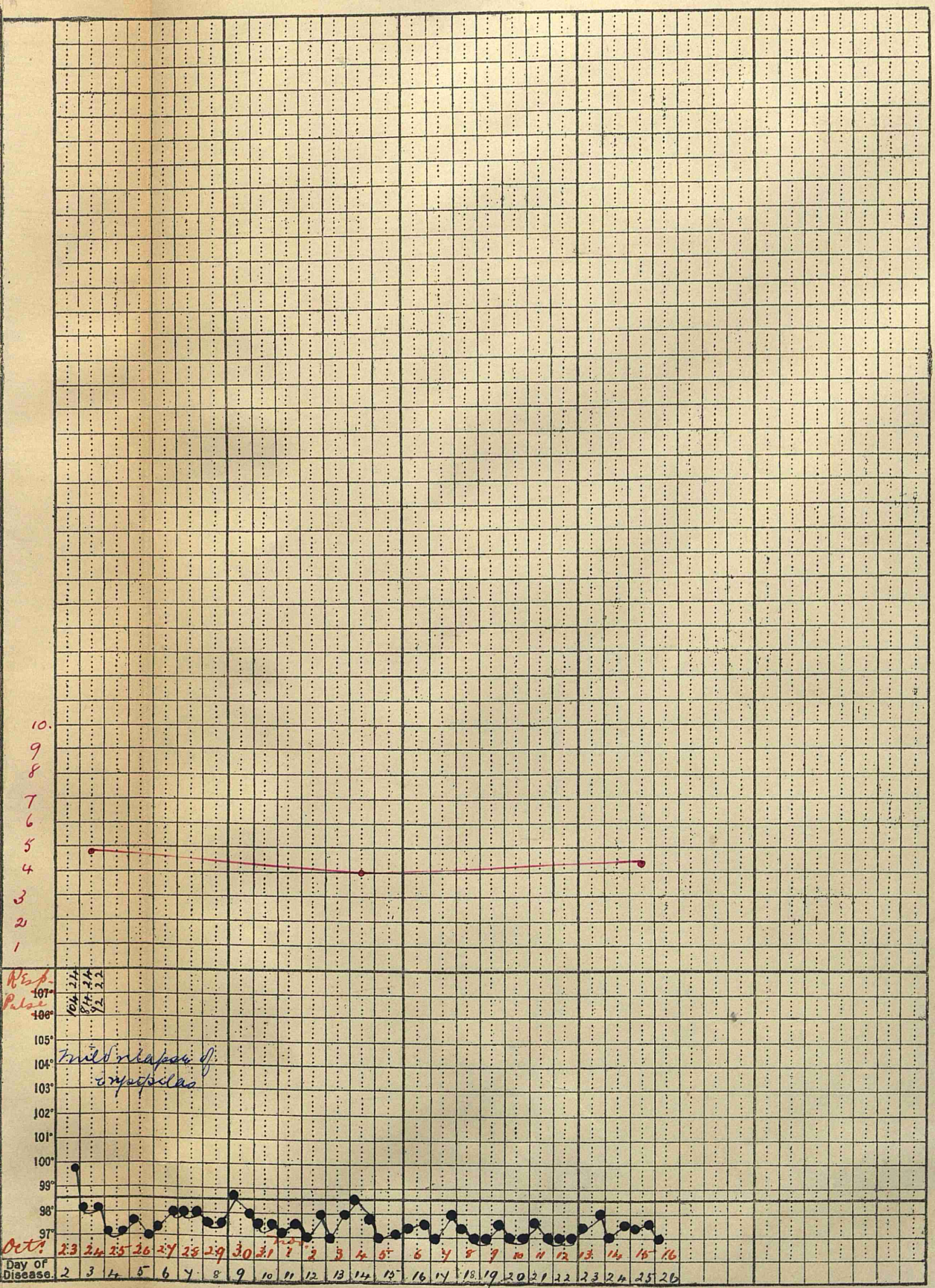
My. Thomson, Agd. 40.  
 Facial Erysipelas.

Chart XXI.



Thomson, Agd. 40 -  
 recurrent Facial Erysipelas.

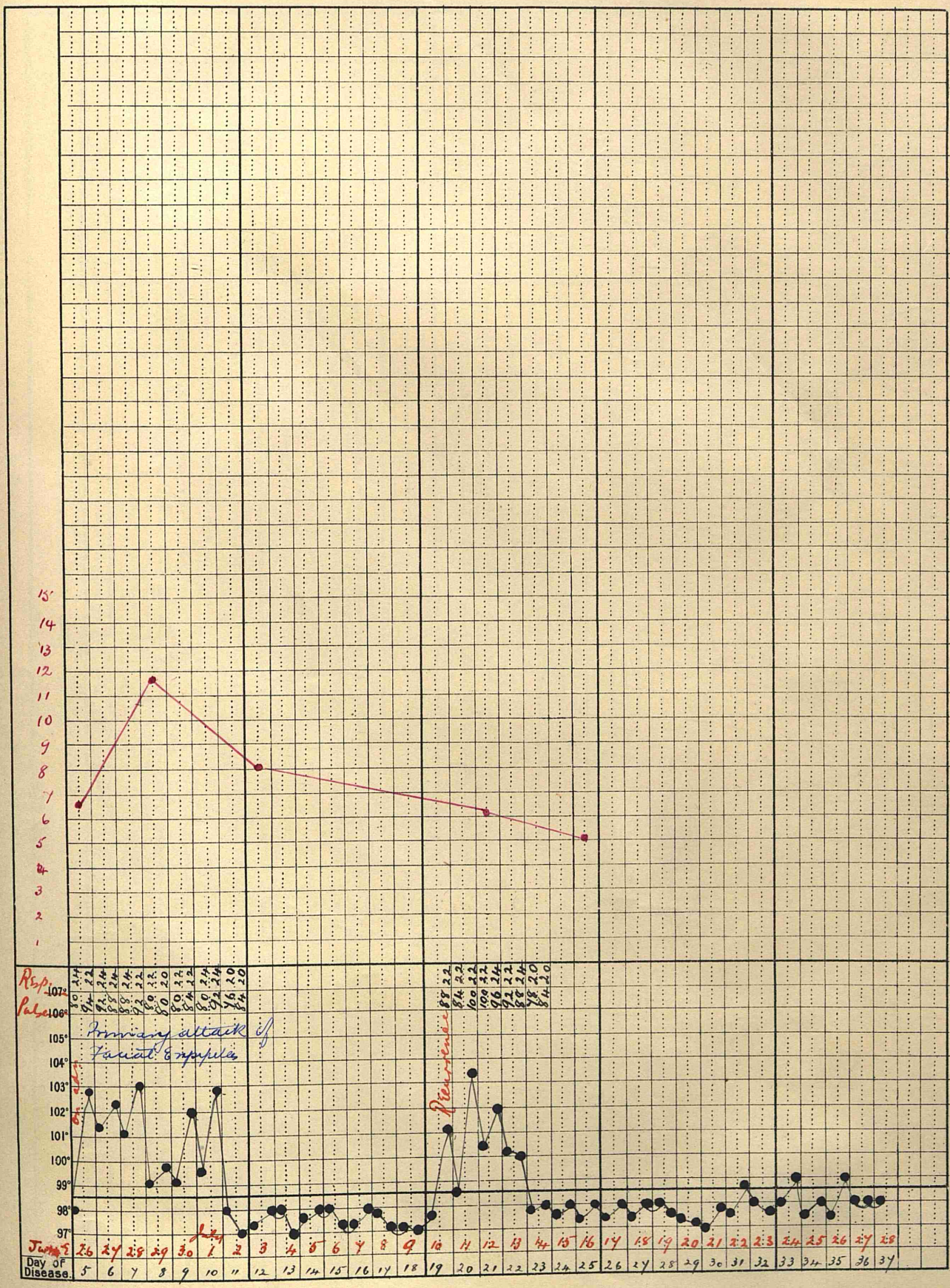
2/a





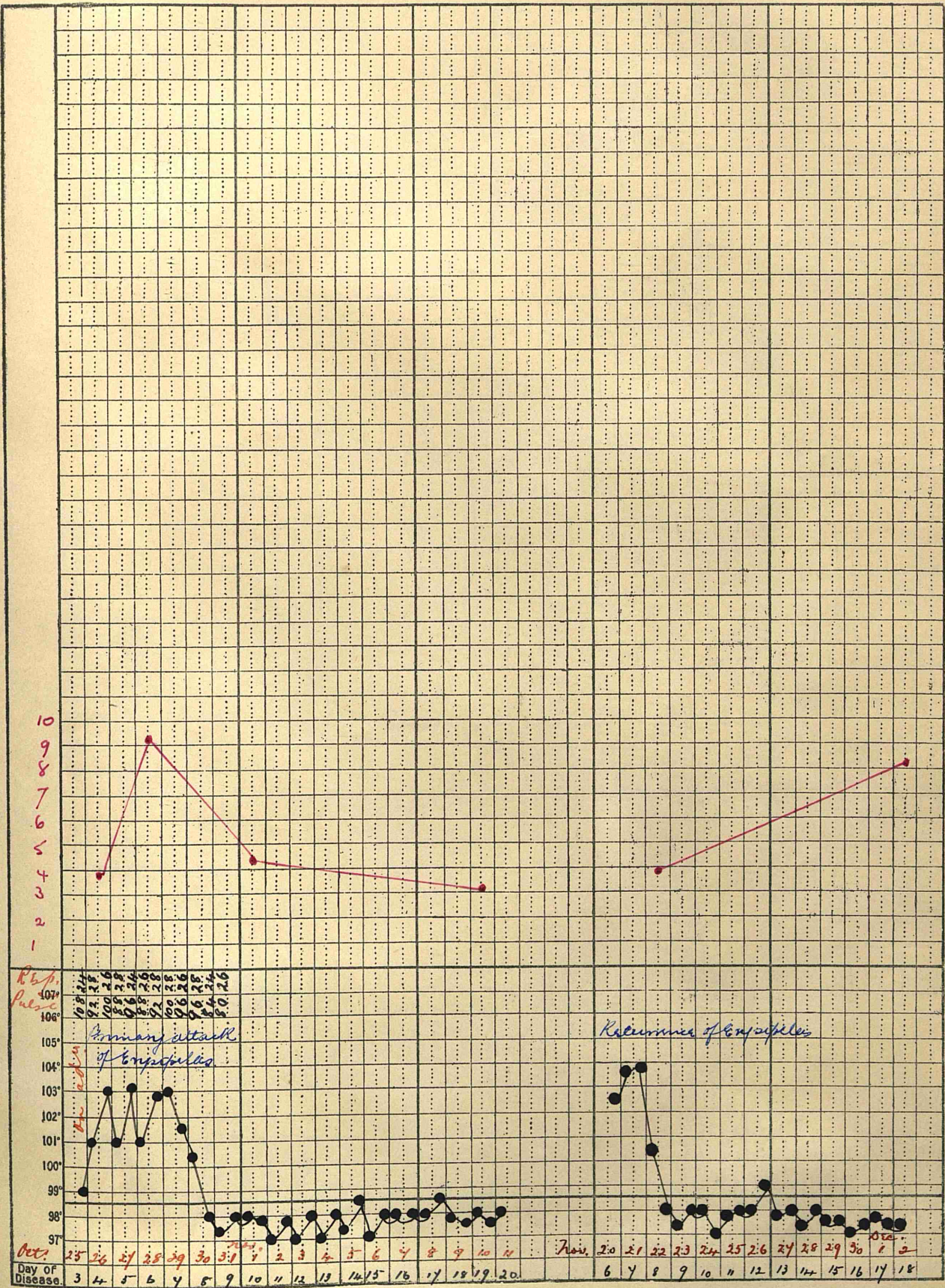
Duncan H. Dean, Age 50  
 Facial Erysipelas.

Chart XXII



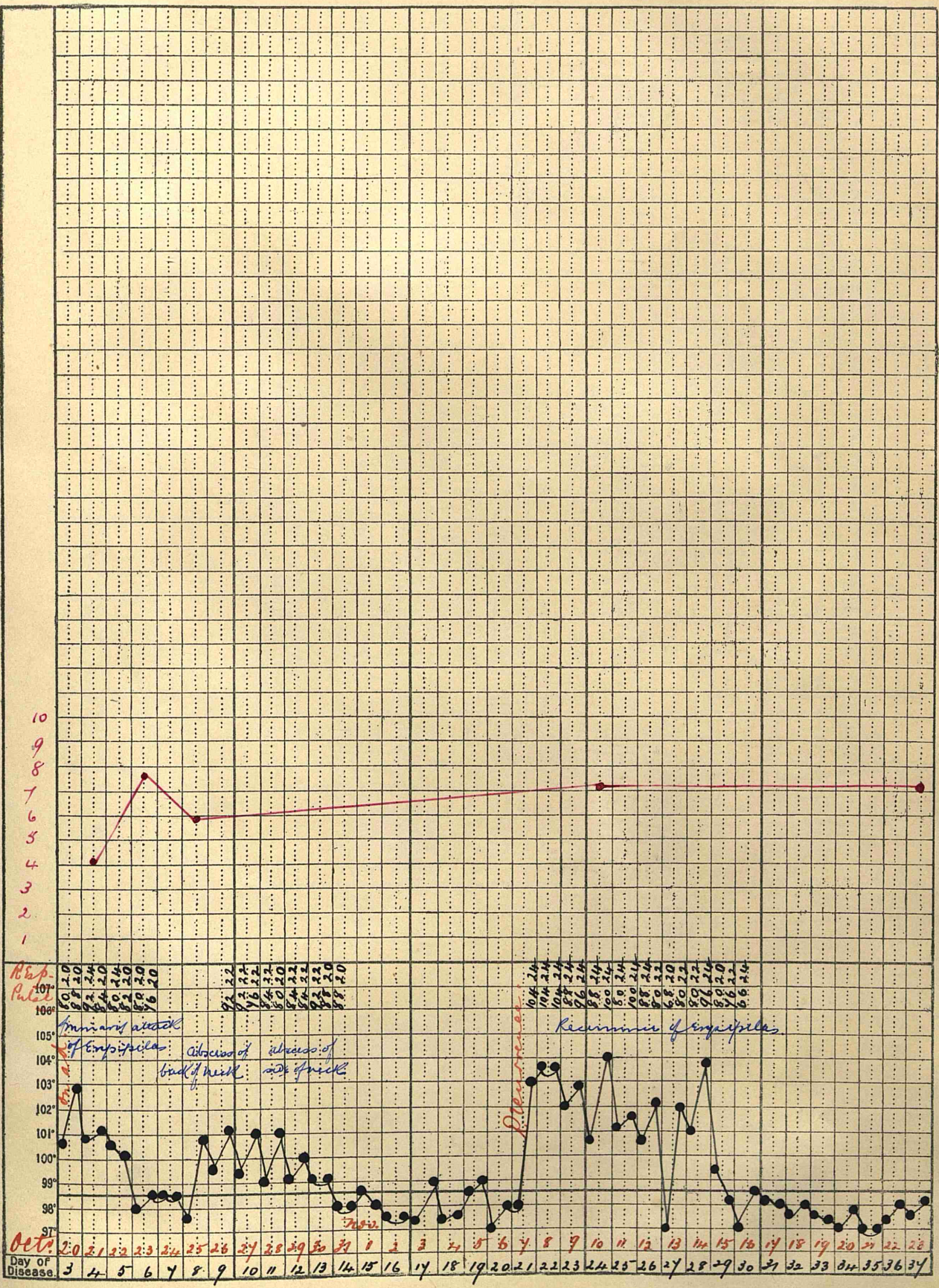


James Jeffreys. Ag. 70  
 Facial Erysipelas.  
 Chart XXIII





Daniel Gillespie, age 46.  
 Facial Erysipelas  
 Chart XXIV





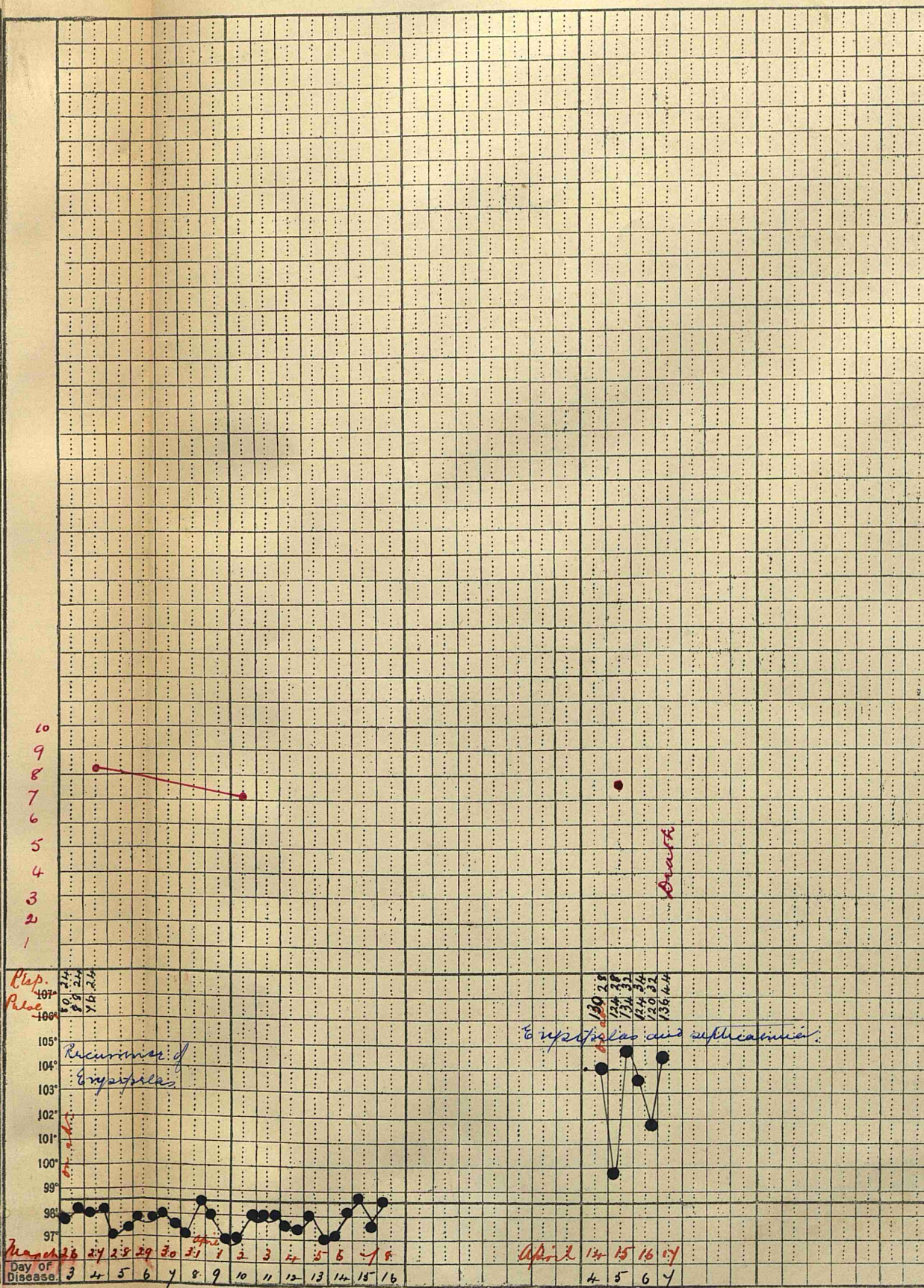
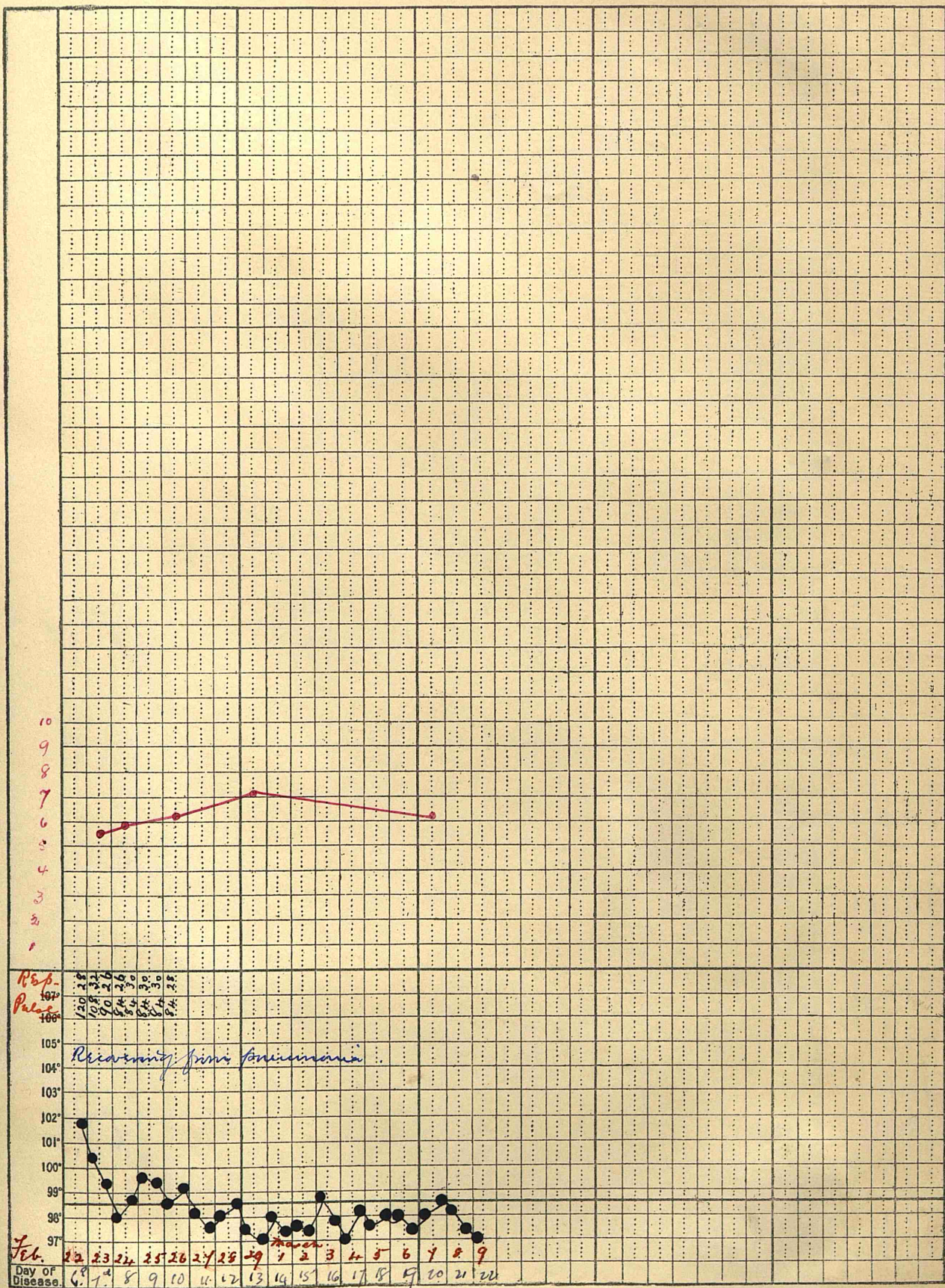
James Morris' age 58.

Lobar Pneumonia, and facial erysipelas with neuritis  
chart XXV.

James Morris' age 58.

Facial Erysipelas & septicaemia  
Chart XXV

25a





Alex. Johnston, Apr. 5.

Facial Erysipelas.

Suppuration of scalp and forehead.

Chart XXVI.

26

17  
16  
15  
14  
13  
12  
11  
10  
9  
8  
7  
6  
5  
4  
3  
2  
1

Temp.  
Pulse

Erysipelas

Abcesses  
scalp

Abcesses of forehead

Suppuration of the  
back of the scalp  
(Puritis)

Staphylococcus  
forming  
scalp

Recesses of forehead

March 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 1 2 3 4 5 6 7 8 9 10  
Day of Disease

Johnston, Apr. 5.

Facial Erysipelas.

26a

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

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

Staphylococcus  
forming  
scalp

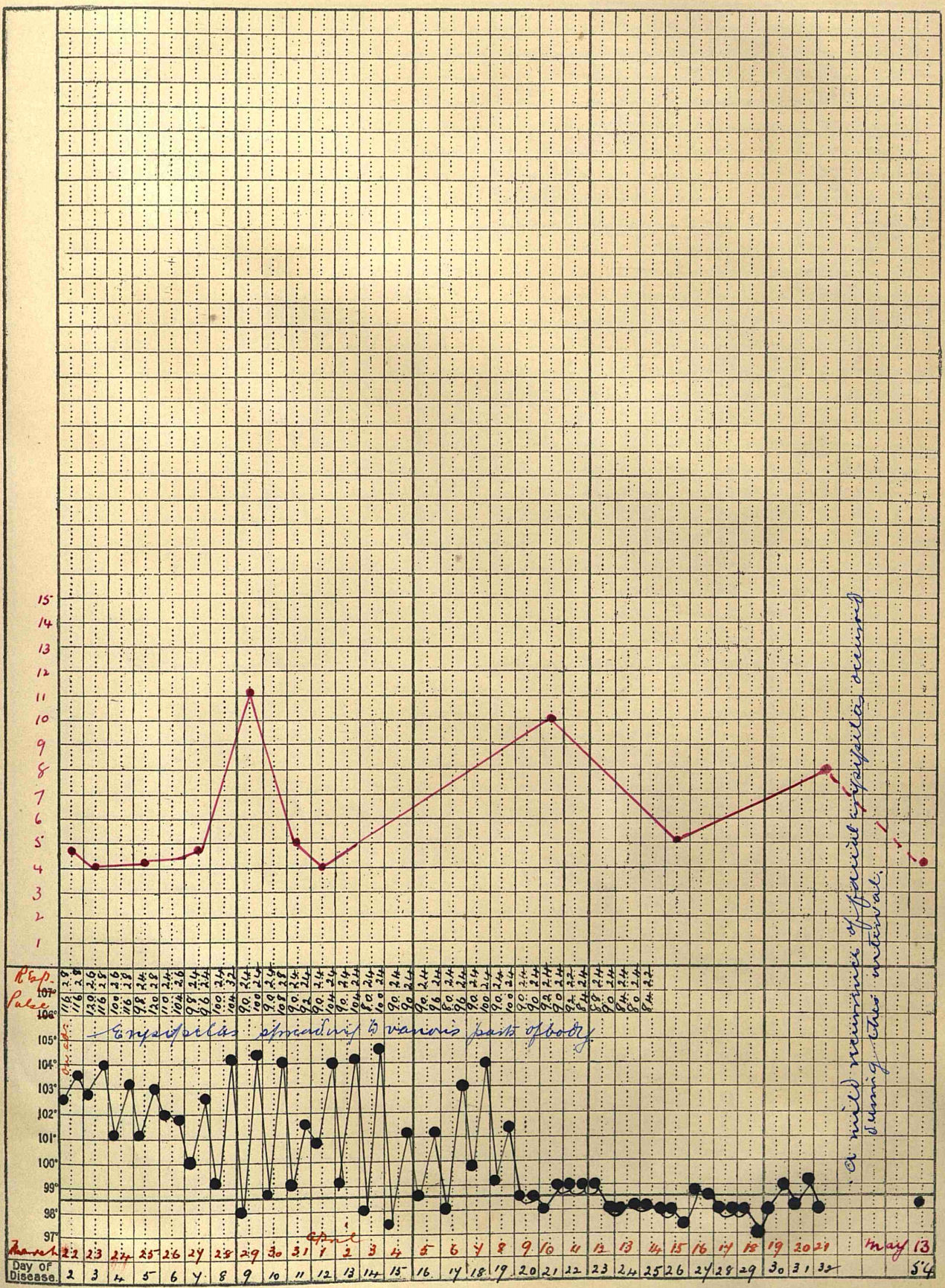
April 11 12 13 14 15 16 17 18 19 20 21  
Day of Disease

May 13  
72



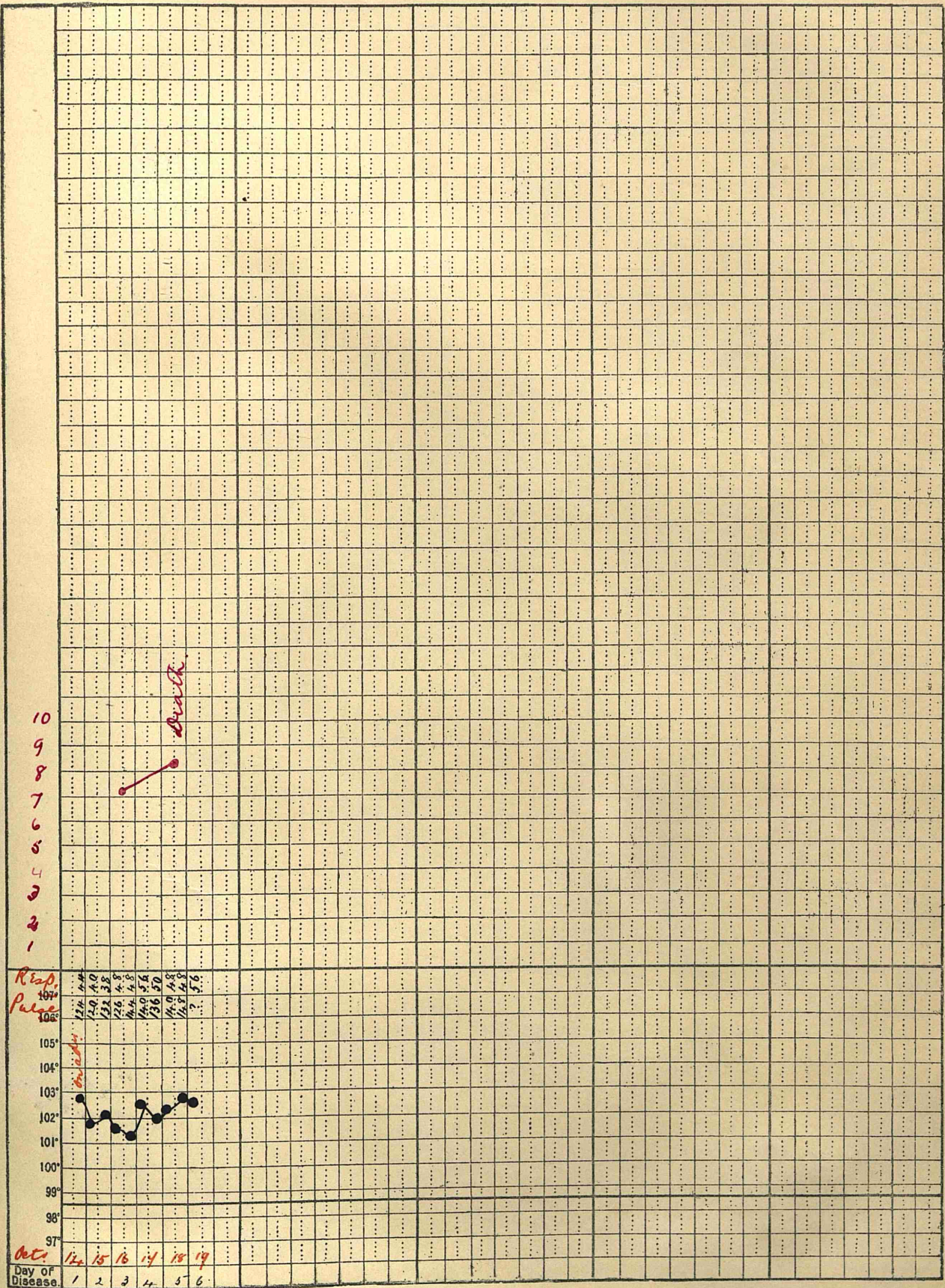
Post. Parvex, Apr. 31.

Erysipelas. chart XXVII





Thos. Anderson Agd. 50.  
 Facial + Erythema.  
 Pneumonia 6 hours XX VIII.

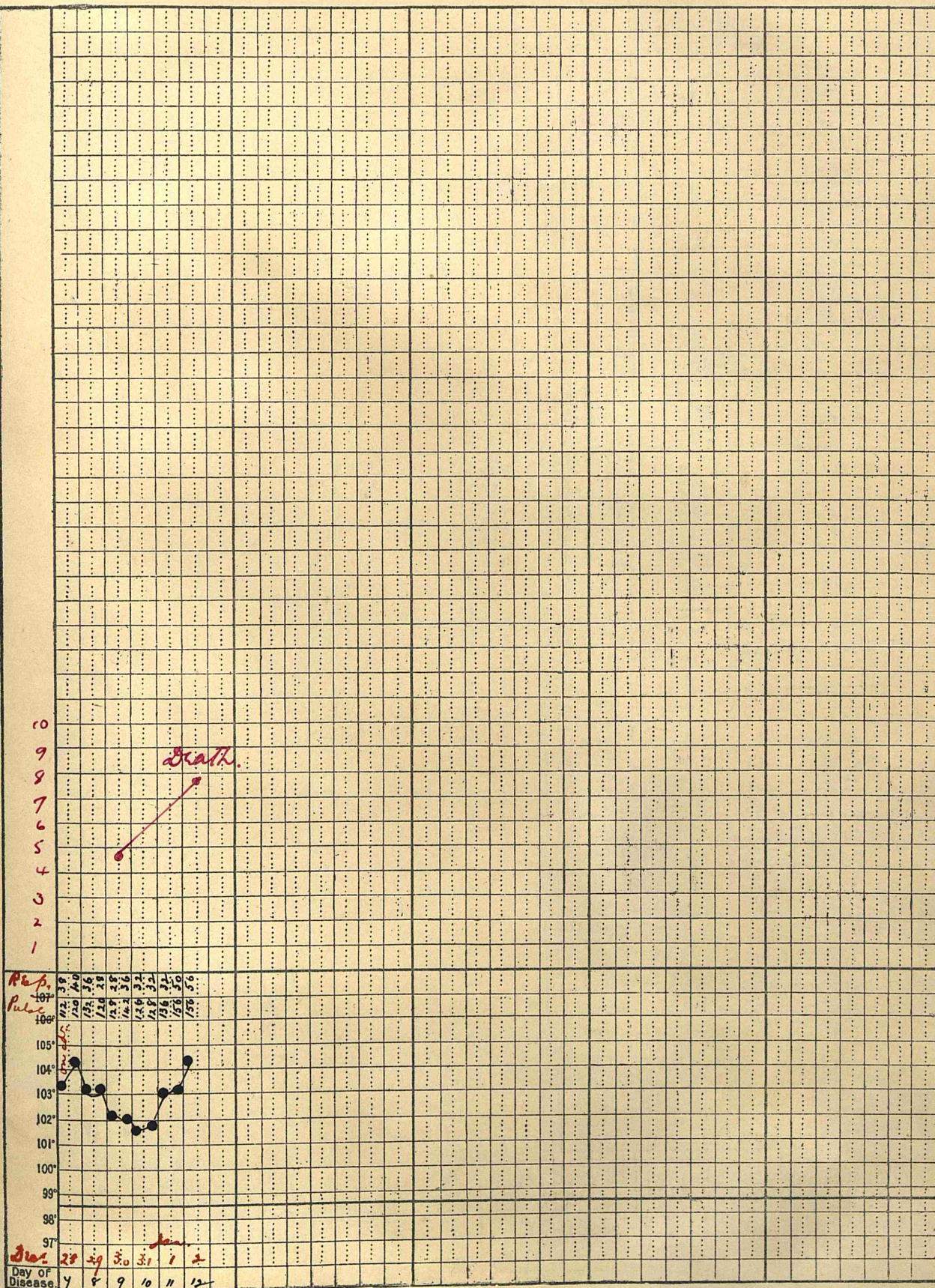




Hugh Hughes, Age 37.

carbuncular condition of upper lip with  
Erysipelas and septicaemia.

Chart XXIX.

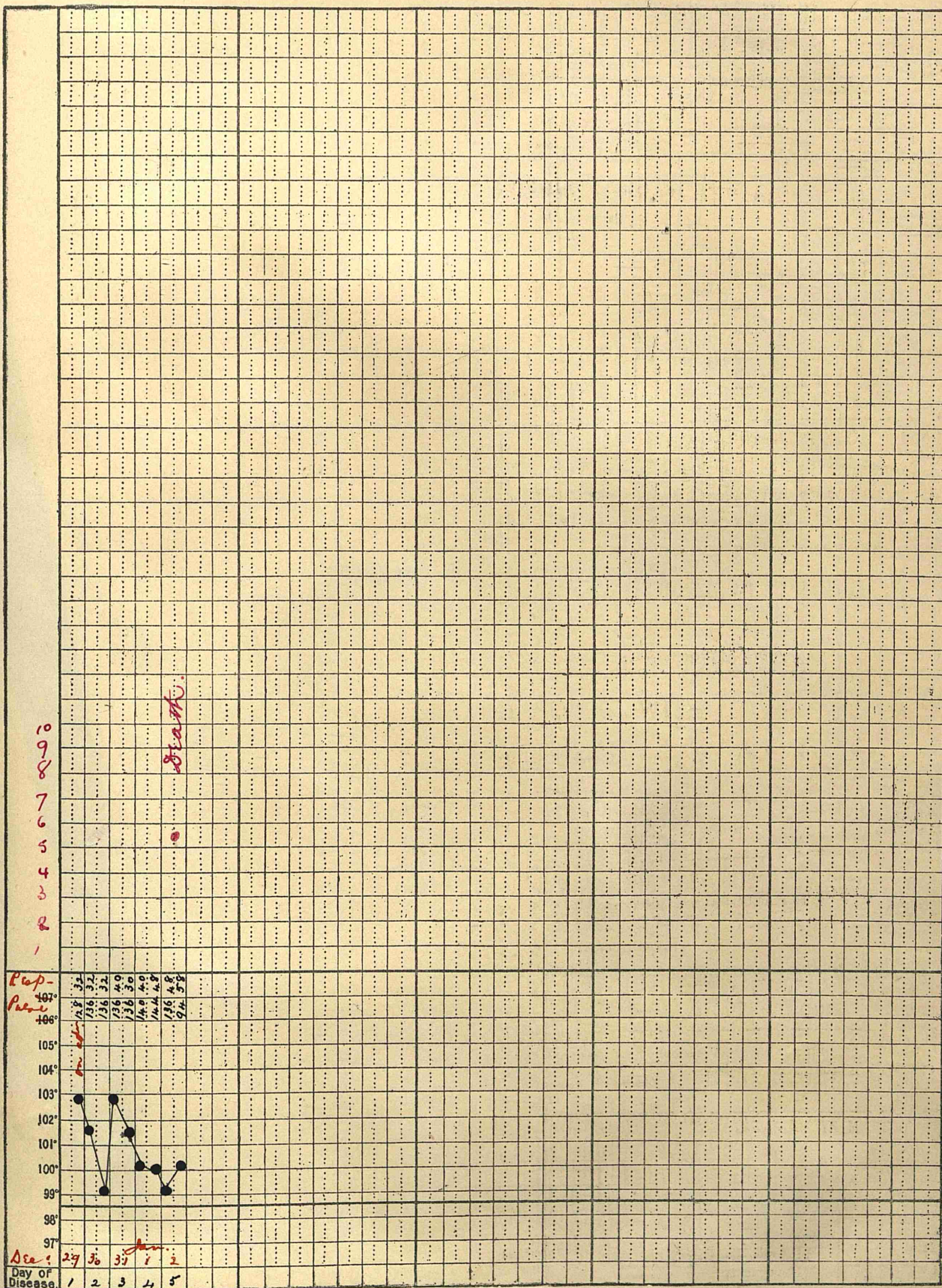




Hugh McCall Aug. 85.

Facial Erysipelas.

Chart XXX.





**SECTION C - DIPHTHERIA**

-----

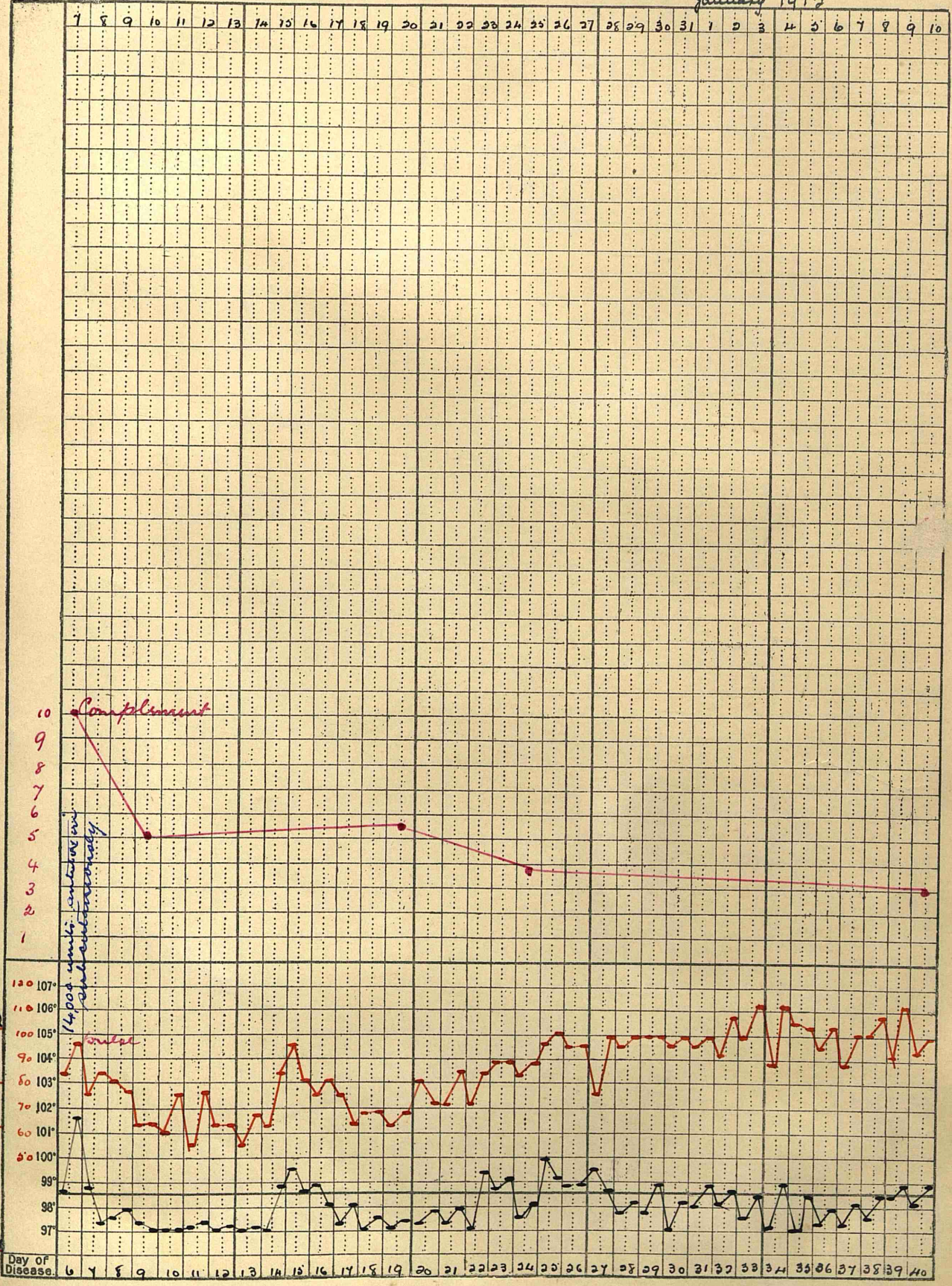


Annual  
Diphtheria

# Chart ~~III~~ I

December

January 1912



29 G.S.  
2. 11

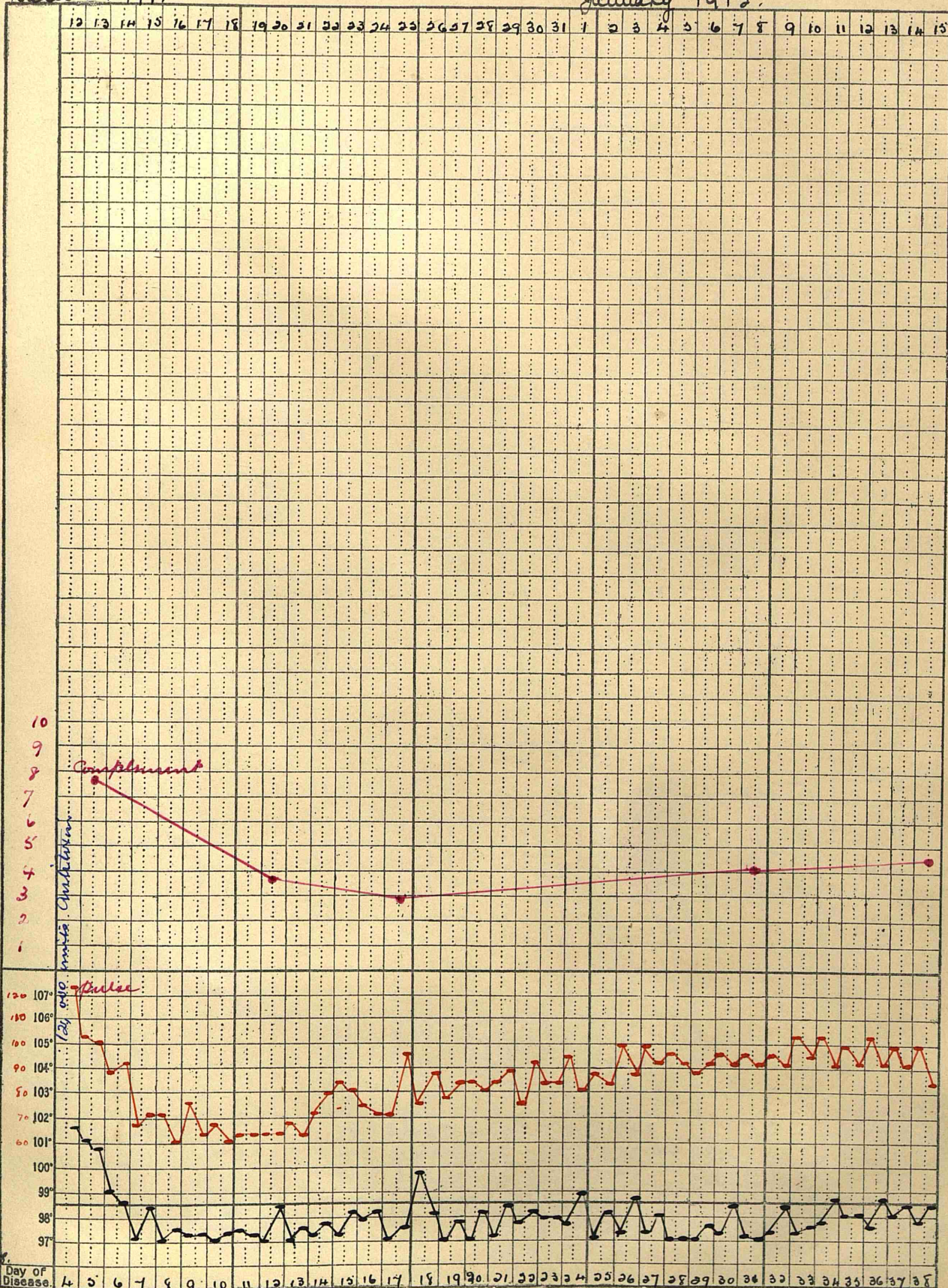
14000 units



# Chart II 11 Yanaiel Diphtheria

December 1911

January 1912



16 yrs.  
12. 11  
12000 units



Yanciel Siphthene

Chart IV III

March

April





# Fancial Diphtheria. Chart ~~VIII~~ IV

March

April

23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

Complement

14000 units  
Diphtheria  
antitoxin

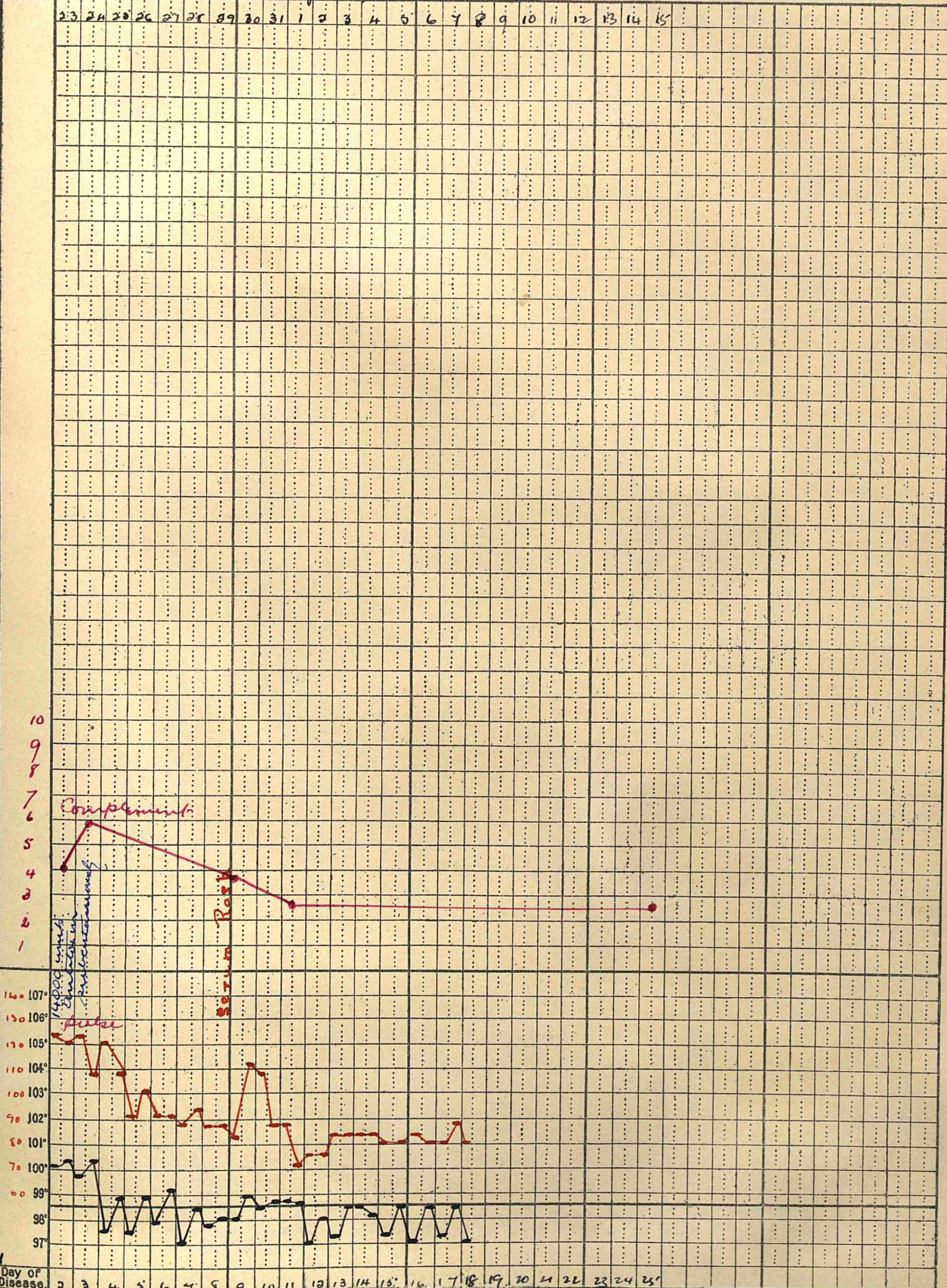
Red

pulse

1400  
130  
120  
110  
100  
90  
80  
70  
60  
50  
40  
30  
20  
10  
0

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



in m. Side  
8 yrs  
3. 12

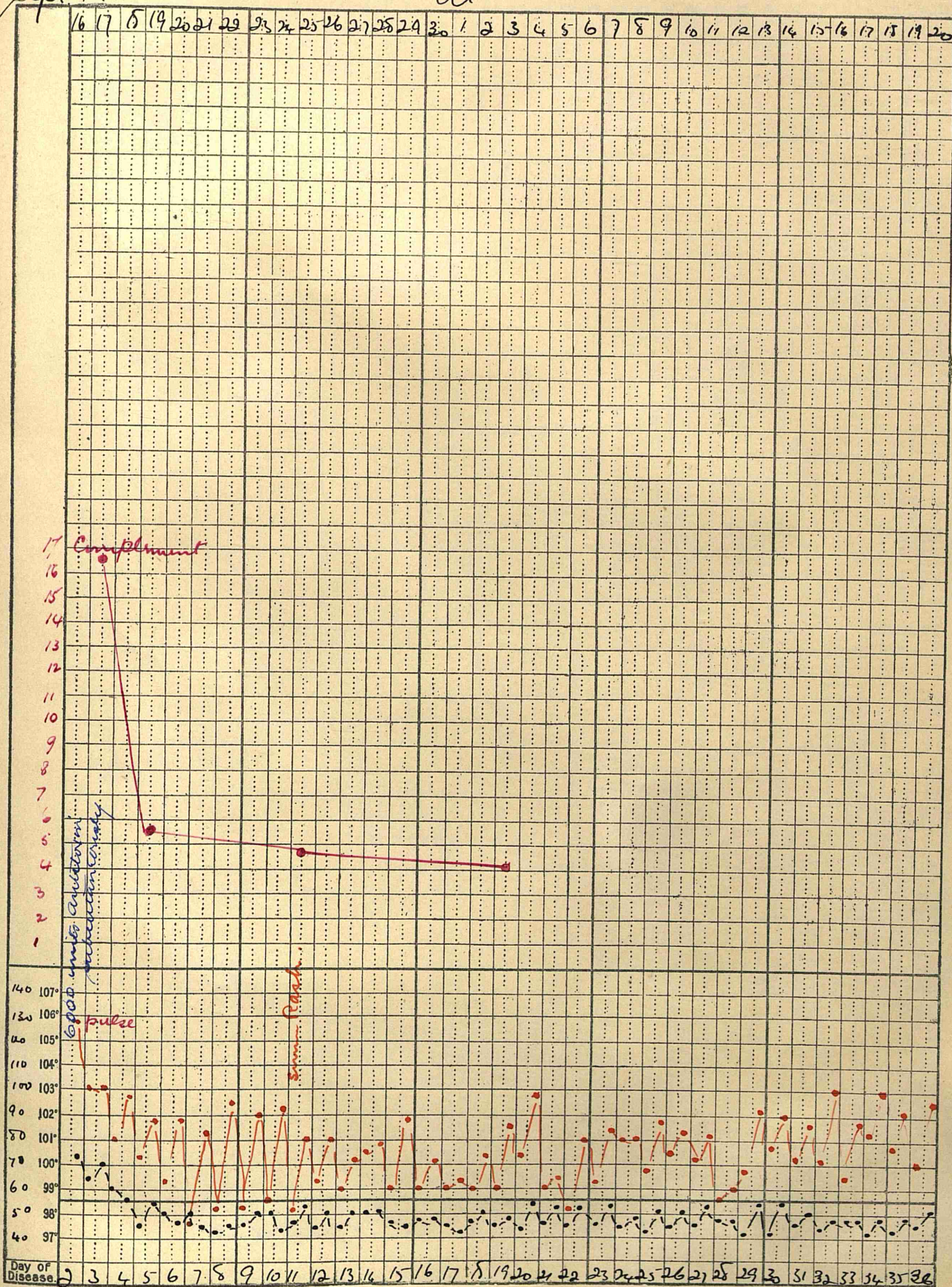
14000 units



# Yancial Diphtheria Chart ~~IX~~ V

Sept 1911

Oct



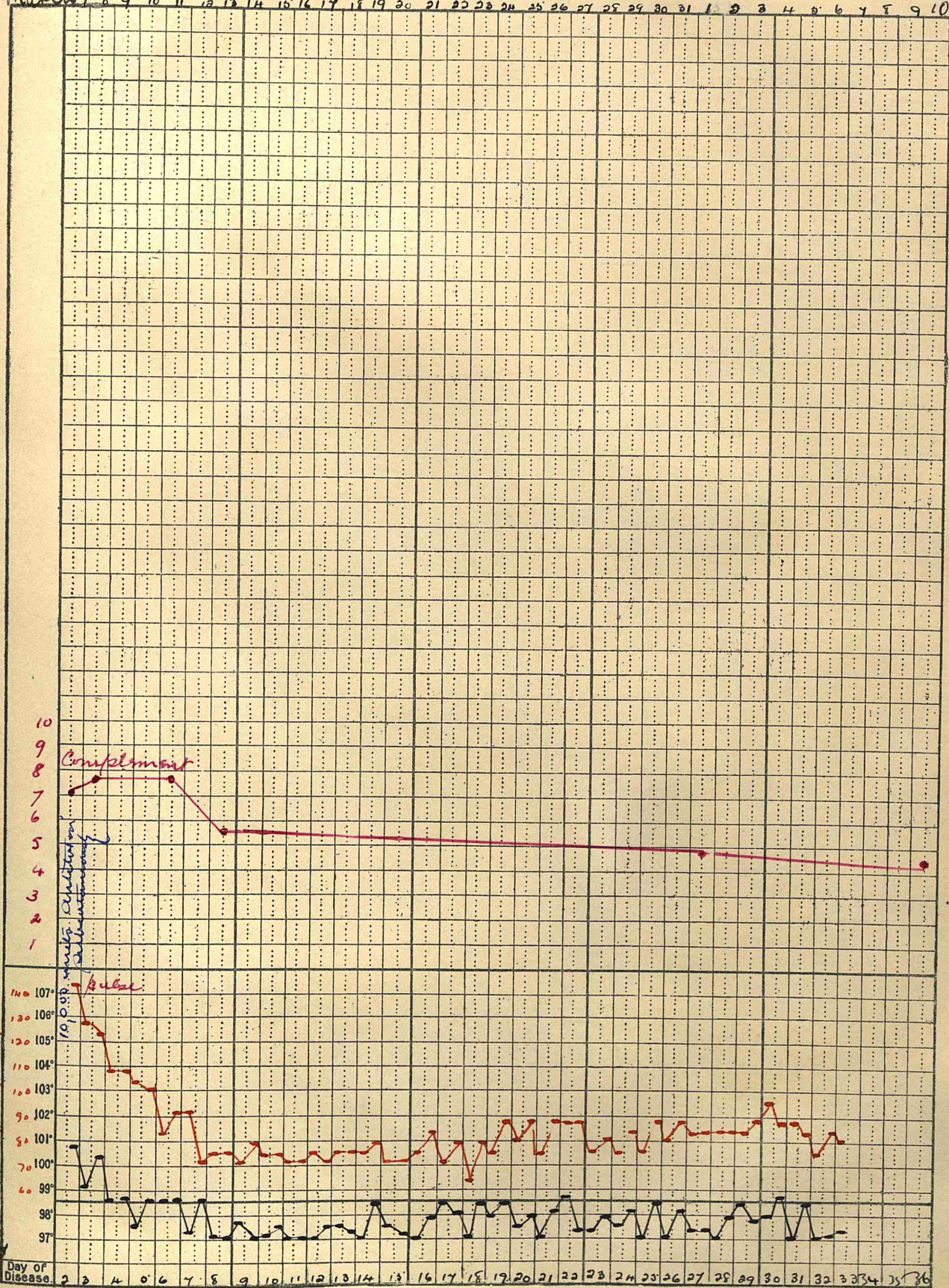
Dwyall  
 17 June  
 16-9-11  
 13



# Chart ~~XX~~ VI

Faucial Diphtheria.

March 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 April 1 2 3 4 5 6 7 8 9 10



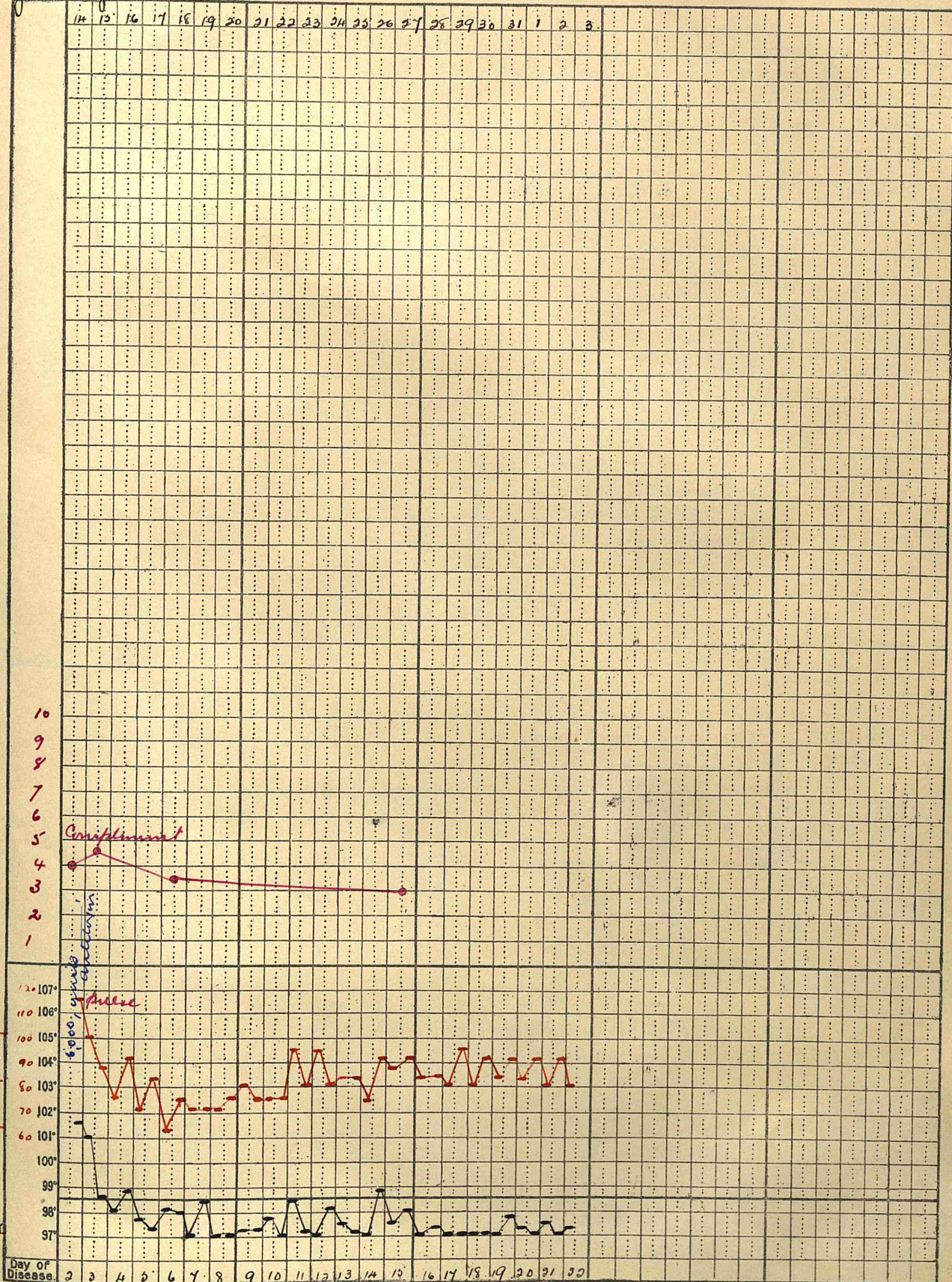
all began  
4 yrs  
3.12  
10000. unit



Facial Erythema.

Chart VII.

January.



Ward 1011  
35 yrs.  
1. 12  
6000 units



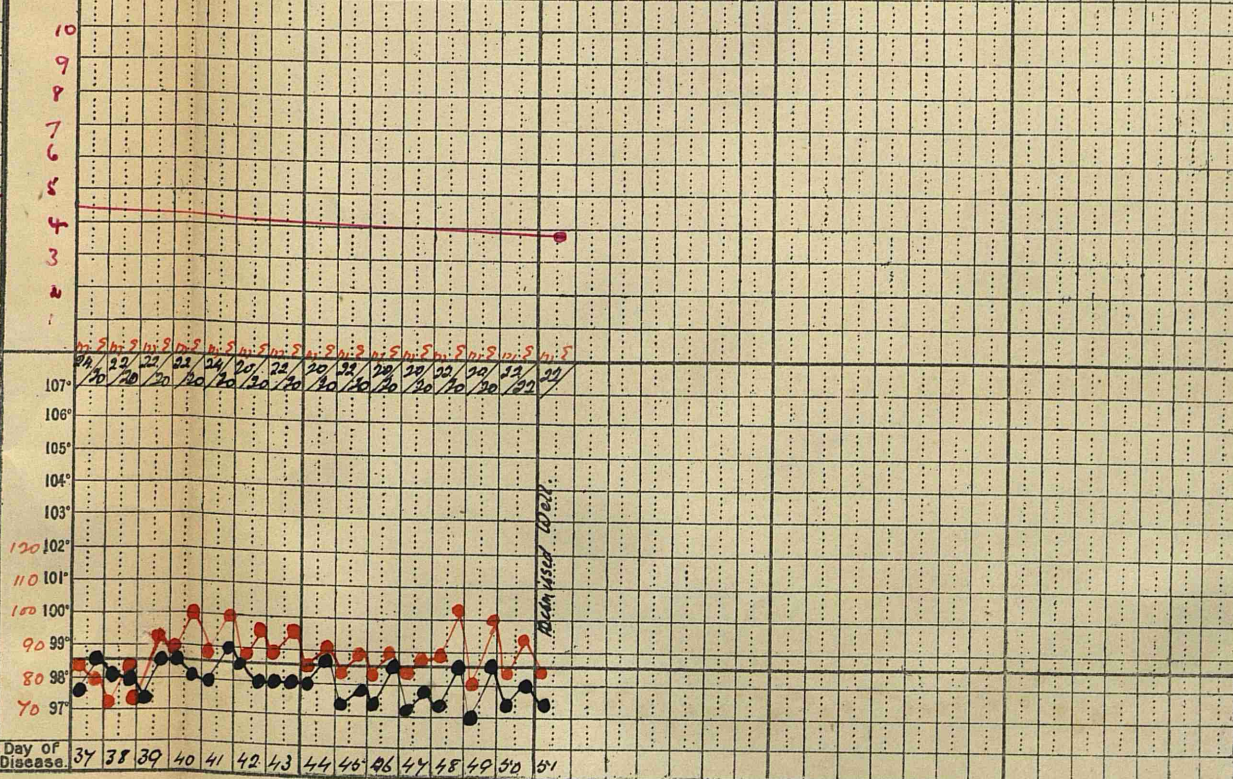
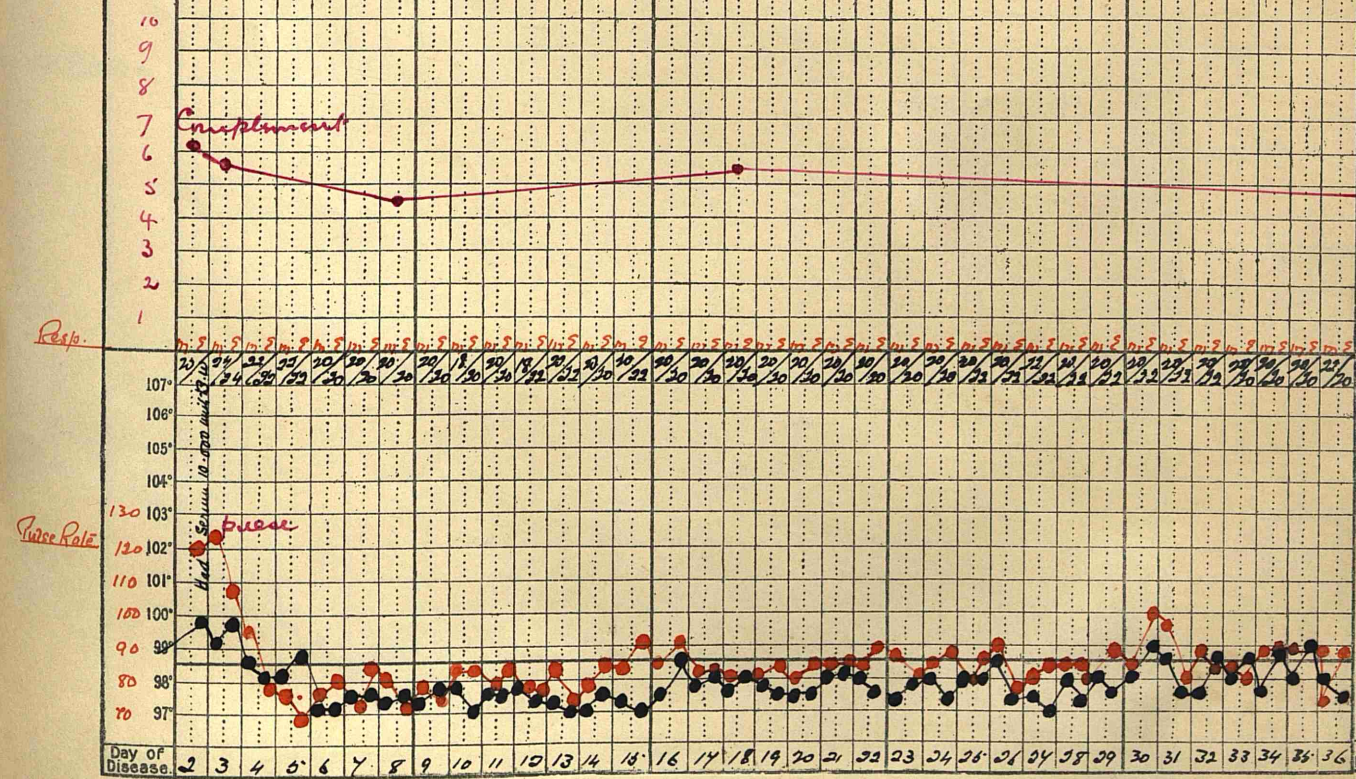
January 1912  
Admitted 14<sup>th</sup> 15<sup>th</sup> 16<sup>th</sup> 17<sup>th</sup> 18<sup>th</sup> 19<sup>th</sup> 20<sup>th</sup> 21<sup>st</sup> 22<sup>nd</sup> 23<sup>rd</sup> 24<sup>th</sup> 25<sup>th</sup> 26<sup>th</sup> 27<sup>th</sup> 28<sup>th</sup> 29<sup>th</sup> 30<sup>th</sup> 31<sup>st</sup>  
February 1912  
1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> 6<sup>th</sup> 7<sup>th</sup> 8<sup>th</sup> 9<sup>th</sup> 10<sup>th</sup> 11<sup>th</sup> 12<sup>th</sup> 13<sup>th</sup> 14<sup>th</sup> 15<sup>th</sup> 16<sup>th</sup> 17<sup>th</sup> 18<sup>th</sup> 19<sup>th</sup> 20<sup>th</sup> 21<sup>st</sup> 22<sup>nd</sup> 23<sup>rd</sup> 24<sup>th</sup> 25<sup>th</sup> 26<sup>th</sup> 27<sup>th</sup> 28<sup>th</sup> 29<sup>th</sup> 30<sup>th</sup>

March  
1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> 6<sup>th</sup> 7<sup>th</sup> 8<sup>th</sup> 9<sup>th</sup> 10<sup>th</sup> 11<sup>th</sup> 12<sup>th</sup> 13<sup>th</sup> 14<sup>th</sup> 15<sup>th</sup> 16<sup>th</sup> 17<sup>th</sup> 18<sup>th</sup> 19<sup>th</sup> 20<sup>th</sup> 21<sup>st</sup> 22<sup>nd</sup> 23<sup>rd</sup> 24<sup>th</sup> 25<sup>th</sup> 26<sup>th</sup> 27<sup>th</sup> 28<sup>th</sup> 29<sup>th</sup> 30<sup>th</sup> 31<sup>st</sup>

W. Carnegie

9 yrs

Palatal Diphtheria





Yaucial  
Diphtheria.

Chart ~~XVI~~ IX

December 1911.

January 1912.

Admitted 25<sup>th</sup> 26<sup>th</sup> 27<sup>th</sup> 28<sup>th</sup> 29<sup>th</sup> 30<sup>th</sup> 31<sup>st</sup> 1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> 6<sup>th</sup> 7<sup>th</sup> 8<sup>th</sup> 9<sup>th</sup> 10<sup>th</sup> 11<sup>th</sup> 12<sup>th</sup> 13<sup>th</sup> 14<sup>th</sup> 15<sup>th</sup> 16<sup>th</sup> 17<sup>th</sup> 18<sup>th</sup> 19<sup>th</sup> 20<sup>th</sup> 21<sup>st</sup> 22<sup>nd</sup> 23<sup>rd</sup> 24<sup>th</sup> 25<sup>th</sup> 26<sup>th</sup> 27<sup>th</sup> 28<sup>th</sup>

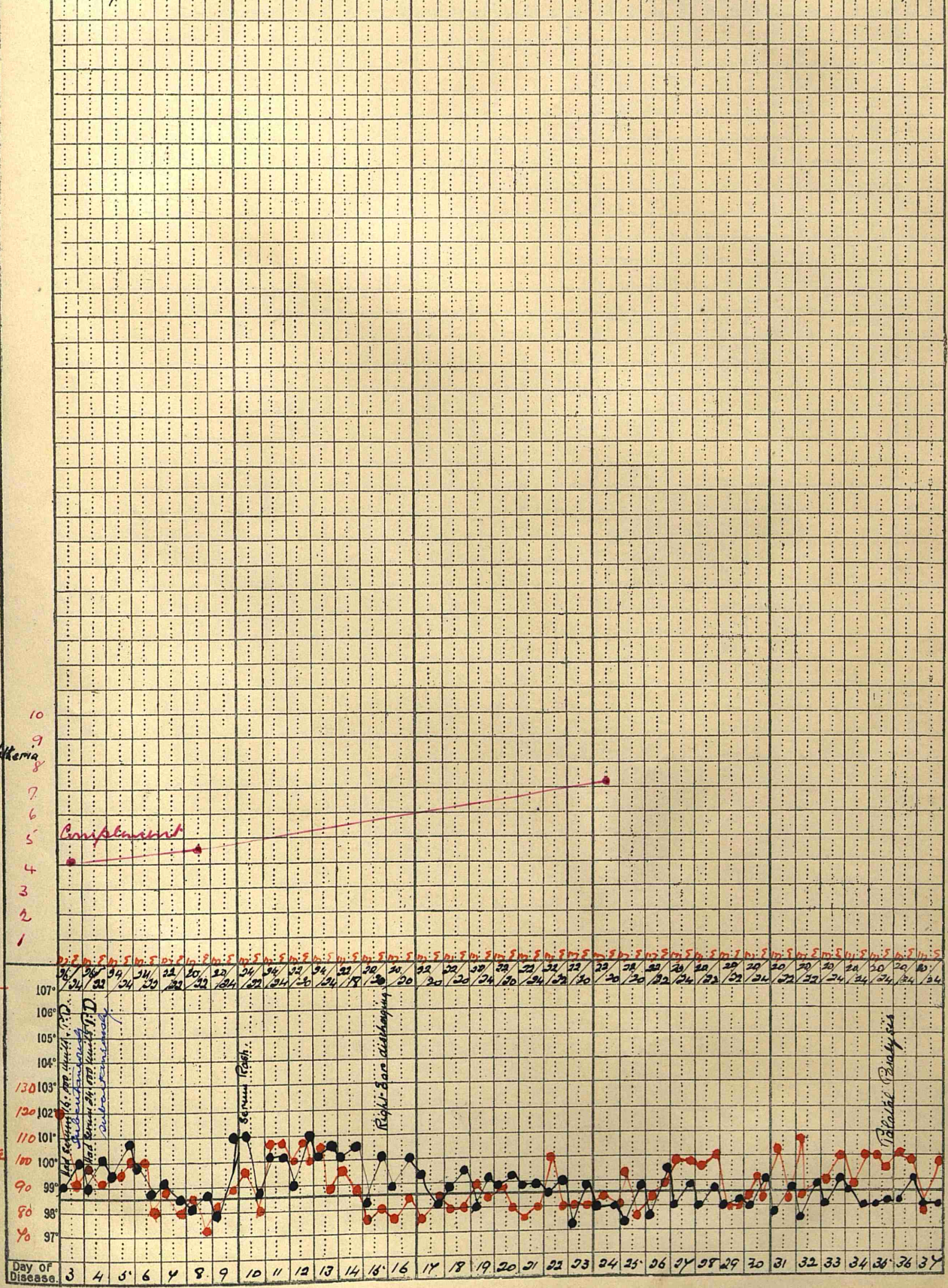
Under Waddle.

13 yrs.

Palatal Diphtheria

Resp.

Pulse Rate

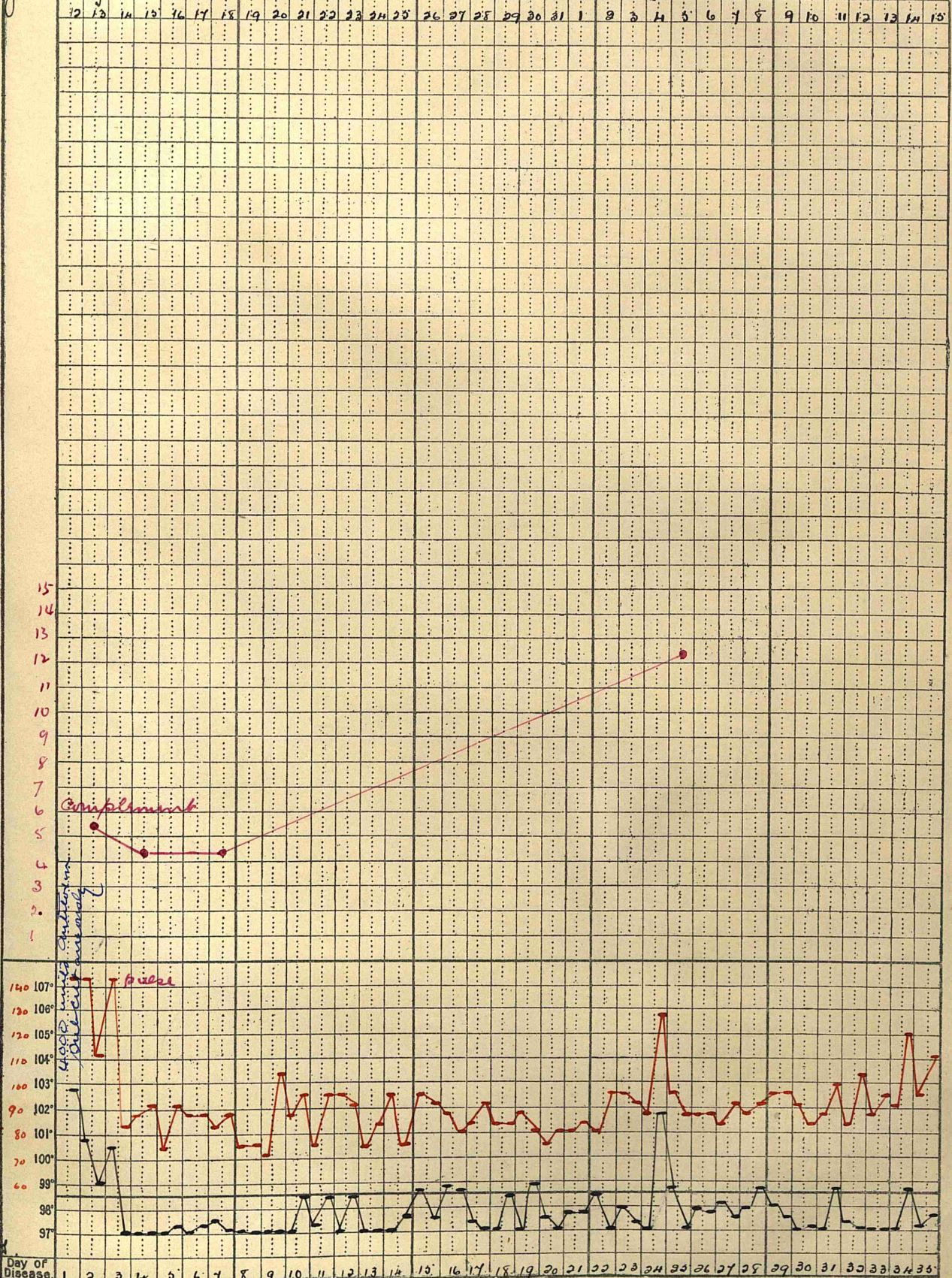




# Taucial Diphtheria Chart XVI, X

January

February

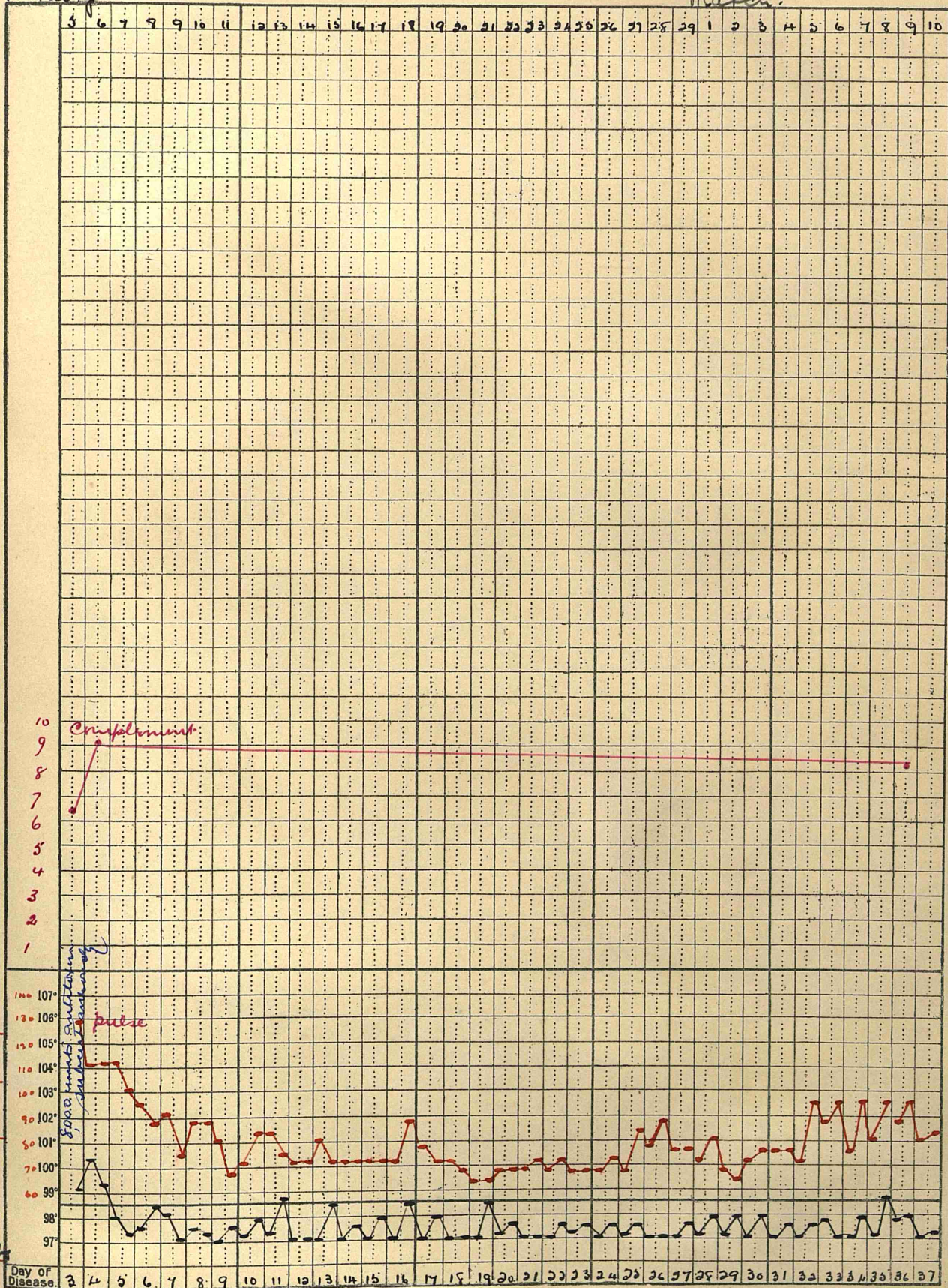




# Faural Diphtheria. Chart XI

February

March



6 yrs  
12  
5000 units

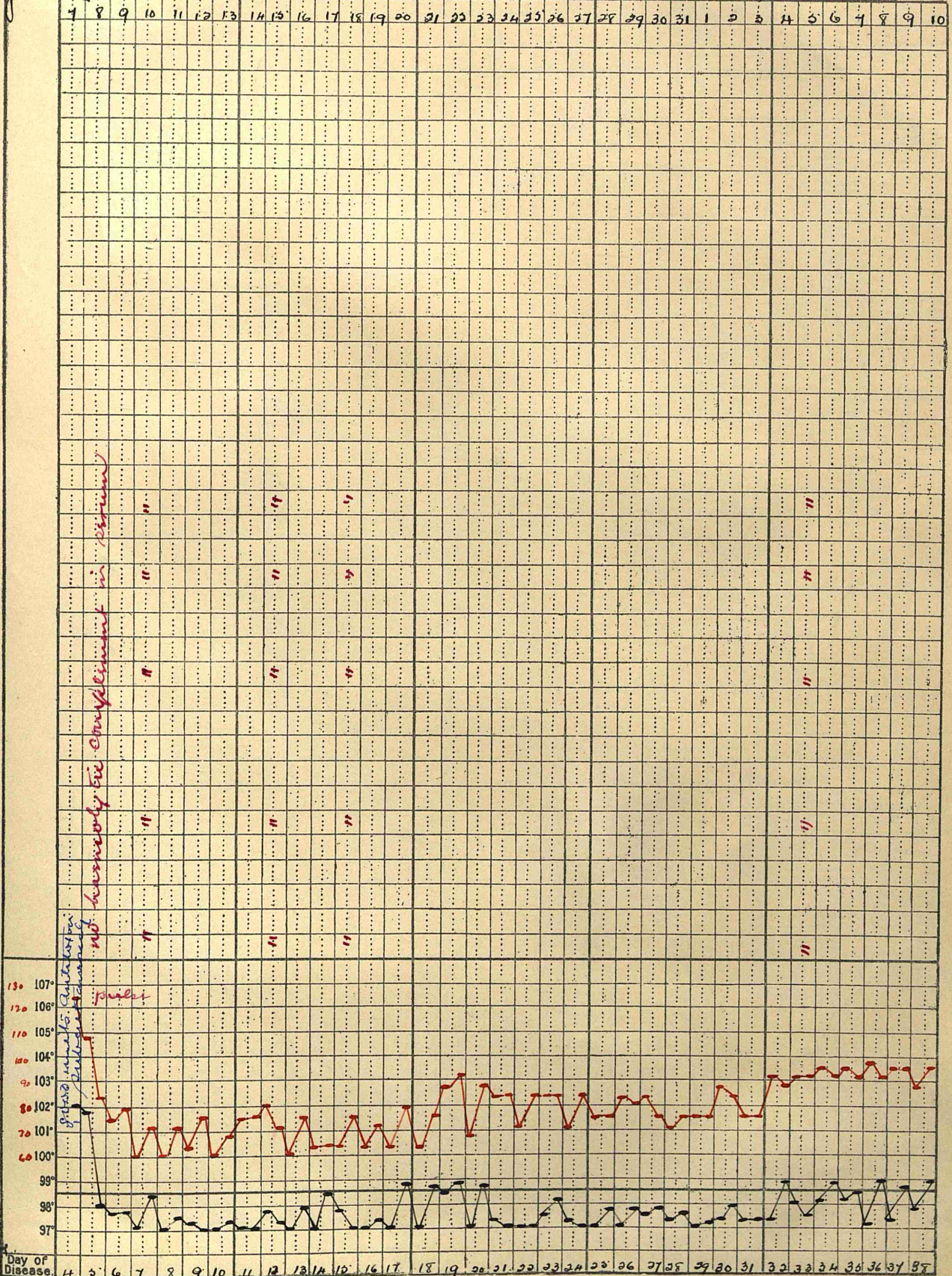


Yarnal  
siphthina

Chart  $\frac{1}{1}$

January 1921

February



10 yrs  
12

Spoo line

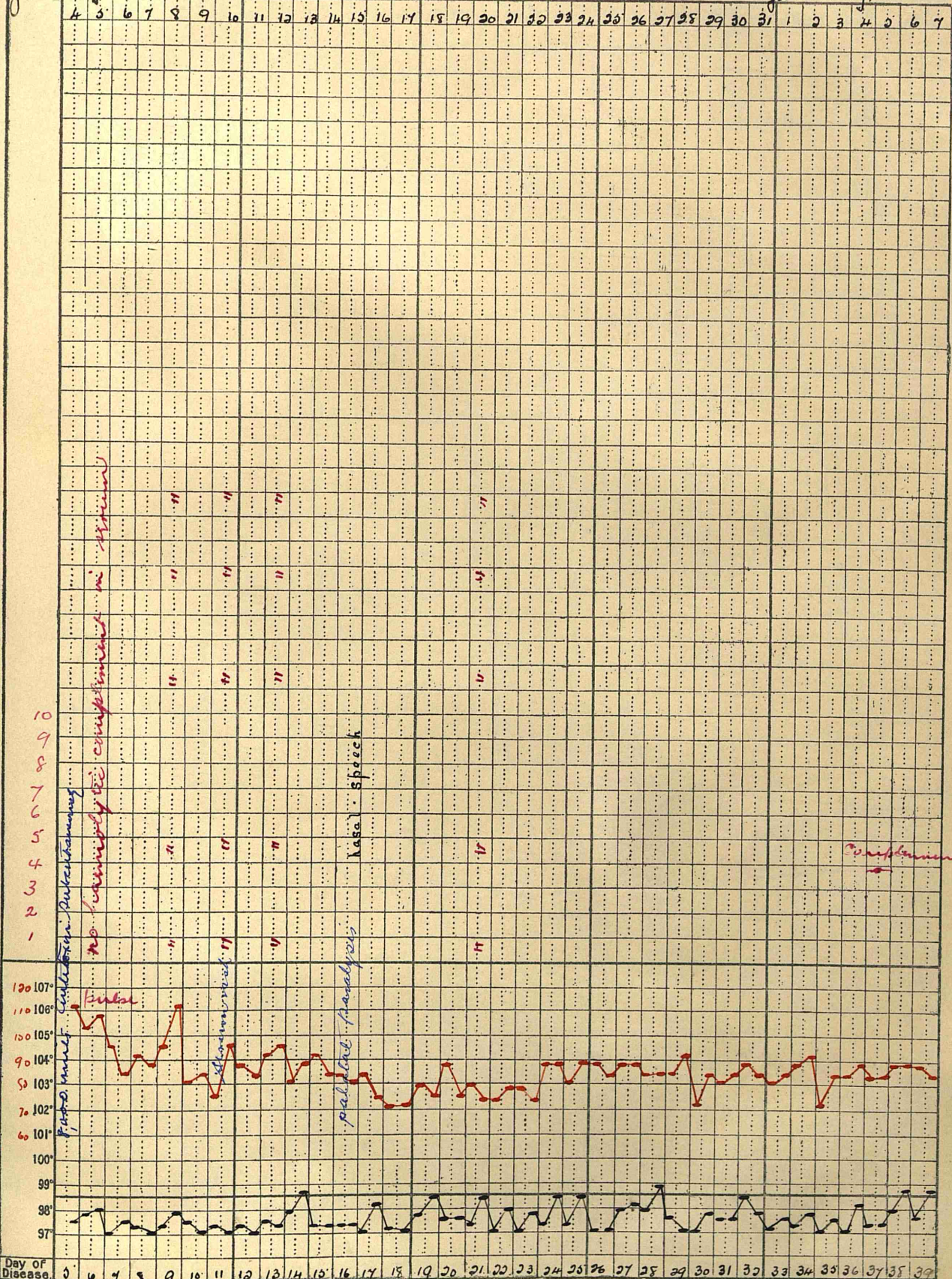


7 annual  
Diphtheria.

Chart XIII

January

February



Bill  
7 yrs.  
1. 12

12000 units

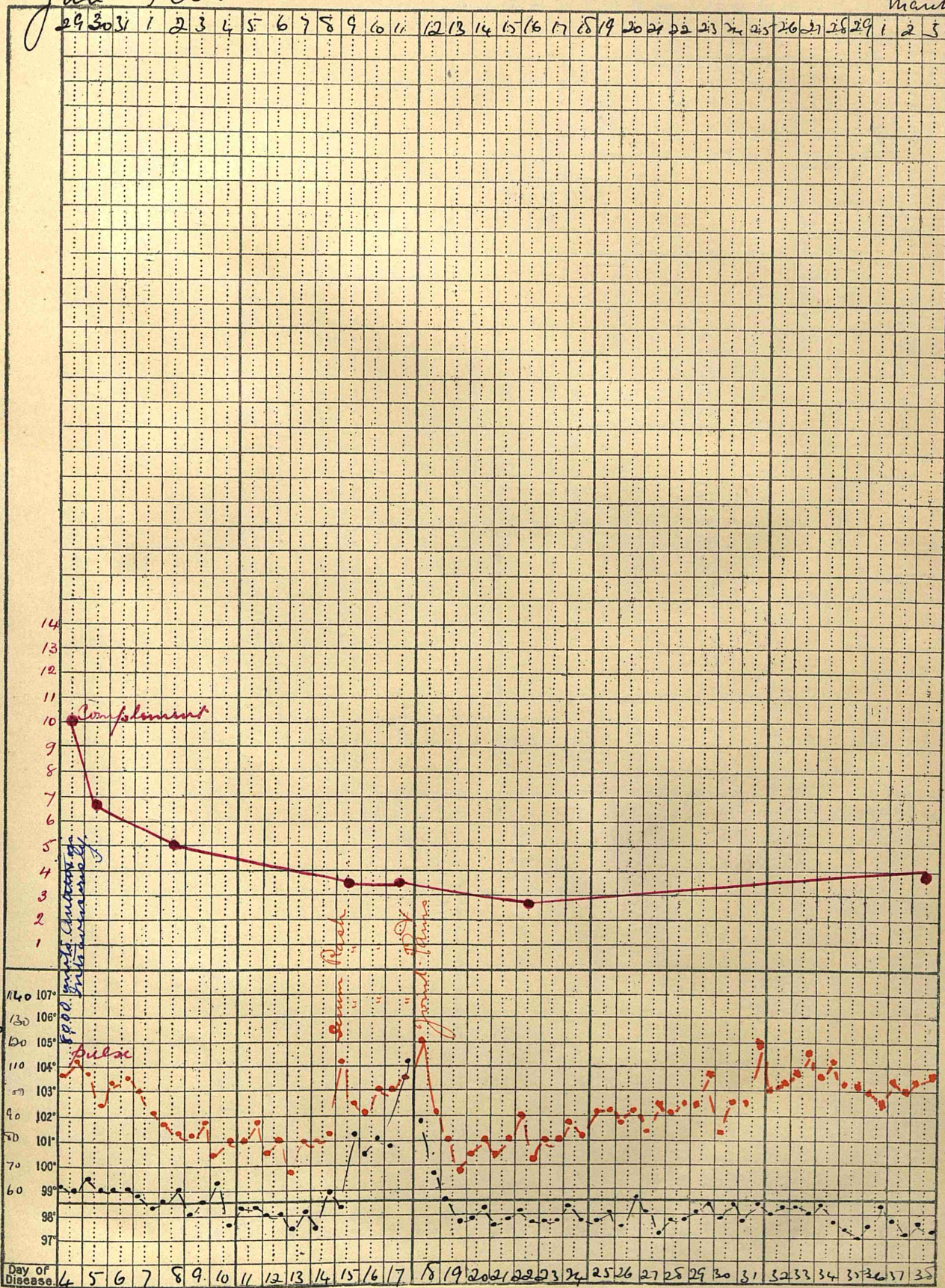


Diphtheria  
facial & nasal

Chart XIV.

Jan Feb.

March

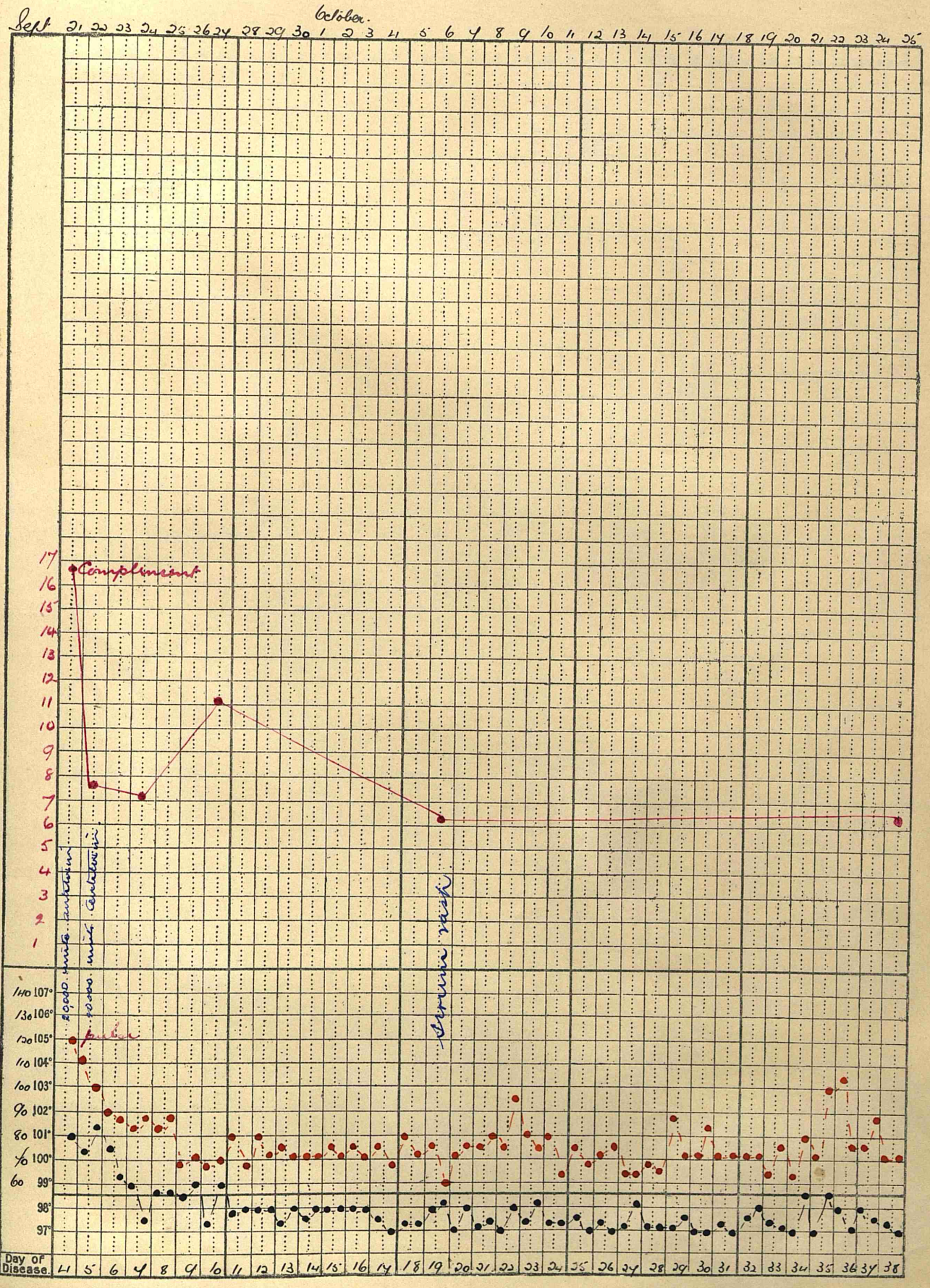


13 1/2 hours  
Jan 1912  
100 miles  
thamously



*Diphtheria*

Facial and Nasal. Chart XV



Local  
Griffiths  
years.

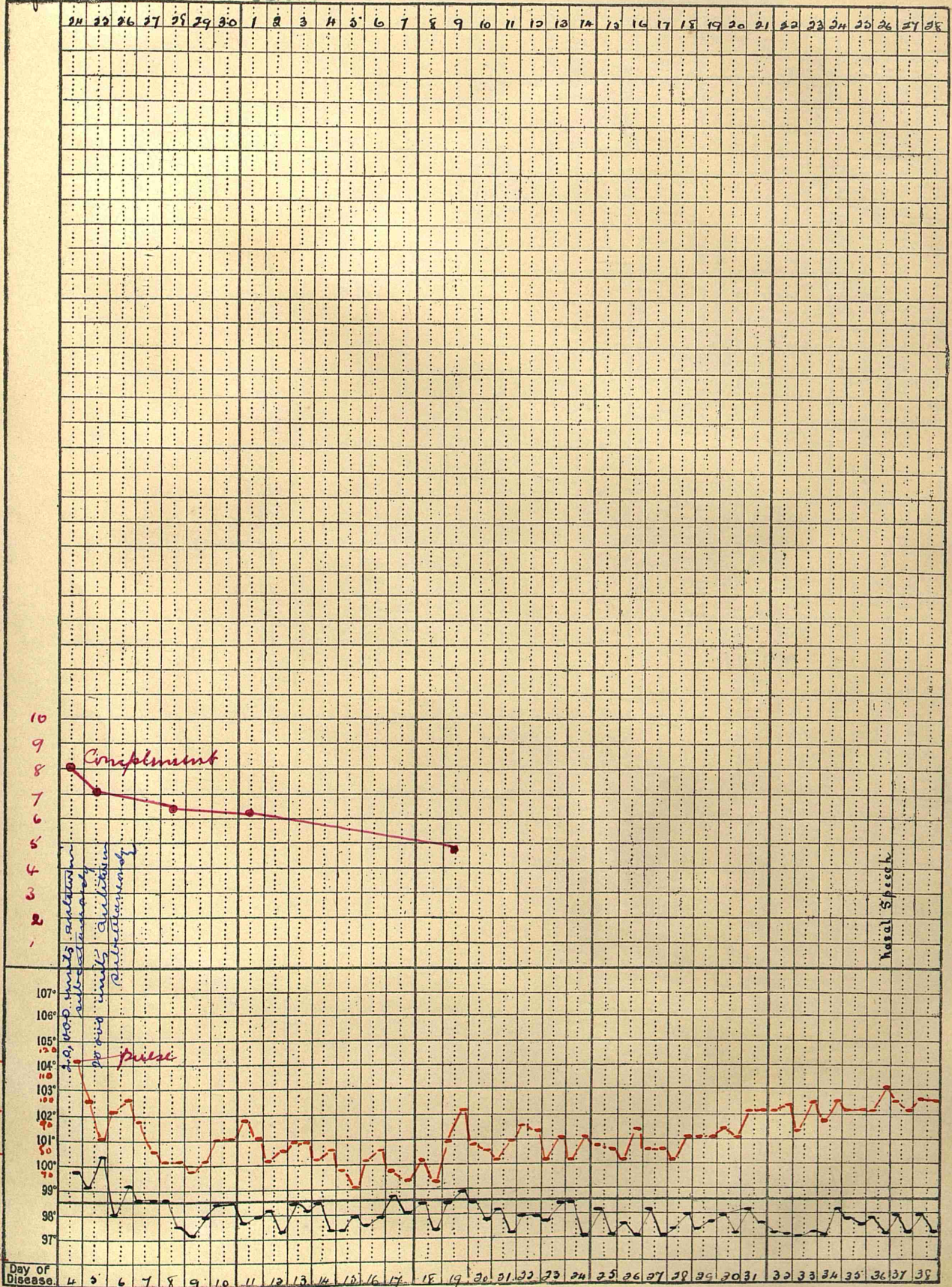
9. 11



Chart XVI

Sept.

6 Chole,



Agnew

31 yrs

9. 11

45,000



Chart XVII

Chart XVII

17a

January

February

branch

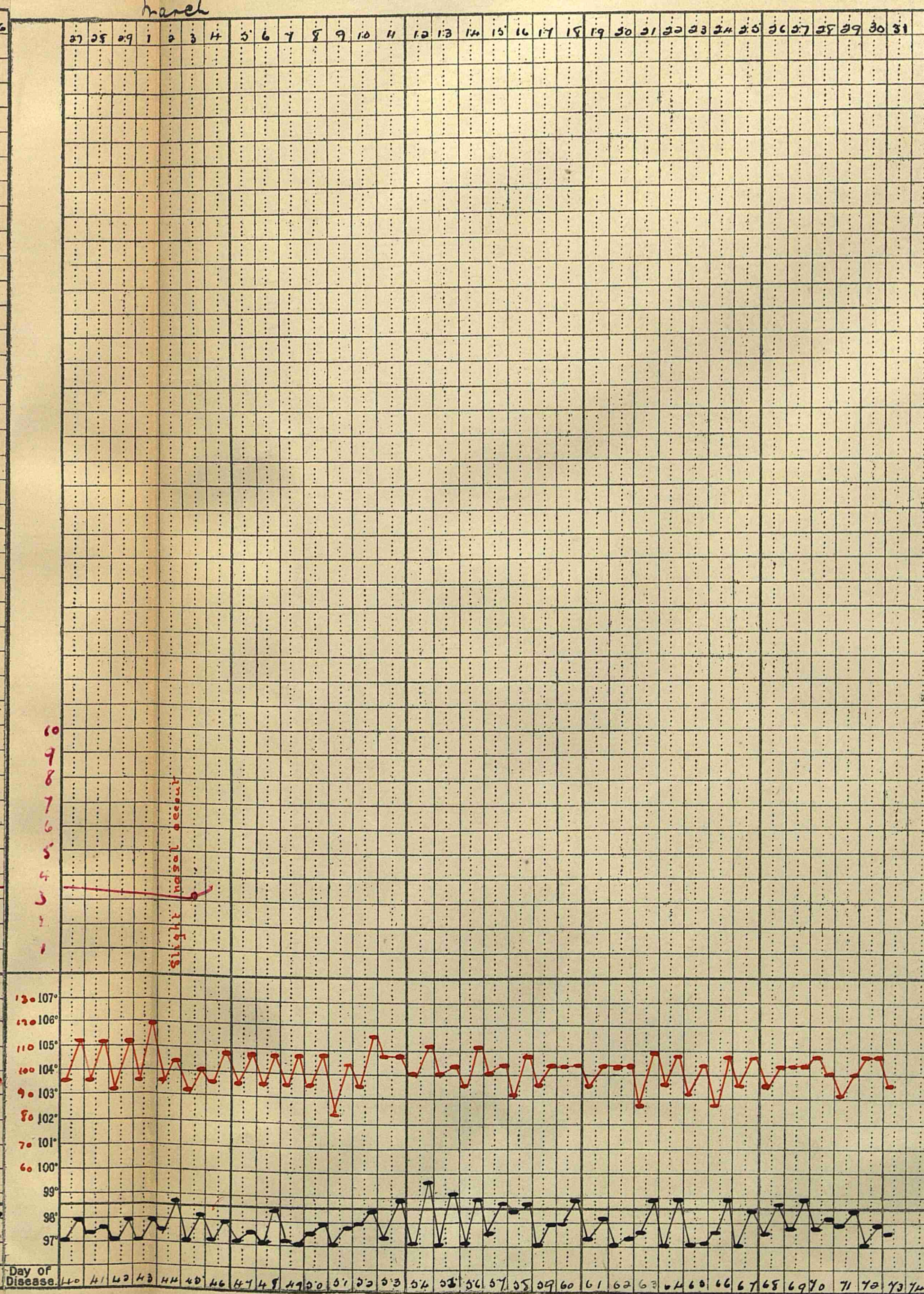
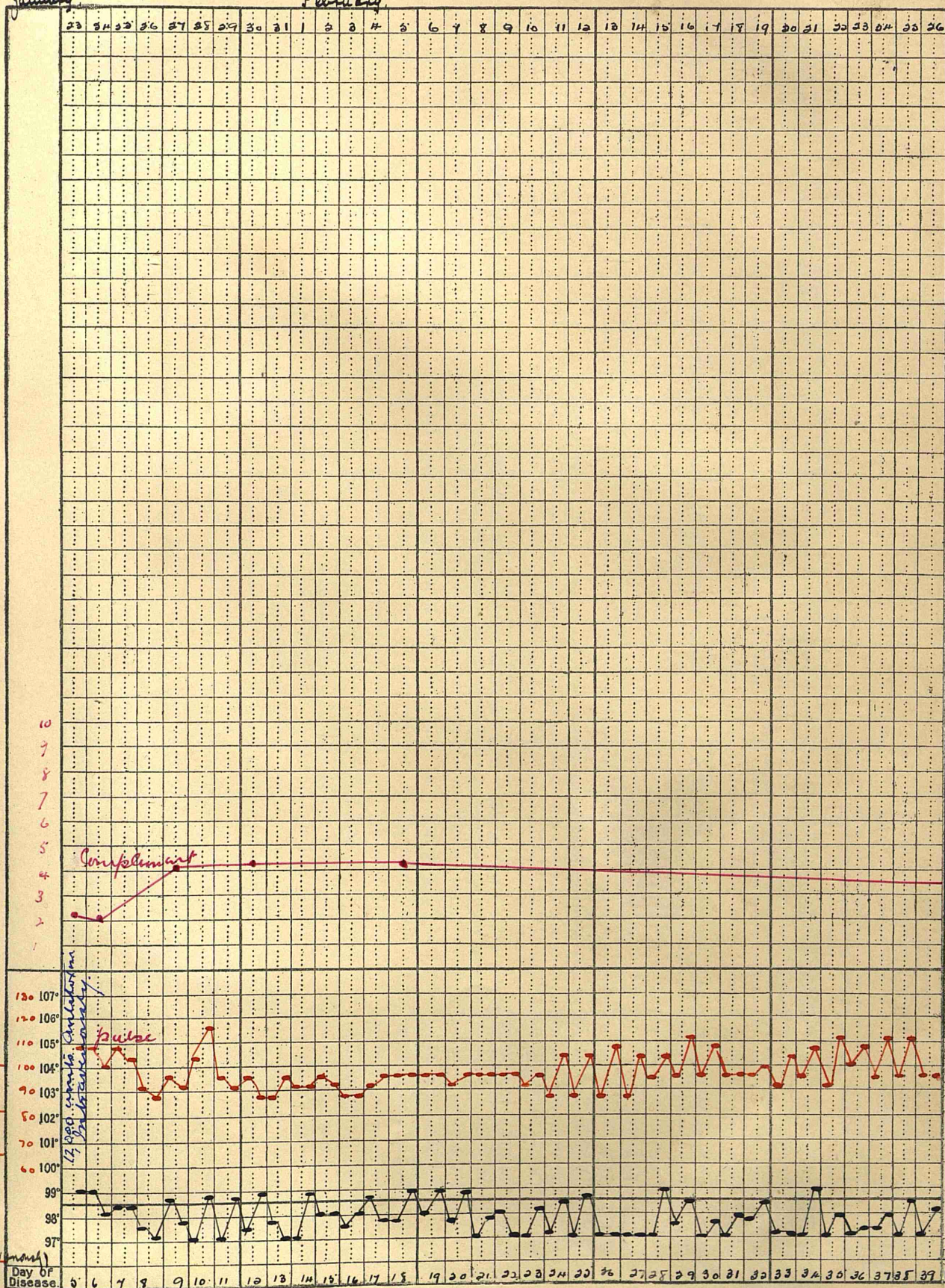
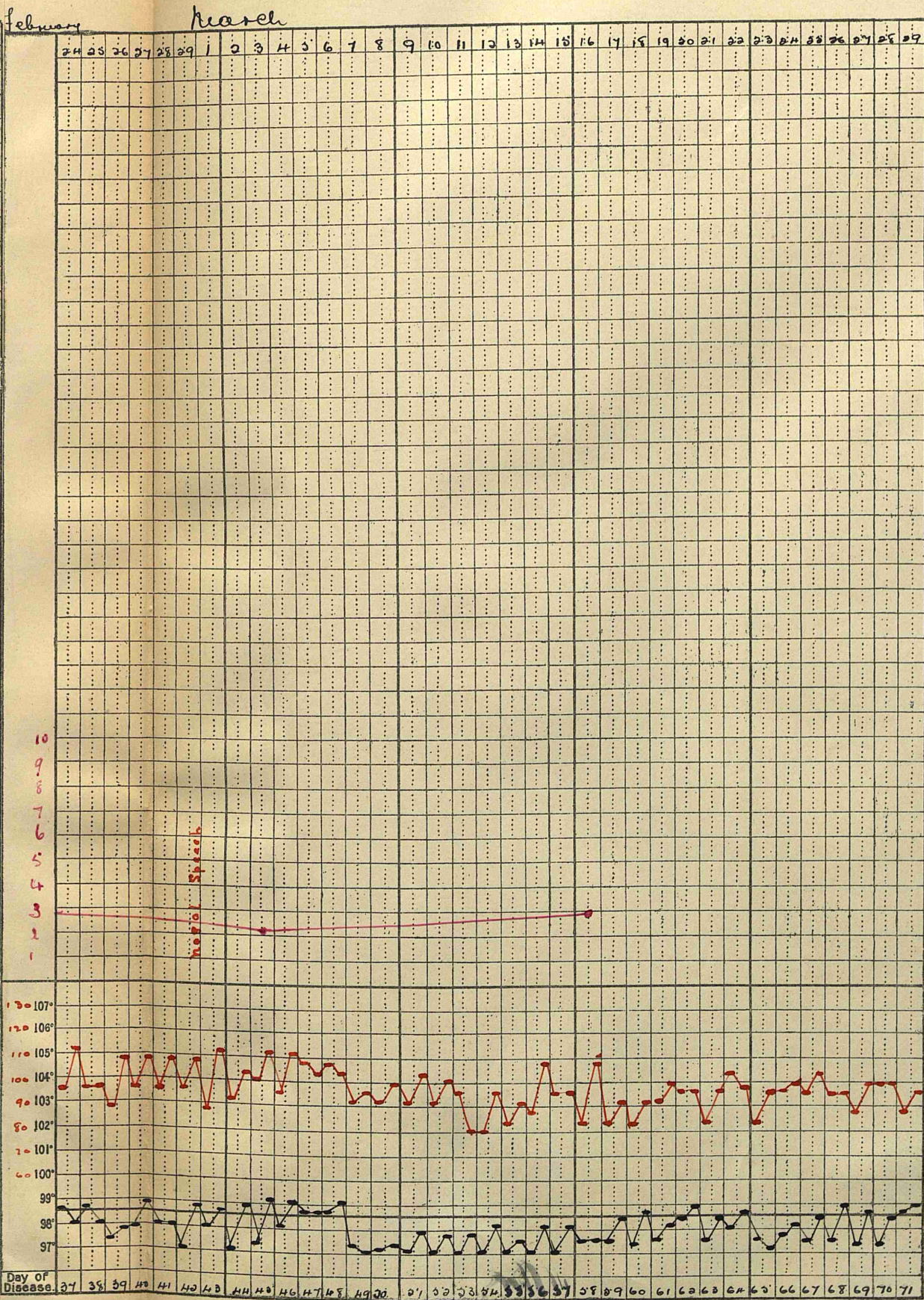
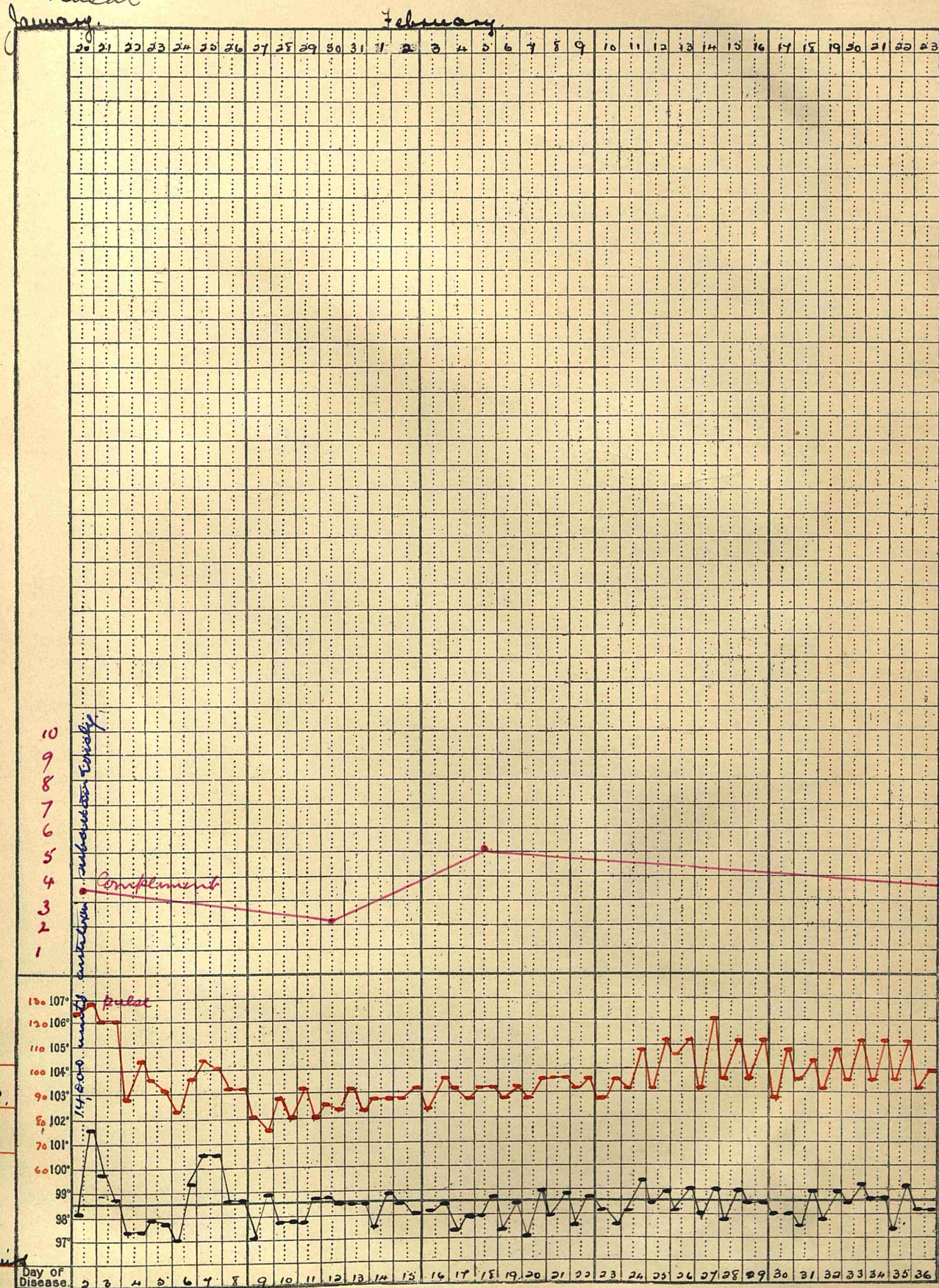




Chart XVIII  
Tarsal Diphtheria.  
and  
nasal

18a

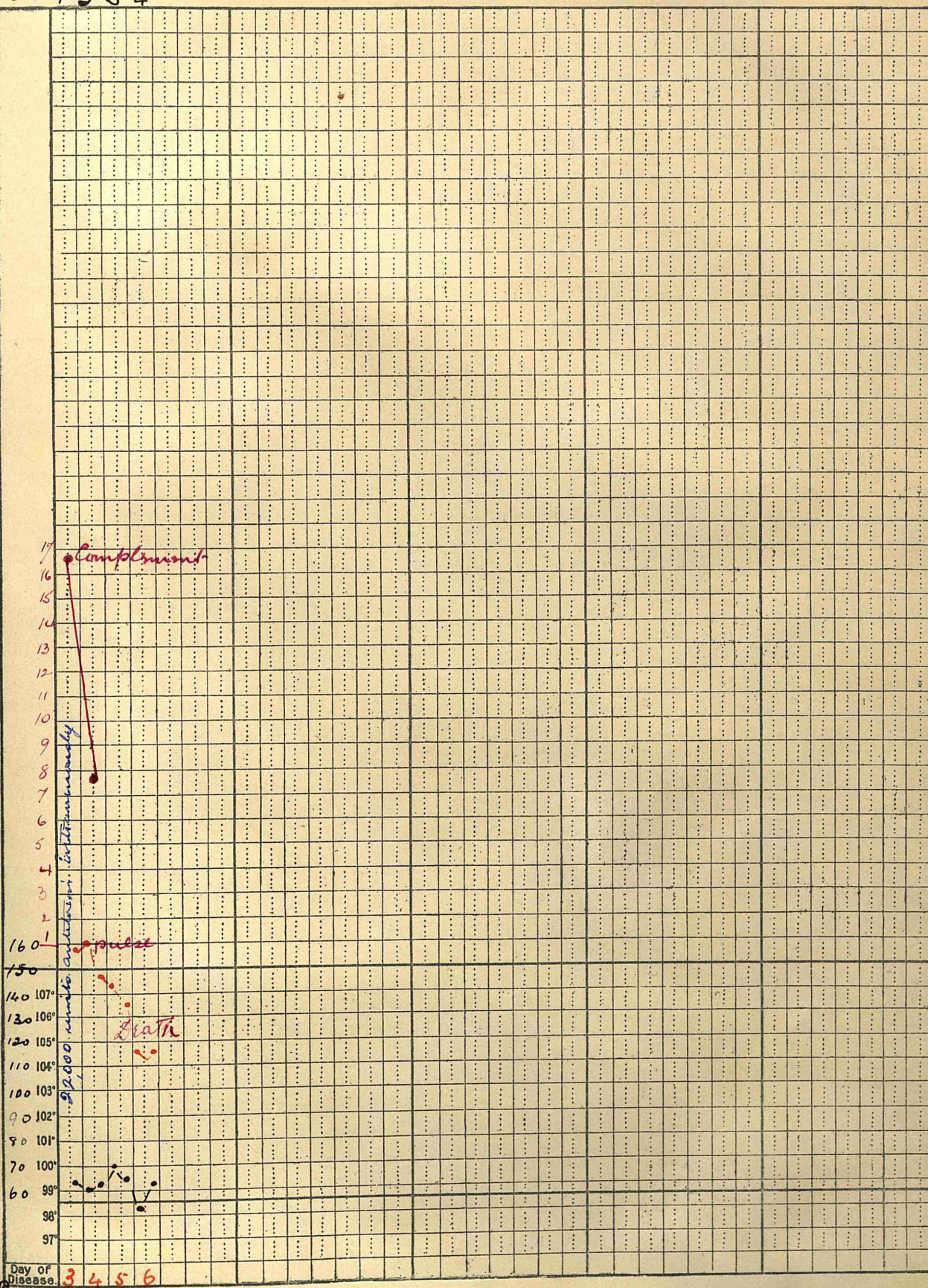




Malignant.  
 faucial and nasal  
 Diphtheria.

Chart XIX.

Feb. 1 2 3 4



ing  
Wallace  
to  
Years.  
not  
2. 12  
to units L.V.S.  
unanimously



# Faucal and nasal Diphtheria. Chart XX.

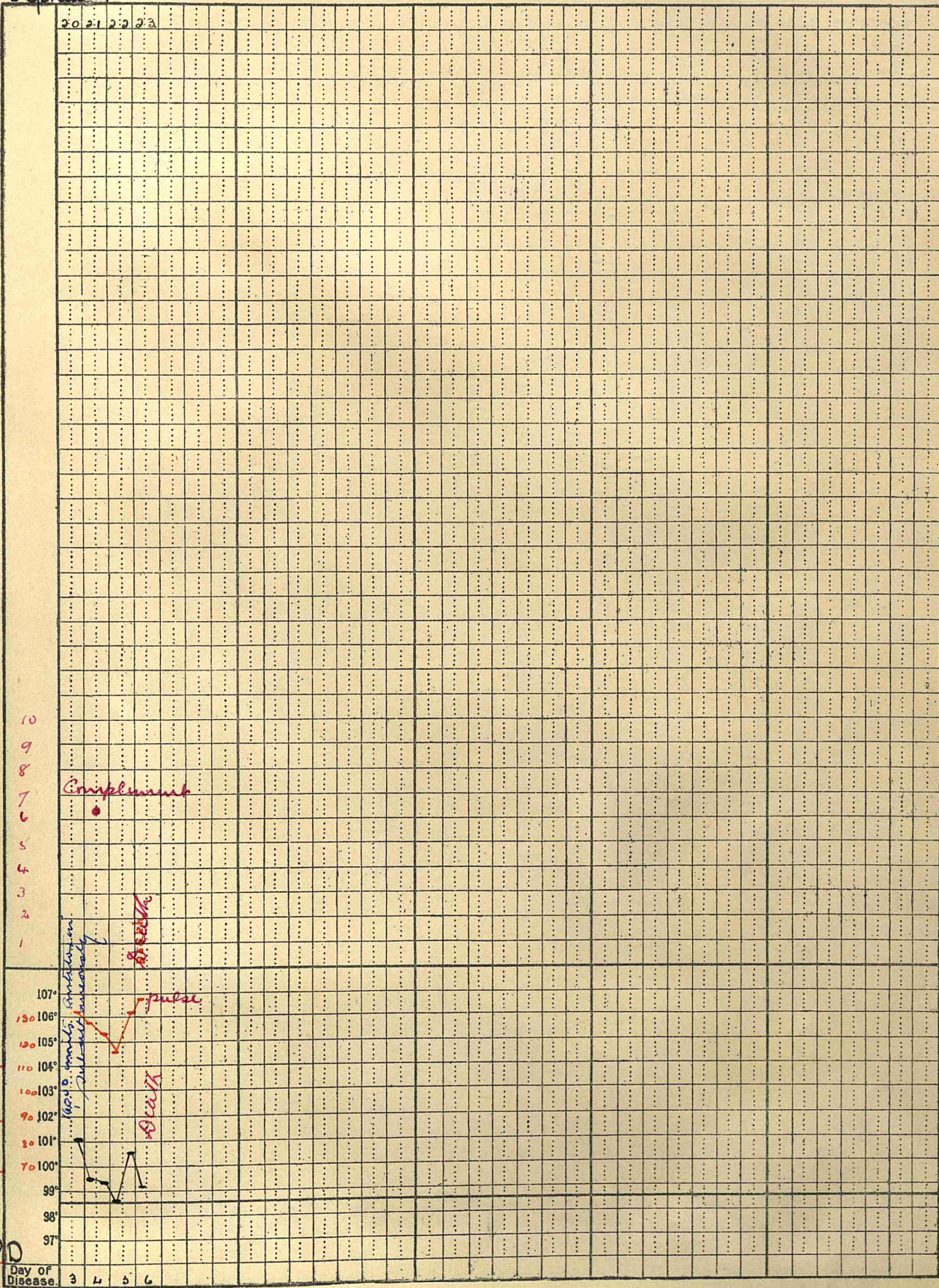
September.

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

107  
130 106  
100 105  
110 104  
100 103  
90 102  
80 101  
70 100  
99  
98  
97

6 yrs.  
9. 10

10000 units P.D.

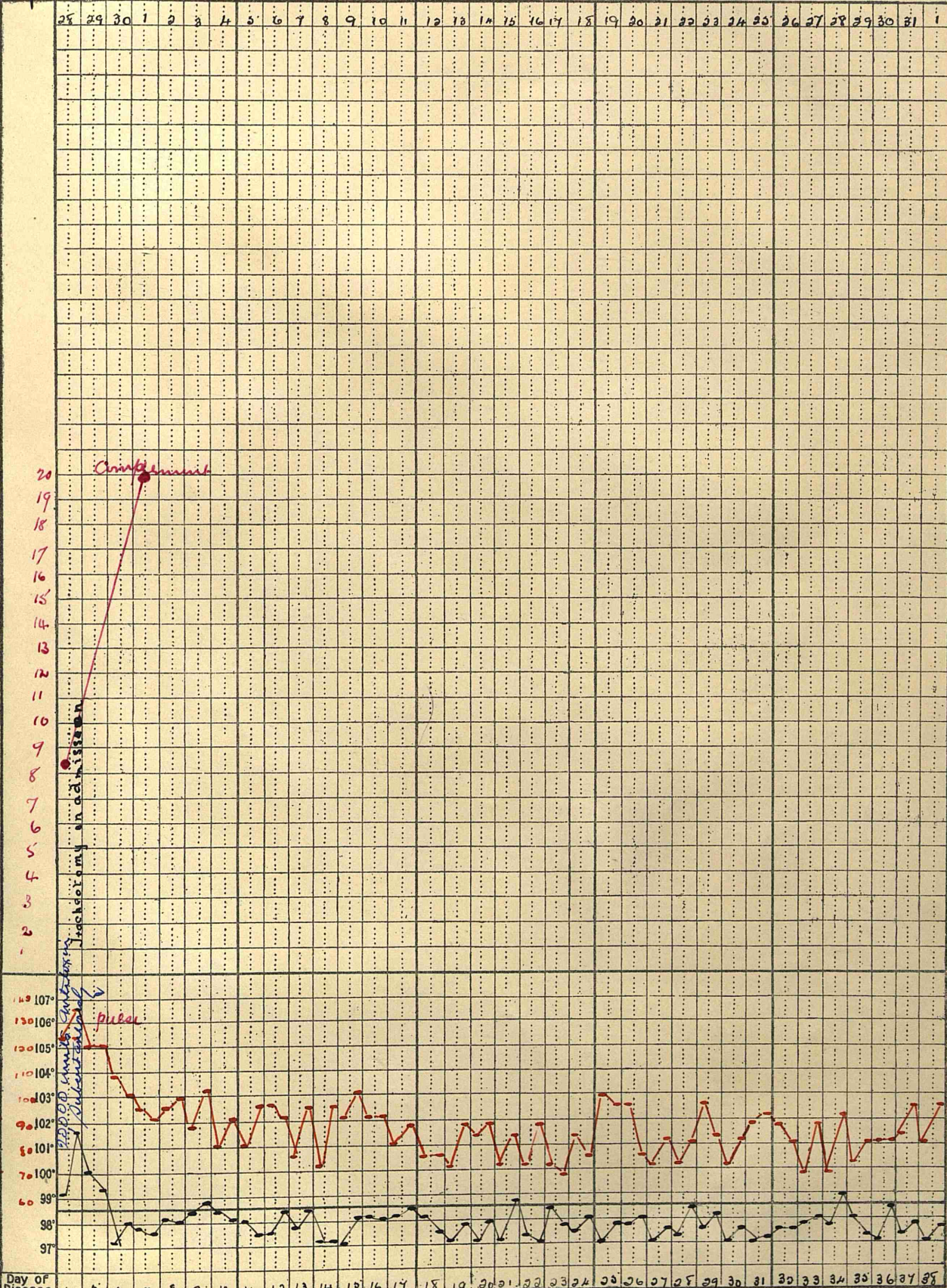




# Laryngeal and Tracheal Stenosis Chart ~~XVII~~ XXI

Sept.

October.



and black

6 yrs

11

20000 units



# Chart XXII.

1912

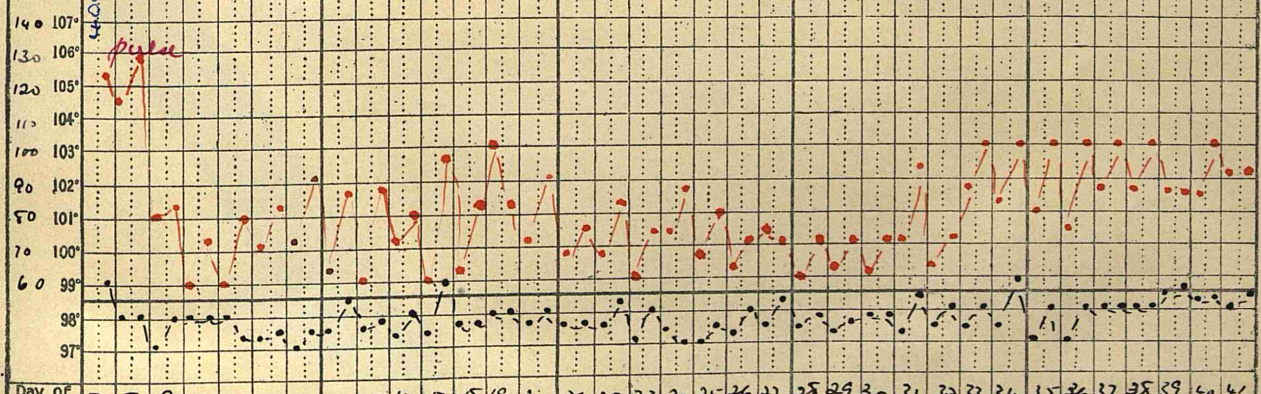
Feb

Jan 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 Feb 1 2 3 4 5 6 7

Complement

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

Pulse



Day of Disease 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 38 39 40 41

Initial  
and  
myocard  
phthisis.  
  
5 1/2 years  
to 1912.  
  
to sum 5.13



**SECTION D - SCARLET FEVER**

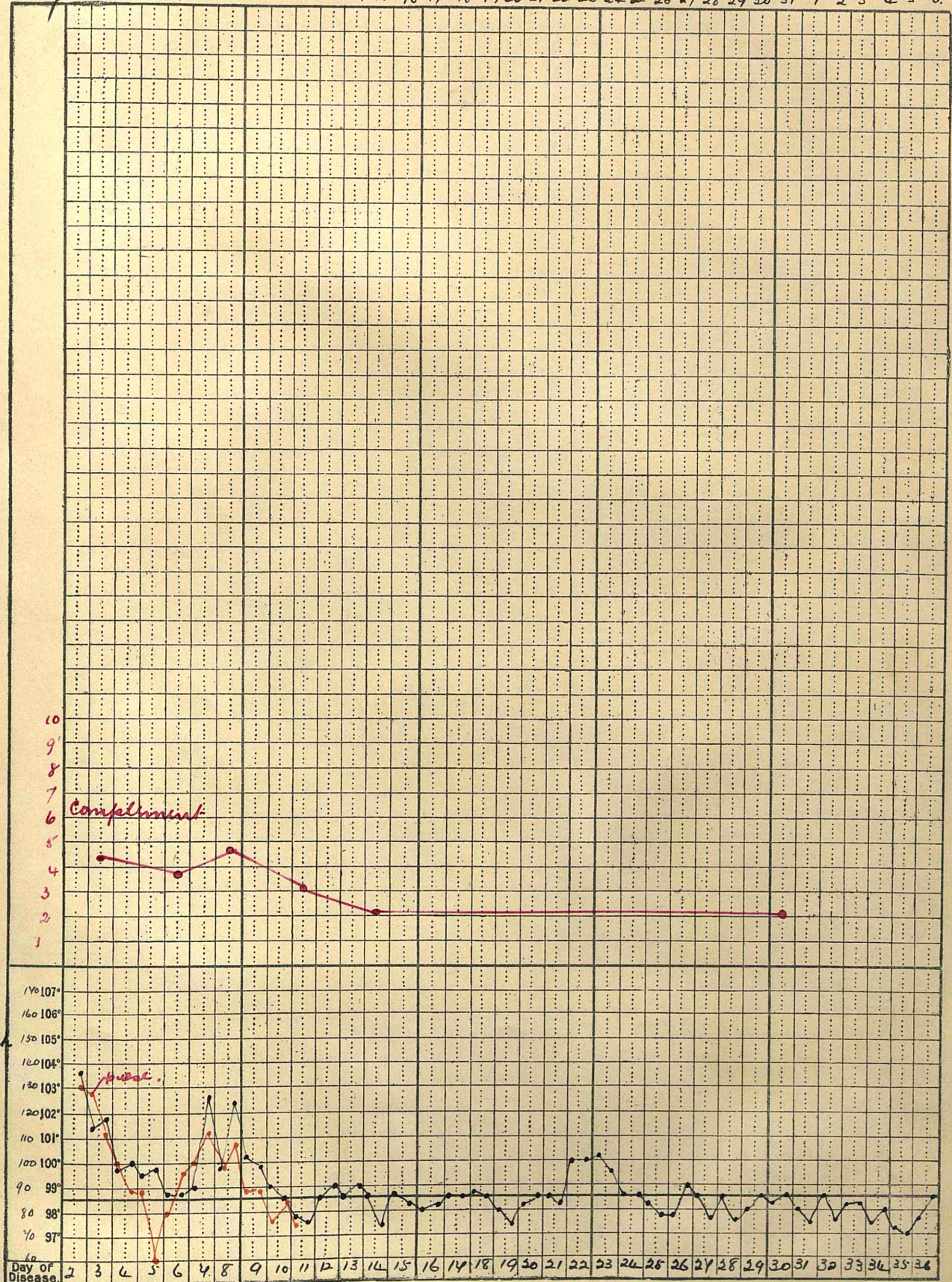
-----



Scarlet Fever.

Chart I.

January 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 February 1 2 3 4 5 6.



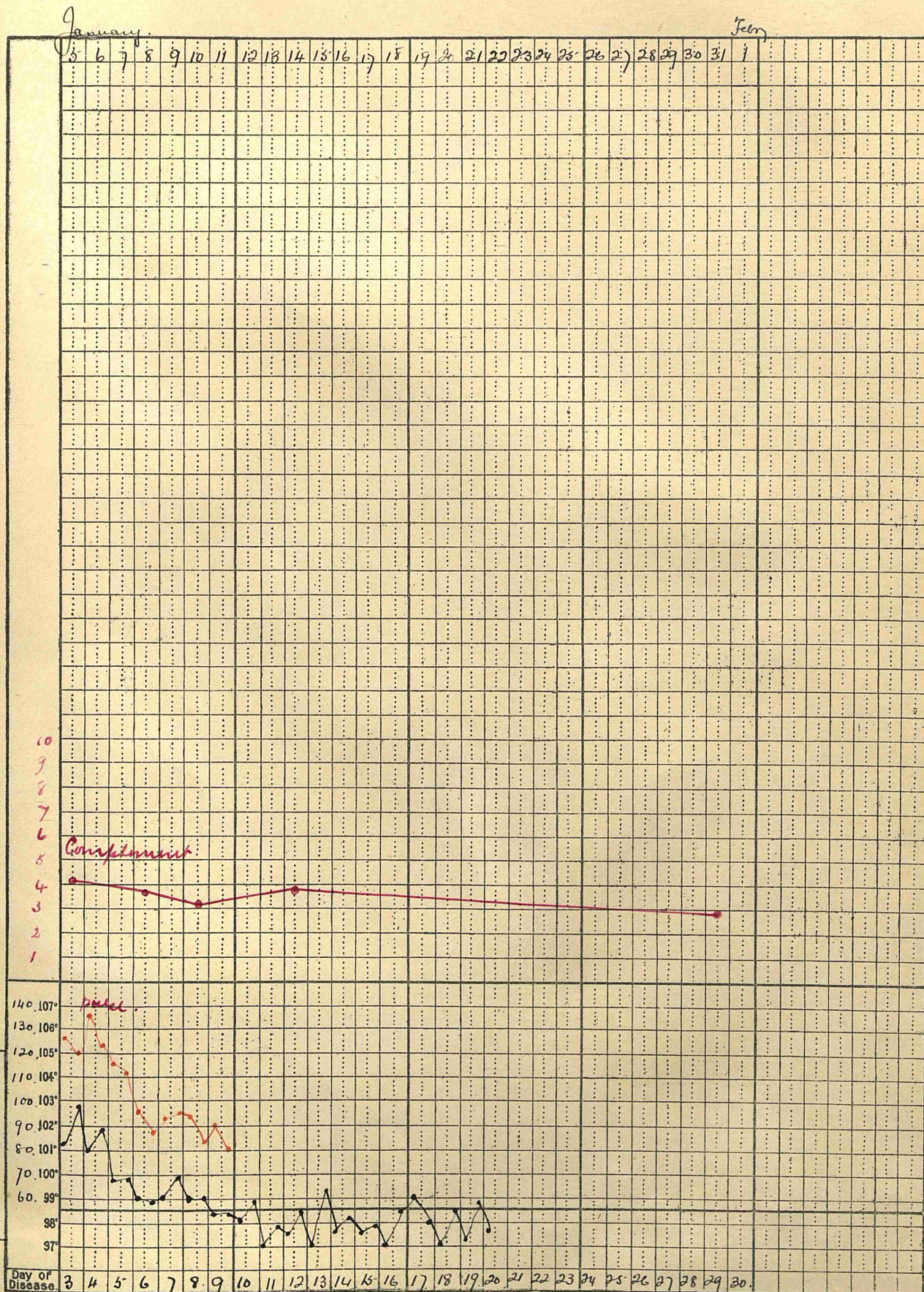
10 yrs.  
3<sup>10</sup> = 1912.



Scarlet F. wa 13.

Scarlet Fever.

Chart ii.



Daily.

Det 9 years.

5-1-12.

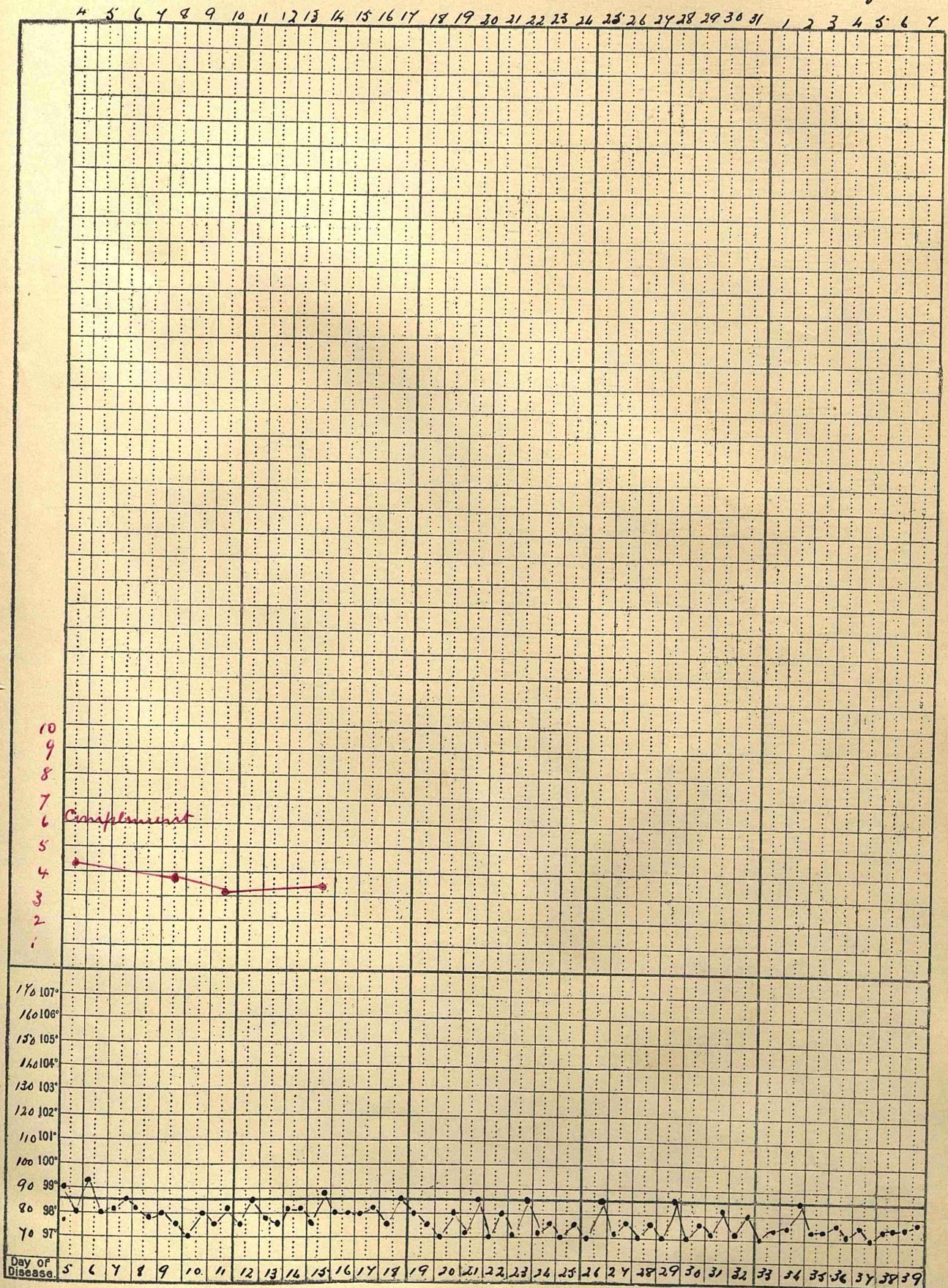


January.

Scarlet Fever.

Chart <sup>111</sup>  
181.

February.



John Kerr.

Age 7 yrs.

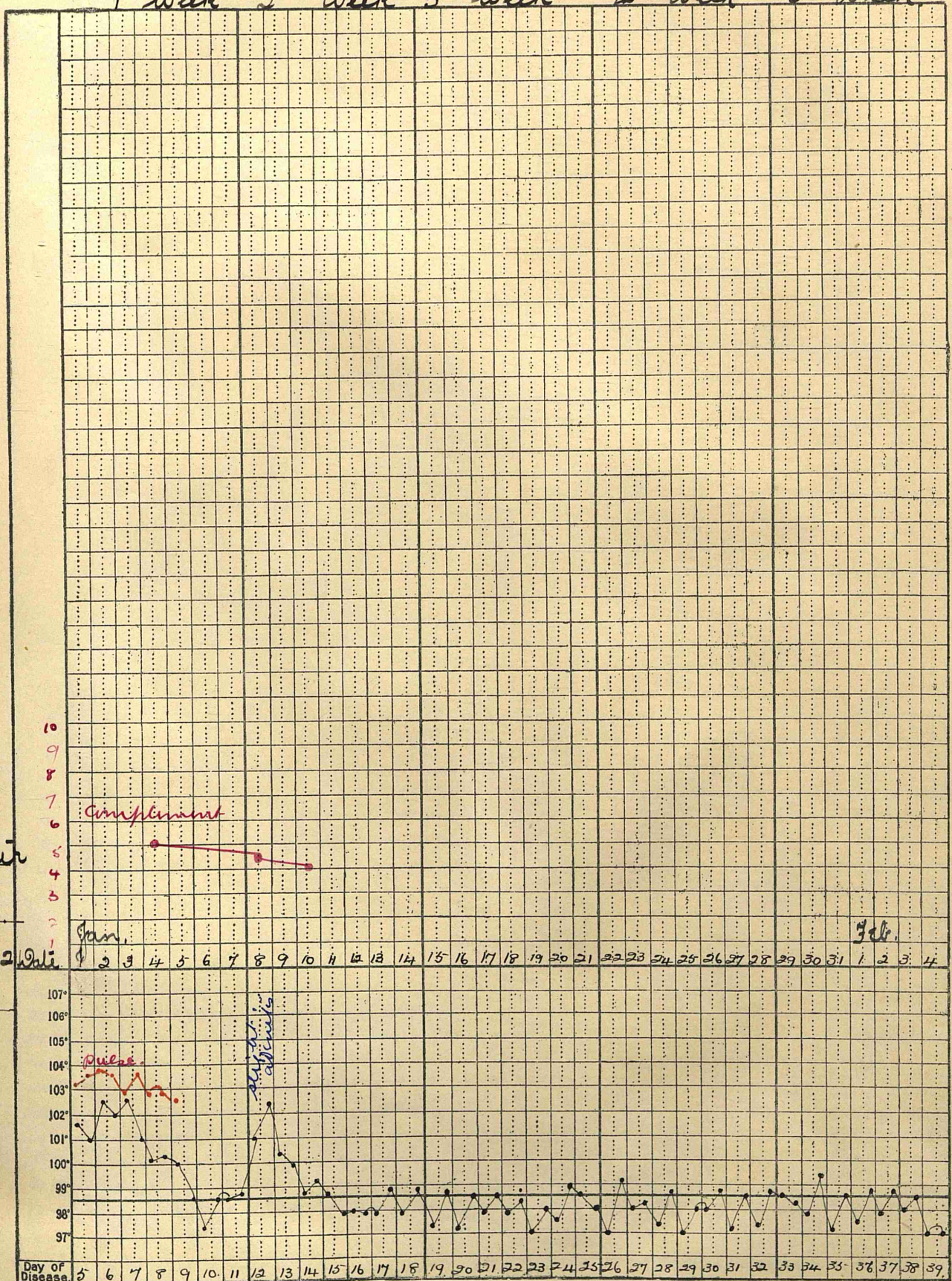
No. 1, 12.



Scarlet Fever.

Chart IV.

1<sup>st</sup> Week 2<sup>nd</sup> Week 3<sup>rd</sup> Week 4<sup>th</sup> Week 5<sup>th</sup> Week



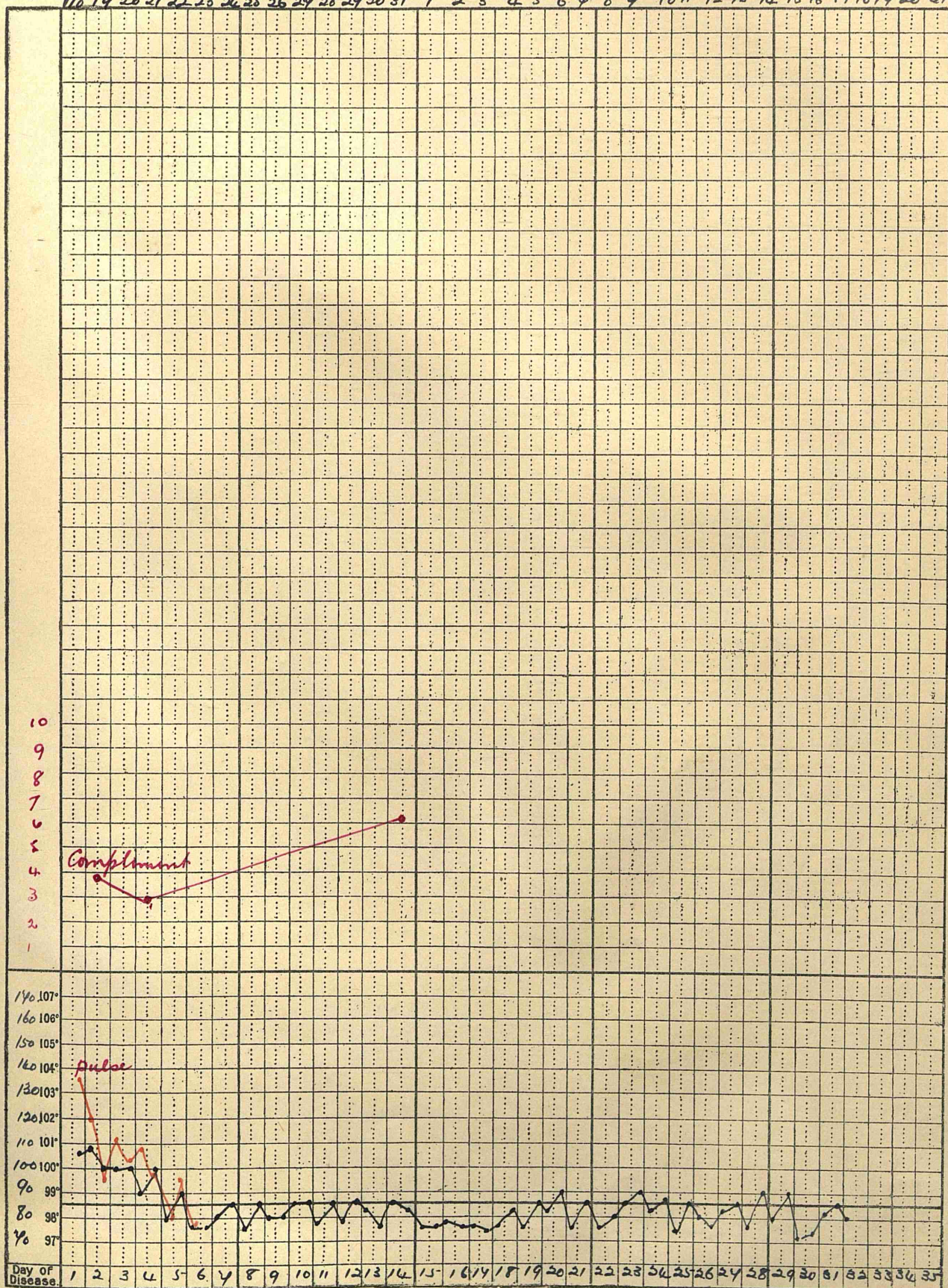


Scarlet Fever. Chart ~~IV~~ V.

January

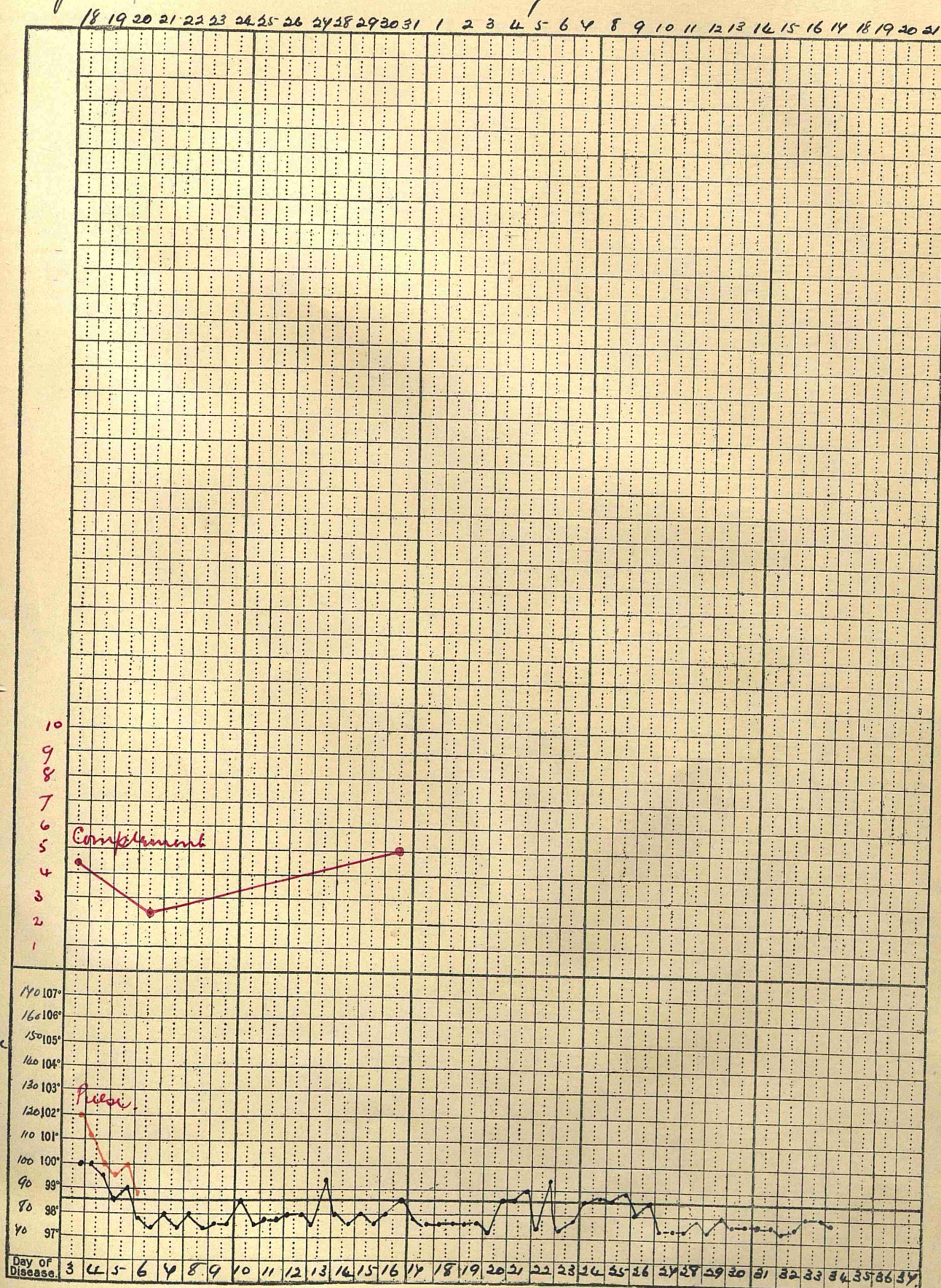
February

18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21





January  
 Scarlet Fever.  
 Chart ~~III~~ <sup>VI</sup>  
 February



H. B. Wilson  
 Page 6 of 12  
 18. 1. 12.

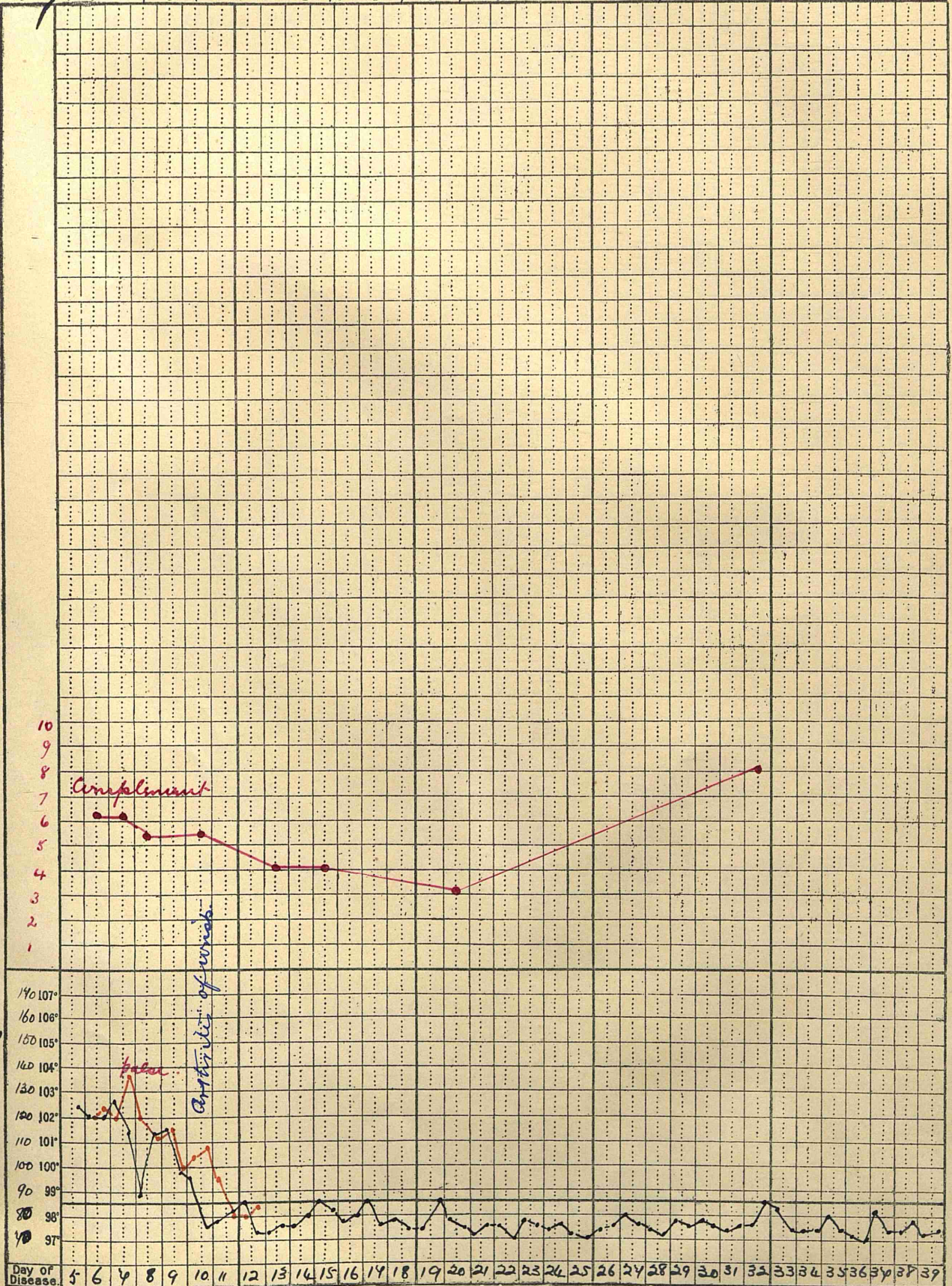


Scarlet Fever.

Case VII.

February

January 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 1 2 3 4 5 6 7



David Douglas  
Age 43 yrs.  
Ad. L. 1. 12.



S.I. ward 13.

Scarlet Fever. Chart 111

January

February

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

Chills

140 107°  
130 106°  
120 105°  
110 104°  
100 103°  
90 102°  
80 101°  
70 100°  
60 99°  
50 98°  
40 97°

Diarrhea

Anderson.  
10 years old.  
Jan 14-1-12.

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



# Tubercular disease of skin.

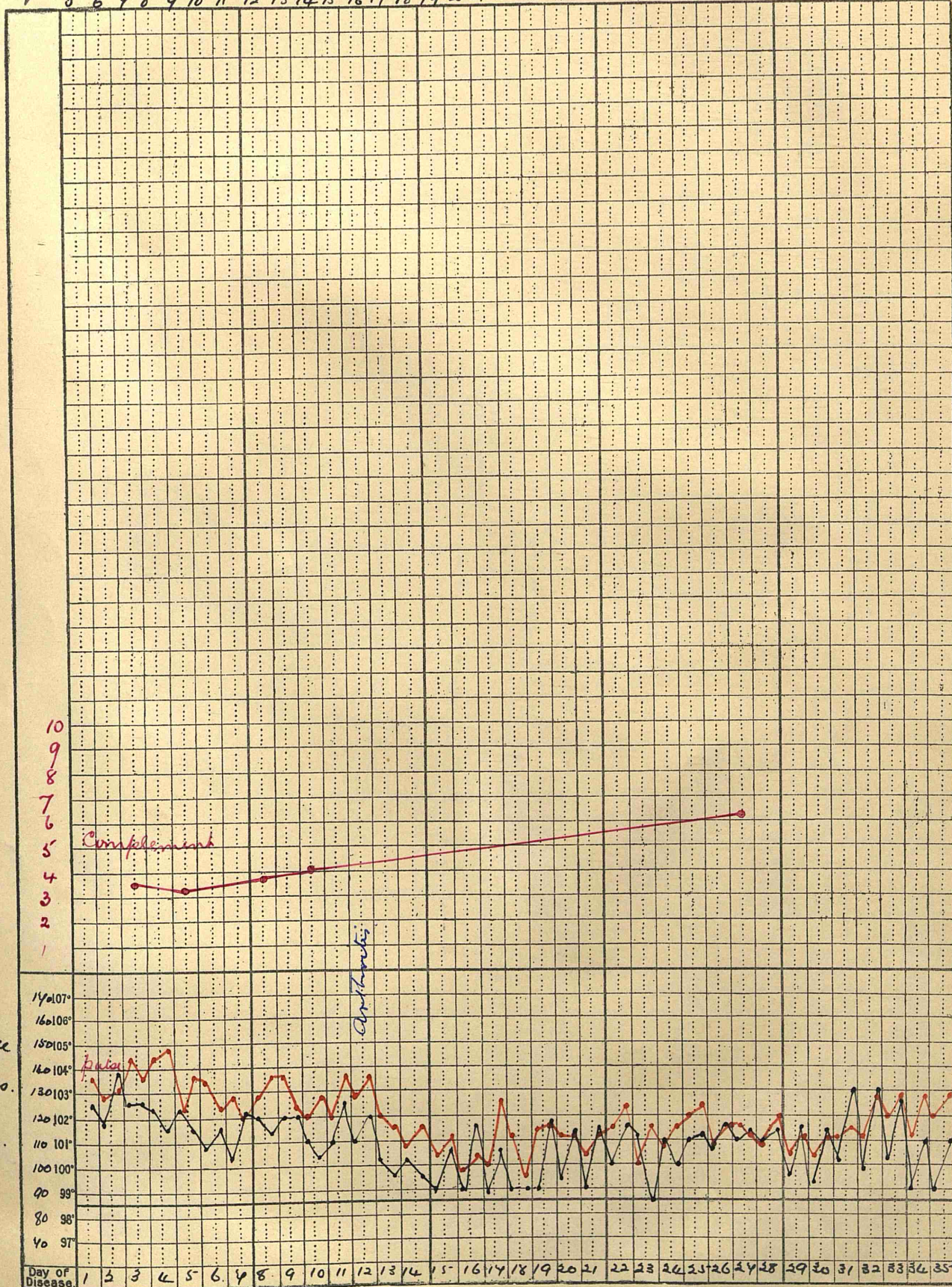
Scarlet Fever

Chart ~~VII~~ IX

February

January.

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 1 2 3 4 5 6 7 8



ward 9.

Scarlet Fever

Ward Queen

Age 12 yrs.

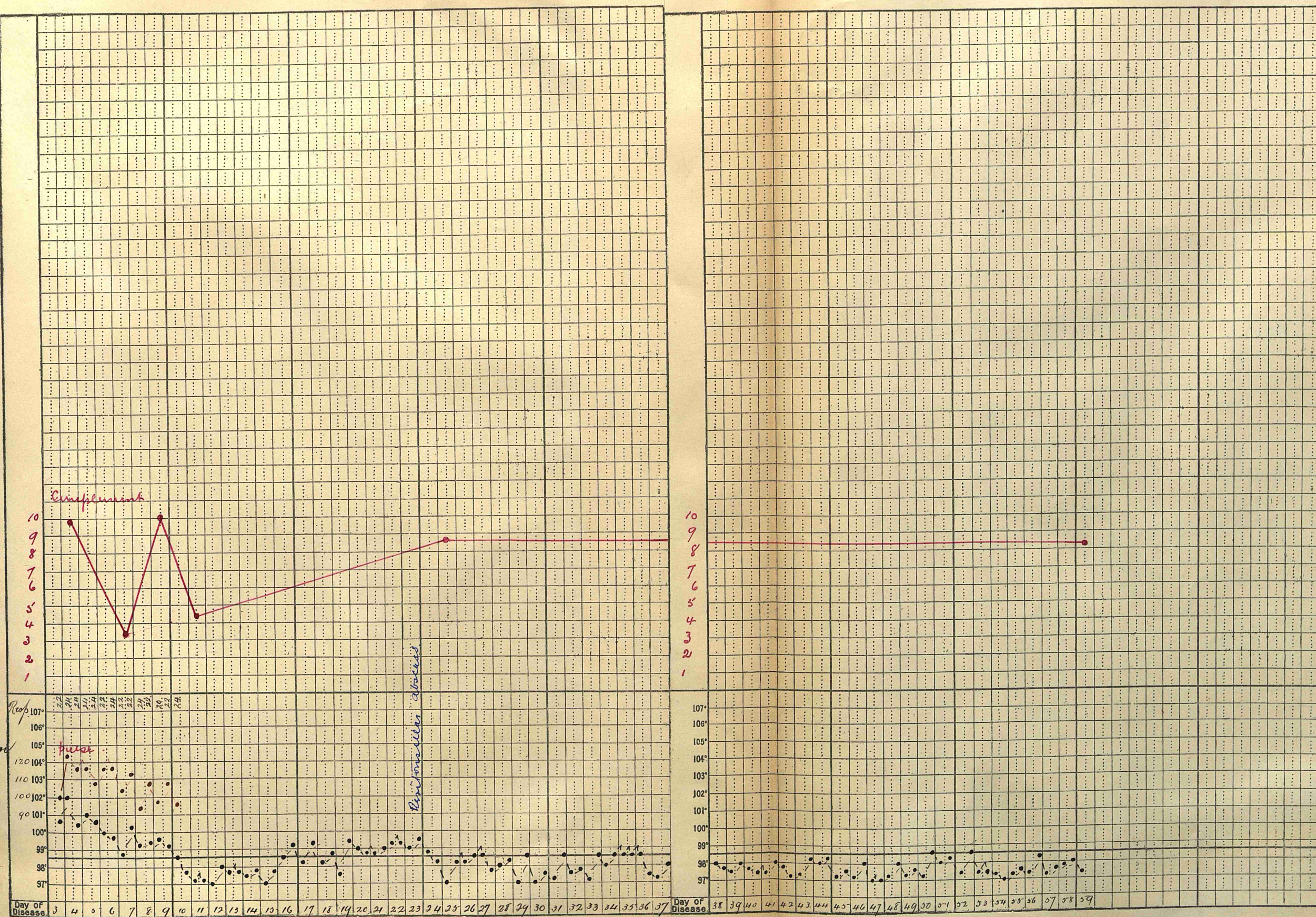
Ad. 5: 1: 12.



Scarlet Fever.

Case No.

10a



Davidson

27/4/00

Ward 14



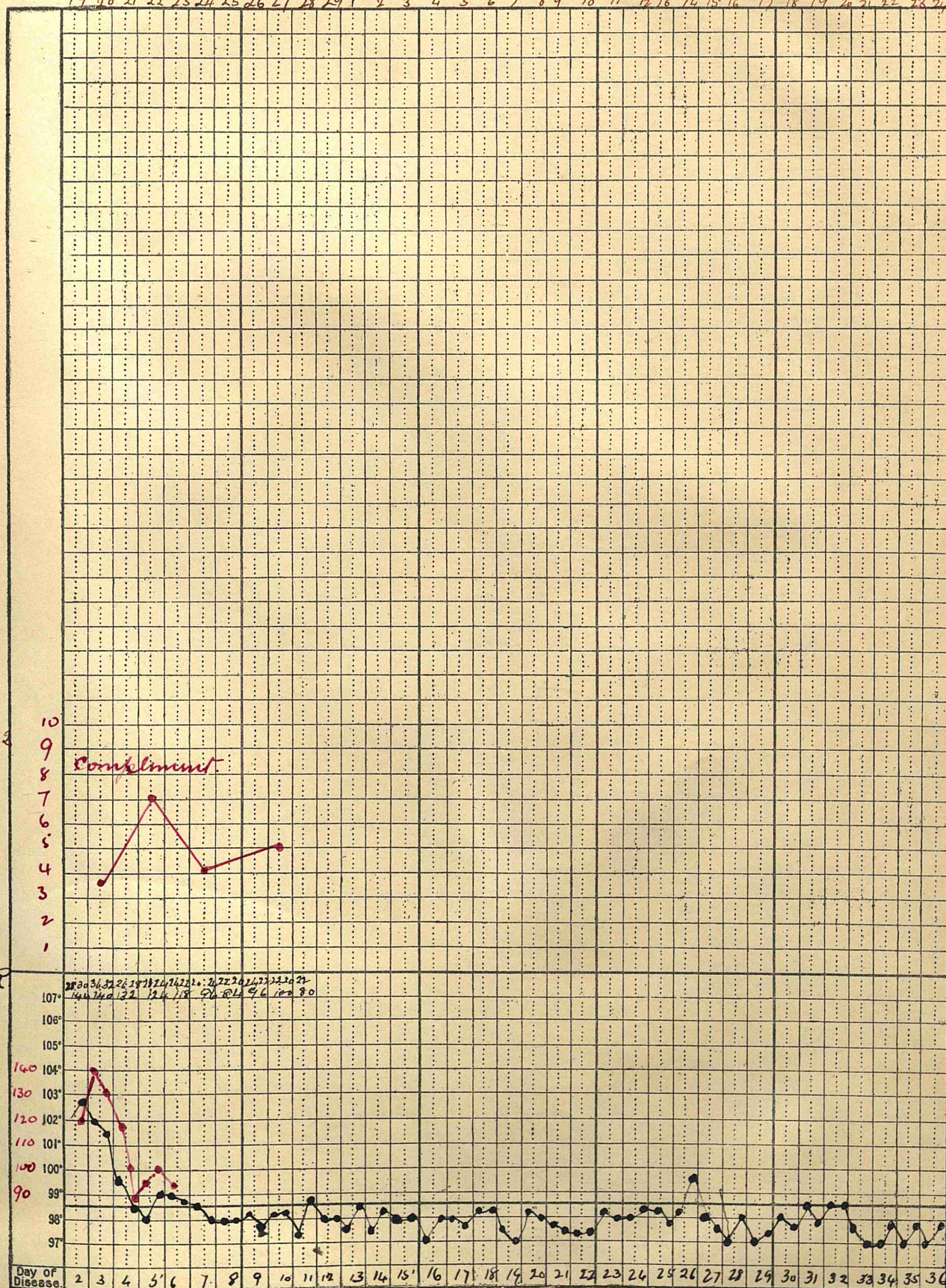
Scarlet Fever.

Chart XI

Feb. 12

March

19<sup>6</sup> 20 21 22 23 24 25 26 27 28 29 1<sup>st</sup> 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24



Heming

12 years

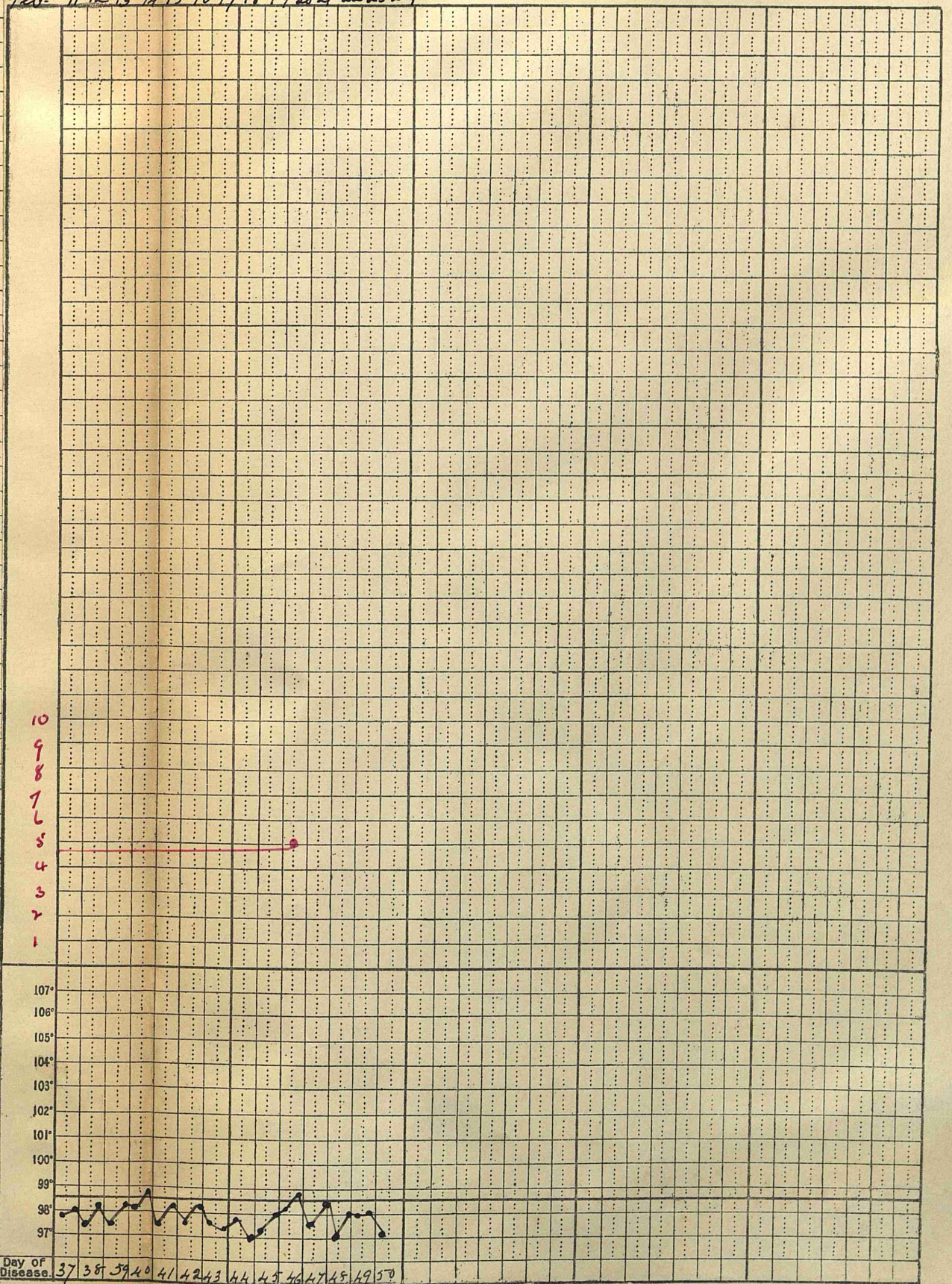
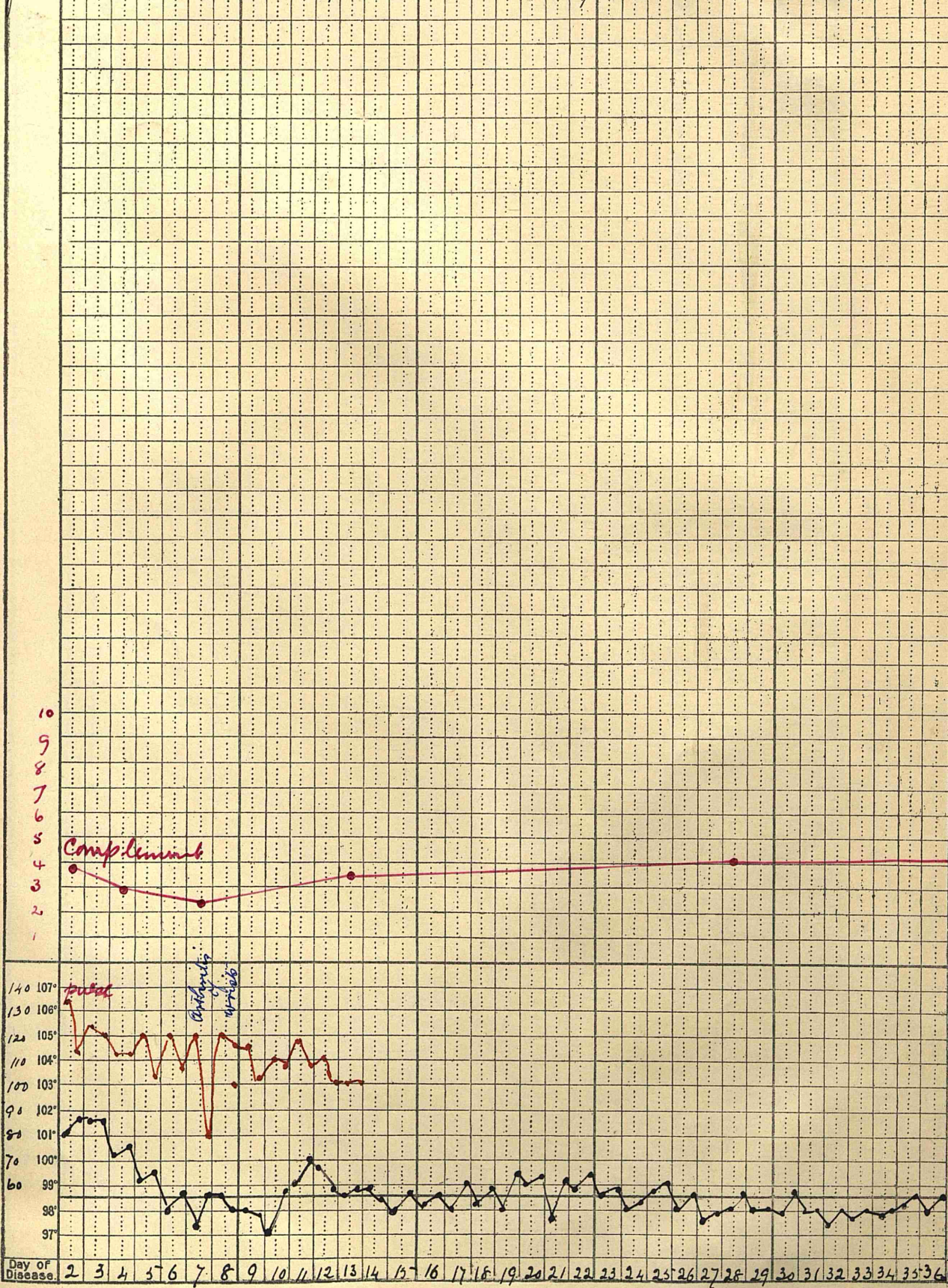
ad-19<sup>6</sup> 2-12



Scarlet fever and Chronic nephritis.  
Albuminuric Retinitis.

Jan 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 Feb 1 2 3 4 5 6 7 8 9 10

Feb 11 12 13 14 15 16 17 18 19 20 21 22 23 24



7-1-12



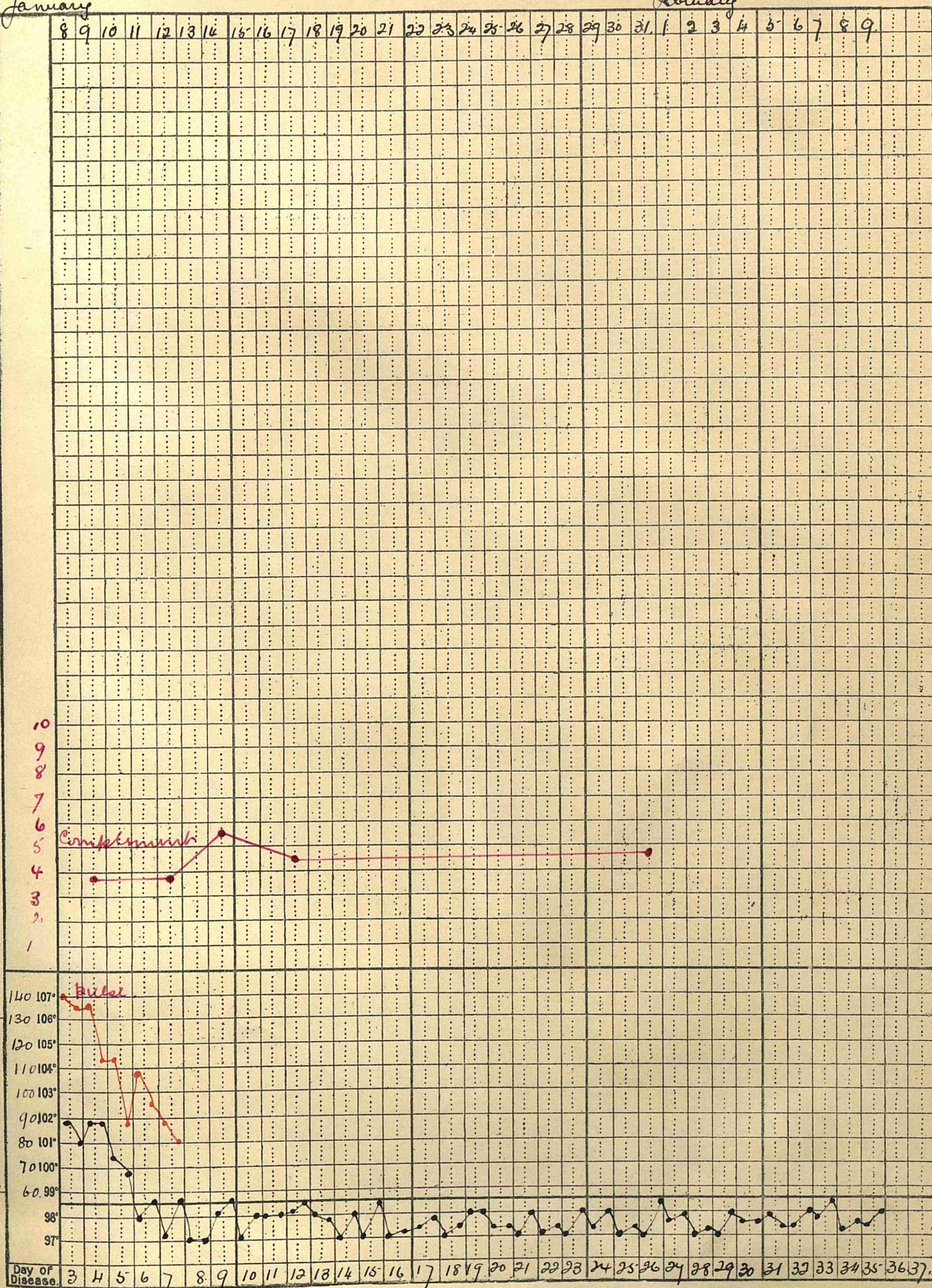
S. F. ward 13.

Chart XIII

Scarlet Fever.

January

February



Ellis.

8-1-12.



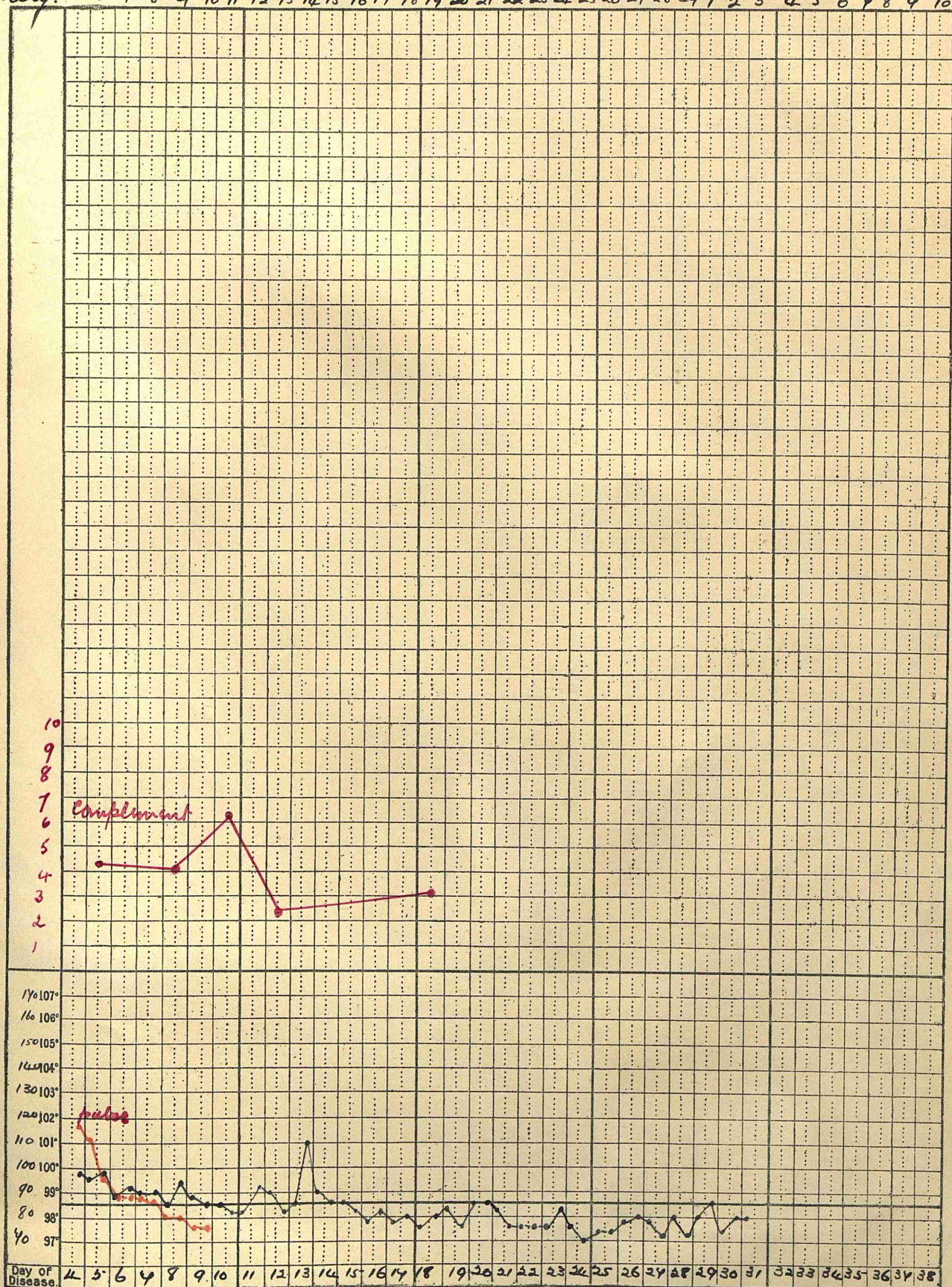
# Scarlet Fever.

Chart XIV

February.

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 1 2 3 4 5 6 7 8 9 10

March



Ross.  
age 10 yrs  
5:2. 12.



# Scarlet Fever. Chart XV

1<sup>st</sup> Week

2<sup>nd</sup> Week

3<sup>rd</sup> Week

4<sup>th</sup> Week

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

Conspicuous

Sep

Oct

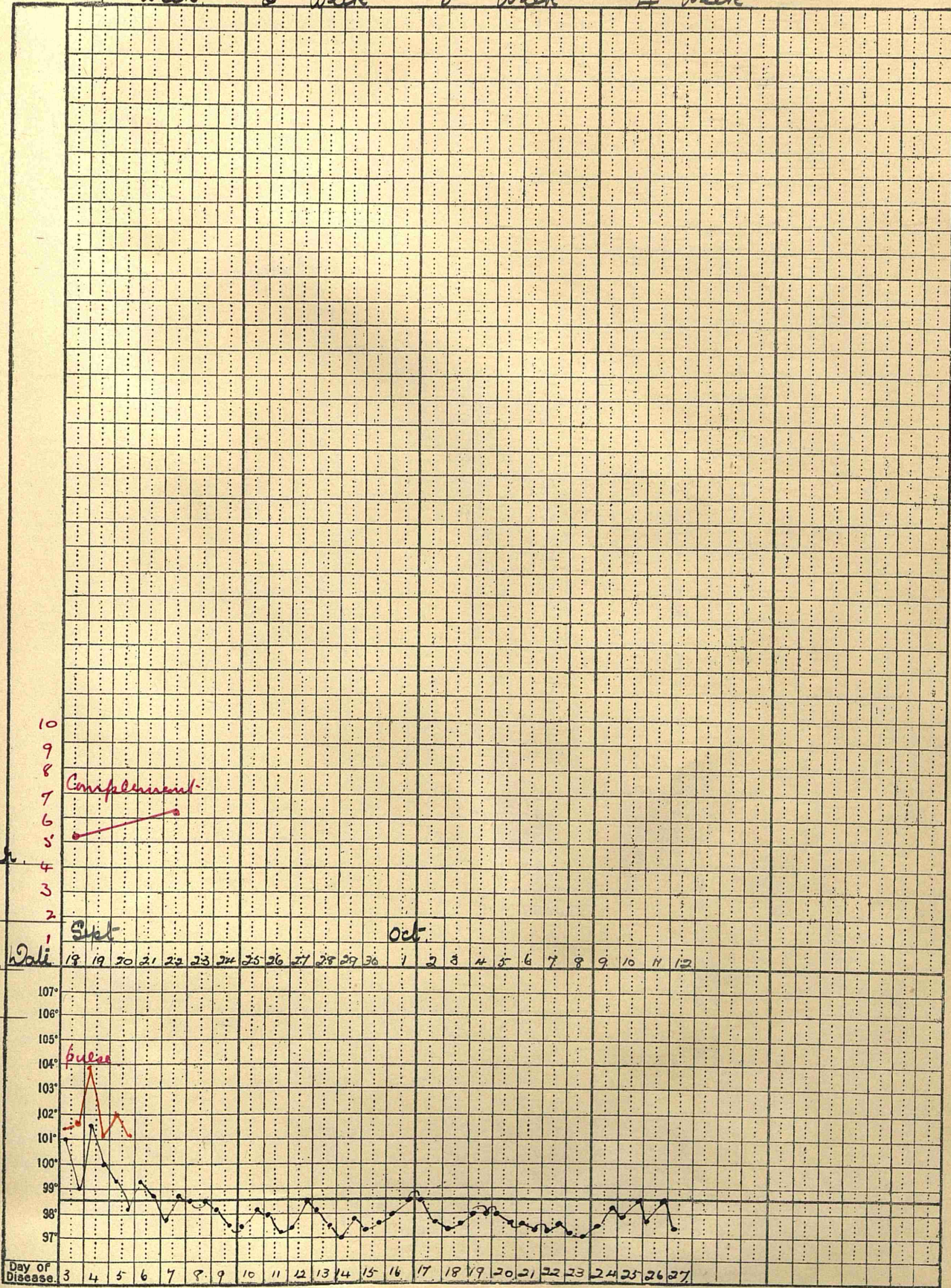
18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12

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

fever

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



Walker

9 yrs

18 9 11

16



S. I.

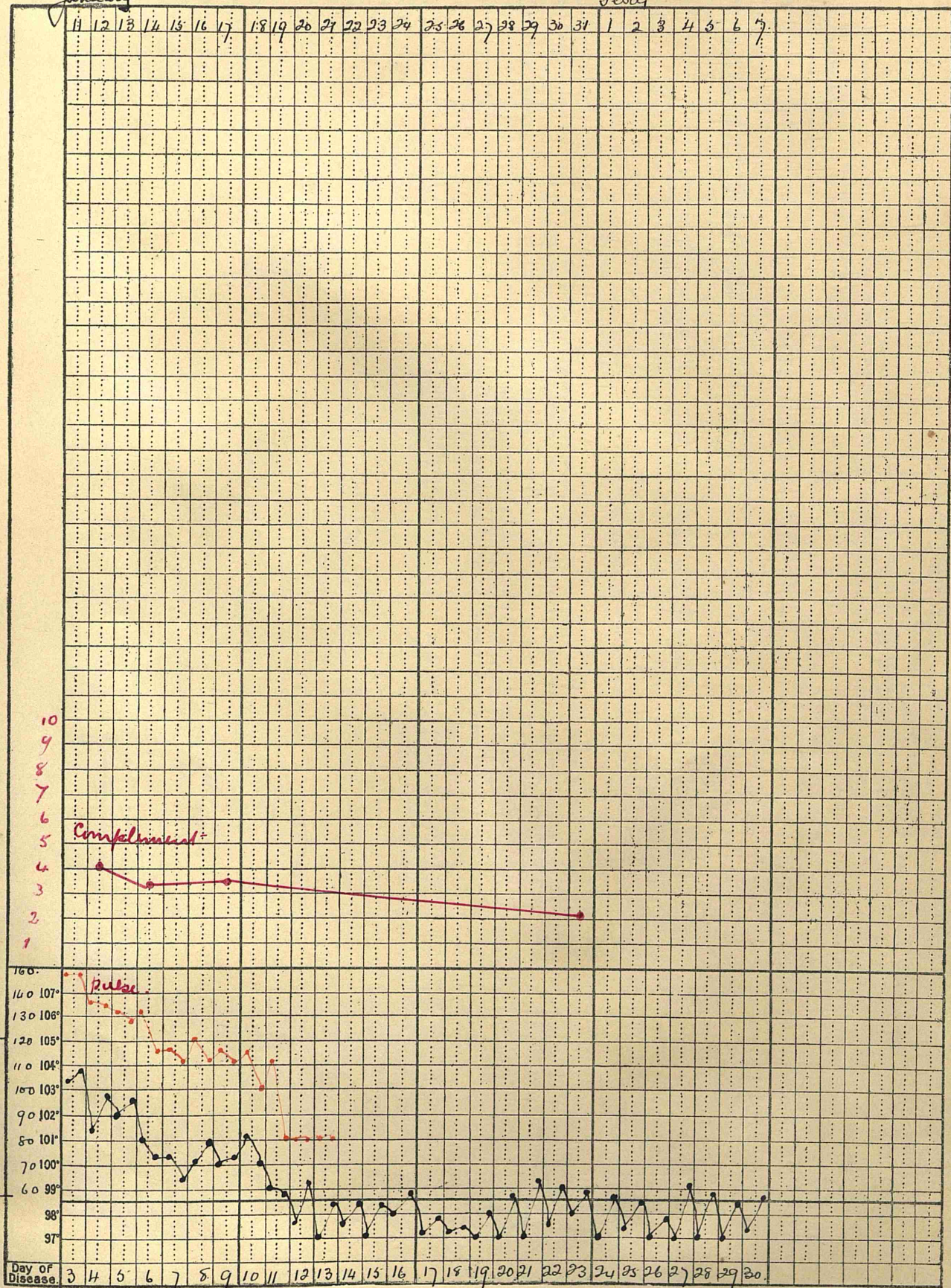
Ward 13.

Scarlet fever.

Chart XVI.

January

February



McLaren

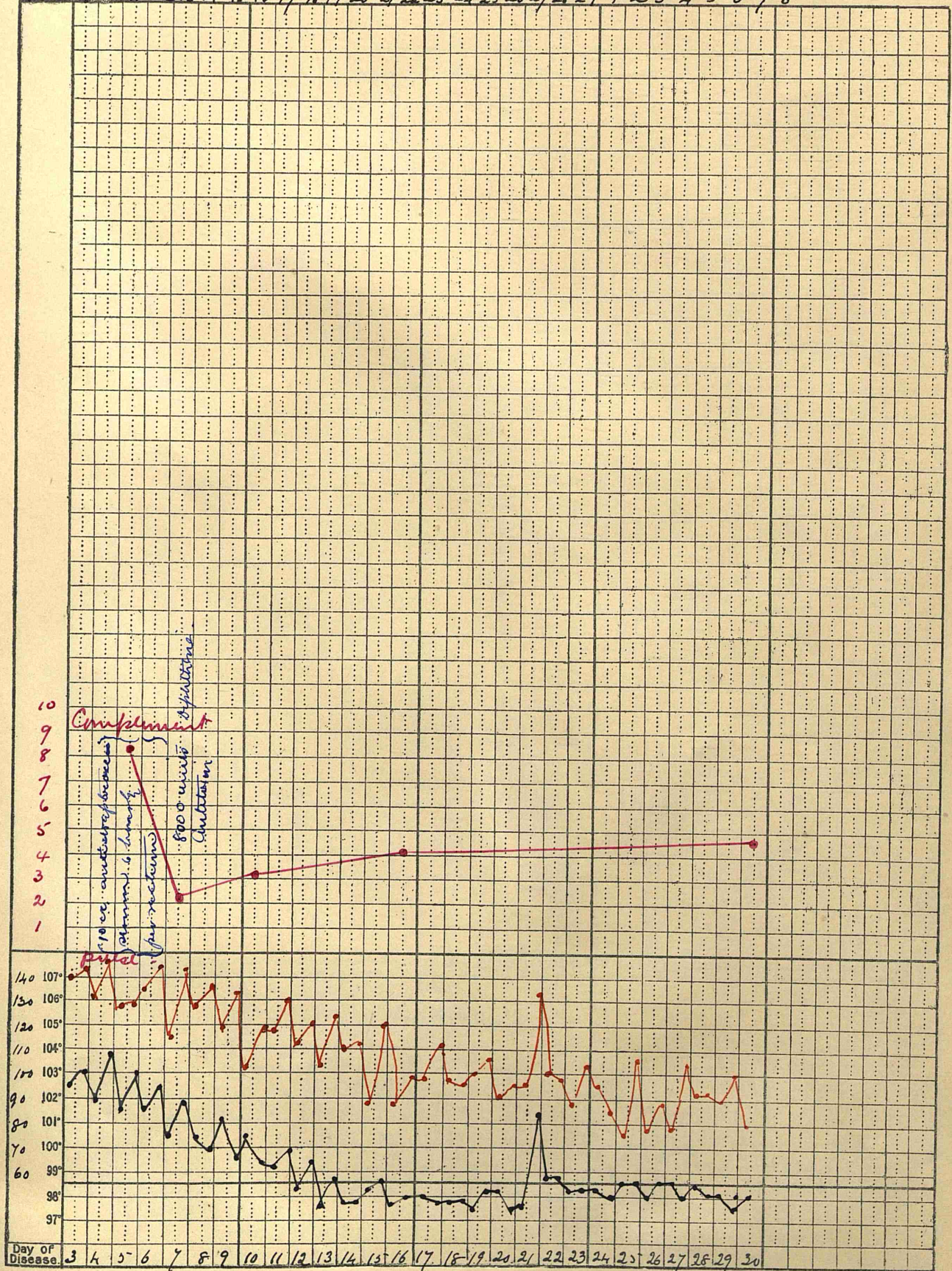
5 y.

11-12



Septic Scarlat fever.  
with Diptheria. Chart XVII.

Feb 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 / March 1 2 3 4 5 6 7 8



9-2-12



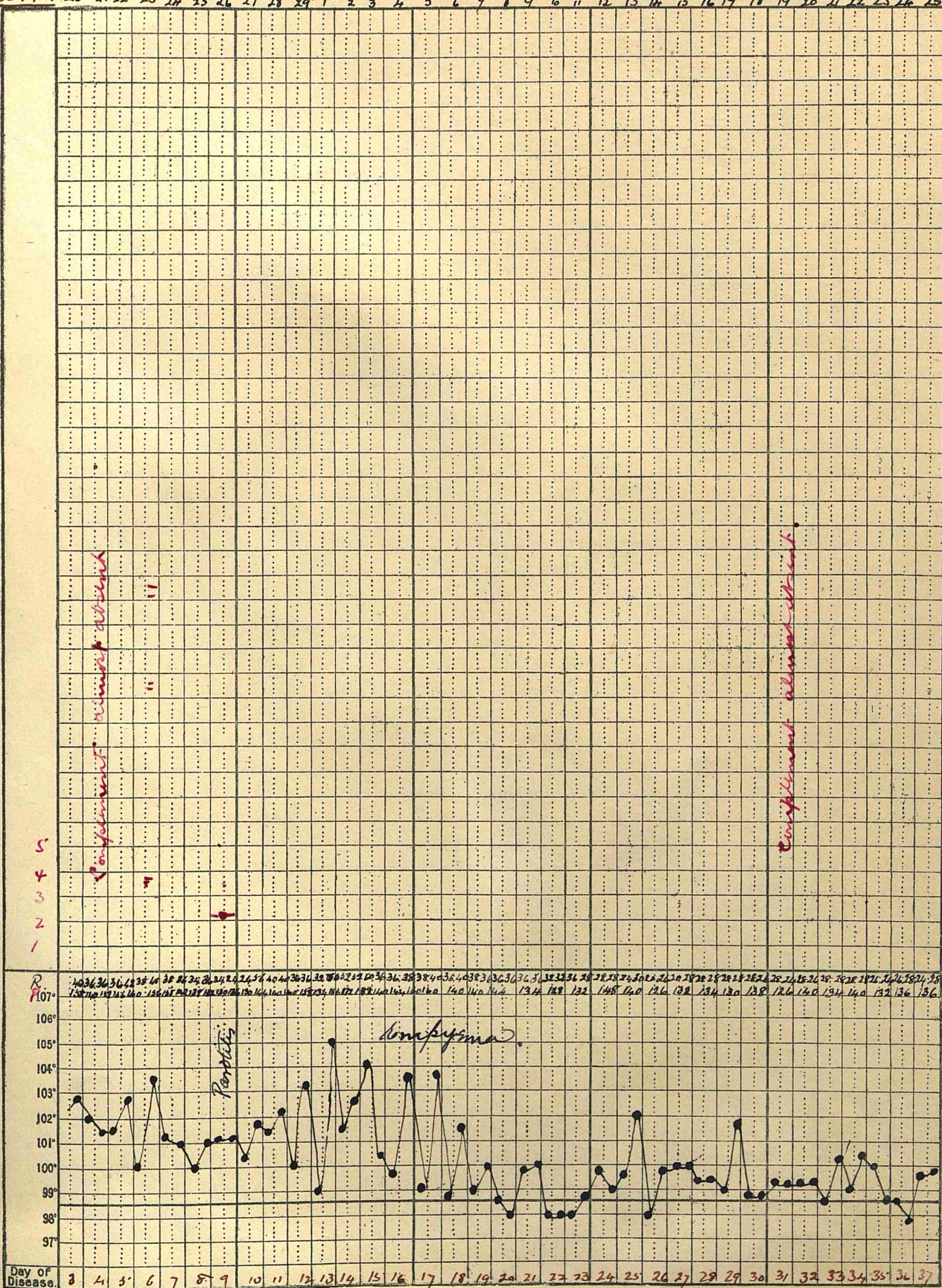
Septic  
Scarlet fever.

Chart.

XVIII

Date. Feb. 12. 20 21 22 23 24 25 26 27 28 29 30 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

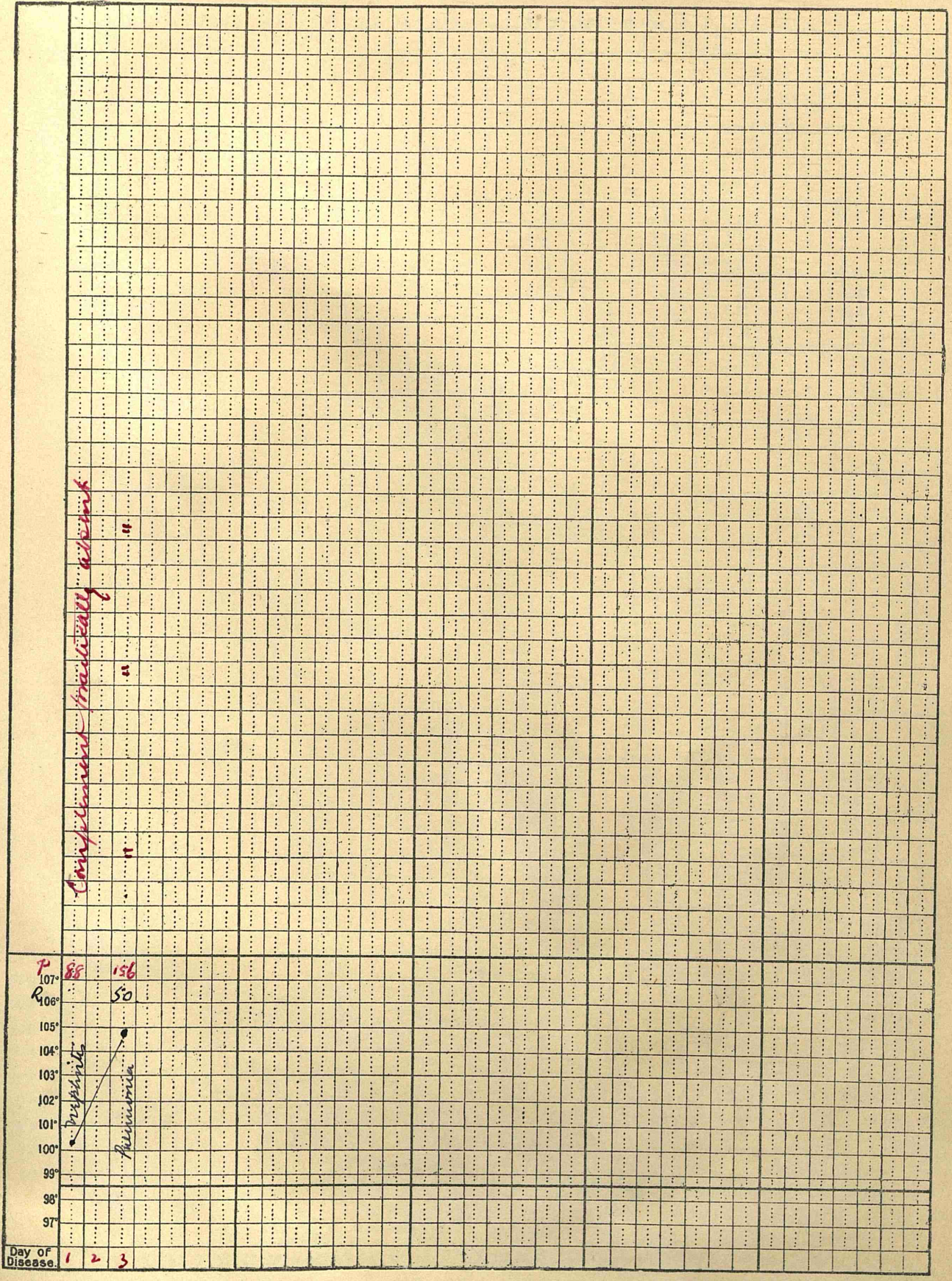
Haughy  
6 years  
Feb 20<sup>th</sup> 12  
" " "





# *Scarlatinal nephritis Chart XIX.*

*March 2<sup>nd</sup> 3<sup>rd</sup>*



*Compliments gradually about*

*9 1/2 years.*

*P 88 156*  
*R 50*  
*Protein*  
*Residue*  
 Day of Disease 1 2 3



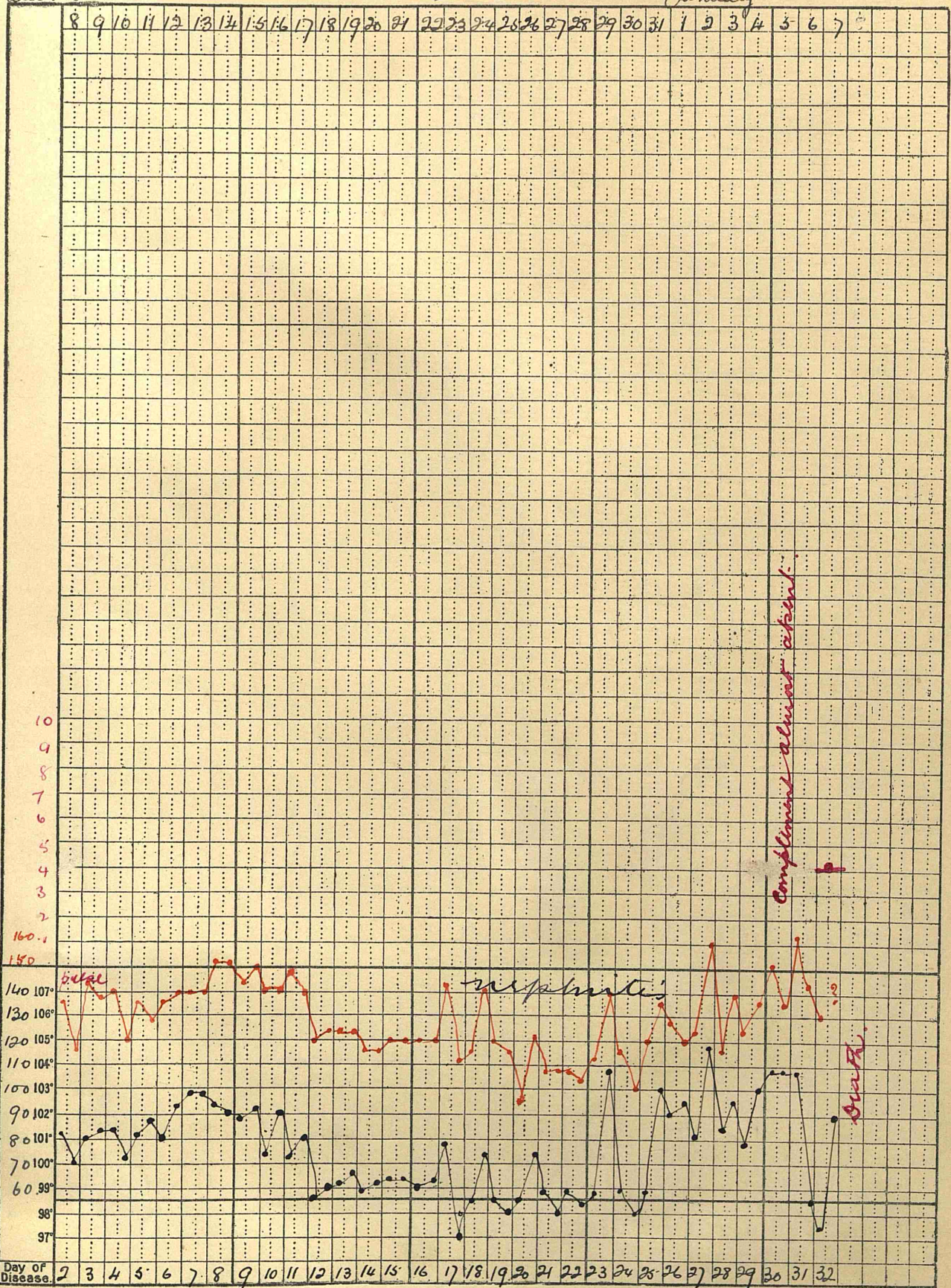
S. J. wa 13.

# Scarlatinal Inphritis

Chart XX.

December

January



McCallum

4 yrs.

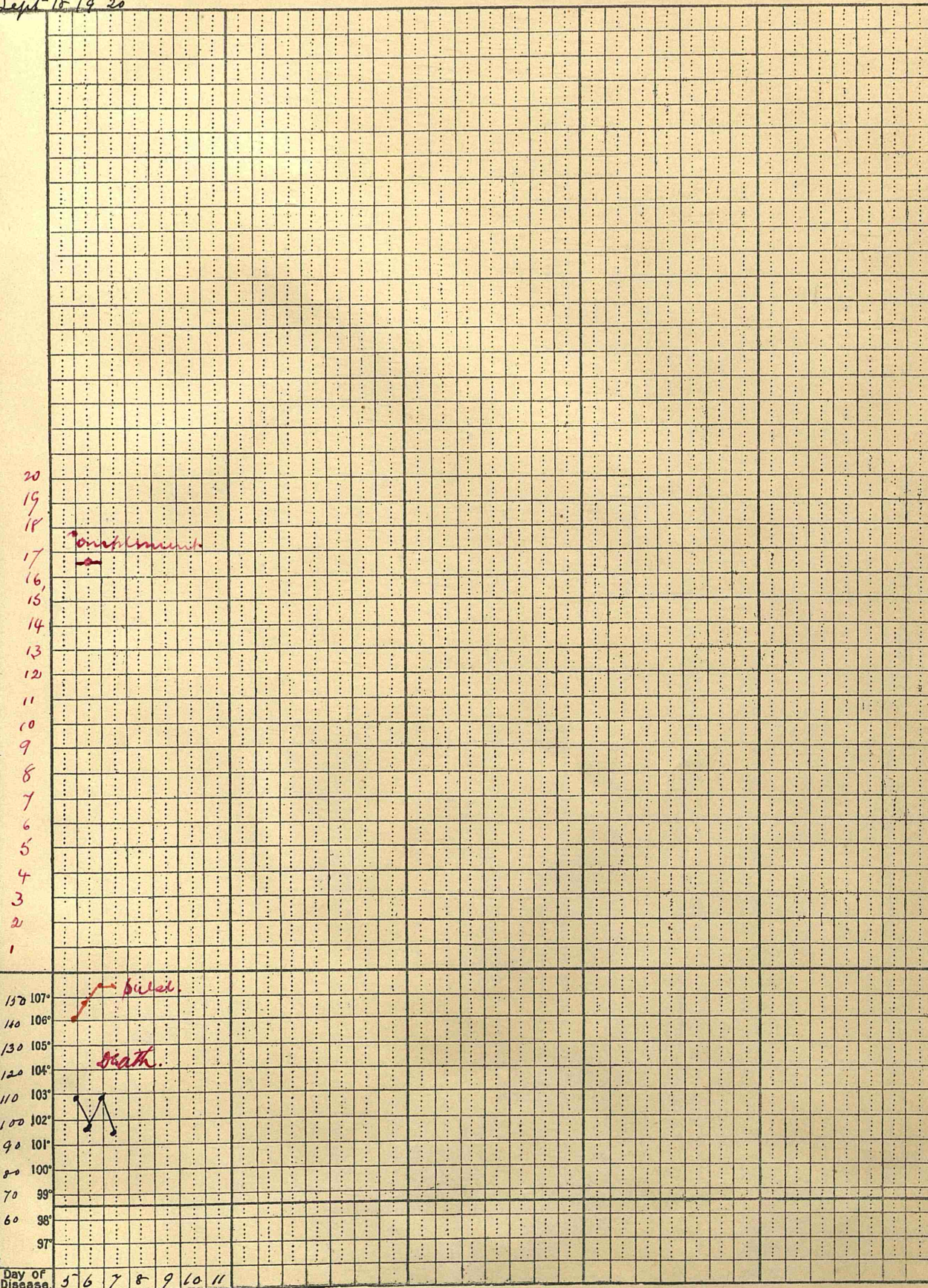
8-12-11



Malignant Scarlet Fever

Chart XXI

Sept 18 19 20



Scarlet Fever

1 1/2 yrs

Jan 18-9-11

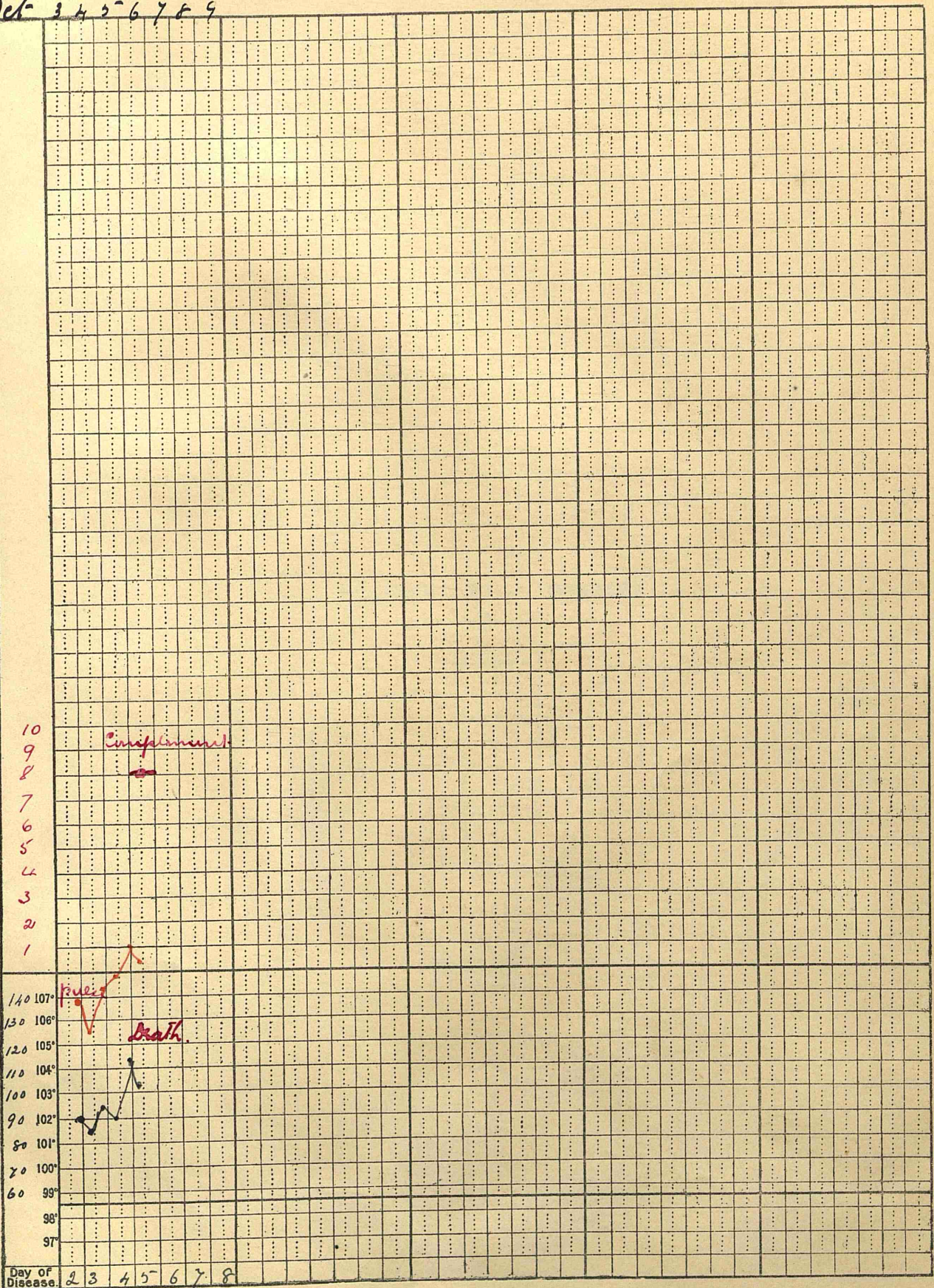
Dead



Malignant Scarlet Fever.

Chart XXII.

Oct- 3 4 5 6 7 8 9



Monday

3-10-11

admitted to W. H. H.

6-10-11



**SECTION E - MEASLES**

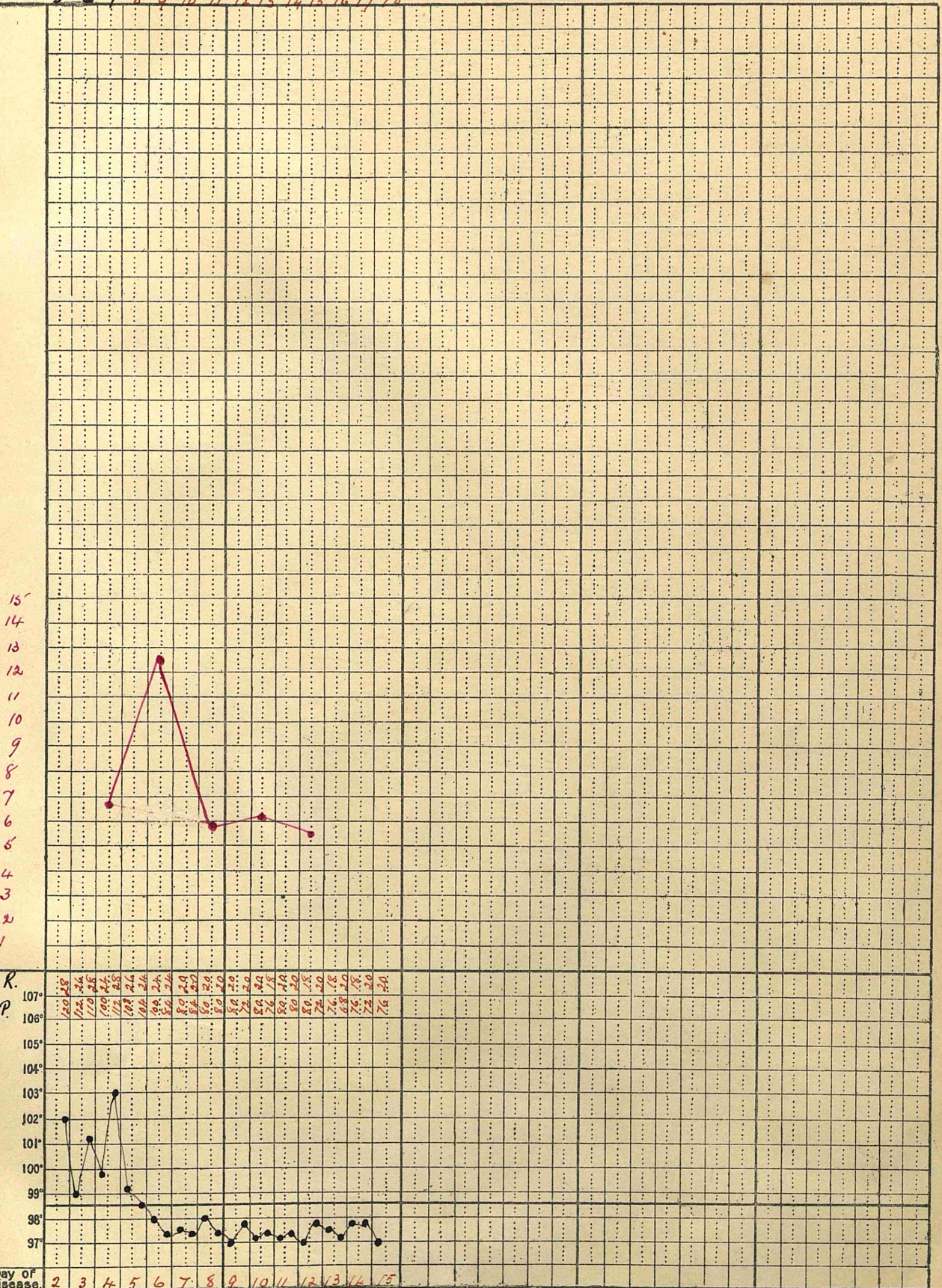
-----



do hart I

Date March

5 6 7 8 9 10 11 12 13 14 15 16 17 18



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

R.  
P.  
107  
106  
105  
104  
103  
102  
101  
100  
99  
98  
97  
Day of Disease

120 118 116 114 112 110 108 106 104 102 100 98 96 94 92 90 88 86 84 82 80 78 76 74 72 70 68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0

hard y.  
Mr. Jones.  
age. 20 years  
also.



# Chart II

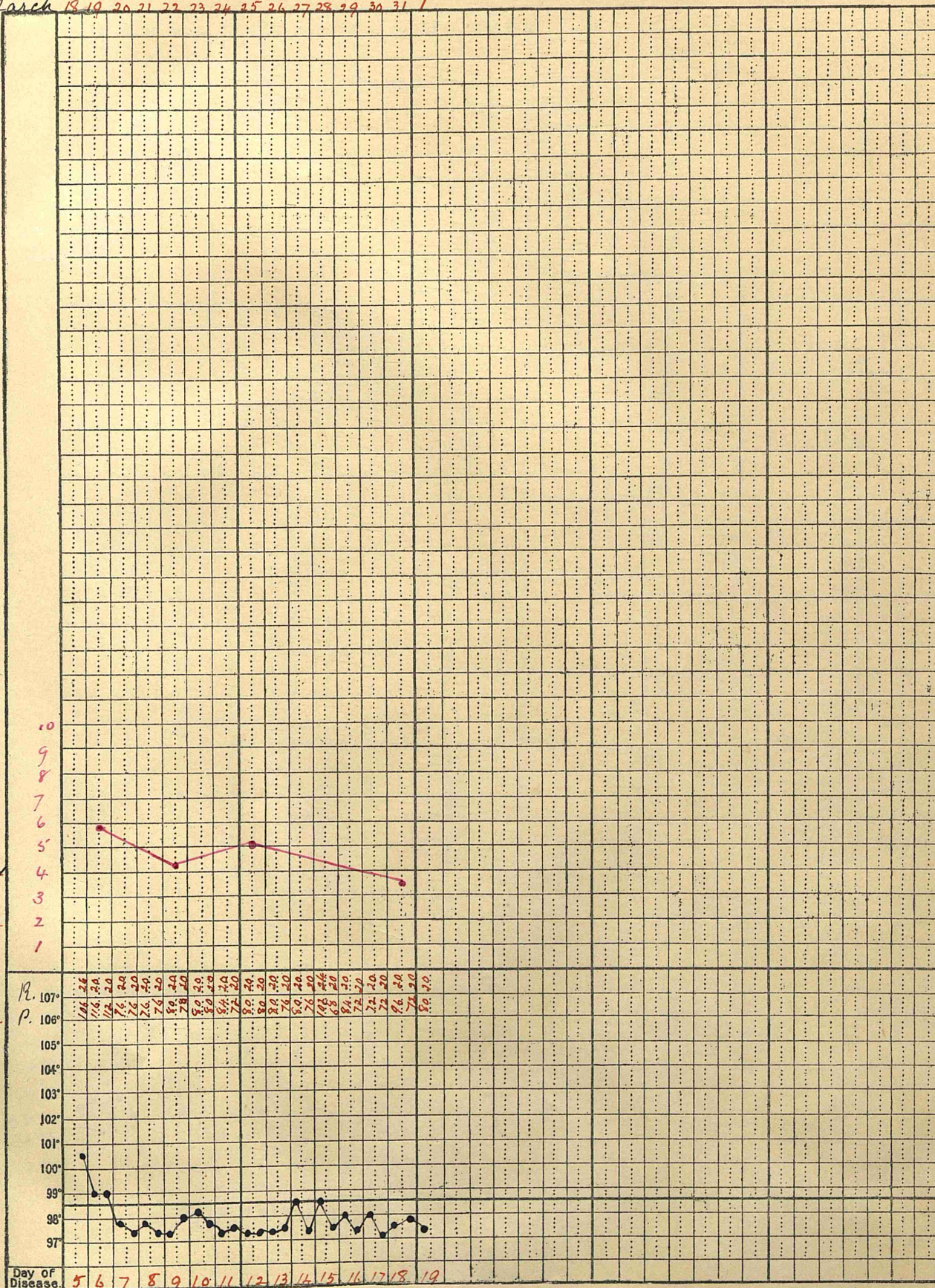
Date March 18 19 20 21 22 23 24 25 26 27 28 29 30 31 / April.

and Y.

by Kennedy

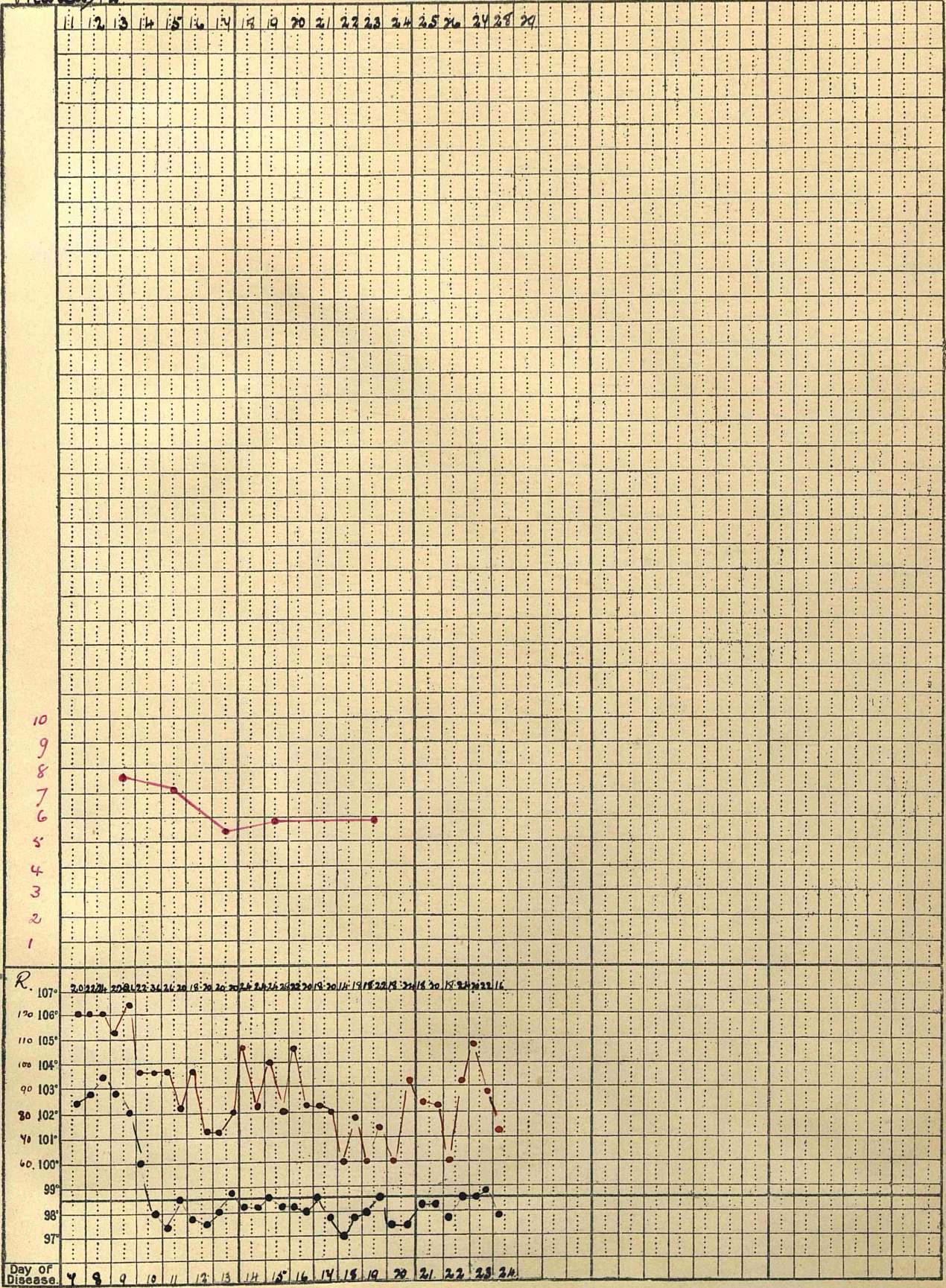
25 years

Measles





Date. March 12



11-3-12.

18.

Small  
ages. 25  
asles.



# Chart 15

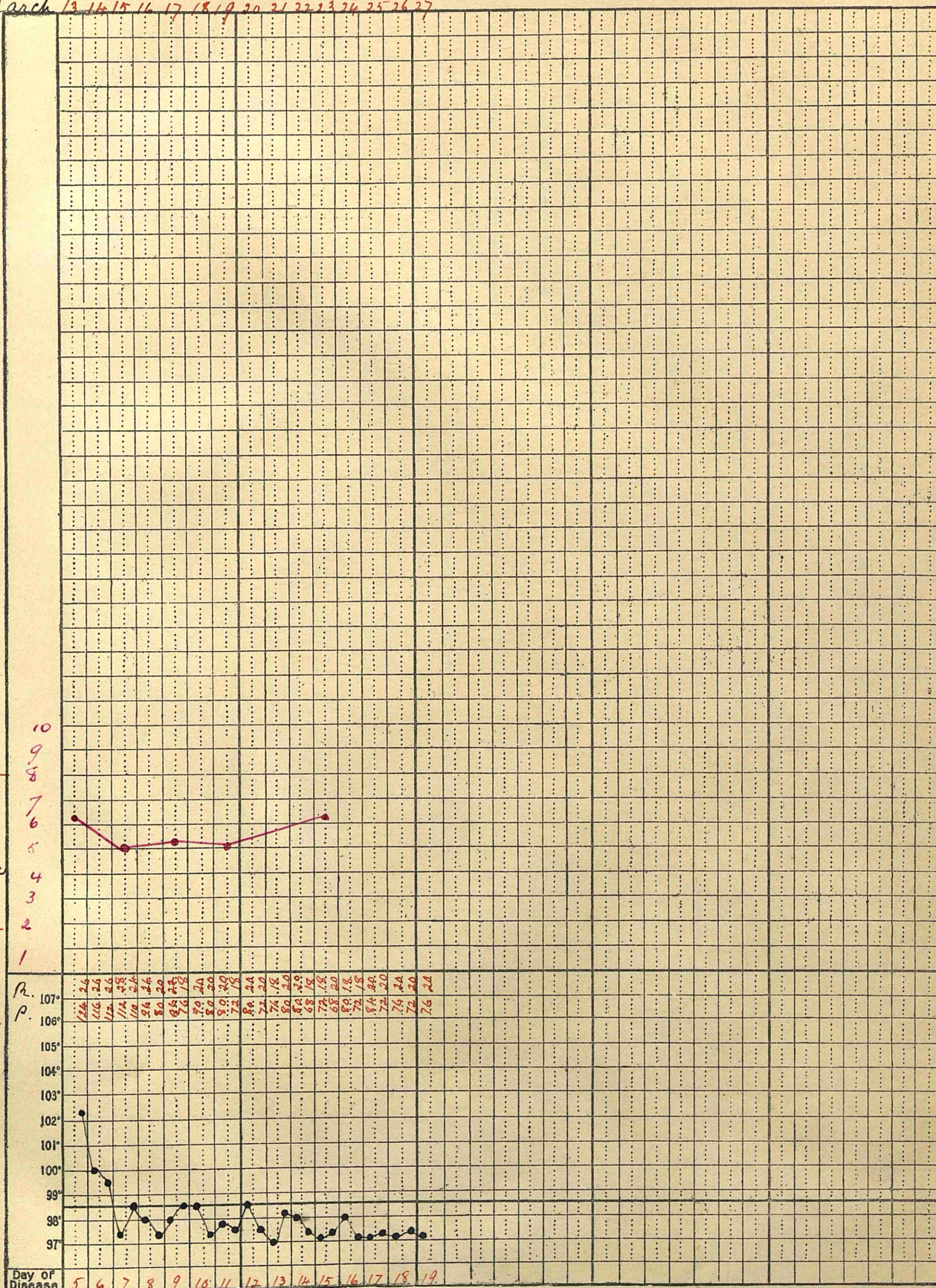
Date March 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

Card 4

M. C. Finmore

30 years

Measles





# Chart V

Date Febry

March

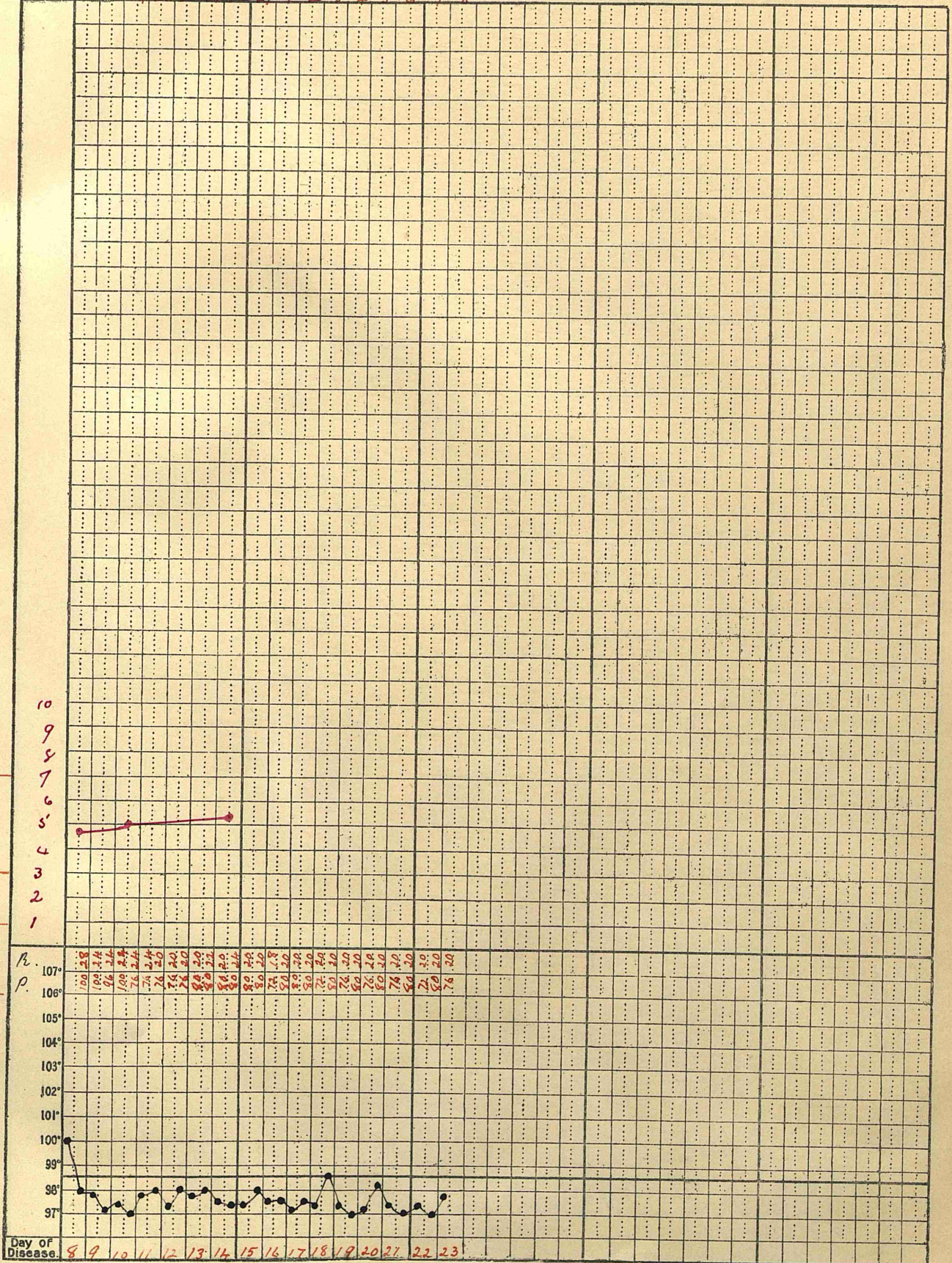
22 23 24 25 26 27 28 29 1 2 3 4 5 6 7 8

Card 7

Laurie

17 years

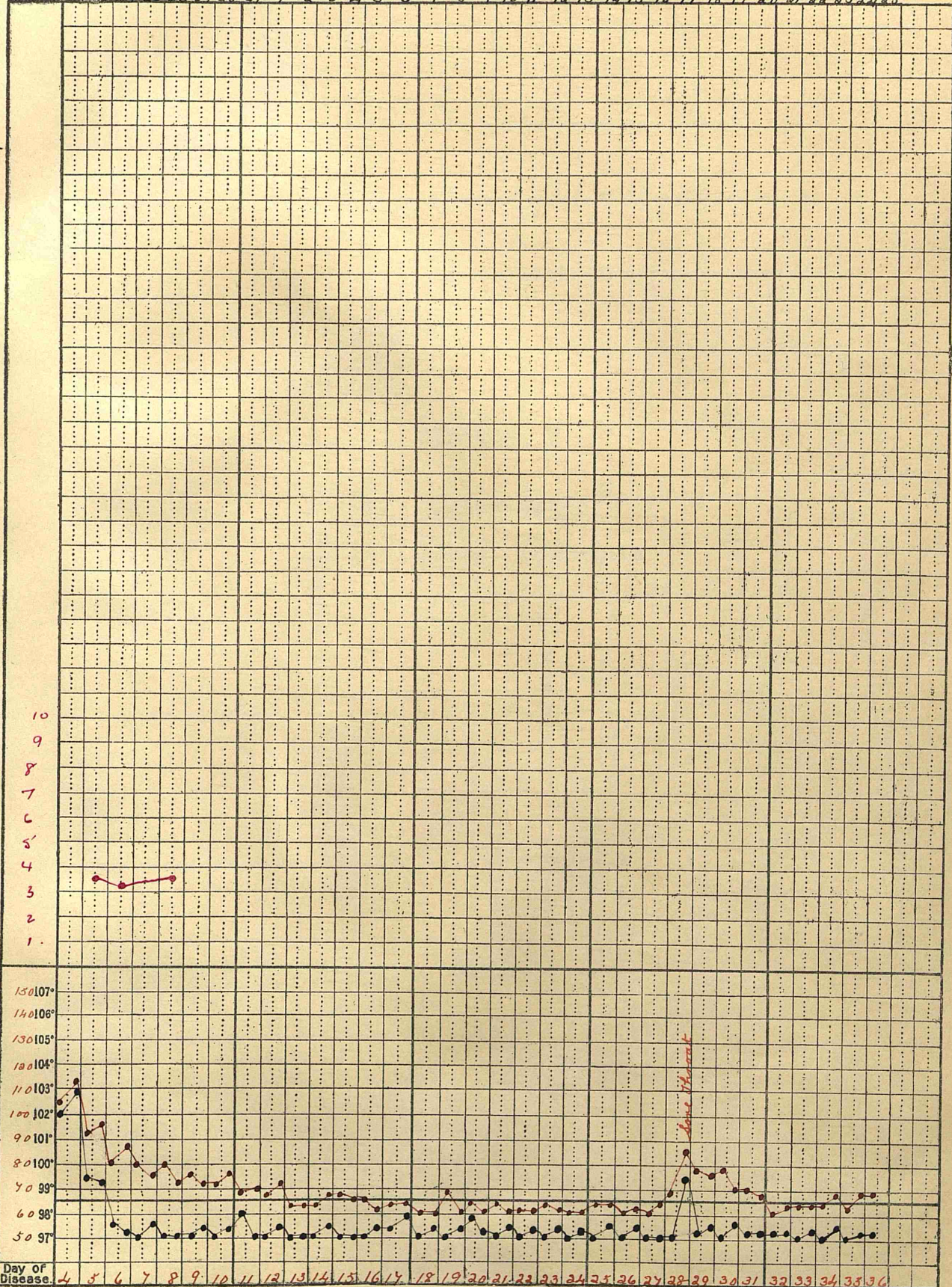
Measles





# Chart VI

Feb 22 23 24 25 26 27 28 29 / march 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



old Weight  
18 years  
at 22.2.12  
died 25.3.12  
VI. Measles



**SECTION F**

**(a) Typhus Fever**

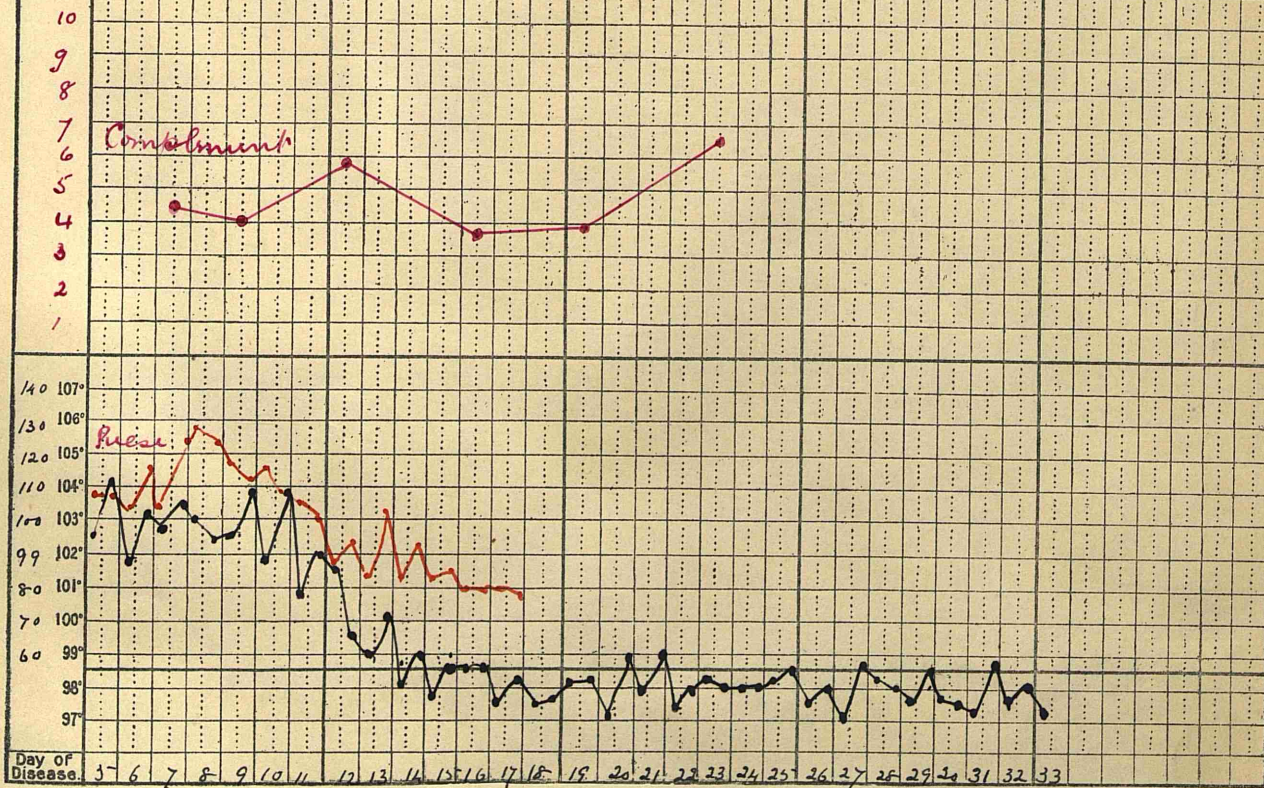
**(b) Lobar Pneumonia**

-----



# *Typhus Fever. Chart I*

Jan. 1912 22 23 24 25 26 27 28 29 30 31 Feb 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



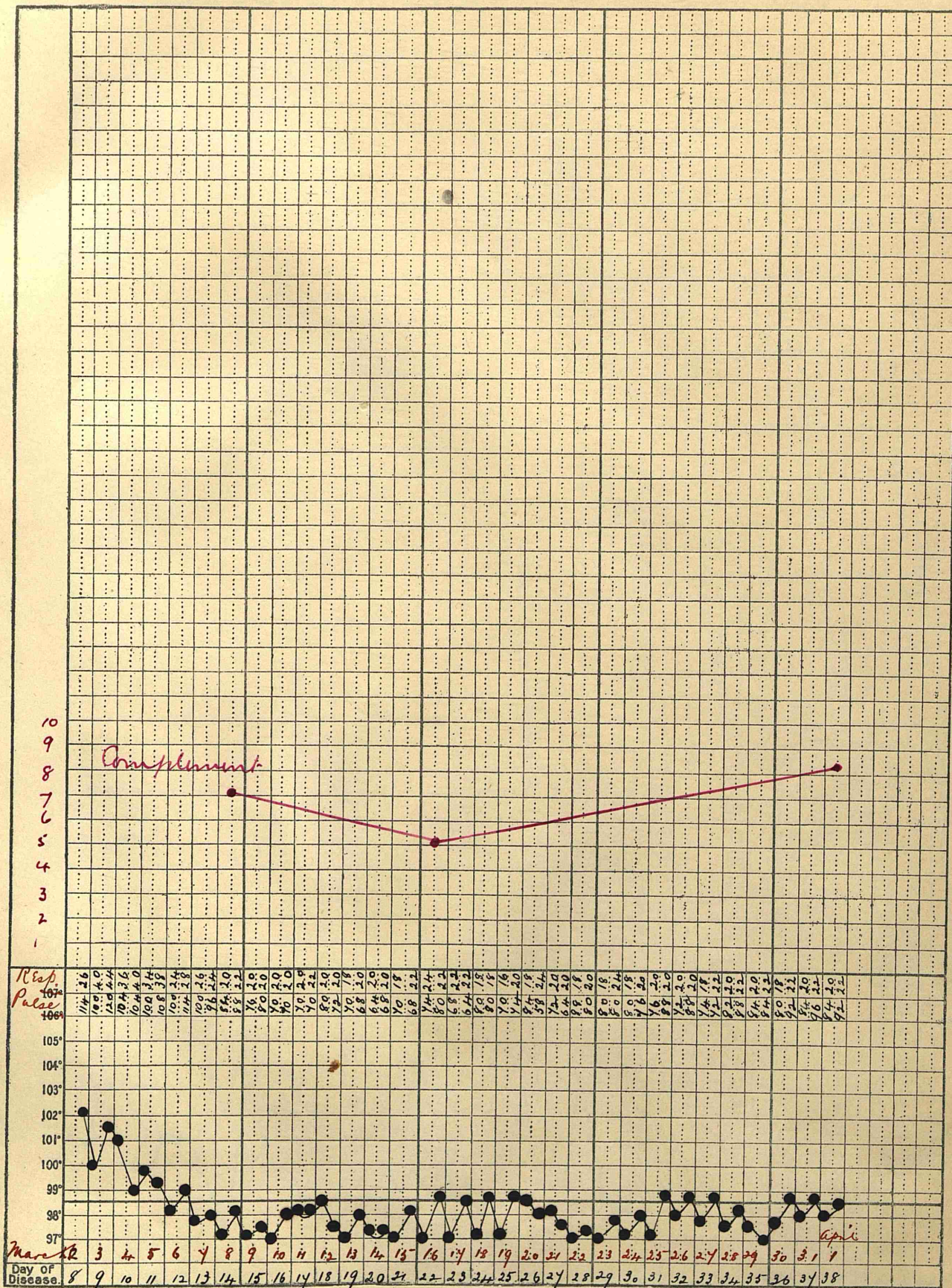
*Guinea*  
23 yr  
Jan 22-1-12



Margaret McCormack.  
 Age. 22 yrs.

Typhus  
 fever.

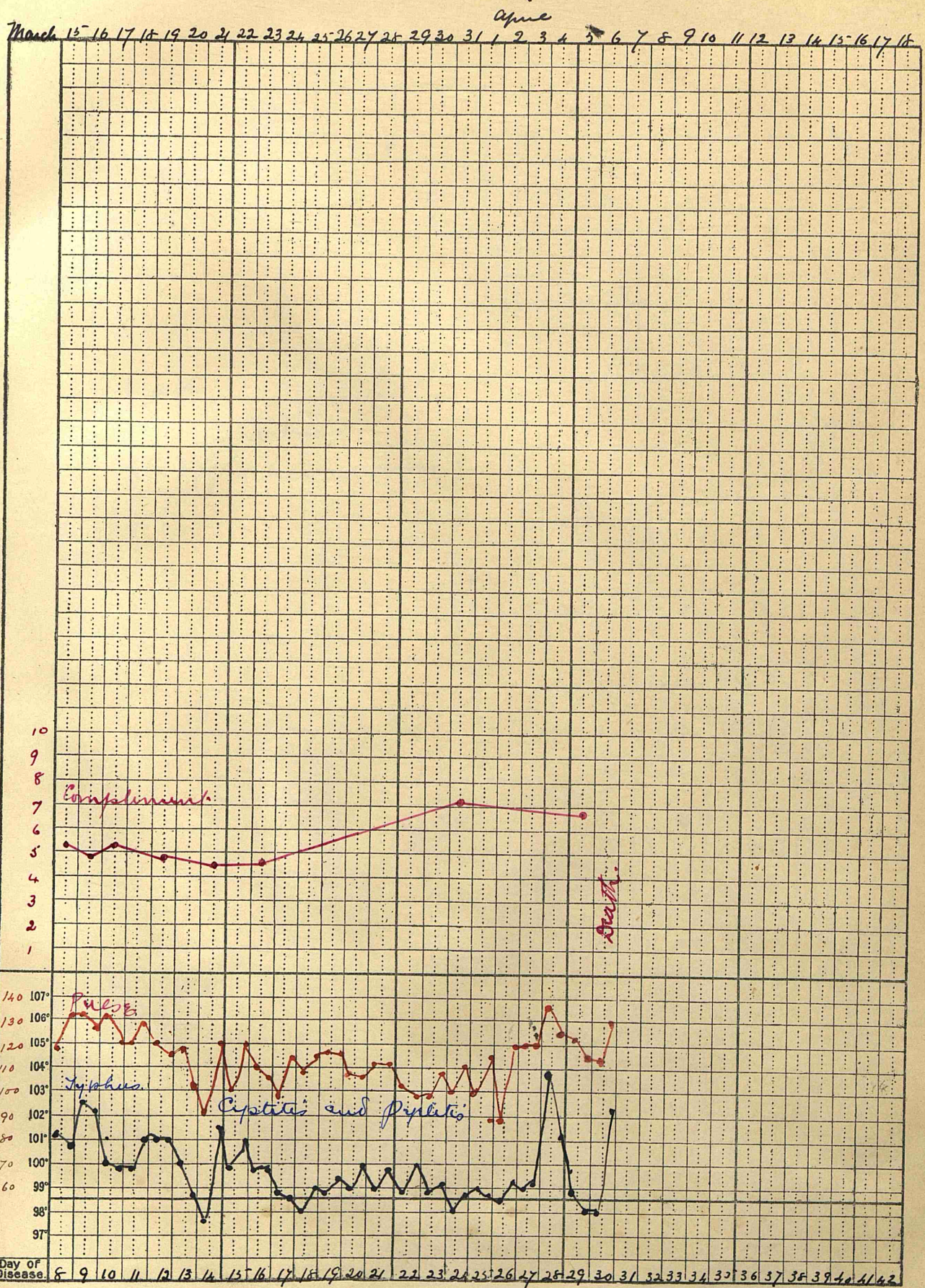
Chart 11





Typhus Fever.

Chart III.





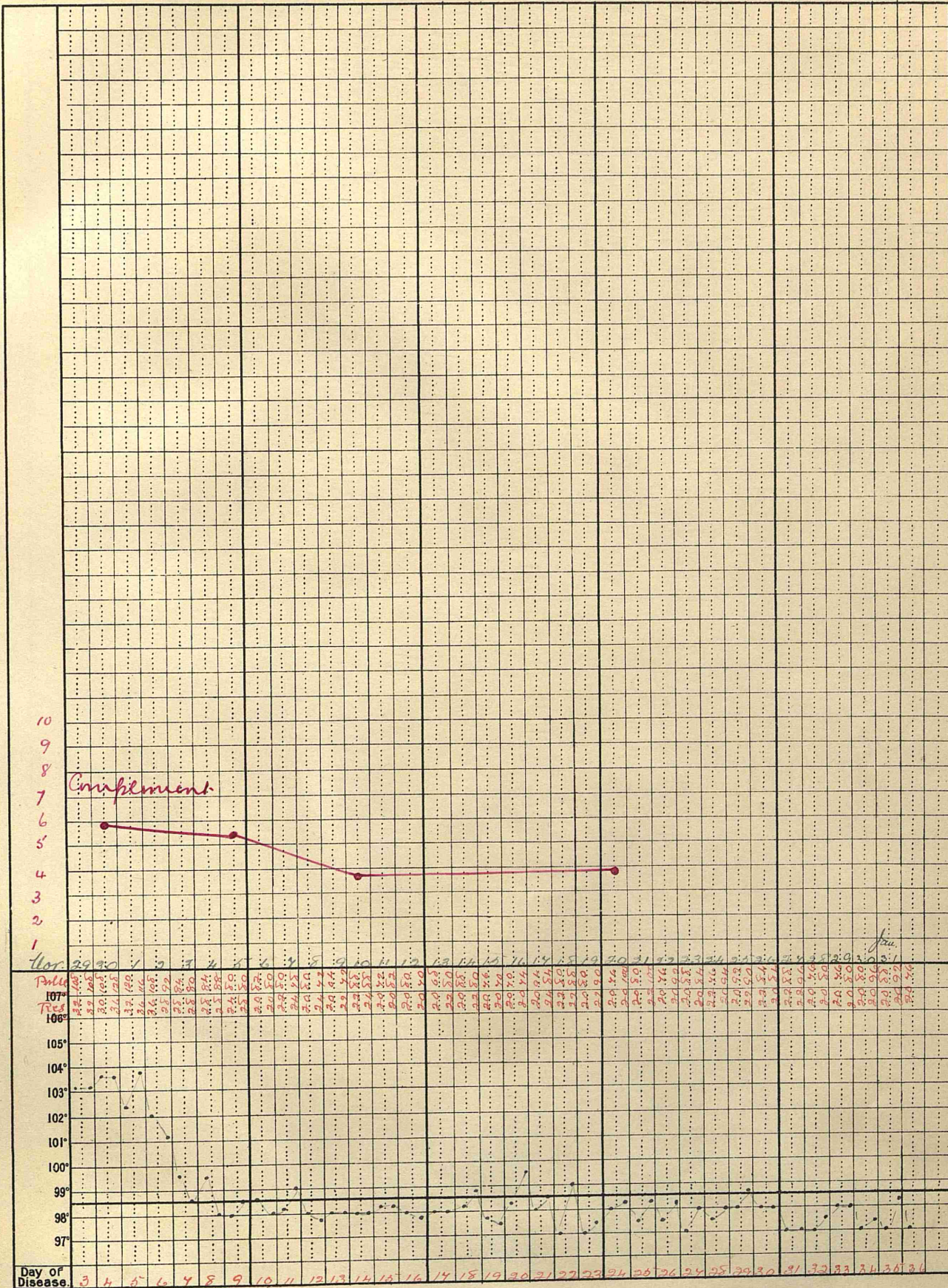
Charts

(b) Lobes.  
Pneumonia.



John Brady  
Age 13 yrs  
Jul 29. 11. 11

Lobar Pneumonia  
Chart I





# Lobar Pneumonia.

Chart ii

Nov 29 30 1 Dec 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

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

Complement

R  
140 107°  
130 106°  
120 105°  
110 104°  
100 103°  
90 102°  
80 101°  
70 100°  
60 99°  
50 98°  
40 97°

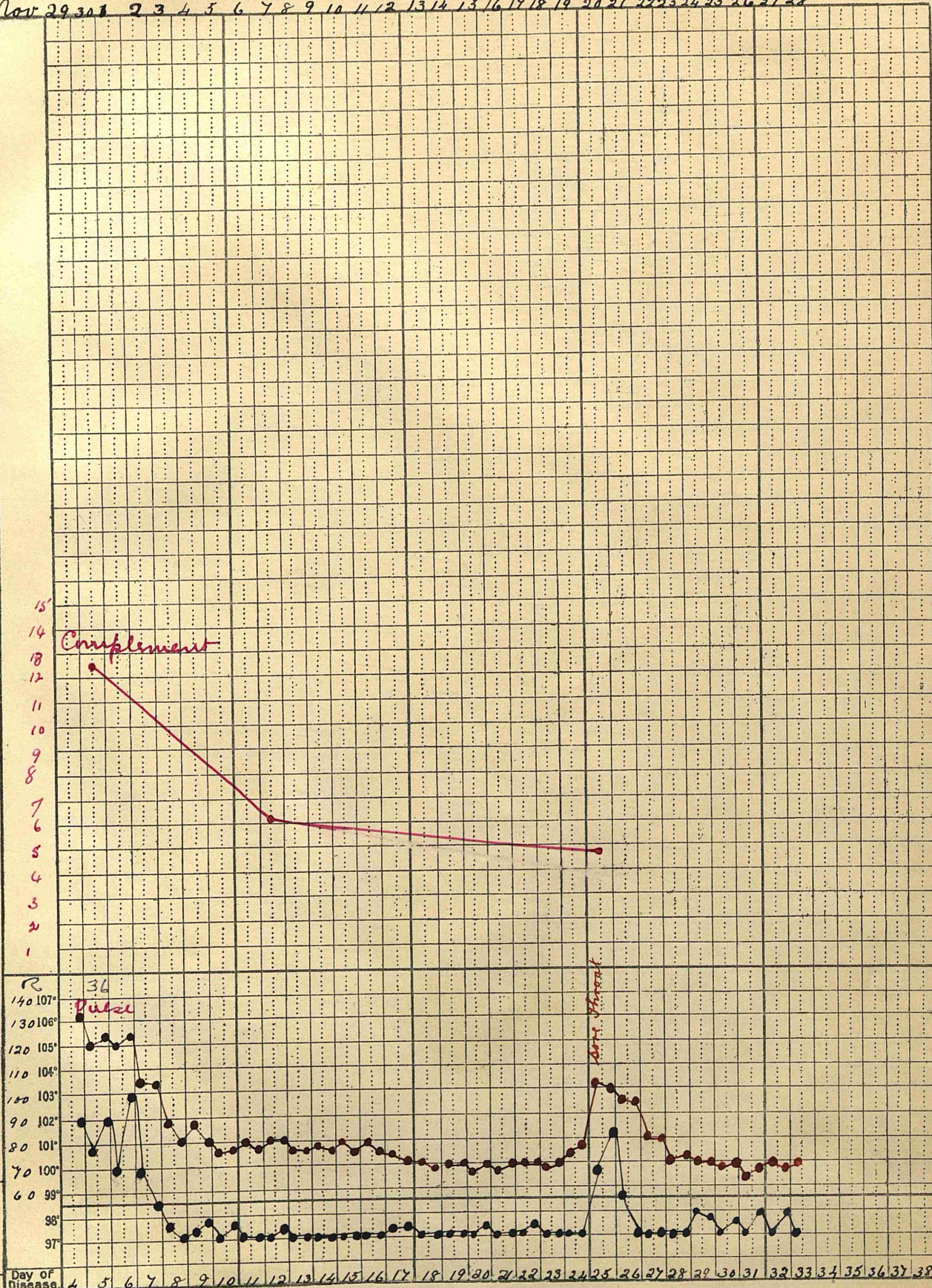
36  
Pulse

Wet throat

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 29 30 31 32 33 34 35 36 37 38

Pauline Jones  
Age 29 years  
November 1911

Pneumonia





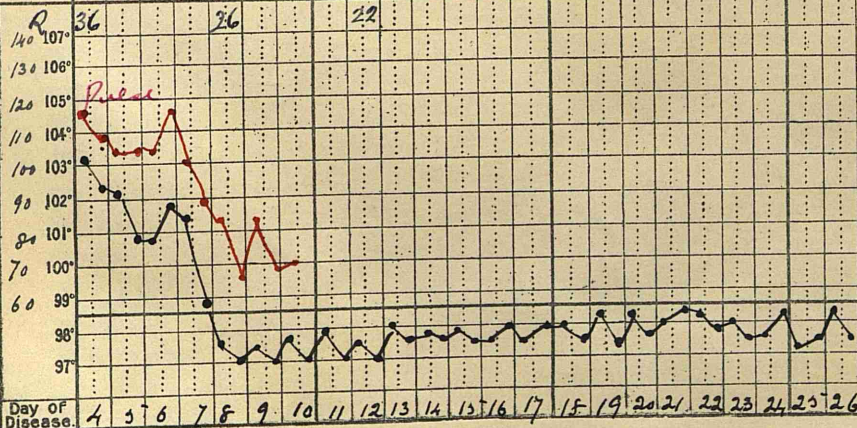
# Lobar Pneumonia

## Chart III

Dec 21 22 23 24 25 26 27 28 29 30 31 Jan 1 2 3 4 5 6 7 8 9 10 11 12

10  
9  
8  
7  
6  
5  
4  
3  
2  
1

Compilment



Age Latham  
15 yrs  
Jan 21 - 12 - 11



Thomas Simpson  
 Age 32 years  
 Dec. 22.2.12

Lobar pneumonia.  
 (Plural effusion)  
 Scarlat fever. Chart IV

4a

