

REPORT

OF THE

MUNICIPAL COMMISSIONER

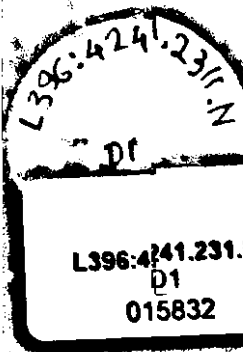
ON

THE PLAGUE IN BOMBAY

FOR THE YEAR ENDING 31ST MAY 1900.

Part I.—General Administration.

Part II.—Hospitals (Public & Private.)



Bombay:
PRINTED AT THE "TIMES OF INDIA" PRESS.

1901.

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No. OF 190

FROM

W. L. HARVEY, Esq., I.C.S.,
Municipal Commissioner for the City of Bombay,

TO

THE UNDER SECRETARY TO GOVERNMENT,
General Department (Plague).

MUNICIPAL COMMISSIONER'S OFFICE,
BOMBAY, *December 1900.*

SIR,

I have the honour to forward herewith the Report on Plague Operations in Bombay during the year ending 31st May 1900.

2. Mr. J. H. DuBoulay, I.C.S., was in charge of general plague operations throughout the year, and Col. Wilkins, D. S. O., exercised control over all hospitals and camps from the time of his return to plague duty in September 1899 till the end of the year. In forwarding their last Annual Report I brought to the notice of Government the very valuable services rendered by these officers, and it only remains for me to add that during the period under report their duties were carried out with the utmost tact, zeal and ability. Mr. DuBoulay has now proceeded on furlough and Col. Wilkins has reverted on promotion to the Military Department, and while the loss to plague administration is a severe one, the admirable state of efficiency in which these officers left the departments subordinate to them has rendered the task of their successors lighter than it might otherwise have been.

3. The services rendered by the Staff Corps Officers in charge of Districts were maintained at the same high standard as before and the ease with which they adapt themselves to this class of work, requiring as it does, tact, sympathy with the people and withal firmness, demonstrates their peculiar suitability for it. Many of our most experienced officers have been withdrawn owing to the exigencies of Military duty, and their services have been separately acknowledged by Government; of the others who have served for the greater part of the year I would specially mention Captain Pritchard and Lieutenants Dagleish and Browne, as deserving the commendation of Government for their excellent work. The constant changes among District Officers detailed in paragraphs 1—3 of the Report undoubtedly interfered with the efficiency

of the administration, and I may be allowed to express a hope that during the coming season it will not be necessary to make so many transfers. However able and zealous a new officer may be he requires time to obtain the confidence of the people in his charge, and until he obtains this he cannot effect much.

- * 1 Dr. K. B. Shroff, Deputy Health Officer.
- 2 " Britto.
- 3 " Fazal Ahmed.
- 4 " R. V. Patel.
- 5 " Dady Burjor.
- 6 " Bardi.
- 7 " Matthal.
- 8 " Kapadia.
- 9 " Pedneker.
- 10 " Munshi.
- 11 " Contractor.
- 12 " Jayakar.
- 13 Mr. Guider.

4. The staff subordinate to the District Officers have carried out their duties to my entire satisfaction. Among the Sectional Medical Officers I would specially mention those noted in the margin* as having been very successful in the performance of the work assigned to them.

I have the honour to be,

Sir,

Your most obedient Servant,

W. L. HARVEY,

Municipal Commissioner

for the City of Bombay.

APPENDIX No. I.

A paper on Professor Lustig's Curative Plague Serum.

A paper was read at a meeting of the "Bombay Medical Union" on the 21st of April, 1900, by Dr. A. Mayr, of the Municipal Laboratory, Parel. Sir Bhalchandra Krishna occupied the chair. The following is the substance of the paper :—

Two years ago Mr. W. M. Haffkine, Sc. D., C.I.E., expounded in this hall the facts relating to the efficacy of the preventive treatment of plague to the Medical Profession of Bombay in order to enable them to form their own opinion on the subject; to-day I ask your permission to do the same with regard to the curative treatment, the experimental stage of which—I am glad to say—has been brought to a successful termination.

The treatment with Professor Lustig's curative plague serum, in the manufacture of which Dr. G. Polverini and myself are engaged at present, was commenced at the Arthur Road Hospital in March 1898, under the direction of Khan Bahadur Dr. N. H. Choksy, the Medical Officer in charge, to whom the application of the serum was entrusted and is still being continued there. Till May 1899, the patients were selected for treatment; since then they are taken alternately as they are admitted. The clinical selection, which recommended itself naturally to the physician, has come in for much adverse criticism, and the results obtained by it have been questioned. It is not my intention here to vindicate the selection; the reasons which prompted it in the beginning have been laid down fully in a report to the Municipal Commissioner. What I am tempted to say here is, that many disappointments which followed the announcement of curative results in other diseases and have discredited serotherapy would have been avoided, if exhaustive clinical investigation had preceded the statistical conclusions. The clinical investigation gives us the only possible means to fix approximately the minimum number of observations which is necessary in order to eliminate essential errors of subsequent statistics. I may be allowed to quote a medical paper on the subject. Writing on the results of the serum treatment of diphtheria the *British Physician* says: "When a procedure of a theory is on its trial, selection, with the view not of emphasising its advantages, but simply of giving it a fair trial by excluding, disturbing and antagonising influences, is justifiable, indeed necessary, since such factors tend to obscure the main issue."

The guiding principles of selection were two: exclusion of patients of the later days of disease, and of moribund and mild cases. No undue advantage accrued to the serum treatment from this selection, as the patients of the earlier days show the highest mortality in hospitals, whereas the exclusion of moribunds was irrelevant, their place being taken, not by mild cases, but by such, as would have died later on under the ordinary treatment. Sudden changes for the worse being so common in plague there were not seldom errors of prognosis; in fact, the selected cases showed 15 per cent. deaths within the first 24 hours. But before entering into statistical details of the hospital, I may be permitted to give some particulars regarding the manufacture of the serum.

The axioms of serotherapy are well known to us all. By injecting suitable animals with substances of bacterial origin we are able to confer immunity upon them. The carrier of the immunity is the blood serum which possesses often immunising and also curative properties. The immunising substance used for the manufacture of Professor Lustig's curative plague serum is prepared in the following way: plague bacilli are cultivated in large dishes on a solid culture medium on which they form

a thin layer. The microbes are then scraped off from the surface of the culture medium and dissolved in caustic potash whereby they are killed and completely disintegrated. By neutralisation with acid, the immunising substance, a so-called nucleoproteid is precipitated in large white flakes. The proteid is then dissolved in carbonate of soda and used for the immunisation of horses. After 6 or 7 immunising injections the horses are bled and their serum is used for treatment.

During the time of selection, 403 patients were treated with the serum at the Arthur Road Hospital, 154 of whom recovered, the rate of recovery being 38·2 per cent., 1,190 cases were under the ordinary treatment and had 233 recoveries or a rate of 19·5 per cent. If we compare these figures we see that the serum gave twice as many recoveries as the ordinary treatment. The increase can only be credited to the serum, if it was not due to the selection. To investigate this we have two means: first, comparison of the recovery rate of the non-serum patients with that of the Arthur Road Hospital at a time when the serum was not used, and, secondly, comparison with that of other hospitals. No serum was available during the inter-epidemic months of November and December, 1898, and January, 1899. The admissions were 273 with 51 recoveries or 18·6 per cent., being even less than in the non-serum patients of the serum period. The Mahratta and Modikhana Hospitals had 4,762 admissions from February, 1898, till June, 1899, the 3 abovementioned months being excluded. The recoveries were 941 or 19·7 per cent. The selection has, therefore, not lowered the recovery-rate of the non-serum patients at the Arthur Road Hospital, and the increase on the serum side is real, and must be attributed to the serum. The crucial test for its efficacy is given by the higher total recovery-rate of the Arthur Road Hospital, when compared with that of the two other hospitals. The Mahratta and Modikhana Hospitals had a recovery-rate of 19·76 per cent. in 4,762 patients, and the Arthur Road Hospital a rate of 24·29 per cent. in a total of 1,593 patients. The increase is 4·5 per cent. in favour of the latter, although only one-fourth of all the patients received specific treatment.

That the increase of the recovery-rate at the Arthur Road Hospital was due to the serum is made evident also by the following figures: From February to November, 1898, the serum was used during the height of the epidemic and during its recrudescence; the total admissions were 663 with 186 recoveries or 28 per cent. From October, 1898, till February, 1899, during the inter-epidemic months no serum was available. The admissions were 273 with 51 recoveries or 18·6 per cent. From January to June, 1899, during the worst epidemic Bombay has gone through, the serum was again used. The admissions were 930 with 201 recoveries or 21·6 per cent. The total recovery-rate was therefore higher in both the serum periods than in the intermediate period, although, considering the epidemiological conditions the contrary might have been expected.

That the higher total recovery-rate at the Arthur Road Hospital during the serum periods was due to the treatment, and not to other influences, is further proved by the fact that the rate increased in the months of the beginning of the treatment in spite of the rising epidemic. The rising of the epidemic can be demonstrated by the increase of the mortality in the whole City of Bombay and in the Maratha Hospital in the corresponding months. The City of Bombay shows a mortality of 94·5 per cent. in February 1898, rising to 100 per cent. in March, and of 84·7 per cent. in January 1899, rising to 87·4 per cent. in February. The Maratha Hospital had a mortality of 81·2 per cent. in February 1898, rising to 87·8 per cent. in March, and of 80·5 per cent. in January 1899, rising to 83·5 per cent. in February. The Arthur Road Hospital on the contrary had a mortality of 78 per cent. in February 1898, falling to 75·1 per cent. in March, and of 83·7 per cent. in January 1899, falling to 79·3 per cent. in February,

The influence of the serum treatment showed itself not only in the saving of life but also in the prolongation of life in patients who eventually died. The prolongation of life is proved by the reduction of the total deaths within the first 48 hours after admission, which amounts to 8 per cent., the corresponding figures being 57 per cent. for the intermediate period and 49 per cent. for the whole serum period.

The demonstration for the time of the alternative treatment is simple. From April, 1899, to April of this year, 361 patients received specific treatment and had 122 recoveries or a rate of 33·8 per cent. An equal number was under the ordinary treatment and had 77 recoveries or 21·3 per cent. The recovery-rate on the serum side shows, therefore, an absolute increase of 12·5 per cent. It might properly be objected—and that is one of the drawbacks of the alternative method—that the evidence is not conclusive; if it cannot be shown that the total recovery-rate at the Arthur Road Hospital was higher than in other hospitals. In order to compare the total recovery-rate of the Arthur Road Hospital with that of other hospitals we have to add to the 722 cases treated alternately, 36 cases with only 5 recoveries in which cases the diagnosis could not be made in time to take them for the alternate treatment. (Only such cases were dealt with which under diagnosis showed undoubted symptoms of plague.) The total admissions stand thus at 758 with 204 recoveries, the rate being 26·9 per cent.

The Maratha Hospital had 2,131 admissions with 455 recoveries, the rate being 21·35 per cent., almost identical with the rate of the non-serum patients of the Arthur Road Hospital. The total recovery-rate at the Arthur Road Hospital was, therefore, in the same proportion, higher than that of the other hospital, as the difference of 12·5 per cent. between serum and non-serum cases lead to expect. As the Maratha Hospital had 3,378 admissions with 646 recoveries or 19·1 per cent. during the time of selection the figures for the whole time of the serum treatment stand thus: 5,509 admissions with 1,101 recoveries or 19·9 per cent. at the Maratha Hospital and 2,351 admissions with 591 recoveries or 25 per cent. at the Arthur Road Hospital. The Arthur Road Hospital gave therefore 5 per cent. more chances of recovery since the beginning of the serum treatment, although only one-third of the patients received it. The patients of the Arthur Road Hospital belonging almost exclusively to the lowest castes have, moreover, less individual resistance than the Marathas.

Although the concurrence of all this evidence pointing to one conclusion is sufficient to put the efficacy of the serum beyond any reasonable doubt, I will not omit to mention another fact which was conclusive to the experimenters themselves, at a time when statistics were not available. I refer to the marked difference in the curative results obtained by sera derived from different horses. Whereas the serum of horse No. 1 immunised in Italy gave 27 per cent. recoveries in 90 treated patients, the three other horses, also immunised in Italy, gave 53 per cent. in 155 treated cases. Similar differences are observed in the results obtained by the sera prepared here. Thus, the serum of horse No. 1, gave 34 recoveries in 122 patients, and the serum of horse No. 4, gave 51 recoveries in 125 patients. The differences are so remarkable that they cannot be due to the chances of distribution, but must be explained by a varying degree of efficacy. I do not think it necessary to add more to the above. There is material enough for an unbiassed mind to form a judgment upon, and I now pass on to the application of the serum and to the clinical features of the treatment.

First of all I should like to state emphatically that the serum is perfectly innocuous even in larger doses than are needed for treatment. There seems to exist a superstitious fear of the serum, which is warranted neither by our experience

nor by that of serotherapy generally. The curative plague serum has moreover been tried in other diseases and also on healthy beings without causing any inconvenience.

The serum is usually injected under the skin once or twice a day. The single dose for an adult is from 20 to 60 c. c., for children about the half. The injections do not cause special pain and no local irritation or abscesses if the syringe is kept septicly clean, and the skin is well disinfected. The effect of an injection becomes manifest within 12 hours. The temperature either does not rise, or falls distinctly, the arterial pressure is increased, the delirium subsides, the bubo is less tender and diminishes sometimes considerably. Improvement after the first injection is generally observable, although it may not be progressive. This latter cannot be surprising if we consider the probable mode of action of the remedy. The serum induces a reaction in the tissues of the body, stimulating them to the production of bactericidal or antitoxic substances by which the infection is overcome, or its poison neutralised. Against degenerative changes which may have been already established in different organs, principally in the heart, before the patient comes under treatment, the serum is powerless. The gravity of such degenerations is determined by three factors: the virulence of infection; the time since the beginning of the infection; and the individual resistance. As we can neither diminish the virulence nor increase the resistance, we must try to shorten the time, that is, we must resort to the treatment as early as possible. This is a point that cannot be emphasised too strongly. The earliest treatment is essential for the cure of a disease which leads to death usually within 4 days and sets up irreparable changes in the heart within 24 hours and even less. No time should be lost as every hour's delay may prove fatal, especially as the serum itself needs some time to develop its action. Fortunately the diagnosis of plague in times of epidemic is so easy that in 90 per cent. of cases it might be made by a layman.

Also symptomatic treatment has not to be neglected. The judicious use of alcoholic stimulants and cardiac remedies when the heart shows signs of impending failure, or cold sponging when the fever is very high, will prove of great value.

The quality of the pulse, as an index of the condition of the heart is chiefly of importance for the prognosis of patients treated with the serum. However alarming the other symptoms may be, so long as the pulse can be felt well and is not too frequent (*i. e.*, over 140) and soft, there is always the possibility of recovery. Certainly also in such cases collapse and death may follow very soon after injection. Such coincidence is not to be wondered at if we remember how often unexpected sudden changes for the worse occur in plague. If the pulse be almost imperceptible very soft, and frequent, or intermittent then even serum treatment is of no avail and had better be abandoned. There are limits for every remedy and the experienced physician ought to know and to respect them.

The best results are obtained in the forms of plague in which recovery by nature is more frequent, as in simple bubonic plague. Also septicæmic forms can be cured if they are treated on the first day. No results have been obtained in plague pneumonia. Too few cases have been treated to form a definite opinion whether this worst type of plague infection is accessible to cure or not. As regards class it can be said with certainty that children give the best results, no doubt because the resistance of the heart is greater than in adults.

The observations outside the hospital which interest practitioners most, are but scanty. Thirty-two cases have been treated and recorded. Nineteen of them recovered. The cases were without exception very severe, and the majority of them far advanced, as the public seems to look upon the serum as the last resource to be

tried when all others have failed. Although the number is too small for general conclusions the favourable influence of better conditions of life is unmistakable. It is to be hoped that in the future the serum will have an extensive trial in private practice where it will show to full advantage.

I have but few more remarks to make and they bear on the future of the serum-treatment of plague. Going over its history in this City, and recollecting the exaggerated expectations with which Dr. Yersin was received in 1897, I should not be surprised to hear some one exclaim: Only twelve per cent. ! That is nothing to speak of ! There is no arguing with such a cold-blooded arithmetician. Twelve per cent. is a handsome profit in business ; should it be otherwise where human life is concerned ? Let him ask the twelve per cent. who owe life and health to the serum, if they agree with him, or let him go to our plague hospitals and look at the poor plague-stricken inmates and he may perhaps begin to wonder that even one per cent. could be saved by human intervention. Would he not change his views if he or his family or friends were threatened ? And if we are to adopt Mr. W. M. Haffkine's statistical method of calculating the benefit of plague prevention, the serum shows an increase of fifty-eight per cent. on the actual recovery rate by ordinary treatment. In other words for every hundred who recover by ordinary treatment a hundred and fifty-eight recover by serum treatment. The serum cures one-third and nature but one-fifth of those attacked. Is that not worth while ?

It would be just as great an error to rely entirely upon the curative serum and neglect the prophylaxis. In such a rapid and deadly disease prevention will always be safer than cure. No one would be careless in handling fire just because there was a fire-engine round the corner.

The question whether no improvement is possible, deserves full consideration. I can answer confidently that improvement is certain, the results of the past having been obtained under the most unfavourable conditions.

The serum was on its trial ; the laws how to prepare it best have yet to be laid down ; sera of inferior quality had to be used ; the mode of application to be studied ; while, on the other hand, there were patients of the lowest castes, with little natural resistance and in an advanced stage of disease—only nine per cent. being patients of the first day—ill-fed ; weakened by previous illness, not seldom simultaneously suffering from complications, such as relapsing fever, malaria, phthisis, or infection by cocci—a multitude of "factors tending to obscure the main issue."

If we now ask what are the best results we may hope for, we have to distinguish treatment in hospitals from treatment in private practice. There are unfavorable conditions inherent in the treatment in hospitals which we have to reckon with. As long as patients do not avail themselves at the earliest date of the advantages the hospital offers them, the best results will be an increase of the recovery-rate from 20 per cent. to 50 per cent. This increase has already been obtained with the best serum and it will be obtained again, since the regular manufacture of a serum of highest activity is merely a question of time and further experience. The prospects of the serum treatment must not therefore be judged by the average result obtained, but by the best results. If the serum be prepared on a larger scale it will, moreover, be possible to discard the use of inferior sera.

That a further increase cannot be obtained in our large hospitals even with the most active serum, I am led to believe by the following considerations :—

Fifty per cent., and sometimes more, of the patients admitted into the large hospitals die within 48 hours after admission. It is certainly not an accidental coincidence that out of the 51 series, in which the treated cases are divided according to the different bleedings of every horse, only one shows a recovery rate considerably above fifty per cent. But the cases were only twelve and the epidemic declining.

The percentage of patients which in the ordinary course dies within 48 hours after admission, could not be saved even with the best serum. The fate of these patients is unalterable at the moment they reach the hospital, they are *morituri*—doomed to die. The reduction of a mortality of 80 per cent. to the insignificant figure which was demanded by those who were ignorant of the clinical features of plague is impossible in hospitals. It remains to be seen if the intravenous injections of the serum which could be made only occasionally, owing to the pressure of work, or a serum of still higher activity, or the excision of solitary buboes in suitable cases, or the combination with some drug treatment, will increase the recovery-rate still further, thus proving my views to be erroneous. The above makes it clear that the limits of the efficacy are not determined by the remedy, but by circumstances of the hospital. In private practice, where no such limitations exist, and the greater individual resistance is a potent factor in aid of the treatment the efficacy of a strong serum will be almost unlimited and in direct proportion to promptitude with which the diagnosis is established and the treatment inaugurated. Grave responsibility devolves for this reason upon the physician who in times of plague loses precious hours musing over all possible improbabilities to which a tender bubo is due!

I must not be misunderstood.

The day may still be far ahead when, owing to the serum treatment, plague will have lost some of its terrors. Death does not give up its prey so readily.

But we are on the right path, we see the goal for which to strive with patient confidence.

That has been fully realised by Lient.-Col. T. S. Wilkins, D.S. O., I. M. S., Special Medical Officer, Plague Operations, who took great interest and pains in watching personally the progress of the experiments at the Arthur Road Hospital. He wrote as far back as June, 1899, to the Municipal Commissioner: "I personally am of the opinion that the manufacture of this serum should be continued as long as the results are hopeful, which they decidedly are, or until some other more potent remedy is found to act on this most fatal disease."

APPENDIX No. **II.**

FROM

G. POLVERINI, M. D.,

OFFICER IN CHARGE, MUNICIPAL LABORATORY,

PAREL.

To

THE MUNICIPAL COMMISSIONER FOR THE CITY OF BOMBAY

THROUGH THE HEALTH OFFICER,
BOMBAY MUNICIPALITY.

MUNICIPAL LABORATORY, PAREL,

17th November 1899.

SIR,

I have the honour to submit a report on the experiments carried out on behalf of the Bombay Municipality from the 12th of March 1898 to the 31st of May 1899 with Prof. Lustig's curative plague serum in hospitals, and also in private practice in Bombay. In the preparation of this Report I had the advantage of the valuable collaboration of Dr. A. Mayr, at present assisting me in the manufacture of the serum. I also attach herewith a report from Veterinary Surgeon S. N. Ranina on the horses immunised in Bombay for the preparation of the serum.

I have the honour to be

Sir,

Your most obedient servant,

G. POLVERINI, M. D.,

Officer in charge, Municipal Laboratory.

Report on 475 Plague Cases treated in Bombay with Professor Lustig's Curative Serum.

By G. POLVERINI, M.D.

SEROTHERAPY, in general, is based on the principle that suitable animals, when injected with the germs of a particular disease, or with their metabolic products, or with both, acquire immunity against the disease, and that the blood serum of animals so immunised, besides possessing *immunising* qualities, shows often decided *curative* effects as well.

For reasons which would take too long to explain here, Professor Lustig was led to try the following method of immunisation against plague infection, *viz.*, the injection of animals with the albuminous substance of which the *body* of plague microbes is chiefly composed. This albuminous substance is a nucleoproteid and can be isolated from the bodies of plague bacilli in the following way. When plague microbes are cultivated on large Agar-Agar plates, they form a thin layer which is scraped off from the surface of the solid culture medium and treated with caustic potash. By the strong alkali the microbes are not only killed, but also completely disintegrated and dissolved. To the resulting solution, which is of a mucilaginous consistence, acetic acid is added till a white and flocculent precipitate is thrown down, which changes on drying to a brown amorphous mass, without losing its properties. This precipitate is the above-mentioned nucleoproteid *free* from the metabolic products of the plague bacteria, and is used for immunisation after solution in Carbonate of Soda.

Numerous experiments confirmed Professor Lustig in his idea, that the immunisation with the nucleoproteid protects animals susceptible to plague, *e.g.*, mice, rats, guinea-pigs and monkeys, and that the blood serum of these animals has marked curative effects, if injected, into other infected animals.

Not only susceptible animals are able to produce a curative serum after immunisation, but also others, like horses, &c., which are refractory to plague infection.

The presumption that the serum from immunised animals, more especially from horses, may act identically in human beings who have contracted plague by natural infection, is supported by the experience gained in the serum treatment of other diseases, and the attempt to apply such serum as a remedy in man is therefore scientifically justified.

Hence, for the preparation of the curative plague serum, as asked for by the Bombay Municipality, eleven horses have been immunised by injecting them under the skin at given intervals, with increasing quantities of the already mentioned proteid.

Five of the horses were immunised in Florence by Professor Lustig and six in Bombay by Professor Galeotti and the undersigned.

The horses re-not to the injections with fever, general signs of sickness and swelling at the seat of injection. These symptoms subside usually within a fortnight, the horses losing much flesh during this time.

For more particulars on this subject, I refer to the adjoined report of Veterinary Surgeon Ranina.*

When a horse has recovered from the effects of one injection, a second one is made, and so on, until immunisation is obtained.

The quantity to be injected, and the intervals between the single injections, have been subjected to some variations in order to find out the best and shortest way of immunisation. Valuable data have thus been obtained, which require, however, further confirmation.

Generally, it can be said that the efficacy of the serum is, within certain limits, in direct proportion to the quantity of the immunising material injected.

The time required for efficient immunisation before the first bleeding is, on the average, 3 to 4 months.

The horses are bled from the jugular vein. Blood to the amount of 5 to 7 litres is withdrawn and kept in ice till coagulation has taken place. The separated serum is then decanted into sterile bottles, fitted with rubber corks, and kept in a dark and cool place.

In Bombay, the serum was usually prepared just before it was needed, in order to prevent possible deterioration. The serum sent out from Florence (for the transport of which special arrangements had been made with the P. & O. Co.) arrived sometimes in an altered condition and could not all be used.

It is needless to say that all manipulations involved in the preparation have to be conducted with extreme precautions in order to avoid accidental contamination.

When the horses have recovered from one bleeding, the immunisation begins again and is achieved in shorter time. So a horse may be bled and immunised three to four times, giving altogether about ten litres of serum, which is approximately sufficient for the treatment of 100 patients. I say approximately, as, on the one hand, the same amount of blood gives sometimes less serum, owing to incomplete coagulation; whereas, on the other hand, a serum with inferior curative properties has to be used in larger doses.

After the fourth bleeding, the horses are, as far as experience goes, so reduced in their vitality, that they are considered unfit for further immunisation. It may even be that a horse becomes unfit much earlier, as it happened with horse No. 6 immunised at Parel, which, after the first bleeding, never recovered again.

Before using the serum in human beings, it was always tried on animals to ascertain its curative properties. The single dose used for treatment in patients was on an average 20 c.c. ($5\frac{1}{2}$ drachms), the largest single dose was 40 c.c., the largest collective dose 200 c.c.

The injections were made usually under the skin of the arm or thigh after careful disinfection. In a few moribund patients, injections directly into a vein were tried, but without effect. In others, the serum was injected into the bubo itself: this practice was abandoned, as it was very painful and without better results.

The injection of the serum does not cause special pain and no local reaction whatever. The serum is absorbed in a few minutes. Abscesses never occur, if the disinfection of the skin and syringe is carefully done; in some cases, an urticarial rash appeared after injection.

* This report only accompanies the Commissioner's copy.

The serum derived from different horses showed very different curative properties, which always corresponded with the results of the experiments on animals. As the *difference* of the results obtained from different sera is one of the *chief proofs* of the efficacy of the serum treatment, the results are given in detail in the following table:—

(a) *Horses immunised at Florence.*

Serum from horse.	No. of Patients treated.	Recoveries.	Deaths.	Percentage of recovery.
No. 1 ...	90	25	65	27·77
No. 2 ...	42	22	20	52·38
No. 3 ...	70	38	32	54·28
No. 4 ...	43	23	20	53·48
No. 5 ...	12	4	8	33·33
Total ...	257	112	145	43·57

(b) *Horses immunised in Bombay.*

Serum from horse.	No. of Patients treated.	Recoveries.	Deaths.	Percentage of recovery.
No. 1 ...	47	17	30	36·17
No. 2 ...	24	5	19	20·83
No. 3 ...	31	14	17	45·16
No. 4 ...	51	19	32	37·25
No. 5 ...	52	15	37	28·84
No. 6 ...	13	5	8	38·45
Total ...	218	75	143	34·40

(a) Some serum from horses Nos. 2 and 4 immunised in Florence arrived deteriorated in Bombay and could not be used. Horse No. 5 could not be further immunised, as after the plague cases at Vienna the working with plague microbes was not allowed in Italy.

(b) The horses immunised at Parel have been twice bled except Nos. 2 and 6, which were once bled; the latter became unfit for use after the first bleeding.

The table shows that the serum from horse No. 1 immunised in Florence with which the treatment was commenced in March 1898, gave throughout little satisfaction, as out of 90 patients treated 65 died, and 25 only recovered, giving a recovery rate of 27·77%. The serum of horse No. 3, also immunised in Florence, gave the best results with 38 recoveries in 70 cases treated, equal to a recovery rate of 54·28%.

This difference is independent from other influences, as both sera were used under the same circumstances in the Arthur Road Hospital. I think it worth while to enter into some details of it.

From the 12th to the 29th of March the serum from horse No. 1 was used; 24 patients were injected, 18 of whom died and 6 recovered.

From the 28th of March to the 9th of April, the serum from horse No. 3 was tried; 19 patients were treated, of whom 10 died and 9 recovered.

From the 12th to the 23rd of April, the serum from horse No. 1 was again used (2nd bleeding); 41 patients were treated, of whom only 11 recovered.

From the 29th of April to the 12th of May the serum from horse No. 3 (2nd bleeding) was tried. Of 24 cases treated, the results were 12 recoveries and 12 deaths.

From the 22nd to the 26th of May the serum of horse No. 1 (3rd bleeding) was once more used; 6 patients were treated, of whom 1 recovered.

From the 12th of May to the 3rd of June the serum of horse No. 3 (3rd bleeding) was again employed; 12 patients were treated, of whom 9 recovered.

Simultaneously, with the serum of horse No. 1, the sera from horses Nos. 2 and 4 were used; of 22 patients treated, 10 recovered. The serum of horse No. 1 gave, therefore, in every instance less recoveries than any of the other sera. The occurrence of a sequence of inferior results from one serum (which results were, however, still better than those obtained by the ordinary treatment) can only be explained by a variation in the degree of efficacy. The difference in the results, 18 recoveries in 71 patients treated with the serum of horse No. 1, and 40 recoveries in 77 treated with the serum of the other horses, is so considerable that it cannot be due to chance.

The recovery rate (*vide* table, page 3) obtained from the use of the serum prepared in Florence is considerably reduced by the failure of the first horse with the serum of which the largest number of patients was treated. For, if from 257 cases treated with the serum obtained from Florence are deducted those injected with the serum from horse No. 1, the recovery rate is 52.09 % instead of 43.57 %.

The fact that the later bleedings of this horse did not yield better serum tends to show that the horse was *a priori* refractory to effective immunisation. In fact, some horses seem never to give active serum. This is also observed in the preparation of other sera, as, for example, in the preparation of the anti-diphtheric serum. A knowledge beforehand as to whether a horse will or will not give an active plague serum is as yet impossible.

The table given above shows further that the recovery rate from the serum prepared in Bombay is up to now 9 % less than from the serum prepared in Italy. It is difficult at present to account for this. It may be due to the increased virulence of the disease in 1899, and to the confidence with which the most desperate cases were subjected to the treatment by Dr. Choksy, the Medical Superintendent of the Arthur Road Hospital; or it may be explained by the fact that the horses have been bled only twice, as there are strong reasons to believe that the serum improves with every bleeding. The race of the horses and the climatic conditions in India might also lessen the resistance of the animals to the immunising injections and impair their faculty to produce the substance which is the curative agent of the serum.

The observations recorded in this report were made from the 12th of March to the 31st of October 1898 with the serum prepared in Italy, and from the 1st of February to the 31st of May 1899 with the serum prepared in Bombay.

The total number of patients treated during this time was 475. Serum for 50 patients was, moreover, given to the Indian Plague Commission by order of the Municipal Commissioner, and some serum was used for the necessary control experiments on animals.

For the preparation of the serum 25 bleedings were made, and 78 immunising injections performed.

The patients were treated in hospitals and in private practice as follows :—

	No. of Patients treated.	Recoveries.	Deaths.	Percentage of recovery.
Arthur Road Hospital	403	154	249	38·21
Maratha Hospital	28	11	17	39·28
Government House, Parel	12	3	9	25·00
Private	32	19	13	59·37
Total	475	187	288	39·36

The rate of recovery was therefore 39·36 per cent.

These results appear in themselves satisfactory if we compare them with the following figures :—

At the Arthur Road Hospital, 1,190 patients were treated without serum during the same period, 233 of whom recovered, equal to a recovery rate of 19·57 per cent.

At the Maratha Hospital, 3,378 patients were similarly treated, of whom 646 recovered, equal to a recovery of 19·12 per cent.

At the Modikhana Hospital, 1,384 patients were treated, of whom 295 recovered, equal to a recovery rate of 21·31 per cent.

It is interesting to note that for the whole City of Bombay 24,752 attacks from plague have been recorded with 21,193 deaths, equal to a recovery rate of 14·37 per cent.

But it would be entirely misleading, as statistics usually are, if not drawn from very large numbers, to presume that the recovery rate of 39·36 per cent. represents the whole efficacy of the serum treatment either in the past or for the future.

To come to a true judgment of the value of the serum treatment we have not only to consider statistics, but also all the circumstances of the preparation and application of the serum, which cannot be expressed in mere numbers, although they may have influenced the results.

As to the preparation it has to be borne in mind that the manufacture of a curative serum is not only the highest, but also one of the most complex problems of practical medicine, the complete solution of which is not to be arrived at by the first attempt, but by repeated experiments. This is instanced in the case of the diphtheria serum. It took many years and numerous experiments before a satisfactory curative serum was obtained.

It has further to be remembered that this report gives the results of a treatment in its *experimental stage*, in which the dose of the remedy, the mode of its application, and its effects under varying conditions, had to be ascertained ; so that the investigations had to be carried on under conditions unfavourable for statistical results.

But before dealing in detail with the circumstances of the application of the serum, I think it necessary to say a few words about the method adopted in the experiments, as the results obtained by this method have been questioned.

Whenever a new remedy is recommended there are two questions which have to be decided in regard to it :—(1), Is it a remedy at all ? (2), Is it generally applicable as a remedy ?

The first question can be solved immediately by the physician; the solution of the latter must be left to time and wider experience.

The attempt to solve both questions at once by statistics has been shown to lead to errors.

We can ascertain the action of a substance on *healthy beings* by statistics, as we are able to equalize approximately by selection the conditions of the individuals experimented upon: such equalising selection is impracticable as soon as we have to do with *sick persons*. Sickness introduces so many unknown conditions, that comparison is well nigh impossible. The sick person is an entity by himself, not to be compared with anybody but himself. This fact must have struck even a layman, who had the opportunity of seeing the efficacy of curative treatment tested by the so-called "control case" method, or by the method of "alternative cases." The error of such methods can only be eliminated when the objects of comparison are so *numerous*, that we may expect, according to the law of probability, to find on both sides a *majority* of corresponding units.

Unfortunately, we can never know beforehand how large the number of observations must be in a particular instance, in order to eliminate the errors of statistics as the number must differ with the disease and with the efficacy of the remedy itself. Thus the number may be small in a disease, like typhoid fever, where there is plenty of time for intervention; it must be much larger in plague with its rapid course, high mortality, and sudden deaths.

As the accuracy of conclusions arrived at by statistics is in direct proportion to the number of observations, becoming absolute if the number is infinite, it follows that with the decreasing number, the accuracy must decrease till it falls to zero. In such a case, statistics do not allow of any conclusion. If we reduce the number of observations further still, the accuracy may even become negative and the conclusions drawn from such observations may be positively wrong and contrary to the truth.

It is this possibility of giving results contrary to the truth, which often discredits statistics as a method of investigation.

I do not hesitate, therefore, to state here that the clinical method of selecting such cases, as were thought accessible to cure, approved of by the Health Officer, Col. Weir, is the only one employed by the science of medicine at the sick bed in similar *original* investigations, and that the experimenters could not have adopted a statistical one without derogating from their dignity as physicians, and without putting themselves in contradiction to the principles of their science.

In science generally statistical methods of investigation are only resorted to when other more reliable means are not applicable.

Medicine especially, having for its object the human body, with its thousand fold varying abnormal conditions produced by disease, excludes statistical methods from the sick room, as statistics are incompatible with the first principle of medicine—the principle of *individualisation*.

But, even setting aside scientific principles, there was also a practical reason for clinical selection. It was necessary to come to a conclusion in short time and with little material, as it was not known how long the experiments could be continued. Under these circumstances this could not be done by statistics which had to be based on large numbers in order to avoid essential errors, on numbers much larger than were considered sufficient by some.

In fact, within a few weeks after the beginning of the experiments, no doubt was left in the minds of the experimenters that the treatment was effective, although the results were, at the time, anything but favourable from a statistical point of view.

And last, but not least, I cannot omit to say that the statistical method in its application to human beings is repulsive to the physician who does not look upon patients as mere objects of experiment, but as *sui similis* when he is called upon to help and to cure.

We come now to explain the principles followed in the selection of cases.

The first principle was to select for treatment cases which were admitted in the first days of disease; for it is obvious that, in a disease which leads usually to death within four days, early treatment give the only chance of recovery.

It has been said that this principle brings about the selection of cases which have the greatest chance of natural recovery. To this I can give the answer of Dr. Simonds quoted in his report on the patients treated by him at Karachi with Roux serum, that it is a "gross error."

Experience and statistics show that in hospitals the highest mortality is just amongst the patients admitted in the first days of disease. Thus, this principle leads, on the contrary, to the selection of patients the mortality in whom is higher than the average.

Considering further, that, on the one hand, more than 30 per cent. of the patients admitted in the large hospitals are evidently moribund and beyond any possibility of recovery, dying within 24 hours and even less after admission, and that, on the other hand, about 20 per cent. recover under ordinary treatment, it was thought best to try to exclude both categories from the serum treatment. The first, because it could not reasonably be expected that any treatment could be effective in patients already showing signs of approaching death; the second, for mere economy and in order to meet beforehand the objection that the treated patients would have recovered without specific treatment. In itself there is naturally no reason to exclude the latter: in such patients the recovery may be hastened and sequelæ prevented. It would, moreover, be unsafe to rely on nature unaided, when the mortality is one of 80 per cent.

It was usually easy to exclude patients recovering by nature from the treatment.

Experience and statistics show again that in hospitals the majority of recoveries by nature takes place in patients admitted in the later stages of the disease, when the battle for life has already been fought and won outside the hospital.

Greater difficulty was, however, experienced in excluding the small number of patients brought to the hospital in the first days of disease, who might have recovered by themselves, and there is no doubt that some such cases came under treatment in consequence of the impossibility of recognising them as such.

But the greatest difficulty was encountered in excluding cases beyond hope of recovery. Unexpected sudden changes, never for the better but always for the worse, are so common in plague, that even the most experienced fail in predicting the course of the disease. So it happened rather often, that death followed some hours after the commencement of the treatment, thus demonstrating the error in prognosis.

It may appear to the superficial observer that the exclusion of moribund cases must have influenced favourably the results of the serum treatment. This is by no means the case. The place of the excluded moribunds was taken by other patients,

who, although not moribund, would have died later on under the ordinary treatment. The decisive factor in the selection is the exclusion of the patients recovering by nature; and this factor went against the serum treatment. Sometimes no selection was made, e.g., in private practice, and again at the Arthur Road Hospital, when suitable patients came in in small numbers at a time when the urgency of reporting on the progress of the experiments did not allow of any delay. In May 1899, by special request, the cases were taken alternatively for treatment.

In other instances, the cases were selected by the medical officers in charge of the respective hospitals and also so-called "control cases" supposed to be in a similar condition. Sometimes patients known to be hopeless were injected in order to study the effect of the treatment on special or distressing symptoms.

It is thus to be seen that, although selection was the rule, patients came also in other ways under the serum treatment; and it is further clear, that the selection, far from giving undue advantage to the treatment, put it, on the contrary, at distinct disadvantage.

So much for the method of clinical selection.

As to the results claimed for the treatment, it seems to me that they must be accepted as established, if the general recovery rate from plague was at the time, in fact, about 20 per cent, which has been taken as the basis for comparison, and if the higher recovery rate of 39.36 per cent obtained by the serum, was not due to the selection.

To prove this, I shall proceed in the following purposely on statistical lines, and shall confine myself only to the patients treated at the Arthur Road Hospital for whom all the necessary data are at hand.

As an introduction to these statistics I may be permitted to give here shortly, the history of the serum treatment.

The first patients were treated, in June and July 1897, at Poona and Bombay, by Professor Lustig himself. Out of 30 patients selected by the officers in charge of the respective hospitals, 26 recovered and 4 died. It was on the strength of these results that the Bombay Municipality requested Professor Lustig to continue the experiments.

When Professor Galeotti and the undersigned came to Bombay in March 1898, with the serum prepared for the Municipality, they came naturally with high expectations which, however, were not at first fulfilled.

The treatment was commenced on the 12th of March 1898 at the Arthur Road Hospital with the serum of horse No. 1.

The epidemic was raging with unusual severity and seemed to baffle all medical efforts.

No appreciable curative results could be obtained in the first weeks; and had it not been for the clinical observations showing undoubtedly that the specific treatment was not without beneficial effect, the experiments would have been abandoned at this early stage.

The arrival of a new serum was anxiously awaited. It came on the 26th of March, and with it the solution of the problem. It was obtained from horse No. 3, and was first used on the 28th of March. The difference in the efficacy of the first and second serum was not only unmistakable clinically, but soon also evident numerically as has already been shown in detail (*vide* page 3).

There could not have been a more *conclusive* proof of the efficacy of the treatment than the marked *difference* of the results obtained. The experimenters thought themselves therefore at *this stage*, entitled to the conclusion that by Prof. Lustig's method a serum with high curative properties could be prepared.

Further experience substantiated this belief, although disappointments were not wanting.

The experiments were continued till 31st of October 1898, during a recrudescence of the epidemic, which is known for its high mortality.

The treatment was then discontinued till February 1899, while serum was being prepared locally at the Municipal Laboratory at Parel.

In February 1899, when the severest epidemic Bombay ever saw, was rapidly increasing, the treatment commenced again and has been continued without interruption up to date.

As the bulk of patients were naturally treated when they were numerous, the results reported here have been chiefly obtained during the height of three epidemics of exceptional virulence.

Considering this, and the exclusion of mild cases, and the most unfavourable conditions of application in a large Indian plague hospital, it can be said, without exaggeration, that the serum has been put to a test as severe as can be conceived.

And now to the statistics.

From the 12th of March till the 31st of October 1898, and from the 1st of February till the 31st of May 1899, 403 patients have been treated with the serum at the Arthur Road Hospital, of whom 154 recovered, the recovery rate being 38·21 per cent. During the same time 1,190 patients were treated without serum, with 233 recoveries, the recovery rate being 19·57 per cent. Altogether 1,593 acute cases were admitted into the hospital, 387 of which recovered, the rate being 24·29 per cent.

If the serum has really saved lives, the total recovery rate at the Arthur Road Hospital must have been higher than in other hospitals in which a similar class of patients was admitted. But none of the other public hospitals receives the ordinary low caste patients who form the bulk of admissions at the Arthur Road Hospital; still we shall take for comparison the Maratha and the Modikhana Hospitals and will see what was the recovery rate from plague there during the same period.

At the Maratha Hospitals, 3,378 patients were admitted from the 1st of March till the 31st of October 1898, and from the 1st of February to the 31st of May 1899 of whom 646 recovered; the rate of recovery being 19·12 per cent.

At the Modikhana Hospital, 1,384 patients were admitted during the above period, of whom 295 recovered; the rate of recovery being 21·31 per cent.

In both hospitals together, 4,762 patients were admitted, of whom 941 recovered; the rate being 19·76 per cent.

The recovery rate at the Arthur Road Hospital was therefore 45·3 per cent. higher than in the former two hospitals, although the patients admitted to them are in general, of a better and more resistant class, better fed and, as a rule, earning wages.

It has, moreover, to be noted here that, in the account of the Arthur Road Hospital, 53 convalescent patients are not included, who were transferred from other hospitals which were closed with the decline of the epidemic in 1898. If they be included, the recovery rate of the Arthur Road Hospital is 26·73 per cent. This would probably be the correct number for comparison, as no doubt also the Maratha and Modikhana Hospitals had convalescent admissions in 1898, which are not separated in the records furnished to me. The surplus on recoveries would be in such a case 7 per cent. in favour of the Arthur Road Hospital.

Still, as I cannot give the exact number of such convalescent patients admitted into the other hospitals, I shall not take advantage of the doubt, but base my conclusions on the lower recovery rate of 24·29 per cent.

The average recovery rate of 19·76 per cent. in the two other hospitals enables us to ascertain statistically what advantage the selection gave to the serum treatment.

It is clear that the recovery rate of the non-serum patients of the Arthur Road Hospital ought to have *decreased*, if the increase in the recovery rate of the serum patients was due to the selection.

The recovery rate in the non-serum cases was 19·57 per cent. at the Arthur Road Hospital and 19·76 per cent. in the patients treated at the other two hospitals. The difference, therefore, is 0·19 per cent. This difference may be taken as the numerical expression of the advantage the serum treatment derived from the selection.

To eliminate this advantage, we have to add this difference to the recovery rate of the non-serum patients at the Arthur Road Hospital which is then also 19·76 per cent.

As the recovery rate in the serum cases is 38·21 per cent. the difference of 18·45 per cent. must be credited to the serum.

This number being based on merely statistical calculations, cannot express the real efficiency of the serum treatment, because the experiments were not conducted for statistical purposes.

If we remember that the first principle of selection brought to the serum treatment cases in which the recovery rate is *lower* than the average, and that the second principle excluded, as far as possible, mild cases, in which the rate is *higher* than the average, we arrive at the conclusion that the serum treatment must have favoured the results in the non-serum cases.

In fact, such favourable influence is the necessary consequence of the principles of selection.

Whereas the addition of moribund patients within the limits in which it took place was irrelevant for the recovery rate of the non-serum cases, this rate had to increase, because a larger number of mild cases came to the non-serum side than corresponded to the incidence among the ordinary admissions. Although the advantage the non-serum side thus derived from the selection cannot be put down in figures, it is real and not to be denied. It helps to explain the fact that the recovery rate of the non-serum cases is even higher than that of the patients of the intermediate period, in which the serum was not used, and also that the recovery rate in the non-serum cases is only 0·19 per cent. lower than that of other hospitals receiving patients of better stamina.

That the addition of moribunds to the non-serum cases has not influenced their recovery rate, is shown by the following figures :—

Of the 493 serum cases 63 died within the first 24 hours and 68 within the next 24 hours after the beginning of the treatment. As the day of admission was not always identical with the day of the beginning of the treatment, the respective figures are 52 and 58 in regard to the admission. The serum cases had therefore 27 per cent. deaths within the first 48 hours after admission. For the 1,190 non-serum cases the figures are 445 and 227 respectively. The deaths within the 48 hours are therefore 672 or 56.47 per cent. As is well known, the mortality within the 48 hours after-admission is 50 per cent. and more in the large Plague hospitals, and therefore its increase in the non-serum cases is at the most 7 per cent. That a greater number of patients who die within the first 48 hours cannot influence unfavourably the recovery rate, as long as the exchange does not take place in the class of recovering patients, is obvious.

The 7 per cent. more deaths within the first 48 hours after admission in the non-serum cases correspond probably to the number of patients who died a few hours after admission and could not possibly have been taken for treatment, as patients arriving in the evening had to wait till the next morning before the special line of treatment was decided upon by the Medical Officer.

Hence the exclusion of moribunds was due to involuntary causes rather than to anything else. When intentional, it was strictly confined to actually dying patients. That the principles of selection were so rigorously adhered to, reflects great credit to the conscientiousness and ability of Dr. Choksy, by whom the selection was made in the majority of cases.

We have already seen from the comparison with the recovery rate of other hospitals that the selection brought no advantage to the serum treatment. This can be further demonstrated from the records of the Arthur Road Hospital itself. During the months of November and December 1898, and January 1899, the serum treatment was discontinued as no serum was available. During this time 273 patients were admitted, 51 of whom recovered, the rate being 18.68 per cent. or 0.89 per cent. *lower* than in the non-serum cases of the serum period. The total recovery rate of this serum period compared with the above period gives a difference of 5.61 per cent. in favour of the serum. Or we may put it in another way.

From the 12th of March to the 31st of October 1898, the serum was used during the epidemic and the recrudescence : the admissions were 663 with 186 recoveries or 28.05 per cent. the 53 convalescents being excluded. During the inter-epidemic months of November and December 1898 and January 1899, the serum was not used : the admissions were 273 with 51 recoveries or 18.68 per cent.

From the 1st of February to the 31st of May 1899 the serum was used again : the admissions were 930 with 201 recoveries or 21.61 per cent.

Thus the total recovery rate was *higher* in both periods in which the serum was used than in the period in which it was not employed, although considering the epidemiological conditions the *contrary* should have been the case.

That the higher total recovery rate at the Arthur Road Hospital was due to the serum treatment and not to other unknown influences, is directly proved by the fact that in 1898 as well as in 1899 the recovery rate rose immediately with the commencement of the treatment in spite of the synchronous rising of the epidemic.

The recovery rate at the Arthur Road Hospital was 22·19 per cent. in February 1898, rising to 24·89 per cent. in March, whereas at the Maratha Hospital the rate was 18·84 per cent. and 12·28 per cent. respectively. (In the City of Bombay, 4,750 attacks and 4,493 deaths have been recorded in February 1898, and 4,780 attacks and 4,969 deaths in March.)

A similar increase in the recovery rate following the introduction of the treatment was experienced in February 1899. In January of this year, 178 patients were admitted, of whom 29 recovered, the rate being 16·29 per cent. Although the number of admissions was 324 in February, indicating the rising epidemic, the recovery rate was 20·68 per cent. or 4·39 per cent. higher than in the previous month.

The Maratha Hospital, on the contrary, had 430 admissions in January 1899 with 85 recoveries, the rate being 19·76 per cent. or more than 3 per cent. higher than at the Arthur Road Hospital in January. It had 769 admissions with 127 recoveries in February, the rate being 16·51 per cent. or more than 4 lower per cent. than at the Arthur Road Hospital in the same month. In the City of Bombay 1,879 attacks and 1,591 deaths were recorded in January 1899, against 3,476 attacks and 3,038 deaths in February, the rate being 15·32 per cent. and 12·60 per cent. respectively.

The corresponding figures of the Modikhana Hospital could not be given, as the recovery rate for single months is worked out on a different basis, but there is no doubt that also there the rate followed the general course of the epidemic, which was at its worst in March 1898 and in February and March 1899.

I have nothing further to add to the above. Even the most sceptical will admit that the increase of the recovery rate at the Arthur Road Hospital in both years and just in the month of the beginning of the serum treatment, cannot have been accidental considering that the rate became lower everywhere else.

As might be expected, the influence of the serum treatment tended to show itself not only in the saving of life, but also in the prolongation of life in patients who eventually died.

The patients with the hopeful red L on their temperature charts—the sign of the serum treatment—lived distinctly longer than their less fortunate neighbours, who died with appalling rapidity.

If we look into the statistics for the expression of the prolongation of life, we find it in the reduction of the mortality within the first 48 hours after admission. Comparing the mortality within the first 48 hours after admission in the different periods of the years 1898 and 1899, the reduction due to the serum treatment is unmistakable. The following tables give the details:—

No. 1.

	NON-SERUM TREATMENT		SERUM TREATMENT.	
	1898. Jan. till 12th March, Nov. till Jan.	1899, January.	1898. 12th March till Nov.	1899. Feb. till June.
Admissions	14·71	178	663	930
Deaths within 48 hours ...	720	115	309	473
Percentage	48·94	64·60	46·60	50·86

No. 2.

	SERUM PERIOD. 12th March till 10th Nov. 1898 ; 1st Feb. till June, 1899.	INTERMEDIATE PERIOD. Nov. Dec. 1898. Jan. 1899.
Admissions	1,598	273
Deaths within 48 hours	782	156
Percentage	49.08	57.14

Most remarkable is the reduction in the mortality within 48 hours which took place from January to February 1899. It amounts to 14 per cent. and is fully established in February, the month of the beginning of the treatment with 324 admissions and 165 deaths within 48 hours. What was to be expected from an epidemic which in its initial stage had a mortality of 64 per cent. within 48 hours after admission, can probably be gathered from the records of other hospitals.

The prolongation of life is still more evident from the following table :—

	NON-SERUM CASES.		SERUM CASES.	
	Total.	Percentage.	Total.	Percentage.
Deaths within 48 hours ...	672	56.47	110	27.29
Deaths later on	285	23.94	189	34.49
Recoveries	233	19.57	154	38.21
Total ...	1,190	.....	403	.....

It is to be seen that the non-serum cases have only *double* the number of deaths later on, although their total number is *three times* larger than that of the serum cases.

It is further interesting to observe that in the non-serum cases the percentage is highest for the deaths within 48 hours, lower for the deaths later on, and lowest for the recoveries. In the serum cases just the opposite is the case. This corresponds with clinical observations.

In a certain number of patients the serum seems to have no effect whatever. They die within the first two days.

In a large number there is so decided an improvement after the first injections that recovery is hoped for. Then the patient gradually changes for the worse in spite of the continued treatment. It seems as if by the first injections the infection has been overcome ; but the patient dies in consequence of the irreparable degenerative changes which have already taken place.

In the largest number of patients in whom such changes are not established, the improvement after injection is followed by recovery.

As it has been said that the results of the serum treatment are not in conformity with the axiom of serotherapeutics, "that the earlier the treatment the more favourable the prognosis"—an axiom which in this relation holds good for any kind of treatment—I shall analyse the distribution of the recoveries over the different days of illness on which the patients came in for treatment.

In this connection I should like to correct an error regarding this distribution which occurs in Capt. Childe's report, dated the 4th of April 1899, No. 226, to Surgeon-General G. Bainbridge, M.D., concerning 148 patients treated with Prof. Lustig's serum from February 2nd to March 27th. Capt. Childe gives on page 19 a table showing the number of patients treated on the different days of illness. According to this table, out of a total of 148 patients, 30 received treatment on the first day of illness. He states further, on page 20, para. 6, that 22 of them died, the mortality being 73·3 per cent. and demonstrates that, contrary to the axiom of serotherapeutics, the mortality of the patients treated on the first day is *higher* than that of all the patients who underwent the treatment; the figures being 73·3 per cent. and 69·7 per cent. respectively, and continues by saying "that this points to the same conclusion, namely, that treatment by Prof. Lustig's serum has not much influence on the course of plague."

These statistics need rectification. By looking closer through Capt. Childe's report one will find that of the 30 patients admitted on the first day of disease 4 received the treatment on the day after admission, that is, on the *second* day of disease. On the first day there were therefore 26 patients treated, of whom 18 died and 8 recovered; the mortality being 69·2 per cent.

Hence the mortality of the patients who received treatment on the first day was *lower* than the mortality of all the patients who underwent the treatment; the figures being 69·2 per cent. and 69·7 per cent. respectively, instead of 73·3 per cent. and 69·7 per cent. as stated by Capt. Childe.

This error to consider the day of admission as identical with the day of the beginning of the treatment amounts to 11 for the patients admitted on the second day of illness and has vitiated the corresponding statistics and the conclusions drawn from them, which latter had in any case a very limited value indeed, based as they were on results which could be *materially* altered by an error of 4.

It is worth mentioning here that in Capt. Childe's report the Maratha Hospital shows 9 patients treated on the first day, in a total of 12, and the Arthur Road Hospital only 12 such patients in a total of 125.

After this necessary digression I return to my subject. The relation between recoveries and days of illness on which the treatment, commenced, is shown in the following table:—

Days of illness.	No. of patients treated.	Recoveries.	Percentage of recovery.
1st	37	14	37·8
2nd	140	49	35·
3rd	117	39	33·3
4th	54	26	48·1
5th	24	12	50·
6th	13	6	46·1
7th	18	8	44·4
	408	154	38·21

In remarking on the above it is surprising that so few patients received treatment on the first day of illness. The reason is that only about 6 per cent. of the admissions are patients in this early stage, at least at the Arthur Road Hospital. These patients are moreover mostly in a very bad condition. Their mortality is very high and many of them die soon after admission.

It is a serious disadvantage for the serum treatment in our plague hospitals that on the first day of disease when the chances of recovery are favourable so few patients are admitted.

The majority of patients were admitted to the hospital and received serum treatment on the second and third days of illness.

From the third day the number of treated decreases considerably, and this out of proportion to the number of admissions. This is due to the selection.

After the sixth day only 18 patients were treated, in all of whom protracted dangerous symptoms called for special intervention.

If we compare the percentage of recoveries on the different days without giving undue weight to this comparison, as the figures are small, we see that for the first three days the recovery rate corresponds to that axiom of serotherapy which has already been referred to. At first sight, in apparent contradiction to the above-mentioned axiom, is the higher recovery rate for the fourth and the following days. To understand this discrepancy, which has also been noted in the results of other plague sera, we have to remember that no treatment can *essentially* alter the curve of mortality of a particular disease. It can only keep it lower on the whole and modify it in certain phases, but the characteristic features must always remain. We can even perceive that in a single instance the recovery rate might be cent. per cent. higher in patients who came late to treatment, if this corresponds to the normal curve of mortality of a disease. We have, therefore, to see how the curve of mortality from plague runs normally.

If we put the time of incubation down to 10 days we may say that in the first days no deaths occur. In the later days of incubation deaths, no doubt, occur, but they are not always recognized as due to plague, evident symptoms being absent. With the eleventh day of infections or first day of illness manifest symptoms set in, the disease reaching its height in the majority of cases already on this day. The curve of mortality rises suddenly almost to its highest point, which is arrived at on the third or fourth day of illness. Then the mortality declines slowly to the sixth or seventh day, being somewhat *lower* on these days than it was on the first. The decline continues in moderate progression till the tenth day which can be looked upon as the end of the acute stage.

Patients in the incubation period are almost never to be found in hospitals, which is unfortunate, as in this period, or even in the first hours of the first day of illness, serum treatment can arrest and abort entirely the disease as was experienced in some cases.

The curve of mortality in hospitals begins therefore on the first day of illness and is higher than among patients treated outside, as only such patients are brought in who show very severe symptoms in the beginning. There is in fact little difference in hospitals between the mortality of the patients of the first or the third day, which latter shows the highest mortality. From the third day the mortality may deviate probably little from the general mortality. As has already been mentioned, the mortality in the serum cases follows the mortality in hospitals for the first three days, the mortality being highest on the third day. With the fourth day the mortality in the serum cases falls off considerably more than in the non-serum cases.

How can we explain that the serum is effective even at this later stage? Clinical observation gives the information.

Plague is characterized by attacks of three to four days' duration. The first attack is the most malignant one and carries away the most victims. Then there is a short

remission of symptoms indicated by a fall in the temperature so frequent on the third or fourth day. Patient and disease seem to gather strength for the final struggle.

At this stage, before the relapse comes on, the serum has proved useful; hence the quicker declining of the mortality on the fourth day. We have really a new first day of disease, and the patient who had resistance enough to survive the more dangerous first onslaught comes easier over the second one with the help of the serum, than with his own exhausted resources.

Were it not for this critical relapse the serum could not have any influence on the course of the disease after the third or fourth day, as it can only act against the infection and not against its established consequences.

The possibility of checking or mitigating the relapse is a most important and favourable feature of the treatment in Indian plague hospitals whither patients come usually too late for the treatment of the first attack.

We understand now why the rate of recovery in patients of the later days is cent. per cent. higher than in those of the earlier days. The absolute number of recoveries is naturally always higher among the more numerous admissions in the first days of illness.

I have tried to bring the results of the limited statistics available into harmony with the knowledge derived from the clinical observations of the disease and of the treatment, and I admit willingly that my deductions may have to be modified in the light of later experiences. Still the chief point in question, the efficacy of the serum treatment, even at a later stage, will remain untouched, however the connection of the facts may vary.

I have little more to say about the patients of the Arthur Road Hospital. The great majority of them were low-caste Hindu males who have generally a mortality 2·3 per cent. higher than Hindu females, so that also in this respect the serum was not favoured.

All ages were represented, the youngest child was four months, the eldest man 75 years. Forty children under 10 years had a recovery rate of 50 per cent. It can be said that they answer best to the serum treatment. Their mortality is in general the lowest.

In order to judge of the severity of the treated cases I attach copies* of the charts of temperature of the first 100 patients who recovered under the serum treatment as well as the corresponding ones of the patients who were under the ordinary treatment. They bear out fully what has been said about the selection of cases. No other clinical details are given than the curve of temperature during the acute stage, which may be taken as an approximate index of the course of the disease.

Certain charts have been signed on the right corner as "mild"; taking as criterion the shortness of the acute stage, the low temperature and the admissions on the later days. This classification has no scientific value and does not always correspond with the facts; it only facilitates comparison. Strictly speaking, such comparison is impossible as the mild course in many serum cases was brought about by the treatment.

* These copies only accompany the Commissioner's copy.

Still, as the charts are written with all the modifications due to the serum, there are only 27 charts that could be marked "mild;" whereas from the charts of the non-serum patients 54 had to be put down as "mild." Special attention is drawn to the chart No. 22 of a patient who came a few hours after the appearance of the first symptoms to the treatment. The curve of temperature under the influence of the serum suggests a mild attack; but, as a matter of fact, the case was a desperate one, with numerous plague bacilli in the blood.

Careful examination and comparison of the charts leave only two alternatives open: either the recoveries on the serum side have been obtained in patients who were on the average more gravely affected than the patients on the other side, or that the more severe course shown by the charts is due to the serum.

Although no less an authority than Dr. Ruffer, of the Indian Plague Commission, hinted that the high mortality at the Arthur Road Hospital—it was still higher at other hospitals—may be in causal connection with the application of the serum, I do not think it necessary to deal seriously with such an assertion. It is not only contradicted by all facts contradicted in this report, but also by all experience of the serum treatment in other diseases.

No curative serum has yet proved harmful as long as it was sterile and not used in doses in which blood serum in general may sometimes be injurious. The innocuousness guaranteed, the prejudice against the serum treatment seems very strange, and stranger still it seems that this prejudice is prevalent just amongst that part of the population which ought to know better and would eventually benefit the most by the treatment.

For completeness sake it may be mentioned that Lustig's serum has been tried in pneumonia, malaria, relapsing fever and streptococic infection in order to demonstrate its specific action. As was expected it showed neither good nor ill effects. It was further tried on healthy persons without causing the slightest inconvenience.

The patients treated outside the Arthur Road Hospital do not call for many remarks. Sixteen were treated in 1898 and 12 in 1899 at the Maratha Hospital. The recoveries were 8 and 3 respectively. The clinical notes show that the cases were, with few exceptions, of a very severe type, and that the Marathas seemed to answer better to the serum than to the patients of the Arthur Road Hospital.

Twelve patients were treated at the Parel Hospital in 1898 with the serum of horse No. 1, three of them recovering, eight patients who had been taken as control, all died.

Of more interest are 32 patients, treated in private practice, 19 of whom recovered. They were from the middle classes and of different nationalities. Some were hopeless and only treated at urgent request. Still the number of recoveries indicates clearly how much more effective the serum treatment is when applied under better conditions of life.

I pass now on to the clinical features of the serum treatment. Foremost in evidence is the antithermic action of the serum which is seldom wanting even in patients who in the end die. The increase of the arterial pressure and the improvement in the condition of the heart can be demonstrated by the sphygmograph. Delirium and headache very often subside considerably and the

patient becomes quiet and falls asleep. It is surprising how quick a dry tongue sometimes gets moist after one or two injections, even in patients who die later. The bubo does not increase in size and sometimes diminishes distinctly, becoming at the same time less tender and reabsorbing oftener than otherwise. The recovery is speedy and sequelæ appear seldom, if the patients come early for treatment. The first signs of the influence of the treatment show themselves usually within 12 hours after injection. A decided improvement in the general condition of the patients takes place in the majority of cases within 24 hours, and is naturally more pronounced in patients who recover.

Contra indications for the use of the serum do not exist. Still if a patient is sinking in collapse, it is wise to delay the injection, lest the antithermic effect may coincide with the collapse, and death, shortly after the beginning of the treatment, be attributed to the serum. In such cases, it is better to try to improve the heart's action by the use of stimulants. If the heart improves then the serum may still be useful: if the heart cannot be revived, then the serum is useless and is probably not absorbed quick enough to be effective.

It has always to be remembered that the serum influences symptoms only indirectly through acting upon the cause which has produced them. The exact mechanism of this action is not sufficiently known as yet. All that we can say at present is that recovery by curative as well as immunity by prophylactic treatment is due to a reaction in the body's tissues brought on by the respective agents. Sometimes without apparent reason no such reaction is produced; then cure and prophylaxis fail.

The serum gives the best results as may be expected in the forms of plague in which recovery by nature is more frequent, *e.g.*, in uncomplicated bubonic plague.

Cases which show signs of septicæmia from the beginning can be cured, if the serum is used on the first day.

Mixed and secondary infections are unfavourable. The recent investigations of the Austrian and German Plague Commissions have shown that in a considerable number of patients, death is not directly due to plague, but to infection by various cocci. Plague, no doubt, paves the way for other micro-organisms which find a suitable soil in a body weakened by its action. Against the coccic infection, the plague serum, as a specific remedy, is without any effect. We can, therefore, appreciate still more the necessity of early treatment which, by checking the plague at its beginning, prevents the infection by other bacteria.

The frequency of such bacterial associations may vary in different epidemics of plague, as it is known to vary in other diseases in which such associations also occur, and they may have something to do with the malignity of certain epidemics and the non-typical course of single cases. In these mixed or secondary infections, a combined serum treatment may prove efficacious and is certainly worth trying.

Unfavourable also are complications with relapsing fever, or malaria, which were not infrequent in the patients at the Arthur Road Hospital.

No cures have been obtained in plague pneumonia. Comparatively few such cases have been treated, as pneumonia patients are mostly beyond help when they are admitted.

Symptomatic treatment is not to be neglected in serum cases. The patients at the Arthur Road Hospital received a small quantity of rum every two hours and cardio stimulants when the heart showed signs of impending failure.

In order to facilitate a review of the facts relating to the efficacy of the serum that have been brought forward in this report, the following summary may be given :—

(a) *Clinical statement*—

1. Fall of temperature.
2. Increase of arterial pressure.
3. Mitigation of nervous symptoms.
4. Lessening of tenderness in the bubo.
5. Diminution of size of the bubo.
6. More frequent re-absorption of bubo.

(b) *Statistical statement*—

1. Varying efficacy of the different sera employed.
2. Higher recovery rate in the serum cases than in the non-serum cases.
3. Higher total recovery rate in the serum periods than in the intermediate period.
4. Increase of the monthly recovery rate coinciding in both serum periods with the commencement of the treatment.
5. Lower death-rate within the first 48 hours after admission during the serum period than during the intermediate period.
6. Higher total recovery rate at the Arthur Road Hospital during the time of the serum treatment than at other hospitals where the serum was not employed.

There is no missing link in this chain of proofs and the curative properties of Prof. Lustig's serum have, therefore, to be accepted as an established fact.

If I were to compress the conclusions to be drawn from this evidence in one sentence, I should say that "by Prof. Lustig's method a curative plague serum can be prepared which has shown in its experimental stage results which allow a hope that the serum will become an effective weapon in combating the disease."

Considering now the application of the remedy to a disease which attacks so numerously the poorest class of the population, one has to admit, hard as it is to admit it, that the *practical* value of the serum is in direct proportion to the percentage of recoveries which can be obtained under the unfavourable circumstances common to such a class of population. If this percentage falls under a certain standard, the cost of the preparation of the serum may be prohibitive.

Having ascertained by the clinical method, *that* the serum cures, it is all important therefore to ascertain, by an adequate method, which will be also convincing to the public at large, *how many* it cures. The treatment with the serum is therefore being continued at the Arthur Road Hospital, every alternative case being subjected to it.

No fundamental objection can be raised now against statistics as the experimental stage of the treatment is past. Variations on the preparation or application which may still have to be adopted, will serve as improvements only. Such improvements are already under contemplation. They have not been attempted until

now as, owing to the small number of the horses, a good method could not be abandoned for a possibly better one as long as the efficacy of the serum was not universally acknowledged.

After all that has been said about the errors of statistics, it is hardly necessary to repeat that the number of observations must be large. If I should be called upon to fix this number, I should say that at least 500 comparable observations will be necessary in order to allow reliable statistical conclusions. But if the observations are made under the varying conditions of different surroundings or by persons, not familiar with the treatment, new unknown factors are introduced and the number of observations has to be still further increased. It is for this reason that the experimenters are as yet reluctant to have the observations scattered over different places, the supply of serum being still limited.

The issue at stake is of such great importance that every step forward has to be taken with the utmost precautions in order to avoid accidental non-successes. These remarks may also be applied to the use of the serum in private practice where the indiscriminate administration of the serum may discredit it in single instances. This disadvantage, however, will be greatly counterbalanced by the favourable conditions of application, and we may expect from private practitioners early accounts of good results.

What are the *best* results we may hope for in hospitals?

Provided future epidemics are not of increased virulence, the percentage of recoveries ought to be higher than it was in the selected cases. Firstly, because the results of the past have been obtained in patients who, owing to the selection, would have had an increased mortality under the ordinary treatment, and secondly, because we may expect that sooner or later the production of a serum of the highest activity will be the rule.

The efficacy of a serum must not be judged by the *average* results which have been obtained, but by the *best* results. If a serum with high curative properties has once been prepared, it will be possible to prepare it *again*, and with certainty. This is merely a question of time and experience.

Considered numerically, it may be said that about 30 per cent. of the patients at the large plague hospitals die within the first 24 hours after admission, and that recovery in them will be exceptional even with the best serum. Within the next 24 hours another 20 per cent. die: that many of these may be saved is open to doubt. About 20 per cent. recover under the ordinary treatment. Thus there remain 30 per cent. in which there is the *possibility* and *probability* of the serum influencing recovery.

An increase of the recovery rate from 20 per cent. to 50 per cent. is what we can confidently hope for.

It can be said that this does not correspond to 26 recoveries in 30 cases treated by Prof. Lustig in 1897. To this I would reply, that a generalisation from the lower to the higher number is in itself erroneous, that the average recovery rate in 1897 was 15 per cent. to 20 per cent. higher than it is now, and that the treated patients were mostly Mahomedans or soldiers of good physique, well fed and brought early to the hospital—all the above conditions being favourable to the serum treatment.

That by the serum treatment a mortality of 80 per cent. should be reduced to an insignificant number, as some demanded, is an exaggeration which could only have been indulged in by those who were ignorant of the clinical features of plague.

In private practice a higher recovery rate will be obtained.

If the above estimated benefit is approximately correct, would the increase of the recovery rate from plague by 30 per cent. constitute the practical value of the serum and would the cost allow of its preparation on a corresponding scale?

When the serum treatment was begun in Bombay, the public interest was concerned with Prof. Haffkine's prophylactic, the method of which is *wholesale application*. By an unconscious mental process which was facilitated by the still existing confusion between the names, the requirements of the one were applied to the other, although they differ *essentially*.

The prophylactic treatment is confronted with the ubiquitous possibility of infection and must, therefore, be wholesale in order to be effective.

Quite different are the requirements of a curative treatment. Its object is the sick, and its aim recovery, which latter is the direct proof of the efficacy: but as recovery is not possible in every case, a curative treatment is always *selective* and ought to be confined to those who can be influenced by it. Such selection is feasible in plague as very often the possibility of recovery is absolutely excluded. It is also necessary as without selection the preparation of a sufficient quantity of serum would be difficult and the cost considerably increased. The question therefore stands thus:—

Shall we *cure none* because we cannot *treat all*?

There should be only one answer to this question. But whatever the answer may be, and whatever the future of the serum treatment of plague here in India, the knowledge that there is a remedy for those sick of the pestilence will be of value to mankind, while the merit of having been instrumental in the acquisition of this knowledge will always remain with the Bombay Municipality and their advisers, Col. Weir and the late Commissioner Mr. Snow, who were active in initiating the serum treatment.

APPENDIX No. III.

REPORT ON THE TREATMENT OF PLAGUE

BY

DR. GALLEOTTI'S CURATIVE SERUM

BY

CAPTAIN L. F. CHILDE, I.M.S.

Statement of Plague Cases treated by Dr. Galleotti's Serum at Marátha Plague Hospital.

No.	Name.	Date of Admission.	Age.	Sex.	Caste.	Day of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS.
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.			
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.		
1	Narbada Laximan ...	2nd February 1899	18	Female.	Hindu	2 days ...	3rd February 1899.	18	15	15	15	19	19	19	...	...	...	...	Died 8-50 P.M., 6th February 1899.	
2	Maruti Gopal ...	2nd do. ...	20	Male ...	Do. ...	1 day ...	2nd do. ...	15	15	10	...	...	...	...	...	...	...	...	Recovered.	
3	Saku Malji ...	3rd do. ...	35	Female.	Do. ...	1 ,, ...	3rd do. ...	20	...	10	...	10	...	...	...	...	...	...	Died 6 P.M., 6th February 1899.	Vapour bath in addition given.
4	Bhicu Ramaji ...	3rd do. ...	6	Child ...	Do. ...	1 ,, ...	3rd do. ...	5	12	10	...	...	...	...	...	...	...	...	Died 4-30 P.M., 4th February 1899.	
5	Uma Mahadu... ..	3rd do. ...	15	Female.	Do. ...	1 ,, ...	3rd do. ...	...	10	10	15	10	...	...	...	...	...	...	Recovered.	
6	Dagdu Honaji ...	4th do. ...	30	Male ...	Do. ...	1 ,, ...	4th do. ...	19	19	18	19	...	...	...	...	...	...	...	Died 7-50 P.M., 5th February 1899.	
7	Sayi Tukaram ...	4th do. ...	15	Female.	Do. ...	3 days ...	6th do. ...	15	...	...	...	...	...	...	...	...	...	...	Died 5 A.M., 7th February 1899.	Vapour bath in addition given.
8	Kalappa Basappa ...	5th do. ...	30	Male ...	Do. ...	1 day ...	5th do. ...	15	19	19	...	19	...	...	...	...	...	...	Recovered.	
9	Babaji Narayan ...	7th do. ...	30	Do. ...	Do. ...	1 ,, ...	7th do. ...	10	19	...	19	...	19	...	...	...	...	...	Died 12-30 P.M., 11th February 1899.	
10	Narayan Bhanu ...	7th do. ...	25	Do. ...	Do. ...	1 ,, ...	7th do. ...	...	19	19	...	19	15	...	10	...	...	...	Died 7 A.M., 11th February 1899.	
11	Ganu Kolu ...	7th do. ...	30	Do. ...	Do. ...	1 ,, ...	7th do. ...	...	15	...	19	...	...	...	...	...	...	...	Died 1-10 A.M., 10th February 1899.	
12	Radha Hari ...	11th March 1899	20	Female.	Do. ...	2 days	15	15	16	Died 11-30 A.M., 12th March 1899.	Heart failure	

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Statement of Plague Cases treated by Dr. Galleotti's Serum, at the Arthur Road Hospital.

No.	Name.	Date of Admission.	Age.	Sex.	Caste.	Date of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS.	
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.				
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.			
	Series.		Years.					c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.			
12	Girsa Babu...	1st	29th January 1899.	10	Child	Hindu	3 days	29th January 1899.	...	18	...	10	...	...	...	...	...	...	...	...	Died 3-15 P.M., 81st	Temp. 106-4.
13	J. J. DeSilva	do.	38th do.	61	Male	Christian	4 "	30th do.	...	20	...	...	...	...	...	...	...	...	...	...	Died 2-15 A.M., 31st	
14	Unknown	do.	31st do.	42	Do.	Hindu	1 day	31st do.	...	15	...	15	...	15	...	...	...	...	...	...	Died 12 o'clock, 1st	Moribund.
15	Rama Baghu	do.	1st February 1899.	20	Do.	Do.	4 days	1st February 1899.	15	15	10	10	10	10	...	...	10	20	15	20	Recovered ...	Septic type.
16	Bbambu Raju	do.	1st do.	20	Do.	Do.	4 "	1st do.	...	15	...	15	...	...	...	...	...	...	...	...	Died 10 P.M., 1st	Moribund.
17	Mahadu Ithu	do.	31st January 1899.	10	Child	Do.	4 "	1st do.	...	10	10	5	5	5	10	10	10	5	5	5	Recovered ...	Intestinal hæmorrhage.
18	Shiva Iasu	do.	1st February 1899.	40	Male	Do.	2 "	1st do.	...	15	15	15	15	15	16	...	...	...	...	...	Do. ...	Septic type.
19	Ganesh Khedu	do.	1st do.	88	Do.	Do.	2 "	1st do.	...	...	15	10	15	15	16	...	...	...	...	...	Died 7 A.M., 4th	Improvement and then relapse.
20	Biranji Ganesh	do.	1st do.	25	Female	Do.	3 "	1st do.	...	...	15	...	10	15	15	20	20	...	...	...	Died 6-50 P.M., 4th	Meningeal symptoms and hæmatemesis.
21	Deuba Gainu	do.	2nd do.	18	Male	Do.	3 "	2nd do.	...	15	...	15	10	...	...	...	...	...	...	...	Died 9 P.M., 3rd	Multiple buboes.
22	Esu Kondajt	do.	1st do.	30	Do.	Do.	5 "	2nd do.	...	...	15	...	...	...	...	...	...	...	...	...	Died 7 P.M., 3rd	Moribund.
23	Gannu Gosai	do.	2nd do.	29	Do.	Do.	3 "	2nd do.	...	...	15	...	...	...	...	...	...	...	...	...	Died 12-15 P.M., 3rd	Moribund.
24	Pandu Gopal	do.	2nd do.	15	Do.	Do.	1 day	2nd do.	...	...	15	18	10	15	15	...	...	...	...	...	Died 8 A.M., 5th	Semi-conscious on admission.
25	Shiva Hari	do.	4th do.	80	Do.	Do.	4 days	4th do.	...	...	15	15	15	15	15	...	...	...	...	...	Died 9-15 P.M., 6th	Died of heart failure.

No.	Name.	Date of Admission.	Age.	Sex.	Caste.	Date of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS						
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.									
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.								
26	Abba Bala	1st	4th February 1899.	32	Male	Hindu	7 days	4th February 1899.	...	20	15	20	20	20	15	15	...	...	...	...	...	...	...	...	Died 6-30 P.M., 13th February 1899.	Improvement and then relapse.
27	Govind Hiru	do.	6th do.	25	Do.	Do.	3 "	6th do.	...	20	20	20	20	20	...	...	...	...	...	...	...	...	...	...	Died 9 P.M., 8th February 1899.	Very delirious and feeble pulse.
28	Maruthi Jiwha	2nd	3rd do.	25	Do.	Do.	6 "	3rd do.	...	10	10	...	...	...	...	...	...	...	...	...	...	...	...	...	Died 10 P.M., 6th February 1899.	Tetanic. Injection stopped.
29	Jani Bhawu	do.	2nd do.	20	Female	Do.	8 "	3rd do.	...	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Died 12-50 noon, 3rd February 1899.	Moribund.
30	Ramchander Fana	1st	3th do.	22	Male	Do.	4 "	8th do.	...	20	20	20	20	15	15	15	15	...	...	...	...	...	...	...	Died 21st February 1899.	Death from cedema of lungs.
31	I. M. Fernaudes	2nd	3rd do.	18	Female	Christian	2 "	3rd do.	...	15	15	15	15	10	10	10	10	...	...	...	...	...	...	...	Recovered	
32	Dama Lemba	do.	3rd do.	28	Male	Hindu	4 "	3rd do.	...	15	15	15	...	...	...	...	...	...	...	...	...	...	...	...	Died 10-15 A.M., 5th February 1899.	Unconscious.
33	Maracti Santu	do.	3rd do.	35	Do.	Do.	4 "	3rd do.	...	15	10	10	15	20	20	20	...	...	...	...	...	...	...	...	Died 10 A.M., 7th February 1899.	Do.
34	Sambu Ganu	do.	4th do.	24	Child	Do.	3 "	4th do.	...	5	5	...	...	...	...	...	...	...	...	...	...	...	...	...	Died 6-45 A.M., 5th February 1899.	Sudden failure of heart.
35	Jumnabye Dulbi	do.	4th do.	6	Do.	Do.	2 "	4th do.	...	10	...	10	10	...	...	...	...	...	...	...	...	...	...	...	Died 8-30 P.M., 6th February 1899.	Convulsions and cedema of lungs.
36	Tribhowan Govind	do.	3rd do.	18	Male	Do.	2 "	3rd do.	...	15	15	15	10	15	10	10	10	10	Recovered.	
37	Soma Mitha	do.	5th do.	15	Do.	Do.	1 day	5th do.	...	20	20	20	20	15	15	...	20	10	10	10	...	...	...	...	Do.	
38	Shivram Bhau	do.	5th do.	12	Do.	Do.	2 days	5th do.	...	15	15	15	...	...	...	...	...	...	...	...	...	...	...	...	Died 3-55. 7th February 1899.	Sudden failure of the heart.
39	Dagru Janu	3rd	7th do.	10	Child	Do.	1 day	7th do.	...	20	20	20	...	...	...	...	...	...	...	...	...	...	...	...	Died 3 A.M., 8th February 1899.	Heart failure.
40	Dhondu Bhairu	do.	7th do.	30	Male	Do.	3 days	7th do.	...	20	20	15	15	20	20	15	Died 9-30 P.M., 17th February 1899.	Died of exhaustion.
41	Jai Tukaram	do.	7th do.	50	Female	Do.	4 "	7th do.	...	20	20	15	Died 7-30 P.M., 6th February 1899.	

42	Salvador Noronha ...	2nd	5th	do.	...	40	Male ...	Christian...	3	"	...	5th	do.	...	...	20	20	20	20	20	10	...	10	10	10	...	Died 23rd February 1899.	Died of exhaustion from sloughing of iliac bubo.
43	Balu Laku ...	...	3rd	8th	do.	...	18	Do. ...	Hindu ...	1	day	...	8th	do.	...	20	...	...	...	...	...	...	...	...	...	...	Died 6-15 P.M., 5th February 1899.	Moribund.
44	Pira Bapuji...	...	do.	7th	do.	...	20	Female .	Do. ...	2	days	...	7th	do.	...	20	20	15	...	15	15	15	15	15	10	...	Recovered.		
45	Bhawansing Rysing.	do.	8th	do.	...	12	Male ...	Do. ...	2	"	...	9th	do.	...	...	...	15	...	10	10	10	10	...	...	...	Do.		
46	Dhondu Haghu ...	do.	8th	do.	...	19	Do. ...	Do. ...	4	"	...	9th	do.	...	...	...	20	...	15	20	15	20	15	10	10	10	Do.	
47	Condi Babul ...	do.	10th	do.	...	12	Female .	Do. ...	1	day	...	11th	do.	...	20	20	20	15	20	20	...	...	...	...	...	...	Died 7-20 A.M., 14th February 1899.	
48	Shamji Pitamber	do.	13th	do.	...	40	Male ...	Do. ...	3	days	...	13th	do.	...	20	...	...	...	...	...	...	...	...	...	...	...	Died 5 P.M., 13th February 1899.	Sudden failure of heart.
49	R. M. DeSilva ...	do.	9th	do.	...	22	Female .	Christian .	3	"	...	11th	do.	...	20	...	...	...	...	...	...	...	...	...	...	...	Recovered.	
50	Jiji Khandu ...	do.	14th	do.	...	12	Do. ...	Hindu ...	3	"	...	15th	do.	...	20	20	15	20	7	...	...	...	...	...	...	...	Do.	
51	Dhondu Suecaram...	do.	12th	do.	...	25	Male ...	Do. ...	8	"	...	13th	do.	...	...	20	20	20	10	...	15	20	20	...	...	...	Died 1 A.M., 18th February 1899.	From oedema of lungs.
52	Mr. M. (Private)	do.	9th	do.	...	25	Do. ...	Parsi ...	2	"	...	10th	do.	...	20	20	...	...	...	...	...	...	...	...	...	...	Recovered.	
53	Chemi Bapu do.	do.	13th	do.	...	40	Female .	Hindu ...	1	day	...	13th	do.	...	...	20	20	20	10	...	...	...	...	...	...	...	Died 5-30 P.M., 15th February 1899.	
54	Miss P. (Private) ...	1st	30th	January 1899.	...	16	Do. ...	Parsi ...	2	days	...	30th	January 1899.	...	15	15	15	15	15	15	10	5	5	...	...	...	Recovered.	Had a relapse with iliac bubo.
55	Mrs. K. do.	...	3rd.	11th	February 1899.	...	46	Do. ...	Do. ...	4	"	...	11th	February 1899.	...	20	20	...	...	...	...	...	...	...	...	...	Died 2 A.M., 13th February 1899.	Mitral Regurgitation and Diabetes.
56	Miss K. do.	...	do.	11th	do.	...	16	Do. ...	Do. ...	1	day	...	11th	do.	...	20	18	28	Recovered.	
57	Joda Harsayal ...	4th	21st	do.	...	40	Male ...	Hindu ...	4	days	...	21st	do.	...	...	20	...	...	...	...	...	...	...	...	...	...	Died 9 A.M., 21st February 1899.	Moribund.
58	Jiwa Kalu ...	...	do.	21st	do.	...	18	Do. ...	Do. ...	2	"	...	21st	do.	...	20	...	...	...	...	...	...	...	...	...	...	Died 4 P.M., 22nd February 1899.	Heart failure.
59	Parbu Narsu ...	do.	21st	do.	...	30	Do. ...	Do. ...	3	"	...	21st	do.	...	...	20	20	20	...	...	...	...	...	...	...	...	Died 7-55 P.M., 22nd February 1899.	Secondary Pneumonia.
60	Hiralal Lon ...	do.	21st	do.	...	35	Do. ...	Do. ...	3	"	...	21st	do.	...	...	20	20	20	20	...	20	20	...	...	...	...	Died 4 P.M., 3rd March 1899.	Do.
61	Nama Rama ...	do.	24th	do.	...	35	Do. ...	Do. ...	2	"	...	24th	do.	...	20	20	20	20	20	20	...	...	...	...	...	...	Died 6 P.M., 27th February 1899.	
62	Ganu Chandria ...	do.	23rd	do.	...	22	Do. ...	Do. ...	2	"	...	24th	do.	...	30	30	20	20	20	20	...	...	...	...	...	...	Died 10 A.M., 27th February 1899.	
63	Gaugaram Bholla ...	do.	24th	do.	...	50	Do. ...	Do. ...	2	"	...	24th	do.	...	20	20	20	20	20	20	...	...	...	...	...	...	Died 7-15, 28th February 1899.	

No.	Name.	Date of Admission.	Age.	Sex.	Caste.	Day of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS.
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.			
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.		
64	Shanker Suka	4th	24th February 1899.	5	Child...	Hindu	2 days ... 24th February 1899.	10	10	5	5	5	...	...	...	...	...	...	Recovered.	
65	Raghu Krishna	do.	24th do.	82	Male ...	Do.	3 " ... 24th do.	...	...	20	20	20	20	...	...	...	...	...	Died 12-30, 26th February 1899.	
66	Sucaram Bapu	do.	25th do.	18	Do. ...	Do.	2 " ... 25th do.	20	20	20	...	...	...	...	...	...	...	...	Do.	
67	Dhondu Vithu	do.	26th do.	12	Do. ...	Do.	3 " ... 26th do.	15	...	...	...	...	...	...	...	...	...	...	Died 3-30 P.M., 26th February 1899.	Moribund.
68	Ganput Yessu	do.	25th do.	22	Do. ...	Do.	2 " ... 26th do.	20	...	...	...	...	...	...	...	...	...	...	Died 5-30 P.M., 26th February 1899.	
69	Babukhan Husain	5th	24th do.	18	Do. ...	Mussalman	2 " ... 23rd do.	...	15 at his house	20	20	15	20	15	15	...	...	...	Died 9-15 A.M., 2nd March 1899.	Secondary Pneumonia.
70	Rama Dargu	do.	26th do.	25	Do. ...	Hindu	2 " ... 26th do.	...	20	20	10	...	...	...	...	...	...	...	Died 8-30 P.M., 27th February 1899.	Heart failure, septic type.
71	Bhanu Babaji	do.	26th do.	19	Do. ...	Do.	2 " ... 26th do.	...	20	20	20	15	10	...	20	15	...	...	Died 3-45 A.M., 3rd March 1899.	Do.
72	Reva Begla	do.	26th do.	30	Do. ...	Do.	2 " ... 26th do.	...	20	20	15	10	15	...	...	...	...	...	Died 8 P.M., 28th February 1899.	Edema of lung.
73	Mahadu Tanu	do.	27th do.	27	Do. ...	Do.	3 " ... 27th do.	...	80	80	80	20	20	15	...	...	...	...	Recovered.	
74	Yedu Rama	do.	26th do.	6	Child...	Do.	3 " ... 28th do.	10	10	5	...	...	...	...	...	...	...	...	Do.	
75	Sawalia Dhondi	do.	2nd March 1899...	12	Male ...	Do.	5 " ... 2nd March 1899	15	15	10	...	...	...	...	...	...	...	...	Do.	A mixed case of plague and remittent fever.
76	Kondiba Maroti	do.	5th do.	20	Female.	Do.	2 " ... 5th do.	20	...	...	...	...	...	...	...	...	...	...	Died 7 P.M., 5th March 1899.	Heart failure.
77	Walji Tricum	do.	5th do.	10	Child...	Do.	" ... 5th do.	10	10	5	...	...	...	...	...	...	...	...	Died 3-40 A.M., 7th March 1899.	Do.
78	Tricum Purshotam	do.	5th do.	30	Male ...	Do.	3 " ... 5th do.	20	20	10	...	...	...	...	...	...	...	...	Died, 16th March 1899.	Marasma and exhaustion.

79	Marjiwan Tricum... do.	5th do.	19	Do.	Do.	5 "	5th do.	20	15	10	...	...	...	...	...	...	...	...	...	Died 10-45 P.M., 6th March 1899.	Heart failure.
80	Abba Bayaji ... do.	1st do.	80	Do.	Do.	3 "	1st do.	...	80	80	30	20	...	20	...	...	...	...	...	Died, 8th March 1899.	Secondary Pneumonia.
81	Sonu Babaji ... 3rd	21st February 1899	30	Do.	Do.	3 "	31st February 1899	...	40	...	...	...	...	...	...	...	...	...	...	Died 7 A.M., 32nd February 1899.	Multiple buboes.
82	Mr. B. P. M. (4th Private)	15th do.	6	Child	Parsi	1 day	15th do.	...	49	c.c.	Total	...	...	...	...	...	...	...	...	Recovered.	
83	Bhagwan Bhana ... 5th	6th March 1899	25	Male	Hindu	2 days	6th March 1899	...	20	10	...	...	...	...	...	...	...	...	...	Do.	
84	Pundharinath Bala- shet ... do.	6th do.	22	Do.	Do.	2 "	6th do.	...	15	10	...	...	...	...	...	...	...	...	...	Died 10 P.M., 7th March 1899.	Heart failure.
85	Vasan Govind ... do.	7th do.	30	Do.	Do.	2 "	7th do.	...	15	10	10	10	10	...	...	...	...	...	...	Died 9-30 P.M., 9th March 1899.	Secondary Pneumonia.
86	Kashibai (Private do.)	27th February 1899	27	Female.	Do.	1 day	27th February 1899	...	110	c. c.	total quantity	...	...	...	...	...	...	...	...	Recovered.	
87	Mr. S. P. C. (Private, 5th.)	28th do.	40	Male	Portuguese	1 "	28th do.	...	55	c. c.	total quantity	...	...	...	...	...	...	...	...	Died, 2nd March 1899.	Heart failure.
88	Manecklal Lallu ... 6th	4th March 1899	33	Do.	Hindu	1 "	4th March 1899	...	80	15	20	...	...	...	...	...	...	...	...	Died, 5th March 1899.	Do.
89	Rama Sakaram ... do.	5th do.	14	Do.	Do.	1 "	5th do.	...	20	...	...	...	...	...	...	...	...	...	...	Died, 6th March 1899.	Moribund.
90	Binda Bapu ... do.	7th do.	32	Do.	Do	3 days	7th do.	...	18	...	...	...	...	...	...	...	...	...	...	Died, 7th March 1899.	Do.
91	Chadulla Shaik Farid ... do.	7th do.	40	Do.	Mahomedan	4 "	7th do.	...	17	...	20	15	...	...	...	...	...	...	...	Died, 13th March 1899.	Improvement and then relapse.
92	Ganu Gabur ... do.	8th do.	20	Do.	Hindu	3 "	8th do.	...	15	15	10	...	...	...	...	...	...	...	...	Died, 9th March 1899.	Heart failure.
93	Gaffur Lalla ... do.	7th do.	7	Child	Mahomedan	2 "	7th do.	...	10	10	...	...	...	...	...	...	...	...	...	Died, 10th March 1899.	Plague and Measles, heart failure.
94	Bhiku Ramchandra do.	7th do.	20	Male	Hindu	1 day	8th do.	...	15	20	...	...	...	...	...	...	...	...	...	Died, 9th March 1899.	
95	Ambu Govinda ... do.	6th do.	18	Do.	Do.	2 days	8th do.	...	30	10	10	...	...	...	...	...	...	...	...	Recovered ...	Septic type.
96	Hurshunkar Buldev. do.	8th do.	45	Do.	Do.	3 "	8th do.	...	20	15	10	10	...	...	...	...	...	...	...	Do.	
97	Nathia Bhanu ... do.	9th do.	23	Do.	Do.	3 "	9th do.	...	15	10	...	...	...	...	...	...	...	...	...	Died, 10th March 1899.	Heart failure.
98	T. V. Mungabun ... do.	9th do.	30	Do.	Native Christian.	2 "	9th do.	...	20	15	15	10	10	...	...	...	...	...	...	Died, 13th March 1899.	Do.
99	Mr. I. B. I. (Private do.)	3rd do.	11	Do.	Portuguese	2 "	4th do.	...	...	...	...	...	...	...	...	...	...	...	...	Recovered ...	Septic type.
100	Bipati Mehge ... 6th	11th do.	20	Do.	Hindu	3 "	11th do.	...	20	15	...	10	10	10	10	...	...	...	...	Do.	

No.	Name.	Date of admission.	Age.	Sex.	Caste.	Day of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS.				
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.							
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.						
	Series		Years.					c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.		
101	Dadu Sadu ... 6th	11th March 1899	30	Male	Hindu	3 days	12th March 1899	20	15	10	20	20	...	...	...	...	...	...	...	...	...	...	...	Died, 15th March 1899.	Secondary Pneumonia.
102	L. C. Sequeira ... do.	12th do.	45	Do.	Christian	3 "	12th do.	20	10	...	10	15	15	...	...	...	...	...	...	...	...	...	...	Do.	Fatty heart and do.
103	Pandu Janu ... do.	13th do.	20	Do.	Hindu	2 "	13th do.	20	15	15	15	15	...	...	...	...	...	...	...	...	...	...	...	Recovered.	
104	Kessu Lalla ... do.	12th do.	60	Do.	Do.	2 "	13th do.	15	15	15	15	10	10	...	...	...	...	...	...	...	...	...	...	Died, 23rd March 1899.	From exhaustion after 11 days.
105	Bhawanisunker Hary ... do.	13th do.	17	Do.	Do.	2 "	13th do.	15	15	10	...	...	...	...	...	...	...	...	...	...	...	...	...	Recovered.	
106	Nana Bhana ... do.	13th do.	25	Do.	Do.	2 "	13th do.	...	20	20	20	...	...	...	...	...	...	...	...	...	...	...	...	Died, 15th March 1899.	Heart failure.
107	Francis X. Fernandes ... do.	13th do.	20	Do.	Christian	3 "	14th do.	20	20	20	15	10	...	...	...	...	...	...	...	...	...	...	...	Recovered.	
108	Gunia Sudu ... do.	11th do.	35	Do.	Hindu	4 "	14th do.	20	15	15	15	10	...	...	...	...	...	...	...	...	...	...	...	Do.	
109	Apa Bhaukhan ... do.	14th do.	20	Do.	Do.	2 "	14th do.	...	20	10	10	16	...	...	...	...	...	...	...	...	...	...	...	Do.	
110	Sheva Khondaji ... do.	14th do.	35	Do.	Do.	2 "	14th do.	...	20	20	20	15	20	20	...	15	...	...	...	...	...	...	...	Do.	
111	Ciprion Fernandes ... do.	14th do.	25	Do.	Christian	2 "	14th do.	...	20	10	...	...	...	...	...	...	...	...	...	...	...	...	...	Do.	
112	John DeCosta ... do.	15th do.	30	Do.	Do.	3 "	15th do.	...	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	Died, 15th March 1899.	Moribund.
113	Sukai Ishari ... do.	15th do.	30	Do.	Hindu	4 "	15th do.	...	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	Died, 16th March 1899.	Secondary Pneumonia and heart failure.
114	Deria Isra ... do.	15th do.	23	Do.	Do.	5 "	15th do.	...	20	10	10	...	...	...	...	...	...	...	...	...	...	...	...	Recovered.	
115	Mamiaji Yesram ... do.	16th do.	15	Do.	Do.	8 "	16th do.	...	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	Died, 17th March 1899.	Heart failure.

116	Cyprian Alphonso ... do.	15th do.	40	Do.	Christian.	1 day	16th do.	20	20	10	10	10	10	Died, 18th March 1899.	Do.	do.
117	Private do.	37th February 1899	14	Do.	Hindu	4 days	...	70	c.c.	Recovered.		
118	Mrs. H. S. ... Private do.	15th March 1899	56	Female	Parsi	3 "	15th March 1899	57	c.c.	Died, 22nd March 1899.	Do.	and oedema lung.
119	Bhagwandas Baghu do.	16th do.	30	Male	Hindu	4 "	16th do.	...	10	10	10	10	...	10	Recovered.		
120	Domingo Caitan ... do.	16th do.	68	Do.	Christian.	1 day	16th do.	...	20	15	10	10	...	...	...	...	...	...	...	Died, 18th March 1899.	Edema lung and heart failure.
121	Khrishna Vithu ... do.	17th do.	40	Do.	Hindu	3 days	17th do.	30	20	15	15	...	...	...	...	...	...	...	...	Died, 19th March 1899.	Heart failure.
122	Cosme Damian ... do.	17th do.	23	Do.	Christian.	3 "	17th do.	30	20	20	15	20	...	...	...	...	...	...	...	Do.	Do.
123	Walla Prema ... do.	17th do.	28	Do.	Hindu	4 "	17th do.	...	20	15	10	10	...	...	...	...	...	...	...	Died, 20th March 1899.	Edema lung.
124	Gandaram Karamchand ... do.	16th do.	30	Do.	Do.	4 "	17th do.	...	20	15	10	10	10	...	...	...	...	...	...	Do.	Septic type.
125	Mrs. Moses ... do.	17th do.	30	Female.	Christian.	4 "	17th do.	...	20	20	10	5	10	5	Recovered.		
126	Babaji Zora ... do.	17th do.	40	Male	Hindu	3 "	18th do.	15	10	10	15	10	...	...	...	...	...	...	...	Died, 26th March 1899.	Secondary Pneumonia.
127	Peter Fernandes ... do.	18th do.	30	Do.	Christian.	3 "	18th do.	30	10	10	...	...	...	...	...	...	...	...	...	Died, 19th March 1899.	Heart failure.
128	Maruti Gainu ... do.	18th do.	20	Female.	Hindu	3 "	18th do.	30	15	15	15	5	Recovered.		
129	Miss B. I. S. Private do.	17th do.	16	Do.	Parsi	3 "	17th do.	50	c.c.	...	...	...	...	...	...	...	...	...	...	Died, 19th March 1899.	Heart failure.
130	Sawatie Saurela ... do.	18th do.	35	Do.	Hindu	3 "	18th do.	...	20	15	20	...	...	...	...	...	...	...	...	Died, 20th March 1899.	Bronchitis.
131	Francis Pereira ... do.	18th do.	30	Male	Christian.	1 day	18th do.	...	20	15	10	Recovered.		
132	Antone Salvador ... do.	18th do.	60	Do.	Do.	3 days	18th do.	...	15	20	...	...	...	...	...	...	...	...	...	Died, 19th March 1899.	Heart failure.
133	Shalk Madar ... do.	18th do.	30	Do.	Hindu	3 "	18th do.	...	15	15	...	...	...	...	...	...	...	...	...	Do.	Do.
134	Pedro Bustaw Costa ... do.	6th 18th do.	42	Do.	Christian.	1 day	18th do.	...	15	20	15	15	10	...	...	...	...	...	...	Died, 22nd March 1899.	Secondary Pneumonia.
135	Piran Amer ... do.	7th 16th do.	35	Do.	Mahomedan.	2 days	16th do.	...	30	20	20	15	...	10	10	Recovered.		
136	Salva Mahado ... do.	18th do.	35	Do.	Hindu	1 day	18th do.	...	30	20	...	...	...	...	...	...	...	...	...	Died, 20th March 1899.	Moribund and heart failure.
137	Dhondu Krishna ... do.	19th do.	30	Do.	Do.	3 days	19th do.	20	10	10	10	5	Recovered.		

No.	Name.	Date of Admission.	Age.	Sex.	Caste.	Day of Disease.	Date of Serum injected.	AMOUNT OF SERUM INJECTED.												Result.	REMARKS.	
								1st day.		2nd day.		3rd day.		4th day.		5th day.		6th day.				
								Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.	Morning.	Evening.			
	Series.		Years.					c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.					
<u>138</u>	Sitta Balco ...	... 7th	20th March 1899 ...	22	Male ...	Hindu ...	8 days ...	20th March 1899 ...	15	15	15	15	...	15	10	15	...	...	...	Died, 24th March 1899.	March	Heart failure.
<u>139</u>	Michael Francis ...	do.	21st do.	14	Do. ...	Christian	2 "	21st do.	...	20	15	15	15	10	10	...	...	...	Do,			
<u>140</u>	Sonia Prema ...	do.	22nd do.	12	Do. ...	Hindu	5 "	23rd do.	15	15	15	10	10	10	7	5	...	...	...	?
<u>41</u>	Nama Bawji ...	do.	23rd do.	25	Do. ...	Do.	1 day	23rd do.	...	20	20	...	...	...	...	...	...	...	Died, 24th March 1899.	March	Heart failure.	
<u>142</u>	Bhagla Puchya ...	do.	24th do.	18	Do. ...	Do.	3 days	24th do.	20	15	15	15	10	15	...	15	...	...	?	
<u>143</u>	Mahadeo Panga ...	do.	25th do.	25	Do. ...	Do.	2 "	25th do.	20	20	15	10	10	10	...	...	...	...	?
<u>144</u>	Bhagwan Hanuiman . do.	do.	25th do.	18	Do. ...	Do.	2 "	26th do.	20	20	15	15	15	...	...	...	...	...	?
<u>145</u>	Tatya Babaji ...	do.	25th do.	25	Do. ...	Do.	1 day	26th do.	20	...	...	...	...	...	...	...	...	...	Died, 27th March 1899.	March	Secondary Pneumonia.	
<u>146</u>	Ratan Dhana ...	do.	26th do.	14	Do. ...	Do.	2 days	27th do.	15	15	10	...	...	...	...	...	...	...	?
<u>147</u>	Babajl Dhakoo ...	do.	27th do.	80	Do. ...	Do.	8 "	27th do.	...	20	15	...	...	...	...	...	...	...	?

Observations.—The total number of cases treated by Dr. Galleotti's serum from February 2nd to March 27th has been 148 ; of which 125 were treated at the Arthur Road Hospital, 12 were treated at the Maratha Hospital, and 11 were treated in their own houses.

By sex, these 148 persons consisted of 118 males and 30 females (11 being children) ; and

By caste, there were 117 Hindus, 18 Native Christians, 9 Pársis and 4 Mähomedans.

With regard to duration of disease, it is found that—

30	were treated on the 1st day of disease.
49	do. 2nd do.
43	do. 3rd do.
20	do. 4th do.
4	do. 5th do.
1	was do. 6th do.
1	do. 7th do.

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so that 122 out of 148 patients were receiving the serum treatment on or before the 3rd day of plague.

Mortality.—Of the total 148 cases, 99 died, 43 recovered, and 6 are still under treatment.

Out of the 113 adult males, 78 died, 29 recovered, and 6 are under treatment.

Of the 24 adult females, 14 died, 10 recovered.

Of the 11 children, 7 died, 4 recovered.

Mortality by Caste.—Of the 117 Hindus, 80 died, 31 recovered, and 6 are under treatment.

Of the 18 Native Christians, 12 died, 6 recovered.

Of the 9 Pársis, 4 died, 5 recovered.

Of the 4 Mähomedans, 3 died, 1 recovered.

Percentage Mortality.—Of all the cases, the percentage of deaths to recoveries is 66·9, but if the 6 cases under treatment be excluded, the percentage mortality is 69·7.

By Sex.—Of the 113 adult males, the mortality is 69·1 per cent., but excluding the 6 cases under treatment, it amounts to 72·9 per cent.

Of the 24 adult females, the mortality is 58·3 per cent.

Of the 11 children, the mortality is 63·6 per cent.

By caste, the mortality is as follows :—

Hindus ...	...	...	...	...	68·4 per cent.
Mähomedans ...	...	...	...	...	75 do.
Native Christians ...	...	...	...	...	66·7 do.
Pársis ...	...	...	...	...	44·4 do.

(1) *General Remarks.*—Selection of cases for treatment. In this enquiry an endeavour was made to confine the treatment to cases of average severity, that is to those who, on admission, seemed to have a reasonable chance of recovery ; so that two classes of patients did not receive the serum, namely, those who were obviously moribund, and those whose symptoms were mild, and who were likely to recover, irrespective of treatment. It must be admitted that it is difficult to make a prognosis in any case of plague, as the most unexpected results occur ; still, as far as could be judged from the symptoms on admission to hospital, the above selection of cases was made.

(2) *Treatment in addition to the serum.*—In all cases at the Arthur Road Hospital a stimulant (rum) was given every two hours; and in cases showing symptoms of heart-failure cardiac tonics were also administered, such as digitalis, strychnine, strophanthus, caffeine.

(3) *Causes of death.*—These were sudden heart-failure, secondary pneumonia, bronchitis, œdema of the lungs, hæmorrhage, or exhaustion; in fact death was due to the same causes as in plague-patients not treated by the serum.

(4) *Effects of the serum treatment.*—In many cases the temperature fell 1 or 2 degrees shortly after the injection of serum, and with this fall there was a corresponding improvement in the patient's general condition; but this improvement was often only temporary, and would be observed after each subsequent injection; still in those patients who died, the general course of the disease was steadily from bad to worse, and their symptoms were practically identical with those of plague-patients treated in other ways.

(5) *General conclusions.*—From the evidence of this enquiry it cannot be said that Dr. Galleotti's serum-treatment of plague shows any marked curative results; for of the 142 completed cases the mortality is 69·7 per cent., and the general death-rate of plague-patients treated in a hospital is only a little higher. I am informed that this rate is 80 per cent., but have no means of verifying the statement; still accepting this figure as correct, the most that can be claimed for Dr. Galleotti's treatment is a 10 per cent. reduction in mortality.

(6) *Evidence of early cases.*—Of the 148 cases, 30 received the serum-treatment on the first day of disease; and of these 30, 22 died and 8 recovered, so that in this series the death-rate was 73·3 per cent. Now it is an axiom in serum-therapeutics that the earlier the treatment, the more favourable the prognosis; yet in this instance we find that the mortality of the patients treated on the first day is higher than that of all the patients who underwent the treatment; the respective figures being 73·3 and 69·7 per cent. This fact points to the same conclusion, namely, that treatment by Dr. Galleotti's serum has not much influence on the course of plague.

L. F. CHILDE, M.B., Captain, I. M. S.,
Acting First Physician, Sir J. J. Hospital.

Extract from the Report by the Extra Assistant Health Officer, Arthur Road Hospital, dated 3rd May 1899.

SIR,

I have the honour to submit herewith the following report and return of cases treated with Professor Lustig's serum during April 1899:—

The number of cases treated was 39, of whom 21 died and 18 recovered, giving a mortality rate of 53·84 per cent. The mortality rate of cases not similarly treated was 77·51 per cent., thus showing a difference of 23·67 per cent. in favour of the former.

2. The cases were divided into the following series:—

Series.	Horse Number.	Bleeding.	Number Treated.	Number Died.	Number Recovered.
VIII (completed)	5	Second.	16	10	6
IX	Donkey.	First.	2	1	1
X	3	Second.	14	7	7
XI (to be continued)	1	Do.	7	3	4
Total	.....	.....	39	21	18

3. From a comparison of the returns for February, March and April it appears that each succeeding month the serum shows better results as it becomes stronger and more active. And considering that the present epidemic did not show any marked decline till about the middle of April, and that the individual cases do not even yet show any marked diminution in their virulence, in spite of the fact that the epidemic is steadily declining, the results so far achieved should be considered satisfactory. This is better illustrated by the following table which compares the results during the period :—

Months.	Mortality rate of cases not treated with the serum.	Mortality rate of cases treated with the serum.	Difference in favour of serum cases.
1899.			
February	79.16	70.58	8.58
March... ..	79.48	66.21	13.27
April	77.51	53.84	23.67

The above table shows that whereas the mortality rate has varied very little amongst the cases not treated with the serum, it shows a very appreciable improvement in those treated with it, and the improvement has steadily bettered from 8.58 per cent. to 23.67 per cent., a difference of over 15 per cent.

4. When all the series of cases are compared, two points are clearly brought out, *viz.*: (1) that the serum obtained from the second bleedings is more active than from the first, and (2) that the serum from the different horses shows different degrees of activity :—

Series.	Horse Number.	Bleeding.	Number treated.	Number died.	Number recovered.
I	5	First.	18	14	4
II	2	Do.	11	8	3
III	3	Do.	17	10	7
IV	2	Do.	13	11	2
V	1	Do.	17	12	5
VI	4	Do.	47	30	17
VII	6	Do.	13	8	5
VIII	5	Second.	22	14	8
IX	Donkey.	First.	2	1	1
X	3	Second.	14	7	7
XI	1	Do.	7	3	4
Total ...	...	...	181	118	63

The above statement indicates that the results from the first and second bleedings were 68.38 per cent. and 55.81 per cent., respectively, thus clearly showing a difference in greater activity of 12.57 per cent. from the latter, and as the serum gets stronger at each subsequent bleeding, it is to be expected that better results would be shown in the near future. The serum supplied from Florence last year also showed similar variations between the first and second bleedings.

The table further demonstrates that different horses give serums of different activities, and this also materially corroborates the experiences of last year when it was observed that the different horses under experiment at Florence gave serums of different curative values.

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No. 4816 of 1899.

From

THE SURGEON-GENERAL WITH THE
GOVERNMENT OF BOMBAY ;

To

THE SECRETARY TO GOVERNMENT,
General Department (Plague),
Bombay.

*Office of the Surgeon-General with the
Government of Bombay, Town Hall,
Bombay, 29th May 1899.*

SIR,

With reference to your No. 2902-P., dated 28th ultimo, I have the honour to submit the following observations upon the report of Khan Bahadur Dr. N. H. Choksy on the trial of Professor Lustig's curative for plague submitted to you by the Municipal Commissioner for the City of Bombay.

2. The series of 142 cases is the same as that reported on by Captain Childe, I. M. S., and forwarded to you with my letter No. 4006, dated 2nd instant. The only difference worth noticing in their details is that Captain Childe records 99 deaths, whereas Dr. Choksy gives only 97; but since this discrepancy does not materially affect the conclusions to be drawn from the results, it may be disregarded.

3. The figures in each report, excluding six remaining cases, stand thus :—

	Cases,	Deaths.	Recoveries.	Mortality per cent.
Captain Childe	} 142	99	43	69.7
Dr. Choksy		97	45	68.4

Dr. Choksy's case mortality rate of 68.4 is therefore exactly equal to the mean mortality among 8,998 patients treated, *without any selection* by ordinary therapeutical measures in certain of the best organized plague hospitals during 1896-98, as mentioned in paragraph 2 of my letter No. 4006 above quoted. As regards the latter figures, I would remark that the close correspondence of those given in four different reports is strongly indicative of their trustworthiness.

4. Dr. Choksy compares the results by Dr. Lustig's serum with those obtained among patients in the Arthur Road Hospital not so treated, who yielded a case mortality of 79.48 per cent. This ratio seems to me a very high hospital mortality, and I am unable to allow that it can be adopted as a standard of comparison. Dr. Choksy writes that the recent epidemic was of an extremely virulent type; but it would be necessary to carefully examine the figures before accepting either this assertion, or hospital mortality of between 85 and 90 per cent. among all cases. Dr. Childe apparently considered the latter point, and remarks that he has no means of verifying the ratio.

5. Dr. Childe remarks that an endeavour was made to confine that treatment to cases of average severity which had a reasonable chance of recovery, so that patients obviously moribund, and those who were not severely attacked, did not receive the treatment. Dr. Choksy also says that moribund cases were excluded. Yet I find that each of these gentlemen has entered in his tables as moribund 12 cases which received the serum.

In my previous letter, I omitted to notice that Dr. Childe, whilst professing to exclude hopeless cases, had in fact entered 12 as moribund. As regards Dr. Choksy's remark that the death-rate amongst the cases not treated with the serum would have been higher, but for the inclusion of convalescents and semi-convalescents, I have already observed that it was, in my opinion, high enough, and not a fair criterion of the effects of ordinary medicinal treatment. Had this rate been made higher by the exclusion of convalescents, it would have been even more inapplicable for purposes of comparison.

6. The average duration of the illness at the time of admission, as taken from both reports, was in the fatal cases 2.5 days, and among the recoveries 2.4 days; so that, in this respect, the latter, so far as this record goes, had no initial advantage over the former; and the figures, as a whole, prove nothing as to the value of early injection of the serum.

7. Dr. Childe, however, shows that the mortality among 80 patients who received the serum from the first day of the disease was 73.3 per cent.; and I concur with him in the opinion that the inefficacy of this agent is strongly indicated by such a result.

8. Dr. Choksy gives the case mortality in March as 4 per cent. lower than in February; but I observe that during March the ratio of "moribund" cases to admissions was only 6.7, whilst in February it was 10.5 per centum. If the moribund cases in March had been equal in proportion to those during February, they would have numbered 7.7 instead of 5, and the case mortality would have been the same as that of February.

It is true that the severe cases were not limited to those marked "moribund"; yet I do not see that Lieutenant-Colonel Wilkins is justified in his opinion that the results obtained by the serum in March were more encouraging than those in February.

9. Comparing the mortality under each sample of serum, I note that, except in two series (Nos. I and IV), it was fairly uniform, but the figures do not appear to teach anything, except that the death ratio might be as high as 77 and 84 per cent. —

Series.	Cases.	Deaths.	Deaths per cent.
I	18	14	77.7
II	11	8	73.6
III	17	10	59.0
IV	13	11	84.6
V	17	12	70.5
VI	17	30	64.0
VII	13	8	61.5
VIII	6	4	66.6

10. I consider, therefore, that Lustig's serum has been well, though not severely tested; and that, although the deductions to be drawn from a somewhat small number of cases may not be absolutely conclusive, this series gives practically no indications that the remedy would prove efficacious on further trial; I would remark, however, that a more accurate estimate of the value of this remedy would have been possible if two series of consecutive cases, or two series composed of alternate cases, had been utilized, the one for testing treatment by the serum, and the other, for comparison, under ordinary treatment.

I have the honor to be,

Sir,

Your most obedient Servant,

G. BAINBRIDGE, M. D., Surg.-Genl.,
Surgeon-General with the Government of Bombay.

APPENDIX No. IV.

Report on Cases treated with Professor Lustig's Serum in 1899-1900.

The Bombay Municipal Corporation having accepted, at their meeting of the 8th of May 1899, the Hon'ble Mr. Pheroze Shah Mehta's proposition, "that in the opinion of the Corporation the experiments with Professor Lustig's serum should be continued for a much longer period of time," arrangements were made accordingly by the Municipal Commissioner.

As Professor G. Galeotti had to return to Italy to take up his duties there Dr. G. Polverini was given charge of the Municipal Laboratory at Parel, where the serum was being prepared, and Dr. A. Mayr, then at the Imperial Plague Research Laboratory, was appointed to assist him.

Ten more horses were purchased at different periods, the first in July and the last in December 1899, nine being country-bred and one Arab. The latter proved very sensitive, and its immunisation was much delayed, whereas the former stood the immunising injections very well, recovering quickly and keeping throughout in good condition, having been ably attended to by Mr. S. N. Ranina, V. S. One of the country-bred horses on arrival was found to be too small and weak, and was sold, as was also one of the old horses which had become useless. Another horse contracted malignant œdema in December 1899 and died. Horse No. 4, which had always given a strong serum, developed tetanic symptoms in May last and succumbed also. Two of the newly acquired animals were for a considerable time sick, independent of the immunisation, which therefore proceeded only in ten horses without hindrance. In consequence of this the manufacture of the serum could not keep pace with the demand when the admissions at the Arthur Road Hospital ran up to twenty a day in the beginning of March last, and the treatment had to be interrupted for a fortnight. For the same reason only one horse could be selected, with the sanction of the Municipal Commissioner, for the immunisation by intravenous injections which, while promising an important improvement, might have been fatal, and have further reduced the already limited number of horses. The immunisation of this horse was not taken in hand before it was made sure that the others would serve their purpose, and although progressing satisfactorily, the bleeding could not be made in time to try the serum under the alternate treatment. One patient was treated with this serum at the Modikhana Hospital in July last by order of Lieutenant-Colonel J. S. Wilkins, I.M.S., who informed us that the patient did exceedingly well. It was not deemed advisable to experiment upon the other horses, which had to furnish the serum on the results of which the fate of the serum treatment depended, and their immunisation was carried on strictly on the lines followed hitherto. Until the new horses were ready the serum was taken from the old one which were bled two or three times more. The new horses were all bled once or twice.

During the time covered by this report 72 immunising injections and 22 bleedings were made, the latter yielding 60 litres (15 gallons) of serum—forty-five litres were used for the treatment of the patients and the remainder is in stock at the laboratory at Parel.

The total number of patients treated was 566.

The treatment of selected cases having shown that the serum has curative properties, the second stage of the experiment was to ascertain the average percentage of cures which could be obtained under those circumstances in which the serum was chiefly to be used. Hence the patients were no longer selected for the serum treatment with regard to the possibility of recovery, but taken alternately as they were admitted into the hospital, an equal number remaining as so called "Controls" under the ordinary treatment. The difference between the mortality of the two sides would then be the expression of the efficacy of the serum. The selection was thus left to the chance of the distribution, and the admissibility of such a selection rested on the presumption that, according to the law of probability, the admissions

would be divided in two parts equal in all conditions influencing the recovery. As the law of probability does not work out correctly on small figures and under different circumstances of the surroundings, it was decided that at least about 500 patients should be treated alternately at the same hospital before a final conclusion would be drawn. This method of alternate treatment was agreed upon with the Municipal Commissioner in deference to the public opinion in Bombay which had become familiar with it through the experiments with the plague prophylactic. It was hoped that this merely statistical method of investigation would do away with the objections raised against the clinical selection, and that the results would be convincing to those for the benefit of whom the serum treatment had been initiated by the Municipality of Bombay. The treatment was to be continued at the Arthur Road Hospital which receives the lowest and poorest classes of the population, representing the most unfavourable material for a serum treatment, so that it might be relied upon that the results obtained there would be obtained again under all other circumstances. It was to be directed as hitherto by Dr. N. H. Cheksy, the Chief Medical Officer in charge of the hospital, who knew how to use the serum to its full advantage and could be trusted to do willingly the considerable amount of extra work the serum treatment entailed.

The alternate treatment was carried out at the Arthur Road Hospital in the following manner. Every second patient suffering from plague was, immediately after admission, injected with the serum either by the Medical Officer or, in his absence, by the Hospital Assistant on duty. Cases doubtful on admission were kept under observation until the diagnosis was established. If found to be suffering from plague they were taken for the alternate treatment in the order in which the disease was recognised. Such doubtful cases were few and far between, so that, for statistical purposes, the day of admission may be considered as the day of the beginning of the serum treatment. There were observation cases, 38 in all, with 6 recoveries, mostly patients without buboes or with pneumonia, in which the diagnosis remained doubtful till death confirmed it, or until the recovery was so far advanced, that it would have been superfluous to take them for the alternate treatment. These were called extra cases and recorded separately. As the results obtained by the serum treatment are only of value if the diagnosis of plague was substantially correct, it will not be out of place here to discuss to what extent errors might have been committed and how such errors might have influenced the accuracy of the results. We have regularly controlled the diagnosis in the patients of either side clinically, and by bacteriological means also after death, and we have in no instance failed in verifying it. Almost all the patients had buboes, and of those who had none all died except two. During the time of an epidemic the diagnosis of plague is exceedingly easy in the great majority of the cases, at least in our hospitals, where the patients come with few exceptions in an advanced stage of the disease. But even if it were otherwise, and that frequent errors should have been made, they would have been irrelevant under the alternate treatment, as they had to equalise themselves like all other conditions. Errors of diagnosis could well have reduced the mortality of *all* the patients, but could not have created a difference between the results of the two sides. It was more difficult to avoid mistakes in the alternation, and special precautions were taken in this direction. Two records were kept, one by the Medical Officer with all the particulars of the patients, and one by the Hospital Assistant present on admission. The patients were, moreover, divided in series according to the bleedings of every horse, and this division, and the current number in the series was made visible on the charts of temperature in the form of a fraction, to which was added a red "L" on the charts of the serum patients, and "Control" on those of the controls—"L $\frac{5}{20}$ " would thus signify the fifth serum-patient of the 20th series, and "Control $\frac{5}{20}$ " would be the corresponding control. The distribution of the patients, according to the series and the results of the treatment, are seen from the following table:—

Series.	SERUM PATIENTS.							CONTROL PATIENTS.				TOTAL.			
	Horse.	Bleeding.	Number of Patients.	Died.	Recover-ed.	Percentage of Mortality.	Number of Patients.	Died.	Recover-ed.	Percentage of Mortality.	Number of Patients.	Died.	Recover-ed.	Percentage of Mortality.	
1	No. 1	2nd bleeding	23	15	8	65.21	23	15	8	65.21	46	30	16	65.21	
2	" 4	2nd do.	6	2	4	33.33	6	5	1	83.33	12	7	5	58.33	
3	" 3	2nd do.	16	12	4	75.00	16	9	7	56.25	32	21	11	65.62	
4	" 1	1st do.	6	5	1	83.33	6	5	1	83.33	12	10	2	83.33	
5	" 5	3rd do.	16	11	5	68.75	16	12	4	75.00	32	23	9	71.87	
6	" 3	3rd do.	24	16	8	66.66	24	21	3	87.50	48	37	11	77.08	
7	" 1	3rd do.	36	26	10	72.22	36	32	4	88.88	72	58	14	80.55	
8	" 4	3rd do.	37	23	14	62.16	37	29	8	78.37	74	52	22	70.27	
9	" 1	3rd do.	4	3	1	75.00	4	3	1	75.00	8	6	2	75.00	
10	" 2	2nd do.	15	8	7	53.33	15	12	3	80.00	30	20	10	66.66	
11	" 5	4th do.	23	15	8	65.21	23	13	5	78.26	46	33	13	71.73	
12	" 1	4th do.	35	25	10	71.42	35	33	2	94.28	70	58	12	82.85	
13	" 3	4th do.	25	18	7	72.00	25	19	6	676.0	50	37	13	74.00	
14	" 8	1st do.	26	20	6	76.92	26	17	9	75.38	52	37	15	71.15	
15	" 4	4th do.	24	13	11	54.16	24	18	6	5.000	48	31	17	64.58	
16	" 2	3rd do.	34	23	11	67.64	34	28	6	82.35	68	51	17	75.00	
17	" 9	1st do.	16	10	6	62.50	16	11	5	68.75	32	21	11	65.62	
18	" 5	5th do.	25	21	4	84.00	25	20	5	80.00	50	41	9	82.00	
19	" 10	1st do.	25	18	7	72.00	25	23	2	92.00	50	41	9	82.00	
20	" 7	2nd do.	11	8	3	72.72	11	9	2	81.81	22	17	5	77.27	
21	" 1	5th do.	17	12	5	70.58	17	11	6	64.70	34	23	11	67.64	
22	" 6	1st do.	19	13	6	68.42	19	18	1	94.73	38	31	7	81.57	
23	" 12	1st do.	10	6	4	60.00	10	8	2	80.00	20	14	6	70.00	
24	" 9	2nd do.	7	5	2	71.42	7	6	1	85.71	14	11	3	78.57	
Total ...			480	328	152	68.33	480	382	98	79.58	960	710	250	73.95	

In this table we have to point out two facts—first, that the serum treatment shows only in two series, viz., 4 and 18, which total 31 patients, a higher mortality than the average death-rate of the controls; secondly, that in four series, viz., 3, 14, 18 and 21, the mortality of the serum patients is higher than that of the controls. Still, in three of these series, viz., 3, 14 and 21, the mortality of the controls is far below their average mortality, and the reduction, therefore, is accidental and due to the distribution of the convalescents, as could be shown from the charts of temperature. Looking at the total mortality in the three series, which is also well below the average mortality of the controls, there can be no doubt that the serum was effective in these three series. On the other hand, the lower mortality on the serum side does not always correspond to a reduction of the total mortality of the series. Thus the total mortality is higher than the average death-rate of the controls in six series, viz., 4, 7, 12, 18, 19 and 22, which indicates clearly that the serum was without effect in these series, although the differences between the mortality of the serum patients and the controls are very considerable in four of the series, viz., 7, 12, 19 and 22, being 16 per cent., 23 per cent., 20 per cent. and 26 per cent., respectively, and they point to a great efficacy of the serum. We are thus confronted with the peculiar fact that the serum was effective when the difference between the results on both sides suggested that it was not, and that the serum had no effect when the difference made us believe that it was very efficacious. This seems rather striking, and an explanation will be necessary. With regard to the effects of the serum treatment and non-serum treatment we can divide the total plague admissions into three classes—first, patients who die under either treatment; secondly, patients who recover under either treatment; and thirdly, patients who but for the serum will die. If we take 200 plague admissions and distribute them by alternation, as was done at the Arthur Road Hospital, and if we suppose, as is the case, that the mortality from plague is 80 per cent., and that the serum can reduce this mortality to 70 per cent., we might have the following distributions and results:—

TABLE 1.

Serum Patients.		Control Patients.				All Patients.
Patients who die under either treatment.	Percentage of Mortality.	Patients who die under either treatment.	Patients who but for the serum die.	Patients who recover under either treatment.	Percentage of Mortality.	Percentage of Mortality.
100	100	40	20	40	60	80

Although the serum had no chance of exercising any influence, the comparison between the two sides allows only one conclusion, viz., that the serum does harm.

TABLE 2.

Serum Patients.			Control Patients.			All Patients.
Patients who die under either treatment.	Patients who but for the serum would die.	Percentage of Mortality.	Patients who die under either treatment.	Patients who recover under either treatment.	Percentage of Mortality.	Percentage of Mortality.
80	20	80	60	40	60	70

Although the serum has cured all who can be cured by it, the comparison between the two sides allows again only one conclusion, viz., that the serum does harm.

TABLE 3.

Serum Patients.			Control Patients.			All Patients.
Patients who die under either treatment.	Patients who recover under either treatment.	Percentage of Mortality.	Patients who die under either treatment.	Patients who but for the serum die.	Percentage of Mortality.	Percentage of Mortality.
60	40	60	80	20	100	80

Although the serum has practically cured none, the comparison between the two sides allows only one conclusion, *viz.*, that the serum is very effective.

TABLE 4.

Serum Patients.				Control Patients.		All Patients.
Patients who die under either treatment.	Patients who recover under either treatment.	Patients who but for the serum would die.	Percentage of Mortality.	Patients who die under either treatment.	Percentage of Mortality.	Percentage of Mortality.
40	40	20	40	100	100	70

Although the serum can cure only 20 per cent., the comparison between the two sides indicates an efficacy of 60 per cent.

The four tables show the limits within which the distribution will vary continually. With the distribution the results must change continually, not only quantitatively, but also qualitatively. Only the comparison of the mortality of *all* the patients with the average mortality from plague, which latter must either be known or ascertained otherwise, tells us when the serum is effective and when it is not. The conclusion is easy. With the present ratio between the mortality from plague and the efficacy of the serum, the results obtained by the alternate treatment might be utterly fallacious. They might be fallacious so long as the serum cannot reduce the mortality from 80 per cent. to less than 30 per cent. In this case a distribution, as given in Tables 1 and 2, would be impossible. The alternate treatment of patients as a method of investigation is therefore only admissible if a minimum ratio exists between the degree of the efficacy of a remedy and the percentage of the mortality of a disease. As it is just the ratio that we have to find out, the method of the alternate treatment is illogical. This demonstration might modify the views held with regard to the value of the method of the alternate treatment of patients and might justify the unwillingness of the experimenters to subject the serum to such a test before the efficacy had approximately been ascertained by more reliable means. The proof for the efficacy of a remedy whether it is tried on clinically selected patients or on patients selected by alternation is not given by the difference between the mortality of the treated and non-treated patients, but always by the reduction of the mortality of *all* the patients. Thus the alternate treatment furnishes no other or better evidence, whereas the treatment of clinically selected patients obtains an absolutely larger number of recoveries which must always be the only aim of a treatment also in its experimental stage. The alternate treatment is not only illogical and expensive, it is also cruel, as it delivers patients to death while the remedy is at hand to preserve life. In short, it is not a method of the sick-room

but of the laboratory. Dr. Choksy and we ourselves have bitterly condemned that method whenever we had to abandon a control patient to his untimely fate whom the serum could in all probability have saved, or had to inject a patient who, as we knew, would never benefit by the pain the injection might have caused him.

The routine treatment was identical for all plague admissions—rum every two hours, cardiac stimulants, sleeping draughts, wet pack, etc., whenever needed. The serum was given exclusively by sub-cutaneous injections, that being the way in which the serum can be administered on a large scale in Indian hospitals. Twenty to 40 c.c. were given in the morning and evening. With the growing experience, one large dose of 50 to 80 c.c. once a day, if possible in the morning, was found more convenient. All patients had a full dose on admission, except those evidently convalescent, who received a nominal dose of 5 or 10 c.c. Then the dose was varied as the case required it. The utmost economy was the rule, and the serum was immediately omitted when the temperature had come down and the pulse was fairly good. The quantity of serum marked on the charts of temperature as injected gives therefore the best information of the gravity of the disease. The largest dose injected at once was 80 c.c. The largest amount injected in a single case was 320 c.c. within five days, in a patient who died, and 300 c.c. in several cases that recovered. The average quantity needed for recovery was 110 c.c., the average amount injected in patients who died was 80 c.c. The total amount of serum used at the hospital was 38 litres, only 14 of which were used for patients who recovered. The total number of injections was 1,900, of which 1,175 were made in patients who died. On an average, three injections were made in patients who died, and six in patients who recovered, the convalescents being excluded. Any unfavourable influence of large doses has never been observed; on the contrary, all the experience points to the fact that, with the present strength of the serum, large doses are the right policy. Urticaria appeared seldom after injection, and pains in the joints seemed not to be more frequent than in patients who did not receive the serum. Abscesses on the seat of injection were rare except during the height of the epidemic when several were observed in succession, no doubt due to deficient disinfection. It is surprising that abscesses were not more frequent, considering that the staff of the hospital was insufficient in number to deal with the amount of work imposed on them by the serum treatment, so that the disinfection of the skin had often to be left to the menial servants.

In order to give an idea of the conditions of the patients who recovered, a complete list with the necessary particulars is given:—

List of the Serum Patients who Recovered.

Current Number.	Hospital Number.	Caste.	Sex.	Age.	Days of illness on admission.	Manifestation of disease.	Highest temperature.	Bubo suppurated.	Number of injections.	Quantity of serum injected.	Remarks.
1	1608	Hindu	Male	35 years.	4	Femoral bubo	102°	1	5	60 c. c.	
2	1617	Do.	Do.	6 do.	5	Axillary do.	102°		4	80 c. c.	
3	1619	Do.	Female	28 do.	4	Inguinal do.	103°		4	50 c. c.	
4	1627	Do.	Male	22 do.	4	Femoral do.	100°		1	19 c. c.	
5	1660	Do.	Do.	20 do.	8	Axillary do.	103°	1	8	55 c. c.	
6	1666	Do.	Female	6 do.	5	Inguinal do.	101°		2	20 c. c.	
7	1688	Do.	Do.	80 do.	2	Cervical do.	105°		3	60 c. c.	
8	1744	Do.	Male	14 do.	4	Femoral do.	104°		2	85 c. c.	
9	1825	Do.	Female	18 do.	4	Axillary do.	108°	1	10	140 c. c.	
10	1829	Do.	Do.	8 do.	2	Inguinal do.	105°		4	45 c. c.	
11	1848	N. Christian	Male	12 do.	2	Do. and iliac bubo	102°		8	72 c. c.	
12	1824	Hindu	Do.	80 do.	8	No bubo	105°		8	145 c. c.	
13	1868	Do.	Do.	3 do.	5	Femoral bubo	108°		8	40 c. c.	
14	1880	Do.	Female	85 do.	2	Do. do.	105°		7	210 c. c.	
15	1891	N. Christian	Male	10 do.	1	Do. and Inguinal bubo	100°		1	10 c. c.	Twice Haffkinised.
16	1912	Hindu	Do.	25 do.	8	Parotid and Axillary do.	104°		4	140 c. c.	
17	1959	Do.	Female	7 do.	2	Axillary bubo	102°		6	80 c. c.	
18	1988	Parsee	Male	19 do.	2	Femoral do.	104°	1	8	240 c. c.	Convalescent.
19	1997	Mussalman	Do.	50 do.	12	Do. do.	100°		1	10 c. c.	Convalescent.
20	2040	Hindu	Do.	20 do.	8	Do. do.	102°		7	200 c. c.	
21	2042	Do.	Do.	20 do.	6	Inguinal and iliac bubo	108°	1	7	190 c. c.	
22	2045	Do.	Female	30 do.	8	Axillary bubo	104°		6	230 c. c.	
23	2088	Parsee	Male	32 do.	4	Femoral and Inguinal bubo	101°		2	50 c. c.	Haffkinised.
24	2081	Hindu	Female	10 do.	4	Do. and iliac bubo	101°		8	80 c. c.	
25	2105	N. Christian	Male	30 do.	3	Axillary and Cervical do.	108°		4	90 c. c.	
26	2127	Hindu	Do.	25 do.	2	Femoral bubo	105°		7	180 c. c.	
27	2186	Do.	Do.	30 do.	11	Inguinal do.	100°	1	2	20 c. c.	Convalescent.
28	2142	Do.	Do.	25 do.	4	Do. do.	101°		1	10 c. c.	
29	2196	Do.	Female	45 do.	5	Femoral do.	108°	1	7	150 c. c.	
30	2209	Do.	Male	40 do.	Unknown.	Do. do.	102°		6	140 c. c.	
31	2250	Do.	Do.	50 do.	6	Inguinal do.	100°	1	2	80 c. c.	
32	2253	Do.	Do.	22 do.	8	Femoral do.	103°		4	95 c. c.	
33	2297	Mussalman	Do.	12 do.	1	Inguinal, Femoral and Iliac bubo	102°		6	80 c. c.	
34	2828	Hindu	Female	18 do.	4	Femoral bubo	104°	1	6	110 c. c.	
35	2839	N. Christian	Male	20 do.	8	Do. do.	104°	1	7	180 c. c.	
36	2856	Hindu	Do.	12 do.	5	Axillary do.	102°	1	6	75 c. c.	
37	2886	Do.	Do.	28 do.	15	Do. do.	99°		1	10 c. c.	Convalescent.
38	2474	Do.	Do.	35 do.	5	Femoral, Inguinal and Iliac bubo	103°	1	5	110 c. c.	
39	2614	Do.	Do.	18 do.	4	Do. bubo	103°	1	2	20 c. c.	
40	2654	Mussalman	Female	10 do.	10	Inguinal do.	98°	1	1	10 c. c.	Convalescent.
41	2664	N. Christian	Male	12 do.	8	Cervical do.	104°		8	85 c. c.	
42	2679	Hindu	Do.	28 do.	8	Femoral and Axillary bubo	101°	1	2	20 c. c.	Convalescent.
43	2693	Do.	Do.	30 do.	10	Do. Inguinal and Iliac bubo	101°	1	1	10 c. c.	Do.
44	2714	N. Christian	Do.	22 do.	2	Do. bubo	103°	1	8	165 c. c.	
45	2724	Do.	Do.	12 do.	2	Iliac do.	104°		11	110 c. c.	
46	2724	Do.	Do.	12 do.	2	Inguinal do.	102°	1	8	85 c. c.	
47	2777	Do.	Do.	60 do.	4	Double Axillary bubo	102°		6	80 c. c.	

48	2814	Do.	Do.	3	do.	2	Femoral bubo	102°	1	6	50 c. c.	
49	15	Do.	Female	25	do.	3	Axillary do.	104°	.....	9	170 c. c.	
50	50	Do.	Male	50	do.	5	Inguinal do.	104°	1	7	130 c. c.	
51	74	Do.	Do.	25	do.	4	Femoral and Inguinal bubo	104°	1	8	150 c. c.	
52	106	Do.	Do.	30	do.	Unknown.	Cervical and do. do.	98°	.....	2	20 c. c.	Convalescent.
53	204	Do.	Do.	10	do.	9	Inguinal bubo	101°	1	1	10 c. c.	Do.
54	222	Do.	Female	15	do.	10	Femoral do.	100°	1	1	10 c. c.	Do.
55	264	Do.	Male	30	do.	4	Supra trochi bubo	101°	.....	1	15 c. c.	
56	314	Do.	Female	10	do.	8	Double Axillary bubo	101°	.....	6	82 c. c.	
57	354	N. Christian	Male	20	do.	2	Do. Femoral do.	102°	.....	8	50 c. c.	
58	383	Hindu	Female	22	do.	3	Iliac bubo	104°	.....	9	160 c. c.	
59	398	Do.	Do.	70	do.	11	Cervical bubo	100°	1	1	5 c. c.	Convalescent.
60	426	Do.	Male	45	do.	4	Inguinal do.	105°	.....	6	110 c. c.	
61	442	Do.	Female	25	do.	2	Axillary do.	105°	1	15	300 c. c.	
62	447	Do.	Male	32	do.	2	Do. do.	102°	.....	9	160 c. c.	
63	454	Do.	Female	12	do.	3	Inguinal do.	102°	.....	5	55 c. c.	
64	464	Do.	Do.	20	do.	9	Femoral do.	100°	.....	1	10 c. c.	Convalescent.
65	515	N. Christian	Male	50	do.	3	Axillary do.	102°	.....	7	120 c. c.	
66	576	Hindu	Do.	8	do.	3	Double Inguinal bubo	102°	1	6	80 c. c.	
67	602	Do.	Female	40	do.	6	Femoral bubo	102°	.....	6	90 c. c.	
68	618	Do.	Male	50	do.	6	Cervical do.	103°	.....	4	60 c. c.	
69	686	Do.	Do.	25	do.	2	Femoral do.	103°	.....	10	200 c. c.	
70	752	Do.	Do.	25	do.	3	Do. do.	104°	.....	9	200 c. c.	
71	772	Do.	Female	2	do.	2	Sub-Lingual bubo	102°	.....	6	50 c. c.	
72	792	Do.	Do.	30	do.	3	Pectoral bubo	98°	.....	1	10 c. c.	Convalescent.
73	815	Do.	Male	35	do.	4	Femoral do.	102°	.....	7	120 c. c.	
74	817	Do.	Female	25	do.	1	Do. do.	103°	.....	2	60 c. c.	
75	849	Do.	Male	49	do.	3	Do. and Inguinal bubo	100°	1	1	10 c. c.	Convalescent.
76	836	Do.	Do.	26	do.	3	Inguinal bubo	90°	1	1	5 c. c.	Do.
77	929	Do.	Do.	30	do.	15	Do. and Femoral bubo	98°	1	1	5 c. c.	Do.
78	977	Do.	Female	4	do.	3	Femoral bubo	97°	.....	1	5 c. c.	Do. Haikinised.
79	848	N. Christian	Male	21	do.	7	Inguinal do.	100°	1	3	25 c. c.	
80	991	Hindu	Do.	32	do.	5	Femoral and Inguinal bubo	102°	1	6	125 c. c.	
81	1055	Do.	Do.	25	do.	3	Inguinal bubo	102°	1	1	115 c. c.	
82	1097	Do.	Do.	14	do.	3	Cervical do.	99°	1	1	10 c. c.	Convalescent.
83	1118	Musselman	Do.	10	do.	3	Axillary do.	104°	1	6	100 c. c.	
84	1131	Hindu	Do.	30	do.	3	Femoral, Inguinal and Iliac bubo	100°	1	1	10 c. c.	Convalescent.
85	1163	N. Christian	Do.	19	do.	15	Inguinal bubo	100°	1	1	10 c. c.	Do.
86	1172	Hindu	Female	14	do.	3	Cervical do.	100°	1	4	70 c. c.	
87	1194	Do.	Male	15	do.	5	Axillary do.	103°	1	7	115 c. c.	
88	1237	Do.	Do.	35	do.	4	Do. do.	100°	.....	2	50 c. c.	Haikinised.
89	1252	Do.	Do.	25	do.	5	Femoral and Iliac bubo	100°	.....	4	75 c. c.	
90	1267	Do.	Female	8	do.	2	Cervical bubo	103°	.....	4	50 c. c.	
91	1239	Do.	Male	21	do.	3	Femoral, Inguinal and Iliac bubo	104°	1	3	175 c. c.	
92	1295	Do.	Do.	25	do.	3	Axillary bubo	105°	.....	3	145 c. c.	
93	1311	Do.	Do.	23	do.	3	Supra Clavicular bubo	10°	1	7	135 c. c.	
94	1315	Do.	Do.	23	do.	1	Cervical bubo	104°	.....	6	85 c. c.	Convalescent.
95	1321	Do.	Do.	5	do.	2	Do. do.	99°	.....	3	20 c. c.	
96	1330	Do.	Do.	30	do.	3	Femoral do.	102°	.....	4	60 c. c.	
97	1332	N. Christian	Do.	20	do.	1	Inguinal do.	100°	.....	4	60 c. c.	
98	1336	Hindu	Do.	30	do.	1	Axillary do.	104°	1	3	140 c. c.	
99	1338	Do.	Female	23	do.	2	Inguinal and Iliac bubo	105°	1	6	110 c. c.	
100	1358	N. Christian	Do.	18	do.	2	Double Axillary bubo	101°	.....	6	95 c. c.	
101	1361	Hindu	Do.	55	do.	2	Iliac bubo	104°	.....	7	115 c. c.	
102	1384	N. Christian	Male	25	do.	2	Inguinal bubo	105°	1	11	210 c. c.	
103	1385	Hindu	Do.	8	do.	2	Cervical do.	101°	1	6	60 c. c.	
104	1404	Do.	Do.	25	do.	4	Axillary do.	103°	.....	3	120 c. c.	

List of Serum Patients who Recovered—(contd.).

Current Number.	Hospital Number.	Caste.	Sex.	Age.	Days of illness on admission.	Manifestation of Disease.	Highest Temperature.	Bubo suppurated.	Number of Injections.	Quantity of Serum injected.	Remarks.
105	1443	Hindu ...	Female	40 years.	9	Femoral bubo ...	101°	.....	2	20 c. c.	Convalescent.
106	1452	Do. ...	Male	20 do.	12	Do. do. ...	98°	.....	1	10 c. c.	Do.
107	1456	N. Christian	Female	20 do.	8	Axillary do. ...	102°	.....	6	140 c. c.	
108	1460	Hindu ...	Male	28 d.	Unknown.	Inguinal do. ...	104°	.....	7	140 c. c.	
109	1464	N. Christian	Do.	18 do.	8	Femoral do. ...	106°	1	10	230 c. c.	Haffkinised.
110	1468	Hindu ...	Do.	32 do.	4	Inguinal do. ...	104°	.....	8	190 c. c.	
111	1474	Do. ...	Do.	25 do.	8	Axillary do. ...	91°	.....	3	60 c. c.	
112	1498	Do. ...	Do.	10 do.	8	Do. do. ...	98°	.....	1	10 c. c.	Convalescent.
113	1510	Do. ...	Female	12 do.	21	Femoral, inguinal and iliac bubo ...	98°	1	1	10 c. c.	Do.
114	1515	Do. ...	Male	35 do.	8	Cervical bubo ...	102°	.....	5	120 c. c.	
115	1521	N. Christian	Do.	40 do.	Unknown.	Do. and Maxil bubo ...	104°	.....	6	150 c. c.	
116	1550	Hindu ...	Do.	24 do.	4	Femoral bubo ...	104°	.....	5	180 c. c.	
117	1568	Do. ...	Female	20 do.	8	Inguinal do. ...	101°	.....	7	160 c. c.	
118	1577*	Do. ...	Male	40 do.	6	Femoral do. ...	99°	.....	4	80 c. c.	Haffkinised.
119	1594	N. Christian	Do.	32 do.	5	Cervical do. ...	108°	1	9	225 c. c.	
120	1602	Hindu ...	Do.	12 do.	4	Do. do. ...	103°	1	5	100 c. c.	
121	1833	Do. ...	Female	40 do.	8	Femoral do. ...	105°	.....	7	170 c. c.	
122	1861	Do. ...	Male	20 do.	1	Do. and iliac bubo ...	104°	.....	9	270 c. c.	
123	1886	Do. ...	Do.	11 do.	15	Inguinal and femoral bubo ...	99°	.....	1	10 c. c.	Convalescent.
124	1892	Do. ...	Do.	40 do.	Unknown.	Femoral bubo ...	111°	1	1	40 c. c.	
125	1942	Do. ...	Do.	6 do.	8	Do. and inguinal bubo ...	99°	1	1	10 c. c.	Convalescent.
126	1954	Do. ...	Female	28 do.	8	Inguinal and iliac bubo ...	108°	1	5	160 c. c.	
127	1937	Mussalman	Male	35 do.	Unknown.	Do. bubo ...	100°	.....	2	40 c. c.	
128	1987	Hindu ...	Do.	20 do.	8	Femoral do. ...	99°	.....	3	90 c. c.	
129	2047	Do. ...	Female	25 do.	4	Inguinal do. ...	101°	1	4	110 c. c.	
130	2045	Do. ...	Do.	12 do.	8	Axillary do. ...	101°	.....	4	110 c. c.	
131	2057	Do. ...	Do.	18 do.	8	Cervical do. ...	108°	1	6	160 c. c.	
132	2065	Do. ...	Male	20 do.	8	Femoral and iliac bubo ...	103°	.....	3	90 c. c.	
133	2126	Do. ...	Do.	25 do.	7	Do. bubo ...	101°	.....	1	10 c. c.	Convalescent.
134	2156	Do. ...	Do.	25 do.	8	Inguinal do. ...	105°	1	6	200 c. c.	
135	2162	Do. ...	Do.	31 do.	8	Do. and cervical bubo ...	108°	.....	4	120 c. c.	
136	2186	N. Christian	Do.	18 do.	2	Axillary bubo ...	105°	1	3	223 c. c.	
137	2245	Hindu ...	Do.	25 do.	2	Femoral do. ...	105°	1	9	300 c. c.	
138	2269	N. Christian	Female	25 do.	8	Inguinal and iliac bubo ...	105°	.....	6	210 c. c.	
139	2303	Hindu ...	Male	50 do.	2	Femoral bubo ...	108°	.....	5	160 c. c.	
140	2314	Do. ...	Do.	50 do.	20	Axillary do. ...	99°	.....	1	10 c. c.	Convalescent.
141	2337	Do. ...	Do.	16 do.	Unknown.	Inguinal do. ...	104°	1	5	160 c. c.	
142	2396	N. Christian	Do.	8 do.	2	Do. and femoral bubo ...	102°	.....	4	55 c. c.	
143	2422	Mussalman	Do.	40 do.	11	Femoral bubo ...	98°	.....	1	10 c. c.	Convalescent.
144	2466	Hindu ...	Do.	25 do.	2	Do. do. ...	105°	.....	6	200 c. c.	
145	2476	Do. ...	Female	8 do.	8	Do. do. ...	103°	1	4	65 c. c.	
146	2483	Do. ...	Do.	8 do.	8	Axillary and cervical bubo ...	103°	1	4	80 c. c.	
147	2552	Do. ...	Male	9 do.	Unknown.	Do. and femoral do. ...	102°	.....	3	40 c. c.	
148	2572	Do. ...	Do.	30 do.	4	Femoral and inguinal do. ...	108°	.....	4	140 c. c.	
149	2589	Do. ...	Do.	28 do.	4	Axillary bubo ...	104°	.....	6	190 c. c.	
150	2658	Do. ...	Do.	32 do.	4	Double inguinal bubo ...	108°	.....	6	210 c. c.	
151	2765	Mussalman	Female	12 do.	Unknown.	Do. cervical do. ...	105°	.....	7	120 c. c.	
152	2772	Hindu ...	Male	22 do.	Do.	Popliteal bubo ...	101°	.....	5	160 c. c.	

List of the Control Patients who Recovered.

Current Number.	Hospital Number.	Caste.	Sex.	Age.	Days of illness on admission.	Manifestation of Disease.	Highest temperature.	Bubo suppura- ted.	REMARKS.
1	1615	Hindu	Male	33 years.	5	Femoral bubo	108°	.....
2	1618	Do.	Female	4 do.	15	Do. do.	98°	.....	Convalescent.
3	1628	Do.	Male	40 do.	8	Sub-maxill do.	100°	.....	Do.
4	1661	Do.	Do.	80 do.	6	Axillary do.	101°	.....
5	1674	N. Christian	Do.	22 do.	9	Inguinal do.	108°	.....
6	1708	Hindu	Do.	80 do.	2	Do. Femoral and Iliac bubo	104°	1	
7	1728	Mussalman	Do.	50 do.	22	Double Inguinal bubo	99°	.....	Convalescent.
8	1748	Hindu	Do.	12 do.	7	Cervical and Femoral do.	99°	.....	Do.
9	1828	Do.	Female	7 do.	8	Femoral bubo	108°	.....
10	1881	Do.	Do.	45 do.	5	Axillary do.	108°	.....
11	1885	N. Christian	Male	15 do.	1	Femoral do.	99°	.....	Twice Haffkinised.
12	1886	Hindu	Do.	25 do.	2	Pneumonia	108°	.....
13	1898	Do.	Do.	20 do.	4	Double Inguinal bubo	108°	.....
14	1914	N. Christian	Do.	8 do.	2	Do. Femoral do.	104°	.....	Twice Haffkinised.
15	1916	Do.	Do.	10 do.	8	Femoral Inguinal and Iliac bubo	108°	.....
16	1941	Hindu	Female	65 do.	4	Do. bubo	101°	.....
17	1961	Do.	Male	18 do.	Unknown.	Inguinal do.	104°	1	
18	1991	Mussalman	Do.	25 do.	8	Cervical do.	108°	.....
19	1998	Hindu	Do.	18 do.	8	Inguinal and Femoral bubo	100°	.....
20	2007	Parsee	Female	14 do.	2	Do. Femoral and Iliac bubo	105°	1	
21	2041	Hindu	Male	85 do.	8	Axillary bubo	104°	.....
22	2159	Mussalman	Do.	55 do.	12	Inguinal and Femoral bubo	99°	1	Convalescent.
23	2212	Hindu	Do.	18 do.	4	Cervical bubo	108°	.....
24	2226	Do.	Do.	16 do.	8	Inguinal do.	101°	.....	Convalescent.
25	2822	Do.	Female	8 do.	8	Axillary do.	108°	1	
26	2865	Do.	Male	60 do.	14	Femoral and Inguinal bubo	100°	.....	Convalescent.
27	2884	Do.	Do.	80 do.	7	Inguinal bubo	101°	.....
28	2898	Do.	Do.	7 do.	12	Femoral and Cervical bubo	100°	1	Convalescent.
29	2749	Do.	Do.	8 do.	4	Cervical bubo	102°	.....
30	2802	N. Christian	Do.	20 do.	8	Inguinal and Femoral bubo	108°	1	
31	78	Hindu	Female	11 do.	12	Cervical bubo	102°	.....	Convalescent.
32	75	Do.	Male	15 do.	4	Do. do.	102°	.....
33	117	Do.	Female	20 do.	Unknown.	Inguinal do.	102°	1	Convalescent.
34	240	Do.	Male	20 do.	22	Axillary do.	101°	.....	Do.
35	248	Do.	Female	80 do.	7	Femoral and Iliac bubo...	101°	.....	Do.
36	259	Do.	Male	20 do.	4	Double Axillary do.	102°	.....
37	282	Do.	Do.	18 do.	9	Cervical bubo	108°	1	Convalescent.
38	818	Do.	Do.	12 do.	9	Axillary do.	101°	1	Do. Haffkinised.
39	899	Do.	Female	8 do.	12	Femoral and Iliac bubo...	104°	1	Do.
40	416	Do.	Do.	7 do.	6	Double Cervical do.	104°	1	Haffkinised.
41	575	Do.	Male	80 do.	8	Femoral bubo	101°	.....	Convalescent.
42	599	Do.	Do.	1 do.	2	Do. and Cervical bubo	108°	.....
43	669	Do.	Do.	22 do.	8	Double Inguinal bubo	101°	1	
44	685	Mussalman	Do.	80 do.	7	Femoral bubo	101°	.....	Convalescent.
45	710	Hindu	Do.	45 do.	6	Inguinal and Iliac bubo	102°	1	
46	886	Do.	Do.	12 do.	Unknown.	Femoral and Inguinal bubo	101°	.....
47	1081	Do.	Do.	5 do.	Do.	Axillary bubo	98°	.....	Convalescent.
48	1059	Do.	Do.	85 do.	2	Femoral and Inguinal bubo	108°	1	
49	1056	Do.	Do.	80 do.	8	Inguinal bubo	104°	.....
50	1111	Mussalman	Do.	35 do.	12	Cervical do.	99°	1	Convalescent.

List of the Control Patients who Recovered—(contd.).

Current Number.	Hospital Number.	Caste.	Sex.	Age.	Days of illness on admission.	Manifestation of disease.	Highest temperature.	Bubo suppurated.	REMARKS.
51	1138	Hindu	Male	40 years	Unknown.	Double Femoral bubo	101°	.....	Convalescent.
52	1140	Do.	Do.	24 do.	2	Supra hyoidal bubo	105°	1	
53	1164	Do.	Do.	20 do.	8	Cervical bubo	104°	1	
54	1211	Do.	Do.	8 do.	4	Inguinal do.	104°	1	
55	1168	Do.	Female	80 do.	6	Femoral do.	104°	.....
56	1228	N. Christian	Male	13 do.	8	Cervical do.	104°	1	
57	1256	Hindu	Female	6 do.	6	Supra hyoidal bubo	99°	.....	Convalescent.
58	1250	Do.	Male	28 do.	2	Axillary bubo	104°	.....
59	1270	Do.	Do.	22 do.	1	Inguinal do.	106°	1	Haffkinised.
60	1273	Do.	Female	20 do.	6	Femoral do.	106°	.....
61	1282	Do.	Male	15 do.	2	Inguinal do.	104°	1	
62	1293	Do.	Female	25 do.	2	Do. do.	104°	1	
63	1316	Mussalman	Male	20 do.	2	Double Inguinal bubo	99°	.....	Haffkinised.
64	1357	N. Christian	Do.	15 do.	11	Inguinal and Cervical bubo	106°	.....	Convalescent.
65	1349	Hindu	Do.	32 do.	3	Pectoral bubo	108°	.....
66	1386	Do.	Female	12 do.	2	Femoral and Iliac bubo	103°	1	
67	1395	N. Christian	Male	85 do.	10	Inguinal and Iliac do.	98°	1	Convalescent.
68	1405	Do.	Do.	80 do.	2	Axillary bubo	104°	.....
69	1420	Hindu	Do.	8 do.	Unknown.	Cervical do.	101°	.....	Convalescent.
70	1433	Do.	Do.	8 do.	6	Femoral Iliac and Inguinal bubo	104°	1	
71	1455	Do.	Female	16 do.	5	Cervical bubo	105°	.....
72	1485	Do.	Male	35 do.	2	Femoral and Iliac bubo	103°	1	
73	1489	Do.	Female	35 do.	4	Cervical bubo	105°	.....
74	1543	N. Christian	Male	52 do.	8	Inguinal do.	100°	.....
75	1562	Hindu	Do.	85 do.	10	Cervical and Axillary bubo	101°	1	Convalescent.
76	1588	Do.	Female	7 do.	4	Femoral and Inguinal do.	104°	.....
77	1590	Do.	Male	10 do.	4	Femoral bubo	103°	.....
78	1825	Do.	Do.	36 do.	8	Inguinal do.	99°	1	Convalescent.
79	1829	Do.	Do.	12 do.	20	Femoral do.	99°	1	Do.
80	1849	Do.	Female	20 do.	3	Do. do.	104°	1	
81	1877	Do.	Male	80 do.	3	Do. do.	104°	.....
82	1897	Do.	Do.	6 do.	3	Cervical do.	98°	.....	Convalescent.
83	1936	N. Christian	Do.	40 do.	3	Femoral and Inguinal bubo	101°	.....	Do.
84	1943	Hindu	Do.	80 do.	6	Do. bubo	105°	1	
85	1995	Do.	Do.	22 do.	3	Inguinal and Iliac bubo	105°	1	
86	2035	Do.	Do.	40 do.	10	Double Inguinal do.	103°	.....	Convalescent.
87	2103	Do.	Do.	25 do.	Unknown.	Femoral and Iliac do.	103°	1	
88	2169	Do.	Do.	20 do.	15	Femoral and Cervical bubo	104°	1	Convalescent.
89	2184	Do.	Do.	25 do.	10	Inguinal bubo	102°	1	Do.
90	2191	Do.	Do.	20 do.	7	Femoral do.	102°	1	
91	2231	Do.	Do.	25 do.	3	Do. do.	104°	1	
92	2243	Do.	Do.	15 do.	3	Do. do.	100°	.....
93	2286	Do.	Female	28 do.	2	Axillary and Cervical bubo	103°	.....
94	2300	Do.	Do.	9 do.	7	Do. bubo	103°	1	
95	2382	Do.	Do.	85 do.	3	Femoral and Inguinal bubo	103°	.....
96	2494	Mussalman	Do.	25 do.	26	Axillary bubo	98°	.....	Convalescent.
97	2584	Hindu	Male	8 do.	2	Inguinal do.	104°	1	
98	2779	Do.	Do.	16 do.	2	Axillary do.	105°	.....

A number of patients is put down as convalescent in the lists, *viz.*, 28 among the serum patients and 33 among the controls. They have no value in the experiment, as they were admitted on such a late day of illness that the influence of the serum was excluded. The number of convalescents recorded here does not tally exactly with that given by Dr. Choksy, *viz.*, 28 for the serum side and 38 for the controls. Dr. Choksy's criterion of the convalescence was a clinical one, whereas we call all those patients convalescent who had passed the acute stage of plague when they were admitted. Although our distinction means a numerical gain to the control side we have preferred it because it gives the possibility of proving the number of convalescents from the figures in the lists. We gather from the lists that the serum treatment gave 152 recoveries * and the ordinary treatment 98 recoveries, and that one-fourth of all the patients who recovered was convalescent on admission. As the efficacy of the serum must be judged by the results obtained on patients who were actually sick with plague, the convalescents must be excluded from our account. We give in the following table the original figures and the corrected ones:—

	SERUM PATIENTS.			CONTROL PATIENTS.		
	Admitted.	Died.	Recovered.	Admitted.	Died.	Recovered.
Original figures	480 (28 convalescents.)	328 *	152 (28 convalescents.)	480 (33 convalescents.)	382	98 (33 convalescents.)
Corrected figures.	452 (no convalescents.)	328	124 (no convalescents.)	447 (no convalescents.)	382	65 (no convalescents.)

Calculating the ratio between the recoveries of either side, we find that for every 100 patients who recovered by the serum 53 patients recovered by ordinary methods. If we take the ratio between the recoveries amongst the patients admitted on the first five days of illness, *viz.*, admitted during the acute stage of the disease, it is still more in favour of the serum, as for every 100 serum patients who recovered only 49 recovered amongst the controls. We can, therefore, say that the serum has doubled the recoveries for the acute stage of plague. We see further from the lists that 59 buboes suppurated under the serum treatment and 40 under the ordinary treatment corresponding to 38.50 per cent. and 41.00 per cent., respectively. The difference seems trifling, but it increases considerably if we take into account only the patients admitted on the first and second day of illness. We have then 33 patients with 10 suppurating buboes on the serum side and 18 patients with 10 suppurating buboes on the control side. The statistics thus confirm the clinical observation that buboes reabsorb oftener in serum patients. It is natural that the serum treatment should prevent the suppuration only in the patients of the earlier days.

In order to show how the serum was administered, how it acted, and also for the sake of comparison, there are attached the charts of the first 30 patients who recovered during the alternate treatment, one chart of a patient treated in private practice with the serum and two charts of patients who died under the serum treatment. No other clinical details are given than the temperature during the acute stage of the disease. Considerations of economy forbade the publication of more charts which would have furnished the best proof for the efficacy of the serum. We draw the attention to chart No 12 of a patient who received the serum treatment although no sure signs of plague were found when it was commenced. Cases of a similar nature had previously been observed and considered as extra cases,

* One patient died when this report was being prepared.

the bacteriological examination having been negative even after death. The patient was admitted on the third day of illness in a stupor and very low condition. He was kept under observation for three days, and as the disease seemed to take the same fatal turn as in the cases mentioned, he was declared and came to the serum treatment. The temperature had been 104.5° on the previous evening and had fallen to 102.5° on the morning of the fourth day. It was again rising, the thermometer showing 103° at 11 o'clock, when 20 c.c. of the serum were injected. After three hours the temperature had fallen to 101.5° . It rose to 102.5° until 4 p. m., when another 20 c.c. were given which brought the temperature to 101° at midnight. On the next morning the general condition was much improved, the patient was conscious and able to speak. Five more injections had to be made till the temperature fell finally to normal on the morning of the fourth day of the treatment. The recovery was speedy and uninterrupted. Simultaneously with the first injection blood was taken for examination, from which a fairly abundant growth of plague bacilli was obtained. There was no more occasion to try the serum in such cases as they became rare and happened to come to the control side. The chart of the private patient is interesting, because an exceptionally large quantity of serum was injected within a short time. The patient came under treatment on the evening of the fourth day of illness with swollen glands all round the neck and extreme infiltration and œdema glottidis which threatened suffocation. Dr. Choksy realising the gravity of the situation resorted to doses not tried before. The temperature was 105° when he injected the first 60 c.c. It fell but by one degree until the next morning, when another 60 c.c. were given. In spite of that the temperature went up to 105.5° in the evening, when 60 c.c. more were injected. On the next morning the temperature was 102° ; still a further injection of 60 c.c. was thought advisable, the patient having thus received 240 c.c. of serum within 36 hours. There was no evening rise, almost invariably a favourable sign, and the treatment was discontinued and the last 30 c.c. were given on the next morning. From this time the temperature fell steadily, the patient making a good recovery, all buboes reabsorbing. From the two charts of the serum patients who died, it appears that death was not due to plague. The patients were transferred from the J. J. Hospital with well developed buboes and all other symptoms of plague. They seemed on the highway to recovery when relapsing fever set in, to which the patients eventually succumbed. Relapsing fever, complicated with plague, must have been common during the past years: relapsing fever is a disease of longer duration; it was prevalent in epidemic form, and it attacks with predilection the same class of the population as plague does. Clinically, it cannot be diagnosed with certainty during the acute stage of the plague.

The alternate treatment was properly commenced on the first of July, 1899, and was continued until the 31st of July, 1900, when it was abandoned by order of the Municipal Commissioner in favour of the clinical selection. As already in May, 1899, the patients had been alternately treated, the record for this month has also been included in this report, although it is incorporated in that of the last year. July, 1900, has been excluded, as the results were not known when the report was taken in hand. Only 4 cases were treated on either side in that month. Three of the serum patients recovered and three of the controls died. The records for the single months are seen from the following table:—

MONTHS.	ARTHUR ROAD HOSPITAL.																MARATHA HOSPITAL.			
	SERUM PATIENTS.				CONTROL PATIENTS.				EXTRA PATIENTS.			TOTAL.				ORDINARY TREATMENT.				
	Number of patients.	Died.	Recovered.	Percentage of mortality.	Number of patients.	Died.	Recovered.	Percentage of mortality.	Number of patients.	Died.	Recovered.	Number of patients.	Died.	Recovered.	Percentage of mortality.	Number of patients.	Died.	Recovered.	Percentage of mortality.	
1899.																				
May	23	15	8	65·21	23	15	8	65·21	6	4	2	52	34	18	65·38	121	96	25	79·33	
July	21	13	8	61·90	21	14	7	66·66	6	6	...	48	33	15	68·75	48	34	14	70·83	
August	15	12	3	80·00	15	10	5	66·66	...	...	...	30	22	8	73·33	47	39	8	82·97
September	17	9	8	52·94	17	15	1	94·11	4	3	1	38	28	10	73·68	69	56	13	81·16	
October	26	21	5	80·77	25	22	3	88·00	7	5	2	58	48	10	82·75	77	58	19	75·32	
November	15	10	5	66·66	16	12	4	75·00	...	...	...	31	22	9	70·96	83	71	12	85·54
December	25	14	11	56·00	25	23	2	92·00	6	5	1	56	42	14	75·00	220	171	49	77·72	
1900.																				
January	59	38	21	64·40	59	45	14	76·27	2	2	...	120	85	35	70·83	336	275	61	81·84	
February	86	64	22	74·41	85	68	17	80·00	5	5	...	176	137	39	77·84	504	416	88	82·54	
March	74	45	29	60·81	75	59	16	78·66	...	...	...	149	104	45	69·79	596	487	109	81·71
April	80	61	19	76·25	79	62	17	78·48	1	1	...	160	124	36	77·50	356	294	62	82·58	
May	31	21	10	67·74	32	29	3	90·62	1	1	...	64	51	13	79·68	142	107	35	75·35	
June	8	5	3	62·50	8	7	1	87·50	...	...	...	16	12	4	75·00	.....	.....	.....	.....
Total	480	328	152	68·33	480	362	98	79·58	38	32	6	998	742	256	74·34	2,599	2,104	495	80·95	

In the table are included the extra cases in order to allow a comparison with the records of the Maratha Hospital which are also given for the last official year. With regard to this table it may not be superfluous to mention that the mortality amongst the serum patients, and the total mortality, compared favourably with that of the controls, when the serum treatment had to be discontinued in March last, and that the total mortality for the first half of the month, when the serum was used, was more than 5 per cent. less than for the second half when it was not employed. The comparison with the Maratha Hospital shows that the monthly mortality at the Arthur Road Hospital, except during October, 1899, and May, 1900, was lower than at the former, and that the lower mortality was maintained during the four months, January to April, 1900, when the epidemic was at its height. It is of special interest to observe how the mortality at the Arthur Road Hospital followed the fluctuations of the death-rate at the other hospital during the above-mentioned months. In February and April the disease showed the highest virulence, and the difference of the mortality of the two hospitals is 5 per cent., in January and March the virulence was a trifle less, and the difference increased to 11 per cent. The higher figures on which the mortality works out during these months are a safeguard that the increase was not accidental, and we shall see later on that it corresponds to a law of serotherapeutics. The mortality for the period of the alternate treatment was less by 6.5 per cent. at the Arthur Road Hospital, although only half the patients received the serum treatment. If all the patients had received it the reduction of the mortality would have to be calculated at 13 per cent. The difference between the mortality of the serum patients and the controls at the Arthur Road Hospital itself is 11.25 per cent. and, therefore, fairly conforms with the calculated difference of the mortality of both the hospitals. It is this conformity which gives the proof that the reduction of the death-rate on the serum side is real. It might be suggested that the mortality at the Arthur Road Hospital is generally lower than at the Maratha Hospital. Although there seems to be no apparent reason for this, the Maratha Hospital receiving the higher Hindu castes, we thought it useful to meet this suggestion with facts and figures. The Maratha Hospital opened on January 21st, 1898, as we find from Sir James Campbell's Report of 1897-1898. The plague mortality up to the 30th of April, 1898, amongst 738 patients under English treatment, was 73.44 per cent. During the same period, also including one month and a half of the serum treatment, which was commenced on the 13th March, the Arthur Road Hospital had 1,231 admissions with a mortality of 74.16 per cent. It had 273 admissions with 222 deaths, equal to a mortality of 81.31 per cent. in November and December, 1898, and January, 1899, when no serum was available. During these months the Maratha Hospital had 557 admissions with 453 deaths, equal to a mortality of 81.32 per cent. The mortality during the time when no serum was used was, therefore, somewhat higher at the Arthur Road Hospital.

It follows from the last table that the mortality amongst the serum patients was 68.33 per cent. and amongst the controls 79.58 per cent., the difference being 11.25 per cent. in favour of the serum. The alternate treatment was started under the impression that this difference would be the expression of the efficacy of the serum. We have been obliged to demonstrate that such might, or might not, be the case, and to undermine thus the very ground on which we were to base our arguments for the efficacy of the serum. Truly, not an enviable position in which we find ourselves. There is only one way out of this difficulty. The results obtained by the alternate treatment might be accepted as essentially correct if the three classes in which we have divided the patients with regard to the effects of the serum and non-serum treatment were evenly distributed on both sides. That cannot be ascertained directly, but we might find it out indirectly by going into the details of the distribution of the patients as regards caste, sex, age, individual resistance, duration, mode and virulence

of infection. If the patients were fairly distributed according to these factors, we could be certain that the same was the case also with respect to the three classes mentioned. We shall, therefore, compare in the following the details of the distribution one by one in the order given above, so far as it is statistically feasible. The material for the statistics is taken from the charts of temperature of our patients, which we have gone through carefully ourselves. We begin with the statistics of the distribution according to the caste:—

Caste.	Hindus.	Mussalmans.	Native Christians.	Parsees.	Total.
Serum patients ...	404	21	47	8	480
Control patients ...	405	27	40	8	480

No comments are necessary on this table. The same can be said of the following, showing how the patients were distributed according to the sex:—

Sex.	Males.	Females.	Total.
Serum patients	350	130	480
Control patients	358	127	480

The next table gives the distribution with regard to the age period:—

Age period.	0-10 years.	10-20 years.	20-30 years.	30-40 years.	40-50 years.	50 years and more.	Total.
Serum patients ...	50	129	162	81	37	21	480
Control patients ...	60	127	159	99	25	10	480

The distribution is here in favour of the controls which have 10 more children, among whom the mortality is about 12 per cent. lower than the average, and 23 fewer patients over 40 years, among whom the mortality is higher than the average.

The individual resistance is dependent on caste, sex, age and previous immunisation. The benefit of the latter was identical, as on either side eleven patients had been inoculated with the plague prophylactic.

With regard to the days of illness on admission the patients were distributed as follows:—

Day of illness on admission.	1st day.	2nd day.	3rd day.	4th day.	5th day.	6th day.	7th day.	8th day.	9th day.	10th day & more.	Un-known	Total.
Serum patients...	18	121	186	79	82	17	4	16	4	19	84	480
Control patients..	20	120	100	67	88	25	13	20	4	26	47	480

The advantage lies here again with the controls. It is well known that the mortality from plague in our hospitals is highest amongst the admissions of the earlier days. A marked reduction of the mortality only takes place in the patients admitted after the fifth day of illness. If we divide the cases accordingly, we find

on the serum side 386 patients of the first 5 days of illness with a mortality of 71.76 per cent., and on the control side 345 such patients with a mortality of 86.08 per cent. The patients of the sixth and the following days of illness are 60 on the serum side with a mortality of 45.00 per cent. and 88 on the control side with a mortality of 51.13 per cent. The serum side had thus 41 more patients who had under the ordinary treatment a mortality of 86.08 per cent. and 28 fewer patients who had a mortality of 51.13 per cent. These facts represent a material advantage for the controls, and they demonstrate at the same time that Dr. Choksy estimated correctly the number of convalescent patients on both sides. We see, moreover, that the reduction of the mortality due to the serum was almost entirely obtained in the patients in the acute stage of the disease.

We come now to compare the distribution according to the manifestation of the disease which indicates to some extent the mode and virulence of the infection. For statistical purposes, the manifestations of the disease have been brought in such groups as show generally a distinct difference of the mortality between each other, the single femoral or inguinal, or other single buboes of more rare occurrence with the lowest mortality heading the columns in the following table. Contiguous buboes are such as femoral and inguinal, femoral and iliac, etc. Only the buboes present on admission were taken in consideration :—

Manifestation of disease.	Single inguinal, femoral buboes.	Single Cervical buboes.	Single Axillary buboes.	Contiguous buboes.	Multiple buboes.	No. buboes.	Pneumonia.	Total.
Serum patients ...	170	52	88	131	32	3	4	480
Control patients ...	157	46	100	128	20	15	13	480

The advantage is here on the serum side which has 13 more cases of single inguinal or femoral buboes, showing the lowest mortality, and 34 fewer cases with axillary buboes, without buboes or with pneumonia, which have the highest mortality. Also, without calculating numerically the statistical value of this advantage, this much can be said with certainty that it cannot have preponderated over the benefit the controls derived from the distribution according to the days of illness where every second patient of the later days represented a recovery.

The following table gives the distribution according to the temperature on admission ; for a fraction of a degree the next lower degree has been recorded.

Temperature on admission.	100° F.	101° F.	102° F.	103° F.	104° F.	105° F. and more.	Total.
Serum patients ...	141	79	97	88	54	21	480
Control patients ...	127	78	112	95	47	21	480

The temperature on admission gives little information as to the severity of the attack, high temperatures being frequently due to the excitement of the transport, whereas low ones in the acute stage of plague are often signs of collapse and impending death. All we can guess from the table is that there are no differences worth mentioning.

There are no more items allowing of a statistical comparison and we can review the facts as follows. The distribution, according to the caste, sex, previous immunisation and temperature on admission, was practically the same for both sides. With regard to the age period and the days of illness on admission the distribution has

favoured the controls, and with respect to the manifestation of the disease, the serum treatment. There is no aim in urging that clinically the advantages on the control side were more important, and we are satisfied if it be admitted that the distribution was *not in favour of the serum*.

Now we can accept the results at the Arthur Road Hospital as correct without fear of being contradicted by any one whose syllogisms are directed by the principles of logic, and we can say that cures have been effected by the serum treatment, which could not have been effected by any other known means. Compared with that fundamental fact the percentage of the cures is of minor importance, as it is a variable quantity which can change only in one direction—in the direction of progress. The treatment of plague with Professor Lustig's serum has thus passed once for all the stage of experiment, its efficacy has become an established fact, against which scepticism would no longer be legitimate.

Hence the serum treatment of plague will be an acknowledged implement in the armoury of the physician, restoring life and health to many, and will rank side by side with that of diphtheria as a great achievement which represents a further and important step towards the solution of the problems of serotherapeutics, it being the second instance in which indisputable evidence has been brought forward for the efficacy of serotherapy in human beings.

Having demonstrated the efficacy of the serum we shall analyse the results obtained in order to solve a question of practical importance, *viz.*, under what circumstances the serum was most efficacious. From *a priori* considerations we have to expect that the mortality under the serum treatment followed on a lower level closely the fluctuations of the general mortality from plague. Indeed, should we not find any indication of this principle in the course of our investigations, we could even doubt the proofs furnished hitherto. On the other hand, we cannot exclude that there might be considerable deviations from that rule, due to the peculiarity of the remedy or the disease, or to other influences which it would be necessary to trace. If we find such deviations we shall have to ascertain whether they were accidental or the expression of a law governing the application of the serum. In order to answer our query we shall resort again to the statistics. With regard to them we have to remember that the information we may get might not always be of an absolute but only of a comparative value, or even valueless owing to the small number of observations on which the statistics might be based in single instances. In such a case we might be obliged to control our statistics by those drawn from larger figures. On the whole, we shall find that the results on the serum side are more congruous with those of the general statistics, as the action of the serum and the larger number of recoveries tended to neutralise disturbing influences, of which the distribution of the convalescents was the most important one on the control side. We shall go through our statistics in the same order as before and begin with that showing the results according to the caste:—

Caste.	Serum patients.				Control patients.			
	Number of patients.	Died.	Recovered.	Percentage of mortality.	Number of patients.	Died.	Recovered.	Percentage of mortality.
Hindus	404	282	122	69.80	405	326	79	80.49
Mussalmans	21	14	7	66.66	27	20	7	74.07
Native Christians	47	26	21	55.32	40	29	11	72.5
Parsees	8	6	2	75.00	8	7	1	87.5
Total	480	328	152	68.33	480	382	98	79.58

The results shown in this table fulfil our expectations, the mortality of the serum patients repeating the fluctuations on the other side. We note here that the reduction of the average mortality of the controls by 7 per cent. in the case of Native Christians corresponds to a reduction of 24 per cent. on the serum side:—

The next table gives the results according to the caste and sex:—

Caste and Sex.		Serum Patients.				Control Patients.			
		Number of patients.	Died.	Recov-ered.	Percent- age of Morta- lity.	Number of patients.	Died.	Recov-ered.	Percent- age of Morta- lity.
Hindus	Males ...	291	207	84	71.13	298	236	57	80.54
	Females ...	118	75	88	66.97	112	90	22	80.35
Musalmans	Males ...	18	13	5	72.22	22	16	6	72.72
	Females ...	8	1	2	83.33	6	4	1	80.00
Native Christians ...	Males ...	37	19	18	51.35	33	22	11	66.66
	Females ...	10	7	9	70.00	7	7	...	100.00
Parsees	Males ...	4	2	2	50.00	5	5	...	100.00
	Females ...	4	4	...	100.00	3	2	1	66.66
Total ...		480	328	152	68.33	480	382	98	79.58

Considering only the larger figures we see that Hindu males have the highest mortality on both sides. Contrary to the facts of the general statistics, which show that Hindu females have a distinctly lower mortality than Hindu males, there is hardly any reduction in Hindu females on the control side. It is otherwise under the serum treatment. Already during the time of the selection of the patients it was observed that females answer better to the serum treatment than males. In the cases of Native Christians it is interesting that the chief reduction of the mortality shows itself on both sides in males. This is correct, Native Christian males having generally a much lower death rate than females.

The results, according to the age period, are seen from the following table:—

Age period.	Serum Patients.				Control Patients.			
	Number of Patients.	Died.	Recov-ered.	Percentage of Mortality.	Number of Patients.	Died.	Recov-ered.	Percentage of Mortality.
From 0-10 years...	50	25	25	50.00	60	40	20	66.66
" 10-20 " ...	129	90	69	69.76	127	95	32	74.80
" 20-30 " ...	162	105	67	64.81	159	135	24	84.90
" 30-40 " ..	81	62	19	76.54	92	84	15	84.34
" 40-50 " ...	37	28	9	75.67	25	22	3	88.00
" 50-60 " and more	21	18	8	86.71	10	6	4	60.00
Total ..	480	328	152	68.33	480	382	98	79.58

Children had also during the time of the selection a mortality of 50 per cent. They give the best results under the serum treatment. That the mortality from plague is generally lower among children than in adults is noteworthy as in other infectious diseases the full-grown individuals are more resistant. The two following periods show especially on the control side differences of the mortality which are

not to be found in large statistics, from which we learn that the mortality is much the same for both the periods and scarcely lower than the average. This discrepancy might be partly accidental and in part due to the inaccuracy of the patients in stating their age. The later periods show an increased mortality in the right proportion.

Concerning the patients who were prophylactically injected it will be sufficient to say that 7 such patients recovered on the serum side and 6 amongst the controls.

We pass now on to the table showing the results according to the days of illness on admission :—

Day of illness on admission.	Serum Patients.				Control Patients.			
	Number of Patients.	Died.	Recovered.	Percentage of Mortality.	Number of Patients.	Died.	Recovered.	Percentage of Mortality.
1st day	18	11	7	61.11	20	18	2	90.00
2nd "	121	95	26	78.51	120	103	17	85.83
3rd "	136	96	40	70.58	100	84	16	84.00
4th "	79	55	24	69.62	67	57	10	85.07
5th "	32	20	12	62.50	38	35	3	92.10
6th "	17	13	4	76.47	25	17	3	68.00
7th "	4	2	2	50.00	13	7	6	53.84
8th "	16	6	10	37.50	20	11	9	55.00
9th "	4	1	3	25.00	4	1	3	25.00
10th " and more.	19	5	14	26.31	26	9	17	34.61
Unknown	34	24	10	70.58	47	40	7	85.10
Total	480	328	152	68.33	480	382	98	79.58

The figures in this table have only a relative value as they are chiefly based on the statements of the patients or their friends. In general, we may say that they are more reliable for the earlier days and that the duration of illness is, if anything, given as too short. Only 4 per cent. of all the patients were admitted on the first day, and only two amongst twenty recovered on the control side. The statistics corroborate thus the clinical observation that only the severest cases are brought to the hospital on the first day. Still the mortality on the serum side is well below the average. It rises by 17 per cent. for the patients admitted on the second day. Then a marked falling off for those of the third day, and a steady decline for the patients of the following days. The mortality amongst the controls is practically the same on the first 5 days of illness, the excessive mortality on the first and fifth day being accidental. We have to record here an essential difference of the results. The curve of mortality of the patients admitted on the first 5 days forms an angle on the serum side and is a straight line on the control side. It was irrelevant for the controls on what day they came to the hospital, whereas it made a considerable difference whether a patient received the serum treatment on the first day or on the second day. So long as the necessity of the early treatment is not fully appreciated and acted upon by the public and the medical profession, the results of the serum treatment will never be as satisfactory as they could be. A famous surgeon was wont to tell his pupils that if they be called to an incarcerated hernia in day time they should not allow the sun to set, and if at night not allow the sun to rise, without having liberated it. *Mutatis mutandis* that must be the principle of the physician in the serum treatment of plague. *One hour lost might be a life lost.*

The next table gives the results according to the manifestation of the disease :—

Manifestation of Disease.	Serum Patients.				Control Patients.			
	Number of Patients.	Died.	Recovered.	Percentage of Mortality.	Number of Patients.	Died.	Recovered.	Percentage of Mortality.
Single inguinal, femoral, etc., buboes.	170	97	73	57.05	157	122	85	77.70
Single Cervical buboes ...	52	38	14	73.07	46	33	16	71.73
Single Axillary buboes ...	88	64	34	72.72	100	88	12	88.00
Contiguous buboes.	181	102	29	77.86	128	99	29	77.34
Multiple buboes ...	32	21	11	65.62	30	12	8	60.00
No buboes ...	8	2	1	66.66	16	16	...	100.00
Pneumonia ...	4	4	...	100.00	13	12	1	92.30
Total ...	480	328	152	68.33	480	382	98	79.58

We note here the considerable reduction of the mortality effected by the serum in single femoral or inguinal buboes, and also in axillary buboes. It can be seen from the list of the recovered patients that this reduction was not due to the distribution of the convalescents, which has materially interfered with the correctness of the results in cervical and multiple buboes. Here again the serum has singled out for its action certain patients, *viz.*, those in whom the disease was localised.

The statistics of the results, according to the temperature on admission, did not promise much information, and we have substituted a table demonstrating not the saving of life, but the prolongation of life :—

Died after admission.	Within 12 hours.	Within 24 hours.	Within 48 hours.	Later on.
Serum patients	12.50%	8.95%	18.33%	28.54%
Control patients	16.87%	12.50%	20.65%	29.58%

The influence of the serum made itself felt even in patients who in the common course died within 12 hours after admission. Comparing the percentage of the total deaths within 48 hours after admission we have 191 patients, or 39.79 per cent., dying under the serum treatment, and 240 or 50 per cent., amongst the controls, this being the usual percentage of deaths within 48 hours after admission occurring in our plague hospitals. In 20 per cent., therefore, of those who would have died within 48 hours after admission life has been prolonged by the serum treatment. The serum patients lived on an average 4.3 days and the controls 3.2 days. That will reassure those who might still be afraid that in certain cases the serum might be injurious. Careful observation on nearly 1,000 patients has shown that it never does harm, either to moribunds or others.

There are no more statistics available, and we can summarise the information we have gained as follows :—

In general, our anticipations have been justified, the mortality under the serum treatment following the fluctuations of the death-rate on the control side closely on a lower level save for being disproportionately lower in :

- (1). Patients of the 1st, 3rd, 4th and 5th day of illness.

This is in accordance with the first law of serotherapeutics, that the earlier the treatment the better the results. It is no contradiction that the patients of the third and the following days had a lower mortality than those of the second day. A similar observation was made in the selected patients and it has been commented

upon in our previous report to which we refer. The plague, as already stated by the German Plague Commission, is characterised by subsequent attacks of a few days duration, the first attack being the most fatal.

- (2). Native Christians.
- (3). Hindu females.
- (4). Children.
- (5). Patients with single buboes.

The disproportionate reduction in these four classes, which have also under the ordinary treatment a lower mortality than the average, corresponds to another law of serotherapy, which we might formulate thus: "Under those conditions where the average mortality from an infectious disease decreases naturally, the decrease under the influence of a serum treatment takes place in a much higher ratio." Thus a serum of a given strength, which would reduce an average mortality of 80 per cent. to 70 per cent., would not give the same difference of the percentages or the same proportion of the reduction if the average mortality were 70 per cent. to begin with. A mortality of 70 per cent. might be reduced to 50 per cent., and less. That is, in the last instance, due to the fact that the germs of an infectious disease multiply in an arithmetical progression, and that the serum becomes more effective in the same ratio as the germs become less in numbers. Following on this law we understand not only the deviations in our statistics, but also why the serum treatment gave so much better results in 1897 when the mortality was considerably lower than it has been in the following years. We understand also the exceedingly favourable reports which came from places where the mortality from plague was much lower than it is in Bombay. A lower mortality means a less virulent infection; a less virulent infection a less rapid course of the disease, *viz.*, a longer interval between the infection and the fatal issue and an enhanced possibility of timely intervention. Here the two laws of serotherapeutics meet, they are indeed one, and we are at the old argument again, *ceterum censeo curam non esse differendam*.

The deviations we have found in the statistics are not striking, and cannot be so, considering that the mortality was 80 per cent. and the reduction 11 per cent. Each one of them could well be accidental. But what cannot be accidental, what excludes every possibility of an error is their concurrence, their harmony with the laws of serotherapy and with the clinical observations. With regard to the latter we can say that they are fully borne out by the statistics. We point in this relation to the statements made in last year's report, *viz.*, that the serum gives the best results in children, in patients with simple bubonic plague, that it is effective also on the fourth and fifth day of illness, that the buboes reabsorb oftener, and that life is prolonged. The analysis of the results obtained has thus not only answered our query when the serum is most efficacious, it has also furnished another and most convincing proof for the efficacy of the serum. Whereas the conditions of the patients were originally the same on both sides, the results were different, on the whole, and in the details, and the differences were not irregular but governed by a law and must logically be ascribed to the one new factor that was intentionally introduced on the one side, *viz.*, to the serum treatment.

Practically, the outcome of the analysis is important in two directions. It is obvious that a Hindu male with contiguous buboes, all other conditions equal, will have a worse prognosis and will require larger doses than a Native Christian male with a single inguinal bubo.

There is nothing more to be said about the alternate treatment, and we have only to mention that four selected cases were treated with the serum in June, 1899, at the Arthur Road Hospital and had one recovery, whereas the 14 remaining patients had two recoveries.

We turn now to the Modykhana Hospital, where in February last an attempt was made to treat patients alternately with the serum. Owing to the pressure of work and the great distance of the hospital from the laboratory at Parel the undersigned were unable to visit it in order to control the carrying out of the experiments which was entirely left to the Medical Officer in charge who had received the necessary instructions. The results are seen from the following table :—

Modikhana Hospital 26th January, to 27th February 1900.	Number of patients.	Died.	Recovered.	Percentage of Mortality.
Serum patients	66	54	12	81·81
Control patients	66	48	18	72·72
Doubtful cases	43	32	11	74·41

Although the failure of the serum treatment might have been merely due to the distribution of the patients, it seemed strange, and stranger still, the large number of doubtful cases.

A minute investigation elicited the following facts :—

- (1). That 21 of the so-called doubtful cases were undoubted cases of bubonic plague, with buboes either on admission or developing buboes in the hospital and that the greater part of the others were either suffering from plague pneumonia or showed other undoubted symptoms of plague. These cases were, for various reasons, some through inadvertance excluded from the alternate treatment.
- (2). That the serum treatment was neither always begun in proper time nor continued regularly.
- (3). That the doses were insufficient, the average quantity of serum used for a patient having been 55 c.c. against 100 c.c., as given in the instructions.
- (4). That the total quantity of serum put down as having been injected was in excess of that actually supplied to the hospital.

It appeared, therefore, that the alternation was frequently and arbitrarily interfered with at the Modikhana Hospital; that the serum was administered in a manner and in doses by which curative results could not be expected, and that the registration of important items was defective. The proofs for these facts and the conclusions drawn from the facts were submitted to Lieutenant-Colonel J. S. Wilkins, Special Medical Officer, Plague Operations, who, after examination, concurred in the opinion that the experiments, as conducted at the Modikhana Hospital, were valueless and not to be included in the statistics of the alternate treatment.

Six patients were treated with the serum at the Parsee Fever Hospital by Dr. S. Nariman, the Medical Officer in charge of it, two of whom recovered. Eight patients, treated during the same period without serum, had also two recoveries. Dr. S. Nariman stated that all the cases were equally severe, and added that from the few observations he can infer with certainty that the serum treatment prolongs life.

Ten patients were treated in private practice and had four recoveries. Except one, the cases were all of the third or fourth day of illness and all were very severe.

After having rendered a full account of the patients treated during the last official year, we shall bring in conclusion the statistics of the serum treatment since March, 1898, except those of the Modikhana Hospital, and also other records necessary for comparison.

Period.	Hospitals and private practice.	Treatment.	Number of patients.	Died.	Recovered.	Percentage of mortality.
March 1898 to 31st of October 1898 and 1st February to 31st April 1899.	Arthur Road Hospital.	Serum treatment, selected patients.	380	234	146	61.57
		Ordinary treatment, remaining patients.	1,167	942	225	80.71
	Maratha Hospital.	Ordinary treatment ...	3,257	2,636	621	80.93
1st of November 1898 to 31st January 1899.	Arthur Road Hospital.	Ordinary treatment, no serum available.	273	222	51	81.31
	Maratha Hospital.	Ordinary treatment ...	557	453	104	81.32
1st of May 1899 to 31st of June 1900 (June 1899 excluded).	Arthur Road Hospital.	Alternate treatment, serum patients.	480	328	152	68.33
		Alternate treatment, control patients.	480	382	98	79.58
1st of May 1899 to 31st of May 1900 (June 1899 excluded).	Maratha Hospital.	Ordinary treatment ...	2,599	2,104	495	80.95
13th of March 1898 to 31st of June 1900.	Different hospitals	Serum treatment, partly selected patients.	50	38	17	66.00
	Private practice...	Serum treatment, not selected patients.	42	19	23	45.23

From the table it appears that on the whole 952 patients were treated with the serum, and that the results have been uniformly in its favour. If we compare those during the periods of the selection and alternation we find a difference of 7 per cent. Does that prove a diminished efficacy in the second instance? Not necessarily so. No direct comparison between the results is possible. The mortality in the alternately treated cases is the average mortality which may be obtained by the serum treatment, whereas that in the selected cases is a minimum mortality. A comparison is only possible between the total mortality of the hospital during the periods of the selection and alternation. This comparison shows that the total mortality of the hospital was 1.36 per cent. lower during the second period. From this and from the small difference between the mortality in the selected cases and in those alternately treated and from the clinical observation, we are convinced that the treatment as practised during the period of the selection would not have given a reduction of 11.25 per cent. if the cases had been treated alternately. This is not due to an improved manufacture, but to the progress

made in the administration of the serum. The possibilities in this direction, apart from the intravenous injections, are by no means exhausted. We admit that partly out of imposed economy the doses have not been pushed for some time past as far as might have been done with advantage, as further experience has taught us. It is certain that with larger doses more cures could have been effected. Moreover, the serum was usually injected in repeated small doses, whereas in all probability one large dose would have been more effective. It might turn out that the first dose, necessarily a large one, decides the question of life or death, and that the subsequent doses are of little value. But experience, where human life is concerned, is not gained so quickly as in the laboratory. Still the increase of the doses can only be a stopgap, until improvement is made in the manufacture of the serum which must be the task of the future. That the task is not an impossible one, probably nobody doubts. What we may hope for from an improved manufacture and application of the serum has already been alluded to in our previous report. The results in private practice will depend on the promptness with which the public and the practitioners will avail themselves of the remedy. The chief responsibility rests with the latter who must be quick with the diagnosis and therapy. The germs of the disease double their number in half-an-hour; there is not a minute to be wasted. Better to inject 100 patients erroneously, who are not sick with plague, than to miss the injection in one who is suffering from it. Unfortunately the probability of a faulty diagnosis is infinitesimal. *In time of an epidemic every swollen and tender gland which cannot be accounted for by other obvious causes must be looked upon as a manifestation of the plague.* The same axiom holds good during epidemics generally with regard to the characteristic symptom of an infection, why, therefore, should it be otherwise in the case of plague? To delay the treatment until the case turns out to be severe would be even worse than to lose time with the diagnosis. When a man is struggling with the waves, who would wait in going to the rescue until he is sinking? In our hospitals, where 50 per cent, of the patients die within 48 hours after admission, the limit of our expectations is more restricted than in private practice.

Notwithstanding the lesson of modesty the plague has taught us with regard to "stamping it out" by sanitary measures, there may still be some who are as yet unwilling to draw the obvious inference also with respect to the curative efforts, and who view with scanty satisfaction the promise we are holding out and esteem slightly the results we offer. Only 11 per cent.! Could it be that such contempt is prompted by the comparison with the results obtained by the serum treatment in other diseases? There is only one disease in which the efficacy of serotherapy has remained undisputed, although it has been claimed for many. What then are the results in diphtheria? We have at hand the latest statistics of the Metropolitan Asylums Board, based on many thousands of observations, which give the mortality from diphtheria at 30 per cent. previous to the serum treatment and at 18 per cent. after its introduction. Only 12 per cent.! And to obtain this the most eminent scientists have been working in the best equipped laboratories for nearly a decade. Yet the results are considered as highly satisfactory and the serum has become a remedy, the public and the physician would be loath to be without. The percentage of the cures is the same in diphtheria and plague, but what a difference of the conditions under which it has been obtained! There the accumulated experience of the whole scientific world, unlimited means, selected horses, selected serum, the public fully aware that time is life, the patients with healthy organs, the disease of relatively slow course and with a mortality of only 30 per cent! Against it here, manufacture and treatment on their trial, the horses selected with regard to their cost, the serum used regardless of its strength, the patients of the lowest classes in an advanced stage of the disease, their vital power undermined by previous or

concurring illness, the disease of a fatal rapidity and with a mortality of 80 per cent. Truly it is the case of two vessels, the one steaming in smooth waters and with a favourable breeze, and the other against a hurricane and heavy seas, yet both make the same headway; but can there be any doubt which one has the more powerful engines? We see we are wrong, it cannot be the comparison with the results in other diseases that makes our 11 per cent. not acceptable. Then perhaps the costs are out of proportion to the gain? Although to the humanitarian such a consideration might be repulsive, we cannot overlook the fact that in practice this must carry weight, and we think it not without advantage to discuss the matter from this point of view.

With the manufacture of the serum, as with any other manufacture, the cost decreases when the output rises. The cost of the experiments were necessarily disproportionately larger than the manufacture on an adequate scale would be. Moreover, the cost could be considerably reduced if only suitable patients be treated and a charge be made for the serum in those cases where the patients can afford it. We think the last point of importance also, because the charge would do away with the impression that the serum is still on its trial. Provided the above conditions be fulfilled the costs of the manufacture of the serum will not be out of proportion to the gain, and we can safely say that the results of the serum treatment of plague, as they are at present, will be acceptable also from a pecuniary standpoint.

That these results have been obtained in a relatively short time and under difficult circumstances is first of all due to the liberality and perseverance of the Municipality and the help of the Government of Bombay who provided the means for the manufacture of the serum, and to the insight of their advisers, who, in spite of adverse criticism, never lost confidence in, or interfered with, the conduct of the experiments. We may be allowed to mention specially Mr. W. L. Harvey, I. C. S., the Municipal Commissioner, who was ever ready to meet our requirements, and to him we are moreover much indebted personally for the kind indulgence he has always shown to us, little versed as we were in language and official ways. It is due to the steady support of the late Health Officer of Bombay, Col. T. S. Weir, I.M.S., who has also the merit of having done his best for the introduction of the prophylactic treatment of plague, and to the assistance of Lieut.-Col. J. S. Wilkins, I.M.S., D.S.O., Special Medical Officer, Plague Operations, one amongst the few of the medical profession who thought it incumbent to form an opinion based on personal experience. It is due to the untiring energy of Khan Bahadur N. H. Choksy, M.D., *Hon. Causa*, of Freiburg, on whom the treatment with the serum devolved. Three qualities fitted him best for the task entrusted to him; his unique experience of plague, his interest in the experiments, and the scientific spirit in which he approached the problem. Although an advocate of the treatment, he was always critical, ever on his guard against self-deception and errors. He has well deserved the satisfaction of the success after the two years' arduous work. We take here the opportunity to tender our hearty thanks to Dr. Choksy for his invaluable collaboration and to his assistants, Dr. D. S. Fraser and Dr. D. C. Setna, and the whole staff of the Arthur Road Hospital for the zeal with which they carried out their duties in connection with the serum treatment. Our thanks are also to all those who have taken interest in, or given aid to, the serum treatment and whose names it would take too long to mention.

G. POLVERINI, M.D.

A. MEYR, M.D.

APPENDIX No. V.

Bacteriological Examination of Hospital Cases.

From the 6th December 1899 to the 16th of June 1900, 149 examinations were made into the cases of 105 patients. Of these examinations 36 were from plague cases, 63 for relapsing fever, 14 for malaria, 8 capsules were taken for serum diagnosis, 4 samples for leprosy and 24 for various other diseases. These examinations were carried out at the Plague Research Laboratory, Parel.

Plague.

36 examinations were made in plague cases, of which 12 were cultures from plague buboes, 13 were samples of pneumonic expectoration in plague, 4 were agar cultures of blood (taken by puncture of the skin), 5 were from plague carbuncles and sores and 2 cultures were from a small-pox case with buboes.

Of the 12 cultures from buboes, in 8 the plague bacilli were found, usually associated with organisms from the surface of the skin, or the cocci of commencing suppuration. One of those in which the bacilli were found was a case of *pestis ambulans* with hardly any symptoms besides the buboes. In 4 of the cultures the bacilli were not found; in 3 of these this was due to the pus organisms being present in great numbers, and in the other case I probably missed the gland, which was small. 2 cultures were made from a small-pox case which had buboes before and at the commencement of the small-pox eruption (A.R. 1539), but the plague bacillus was not present. The question, therefore, remained whether (or not) the bacilli had been present and had been killed by the presence of the small-pox virus.

In the 13 examinations of pneumonic expectoration, the pneumonococcus was found in all but the plague bacilli in only 3. This was probably due to the other organisms present killing the plague bacilli in the agar culture, as in "smear" preparations made from the same expectorations a bacillus was seen resembling the plague bacillus. The 4 cultures from blood were only attempted in very severe cases and in only one case was the bacillus found (A.R. 480) in a little girl with a temperature of 105.2, who died in a few hours. The blood was taken from the lobe of the ear.

Relapsing Fever.

Of the 63 examinations made from known or suspected cases of Relapsing Fever, 47 were blood samples, 8 were samples of blood and mucus from stools, and 8 were cultures from relapsing fever buboes.

Results:—Of the 47 blood samples the spirillum was found in 25 cases and not found in 22. In the cases in which the spirillum was not found 11 were doubtful cases and were probably not relapsing fever, but with the rest the blood was taken when the temperature was rising at the beginning of a relapse. These cases show the uncertainty of finding the spirillum even when most expected and in some cases in which it may have been found in a previous examination. The spirilla were found to be fairly numerous in the blood of epistaxis of relapsing fever. In 4 of the cases clumping of the spirilla was observed; this occurred just before the crisis. In cases where the spirilla were found in large numbers (say 8 to 10 or more in a field) a fatal issue has followed. The number of spirilla has, as a rule, no relation to the temperature observed, e.g., in one case (A.R. 1318) a very few spirilla were found with a temperature of 106°.4. Another case which illustrates well the want of relation between the temperature and the presence of spirilla was (A.R. 2817) where

I failed to find a single spirillum with a temperature of 105° on the first day of relapse. In some cases with buboes the spirilla were found in large numbers, *e.g.*, (A.R.1596) and (Mar. 3670).

In the 8 examinations of blood and mucus from relapsing fever stools (slide smears and agar cultures) I failed to find the spirillum. On culture the bacillus coli communis was constant, the occasional organisms being other bacilli, cocci, yeasts, &c.

Relapsing Fever Buboes—8 cultures were made from the 5 most typical cases met with. In no case was any bacillus found. 6 of the cultures were absolutely sterile; in the other 2 cases a few pus cocci were found; in one case (Mar. 3408) the surface of the skin over the bubo had been burnt with the "marking nut" and the pipette probably touched the skin in taking the culture. The bubo did not suppurate. The other case (M.K.6664) had a large indurated bubo over, but not involving, the parotid, exactly resembling a plague bubo. A few staphylo cocci were found (*pyogenes aureus* and *citreus*), but the greater part of the agar surface was devoid of growth. This bubo subsequently suppurated freely. This patient had three attacks (or relapses), each ending with crisis, the temperatures rising respectively to 104°, 108° and 102°·6.

Note.—Relapsing fever with buboes is no new thing. In one epidemic in Russia, buboes were so prevalent that the cases were at first diagnosed as plague and the same thing happened on the outbreak of the present epidemic in Bombay prison where the difficulty of diagnosis was greater, owing to the presence of both diseases amongst the community. During the major part of the present epidemic these buboes were rare, forming only (roughly) 3 per cent. of the cases admitted into the Maratha Hospital. For an inspection of the figures I am indebted to the courtesy of Dr. Dhargalker. The distribution of the buboes is much the same as in plague; but, as a rule (to which there are exceptions), they are smaller and more numerous.

Summarising the results obtained in these examinations of relapsing fever (but remembering the limitation of the numbers) we find:—

1. The temperature gives no indication of the number of spirilla present.
2. Clumping together of the spirilla indicates the approach of crisis.
3. A large number of spirilla found indicates a probable fatal issue to the case.
4. Few or no spirilla found gives no indication of the severity of the case.
5. Spirilla were found in the blood of epistaxis, but not in blood from stools.
6. The buboes of relapsing fever cases examined did not contain bacilli and were usually sterile.

Serum Diagnosis.

8 blood capsules were taken for the purpose of serum diagnosis. In the case of a Brahmin at the Colaba Hospital the Malta fever reaction was obtained on the 21st of February. In another case (Mar. 785) an incomplete Malta fever reaction was obtained, meaning that the patient may have had Malta fever in the past but not in the present illness. A little boy (Mar. 3492) gave the typhoid reaction. Two other cases having the temperature curve, diarrhoea, &c., resembling typhoid did not give any reaction; these were adults. The other 3 cases did not give any reaction.

Malaria.—14 examinations of blood were made for malaria, which, however, was only found in 2 cases, and whether due to the dry season or not malaria did not appear to be prevalent amongst the hospital cases. Most of the cases were examined on the principle of "Diagnosis by exclusion," and several were thus traced to their cause; of these causes tuberculosis appeared to be the most common. One case was abscess of the lung and in one or two other cases simple abscesses formed.

Leprosy.

There were only four examinations made for leprosy amongst three patients. A sample was taken from a tubercle and one from the nasal secretions, both of which were successful. The latter success was interesting as the existence of leprosy bacilli in the nasal secretions is a comparatively recent discovery, and further it has been suggested that this is the usual mode of entrance into the system. The other cases were doubtful and did not show the bacillus.

Varicæ.

24 examinations were made from patients with various other diseases, e.g., a sailor (M.K. 6235) was sent to hospital as plague with an enlarged gland near the left angle of the jaw due to the "irritation" of a gum boil. This gland was sterile. Amongst the cases were catarrhal pneumonia, bronchitis, diarrhoea, &c., examined for various reasons, but generally to clear up any doubt as to their infectious nature.

In the above notes A. B. stands for the Arthur Road Hospital.

M. K. " " the Modikhana "

Mar. " " the Maratha "

The numbers given are the Hospital numbers of the cases cited.

GEORGE TAYLOR.

 APPENDIX No. VI.

FROM

ASSISTANT HOSPITAL VISITOR,

To

SPECIAL MEDICAL OFFICER

TO THE PLAGUE COMMISSIONER,

BOMBAY PRESIDENCY.

Report of Assistant Hospital Visitor, Plague Epidemic, 1899-1900.

1. My duties as the Assistant Hospital Visitor were commenced on December 13th, 1899, and ceased on June 13th, 1900.

The duties consisted in visiting the private plague hospitals.

At these visits there was to be no interference with the treatment of cases, but the attention was to be confined to the sanitary state of the hospital.

The daily returns sent in by the private plague hospitals were to be checked.

2. List of private plague hospitals visited—

Parsee, Parel Road.

Do. Supplementary Ward, Frere Road.

H. H. Aga Khan's, Dondad Cross Lane.

Port Trust, Frere Road.

Adamjee Peerbhoy, Queen's Road.

Pathare Prabhu, Charni Gardens.

Khatri, Babu Khote Street.

Brahmo Kshatrya, Pinjrapole Lane, Bhuleshwar.

Kapole and Lad, Frere Road.

Bhatia, Frere Road.

Thakordwar, Lohana.

Telegu, Kamatipura.

3rd Bhoiwada, Bhuleshwar.

Jain, Parel Road.

Do. Pinjrapole, Bhuleshwar.

Bene Israel, Victoria Gardens.

Marwari and Futtipura, 2nd Pinjrapole Lane, Bhuleshwar.

Islami Nagdevi, Nagdevi Street.

Petit Mills.
 Empress Mills, DeLisle Road.
 Narielwadi Mahomedan Hospital.
 Cutch Lohana, Olive Road.
 Mogul, Baboola Tank.
 V. S. Maharajah's Servants, Cathedral Street, Bhuleshwar.
 Sarvajanic, Government House Grounds, Parel.
 Stewart Strong's, Colaba.
 Hindoo Fever, Charni Gardens.

3. When visiting a hospital, its general sanitary condition was considered, while special attention was bestowed on the following points :—

- (a) The condition of the bedding, sheets, blankets and cloths of a patient.
- (b) The cleanliness of floors and walls.
- (c) The providing patients with spittoons and encouraging them, through the hospital assistants and ward-boys, to expectorate into these instead of promiscuously about on the bedding, floors and walls.
- (d) The limiting of the number of visitors to patients with a view to preventing more than two visitors at a time to each patient.
- (e) The calling the attention of the hospital assistants to dressings, &c., thrown about the floors or out of the windows.
- (f) The disinfection of bedding sheets and cloths used for the patients and of other articles likely to spread infection.

4. If there was any cause for complaint, remarks were written in a book kept at the hospital for the purpose. The remarks thus made were seen by the visiting physician or managing committee, while at my next visit I was able to refer to my note and ascertain if that particular matter had been put right.

5. In all cases of continued or gross defect in the management of the hospital the matter was reported to the Special Medical Officer.

6. Seeing that at these hospitals the patients were, in the great majority of cases, admitted for a contagious disease, thorough disinfection of all that might be likely to convey infection was, I considered, the most important point for consideration. When first I commenced visiting the private plague hospitals, I learnt from answers to questions I put to the hospital assistants that in many cases somewhat hazy ideas were held on the subject of disinfection.

In consequence of this, I drew up some suggestions as to methods of disinfection, and, with the sanction of the Special Medical Officer, had a copy of these sent to each private plague hospital.

The following are the suggestions which were sent round :—

Very few of the private hospitals made use of the steam disinfectors, the reason apparently being the difficulty of transport. If each steam sterilizing station were supplied with a cart that could be sent round to the private plague hospital in its vicinity and collect from these the things for disinfection, more use might be made of this method of disinfection.

7. Any suggestion made was in all cases productive of an effort on the part of the hospital to carry it into effect.

8. The following are some remarks about the different hospitals :—

- (a) The Empress Mills (DeLisle Road), the Supplementary Parsee Ward (Frere Road), the Marwari and Futtipura (2nd Pinjrapole Lane, Buleshwar), require better direct supervision.
- (b) There is room for considerable improvement in the Narielwadi Mahomedan and V. S. Maharajah's Servants' Hospitals.
- (c) The following hospitals should be re-opened on new sites :—
- | | |
|------------------|--------------------|
| Telegu. | Thakordwar Lohana. |
| Brahmo Kshatrya. | Cutch Lohana. |
| Aga Khan's. | Islami Nagdevi. |
| 3rd Bhoiwada. | Mogul. |
- (d) The Bapu Khote and Petit Mills Hospitals I never found containing patients : the former, I think, ought to re-open on a new site ; the latter should be an excellent little hospital from its appearance.
- (e) The remaining hospitals are, I think, sufficiently suitably situated. All of them were well managed, but the number of patients treated at the different hospitals varied considerably.
- (f) Especial praise is, I think, due to the Hindu Fever Hospital, the Sarvajanic Hospital and the Stewart Strong's Hospital, Colaba.
- (g) Three of the Municipal Hospitals were also visited, viz., the Mahim, the General Mahomedan (Northbrook Gardens) and the Zullai Sunni (Ripon Road); the last of these was visited twice a week for the purpose of discharging patients.

9. As regards the advisability of the existence of private plague hospitals, my opinion is at present the following :—

So long as a community that maintains a private hospital is ready to receive advice which they are willing and able to efficiently carry into effect, and provided the hospital be suitably situated, a private plague hospital is a means of checking the spread of infection and a service to its particular caste or community, for the many points of infection are brought to a focus, as it were, at one point, and the infection is here smothered.

When, however, advice given is not, or cannot be, efficiently carried into effect, the result is the removal of infection from one locality to another without its being smothered at the latter.

Therefore, encourage the starting and carrying on of such private plague hospitals, as are both willing and able to efficiently follow the advice given.

10. It remains to be seen whether those living in the vicinity of plague hospitals are more subject to infection than others not so placed. The part played by rats in the spreading of plague infection makes one think that such a thing is possible and even likely. The reports of the various District Plague Officers might throw some light on this matter.

I have the honor to remain,

Your most obedient Servant,

E. L. HUNT,

At present Inspector of Inoculation,

Formerly Assistant Hospital Visitor.

METHODS OF DISINFECTION.

Suggestions to medical officers in charge of private plague hospitals, Bombay.

(Sd.) E. L. HUNT,
Assistant Hospital Visitor.

DISINFECTION.

Clothing and Bedding.

1. All articles of little value, *burn*.
2. Bedding, Blankets, Clothing, Mattresses, (take out hair or wool or feathers, and loosen them before disinfecting) in Steam Sterilizer.

1	steam sterilizer	at	Modikhana.
1	"	"	" Northbrook Gardens.
1	"	"	" Narielwadi.
1	"	"	" Arthur Road.
3. Failing (2), *burn*
4. Failing (2) and (3), boil for 1 hour and wash well with soap and water.
5. Failing (2), (3) and (4), soak for 24 hours in any of these
 - (1) Carbolic acid, 1 in 20.
 - (2) Izal " 1 in 20.
 - (3) $\frac{1}{2}$ ounce perchloride of mercury.
1 ounce of hydrochloric acid in 480 ounces of water.

DISINFECTION.

Rooms and Furniture.

Fresh air and sunlight (open doors and windows and remove tiles if possible).
Lime-wash floors and walls.
Wash furniture with solution of phenyle or chloride of lime (1 in 100).

DISINFECTION.

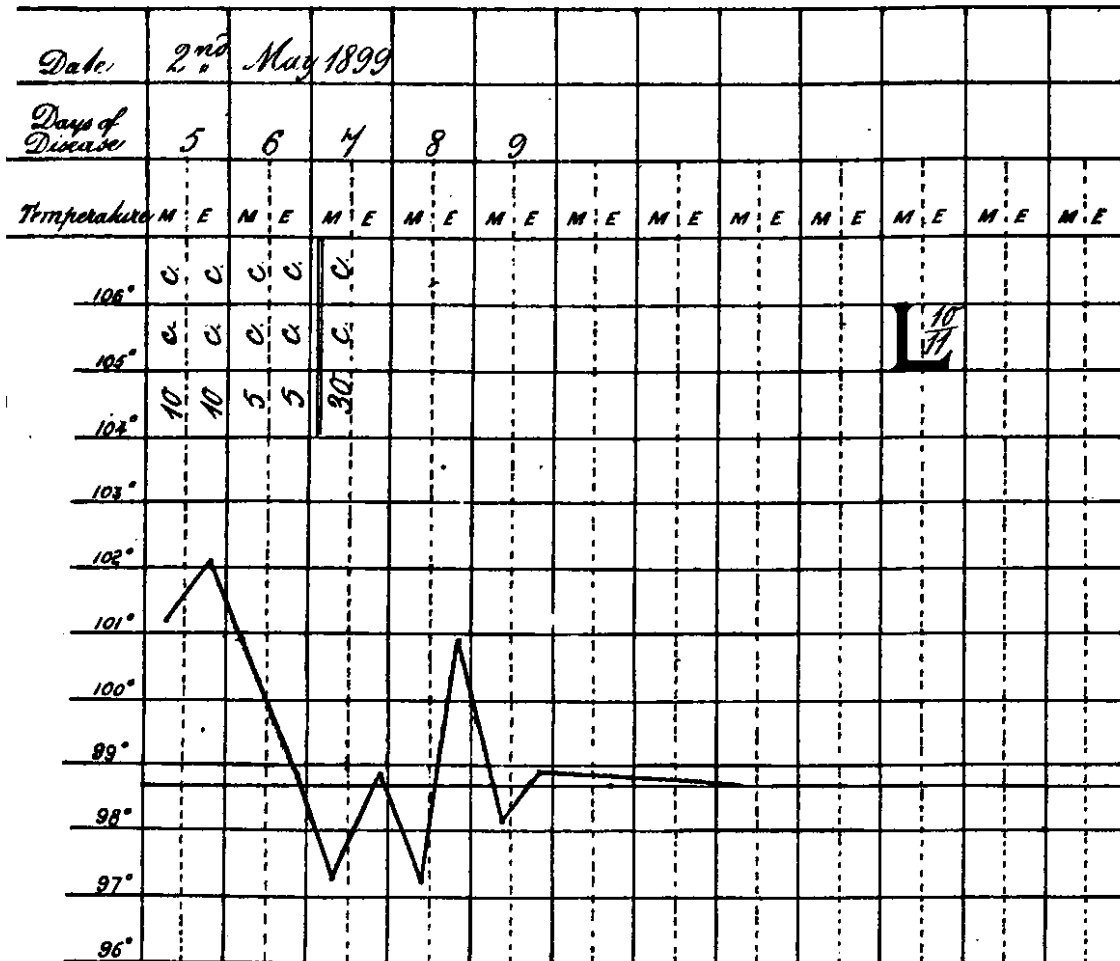
Excreta and Discharges.

(From bowels, bladder, lungs, abscesses, etc.)

1. Should be well mixed with 1 in 20 carbolic acid and left quarter of an hour and finally burnt or buried or thrown down closet which should be well flushed with water.

No 2

Hospital No. 1614. Diagnosis: Plague. Previous duration: 5 days.
Sex: Male, Age: 6, Caste: Hindu, Occupation: Nil.

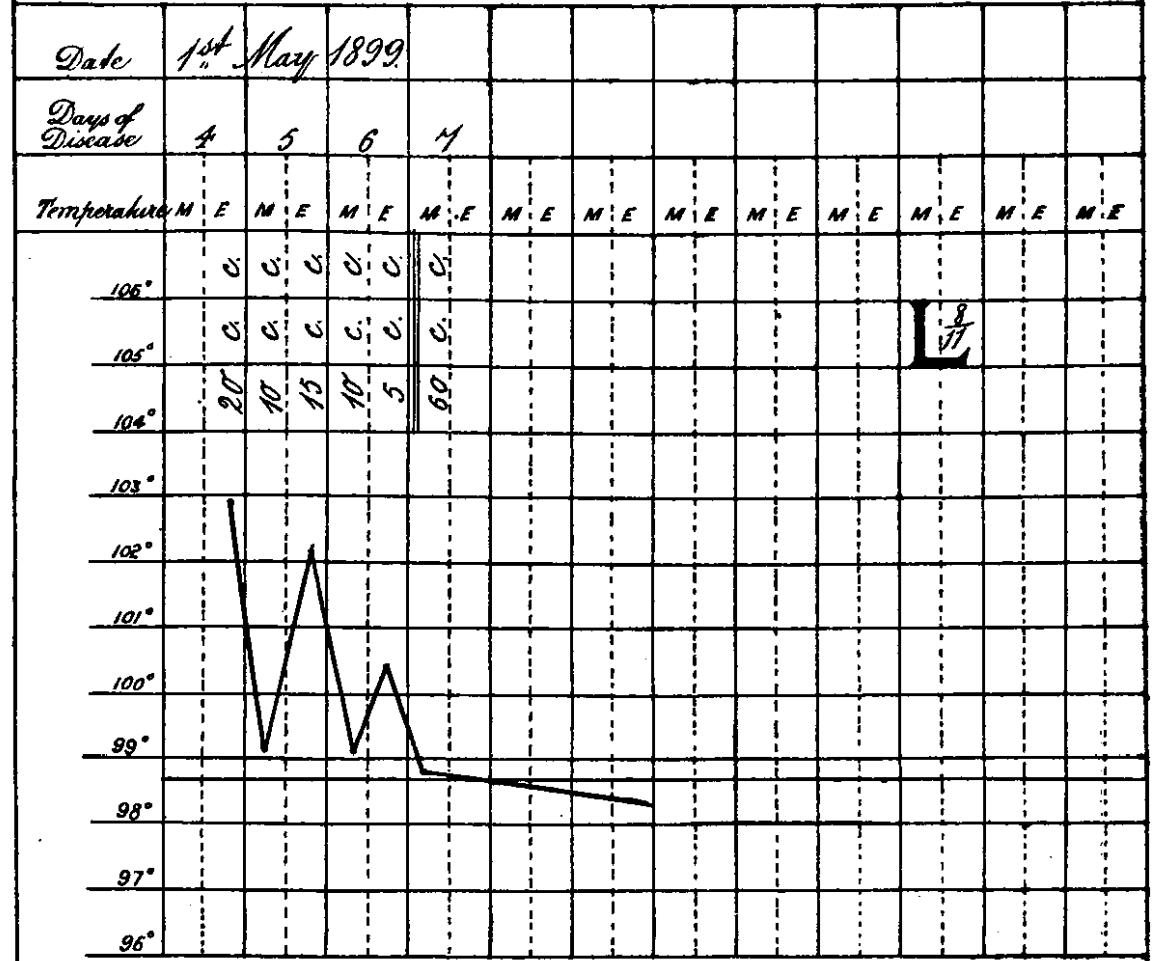


Position of Bubo: R. Axillary.

Result: Discharged after 16 days.

No 1

Hospital No. 1608 Diagnosis: Plague Previous duration: 4 days
Sex: Male, Age: 35, Caste: Hindu, Occupation: Labourer.



Position of Bubo: L. Femoral, (Incised)

Result: Discharged after 42 days.

No 4

Hospital No. 1627 Diagnosis: Plague. Previous duration, 4 days.
 Sex: Male, Age: 22, Caste: Hindu, Occupation: Kamal.

Date	2 nd May 1899													
Days of Disease	4	5		6										
Temperature	M	E	M	E	M	E	M	E	M	E	M	E	M	E
106°			C		C									
105°			C		C									
104°			10		10									
103°														
102°														
101°														
100°														
99°														
98°														
97°														
96°														

Position of Bubo: L. Femoral.

Result: Discharged after 33 days.

No 3

Hospital No. 1619 Diagnosis: Plague. Previous duration, 4 days.
 Sex: Female, Age: 28, Caste: Hindu, Occupation: Nil.

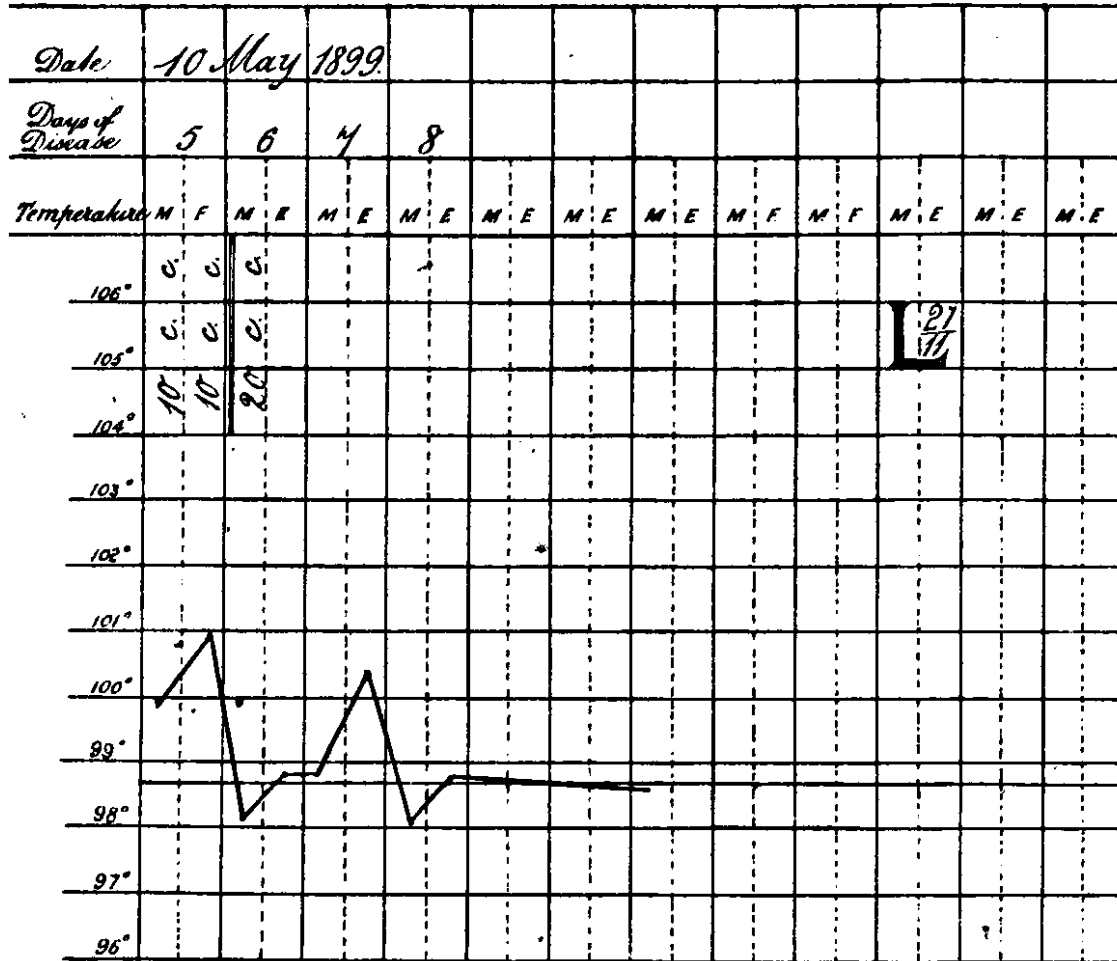
Date	2 nd May 1899													
Days of Disease	4	5		6	7									
Temperature	M	E	M	E	M	E	M	E	M	E	M	E	M	E
106°			C		C									
105°			C		C									
104°			15		15									
103°														
102°														
101°														
100°														
99°														
98°														
97°														
96°														

Position of Bubo: R. Inguinal.

Result: Discharged after 53 days.

No 6

Hospital No. 1666 Diagnosis: Plague. Previous duration, 5 days.
Sex: Female, Age: 6, Caste: Hindu, Occupation: Nil.

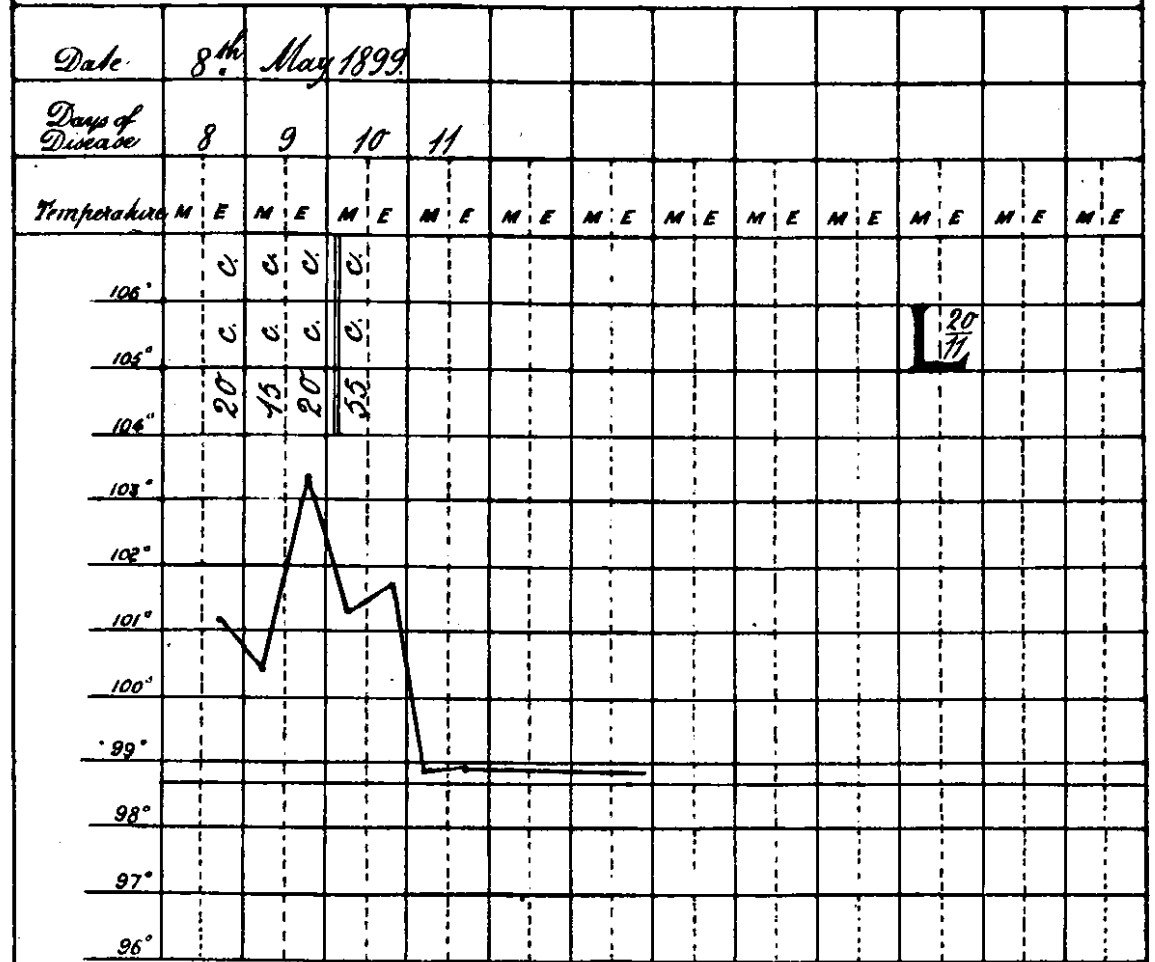


Position of Bubo: L. Inguinal

Result: Discharged after 52 days.

No 5

Hospital No. 1660 Diagnosis: Plague. Previous duration, 8 days.
Sex: Male, Age: 20, Caste: Hindu, Occupation: Barber.

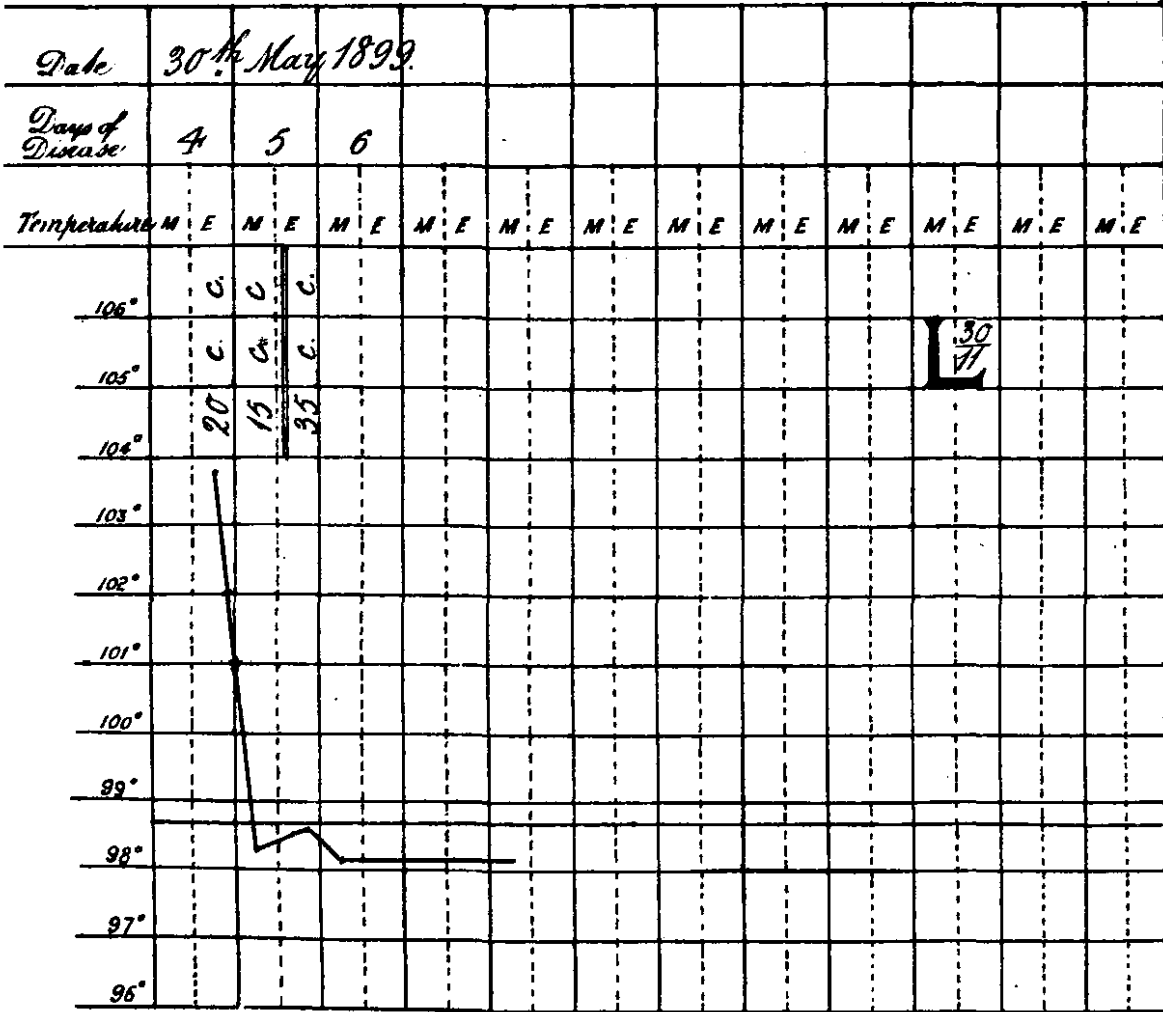


Position of Bubo: R. Axillary (Incised)

Result: Discharged after 39 days.

No 8

Hospital No. 1744. Diagnosis: Plague. Previous duration, 4 days.
 Sex: Male, Age: 14, Caste: Hindu, Occupation: Nil.

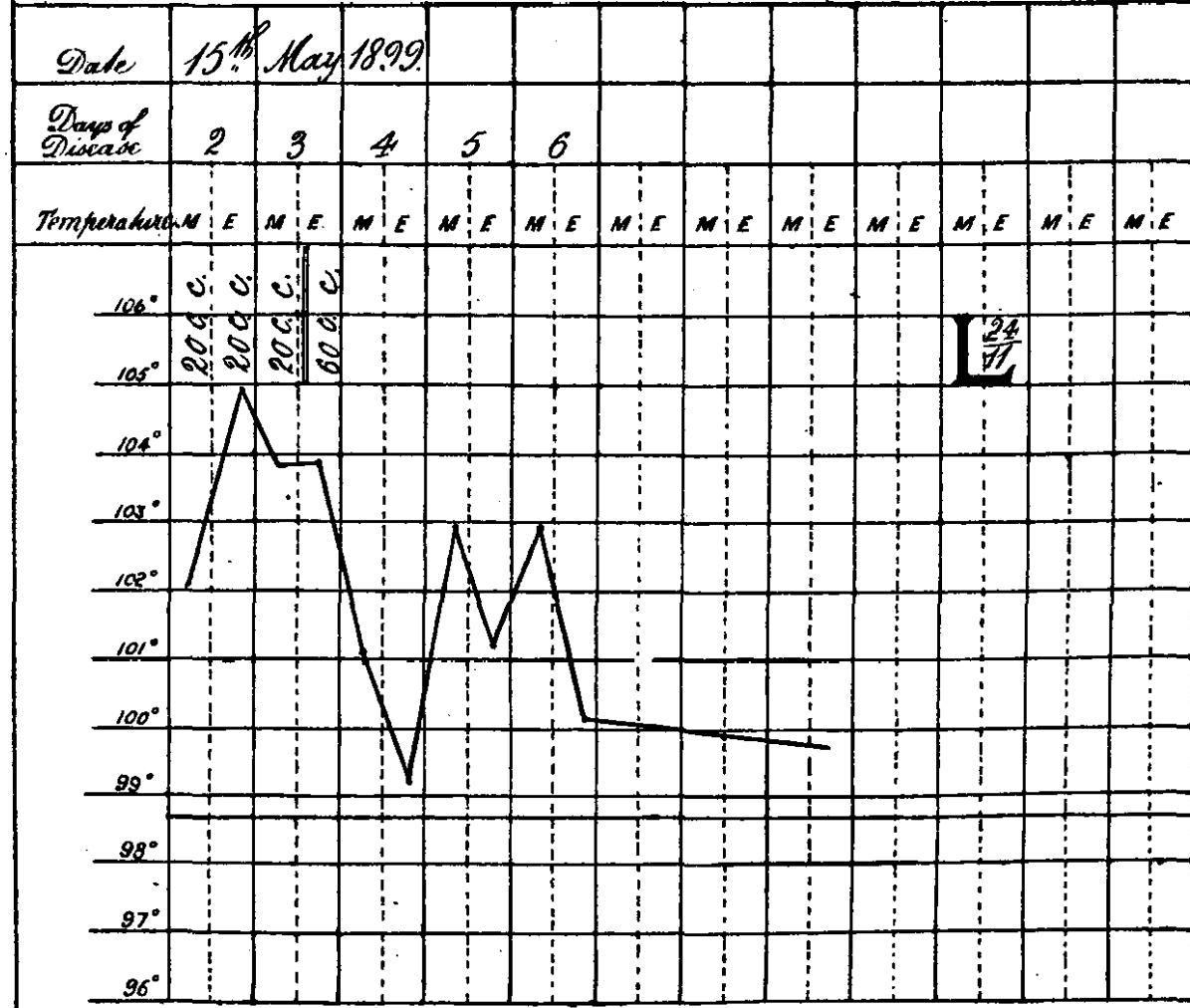


Position of Bubo: R. Femoral

Result: Discharged after 19 days.

No 7

Hospital No. 1688. Diagnosis: Plague. Previous duration, 2 days.
 Sex: Female, Age: 30, Caste: Hindu, Occupation: Mill-hand.

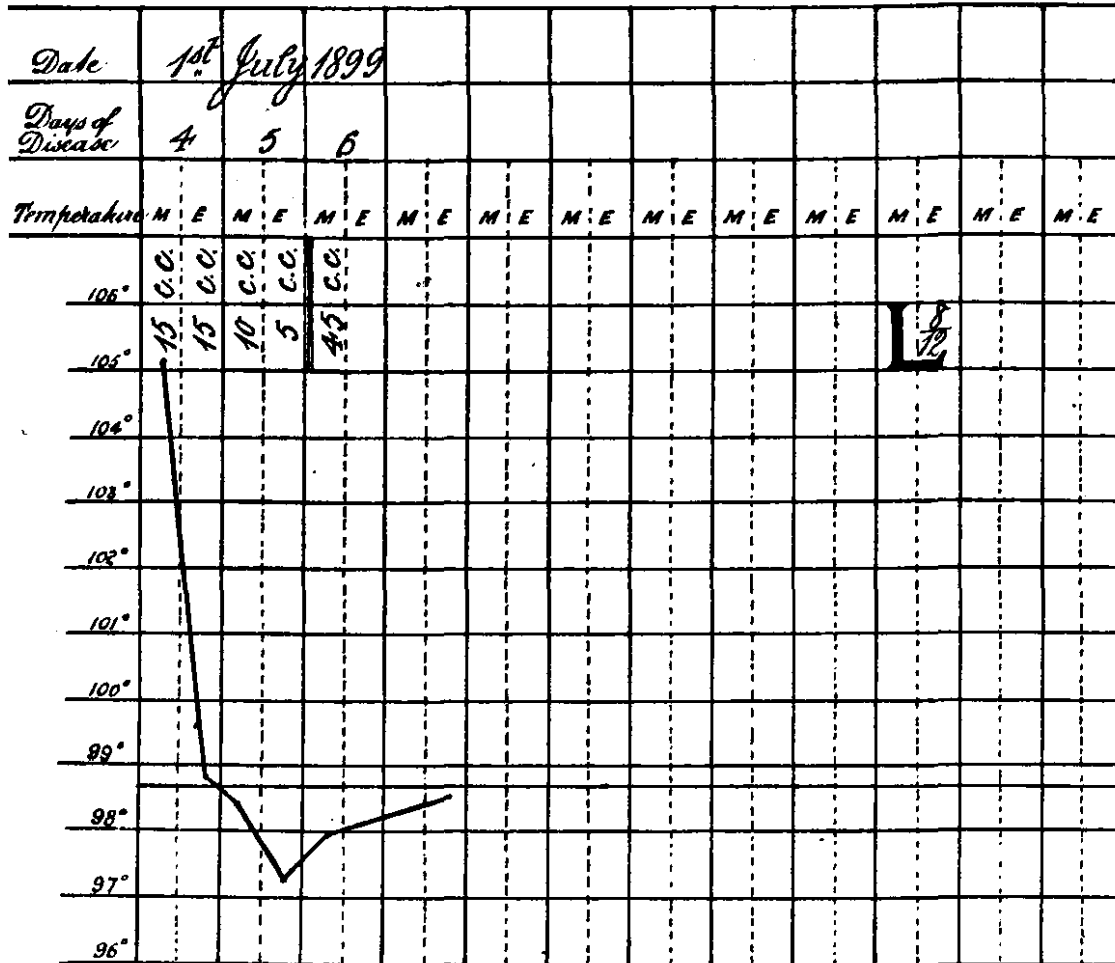


Position of Bubo: R. Cervical

Result: Discharged after 40 days.

No 10

Hospital No. 1829 Diagnosis: Plague. Previous duration, 4 days.
Sex: Female, Age: 8, Caste: Hindu, Occupation: Nil.

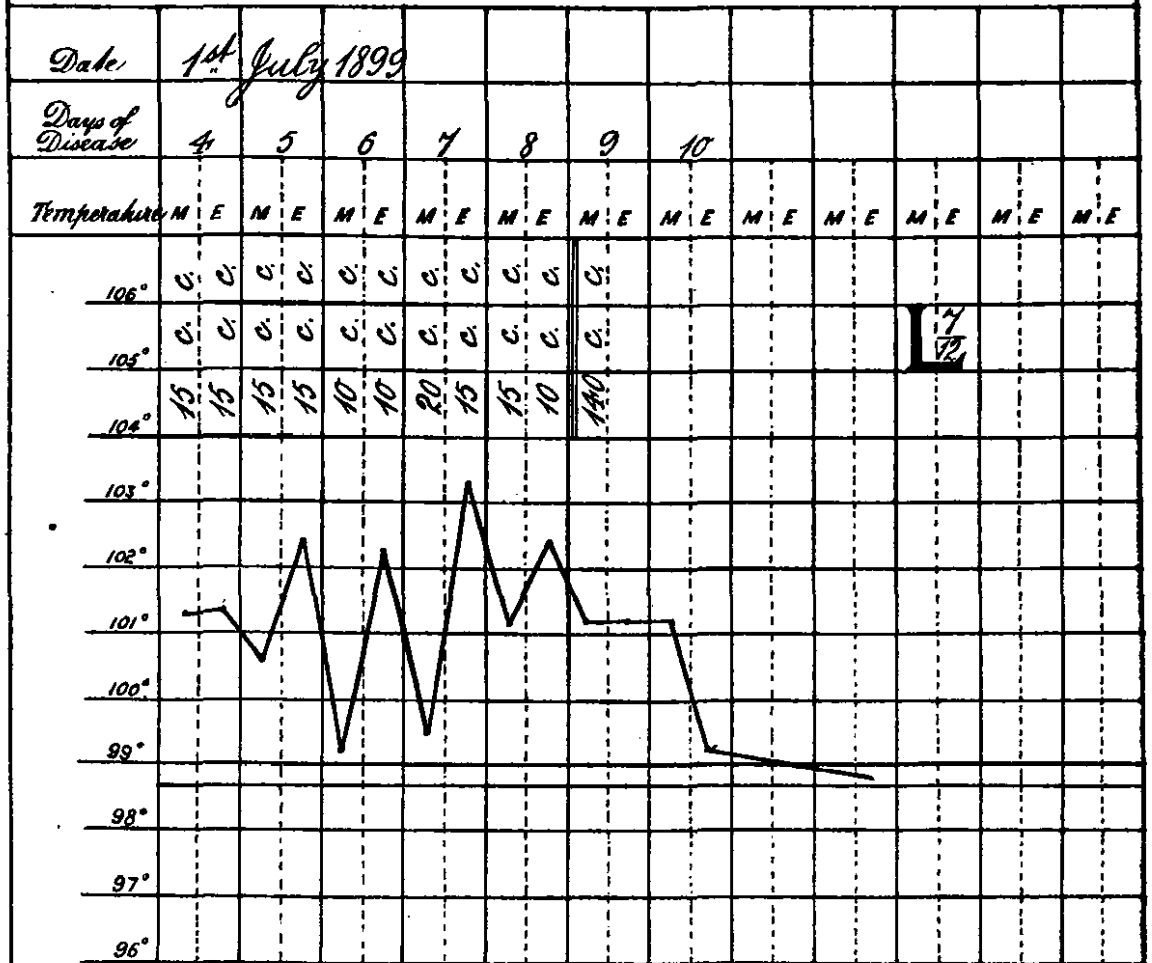


Position of Bubo: R. Inguinal.

Result: Discharged after 36 days.

No 9

Hospital No. 1825 Diagnosis: Plague. Previous duration, 4 days.
Sex: Female, Age: 13, Caste: Hindu, Occupation: Nil.



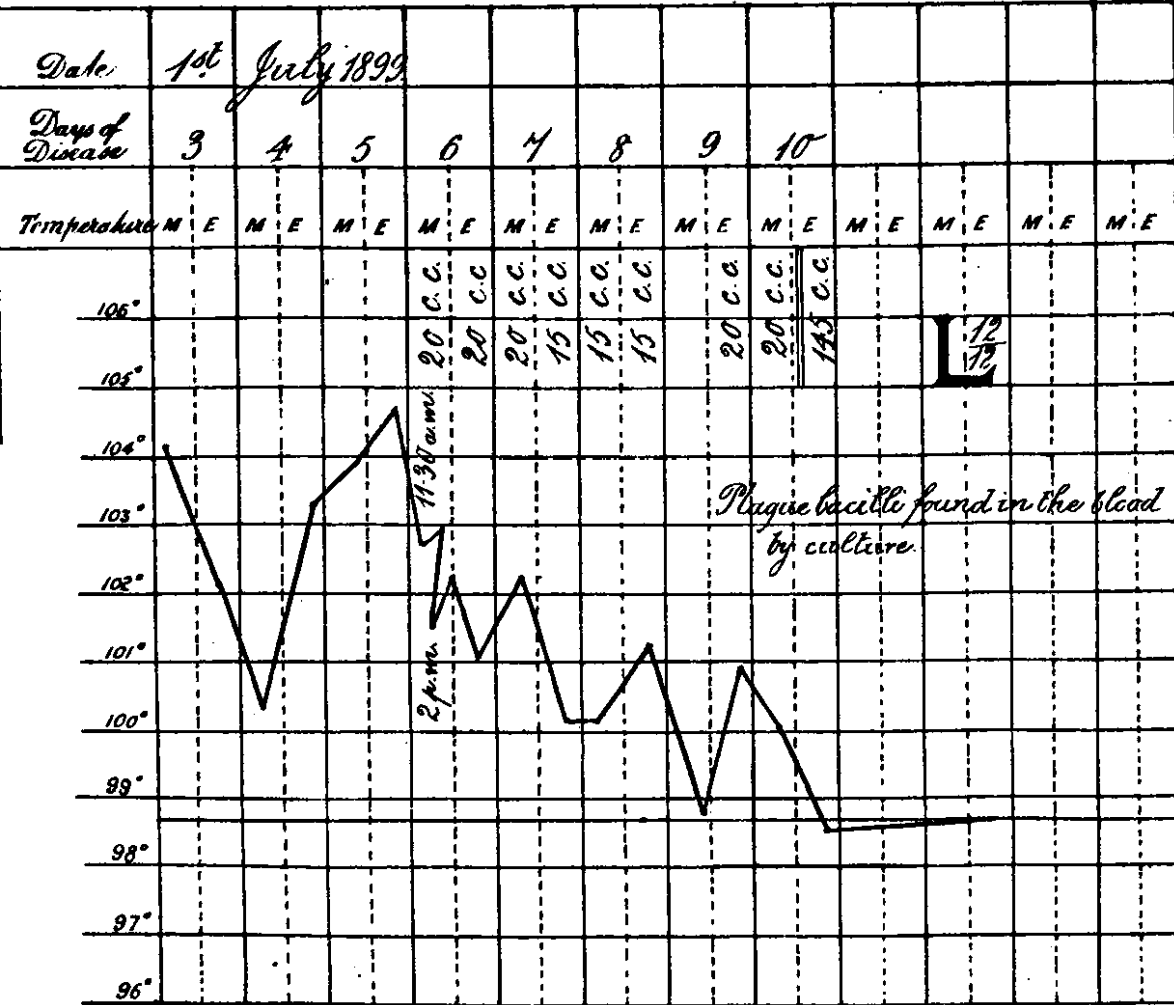
Position of Bubo: R. Axillary (Incised)

Result: Discharged after 58 days

No 12

Hospital No. 1824. Diagnosis: Plague. Previous duration, 3 days.

Sex: Male, Age: 30, Caste: Hindu, Occupation: Labourer.



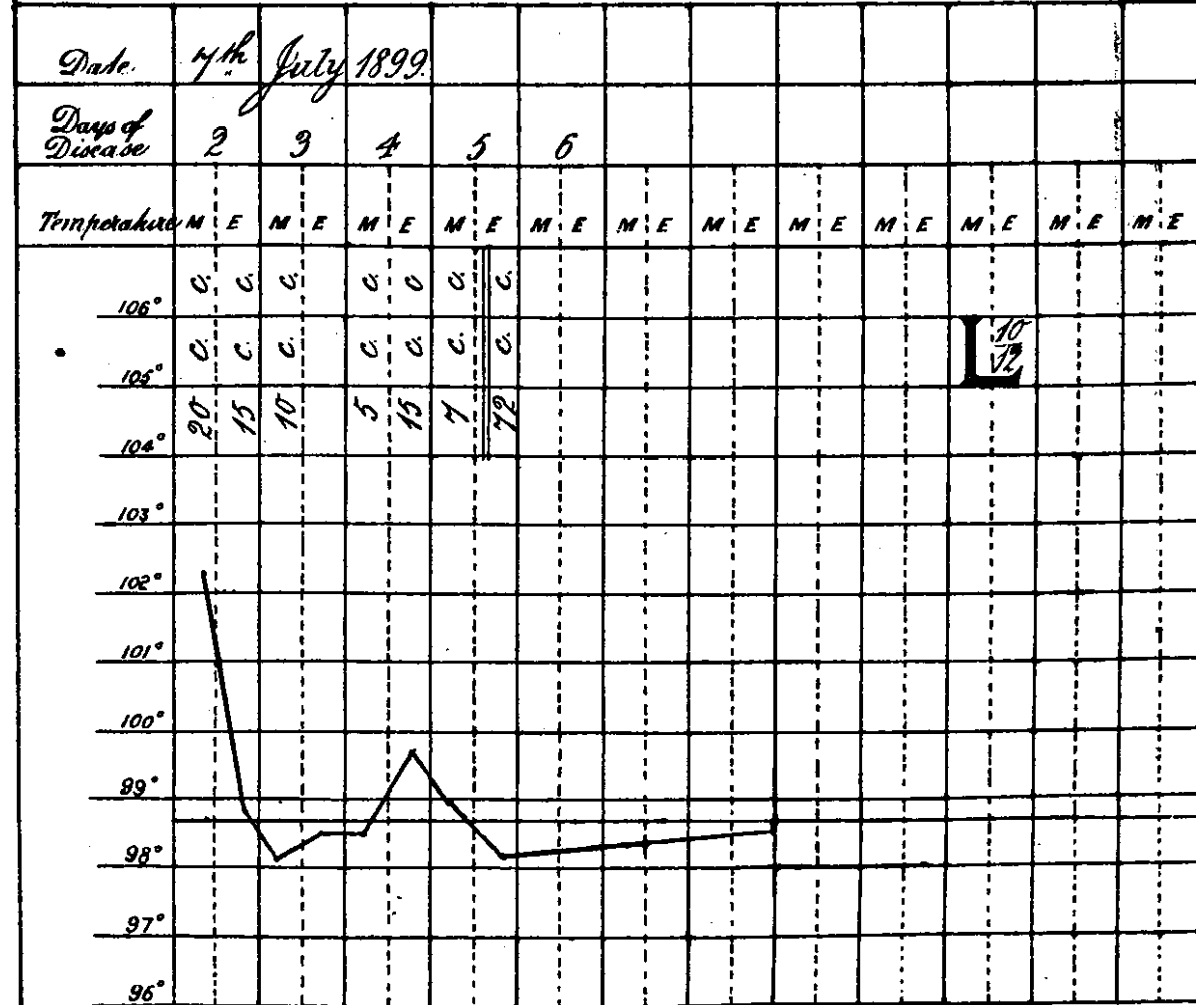
Position of Bubo: No bubo, No pneumonia.

Result: Discharged after 23 days.

No 11

Hospital No. 1843. Diagnosis: Plague. Previous duration, 2 days.

Sex: Male, Age: 12, Caste: N. Christian Occupation: Nil.

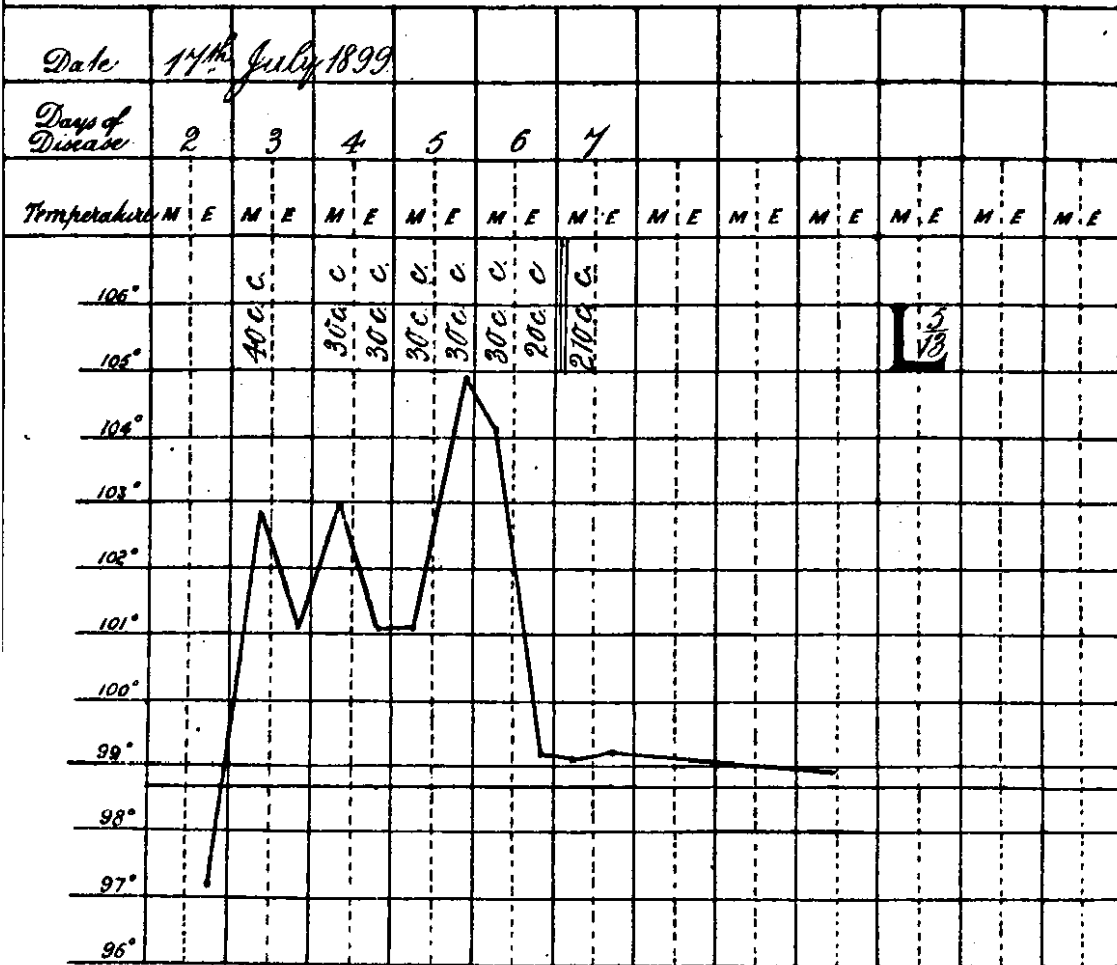


Position of Bubo: L. Inguinal and Iliac

Result: Discharged after 24 days.

No 14

Hospital No. 1880 Diagnosis: Plague. Previous duration: 2 days.
 Sex: Female, Age: 35, Caste: Hindu, Occupation: Nil

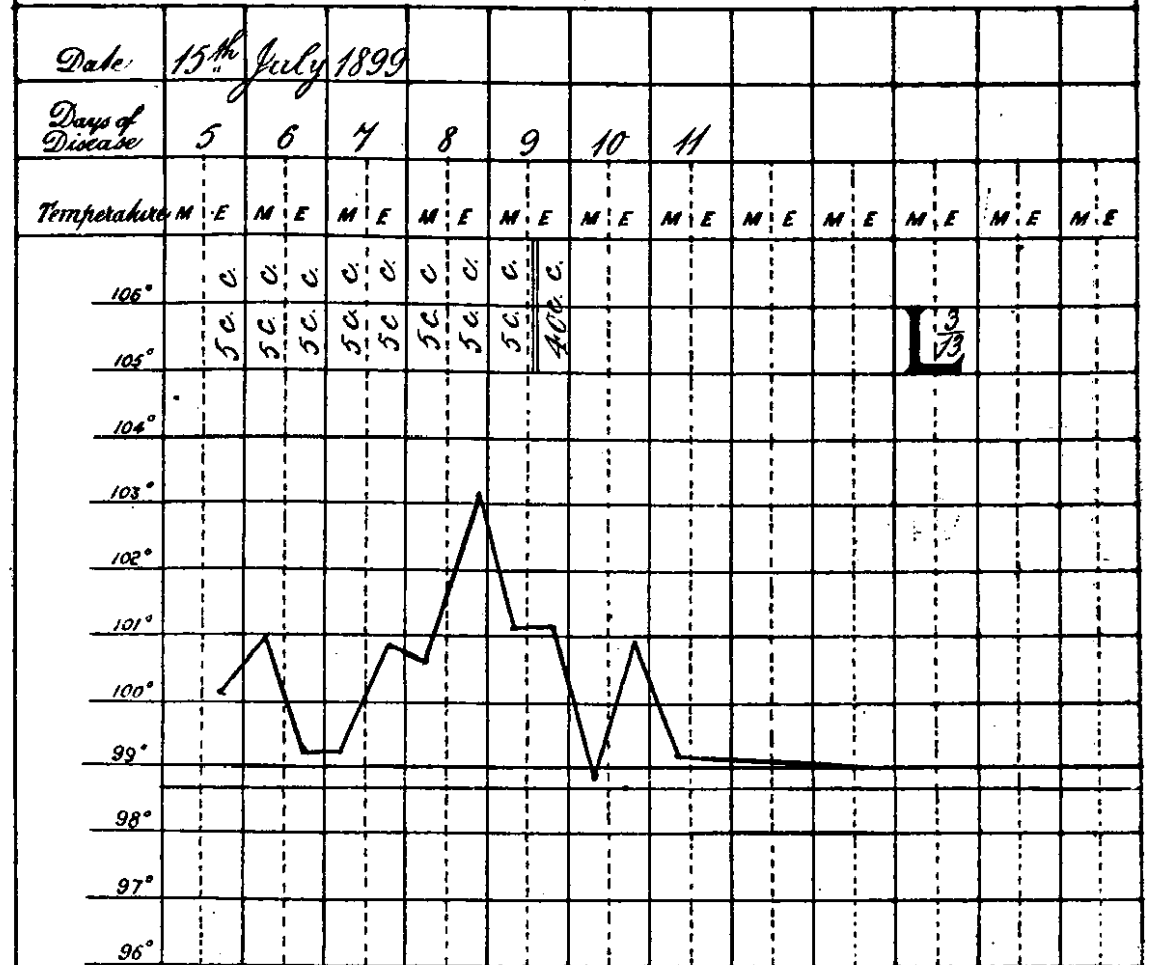


Position of Bubo: L. Femoral.

Result: Discharged after 73 days.

No 13

Hospital No. 1868 Diagnosis: Plague Previous duration: 5 days.
 Sex: Male, Age: 3, Caste: Hindu, Occupation: Nil

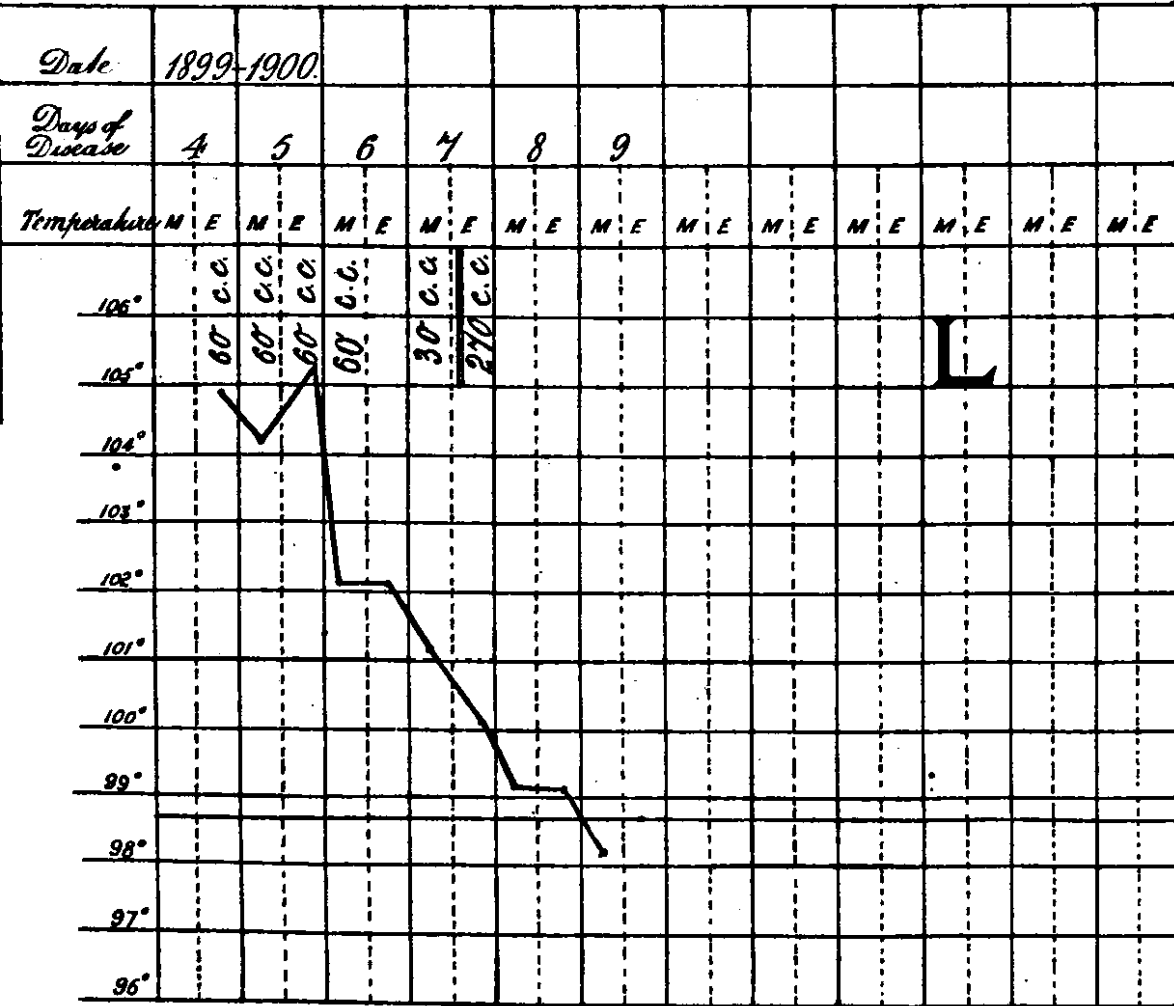


Position of Bubo: L. Femoral

Result: Discharged after 75 days.

No 16

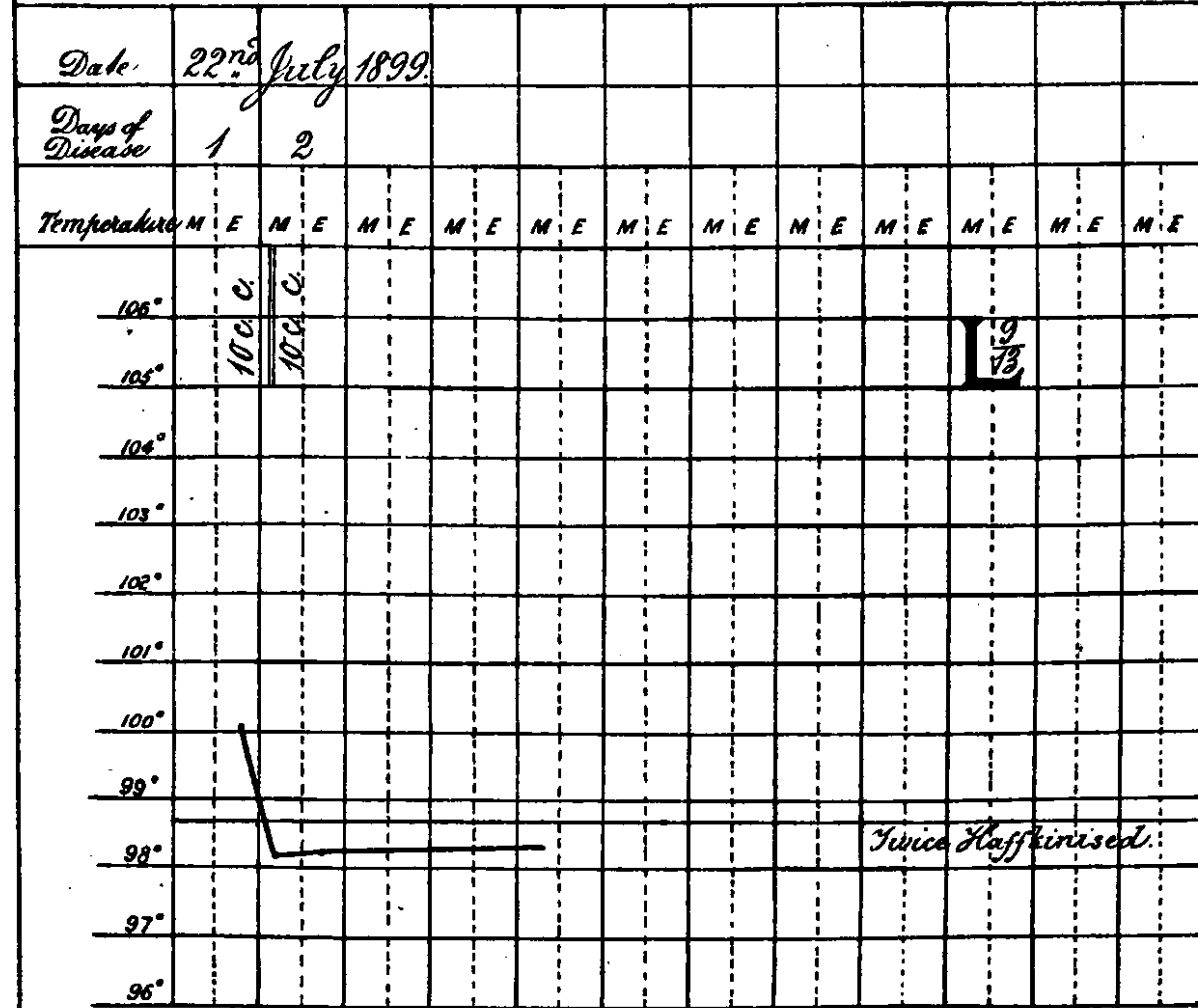
Private patient. Diagnosis: Plague. Previous duration: 4 days.
 Sex: Male, Age: 42, Caste: Parsee, Occupation: Merchant.



Position of Bubo: Double sub-maxillary, Double cervical, Result: Cured.
 and infiltration round the neck.

No 15

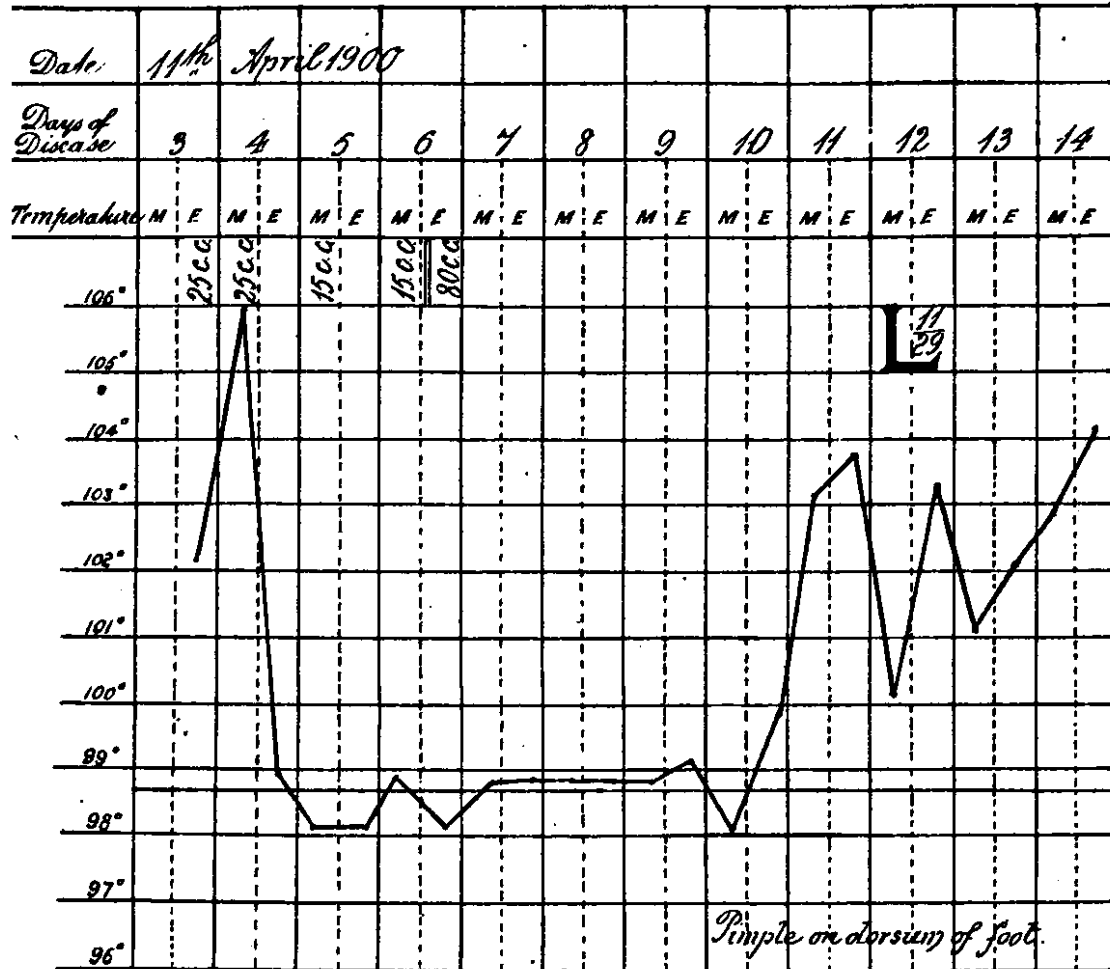
Hospital No. 1891. Diagnosis: Plague. Previous duration: 1 day
 Sex: Male, Age: 10, Caste: N. Christian, Occupation: School boy.



Position of Bubo: L. Femoral and Inguinal. Result: Discharged after 9 days.
 Twice flaccidised.

No 18

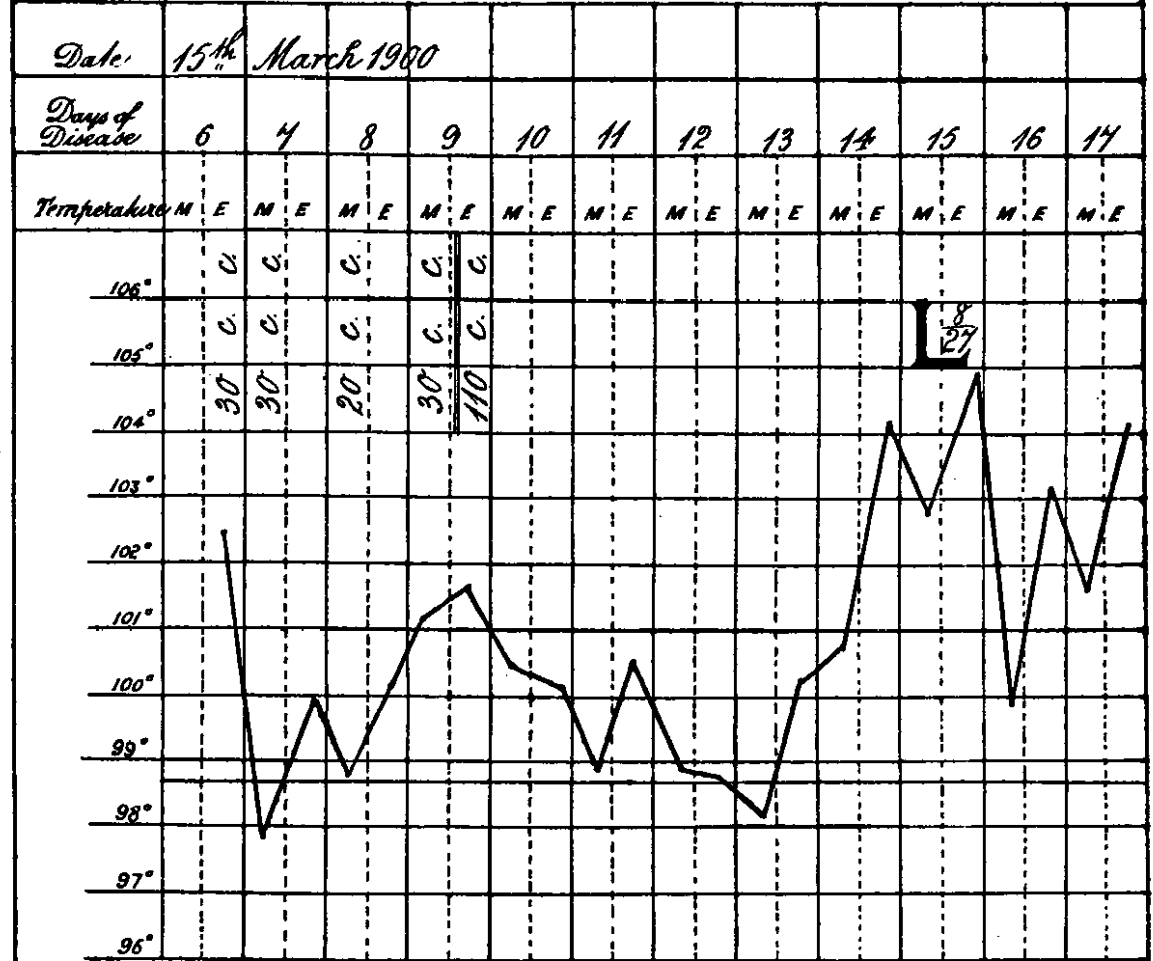
Hospital No. 2032. Diagnosis: Plague and Previous duration: 3 days.
relapsing fever.
Sex: Male, Age: 10, Caste: Mussalman, Occupation: Nil.



Position of Bubo: R. Femoral and Iliac. Result: Died

No 17

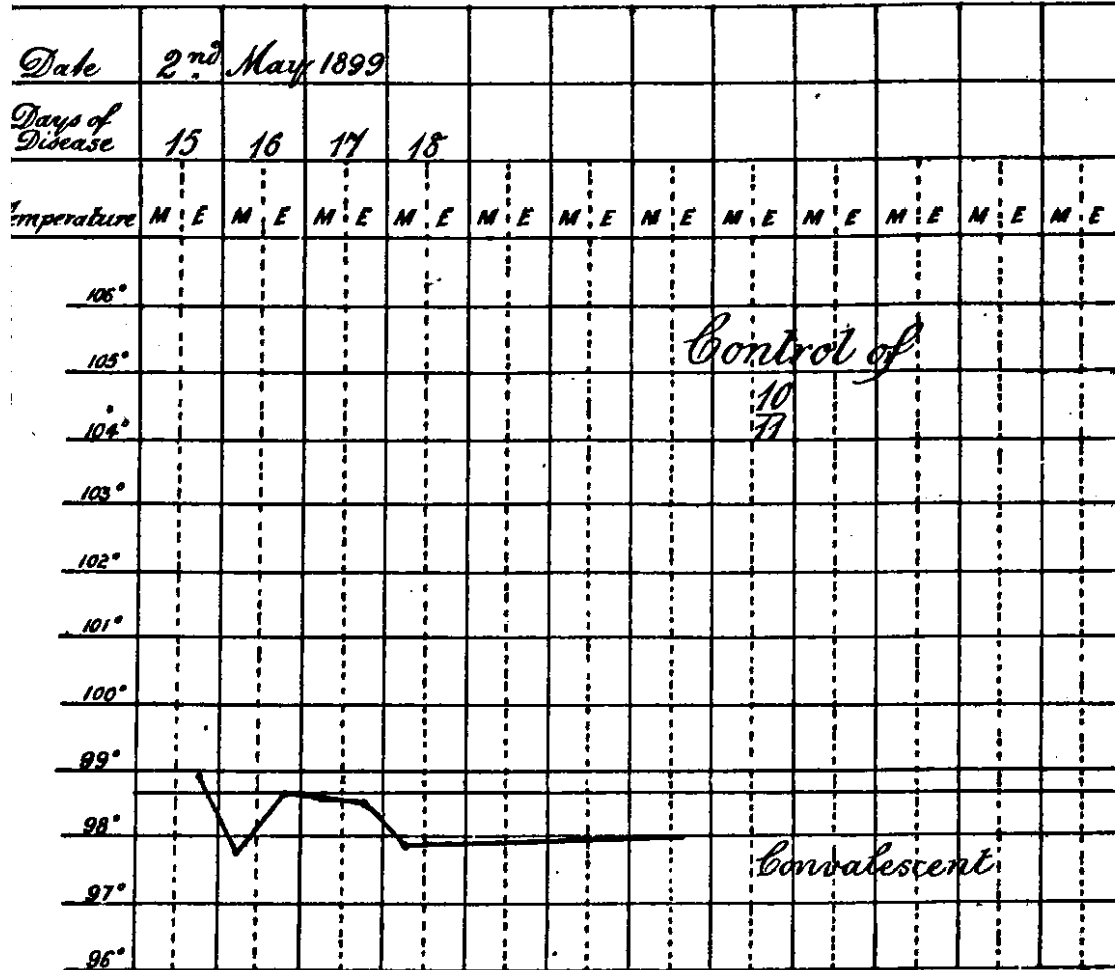
Hospital No. 1596. Diagnosis: Plague and Previous duration: 6 days.
relapsing fever.
Sex: Female, Age: 25 Caste: Hindu, Occupation: Labourer.



Position of Bubo: R. Axillary. Result: Died

Nº 2

*Hospital Nº 1618. Diagnosis: Plague. Previous duration: 15 days.
Sex: Female, Age: 4, Caste: Hindu, Occupation: Nil.*

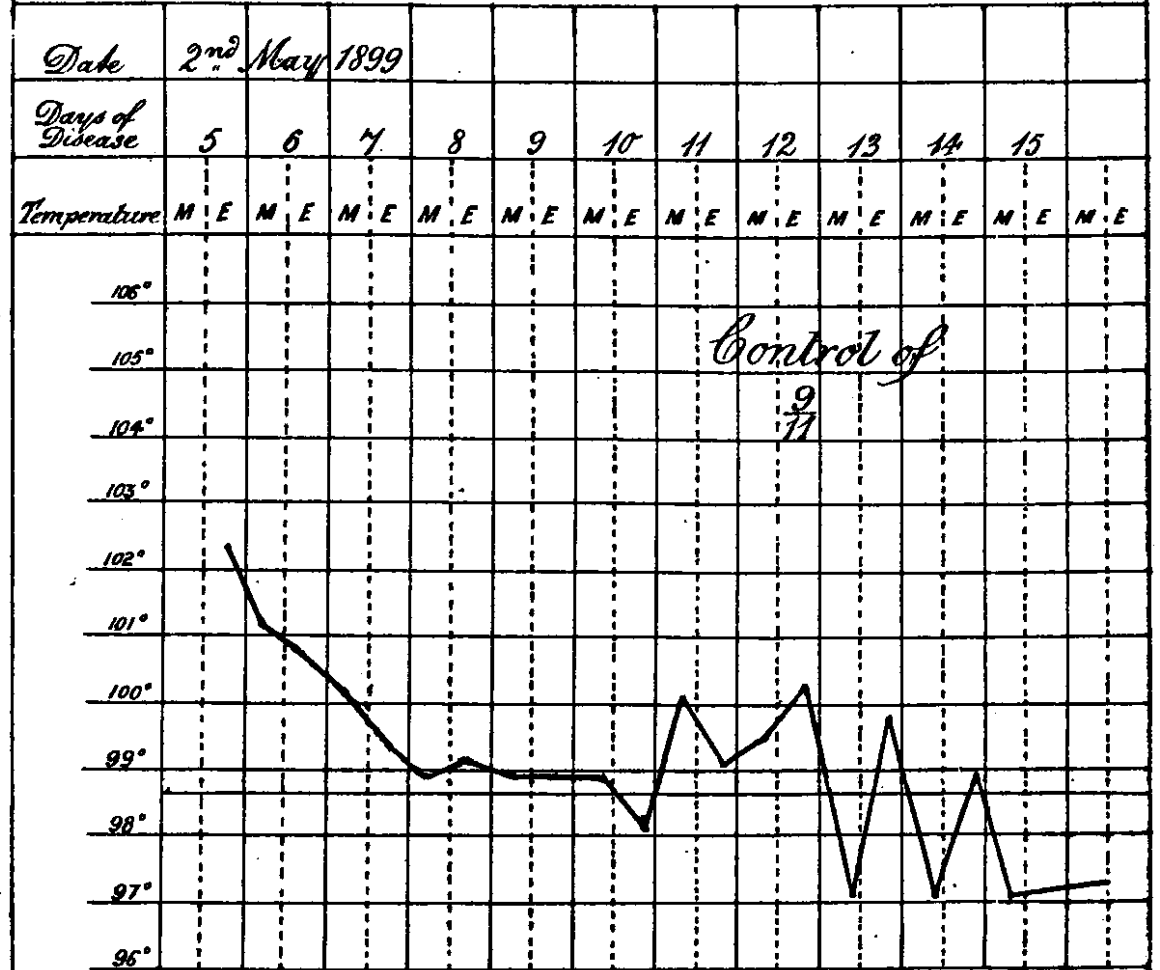


Position of Bubo: L. Femoral.

Result: Discharged after 16 days

Nº 1

*Hospital Nº 1615. Diagnosis: Plague. Previous duration: 5 days.
Sex: Male, Age: 33, Caste: Hindu, Occupation: Labourer.*

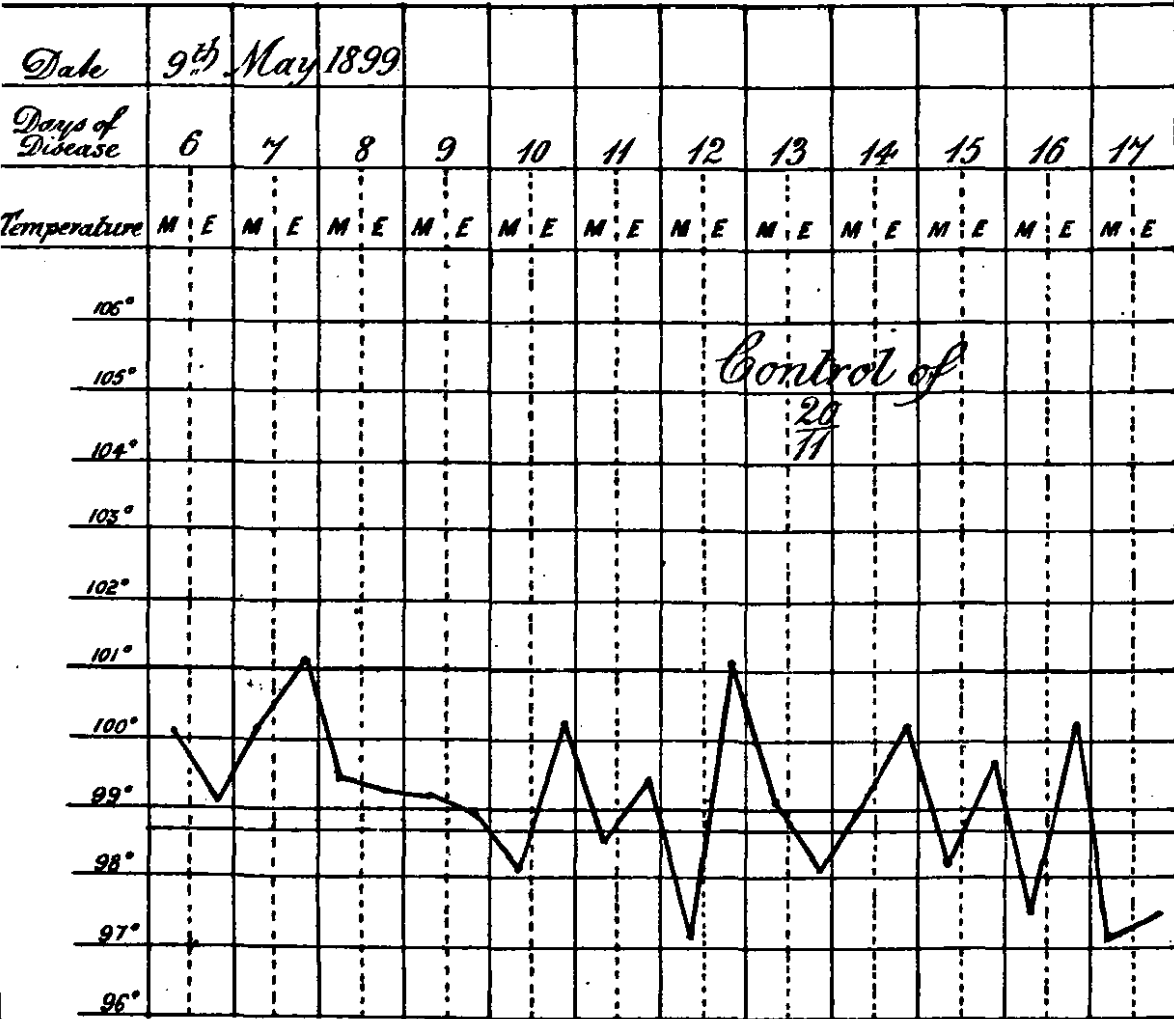


Position of Bubo: R. Femoral.

Result: Discharged after 52 days.

No 4

Hospital No 1661 Diagnosis: Plague. Previous duration: 6 days.
Sex: Male, Age: 30, Caste: Hindu, Occupation: Fruit-seller.

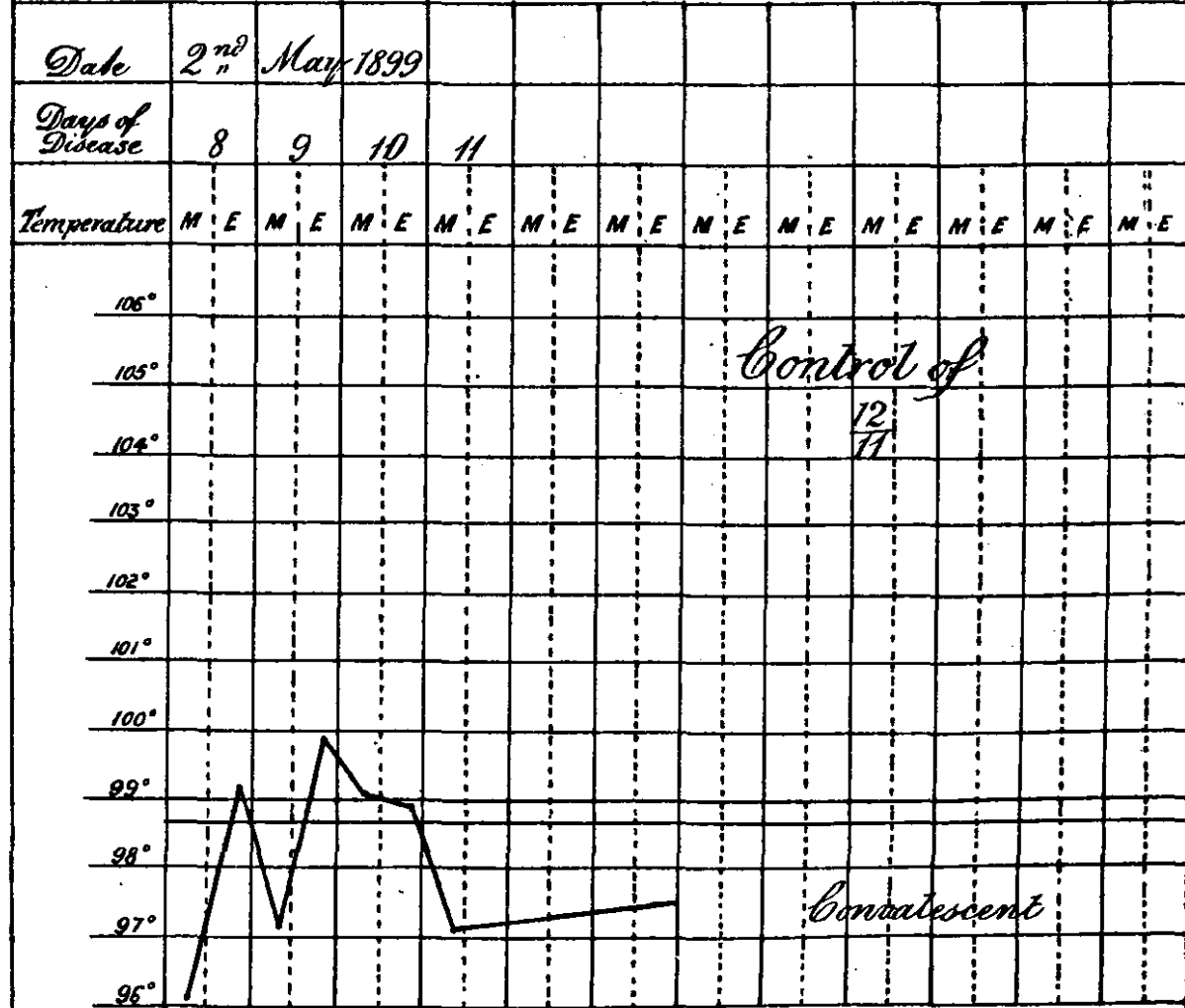


Position of Bubo: R. Axillary.

Result: Discharged after 32 days.

No 3

Hospital No 1623. Diagnosis: Plague. Previous duration: 8 days.
Sex: Male, Age: 40, Caste: Hindu, Occupation: Mill-hand.

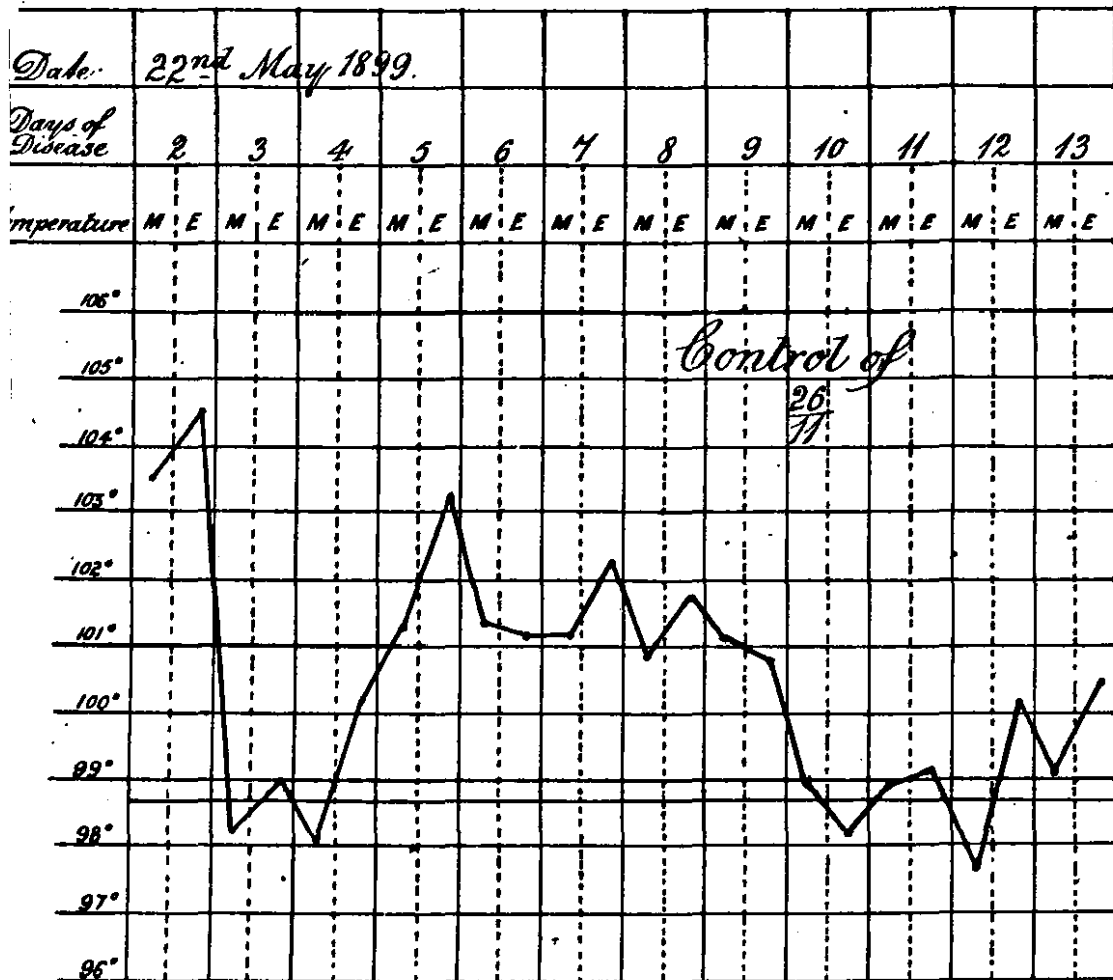


Position of Bubo: Sub-maxill.

Result: Discharged after 11 days.

No 6

Hospital No 1708 Diagnosis: Plague. Previous duration: 2 days
 Sex: Male Age: 30, Caste: Hindu Occupation: Shop-keeper.

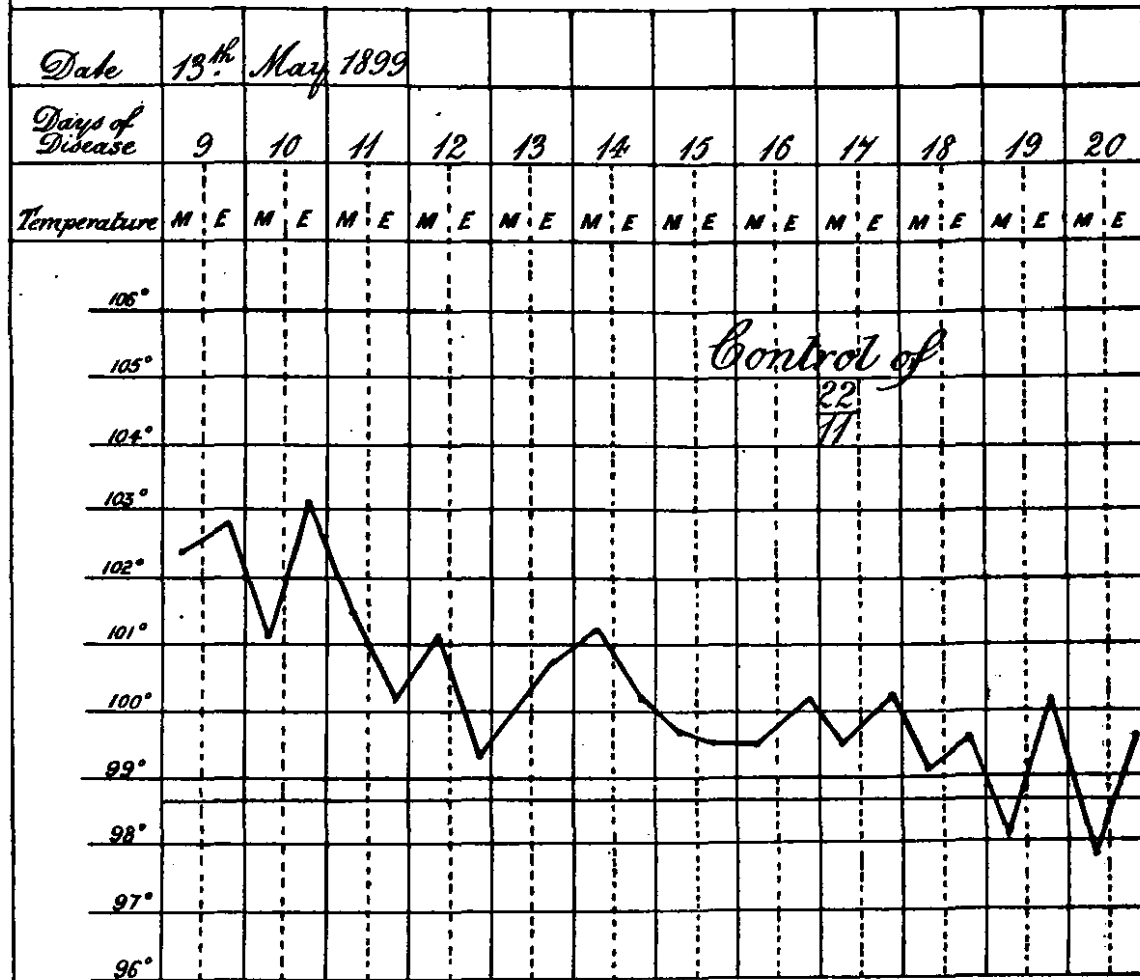


Position of Bubo: L. Inguinal & Femoral and Iliac (Incised)

Result: Discharged after 81 days.

No 5

Hospital No 1674 Diagnosis: Plague. Previous duration: 9 days.
 Sex: Male, Age: 22, Caste: N. Christian, Occupation: Fitter.

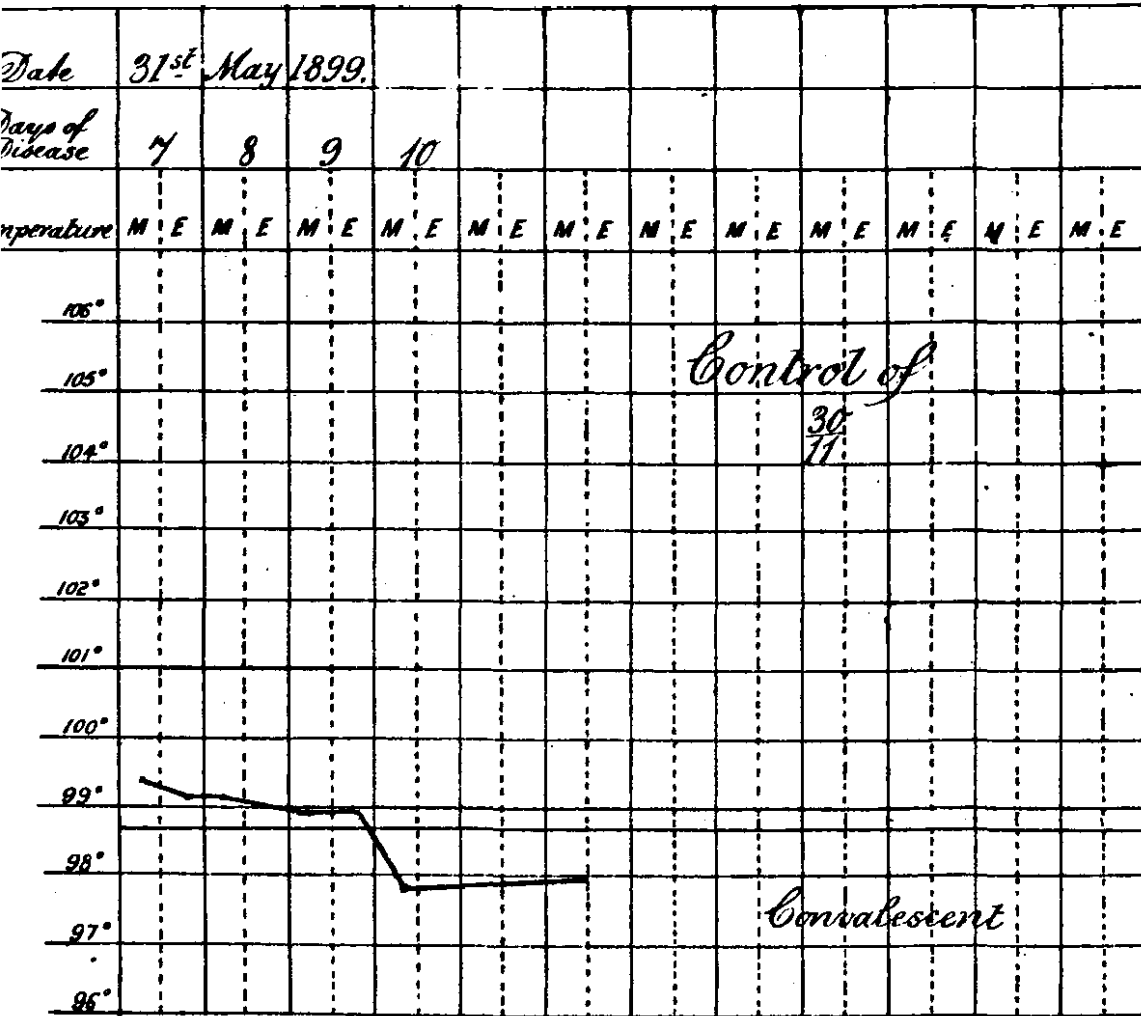


Position of Bubo: R. Inguinal.

Result: Discharged after 35 days.

No 8

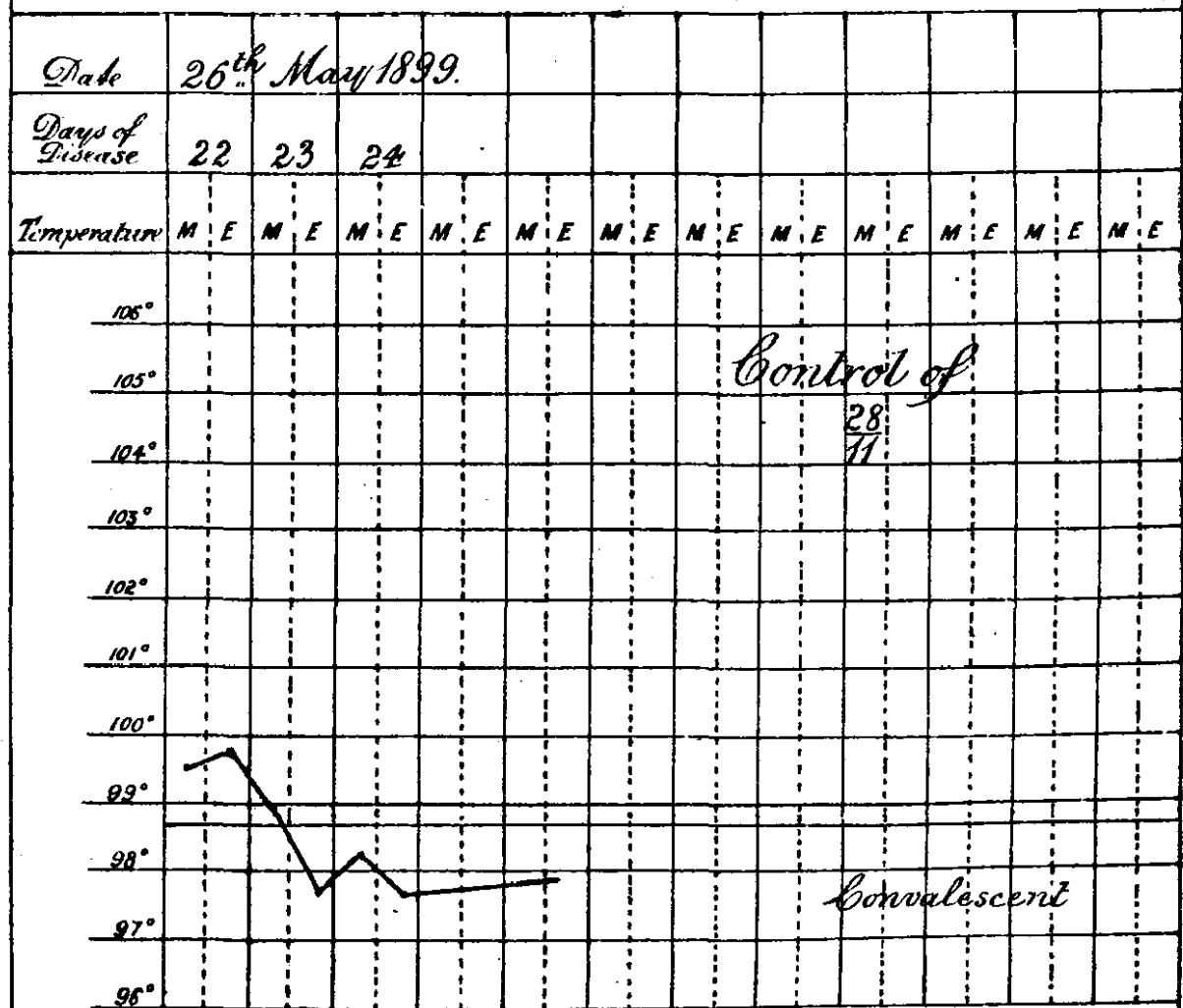
Hospital No 1748. Diagnosis: Plague. Previous duration: 7 days.
Sex: Male, Age: 12, Caste: Hindu Occupation: Nil.



Position of Bubo: R. Cervical and R. Femoral. Result: Discharged after 18 days.

No 7

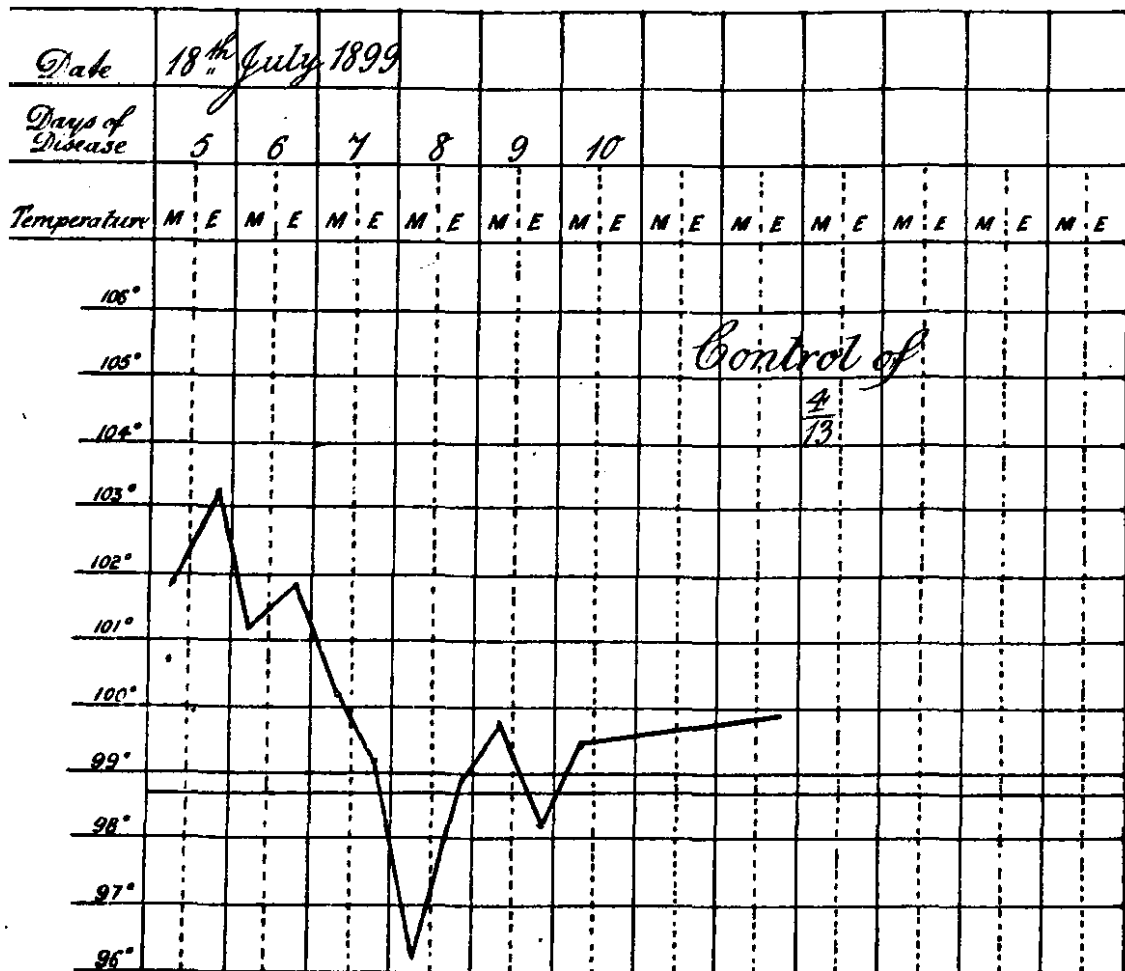
Hospital No 1723. Diagnosis: Plague. Previous duration: 22 days.
Sex: Male, Age: 50, Caste: Mussalman, Occupation: Dyer.



Position of Bubo: Double Inguinal. Result: Discharged after 19 days.

No 10

Hospital No 1881 Diagnosis: Plague. Previous duration: 5 days.
Sex: Female, Age: 45, Caste: Hindu, Occupation: Labourer

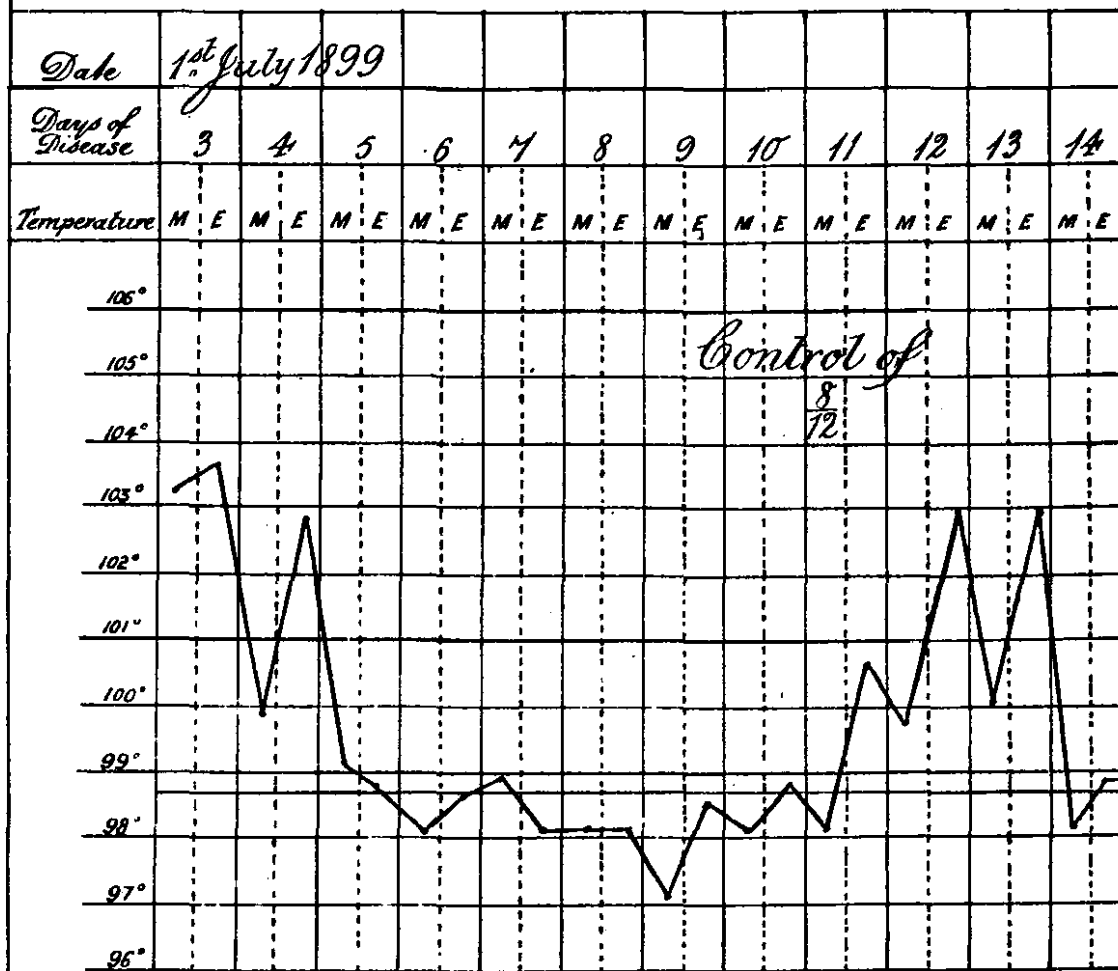


Position of Bubo: R. Axillary.

Result: Discharged after 18 days.

No 9.

Hospital No 1828 Diagnosis: Plague. Previous duration: 3 days.
Sex: Female, Age: 7, Caste: Hindu, Occupation: Nil



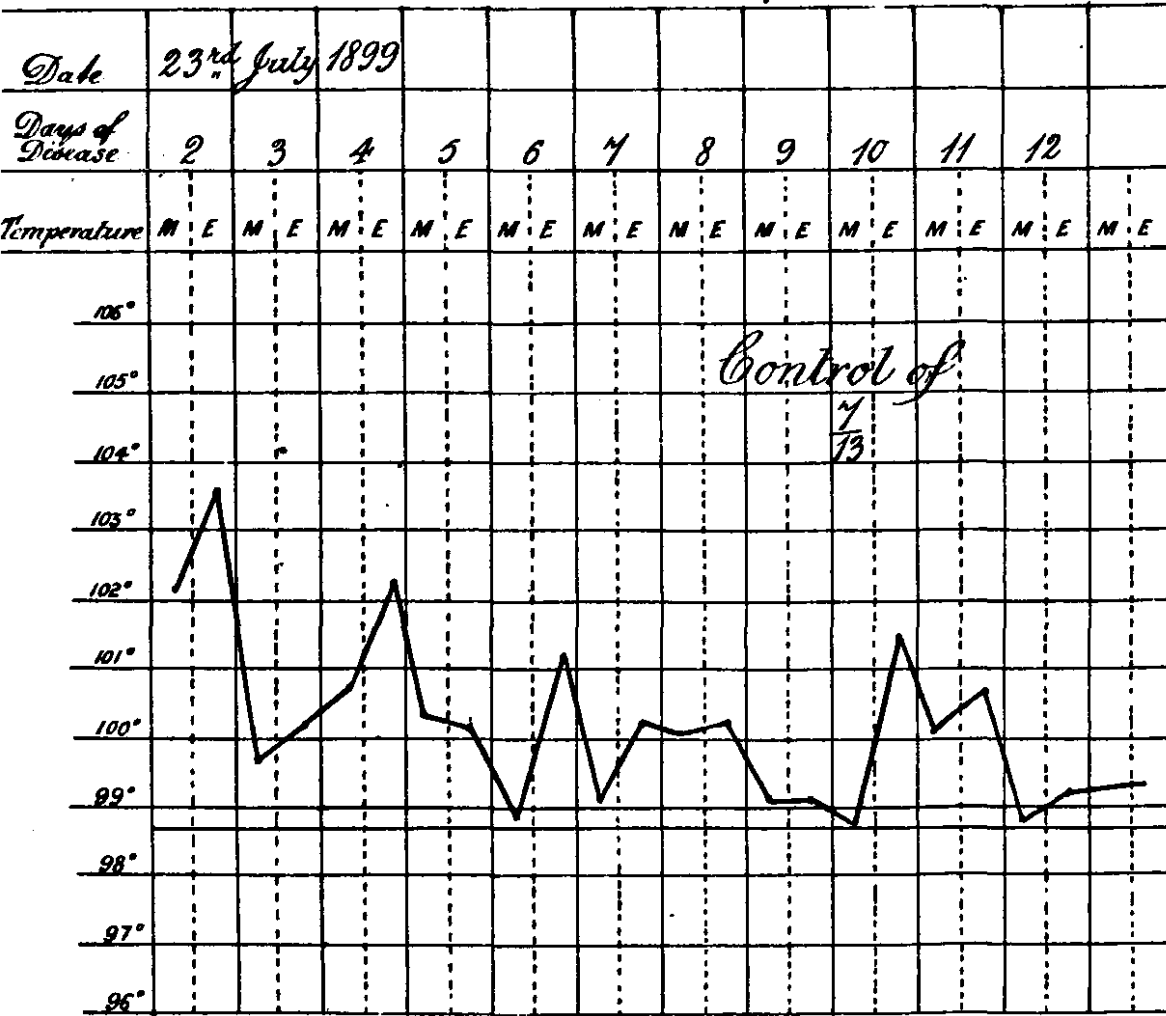
Position of Bubo: L. Femoral.

Result: Discharged after 37 days.

No. 12

Hospital No 1886. Diagnosis: Plague. Previous duration: 2 days.

Sex: Male, Age: 25, Caste: Hindu, Occupation: Labourer.

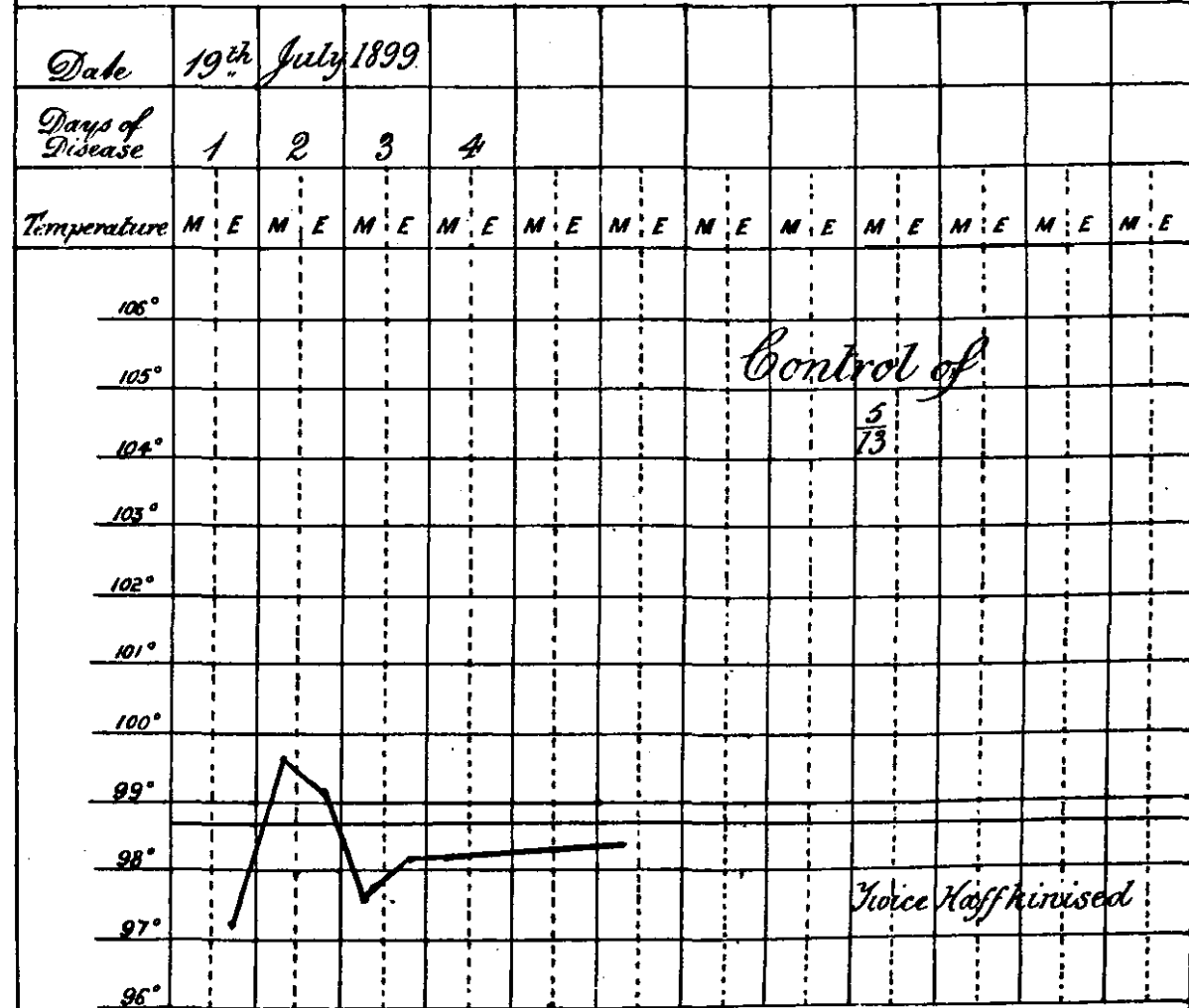


Position of Bubo: N. bubo, Primary pneumonia. Result: Discharged after 23 days.

No. 11

Hospital No 1885. Diagnosis: Plague. Previous duration: 1 day.

Sex: Male, Age: 15, Caste: N. Christian, Occupation: Student.

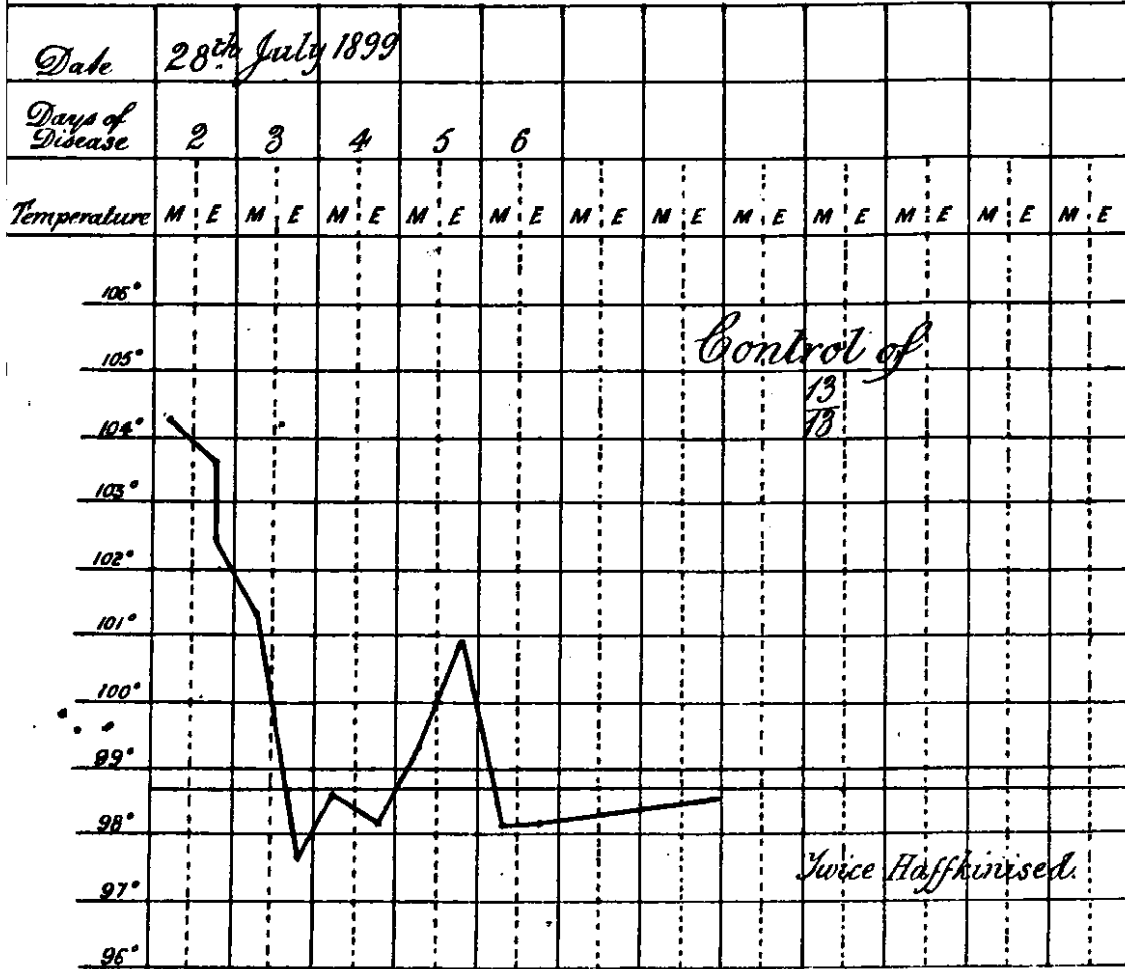


Position of Bubo: L. Femoral.

Result: Discharged after 19 days.

N^o 14

Hospital N^o 1914. Diagnosis: Plague. Previous duration: 2 days.
Sex: Male, Age: 8, Caste: N. Christian, Occupation: Schoolboy.

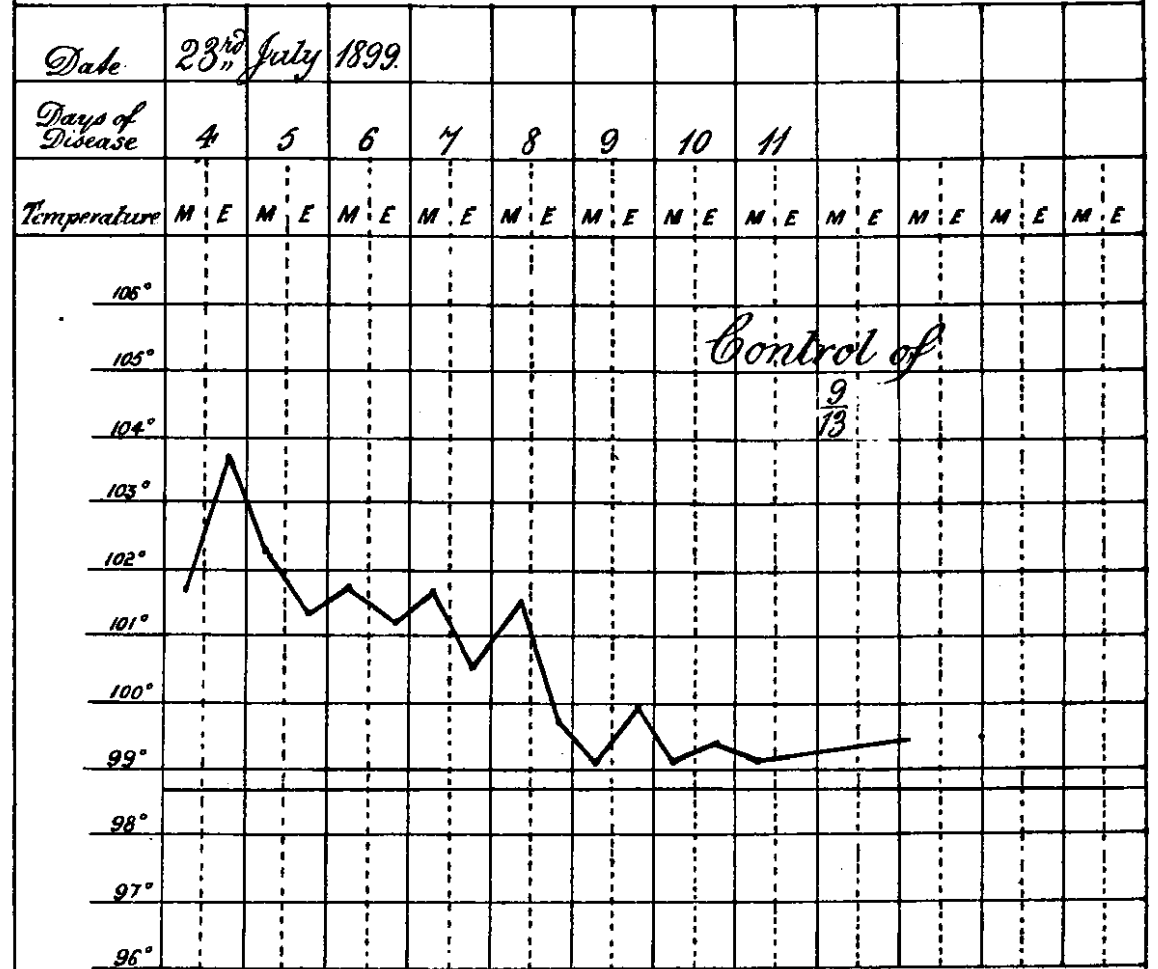


Position of Bubo: Double Femoral.

Result: Discharged after 15 days.

N^o 13

Hospital N^o 1893 Diagnosis: Plague. Previous duration: 4 days
Sex: Male, Age: 20, Caste: Hindu, Occupation: Mill-hand.



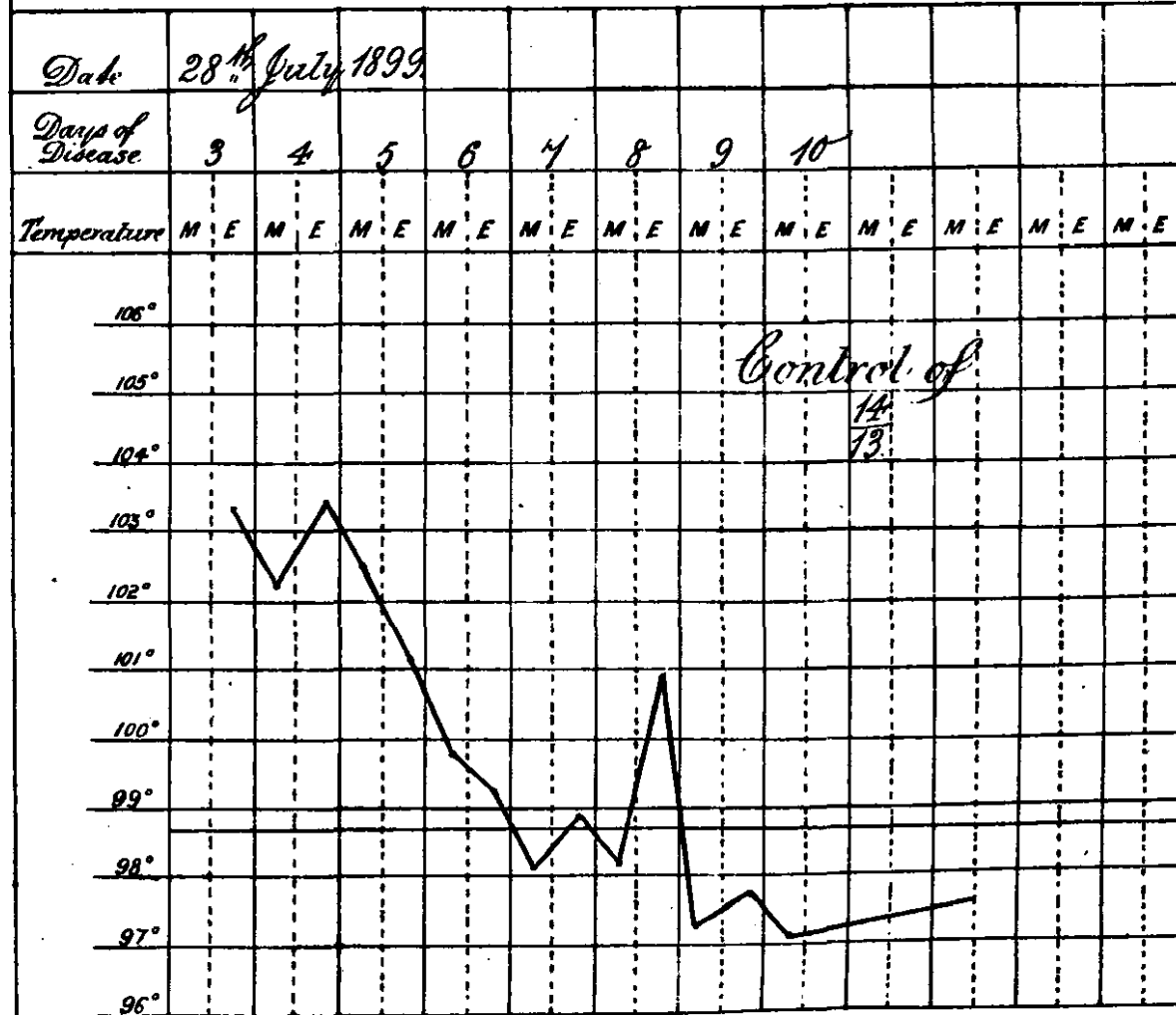
Position of Bubo: Double Inguinal.

Result: Discharged after 27 days.

N^o 15

Hospital N^o 1916 Diagnosis: Plague. Previous duration: 3 days.

Sex: Male, Age: 10, Caste: N. Christian, Occupation: Schoolboy.



Position of Bubo: L. Femoral, Inguinal, and Iliac Result: Discharged after 22 days.