Observations on the Blood in

Acute Lobar Pneumonia.

Thesis

by

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While acute Lobar Pneumonia has been recognised as a morbid condition for a considerable period of time, it, until lately has been considered a purely local disease and has been extensively studied and discussed from the point of view of the lung condition. Of recent years, however, with the advent of modern bacteriological methods and consequently of entirely altered views, as to the causation of disease, it has been classified as a specific infection; accordingly, considerable attention has been paid to the condition of the blood during the course of the disease and many interesting facts have been elicited. As far back as 1839, Piorry observed, that the "crusta phlogistica" which forms on blood coagulating after venesection was thicker in Pneumonia than in a normal condition; this he attributed to an inflammation of the blood. Virchow in 1871 noticed an increase in the number of leucocytes; while Halla in 1883 stated that cases, in which there was no new formation of leucocytes proved fatal. Since that time a considerable number of observers have added to the knowledge of the subject and have promulgated various theories to account for the different changes. All unite in agreeing that an increase in the number of leucocytes is usual, and nearly all consider a diminution in their number of the gravest prognostic importance; Maragliano, however, states that the leucocyte count is of no prognostic value, while Billings considers that their presence or absence while indicating the virulence of the bacterial invasion/

invasion, cannot be taken as a criterion of the absolute prognosis. Tchistovitch affirms that, if a case in which there is a leucocytosis proves fatal, death has been due not to the bacterial poison, but to some other pathological condition as e.g. endocarditis or meningitis. With this view Billings agrees pointing to Postmortem examinations of three such cases in which the apparent cause of death was respectively:-- Meningitis, Extensive Consolidation (both lungs) and Nephritis complicated by a Fatty Heart.

Schulz, while admitting a leucocytosis, denies a new formation of white corpuscles considering that the increase is due to a transference of those cells from the abdominal to the peripheral circulations; while Roviglii experimentally showed that when the body was heated the corpuscles in the peripheral circulation were increased, while the reverse took place when the body was cooled. Muir, however, points out that the leucocytosis is due to an increased formation of polymorpho-:nuclear neutrophiles in the bone marrow.

With regard to the relationship of the leucocytosis to the other signs of the disease Tumas points out that there is a rough correspondence between the leucocyte curve and that of the temperature; with this statement Boekmann and Van Jaksch agree. Ewing further considers, that, while the coont principally depends on the systemic reaction, the greater the amount of lung involved, the higher is the leucocytosis; so also Von Limbech/

Von Limbech is of opinion that the count depends on the extent of the exudate, while Muir considers that an increase in the leucocytosis indicates a spread of the inflammation.

Muir, Emanuel, Hewetson and Cabot, however, agree that the leucocytosis depends principally on the systemic reaction.

Introduction.

The patients, on the examination of whose blood the observations in this paper are based, were inmates of the Town's Hospital, Glasgow; they were nearly all adult males, the majority being past middle life. Most of them were derelicts, recruited from model lodging-houses and similar places where the standard of living is very low, men who have paid little attention to food or clothing, whose habits have been very irregular and whose pastlife can show numerous instances of indulgence in alcoholic excess.

Few of these entered hospital during the first few days of the illness, but 'roughed' it till compelled by utter prostration to send for relief. The fatality rate is therefore considerable higher than usual. Owing to these circumstances while it has been impossible to examine the blood from the onset of the disease, its condition in a considerable number of fatal cases has been recorded.

Methods. As a rule the blood was examined daily and as much as possible at the same hour of each day, to eliminate diurnal physiological variations.

A drop of blood was taken from the lobe of the ear (in the first few cases from the finger but this was found to cause more pain and to yield a smaller drop).

The rate of flow of the blood and its time of coagulation were noted. On the first examination a fresh specimen was mounted and cover-glass films prepared for staining. Two Pipettes were then filled for counting respectively the white and the red corpuscles. In the case of the leucocytes the blood was diluted with a half per cent solution of acetic acid to which a little Gentian Violet was added. A Toma-Zeiss haemocytometer was used, all the squares being counted and an average of two or more drops taken. In counting the red corpuscles an average of 32 small squares was noted. The films were heated by being passed 70 or 80 times through the flame of a small spirit lamp and were then placed for 5 minutes in Ehrlich's triple stain (Acid Fuchsin, Orange Green, Methyl Green).

It was found that the most important point in staining was the temperature to which the cover-slide was raised, under or overheating giving equally bad results.

Flow of Blood. In the great majority of cases the rate of Flow of Blood from the puncture was more sluggish than usual; in only two cases was there a rapid Flow and in both, the Pneumonia was ~~accompanied~~ complicated by a General Diffuse Bronchitis accompanied by marked lividity of the ears and fingers. This sluggish Flow is contributed to by two different conditions, the one, as Maragliano has pointed out, common to all febrile states, a contraction of the peripheral vessels - and the other while present in Pneumonia absent in the acute Exanthemata (Cabot) an/

an excessive coagulability of the blood.

Examination of Fresh Specimens.

The principal points to be elicited from the examination of a fresh specimen of blood are:-

1st. The amount of fibrin present.

2nd. The proportion of white to red cells.

3rd. The shape of the red cells.

1st. In all cases examined, the formation of the fibrin was found to be early and excessive. Unfortunately there are no notes regarding this point in the few cases in which there was a leucopenia though Cabot states that in such cases fibrin-formation is absent or diminished.

2nd. In most cases, as will be seen more fully further on, the proportion of white to red cells was considerably increased.

3rd. No mal-formation of the red cells was noticed.

Red Corpuscles. The normal number of red corpuscles per cubic millimetre in healthy adult males is considered to be 5,000,000; this number however, is found to be considerably reduced in poorly nourished people and in alcoholics, Cabot in two counts from Acute Alcoholics finding:- 3,936,000 and 4,288,000 red cells.

In this series, the number of corpuscles per c.m.m. counted during the fastigium varies considerably, the extremes being 7,800,000 and 3,000,000, the mean of all cases being 4,600,000;

leaving out of account two cases which became tubercular and three which showed an abnormally high count. (this being due to impending dissolution with blood-stasis ,)the average number is 4,260,000.

In the cases which preceeded to a favourable termination, the average count before crisis is 4,300,000, after crisis 3,740,000. In fatal cases the average count is 4,850,000, but deducting the three high counts already referred to, the total is reduced to 4,185,000.

General Observations.

1st. While the number of corpuscles is considerably below the normal mean, the count is as high as would be anticipated in such a poor class of patients in their usual health. That this should occur in a disease associated with high fever and consequently a marked increase in the rapidity of general tissue destruction, is at first sight a somewhat astounding fact; this height of the count however, is found to be apparent only, being brought about by a concentration of the blood in the peripheral vessels, a concentration due to two causes common to all febrile conditions - a contraction of the peripheral vessels and a loss of water from the severe sweating which usually occurs.

2nd. The average count taken after crisis shows a decrease of 500,000 corpuscles (the figures being 4,300,000 - 3,740,000). This decrease while no doubt partly due to a dilution of the blood caused by a post critical dilatation of the peripheral vessels (Maragliano) is to a large extent an evidence of the blood/

blood destruction which occurs during the height of the fever.

3rd. The average early count in cases which recovered is slightly higher than the corresponding count in fatal cases - the figures being respectively 4,300,000 and 4,185,000 - but the difference scarcely justifies the drawing any definite inference of prognostic importance.

Behaviour at Crisis. After the post-critical fall, there is a gradual rise in number of the corpuscles as regeneration sets in: the rise is however slow, in fact in no case has the count reached the height before crisis, when the patient left hospital (they usually leave as soon as they can walk about again) A good example of this is one case in which the count on the seventh day was 5,700,000 on the eighth (the crisis having intervened) , 3,000,000, on the 9th, 3,500,000 and on the 14th 4,100,000. In another case. the number on the 6th day was 3,500,000, on the 7th (crisis on the 6th) 2,500,000 and on the 14th 3,000,000. The fall in this case however, was rather above the average, a more typical case showing a fall from 5,000,000 on the 7th day to 4,300,000 on the 9th.

Fatal cases. The highest count recorded was 7,800,000 - shortly before death in a case where there had been intense cyanosis of ears and finger tips for at least two days; the next highest count were two of 5,700,000 obtained in similar circumstances. These three patients were admitted in a moribund state, so that there were no opportunities of noting the daily variations /

variations of the count; it must be granted there was a considerable increase in the number of corpuscles in the peripheral blood during the course of the disease, as the counts are much higher than the average at the commencement of the disease in similar subjects. That this is so is borne out by reference to another case in which the count taken two days before death - 3,000,000 had increased to 3,800,000 on the day of death. This ante-mortem increase of red corpuscles it is interesting, though somewhat in anticipation of a later part of the subject, to observe, was accompanied by a similar though much more marked increase in the leucocytes.

Even in these cases, however, a rise in the number of red corpuscles does not always occur, as e.g. in one case, where there was a rapidly progressive leucocytosis, a diminution of red corpuscles was noted, the number on the day before death being 4,300,000 and on the day of death 3,800,000. Again, in another case a continuous diminution in the number was noted - on the third day 4,000,000, on the fifth 3,750,000, on the 7th 3,350,000 and on the 8th and last day 2,800,000; in this case however, there was a leucopenia, instead of the usual leucocytosis.

White Corpuscles.

Number.

As a general rule though there are most notable exceptions, a leucocytosis occurs during the fastigium. Leucocytosis is defined by Cabot as an increase in the number of leucocytes in the peripheral blood over the number normal in the individual case, this increase never involving a diminution in the poly-morpho nuclear varieties, but generally a marked absolute and relative gain over the number previously present. Of course in observations on patients suffering from an acute disease like Pneumonia, it is impossible to state the normal number in the individual, as such patients only seek admission to hospital when the disease is well established. Again, even in persons who are in their usual state of health, the number of leucocytes is found to vary so greatly, that anything from 5,000 - 10,000 must be considered normal; counts as low as 3,000 have been noted in persons, who, though habitually ill-nourished and poverty-striken, might be considered at the time of examination to be in a normal state of health, while on the other hand 10,000 is quite a normal count in subjects of the opposite type, well nourished and vigorous. Striking an average, 7,500,~~000~~ may be considered the normal for purposes of comparison. Even in a state of health, the number varies with the time of day, an increase being noted after meals and a diminution after a long fast. As has already been indicated, in/

in order to eliminate as far as possible such a physiological variation, an endeavour was made to examine the blood at the same time daily but this of course could not always be managed owing to the exigencies of busy hospital practice.

In the treatment of the disease, however, food of a light and easily digestible nature was administered at frequent intervals so that with the process of digestion never greatly strained and yet seldom at entire rest, much daily physiological variation was not to be expected. Cabot who states that the count rises 33% after a meal rich in proteids in a normal person, gives as an example of digestion leucocytosis a case of Pneumonia in which the count before food was 10,400 and after food 21,700 - a variation which seems more than physiological.

In this series, taking in each case, the highest count noted the following results were obtained.

Table No. 1.

Leucocytes	No. of Cases	Per-centage
Under 10,000	4	12.5
10 " 20,000	8	25. 0
20 " 30,000	11	34.375
30 " 40,000	5	15.625
40 " 50,000	2	6.25
50 " 60,000	1	3.125
60 " 70,000	1	3.125
	32	100

As the majority of cases were admitted after the disease had progressed for 4 or 5 days these figures cannot be considered as representing the average number throughout the usual 8 days; they however clearly show that a leucocytosis was present in all cases except 4 during some period or other of the fever.

For purposes of comparison, it is interesting to note the summarized results of 566 cases from the Massachusetts Hospital.

Table No. 11.

Leucocytes.	Cases.	Percentages.
Under 10,000	62	10.9
10 - 20,000	220	38.8
20 - 30,000	197	34.8
30 - 40,000	53	9.4
40 - 50,000	23	4.1
50 - 60,000	8	1.4
60 - 70,000	2	.4
110 - 110,000	1	.2
	566	100

The source from which this table was derived does not state whether the counts here enumerated represent the average number during the attack or the highest number noted; but presuming that the latter method has been followed, the percentages of the two tables correspond sufficiently to show that the cases /

cases from which the smaller table has been constructed, are fairly representative. When the numbers are arranged according to the broad issue of the illness - recovery or death - the following table summarizes them.

Table No. 111.

Leucocytes.	Recoveries.	Fatal.	Total.
Under 10,000	0	4	4
10- 20,000	6	2	8
20 - 30,000	9	2	11
30 - 40,000	2	3	5
40 - 50,000	1	1	2
50 - 60,000	0	1	1
60 - 70,000	0	1	1
	18	14	32

The high counts in the fatal cases, however, were altogether noted shortly before death, so that a table of the average height during the fastigium should be given for comparison (of course in some cases, only one count was obtained).

Table No. 1V.

Leucocytes.	Recoveries.	Fatal.	Total.
Under 10,000	1	4	5
10 -20000	9	2	11
20 -30000	7	4	11
30 -40000	1	2	3
40 -50000			0
50--60000		1	1
60 -70000		1	1
	18	14	32

This table of averages must only be accepted with certain qualifications, as will be more particularly pointed out when the cases come to be analyzed individually; since many of the cases were admitted when the disease was well advanced, in these instances only one count was obtained before crisis. Again, with regard to classification as to their ultimate issue, it should be stated that one case which eventually terminated by death from Tuberculosis is included in a table of recoveries, as the Pneumonia infection actually terminated by crisis, which in other cases, although a definite crisis was present, eventual recovery only ensued after a long drawn-out complication such as Empyema . .

Taking a glance at the tables as a whole, without noticing special circumstances, it is observed:-

1. That in all cases but 4, a leucocytosis was present, and that in the majority (22) it was of moderate extent.

11. That all cases in which the count was less than 10,000 or more than 40,000 proved fatal, while on the other hand, cases with a moderate leucocytosis (under 30,000) showed a tendency to recover (16 recoveries out of 22 cases).

Remarks on Fastigium.

In all probability shortly after the initial chill heralding the onset, the leucocytes begin to increase in number. In the present series, on only one occasion was the /

the patient in hospital on the first day; in this case, the rise in temperature was brought about by a second attack associated with involvement of the other lung; not only was there a leucocytosis (18,000) at the very hour when the temperature began to rise, but on the day before, the leucocytes which had fallen in number after the crisis of the initial attack were showing a tendency to increase in number. Two other cases admitted as early as the third day showed a leucocytosis though of moderate extent (11,000 and 14,000); while the great majority admitted later in the illness showed a higher count. It may therefore further be stated that the leucocytosis does not reach its height at the onset, but increases with the march of the disease. This is borne out by reference to the case above quoted in which the count rose from 15,000 on the first day to 18,000 on the second, 20,000 on the 3rd and 32,000 on the 4th, and while the other cases in which several counts were obtained do not show such a steady daily rise, all exhibit a marked rise on the day of crisis.

Crisis.

In every case which terminated by crisis, there was a substantial drop in the first 24 hours, the fall in number varying from 1,300 to 22,500 and averaging 9,100. The two cases in which the fall was least, (1,300 and 3,000) developed complications/

complications (Tuberculosis & Empyema); leaving them aside the average reduction is found to be 11,000. Of course this reduction in numbers as has already been indicated under red corpuscles, is not solely due to the crisis of the Pneumonia infection but is also contributed to by the post-critical dilution of the blood.

While there was a marked drop in 24 hours, in only two cases was the normal number reached on the day after crisis (the normal being considered the lowest reached by the progressive fall) and in both these cases the Pneumonia was of a mild type. As a rule the normal was only reached on the third and 4th day after; in two a normal count was not obtained till the 10th and 11th day (after crisis) respectively, these two being associated with delayed resolution; while in the two complicated cases above referred to, the normal was never reached in the Tubercular one which ultimately proved fatal, and in the Empyema a normal count was not noted before operation.

With one exception, no fall in number was noted before crisis actually commenced; on the contrary in two cases in which counts were obtained 1 hour and 2 hours before the temperature began to fall, the leucocytes were still increasing in number. In the exception referred to there was a slight fall of 2,000, 2 hours before crisis. In this connection J.T. Hewetson remarks that in mild cases the

curve /

curve may anticipate the crisis, but in severe cases it is often maintained for several days after the crisis, and then falls gradually. While the present series shows an agreement with the latter part of his statement, curiously enough in the only case in which an ante-critical fall took place, Empyema developed.

Post-Critical rise and Pseudo-crisis.

Three cases in this series exhibited a rise of temperature after an apparent crisis, which in all three instances was accompanied by a similar marked fall in the pulse and respiration rate and by a distinct feeling of relief to the patient. In all three an actual increase in the number of leucocytes was noted on the day following the first fall of temperature. In one where the temperature fell from 102° at 10 p.m. to 98° at 10 a.m. of the following day, the count at the corresponding hours rose from 13,000 to 23,400 heralding a rise of temperature to 101.40 on the following day; in the second the count after the fall of temperature had risen from 32,000 to 41,000 fore-shadowing a rise of temperature to 1000 ; while on the third a count of 11,000 at 4 p.m. when the fall of temperature began, rose to 18,000 on the following evening when a second rise of temperature commenced.

Cabot in this connection states that "in cases in which a pseudo-crisis occurs (the temperature falling, but rising again) the leucocyte count usually remains high". It is difficult to know whether to classify the cases above mentioned as/

as examples of pseudo-crisis or of post-critical rise of temperature; Osler states that a pseudo-crisis may occur on the 6th day, whereas, while one of the cases shewed a fall of temperature on the 5th day , in the other two this did not occur till the 8th day, the most common day of crisis. Probably in the light of the leucocyte count, the first fall is to be considered a false crisis, the real crisis coinciding with the fall in number of the leucocytes.. This is borne out by reference to a 4th case in which after a crisis on the 7th day, there were evening rises on the 8th, 9th, 10th and 11th days to 99 , the lung resolving as in normal circumstances. Here, it is interesting to observe, the leucocytes fell from 25,000 on the 7th day to 8,500 on the 8th, and 6,000 on the 9th.

One may thus state that in pseudo-crisis the count remains high, while in a post-critical elevation of temperature unaccompanied by any pathological condition, the count drops as usual.

Fatal Cases.

One point stands out with special clearness - that all the cases which shewed a leucopenia (i.e. a diminution in the number of the leucocytosis) proved fatal - a statement borne out by all observers on this subject. In this series the leucocyte curve in fatal cases is of two distinct types; in the one a leucopenia or a very slight degree of leucocytosis is/

is present; in the other there is a progressive daily rise of leucocytes till the termination.

In the former category there are six cases : in the latter , 8. Of these 6 , 4 showed leucopenia while of the other 2, one shortly before death had a count of 12,000 (the only count obtained) while the other showed a fall from 36,000 in the day preceding death to 12,600 on that day. It may therefore be presumed that in these 6 cases, the pneumonic poison was so virulent that it not only destroyed some of the existing leucocytes, but that it also entirely inhibited their new formation.

Of the 8 cases in which there was a high leucocytosis 5 showed a progressive daily increase in the count while the other 3 were admitted moribund with counts of 25,000,60,000 and 70,000 respectively, thus indicating a similar progressive rise.

The daily rise in the 5 ranged from 2,000 - 12,500, averaging 7,500, a greater increase than was noted in the cases which recovered. Of course the leucocyte curve will be noticed to correspond with that which occurred in cases which ended favourably by crisis, but the gradients are steeper and a much greater height is reached.

In this connection V. Limbech states that a steady rise foretells a fatal issue; while Tchistovitch followed

by /

ny Billings states that if a case in which leucocytosis is found, proves fatal, death has been due to some pathological lesion other than the virulence of the toxin. In this series whilst post-mortem examinations were not made, in one of these cases there was extensive consolidation of both lungs, but in the other 7 no particular complication was noticed excepf of course alcoholism, and general poverty of health.

Complications.
(a) Delayed Resolution.

In those cases in which resolution of the lung was delayed the leucocyte curve was longer in reaching the normal. One case exhibited an actual increase of the leucocytosis after crisis (unaccompanied by a rise of temperature or any symptoms of recrudescence); on the 3rd day after, the count was 15,000 on the 4th 19,000 and on the 9th 15,000 and on the 11th the count had only fallen to 11,000, considerably above the normal average of these cases; on that date (in which the last count was taken), there was still noted dulness and tubular breathing in the affected lobes.

b. Empyema.

In one case which developed Empyema, the leucocytes at crisis fell from 15,000 - 12,000 but the immediately afterwards rose in numbers-24,000, 19,000, and 25,600. This last count was noted 5 days after crisis,/

after crisis, but unfortunately it is the last count taken (as I then left hospital).

This case therefore presents two marked features, the comparatively low leucocytosis at crisis and the greater hight reached afterwards, a condition of affairs which is unique in this series and in connection with the after-history of the patient, it seems of valuable prognostic significance.

The after history briefly was as follows:-

The temperature assumed a hectic type, the lung dulness persisted, exploratory punctures were made, but no fluid obtained; the temperature gradually dropped reaching normal and remained normal for a week or two, when it then shot up to 104° ; pus was obtained a few days later, the empyema evacuated and the patient left hospital well. It will thus again be observed that though pus was not detected till many weeks afterwards, the leucocytes on the 2nd day after crisis, were increasing in numbers.

c. Tuberculosis.

One patient was admitted with the symptoms and signs of an ordinary Lobar Pneumonia, but died on the 3rd week from acute Pneumonic Phthisis. Osler, in stating the extreme difficulty of diagnosing such a case/

case gives the following account of one:-

"A healthy robust-looking young Irishman, a cabdriver, who had been kept watiing on a cold blustering night until 3 in the morning was seized the next afternoon with a violent chill, and the following day was admitted to my wards at the University Hospital, Philadelphia. He was made the subject of a clinical lecture on the 5th day, when there was absent no single feature in history, symptoms or physical signs of Ac. Lobar Pneumonia of the right upper lobe. It was not until 10 days later, when bacilli were found in his expectoration that we were made aware of the true nature of the case. I know of no criterion by which cases of this kind can be distinguished in the early stage". Tranbe considers that an important fact is the absence of breath sounds in the consolidated region; this is also remarked on by Herard and Cornil . Such a condition however, suppression or enfeeblement of the respiratory murmur is often an early sign of an ordinary lobar Pneumonia; and while it was noted by me in another case Pneumonic Phthisis (no blood counts taken), in the case under discussion, it was absent, the physical signs revealing dulness and tubular breathing over right lower lobe. The only difference bewteen this case and a case of delayed resolution was the fact that the sputum became muco- purulent and of a greenish colour,/

colour, a point to which Tranbe also alludes; this was not its appearance at first, it being of a viscid tenacious consistence, stained by the characteristic rusty tinge. Even that characteristic sign of Phthisis the presence of Tubercle Bacilli in the sputum - cannot be relied on at an early stage, in fact one of my cases showed Pneumococci on the 7th day.

In this case, however, while there was not a true crisis, i.e. the temperature falling to normal, there was an apparent crisis, the temperature after having been sustained at 102° falling to 99.8°; and in the light of several other cases examined, this may be considered the Pneumonic crisis.

Now, on the days of admission, the leucocytes numbered 17,500, rising on the day following to 28,125; but on the next day, the crisis, the count at 7-30 p.m. had fallen to 26,690, the lowest temperature 99.6° having been reached at 2 p.m.; thereafter there was a gradual fall in numbers - 21,250, 18,280, 18,905 and 14,220 (the last count obtained).

We have thus opposed to the rise of leucocytosis associated with Empyema a distinct fall and instead of the sudden drop of an ordinary Pneumonia , a gradual decrease. It may be argued that such a gradual fall is noted in cases of ordinary delayed resolution, but/

but in the latter, at least in this series, there is a much greater drop at crisis, and of course the two conditions can be clearly differentiated by a temperature curve.

A low count of leucocytes in noted in all published cases of acute Miliary Tuberculosis. Thus Warthin reports a case in which he made 30 counts - the highest being 10,000, the mean 3,000.

Of 27 cases in the Massachusetts General Hospital, 23 showed counts of under 9,000, ranging from 1,300 - 9,000, the only case showing a marked leucocytosis - 32,000 - being complicated by Diphtheria. Emanuel, however, while agreeing with the low count in Tuberculosis, mentions among several exceptions in which leucocytosis is present, acute Pneumonic Phthisis.

This therefore tends to show that in this condition the original infection is Pneumonic, the tubercular element supervening.

d. Bronchitis during convalescence.

The patient developed bronchitis on the 7th day after crisis. Here, the leucocytes which 2 days after crisis had fallen to 6,250, rose on the onset of the bronchitis to 15,625, four days later, falling to 10,625.

This increase of the leucocytes is in general agreement with the counts made in the Massachusetts General Hospital; while of 45 cases, 32 shew a count over /

over 10,000, in the majority the count is above 15,000-. Cabot states that apart from "capillary bronchitis" it is not infrequent to find cases in which while there are only signs of General Bronchitis, the symptoms are much more like Pneumonia, and that the blood count in no way helps the differential diagnosis. This is an interesting statement in view of the fact that this case developed Bronchitis when convalescing from Pneumonia.

The only other reference to this point is that of V. Limbech who briefly states "that acute catarhal and chronic purulent Bronchitis have relatively little leucocytosis in most cases".

e. Acute Nephritis.

In one patient the pneumonia was associated with acute Nephritis; there was consolidation of the right base, while the urine showed a considerable quantity of albumen, and the presence of blood and tube-casts . Only one count was obtained before crisis, the Red Corpuscles numbering 3,487,500, the leucocytes 25,000 and the Haemoglobin showing a percentage of 52.

Referring to the condition of the blood in Nephritis, Cabot states that while the Red corpuscles are often diminished, the haemoglobin suffers still more. Laache reports an average loss of 19% of the Red Cells/

cells and 26% of the haemoglobin; which Hayem finds no considerable loss of red corpuscles unless the urine is hoemorrhagic.

Grawitz records a case in which the red cell count was 3,400,000, while Sadler finds two of 6 cases showing counts of 3,690,000 and 2,262,000 respectively, the other 4 showing normal counts.

It will be observed that whereas the average red cell count in this series of Pneumonias is 4,260,000 the count in this case is 3,487,500, thus showing a marked diminution, while the Haemoglobin percentage is also considerably below normal.

With reference to the leucocytes, Cabot in 14 out of 26 cases obtained a count above 10,000, only two of these however, being over 20,000. Hayem gives counts of 14,973, 12,400, 15,000 and 13,000; but Sadler notes a leucocytes (13,312) in one only out of 6 cases, while Koblank and Grawitz each in a single case record a normal count. (7,300;5,600).

In this case, therefore, the high count (25,000) must be due to pneumonic toxin, and, in point of fact, it agrees with the usual leucocyte count. The blood in this patient then, comes under two influences - the loss of blood in the urine due to the Nephritis reducing the red corpuscles and the haemoglobin, while the white/

the white corpuscles increase in number in response to the stimulus of the Pneumonia.

f. Fracture of Rib.

In two cases in which the Pneumonia followed (or perhaps simply coincided with) Fracture of the Rib the leucocyte curve follows its usual course.

Related to Lung Condition.

Of 23 cases, in which a careful note has been recorded of the lung condition, 10 showed an involvement of the right lung alone, 6 of the left, and 7 of both lungs, but of these 7 two showed only a very small patch on the left side and have been considered for purposes of comparison right sided pneumonias.

Table No. V.

Right Lung. - 12 Cases.

Lobe Affected.	Leucocytes.
Upper middle & Lower.	15000
do.,	28000
do.	28000
do.	26000
	37600
Upper	26500
Upper & Middle.	18000
Middle.	20000
Middle & Lower.	40000
do.,	11560
Lower.	25000
do.,	7500
do.,	

Table No. VI.

Left Lung.	6 Cases.
Lobe Affected.	Leucocyte Count.
Lower.	25,000
"	23,000
"	45,000
"	23,000
"	8,400
"	26,500

Table No. VII.

Both Lungs.		5 Cases.
Right.	Left.	Leucocytes.
Upper, Middle & Lower.	Upper & Lower.	12,800
Middle.	Lower.	17,000
Lower.	Lower.	12,500
"	"	32,000
Middle & Lower.	"	35,800

The leucocyte count in each case is the highest noted throughout the fastigium.

The next table summarizes the last three, giving the average count corresponding to the lung affected; in the case of the right lung, however, the count of 70,000 is left aside as it was due to the special reasons already referred to.

Table No., VIII.

Lung Affected.	Average Count.
Both Lungs.	23,000
Whole of right Lung.	23,000
Part of right "	23,000
Part of left "	25,000

It will thus be observed that these figures indicate in a most striking manner that the degree of leucocytosis bears no relation whatever to the particular lung affected or to the extent of the consolidation. This agrees with the conclusions of Cabot on this part of the subject, who states "that the degree of leucocytosis does not run parallel to the amount of lung involved." Ewing and Billings however, on the contrary conclude that the more the amount of lung involved, the higher the leucocyte count is expected to be; while Cabot himself further states that cases with extensive signs in both lungs are more apt to

to have very high counts, but adds the qualifying statement "provided the reaction of the patient against the infection is vigorous". The only case in this series however, in which consolidation was present in the whole of both lungs had a very small count - 12,800; while high counts of 37,600, 40,780 and 45,300 were found in 3 cases in which were only involved respectively:- upper lobe of right, lower lobe of left and middle and lower lobe of right. It is interesting however, to note that two cases in which the right upper lobe alone was involved, a condition in which the disease is considered to be of a more ~~serious~~ severe type, the counts were 37,600 and 26,500 respectively, both being thus above the average.

Related to Temperature.

1. The following table represents the highest temperature recorded throughout the case and also the highest leucocyte count; of course, while the average temperature might be but moderate, on occasion the temperature might reach a very high figure, accordingly, the figures noted cannot be said to demote exactly the average fever throughout the fastigium ; nevertheless, as a general rule, the temperature throughout is fairly uniform, so the highest may be taken as at least an index of the general curve. So also with regard to the leucocytosis.

Table No. IX.

Temperature.	Leucocytes.		Average.	
105°	26,500		26,500	(1)
104°	26,000	11,000		
	15,000		17,300	(3)
103°	12,800	25,000		
	20,000	36,000		
	23,400	36,000		
	24,600	45,000		
	25,000	(70,000)	27,500.	(10)
102°	18,000	41,000		
	28,000	(60,000)	29,000	(4)
101°	32,000		32,000	(1)
100°	11,500		11,500	(1)

Admitting the above qualifications, it will thus be observed, that the amount of leucocytosis bears no relation to the height of the fever, e.g. counts with a temperature of 104° varied from 11,000 - 26,000; temperature of 103° from 12,800 -70,000; temperature of 102° from 18,000 - 60,000.

qq qq

ii. The next table of cases in which consecutive daily counts were obtained shows the actual height of the temperature at the time when the blood was examined.

Table No. X.

No.	Temperature.	Leucocytes.
i.	103.6°	36,000
	103°	12,500
ii.	100 . 4°	10,600
	101 °	20,000
iii.	103.8°	7,800
	102.6°	3,000
	102.6°	10,000
	103.8°	4,600
iv.	101.8°	28,000
	102.4°	39,000
	101.2°	45,000
v.	102°	13,000
	98°	23,000
vi.	100.6	33,000
	100°	41,000
	98.4°	28,000
vii.	101°	18,000
	101.8°	28,000
	100.4°	26,000
viii.	98°	14,000
	100°	15,000
	99.2°	18,000
	100°	20,000
	100°	32,000
ix.	102.6°	13,000
	101.2°	18,000
x.	101.4°	21,000
	102.6°	23,000
	100°	26,000
xi.	104.2°	11,000
	100.8°	10,000
	101°	15,000
	101.2°	12,000
	98°	11,000

From a perusal of these figures it will be observed that in only three instances (i, ii, & Vii) do the curves arise and fall together; in some the count falls with the temperature rising, in others the reverse happens, while in others again with a steady temperature, the count is noted to be increasing rapidly.

These cases, then, indicate that, apart from the fall of the count after crisis, there is little or no relationship between the temperature and leucocyte curves. It must be stated however, that Tumas, Boekmann and Von Jaksch , on the contrary, find that there is a rough correspondence between the two curves, while Rovighi. on the other hand, states that the count is highest during the fall of the temperature.

Age.

In the following table are shown the age of the patient (arranged in decades) the average leucocyte count, the highest count and the average for the decade.

Table No. XI. ( )

Decade.	Age.	Average.	Highest.	Average of Decade.
60-70	65	26,000		
	70	24,000	56,000	24,300.

Table No. XI.

Decade ~~Male.~~	Age.	Average.	Highest.	Average of Decade.
Under. 10	8	21000	23000	
	10	25000		23000
10-20	13	8,500	10,600	
	15	15,000	18,000	
	20	12,800	12,800	12,000
20-30.	24	18,000	23,400	
	24	11,000		
	25	17,000	28,000	
	26	17,000		
	30	12,000	15,000	
	30	34,000	37,000	18,000
30-40.	40	25,000		25,000
40-50	43	26,500		
	44	21,500	32,000	
	45	37,000	40,700	
	45	26,500		
	47	5,800	11,000	
	47	24,000	28,000	
	47	(70,000)		
	49	14,000	16,000	22,600
50-60	51	22,000	28,500	
	53	7,300		
	53	7,000	8,400	
	56	12,500		
	56	26,500	35,800	
	57	37,000	45,000	
	57	(60,000)		
	58	15,000	20,000	18,000
60-70	63	26,000		
	70	24,000	36,000	24,300

With reference to the influence of the age (and consequently to a certain extent of the vitality) of the patient, Cabot briefly states that children as a rule have especially high counts. It will be observed, however, that in the above table the highest of the counts under 15 was 25,000, whereas 7 out of 8 counts above 30,000 occurred in patients over 44 i.e. past middle age as it usually appears among that class. It should, however, be further stated that the disease in those 4 children was of a comparatively mild type and hence a high count could scarcely be expected. Accordingly, it would appear that leucocytosis is not much affected by age.

Classification of Leucocytes.

As has already been indicated a leucocytosis proper is distinguished from a leukaemia not by the number of the leucocytes, but by the proportion of the different varieties. As several classifications of leucocytes are recognised, it should be stated that the method adopted is after Cabot, as follows:-

(i). Polymorpho-nuclear neutrophiles. (hereafter styled for brevity P.M.N.)

These cells, as the name indicates, possess a protean nnucleus which is so irregularly twisted in the body of the cell as to present the appearance of several different nuclei. The granules do not stain well with markedly acid or alkaline dyes, but are most clearly brought out by a faintly acid stain, hence termed by Kanthack and other observers fine granular oxyphiles.

These cells originate in the bone-marrow, and are, as Muir has pointed out, an advanced stage of the myelocyte their twisted nucleus allowing them to pass through very narrow channels.

(ii) Lymphocytes.

These consist of cells having a single round nucleus surrounded by a narrow coating of protoplasm, which stains faintly with Ehrlich's triple stain. According to their size, they are known as "small" and "large"; the large have rather more protoplasm in proportion to their size than the small, and their nucleus/

nucleus is not so deeply stained.

Varieties having an indented nucleus are known as "transitional"

They originate in the Lymphatic gland tissue.

(iii) Eosinophiles.

They are cells of loose structure, with a twisted nucleus which stains more faintly than that of the P.M.N.s and with the granules of a larger size which have a marked affinity for acid stains.

(iv) Myelocytes.

These are not found in normal blood.

They are large spherical cells consisting mostly of nucleus embedded in protoplasm, containing neutrophilic granules.

Their large firm nucleus prevents their exit from the bone-marrow in normal circumstances, but, as Emanuel points out, a looser cellular condition of the marrow allows their escape.

There is also an "eosinophilic" variety, in which the granules are markedly brought out by the acid stains.

The following table from Cabot gives the usual percentage in normal blood, with the number present in a cubic millimetre (7,500 being considered a normal mean.)

Table XIIa.

Variety.	Percentage.	Mean.	No. in 1 c.mm
P.M.N.	62 - 70	66	4,800
Small lymphocytes.	20-- 30	25	1,875
Large lymphocytes.	4 - 8	6	450
Eosinophiles	½ - 4	2	150

Of course, even in the absence of organic disease, the proportion of the different types may vary considerably e.g. Cabot points out a case in which he found 25% P.M.N.s and 74%9% lymphocytes, while two days later he found the usual proportions. The next tables represent the average proportion of all counts during the fastigium and the average of five cases after crisis.

Table No. XIII.

Variety.	During Fastigium.	After Crisis.
P.M.N.	84.1	70.3
Small lymphocytes.	9.8	14.7
Large lymphocytes.	4.9	7.9
Eosinophiles.	.6	7.0

(a). From these figures it will be observed that during the course of the Pneumonia (i) there is a markedly increased proportion of the P.M.N.s with (ii) a corresponding diminution of the lymphocytes and more especially of the small lymphocytes while (iii) the eosinophiles are reduced to almost a vanishing point, in fact several of the cases showed the eosinophiles to be altogether absent. Of course, when the usual high leucocyte count is taken into consideration, the increase in numbers of the /

the P.M.N.s is found to be very great, while the lymphocytes may also be found absolutely increased in numbers.

(b) It will be further noticed that in the <u>classification after crisis,</u> the relative proportions are changed as follows:-

(i) The P.M.N.s are only very slightly increased - their percentage 70.3 being only 0.3% above what Cabot considers a normal percentage.

(ii) The small lymphocytes are considerably increased in proportion, though not at first reaching their normal percentage.

(iii) The large lymphocytes are increased to such an extent that they actually exceed their normal proportion. (This is also observed by Becker, who notes a considerable increase in the large mononuclear corpuscles.

(iv) There is also a marked proportional increase in the eosinophiles. In this series their percentage 7% is probably rather high, being considerably raised by a count of 13.3%; in this case, the patient had been suffering from Emphysema with intervening attacks of acute bronchitis for a period of at least 12 months before the Pneumonia set in, so that the high count has probably some relation to that condition. High eosinophile counts in Emphysema have been noted by Muller, Gallasch and Gabritchewsky, while Cabot in a case of Subacute Asthma without /

without marked paroxysms, frequently observed a slight leucocytosis with an eosinophilic proportion of 11-15%. Cabot states that after crisis the P.M.N.s often fall below 60%, while the lymphocytes are above normal. The former condition occurred in only one case in this series, the P.M.N.s numbering 54.4%, the lymphocytes 42.8% and the eosinophiles 2.8%. He further states that the eosinophiles may return to the circulation a day or two before crisis, this indicating that the acme of the process has passed and so constituting a favourable sign. This is noted in one case only in this series. The count on admission showing eosinophiles absent, while on the day before crisis 1% is noted. It is interesting however, to note that out of 7 fatal cases, 4 showed no eosinophiles while in only 2 out of 14 cases which recovered were they absent; this seems to bear out the view that the presence of eosinophiles even in small numbers is a favourable prognostic indication, whilst their absence is of grave import.

The presense of P.M.N.s in large numbers, Muir attributes to some substance in the blood which exerts a positive chemio-taxis on the bone-marrow, a stimulus which is responded to. The eosinophiles, he considers, are attracted by a different chemio-tactic substance and further states that a substance which attracts eosinophiles to the tissues from the blood will also produce eosinophiles.

Related/

Relating to Numbers.

The next table represents the proportion of the different varieties according to the actual number of the leucocytes.

Table No. XLV.

Variety.	Under 7,500.	7,500-10,000.	10,000-20,000
P.M.N.s	77.8	82.7	84.
Small lymphocytes.	11.5	9.2	10.1.
Large lymphocytes.	6.3	5.6	5.1
Eosinophiles.	.4	.6	.2

	20-30,000	above 30,000
P.M.Ns	85.2	91.6
Small lymphocytes.	8.4	5.8
Large lymphocytes.	5.0	2.1
Eosinophiles.	.7	.1

It will be noticed that, while in all cases, there is a relative increase in the number of P.M.N.s, the greater the absolute increase in number, the greater also is their relative proportion, till in a count of 37,000, their percentage was found to be 93 with 6.6% of lymphocytes.

Leucopenia.

It will further be observed that even in cases of leucopenia the relative/

relative proportion of P.M.N.s is increased leading one to infer that the same process which usually leads to a leucocytosis, is at any rate being attempted. With regard to the proportion of the several varieties in leucopenia, observers are at variance. Thus Rieder and Hewetson find an increase of P.M.N.s, Billings finds them normal, while Bieganski and Muir consider that they are diminished while the latter further states that myelocytes may appear.

The following tables show ~~first~~ :-

(i) The percentage of the different varieties and

(ii) The actual number found per c.m m. in the 3 cases associated with leucopenia, compared with the normal as obtained in table No. XII.

Table No. XV.

Variety.	A	B	C.
P.M.Ns.	78.3	79.3	76
Small). lymphocytes.	13.3	14.3	7
Large). lymphocytes.	8.3	4.6	6
Eosinophiles.	0	.3	1
Myelocyte.	-	1.3	-

Table No. XVI.

	Normal.	A	B	C
P.M.N.	4,800	5,875	5,556	2,365
ymphocytes. Small	1,875	1,650	1,004	532
ymphocytes. Large.	450	625	325	187
Eosinophiles.	150	0	22	31
Myelocyte.	0	0	93	0
		7,500	7,000	3,125.

It will thus be seen that while in all these cases the absolute number of lymphocytes is diminished and that of eosinophiles much diminished, in two cases the absolute number of P.M.N.s is actually increased while in all three it is relatively increased though to a smaller extent than usual, leading one to infer, as stated above, that there is some response on the part of the bone marrow to the usual stimulus, even though that response is not sufficient to cause a leucocytosis.

Related to Fatality.

The next table compares the proportions in recoveries and deaths:-

Table No. XVII.

Variety.	Recoveries.	Deaths.
P.M.N.	85.9	81.8
ymphocytes Small	8.4	9.7
" Large	4.4	5.3
Eosinophiles.	.6	.5

The increase of P.M.N.s is, therefore, more marked in cases which had a favourable termination than in the fatal ones. The lower P.M.N. proportions, however, in these latter cases is to a certain extent due to the influence of those cases in which leucopenia / with a less increased P.N.M. proportion, was present; hence this lessens tha value of the difference in proportion, from the point of view of prognosis.

Related to Complications.

In the instances where the leucocytosis is associated with a pseudo-crisis; with delayed resolution or with the development of empyema the different varieties are present in substantially the same proportion as in counts during fastigium, the P.M.N.s being considerably increased.

Myelocytes.

In three instances myelocytes were observed, their percentages being respectively, 1.3, 1.6 and 2 ; of these cases two proved fatal, while the third after crisis had a recrudescence of the fever associated with involvement of the other lung. This would indicate that their appearance is of unfavourable omen.

Cabot states that while their appearance in the blood is almost always / pathological, their presence in small numbers may be frequently demonstrated in all diseases which are accompanied by a leucocytosis /

leucocytosis; while Muir attributes their presence to a looser cellular structure in the bone-marrow, due to increased proliferation, allowing their escape into the general circulation

Diagnosis.

It must be premised that in the majority of cases of Pneumonia the diagnosis presents little or no difficulty; still in a not inconsiderable number, the symptoms simulate some other condition, and with a late development of the physical signs (occasionally, for example the characteristic signs may not appear till the 6th, 7th or 8th day) , considerable doubt may arise. On the one hand, Pneumonia has to be differentiated from such conditions as Hypo-static Congestion of the Lung, Acute Bronchitis, Acute Phthisis, and Pleurisy with Effusion; while on the other hand its initial symptoms may simulate other diseases, such as Gastro Intestinal disturbance, Peritonitis, Meningitis, and Influenza, Typhoid or Typhus Fever, Delirium Tremens; and again, when occuring in the aged or supervening on some chronic disease, its characteristic symptoms are often absent. In a considerable number of these instances, an examination of the blood is of great value.

i. Broncho-pneumonia & Acute Bronchitis.

A blood count is of no value, as a leucocytosis is present in both/

both these conditions.

ii. Pleurisy with Effusion.

242 counts of cases in the Massachusetts General Hospital show an average of 6,130 per c.m m. ; during the early febrile stage, however a slight leucocytosis (under 12,000) was usual while the fibrin net-work is found to be much less dense (Hayem); and in children a considerable increase in number of the leucocytes is sometimes noted. As it is in children that a differential diagnosis is sometimes difficult, a blood count is again of no great assistance.

iii. Acute Tuberculosis.

In acute Miliary Tuberculosis, in the absence of mixed infection, a normal or sub-normal count of leucocytes is the rule, thus differentiating it from Pneumonia.
In acute Pneumonia Phthisis, however, as already stated, a leucocytosis is to be expected; thus a blood count cannot distinguish the two conditions before crisis. The behaviour of the temperature curve and leucocyts curve after crisis, however, enables one, as noted above, to distinguish between a tubercular condition, a state of delayed resolution and the development of empyema.

iv. Acute or Hypostatic Congestion of the Lung.

A leucocyts count seems to differentiate these conditions from Pneumonia e.g. A man was admitted to Hospital with a high /

high temperature, a pain in his side and rapid breathing, auscultation revealing moist crepitations at the base of the left lung, the symptoms and signs, in fact, of a commencing Pneumonia. A blood count showed 9,000 leucocytes with 70% P.M.N.s - a practically normal condition. Suspicion was thrown on the diagnosis of Pneumonia, and rightly so, as the next day the temperature dropped to normal and remained there without further development.

v. Meningitis.

In Meningitis, leucocytosis is not only present, but is usually well marked (Cabot). Even in cases of Tubercular origin, Emanuel and other observers state that a leucocytosis is to be found, although an exception to the usual rule in Tuberculosis.

A blood count is, therefore, again of no assistance.

vi. Enteric Fever.

In the differentiation of Enteric Fever from marked Pneumonia with Typhoid symptoms, Widal's serum reaction is not of great assistance, as it is not usually found before the 6th - 8th days. An examination of the leucocytes, however, is of the greatest assistance because in Enteric Fever, not only is there a reduction in number (the average at the height being 5,000) but there is a relative and absolute diminution/

diminution of the P.M.N.s , a condition which helps to distinguish from the few cases of Pneumonia with a leucopenia

vi. Influenza.

A normal or sub-normal count is the rule in Influenza. Hewetson in a Pneumonia following Influenza found a leucopenia ; his patient recovered so that the leucopenia was probably due to the influence of the Influenza.

vii. Acute Alcoholism.

Cabot in an analysis of 26 cases found a leucocytosis in 10, but in only 4 cases was the count above 20,000. Thus, at the very least, a marked leucocytosis occurring in an alcoholic would make one suspect the presence of Pneumonia, and direct attention to a very careful examination of the chest.

viii. Aged and Chronic.

It is well known that in the type of the disease occurring in old people or supervening on such a chronic condition as cancer, chronic Bright , the usual symptoms may be absent, a slight rise of temperature alone indicating the onset.

Two cases in this series illustrate the value of a leucocyte-count in such a condition. In the one, Pneumonia concluded

a/

a long period of general debility in a man of 58; in the latter an old man of 70 who had been long resident in the Institution succumbed to a Pneumonic infection. In both cases the physical signs of consolidation were late in appearing, while cough, expectoration, marked dyspnoea and painin the side were absent; in both again, the first examination of the blood after the onset of the slight fever, revealed a high leucocytosis and directed attention to the lung condition.

ix. Empyema.

The value of a blood count in differentiating delayed resolution, empyema and tuberculosis has already been referred to.

Prognosis.

One point stands out with great clearness - an absence of leucocytosis is an almost certain forerunner of death. In this series 4 out of 35 cases showed a leucocyte count under 10,000 and all proved fatal. This agrees with other observers:-

Halla out of 14 cases had 2 with no leucocytosis, both of which were fatal. Billings out of 22, 1 such case which was also fatal. Laehr , Rieder, Von Jaksch, Ewing and Kilodse , show similar results.

Of the 4 cases in this series, 2 were very ill on admission and died within 36 hours, the leucopenia , having been

been scarcely necessary to foretell such an issue; but in the other two, the small count is the first sign to suggest such an unfavourable issue; In both, while the attack was evidently a severe one, the pulse kept satisfactory, and there were no signs of grave omen, till the 7th day when the temperature kept high and the pulse began to run, death ensuing the next day. In the last patient, although he appeared to be progressing perfectly favourably in the early days of the illness, I remember suggesting a probably fatal termination on the strength of the leucopenia.

When leucocytosis is present, most observers agree that that fact is of no assistance in determining ths issue. In this series, however, as already stated, the chances of recovery seem to be greater when the leucocytosis is moderate than when it is very marked.

The concensus of opinion is that the amount of leucocytosis depends on the issue of the struggle between the toxin of the Pneumonia on the one hand and the resisting power of the patient on the other.

It has been reduced to tabular form by Cabot and others:-

Table No. XVlll.

	Infection.	Reaction.	Leucocytosis.
i.	Infection.	Vigorous.	Slight.
ii.	Severe or moderate.	Vigorous.	Marked.
ii.	Severe.	Feeble.	None.

It must be remarked however, that the vigour of the reaction does not seem to depend on the general strength of the patient, as, two, in this series, who battled with the infection for 8 days before succumbing, show no leucocytosis.

Treatment.

It need only be stated that artificially induced leucocytosis by the use of drugs such as Turpentine (injected locally) and Pilocarpin has proved of no benefit, in the hands of Von Jaksch and others.

It is further noted that while leucocytosis is checked by anti-pyretic drugs, it is not affected by cold bathing, a fact which therefore favours the latter method of reducing temperature.

11

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APPENDIX.

Individual Cases.

1. E. Lynch. 40 admitted 19 - 2 - 01 (7th day)

crisis on 7th day.

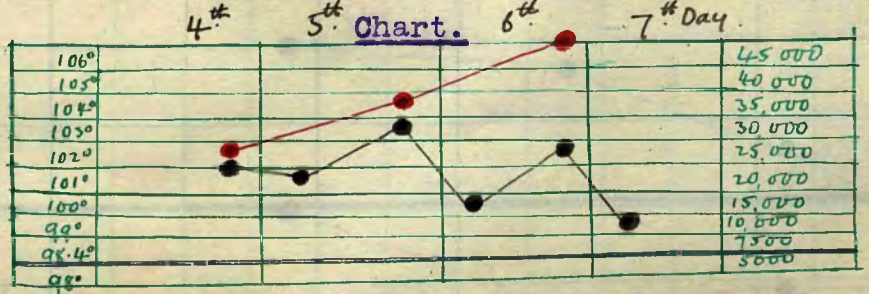
Day.	Red Corpuscles.	Leucocytes.
7	5,000,000	28,050
8	3,000,000	5,468
10	4,190,000	6,250

11. James Doyle. 57. Admitted 27/2/01.

Died on 7th Day.

Day	Red Corpuscles	Leucocytes
4	3,000,000	28,000
5	5,000,000	39,000
6	3,000,000	45,000

Chart.



Temp. – Black
Leucocytes – Red.

Consolidation of left lower lobe.

Note rise of leucocytosis before death; also fall of temperature.

11. John Wilson 47 Admitted 18 2 01 (1st Day.

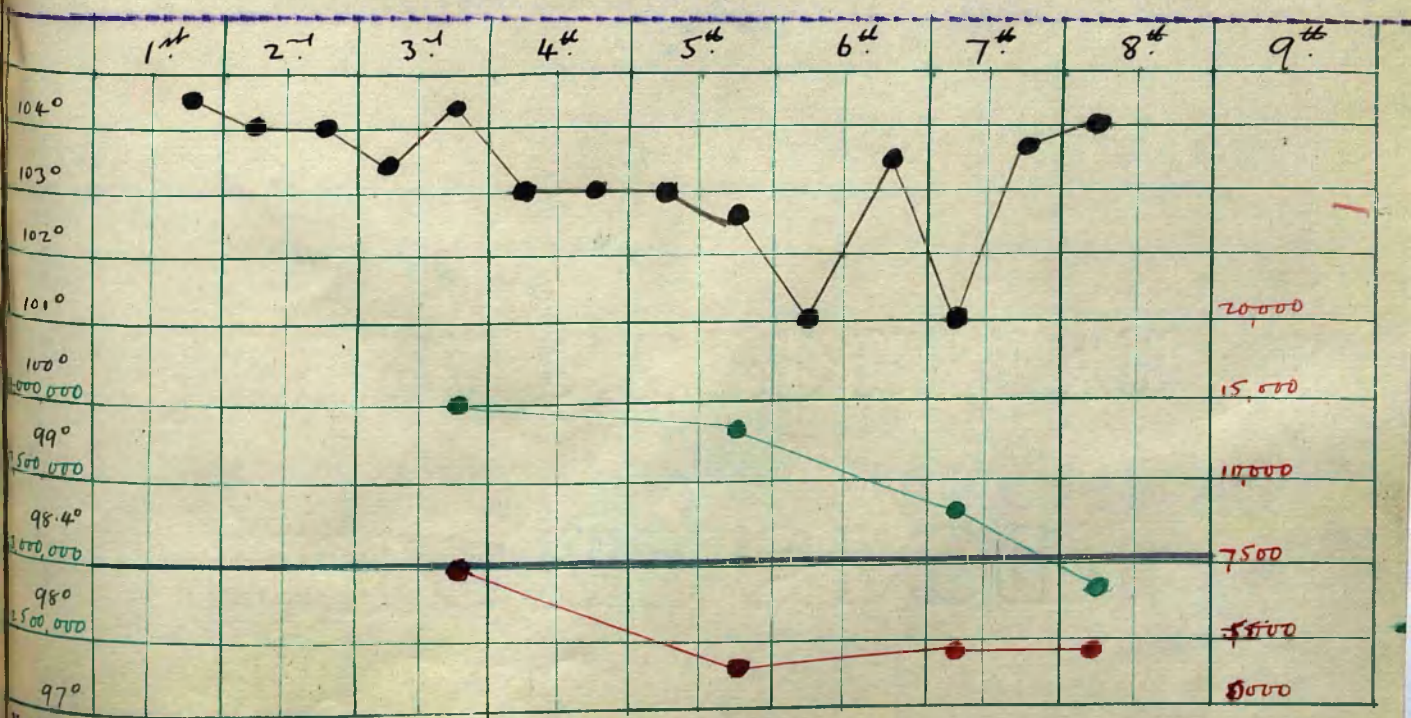
Died on 8th day.

Table of counts.

ay.	Reds	Whites	Per-centage	6day.
3	4,012,500	7,812	P. M. Ns.	76
5	3,762,500	3,125	Small lymph.	17
7	3,359,000	4,690	Large "	6
8	2,815,000	3,125	Eosinophiles	1 %

Temp. — Black
Leucocytes — Red.
Red Corpuscles — Green

Chart No. II



Note/

ote:. (A) the persistent lencopenia, (B) the gradual decrease of red cor. puscles.

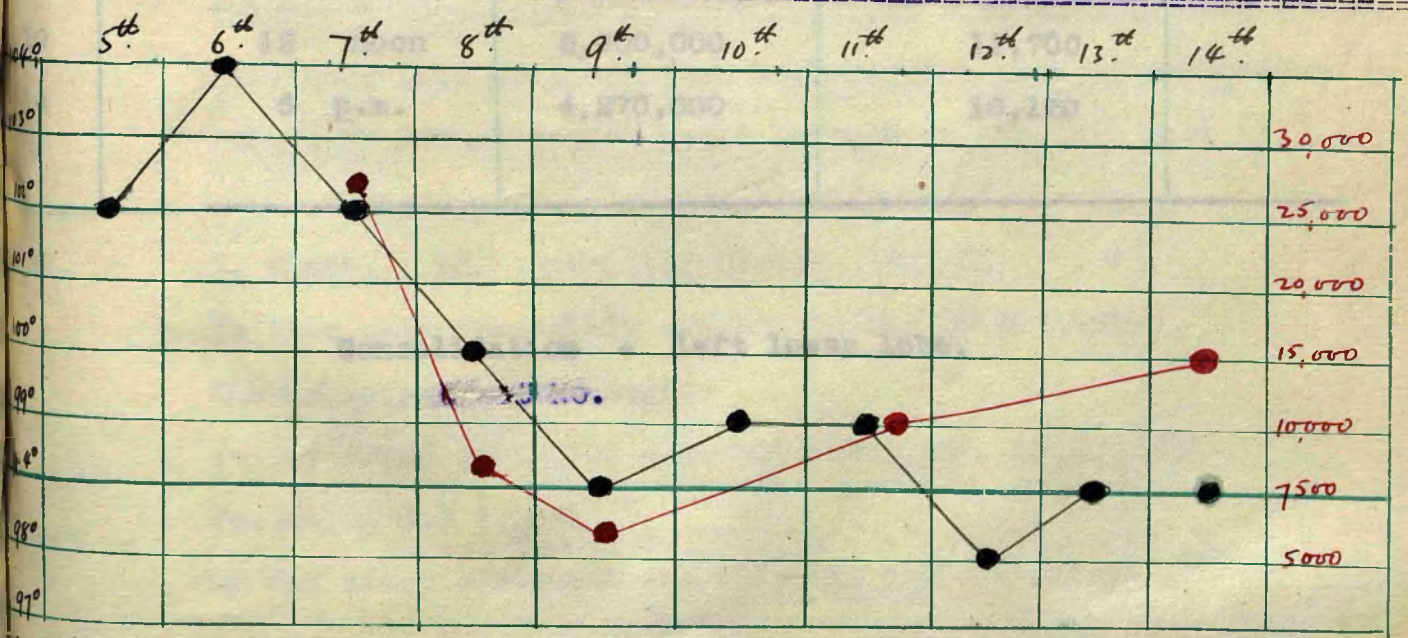
. William Hewitt 43 Admitted 20 2 01 (5th Day).

crisis on 8th day.

onsolidation left base. Lung not clear till 13th day, when Bronchitis set in.

Table No.

Day	Leucocytes	Red Corpuscles	Day	Leucocytes	Red Corpuscles.
7	26,560	5,000,000	11.	10,000	5,175,000
8	8,560	3,000,000	14.	15,625	4,050,000
9	6,250	3,500,000	18.	10,625	



Classification of Leucocytes.

	P.M. N.	82.6	On 11th Day.
Lymphocytes.	Small	7.0	
	Large.	5.6	
Eosinophiles.		1.3	%

N/

Note (a). Leucocytosis on day of crisis (B) Fall after crisis reaching normal in two days (7) Rise on 11th day associated with evening rise of temperature and slow rate of resolution (d) rise on the 14th day when Bronchitis set in (e).
Increased proportion of eosinphiles after crisis but also increased proportion of P.M.N.s as associated with secondary leucocytosis.

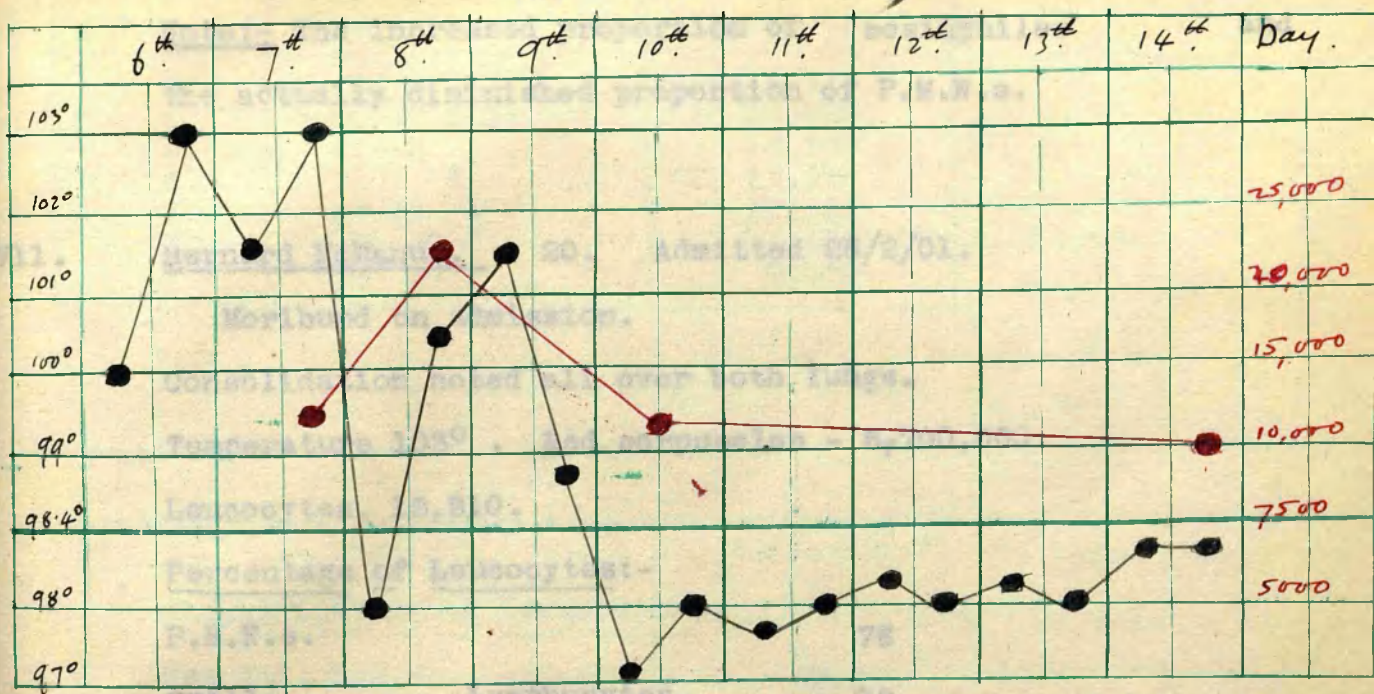
V. Hugh Grubb, 24. Admitted 20/2/01 5th day.

Crisis on 7th day.

Day	Hour	Red Corpuscles	Leucocytes
7	10-30 p.m.	4,990,000	13,280
8	12-30 "	4,312,500	23,430
10	12 noon	5,000,000	11,700
14	6 p.m.	4,270,000	10,150

Consolidation - left lower lobe.

5. Chart, No IV



Note (i) Fall of temperature on 7th day accompanied by rise of leucocytosis heralding rise of temperature on 9th day (either pseudo-crisis or post-critical rise as discussed above) (ii) Slow fall of leucocytes accompanying delayed resolution (signs of consolidation still present on the 14th day).

VI. A. Black. 13. Admitted ~~25/2/01~~ 25/2/01.

In this case the crisis was commencing on admission.

The leucocyte counts were:-

On day after admission - 6,000; next day, 10,000 and following day 9,000.

On day after admission the relative numbers were:-

P.M.N.	54.4 %
Small & Large Lymphocytes.	42.8 %
Eosinphiles.	2.8 %

Note:- The increased proportion of eosinphiles and the actually diminished proportion of P.M.N.s.

VII. Bernard McManus. 20. Admitted 26/2/01.

Moribund on admission.

Consolidation noted all over both lungs.

Temperature 103°. Red corpuscles - 5,700,000.

Leucocytes. 12,810.

Percentage of Leucocytes:-

P.M.N.s.		76
Small.	Lymphocytes.	12
Large.	"	8
Eosinphiles.	"	0 %

Note (i) The slight amount of leucocytosis accompanied however, by a high red corpuscler count the latter due to the blood stasis preceding death.

ii. the absence of eosinphiles.

VIII. A. Galbraith. 25. Admitted ~~26/2/01~~= 26/2/01.

Crisis on 7th day.

Lung consolidation did not clear up for some weeks.

Table of Counts/

Day	Hour	Leucocytes
3	10 p.m.	14,375
4	5-30 p.m.	14,820
5	11-15 "	14,390
6	10 "	13,690
7	7-30 "	28,380
10	10-30 "	14,375
17	8- 30 "	7,970.

Classification of leucocytes:-

3rd day. P.M.N.	89.0
Small lymphocytes.	6.3
Large "	4.3
Eosinphiles.	.3 %

Note (i) The almost constant amount of leucocytosis till day of crisis when the number is almost doubled (ii) the high count, 3 days after crisis associated with delayed resolution.

IX. Christopher Morris. 70. Admitted 26/2/01.

Died 2 (two) days after admission.

Day	Hour	Red Corp.	Leucocytes
26.2	11-30 p.m.	4,600,000	35,940
27.2	3 "		12,500.

Note (i) Marked leucocytosis in an old man of 70 and (ii) fall of leucocytes preceding death.

X. David Harvey. 58. Transferred to hospital.

Died on 7th day.

Day	Hour	Red Corp.	Leucocytes.
6	3-30 p.m.	5,150,000	10,625
7	12 noon.		20,110

Note (i) that this case, in opposition to the last, shows a rise of leucocytosis previous to death, and (ii) absence of eosinphiles.

Classification of leucocytes:-

P.M.N.	82.9
Small lymphocytes.	11.4
Large "	5.7
Eosinphiles.	0

XI. James Docherty. 45. Admitted 27/2/01. (8th day)

Crisis on the 8th day.

Consolidation of right middle and lower lobes, signs of consolidation still present ten days after crisis.

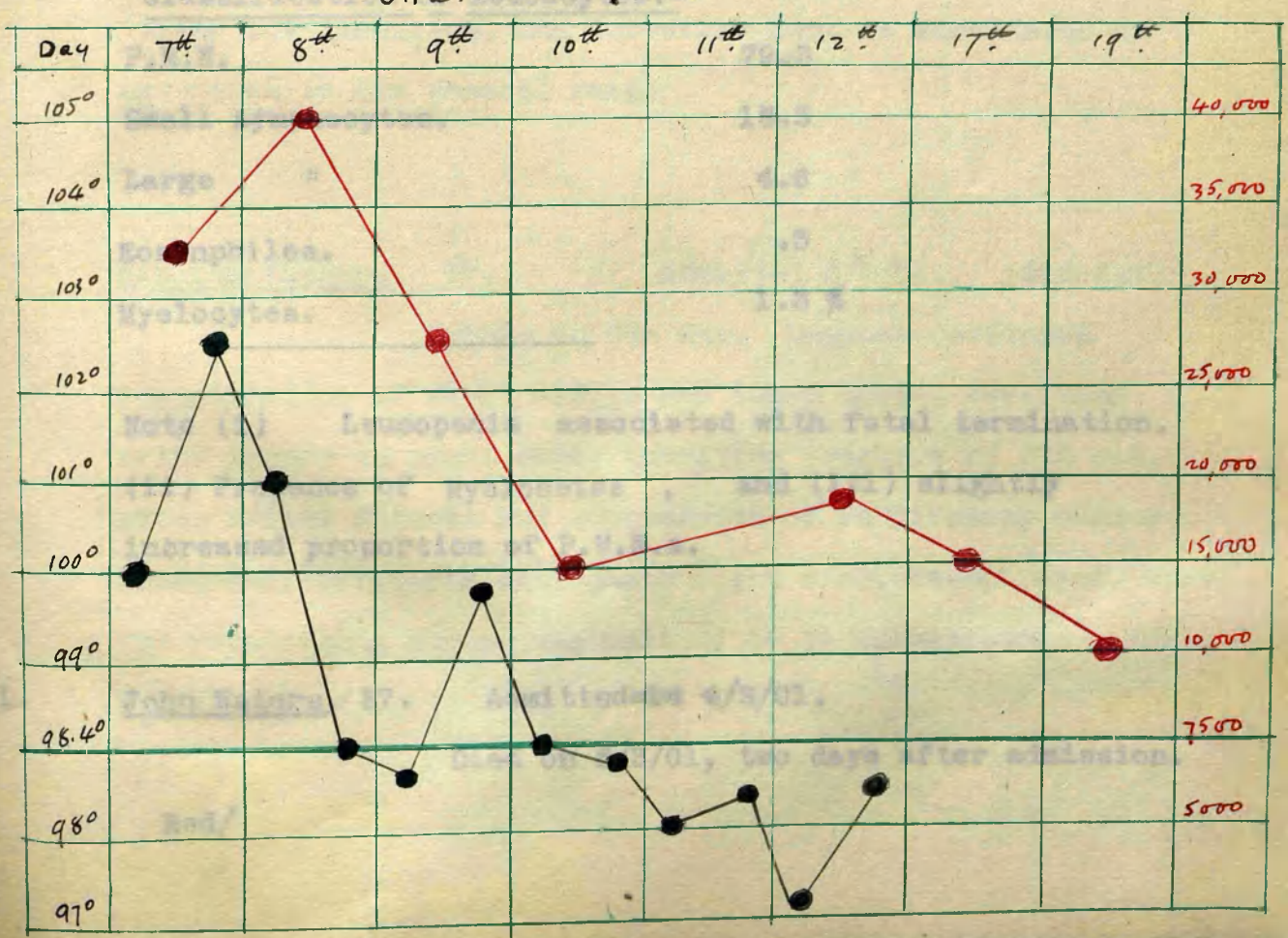
Red corpuscles. on admission 4,170,000; several normoblasts noted.

Day	Hour	Leucocytes
7	12-30 p.m.	32,970
8	4 "	40,780
9	12 Noon.	28,125
10	4 p.m.	15,150
12	12 Noon.	19,370
17	12-30 a.m.	15,625
19	8-15 p.m.	10,940

Classification on 8th day.

P.M.N.	90.3
Small Lymphocytes.	7.0
Large "	2.3
Eosinphiles.	.3 %

" Chart No. V



Note (i) Increase of leucocytosis on day of crisis after temperature had begun to fall and associated with post-critical rise on the following day.
(ii) Slow drop of leucocyte ~~count~~ curve associated with delayed resolution of lung.

XII. Pat. O'Donnell 53. Admitted 5/3/01.

Moribund on admission. Died on day following.

Red Corpuscles.	4,617,000
White "	7,340.

Classification of Leucocytes:-

P.M.N.	79.3
Small Lymphocytes.	15.3
Large "	4.6
Eosinphiles.	.3
Myelocytes.	1.3 %

Note (i) Leucopenia associated with fatal termination. (ii) Presence of Myelocetes , and (iii) slightly increased proportion of P.M.N.s.

XIII. John Waters, 37. Admitted=~~14~~ 4/3/01.

Died on 6/3/01, two days after admission.

Red/

Red Corpuscles,	3,770,000	6/3/01
White "	24,685.	3-45 p.m.

Classification of leucocytes:-

P.M.N.	87.1.
Small Lymphocytes.	5.7
Large "	2.9
Eosinphiles.	2.3
Myelocytes.	2.0%

Note (i). Presence of Myelocytes .(ii) high proportion of Eosinphiles - this is the only case in which a normal proportion of eosinphiles is present during the fastigium, and therefore must be considered an exception to the general rule.

XIV. William Taylor. 37. Admitted 5/3/01. (2nd day)

Crisis on 6th day. Empyema developed

Consolidation of right middle and lower lobes, developed after injury to right side, involving fracture of 6th rib. After crisis dulness and suppression of respiratory murmur increased, extending over whole right side, except apex, where the respiratory murmer was noticed to be exaggerated. The temperature /

cases from which the smaller table has been constructed, are fairly representative. When the numbers are arranged according to the broad issue of the illness - recovery or death - the following table summarizes them.

Table No. 111.

Leucocytes.	Recoveries.	Fatal.	Total.
Under 10,000	0	4	4
10- 20,000	6	2	8
20 - 30,000	9	2	11
30 - 40,000	2	3	5
40 - 50,000	1	1	2
50 - 60,000	0	1	1
60 - 70,000	0	1	1
	18	14	32

The high counts in the fatal cases, however, were altogether noted shortly before death, so that a table of the average height during the fastigium should be given for comparison (of course in some cases, only one count was obtained).

Table No. 1V.

Leucocytes.	Recoveries.	Fatal.	Total.
Under 10,000	1	4	5
10 -20000	9	2	11
20 -30000	7	4	11
30 -40000	1	2	3
40 -50000			0
50--60000		1	1
60 -70000		1	1
	18	14	32

(No. 12 has been omitted. Nos.11-13 read consecutively.)

temperature was hectic in type and remained high until May17th when it became sub-normal. It remained so, til June 6th when there were evening rises to 99° ; on June 26th it again became hectic and continued high til July 24th, when pus was detected. On the next day a part of the rib was removed and the pus evacuated, thereafter convalescence was uninterrupted.

Red Corpuscles:- 5,925,000 on third day.

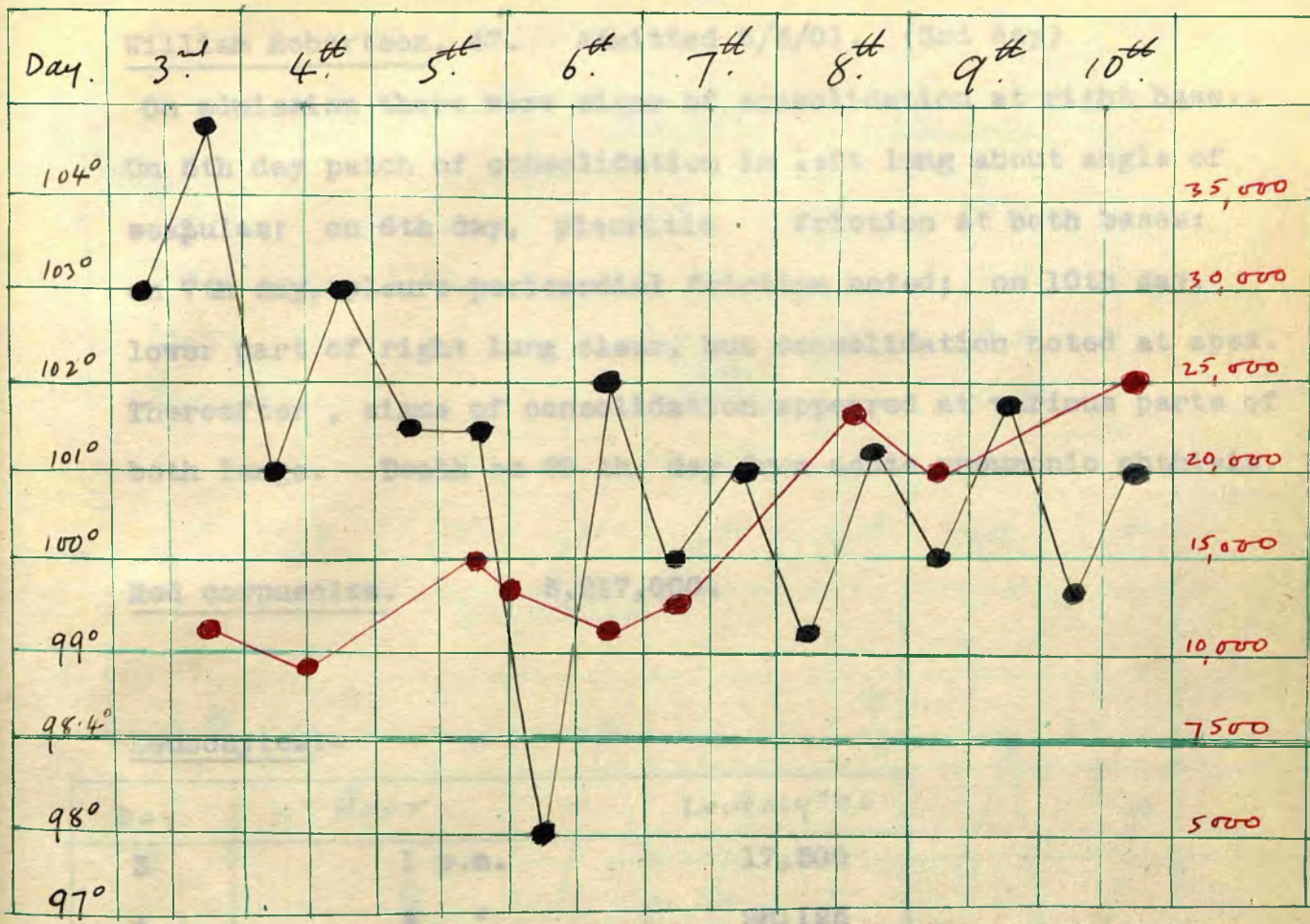
Leucocytes.

Day.	Hour.	Leucocytes.
3	8-30 p.m.	10,935
4	n 12 N.	9,840
5	3 p.m.	15,000
6	12 mid.	12,970
6	4. p.m.	12,030
7	11-15 a.m.	12,810
8	12-30 p.m.	23,435
9	11-20 a.m.	19,220
10	12-20 p.m.	25,625.

Classification of Leucocytes.

	3rd day.	9th day.
P.M.N.	85.4	84.0
Small Lymphocytes.	9.7	9.7
Large "	4.3	5.1
Eosinphiles.	.5	1.1

Chart No VI



Note (i) Highest count of leucocytes during fastigium, on day of crisis (ii) slight fall of leucocytes at 12 midnight, two hours before temperature began to fall (iii) another slight fall on day following crisis. (iv) Thereafter gradual rise of leucocytosis associated with rise of temperature and with development of Empyema (though pus not detected for some months) (v) Increased proportions of P.M.N.s and very small proportions of eosinphiles before crisis. (vi) Still increased proportions of P.M.N.s but also marked increase porportionally of eosinphiles and proportional increase of large lymphocytes, after crisis,

William Robertson, 47. Admitted 6/3/01. (3rd day)

On admission there were signs of consolidation at right base,. On 5th day patch of consolidation in left lung about angle of scapulae; on 6th day, pleuritic friction at both bases; on 7th day, pleuro-pericardial friction noted; on 10th day, lower part of right lung clear, but consolidation noted at apex. Thereafter , signs of consolidation appeared at various parts of both lungs. Death on 20 th. day from acute pneumonic phthisis.

Red corpuscles. 5,217,000.

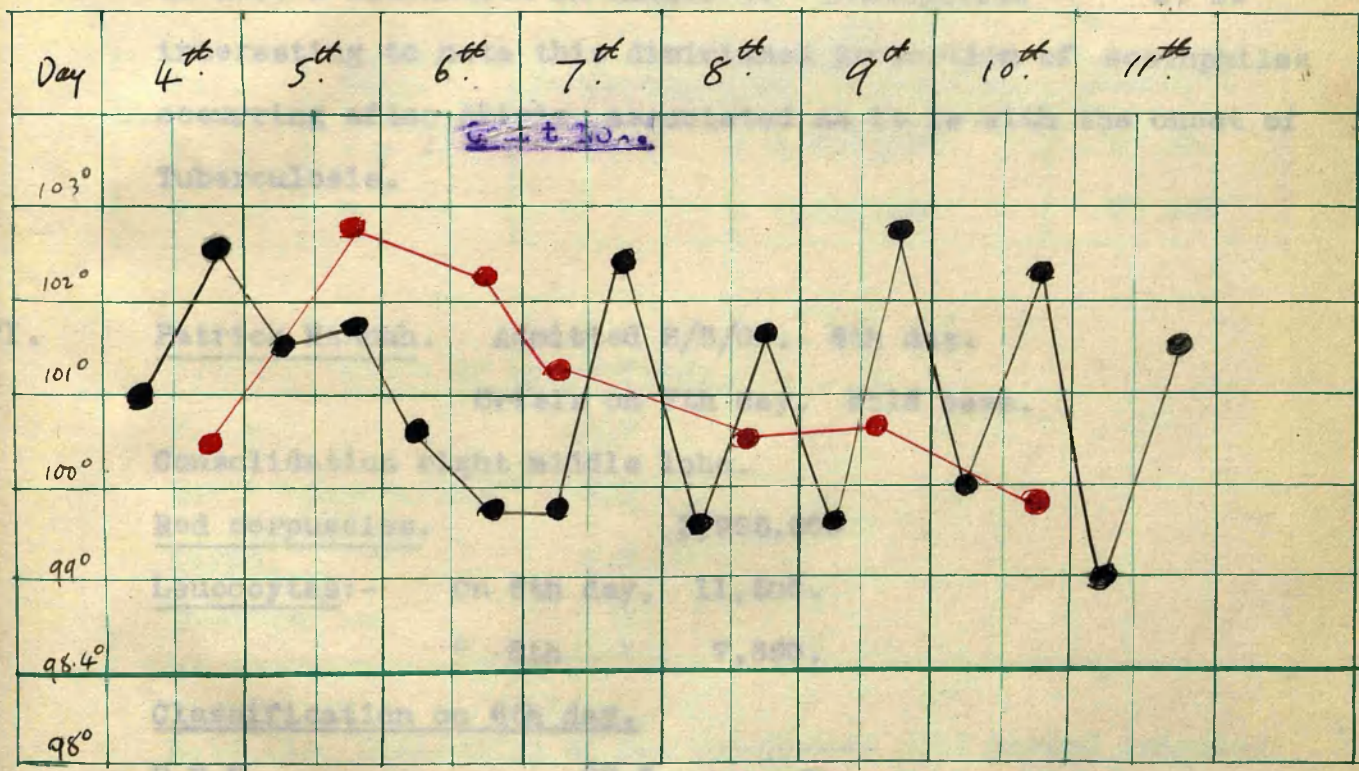
Leucocytes:-

Day	Hour	Leucocytes
3	1 p.m.	17,500
4	5 "	28,125
5	7-30 "	26,190
6	11-45 a.m.	21,250
7	12-50 p.m.	18,280
8	11-45 a.m.	18,905
9	12-40 p.m.	14,220.

Classification of Leucocytes.

	4th day.	8th day.
P.M.N.	84.8	87.0
Small Lymphocytes.	8	6.6
Large "	6.4	5.6
Eosinphiles	0·8%	0·6%

Chart No VII



It will be observed that the temperature is a continuous sustained temperature till the 6th day when there is a fall of 2°; ~~after~~ thereafter the temperature assumes a hectic type. It may further be stated that on the 5th day there was a corresponding drop in the pulse, and respiration rate;-

a/

a crisis of the pneumonic infections has been therefore assumed as occurring on that day.

Note (i) Highest point of leucocytes curve noted on day before crisis. (ii) Slight drop on day of crisis (iii) marked drop (5,400) on day after crisis (iv) thereafter steady fall. (v) Increased proportions of P.M.N.s noted in both counts; so also a diminution in number of eosinphiles It is interesting to note this diminished proportion of eosinphiles occurring after crisis, associated as it is with the onset of Tuberculosis.

XVI. Patrick Hannah. Admitted 8/3/01. 6th day.
Crisis on 7th day. Mild case.
Consolidation right middle lobe.

Red corpuscles. 3,925,000

Leucocytes:- On 6th day, 11,500.
" 8th " 7,660.

Classification on 6th day.

P.M.N.	89.5
Small Lymphocytes	9.0
Large "	1.0
Eosinophiles	0·5%

Note (i) Slight amount of leucocytosis associated with a mild infection. (ii) small proportion of eosinphiles on day before crisis.

XVll. John McManus. 30. Admitted 8/3/01.
(6th) day) Died on 7th day.
Consolidation right upper lobe.

Day.	Hour.	Temperature	Red Corpuscles.	Leucocytes.
6	9 p.m.	103°	4,270,000	31,090
7	5 "	"	3,812,500	37,660

Classification of Leucocytes.

P.M.N.	93.3
Small Lymphocytes.	4.6
Large. "	2.0
Eosinphiles.	0%

Note (i) Diminution of red corpuscles (ii) marked increase in leucocytosis before death; also high counts of leucocytes (iii) absence of cosinophiles.

XVlll. William McIlwain. 44. Admitted 8/3/01. Crisis 7th day.
Second attack.
Admitted on 7th day with signs of consolidation.

consolidation of right lower lobe; temperature fell to normal on evening, remained normal on the 8th day; rose again on 9th day, on 10th day consolidation of left lower lobe detected. It has accordingly been considered that a crisis occurred on on the 7th day and that on the 9th there was a recurrence of the infection with involvement of the other lung. (It should bestated that Osler considers that cases in which, after the temperature has been normal for one or two days, an apparant 2nd attack runs its course, are probably instances of anirregular delayed resolution. In this case, however, it will be observed that the other lung was attacked.)

Leucocytes.

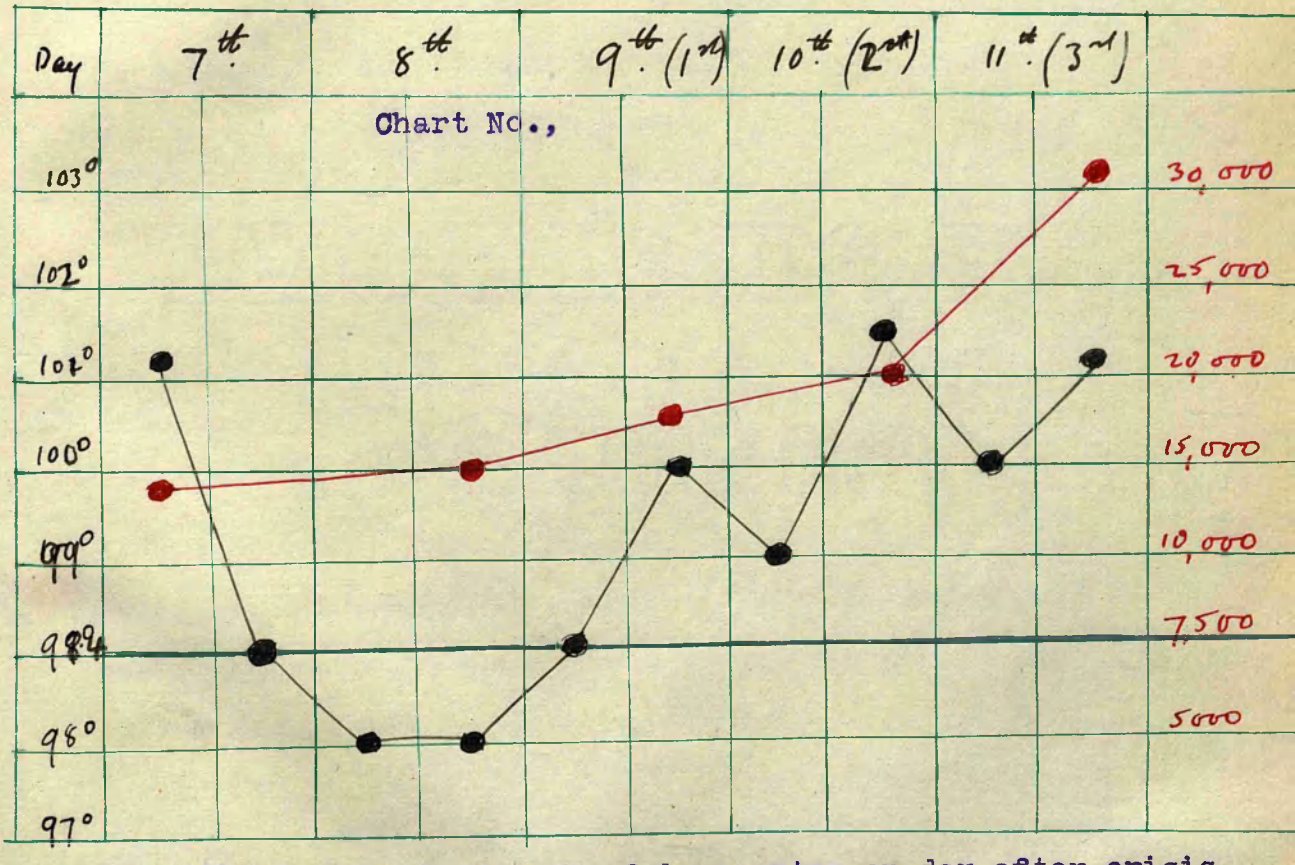
Day.	~~12-30~~	Leucocytes
7	12-30 a.m.	14060
8	1-25 p.m.	15310
9 (1)	1-15 "	18590
10(2)	7-40 "	20000
11(3)	7-15 "	32350

Red corpuscles. 4,012,500.

Classification of Leucocytes.

	7th day.,	10th (2nd) Day.
P.M.N.	85.6 ~~=84.3~~	84.2
Small lymphocytes.	6.3	7.2
Large "	3.6	3.8
Eosinphiles.	2.6	.4
Myelocytes.	1.6 %	4.3 %

Chart No VIII



Note (i) No drop in number of leucocytes on day after crisis.

(ii) Rise in number of leucocytes on 1st day of 2nd attack.

(iii) Thereafter progressive rise in numbers. (iv) Presence

of /

of myelocytes. (v) Increased proportion of eosinphiles / on 7th day (corroborating occurence of crisis) (vl) diminished proportion of eosinphiles - on 10th day i.e. 2nd day of second attack, but increased proportions of myelocytes (Owing to my term of office expiring, I obtained no more blood counts; a temperature chart sent to me, however, showed a fall of temperature to normal, on the 16th day, i.e. the 7th day of the second attack).

XIX. B. Docherty, 51. Admitted 9/3/01.
Died on 10th 3/01.

Leucocytes.

Date	Hour	Leucocytes
9.3	12-55 a.m.	15,000
10-3	12-5 "	23,750
	10-55 "	28,590

Note. (i) Small amount of leucocytosis on admission (ii) marked increase in number of leucocytes before death (13,000 in one day, 4,840 in 11 hours)

XX. A. Bryce. 49. Admitted 12/3/01. Followed fracture of rib.
Mild attack.
Red corpuscles. 3,016,350.
Leucocytes:- /

Leucocytes:-

12.3	12,500	9.20 p.m.
13.3	16, 250	8 p.m.

Classification of Leucocytes:-	13.3
P.M.N.s.	81.7
Small Lymphocytes	12.0
Large "	6.2
Eosinphiles.	0%

"

Note (i) Moderate leucocytosis associated with mild attack,
(ii) but also absence of eosinphiles.

XXI. Thomas Connely, 45. Admitted 7/11/00. 5th day.
Crisis 7th day.

Consolidation right upper lobe.

Day.	Red corpuscles.	Leucocytes.
7	4,300,000	25,560
11.	4,730,000	7,812.

Note (i) Increased number of red corpuscles 4 days after crisis.
(ii) Normal number of leucocytes reached 4 days after crisis.

XXll. Archibald Stewart. 47. Admitted 6/11/00. (4th day)

Died on 6th day (36 hours after admission).

Consoldiation of whole right lung. Marked cyanosis of wars and fingers on admission. Moribund when blood examined.

Red corpuscles. 7,800,000.

Leucocytes. 70,000

Note (i). Very high count of red and white corpuscles due to blood stasis in peripheral vessels, preceding death.

XXlll. William Fleming, 40 admitted 2/11/00.

~~Crisis~~=Consolidation of left lower lobe.

Haemoglobin. 70%

Leucocytes. 25,000

Crisis on 5.11 (2 days after admission)

XXlV. John Reid, 56. Admitted 2/11/00.

Crisis on 8th day.

Consolidation of right lobe (lower); consolidation still persistent on 16th day.

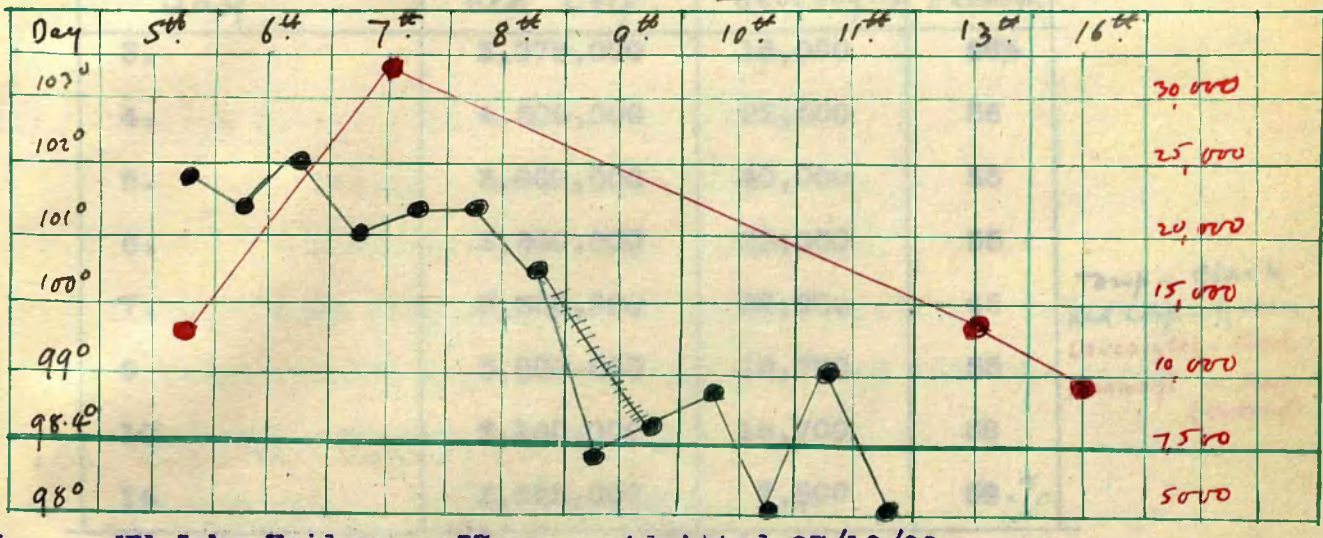
5	12,500
7	36,000
13	14,500
16	9,375.

= Leucocytes

Note/

Note:- (i) Increase of leucocytosis on day before crisis.
(ii) Moderate leucocytosis 6 days after crisis associated with delayed resolution.

Chart No IX



XXV. ~~XX~~ John Hailey. 57. Admitted 27/10/00.
Consolidation right middle and lower lobes. Died on day after admission.
Cyanosis of ears and fingers.
Moribund when blood examined.

Red corpuscles :- 5,720,000
Leucocytes. 60,000

Note:, Another instance of high leucocyte count associated with blood stasis preceding death.

XXVI. James Smith, 32. Admitted 9/10/00. (3rd day--)
pseudo- /

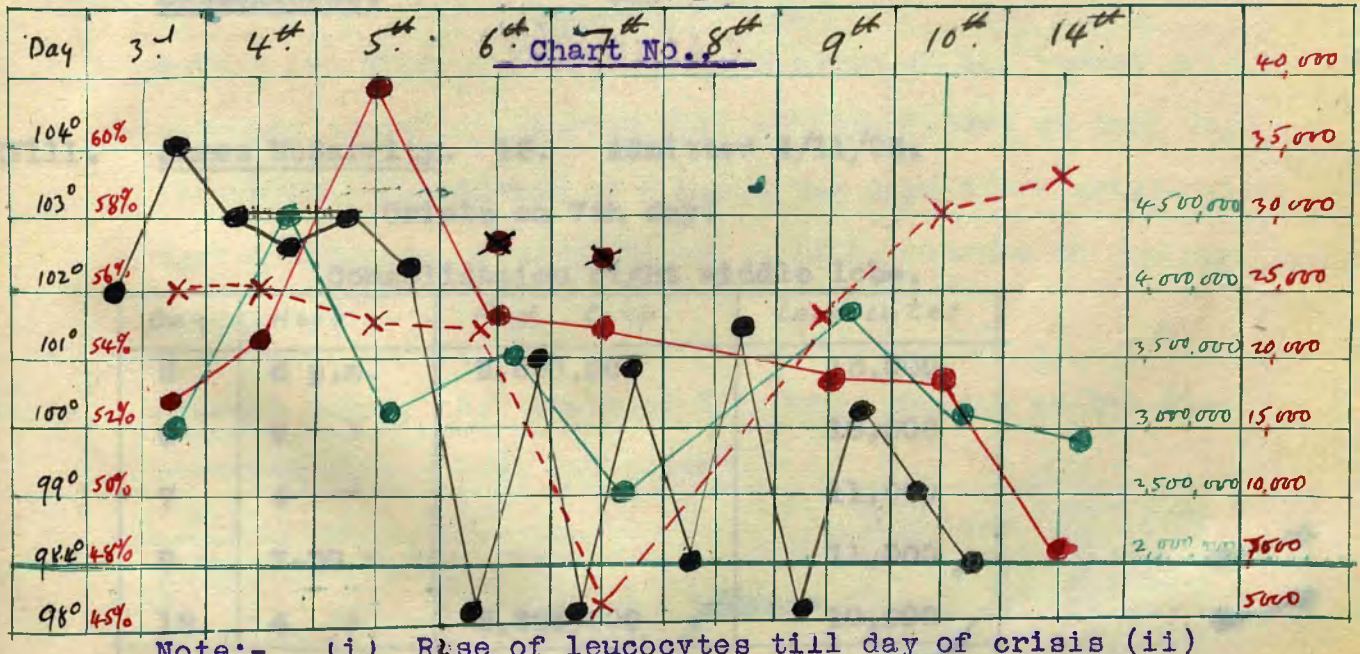
Pseudo-crisis ~~5~~ 5th day, Crisis 7th day.

Consolidation right lower lobe. Still present 6 days after crisis. Lung not clear 14 days after crisis.

Day	Red Corp.	Leucocytes	Haemogl.
3.	3,075,000	16,000	56%
4.	4,500,000	22,500	56
5.	3,000,000	40,000	55
6.	3,500,000	23,000	55
7.	2,500,000	22,000	45
9	3,800-000	18,700	55
10	3,160,000	18,700	58
14	3,025,000	7,800	58.%

Temp - Black
Red Corp - Green
Leucocytes - Red
Haemogl. - Red (Dotted)

Chart No X



Note:- (i) Rise of leucocytes till day of crisis (ii) fall on day after crisis but still considerable amount of leucocytosis (iii) gradual drop in number of leucocytes, normal /

normal not reached till 9 days after crisis, associated with post-critical rises of temperature and delayed resolution.
(iv) gradual drop of haemoglobin percentage throughout fastigium, marked fall on day after crisis, thereafter steady rise,.

XXVII. Joseph Poppy. 10. Admitted 1/10/00.

Crisis 2 days after admission.

Consolidation right lower lobe.

There were also symptoms of acute Nephritis - oedema &c.,

Urine - Acid, s.g. 1018, albumen, blood and tube casts.

Red corpuscles, 3,480,000

Leucocytes. 25,000

Haemoglobin. 52%

XXVIII. James McGarrity. 15. Admitted 4/11/03.

Crisis on 7th day.

Consolidation right middle lobe.

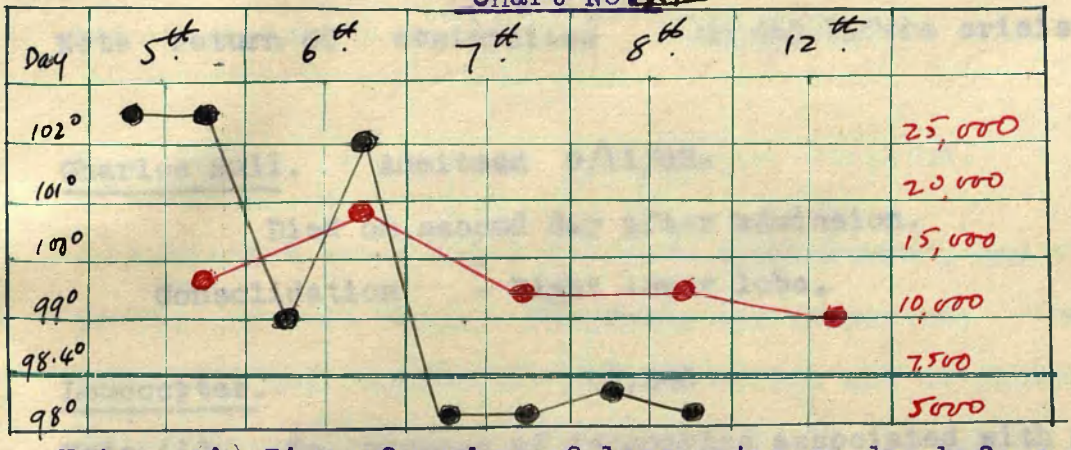
Day	Hour	Red Corp.	Leucocytes
5	5 p.m.	3,600,000	13,000
6	9 "		18,000
7	4 "		11,000
8	7-30 "		11,000
12	4 "	5,325,000	10,000

Classification of Leucocytes,/

Classification of Leucocytes-

	5th day.	8th day.
P.M.N.	82.6	64.0
Small Lymphocytes.	10.6	23.3
Large "	6.6	3.3
Eosinphiles.	0%	6.8%

Chart No. XI



Note:- (i) Rise of number of leucocytes on day before crisis although there is a marked fall of temperature on that day. (ii) Normal proportion of P.M.N.s two days after crisis with marked increase of eosinphiles (iii) absence of eosinphiles on day before crisis.

XxlX. Michael Dolon, 8. Admitted 3/11/03. Crisis on 7th day

Consolidation - Left lower lobe.

Day	Hour	Red Corp.	Leucocytes
5	5 p.m.	4,500,000	22,000
6	8 "		23,000
8	4 "		17,000
10	4 "		7,300.

Classification /

Classification of leucocytes:-

	5th day,	6th day.
P.M.N.	88	88
Small Lymphocytes.	8.6	11
Large "	3.3	
Eosinphiles.	0 %	1 %

Note return of eosinphiles on day before crisis.

XXX. Charles Bull. Admitted 9/11/03.

Died on second day after admission.

Consolidation - Right lower lobe.

Leucocytes. 7,500

Note (i). No Increase of leucocytes associated with fatal termination. (ii) Absence of eosinphiles (iii) Increased porportion of P.M.N.s

Classification of Leucocytes:-

P.M.N.	78.3
Small lymphocytes.	13.3
Large "	8.3
Eosinphiles.	0 %

XXXI. Daniel Mamont. 34. Admitted 19/11/03.

Crisis on admission. Consolidation right lower lobe.

Leucoctes /

Leucocytes:- 9,000

Classification of Leucocytes :-

P.M.N.	82.6
Small Lymphocytes.	9.3
Large "	4.6
Eosinphiles.	3.3%

Note increased porportion of eosinphiles - after crisis.

XXXll. John Smith, 27. Admitted 20/11/03.

On admission there was a feverish temperature , and crepitations at base of left lung. Pneumonia was suspected; but on the following day temperature fell to normal and no consolidation developed. Patient had suffered for some time from Bronchitis and emphysema with occasional exocerbations.

Leucocytes. 9,000 (on admission)

Classification of Leucocytes.

P.M.N.	71.3
Small lymphocytes.	8.0
Large "	7.3
Eosinphiles.	13.3 %

Note (i) Proportion of P.M.N.s very slightly above normal (ii) great increase of eosinphiles associated with Emphysema ,as mentioned already. (iii) Proportion and number of leucocytes not what is usual in pneumonia during fastigium/

XXXIII. John Queen. 56. Admitted 19/11/03.

Died on 24/11/03.

Consolidation of both bases.

Date	Hour	Leuc.
21.11	5.P.m.	21,500
23.11	8-30 "	23,000
24.11	4 "	35,800

Classification of leucocytes.

P.M.N.	81.2
Small lymphocytes	11.4
Large "	7.4
Eosinphiles.	0 %

Note (i) Marked increase of leucocytosis preceding death (ii) absence of eosinphiles.

XXXIV Thomas Walker. 53. Admitted 23/11/..

Died on 26/11/.. (7th day)

Consolidation left lower lobe.

Day	Hour	Leucocytes
5	4 p.m.	6,000
7	4 "	8,400

Note that there is a diminution in the number of the leucocytes on the day after admission with a slight increase on day of death.

On/

On the 5th day patient seemed to be in quite a favourable condition; but the leucopenia suggested a fatal termination.

XXXV. John Love. 26. Admitted 24/11/03.

Crisis on 8th day.

Consolidation both bases. (Slight)

Day	Hour	Leucocytes
7.	4 p.m.	17,000
10.	4 "	9,000

Classification of leucocytes.

P.M.N.	79.2
Small lymphocytes	10.
Large "	2
Eosinphiles.	8.8 %

Note high proportion of eosinphiles after crisis.