THESIS BY FRANK FERGUSON KERR. M.B.

SUBJECT:- The treatment of Nineteen cases of an Epidemic of DIPHTHERIA of two months.

It is not intended in this paper to go into the history or the development of the serum therapy with reference to diphtheria but merely to give in succinct form my opinion of the best treatment for diphtheria and a few results which have been obtained in my practice during the last few years.

Perhaps no discovery of recent years in the world of medicine has been of such good or pruductive of such good results as the introduction of antitoxic serum in the treatment of diphtheria

There is a tendency and doubtless a justifiable one to regard the advent of new remedies with caution but judging from my own experience there seems little room for doubt that the antitoxic treatment is the treatment for diphtheria. The antitoxic treatment robs diphtheria of its terrors

and that disease which formally played such deadly havoc among children now takes its place among the milder diseases. After considerable experience both with and without the antitoxic serum I have no hesitation in saying that it is the treatment for diphtheria which yields the best results; antitoxin is no longer upon its trial and I should consider a man as criminally negligent who did not at once have recourse to this treatment immediately after his diagnosis of the disease and even if his diagnosis were doubtful; and in many cases also as a prophylactic especially when an epidemic of the disease has broken out in the district. It would be a mistake however to regard this treatment as a specific which will save the life in every case; we possess no such specific but in antitoxin we possess a good approximation to a specific.

A still further recommendation of the antitoxic treatment is this fact that it is not opposed but supplementary to the older methods. I find that it adds enormously to the efficacy of the old methods and does not interfere with their being employed at the same time. There seems then no better form of

treatment than to combine the antitoxic method with the older methods.

Diphtheria is a disease of childhood rather than of infancy, the maximum of mortality being at the age of four. Feeble nervous children are most liable to attack and this probably accounts for the higher rate of mortality among girls than boys. In my own experience of an epidemic of diphtheria, out of nineteen cases twelve were girls. The epidemic flourishes most during the months of November and December while in the summer months diphtheria cases are comparatively rare. Supporting this evidence we find the disease commonest in the temperate and cold climates while in the tropics it is more seldom met with. In my own experiences diphtheria is much more fatal in cold climates. In the City of Winnipeg during the winter season in 1890-91 a serious epidemic broke out and the death rate judging roughly from memory, was from sixty to seventy per cent. This was of course before the inauguration of the antitoxic treatment.

An epidemic of diphtheria lasting two months, broke out at Horwich two years ago and nineteen cases cameunder my notice. I could not ascertain

with absolute certainty the cause of the outbreak but it was most probably due to the exposure of a defective drainage system when the road was broken up for the purpose of laying the Car lines. All the nineteen cases were associated with one school and the vicinity of that school was precisely the place where the bad drains were exposed. In the three adjacent districts of Horwich, Blackrod and Aspull there were sixty cases altogether, all of which were treated with antitoxin and all recovered with the exception of two. I may say that all the cases were treated at their own homes as neither of the three districts had an infectious diseases hospital although they are now having one built in conjunction.

The symptoms complained of by my patients in most cases were chilliness, headache and loss of appetite while pain was felt in swallowing. In cases which I saw early I found the throat red at first but soon a membrane of a grayish colour appeared in spreading patches at the back of the throat. In some cases it also extended down the gullet. In laryngeal cases the patient coughed a good deal and had difficulty in breathing. The throat affection was generally accompanied by a low and very dangerous

fever with rapid loss of the patients strength which was still further reduced by the patients inability to take food. My first steps on visiting a diphtheria patient were to remove all superfluous furniture such as carpets, pictures, curtains etc and to provide for thorough ventilation. The patient was kept in bed with light though warm clothing and the body heat was anxiously watched especially in the later stages of the disease. Steaming of the room with a bronchitis kettle may also be resorted to. The floor was then washed with antiseptic solution and a sheet well soaked in the solution was hung up at the door. No one was allowed to enter the room except the nurse when one was obtainable, the mother of the child and myself.

There are few diseases in which the diet is of such vital importance, as it is extremely essential, to maintain the patients strength. Strong stimulating food was given and as frequently as possible. As long as the temperature remained above normal, the food given was of light liquid form such as barley brew, soda water, strong beef juices and milk. Stimulants I have always found

of great advantage such as dilute brandy or whisky or, when these could not be retained Champagne. If the disease progresses and makes headway then peptonization of the food and nutrient enemate should be resorted to.

In mild cases the only prominent symptoms are those connected with the throat. Vigorous local treatment should be carried out. In swabbing the Nurse should seat herself with the child before a window and hold the child in front of her, grasping him tightly round the middle but leaving his head free. The Doctor can then control the head with one hand while with the other he does the swabbing. The child's arms are kept down by his sides and his legs are held between the Nurse's knees. The Nurse should hold the child well up to herself. When the child is held in this position there is no need for a gag and the throat can be thoroughly swabbed and examined. I have found this method of holding the child to be much more convenient than many which are recommended such for instance as resting the child's head on the Nurse's shoulder.

In swabbing I have used various antiseptic

solutions such as dilute carbolic acid solution in alchol or chlorate of potash solution but it is doubtful whether a better can be found than dry sulphur applied on a camel hair brush. When well rubbed down into the throat I find that it is of more value than anything else and I am convinced that it is not employed enough in cases of enflamed mucous surfaces. I believe it to be a most valuable drug and I prefer it to any other application in throat troubles. In the treatment of young children I have found hot poultices and indeed hot applications of any kind extremely beneficial when applied well up the throat. In Adult cases however cold applications are to be preferred.

Such treatment though beneficial so far as it goes is however insufficient and I have never failed in all cases to adopt the antitoxic treatment

I have taken as the basis of my treatment of diptheria the statistics given by the Metropolitan Assylums Board which table shows that in 1894 the mortality was about 30 per cent while in 1900 it fell to 12 per cent. This decrease in the death rate was almost entirely due to the growing popularity of

the antitoxic treatment. In this treatment is is of paramount importance that the child be treated early and I am of the opinion that a considerable part of the mortality of diphtheria is due to the hesitation of parents in calling in a doctor because the child seems merely to be suffering from sore throat. By an early treatment we nip the disease in the bud and the frequency of laryngeal cases is much diminished; we also lessen the probability of complications arising such as degenerative changes in the heart and kidneys. Again if the treatment be late the disease will take deeper root and will require larger doses of the antitoxin to dislodge it and large doses of antitoxin are sometimes followed by unpleasant consequences the commonest form of which is paralysis. Besides, larger doses mean larger expense. Every consideration then, points to the early treatment of the disease. This involves the necessity of a rapid diagnosis. I have therefore always deemed it prudent when the clinical diagnosis was unsatisfactory to err on the safe side, and inject the serum especially in the case of young children where time is very precious and cannot be

spent in waiting for a bacterial examination. The same precaution holds in severe cases in older patients.

The injection of the serum was given slowly into the abdomen of the patient where the subcutaneous tissues are loose. I think the abdomen is to be preferred to the back as the place in injection because should anything go wrong with the wound the patient would be better able to obtain rest while in bed. Before injection the area of the skin was thoroughly sterilized with soap and carbolic lotion. The syringe I used was specially made for the purpose having a glass barrel while the packing of the piston was rubber so as to admit of thorough sterilizing and cleansing. The syringe was boiled before each injection and everything was kept scrupulously clean. After the injection a distinct improvement was seen in every case in the condition of the patient both in ~~th~~ the local and general symptoms. The chief effects I have noticed are, a diminution in the swelling of the fauces, very little discharged from the nose, and the early separation of the membrane in laryngeal cases. Besides these local changes the Temperature fell, the pulse became slower and there was a general

improvement all round.

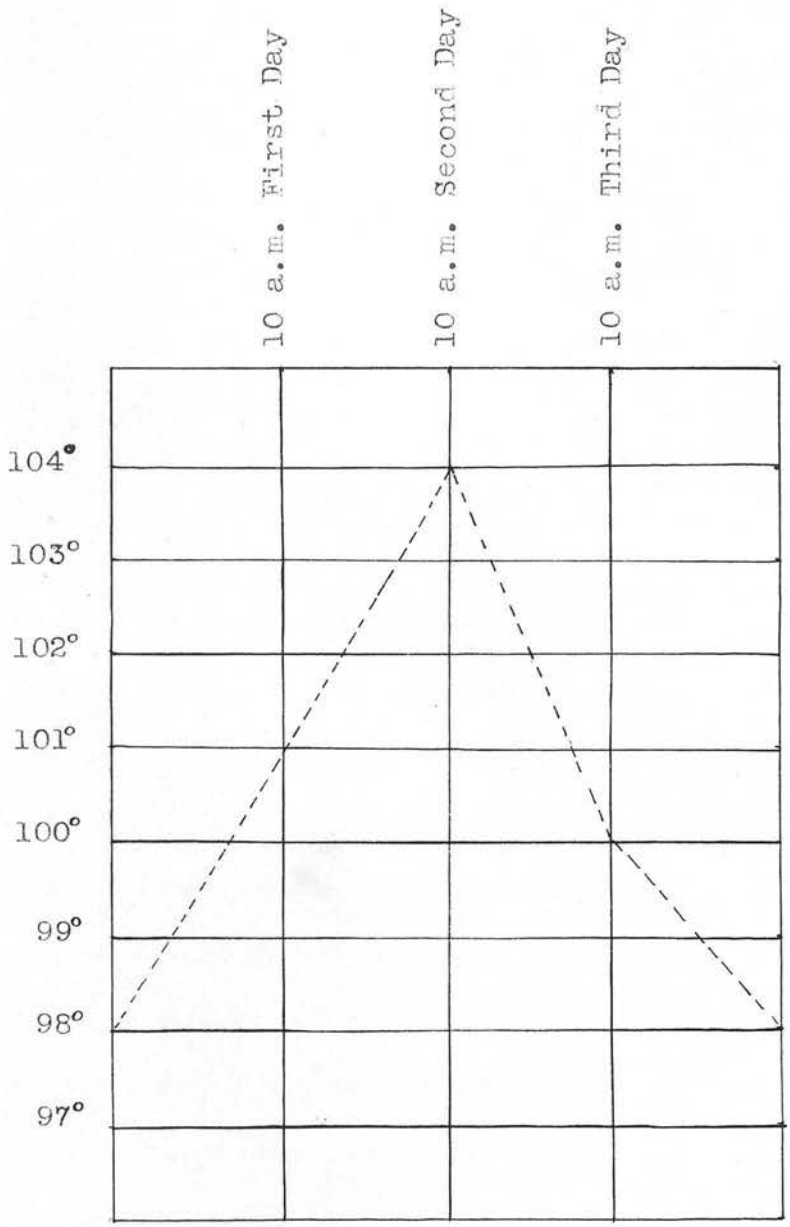
In dosage I followed the advice of the Medical Officers of the Metropolitan Assylums Board which states that the only limit to the amount of the dose is the bulk of the fluid in which it is contained. For children under two years of age 1500 units of the serum will be found sufficient in mild cases or in cases where the patient is seen late as much as six or seven thousand units may be injected at once. I find however that as the disease is most fatal in the case of young children, age should scarcely be considered as a criterion for the amount of dose. The severity or the reverse of the case should determine the amount injected. If there is no improvement in the condition of the patient further injections should be made. I always gave as large doses as possible at the beginning of the disease being confident that the great advantage obtained would more than counteract any bad result which might ensue and repeated it in 10 hours with an even larger dose if the symptoms were not abating. As in most other acute diseases I firmly believe in pushing the dosage at the beginning of the disease instead of having to repeat the doses. As the bulk is the only limit to the amount injected the most concentrated serum is to be

preferred. The common dose I gave was from 1 to 6 cubic centimetres of Parke Davis & Co's ordinary antitoxic serum which contains 375 units per cubic centimetre.

A minimum of a thousand units may be injected as a prophylactic into the other members of the family where one of the children is suffering from the epidemic and this was done in my own experience in several cases. It must always be borne in mind however that this protection is only temporary and cannot be counted upon to give immunity from the epidemic beyond a period of three weeks.

One of my cases was that of Robert K- a badly nourished boy of nine years. His temperature was 104°, pulse 140 and his respiration 40 per minute. Both tonsils were affected with a grayish white membrane about a quarter of an inch in diameter. Four thousand units in all of the serum were injected and on the following morning, some 24 hours after there was a marked amelioration of both the local and general symptoms. The membrane became detached and the child rapidly recovered, his temperature being about 100°, pulse 125 and his respiration 30. I found after another 24 hours that his temperature was normal and it remained so. He made no further complaint of sore throat and was able to swallow

Scheme showing the variations of temperature in the above case will be found on the following page.



The case of Robert K-- ; Injection was given at 10 a.m. the second day.

The chief symptoms I relied on for injecting further doses were persistent rise of temperature, abundance of membrane and dry unspissated mucus broncho-pneumonia and spread of the disease and reinfection. The temperature usually responded to the initial dose and reached the normal by about the third or fourth day after a gradual decline

It has been objected to the antitoxic treatment that several evil results may follow its injection, the chief of which are, the development of a local abscess, skin eruptions, joint pains and albuminuria but it will, I think, be found on examination that such evil results are comparatively rare, while in the case of albuminuria the evidence is not at all conclusive enough to show that it results to any greater extent from the antitoxic treatment than it does from the older methods. I found that when I increased the dose the albuminuria did not increase. In only three cases out of the nineteen was the injection followed by skin eruptions which though not at all serious were sufficiently marked.

These rashes are not attributed in any way to the antitoxin itself because they have also been

caused by normal horse serum. They arise for the most part during convalescence and do not appear in any case to have resulted in death though they have doubtless retarded recovery. These evil results have however been to a large extent counteracted by employing a more highly concentrated serum, thus reducing the bulk of the fluid injected. Parke Davis & Co's serum is issued in phials hermetically sealed in a blow-pipe flame and should be kept in a cool place protected from strong light. I always buy it in small quantities at a time and when a phial is opened I find it best to use it all up at once, so as to avoid the risk of contamination.

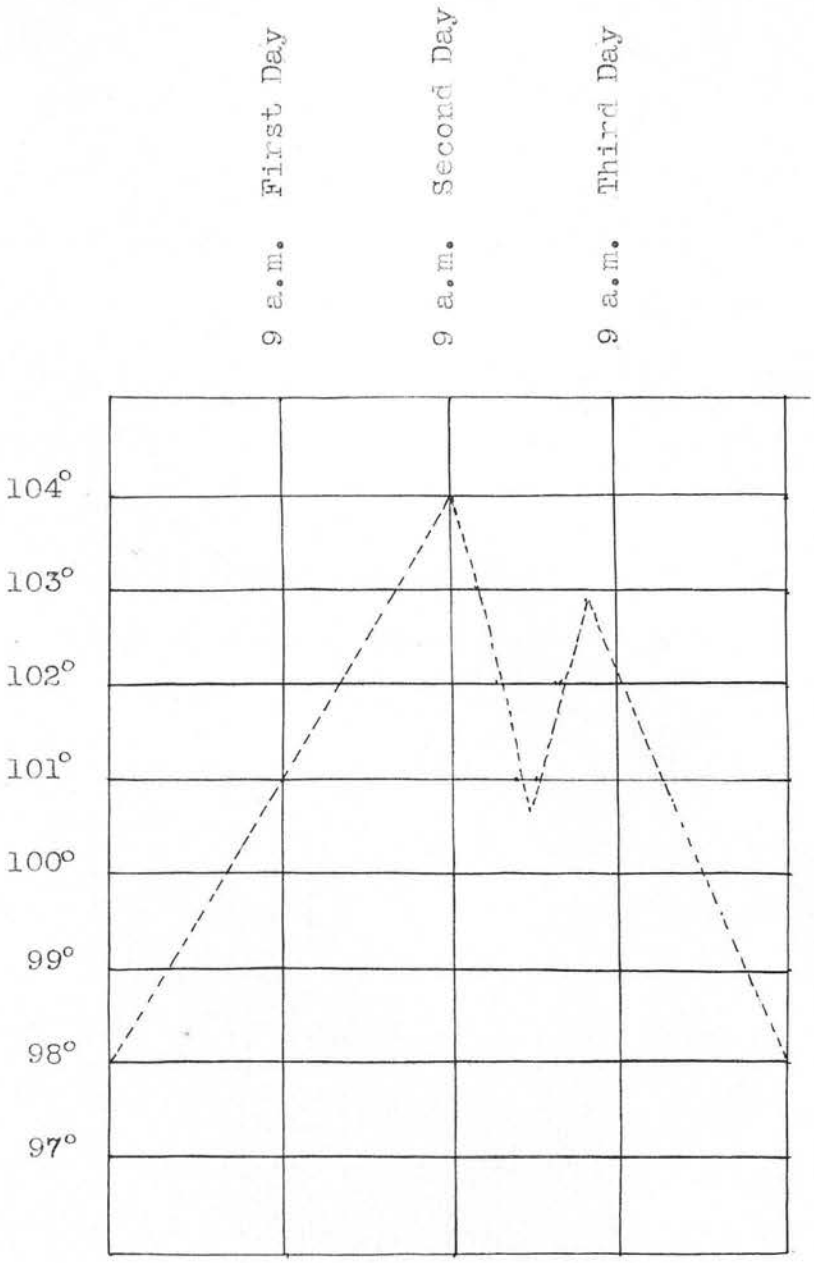
There was a case came under my notice which is worthy of mention as it was one of the most stubborn cases with which I had to deal. The case occurred in December 1901 and was that of a weak unhealthy lad of sixteen. He was troubled with cold shiverings for a day or two and experienced some difficulty in swallowing. On examination I found that the fauces and tonsils were congested and small patches were visible on the tonsils. I

immediately diagnosed the case as one of diphtheria and had his throat swabbed frequently with sulphur

I also ordered him a mixture of perchloride of Iron and glycerine every three hours. Strong beef juices, barley brew, milk and alchol were also recommended. On the following day his temperature rose to over a hundred while the patches had spread to the uvula. The disease quickly spread to the mucous nasal membrane and a discharge was given from the nares. The next day his temperature rose still further to 104° and the membrane had spread over the soft palate. I then injected 8 cubic centimetres (3000 units) of Parke Davis & Co's antitoxic serum and a rapid improvement took place, his temperature falling to below 101°. On the following day however his temperature again rose and acting on the advice of Dr James McIntosh late House Surgeon of Infectious Diseases Hospital I made a second injection of the same strength. The membrane then disappeared and the boy quickly recovered although visited by a slight attack of paralysis. He was detained in his bed and a liberal diet administered to him by means of a nasal

tube. The drugs used were strychnine and iron and after a time massage was resorted to twice a day and electricity. Under this treatment my patient soon returned to his usual state of health.

Scheme showing the variations of temperature in the above case will be found on the following page.



Case of George D--: Injections were made on the second and third days.

Dr Arthur Stanley in a paper to the British Medical Journal 15th February gives his experiences in an epidemic of 500 cases treated at the Metropolitan Assylums Hospital in all of which the antitoxic treatment was employed. The following is an extract from the paper:-

"The diagnosis of doubtful cases were "verified by bacteriological examination. The "total number of deaths in the series was 80, a "death rate of 16 per cent. The antitoxin was "injected in quantities usually of 4000 Behring "antitoxin units immediately after admission but "varied from 1000 to 30000 units according to the "severity of the case and the time of admission after onset; no constant relation between the "quantity of antitoxin given and the frequency of "eruption was noted but in one case where antitoxins "from two different sources were injected at the "same time, two separate antitoxin rashes were "observed, the first occurring 10 days and the "second 14 days after the giving of the antitoxins. "No special sources of antitoxin were found to "cause a preponderating number of eruptions and the "eruptions occurred throughout the two years I was

"working with diphtheria".

"Skin eruptions occurred in about a fourth of "the cases. The period of onset was usually "during the second week after the giving of the "antitoxin. The eruptions met with was not so "peculiar as to be pathognomic, but was sufficiently "marked, especially in relation to the general "symptoms, as to constitute a distinct type".

"There may be a little disquamation and "prolonged erythemata but there is rarely any "confusion between true scarlet fever occurring in "the course of diphtheria and eruptions produced "by antitoxin".

"The general symptoms, beyond a rise of "temperature of some 3°F and its accompanying "malaise, are not marked. Pains in the joints "have been frequently described but were not "observed in one of these 500 cases. This result "may have been due to the cases being chiefly "among children".

"The only marked case in which pain was present "was that of a girl of 13 who had frontal headache "and lunibar pain extending down the thighs. She

"had a marginate erythematons eruption and the
" temperature rose to 101°F."

"Transient early erythematons blushes, and also
"urticuria, often occur soon after the injection
"of the antitoxin but these may generally be
"considered to be of traumatic origin and not to be
"related to any specific property of the antitoxin.
"The area of skin, before injection was sterilized
"with soap and carbolic lotion and the injection
"syringe was boiled before each injection. No
"abscess at the seat of injection occurred".

"The occurrence of an antitoxic eruption during
"the course of a case of diphtheria did not appear
"to influence the prognosis seriously though it
"cannot but be held that any befrile disturbance
"of the heart would tend to have a harmful effect.
"No case however was observed where fatal heart
"failure was precipitated by the occurrence of an
"antitoxin eruption".

In my own experience of nineteen cases, all private, there was only one death, the patient being too far gone before I was called in to see him. The other eighteen cases were seen at an early stage and all recovered. In comparing my results with

those given by Dr Stanley, I attribute my better results to the fact that my patients were nearly all of the better class and received special nursing and attention. As before mentioned I only met with three cases of skin eruption and one of paralysis. There was no disquamation in any of my cases. Doubtless one reason why private treatment yields better results is that there is always a certain delay before the patient can be taken to the Hospital and this delay often means the difference between success and failure. Dr Stanley's statistics of his results with the antitoxic treatment in general hospital work show a marked diminution in the death rate when compared with the results from the older methods but extra care and private nursing should bring the percentage down to about 5 per cent in private practice.

In conclusion I would say that I have such entire confidence in the curative action of the antitoxic treatment, that in a case where the serum employed was absolutely reliable and my diagnosis was doubtful, if no beneficial effect was produced by the injection of the serum, I should decide that it was not a case of diphtheria at all; in other

words so well does the disease respond to the antitoxic treatment that the latter may be considered as a diagnostic as well as a curative agent.

I FRANK FERGUSON KERR of 332 Chorley New Road Horwich in the County of Lancaster Bachelor of Medicine do solemnly and sincerely declare:-

THAT the before written Thesis on the Treatment of Nineteen cases of an Epidemic of Diphtheria in two months is my own work and composed entirely by myself.

AND I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of the Statutory Declarations Act 1835.

DECLARED at Horwich in the County of Lancaster this 28th day of April 1903.

Before me

John Wood

A Commissioner to Administer Oaths in the Supreme Court of Judicature in England.

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THESIS

SOME OBSERVATIONS ON THE BLOOD

in

PHTHISIS PULMONALIS.

Howard G. Pesel, M.B.

1903.

Some Observations on the Blood in Phthisis Pulmonalis.

Bibliography.

Many observers have published interesting monographs on this subject, which, though agreeing in several points, are by no means unanimous on others.

Besides the changes due to the infection by the tubercle bacillus itself there are other considerations which must have an influence on the condition of the blood, phthisis pulmonalis being a disease of many phases. The majority of observers classify their cases according to the amount of involvement of lung tissue, generally separating them into classes or stages, such as "early" and "advanced", or "1st. 2nd. and 3rd. class."

A short summary of the results previously obtained may be of interest here.

Malassez calls attention to the fact that in phthisis pulmonalis it is common to find a diminution in the number of red blood corpuscle with a lowering of the percentage of haemoglobin.

Jaccond notices that in the anaemia due to tuberculous infection the diminution in haemoglobin is less marked than in chlorosis. (1887)

Fonaglio

Fonaglio, Laache, Engelson, and Laker agree in the conclusions of Malassez. (1882), (3), (4), (6)

Strauer[1] notes that in early apical lesions there is an anaemia resembling chlorosis, together with an irregular leucocytosis. In chronic cases with cavities though little or no fever the red cells are nearly normal, or perhaps a little over normal: for instance 5,000,000 to 5,500,000; the leucocytes numbering 5 – 10,000. In cases with suppurating cavities the erythrocytes are reduced and the leucocytes are often much increased. (1894)

Loomis calls attention to the fact that though the general appearance of the patient may give the casual observer the impression that he has a considerable degree of anaemia, an examination of the mucous membranes shows a fairly good colour, while an examination of the blood and haemoglobin confirms this.

Halle found a leucocytosis in advanced febrile cases.

Reider noticed this difference between early cases and chronic febrile cases.

Achard and Loeper[2] note a leucocytosis which is mononuclear in form. (1901)

Appelbaum[3] observes that in early cases with good

good general condition and no heredity there is a reduction in the number of leucocytes, erythrocytes and haemoglobin, viz.,

Haemoglobin	Leucocytes	Erythrocytes
69 %	6500	3,800,000

On a differential examination of the white corpuscles he found an increase in eosinophile cells and a slight diminution in lymphocytes.

In cases rather more advanced with some elevation of temperature, night sweats and cough with expectoration, the blood is practically normal, but the number of erythrocytes is rather high. This he attributes to increased concentration of the blood.

Haemoglobin	Leucocytes	Erythrocytes
90–95 %	8–10,000	5–5,500,000

A differential examination of the leucocytes here showed fewer eosinophile cells with more of a transitional form.

In cases of very far advanced pulmonary disease he found a marked diminution in erythrocytes and haemoglobin with distinct leucocytosis, viz:

Haemoglobin	Leucocytes	Erythrocytes
40–45 %	15,000–20,000	2,000,000

The differential examination here showed a marked increase in polymorphonuclear eosinophiles and a diminution in the transitional forms.

Claudi and Zaky[4] in a recent and interesting article, record the following results:- In an early case with good general health and no fever they find a reduction in the percentage of haemoglobin, a normal number of red cells and a leucocytosis of about 15-16,000. They also find a leucocytosis in afebrile cases with cavitation. In advanced cases fairly quiescent and capable of improvement they find a variable diminution in red cells and haemoglobin with an also variable increase in leucocytes.

On differential examination of the leucocytes they note no increase in the polymorphonuclear eosinophile cells, but an increase in the intermediate sizes of mononuclear transitional cells.

The most interesting fact recorded in this paper, however, is the increase these observers found in the coarsely granular eosinophiles and red corpuscles in cases improving under treatment. This treatment consisted in rest, good food and such medicinal agents as creosote. They ask, may it not be that there is a prognostic value in this increase under treatment? One of the instances they quote may not be out of place:- A case of fairly extensive phthisis pulmonalis before treatment -

red corpuscles.	white corpuscles.
3,872,000	7,800

differential

differential count of leucocytes:

Polymorphs.	Lymph.	Hyal.	Mononuclear.
61.	10.	3	25

coarse. gran. eos.

1.

after treatment –

red corpuscles.	white corpuscles.
4,320,000	6,400

Polymorphs.	Lymphs.	Hyal.	Mononuclear.
60.6	28.4	2.6	5.2

coarse. gran. eos.

3.2

Claudi and Zaky conclude that under treatment the leucocytes diminish, the haemoglobin increases, and the number of coarsely granular eosinophile increases. The increase in the number of mononuclear cells is also well shown in some of their figures. They do not mention the number of cases examined and the latter half of their paper is devoted to observations on the blood of guinea pigs with experimentally produced tuberculosis. These, though interesting, need not be entered into here.

It may be noted, however, that in their counts of the different forms of white cells in guinea pigs gradually succumbing to experimentally

produced

produced tuberculosis the polymorphonuclear corpuscles increase as the disease progresses while the leucocytes as a whole are increased, the red corpuscles gradually diminish, and the percentage of haemoglobin decreases.

Osler in his "Practice of Medicine" says that there is an anaemia in early phthisis more apparent than real, the red cells seldom going below two millions. There is frequently a leucocytosis, especially in the later stages of the disease.

Percy Kidd, in Albutt's "System of Medicine," records that in his experience the blood shows changes similar to chlorosis with considerable reduction of haemoglobin, a relatively slight diminution in red cells and also a diminution in mass of the cells. In active pyrexial cases a moderate degree of leucocytosis is found.

Ewing[5] says that in the majority of uncomplicated cases the number of the leucocytes is normal. When a marked increase in leucocytes is present it is generally due to septic cavities, an advanced pneumonic condition, severe anaemia or haemoptysis. This he says is of value in diagnosing pulmonary tuberculosis from pneumonia.

He holds that uncomplicated tuberculosis

of

of the lung is a disease without leucocytosis, and cites as evidence acute miliary tuberculosis as an example of the failure of tuberculosis to induce leucocytosis.

He divides cases of phthisis into three groups:-

1. A primary anaemia of tuberculosis resembling chlorosis with some reduction of red cells, and a marked reduction of haemoglobin, and a slight relative or absolute leucocytosis. Yet in some early cases, he admits, there is the appearance of anaemia with a normal amount of red corpuscles and haemoglobin.

2. The blood is slightly altered in quality but concentrated, probably due to the specific lymphogogic action of the toxins of the tubercle bacillus. This view, he says, is supported by the resemblance between tuberculosis and typhoid fever, both tending to concentrate the blood. "In the majority of cases, therefore, of well advanced phthisis approximately normal blood indicates considerable absorption of the toxins of tubercle bacilli."

3. This group includes early and late anaemias. The fever is largely due to mixed infection, which establishes a condition like ordinary pyogenic sepsis.

Ewing

Ewing also notes that the haemoglobin and red corpuscles may even increase while the disease is advancing, and therefore they cannot be taken as an indication of improvement. He finds no marked degeneration of red cells, i.e. poikilocytes, &c.

Cabot[6] classifies the condition of the leucocytes as follows:-

I. Incipient phthisis - leucocytes normal.

II. After haemoptysis leucocytes are increased as after any haemorrhage.

III. Cases with cavities constantly have leucocytosis. Absence of leucocytosis implies no cavitation.

IV. Extensive infiltration may cause marked increase of leucocytes, but not invariably.

V. In fibroid cases there is generally no increase of white cells, or if there is, it is due to the presence of a cavity.

VI. With a normal temperature the leucocytes will be normal, but if there is fever there may or may not be a leucocytosis, according as the fever is due to septic infection or not.

VII. During the reaction of an injection of tuberculin there is a rise in the number of leucocytes. The red corpuscles, he says, are generally normal but a

a certain number of these are decrepit or "half-baked" corpuscles due to hurried output; thus differing from chlorosis where all the red corpuscles are of poor quality. In certain cases both haemoglobin and red cells are reduced. Von Limbrek, he mentions, has recorded an acute miliary case with red cells 730,000 and HbO_2 25%, but thinks there is not sufficient evidence that this was not a case of pernicious anaemia. Tuberculosis, he considers, has no real effect on the blood. Leucocytosis is due to pyogenic infection.

When the fluid and proteid constituents of the blood are drained the red cells seem to be in good number due to concentration of the blood, and may even seem to be increased, but each corpuscle is sure to be lacking in haemoglobin. The leucocytosis is generally polymorphonuclear, but may be basophile.

Neusser, the same authority mentions, advanced the theory that a basophile leucocytosis is a sign that the system is resisting the attack of the tubercle bacilli. Cases tend to show that when basophilia exists – as in gout, bronchial asthma and other diseases of uric acid diathesis, tuberculosis does not frequently occur. And when these diseases do co-exist the tendency is for the tuberculous process to cicatrise and heal. Thus Neusser concludes that

that excess of alloxan bases (xanthin, uric acid, &c.) is hostile to the spread of the tubercle bacillus.

Cabot, in recording this theory, says that coming from Neusser it is worthy of notice and may be true. Commenting in a later edition on this and the observations of Holmes of Denver, Cabot finds that he cannot agree with it. Holmes even considers that in the basophilia he has found a means of diagnosing tuberculosis by the blood alone, and of measuring the degree of advancement of the disease and the resistive power of the patient. Cabot, finding this basophilia present in other debilitating conditions, cannot attach much importance to it. As the eosinophile corpuscles increase in the reaction of tuberculin injection, and also in some cases with cavitation, he thinks that it may be that the patient is inoculating himself with self-produced tuberculin manufactured in the cavity.
Cabot, May and Holmes have found myelocytes in some cases.

M. L. Stevens[7] also finds that in many cases the appearance of anaemia is accompanied by a fairly high rate of haemoglobin. He points out that his observations were made at an elevation of 2,300 ft. above sea level, and so cannot be compared with results obtained on much lower levels. He considers

that

that one cannot speak in general terms about the blood in tuberculosis as the variations in the same stage of the disease are so great.

As regards red cells, he finds two types of case; one with extreme paleness and perhaps emaciation showing red corpuscles 3,742,000 per cubic millemetre. The other with disease circumscribed and good health, with red cells about 5,448,000.

In chronic cases with no fever the blood is nearly normal. In fever from septic infection there is frequently a temporary rise in red corpuscles even up to 7,000,000, lessening as the disease progresses.

In moribund cases the reds are much reduced. In acute febrile cases he finds a marked decline in the number of erythrocytes. In waxy disease also there is a diminution.

This author does not find the ordinary explanation of high counts of corpuscles satisfactory, namely, concentration of the blood, due to copious expectoration, sweats, diarrhoea, &c. He believes it a true oligaemia and finds proof of this in the small peripheral vessels and shrunken veins he discovers in consumptives, and in the fact that he found only small quantities of blood in post mortem examination of such patients.

He

He, therefore, believes a decided anaemia to be present, though appearances may not support the view. In the leucocytes he finds a factor of great clinical importance. In acute miliary cases, chronic cases uncomplicated by septic organisms, and fibroid cases the leucocytes are in normal amount, or if the red cells are reduced the whites are too. Leucocytosis implies pus formation. Marked elevation of temperature is generally attended by increase in leucocytes due to a pneumonic condition or sepsis. In a few cases with septic involvement the leucocytes are low and decreasing in quantity, indicating loss of resistance and consequently bad prognosis. Dry cavities do not cause a leucocytosis.

Galbraith[8] in an article on the dietetic treatment of phthisis mentions that he found no increase in leucocytes in early cases, and an invariable one in the later stages. Under open air treatment with plentiful meat diet he found (1) a moderately constant leucocytosis, (2) a large absorptive leucocytosis, (3) almost constant eosinophilia (4–5 per cent). He considers that basophilia has a special action in phthisis, and is of great importance.

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Criticism and comparison with the writer's own observations.

Malassez, Fonaglio, Laache, Engelson and Laker found a diminution in red corpuscles and haemoglobin. Though this is certainly the case in a proportion of patients, I have not found it so in the majority.

With Strauer's results I agree in the main. Certainly an anaemia resembling chlorosis does occur and also an irregular leucocytosis. In chronic cases with cavities, I found the red corpuscles below the figures he gives in some of my cases, though the rest show a higher rate of red corpuscles than normal. In the febrile septic cavitation cases my results follow his as regards a reduction of red cells in a proportion of the cases. He found a considerable leucocytosis, while in mine, though present, it was not very high compared with some of the other classes.

Jaccond and Loomis's generally stated remarks are borne out by the figures to be given below.

Halle and Reider, as regards the leucocytosis they found in late cases, may be classed with Strauer.

Achard and Loeper mention a mononuclear leucocytosis. This was present in many of the uncomplicated

uncomplicated cases recorded here.

Appelbaum in his early cases finds the HbO_2 and red cells reduced. This combination is not marked in my cases though the HbO_2 percentage is lowered in some. In none of my cases was the number of leucocytes reduced as in his.

In his more advanced cases he agrees with Strauer, and records a high rate of haemoglobin as present while the reds are increased. The increase in transitional leucocytes is found in many of my cases.

I have not found the marked reduction in haemoglobin and red cells he noted in advanced cases, though several show a slight reduction in haemoglobin. A leucocytosis is present in many of my cases of this class, and like his the eosinophile forms are increased at the expense of the basophile.

Claudi and Zaky's results as regards leucocytosis in early, afebrile cavitation and advanced cases are confirmed in my observations, though I did not always obtain the same reduction in red corpuscles that they record. They found an increase in the mononuclear basophile leucocytes which was present in many of my cases.

I cannot say that I have found the coarsely granular eosinophiles so invariably increased in improving cases, but it occurred in some. The haemo-

globin

haemoglobin is so high in my cases that the increase on general improvement is not marked. Attention is, however, called to cases where this phenomenon does occur. These observers emphasise that the leucocytosis diminishes as the patient gets better, while my results show that it also increases in many. It is a pity that no mention is made of the number of cases examined.

Osler's results, in that they agree with several of the previous observers, have already been dealt with. My observations agree with his conclusions.

With Ewing's observations, it will be noticed, that the conclusions drawn from the cases here recorded mainly agree.

Cabot's results follow in the same direction, though I cannot agree that where there is no fever the leucocytes will be in normal numbers, and, when saying that an absence of leucocytosis implies no cavitation, he rather neglects the possibility of a dry smooth-walled vomica. I can at once agree with his observations that the numbers of the red cells are kept up by a production of ill-formed corpuscles. This fact was very noticeable in the great majority of cases which I examined. As he says, the leucocytosis may be polymorphonuclear or

basophile

basophile, but the class of cases in which each occurs can be defined to a large extent.

Both Ewing and Cabot, as well as Appelbaum, strongly advocate the theory of concentration of the blood as the cause of the high numbers of corpuscles found in many cases. And this seems a most rational explanation in a wasting disease, where a heavy strain is made on the proteid bearing tissues and fluids. I cannot agree with Cabot when he repudiates the contention of Neusser that a basophile increase is fraught with prognostic importance. For though I have found it present in patients debilitated from other diseases – chlorosis, cardiac muscular failure, and general debility – yet most of the cases of phthisis which showed this reaction ultimately improved, and in cases gaining strength there is a tendency towards this increase in basophile cells. It will be noticed that Holmes, Stevens, and Galbraith also find importance in the fact.

With Cabot, May and Holmes I also found myclocytes present in some of my cases.

In common with Cabot and Ewing, Stevens finds great variations in the blood of cases of a similar type. So much so, that he confines himself to speaking in general terms only in the conclusions

he

he draws and does not state in figures the grounds of his contentions. This variation in the blood of cases with similar symptoms and physical signs is a striking and rather embarrassing factor in such researches. His conclusions with regard to there being two early types, an anaemic and a normal blooded, are in accord with several of the previously mentioned authorities. His reasons for rejection of the theory of concentration of the blood, as the cause of the high rate of corpuscles found, are rather inconclusive. My own observations lead me to agree with this writer that the leucocytes have a decided prognostic importance, though here again one cannot lay down an axiom as the variations are so frequent.

Galbraith's results agree with mine that under modern hygienic treatment some degree of leucocytosis is to be expected, though I have not found the constant eosinophilia he records. He also advocates the importance of the basophile reaction.

The last two observers' results are of additional interest in this paper as they were obtained under similar forms of treatment to those here recorded, and in many respects agree. The difference of surroundings must not be lost sight of in comparing early and later observations.

It

It seems to me that the trend of recent observation is towards attaching importance to the increase in basophile cells, frequently to be observed in phthisis, as indicating a good reaction to the disease. As these cells are increased in gout and other uric acid diseases one is lead to recall the theories of Hermann Weber and Harper, who for other reasons regard the gouty state as to be desired as a therapeutic factor in consumption. Though one would hesitate to pronounce definitely upon the theory, the combination of results gives material for further research and reflection.

Having now given a summary and criticism of published researches on this subject, I shall next endeavour to state my personal observations and the conclusions drawn therefrom.

The above observers have classified their cases chiefly by the degree of advancement of the tubercular mischief. It has been considered advisable in this paper to still further divide the cases examined, so that the circumstances likely to affect the course of the disease may be more readily grasped. For this purpose the cases have been divided under the following headings:-

Phthisis with laryngeal complications.

Phthisis with bronchitis as a complication.

Early febrile phthisis.

Early afebrile phthisis.

Advanced febrile phthisis.

Advanced afebrile phthisis.

The large class of cases which cannot be classified with any of the above, but include a fair degree of involvement, frequently with cavitation.

Where cases have shown a marked amount of typical phthisical expectoration, that fact is noted. Where not mentioned it has been absent, or only slight. The temperature unless specially mentioned must be understood to be below 99.4°.

A word of explanation is necessary concerning the circumstances under which the observations were made. The cases, with a very few exceptions, were in-patients in a hospital for diseases of the chest, situated over 400 feet above sea-level and conducted on modern "open air" principles. Even in the case of patients who were unable, from the state of their disease, or from complications, to undergo the full treatment, this last factor came into play, for the wards devoted to such cases are very much more airy and fresh than the wards of most general hospitals in which we may conclude most previous observations have been made. Where the observations were taken after treatment for some weeks or months that treatment may be understood to consist in abundant fresh air, good food, and stomachics, and such drugs as guaiacol, izal, and creasotal when indicated.

It must be borne in mind that the difference in surroundings may account for certain differences in result between these and previous observations. Where cases have been examined after residence for an appreciable time - three weeks at least - that fact is denoted by an underlining in red. Certain abbreviations are used to suit the space available. Temperature, which is by Fahrenheit reading is denoted

by

by "T", cough and expectoration by "C & E", Haemoglobin by"HbO_2", Polymorphonuclear eosinophiles by "Polym.", coarsely granular eosinophiles by "coarsely gran. eosin.", Lymphocytes by "Lymph.", Hyalin by "Hyal.", Transitional Leucocytes by "Transits."

With regard to the question of septic infection in cases of phthisis it is interesting to record the result of some personal observations made in the examination of the sputum in 50 cases of phthisis. It is not claimed that the organisms in every case came from the bronchi or even the larynx, but the frequency with which these organisms were found argues at least that there is ample opportunity for septic infection. As in the great majority of cases tubercle bacilli were found ~~were found~~ in fair numbers in these sputa on the same preparations, it is unlikely that they came from the nasopharynx, where tubercle bacilli, though found, are not plentiful. In the cases where cavitation and laryngeal involvement co-existed it is not possible to say which was more likely to harbour septic micro-organisms. None of the laryngeal cases in these observations on sputa received treatment beyond inhalations of antiseptics and in one case swabbing with a solution of lactic acid on alternate days. This case also showed micro-organisms.

35 showed cocci:	of these	9 had cavities
		9 had laryngeal involvement.
		14 had both cavities and laryng.invol.
		2 had pharyngitis.
		1 had none of these complications.
15 showed no cocci:	of these	6 had cavities
		2 had cavities & laryng.involv.
		7 had no complication.
Total 50		Total 50

Thus there was ample opportunity for complication by septic organisms in these cases.

Many cases coming into hospital for the first time have already been receiving treatment outside in the out-patient departments of special and general hospitals and under private practitioners, and therefore the condition of their blood may be already somewhat altered. Sufficient evidence, however, is collected here to enable some conclusions to be formed. That the number of leucocytes recorded in the following cases may be compared with that found in normal persons. I may state that I found the average number of leucocytes of four healthy persons, living in the same institution, whose blood was counted by the same method to be 10,158. Though this

number

number may at first appear rather high, when it is considered that the counting was done by so many fields of the objective and not by the restricted area of the ruled lines of the Thoma-Zeiss slide it is contended that it is more likely to be accurate covering as it does a much larger area than the Thoma-Zeiss Method. With very few exceptions the time of the catamenia was avoided for blood examination in women patients.

*

Phthisis Pulmonalis with Laryngeal Complication.

In this class of case, as inferred by the figures quoted above, the chances of septic complication are great. One is not therefore surprised to find a high rate of leucocytosis in many cases.

As the number of cases examined in this class is not larger one must be cautious in drawing conclusions, yet I think the great similarity shown between many of the individuals allows of reasonable explanation.

The Haemoglobin average of 77.8 per cent is good. The leucocytes, though increased in all the cases except one, are on an average distinctly higher in those cases where ulceration of the larynx is present to give a nidus to extraneous organisms (XL, LVII, LIX, LXXV), or where laryngeal inflammation without ulceration remains untreated by local antiseptic application (LXI).

In the other cases where the increase in leucocytes is less marked the lesions in the larynx comprise no ulceration and one may infer that the breeding ground for micrococci is less suitable.

the treatment referred to in the table comprised such strong antiseptics as formalin, lactic acid phenol and napthol in solution.

Average

Average of leucocytes in the last division (non-ulcerative cases) = 16,180

In the former division (ulcerative cases) = 22,862

In cases of septic infection one expects to find the polymorphonuclear leucocytes in considerable numbers. Thus the average in the ulcerative cases is 68.2 per cent, and in the non-ulcerative 49.6 per cent. In case LVIII the presence of a large vomica is sufficient to account for a high number of leucocytes.

Of cases where a second examination was made, one (LVII) shows a slight further increase in leucocytes, the other (LIX) a reduction. Some improvement took place in both cases. In LVII there is a diminution in the polymorphonuclear leucocytes, and a slight increase in coarsely granular eosinophiles.

Of the other items in the table no special note need be taken here.

In cases LVIII, LX, LXI, XXXIX an increase in basophile cells is present.

Clinically, it is frequently to be noticed that where a serious amount of phthisis laryngea co-exists with phthisis pulmonalis the temperature may keep febrile though the condition of the chest is undoubtedly improving. One can only conclude that the

Phthisis pulmonalis & laryngea

Case.	Hb %	White Corps	Red Corps.	Polym	Coarsely Gran cells	Lymph.	Hyal.	Trans
XL 2 lobes involved. Cavity T 100–104. ulceration of vocal cords.	60	19,625	4,280,000	69	4·7	10·7	10·3	5·3
LVII 2 lobes involved.	85	20,029	4,960,000	69	1	12·2	11·6	6·2
T 100 – 100·8.	4 weeks later. Throat & chest tending to improve							
ulceration of cords	85	24,548	4,640,000	65	2	16·3	9·4	7·3
LVIII Large cavity, tubercular laryngitis improving under treatment no ulceration	80	20,772	4,320,000	52	2·4	10·6	23	12
LIX 2 lobes involved. ulceration of cords C & E.	80	25,088		79	1	5	14	1
		9 weeks later. Throat improving under treatment						
		14,162						
LX 3 lobes involved	80	18,259	5,320,000	44·7	1	21	17	16·3
Tuberculosis of left vocal cords no ulceration	Improving under treatment							

Case	H_2O_2	White Corps	Red Corps	Polym.	Coarsely gran.	Lymph.	Hyal.	Trans.
LXI 2 lobes involved 99°.8–100. Slight involvement of larynx		26.700	6,720,000	56	2	14	22	6
						1 true myeloeyte on blood film		
	no vigorous antiseptic treatment							
XXXIX Swelling of arytenoids & false cords, no ulceration. Debilitated	90	9,500	4,360,000	52	1	19.5	22.5	6
	energetic treatment locally to throat.							
LXXV large dry cavity. 3 lobes involved Throat untreated	70	23,400	5,240,000	77	.2	12	5.8	5.

the condition of
the throat is the cause.

Cases of bronchitic type.

In many cases of this class also one finds extraneous organisms present in large numbers in the sputum. One is not surprised, therefore, to find a considerable leucocytosis in some of the cases in this series (LXIII, LXIV, LXV, LXVI, LXVII, LXXVI).

In others again the leucocytosis is not so large and may be accounted for by the supposition of a less infection together with a certain degree of concentration of the blood (LXII, LXVIII, LXIX, LXXII).

In cases where a differential count was made of the leucocytes only one shows a degree of basophilia (LXVI).

LXII and LXVI show a reduction in the number of leucocytes after treatment, and improvement. The latter shows an increase in the coarsely granular eosinophiles on improvement.

In cases LXIX and LXXVI the polymorphonuclear cells are higher than in the others of this class. In both cases there was difficulty in taking and digesting suitable food, and this may have an effect by keeping the basic forms low, thus making the polymorphs. appear in greater number.

Early

Phthisis of a bronchitic type

Case	Hb %	White Corpx	Red Corpx	Polym.	Coarsely Gran	Lymph	Hyal	Trans.
LXII Extensive 2 cavities, very chronic T100.2 cough & Exp.	60	14,836						
		One month later no fever						
		14,365						
LXIII Advanced unselig C & E. T100 – 101.		20,029						
LXIV Fairly advanced C & E		21.491						
LXV. Very bronchitic & chronic, fairly quiescent		26,706						
LXVI Formerly febrile. 1 apex involved	80	21,486		55·7	·7	12·6	30	1
	Improving							
	3 months later Improving. still bronchitic							
Emphysema C & E	76	20,156	5000.000	68·7	3·3	9	16·7	7·3
LXVII Extensive & Chronic. C & E.	Improving. 80	19,626		67	1	15.	15	2

Case	HbO 2	White Corps	Red Corps	Polym.	Coarse Gran	Lymph.	Hyal	Gran
LXVIII Marked bronchitis. Barrel-shaped chest C & E.	90	13,750	5,840,000	62·7	3	6	12·3	16
LXIX Very bronchitic & extensive involvement. C & E.	90	13,750	5,840,000	72·2	3·8	11·5	8·5	4
LXXII 3 lobes involved	70	15,174	5,720,000	60	2	21	11·3	5·7
LXXVI. 4 lobes involved. C & E Marked bronchitis T 100°6	70	22,660	4,760,000	81	—	13	5 Unidentified 3	·7

Early febrile cases.

As in all the classes the average rate of haemoglobin here is good.

Cases XI and XII where the temperature at first touched 102 and 103 respectively the leucocyte reaction is marked, and the percentage of polymorpho-nuclear corpuscles is higher than in the others of the series, pointing to a septic infection.

Case XII shows the reduction in the number of leucocytes on the improvement of the patient.

None of this class show much basophilia.

Case XIV shows the increase in leucocytes and red cells on improvement. The other items in the count remain much the same, except the coarsely granular eosinophiles which come down from 6 to 2 per cent.

Comparing these cases with those in the early afebrile class, it is interesting to observe, that, as one would expect, the average leucocytosis in the febrile class is higher. Thus the average for the febriles is - - - - - - - - - - - - 19,326
and for the afebrile division - - - - - - 15,232

Early febrile Cases

Cases	Abo.	White Corps	Red Corps.	Polym.	Coarsely Gran.	Lymph.	Hyal.	Trans
XI, 2 lobes affected. T 100-102	80	26,976	5,240,000	76.2	.4	8	10.4	5
		Improved Slightly						
XII 2 lobes	80	25,087		77	4	16	3	—
affected, T. 103,	80	13,555	5,360,000	67.7	1.3	17	11	3
Steady Improvement								
no T. now (a cavity has developed)								
XIII 1 lobe	75	14,297		65	1	22	2	9
affected, T 996-100		Improved no Temp			coarse gran	Bacilli		
XIV 1 lobe	75	10,925	3,400,000	60	6	11	15	8
affected,								
T. 100-101		Improved						
partial staroation, bilated bronchus, or deep seated cavity								
Note In this case Strongly physical signs improved								
the temperature remains very unsteady, examined								
again two months later. Improving, Temp better.								
Still copious expectoration								
	75	17,265	5,040,000	60.3	2	19	12.7	6

Early afebrile cases.

It will be noticed that here again the average percentage of haemoglobin is distinctly good. The number of leucocytes, with four exceptions, is not very high. It may reasonably be supposed that in these exceptions some other organism besides the tubercle bacillus may have an influence. In many cases which show a normal, or reduced, or even increased number of leucocytes there is a tendency to an increase of white cells on improvement.

The converse also is to be frequently noticed; that where a leucocytosis is present a decrease in leucocytes may occur as the patient improves. The red cells if low in amount tend to increase. This fact has been noted by Claudi and Zaky in their paper previously referred to.

In cases VI, VII and VIII this diminution in leucocytes after treatment will be noticed.

Case VII shows the increase in the red cells. In these three cases it will also be observed that the percentage of polymorphonuclear corpuscles diminishes with improvement, suggesting a lessening in the effect of the septic organisms which caused the initial reaction.

The same authorities found in such cases

that

that the percentage of haemoglobin increased in cases which improved. This does take place in cases VI and X, and no doubt might be perceptible in the others if the rate were not already high at the first observation.

Case X shows the other alternative for here the leucocytosis is high at the start and goes higher on the patient showing decided improvement. In this case too the polymorphonuclears reduce in favour of the basophile cells.

As regards an increase in basophile cells this is present in cases VII and XIX and the tendency is towards an increase in these cells with improvement in the condition of the lungs. This will be referred to again under "Conclusions".

Cases VI and VIII show the increase in coarsely granular eosinophile cells on improvement - also mentioned by Claudi and Zaky.

Early Afebrile Cases. All improved except those specially noted

Case	Hb	White Corps	Red Corps	Polym	Coarsely Gran	Lymph	Hyal	Trans.
I 2 lobes affected		17,800						
II 2 lobes affected		18,343						
III 1 lobe affected		15,731		68	2	24	6	—
IV 1 lobe affected	90	11,927		60	2	15	15	8
V 1 lobe affd	95.	10,520.		59	2	21	5	13
VI 1 lobe affd	85.	15,781		82	1.5	6.5	3.5	7
6 weeks later — improving	90	10,480	5,480,000	69	·7	17.3	10	3
VII 2 lobes affected Early	80	11,734	4,000,000	65	2	6	18	19
6 weeks later improving	80	10,005	5,920,000	45.8	2	4	24.5	8.2
VIII 2 lobes affected	70	19,220		72	—	19	9	·5
3 months later not much improved	70	13,353	4,450.000	70	2	14	10.5	3.5

Cases	H_2O	White corps	Red corps	Polym	Coarsely Gram	Lymph	Eyel	Trans
XIX 2 lobes affected C & E. no great improvement	95	15,000	5,520,000	50	6	9.8	17.1	17.1
X 1 lobe affected C & E.	60	21.848	6,520,000	66.3	2.1	5.3	10	16.3
7 wks Later Improving	65	26,167	6,120,000	50.3	1.7	17.7	20	10.3
XX 2 lobes affected. C & E under treatment before Admission	60	13,150	6,000,000	68.3	.4	14	13	1.3
XXII 2 lobes affected. Has been under treatment outside Hospital	90	13,555	6,600,000	68	2.7	20.3	7	2
XXIII 1½ lobes affected. Improving before admission	80	10,135	6,440,000	47	1.5	20	26.5	5
XXIV 1 apex affected C & E	70	11,330	5,640,000	70.4	.7	14.3	11.3	3.3

More advanced cases – Cavitation in many.

In this series the rate of haemoglobin is good with two exceptions (XLVIII and XLIX). In both of these the haemoglobin increased as the patients got better. The leucocytes are markedly increased in cases XLVII, XLIX and LI. In the last two the rise is in all constituents, and in the first in basophiles. All these three cases have cavitation and expectoration.

In XLVI, XLVII and LIV the basic-staining corpuscles are increased.

The gradual rise in leucocytes under treatment is exemplified by cases XLI, XLIV, XLVIII, LII and LVI.

Cases XLVIII and LVI show also an increase in red cells on second examination; XLIV, XLVIII and XLIX show the increase of haemoglobin on improvement.

In cases LVI and XLVIII the rise on improvement is in basophiles, while in XLIV it is in eosinophile polymorphonuclears. Case LVI illustrates the increase in the coarsely granular eosinophiles on improvement.

Older standing more advanced cases

In many cases cavitation

Cases	Hb %	White corps	Red corps	Polym.	Coarsely Gran.	Lymph.	Eosph.	Trans.
XLI small cavity scattered areas ex ? (febroid) much Improved		11,127						
		16,590		60		12	14	13.5
								Coarse trans. .5
			Left much improved					
XLII dry cavity 2 lobes affected fairly quiescent Occasionally 99°4. Wavy Pulse Left Improved	75	15,578	4,840,000	66.8	2	6.8	11.8	12.6
XLIII 2 lobes affected. frequent pleurisies. occasion fever.	80.	10,116						
			Unimproved					
XLIV 2 lobes affected. Cavity.	80	9,981		67.4	1.2	15.2	14.2	11.6
						Coarse Basso		.4
2 months Later Improving	85	11,937	5,160,000	61.5	1.5	22.7	10.3	4
XLV 2 lobes affected ? retain	85	14,868	5,000,000	59	2.5	25	11	4
						Impeloeyte		.5.

Cases	HbO_2	White corps	Red Corps	Polym.	Coarsely Gran.	Lymph.	Hyal.	Trans.
XLVI One lobe affected, Cavity	80	15,916	4,600,000	50	4	17	19	6
		Improving				Myelocytes		4
XLVII 2 lobes affected, Cavity C&E, advanced	80	20,024	4,840,000	53	1	17	19	10
XLVIII 2 lobes affected, old standing.	45	13,960	4,400,000	65.7	2	12.7	14	5.6
5 weeks later Improving	60	18,343	4,480,000	44	1	26.5	22.5	6
XLIX 2 lobes affected, cavity C&E.	50	21,850	5,900,000	66.3	2	9	12.7	10
6 weeks later some Improvement	70							
XL 2 lobes affected, moist cavity, C&E. T 99.4	85	10,922	4,440,000	58	3.5	16.7	16.1	5.7
LI 3 lobes affected, cavity C&E.	70	29,404	5,800,000	75.3	1	6.6	8.5	8.6

Cases	HbO$_2$	White Corps	Red Corps	Polym	Coarse grans	Lymph	Hyal	Trans
LII 2 lobes affected, cavity, general condition very good Improving previously	80	9,441	5,600,000	66	3	15	11	5
		18,613	3 weeks later Improving					
LIII 2 lobes affected, cavity very chronic, Improved before Admission	85	11,734	4,960,000	57	1.5	21	12.5	6
LIV 2 lobes affected. cavity. c&e.	85	18,612	6,040,000	55	3	22.5	15	4.5
LV 2 lobes affected, c&e very chronic	75	17,602		74	1	7.5	11.5	4.5
						Coarse basophile ·5,		
	Improving							
LVI 3 lobes affected, cavity c&e dyspeptic	80,	15.174.	4,200.000	72	1	5	15	7
	80	20,502	6,480,000	68	2.4	11.6	12.8	5.2

Improving Cavity drier.

Advanced febrile cases.

One is struck on glancing at the table of cases of this class by the comparatively low rate of leucocytosis in most, especially as one might reasonably expect that septic organisms had obtained an entrance and were active in the extensive and devitalised lesions. This may, however, be again explained by the tissues having become accustomed to the infection, and having ceased to react; as suggested under "Advanced afebrile cases".

Cases XXVII and XXIX show the decrease of leucocytes with improvement, while XXXVI shows the increase of leucocytes and fall of polymorphonuclear leucocytes also on improvement. This case also shows the increase in coarsely granular eosinophiles.

Case XXXII is of interest because of the general nature of the disease. The lesions were confirmed by autopsy. It is rather striking that the haemoglobin is not lower and that the red corpuscles are found to be in such numbers. The only appreciable difference shown in the subsequent examination is the rise in polymorphonuclear forms of leucocytes.

Cases XXIV and XXIX show some increase in basophile forms.

It will

It will be remembered that Appelbaum finds an increase in polymorphonuclear cells in this type of case. This is approached in my series of this class, where the average of polymorphonuclear corpuscles is 68.3 per cent. as opposed to 62.7 in the "Advanced afebrile Class."

Advanced Febrile Cases

Cases	Hb %	White Corps	Red Corps	Polym.	Coarsely Gran	Lymph.	Hyal	Trans
XXIII Extensive T 100 – 101 copious C & E.		11,330						
		Died some months later						
XXIV Advanced worst cavity C & E, T 100–101		12,139		52	1	40	7	
		Left with advancing disease						
XXV 2 lobes affected, very advanced, T 102	70	13,145		71	2·4	20	3·3	3·3
		Some improvement later						
XXVI Very advanced worst cavity T 100–101, C & E		11,286						
		Miliary tuberculosis of genital. Lost ground						
XXVII 3 lobes affected, C & E T 100 – 100°-8	80	14,297		79	4·5	10	4	·5
		Five months later Improving,				True hyaline casts		
		13,150	3,600,000					2%
XXIX Both lungs affected, cavity worst, C & E Albuminuria, T 100	80	14,082	4,120,000	57·5	3	20	15	4
					Coarsely gran Basophilic ·5%			
		11,127	4,644,000.	Five months later Improving				
		Albuminuria increasing						

Cases	Hb	White Corps	Red Corps	Polym.	Coarsely Gran.	Lymph.	Hyal.	Trans.
XXX. Both sides affected, extensive cavity. C & E T 99-8-101	80	14,027		63	1	4	10.5	21.5
		Left very bad						
XXXI 3 lobes affected, moist cavity. C & E T 99.6-100	80	14,769		72	2	2.7	4.7	18.3
						Trachyelocyte		.3
		Left unimproved						
XXXII. Disseminated tubercle of lungs. (Cavities), Kidneys & meninges	60	14,972	5,000,000	42	2.8	8	11.2	6
		10 days later, almost comatosed. Incontinence of urine & faeces.						
T. 102, C & E	60	14,970	5,000,000	81	—	4.7	6	8.3
XXXIII 3 lobes involved. C & E T. 100.	70	18,613	5,120,000	70.5	1.5	14.5	11.5	2
			Improvement					
XXXIV 3 lobes involved, C & E T 100-100.8		14,114						
			Some Improvement					

Cases	H_2O	White Corps	Red Corps	Polym.	Coarsely Gran	Lymph.	Hyal.	Gran
XXXV 3 lobes involved, moist cavity. T. 99–101. e&E	70	15,174	6,250,000	74.7	1.7	11.3	8.8	3.5
		Perhaps some Improvement						
XXXVI 2 lobes involved T. 99–100	65	19,018	5,400,000	73.6	1	11	11.4	2.8
				coarsely granular Basophile 2%				
		Five weeks later. Slight Improvement						
Less Temp	65	23,065	5,080,000	62.3	2.3	23.7	9.7	2
LVII 2 lobes e&E. Temp 100–101	90	15,073	6,450,000	66.4	2	7	11	13.6
		Improving						
XXVIII Very advanced, great emaciation, very near end. T 100–101 e&E		15.645	4.769.000					
		No Improvement						

Advanced afebrile cases.

In none of the cases in this series except one is the initial leucocytic count very high. This is rather contrary to what one would expect, namely, that in cases with much involvement and of some duration organisms of sepsis would have entered and set up a reaction in a body, the general condition of which is impaired. It may be, however, that the tissues have become accustomed to the presence of these organisms and have ceased to react.

In Case XVII the reaction referred to under "Early afebrile cases" is well illustrated. Beginning with leucocytes 8,902, the number gradually progressed to 12,948, and finally 16,590 six weeks later. The red cells also increase from 4,240,000 to 5,920,000 and the polymorphs. reduce from 86 per cent. to 67.3 per cent. This case also shows a slight increase in coarsely granular eosophiles on improvement.

Case XV is of interest because of the large number of coarsely granular eosinophile cells. This case has two large cavities and the expectoration is profuse. The digestion was good and the menses were not present at the time of the blood examination, and there was no history of recent haemoptisis or asthma. One is therefore inclined to favour Cabot's explana-

tion

tion of an auto-inoculation with tuberculin manufactured in the cavities, as the cause of this remarkable rise.

Cases XVIII and XXXVIII show some basophilia.

Advanced Afebrile

Cases	Hb %	White Corp	Red Corps	Polym	Coarsely Grans	Lymph	Hyal	Grans
XV Both sides affected, 2 cavities C & Q.	90	14,639	5,620,000	54·5	13	9·5	20	2·5
							Coarse grans Basophile 5	
		Eventually Improved						
XVI Both sides exclusively affected moist cavity very chronic	85	14,769	3,880,000	63	—	8	19	10.
XVII Both sides 1 fairly dry cavity	85	8,902	4,240,000	86	—	4	5	5
	14 days later	12,948						
Improving 1 month + 14 days later.								
No C or Q.	85	16,590	5,920,000	67.3	·4	12	15	5·3
XVIII Advanced 2 moist cavities C & Q. Heart displaced by fraction	70	12,678		54	1	12	25	8
		Left Improved						
XIX 4 lobes affected very advanced.	80	13,757	5,560,000	66	1	13·7	14·3	5
		Slight Improvement later						

Cases	Hb %	White Corps	Red Corps	Polym	Coarse Gran	Lymph	Hyal	Trans.
XX 3 lobes affected, cavity fairly dry	80	16,725						
		Left Improved						
XXI 3 lobes affected c+s	80	19,018	6,000,000	62·8	1·2	6·8	12·4	16·8
		Improved later*						
XXII 4 lobes affected, c+s albumenuria	65	11,532	5,120,000	71·6	1·3	4·7	10·7	11·7
XXXVIII 1 apex affected, some E	70	7.638	6,160.000	43·7	1·3	45.	36·7	3

General Conclusions.

1. In the majority of cases of phthisis of all stages the rate of haemoglobin is surprisingly high. Of those examined 85.7 per cent had 70 per cent or more of haemoglobin. In a few cases, however, of both early and advanced disease it is lowered. The proportion under 70 per cent in my series is 14.3 in the hundred.

If the percentage is low at first it will increase as the patient improves under treatment.

2. The red corpuscles are generally present in good amount, sometimes in abnormally high amount. Thus the cases with red cells numbering 5,000,000 or more make 61.5 per cent in those examined in my series of all stages, while those with red cells below 5,000,000 number 38.5 per cent of the whole.

It is to be noted that these numbers are attained by the production of many immature and ill-formed corpuscles, as has been noted by Cabot. I did not find poikilocytotic forms present, or nucleated red cells.

3. Frequently the red corpuscles increase as the disease gets better.

4. In the majority of cases of phthisis there

is

is present at some stage of their history a variable increase in the leucocytes. This leucocytosis I believe to be of two kinds –

(a) A polymorphonuclear increase where the entrance of septic organisms calls forth resistance.

(b) A basophile increase accompanying improvement under appropriate treatment, with plentiful nitrogenous diet and hygienic surroundings.

Both forms of leucocytosis are desirable. The first because it shows that the system is resisting the mixed infection. The second, because it indicates that the blood and the body generally are responding to treatment. The first form is usually the higher in numbers. I believe, further, that these two forms of leucocytosis may co-exist or follow one another; that is the basophile increase follow a polymorphonuclear increase.

It has been pointed out that the polymorphonuclear cells decrease in favour of the basophile in certain of the cases showing improvement. In such cases I believe that this change from a polymorph. leucocytosis to a basophile leucocytosis was taking place.

It has also been noted that the leucocytes in some cases were found to increase on improvement,

and

and in others to decrease.

On looking into the two groups of cases we find that when the leucocytes increased after a period of treatment the initial count, in the majority, was not very high. On the other hand, in those cases where the leucocytosis diminished, the first count was fairly high in every case. One is therefore led to conclude that the leucocytes increase when their aid is needed, and gradually diminish when the demand is less urgent.

No doubt the change from a polymorphonuclear increase, which is fairly high, to one of basophiles, which is not quite so high, accounts in part for the fall. This may also explain why certain observers have recorded an increase in leucocytosis, and others a decrease under treatment with improvement.

Of the cases examined immediately on admission, 69.2 per cent showed no basophilia, while those showing basophilia numbered 30.8 per cent.

Of those examined after varying periods of treatment, 40 per cent showed some degree of basophilia.

In addition to this number many showed an increase in basophile cells not marked enough to be classified with the last-named 40 per cent. In this category must be placed many of those cases which

showed

showed a normal or increased number of polymorphonuclear forms at first, due to septic infection, and which were found to have a diminished number of polymorphs. when the patient had been improving some time. The overcoming of the mixed infection, no doubt, largely contributing to the general progress.

Of the cases which showed a basophile reaction after treatment and were resident in hospital long enough for an opinion of their pregress to be formed; 81.2 per cent made good progress, while 18.8 per cent were doubtfully improved.

From these facts I conclude that a basophile reaction is of good prognostic importance.

5. Myelocytes were found in small numbers in 9.4 per cent of the cases examined.

6. In certain cases the coarsely granular eosinophiles increase as the patient progresses.

7. It must be remembered that the concentration of the blood, which is probably present in the greater number of cases of phthisis at all extensive or old standing, must exercise a decided influence in producing the apparently high number of corpuscles and haemoglobin which are found in so many cases, and must thus make the leucocytosis appear larger than it is.

Finally, I should like to add that the variations in any given class of case are very wide and make conclusions difficult to draw. For this reason I have thought it better to confine myself to general conclusions, and not to attempt to lay down definite laws for the different classes of the disease, further than has been done as each section was discussed.