EPIDEMIC CEREBRO-SPINAL MENINGITIS - 1906-7

A

CLINICAL DESCRIPTION

TOGETHER WITH

AN INVESTIGATION

INTO

THE LEUCOCYTOSIS

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Haemorrhagic Rash of Cerebro-spinal Fever on Face

The irregular outline of eruption is well illustrated

Petechial Eruption on Trunk

EPIDEMIC CEREBRO-SPINAL MENINGITIS

The first known cases of this epidemic occurred in Glasgow in March, 1906, but they were associated with cases occurring in the environment of the city within a radius of 15 miles. The first case treated in Belvidere Fever Hospital which was bacteriologically verified was admitted in May, 1906, but there had been a few cases verified in the city in the two months prior to this. From May, 1906, to the beginning of January, 1907, 55 cases subsequently verified were admitted, and these comprised practically all the cases occurring in the city which were sent to hospital. Of these, two cases were admitted in May, five in June, seven in July, seven in August, five in September, 14 in October, five in November, and 10 in December. Of these, 21 were acute cases (i.e., death taking place within the first 14 days); two were mild (i.e., the onset being mild, and complete recovery taking place in from 21 to 40 days); seven were of an abortive type (i.e., those which recovered within the first 10 days); and the remainder (25 in all) ran a chronic course (i.e., the onset being acute but lasting longer than 30 days). These cases were taken almost entirely from the poorer localities in the southern and eastern districts of the city. With the onset of very cold weather in December, 1906, a marked increase took place, so that in January of last year

17 cases were admitted, this being the greatest number since the commencement of the epidemic. Fifteen cases subsequently verified were admitted in February, 26 in March, 42 in April, and 28 in May, 1907. In all, 128 cases subsequently verified were admitted during the first five months of last year. Of these, 55 were acute cases, eight mild, nine abortive, and 56 were chronic. During the latter phase of the epidemic, the cases have been of a more acute type. The Glasgow epidemic therefore commenced in March, 1906; continued throughout the summer and autumn in a mild degree; and with the sudden onset of very cold weather about the beginning of January of the past year, a marked exacerbation took place, culminating in April and since declining.

The distribution of the cases as regards age, sex, and fatality is given in the accompanying tables. As the cases are so few, any elaborate discussion of these figures is unnecessary. Certain points may be noted: the number of males and females has been practically identical. The fatality during both phases of the epidemic has been practically the same, viz., about 73 per cent.

TABLE I - MAY 1906 TO JANUARY 1907

Ages of patients (years)	Males			Females			Total		
	Admitted	Died	Mortality per cent.	Admitted	Died	Mortality per cent.	Admitted	Died	Mortality per cent.
Under 1	3	3	100.0	3	3	100.0	6	6	100.0
1 and under 2	-	-	-	5	4	80.0	5	4	80.0
2 " 3	1	1	100.0	1	1	100.0	2	2	100.0
3 " 4	2	2	100.0	1	-	-	3	2	66.6
4 " 5	2	1	50.0	-	-	-	2	1	50.0
5 " 6	6	5	83.3	3	2	66.6	9	7	77.7
6 " 7	3	3	100.0	2	1	50.0	5	4	80.0
7 " 8	-	-	-	3	2	66.6	3	2	66.6
8 " 9	2	-	-	3	2	66.6	5	2	40.0
9 " 10	1	-	-	-	-	-	1	-	-
10 " 15	-	-	-	5	4	80.0	5	4	80.0
15 " 20	3	3	100.0	2	1	50.0	5	4	80.0
20 " 25	3	2	66.6	-	-	-	3	2	66.6
25 " 30	-	-	-	-	-	-	-	-	-
30 " 35	-	-	-	1	-	-	1	-	-
Total	26	20	76.9	29	20	68.9	55	40	72.7

TABLE II - JANUARY TO MAY 1907

Ages of patients (years)	Males			Females			Total		
	Admitted	Died	Mortality per cent.	Admitted	Died	Mortality per cent.	Admitted	Died	Mortality per cent.
Under 1	10	8	80.0	8	8	100.0	18	16	88.8
1 and under 2	4	4	100.0	7	6	85.7	11	10	90.9
2 " 3	1	1	100.0	6	4	66.6	7	5	71.4
3 " 4	7	6	85.7	5	4	80.0	12	10	83.3
4 " 5	7	6	85.7	3	2	66.6	10	8	80.0
5 " 6	2	1	50.0	5	5	100.0	7	6	85.7
6 " 7	3	3	100.0	2	2	100.0	5	5	100.0
7 " 8	-	-	-	2	-	-	2	-	-
8 " 9	3	1	33.3	2	1	50.0	5	2	40.0
9 " 10	1	1	100.0	-	-	-	1	1	100.0
10 " 15	8	5	62.5	11	9	81.8	19	14	73.6
15 " 20	12	7	58.3	5	2	40.0	17	9	52.9
20 " 25	2	1	50.0	1	1	100.0	3	2	66.6
25 " 30	1	1	100.0	1	-	-	2	1	50.0
30 " 35	-	-	-	1	-	-	1	-	-
35 " 40	-	-	-	2	2	100.0	2	2	100.0
40 " 45	2	1	50.0	2	1	50.0	4	2	50.0
45 " 50	-	-	-	1	-	-	1	-	-
50 " 55	-	-	-	1	1	100.0	1	1	100.0
Total	63	46	73.01	65	48	73.8	128	94	73.4

The clinical symptoms of the cases in Belvidere Fever Hospital, as they have been observed during the recent epidemic, are recorded below under appropriate headings.

SYMPTOMS OF ONSET - The onset has in general been sudden. Headache and vomiting have been the chief initial symptoms. The former has always been present, and the latter has only been absent very occasionally. In adults there has often been a history of shivering or rigor, and in infants of convulsions. Vertigo has been present in many instances at this stage, sometimes so acute as to cause the patient to fall down on the street. Prodromal symptoms have generally been absent, but as the great majority of the cases were children, their frequency cannot be estimated. Malaise has been occasionally present for a few days prior to the onset, and in some cases a feeling of uneasiness incapable of definition has preceded the acute attack by a number of hours. Sore throat of one to two days' duration has been noted. Nasal discharge has been only occasionally observed. The onset has in many cases been fulminant, in some instances the patient having taken a full and hearty meal immediately before.

The physiognomy has been very characteristic. Generally the cheeks are flushed, and in acute cases the flush is dusky or even cyanotic. Herpes, when present, usually appears round the lips at this stage, so that the facies resembles that of a typical pneumonia. There is generally a look of anxiety. In severe cases the conjunctivae are suffused. The condition of the pupil is variable, and will be discussed more fully later. A petechial rash sometimes appears within the first 12 hours in fulminant cases, but when present in other cases, it

has commonly been observed for the first time on the second, third, or fourth day. The patient is restless and lies with his head rigid or somewhat pulled back, and the arms and legs may be tossed from one part of the bed to another. There has always been stiffness of the head and neck, unless sometimes in children under a year old, when even this sign has been absent. Kernig's sign has been present in the majority of the cases a few hours after the onset, but by no means always. A type of case has occasionally occurred, death taking place in from 24 to 48 hours, in which neither rigidity of the head and neck nor Kernig's sign has developed. All degrees of mental activity have been displayed, but stupor more or less profound, and less frequently delirium, have succeeded the onset according to the gravity of the case.

The type of case has varied considerably, and for purposes of description they will be referred to hereafter under the following heads: the acute, the chronic, the mild, and the abortive. In the acute case, delirium with more or less coma develops within the first few hours, and death occurs within the first 14 days. The chronic case is generally acute at onset, being ushered in with delirium, semi-coma, or coma, within the first few hours, but a fatal result does not immediately occur, and after about 14 days the case assumes a chronic character. Mild cases are those in which the symptoms of onset are quite characteristic, but there is an entire absence of delirium and coma; consciousness persists throughout the attack, and there is only moderate complaint of pain. In some of these cases there is considerable retraction of head and neck, and even opisthotonos. Abortive cases are those in which the onset has been commonly acute, and in rare instances

Petechial Eruption on Lower Limbs

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mild, but in which recovery is complete within the first few days.

SKIN - The features have as a rule been flushed at the commencement of the disease, but in advanced cases they have been pallid. Temporary flushings of the face and of the skin generally have been common throughout the course of the disease. On the face especially, circumscribed areas of deep congestion surrounded by areas of pallor have been seen. These are very evanescent, passing within half an hour from the stage of extreme brilliance to a condition only recognisable with difficulty. Goose skin has been common in the chronic stage. The tache cerebrale has been common throughout the course of the disease. Considering that the disease has been named from the eruption which accompanies it, it is noteworthy how seldom the true rash has been present. This rash, however, does not conform in the least to any of the types which we are accustomed to associate with the acute exanthemata. It has consisted of small haemorrhages into the more superficial part of the corium, which on appearance have been bright purple in colour and of irregular form. They commonly have varied in size from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, but smaller and larger elements have been not unusual. The largest observed approached the area covered by a shilling piece. The common duration of these haemorrhages has been from three to four days, and they have faded in brightness usually within 24 hours. They pass through the ordinary stages of the disappearance of a haemorrhage. Their whole course is much shorter than that seen in the typhus eruption, and they have never been preceded by the roseola commonly present in the latter disease. When these haemorrhages have occurred in the subcutaneous tissues, they have been faint blue in appearance. Another feature of

Herpes on Cheeks, Lips, Nose
and Eyelids

the skin occasionally observed has been a mottling not unlike that seen in typhus fever, but this has never appeared with the widespread distribution common in the latter disease. This has been observed in seven cases, and in the first week of the disease. It has only been associated with the rash in one case. As regards the appearance of the eruption, there is little to distinguish it from an ordinary purpura except its rapid evanescence. This would seem to show that the amount of blood effused is very small and very superficial. This eruption has commonly appeared from the first to the fifth day, the commonest days having been the third and fourth. A petechial eruption not distinguishable from that described, distributed generally, has been observed in four instances immediately prior to death. In cases which have developed chronic hydrocephalus, an eruption of very small petechiae distributed more or less generally have been common shortly before death. These have been a faint blue in colour and not easily visible. Six cases out of 55 treated during 1906, or 10.9 per cent., had a generalised petechial eruption all over the body. Twenty-seven out of 128 cases, or 21.09 per cent., treated during the first five months of 1907 had generalised petechial eruptions, so the petechiae have been much more common during the latter phase of the epidemic. Four out of these latter cases had haemorrhages also under the conjunctivae. Two had haemorrhages under the conjunctivae alone. Recovery has only taken place in one case where petechiae were found in the skin. In this case the fever continued for 160 days, recovery taking place with deafness.

Herpes has occurred in 18.1 per cent. of cases in the first phase of the epidemic, and in 21.09 per cent. of cases in the second phase.

Herpes on Side of Face and Neck

The frequency of the occurrence of herpes and the petechial rash has been therefore exactly the same in the latter part of the epidemic. It has, as a rule, occurred on the first or second day, but sometimes as late as the second week. Its most common situation has been the angles of the mouth, as in a pneumonia, but frequently it has appeared on the cheek, around the ears, and the alae of the nose. The number of the clusters of herpetic eruptions has varied from six to eight. In two instances the cluster upon the side of the face and neck has been as large as, or larger than, the hand. In one case the herpes has appeared extensively over one shoulder blade, and in another over the inside of one knee. In one instance a scarlatiniform rash has been present soon after the onset.

In two of the chronic cases an eruption, beginning as papules and becoming pustular, appeared distributed over the body. It ran a moderately definite course, and but for the fact of its healing, did not differ a great deal in appearance from those generally distributed septic infections of the skin frequently seen in emaciated children. The rose spots described by other writers have never been observed in this epidemic.

NERVOUS SYSTEM - Variation in the nervous symptoms naturally occurs according to the extent and intensity of the meningitis, and the degree in which the cerebro-spinal axis is congested or implicated, but certain symptoms have occurred in all, or nearly all, cases, and must be considered characteristic. Pain, already described as an initial symptom, has continued during the acute period of the illness. It has ordinarily been severe, but its intensity has varied in different patients.

Its most frequent seat has been the occiput, the frontal region, and the top of the head, and the same patient at different times has complained of all of these parts. It has also been common in the nucha and along the spine. The epigastrium, the umbilical and lumbar regions, and the extremities are frequently affected, and the pain shifts from one part to another. It has been more common and persistent in the head and along the spine than elsewhere. In these situations its appearance is in all cases coincident with the onset of the disease, and it begins to abate as a rule within the first few days, and is much less pronounced by the end of the second week. The state of the mind is that of apathy or indifference, and between this mental state and coma there is every grade of disturbance. Delirium has not been infrequent. It is rarely quiet in form, and seems chiefly the result of pain which rouses the patient from the state of stupor, and causes him to cry out frequently and name the affected part. If the pain is severe, such patients can hardly be restrained in bed, their restlessness is extreme, and their management is difficult. The patient may be quiet for a few minutes, and then, aroused, roll and toss from one part of the bed to another. It has always been primary, occurring with the onset of the disease and has lasted a variable time, in some cases passing off after a few days, and in others persisting until death. When delirium ceased, it was an indication that the case was passing into a chronic form, and did not necessarily mean commencing recovery. The form has varied from muttering to maniacal delirium, but in most cases the condition suggested that the origin of the mental symptoms was rather to be sought in the action of pain on a semi-conscious sub-

Head Retraction - Front View

Head Retraction - Back View

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ject rather than in cerebral intoxication seen in other forms of infective disease. In one instance insanity was diagnosed at the onset. The patient was suffering from a muttering form of delirium. He seemed to answer certain questions quite intelligently, but talked away to himself in an incoherent rambling manner. There was no complaint of pain. The fluid removed from the spine was purulent, and he died after an illness of six days' duration.

Hyperaesthesia of the skin has been a common symptom, friction upon the surface and even slight pressure with the fingers eliciting cries of pain. Contraction of certain muscles has been present in all cases, unless sometimes in very young children. This contraction has been most marked in the posterior muscles of the neck, causing retraction of the head, but it has been also common in the posterior muscles of the trunk causing opisthotonos, and in less degree in those of the abdomen, and in the hamstring muscles of the lower extremities. In consequence of this, the patient lies usually with his head thrown back. with the thighs and legs flexed, and with some degree of arching of the spine. Contractions have also occurred in the flexors of hands and feet, especially affecting the thumb and great toe. The varieties of these symptoms are naturally best seen in the chronic cases. In those which end fatally. the muscular contraction and rigidity continue to the end, and in some of these the body is so rigid that it can be lifted like a statue. However, during the intervals of apyrexia which often occur in these cases, the muscular rigidity frequently passes partly off, and in rare instances completely, to re-appear again with the recrudescence of the fever.

To show extreme emaciation

The plantar reflex has been exaggerated in acute cases before the onset of coma. It has been present throughout the disease in all cases, but in the chronic it is somewhat less active. Babinski's sign has never been obtained in any of the cases. The other superficial reflexes have also been active in the early stage, but have been difficult to obtain later in the disease. The knee-jerk is generally exaggerated in acute cases before the onset of coma, but may be unequally present in both limbs. It is almost generally absent throughout the course of the disease in all the chronic cases. The loss of knee-jerk persists into convalescence. Ankle or patellar clonus has never been elicited at any stage of the disease, nor has increased reflex of the tendons of the arms and wrists been observed.

Rapidly progressing emaciation begins to be observed in chronic cases from the fourteenth day onwards. The skin, particularly of the abdomen, in these cases becomes dry, wrinkled, and inelastic. The muscles also become extremely atrophied. Trophic lesions of the skin have not been observed. In cases which recover, flesh is put on rapidly.

Chronic hydrocephalus is fairly common, and its presence may be recognised from the twentieth day onwards, and sometimes earlier. The condition is suggested by the extremely wasted appearance of the face, and its small size in comparison with that of the head. The eyes have a fixed stare. There is commonly retraction of the upper eyelid, which is occasionally associated with an irregular form of nystagmus, and rhythmic contraction and dilatation of the pupil, a form of hippus which is described fully later. Optic neuritis is found in all these

cases. Headache already described is present. The mental condition is variable. The mental faculties in some degree as a rule are retained, but sometimes there is coma. Convulsions occasionally occur in children at this stage. Polyuria is also a symptom. In these cases, although the symptoms present for the most part can be referred to the hydrocephalus, it is noteworthy that the organism is still usually abundant in the spinal fluid. The extreme loss of nutrition is not due to the loss of power of feeding or digestion, as such patients in general feed well. Paralysis of any muscle or group of muscles has only occurred in one case, when complete hemiplegia affecting the right side developed a few days before death. In the very acute cases, however, difficulties of deglutition appeared shortly before death.

History of convulsions is commonly obtained as accompanying the onset in children under a year, but no such history has been recorded in adults. Convulsions have occurred in the course of the disease in children in acute cases, and they have been found associated post mortem with leptomeningitis extending over the vertex of the brain. They also occur in children throughout the course of the disease in chronic cases, when basal meningitis is present. Convulsions have been absent in adults, but seem to have been represented by muscular twitchings in acute cases. These twitchings have been observed in the face, the arms, and the legs. They occur only at intervals, and are commonly produced reflexly by movements of the limbs or by touching the skin.

ORGANS OF SPECIAL SENSE - Of the organs of special sense, the eye and the ear have been most frequently affected. With regard to the former, the pupils in the irritative stage of the disease have been contracted when

there has been delirium. In the stage of coma they have commonly been dilated. Inequality of the pupils has been very frequent in all stages of the disease. They have commonly responded very feebly to light. An irregular form of hippus has been frequently observed, both in acute and in chronic cases. In this the pupils have contracted and dilated with something approaching a rhythmic frequency, the oscillations commonly occurring from 10 to 15 times a minute. A comparison between the maximum of dilatation and maximum of contraction has been greater than normal, and the oscillations have been irregular in speed and in rhythm. This has occurred without the eye being illuminated or the gaze being fixed on a distant object. Strabismus has been moderately common at all stages, being apparently due to pressure rather than to central lesion of the nerve, as it varied in the same subject from day to day. In only one case which recovered was the squint permanent, and in this case it was internal. Nystagmus, both horizontal and vertical, has been commonly observed in very acute cases and occasionally in the chronic stage.

A curious condition, consisting of an associated movement of the upper eyelids, pupils, and eyeballs, has been occasionally observed in chronic cases in the stage of chronic hydrocephalus. This consisted of spasmodic retraction of the upper eyelids, accompanied with the form of hippus already described and with an irregular form of nystagmus, but not true nystagmus, where an involuntary oscillation of the eyeball occurs from side to side of the central line of vision. In these cases the nystagmus has consisted in irregular twitchings of the eyeballs in all directions, and not from side to side of the middle line. Retrac-

tion of the upper eyelids has been moderately common in the stage of chronic hydrocephalus. Ptosis has not been observed. Conjunctival haemorrhages have been only observed in six cases. In acute cases there has commonly been a uniform diffuse redness of the conjunctivae. In only a very few cases has there been purulent conjunctivitis, and this in exceptional instances has proceeded to ulceration of the cornea. Out of a series of about 40 cases which were examined carefully for changes in the fundus optic, neuritis has been observed in all the cases which had developed chronic hydrocephalus, but has not been found at any other stage of the disease. In the acute cases, hyperaemia of the optic discs has commonly been noted. A few patients have appeared to be blind throughout the course of the disease, but none of these have recovered with blindness.

As to the ear, both the middle ear and the central auditory system have been frequently affected. In children, inflammation of the middle ear with purulent discharge has been moderately common. The diplococcus of Weichselbaum has never been isolated in pure culture from this discharge. Out of the 14 recoveries in the first portion of the epidemic, complete deafness was present in four. In two of these the disease was abortive in character and in two it was chronic, and the deafness was observed in all immediately after the initial stage of coma had passed away. Out of 30 patients who recovered from January to May, 1907, five were completely deaf. Of these, three were abortive cases and two were chronic, and the deafness was observed in all, in the early stage of the disease, as soon as the stupor had passed away. Other patients, especially children in whom a fatal result occurred,

may have been deaf during the course of the disease, but it has been difficult to make this out. The deafness in all cases has been bilateral and complete. In none of these cases has improvement in hearing taken place since dismissal. No discharge from the middle ear has occurred in any of those who recovered with deafness.

Taste and smell have not been affected.

Nasal discharge has not been a feature of any of the cases.

TEMPERATURE - At the onset in acute cases the temperature commonly ranges from 102° to 104° F. In these cases it commonly continues at this level without remitting throughout the course of the illness, and rises or falls immediately before death. In many cases, however, in which coma has occurred within the first few hours after the onset, the temperature has been sub-febrile, normal, or subnormal when admitted on the first or second day of illness. Fever has probably been present at the onset, and the temperature has fallen with the commencement of coma. When the acute case aborts, the temperature remains high for some days, and falls by crisis or less commonly by lysis. In the chronic cases there has been so much variability in the course of the temperature that classification is impossible. In many of these cases the temperature has been apparently arbitrary. In some there have been periods of apyrexia, lasting from three to seven days, followed by febrile periods remittent in character, lasting for about a similar period, though the periods of apyrexia became gradually longer as the illness progressed. In one chronic case this form of fever lasted for 160 days, but the pyrexia did not occur at regular intervals. In this case, during the latent intervals of the fever all the symptoms of

pain, rigidity, etc., passed completely away, but the renewal of the fever on every occasion was accompanied with nausea and vomiting, headache, and rigidity of the muscles. There is, however, one form which has been much more common than the rest. In this, commencing at a period from the eighth to the fourteenth day, the temperature has taken on a markedly remittent type, the daily swings amounting to as much as 3° or 4°. The maxima and minima do not regularly occur at set hours, and consequently the phenomenon is much more discernible in a four-hourly chart. This remission in some cases reaches the normal line, or even a degree below it, and persists for a considerable time. There is no phenomenon such as sweatings or burnings of the skin associated with this daily oscillation, but headache and vomiting are common. The oscillation may persist for five weeks or longer, and either end abruptly or by the excursus becoming gradually less marked. The return of the temperature to normal may either mean approaching convalescence or the approach of a stage of gradual wasting, fatal sooner or later. The commencement of this stage of daily remission supervenes sometimes on the acute high fever, while sometimes there is a period of several days' normal temperature between the end of the primary fever and the beginning of this stage. In many of the chronic cases the temperature has been more or less normal for weeks before death. In some of the milder cases the temperature has remitted regularly from 101° to 102° to normal in the morning throughout. In cases of this kind, where there has been no delirium or coma and where relapses have not occurred, recovery has been the rule.

CIRCULATORY SYSTEM - The pulse rate had varied greatly in different cases. As a rule it has been much accelerated. In a number of cases the pulse has been slow, in a few ranging as low as 40 to 50 per minute. Marked variation in its frequency at different hours of the day and on consecutive days has been frequently observed in the same individual. The pulse rate is ordinarily little influenced by alterations in temperature. In two cases which recovered, its rate remained normal during the whole course of the disease, although the temperature throughout the illness was considerably elevated. In the early stage the pulse has been full, regular, and of good tension, and it remains good in cases which recover. In chronic cases it becomes rapid, irregular, and of poor tension. Several hours before death in acute cases the pulse has usually become very rapid and feeble. This has been associated with lividity of the body. No changes in the heart sounds are observed beyond what are common in all wasting diseases.

RESPIRATORY SYSTEM - The respirations as a rule have been accelerated at the commencement of the illness, always absolutely, but frequently also out of proportion to the acceleration of the pulse, though no lesions of the lungs could be detected on auscultation. This has been one of the conditions which produced the resemblance of the patient's appearance to that of one suffering from acute pneumonia. In those cases in which the pulse rate has been slow at the commencement, the pulse respiration ratio has been as high as 1 to 2 or even higher. In the acute cases various forms of nervous breathing were frequent, particularly in young children, and shortly before death. True Cheyne-Stokes breathing was very rare, but the various modifications of this, such as that where

the breathing rises gradually to a maximum, falls suddenly to a minimum, rises slowly again, and passes through cycles of irregular length, have been not infrequent. In some of these the pulse has followed the respiration, and in some not. How far these irregularities of the respiration have been pain reflexes in a patient in a state of stupor is naturally not clear, but a number must undoubtedly be placed under this category. In the acute cases immediately prior to death, intermittent, sighing, and irregular respiration have been frequent. In chronic cases the breathing has generally been quiet.

DIGESTIVE SYSTEM - Vomiting has been the most prominent symptom of disorder of the digestive system. A history of this has been almost uniformly obtained. It commonly ceases after the first few days, but in chronic cases it may occur at intervals without reference to the pyrexia. In those cases, however, in which relapses occur, it has been a feature of the periods immediately preceding the recrudescence of the fever. It has occurred with little effort and without apparent nausea. Unless throughout the first few days, during the acute stage of the disease the appetite has as a rule been good, and considerable nutriment has been taken, and often with apparent relish. The occurrence of vomiting seems to have interfered very little with the taking of food. The faeces in general have been quite normal, showing no evidence of incomplete digestion. Throughout the course of the disease the tongue, as a rule, has been fairly clean, with perhaps a thin white moist fur. In very severe and protracted cases only has it been dry and brown. It has been observed to peel in an irregular and patchy manner in some cases. The abdomen has never been distended, nor has the spleen been found to be enlarged. The bowels, as a rule, have been constipated.

There has been loss of control of the rectum in all the acute cases, and also in many of the children even when they have been conscious.

URINARY SYSTEM - In the acute stage of the illness the amount of urine passed has not been altered. In chronic cases, however, where hydrocephalus has developed, the amount has been greatly increased and the colour has been pale. No sugar has been present in any of the cases. Albumin has only been found very occasionally, and in small quantity in acute cases shortly after onset. It has never been present at any other stage of the disease. Blood has never been found. There has been no instance of nephritis observed. Incontinence of urine has been common in children throughout the course of the disease. It has only been observed in adults during the state of unconsciousness.

JOINTS - Arthritic pain, though it has been a feature of some other epidemics, has only occurred in a very few cases. The wrists, knees, and ankles have been chiefly affected. The joints have been tender to touch. This symptom when present appeared shortly after the onset and subsided in a few days. A purulent arthritis has occurred in only two cases. In the first case the knee-joint alone was affected. The patient had a sharp attack of the disease, which aborted. The swelling appeared the day in which the crisis occurred, when the patient was otherwise well. The cavity of the joint was much distended. The skin was red and tender to the touch. On exploring, thick yellow pus was obtained, from which the diplococcus of Weichselbaum was isolated in pure culture. The knee was opened and drained, and the patient made an uninterrupted recovery with, however, an ankylosed joint. The other

case was chronic in character. Swelling of both wrists, both ankles, and the right knee-joint developed within a few days of each other, well on in the course of the disease. Slightly turbid fluid was obtained on aspirating the knee-joint, and the diplococcus of Weichselbaum was again isolated in pure culture from this fluid. This patient died eventually, but the swelling of the joints subsided without surgical interference.

HISTORICAL NOTE

In view of the fact that cerebro-spinal fever has assumed epidemic proportions in Scotland for the first time, an account of its history and its clinical aspect should not be without interest.

The first case definitely recognised occurring in Scotland was communicated to the Glasgow Clinical and Pathological Society in 1883* by the late Dr. James Finlayson. This case was admitted to the Glasgow Western Infirmary in February of the same year, and was verified by post-mortem examination. However, in 1878 the late Dr. T. J. Maclagan had reported in "The Lancet"** a series of cases occurring in Dundee, but doubt was expressed at the time as to their real nature, many considering that they were aberrant cases of typhus fever, and a careful

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*"Glasgow Medical Journal", September, 1883, p. 219

**"The Lancet", 9th February, 1878, p. 219

comparison of his clinical account with the symptoms observed in this epidemic leads to the belief that such was really the case. One of his chief points, the absence of rash, is of much less weight at the present time, as it is now known that the characteristic rash of typhus fever is absent in fully a third of the cases. Dr. Maclagan reported these cases again more fully in the "Edinburgh Medical Journal" in the year 1886.

In May, 1883,* a case subsequently verified by post-mortem examination was admitted to the late Sir William Gairdner's wards in the Glasgow Western Infirmary. In January, February, and March, 1884,** the first definitely recognised outbreak of this disease in Scotland occurred in Galston, Ayrshire. These cases, six in all, were reported by Dr. William Frew (Kilmarnock) to the Clinical and Pathological Society of Glasgow in May of that year. Two of them were verified by post-mortem examination. Dr. Frew also describes some cases of an abortive type which occurred at the same time. Immediately on seeing this paper Dr. Byrom Bramwell*** wrote to Dr. Frew stating that he himself had observed sporadic cases in Edinburgh. Dr. Alexander Collie**** also wrote about the same time stating that cases of this disease had come under his own observation in Scotland.

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*"Glasgow Medical Journal", June, 1883, p. 459

**Ibid., July, 1884, p. 21

***Ibid

****Ibid.

In 1885* the late Dr. Finlayson reported a further case occurring in his wards in which the diagnosis was confirmed post-mortem. In the same year** Dr. J. Nigel Stark reported two cases occurring in the Royal Infirmary, Glasgow, in which the diagnosis was likewise confirmed post-mortem. In 1887*** Dr. Anstruther Davidson (Sanquhar) reported a case which recovered, convalescence being very protracted. From 1884 to 1888**** single sporadic cases of the disease occurred in Rothesay, Dumbarton, and Kilmarnock, while in the four years, six further cases were observed in Galston. These were also recorded by Dr. Frew. In some of these the diagnosis was verified by pathological examination. In 1892***** Dr. W. A. Maclachlan of Dumbarton reported a case which recovered. At the annual meeting of the British Medical Association at Carlisle in 1896, Dr. Frew read a further paper in which he states that he had collected notes of upwards of 100 cases of cerebro-spinal fever which had occurred in Scotland without, however, specifying the exact localities in which they occurred. A third fatal case verified post-mortem was admitted into the wards of the late Dr. Finlayson in 1900. In the same year****** Dr. T. K. Munro reported a case occurring in the Glasgow Royal Infirmary in which recovery took place in five days. The

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*Ibid., July, 1885, p. 56

**Ibid., July, 1885, p. 58

***Ibid., April, 1887, p. 241

****Ibid., March, 1888. p. 193

*****Ibid., August, 1892, p. 90

******Glasgow Hospital Reports, 1900, p. 253

three cases of Dr. Finlayson, the case of Sir William Gairdner, and the two cases of Dr. Stark all occurred in persons residing in Glasgow, and afford proof that the disease has been present in the city since 1883.

Professor J. Glaister made in 1902 a post-mortem examination on a case of sudden death occurring in Paisley. In his report to the corporation he stated that he had found the characteristic organism of cerebro-spinal fever in the exudation round the brain and spinal cord, and he also expressed the opinion that six other cases occurring at the same time were clinically cases of the same disease. Six undoubted cases occurred in Rothesay between 6th May, 1904, and 4th June, 1905, one of which was verified by lumbar puncture. Dr. F. Dittmar made a report on these to the Local Government Board of Scotland. Dr. J. Wallace Anderson has believed for a considerable number of years that the disease was constantly present in Glasgow in small amount. He has published a note of his cases in the Transactions of the Epidemiological Society, and he recently gave a demonstration of cases that had recovered in the Glasgow Public Health Office. I had the fortune to be present at this demonstration, and I had no doubt that the majority of his cases had been genuine examples of the disease. Sporadic cases have therefore occurred in Scotland during the last 20 to 30 years, but this is the first occasion there has been an epidemic comparable in extent with any that has occurred in the Continent or America.

AN INVESTIGATION

into

THE LEUCOCYTOSIS

of

EPIDEMIC CEREBRO-SPINAL MENINGITIS

The following observations on the leucocytosis of Cerebro-spinal Fever were made in the year 1906 during the first part of the recent epidemic. Fifty-five verified cases were admitted into Belvidere Fever Hospital during that year, and in 36 of these, observations into the leucocytosis were made. The blood was examined usually every third or fourth day between 10 and 11 a.m. throughout the whole course of the disease. Daily observations were sometimes made with a view of observing the relation of the leucocytosis to the pyrexia, while in chronic cases observations were often only made at weekly intervals. The red corpuscles were not counted, nor was the haemoglobin estimated. The blood was usually taken without pressure from the lobe of the ear, but occasionally it was found more convenient to collect it from the finger. Films were prepared at the same time, and fixed and differentiated by Leishman's modification of the Romanowsky stain.

In the course of the present investigation the leucocytosis was estimated 259 times, and in 171 of these the different forms of leucocytes were counted. The patients were of both sexes, and at all stages of

life. For the differentiation of the leucocytes, 500 cells were counted on the average.

The cases have been classified in the four groups* already described:-

I The Acute Cases
II The Abortive
III The Mild, and
IV The Chronic Cases

The Acute Cases number 10; the Abortive, two; the Mild, three; and the Chronic, 21. All those in the first and last classes, with the exception of three chronic cases, were fatal, while those in Groups II and III all recovered. Of the acute cases five were males and five were females, their ages ranging from one to 24 years; the two abortive cases were males, their ages being nine and 20 respectively; of the mild cases, two were females and one male, their ages being 31, six, and five respectively; while of the chronic cases, 11 were males and 10 females of ages varying from four months to 16 years.

To save undue repetition in the text, the results of the whole observations have been collected in the tables in the Appendix. Ehrlich's nomenclature has been used as that most generally approved. The tables give the morning and evening temperatures of the cases observed, and the total number of leucocytes recorded on each observation, along with the absolute numbers and percentages of each variety of white cell observed on each occasion. In those instances where the total leucocytosis alone is recorded, a differential count was not made.

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*See page 6

The general results of the observations may be briefly outlined. If we take 7,000 to 8,000 leucocytes per c.mm. of peripheral blood as the standard, it will be observed that the number of the leucocytes was constantly in excess of this. In one of the mild* cases, however, a single count of 2,600 cells was obtained. This case, though the pyrexia lasted 50 days, is included among the mild cases, because there was never any of the severer symptoms present, nor was the patient's life ever considered in danger. In addition it should be noted that the leucocytosis was due as a rule to an increase both absolute and relative of the polymorphonuclear cells. In those cases where the patients were infants or young children, a distinct lymphocytosis both absolute and relative was very occasionally observed. This was more marked in the chronic form of the disease. The leucocytosis in the cases recorded was generally considerable. It has in general risen and fallen with the temperature.

The particular results in each type of the disease now falls to be discussed. The acute cases will be described first.

GROUP I - ACUTE CASES - FATAL

In the acute cases examined, the patients were admitted between the third and sixth days of illness, and as all of them died within about 24 to 48 hours after admission, only one observation was made except in one instance. In all these cases the leucocytosis was very considerable. The maximum number of white cells varied between 18,000 and 66,800, the latter being the highest individual count in any of the groups. The

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*See pages 6 and 17

leucocytosis was always due to an increase both absolute and relative of the polymorphonuclear cells.

Even in infancy the leucocytosis is polymorphonuclear. In the case of a child (Case 4) aged only 16 months, the percentage of polymorphonuclear cells was 88.75 and of lymphocytes 10.25, which is evidence of a very great increase. In the case of another child of the same age (Case 3), the percentage of polymorphonuclear cells was 54.4 and of lymphocytes 40, which is almost an exact interchange of the normal proportions, and still shows a considerable increase.

The large mononuclear cells retained their normal relative proportions in four of the cases, and in the other six their relative percentage was very much reduced. In one instance (Case 6) in which the differential count showed 94.3 per cent. of polymorphonuclear cells, no large mononuclear cells were observed in the film examined. This diminution was absolute as well as relative in two of the cases (Cases 2 and 6).

Eosinophile corpuscles were not observed in the films examined of any of this series of cases. This is what one would expect to find, as these cells are recognised to be rare in cases of septic disease which are fatal. Complete absence of these corpuscles is found in Typhus and Pneumonia and Plague, etc., and is observed apparently only in cases which eventually terminate unfavourably.

As the acute form of Cerebro-spinal Meningitis was always fatal, it is noteworthy that eosinophile corpuscles were found absent in all of this group, although they were found in varying amounts in all the other forms of this disease.

GROUP II - ABORTIVE CASES - RECOVERIES

This group comprised two cases, in both of which the leucocyte counts were taken after the temperature had become normal. In the one case (Case 11) the patient was admitted on his 11th day of illness, and there had been no pyrexia from time of admission onwards. In the other case (Case 12) the patient was admitted on the fourth day of illness, and the leucocytosis was obtained from the 16th to the 27th days of illness, although there had been an absence of pyrexia from the seventh day onwards unless for a temporary rise of temperature on the 15th day. Both patients, however, were still complaining of pains in the head and the back for several days after the disappearance of the pyrexia.

In the former case (Case 11, aet. 20) the estimate varied between 10,000 and 14,000. The relative percentage of the polymorphonuclear cells remained practically the same as in normal blood, but the relative percentage of lymphocytes was slightly increased at the expense of the large mononuclear cells, which were both absolutely and relatively diminished. In the latter case (Case 12) the estimate was from 14,000 to 23,400. Out of the four differential estimates made, the polymorphonuclear cells preserved the relative percentages obtained in adult normal blood on the first and last occasions. In the other two observations, a relative and absolute lymphocytosis was present, which might be accounted for in part by the youth of the patient.

The large mononuclear cells were relatively diminished. This change was absolute as well as relative in one instance, and on one

occasion these cells were entirely absent.

Eosinophile cells were present throughout in the former case (Case 11), but were not observed in the latter case (Case 12) till far on in convalescence.

GROUP III - MILD CASES - RECOVERIES

This group comprised three cases, all of whom recovered. The temperature remitted from 101 to 103 to about normal in the morning throughout the whole course of the fever, which lasted from about 40 to 50 days. The differential estimate was done in the first two cases (Cases 13 and 14) throughout the whole period of pyrexia. In the third case (Case 15), only one leucocyte count was taken and no differential estimate was made, so that no value can be attached to this observation unless to show that a single count taken at random revealed a leucocytosis. The number of white cells during the pyrexia will be seen to vary in the first case (Case 13) between 10,000 and 30,000; in the second case (Case 14), between 2,600 and 16,200. The single count in the third case (Case 15) revealed 24,000 white cells. With the fall of the temperature, the leucocyte counts became normal. The leucocytosis in this group of cases was not specially high. As in the Chronic Group, it increased and decreased in a very irregular manner from day to day, and this can only be explained by the variability in the temperature. To a certain extent the leucocytosis has risen and fallen with the temperature in these cases, but this was not a constant phenomenon, nor did the variation in the number of the leucocytes show any correspondence with any other

clinical symptom. In the second case (Case 14), the leucocyte count remained low from the 14th day onwards to the 50th day, when the patient was quite well. This change occurred the day after the patient had a first injection of anti-meningococcic serum, so that there was practically an absence of leucocytosis from that date onwards while the patient was under observation. A hypo-leucocytosis is recorded after the injection of antitoxic serum in Diphtheria, and as these low counts were quite exceptional in the ordinary course of the disease, it may be presumed that they were due to the injection of anti-meningococcic serum.

In the first case (Case 13), a child, aged six years, the polymorphonuclear cells showed a relatively higher percentage than they normally should at that period of life. In a single differential estimate taken two days after the temperature had become normal, a relative and absolute increase of lymphocytes was obtained, and if we take this as approximating the normal percentage of the different forms of cells in this case, then it might be reasonable to infer that the previous estimates revealed a polymorphonuclear leucocytosis. The large mononuclear cells were diminished both absolutely and relatively.

In the second case (Case 14), the relative percentage of the polymorphonuclear cells remained practically in the ratio observed in normal blood, unless on two occasions when the percentage was over 80. The relative percentage of lymphocytes was slightly increased at the expense of the large mononuclear cells, which were relatively and absolutely diminished, and on four occasions entirely absent.

Eosinophile cells were present throughout in both cases. In the second case (Case 14), the proportion of these cells was as high as five

per cent., but there was no real eosinophilia. This is interesting in view of the fact that, in the acute cases, all of which were fatal, these cells were completely absent.

GROUP IV - CHRONIC CASES

TWENTY-ONE CASES - THREE RECOVERIES

This group comprised 21 cases, in 16 of which a differential estimate was made throughout the course of the disease. The patients were all infants and children from four months to seven years of age, unless in the instance of a girl aged 16. All but three had a fatal issue, but a differential estimate was made in only one of the former (Case 29).

There was so much variability in the course of the temperature in these cases that classification was impossible. The number of white cells varied markedly from day to day, without relation to the course of the disease and without reference to any particular law. There was not a gradual increase to a maximum and decline to a minimum, and it cannot be stated definitely at what period of the disease the leucocytosis was greatest, as this was so variable, occurring both at the commencement, the middle and the end of the disease. The number of white cells will be seen to vary in this group between 7,000 and 59,000.

The leucocytosis was due essentially to an increase both absolute and relative of the polymorphonuclear cells. As the majority of the cases were in infants and young children, the relative percentage of these cells was naturally not increased to such an extent, as you would

expect to find in the adult, but it was sufficiently high to indicate in practically all instances a distinct polymorphonuclear leucocytosis. In a child aged six months (Case 30) the relative percentage of the polymorphonuclear cells was only once as high as high as 42, and towards the end of the disease fell to 21. This however is quite physiological in a child of this age, and the case is quoted in order to show the influence that age has on the leucocytosis, as it is well known in the various pathological leucocytoses that, while otherwise you may have constantly a polymorphonuclear increase, in the case of young infants occasionally a relative and absolute lymphocytosis may be observed. In another child of the same age (Case 21), on the other hand, there was on an average 60 per cent. of the polymorphonuclear cells, which is a considerable increase for a child of that age. In three children, all aged 18 months (Cases 17, 18 and 23), the average relative percentage of the polymorphonuclear cells was 74, 80, and 83 respectively. This reveals also quite a marked increase of these cells at this period of life. In still one more instance, a patient aged five years (Case 29), the behaviour of the leucocytosis is worthy of special description. In this case there was a form of fever* with periods of apyrexia lasting from three to seven days, followed by febrile periods remittent in character, having about a similar duration. The pyrexia lasted 160 days and the patient eventually recovered, and this was the only instance, out of the three recoveries in this group, in which a differential count was taken throughout the course of the disease. From the 121st to the 125th days, and from the

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*See page 16

128th to the 138th days, the leucocytosis was observed every day in order to see if it varied with the rise and fall in the temperature.

It will be observed that the blood count was, as a rule, particularly high during the periods of pyrexia, but was of only moderate extent during the afebrile periods. On the 125th day a count of only 10,400 was obtained, but this can be explained by the fact that the period of pyrexia in that instance did not commence till the evening of that day, when the temperature reached 102.6°F. On the 128th day a count of 26,200 was obtained, although the morning and evening temperatures remained normal, but this may also be explained by the fact that the temperature had just fallen on that day, and the period of apyrexia was just commencing. It cannot be definitely stated that the leucocytosis corresponded with the temperature in this way throughout the whole course of the disease, and it may be noted in this connection that, although the patient was usually well when the temperature remained normal, at other times this was not the case. The leucocytosis in this instance was essentially a polymorphonuclear one, and this was most evident as a rule during the periods of pyrexia. Quite frequently, however, both a relative and absolute lymphocytosis was obtained both in the periods of pyrexia and apyrexia, although oftener in the latter, but this may be accounted for by the fact that the patient was only five years of age.

In the remaining ten cases of this group in which a differential estimate was made, the leucocytosis was quite definitely polymorphonuclear. In two instances in children (Cases 27 and 28) there was a tendency towards a slight lymphocytosis towards the end of the disease.

The large mononuclear cells had an average relative percentage of

five throughout the whole of this group. This percentage was sometimes slightly decreased, and in other instances a little increased in individual cases, but remained fairly constant throughout. In consideration of the fact that the majority of the cases were in young children, the percentage of these cells was somewhat reduced, although it was higher and more constant than in any of the other three groups. The absolute numbers of these cells, however, were not definitely diminished.

Eosinophile cells were present also in small amount in all of these cases during their whole course, although they were practically all fatal. In the only instance (Case 29) in which the patient recovered where the differential count was done, these cells were not more constant or more numerous than in the other cases which proved fatal.

Basophile cells were observed in four instances (Cases 27, 28, 30, and 31) at very occasional intervals. Their absolute numbers varied from 35 to 105, thus constituting a slight basophilia. These cells, however, were not observed in the chronic case which recovered.

VALUE AS TO DIAGNOSIS AND PROGNOSIS

From the point of view of diagnosis, epidemic Cerebro-spinal Meningitis as observed in the recent outbreak quite frequently resembles tubercular meningitis, other forms of non-tubercular meningitis, and pneumonia; and occasionally the clinical features are not unlike those of enteric fever, typhus and bubonic plague. In attempting these diagnoses, the presence of a leucocytosis is only of value in excluding typhoid fever, coming on with meningeal symptoms, as it is well known a leuco-

poenia is constantly present in the latter disease, unless the illness is complicated by some inflammatory phenomena.

While the diagnostic significance of the condition of the blood in cerebro-spinal fever is found to have been of importance in differentiating between that disease and enteric fever, the same cannot be said regarding its significance in the other diseases mentioned.

In regard to tubercular meningitis, it is very often quite impossible, from the character of its onset and clinical characteristics, to distinguish it from cerebro-spinal fever. In the former disease also, unlike other forms of tuberculosis, leucocytosis of the polymorphonuclear variety is now recognised to be almost invariably the rule (Da Costa), and thus the blood examination does not assist much in the diagnosis. An increase in the number of the white cells does not seem, however, to be so constant a feature of the blood in tubercular meningitis as in the non-tubercular forms, so that the absence of leucocytosis rather suggests the former, although the presence of leucocytosis does not of necessity exclude it.

In distinguishing between other forms of non-tubercular meningitis, pneumonia, typhus, bubonic plague and epidemic cerebro-spinal meningitis, the blood unfortunately offers but little help. There is a leucocytosis in all of these diseases of the polymorphonuclear variety. The eosinophile cells are absent in acute cases of cerebro-spinal fever ending in death, and are also absent in fatal cases of typhus. These corpuscles are also recognised to be very much reduced, if not entirely absent, in unfavourable cases of pneumonia and bubonic plague.

In these respects, therefore, the blood of these diseases presents

similar characteristics, and an examination of that fluid alone gives little or no help in arriving at a diagnosis. The only certain method of diagnosis is by lumbar puncture, by which procedure, and from a careful study of the character of the fluid obtained, and by bacteriological tests, an accurate diagnosis can be practically always arrived at.

As regards prognosis, little can be said concerning the general leucocytosis of epidemic cerebro-spinal fever. The fact that eosinophile corpuscles were not found in the acute fatal cases has already been mentioned, and may be regarded as of grave significance. These cells, however, were sometimes absent during the acute stage of an illness, which eventually became chronic. It may be inferred that if these cells are present during the acute stage, an unfavourable issue will not immediately ensue, but if no corpuscles of the eosinophile type are found during the acute illness, it does not necessarily mean that a fatal termination will soon follow, as the case may eventually become chronic.

The degree of leucocytosis in general appears to have little or no prognostic value.

GENERAL CONCLUSIONS

An analysis of these observations under their respective headings, and of the tables and charts in the appendix in which the various blood cells are dealt with, leads to the following conclusions:-

(1) That cases of epidemic cerebro-spinal meningitis are always accompanied by a leucocytosis, whether the attack is acute,

abortive, mild, or chronic

(2) That the character of the leucocytosis is practically the same in all instances, both adults and children, and is the result mainly of an increase in the number of the polymorphonuclear cells

(3) That, nevertheless, a lymphocytosis may be very occasionally observed in infants and young children

(4) That there is a relative decrease of the large mononuclear elements alike in fatal and non-fatal cases, though less marked in the chronic type

(5) That in the first three groups there is sometimes an absolute decrease of the large mononuclear elements, and occasionally total absence of these cells. In the chronic group, absolute decrease, like relative decrease, is little marked

(6) That eosinophile corpuscles in acute fatal cases are always absent, although present in varying degree in all the other groups

While bearing these general conclusions in mind, the full significance of the observations can only be determined after a careful and detailed analysis of the characters and numbers of the different groups of white cells, as well as of the conditions under which these are present.

In the present series the highest individual count was obtained in an acute case (Case 5, Group I), the leucocytes numbering on one occasion, 66,800. This degree of leucocytosis may be regarded as a rough

gauge of the intensity of the infection, as it was usually greater in severe than in mild cases.

In the two abortive cases (Cases 11 and 12, Group II) the leucocytosis was observed after the temperature had become normal, and convalescence was well advanced. The normal relative percentage of the different cells was not much disturbed in these two cases, but it is necessary to bear in mind that their blood was not examined during the febrile period.

In the two mild cases (Cases 13 and 14, Group III) the leucocytosis, although polymorphonuclear, was only moderate. This may be taken to indicate that a moderately intense infection was linked to fairly well developed resisting powers, as both these patients recovered.

It may again be noted that, although a hypo-leucocytosis was obtained from the 14th day onwards in one of these cases (Case 14), this may be accounted for by the injection of anti-meningococcic serum. The eosinophile cells were sometimes as high as five per cent. in the latter patient, who recovered, and this is interesting in view of the fact that, in the acute fatal cases, these corpuscles are absent.

The number of white cells in general varies markedly from day to day, and without relation to the course of the disease, nor can any clear relationship be established between the leucocytosis and the character of the temperature. As already stated, in one case (Case 29, Group IV) the leucocytosis was observed to be very high during certain periods of pyrexia. This observation, however, was not invariable, either as regards this patient or others.

The large mononuclear cells were relatively diminished in all the cases, both in those ending fatally and in those which recovered, al-

though not so markedly in the chronic group, so that no special significance can be attached to this fact.

The occasional presence of basophile cells in four chronic cases (Cases 27, 28, 30 and 31) cannot be readily explained, unless due to the influence of some specific chemotactic substance.

It may be here remarked that myelocytes were never observed in any of the films examined.

Blood platelets were always present in the blood of all the cases examined, sometimes in large numbers. No marked difference was noted in the frequency of occurrence of these elements in the fatal and non-fatal cases respectively.

As regards diagnosis, it may be again noted that the leucocytosis is only of value in excluding typhoid fever.

From the point of view of prognosis, the absence of eosinophile corpuscles in the acute stage of the disease may be considered of grave significance, but it does not necessarily mean that a fatal issue will immediately ensue, as the case may eventually become chronic.

APPENDIX

GROUP I - ACUTE CASES

CASE NO. 1 - A. C., aet. 15; admitted to Hospital on the fifth day of illness; died on the seventh day of illness

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
5	101	101.8	27,600	25,875	1,173	552		93.75	4.25	2	

CASE NO. 2 - M. MacD., aet. 5; admitted to Hospital on the sixth day of illness; died on the eighth day of illness

8	103.2	105.8	20,200	17,675	2,373	152		87.5	11.75	.75	

CASE NO. 3 - M. S., aet. $1\frac{4}{12}$; admitted to Hospital on the fourth day of illness; died on the fifth day of illness

5	101.8	103.8	20,000	10,880	8,000	1,120		54.4	40	5	

CASE NO. 4 - C. C., aet. $1\frac{4}{12}$; admitted to Hospital on the fifth day of illness; died on the seventh day of illness

6	99	102	23,400	20,768	2,398	234		88.75	10.25	1	

CASE NO. 5 - C. C., aet. 6; admitted to Hospital on the third day of illness; died on the fourth day of illness

3	101.8	99.6	55,000	45,513	8,525	962		82.75	15.5	1.75	
4	98.4	98.4	66,800	55,277	9,352	2,171		82.75	14	3.25	

GROUP I Contd.

CASE NO. 6 - M. P., aet. 13; admitted to Hospital on the third day of illness; died on the fifth day of illness

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
4	100.2	101	35,000	33,005	1,995			94.3	5.7		

CASE NO. 7 - J. T., aet. 22; admitted to Hospital on the fourth day of illness; died on the fourth day of illness

4	103.2	104.8	38,600	34,740	1,930	1,930		90	5	5	

CASE NO. 8 - J. A., aet. 2; admitted to Hospital on the third day of illness; died on the fourth day of illness

4	103		18,000	13,608	3,600	792		75.6	20	4.4	

CASE NO. 9 - J. D., aet. 24; admitted to Hospital on the fourth day of illness; died on the ninth day of illness

4	100.2	101.2	30,000	27,420	1,380	1,200		91.4	4.6	4	

CASE NO. 10 - A. G., aet. 11; admitted to Hospital on the fourth day of illness; died on the fifth day of illness

5	99.6	104.8	40,000	35,040	3,760	1,200		87.6	9.4	3	

GROUP II - ABORTIVE CASES - RECOVERIES

CASE NO. 11 - P. W. G., aet. 20; admitted to Hospital on the eleventh day of illness

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
12	98	99	12,200	8,510	3,446	61	183	69.75	28.25	.5	1.5
13	98	99	13,000	8,715	4,355	65	65	65.5	33.5	.5	.5
17	98	98.4	14,000	9,800	3,990	175	35	70	28.5	1.25	.25
19	98	99	10,000	6,050	3,875	25	50	60.5	38.75	.25	.5

CASE NO. 12 - C. C., aet. 9; admitted to Hospital on the fourth day of illness

16	99	99	18,800	14,100	4,653	47		75	24.75	.25	
18	98.6	97	15,200	7,866	7,334			51.75	48.25		
20	97	98	23,400	7,898	15,151	351		33.75	64.75	1.5	
27	97	98	14,000	10,220	3,255	245	280	73	23.25	1.75	2

GROUP III - MILD CASES - RECOVERIES

CASE NO. 13 - S. MacK., aet. 6; admitted to Hospital on the first day of illness

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
3	101	102.8	24,400								
4	100.4	103.2	19,000	12,730	6,223	47		67	32.75	.25	
6	98	101.6	18,000								
11	100.6	101.8	10,000	6,550	3,275	125	50	65.5	32.75	1.25	.5
18	98	101.2	11,000	8,030	2,750	220		73	25	2	
20	97.8	98.4	11,400	7,952	2,936	313	199	69.75	25.75	2.75	1.75
21	99.8	99.8	16,000								
23	103	102.4	30,000	22,500	6,900	600		75	23	2	
29	99	100.6	10,000								
35	97	98	6,200	2,759	3,286	124	31	44.5	53	2	.5

CASE NO. 14 - Mrs. P., aet. 31; admitted to Hospital on the fifth day of illness

5		102.4	11,600	9,048	2,494	29	29	78	21.5	.25	.25
8	98.2	102.6	13,400	9,782	3,350	201	67	73	25	1.5	.5
9	100.2	101.2	12,000								
10	101.8	103.8	16,200								
11	98.4	104	14,000								
14	100.4	103.8	12,200	9,974	1,983	152	91	81.75	16.25	1.25	.75
17	98	103.8	9,000	6,075	2,700		225	67.5	30		2.5
19	99.4	102.4	7,000	4,550	2,310		140	65	33		2
20	98.4	102.4	7,200	5,148	1,872		180	71.5	26		2.5
21	98.4	99.8	7,600	5,092	2,052	76	380	67	27	1	5
23	99.6	100.8	4,600	3,220	1,150		230	70	25		5
25	99.6	102.4	6,000	4,170	1,605	30	195	69.5	26.75	.5	3.25
29	102.2	99.8	11,600								
33	100.2	101.2	2,600								
37	99.2	100.4	7,600								
39	97	102	9,400	6,204	3,032	23	141	66	32.25	.25	1.5
44	97.4	99.6	10,400	8,398	1,794	208		80.75	17.25	.2	
50	98.8	98.8	6,800	4,536	2,142	102		67	31.5	1.5	

CASE NO. 15 - J. C., aet. 5; admitted to Hospital on fourth day of illness

10	98.4	98.4	24,000								

GROUP IV - CHRONIC CASES

CASE NO. 16 - A. D., aet. 5; admitted to Hospital on sixth day of illness; death

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
6	100.2	102.2	28,000	23,240	3,080	1,680		83	11	6	
10	102.8	101.8	26,800	22,244	3,216	1,340		83	12	5	
14	102	104	34,200	28,728	3,420	2,052		84	10	6	
18	101.4	103.6	25,200	18,396	5,296	1,512		73	21	6	
22	99.8	101.2	33,600	28,896	3,360	1,008	336	86	10	3	1
26	101.4	103.8	18,400	14,720	2,944	414	322	80	16	2.25	1.75
31	99.4	103.2	16,800	13,944	2,184	546	126	83	13	3.25	.75
37	97.8	103.6	17,000	12,410	3,570	1,020		73	21	6	
40	99.4	103.6	17,800	15,041	2,180	534	45	84.5	12.25	3	.25
42	97	101.2	19,000	17,150	1,282	570	48	90	6.75	3	.25
45	101.2	102.6	18,600	16,182	1,813	558	47	87	9.75	3	.25
47	97.8	101.6	20,000	16,000	3,050	900	50	80	15.25	4.5	.25
51	98.6	101.6	20,000	16,000	3,200	750	50	80	16	3.75	.25
54	100.6	102.2	18,800	15,604	2,303	893		83	12.25	4.75	
57	97	101.2	18,600	15,903	2,092	605		85.5	11.25	3.25	
61	97	98	17,400	12,832	3,828	740		73.75	22	4.25	
71	97.6	97.8	40,400	35,956	2,626	1,818		89	6.5	4.5	
76	97.8	97.2	17,800	15,753	1,246	801		88.5	7	4.5	

CASE NO. 17 - A. T., aet. $1\frac{5}{12}$; admitted to Hospital on eleventh day of illness; death

12	101.2	101.6	27,000	27,000	5,940	1,215		73.5	22	4.5	
16	99.8	102	30,000	22,050	6,750	1,200		73.5	22.5	4	
20	97.2	100	30,400	23,788	5,700	912		78.25	18.75	3	
26	99	101.6	18,600	13,857	3,766	930	47	74.5	20.25	5	.25

CASE NO. 18 - J. O'D., aet. 18 months; admitted to Hospital on sixteenth day of illness; death

16	99.8	99.8	16,800								
21	100.2	100.2	34,200	22,657	9,833	1,710		66.25	28.75	5	
25	98.8	103.8	26,800	23,919	2,077	804		89.25	7.75	3	
29	100.8	102.4	23,000	20,182	1,725	920	173	87.75	7.5	4	.75
37	100.4	99.6	27,400								
41	100.2	100.6	22,000	17,050	3,960	990		77.5	18	4.5	
44	102.8	103.8	16,600	13,778	2,158	664		83	13	4	
48	99.8	100.2	15,000								

GROUP IV Contd.

CASE NO. 19 - P. K., aet. 5; admitted to Hospital on third day of illness; death

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
5	100.4	100	13,800	11,902	1,483	414		86.25	10.75	3	
18	99	102.6	15,700	10,519	4,710	471		67	30	3	
25	99	100	16,200	9,194	6,399	567	40	56.75	39.5	3.5	.25
29	100.6	100.2	18,000	12,150	5,040	720	90	67.5	28	4	.5
32	99.8	101.2	18,000	14,850	1,980	1,170		82.5	11	6.5	

CASE NO. 20 - W. A., aet. 8; admitted to Hospital on

18	101.4	100.6	18,800	15,980	2,256	564		85	12	3	
20	100.8	99.6	14,000	11,795	1,715	490		84.25	12.25	3.5	
23	101.2		21,400	18,618	2,140	642		87	10	3	

CASE NO. 21 - I. MacK., aet. 4 months; admitted to Hospital on eighth day of illness; death

9	103.8	103.8	59,200	36,260	20,276	2,664		61.25	34.25	4.5	
10	100.8	101.8	32.200	14,248	16,744	1,208		44.25	52	3.75	
11	101.2	101.8	21,000	14,542	5,618	840		69.25	26.75	4	
13	99.8	99.8	29,200	18,396	9,490	1,241	73	63	32.5	4.25	.25

CASE NO. 22 - J. M. C., aet. 2½; admitted to Hospital on fourteenth day of illness; death

15	98	101.8	27,000	17,820	8,100	1,013	67	66	30	3.75	.25
21	98	100	20,000	13,550	5,600	850		67.75	28	4.25	
24	99	100	22,000	20,240	1,320	440		92	6	2	

CASE NO. 23 - W. MacK., aet. 18 months; admitted to Hospital on eleventh day of illness; death

49	101	103.4	16,400	12,833	2,952	574	41	78.25	18	3.5	.25
50	103.8	104.4	27,600	24,495	2,139	966		88.75	7.75	3.5	

CASE NO. 24 - J. C., aet. 3; admitted to Hospital on twenty-eighth day of illness; death

30	98	98.6	17,000	12,750	3,485	723	42	75	20.5	4.25	.25

GROUP IV Contd.

CASE NO. 25 - A. D., aet. 5; admitted to Hospital on third day of illness; death

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
4	100.4	103.2	25,400	14,986	8,827	1,587		59	34.75	6.25	
6	101.4	101.6	18,000	12,600	4,275	765	360	70	23.75	4.25	2
8	101.6	102.6	18,200	13,514	3,776	728	182	74.25	20.75	4	1
13	100.2	102	19,000	14,298	3,752	855	95	75.25	19.75	4.5	.5
19	100.2	99.8	12,000	8,250	3,240	480	30	68.75	27	4	.25
25	100	100.8	18,000								
33	99.6	100	25,000	18,812	4,938	1,125	125	75.25	19.75	4.5	.5
42	97	99	12,200	7,747	3,752	579	122	63.5	30.75	4.75	1
49	99.6	100.2	9,600	6,528	2,568	360	144	68	26.75	3.75	1.5
58	99	99.2	20,000								

CASE NO. 26 - B. S., aet. 16; admitted to Hospital on the fifth day of illness; death

7	101.2	102.8	12,800	8,448	3,680	640	32	66	28.75	5	.25
11	100.8	102.4	14,000	11,865	1,575	560		84.75	11.25	4	
17	98	102.4	16,400	13,120	2,501	779		80	15.25	4.75	
21	101	99.8	7,200	5,220	1,656	324		72.5	23	4.5	
30	102.4	100.8	18,600	15,717	2,093	790		84.5	11.25	4.25	
31	97.8	98.6	20,800								
32	98.4	99.4	20,800								
33	97.8	102	11,200								
35	98	99.8	12,600	9,891	2,111	598		78.5	16.75	4.75	
36	97	98	18,600								
37	98	98.4	21,800								
38	98	100	21,800								
39	98	99.4	15,200								
41	98	98.4	14,200								
54	98.6	98	12,200	7,839	3,660	549	152	64.25	30	4.5	1.25
64	99	100.8	12,000	10,290	1,110	600		85.75	9.25	5	
72	98	97.8	14,400	10,980	2,808	612		76.25	19.5	4.25	

ROUP IV Contd.

ASE NO. 27 - A. P., aet. 3; admitted to Hospital on second day of illness; death

Day of Illness	Temperature		Total Number of						Percentages of				
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eos.	Baso.	Polymorphs	Lymphocytes	Large Mononuclears	Eos.	Baso.
3	99.4	98.2	25,800	22,188	2,580	1,032			86	10	4		
8	100.6	101.2	29,000										
10	98.4	100	38,000										
11	103.4	102	31,400	24,963	5,024	1,413			79.5	16	4.5		
15	98.2	100.2	15,800										
17	99.8	100.4	21,200	14,363	5,512	901	371	53	67.75	26	4.25	1.75	.25
19	99.8	101.4	14,400	9,720	4,032	612	36		67.5	28	4.25	.25	
20	99.4	101.6	16,000	11,880	3,200	880		40	74.25	20	5.5		.25
22	100.4	101.6	23,000										
26	99.4	101	21,800	17,712	3,161	872	55		81.25	14.5	4	.25	
30	100.6	98.6	14,000	7,910	5,250	665	140	35	56.5	37.5	4.75	1	.25
33	100.4	101.2	10,000	5,550	4,000	450			55.5	40	4.5		
37	98.4	99	11,200	6,412	4,256	532			57.25	38	4.75		
46	97.4	98.8	14,000	10,185	3,150	665			72.75	22.5	4.75		
52	97.8	99.2	13,200	6,996	5,412	660	132		53	41	5	1	

CASE NO. 28 - B. E., aet. 2; admitted to Hospital on fifth day of illness; death

6	102.4	103.8	22,800	15,276	5,928	1,425	171		67	26	6.25	.75	
10	99.8	103.4	44,400										
14	101.2	101.6	33,600	26,292	5,796	1,512			78.25	17.25	4.5		
18	98.2	99.8	19,600	12,838	5,831	784	98	49	65.5	29.75	4	.5	.25
23	102.8	99.2	21,800	15,969	4,850	981			73.25	22.25	4.5		
26	98	103	21,200										
29	98.2	102.8	19,600										
31	99.4	101.6	17,400	12,441	4,046	870	43		71.5	23.25	5	.25	
35	98.6	102.2	23,200	15,254	6,554	1,392			65.75	28.25	6		
37	100.2	101.2	26,000	21,320	3,510	1,170			82	13.5	4.5		
38	101.2	98.4	21,200	16,006	4,081	1,007	106		75.5	19.25	4.75	.5	
43	97	100.8	17,200	12,642	3,741	817			73.5	21.75	4.75		
49	98.6	99.8	24,400	20,008	3,294	1,098			82	13.5	4.5		
54	97	100.2	13,800	10,178	3,001	621			73.75	21.75	4.5		
58	99	99.2	14,000	8,680	4,690	630			62	33.5	4.5		
62	97	97.8	15,600	10,140	4,485	975			65	28.75	6.25		
69	97.8	98	15,600										
73	97.2	98	9,200	5,405	3,174	621			58.75	34.5	6.75		
75	98	98.6	18,400	10,166	7,038	1,196			55.25	38.25	6.5		
87	99.8	99.8	26,600	17,556	7,714	1,264	66		66	29	4.75	.25	
94	97.2	99	17,000										
102	97.4	98	12,600	6,584	5,166	756	63	31	52.25	41	6	.5	.25
109	98	98.8	12,800	6,592	5,568	640			51.5	43.5	5		
118	98	98.8	29,200	17,520	10,220	1,387	73		60	35	4.75	.25	
128	97.4	97	22,800										

GROUP IV Contd.

CASE NO. 29 - M. C., aet. 5; admitted to Hospital on sixth day of illness; recovery

Day of Illness	Temperature		Total Number of					Percentages of			
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles	Polymorphs	Lymphocytes	Large Mononuclears	Eosinophiles
6	101.2	102.8	17,400	12,528	4,176	696		72	24	4	
9	99.8	99.6	19,000	9,690	8,360	760	190	51	44	4	1
14	99.4	103.8	20,200	9,444	9,342	1,161	253	46.75	46.25	5.75	1.25
18	98.4	104.8	18,000	8,595	8,325	810	270	47.75	46	4	1.5
21	101.2	101	10,000								
25	100	103.2	13,000								
29	100.4	102.4	16,000								
32	101.6	102.6	18,000								
36	98	102	20,600								
40	100.2	98	21,000								
46	97	101.8	20,200	7,625	11,565	909	101	37.75	57	4	.5
50	97.8	97	12,600	3,843	7,812	945		30.5	62	7.5	
55	98	103.8	11,800	6,136	5,192	472		52	44	4	
58	98.6	102	14,800	7,289	6,845	666		49.25	46.25	4.5	
62	97.8	99.2	20,600	13,338	5,768	1,494		64.75	28	7.25	
66	97.2	97.2	13,000	5,753	6,435	812		44.25	49.5	6.25	
69	99.2	98	15,000	8,588	5,662	750		57.25	37.75	5	
72	99	97	16,800								
75	98	98	16,200								
77	99.2	100.8	10,400	4,420	5,486	468	26	42.5	52.75	4.5	.25
83	97	101.8	10,000	3,800	5,650	475	75	38	56.5	4.75	.75
84	103.4	103.8	25,800	17,480	6,901	1,419		67.75	26.75	5.5	
87	98	97.2	17,600								
90	101.2	101.4	22,000	15,620	5,115	1,210	55	71	23.25	5.5	.25
95	97.6	98	8,800								
100	97.6	99.2	13,800	6,555	6,486	759		47.5	47	5.5	
105	97	99.2	12,600	6,206	5,575	788	31	49.25	44.25	6.25	.25
108	100.6	99	22,800	17,100	4,731	969		75	20.75	4.25	
114	100.4	100.8	31,000	21,390	7,750	1,860		69	25	6	
118	97.2	98	19,200	10,032	8,208	960		52.25	42.75	5	
121	103	101.8	23,000	15,813	5,980	1,207		68.75	26	5.25	
122	97.6	98.8	18,200	18,200	6,825	910		57.5	37.5	5	
123	97.4	98.4	13,200	5,016	7,491	594	99	38	56.75	4.5	.75
124	97.8	98.4	14,800	7,215	6,771	703	111	48.75	45.75	4.75	1
125	99.8	102.6	10,400								
128	97.8	98.2	26,200	17,882	7,336	982		68.25	28	3.75	
129	97.4	99.8	12,800	6,944	5,248	608		54.25	41	4.75	
130	98	99.6	12,800								
131	98	102.8	25,000	21,250	2,500	1,250		85	10	5	
132	102.6	100.2	23,400	13,689	7,956	1,755		58.5	34	7.5	
133	98	98	13,800	5,934	6,624	966	276	43	48	7	2
134	98	98.6	14,000	7,000	5,740	1,050	210	50	41	7.5	1.5
135	98.2	98.2	10,000								
137	103.8	102.4	28,200	21,291	4,935	1,974		75.5	17.5	7	
138	97	100.4	24,000	19,500	3,240	1,260		81.25	13.5	5.25	
139	98	99.2	15,400	7,084	7,084	1,001	231	46	46	6.5	1.5
147	97	98	12,800	7,296	4,672	768	64	57	36.5	6	.5

ROUP IV Contd.

ASE NO. 30 - I. S., aet. 6. months; admitted to Hospital on fifth day of illness; death

Day of Illness	Temperature		Total Number of						Percentages of				
	Morning	Evening	Leucocytes	Polymorphs	Lymphocytes	Large Mononuclears	Eos.	Baso.	Polymorphs	Lymphocytes	Large Mononuclears	Eos.	Baso.
8	102.4	101.8	17,800	7,476	9,746	578			42	54.75	3.25		
25	97	99.2	16,000										
29	98	98	14,000										
31	97.8	97	16,200										
36	97	99	15,400	5,159	9,394	578	269		33.5	61	3.75	1.75	
40	97.4	97.2	15,200	4,218	10,222	456	304		27.75	67	3	2	
44	97	98	16,400	3,485	12,136	533	164	82	21.25	74	3.25	1	.5

CASE NO. 31 - M. M., aet. 7; admitted to Hospital on fourth day of illness; death

6	101.6	103	50,000	37,875	10,000	2,125			75.75	20	4.25		
10	100	103	24,000										
13	100	99.4	37,200										
16	100.6	102.8	29,900										
20	101	101.8	20,000										
26	102.2	104.4	23,400										
30	100.2	99.8	22,000										
33	98	97.6	14,000										
37	98.4	99.2	14,000	9,450	3,920	490	35	105	67.5	28	3.5	.25	.75
41	97	98	8,800	4,796	3,520	396	88		54.5	40	4.5	1	
43	103.8	102.2	19,400	16,054	2,619	727			82.75	13.5	3.75		

GROUP IV Contd.

CASE NO. 32 - A. W., aet. 10; admitted to Hospital on twenty-eighth day of illness; death

Day of Illness	Temperatures		Total Number of Leucocytes
	Morning	Evening	Morning
37	97	97.8	16,400
43	97	101.2	30,600
47	98.8	99.6	18,600
52	99	99	17,000
57	98.6	99.6	20,800
61	99.8	98.4	22,000
64	97.8	98.2	19,800
69	98.4	97.8	17,000
73	98.8	97	18,600

CASE NO. 33 - W. E., aet. 15; admitted to Hospital on fourth day of illness; death

5	100	101.2	15,000
7	100.2	100.4	12,400
12	99.4	102.8	12,900
16	100.2	99.8	14,000
21	99.2	97	26,000

CASE NO. 34 - A. MacL., aet. 7 months; admitted to Hospital on fifteenth day of illness; death

16	99	99	15,400
20	99.8	99.2	13,200
24	98.6	99.2	10,200
28	98.6	98.6	13,200
31	98	98	18,000
33	98	97.2	20,400

GROUP IV Contd.

CASE NO. 35 - A. F., aet. 4; admitted to Hospital on third day of illness; recovery

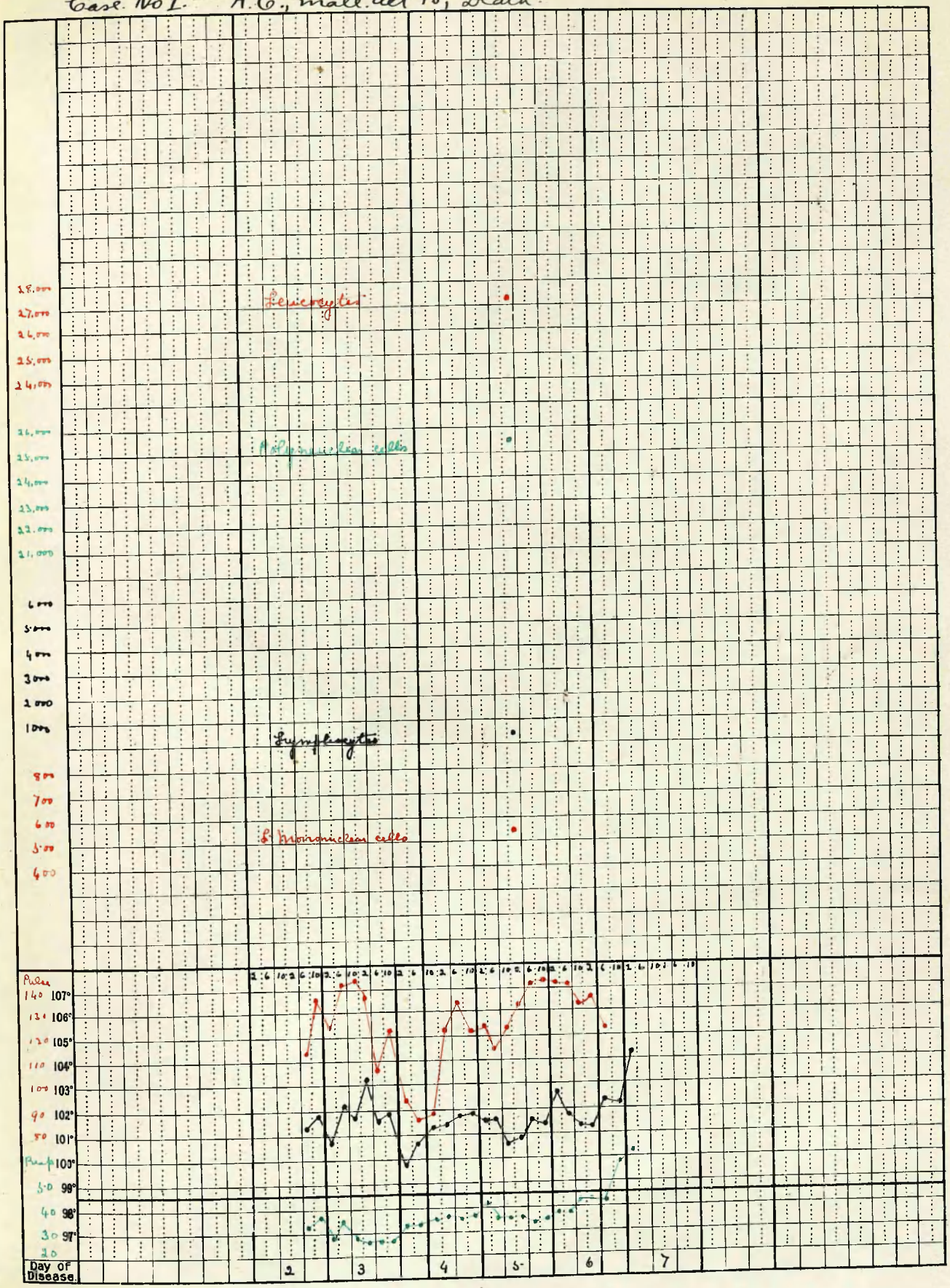
Day of Illness	Temperatures		Total Number of Leucocytes
	Morning	Evening	Morning
4	102	100.4	25,600
7	100.2	99.8	18,400
14	98	100.4	24,200
22	100	99.8	23,200

CASE NO. 36 - A. W., aet. 3; admitted to Hospital on third day of illness; recovery

4	102.6	103	16,400
8	101.2	101.6	31,500
10	100	104.2	18,000
15	103.8	100	17,000
18	102.6	101.6	18,000
25	99	102	20,000
33	97	98	23,000

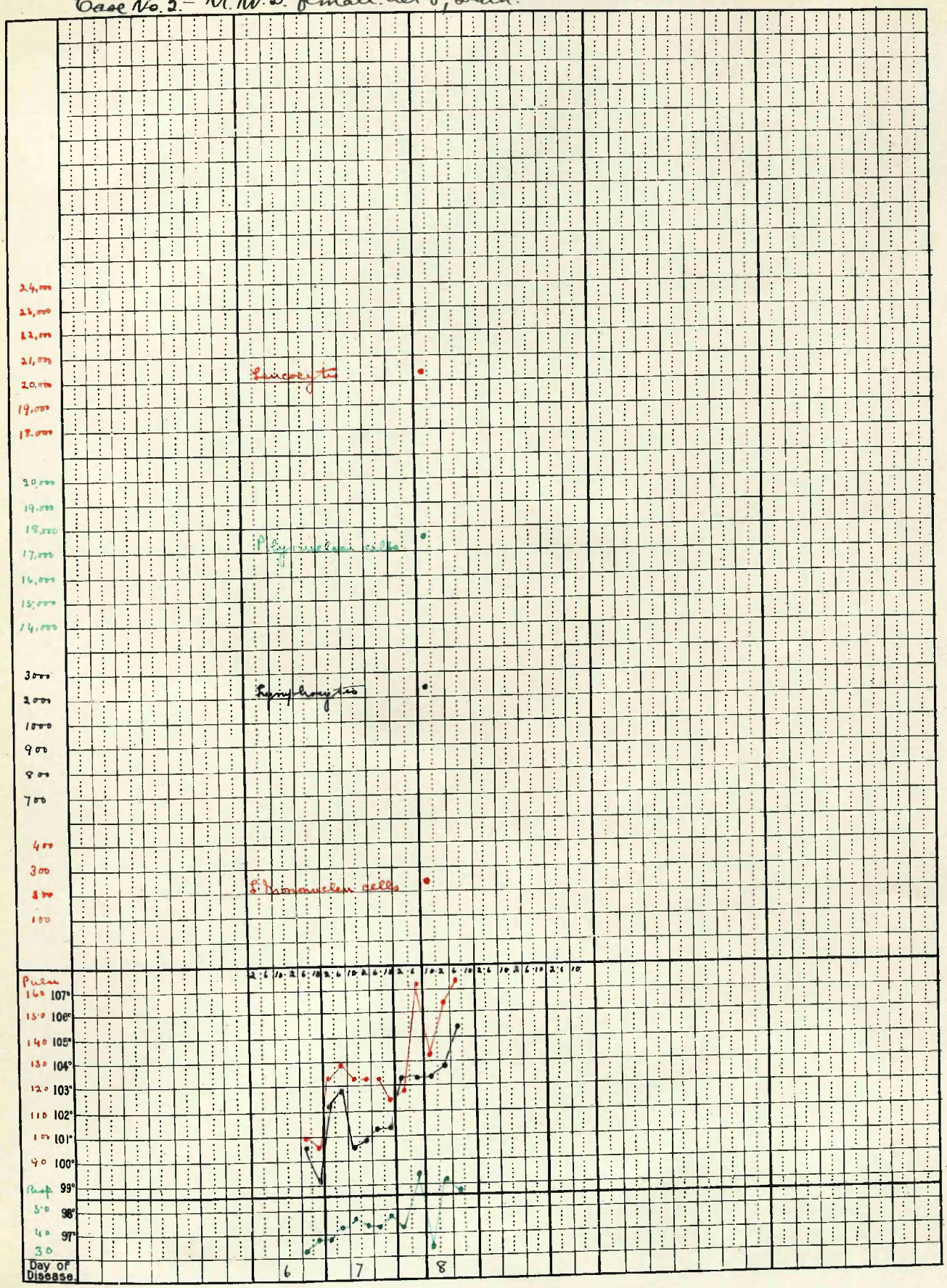
Acute Case.

Case. No I. — A. C., male. aet 15; Death.



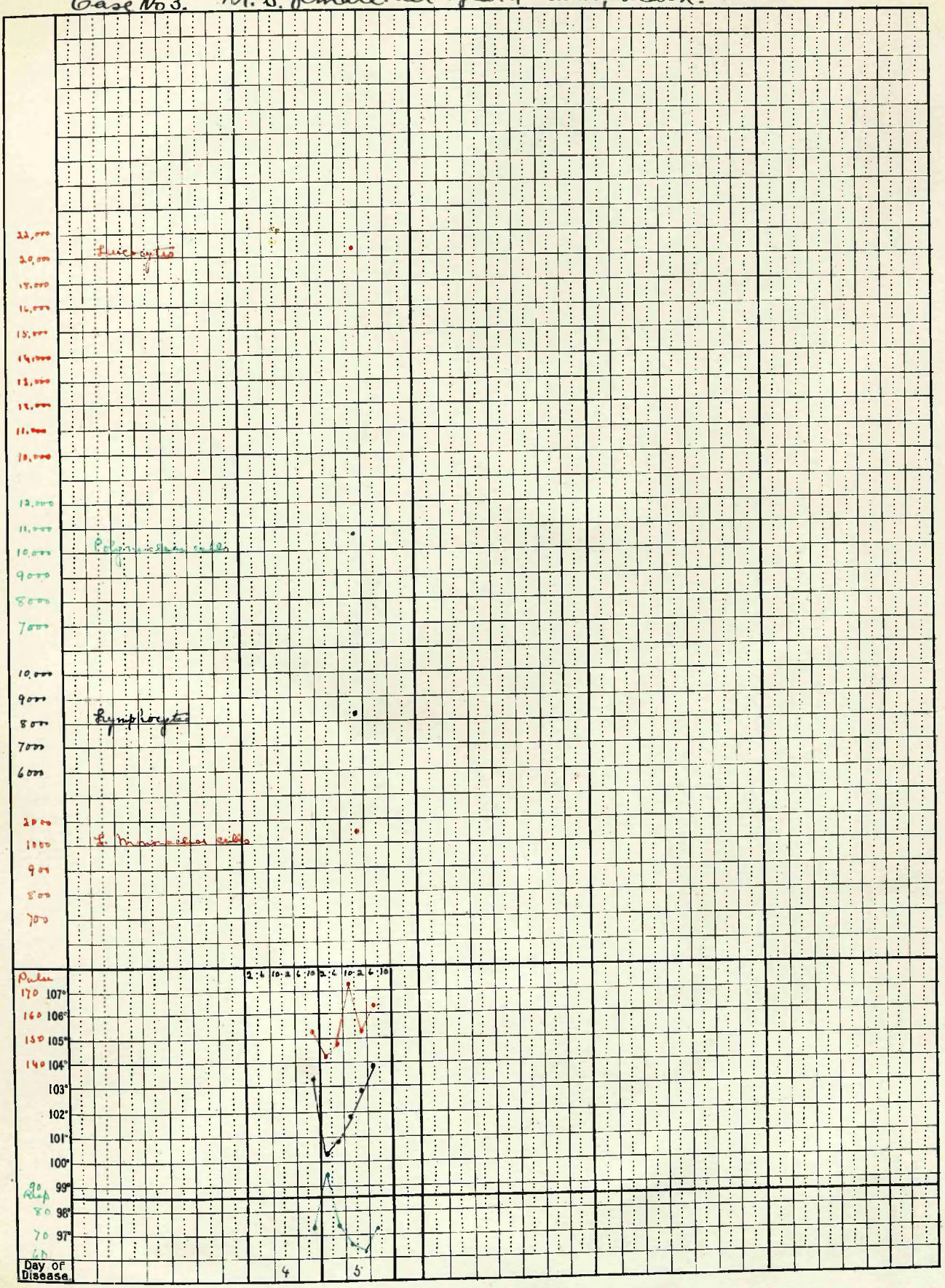
Acute Case

Case No. 2.– M. W. D. female. aet 5; Death.



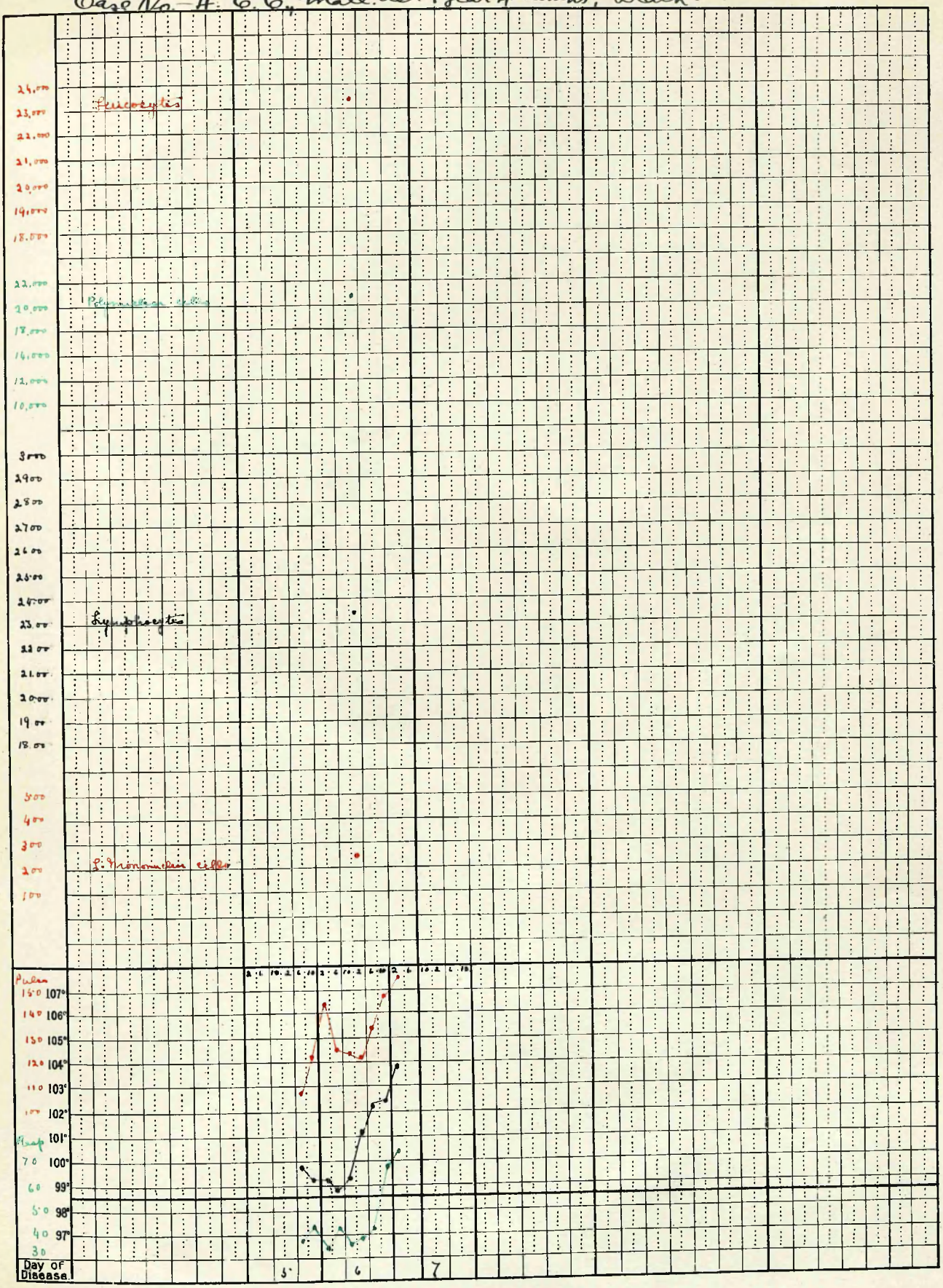
Acute Case

Case No 3. – M. S. female. aet 1 year 4 months; Death.



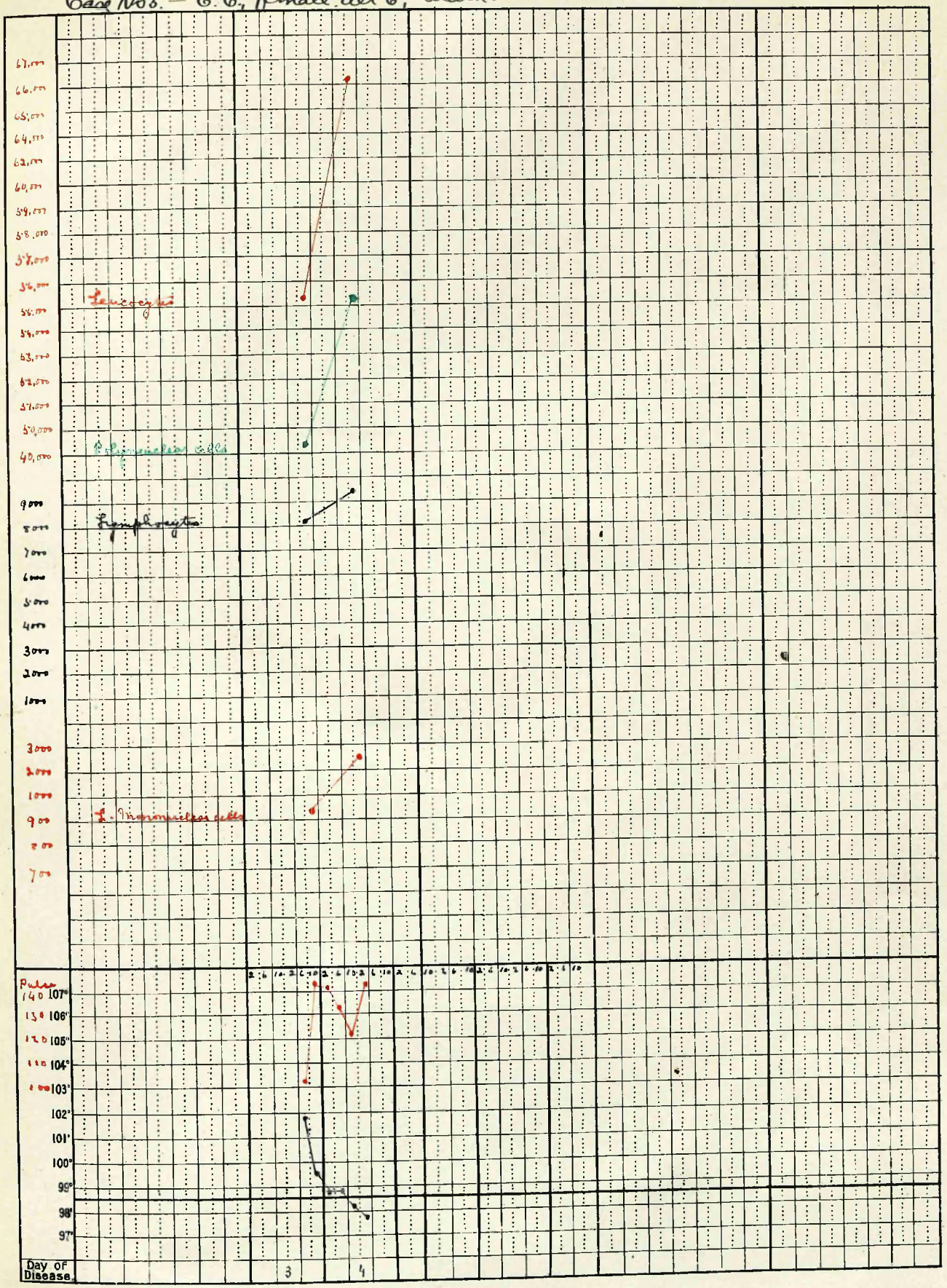
Acute Case

Case No. H. C. C. male. aet 1 year 4 months; Death.



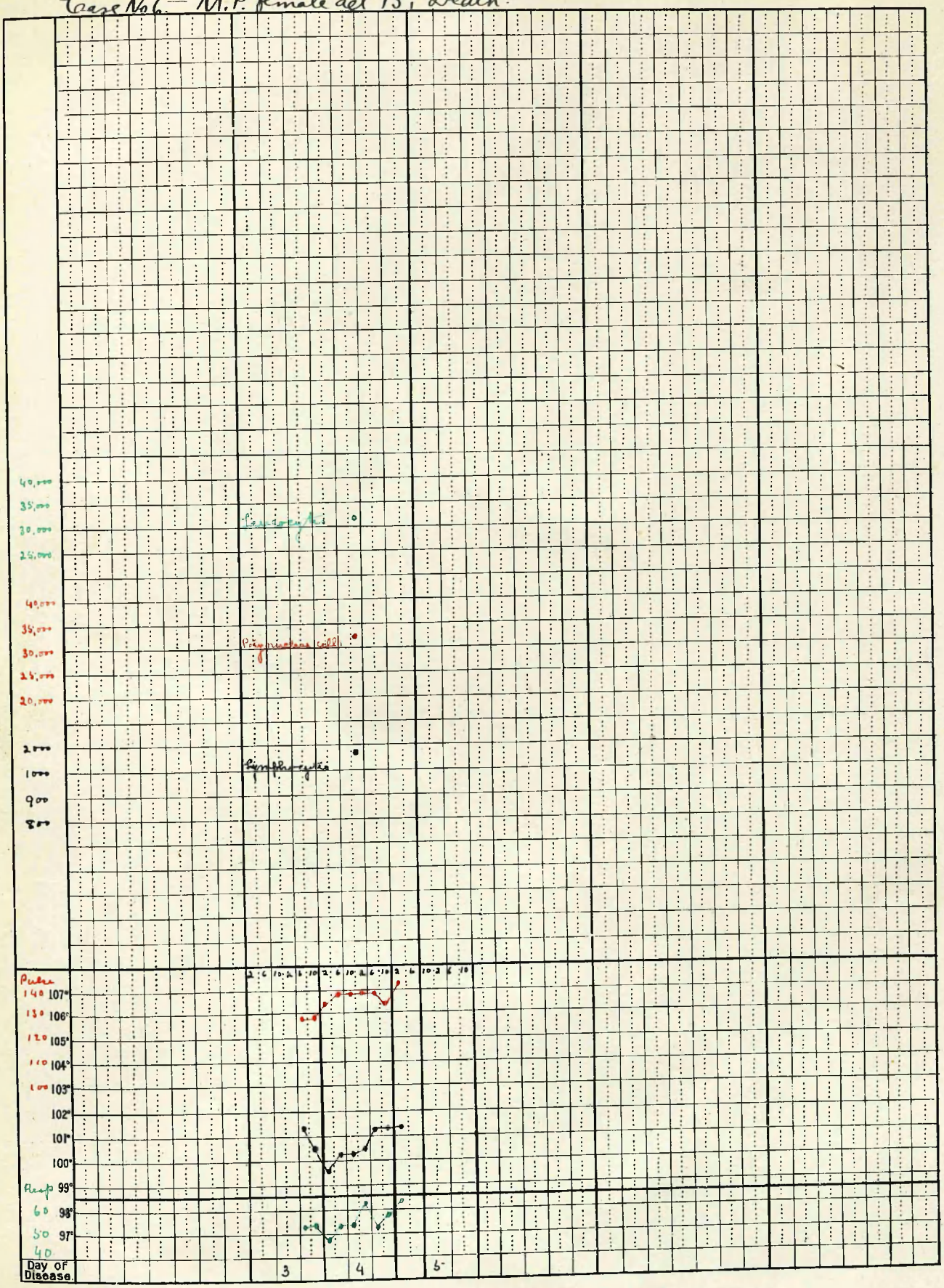
Acute Case.

Case No 5. — C. C., female. aet 6; Death.



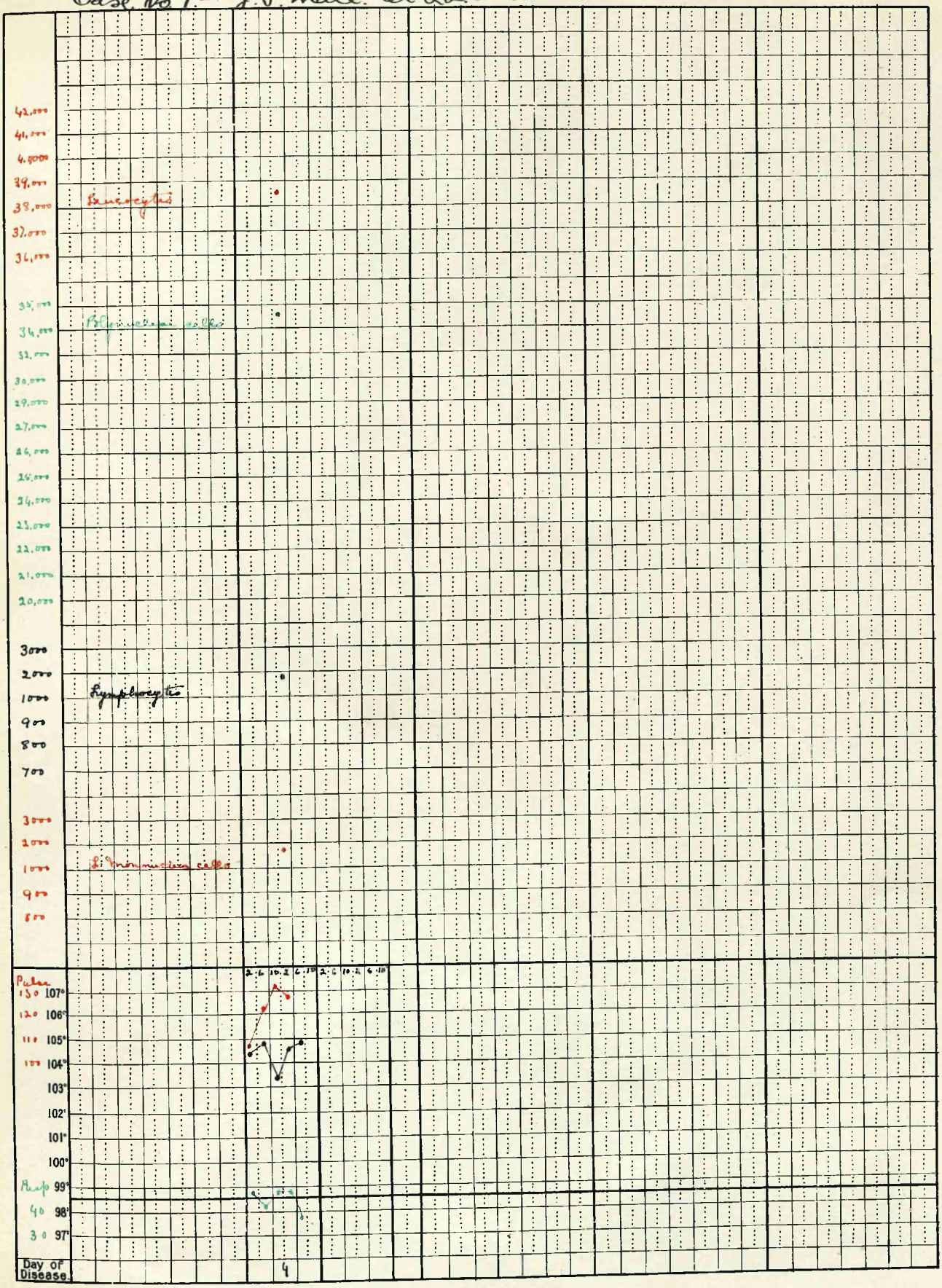
Acute Case.

Case No 6 — M.P. female aet 13', Death.



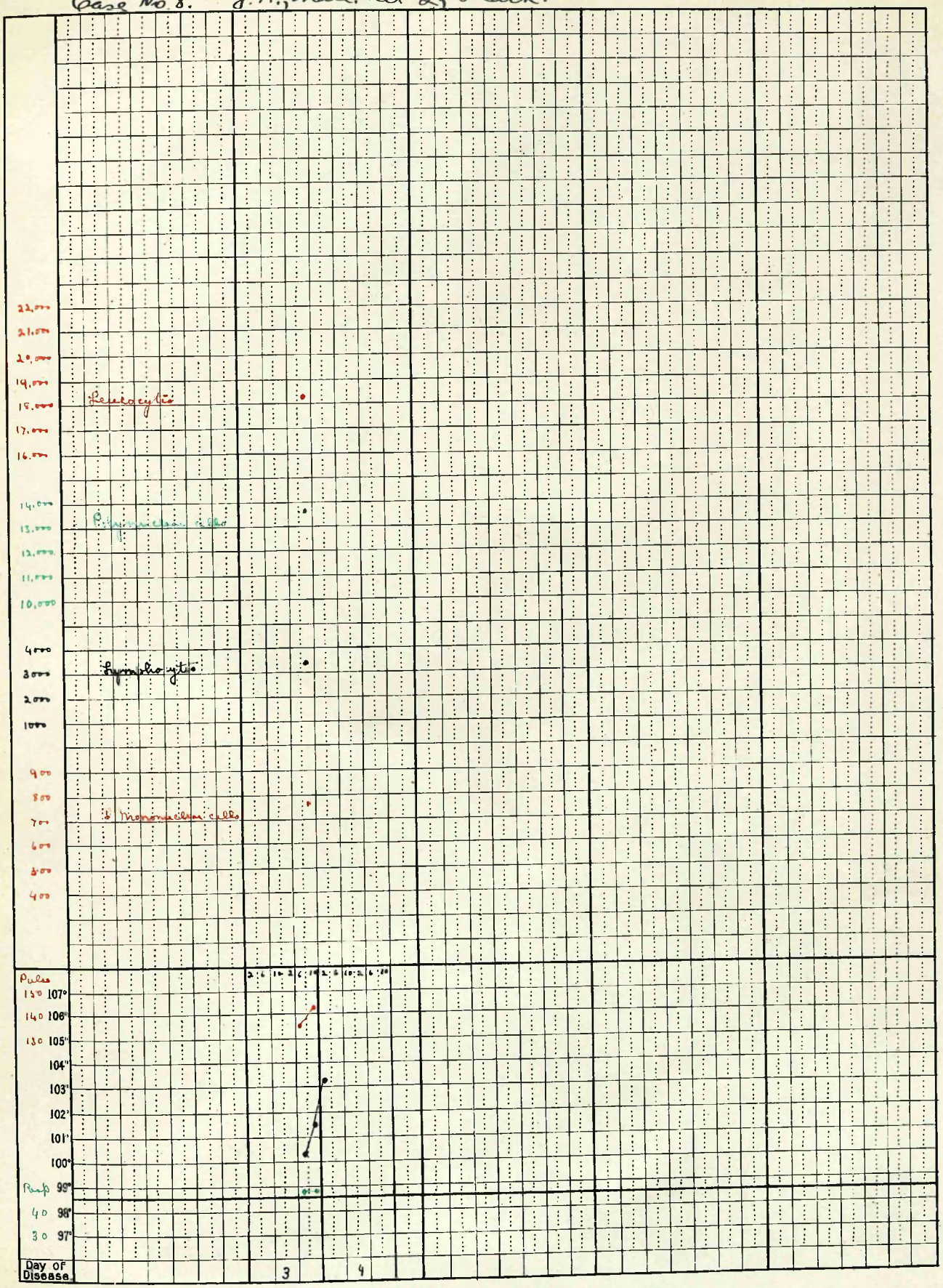
Acute Case.

Case. No 7. — J. J. male. æt 22. Death.



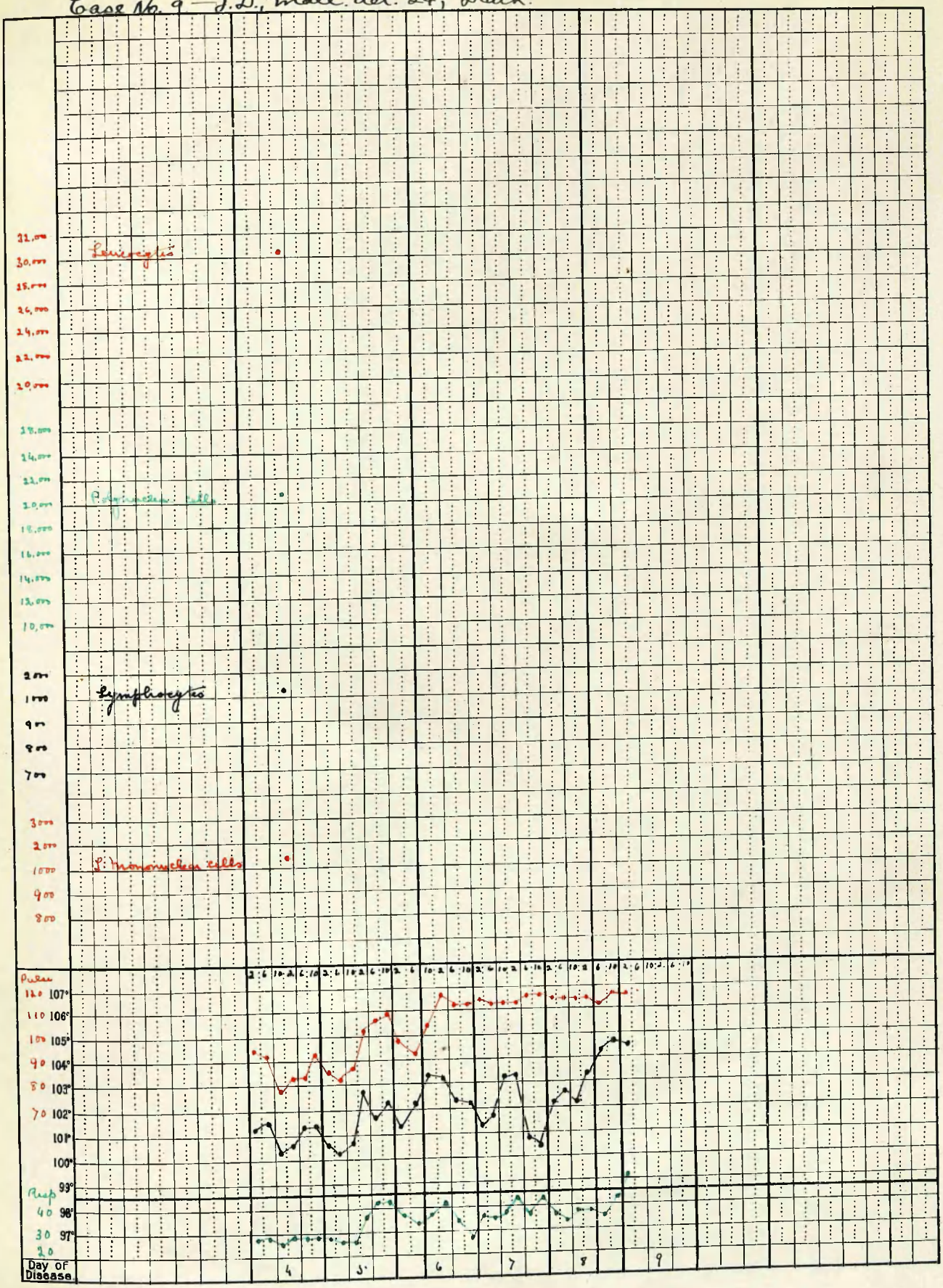
Acute Case.

Case No. 8. — J. A., male. aet 2; Death.



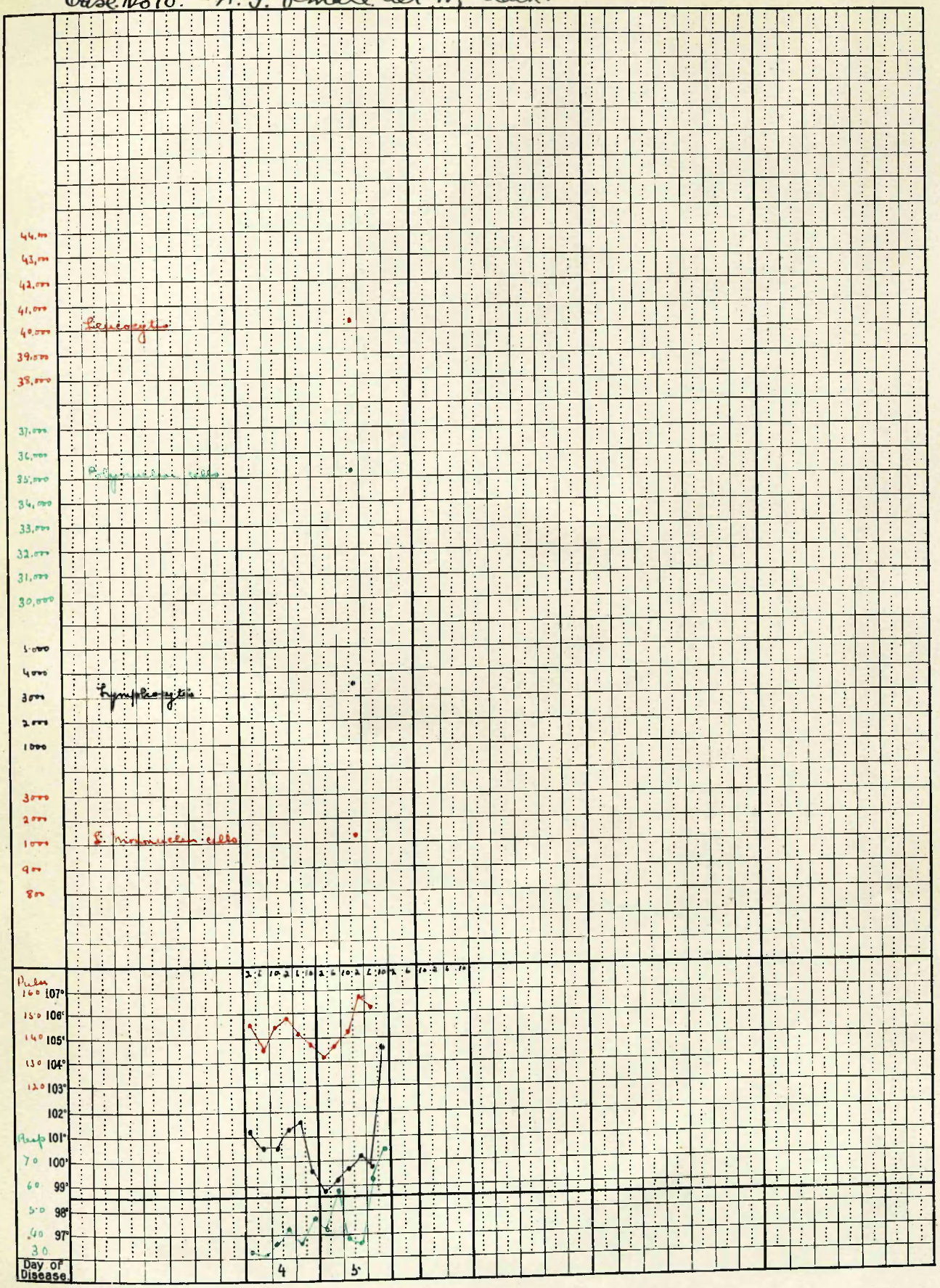
Acute Case.

Case No. 9 — J.D., male. aet. 24; Death.



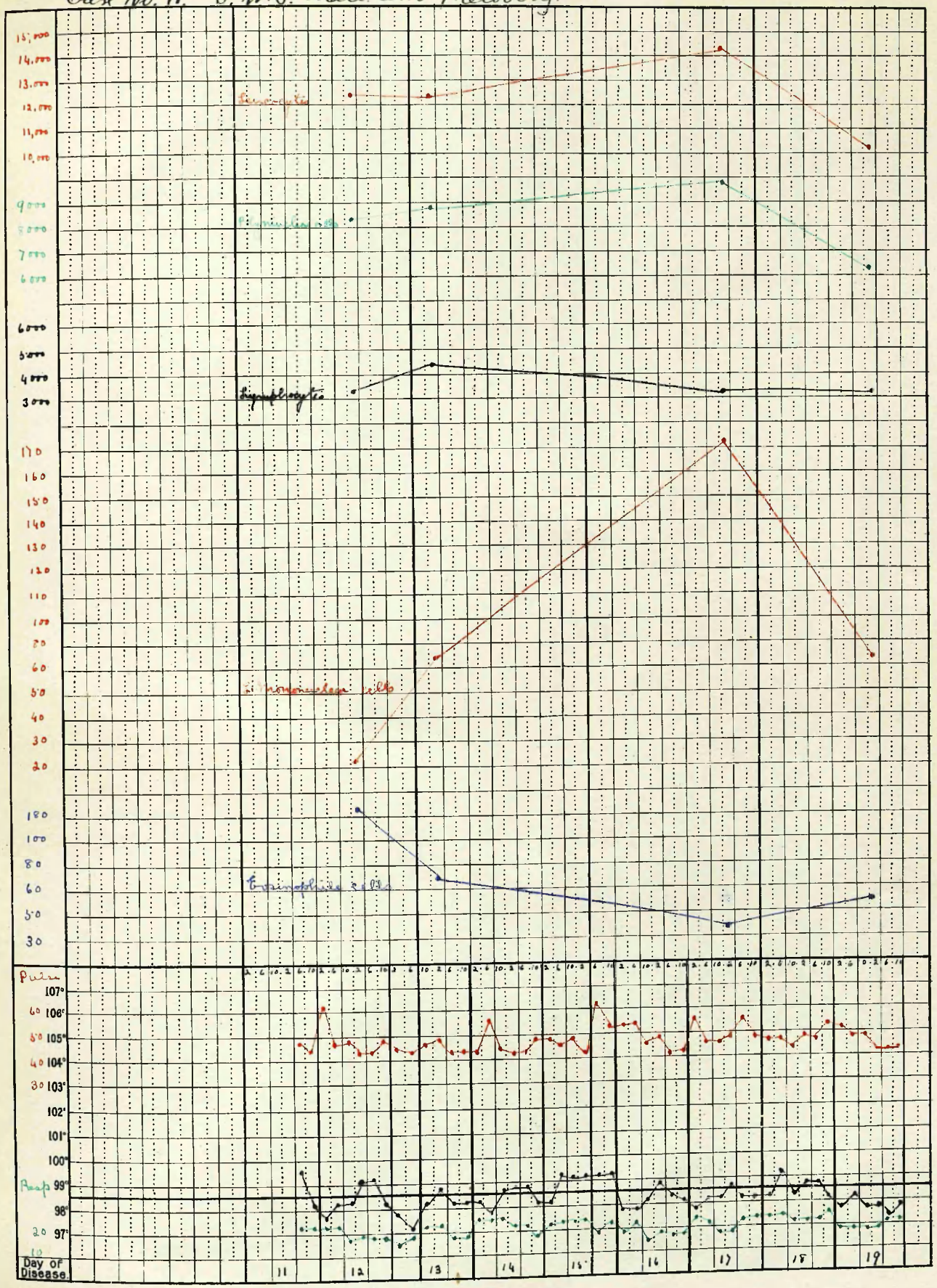
Acute Case.

Case No 10. — A. G. female aet 11; Death.



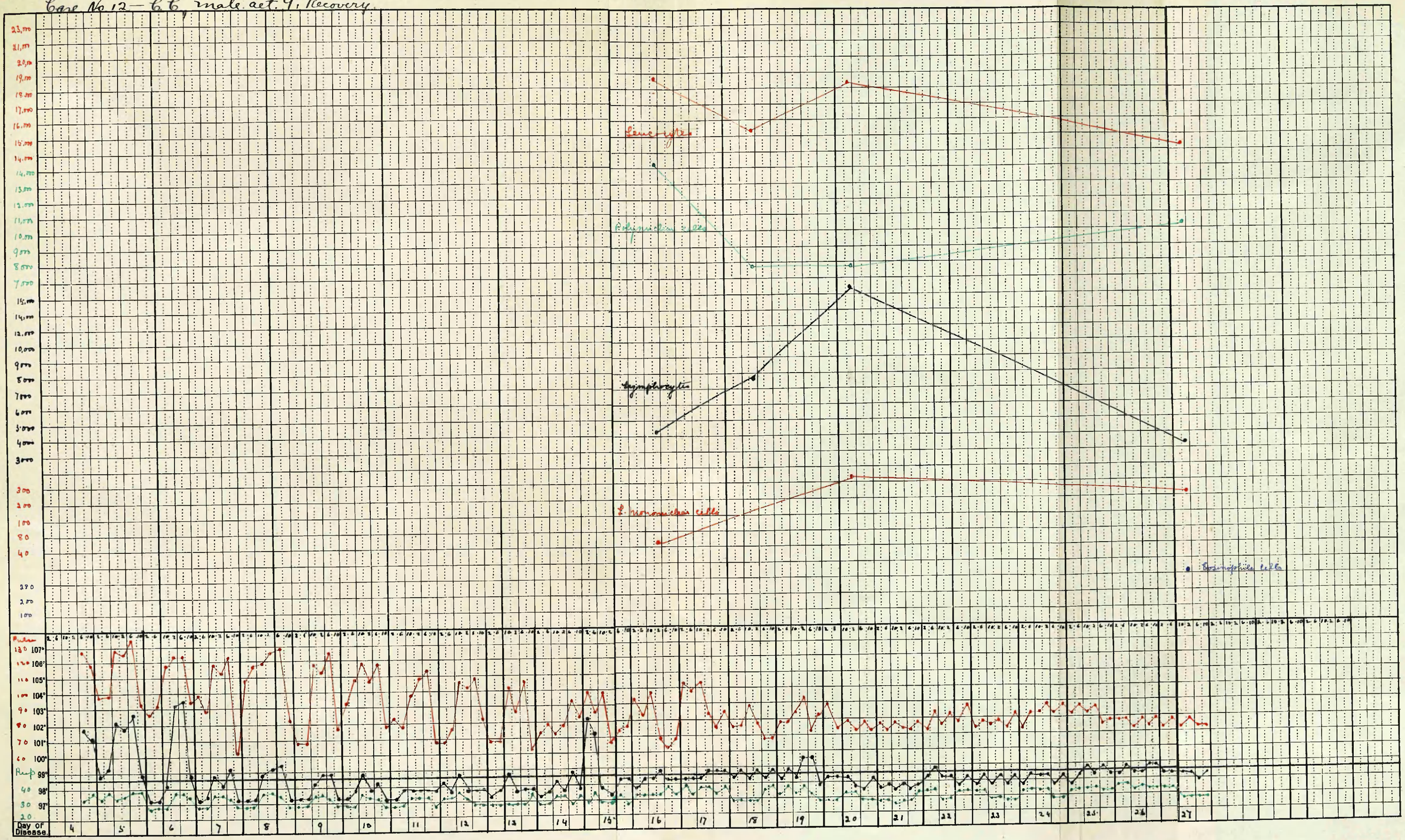
Abortive Case

Case No. 11. — P. W. G. male aet. 20'; Recovery.



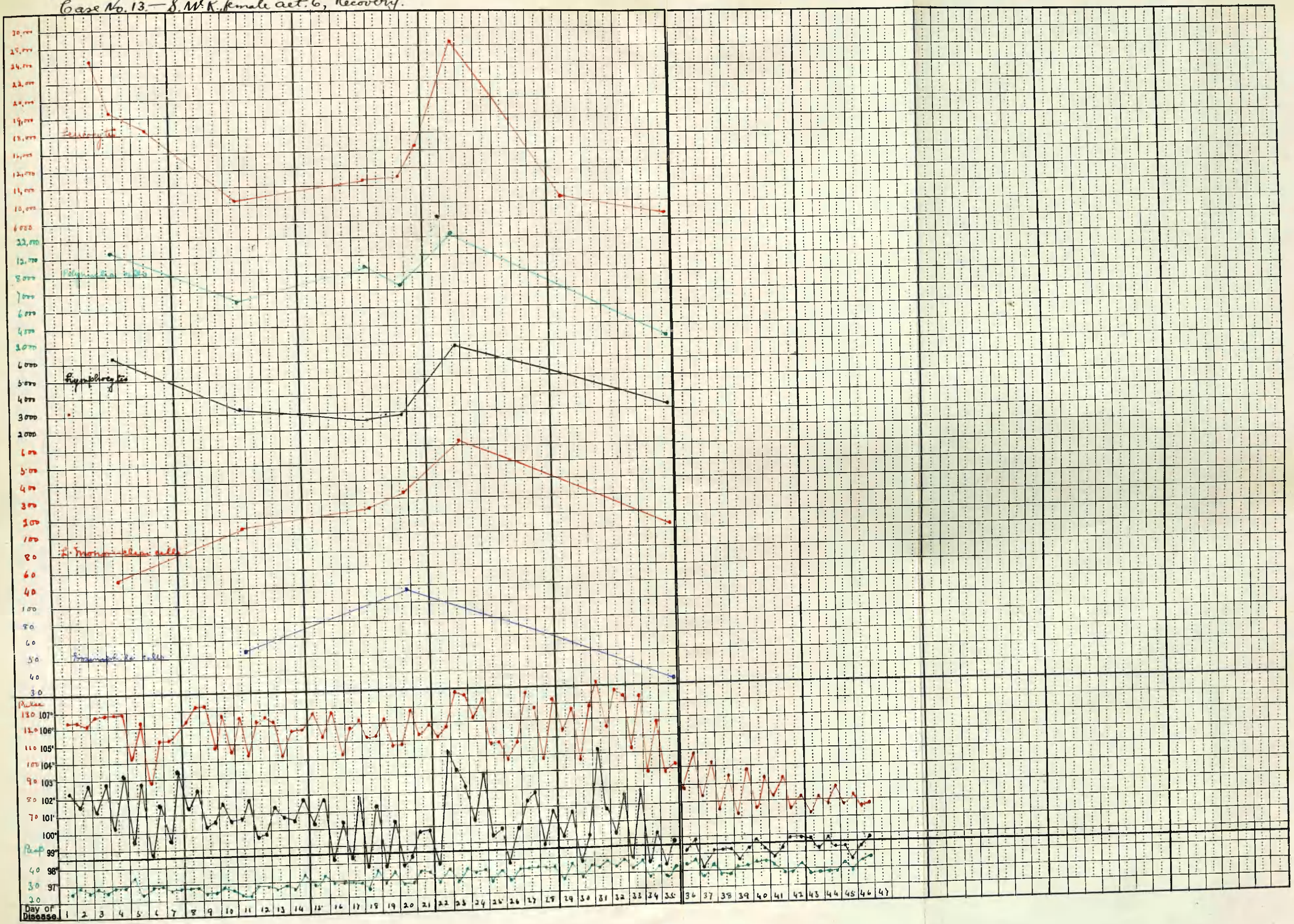
Abortive case

Case No 12 — C C, male aet. 9; Recovery.



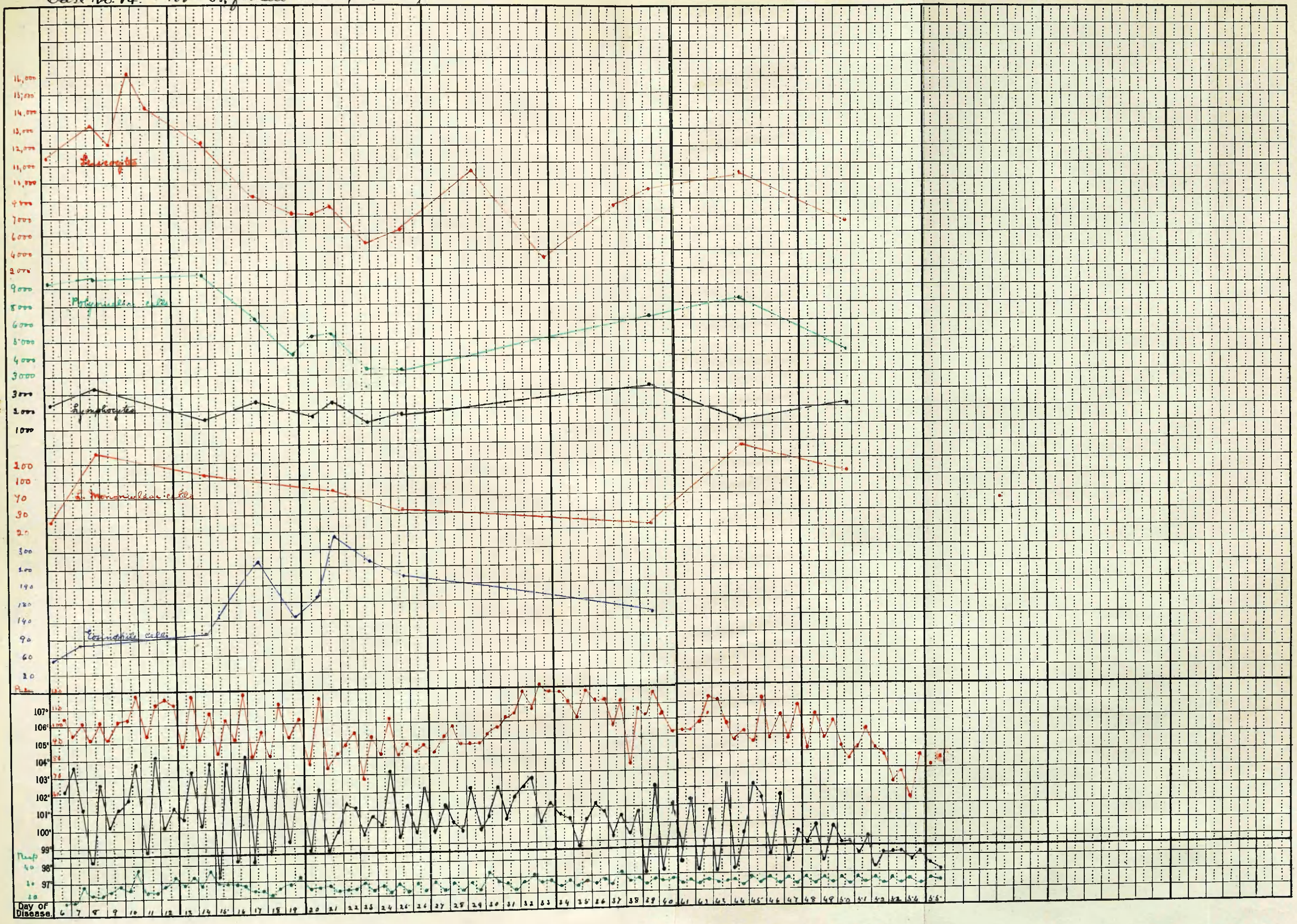
Mild Case

Case No. 13 — S. M. K. female aet. 6; Recovery.



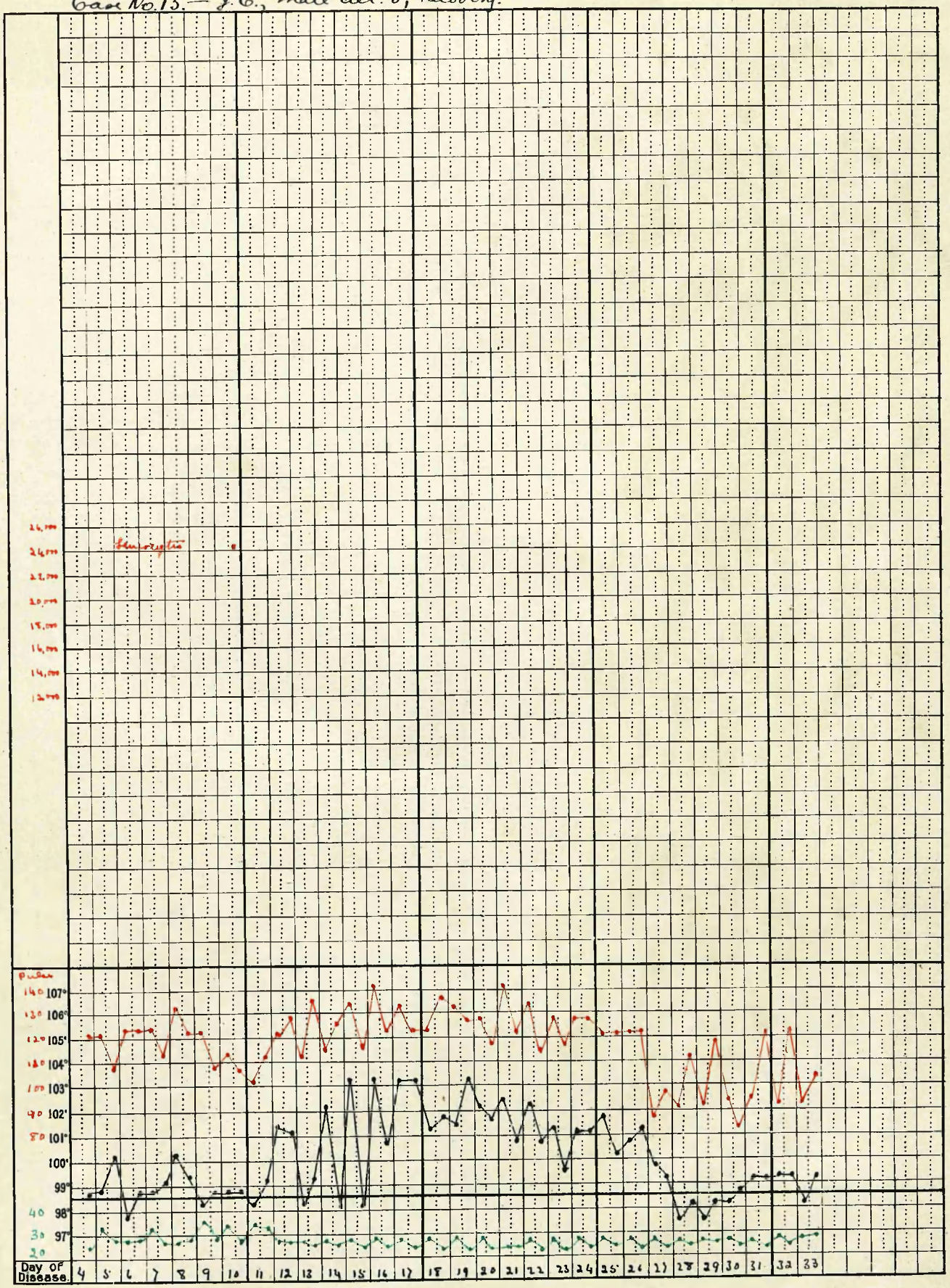
Mild Case

Case No. 14. — Mrs P., female aet. 31; Recovery.



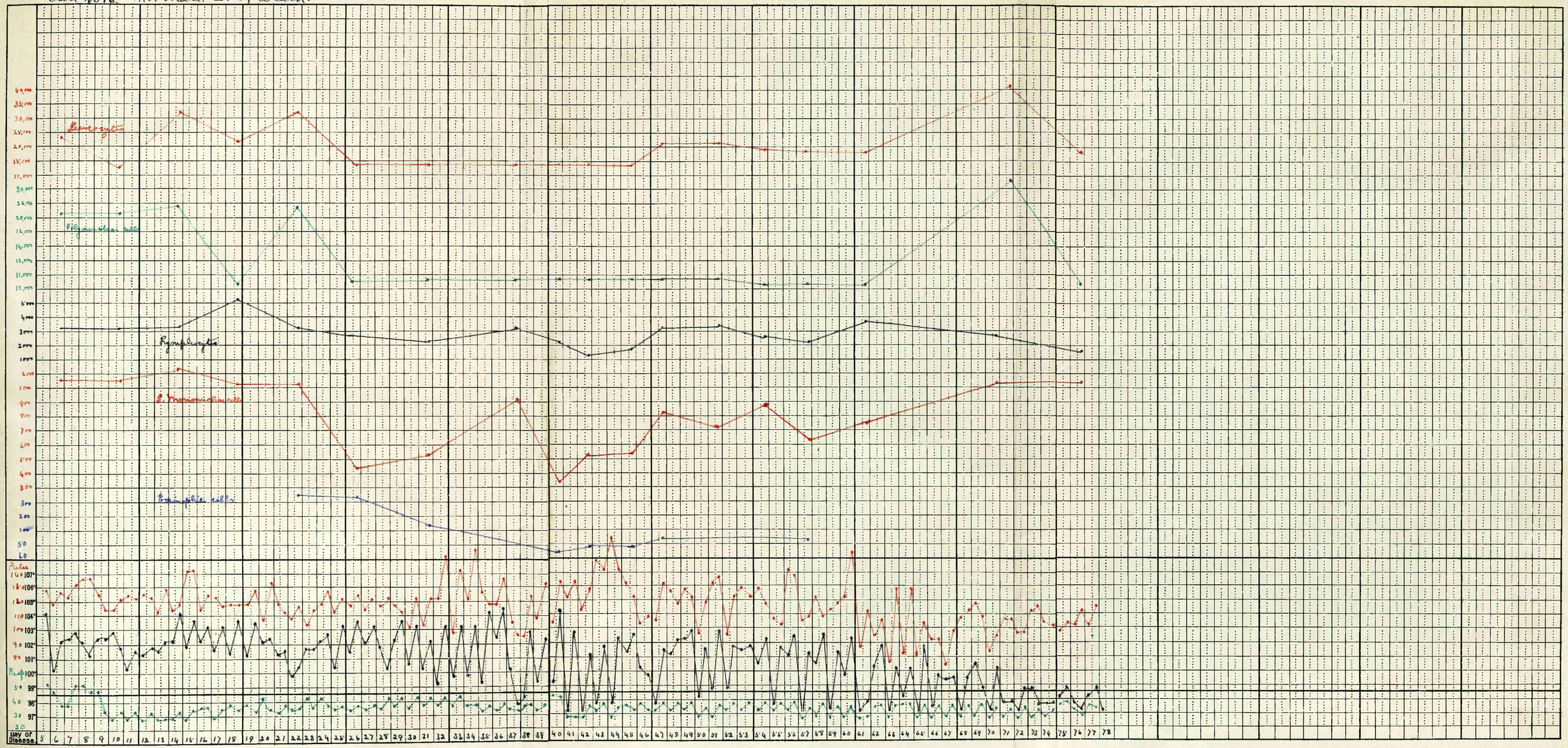
Mild Case

Case No. 15. — J. C., male aet. 5; Recovery.



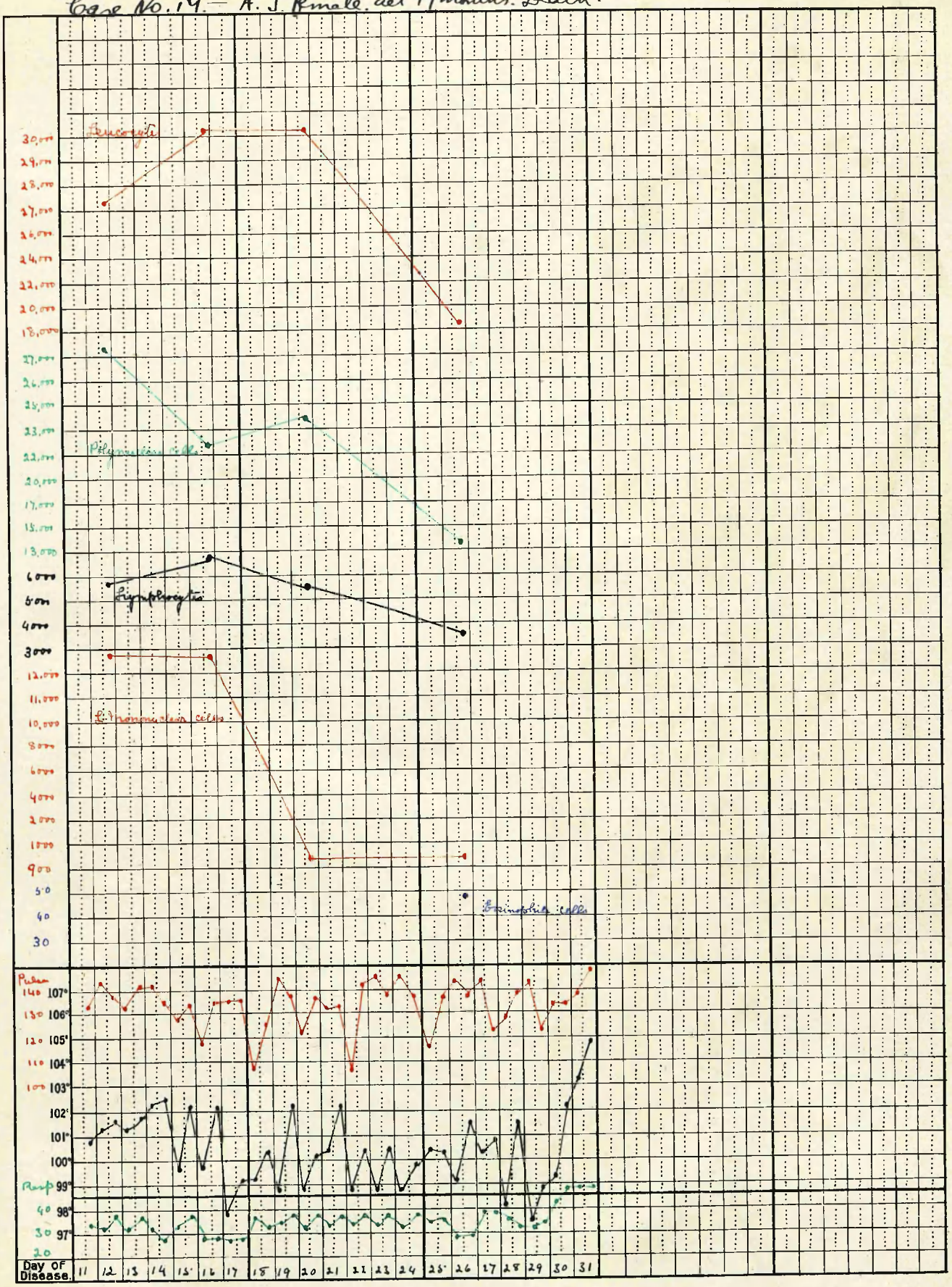
Chronic Case

Case No 16. – A.D. male. aet 5; Death.



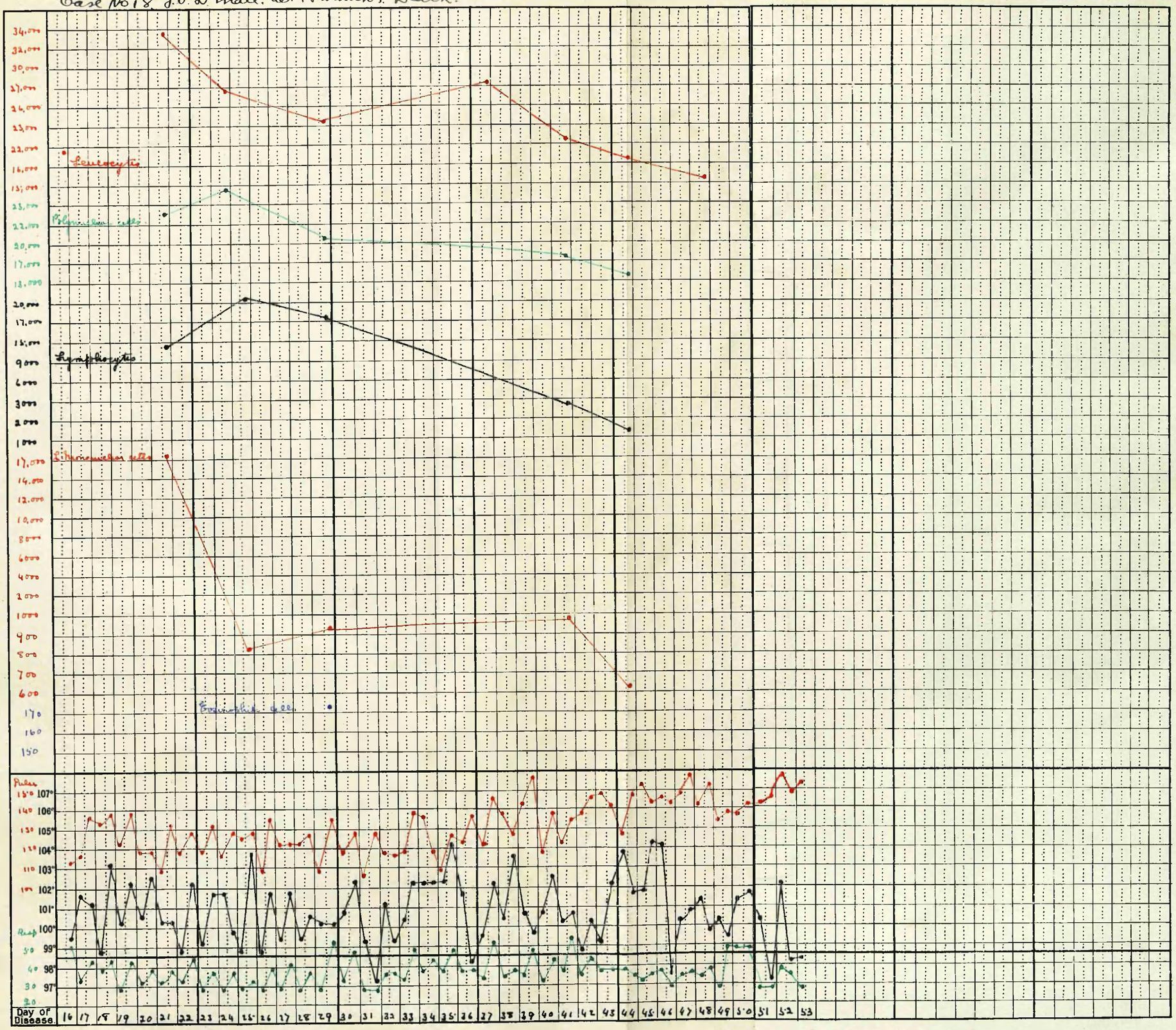
Chronic Case

Case No. 14. — A. J. female. aet 17 months. Death.



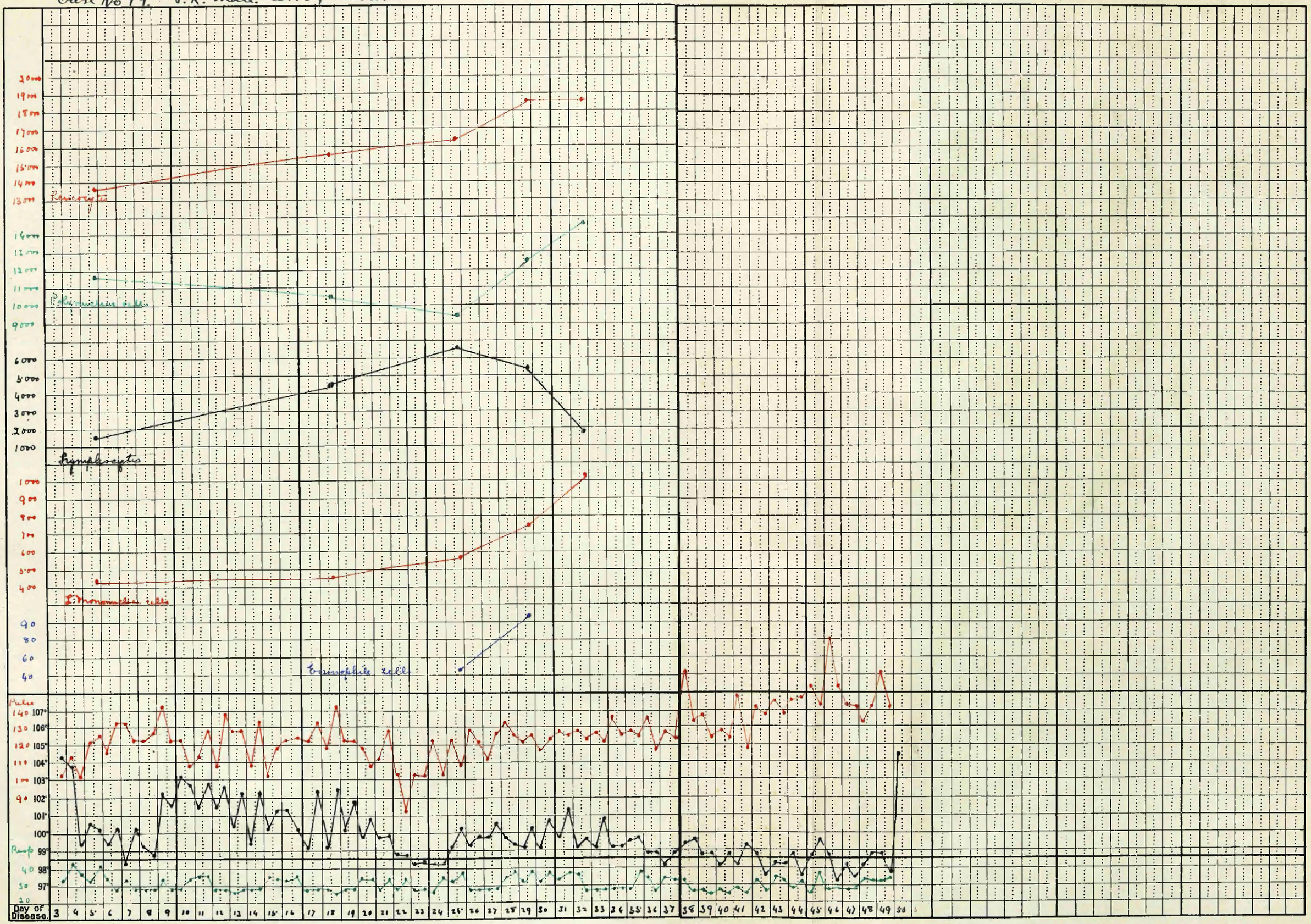
Chronic Case

Case No 18 J.O'D male. aet 18 months. Death.



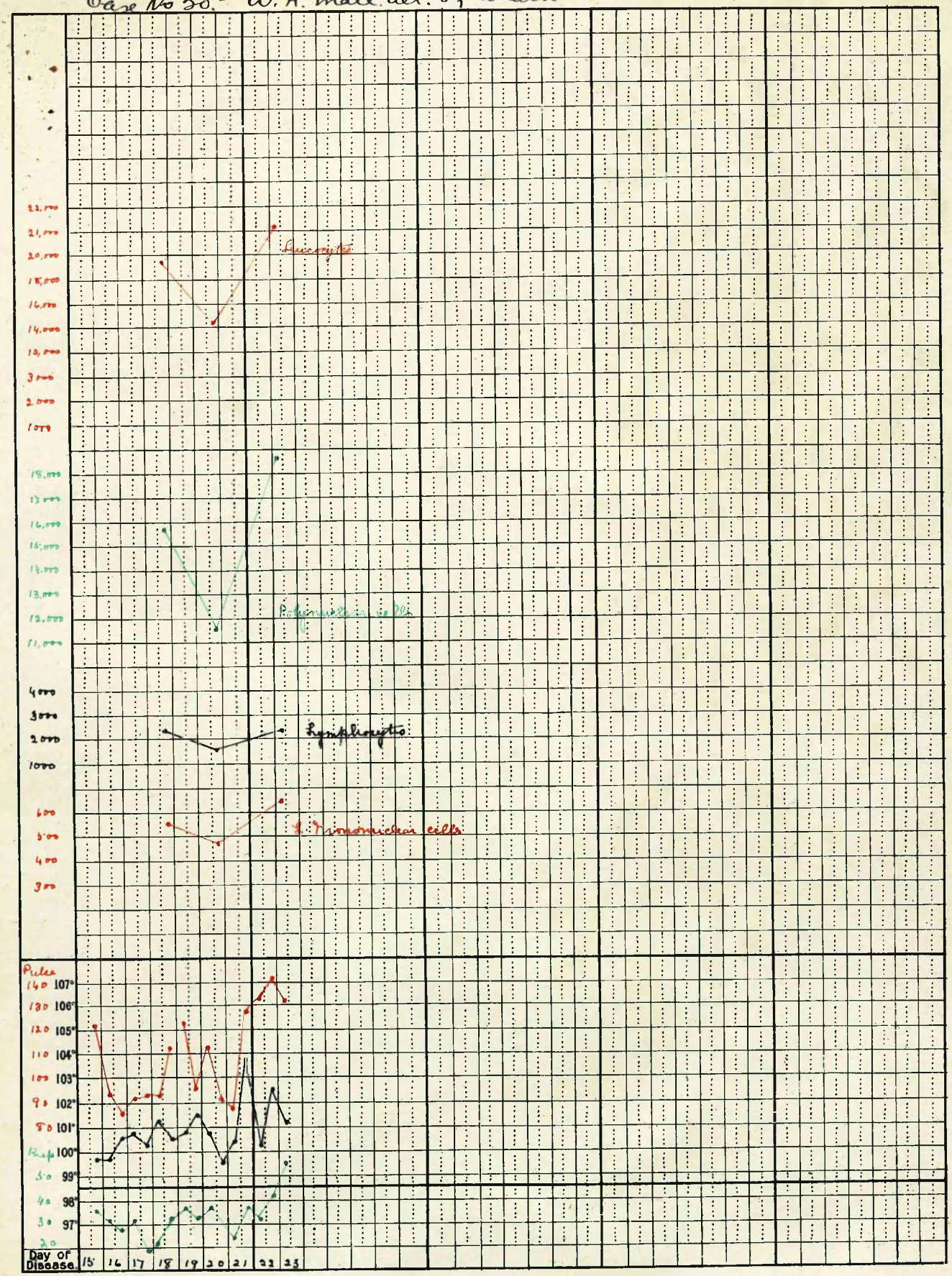
Chronic case

Case No 19. — P.K. male. aet. 5; Death.



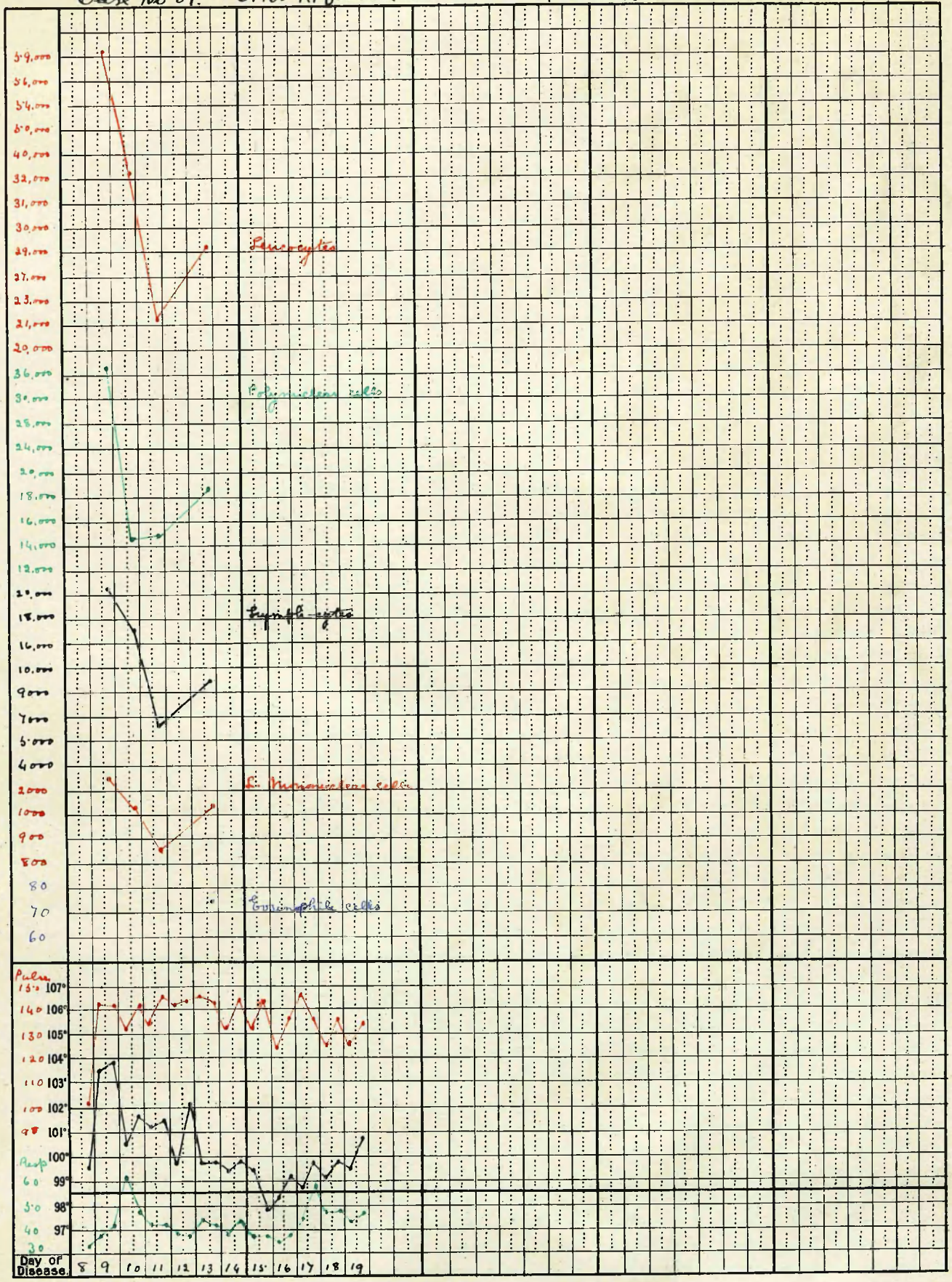
Chronic Case.

Case No 20. — W. A. male. aet. 8; Death.



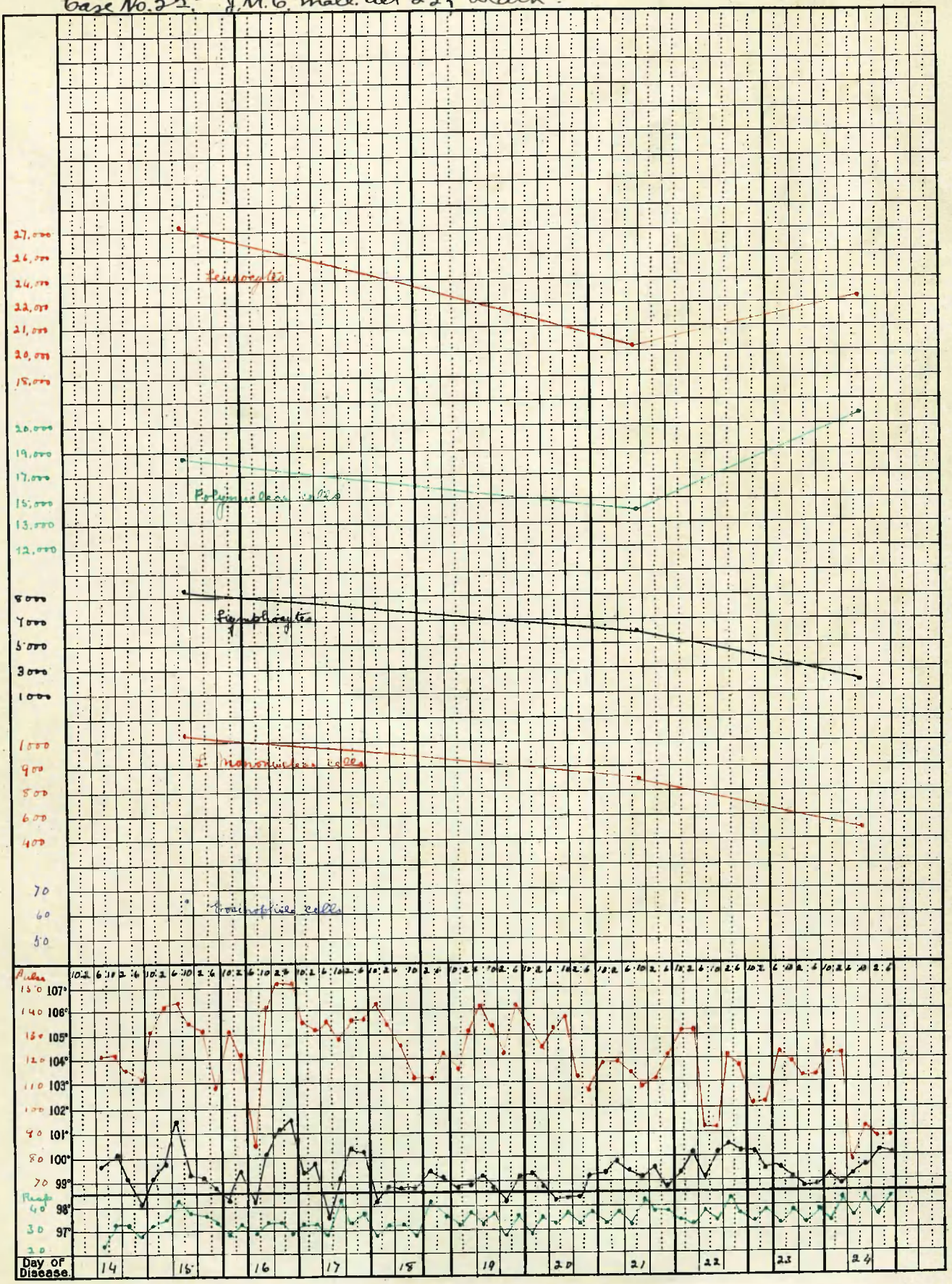
Chronic Case

Case No 21. — J. N. K. female. aet. 4 months; Death.



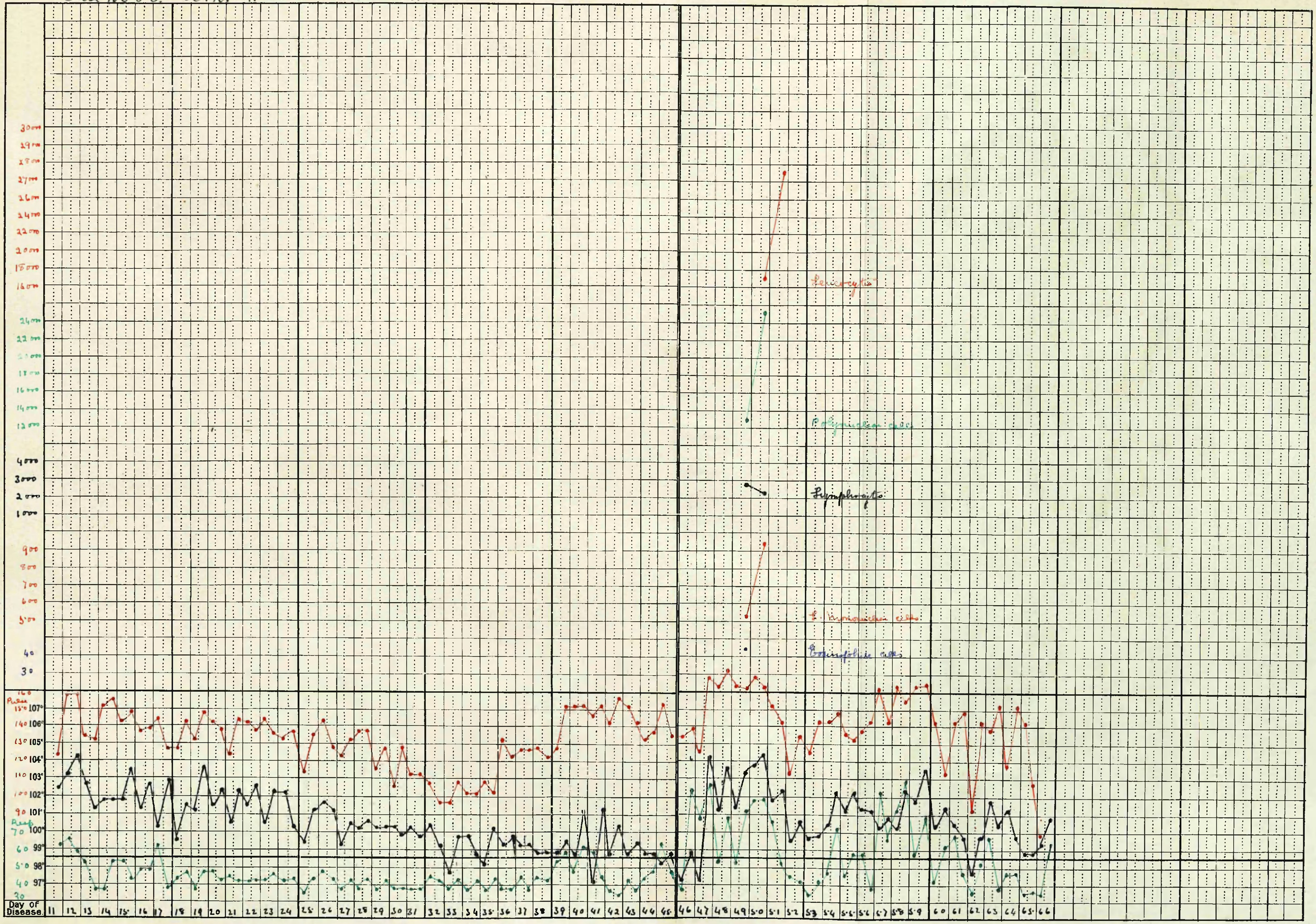
Chronic Case

Case No. 22. — J. M. C. male. aet 2½; Death.



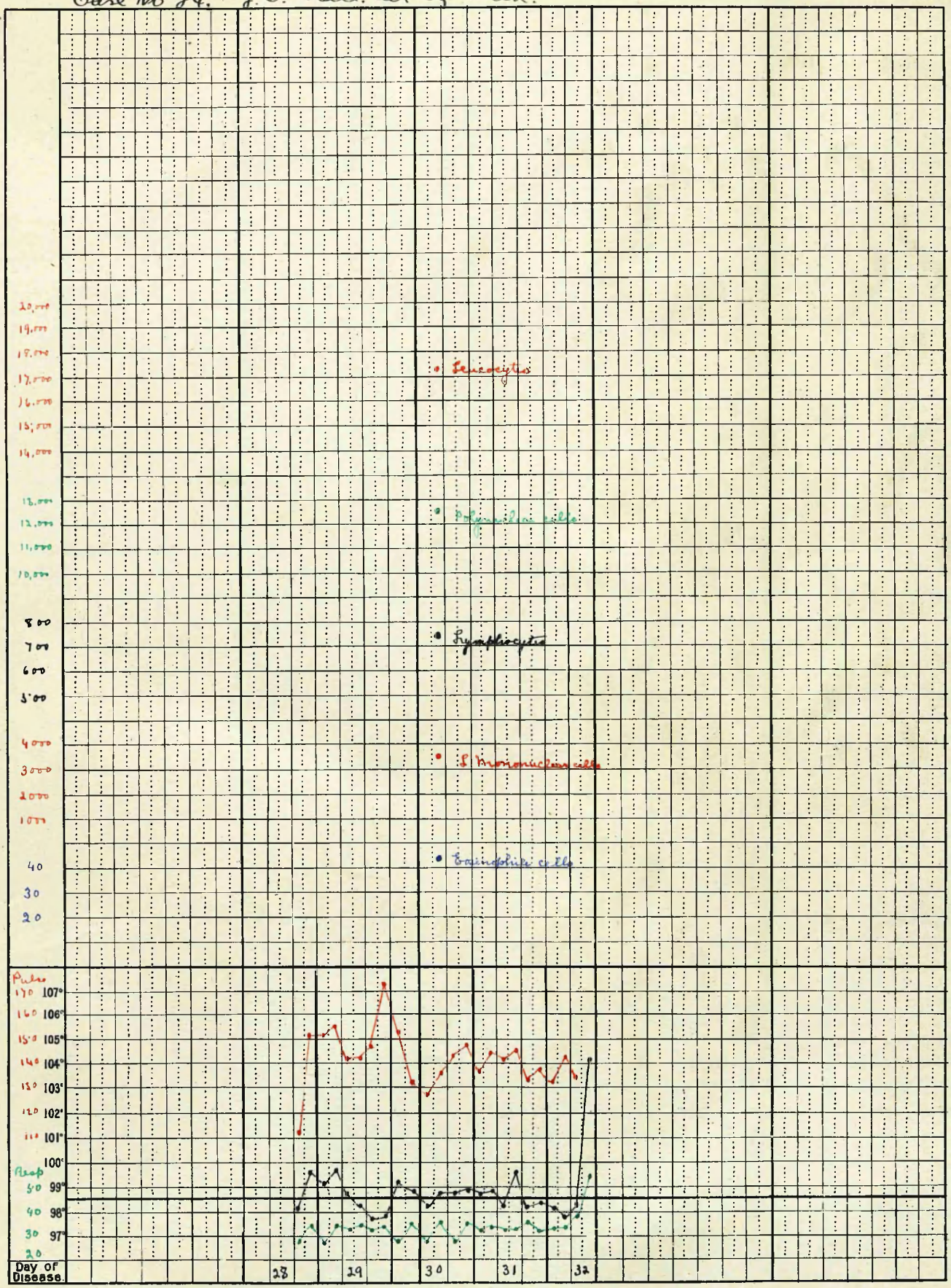
Chronic Case

Case No 23.— W. McK. male aet. 18 months. Death.



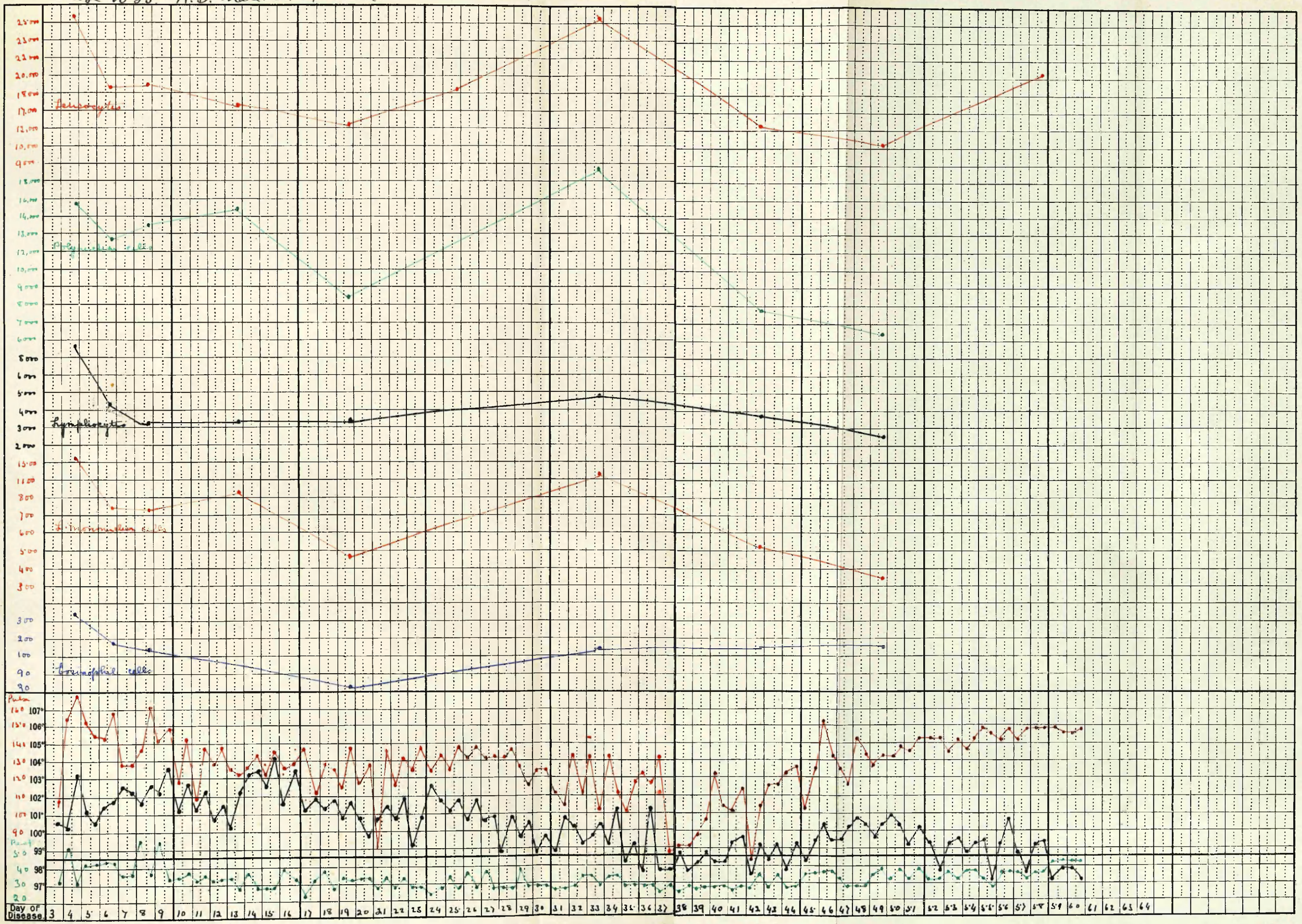
Chronic Case

Case No 74. — J. C. male. aet 3; Death.



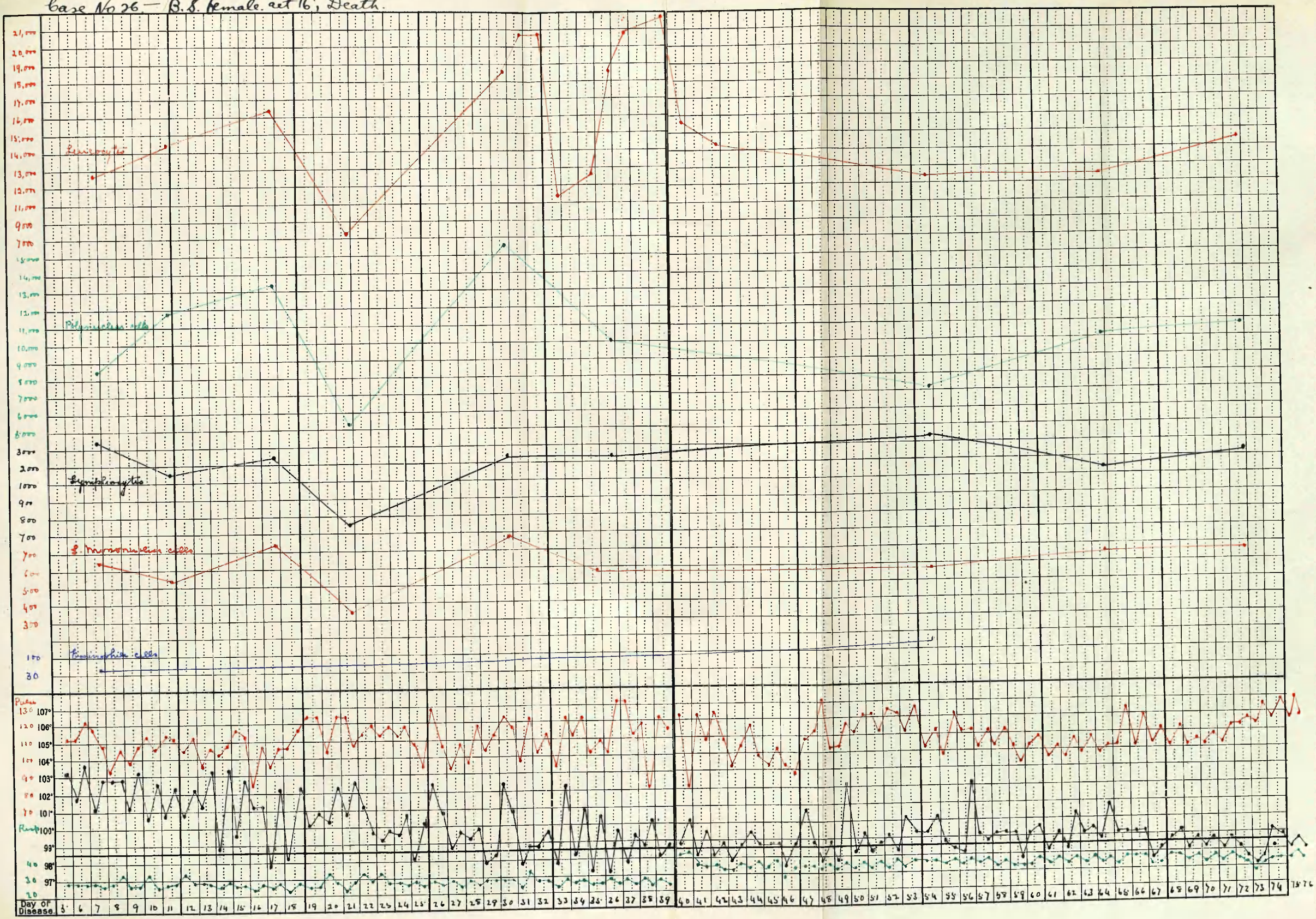
Chronic case

Case No 25 — A.D. male. aet 5; Death.



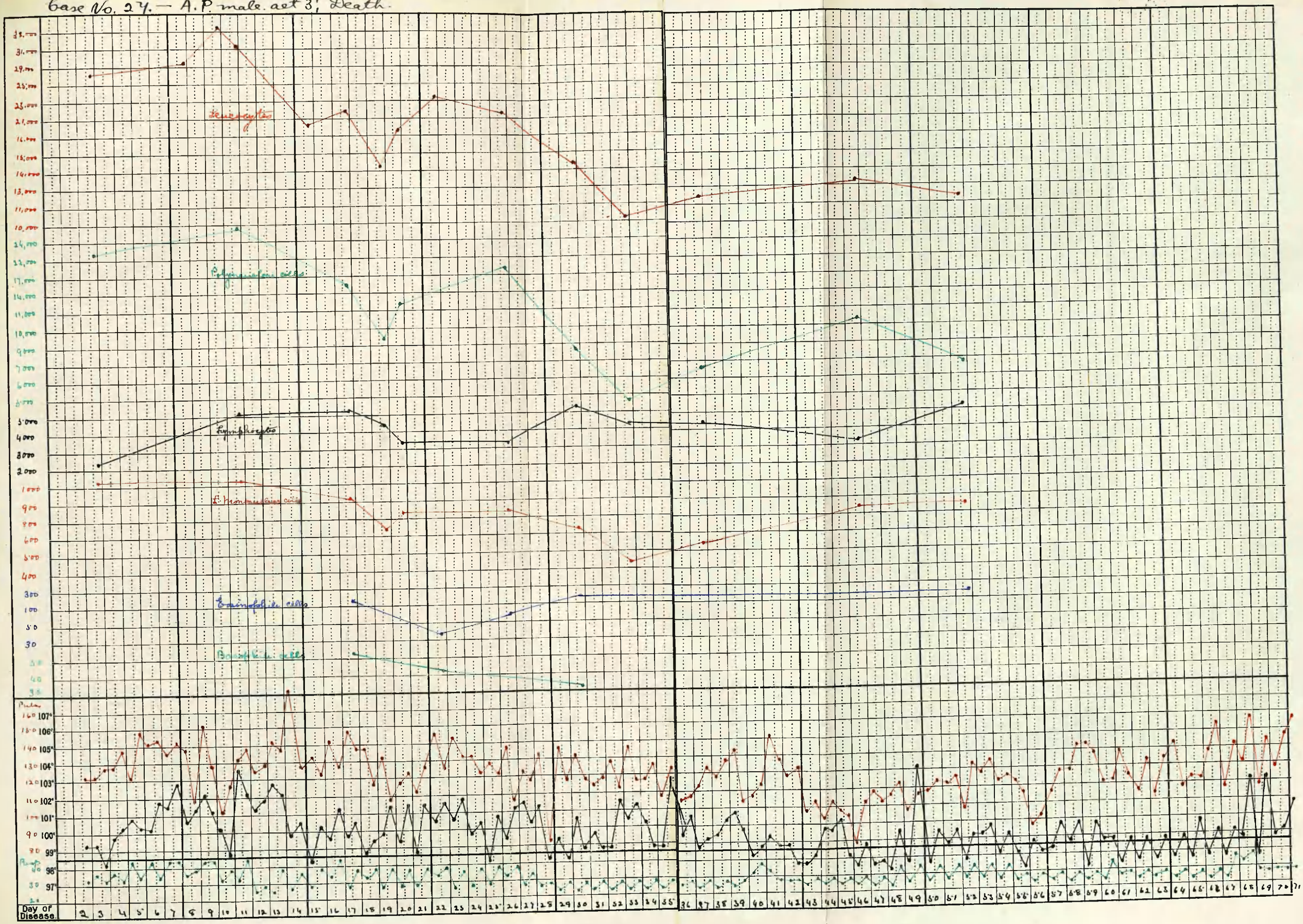
Chronic Case.

Case No 26 — B. S. Female. aet 16'; Death.



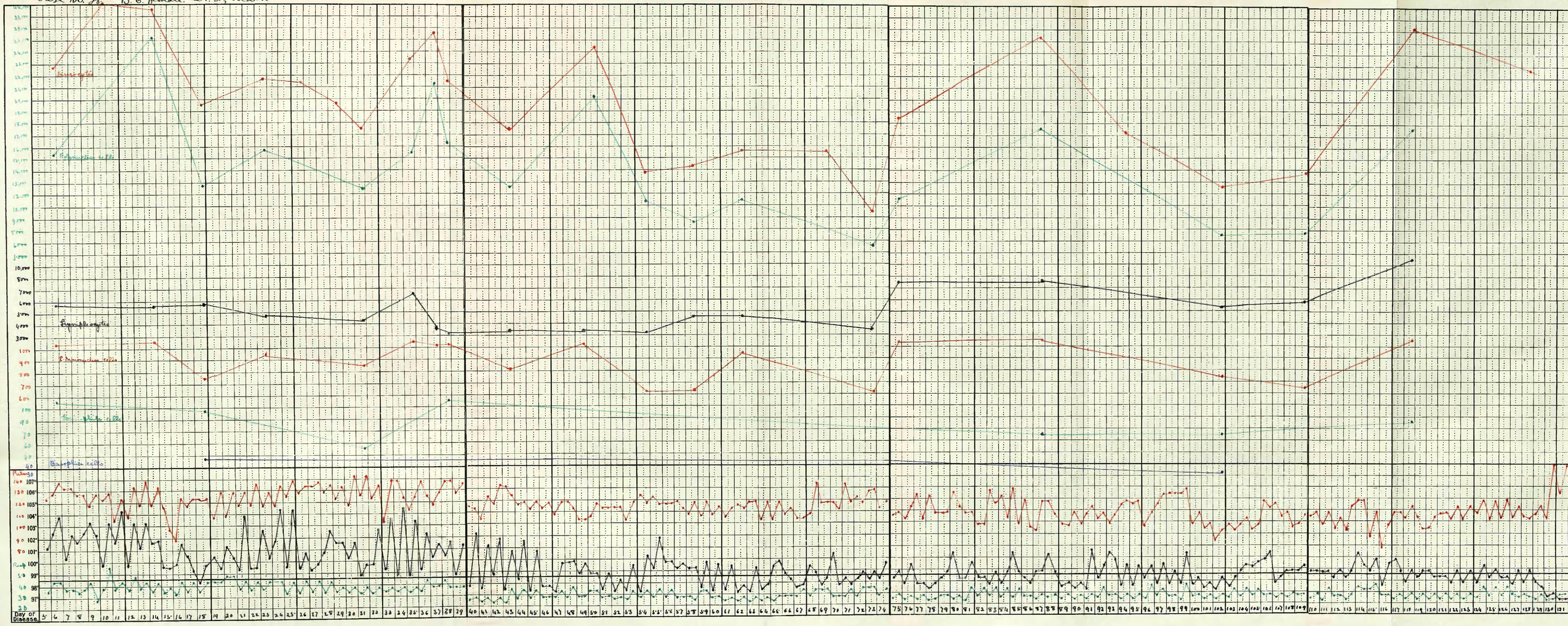
Chronic Case

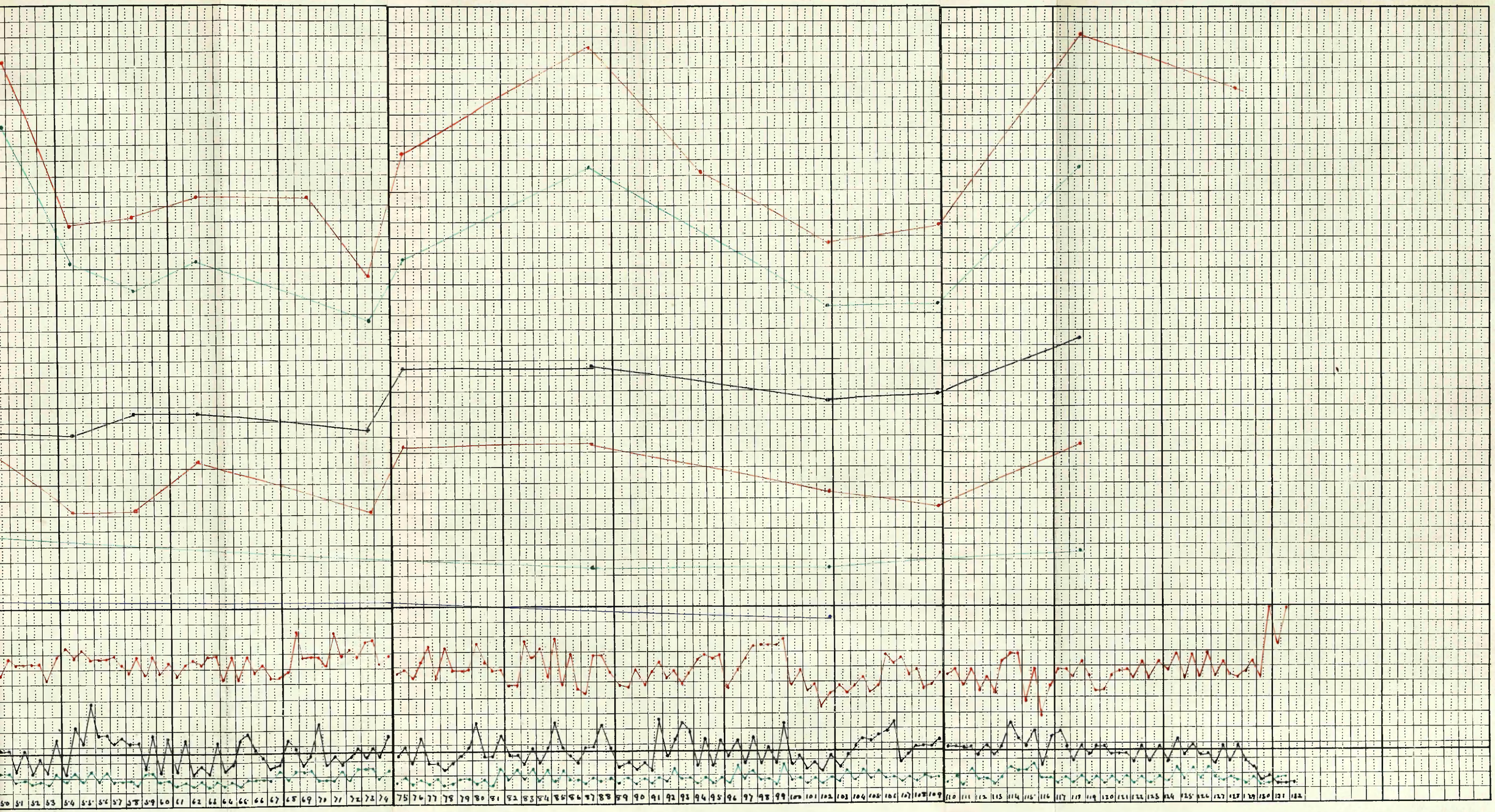
Case No. 24. — A.P. male. aet 3; Death.



Chronic case

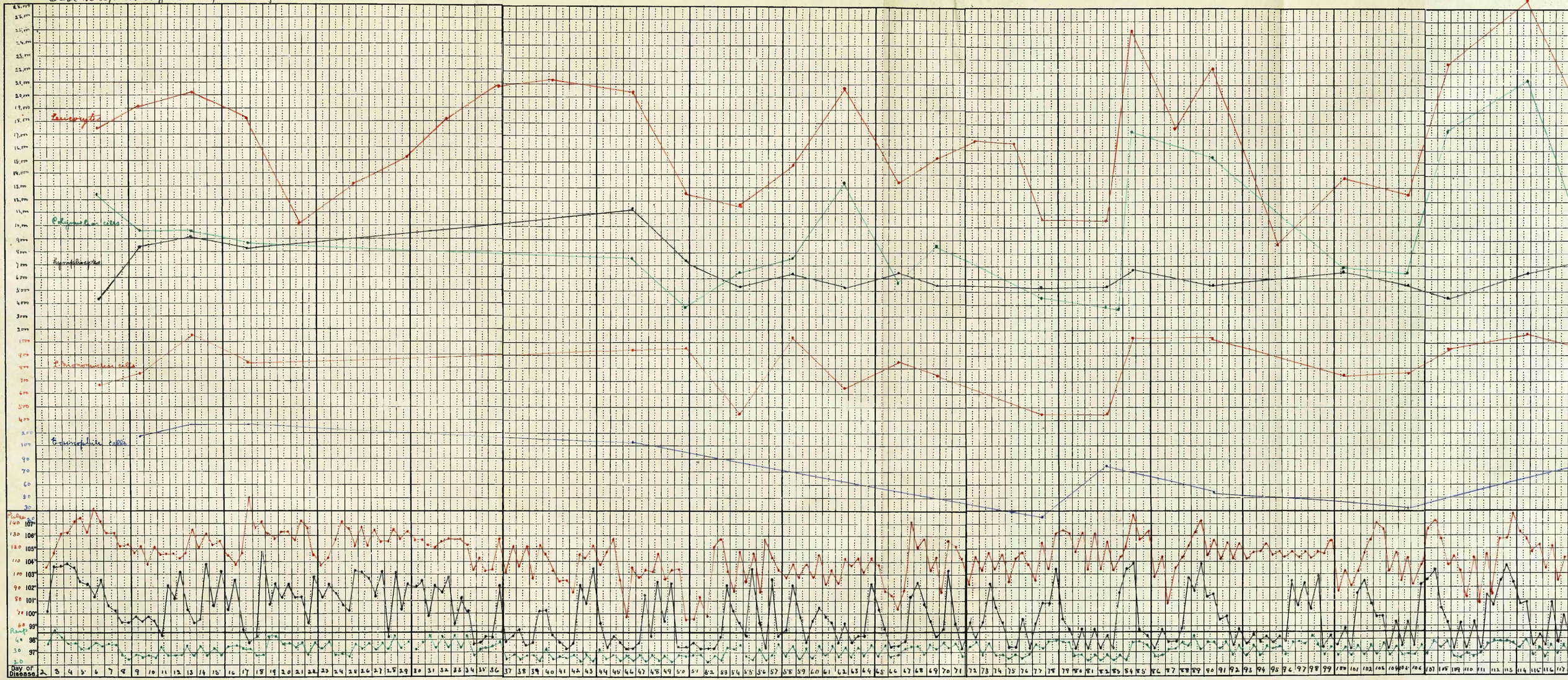
Case No. 78 — B. E. female. aet. 2', Death.

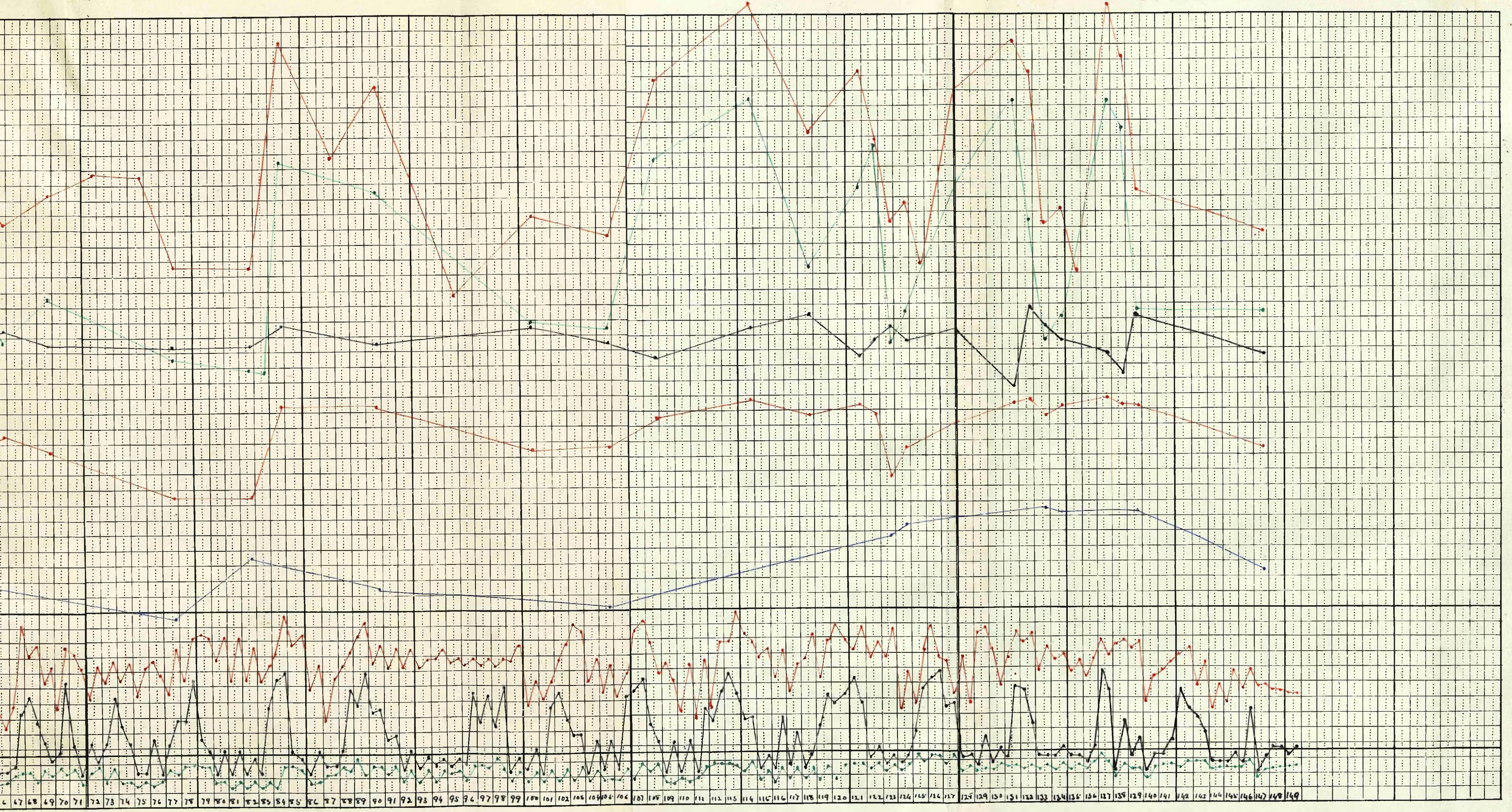




Chronic Case

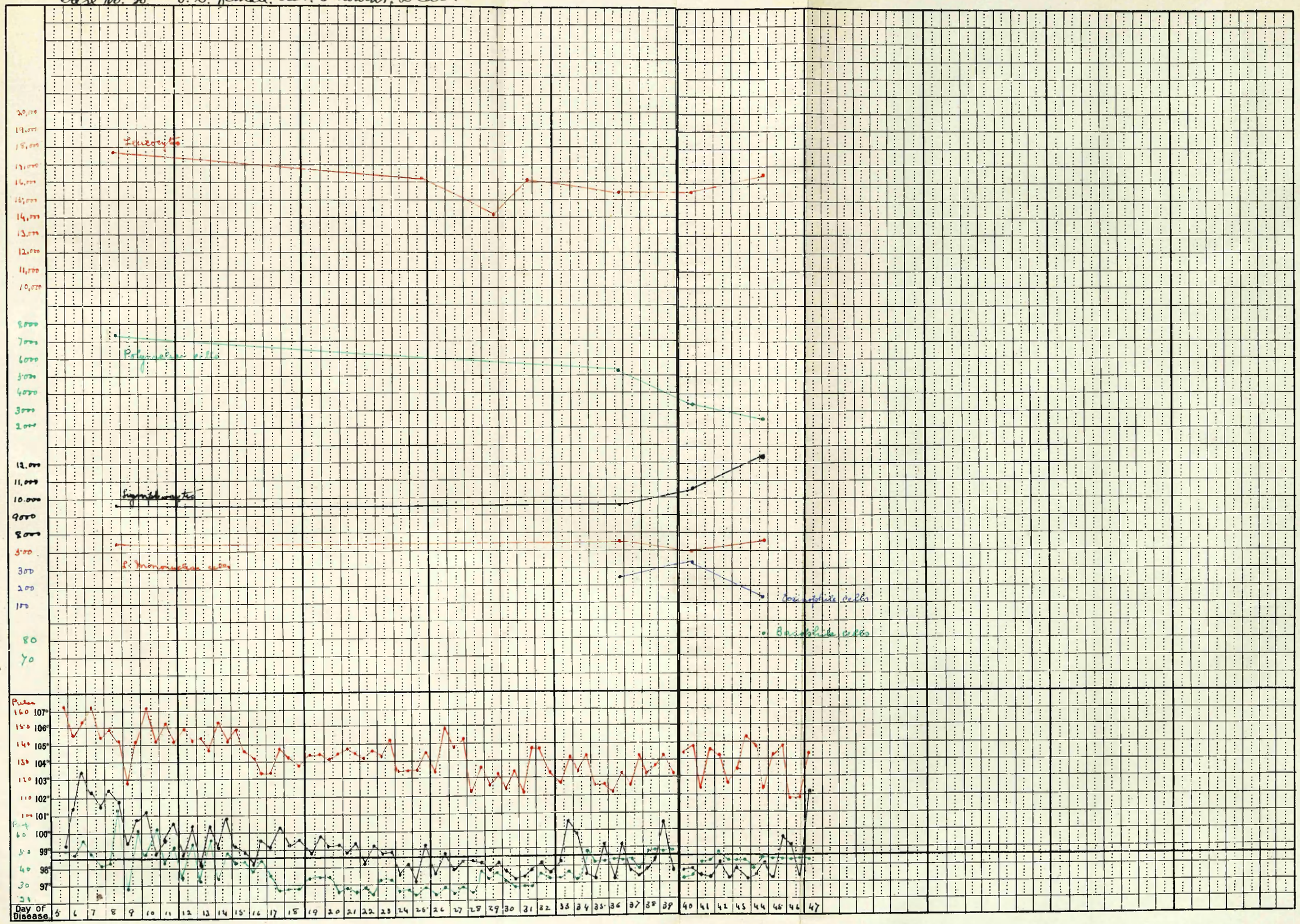
Case No 29.—M.E. female aet, 5. Recovery.





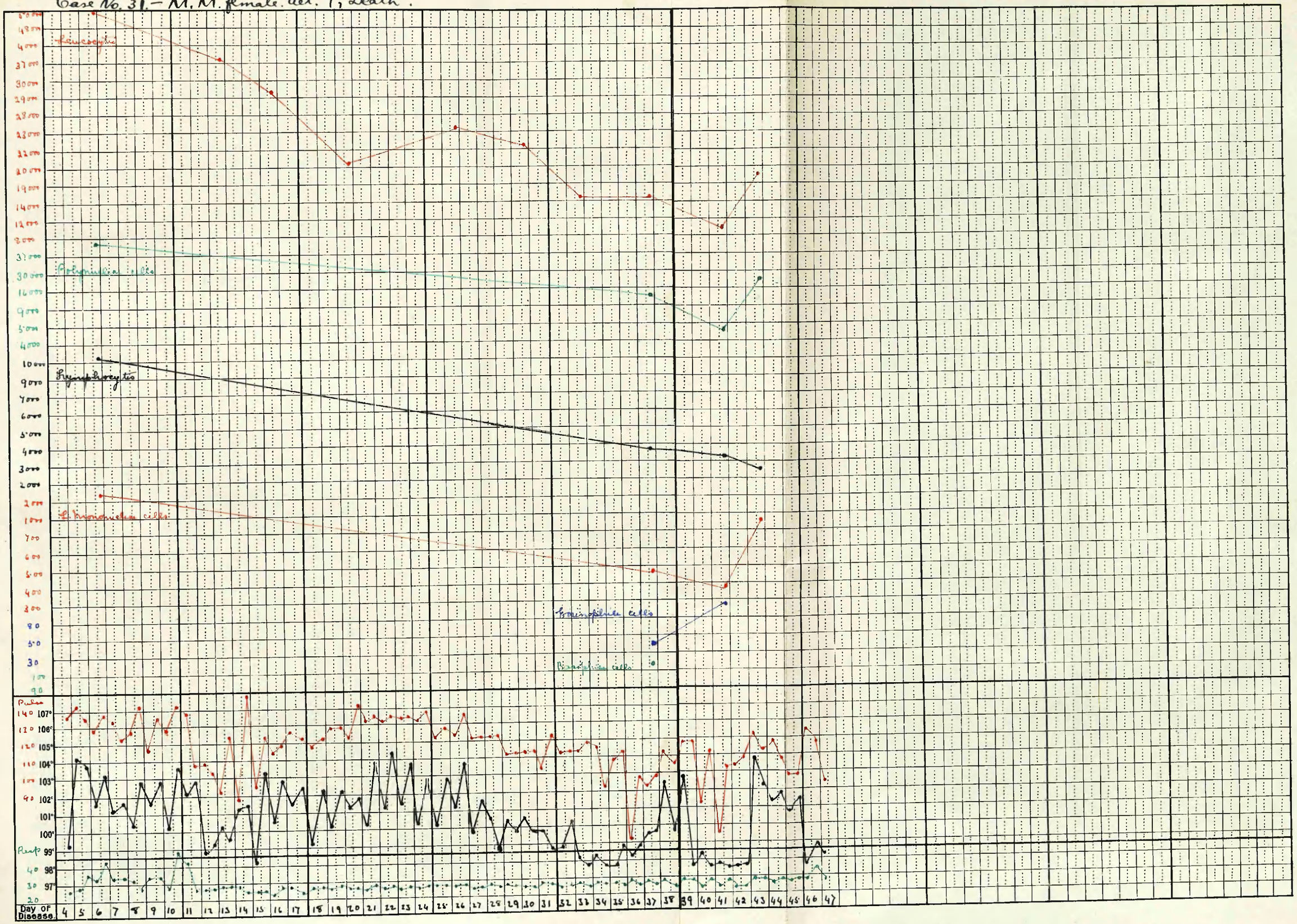
Chronic Case

Case No. 30. — I. S. female. aet. 6 months; Death.



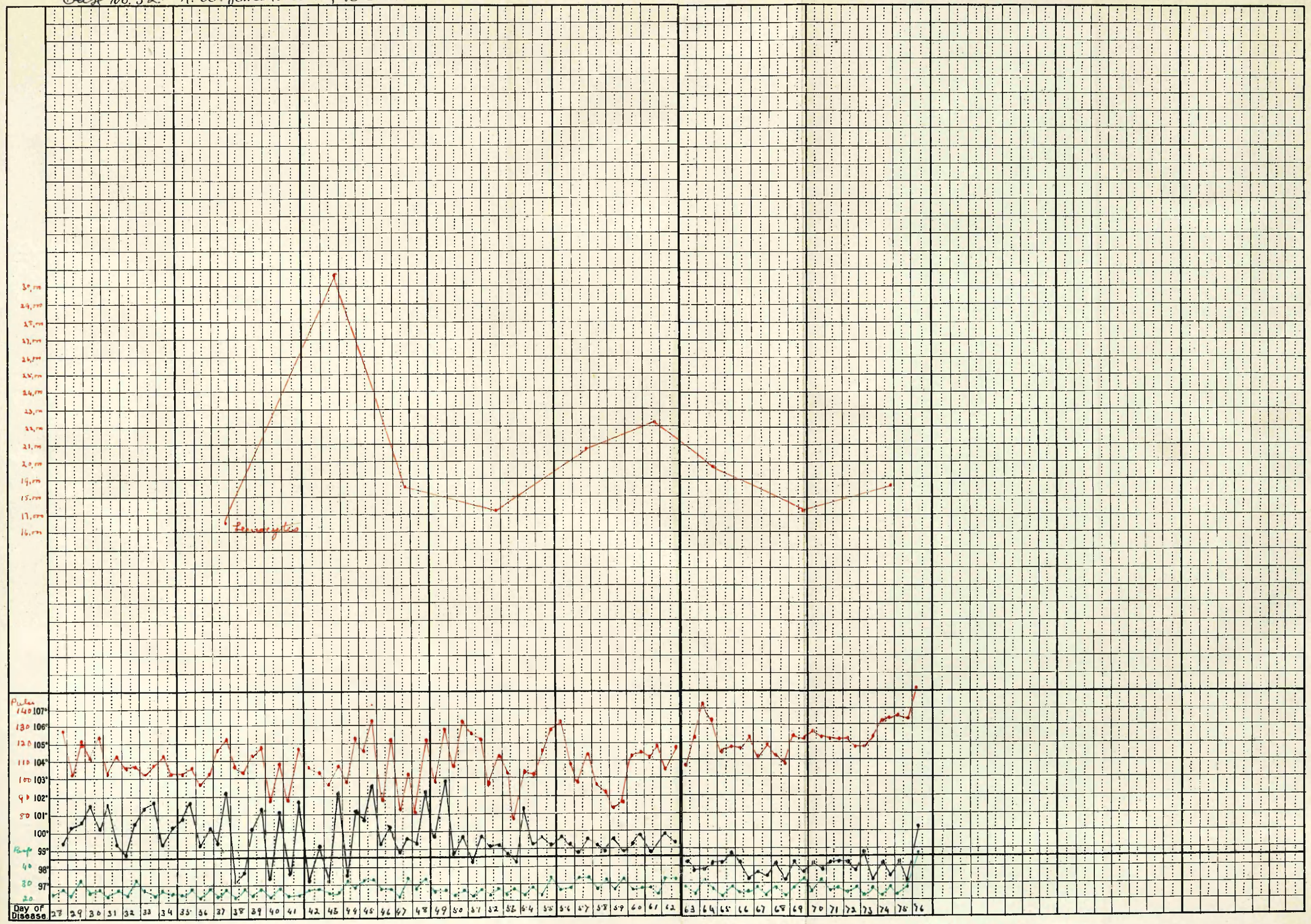
Chronic Case

Case No. 31. – M. M. female. aet. 7; Death.



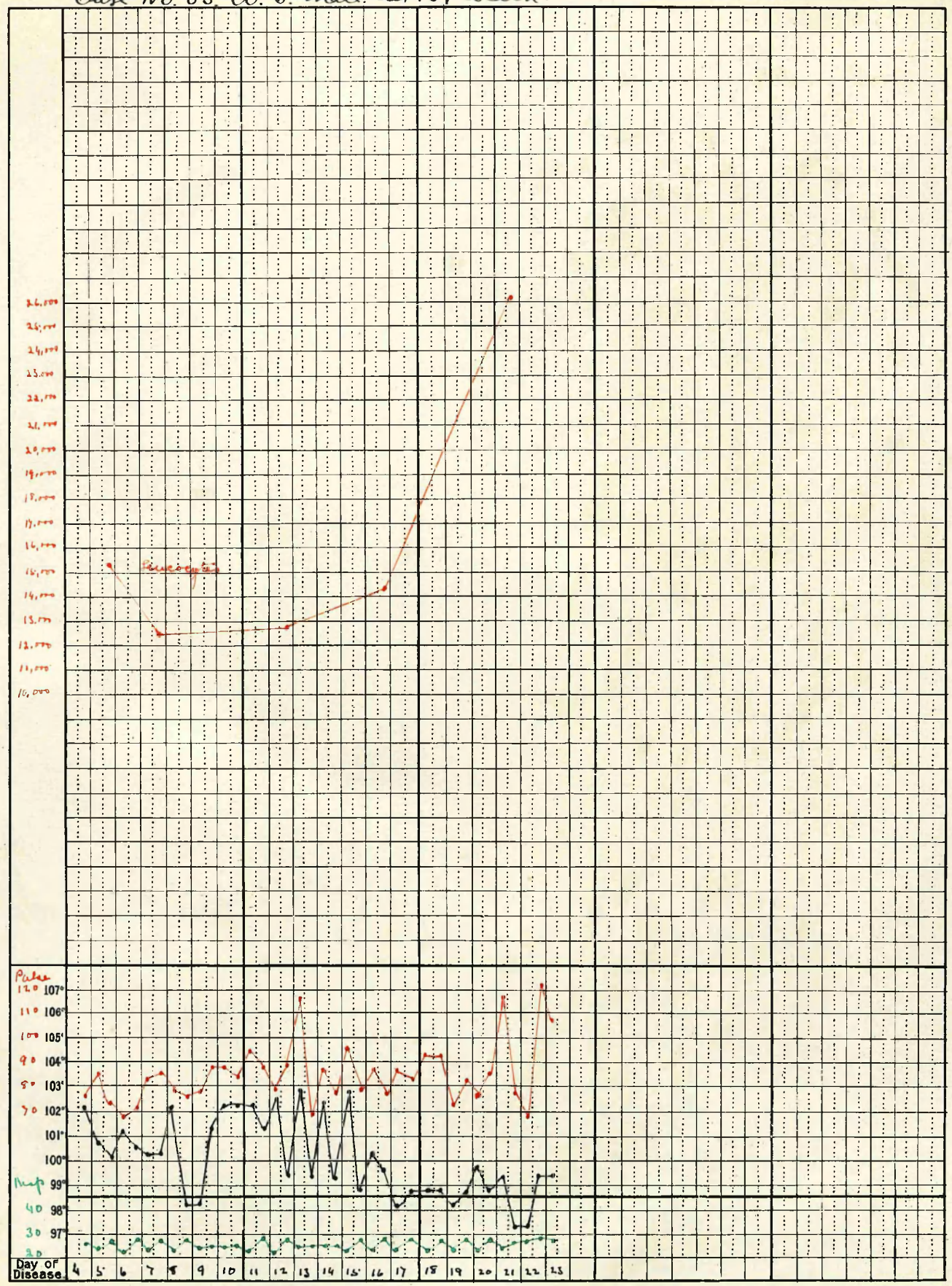
Chronic Case

Case No. 32 — A. W. female. aet 10; Death.



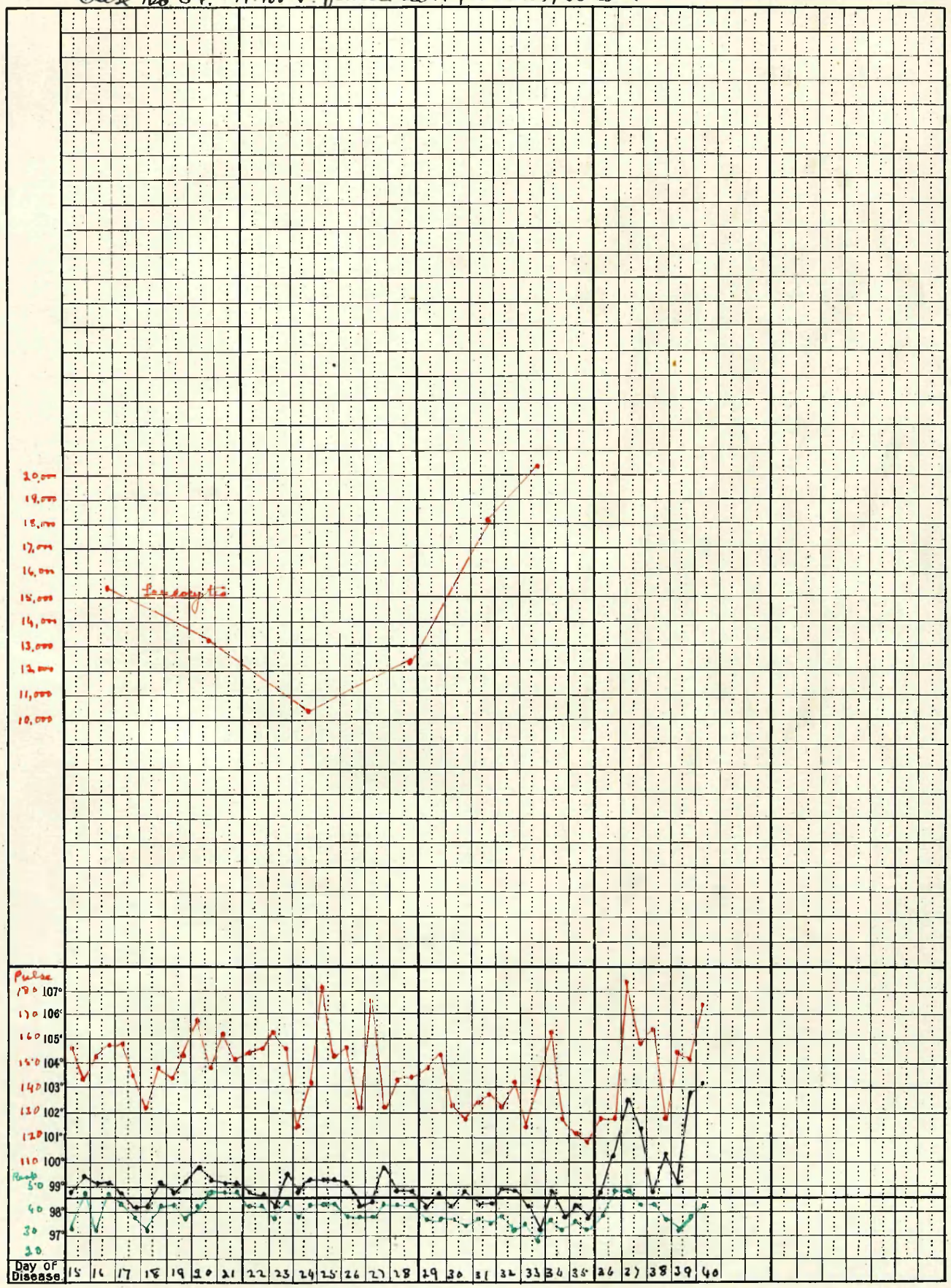
Chronic case.

Case No. 33 – W. E. male. aet 15; Death.



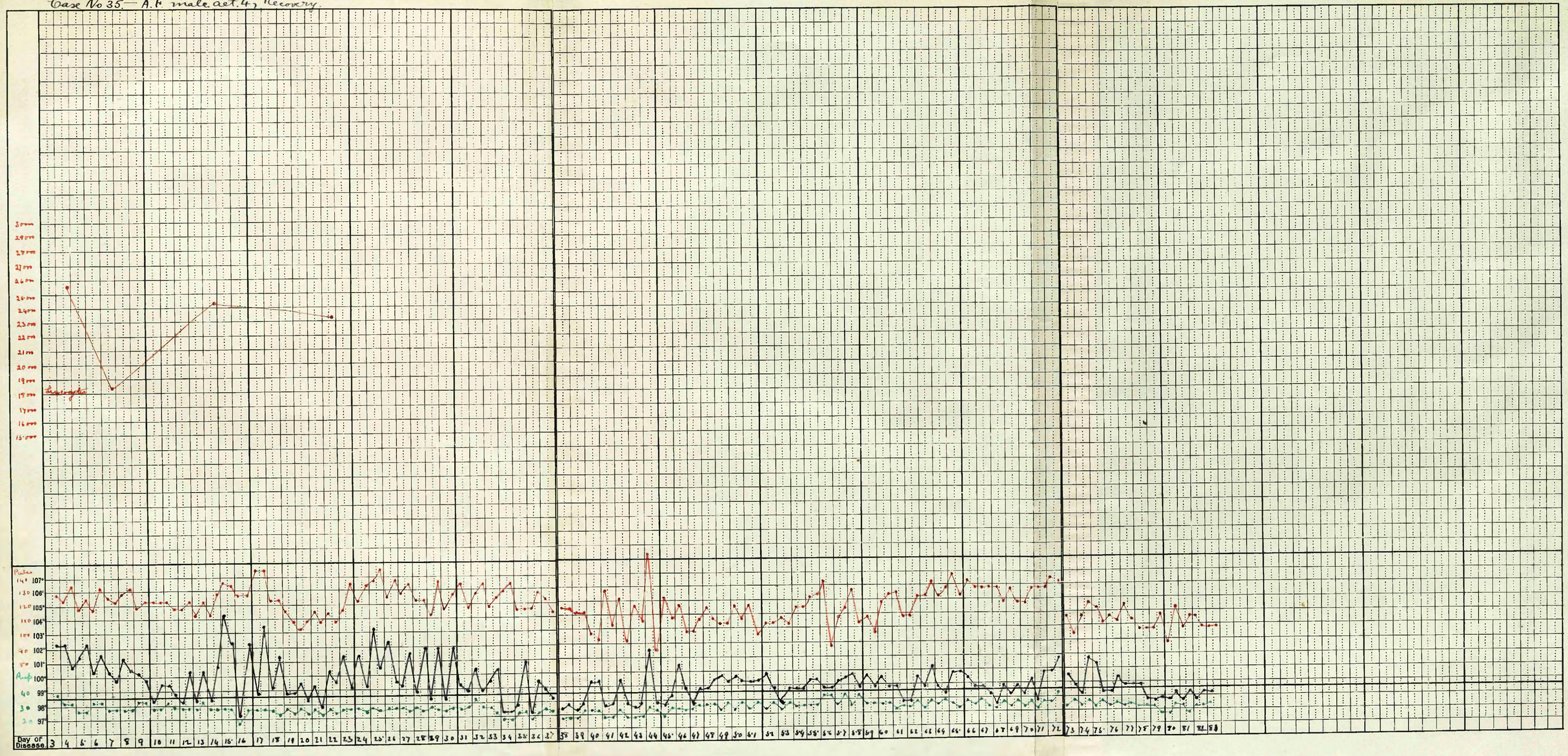
Chronic Case

Case No 34. – A. M. L. female aet. 4 months; Death.



Chronic case.

Case No 35— A.F. male. aet. 4½ Recovery.



Chronic case

Case No. 36 — A. W. female. act 3; Recovery.