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[Despatch Abstract.]

Preventive inoculation against plague

Ordering the publication of certain reports showing the effect of ——

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Government {1898} of Madras.

LOCAL AND MUNICIPAL.

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G.O., No. 485 P., 16th May 1898.

MAY.

Preventive Inoculation against Plague.

Ordering the publication of certain reports showing the effect of —.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

From W. M. HAFFKINE, Esq., C.I.E., to the Secretary to the Government of Madras, Local and Municipal Department, dated Plague Research Laboratory, Bombay, 5th May 1898, No. 162.

I have the honour to forward herewith a report on the results of preventive inoculation against plague carried out in the village Undhera, Taluka Baroda, on the 12th February 1898.

ORDER—No. 485 P., dated 16th May 1898.

The papers printed as an appendix to this order will be published in the Fort St. George and all District Gazettes, and also placed on the Editors' Table. The Translators to Government are requested to furnish the necessary translation of the papers to the Superintendent, Government Press, who will print the required number of copies in English and in the vernaculars and forward them to the Collectors concerned for publication.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To all Collectors.
„ all Presidents of District Boards.
„ all Chairmen of Municipal Councils.
„ the President, Municipal Commission, Madras.
„ the Surgeon-General.
„ the Sanitary Commissioner.
„ all District Medical and Sanitary Officers.
„ the Political Department.
„ the Translators to Government.
„ the Superintendent, Government Press.
Gazette.
Editors' Table.

Exd. C. M. Thumboswamy.

APPENDIX.

I.—A CONVERSAZIONE on the Preventive Inoculation against Plague, held by Mons. W. M. HAFFKINE in the Cantonment Magistrate's Office, in Poona, on the 3rd January 1898; Major-General J. DUNCAN, Commanding the District, in the chair.

GENERAL DUNCAN having introduced Mons. Haffkine, the latter spoke as follows :—

"GENERAL DUNCAN AND GENTLEMEN,—This meeting was convened to give you an opportunity of obtaining from me such information on the preventive inoculation against plague as you may think interesting to have, and not for me to deliver a comprehensive address on that subject. The remarks which I am going to make will, therefore, serve only as an introduction to our conversation.

"The fact that the cause of the epidemic is a living being helps to understand a large number of details connected with the question. The germs of plague are invisible to the naked eye, and not every one is accustomed to think of, or to make conclusions with regard to the life of the microscopic world. But whether an animal or vegetable be big or small, the fundamental laws regulating their existence and propagation are the same. In a large number of instances one is justified in making complete analogies between what one knows of the higher forms of life and what takes place among lower beings. In this order of ideas, I will resort for my explanations to a few phenomena in Nature, similar to a plague invasion, but being of a kind easier to be watched and understood. As you know, the flora and fauna of Australia are different from those of other countries, and one of these differences was, up to quite lately, that there were no rabbits in the island. These animals were first introduced for the sake of sport, or as pets, by private individuals. The conditions of life appeared favourable to their propagation, and soon they spread to such an extent that they became first a nuisance, and afterwards a real plague to the country, attacking and ruining the plantations. The question has since occupied very many Committees and Legislative Councils. The Government offered a huge reward of many thousands of pounds to any one who would discover a way of ridding them of the rabbits. The island of Australia suffers, therefore, from the invasion of a species of animals, from a kind of infectious disease. The problem is to cure that country by removing or destroying the infection. You perceive how much simpler that problem is when compared with our plague epidemic. The rabbits can be seen, captured, killed by poisons like perchloride of mercury, or other far cheaper ones; they can be hunted, shot. Had the first couples of rabbits been thus destroyed, the disease would have been 'checked' in its inception. All those who hold that, provided you take proper measures, the plague should be stamped out easily, must, first of all, prove this by stamping it out, or, at least, admit the argument that it should be still much easier to solve that Australian question. You know, however, that the pounds offered by the Australian Government remain unclaimed to this day.

"There is another disease which fatally affects the agricultural industry of many countries in the south of Europe. It is produced by a small insect living under ground—the phyloxera, which can be pointed out and seen by the naked eye.

"The insect attacks the roots of the vine, and spreads very gradually and slowly from one bush to the neighbouring ones. You can easily see how and when the disease is introduced into your garden. All the bushes in a vineyard, in the beginning of winter, are cut down to the level of the ground, and covered with earth to protect them against the frost. In the spring they are unearthed, and begin to sprout again. If the bushes are all healthy, they grow uniformly, and their tops present to the eye an even surface of green, rising higher and higher as time goes on. If, however, the roots of a particular bush are affected by the phyloxera, this bush soon remains behind in its development. In this case you observe that, a few weeks later, the other bushes surrounding the affected one begin to take the disease in their turn, to grow more slowly; having, however, caught the infection later, a little taller than the one which first showed the symptoms. Ordering the path continues to spread, and there appears soon a very

regular depression on the surface of the vineyard, having its deepest point, its centre, in the bush which first became infected. This depression in a garden is, at least, as typical for the phyloxera infection as the bubo, and fever, and a coated tongue are for the plague. You do not require a house-to-house visitation to detect your first focus of infection. You see at a glance at your vineyard where the infection is and how far it has gone. Apparently you should be able to deal with it easily. You have not to contend with the religious, or caste, or other objections of your patient bushes. You do not require quarantine or railway inspection to prevent them from running away and spreading the disease elsewhere. This disease is most remarkably localised, and extends only with extreme deliberation. Your patients don't object to your disinfecting them as much as you wish. The insect is exceedingly easily killed. You can pour deadly antiseptics down to the roots, without, however, damaging the root; or you can dig up the bushes and the soil, and roast and burn them all, or treat them otherwise as you please. You know, however, that, once phyloxera has been introduced into a country, there is no method as yet invented to 'stamp it out.' It so happens that there are species of vine naturally immune against the disease, which the insect never attacks. The manœuvre now largely resorted to consists in destroying the garden, planting the roots of other, immune species, and trying to graft upon them those which one wants to grow. The phyloxera remains in the garden, but the bushes cease to undergo its attack.

"The problem of rinderpest in South Africa is an instance of a disease more difficult to deal with than diseases of plants, but still infinitely simpler than the plague. You can induce your cattle somewhat easier to conform with your arrangements, they will stay in your quarantines more patiently, and they generally make fewer objections to anything, and interfere with your plans much less, than when you deal with a free population, which may not always share the ideas of their Medical Officers of Health. The rinderpest in South Africa is, however, not yet 'stamped out' either.

"There are, therefore, both in the animal and vegetable worlds, diseases of which the cause, the morbid organism, can live and propagate outside the patient's body; can grow in the soil, in water, be carried by clothing, bedding, instruments, by any living or dead object. If it happens that the natural conditions of a country are favourable to the life and propagation of such an infectious organism, and as long as these conditions continue unchanged, and we are unable to artificially alter them, there is no instance known of such morbid organisms having been 'stamped out,' as the expression in our daily reports is, by the will of men. If it was otherwise, there would be no typhoid fever now in the European barracks in India; or the microbe of cholera, let us say, would have been 'exterminated' from the plains of Bengal, or the microbe of malaria from the rest of the country.

"Every time, therefore, that you may think of these matters, recall to your memory that rabbit question of Australia, or the phyloxera problem in the vine growing countries of Europe. I hope you will then cease to wonder at the fact that, when the Government and Municipalities appoint Committees to deal with, and to 'stamp out' the plague, the disease does not seem to always obey their measures.

"This state of affairs does not mean that, while the evil is still small, and you get in time aware of it, good cannot be effected by promptly attempting to extinguish it. If the plague penetrates into a village or small town, or if an actually first case of the disease is discovered in a big population, it should be almost as easy to arrest its development, at least locally and at least temporarily, as to put out a burning match. But it is absolutely certain that the tumbler of water, which looks so marvellously effective for the match, is useless when you have to face a big jungle in conflagration; and a big Indian town, densely populated, with cases of plague beginning to crop up in every quarter of it, is such a jungle in a state of occult conflagration.

"I was in Bombay soon after the first cases of plague were brought to the public notice, at the end of September 1896. There were then 20 to 30 cases of plague occurring daily. The real beginning of the disease could afterwards be traced to the month of July, so that it had been spreading for some three months unnoticed. I was taken to the ward of the town first affected, in Mandvi, a small place with a population of about a hundred thousand. When they showed me some of the

buildings, in which there were from 700 to 1,000 people living, and told me that cases were occurring daily all over that ward of Mandvi in houses like that, there was no need for me to interfere with the measures which the municipality had adopted. No public, or Government would have ever forgiven that municipality if it had not adopted the measures. But the future of the campaign was perfectly clear to me. I approved of all that was being done, the burning of sulphur in dishes in the open streets included.

"I mean to state by this that it was *not* in the power of the Executive to arrest the growth of the plague in Bombay in October 1896!

"There are, however, many phenomena in Nature which it is not in our power to arrest; but we can run away from them, or protect ourselves against them individually. On another occasion I quoted the analogy of our not being able to stop the heat in the plains of India; but those who can afford can easily escape it by going away to the hills, or by providing themselves with good punkhas, if they cannot get away. Or if, on the contrary, it is the monsoon that annoys you: it is true, you cannot arrest it, but a good Macintosh or an umbrella may protect you efficiently. Or, if you cannot dry up the rivers and marshy lands in your vicinity to deprive the mosquitoes of their breeding ground, you can protect your individual person by a mosquito net.

"The marvellous success of vaccination against small-pox, and the history of the bacteriological efforts of the last 15 years made the plan for effecting such a protection against plague obvious; and, early after the outbreak of plague in Bombay, I put myself to the task of working out a preventive inoculation to check the liability of individuals to that awful disease.

2. "The details of the system of preventive inoculation against the plague have been published in the Medical papers, and are accessible to any specialist. In this meeting I shall mention only the facts which, I believe, interest you most, namely, those which refer to the question as to the actual efficacy or otherwise of our preventive inoculations.

"The first demonstration of the working of this system can be made in the Laboratory, and this has been already repeated and confirmed by many observers. You are aware that rats are exceedingly susceptible to plague. One takes twenty rats from a ship that has newly arrived in harbour, say from Europe, where there is no plague. Ten of them are inoculated with the prophylactic against plague, and the others are left as they are. Put back all the twenty rats together, and introduce among them a rat that has the plague, or infect them all artificially with virulent plague microbes. In the course of time you will find that eight, or nine, or the whole of the unprotected will die of the disease; while perhaps only a single rat that had been inoculated with the protective lymph, or even not a single one, will contract the disease.

"These observations made by us in December 1896 have afforded the first ground for trying our protective method on human beings.

"During the month of January 1897 a large number of leading European and Native gentlemen offered themselves to be inoculated to prove the harmlessness of this method, and by the end of that month this question was solved, I believe, to the satisfaction of every one who took the trouble of attentively examining it.

"In the last week of January the plague broke out in the Byculla House of Correction in Bombay, and affected nine prisoners, of whom six eventually died.

"A couple of dozen of Professors and Students of the Grant Medical College offered to go to the jail to be inoculated in front of the prisoners, in order to encourage them by an example to try the protective effect of inoculation.

"When the measure was actually offered to the inmates, a little less than one half of them at once came forward to be inoculated.

"On the day of inoculation, the 30th January 1897, before the inoculation was applied, there occurred in the jail six more cases, of which three proved fatal. After the inoculation we discovered that one of the inoculated men had already a bubo, and two others developed buboes in the same evening. These three cases, inoculated, attacked on the day of inoculation, also proved fatal.

"The inoculated and the uninoculated remained under absolutely identical conditions of life; had the same food, drink, the same resting and working hours, slept in the same barracks, etc., were, therefore, exposed to absolutely the same chances of infection. From the next morning after inoculation, the following difference, however, showed itself in the plague incidences in the inoculated and the non-inoculated. The epidemic lasted for eight days longer, and of the 173 uninoculated 12 got the disease and 6 died; while of the 148 inoculated 2 were attacked, and both recovered. This was the result. I considered it as distinctly encouraging, but did not accept it as being already a final proof of the unfailing efficacy of the inoculation.

"In the course of the next months, not less than 8,200 persons presented themselves for inoculation in Bombay. A large number of these persons belonged to the better classes, and their having *escaped the infection* would have had perhaps little bearing on the question of the efficacy or otherwise of inoculation, if it had not happened that, of the 8,200, eighteen, all natives of India, actually contracted the plague during the subsequent months of the epidemic, and ran through a course of the disease. Sixteen, however, of the eighteen recovered. The two who died had developed the disease within 24 hours of inoculation, and most probably had the plague on them at the time they came to be inoculated.

"The above information was supplied to us by different Medical officers of Bombay, who were watching our operations and their results with a keen, though, I am sure, a perfectly friendly criticism. But in a big town like Bombay there remains the possibility of a certain number of incidences having escaped the vigilance even of critics. The first small mufassal station where the inoculations were applied and where we obtained information as to their effect was Mora, in the Kolaba district, half-an-hour's journey across the harbour of Bombay. Mora had a population of about 1,000 souls. The plague broke out there in due course, and 429 inhabitants asked to have the preventive inoculation, the rest remaining uninoculated. Of the 429 persons, up to the end of the epidemic, 7 got attacked with plague, and all of them recovered. We learn now that, during the same time under observation, there were not less than 26 attacks among the uninoculated half of the population, 24 attacks ending fatally.

"The next place of observation was Lower Damaun, one of the two towns in India which, as you know, were most severely affected during the epidemic of last cold season. Not less than 2,197 persons were there inoculated, while 6,033 remained uninoculated. A careful investigation carried out towards the end of the epidemic showed that, between the end of March and the end of May 1897, the uninoculated lost from plague 1,482 of their number. The 2,197 inoculated, when compared week by week with the others, and supposing that they had remained as susceptible to plague as their uninoculated neighbours, should have lost 332 individuals. The actual number of deaths among them was 36, which represents a reduction of 89·2 per cent. of mortality.

"The next place where the inoculations were tested was Lanowli, a couple of hours distant from your city. The plague broke out at Lanowli while the season visitors were still there, and about twenty cases occurred. The disease then subsided; but suddenly, a month or so later, when the season was over, and the population was reduced to below 2,000, it broke out afresh. My assistants and myself arrived there in the last week of July, and, according to an agreement with the local Plague Committee, we took over charge of the two wards of the city most severely affected, including the old and new bazaars and the densely-populated quarters round them.

"We began by taking a census of the inhabitants, and found that there were in all 700 persons living in those wards. Their names, father's names, sexes, ages, castes, places of birth, occupations, &c., were all carefully recorded.

"After that we made daily house-to-house inspection in these wards, and while doing so were performing inoculation on those of the inhabitants who lived in, or close by affected houses, and who volunteered to undergo the operation. In the course of the first week, 323 persons were inoculated, while 377 remained uninoculated. The result of this, at the end of the epidemic, appeared as follows: Among the 323 inoculated,

there were 14 cases and 7 deaths, while among the 377 uninoculated 78 persons contracted the disease and 58 died. Supposing that the inoculated had remained as susceptible and as little resistant to the disease as were their uninoculated relatives and neighbours, they should have produced 67 cases and 49 deaths in proportion to their numerical strength. This number of 49 deaths, appeared reduced by 42, which represents a difference of 85·7 per cent. of mortality.

"After Lanowli the inoculation was tested at Kirkee, your closest neighbour, where, as you know, among other people, the followers of the Artillery stationed there contracted the disease. There were 1,530 men, women and children living in about 40 barracks on the Kirkee Maidan which probably all of you know. There cannot be any doubt that the Military authorities are infinitely better organised for carrying out thoroughly any executive work, any plan of general measures, than a civil body can ever be. There cannot be either any doubt that these authorities, under the immediate supervision of General Duncan, who does us the honour of presiding at the present meeting, did every possible thing,—I mean absolutely everything which was practicable at the time, for arresting or minimising the effect of the epidemic on their own servants.

"In spite of all, among those who had not the additional protection of inoculation, one person out of every six got attacked, and one out of every nine died. It is more than possible that, if the Military authorities had not carried out the programme of preventive measures, even larger numbers than the above would have been attacked and died. In any case, with regard to the specific measure of inoculation, we are in a condition to say with a very great degree of accuracy what would have happened to the inoculated if they had not been inoculated. Out of the total of 1,530 individuals, 671 availed themselves of inoculation, while 859, belonging to the same families, living under the same roofs, having the same food, drink, &c., and subject to the same general preventive measures adopted by the Military, remained uninoculated. From the time of inoculation up to the end of the epidemic, the 859 uninoculated had 143 cases with 98 deaths. Seeing the absolute similarity of the conditions, the 671 inoculated should have had proportionately 112 cases with 77 deaths, if they had remained as susceptible to the disease as were their uninoculated brothers, sisters, parents, wives, husbands, children. Instead of that they had 32 cases with 17 deaths. The number of 77 deaths was, therefore, reduced for them by 60, that is by 77·9 per cent.

"Mr. Chairman and gentlemen, this is the review of the observations collected up to now in the midst of the actual epidemic. They appear, permit me to state, in perfect conformity with the expectations which we had formed and based upon precise Laboratory investigation. The object of the present meeting was to bring to your knowledge the above facts, and to effect through you as wide a dissemination of this knowledge as possible. I shall be happy now to supplement the above with further details which you may ask for."

3. Major-General Duncan then addressed the meeting, and asked whether any one desired to have some additional information.

The following questions were put by the gentlemen present, and answered by Mons. Haffkine:—

QUESTION BY DR. CABANIS DEMELLO.

"*Q.*—Suppose a person was inoculated once, how long would the effect last, and supposing he was inoculated twice, how long would it last then?"

"*A.*—In all the places mentioned in my review, the majority of the persons were inoculated,—either once or twice,—in the beginning of the epidemic, and were *not* re-inoculated later on, during the whole time the epidemic lasted. Two, or even three, injections are now given chiefly with the object of avoiding the discomfort caused by a simultaneous injection of the full dose. In such cases only *half* or even *one-third* of the dose is given at a time. It is evident, therefore, that one inoculation appears to be sufficient for carrying a person at least over one year's epidemic season.

For the present we are still unable to say for certain whether the same inoculation will suffice for a second or a third epidemic. It is only when it happens that one and the same place has the misfortune to suffer from two or three consecutive epidemics, and the people inoculated on the first occasion remain in that place during the subsequent outbreaks, that it becomes possible to ascertain whether their protection lasts for more than one season.

"Up to now Poona is the only place in India which had the melancholy fate of being attacked by a severe second outbreak. The information which I have obtained from the General Plague Hospital here and from the Sassoon General Hospital, as to the admissions for plague of any persons inoculated during the last cold season, seems to be most remarkably favourable. In an isolated instance, His Highness Aga Khan informed me that his 600 servants were inoculated during the last cold season, and that up to now not one of them was attacked with plague, though they were here all throughout this second outbreak, were going about in the bazaars, mixed freely with the rest of the people, and some of their own relatives were attacked with and succumbed to the plague. These facts are highly encouraging, but would not justify us in making final conclusions. The total duration of the effect of the antiplague inoculation will probably not be known for several years to come."

QUESTION BY DR. KOLHAPOREWALLA.

"Q.—What is the highest degree of fever observed in inoculated persons up to the present time? And how long does the fever last?"

"A.—The highest temperature observed was 105° F. This has happened in a very small number of persons, out of about 20,000 inoculated up to now. The temperature, in those persons, came down soon, and the inoculation and its fever did not cause them the slightest degree of harm. One of these persons was Dr. King, on medical duty in the Byculla House of Correction. Though he was ailing during the whole week *preceding* the inoculation, and though possibly this bad state of health accounted for the amount of fever he had, the inoculation did not aggravate his conditions in the least, and he was fully about his work three days after the injection.

Another person who got a similarly high temperature was Surgeon-Major Bannerman, who was and is still working in my Laboratory in Bombay. We had full opportunity of observing him during and after the reactionary period. The incident did not produce the smallest impression on his most excellent state of health.

I had myself a simultaneous injection of *four* doses of the strongest material we ever had . . . but, pray, do not remark upon that that, indeed, I appear still as if I was somewhat under the effect of that treatment . . . Generally the fever disappears completely within 24 hours after inoculation: in exceptional cases, however, it continues, in a low form, for 2 or 3 days. As a rule, the higher the degree of fever produced, the sooner it disappears."

QUESTION BY DR. S. H. MODY.

"Q.—Is it a fact that persons who are predisposed to certain diseases get the same degree of excitement after inoculation?"

"A.—Originally we were on our guard against that; and we adopted once for all the following proceeding: every time a person who wishes to be inoculated informs us that he is suffering from any chronic or recurring complaint we allow him to get first a very mild, tentative dose. If that dose does not cause him any inconvenience, we give him either the rest in one injection, or, if there is reason to be cautious, we continue to divide the rest into fractions. We have never had reason to ascribe the least ill-effect to the operation; and very soon we adopted the rule to refuse inoculation only to persons who have *fever* on them at the time when they present themselves for inoculation, or who had fever a day or two before. This exception is made for two reasons:

(1) A person having fever on him may be in the beginning stage of plague. Although, in our experience, we had no indication that inoculation aggravates the

condition of such a person, it is not likely, however, to effect any good either. Under these conditions, and seeing that such cases are likely to create confusion in the public mind as to the effect of inoculation, it is important to avoid them as carefully as possible. (2) If a person is suffering from any other fever, for instance, from an attack of malaria, the addition of the inoculation fever, coinciding with his own attack, may make him more than necessarily uncomfortable, and create analogous confusion as to the amount of reaction caused by inoculation.

In considering this question in general, one has to take into account the following circumstances:—As I mentioned already, we inoculated in Bombay alone during the last cold season close upon 8,200 persons. The age of these persons varied between three months and 83 years, no exception being made for persons of whatever constitutional disorders. Under these circumstances one may fairly admit that the inoculated, as regards their liability to general sickness, represented very closely the same average as the majority of the Bombay inhabitants. Now, under the best conditions, in an ordinary, healthy year, without any abnormal influences of weather or other factors predisposing to sickness, the mortality in Bombay is over 30 per mille per annum. An average number of 8,200 people in Bombay should, therefore, have, in a year, not fewer than 246 deaths. For every person who actually dies in the course of a year there are probably not less than 3 who start some ailment, or contract for the first time some disease not actually fatal. So that, in a healthy year, in Bombay, 8,200 persons should have some 984 persons passing from a good state of health into a bad, or actually struck by death, without reference to any inoculation whatever.

The thousands of inoculated who do not happen to belong to this unfortunate group of 984, and who feel absolutely as fit after the inoculation as they felt before, do not say a word about it, and their existence does not attract attention. This is as it should be; but at the same time, when one comes across a person who says he feels unwell in this year, consecutive to the time of his inoculation against plague, it does not follow that his case is due to the inoculation.

In order to be absolutely sure in our reasoning, let us admit that, of the above number, 365 persons only, or as many as there are days in a year, instead of the 984 calculated above, should in the ordinary course of events, pass from a good state of health into a bad one. This alone will show that we may have at least one person every day in the year who will begin to feel unwell from the day of inoculation, without this fact being due in the least to the fact of inoculation."

QUESTION BY MR. GUNGARAM BHAO MHUSKE.

"Q.—Can you tell us why the disease attacks more particularly natives than foreigners in spite of it being proved that it is not a filth disease? Is this due, as some assert, to the natives walking barefoot?"

"A.—No, not necessarily so. In spite of all that might have appeared to an inattentive observer, at no moment up to now was there any reason to believe that the difference you mention was due in any great extent to the difference in the mode of life of the two classes of population. Both physical and biological factors make constantly such distinctions between even closely allied races, and this fact can be observed in human communities, in animals, and in plants. I have alluded already to the fact that the American vine bush is most strangely immune against the phylloxera. When you plant side by side, in a European vineyard, an American specimen and a French one, the latter will be attacked by the insect, and the former left alone. The observations on animals are perfectly demonstrative in this respect. If you bring into your farm a French and an Algerian sheep, and both happen to be equally exposed to the danger of infection with anthrax, or are artificially subjected to it, the French sheep contracts an invariably fatal disease, while the Algerian is not inconvenienced at all. A similar difference is observed between the grey field mouse and the white mouse with regard to glanders: the latter succumbs, while the former invariably resists. Turning to the human community, there is no lack of similar distinctions, which are some time in favour of one race, some time of another.

The custom in Bengal is to expose newly born babies, or babies with shaven heads, for 5 or 6 hours daily to the direct rays of the sun. You know what would

happen if we tried the experiment in the same manner with our own babies. The climate of India in general, which is so favourable to the growth and multiplication of the Indian races, kills off European families in the third or fourth generation. Passing to the effect of microbial infection in human beings, we find that typhoid fever, which causes such ravages in the barracks of European soldiers, is quite exceptional among the Native races, at least some of them; so much so that it is possible for many physicians in India not to believe that Indians ever suffer from that disease. The above instances of difference are in favour of the Indian races. With regard to the plague, the Native community apparently has the misfortune of being, physiologically, more susceptible to the disease than the Europeans. This conforms with the fact that the Europeans not only show a smaller percentage of attacks, but, when, in spite of the precautions, they are actually affected, the disease runs in them a strikingly milder course than in the Natives of India. Since we suffer so much more than you in other respects, you should forgive us the present, really invidious, distinction with regard to the plague."

No other questions having been asked, Major-General Duncan made some concluding remarks, in the course of which he said that he, as probably every one present at the meeting, was greatly impressed by the considerations and facts of Mons. Haffkine's speech, which he listened to with the keenest interest. At the same time, he said, he was convinced that the general measures did a large amount of good, and he was sure that, if the measures had not been taken, the mortality would have been much higher than it actually was,—it would probably have been simply appalling.

II.—Experiment on the effect of Protective Inoculation in the Epidemic of Plague at Undhera, Taluka Baroda, February and March 1898.

The inoculations were performed in Undhera on the 12th February 1898, with the object of demonstrating to the Baroda authorities the protective effect of the measure. On the above date the population of the village, exclusive of the adjacent suburb, consisted of 950 souls, of whom 47 had been inoculated previously, between the 26th January and the 2nd February 1898, by Dr. C. D. Divanjee, of the Baroda Medical establishment, and were not inoculated again. All the others, for the purpose of inoculation, were collected in the streets and grouped according to the wards where they resided, family by family. In each household, as nearly as was possible, half the number of the male members, half the number of the females, and half the number of the children were inoculated. The total number of persons thus inoculated was 466, giving, with the 47 inoculated previously, a total of 513, while 437 remained uninoculated. These operations were carried out by Mons. W. M. Haffkine and Surgeon-Major Bannerman, Deputy Sanitary Commissioner of Madras, in the presence of M. Rao Bahadur V. M. Samarth, Suba of Baroda Prant, Rao Bahadur Nilkantrao K. Ambegavekar, District Plague Officer, and Dr. K. V. Dhurandhar, L.M. & S., Sanitary Commissioner and Secretary, Plague arrangements, Baroda State, and with the assistance of the following physicians of the Baroda Medical establishment:—Dr. Dhanjibhai H. Mehta, L.M. & S., Dr. Chaganprasad D. Divanjee, L.M. & S., District Plague Duty Medical Officer, Sevaklal M. Dave, L.M. & S., Gopinath C. Chitnis, L.M. & S., Gundadhar B. Parnjpe, L.M. & S., and Surajlal M. Dolatjada, L.M. & S.

The investigation as to the result of the measure was made on the 4th April 1898 by Surgeon-Major-General R. Harvey, Acting Director-General, Indian Medical Service, Mons. W. M. Haffkine, Surgeon-Major Bannerman, M. Rao Bahadur V. M. Samarth, Rao Bahadur Nilkantrao K. Ambegavkar, Rao Saheb Ramlal H. Desai, B.A., LL.B., Vahivatdar of Baroda Taluka, and Dr. Chaganprasad D. Divanjee, L.M. & S. All the results were compared with and confirmed by the official documents kept during the course of the epidemic.

The following was the result of the investigation. The plague continued in Undhera up to 26th March 1898, *i.e.*, for 42 days after the inoculations, and affected 28 families. The mortality among the inoculated and uninoculated members was as follows:—

A—Among the Uninoculated Members.

(*a*) One child, of 1 year, named Chitiyo, belonging to the house 68, ward 1, died of bronchitis, on the 21st February 1898.

(*b*) Three uninoculated died of plague during the first three days after the 12th February 1898, and were not taken into account as having been attacked before the others were inoculated. These persons were:—Bai Bhagirthi, female, 20, of the house 14, Ward 2; Suri *alias* Chanchi, female, 4 years, of the house 15, Ward 3; and Gurtood Jeeva, male, of the house 67, Ward 1.

(*c*) Lastly, from the 15th February 1898 until the end of the epidemic, 27 more attacks of plague occurred amongst the uninoculated, of which 26 died.

B—Among the inoculated members.

(*a*) There were no deaths from other causes than plague.
(*b*) There were no deaths during the first three days after inoculation.
(*c*) Altogether, up to the end of the epidemic, there were 8 attacks of plague in inoculated, of which 3 were fatal. In one of these three, there was no interval between the inoculation fever and the time when the bubonic fever set in; in the second there was an interval of six days, and in the third of eight days.

Annexed to this report are 28 sheets * giving in detail the composition of each affected family and the occurrences of plague among them. The details are summarised in the following table:—

Ward No.	House No.	Uninoculated members of the family.			Inoculated members of the family.		
		Total uninoculated in the family.	Number of attacks among them.	Number of fatal attacks.	Total inoculated in the same family.	Number of attacks among them.	Number of fatal attacks.
1	8	1	1	1	4	..	..
,,	63	2	1	1	3	..	..
,,	67	2	1	1	3	..	..
2	24	1	1	1	1	..	..
3	1	2	1	1	2	..	..
,,	15	3	..	..	2	1	..
,,	20	4	1	1	3	1	..
,,	29	2	1	1	3	..	..
,,	39	3	1	1	4	1	1
,,	42	2	1	..	1	..	..
,,	48	3	1	1	5	..	..
,,	49	5	1	1	1	..	..
4	7	1	1	1	1	1	..
,,	8	1	..	..	2	1	..
,,	10	1	..	..	4	1	..
,,	12	2	1	1	2	..	..
,,	13	1	1	1	2	..	..
,,	18	2	2	2	3	..	..
,,	26	2	2	2	1	..	..
,,	30	3	1	1	1	..	..
,,	31	2	..	..	4	1	1
,,	34	3	1	1	2	..	..
,,	35	1	1	1	1	1	1
,,	53	2	1	1	2	..	..
,,	80	4	1	1	4	..	..
,,	84	5	2	2	5	..	..
,,	89	1	1	1	2	..	..
,,	90	3	1	1	3	..	..
	Total ..	64	27	26	71	8	3

The 64 uninoculated members of the affected families had therefore 27 attacks, of which 26 were fatal. The 71 inoculated had 8 attacks, of which 3 were fatal.

If the inoculated had suffered to the same extent as their uninoculated relatives, they would have had, proportionately to their number, 29 deaths from plague. The actual number appeared reduced by 26, which is a reduction of 89·6 per cent. of mortality attributable to inoculation.

* Not printed.

The result as here obtained tallies with all the observations made up to now upon the protective effect of the plague prophylactic, the reduction of mortality effected by it in a plague-stricken population averaging, with a remarkable regularity, between 80 and 90 per cent.*

Further details upon the operations carried out in the Baroda territory will be reported later on.

W. M. HAFFKINE.

THE PLAGUE RESEARCH LABORATORY,
BOMBAY, 10*th April* 1898.

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* Analysing the occurrences of plague in the 28 families according to the sexes of the patients, it appears that amongst the uninoculated there were 24 males, of whom 7 were fatally attacked. Amongst the inoculated there were 41 males, of whom 3 were attacked fatally. This represents a reduction of mortality in males by 75 per cent.

Amongst the uninoculated there were 40 females, of whom 19 were fatally attacked. Amongst the inoculated there were 30 females, of whom none was attacked fatally, though proportionately they should have had 14 deaths. This represents a reduction of mortality in females by 100 per cent.

Analysing the occurrences according to the ages, it appears that amongst the uninoculated there were 16 children under 10 who had 5 deaths and 4 people above 50 who had 2 deaths. Amongst the inoculated there were 19 children under 10 who had 1 death and 4 people above 50 who had no death. This represents a reduction of mortality amongst inoculated children by 83·3 per cent., and amongst people above 50 by 100 per cent.

Amongst the uninoculated there were 44 people between the age of 10 and 50 who had 19 deaths, and amongst the inoculated 48 people of the same age who had 2 deaths. This represents a reduction of mortality in middle-aged people by 90·5 per cent.

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42

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LOCAL AND MUNICIPAL.

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MAY.

Preventive Inoculation against Plague

Ordering the publication of certain reports showing the effect of ~~preventive inoculation against plague~~

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

From W. M. HAFFKINE, Esq., C.I.E., to the Secretary to the Government of Madras, Local and Municipal Department, dated Plague Research Laboratory, Bombay, 5th May 1898, No. 162.

I have the honour to forward herewith a report on the results of preventive inoculation against plague carried out in the village Undhera, Taluka Baroda, on the 12th February 1898.

ORDER—No. 485 P., dated 16th May 1898.

The papers printed as an appendix to this order will be published in the Fort St. George and all District Gazettes, and also placed on the Editors' Table. The Translators to Government are requested to furnish the necessary translation of the papers to the Superintendent, Government Press, who will print the required number of copies in English and in the vernaculars and forward them to the Collectors concerned for publication.

(True Extract.)

for *Ag. Secretary to Government.*

To all Collectors.
„ all Presidents of District Boards.
„ all Chairmen of Municipal Councils.
„ the President, Municipal Commission, Madras.
„ the Surgeon-General.
„ the Sanitary Commissioner.
„ the Translators to Government.
„ the Superintendent, Government Press.
Editors' Table.

Gazette

All District Medical and Sanitary Officers
The Political dept.

[Appendix.

Exd. C. M. Thumbuswamy.

APPENDIX.

I— A CONVERSAZIONE on the Preventive Inoculation against Plague, held by Mons. W. M. HAFFKINE in the Cantonment Magistrate's Office, in Poona, on the 3rd January 1898; Major-General J. DUNCAN, Commanding the District, in the chair.

GENERAL DUNCAN having introduced Mons. Haffkine, the latter spoke as follows :—

"GENERAL DUNCAN AND GENTLEMEN,—This meeting was convened to give you an opportunity of obtaining from me such information on the preventive inoculation against plague as you may think interesting to have, and not for me to deliver a comprehensive address on that subject. The remarks which I am going to make will, therefore, serve only as an introduction to our conversation.

"The fact that the cause of the epidemic is a living being helps to understand a large number of details connected with the question. The germs of plague are invisible to the naked eye, and not every one is accustomed to think of, or to make conclusions with regard to the life of the microscopic world. But whether an animal or vegetable be big or small, the fundamental laws regulating their existence and propagation are the same. In a large number of instances one is justified in making complete analogies between what one knows of the higher forms of life and what takes place among lower beings. In this order of ideas, I will resort for my explanations to a few phenomena in Nature, similar to a plague invasion, but being of a kind easier to be watched and understood. As you know, the flora and fauna of Australia are different from those of other countries, and one of these differences was, up to quite lately, that there were no rabbits in the island. These animals were first introduced for the sake of sport, or as pets, by private individuals. The conditions of life appeared favourable to their propagation, and soon they spread to such an extent that they became first a nuisance, and afterwards a real plague to the country, attacking and ruining the plantations. The question has since occupied very many Committees and Legislative Councils. The Government offered a huge reward of many thousands of pounds to any one who would discover a way of ridding them of the rabbits. The island of Australia suffers, therefore, from the invasion of a species of animals, from a kind of infectious disease. The problem is to cure that country by removing or destroying the infection. You perceive how much simpler that problem is when compared with our plague epidemic. The rabbits can be seen, captured, killed by poisons like perchloride of mercury, or other far cheaper ones; they can be hunted, shot. Had the first couples of rabbits been thus destroyed, the disease would have been 'checked' in its inception. All those who hold that, provided you take proper measures, the plague should be stamped out easily, must, first of all, prove this by stamping it out, or, at least, admit the argument that it should be still much easier to solve that Australian question. You know, however, that the pounds offered by the Australian Government remain unclaimed to this day.

"There is another disease which fatally affects the agricultural industry of many countries in the south of Europe. It is produced by a small insect living under ground—the phyloxera, which can be pointed out and seen by the naked eye.

"The insect attacks the roots of the vine, and spreads very gradually and slowly from one bush to the neighbouring ones. You can easily see how and when the disease is introduced into your garden. All the bushes in a vineyard, in the beginning of winter, are cut down to the level of the ground, and covered with earth to protect them against the frost. In the spring they are unearthed, and begin to sprout again. If the bushes are all healthy, they grow uniformly, and their tops present to the eye an even surface of green, rising higher and higher as time goes on. If, however, the roots of a particular bush are affected by the phyloxera, this bush soon remains behind in its development. In this case you observe that, a few weeks later, the other bushes surrounding the affected one begin to take the disease in their turn, and commence to grow more slowly; having, however, caught the infection later, they had time to grow a little taller than the one which first showed the symptoms. The process of slow growth continues to spread, and there appears soon a very

regular depression on the surface of the vineyard, having its deepest point, its centre, in the bush which first became infected. This depression in a garden is, at least, as typical for the phyloxera infection as the bubo, and fever, and a coated tongue are for the plague. You do not require a house-to-house visitation to detect your first focus of infection. You see at a glance at your vineyard where the infection is and how far it has gone. Apparently you should be able to deal with it easily. You have not to contend with the religious, or caste, or other objections of your patient bushes. You do not require quarantine or railway inspection to prevent them from running away and spreading the disease elsewhere. This disease is most remarkably localised, and extends only with extreme deliberation. Your patients don't object to your disinfecting them as much as you wish. The insect is exceedingly easily killed. You can pour deadly antiseptics down to the roots, without, however, damaging the root; or you can dig up the bushes and the soil, and roast and burn them all, or treat them otherwise as you please. You know, however, that, once phyloxera has been introduced into a country, there is no method as yet invented to 'stamp it out.' It so happens that there are species of vine naturally immune against the disease, which the insect never attacks. The manœuvre now largely resorted to consists in destroying the garden, planting the roots of other, immune species, and trying to graft upon them those which one wants to grow. The phyloxera remains in the garden, but the bushes cease to undergo its attack.

"The problem of rinderpest in South Africa is an instance of a disease more difficult to deal with than diseases of plants, but still infinitely simpler than the plague. You can induce your cattle somewhat easier to conform with your arrangements, they will stay in your quarantines more patiently, and they generally make fewer objections to anything, and interfere with your plans much less, than when you deal with a free population, which may not always share the ideas of their Medical Officers of Health. The rinderpest in South Africa is, however, not yet 'stamped out' either.

"There are, therefore, both in the animal and vegetable worlds, diseases of which the cause, the morbid organism, can live and propagate outside the patient's body; can grow in the soil, in water, be carried by clothing, bedding, instruments, by any living or dead object. If it happens that the natural conditions of a country are favourable to the life and propagation of such an infectious organism, and as long as these conditions continue unchanged, and we are unable to artificially alter them, there is no instance known of such morbid organisms having been 'stamped out,' as the expression in our daily reports is, by the will of men. If it was otherwise, there would be no typhoid fever now in the European barracks in India; or the microbe of cholera, let us say, would have been 'exterminated' from the plains of Bengal, or the microbe of malaria from the rest of the country.

"Every time, therefore, that you may think of these matters, recall to your memory that rabbit question of Australia, or the phyloxera problem in the vine growing countries of Europe. I hope you will then cease to wonder at the fact that, when the Government and Municipalities appoint Committees to deal with, and to 'stamp out' the plague, the disease does not seem to always obey their measures.

"This state of affairs does not mean that, while the evil is still small, and you get in time aware of it, good cannot be effected by promptly attempting to extinguish it. If the plague penetrates into a village or small town, or if an actually first case of the disease is discovered in a big population, it should be almost as easy to arrest its development, at least locally and at least temporarily, as to put out a burning match. But it is absolutely certain that the tumbler of water, which looks so marvellously effective for the match, is useless when you have to face a big jungle in conflagration; and a big Indian town, densely populated, with cases of plague beginning to crop up in every quarter of it, is such a jungle in a state of occult conflagration.

"I was in Bombay soon after the first cases of plague were brought to the public notice, at the end of September 1896. There were then 20 to 30 cases of plague occurring daily. The real beginning of the disease could afterwards be traced to the month of July, so that it had been spreading for some three months unnoticed. I was taken to the ward of the town first affected, in Mandvi, a small place with a population of about a hundred thousand. When they showed me some of the

buildings, in which there were from 700 to 1,000 people living, and told me that cases were occurring daily all over that ward of Mandvi in houses like that, there was no need for me to interfere with the measures which the municipality had adopted. No public, or Government would have ever forgiven that municipality if it had not adopted the measures. But the future of the campaign was perfectly clear to me. I approved of all that was being done, the burning of sulphur in dishes in the open streets included.

"I mean to state by this that it was *not* in the power of the Executive to arrest the growth of the plague in Bombay in October 1896!

"There are, however, many phenomena in Nature which it is not in our power to arrest; but we can run away from them, or protect ourselves against them individually. On another occasion I quoted the analogy of our not being able to stop the heat in the plains of India; but those who can afford can easily escape it by going away to the hills, or by providing themselves with good punkhas, if they cannot get away. Or if, on the contrary, it is the monsoon that annoys you: it is true, you cannot arrest it, but a good Macintosh or an umbrella may protect you efficiently. Or, if you cannot dry up the rivers and marshy lands in your vicinity to deprive the mosquitoes of their breeding ground, you can protect your individual person by a mosquito net.

"The marvellous success of vaccination against small-pox, and the history of the bacteriological efforts of the last 15 years made the plan for effecting such a protection against plague obvious; and, early after the outbreak of plague in Bombay, I put myself to the task of working out a preventive inoculation to check the liability of individuals to that awful disease.

2. "The details of the system of preventive inoculation against the plague have been published in the Medical papers, and are accessible to any specialist. In this meeting I shall mention only the facts which, I believe, interest you most, namely, those which refer to the question as to the actual efficacy or otherwise of our preventive inoculations.

"The first demonstration of the working of this system can be made in the Laboratory, and this has been already repeated and confirmed by many observers. You are aware that rats are exceedingly susceptible to plague. One takes twenty rats from a ship that has newly arrived in harbour, say from Europe, where there is no plague. Ten of them are inoculated with the prophylactic against plague, and the others are left as they are. Put back all the twenty rats together, and introduce among them a rat that has the plague, or infect them all artificially with virulent plague microbes. In the course of time you will find that eight, or nine, or the whole of the unprotected will die of the disease; while perhaps only a single rat that had been inoculated with the protective lymph, or even not a single one, will contract the disease.

"These observations made by us in December 1896 have afforded the first ground for trying our protective method on human beings.

"During the month of January 1897 a large number of leading European and Native gentlemen offered themselves to be inoculated, to prove the harmlessness of this method, and by the end of that month this question was solved, I believe, to the satisfaction of every one who took the trouble of attentively examining it.

"In the last week of January the plague broke out in the Byculla House of Correction in Bombay, and affected nine prisoners, of which six eventually died.

"A couple of dozen of Professors and Students of the Grant Medical College offered to go to the jail to be inoculated in front of the prisoners, in order to encourage them by an example to try the protective effect of inoculation.

"When the measure was actually offered to the inmates, a little less than one half of them at once came forward to be inoculated.

"On the day of inoculation, the 30th January 1897, before the inoculation was applied, there occurred in the jail six more cases, of which three proved fatal. After the inoculation we discovered that one of the inoculated men had already a bubo, and two others developed buboes in the same evening. These three cases, inoculated, attacked on the day of inoculation, also proved fatal.

"The inoculated and the uninoculated remained under absolutely identical conditions of life; had the same food, drink, the same resting and working hours, slept in the same barracks, etc., were, therefore, exposed to absolutely the same chances of infection. From the next morning after inoculation, the following difference, however, showed itself in the plague incidences in the inoculated and the non-inoculated. The epidemic lasted for eight days longer, and of the 173 uninoculated 12 got the disease and 6 died; while of the 148 inoculated 2 were attacked, and both recovered. This was the result. I considered it as distinctly encouraging, but did not accept it as being already a final proof of the unfailing efficacy of the inoculation.

"In the course of the next months, not less than 8,200 persons presented themselves for inoculation in Bombay. A large number of these persons belonged to the better classes, and their having *escaped the infection* would have had perhaps little bearing on the question of the efficacy or otherwise of inoculation, if it had not happened that, of the 8,200, eighteen, all natives of India, actually contracted the plague during the subsequent months of the epidemic, and ran through a course of the disease. Sixteen, however, of the eighteen recovered. The two who died had developed disease within 24 hours of inoculation, and most probably had the plague on them at the time they came to be inoculated.

"The above information was supplied to us by different Medical officers of Bombay, who were watching our operations and their results with a keen, though, I am sure, a perfectly friendly criticism. But in a big town like Bombay there remains the possibility of a certain number of incidences having escaped the vigilance even of critics. The first small mufassal station where the inoculations were applied and where we obtained information as to their effect was Mora, in the Kolaba district, half-an-hour's journey across the harbour of Bombay. Mora had a population of about 1,000 souls. The plague broke out there in due course, and 429 inhabitants asked to have the preventive inoculation, the rest remaining uninoculated. Of the 429 persons, up to the end of the epidemic, 7 got attacked with plague, and all of them recovered. We learn now that, during the same time under observation, there were not less than 26 attacks among the uninoculated half of the population, 24 attacks ending fatally.

"The next place of observation was Lower Damaun, one of the two towns in India which, as you know, were most severely affected during the epidemic of last cold season. Not less than 2,197 persons were there inoculated, while 6,033 remained uninoculated. A careful investigation carried out towards the end of the epidemic showed that, between the end of March and the end of May 1897, the uninoculated lost from plague 1,482 of their number. The 2,197 inoculated, when compared week by week with the others, and supposing that they had remained as susceptible to plague as their uninoculated neighbours, should have lost 332 individuals. The actual number of deaths among them was 36, which represents a reduction of 89·2 per cent. of mortality.

"The next place where the inoculations were tested was Lanowlie, a couple of hours distant from your city. The plague broke out at Lanowlie while the season visitors were still there, and about twenty cases occurred. The disease then subsided; but suddenly, a month or so later, when the season was over, and the population was reduced to below 2,000, it broke out afresh. My assistants and myself arrived there in the last week of July, and, according to an agreement with the local Plague Committee, we took over charge of the two wards of the city most severely affected, including the old and new bazaars and the densely-populated quarters round them.

"We began by taking a census of the inhabitants, and found that there were in all 700 persons living in those wards. Their names, father's names, sexes, ages, castes, places of birth, occupations, &c., were all carefully recorded.

"After that we made daily house-to-house inspection in these wards, and while doing so were performing inoculation on those of the inhabitants who lived in, or close by affected houses, and who volunteered to undergo the operation. In the course of the first week, 323 persons were inoculated, while 377 remained uninoculated. The result of this, at the end of the epidemic, appeared as follows: Among the 323 inoculated,

there were 14 cases and 7 deaths, while among the 377 uninoculated 78 persons contracted the disease and 58 died. Supposing that the inoculated had remained as susceptible and as little resistant to the disease as were their uninoculated relatives and neighbours, they should have produced 67 cases and 49 deaths in proportion to their numerical strength. This number of 49 deaths, appeared reduced by 42, which represents a difference of 85·7 per cent. of mortality.

"After Lanowli the inoculations was tested at Kirkee, your closest neighbour, where, as you know, among other people, the followers of the Artillery stationed there contracted the disease. There were 1,530 men, women and children living in about 40 barracks on the Kirkee Maidan which probably all of you know. There cannot be any doubt that the Military authorities are infinitely better organised for carrying out thoroughly any executive work, any plan of general measures, than a civil body can ever be. There cannot be either any doubt that these authorities, under the immediate supervision of General Duncan, who does us the honour of presiding at the present meeting, did every possible thing,—I mean absolutely everything which was practicable at the time, for arresting or minimising the effect of the epidemic on their own servants.

"In spite of all, among those who had not the additional protection of inoculation, one person out of every six got attacked, and one out of every nine died. It is more than possible that, if the Military authorities had not carried out the programme of preventive measures, even larger numbers than the above would have been attacked and died. In any case, with regard to the specific measure of inoculation, we are in a condition to say with a very great degree of accuracy what would have happened to the inoculated if they had not been inoculated. Out of the total of 1,530 individuals, 671 availed themselves of inoculation, while 859, belonging to the same families, living under the same roofs, having the same food, drink, &c., and subject to the same general preventive measures adopted by the Military, remained uninoculated. From the time of inoculation up to the end of the epidemic, the 859 uninoculated had 143 cases with 98 deaths. Seeing the absolute similarity of the conditions, the 671 inoculated should have had proportionately 112 cases with 77 deaths, if they had remained as susceptible to the disease as were their uninoculated brothers, sisters, parents, wives, husbands, children. Instead of that they had 32 cases with 17 deaths. The number of 77 deaths was, therefore, reduced for them by 60, that is by 77·9 per cent.

"Mr. Chairman and gentlemen, this is the review of the observations collected up to now in the midst of the actual epidemic. They appear, permit me to state, in perfect conformity with the expectations which we had formed and based upon precise Laboratory investigation. The object of the present meeting was to bring to your knowledge the above facts, and to effect through you as wide a dissemination of this knowledge as possible. I shall be happy now to supplement the above with further details which you may ask for."

3. Major-General Duncan then addressed the meeting, and asked whether any one desired to have some additional information.

The following questions were put by the gentlemen present, and answered by Monsieur Haffkine:—

QUESTION BY DR. CABANIS DEMELLO.

"*Q.*—Suppose a person was inoculated once, how long would the effect last, and supposing he was inoculated twice, how long would it last then?"

"*A.*—In all the places mentioned in my review, the majority of the persons were inoculated,—either once or twice,—in the beginning of the epidemic, and were *not* re-inoculated later on, during the whole time the epidemic lasted. Two, or even three, injections are now given chiefly with the object of avoiding the discomfort caused by a simultaneous injection of the full dose. In such cases only *half* or even *one-third* of the dose is given at a time. It is evident, therefore, that one inoculation appears to be sufficient for carrying a person at least over one year's epidemic season.

For the present we are still unable to say for certain whether the same inoculation will suffice for a second or a third epidemic. It is only when it happens that one and the same place has the misfortune to suffer from two or three consecutive epidemics, and the people inoculated on the first occasion remain in that place during the subsequent outbreaks, that it becomes possible to ascertain whether their protection lasts for more than one season.

"Up to now Poona is the only place in India which had the melancholy fate of being attacked by a severe second outbreak. The information which I have obtained from the General Plague Hospital here and from the Sassoon General Hospital, as to the admissions for plague of any persons inoculated during the last cold season, seems to be most remarkably favourable. In an isolated instance, His Highness Aga Khan informed me that his 600 servants were inoculated during the last cold season, and that up to now not one of them was attacked with plague, though they were here all throughout this second outbreak, were going about in the bazaars, mixed freely with the rest of the people, and some of their own relatives were attacked with and succumbed to the plague. These facts are highly encouraging, but would not justify us in making final conclusions. The total duration of the effect of the antiplague inoculation will probably not be known for several years to come."

QUESTION BY DR. KOLHAPOREWALLA.

"Q.—What is the highest degree of fever observed in inoculated persons up to the present time? And how long does the fever last?"

"A.—The highest temperature observed was 105° F. This has happened in a very small number of persons, out of about 20,000 inoculated up to now. The temperature, in those persons, came down soon, and the inoculation and its fever did not cause them the slightest degree of harm. One of these persons was Dr. King, on medical duty in the Byculla House of Correction. Though he was ailing during the whole week *preceding* the inoculation, and though possibly this bad state of health accounted for the amount of fever he had, the inoculation did not aggravate his conditions in the least, and he was fully about his work three days after the injection.

Another person who got a similarly high temperature was Surgeon-Major Bannerman, who was and is still working in my Laboratory in Bombay. We had full opportunity of observing him during and after the reactionary period. The incident did not produce the smallest impression on his most excellent state of health.

I had myself a simultaneous injection of *four* doses of the strongest material we ever had . . . but, pray, do not remark upon that that, indeed, I appear still as if I was somewhat under the effect of that treatment . . . Generally the fever disappears completely within 24 hours after inoculation: in exceptional cases, however, it continues, in a low form, for 2 or 3 days. As a rule, the higher the degree of fever produced, the sooner it disappears."

QUESTION BY DR. S. H. MODY.

"Q.—Is it a fact that persons who are predisposed to certain diseases get the same degree of excitement after inoculation?"

"A.—Originally we were on our guard against that; and we adopted once for all the following proceeding: every time a person who wishes to be inoculated informs us that he is suffering from any chronic or recurring complaint we allow him to get first a very mild, tentative dose. If that dose does not cause him any inconvenience, we give him either the rest in one injection, or, if there is reason to be cautious, we continue to divide the rest into fractions. We have never had reason to ascribe the least ill-effect to the operation; and very soon we adopted the rule to refuse inoculation only to persons who have *fever* on them at the time when they present themselves for inoculation, or who had fever a day or two before. This exception is made for two reasons:

(1) A person having fever on him may be in the beginning stage of plague. Although, in our experience, we had no indication that inoculation aggravates the condition of such a person, it is not likely, however, to effect any good either. Under these conditions, and seeing that such cases are likely to create confusion in the public mind as to the effect of inoculation, it is important to avoid them as carefully as possible. (2) If a person is suffering from any other fever, for instance, from an attack of malaria, the addition of the inoculation fever, coinciding with his own attack, may make him more than necessarily uncomfortable, and create analogous confusion as to the amount of reaction caused by inoculation.

In considering this question in general, one has to take into account the following circumstances:—As I mentioned already, we inoculated in Bombay alone during the last cold season close upon 8,200 persons. The age of these persons varied between three months and 83 years, no exception being made for persons of whatever constitutional disorders. Under these circumstances one may fairly admit that the inoculated, as regards their liability to general sickness, represented very closely the same average as the majority of the Bombay inhabitants. Now, under the best conditions, in an ordinary, healthy year, without any abnormal influences of weather or other factors predisposing to sickness, the mortality in Bombay is over 30 per mille per annum. An average number of 8,200 people in Bombay should, therefore, have, in a year, not fewer than 246 deaths. For every person who actually dies in the course of a year there are probably not less than 3 who start some ailment, or contract for the first time some disease not actually fatal. So that, in a healthy year, in Bombay, 8,200 persons should have some 984 persons passing from a good state of health into a bad, or actually struck by death, without reference to any inoculation whatever.

The thousands of inoculated who do not happen to belong to this unfortunate group of 984, and who feel absolutely as fit after the inoculation as they felt before, do not say a word about it, and their existence does not attract attention. This is as it should be; but at the same time, when one comes across a person who says he feels unwell in this year, consecutive to the time of his inoculation against plague, it does not follow that his case is due to the inoculation.

In order to be absolutely sure in our reasoning, let us admit that, of the above number, 365 persons only, or as many as there are days in a year, instead of the 984 calculated above, should in the ordinary course of events, pass from a good state of health into a bad one. This alone will show that we may have at least one person every day in the year who will begin to feel unwell from the day of inoculation, without this fact being due in the least to the fact of inoculation."

QUESTION BY MR. GUNGARAM BHAO MHUSKE.

"Q.—Can you tell us why the disease attacks more particularly natives than foreigners in spite of it being proved that it is not a filth disease? Is this due, as some assert, to the natives walking barefoot?"

"A.—No, not necessarily so. In spite of all that might have appeared to an inattentive observer, at no moment up to now was there any reason to believe that the difference you mention was due in any great extent to the difference in the mode of life of the two classes of population. Both, physical and biological factors, make constantly such distinctions between even closely allied races, and this fact can be observed in human communities, in animals, and in plants. I have alluded already to the fact that the American vine bush is most strangely immune against the phylloxera. When you plant side by side, in a European vineyard, an American specimen and a French one, the latter will be attacked by the insect, and the former left alone. The observations on animals are perfectly demonstrative in this respect. If you bring into your farm a French and an Algerian sheep, and both happen to be equally exposed to the danger of infection with anthrax, or are artificially subjected to it, the French sheep contracts an invariably fatal disease, while the Algerian is not inconvenienced at all. A similar difference is observed between the grey field mouse and the white mouse, with regard to glanders: the latter succumbs, while the former invariably resists. Turning to the human community, there is no lack of similar distinctions, which are some time in favour of one race, some time of another.

The custom in Bengal is to expose newly born babies, or babies with shaven heads, for 5 or 6 hours daily to the direct rays of the sun. You know what would

happen if we tried the experiment in the same manner with our own babies. The climate of India in general, which is so favourable to the growth and multiplication of the Indian races, kills off European families in the third or fourth generation. Passing to the effect of microbial infection in human beings, we find that typhoid fever, which causes such ravages in the barracks of European soldiers, is quite exceptional among the Native races, at least some of them; so much so that it is possible for many physicians in India not to believe that Indians ever suffer from that disease. The above instances of difference are in favour of the Indian races. With regard to the plague, the Native community apparently has the misfortune of being, physiologically, more susceptible to the disease than the Europeans. This conforms with the fact that the Europeans not only show a smaller percentage of attacks, but, when, in spite of the precautions, they are actually affected, the disease runs in them a strikingly milder course than in the Natives of India. Since we suffer so much more than you in other respects, you should forgive us the present, really invidious, distinction with regard to the plague."

No other questions having been asked, Major-General Duncan made some concluding remarks, in the course of which he said that he, as probably every one present at the meeting, was greatly impressed by the considerations and facts of Mons. Haffkine's speech, which he listened to with the keenest interest. At the same time, he said, he was convinced that the general measures did a large amount of good, and he was sure that, if the measures had not been taken, the mortality would have been much higher than it actually was,—it would probably have been simply appalling.

II.—Experiment on the effect of Protective Inoculation in the Epidemic of Plague at Undhera, Taluka Baroda, February and March 1898.

The inoculations were performed in Undhera on the 12th February 1898, with the object of demonstrating to the Baroda authorities the protective effect of the measure. On the above date the population of the village, exclusive of the adjacent suburb, consisted of 950 souls, of whom 47 had been inoculated previously, between the 26th January and the 2nd February 1898, by Dr. C. D. Divanjee, of the Baroda Medical establishment, and were not inoculated again. All the others, for the purpose of inoculation, were collected in the streets and grouped according to the wards where they resided, family by family. In each household, as nearly as was possible, half the number of the male members, half the number of the females, and half the number of the children were inoculated. The total number of persons thus inoculated was 466, giving, with the 47 inoculated previously, a total of 513, while 437 remained uninoculated. These operations were carried out by Mons. W. M. Haffkine and Surgeon-Major Bannerman, Deputy Sanitary Commissioner of Madras, in the presence of M. Rao Bahadur V. M. Samarth, Suba of Baroda Prant, Rao Bahadur Nilkantrao K. Ambegavekar, District Plague Officer, and Dr. K. V. Dhurandhar, L.M. & S., Sanitary Commissioner and Secretary, Plague arrangements, Baroda State, and with the assistance of the following physicians of the Baroda Medical establishment:—Dr. Dhanjibhai H. Mehta, L.M. & S., Dr. Chaganprasad D. Divanjee, L.M. & S., District Plague Duty Medical Officer, Sevaklal M. Dave, L.M. & S., Gopinath C. Chitnis, L.M. & S., Gundadhar B. Parnjpe, L.M. & S., and Surajlal M. Dolatjada, L.M. & S.

The investigation as to the result of the measure was made on the 4th April 1898 by Surgeon-Major-General R. Harvey, Acting Director-General, Indian Medical Service, Mons. W. M. Haffkine, Surgeon-Major Bannerman, M. Rao Bahadur V. M. Samarth, Rao Bahadur Nilkantrao K. Ambegavkar, Rao Saheb Ramlal H. Desai, B.A., LL.B., Vahivatdar of Baroda Taluka, and Dr. Chaganprasad D. Divanjee, L.M. & S. All the results were compared with and confirmed by the official documents kept during the course of the epidemic.

The following was the result of the investigation. The plague continued in Undhera up to 26th March 1898, *i.e.*, for 42 days after the inoculations, and affected 28 families. The mortality among the inoculated and uninoculated members was as follows:—

A—Among the Uninoculated Members.

(*a*) One child, of 1 year, named Chitiyo, belonging to the house 68, ward 1, died of bronchitis, on the 21st February 1898.

(*b*) Three uninoculated died of plague during the first three days after the 12th February 1898, and were not taken into account as having been attacked before the others were inoculated. These persons were:—Bai Bhagirthi, female, 20, of the house 14, Ward 2; Suri *alias* Chanchi, female, 4 years, of the house 15, Ward 3; and Gurtood Jeeva, male, of the house 67, Ward 1.

(*c*) Lastly, from the 15th February 1898 until the end of the epidemic, 27 more attacks of plague occurred amongst the uninoculated, of which 26 died.

B—Among the inoculated members.

(*a*) There were no deaths from other causes than plague.

(*b*) There were no deaths during the first three days after inoculation.

(*c*) Altogether, up to the end of the epidemic, there were 8 attacks of plague in inoculated, of which 3 were fatal. In one of these 3, there was no interval between the inoculation fever and the time when the bubonic fever set in; in the second there was an interval of six days, and in the third of eight days.

Annexed to this report are 28 sheets giving in detail the composition of each affected family and the occurrences of plague among them. The details are summarised in the following table:—

Ward No.	House No.	Uninoculated members of the family.			Inoculated members of the family.		
		Total uninoculated in the family.	Number of attacks among them.	Number of fatal attacks.	Total inoculated in the same family.	Number of attacks among them.	Number of fatal attacks.
1	8	1	1	1	4	..	..
,,	63	2	1	1	3	..	..
,,	67	2	1	1	3	..	..
2	24	1	1	1	1	..	..
3	1	2	1	1	2	..	..
,,	15	3	..	..	2	1	..
,,	20	4	1	1	3	1	..
,,	29	2	1	1	3	..	..
,,	39	3	1	1	4	1	1
,,	42	2	1	..	1	..	..
,,	48	3	1	1	5	..	..
,,	49	5	1	1	1	..	..
4	7	1	1	1	1	1	..
,,	8	1	..	..	2	1	..
,,	10	1	..	..	4	1	..
,,	12	2	1	1	2	..	..
,,	13	1	1	1	2	..	..
,,	18	2	2	2	3	..	..
,,	26	2	2	2	1	..	..
,,	30	3	1	1	1	..	..
,,	31	2	..	..	4	1	1
,,	34	3	1	1	2	..	..
,,	35	1	1	1	1	1	1
,,	53	2	1	1	2	..	..
,,	80	4	1	1	4	..	..
,,	84	5	2	2	5	..	..
,,	89	1	1	1	2	..	..
,,	90	3	1	1	3	..	..
	Total ..	64	27	26	71	8	3

The 64 uninoculated members of the affected families had therefore 27 attacks, of which 26 were fatal. The 71 inoculated had 8 attacks, of which 3 were fatal.

If the inoculated had suffered to the same extent as their uninoculated relatives, they would have had, proportionately to their number, 29 deaths from plague. The actual number appeared reduced by 26, which is a reduction of 89·6 per cent. of mortality attributable to inoculation.

The result as here obtained tallies with all the observations made up to now upon the protective effect of the plague prophylactic, the reduction of mortality effected by it in a plague-stricken population averaging, with a remarkable regularity, between 80 and 90 per cent.*

Further details upon the operations carried out in the Baroda territory will be reported later on.

Copies of this report are forwarded to—

The Secretary to the Government of India in the Home Department.
The Private Secretary to His Excellency the Governor of Bombay.
The Chief Secretary to the Government of Madras.
The Director-General, Indian Medical Service.
The Surgeon-General with the Government of Bombay.
His Excellency the Diwan of Baroda.

W. M. HAFFKINE.

THE PLAGUE RESEARCH LABORATORY,
BOMBAY, 10*th April* 1898.

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* Analysing the occurrences of plague in the 28 families according to the sexes of the patients, it appears that amongst the uninoculated there were 24 males, of whom 7 were fatally attacked. Amongst the inoculated there were 41 males, of whom 3 were attacked fatally. This represents a reduction of mortality in males by 75 per cent.

Amongst the uninoculated there were 40 females, of whom 19 were fatally attacked. Amongst the inoculated there were 30 females, of whom none was attacked fatally, though proportionately they should have had 14 deaths. This represents a reduction of mortality in females by 100 per cent.

Analysing the occurrences according to the ages, it appears that amongst the uninoculated there were 16 children under 10 who had 5 deaths and 4 people above 50 who had 2 deaths. Amongst the inoculated there were 19 children under 10 who had 1 death and 4 people above 50 who had no death. This represents a reduction of mortality amongst inoculated children by 83·3 per cent., and amongst people above 50 by 100 per cent.

Amongst the uninoculated there were 44 people between the age of 10 and 50 who had 19 deaths, and amongst the inoculated 48 people of the same age who had 2 deaths. This represents a reduction of mortality in middle-aged people by 90·5 per cent.

[L. & M.]
500 -16-3-98.

LOCAL AND MUNICIPAL DEPARTMENT.

Papers to be read in Proceedings:—

38

Again G.O., No. dated 189 ,

Again G.O., No. dated 189 ,

Current No. 697 P of 1898, dated 5-5-98 , from Mons Haffkine.

" " " 189 , " " also office Note No 1107 dt 11-5-98 from the Chief Secy

" " " 189 , "

Hon'ble H. Bliss KCSI
Hon'ble Gokuldas C.S.I.

13/5/98

ORDER. No. 485 P., dt 16-5-98

The papers printed as an appendix to this order will be published in the Govt of Bombay and all District Gazettes, and also placed in the Editor's Table. The Translator to Government are requested to furnish the necessary translation of the papers to the Superintendent, Govt Press, who will print the required number of copies in English and in the vernaculars and forward them to the Collectors concerned for publication.

12 5 98

Appendix

(Here enter

(1) Report of the meeting held in Poona on the 3-1-98 (vide Chief Secy's office note No 1107 dt 11-5-98)

(2) Mons Haffkine's report re inoculation in the Epidemic of Plague at Undhera (vide Cus 697 P) pages 1-3.

note Dr Bonserman's report re Mons Haffkine's inoculation which he promised in para 2 of his letter dy 11-3-98 has not yet been received. He said on the 21-4-98 that his final report had been almost finished.

Lang
12/5/98

K.

M.

To
All Collectors
" Presidents of D&B Pots
" Chairmen of Municipal Councils
The President, M.C. Madras
" Surgeon-General
" Sanitary Commissioner
" Political Dept
" Translators to Govt
" Supt Govt Press
Editors' Table
All Govt Dept
Secretary Bombay Govt
Gazette

Orgd 3/6/98
Orgd 11/6/98

Local & Muni. (1898) Department.

CURRENT No. 697 P

From W. M. Haffkine Esqr. C.I.E.
Bombay

Order

The following telegram letter will be despatched to Brof W. M. Haffkine C.I.E.

Your letter fifth instant No 162. Report Inoculation report not received yet. Please expedite.

H T
11-5-98

Lang.
10/5/98

Copy before despatch & ask in the Public Dept & Library

No. 162

Dated 5-5-1898
Received 9-5-1898
Registered 9-5-1898
Enclosures not received yet
Spare copies.

SUBJECT.

Forwarding a report on the results of preventive inoculation against plague carried out in the village of Undhera Baroda Taluka on the 12th February 1898

Secretary

BACK PAPERS.

G.O.	No.	Department.	Date
"	419	P. mis	2-5-98
	253	"	23-3-98
	258	"	29-1-98
	2621	"	26-11-97
	2448	"	6-11-97
	887	"	13-4-97
	417	"	8-3-97
	387	"	1-3-97

FURTHER PAPERS.

G.O.	No.	Department.	Date.

Lo No 1898 Plague Research Laboratory

No. 162 of 1898 C. 806 97 P.

From W. M. Haffkine Esquire, C.I.E.

To The Chief Secretary to the Government of Madras

Plague Research Laboratory

Bombay 5th May 1898

Sir,

I have the honor to forward herewith a report on the results of preventive inoculation against plague carried out in the Village Vadhera, Taluka Baroda on the 12 February 1898.

I have the honor to be
Sir
Your most obedient servant

W. M. Haffkine

[G 78]
2,000—11-96.

Public DEPARTMENT.

OFFICE NOTE No. 1107

Dated 11th May 1898.

From

THE CHIEF SECRETARY,

To

THE SECRETARY L. & M. DEPARTMENT.

The accompanying pamphlet was in Dr. Haffkine's report. It is a lecture in a popular form & is extremely interesting. H.E. & Mrs. wd. no doubt like to see it & perhaps copies might be obtained for the Bombay Press & for distribution to Mun.s & L. Fr. B.D.S.

H.A. 11.5.98

A CONVERSAZIONE
ON THE
PREVENTIVE INOCULATION AGAINST PLAGUE,
HELD BY
Mons. W. M. HAFFKINE
IN THE CANTONMENT MAGISTRATE'S OFFICE, IN POONA,
ON THE 3rd JANUARY 1898,
Major-General J. DUNCAN, Commanding the District, in the Chair.

General Duncan having introduced Mons. Haffkine, the latter spoke as follows :—

"General Duncan and Gentlemen,—This meeting was convened to give you an opportunity of obtaining from me such information on the preventive inoculation against plague as you may think interesting to have, and not for me to deliver a comprehensive address on that subject. The remarks which I am going to make will, therefore, serve only as an introduction to our conversation.

The fact that the cause of the epidemic is a living being helps to understand a large number of details connected with the question. The germs of plague are invisible to the naked eye, and not every one is accustomed to think of, or to make conclusions with regard to the life of the microscopic world. But whether an animal or vegetable be big or small, the fundamental laws regulating their existence and propagation are the same. In a large number of instances one is justified in making complete analogies between what one knows of the higher forms of life and what takes place among lower beings. In this order of ideas, I will resort for my explanations to a few phenomena in Nature, similar to a plague invasion, but being of a kind easier to be watched and understood. As you know, the flora and fauna of Australia are different from those of other countries, and one of these differences was, up to quite lately, that there were no rabbits in the island. These animals were first introduced for the sake of sport, or as pets, by private individuals. The conditions of life appeared favourable to their propagation, and soon they spread to such an extent that they became first a nuisance, and afterwards a real plague to the country, attacking and ruining the plantations. The question has since occupied very many Committees and Legislative Councils. The Government offered a huge reward of many thousands of pounds to any one who would discover a way of ridding them of the rabbits. The island of Australia suffers, therefore, from the invasion of a species of animals, from a kind of infectious disease. The problem is to cure that country by removing or destroying the infection. You perceive how much simpler that problem is when compared with our plague epidemic. The rabbits can be seen, captured, killed by poisons like perchloride of mercury, or other far cheaper ones ; they can be hunted, shot. Had the first couples of rabbits been thus destroyed, the disease would have been "checked" in its inception. All those who hold that, provided you take proper measures, the plague should be stamped out easily, must, first of all, prove this by stamping it out, or, at least, admit the argument that it should be still much easier to solve that Australian question. You know, however, that the pounds offered by the Australian Government remain unclaimed to this day.

There is another disease which fatally affects the agricultural industry of many countries in the south of Europe. It is produced by a small insect living under ground—the phyloxera, which can be pointed out and seen by the naked eye.

The insect attacks the roots of the vine, and spreads very gradully and slowly from one bush to the neighbouring ones. You can easily see how and when the disease is introduced into your garden. All the bushes in a vineyard, in the beginning of winter, are cut down to the level of the ground, and covered with earth to protect them against the frost. In the spring they are unearthed, and begin to sprout again. If the bushes are all healthy, they grow uniformly, and their tops present to the eye an even surface of green, rising higher and higher as time goes on. If, however, the roots of a particular bush are affected by the phyloxera, this bush soon remains behind in its development. In this case you observe that, a few weeks later, the other bushes surrounding the affected one begin to take the disease in their turn, and commence to grow more

slowly; having, however, caught the infection later, they had time to grow a little taller than the one which first showed the symptoms. The process of slow growth continues to spread, and there appears soon a very regular depression on the surface of the vineyard, having its deepest point, its centre, in the bush which first became infected. This depression in a garden is, at least, as typical for the phyloxera infection as the bubo, and fever, and a coated tongue are for the plague. You do not require a house to house visitation to detect your first focus of infection. You see at a glance at your vineyard where the infection is and how far it has gone. Apparently you should be able to deal with it easily. You have not to contend with the religious, or caste, or other objections of your patient bushes. You do not require quarantine or railway inspection to prevent them from running away and spreading the disease elsewhere. This disease is most remarkably localised, and extends only with extreme deliberation. Your patients don't object to your disinfecting them as much as you wish. The insect is exceedingly easily killed. You can pour deadly antiseptics down to the roots, without, however, damaging the root; or you can dig up the bushes and the soil, and roast and burn them all, or treat them otherwise as you please. You know, however, that, once phyloxera has been introduced into a country, there is no method as yet invented to "stamp it out." It so happens that there are species of vine naturally immune against the disease, which the insect never attacks. The manœuvre now largely resorted to consists in destroying the garden, planting the roots of other, immune species, and trying to graft upon them those which one wants to grow. The phyloxera remains in the garden, but the bushes cease to undergo its attack.

The problem of rinderpest in South Africa is an instance of a disease more difficult to deal with than diseases of plants, but still infinitely simpler than the plague. You can induce your cattle somewhat easier to conform with your arrangements, they will stay in your quarantines more patiently, and they generally make fewer objections to anything, and interfere with your plans much less, than when you deal with a free population, which may not always share the ideas of their Medical Officers of Health. The rinderpest in South Africa is, however, not yet "stamped out" either.

There are, therefore, both in the animal and vegetable worlds, diseases of which the cause, the morbid organism, can live and propagate outside the patient's body; can grow in the soil, in water, be carried by clothing, bedding, instruments, by any living or dead object. If it happens that the natural conditions of a country are favourable to the life and propagation of such an infectious organism, and as long as these conditions continue unchanged, and we are unable to artificially alter them, there is no instance known of such morbid organisms having been "stamped out," as the expression in our daily reports is, by the will of men. If it was otherwise, there would be no typhoid fever now in the European barracks in India; or the microbe of cholera, let us say, would have been "exterminated" from the plains of Bengal, or the microbe of malaria from the rest of the country.

Every time, therefore, that you may think of these matters, recall to your memory that rabbit question of Australia, or the phyloxera problem in the vine growing countries of Europe. I hope you will then cease to wonder at the fact that, when the Government and Municipalities appoint Committees to deal with, and to "stamp out" the plague, the disease does not seem to always obey their measures.

This state of affairs does not mean that, while the evil is still small and you get in time aware of it, good cannot be effected by promptly attempting to extinguish it. If the plague penetrates into a village or small town, or if an actually first case of the disease is discovered in a big population, it should be almost as easy to arrest its development, at least locally and at least temporarily, as to put out a burning match. But it is absolutely certain that the tumbler of water, which looks so marvellously effective for the match, is useless when you have to face a big jungle in conflagration; and a big Indian town, densely populated, with cases of plague beginning to crop up in every quarter of it, is such a jungle in a state of occult conflagration.

I was in Bombay soon after the first cases of plague were brought to the public notice, at the end of September 1896. There were then 20 to 30 cases of plague occurring daily. The real beginning of the disease could afterwards be traced to the month of July, so that it had been spreading for some three months unnoticed. I was taken to the ward of the town first affected, in Mandvi, a small place with a population of about a hundred thousand. When they showed me some of the buildings, in which there were from 700 to 1,000 people living, and told me that cases were occurring daily all over that ward of Mandvi in houses like that, there was no need for me to interfere with the measures which the Municipality had adopted. No public, or Government would have ever forgiven that Municipality if it had not adopted the measures. But the future of the campaign was perfectly clear to me. I approved of all that was being done, the burning of sulphur in dishes in the open streets included.

I mean to state by this that it was *not* in the power of the Executive to arrest the growth of the plague in Bombay in October 1896!

There are, however, many phenomena in Nature which it is not in our power to arrest; but we can run away from them, or protect ourselves against them individually. On another occasion I quoted the analogy of our not being able to stop the heat in the plains of India; but those who can afford can easily escape it by going away to the hills, or by providing themselves with good punkhas, if they cannot get away. Or if, on the contrary, it is the monsoon that annoys you: it is true, you cannot arrest it, but a good Macintosh or an umbrella may protect you efficiently. Or, if you cannot dry up the rivers and marshy lands in your vicinity to deprive the mosquitoes of their breeding ground, you can protect your individual person by a mosquito net.

The marvellous success of vaccination against small-pox, and the history of the bacteriological efforts of the last 15 years made the plan for effecting such a protection against plague obvious; and, early after the outbreak of plague in Bombay, I put myself to the task of working out a preventive inoculation to check the liability of individuals to that awful disease.

2. The details of the system of preventive inoculation against the plague have been published in the Medical papers, and are accessible to any specialist. In this meeting I shall mention only the facts which, I believe, interest you most, namely, those which refer to the question as to the actual efficacy or otherwise of our preventive inoculations.

The first demonstration of the working of this system can be made in the Laboratory, and this has been already repeated and confirmed by many observers. You are aware that rats are exceedingly susceptible to plague. One takes 20 rats from a ship that has newly arrived in harbour, say from Europe, where there is no plague. 10 of them are inoculated with the prophylactic against plague, and the others are left as they are. Put back all the 20 rats together, and introduce among them a rat that has the plague, or infect them all artificially with virulent plague microbes. In the course of time you will find that 8, or 9, or the whole of the unprotected will die of the disease; while perhaps only a single rat that had been inoculated with the protective lymph, or even not a single one, will contract the disease.

These observations made by us in December 1896 have afforded the first ground for trying our protective method on human beings.

During the month of January 1897 a large number of leading European and Native gentlemen offered themselves to be inoculated, to prove the harmlessness of this method, and by the end of that month this question was solved, I believe, to the satisfaction of every one who took the trouble of attentively examining it.

In the last week of January the plague broke out in the Byculla House of Correction in Bombay, and affected 9 prisoners, of which 6 eventually died.

A couple of dozen of Professors and Students of the Grant Medical College offered to go to the jail to be inoculated in front of the prisoners, in order to encourage them by an example to try the protective effect of inoculation.

When the measure was actually offered to the inmates, a little less than one half of them at once came forward to be inoculated.

On the day of inoculation, the 30th of January 1897, before the inoculation was applied, there occured in the jail 6 more cases of which 3 proved fatal. After the inoculation we discovered that one of the inoculated men had already a bubo, and two others developed buboes in the same evening. These 3 cases, inoculated, attacked on the day of inoculation, also proved fatal.

The inoculated and the uninoculated remained under absolutely identical conditions of life; had the same food, drink, the same resting and working hours, slept in the same barracks, etc., were, therefore, exposed to absolutely the same chances of infection. From the next morning after inoculation the following difference, however, showed itself in the plague incidences in the inoculated and the non-inoculated. The epidemic lasted for 8 days longer, and of the 173 uninoculated 12 got the disease and 6 died; while of the 148 inoculated two were attacked, and both recovered. This was the result. I considered it as distinctly encouraging, but did not accept it as being already a final proof of the unfailing efficacy of the inoculation.

In the course of the next months not less than 8,200 persons presented themselves for inoculation in Bombay. A large number of these persons belonged to the better classes, and their having *escaped the injection* would have had perhaps little bearing on the question of the

efficacy or otherwise of inoculation, if it had not happened that, of the 8,200, eighteen, all natives of India, actually contracted the plague during the subsequent months of the epidemic, and ran through a course of the disease. Sixteen, however, of the eighteen recovered. The two who died had developed the disease within 24 hours of inoculation, and most probably had the plague on them at the time they came to be inoculated.

The above information was supplied to us by different Medical officers of Bombay, who were watching our operations and their results with a keen, though, I am sure, a perfectly friendly criticism. But in a big town like Bombay there remains the possibility of a certain number of incidences having escaped the vigilance even of critics. The first small Mofussil station where the inoculations were applied and where we obtained information as to their effect, was Mora, in the Kolaba District, half an hour's journey across the harbour of Bombay. Mora had a population of about 1,000 souls. The plague broke out there in due course, and 429 inhabitants asked to have the preventive inoculation, the rest remaining uninoculated. Of the 429 persons, up to the end of the epidemic, 7 got attacked with plague, and all of them recovered. We learn now that, during the same time under observation, there were not less than 26 attacks among the uninoculated half of the population, 24 attacks ending fatally.

The next place of observation was Lower Damaun, one of the two towns in India which, as you know, were most severely affected during the epidemic of last cold season. Not less than 2,197 persons were there inoculated, while 6,033 remained uninoculated. A careful investigation carried out towards the end of the epidemic showed that, between the end of March and the end of May 1897, the uninoculated lost from plague 1,482 of their number. The 2,197 inoculated, when compared week by week with the others, and supposing that they had remained as susceptible to plague as their uninoculated neighbours, should have lost 332 individuals. The actual number of deaths among them was 36, which represents a reduction of 89·2 per cent. of mortality.

The next place where the inoculations were tested was Lanowlie, a couple of hours distant from your city. The plague broke out at Lanowlie while the season visitors were still there, and about 20 cases occurred. The disease then subsided; but suddenly, a month or so later, when the season was over, and the population was reduced to below 2,000, it broke out afresh. My assistants and myself arrived there in the last week of July, and, according to an agreement with the local Plague Committee, we took over charge of the two wards of the City most severely affected, including the old and new bazaars and the densely populated quarters round them.

We began by taking a census of the inhabitants, and found that there were in all 700 persons living in those wards. Their names, father's names, sexes, ages, castes, places of birth, occupations, etc., were all carefully recorded.

After that we made daily house to house inspection in these wards, and while doing so were performing inoculation on those of the inhabitants who lived in, or close by affected houses, and who volunteered to undergo the operation. In the course of the first week 323 persons were inoculated, while 377 remained uninoculated. The result of this, at the end of the epidemic, appeared as follows:—Among the 323 inoculated there were 14 cases and 7 deaths, while among the 377 uninoculated 78 persons contracted the disease and 58 died. Supposing that the inoculated had remained as susceptible and as little resistant to the disease as were their uninoculated relatives and neighbours, they should have produced 67 cases and 49 deaths, in proportion to their numerical strength. This number of 49 deaths appeared reduced by 42, which represents a difference of 85·7 per cent. of mortality.

After Lanowli the inoculations were tested at Kirkee, your closest neighbour, where, as you know, among other people, the followers of the Artillery stationed there contracted the disease. There were 1,530 men, women and children living in the about 40 bartracks on the Kirkee Maidan which probably all of you know. There cannot be any doubt that the military authorities are infinitely better organised for carrying out thoroughly any executive work, any plan of general measures, than a civil body can ever be. There cannot be either any doubt that these authorities, under the immediate supervision of General Duncan, who does us the honour of presiding at the present meeting, did every possible thing,—I mean absolutely everything which was practicable at the time, for arresting or minimising the effect of the epidemic on their own servants.

In spite of all, among those who had not the additional protection of inoculation, one person out of every six got attacked, and one out of every nine died. It is more than possible that, if the Military authorities had not carried out the programme of preventive measures, even larger numbers than the above would have been attacked

and died. In any case, with regard to the specific measure of inoculation, we are in a condition to say with a very great degree of accuracy what would have happened to the inoculated if they had not been inoculated. Out of the total of 1,530 individuals, 671 availed themselves of inoculation, while 859, belonging to the same families, living under the same roofs, having the same food, drink, etc., and subject to the same general preventive measures adopted by the Military, remained uninoculated. From the time of inoculation up to the end of the epidemic the 859 uninoculated had 143 cases with 98 deaths. Seeing the absolute similarity of the conditions, the 671 inoculated should have had proportionately 112 cases with 77 deaths, if they had remained as susceptible to the disease as were their uninoculated brothers, sisters, parents, wives, husbands, children. Instead of that they had 32 cases with 17 deaths. The number of 77 deaths was, therefore, reduced for them by 60, that is by 77·9 per cent.

Mr. Chairman and gentlemen, this is the review of the observations collected up to now in the midst of the actual epidemic. They appear, permit me to state, in perfect conformity with the expectations which we had formed and based upon precise Laboratory investigation. The object of the present meeting was to bring to your knowledge the above facts, and to effect through you as wide a dissemination of this knowledge as possible. I shall be happy now to supplement the above with further details which you may ask for."

3. Major-General Duncan then addressed the meeting, and asked whether any one desired to have some additional information.

The following questions were put by the gentlemen present, and answered by Mons. Haffkine:—

QUESTION BY DR. CABANIS DEMELLO.

"Q.—Suppose a person was inoculated once, how long would the effect last, and supposing he was inoculated twice, how long would it last then?"

"A.—In all the places mentioned in my review the majority of the persons were inoculated,—either once or twice,—in the beginning of the epidemic, and were *not* re-inoculated later on, during the whole time the epidemic lasted. Two, or even three injections are now given chiefly with the object of avoiding the discomfort caused by a simultaneous injection of the full dose. In such cases only $\frac{1}{4}$ or even $\frac{1}{3}$ of the dose is given at a time. It is evident, therefore, that one inoculation appears to be sufficient for carrying a person at least over one year's epidemic season. For the present we are still unable to say for certain whether the same inoculation will suffice for a second or a third epidemic. It is only when it happens that one and the same place has the misfortune to suffer from 2 or 3 consecutive epidemics, and the people inoculated on the first occasion remain in that place during the subsequent outbreaks, that it becomes possible to ascertain whether their protection lasts for more than one season.

Up to now Poona is the only place in India which had the melancholy fate of being attacked by a severe second outbreak. The information which I have obtained from the General Plague Hospital here and from the Sassoon General Hospital, as to the admissions for plague of any persons inoculated during the last cold season, seems to be most remarkably favourable. In an isolated instance, His Highness Aga Khan informed me that his 600 servants were inoculated during the last cold season, and that up to now not one of them was attacked with plague, though they were here all throughout this second outbreak, were going about in the bazaars, mixed freely with the rest of the people, and some of their own relatives were attacked with and succumbed to the plague. These facts are highly encouraging, but would not justify us in making final conclusions. The total duration of the effect of the antiplague inoculation will probably not be known for several years to come."

QUESTION BY DR. KOLHAPOREWALLA.

"Q.—What is the highest degree of fever observed in inoculated persons up to the present time? And how long does the fever last?"

"A.—The highest temperature observed was 105° F. This has happened in a very small number of persons, out of about 20,000 inoculated up to now. The temperature, in those persons, came down soon, and the inoculation and its fever did not cause them the slightest degree of harm. One of these persons was Dr. King, on medical duty in the Byculla House of Correction. Though he was ailing during the whole week *preceding* the inoculation, and though possibly this bad state of health accounted for the amount of fever he had, the inoculation did not aggravate his conditions in the least, and he was fully about his work three days after the injection.

Another person who got a similarly high temperature was Surgeon-Major Bannerman, who was and is still working in my Laboratory in Bombay. We had full opportunity of observing him during and after the reactionary period. The incident did not produce the smallest impression on his most excellent state of health.

I had myself a simultaneous injection of *four* doses of the strongest material we ever had...but, pray, do not remark upon that that, indeed, I appear still as if I was somewhat under the effect of that treatment . . . Generally the fever disappears completely within 24 hours after inoculation : in exceptional cases, however, it continues, in a low form, for 2 or 3 days. As a rule, the higher the degree of fever produced, the sooner it disappears."

QUESTION BY DR. S. H. MODY.

"Q.—Is it a fact that persons who are predisposed to certain diseases get the same degree of excitement after inoculation ?"

"A.—Originally we were on our guard against that ; and we adopted once for all the following proceeding : every time a person who wishes to be inoculated informs us that he is suffering from any chronic or recurring complaint, we allow him to get first a very mild, tentative dose. If that dose does not cause him any inconvenience, we give him either the rest in one injection, or, if there is reason to be cautious, we continue to divide the rest into fractions. We have never had reason to ascribe the least ill-effect to the operation ; and very soon we adopted the rule to refuse inoculation only to persons who have *fever* on them at the time when they present themselves for inoculation, or who had fever a day or two before. This exception is made for two reasons :

(1.) A person having fever on him may be in the beginning stage of plague. Although, in our experience, we had no indication that inoculation aggravates the condition of such a person, it is not likely, however, to effect any good either. Under these conditions, and seeing that such cases are likely to create confusion in the public mind as to the effect of inoculation, it is important to avoid them as carefully as possible. (2.) If a person is suffering from any other fever, for instance, from an attack of malaria, the addition of the inoculation fever, coinciding with his own attack, may make him more than necessarily uncomfortable, and create analogous confusion as to the amount of reaction caused by inoculation.

In considering this question in general, one has to take into account the following circumstances :—As I mentioned already, we inoculated in Bombay alone during the last cold season close upon 8,200 persons. The age of these persons varied between 3 months and 83 years, no exception being made for persons of whatever constitutional disorders. Under these circumstances one may fairly admit that the inoculated, as regards their liability to general sickness, represented very closely the same average as the majority of the Bombay inhabitants. Now, under the best conditions, in an ordinary, healthy year, without any abnormal influences of weather or other factors predisposing to sickness, the mortality in Bombay is over 30 per mille per annum. An average number of 8,200 people in Bombay should, therefore, have, in a year, not fewer than 246 deaths. For every person who actually dies in the course of a year there are probably not less than 3 who start some ailment, or contract for the first time some disease not actually fatal. So that, in a healthy year, in Bombay, 8,200 persons should have some 984 persons passing from a good state of health into a bad, or actually struck by death, without reference to any inoculation whatever.

The thousands of inoculated who do not happen to belong to this unfortunate group of 984, and who feel absolutely as fit after the inoculation as they felt before, do not say a word about it, and their existence does not attract attention. This is as it should be ; but at the same time, when one comes across a person who says he feels unwell in this year, consecutive to the time of his inoculation against plague, it does not follow that his case is due to the inoculation.

In order to be absolutely sure in our reasoning, let us admit that, of the above number, 365 persons only, or as many as there are days in a year, instead of the 984 calculated above, should in the ordinary course of events, pass from a good state of health into a bad one. This alone will show that we may have at least one person every day in the year who will begin to feel unwell from the day of inoculation, without this fact being due in the least to the fact of inoculation."

QUESTION BY MR. GUNGARAM BHAO MHUSKE.

"Q.—Can you tell us why the disease attacks more particularly natives than foreigners in spite of it being proved that it is not a filth disease ? Is this due, as some assert, to the nativies walking barefoot ?"

"A.—No, not necessarily so. In spite of all that might have appeared to an inattentive observer, at no moment up to now was there any reason to beleive that the difference you mention was due in any great extent to the difference in the mode of life of the two classes of population. Both, physical and biological factors, make constantly such distinctions between even closely allied races, and this fact can be observed in human communities, in animals, and in plants. I have alluded already to the fact that the American vine bush is most strangely immune against the phyloxera. When you plant side by side, in a European vineyard, an American specimen and a French one, the latter will be attacked by the insect, and the former left alone. The observations on animals are perfectly demonstrative in this respect. If you bring into your farm a French and an Algerian sheep, and both happen to be equally exposed to the danger of infection with anthrax, or are artificially subjected to it, the French sheep contracts an invariably fatal disease, while the Algerian is not inconvenienced at all. A similar difference is observed between the grey field mouse and the white mouse, with regard to glanders : the latter succumbs, while the former invariably resists. Turning to the human community, there is no lack of similar distinctions, which are some time in favour of one race, some time of another.

The custom in Bengal is to expose newly born babies, or babies with shaven heads, for 5 or 6 hours daily to the direct rays of the sun. You know what would happen if we tried the experiment in the same manner with our own babies. The climate of India in general, which is so favourable to the growth and multiplication of the Indian races, kills off European families in the third or fourth generation. Passing to the effect of microbial infection in human beings, we find that typhoid fever, which causes such ravages in the barracks of European soldiers, is quite exceptional among the Native races, at least some of them ; so much so that it is possible for many physicians in India not to believe that Indians ever suffer from that disease. The above instances of difference are in favour of the Indian races. With regard to the plague, the Native community apparently has the misfortune of being, physiologically, more susceptible to the disease than the Europeans. This conforms with the fact that the Europeans not only show a smaller percentage of attacks, but, when, in spite of the precautions, they are actually affected, the disease runs in them a strickingly milder course than in the Natives of India. Since we suffer so much more than you in other respects, you should forgive us the present, really invidious, distinction with regard to the plague."

No other questions having been asked, Major-General Duncan made some conclusive remarks, in the course of which he said that he, as probably every one present at the meeting, was greatly impressed by the considerations and facts of Mons. Haffkine's speech, which he listened to with the keenest interest. At the same time, he said, he was convinced that the general measures did a large amount of good, and he was sure that, if the measures had not been taken, the mortality would have been much higher than it actually was,—it would probably have been simply appalling.

The proceedings then terminated by the usual vote of thanks to Mons. Haffkine and to the Chair.

This meeting was due to the initiative and activity of Lt.-Colonel E. D. Newnham Smith, the Cantonment Magistrate of Poona.

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CHIEF SECRETARIAT
10 MAY 1898
GOVERNMENT OF BOMBAY

EXPERIMENT

ON THE EFFECT OF

PROTECTIVE INOCULATION

IN THE

EPIDEMIC OF PLAGUE AT UNDHERA,

TALUKA BARODA,

FEBRUARY AND MARCH, 1898.

BY

MONS. W. M. HAFFKINE.

Experiment on the effect of Protective Inoculation in the Epidemic of Plague at Undhera, Taluka Baroda, February and March 1898.

The inoculations were performed in Undhera on the 12th February 1898, with the object of demonstrating to the Baroda authorities the protective effect of the measure. On the above date the population of the village, exclusive of the adjacent suburb, consisted of 950 souls, of whom 47 had been inoculated previously, between the 26th January and the 2nd February 1898, by Dr. C. D. Divanjee, of the Baroda Medical Establishment, and were not inoculated again. All the others, for the purpose of inoculation, were collected in the streets and grouped according to the wards where they resided, family by family. In each household, as nearly as was possible, half the number of the male members, half the number of the females, and half the number of the children were inoculated. The total number of persons thus inoculated was 466, giving, with the 47 inoculated previously, a total of 513, while 437 remained uninoculated. These operations were carried out by Mons. W. M. Haffkine and Surgeon-Major Bannerman, Deputy Sanitary Commissioner of Madras, in the presence of M. Rao Bahadur V. M. Samarth, Suba of Baroda Prant, Rao Bahadur Nilkantrao K. Ambegavkar, District Plague Officer, and Dr. K. V. Dhurandhar, L.M. & S., Sanitary Commissioner and Secretary, Plague Arrangements, Baroda State, and with the assistance of the following physicians of the Baroda Medical Establishment:—Dr. Dhanjibhai H. Mehta, L. M. & S., Dr. Chaganprasad D. Divanjee, L. M. & S., District Plague Duty Medical Officer, Sevaklal M. Dave, L. M. & S., Gopinath C. Chitnis, L. M. & S., Gungadhar B. Paranjpe, L. M. & S., and Surajlal M. Dolatjada, L. M. & S.

The investigation as to the result of the measure was made on the 4th April 1898 by Surgeon-Major-General R. Harvey, Acting Director-General, Indian Medical Service, Mons. W. M. Haffkine, Surgeon-Major Bannerman, M. Rao Bahadur V. M. Samarth, Rao Bahadur Nilkantrao K. Ambegavkar, Rao Saheb Ramlal H. Desai, B.A., LL.B., Vahivatdar of Baroda Taluka, and Dr. Chaganprasad D. Divanjee, L. M. & S. All the results were compared with and confirmed by the official documents kept during the course of the epidemic.

The following was the result of the investigation. The plague continued in Undhera up to 26th March 1898, *i.e.*, for 42 days after the inoculations, and affected 28 families. The mortality among the inoculated and uninoculated members was as follows :

A—AMONG THE UNINOCULATED MEMBERS :

(*a*) One child, of 1 year, named Chitiyo, belonging to the house 68, Ward 1, died of bronchitis, on the 21st February 1898.

(*b*) Three uninoculated died of plague during the first three days after the 12th February 1898, and were not taken into account as having been attacked before the others were inoculated. These persons

were:—Bai Bhagirthi, female, 20, of the house 14, Ward 2; Suri *alias* Chanchi, female, 4 years, of the house 15, Ward 3; and Gurtood Jeeva, male, of the house 67, Ward 1.

(*c*) Lastly, from the 15th February 1898 until the end of the epidemic, 27 more attacks of plague occurred amongst the uninoculated, of which 26 died.

B—AMONG THE INOCULATED MEMBERS:

(*a*) There were no deaths from other causes than plague.

(*b*) There were no deaths during the first three days after inoculation.

(*c*) All together, up to the end of the epidemic, there were 8 attacks of plague in inoculated, of which 3 were fatal. In one of these 3, there was no interval between the inoculation fever and the time when the bubonic fever set in; in the second there was an interval of six days, and in the third of eight days.

Annexed to this report are 28 sheets giving in detail the composition of each affected family and the occurrences of plague among them. The details are summarised in the following table:—

Ward No.	House No.	Uninoculated Members of the Family.			Inoculated Members of the Family.		
		Total uninoculated in the Family.	Number of Attacks among them.	Number of Fatal Attacks.	Total inoculated in the same Family.	Number of Attacks among them.	Number of Fatal Attacks.
1	8	1	1	1	4		
,,	63	2	1	1	3		
,,	67	2	1	1	3		
2	24	1	1	1	1		
3	1	2	1	1	2		
,,	15	3			2	1	
,,	20	4	1	1	3	1	
,,	29	2	1	1	3		
,,	39	3	1	1	4	1	1
,,	42	2	1		1		
,,	48	3	1	1	5		
,,	49	5	1	1	1		
4	7	1	1	1	1	1	
,,	8	1			2	1	
,,	10	1			4	1	
,,	12	2	1	1	2		
,,	13	1	1	1	2		
,,	18	2	2	2	3		
,,	26	2	2	2	1		
,,	30	3	1	1	1		
,,	31	2			4	1	1
,,	34	3	1	1	2		
,,	35	1	1	1	1	1	1
,,	53	2	1	1	2		
,,	80	4	1	1	4		
,,	84	5	2	2	5		
,,	89	1	1	1	2		
,,	90	3	1	1	3		
	Total ...	64	27	26	71	8	3

The 64 uninoculated members of the affected families had therefore 27 attacks, of which 26 were fatal. The 71 inoculated had 8 attacks, of which 3 were fatal.

If the inoculated had suffered to the same extent as their uninoculated relatives, they would have had, proportionately to their number, 29 deaths from plague. The actual number appeared reduced by 26, which is a reduction of 89·6 per cent. of mortality attributable to inoculation.

The result as here obtained tallies with all the observations made up to now upon the protective effect of the plague prophylactic, the reduction of mortality affected by it in a plague-stricken population averaging, with a remarkable regularity, between 80 and 90 per cent.*

Further details upon the operations carried out in the Baroda Territory will be reported later on.

Copies of this report are forwarded to—

The Secretary to the Government of India in the Home Department.

The Private Secretary to His Excellency the Governor of Bombay.

The Chief Secretary to the Government of Madras.

The Director-General, Indian Medical Service.

The Surgeon-General with the Government of Bombay.

His Excellency the Divan of Baroda.

W. M. HAFFKINE.

THE PLAGUE RESEARCH LABORATORY,
BOMBAY, 10*th April* 1898.

* Analysing the occurrences of plague in the 28 families according to the sexes of the patients, it appears that amongst the uninoculated there were 24 males, of whom 7 were fatally attacked. Amongst the inoculated there were 41 males, of whom 3 were attacked fatally. This represents a reduction of mortality in males by 75 per cent.

Amongst the uninoculated there were 40 females, of whom 19 were fatally attacked. Amongst the inoculated there were 30 females, of whom none was attacked fatally, though proportionately they should have had 14 deaths. This represents a reduction of mortality in females by 100 per cent.

Analysing the occurrences according to the ages, it appears that amongst the uninoculated there were 16 children under 10 who had 5 deaths and 4 people above 50 who had 2 deaths. Amongst the inoculated there were 19 children under 10 who had 1 death and 4 people above 50 who had no death. This represents a reduction of mortality amongst inoculated children by 83·3 per cent, and amongst people above 50 by 100 per cent.

Amongst the uninoculated there were 44 people between the age of 10 and 50 who had 19 deaths, and amongst the inoculated 48 people of the same age who had 2 deaths. This represents a reduction of mortality in middle-aged people by 90·5 per cent.

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898.

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.	Census Nos., names, sexes, and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.
Ward No. 1, House No. 8.	25, Dada Shambhu ... Male, 50 years... Inoculated on 12th February 1898. 26, Harkha Dada... ... „ 18 „ ... „ on 1st „ 27, Hira ... ... Female, 18 „ ... „ on 12th „ 29, Maku ... ... „ 1 month.. „ on 12th „	28, Lakhi ... ... Female, 40 years. 28, Bai Lakhi died of plague on 24th Feb. 1898.
Ward No. 1. House No. 63.	269, Koila Kala ... ... Male, 35 years... Inoculated on 12th February 1898. 272, Bapudiya ... ... „ 13 „ ... „ „ 273, Gangadi ... ... Female, 2 „ ... „ „	270, Bai Jivali ... ... Female, 30 years. 271, Shankario ... ... Male, 15 „ 270, Bai Jivali died of plague on 19th Feb. 1898.
Ward No. 1. House No. 67.	287, Laloo ... ... Male, 4 years... Inoculated on 12th February 1898. 288, Fuli ... ... Female, 2 „ ... „ „ 290, Adali ... ... „ 28 „ ... „ „	286, Kashi ... ... Female, 26 years. 291, Dahili ... ... „ 7 „ 286, Kashi died of plague on 20th Feb. 1898.
Ward No. 2. House No. 24.	413, Manji Kashi ... ... Male, 15 years... Inoculated on 12th February 1898.	414, Galal ... ... Female, 50 years. 414, Galal died of plague on 22nd February 1898.
Ward No. 3. House No. 1.	426, Kalyan Ranchod ... Male, 30 years... Inoculated on 29th Jan. and 12th Feb. 1898. 428, Lala ... ... Female, 50 „ ... „ on 12th February 1898.	427, Jamna ... ... Female, 30 years. 428 (A), Fuli ... ... „ 6 „ 428 (A), Fuli died of plague on 20th Feb. 1898.
Ward No. 3. House No. 15.	475, Shanker ... ... Male, 80 years... Inoculated on 12th February 1898. 477, Jitha ... ... „ 60 „ ... „ „ 475, Shanker attacked with plague. There was no interval between inoculation fever and the bubonic fever. Bubo appeared on 23rd February 1898, cured on 3rd April 1898.	473, Shiva Ishver ... ... Male, 32 years. 474, Bai Ganga ... ... Female, 28 „ 478, Deali ... ... „ 3 months.
Ward No. 3. House No. 20.	498, Kashi Trikam... ... Male, 32 years... Inoculated on 12th February 1898. 499, Fula Kashi ... ... „ 9 „ ... „ „ 500, Hira Kashi ... ... Female, 2 „ ... „ „ 499, Fula Kashi attacked with plague on 23rd February 1898. Convalescent. There was an interval of 8 days between the inoculation fever and the bubonic fever.	497, Trikam Dwarka... ... Male, 55 years. 501, Hari ... ... Female, 50 „ 502, Lala ... ... „ 28 „ 503, Dahi ... ... „ 15 „ 503, Dahi died of plague on 5th March 1898.
Ward No. 3. House No. 29.	540, Dula Raiji ... ... Male, 20 years... Inoculated on 27th Jan. and 12th Feb. 1898. 543, Mahilo ... ... „ 5 „ ... „ „ „ 544, Hethi ... ... Female, 3 „ ... „ „ „	541, Bhima Raiji ... ... Male, 20 years. 542, Vagie ... ... Female, 22 „ 542, Vagie died of plague on 16th March 1898.
Ward No. 3. House No. 39.	586, Prag Govind... ... Male, 40 years... Inoculated on 26th January 1898. 587, Darubhai Prag ... „ 15 „ ... „ on 29th „ 588, Shivali ... ... Female, 10 „ ... „ on 12th February 1898. 590, Tribhovan Prag ... Male, 4 „ ... „ on 12th „ 590, Tribhovan Prag died of plague on 24th February 1898. There was an interval of 8 days between the inoculation fever and the bubonic fever.	589, Suraj ... ... Female, 5 years. 591, Kashi ... ... Male, 1 year. 592, Raikor ... ... Female, 35 years. 589, Suraj died of plague on 3rd March 1898.
Ward No. 3. House No. 42.	603, Mahakor ... ... Female, 40 years... Inoculated on 12th February 1898.	601, Bhula Keshar ... ... Male, 26 years. 602, Kasan ... ... Female, 22 years. 602, Kasan attacked with plague on 23rd Feb. 1898. Convalescent.
Ward No. 3. House No. 48.	635, Bhula Kalidas ... Male, 35 years... Inoculated on 29th Jan. and 12th Feb. 1898. 637, Lalloo ... ... „ 18 „ ... „ on 12th February 1898. 638, Madhav ... ... „ 20 „ ... „ on 1st Feb. and 12th Feb. 1898. 639, Moti Bhula ... ... „ 8 „ ... „ on 12th February 1898. 641, Lakha Bhula ... ... „ 1 year ... „ „ „	636, Jamna ... ... Female, 25 years. 637 (A), Divali ... ... „ 17 „ 640, Ishwar ... ... Male, 4 „ 637 (A), Divali died of plague on 26th March 1898.

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898—*contd.*

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the dates of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.	Census Nos., names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.
Ward No. 3. House No. 49.	645, Gangda Ranchod ... Male, 20 years... Inoculated on 2nd February 1898.	643, Parshotam Rughnath ... Male, 40 years. 644, Tribhovan Ranchod ... „ 25 „ 646, Jamnadas Ranchod ... „ 20 „ 647, Daya ... ... Female, 50 „ 648, Jamna ... ... „ 25 „ 643, Parshotum Rughnath died of plague on 26th February 1898.
Ward No. 4. House No. 7.	664, Suraj ... ... Female, 35 years... Inoculated on 12th February 1898. 664, Suraj attacked with plague on 26th February 1898. Convalescent. There was an interval of 11 days between the inoculation fever and the bubonic fever.	665, Amba ... ... Female, 11 years. 665, Amba died of plague on 17th February 1898.
Ward No. 4. House No. 8.	666, Shiva Bhagwan ... Male, 25 years... Inoculated on 12th February 1898. 668, Mahakor ... ... Female, 12 „ ... „ „ 668, Mahakor attacked with plague on 23rd February 1898. Convalescent. There was an interval of 8 days between the inoculation fever and bubonic fever.	667, Dev ... ... Female, 45 years.
Ward No. 4. House No. 10.	672, Raiji Govind ... ... Male, 28 years... Inoculated on 29th Jan. and 12th Feb. 1898. 673, Shankar ... ... „ 26 „ ... „ on 12th February 1898. 674, Chalurbhai Darubhai ... „ 22 „ ... „ on 30th January 1898. 675, Hari ... ... Female, 65 „ ... „ on 12th February 1898. 675, Hari attacked with plague on 22nd February 1898. Convalescent. There was an interval of one week between the inoculation fever and the bubonic fever.	671, Rama Govind ... ... Male, 30 years.
Ward No. 4. House No. 12.	679, Manor Aju ... ... Male, 50 years... Inoculated on 29th Jan. and 12th Feb. 1898. 681, Jhaver ... ... Female, 30 „ ... „ on 12th February 1898.	678, Ranchod Aju ... ... Male, 60 years. 680, Kandas Aju ... ... „ 35 „ 680, Kandas Aju died of plague on 20th Feb. 1898.
Ward No. 4. House No. 13.	682, Jiva Ranchod ... Male, 35 years... Inoculated on 1st Feb. and 12th Feb. 1898. 684, Dahili... ... ... Female, 4 „ ... „ on 12th February 1898.	683, Suraj ... ... Female, 30 years. 683, Suraj died of plague on 22nd Feb. 1898. Had an abortion.
Ward No. 4. House No. 18.	700, Malhur Khoda ... Male, 20 years... Inoculated on 12th February 1898. 702, Harkha Khoda ... „ 10 „ ... „ „ 703, Sada ... ... Female, 40 „ ... „ „	701, Hira Khoda ... ... Male, 8 years. 704, Nathi ... ... Female, 15 „ 701, Hira Khoda died of plague on 1st March 1898. 704, Nathi died of plague on 17th February 1898.
Ward No. 4. House No. 26.	729, Jiva Nana ... ... Male, 45 years... Inoculated on 12th February 1898.	730, Jita ... ... Female, 38 years. 731, Data ... ... „ 10 „ 730, Jita died of plague on 17th February 1898. 731, Data died of plague on 16th „
Ward No. 4. House No. 30.	744, Lakhi ... ... Female, 35 years... Inoculated on 12th February 1898.	743 (A), Jatan ... ... Female, 60 years. 743, Okha Kuber ... ... Male, 45 „ 745, Divali ... ... Female, 12 „ 743 (A), Jatan died of plague on 19th March 1898.
Ward No. 4. House No. 31.	746, Jiva Galab ... ... Male, 35 years... Inoculated on 12th February 1898. 748, Kusli ... ... Female, 9 „ ... „ „ „ 749, Nathi ... ... „ 5 „ ... „ „ „ 750, Kashi ... ... „ 7 „ ... „ „ „ 746, Jiva Galab died of plague on 26th February 1898. Bubonic fever developed 9 days after inoculation. There was an interval of 6 days between the inoculation fever and the bubonic fever.	747, Sama ... ... Female, 30 years. 751, Divali ... ... „ 5 „

Occurrences of Plague in Undhera Village, Baroda Taluka, from the 15th February to the 26th March 1898—*contd.*

Full Address.	Census Nos., names, sexes and ages of the *inoculated* persons who were living in the house on the date of attack, with the date of their inoculation. Name, sex, age of the attacked, if amongst the *inoculated*; date of attack or death.	Census Nos., names, sexes and ages of the *uninoculated* persons who were living in the same house on the date of attack. Name, sex, age of the attacked, if amongst the *uninoculated*; date of attack or death.
Ward No. 4. House No. 34.	759, Sona ... ... Female, 24 years... Inoculated on 12th February 1898. 761, Devla Bahadar ... Male, 35 „ ... „ „ „	758, Iicha Bahadar ... ... Male, 28 years. 760, Vakhat ... ... Female, 50 „ 762, Bhikhla ... ... Male, 30 „ 760, Vakhat died of plague on 23rd February 1898.
Ward No. 4. House No. 35.	763, Natha Jesing ... ... Male, 33 years... Inoculated on 12th February 1898. 763, Natha died of plague on 21st February 1898. The bubonic fever developed without interval after inoculation.	764, Jasu ... ... Female, 50 years. 764, Jasu died of plague on 27th February 1898.
Ward No. 4. House No. 53.	830, Suraj ... ... Female, 50 years... Inoculated on 26th Jan. and 12th Feb. 1898. 831, Mahiji Girdhar ... Male, 10 „ ... „ 2nd Feb. and „ „	832, Dahi ... ... Female, 7 years. 832 (A), Jeshing Girdhar ... Male, 28 „ 832 (A), Jesing Girdhar died of plague on 23rd February 1898.
Ward No. 4. House No. 80.	927, Madhiya Balavantiya... Male, 32 years... Inoculated on 12th February 1898. 930, Ma ... ... Female, 50 „ ... „ „ „ 931, Girdhario ... ... Male, 6 „ ... „ „ „ 934, Harkhi ... ... Female, 8 „ ... „ „ „	928, Jivi ... ... Female, 28 years. 929, Lakhada ... ... Male, 25 „ 932, Mahulo ... ... „ 3 „ 933, Kasaniyo ... ... „ 6 months. 932, Mahulo died of plague on 23rd February 1898.
Ward No. 4. House No. 84.	949, Punjiya Jethiya ... Male, 60 years... Inoculated on 12th February 1898. 950, Panadi ... ... Female, 50 „ ... „ „ „ 952, Dahyo ... ... Male, 32 „ ... „ „ „ 953, Samalo ... ... „ 16 „ ... „ „ „ 957, Magani ... ... Female, 30 „ ... „ „ „	951, Dudhiyo ... ... Male, 35 years. 954, Bharmatiyo ... ... „ 2 „ 955, Girdhariyo ... ... „ 12 „ 956, Kasani ... ... Female, 28 „ 958, Dhani ... ... „ 2 „ 951, Dudhiyo died of plague on 22nd Feb. 1898. 955, Girdhariyo died of plague on 15th Feb. 1898.
Ward No. 4. House No. 89.	975, Kankadi ... ... Female, 40 years... Inoculated on 12th February 1898. 976, Mitki ... ... „ 2 „ ... „ „ „	974, Kusal Nathiya ... ... Female, 4 years. 974, Kusal died of plague on 15th Feb. 1898.
Ward No. 4. House No. 90.	977, Karson Kahinya ... Male, 32 years... Inoculated on 12th February 1898. 978, Bai Manadi ... ... Female, 28 „ ... „ „ „ 981, Kuvedi ... ... „ 2 „ ... „ „ „	979, Dudhali ... ... Female, 8 years. 980, Kasni ... ... „ 6 „ 982, Ramli ... ... „ 70 „ 982, Ramli died of plague on 4th March 1898.

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