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To Sir John Simon K C B etc
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The Anthropological Society of Bombay.

PRESIDENTIAL ADDRESS.

PLAGUE IN BOMBAY,

1896—1900,

BY

LIEUT.-COL. WATERS, I.M.S.

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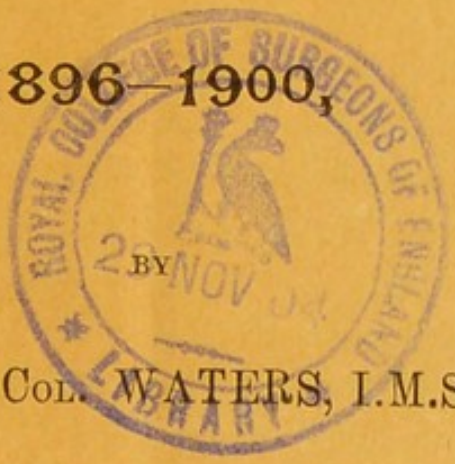

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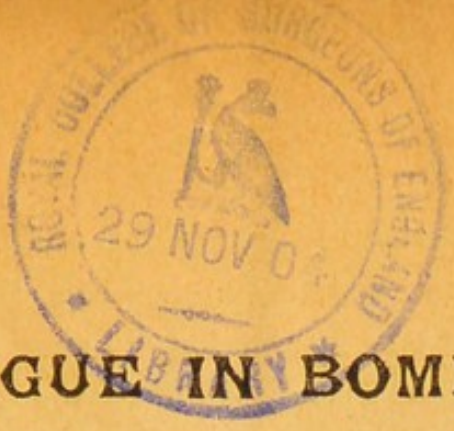

"PLAGUE IN BOMBAY."

THE plague began in Bombay in August 1896; and as only two months now remain for the completion of four years' prevalence of pestilence in this city, I may fittingly add the local history of the disease since October 1898, when I last wrote on the subject. As plague has been the only unusual factor in the Bombay death-rate since August 1896, I consider that the total additional mortality due to that malady may best be shown by deducting the normal mortality of a previous normal year from the respective mortality of the last four years; we thus arrive at the true plague mortality. The plague mortality thus evinced is vastly in excess of the figure given in the Municipal returns. But it should be remembered that these returns depend on the varied success of those whose business it was to detect plague cases; and no one knows better than the Health Officer himself, that the complete plague prevalence was never thus gauged with anything like accuracy; and so the figures representing plague in the daily municipal returns have always been much less than the difference between the actual mortality and the mortality of pre-plague times, which difference, I maintain, is the only valid figure as to the deaths from pestilence. It is true that cholera and smallpox have recently been no inconsiderable factors in the mortality of Bombay, but these, after all, have at most only raised the mortality by a comparatively insignificant figure, and as such unimportant raising of the death-rate in Bombay has not uncommonly been a feature of non-plague times, we may safely dismiss these elements in estimating the ravages of the pestilence. In short the enormous difference between the present and the past mortality of Bombay is, beyond all doubt, a mere

question of plague—steadily persistent and increasing plague. To give some idea of its steady increase in this city of Bombay let us take the mortuary figures for the month of March only, and it will be seen that they have for the last four years risen by no less than a thousand in that same month of each successive year. The plague since its commencement in Bombay may be gauged by a study of the following tabular statement:—

Years.	Total mortality, excluding still-born.	Plague mortality
1895	25,081	.....
1896	33,451	8,370
1897	47,896	22,815
1898	51,961	26,880
1899	56,434	31,353
Total Plague mortality ...		89,418

The above shows the mortality of 1895, a fairly normal year, deducted from the mortality of the several succeeding years; we thus arrive at the figure 89,418 as the total plague mortality in Bombay up to the end of 1899. To this must be added the plague mortality of the last five months, being the first five months of 1900.

Months.	Mortality.
January	9,726
February	10,708
March...	11,410
April	9,173
May	6,678
Total mortality ...	47,695

Same data for 1895 :—

Months.	Mortality.
January	2,157
February	2,084
March...	2,223
April	2,334
May	2,619
Total mortality ...	11,417

Deducting the total mortality of the first five months of 1895 (11,417) from that of the same period of 1900 (47,695), we get 36,278, the plague mortality for the latter interval. And this added to 89,418, the plague mortality up to the end of 1899, gives 123,649 as the total plague mortality in Bombay from the commencement of plague to the end of the month of May last. I would invite careful attention to the above figures, as it is necessary for the further study of this subject to have a clear perception of the significance of these statistics.

The census of 1891 in Bombay gave in round figures 850,000 as the population of this city. But early in 1897, that is, some months after the plague had begun its dire work amongst us, the population fell off from plague panic to what appeared to be less than half the figure for 1891. Meanwhile the mortuary figures have been dealt with on the basis of the population for 1891, and thus the stated ratio of deaths to the thousand of population is considerably less than the real facts would indicate. The Tramway Company's traffic returns are perhaps the best means of estimating the population of Bombay short of actual enumeration, and the Tramway authorities are of opinion

that Bombay has not yet regained its population, as taken in 1891. They think that instead of eight and a half lacs of people the Bombay population at the present moment does not exceed, if it amounts to, eight lacs. Indeed, their estimate of the present population of Bombay is between seven and eight lacs. This fact of the Bombay population having fallen under the figures for 1891 must be borne in mind in estimating the ratio of plague mortality to population. We thus come to see that plague depredation in Bombay has been much greater than the death statistics can possibly indicate. Indeed the figures given in the daily returns as plague sickness and mortality are ludicrously out of harmony with fact. Let us for instance admit that the population stands at the 1891 figure, this at the rate of thirty in the thousand, would give something like 70 per diem as the ordinary mortality. Well, in the month of March last we sometimes had over 400 deaths per diem with a recorded daily plague mortality of only 118. This left 300 as the deaths per diem from other causes, which is altogether absurd. To complete the four years; let us estimate the remaining months of June, July and August as each giving on an average five thousand deaths from plague, and we thus arrive at the figure 138,649 as the complete four years' mortality from plague alone. For convenience let us call the fourth of this grand total one year's mortality from plague, and we thus get 40 in the thousand of population as mortality due to that single ailment each year. In other words, the average duration of life in Bombay as estimated on the last four years' experience of plague alone, only amounts to 25 years. And when to plague is added the general mortality say 30 in the thousand, we thus arrive at 14 years as the average duration of life in Bombay ! And if we estimate on the mortuary figures of the first four months of the current year alone we have the span of human existence in Bombay reduced to a much lower figure, but it would be nothing else than frivolity to make such a calculation. Let me however just say,

for the benefit of the curious, that the duration of life in Bombay on such a basis of estimation, would be reduced to seven years. The gravest aspect of the case now presented to the inhabitants of Bombay, is that the plague has steadily increased in this city from its commencement and is still increasing in an enhanced ratio, and this, despite all that has been done and is being done for its removal from our midst. Many hundreds of thousands of pounds sterling have been spent too in vain. And what seems to me the strangest thing connected with our plague experience is the apparently unbounded faith in the efficacy of measures which yet have exercised no check whatever on the prevalence far less on the increase of the pestilence. Those concerned in plague operations seem utterly blind to the fact that nothing but futility has waited on their endeavours. Far be it from me to say that in this they are to blame, still I venture to remark, that the fact of the uselessness of the measures hitherto in force should by this time have made some impression on the responsible authorities. Some effort should surely have meanwhile been made in the direction of proved experiment and example. In one respect there has been no lack of well-directed effort, and that is in the direction of inoculation as a plague prophylactic. Well-observed experiment would certainly seem to indicate that here we have hope of success. I feel sanguine on this score to a certain extent, but, in the main, I despair of much being achieved in the saving of life by this means. We see in the daily newspapers that something like a fourth of the present population of Bombay have been inoculated with Haffkine's prophylactic, but *pari passu*, we have a steady and indeed enormous increase in the mortality. It will have been seen that the mortality from plague in the first five months of this current year was 36,278. This stupendous figure exceeded the total plague mortality for last year (1899) by 4,925. The plague then has not only been increasing in Bombay, but increasing by leaps and bounds, and curiously

enough its greatest increase has been coincident with the most extended and extensive practise of inoculation. The gravity of the situation lies in the fact that whereas in previous plague years the mortality by this time had almost always reached a normal figure, this year however it still stands at 70 in the thousand, that is, more than twice the usual death-rate at this period, even reckoning plague years!

Theoretically it seems to me that a prophylactic should act something like quinine, *i. e.*, it should have some tendency to cure as well as prevent. This, however, it certainly does not do. Yet I conscientiously attest the fact that inoculation has considerable prophylactic effect. It does not, however, act like the vaccine lymph in preventing or largely modifying small-pox. Given a number of people similarly exposed to plague-attack, some inoculated and some not, and of the non-inoculated 70 to 80 per cent. of the cases die, whilst of the inoculated only 20 to 30 per cent. end fatally. This is saying a great deal in favour of inoculation, and I would not seek to minimise its virtue. My actual contact, however, with inoculation has been such as to give me an experience certainly favourable to it, but less pronouncedly favourable than has been the experience of others. I may here, however, add that I have never had the experience of mortality by the use of the serum as a prophylactic; inoculation is, in my opinion, an altogether harmless expedient, not to speak of the lessened mortality attending its use. I repeat then that my acquaintance with it has led me to form a favourable opinion of it; I, however, admit that my experience has never been so fortunate as the experience of some others. The fact that two lacs of people (200,000) or thereabout have been inoculated in this city, and that the steadily increasing mortality from plague should yet persist, seems to me to proclaim the hopelessness of expecting to overtake and master the pestilence by this means. I do not desire to discountenance inoculation—far from it; I simply seek to accentuate the fact,

having regard to the last four years' experience, that it is desirable to discover some additional, and, if possible, more potent means of combating our present trouble. But I will return to this point later on in this paper.

The plague, beginning in the end of August 1896, almost disappeared in the following October ; began again in November of that year, and increased in prevalence till February 1897, and then began to subside, and all but disappeared in the following month of May. It exhibited a mild prevalence during the monsoon, 1897, fell off almost completely in October, began again in November of that year, and went on increasing, reaching its maximum in March 1898. The lowest point this year of 1898 was in the first week of July. It then began afresh, and steadily increased in mild prevalence throughout the monsoon, diminished again in October, and began to rise again in November as usual, and increased throughout December 1898, and January and February 1899, reaching its maximum again in March of the latter year. It then *more suo* subsided greatly in the hot months of May and June, showed a mild monsoon epidemic also as usual, and, diminishing somewhat in October, rose again in November, and throughout the Winter months showed an unprecedented prevalence, reaching its maximum of over 400 (total mortality) per diem in March 1900, and now, in the middle of June, the death ratio stands at 70 in the thousand. The highest point each year has gone on increasing, and in the end of February and throughout March last all previous record was beaten. At the present moment, as I have shown, the mortality in Bombay is just twice the normal figure on a full population.

The plague has shown a remarkable uniformity of character ; it has the same characteristic symptoms ; the same tendency to pulmonary complication, and the same mortality that it exhibited in the first year of its prevalence. I must, however, say that the plague prevalence in Mandvi, the district first

attacked on the first appearance of the pest in Bombay, was much more fatal than it has been since either there or elsewhere. With this exception, the terrible disease with which we have now been close on four years face to face, has exhibited little or no modification. The characteristic symptom, the glandular swelling—the omerods of the Old Testament—is said by many to be often absent, but my own observation leads me to believe that it is almost a constant feature of plague; only in some cases the enlargements of the lymphatic system appear very late in the course of the disease. I have seen it make its first appearance as late as the tenth day of the sickness. It may, therefore, be considered the most constant and characteristic symptom of plague; it is, in medical phraseology, the pathognomonic feature, and this I believe has been the experience of all times. In my own case the mesenteric glands seemed to have been most implicated, and the chief and most depressing symptom was a drastic bowel complaint with drumlike distension; and the sequel, which did not declare itself till some months later, was pronounced jaundice, attended with remarkable stupor of the mental faculties. Somewhat late in the attack one axillary gland became swollen and tender to the touch. Plague has from remotest time been a dread of humanity. It would appear that the circumstances of modern times are less congenial to its mischievous progress, than were those of the earlier visitations of the disease, as for instance, those recorded in the Bible. I must here, however, say that the plague does not appear to me to be a disease associated with defective sanitation to any marked degree. I find plague a constant accompaniment of damp, and, of course, inasmuch as damp and dirt are often co-existent, it may to a certain extent be alleged that it is a disease of defective sanitation. I nevertheless maintain that plague is not a pythogenic or filth-begotten ailment. I have over and over again seen plague contracted in the very cleanest of places, but I do not think I have seen more than a few cases that were not in obvious

contact with damp. This, indeed, is the explanation of plague in that very clean quarter of Bombay, Malabar Hill, and garden-watering and stable requirements are here the main source of the mischief, the disease occurring among the persons most exposed to the garden and stable moisture—the gardeners and the grooms.

Plague in Bombay has found the great majority of its victims among the poorer classes of the population. Among the well-to-do natives the disease has not had much of a footing, and among Europeans of easy circumstance all the plague victims for the last four years can be counted on the fingers of one hand. It was at first thought that natives were peculiarly, perhaps racially, prone to the plague, and that Europeans enjoyed a corresponding immunity. I am, however, humbly of opinion that plague is no such respecter of persons or races, and that all persons, Europeans and Natives, are equally prone to attack when exposed in equal degree to the operation of the plague-germ. The whole difference in Bombay between those who suffer most from plague and those who would seem to be exempt from attack, is a question of environment. I think I may safely say that among well-to-do Europeans in Bombay there is a complete absence of apprehension on the score of plague. The almost complete freedom from plague enjoyed by them for the last four years would appear to have inspired them with confidence. But well-to-do Natives, living in circumstances identical with those of Europeans, enjoy a similar immunity from plague. I have said that the depredations of plague in Bombay are invariably associated with damp, and when we examine the dwellings of the poor labouring population of this city, some idea of what I mean is easily grasped. These poor dwellings often consist of not more than a single apartment, within which there is the invariable *nani*, or bathing or washing place. The water is usually delivered by a tap over the *nani*, and the supply for all purposes is thence drawn. The corner containing the *nani*

is thus in a state of continual dampness, and this dampness is the main differentiating factor, in regard to plague, between the rich and the poor of this city, and thus it is that disease rages among the latter. The plague organism belonging to the vegetable kingdom is fostered by moisture, and destroyed or rendered inert by drought or a deluge. The plague germ flourishes most, as is exhibited by mortality, in the colder and cloudier months of the year, and thus we have it in its greatest activity in Bombay in the winter and early spring, and during the monsoon in Poona, the coolest period of the year in that locality. In Bombay during the monsoon the plague is slight, because the 80 inches of rain flood the plague germs, and then too, the Bombay temperature is high,—another reason for the lessened activity of the disease. In Poona, on the contrary, the rainfall being only 30 inches in the year, amounts to no more than gentle dampness, and the temperature then too is comparatively low, and thus we have the two conditions—gentle moisture and low temperature—favouring germ activity, and as a consequence great prevalence of plague. This at any rate is my interpretation of the different behaviour of plague in Bombay and Poona during the monsoon. In either place people in good circumstances, living in houses with a plinth several (say five) feet in height, with no garden watering near the walls, and with no dampness in the environment from cooking or washing, or other cause, may, according to my observation, regard themselves as perfectly safe. I, of course, do not deny the possibility of plague being communicated from one person to another, for instance the coughing of a pneumonic plague patient is a danger to a careless attendant, but not to a trained nurse. Plague, however, is so seldom conveyed thus that the question of contagion may be altogether left out of account. It will be gathered from this that I hold plague not to be propagated from place to place by human contact, but by the dispersion of the *contagium vivum*. In other words plague

spreads not by human contact, but by commercial-intercourse. Each plague victim derives the disease from some source in his own environment and not from his fellow-man. I shall best demonstrate this by instancing the case of the jails in Bombay. Some five thousand persons pass through the two Bombay jails in the course of a year, and plague cases have actually been admitted to the jails without any outbreak following. Indeed, I may say that in the period of close on four years that plague has been in Bombay, the jails have never once been infected by the arrival of plague-stricken persons within their walls; and this, be it well noted, though each of the two Bombay prisons is respectively situated in a neighbourhood showing the very highest plague prevalence and mortality.

An outbreak of plague did take place in H. M.'s House of Correction, Byculla, in the end of January 1897, but the first cases occurred among the older inmates and not among new arrivals. I may say of this outbreak, that it began on the 27th January, and no fresh case occurred after the 6th February. The attack was thus of short duration and I may here very briefly describe it. Thirty-two persons were attacked, and of these just one-half died. Having already made plague the subject of the closest study, I had observed the evil effects of damp and the salubrious influence of dryness, and I perceived that the jail was damp in its residential area from the faulty distribution of the water, and, I may add too, from the superabundance of the supply. I therefore very soon combined my efforts in the direction of cutting off the water from the residential portion of the jail altogether. Without going into detail I may here simply say that for several days I failed to achieve my object. At last, however, success was attained, and six days later the visitation of plague stopped as by magic. That is to say, that as soon as the sun had effectually dried the residential environment of the jail, so soon did the pestilence cease to trouble the prisoners. This after all is only what might be expected.

The vegetable plague organism, we have seen, thrives in a damp area, and conversely it fades by absolute and persistent dryness; it in other words dies by desiccation. I had become pretty confident as to the accuracy of this observation before I was called on to fight the plague in the House of Correction, and the result of this fresh experience was to confirm me in the belief that the avoidance of damp in human environment was the great desideratum, and I have ever since acted accordingly with the utmost satisfaction. As a result of this practice, I may say that the institutions of which I am in medical charge, have enjoyed an exemption from plague which stands in striking contrast to the state of things among the surrounding population of this great city. Byculla, for instance, is one of the most plague-stricken districts of Bombay, and the Byculla Schools, of which I am in medical charge, stand in the very centre of it, and among the two hundred and odd pupils, there has only been one death in the last three years. That death was from plague, but it was the case of a boy who had just returned from leave, and who had been residing during leave in a keenly plague-stricken quarter. My wishes as to keeping the Schools and their grounds dry, I am glad to say, receive most scrupulous attention. Now, to return to the House of Correction, I beg to say that at first Mr. Hall, the Superintendent of that Institution, was in doubt as to the arrest of the plague in the jail being due to the cutting off of the water from the residential portion. He was of opinion that it was rather due to the flushing of the jail drains and cells by means of a steam-engine, a measure adopted and carried out by himself with my full concurrence. Well, in the October of that year (1897) I was invalided, as I have already said, for jaundice, and things went all right in the jail till the ensuing spring. Early in January the water was reintroduced to the residential portion of the jail, and when I returned to duty early in the following July, I found that the first six months of the year (1898) showed mortality to the unusually

high figure of 80 in the thousand. On resuming duty I simply had the water again cut off from the residential quarters, and without doing anything further than keeping the place as dry as possible, the mortality for the second half of that same year came down to under 14 in the thousand, and has ever since been less than 20 in the thousand. This striking fact carried conviction to the Superintendent's mind, and the complete freedom from plague, which the jail has ever since enjoyed, has made Mr. Hall my most staunch disciple. For now close on two years since my return from leave, the jail mortality has been on a par with that of Brighton, and meanwhile, on occasion, the death-rate among the surrounding population touches 300 in the thousand. To prove that the prison is not otherwise protected from plague than by the avoidance of damp, I would instance the fact, that abutting on the jail wall outside is the Superintendent's quarters, and his cook died of plague in the month of April last. On being conducted to the Superintendent's kitchen, I at once pointed out the cause of the cook's illness and death. From a leaking water-tap water was constantly dribbling into the scullery space in the corner of the exceedingly small kitchen, and a situation was thus created exactly identical with the cramped dwellings of the poor in Bombay with their invariable *nanies* already described. Between this small kitchen and the prison there only intervened the thickness of the jail wall, and yet the prisoners were all in perfect health, the jail wall protecting them from the damp. This circumstance, I may add, illustrates what I have often advanced, *viz.*, that in Bombay generally, and specially in its most plague-stricken districts, such as Byculla, the plague germs always exist; they remain inert until persistently moistened and then show baleful activity. To make this point clear, beyond all possibility of doubt, I will give yet another illustration. In my report on the outbreak of plague in this jail in 1897, I recommended that the water should not again be allowed in the residential quarters but distributed as remote as possible from these in the corners

of the jail enclosure. This has only recently been carried into actual effect, but meanwhile the prisoners made their toilet as far away as possible from the sleeping yards, at special water-taps specially improvised for the purpose. When the new bathing platform was being prepared, I enjoined special care in the avoidance of the use of unnecessary water. When the bathing place was, however, being finished with a layer of hard plaster and in order that the lime should harden and dry without cracking, it was covered with cane-matting constantly kept wet. This continual damp soon made the position ominous ; the rats began to die in the jail, and some half a dozen men got suspicious fever, and one case of plague actually showed itself. I now had the cane-matting burnt, and the plaster freely exposed to the sun, which rapidly dried it, and soon all our troublous indications disappeared, including the rat sickness and mortality. This shows that the jail is not exempt from plague owing to any inherent circumstance, and that our only protection is the maintenance of dryness, and that the intervention of damp will produce plague among the prisoners as it does elsewhere in Bombay. The monsoon dampness is quite another matter ; it is uniform over the whole surface and soon yields to the drying effect of the strong tropical sun ; and the high temperature during the monsoon months in Bombay is another saving factor. In Poona, as I have explained, the monsoon circumstances are reversed.

A very natural question to ask is : Are the prisoners protected by inoculation ? This is a question of singular and striking interest, and my answer is, they are not so protected. I may here explain that it was when this prison was first visited by plague early in 1897, that I, on my own responsibility, gave M. Haffkine his first opportunity of demonstrating the protective effect of his prophylactic. He inoculated 147 jail inmates, there remaining of prisoners and jail staff some two hundred persons that were not so treated, and thus served the purpose of

a test. The result gave a balance in favour of inoculation, and on the basis of this experience the use of Haffkine's prophylactic was accepted as a plague remedial measure, and so inoculation soon became a widely-accepted expedient. Meanwhile I had made the observation that much was due to the cutting-off of the water from the residential portion of the jail; the plague did not stop gradually, as it usually does, after committing inroads on human life, it stopped suddenly as if by magic, six persons falling sick of plague in one day as the last feature of the visitation. That is, as I have already explained, the plague organisms died by desiccation, being deprived of damp and exposed to the fierce rays of the tropical sun. The aspect of this circumstance, which was to me most instructive and suggestive, was the fact that the plague stopped practically at once, and as soon among the 200 non-inoculated as it did among the 147 inoculated. Armed with this discovery I subsequently altogether dispensed with inoculation, and trusted entirely to the strict maintenance of dryness in the inhabited portion of the jail, with the result that this prison, with a most deadly, plague-stricken surrounding, has, ever since my return from sick leave, now close on two years ago, only had the death-rate of a European sanitarium, that is, under 20 in the thousand. Now, inoculation in a plague centre like Byculla cannot show a result such as this, though I at the same time would not disparage it, for in places where the great desideratum—dryness—cannot be attained, inoculation will save the inhabitants to a considerable extent. It therefore has a great and distinct field of usefulness, and deserves all encouragement. As compared with dryness, however, it must, I would respectfully aver, take a second place, as dryness saves all the people within its protective influence, whilst inoculation has not yet shown itself capable of affording absolute protection. My House of Correction experience has taught me that in a dry environment, even the poorest natives are just as safe as Europeans in similar surrounding, and that plague is thus proved to have no racial predilection.

I have only a few words to say as to the question whether rats are concerned in the propagation of plague from place to place. The House of Correction affords excellent opportunities for the study of this question, it being the home and the hunting ground of rats innumerable. These rodents come into and go out of the jail without available let or hindrance. The rats indeed are always with us ; and having free access to the jail after wandering in its most severely plague-stricken surroundings, how is it possible, supposing them to be plague carriers, for the prison to have the extraordinary healthy record described during the last two years? In other words, if rats are the medium of plague propagation, and having free access to and egress from the jail precincts, and the surrounding district being phenomenally plague-stricken, how is it possible for the prisoners to escape the plague as they do ? I have thus come to the conclusion that rats, dead or alive, are blameless in the matter of plague infection. Indeed we find that unless the examination is made immediately after death, plague organisms cannot be found in the dead bodies of rats or men. The organisms concerned in cadaveric change are so numerous and so predominant, that pathogenic or disease-causing entities stand no chance with them, and so the latter shortly after death are no where to be seen.

The death of rats is, however, an ominous circumstance, a most reliable warning that something is wrong, and it should always be regarded as a possible forerunner of human mortality, and precautions should accordingly be taken with a view to human safety. It was on this principle that I put a stop to the use of water on the new bathing stand in the House of Correction, with the satisfactory result which I invariably observe on the adoption of this expedient. It would seem that the plague poison at first lies close to the ground, and it is thus that the death of rats heralds the approach of human mortality. And

thus no wise man in a plague epidemic regards the death of rats without apprehension.

The enlightened Municipality of Bombay has spared neither pains nor expense for the relief of this beautiful city from the grip of plague. The failure of Municipal effort has not been from want of mighty endeavour, but from the absence of rationale in the proceeding. The great desideratum is to render dry the dwellings of the poor.

GEO. WATERS, Lieut.-Col., I. M. S.