Report upon the outbreak of plague on the Witwatersrand : March 18th to July 31st, 1904 / Rand Plague Committee.

The Editor
Journal of the Roy
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PLAGUE

ON THE

WITWATERSRAND.

1904.

may I obtain from

Presented by

Dr. W. C. C. Pakes.

November 1905.

RAND PLAGUE COMMITTEE.

REPORT

UPON THE OUTBREAK OF

PLAGUE

ON THE

WITWATERSRAND

March 18th to July 31st, 1904.

JOHANNESBURG:
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1905.

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REV. WILLIAM McCULLOCH (Special Representative of the Urban District Board of Springs).
J. W. QUINN, Esq. (Appointed after July, 31st, 1904).

INTRODUCTORY STATEMENT.

The Rand Plague Committee instructed Dr. W. C. C. Pakes on his retirement from the post of Medical Officer of Health to the Committee, which he held from March 18th to May 26th, 1904, to prepare a report on the outbreak of Plague on the Witwatersrand. This report, which covers the period from March 18th to July 31st, 1904, was submitted to the Committee at a meeting held on August 5st, 1905, when its publication was sanctioned.

The Committee desire to avail themselves of the opportunity afforded by the publication of this report to express their high appreciation of the services which were rendered by the members of the Plague Staff throughout the outbreak, including the Clerks and Inspectors of the Municipal Public Health Department who were temporarily attached to the Plague Staff.

The resolutions passed by the Committee with regard to the services rendered by Dr. Pakes, Medical Officer of Health to the Committee, and Dr. R. P. Mackenzie, the Special Plague Officer, are contained in the following extracts from the Committee's Minutes.

EXTRACT FROM MINUTES OF RAND PLAGUE COMMITTEE, 26th May, 1904.

RESOLVED:

That this Committee in accepting Dr. Pakes' resignation as M. O. H. to the Committee convey to Dr. Pakes its heartiest thanks for the invaluable services which he has rendered to the community in that capacity, and record its conviction that the success with which the outbreak of plague has been controlled is mainly due to the skill, energy and promptitude displayed by him in conjunction with Dr. Mackenzie in directing and carrying out the necessary measures.

EXTRACT FROM MINUTES, RAND PLAGUE COMMITTEE, 27th July, 1904.

RESOLVED:

1. That the thanks of the Committee be voted to Dr. Mackenzie for his services.
2. That this resolution be formally conveyed to Dr. Mackenzie together with a copy of the resolution previously passed referring to him in conjunction with Dr. Pakes.

The thanks of the Committee were conveyed by resolution to other professional members of the staff on their retirement.

The Committee desire also to express their appreciation of the manner in which the medical practitioners of the Witwatersrand co-operated with the Committee, and assisted in carrying out precautionary measures.

May, 1905.

W. St. JOHN CARR,
Chairman.

INTRODUCTORY LETTER BY DR. PAKES.

To the Chairman and Members
of the Rand Plague Committee.

GENTLEMEN,—

In presenting the Report of the Outbreak of Plague on the Witwatersrand, I have in the first place to record the regret which is felt by all that it is I and not Dr. Porter who presents this Report. Dr. Porter was seized with illness, thought to be influenza, on the 11th March. He returned to the office on the 16th and 17th March, and submitted urgent reports to the Council and the Public Health Committee on those dates in regard to the dangerous condition of the Coolie Location, and finally failing with Enteric on March 17th, 1904, left me in charge of his work and by a most strange coincidence, plague was discovered on the day following his enforced absence. He was necessarily absent until the middle of May and took over the duties of Medical Officer of Health to the Rand Plague Committee at the end of May.

Although Plague was not discovered until March 18th, there is no doubt that it had been responsible for several deaths in the Coolie location during the earlier portion of that month and probably even during the months of January and February. The fact that the disease was not diagnosed earlier is entirely dependent upon the peculiar phenomenon that the whole of the earlier cases were of the pneumonic type, and the disease so very closely simulated the ordinary pneumonia of this country.

Although the outbreak was continuous I have shewn that there were really two separate outbreaks, the second one being subsequent to and consequent upon the first.

I have pointed out in the report the very great value of what was called the Intelligence Department, and I feel convinced that its value cannot be over-estimated, especially in view of the fact that despite some public opposition it was decided, in accordance with the recommendations of the Durban Conference, not to segregate contacts.

At the time of writing this report it is impossible to estimate the cost of the Outbreak to the Colony, since the allocation of expenditure has not yet been made. One great item of expenditure, which will probably be placed to the plague account, viz., Klipspruit Camp, can hardly be considered a true Plague Expenditure since, if the Coolie location had not been in such a terribly insanitary condition, the drastic measures which were adopted would not have been necessary, and the consequent expenditure would have been unnecessary. Even despite this heavy expenditure I feel sure that, when the figures are published, it will be found that the cost per case will compare very favourably with those of other South African Outbreaks. Further, I feel sure that the reason of the favourable comparison lies in the fact that no expense was spared during the early period of the outbreak. The result was that from the very beginning no department was under-staffed, and therefore, all the work in connection with the suppression could be and was done both thoroughly and expeditiously. As it happened a smaller staff would have sufficed even from the commencement, but on March 21st the problem to be solved by the Rand Plague Committee had not been defined, and it was deemed necessary to employ a staff sufficient to cope with any emergency. The moment that the outbreak was in hand the staff was reduced to such an extent that it could just cope with the work successfully.

Although for a short period I was nominally in charge of the plague operations, it was only because of the whole-heartedness of the entire staff that the operations were carried to a successful issue. When everyone was doing his utmost, it is difficult to call attention to anyone in particular. From the nature of their work, however, I feel that I cannot present this Report without expressing my great indebtedness to Dr. Ronald Mackenzie, the Special Plague Officer ; to Drs. Montgomery, Allan and Bettensen, the Plague Officers; to Mr. F. C. Gavin, the Transport Officer, who unfortunately broke down owing to the stress of work; to Mr. Pittaway, who made all the purchases ; to Mr. Tomlinson, who was in charge of the Klipspruit Camp and to his able assistants, Messrs. Burgess and Jackson ; to Colonel Showers, the Commissioner of Police, for his ready and continual help throughout ; to the Medical Staff at Rietfontein, and to those nurses who volunteered and went at great inconvenience to nurse the patients ; to Mr. Leitch, the Town Engineer, and his department ; to Mr. Price, the General Manager of the Central South African Railways and his officials ; and to Mr. George Lyall, the Assistant Secretary.

In conclusion I can only express my gratitude to the Rand Plague Committee, the Secretary, Mr. Feetham, and the Treasurer, Mr. Hichens, for their unfailing courtesy to myself and to all the officials of the Committee.

I have the honour to be,
Gentlemen,
Your obedient Servant,
WALTER C. C. PAKES,
sometime Medical Officer of Health
to the Rand Plague Committee.

December 16th, 1904.

JOHANNESBURG AND WITWATERSRAND.

Johannesburg, Lat. 26° 11′ S, Long. 28° 3′ E, lies with a southerly aspect, on the water parting between the Atlantic and Indian oceans at an elevation of 5,765 above the sea level The barometer varies from 24.138 in. to 24.900 in., the average being 24.571. The mean temperature in the shade is 60°.9 F., the maximum 96°F, and the minimum 21°F. The rainy season commences about the beginning of November and lasts to about the end of April; the average rainfall is about 30 inches.

Johannesburg owes its existence to the presence of the Gold bearing " reefs " (so called) of the Witwatersrand, which are at present being mined over an extent east and west of forty miles.

The northern suburbs of the town extending over the ridge are drained towards the Indian Ocean by the headwaters of the Limpopo or Crocodile river which falls into the Indian Ocean, while the town and " main reef " are drained by the Vaal, a branch of the Orange river which falls into the Atlantic ocean.

The country between the Rand and the Vaal river, a breadth of 30 to 40 miles is occupied by subsidiary groups of hills, and one of these, the Klipriversberg, lies in front of Johannesburg which occupies the saddle connecting the main ridge therewith.

Eastwards from this saddle runs the shallow valley of the Natal Spruit, these streams ultimately curving round the Klipriverspruit and falling into the Klip river, a feeder of the Vaal.

The town thus extends for some eight miles along the shoulder of the main slope intersected here and there with minor cross drainages running down from the crest, the most important of these forming a basin-like hollow at the west of the town proper, and round the head of this lie the poorest quarters of the town and the Kaffir and Coolie locations, the last named being the seat of the plague outbreak.

The portion of the area described above, which concerns this report, is a tract between the outcrop of the " main reef " (in reality a tilted bed of metamorphic conglomerate) and the crest of the Rand, a distance of 1,200 to 1,800 yards. The rocks in this area consist of metamorphic shales, Quartzites, Sandstones, and Conglomerates; they are highly tilted with a southerly dip of 30° to 50°. The harder rocks outcrop at the surface, but the softer shales have weathered down into a red loam of considerable depth. Dyke faults occur filled with a greasy earth (presumably intrusive) of similar appearance. Some of these rocks carry water so that wells were formerly common throughout the area, but the water-level has gradually sunk during the last ten years, and with a good supply of potable water from dolomite sources the use of well and rain water is being largely abandoned.

Generally speaking the soil is dry, in such a place as the hollow above described (called the Brickfields) where the failing springs and the surface drainage still make the ground swampy in parts. The subsoil or rock is not so much polluted as would be the case in a damper climate for the reason that the surface pollution is evaporated and consumed by the sun-heat, before it can penetrate far, while the accumulations of the dry season are swept off the surface by the heavy rain-storms of the summer. Further, the action of the sun, wind, and rain all combine to harden the crust of the soil so that the surface is impenetrable to moisture.

Previous to 1898 the water supply of the town and suburbs was derived from wells, rain-water tanks, and by a piped supply from a highly polluted source. In that year, however, a supply was brought in, derived from underground waters in dolomite.

This dolomite is a dense crystalline rock, practically impervious to water. The supplies from it, therefore, do not occur in the body of the rock in which they would be filtered and preserved from impurity, but they occur in caves and crevices worn down from the surface and covered by surface deposits. They are of very moderate hardness and are at present pure, but from the nature of their storage in bulk in the rock they may be subject to pollution from the surface in future.

HISTORICAL SUMMARY.

The whole of the town of Johannesburg has been built since the year 1886, that is in less than 20 years. In the older parts of the town there are still very considerable numbers of small wood and iron houses, and many of these houses in the neighbourhood of Ferreira's Town, Burgersdorp, and Vrededorp were, during the plague, densely overcrowded. The Coolie Location, in which the plague first appeared, was in a terrible condition. This location was included in an area of about 150 acres which the Town Council of Johannesburg in March 1902,

decided to expropriate as an insanitary area, provided that the necessary powers could be obtained from the Government. In September 1902, the Government appointed a Commission to report on the Council's expropriation and improvement scheme.

The condition of the Coolie Location is described in the following extract from the evidence given by Dr. Porter, Medical Officer of Health, before this Commission :—

EXTRACT FROM DR. PORTER'S EVIDENCE BEFORE THE INSANITARY AREA COMMISSION, 18TH NOVEMBER, 1902.

"838. How would you describe this particular area ? Well ! it almost passes description. It consists of a congeries of narrow court-yards, containing dilapidated and dirty tin huts, without adequate means of lighting and ventilation, huddled on area, and constructed without any regard to sanitary considerations of any kind. In the middle of each slop-sodden and filth-bestrewn yard there is a well from which the people get their water supply, and as in other places, they choose this place for washing purposes, the urinals and closets in one of these places being the immediate vicinity. In one case the closet is about one pace from the well. I suppose they are a kind of mutual source of supply to each other.

839. Of course this must mean considerable danger ? Of course it does.

840. Is there a large population in this particular area ? I have been in the place repeatedly, and it is as crowded as a rabbit-warren. I have not been there at night, not willingly. I once lost my way, but I have not been there at night officially. Do you want to know any more about it ?

841. Is it very densely populated ? Yes.

846. Mr. Papenfus :—Now, in the event of an outbreak of some infectious disease there, what would be the result ? Well, I wish to say most seriously and advisedly that, as Medical Officer of Health for Johannesburg, I consider the existence and continuance of that Coolie location in the most emphatic manner fraught with danger to Johannesburg. I am not saying this merely as a witness before this Commission, but I shudder to think what would occur if plague or cholera broke out in that place.

847. Small-pox ? No, not small-pox, because sensible people have a protection against that, but I refer to plague and cholera in particular. These people come up to the town as fruit-vendors, and they mingle freely with the people in the town. They act as waiters in the hotels, and in various ways they are brought into close contact with the people living in the rest of the town, and I do wish respectfully to urge upon the Commission that the Coolie location and the other court-yards in the district like it, are the very greatest and most terrible source of possible danger, in my opinion, to the town. I have never seen—and I have seen insanitary places in a great many towns in England—I have never seen anything approaching that location, and I ought to say that there are some other courts throughout the district which are just as bad. The Coolie location I speak of separately. You cannot speak of it in the same category with the other dwellings in the district at all. It is as bad as it possibly can be. Until I saw it I did not think anything could possibly be as bad. One further objection in regard to public health administration is this, that those places are dark dens. You cannot see what is going on inside and accordingly there is every possibility of concealment of disease. They are inhabited by a class of people either without the knowledge or without the intelligence to report the outbreak of disease. They would never think of calling a doctor, and, ostrich-like, would consider it the right thing to conceal the existence of disease. Then it would be extremely difficult to go into those places to find out if disease existed, because of their darkness ; and, from the ordinary sanitary point of view, it would require a whole army of inspectors to keep that place clean.

848. Briefly, doctor, it is, in your opinion, hardly possible to exaggerate the danger ? It is not, in my opinion, and speaking so extremely strongly about this, it is in regard solely to the Coolie location and yards like it, and to no other part of the district."

In March 1903, the Insanitary Area Commission presented their report, which amounted substantially to a verdict of approval on the Council's proposals. The Ordinance conferring on the Council the power to expropriate the Insanitary Area was gazetted on May 1st, 1903, and after giving the notices required by this Ordinance, the Council entered upon the property included in the Insanitary Area on September 26th, 1903.

In the meantime, the Public Health Committee had been giving their careful consideration to the question of providing accommodation for the Asiatics and Natives who would have to be moved from the Coolie Location and other parts of the Insanitary Area, before the area could be cleared, and at the Council's meeting of the 30th September, 1903, the Public Health Committee submitted a report recommending :—

1. That the existing Native Location be removed from its present site in Vrededorp, to the vacant ground to the west, originally intended for an Indian Location.

2. That an Asiatic Location or Bazaar be established on the ground thus vacated, and

3. That the sum of £16,238 be sanctioned for these purposes.

The consideration of this report was ordered by the Council to stand over.

On the 14th October, the report again came up for consideration, but the Chairman of the Public Health Committee asked that the matter might be allowed to stand over, in order to enable the Committee to consider a petition which had been received, objecting to the Council's proposals. This petition was signed by 1,300 persons, mostly residents in Brixton, Mayfair or Fordsburg, the townships adjacent to the site of the existing Native Location and the proposed Asiatic Bazaar.

Between this date and that of the Municipal Elections the 9th December, 1903, the Committee had two interviews with representatives of the petitioners, and after careful examination of the views which they expressed, the Committee decided to recommend:—

1. That the removal of the Native Location be not undertaken for the present but that a temporary extension of this location should be provided for.
2. That the Bazaar for the purpose of accommodating Asiatics should be laid out on the ground west of the existing Native Location, and that an unclimbable fence should be erected along the western and northern boundaries of such bazaar. The estimated capital expenditure involved was £9,200.

This report had to be reconsidered after the Municipal elections by the newly-formed Public Health Committee.

On February 24th 1904, it was submitted to the Council, and ordered to stand over; at the meeting of the Council on March 9th 1905, the Council suspended the standing orders to enable it to receive a deputation representing the inhabitants and ratepayers of the western suburbs, who petitioned for the rejection of the Public Health Committee's proposals on the ground of the injury that the proximity of natives and coloured people would cause to the property of the petitioners. The report and petition were considered and the debate adjourned.

In the meantime, namely, on the 18th February 1904, the Medical Officer of Health (Dr. Porter) reported as follows to the Public Health Committee in regard to the Coolie Location:—

> "On 13th inst., accompanied by Mr. Gandhi, I again inspected this place, with special reference to overcrowding. This overcrowding, and its insanitary consequences, are such that I feel it an imperative duty to repeat formally to you what I so emphatically represented to the Insanitary Area Commission, viz., that the continued existence of the Location is, in my opinion, fraught with the greatest danger to public health. I beg, therefore, most strongly to recommend that the matter be regarded as one of great urgency, that arrangements be made at the earliest possible date for the transference of this population to some other site, and that if necessary they be accommodated in tents, pending the erection of more permanent dwellings."

On the 16th March, 1904, the Medical Officer of Health (Dr. Porter) handed the following letter to the Mayor before the Council meeting, and circulated copies to the Members of the Council:—

> "Having gathered that there is a possibility of material delay in action by the Council as regards the abolition of the existing Indian Location in the Insanitary Area, I consider it my duty to remind you of the very strong terms in which I felt it necessary to represent to the Insanitary Area Commission that the continued existence of this Location is, in my view, fraught with the gravest danger to the public health. I also desire to recall the fact that on the 15th February last I most strongly recommended to the Public Health Committee that this matter might be regarded as one of great urgency, and that arrangements be made at the earliest possible date for the transference of this population to some other site."
>
> "As the condition of the Indian Location has recently, chiefly on account of overcrowding, reached even a lower depth of insanitation than at the time of the sittings of the Insanitary Area Commission, I trust that I shall not be misunderstood in saying that I view with the greatest concern the possibility of any further delay in doing away with this place, as, in the event of an outbreak therein of epidemic disease, the control of the latter would undoubtedly be a matter of the greatest difficulty."
>
> "Personally, I look upon the Public Health Committee's proposal to temporarily place an Indian Bazaar to the west of the Kaffir Location as the best method of *temporarily* dealing with a pressing danger and difficulty, and although such action may not be without grounds of objection by white residents in the vicinity, such objection I venture to submit, is entirely outweighed by the gain to the town at large by the removal of the present exceedingly dangerous location at Burgersdorp.

"I have taken the somewhat unusual course of addressing you thus, as I feel very strongly indeed on the subject from the public health point of view."

At the Council's Meeting of the same date (16th March, 1904) the report was again considered by the Council and its recommendations were withdrawn for further consideration by the Public Health Committee.

At a meeting of the Public Health Committee on the 17th March, the Medical Officer of Health again strongly represented the danger of allowing the Coolie Location to continue in its present condition, and at this meeting it was decided as a *temporary measure* for relieving the overcrowding, etc., to order and erect 300 tents on vacant land immediately west of the Native Location.

On the night of Saturday, 19th March, the outbreak of pneumonic plague in the Coolie Location was recognised.

On Sunday morning, March 20th, the matter was reported to the Colonial Secretary and the Public Health Committee of the Johannesburg Town Council, who immediately met to consider the situation. It was at once apprehended that in order to take effectual measures to prevent the spread of infection throughout the Mining District of the Witwatersrand, there must be one authority established, and placed in a position to take whatever measures were necessary throughout this district. It was obviously impossible that the six different Municipalities, five of which had been but recently established, could take the prompt and concerted measures which were necessary to arrest the spread of infection. Apart from these considerations, it would have been obviously wasteful for the several Municipalities to establish a number of plague camps and different organisations for conveying contacts and patients thereto.

The Government immediately took the matter in hand, but there were considerable legal difficulties which had to be overcome in order to carry out the steps which were undoubtedly required by the emergency which had to be dealt with. The five new Municipalities were established under the Municipal Corporations Ordinance. Section 58 of this Ordinance enabled the Colonial Secretary to make whatever regulations and to take whatever steps were necessary in cases of urgent necessity, but these powers did not apply to Johannesburg Municipality which was established under a Proclamation issued by the Administrator in May, 1901. So far as Johannesburg was concerned it was therefore necessary to deal with the matter under the old small-pox law No. 12, of 1895. For this reason the legal establishment of the Committee was founded both upon the small-pox law of 1895, and the Municipal Corporations Ordinance of 1903. Even so, considerable doubts existed as to the legal soundness of its constitution and in order to remove them the Rand Plague Committee Validation Ordinance was subsequently passed during the ensuing session (see page 73).

The Committee was appointed by the Government in such a manner as to be representative not only of the Municipalities of the Rand, but also of the Chamber of Mines who were directly interested in arresting the spread of the disease among the mining compounds. The Committee included amongst its members, five representatives of the Municipality of Johannesburg, the Mayors or Chairmen of the other five local authorities and five representatives of the Chamber of Mines.

PRECAUTIONARY MEASURES.

In 1902 it was abundantly evident to the Health Authorities, both of the Transvaal and of Johannesburg, that there was very grave danger of Plague being imported into the Transvaal from the Coast towns, and certain precautionary measures were taken both by the Government and by Johannesburg.

In December, 1902, the Government appointed a Special Plague Officer, Dr. Montgomery, at Volksrust. They also increased the Staff of the Government Laboratories, and, in conjunction with the Johannesburg Municipality, laid the foundations of the Plague Camp referred to on p. 77 at Rietfontein.

The Municipality of Johannesburg in the full anticipation that any outbreak of Epidemic plague would be preceded by an outbreak of Epizootic plague appointed a Municipal rat-catcher and provided him with the necessary assistants. The work done by him in 1903 in discovering the plague-stricken rats referred to on p. 53 probably prevented a small outbreak in that year.

Several thousand doses of Haffkine's prophylactic and of Yersin's serum were purchased by the Government.

The urgent representations made by Dr. Porter concerning the Coolie location, were, as it turned out, not only justified, but there can be very little doubt that, had these recommendations been adopted, the outbreak under reference would never have occurred, or if it had occurred, would never have assumed the proportions which it did on March 21st, 1904.

REPORT.

COMMENCEMENT AND GENERAL HISTORY OF THE OUTBREAK.

On the evening of the 18th March, the District Surgeon, Dr. Mackenzie, was informed that a number of Indians were sick in the Coolie Location. The Assistant District Surgeon, Dr. Alexander, visited the Location and found a number of Indians suffering apparently from Pneumonia, of whom one had died. During the evening of the 18th March, Mr. Gandhi, Dr. Godfrey, and Mr. Madenjit interested themselves, removed all the sick Indians they could find to Stand 36, Coolie Location, procured some beds, blankets, etc., and made the sufferers as comfortable as possible.

At 6.30 a.m. on the 19th March, Dr. Mackenzie and the writer visited the Location and found some seventeen patients either dead or dying. A specimen of sputum was obtained from one of the patients and taken to the Government Laboratories for examination.

The Mortuary Van was in attendance and removed five corpses to the Mortuary for post-mortem examination. When Dr. Mackenzie and I arrived at the Mortuary we found another corpse which had come from the Match Factory at Newlands. The post-mortem examinations were made by Dr. Mackenzie and portions of the organs sent to the Government Laboratories for bacteriological examination.

Meanwhile a sick Indian had been taken into the Johannesburg Hospital late on the evening of the 18th March, obviously very ill and apparently suffering from Pneumonia. A specimen of his sputum was collected and sent to the Government Laboratories. This Indian died during the night and portions of the organs were also sent for bacteriological examination.

As the specimen of sputum from the Hospital case had been received at the Laboratories late on the the evening of the 18th it happened that this was examined first and organisms were found which had the morphological appearances and staining reaction of the B. Pestis. Animals were at once inoculated—both rabbits and guinea-pigs—as there were at that time no experimental rats available.

The sputum obtained from the patient in the Location was examined and was found to contain similar organisms. This was, therefore, also inoculated into animals.

The portions of the organs obtained from the Mortuary and the Hospital were also examined, cultivated, and inoculated. The examinations of smears from the lungs and spleens shewed the presence of bacilli morphologically identical with the B. Pestis.

It was known, therefore, by noon on the 19th March at the Government Laboratories that the disease was probably plague.

About 6.30 p.m. on the same day the first guinea-pig which had been inoculated died, and the spleen contained bacilli indistinguishable from the B. Pestis. It was, therefore, decided officially to announce the presence of plague in Johannesburg.

The High Commissioner was informed, and the Commissioner of Police, Mr. Showers, was requested to place a cordon round the Coolie Location in order to prevent all ingress and egress.

On the 20th March the cultures made from the human organs had grown and it then became certain that the diagnosis was correct.

During the course of the 19th March, more Indians died and post-mortems were made in each case, and bacteriological examinations were made in every case except one, the omission of the one case being an oversight. Either cultures or inoculations were made from each case and all the cases were proved to have died of Plague.

Every case that had yet died had shewed only signs of broncho-pneumonia. Enlarged glands were very carefully looked for by Dr. Mackenzie, but none were found,

On Sunday morning, 21st March, we were informed by an Inspector that a Malay was lying dead in the Malay Location. Dr. Mackenzie and I, therefore, visited the house and found that the corpse had a large right femoral bubo. The cause of death given on the death certificate was Septicaemia. It was, therefore, decided to submit the body to a post-mortem examination. It was found that this was a mixed Pneumonic and Bubonic case, because the B. Pestis was isolated both from the lung and from the gland.

The subsequent history can be seen in charts I. and II., on pp. 3 and 5 the black unbroken line giving the total cases for each week; the actual figures being as follows:—

Week Ending.	No. of Cases.
19th March	27
26th ,,	38
2nd April	12
9th ,,	4
16th ,,	3
23rd ,,	4
30th ,,	6
7th May	5
14th ,,	3
21st ,,	2
28th ,,	2
4th June	0
11th ,,	1
18th ,,	4
25th ,,	0
2nd July	1
9th ,,	1
16th ,,	0
	113

The suddenness of the explosion and the deadly nature of the early cases is shown by the fact that by the 25th March 65 cases had occurred and of these 55 had died.

The roll of deaths during the first eight days is given in the subjoined table and indicates the proportions which on March 21st it was feared the outbreak might assume.

Day.	Total number of Deaths.	Daily Deaths.
18th March	1	1
19th March	8	7
20th March	30	22
21st March	37	7
22nd March	43	6
23rd March	50	7
24th March	52	2
25th March	55	3
		55

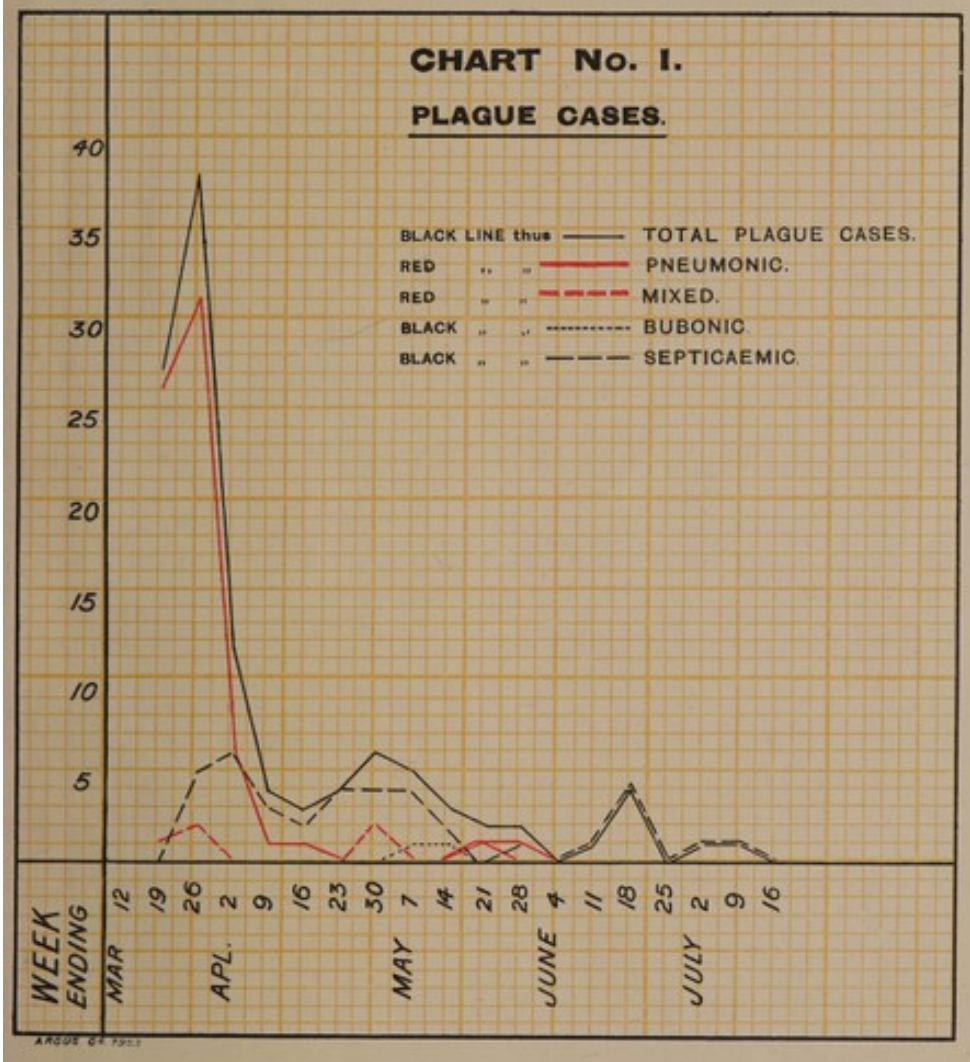


CHART No. I.
PLAGUE CASES.
BLACK LINE thus —— TOTAL PLAGUE CASES.
RED „ „ —— PNEUMONIC.
RED „ „ - - - - MIXED.
BLACK „ „ ---------- BUBONIC
BLACK „ „ — — — SEPTICAEMIC.
40
35
30
25
20
15
10
5
WEEK ENDING
MAR 12 19 26
APL. 2 9 16 23 30
MAY 7 14 21 28
JUNE 4 11 18 25
JULY 2 9 16

CHART II.

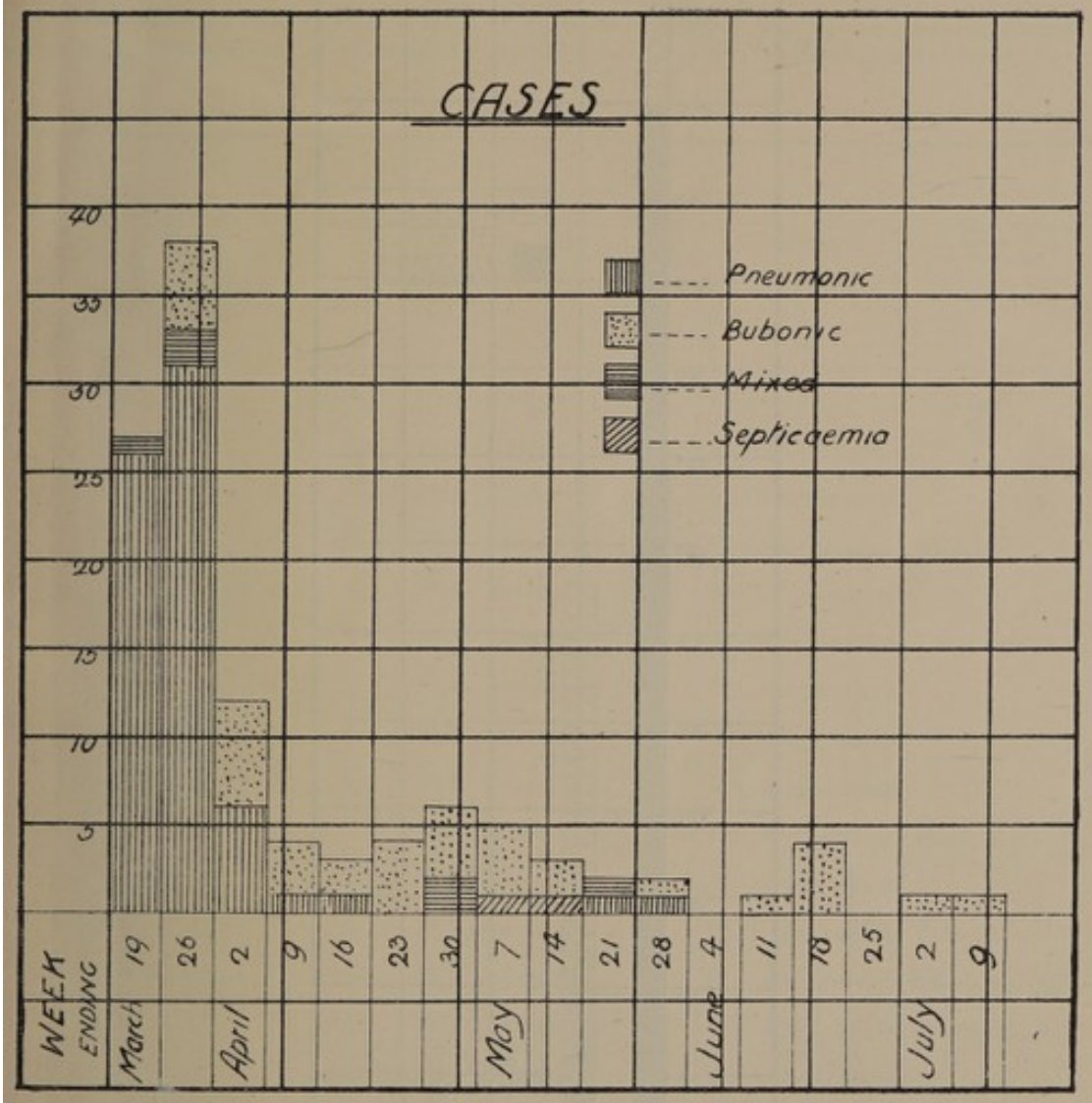
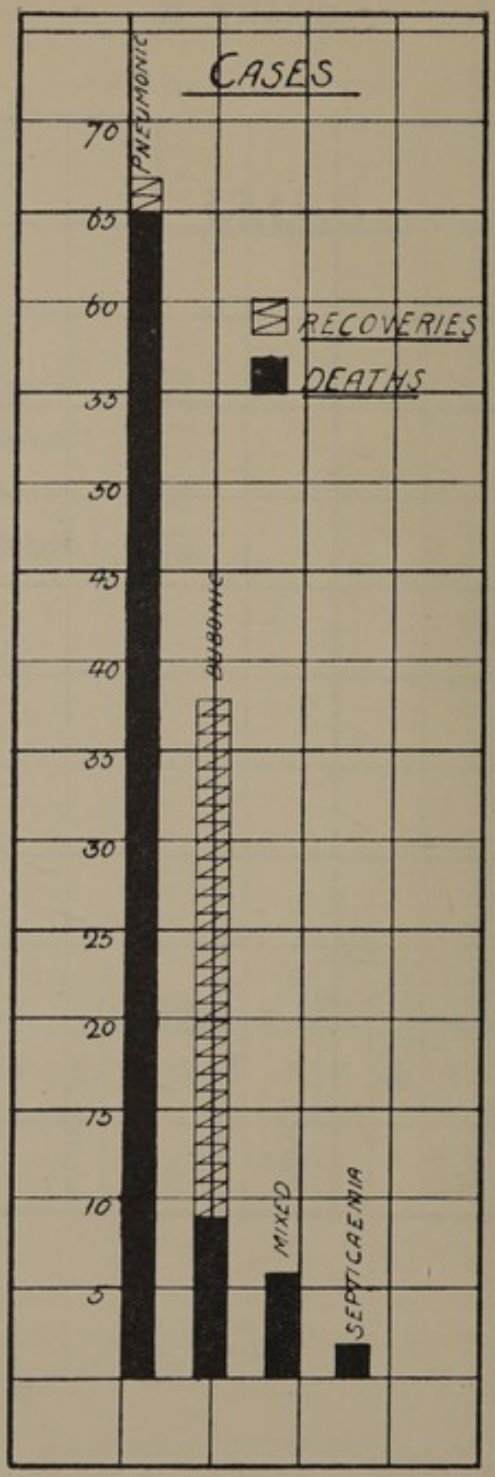

CASES
40
35
30
25
20
15
10
5
Pneumonic
Bubonic
Mixed
Septicaemia
WEEK ENDING
March 19
26
April 2
9
16
23
30
May 7
14
21
28
June 4
11
18
25
July 2
9

CHART III.


CASES
70
65
60
55
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25
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10
5
PNEUMONIC
BUBONIC
MIXED
SEPTICAEMIA
RECOVERIES
DEATHS

The last case occurred on July 9th, so that the outbreak lasted sixteen weeks and one day.

Rats were found infected with Plague as late as August 14th, 1904.

Outside Johannesburg the first case occurred on March 31st at Benoni, this being the only case here.

At Germiston there were eight cases, the first occurring on April 1st, and the last on May 20th.

At Krugersdorp there was one case which occurred on April 14th.

THE GENERAL FEATURES OF THE OUTBREAK.

The following table represents most of the facts concerning the various cases of Plague occurring in Johannesburg from which the general Features of the Outbreak are deducted :—

TABLE I.

Consecutive Number. 1	No. on Plague Register. 2	Nationality. 3	Age. 4	Type of Disease. 5	Method of Infection. 6	Date of Illness. 7	Occupation. 8	Infected from Residence Place of Work or Contact. 9	Residence 10	Place of Work, if different from Residence. 11
1	1	I	22	P	C	20/3	Unknown	P	Unknown	Unknown
2	2	I	22	P	C	20/3	Hawker	R	93, Coolie Location	
3	3	I	32	P	C	20/3	Hawker	P	31, Coolie Location	
4	4	I	—	P	C	20/3	Labourer	P	95, Coolie Location	Unknown
5	5	I	—	P	C	20/3	Newsboy	R	89, Coolie Location	
6	6	I	25	P	C	20/3	Labourer	R	93, Coolie Location	Langlaagte Deep
7	7	I	—	P	C	20/3	Newsboy	P	435, Burghersdorp	
8	8	I	—	P	C	20/3	Storeboy	P	618, Burghersdorp	
9	9	I	—	P	C	20/3	Unemployed	P	618, Burghersdorp	
10	10	I	—	P	C	20/3	Matchmaker	P & R	435, Burghersdorp	Match Factory
11	11	I	—	P	C	20/3	Hawker	R	43, Coolie Location	
12	12	I	—	P	C	20/3	Labourer	R	93, Coolie Location	Village Deep
13	13	I	—	P	C	20/3	Labourer	R	93, Coolie Location	Langlaagte Mine
14	14	I	—	P	C	20/3	Matchmaker	P & R	47, Coolie Location	Match Factory
15	15	I	—	M	PC	20/3	Storeman	—	418, Malay Location	
16	16	I	—	P	C	20/3	Matchmaker	P	93, Coolie Location	Match Factory
17	17	I	—	P	C	20/3	Matchmaker	P	435, Burghersdorp	Match Factory
18	18	I	—	P	C	20/3	Matchmaker	P	435, Burghersdorp	Match Factory
19	19	I	37	P	C	20/3	Shoemaker	P	588, Station Road	
20	20	I	—	P	C	20/3	Newsboy	R	93, Coolie Location	
21	21	I	20	P	C	20/3	Newsboy	R	43, Coolie Location	
22	22	I	—	P	C	20/3	Labourer	R	93, Coolie Location	Brick and Pottery Works
23	23	I	—	P	C	20/3	Hawker	R	93, Coolie Location	

TABLE I.—*continued.*

Consecutive Number. 1	No. on Plague Register. 2	Nationality. 3	Age. 4	Type of Disease. 5	Method of Infection. 6	Date of Illness. 7	Occupation. 8	Infected from Residence, Place of Work or Contact. 9	Residence. 10	Place of Work, if different from Residence. 11
24	24	I	—	P	C	20/3	Newsboy	R	47, Coolie Location	
25	25	I	—	P	PC	20/3	Labourer	—	Crown Deep Mine	
26	26	I	35	P	C	20/3	Newsboy	R	41, Coolie Location	
27	27	I	20	P	C	20/3	Labourer	P R	93, Coolie Location	Village Deep Min
28	28	I	—	P	C	20/3	Unknown	P	588, Burghersdorp	
29	29	I	—	P	PC	20/3	Hawker	—	23, Coolie Location	
30	30	I	—	P	C	20/3	Labourer	R	93, Coolie Location	Unknown
31	31	I	32	P	C	20/3	Storeboy	P	618, Burghersdorp	
32	32	I	23	P	C	20/3	Storeboy	P	618, Burghersdorp	
33	33	I	—	P	C	20/3	Labourer	P	588, Station Road	Langlaagte Mine
34	35	I	22	P	C	21/3	Hawker	R	32, Coolie Location	
35	36	I	—	P	C	21/3	Unknown	P	435, Burghersdorp	
36	37	I	23	P	C	21/3	Newsboy	P	588, Station Road	
37	38	I	26	P	C	21/3	Newsboy	R	47, Coolie Location	
38	39	I	27	P	C	21/3	Labourer	P	Village Deep Mine	
39	40	I	45	P	C	21/3	Unemployed	R	93, Coolie Location	Village Deep
40	41	Wf	42	P	C	21/3	Housewife	P	22, Lilian Road	
41	42	I	30	P	—	21/3	Labourer	—	Station Road	
42	43	I	—	P	C	21/3	Labourer	R	93, Coolie Location	Unknown
43	44	W	32	P	C	21/3	Clerk	P	39, Eloff Street	
44	45	Wf	18	P	C	21/3	Schoolgirl	P	22, Lilian Road	
45	46	W	15	P	C	22/3	Schoolboy	P	22, Lilian Road	
46	47	Wf	16	P	C	22/3	Schoolgirl	P	22, Lilian Road	
47	49	I	22	P	C	22/3	Storeman	P	685, Main Road, Fordsburg	
48	51	I	25	P	C	22/3	Hawker	P	92, Coolie Location	
49	56	N	40	B	—	23/3	Labourer	—	Unknown	
50	60	I	25	M	—	23/3	Unknown	—	Unknown	
51	61	I	35	P	C	23/3	Unknown	P	92, Coolie Location	
52	64	W	45	P	C	23/3	Hospital Watchman	P	Hospital	
53	65	W	40	B	C	23/3	Medical Man	P	Hospital	
54	68	I	30	P	C	23/3	Trolley Driver	R	10, Dam Street, Burghersdorp	

TABLE I.—*continued.*

Consecutive Number. 1	No. on Plague Register. 2	Nationality. 3	Age. 4	Type of Disease. 5	Method of Infection. 6	Date of Illness. 7	Occupation. 8	Infected from Residence, Place of Work or Contact. 9	Residence. 10	Place of Work, if different from Residence. 11
55	71	N	22	P	PC	23/3	Labourer	—	Langlaagte Mine	
56	72	N	35	P	C	24/3	Hospital Boy	P	Hospital	
57	74	N	35	P	PoC	24/3	Labourer	—	76, Coolie Location	Unknown
58	77	N	24	B	R	24/3	Storeman-Driver	W ?	47 Market Street	47, Market Street
59	79	I	25	P	C	24/3	Hawker	P	435, Burghersdorp	
60	82	I	22	B	C	24/3	Hawker	P	438, Burghersdorp	Crown Deep
61	86	I	30	P	C	25/3	Matchmaker	P	504, Burghersdorp	Match Factory
62	87	I	2 mos.	M	—	25/3	Infant	—	50, Coolie Location	
63	92	C	40	B	—	26/3	Labourer	—	Unknown	
64	96	Nf	50	P	PoC	26/3	Washer-woman	—	New Goch Location	
65	99	N	23	P	—	26/3	Labourer	—	Unknown	Consolidated G M. Co., Germiston
66	105	W	25	P	C	26/3	Nurse	P	Rietfontein	Rietfontein Hospital
67	106	W	31	B	—	28/3	Carpenter	—	90, Becker Street	Stand 710, Fordsburg
68	109	W	35	B	—	28/3	Unknown	—	Unknown	
69	110	C	14	B	C	28/3	Schoolboy	P	562, Burghersdorp	
70	111	C	16	B	C	28/3	Schoolboy	P	562, Burghersdorp	
71	112	I	25	P	—	29/3	Laundryman	—	49, Coolie Location	
72	113	N	25	P	R	29/3	Labourer	R	Native Pass Office	Unemployed
73	114	N	23	P	—	29/3	Labourer	—	Robinson Mynpacht	Unknown
74	115	N	—	P	—	29/3	Labourer	—	Klipspruit	Unemployed
75	120	I	15	P	—	31/3	Cigar-maker	—	1011, Burghersdorp	Unknown
76	124	N	15	B	R	31/3	Labourer	R	Native Pass Office	Unemployed
77	135	W	17	B	r	2/4	Waiter	W	Stand 215, Marshall Street	Frascati Restaurant, Market St.
78	143	N	30	B	R	5/4	Labourer	R	Native Pass Office	Unemployed
79	146	N	25	P	r	7/4	Kitchen Boy	R	Stand 422, Marshall Street	
80	147	N	23	B	r	8/4	Kitchen Boy	R	Stand 422, Marshall Street	
81	155	N	17	B	r	10/4	Kitchen Boy	R	Stand 72, Fox Street	
82	158	N	18	B	R	10/4	House Boy	R	38, Marshall Street	
83	164	N	24	B	r	13/4	Sanitary Boy	W ?	Sanitary Compound, Bertrams.	All over town
84	171	N	25	P	r	16/4	House Boy	R	55, Anderson Street	
85	174	N	25	B	R	18/4	Kitchen Boy	R	Market Buildings	

TABLE I.—*continued.*

Consecutive Number. 1	No. on Plague Register. 2	Nationality. 3	Age. 4	Type of Disease. 5	Method of Infection. 6	Date of Illness. 7	Occupation. 8	Infected from Residence, Place of Work or Contact. 9	Residence. 10	Place of Work, if different from Residence. 11
86	175	Wf	17	B	—	19/4	Laundress	—	202, Central Road	
87	177	N	30	B	—	19/4	House Boy	—	Stand 126, Main St.	
88	183	N	25	B	R	23/4	Engine Stoker	R	G. P. O.	
89	185	I	17	B	—	25/4	Hawker	—	Stand 110, Fox St.	
90	186	N	23	B	r	27/4	Store Boy	R	Stand 94, Anderson Street	
91	187	N	20	M	—	27/4	Lab- urer	—	Jumpers Mine	
92	188	N	35	M	R	28/4	Store Boy	W	Market Buildings	
93	192	W	23	B	R	29/4	Photographer	R	Market Buildings	
94	193	W	32	B	R	29/4	Carpenter	R	Market Buildings	Cor. of Main and Polly Street
95	199	I	30	B	—	3/5	Hawker	—	576, Burgherdorp	
96	200	Wf	29	B	r	3/5	Housewife	R	Stand 56, Anderson Street	
97	202	W	13	B	R	5/5	Vagrant	W & R	Stand 902, Commissioner Street	Market Buildings
98	203	Wf	21	B	R	5/5	Waitress	R	Stand 64, Troye St.	
99	204	W	47	S	—	5/5	Bookkeeper	—	21, Clare Road, Fordsburg	Chicken's News Agy., Pritchard St
100	215	W	23	S	r	10/5	Baker	R	Stand 62, Main St.	Unemployed
101	217	Cf	40	B	—	11/5	Domestic	—	Lindley Street, Burghersdorp	
102	221	Wf	23	B	r	14/5	Tailoress	R ?	Stand 301, 10th Street, Vrededorp	Rissik Street
103	223	W	23	B	r	20/5	Sceneshifter	W & R	Stand 144, Kerk St.	Stand 770, Market Street
104	225	N	30	M	R	20/5	Kitchen Boy	W	Stand 770, Market Street	
105	227	N	40	P	—	23/5	Labourer	—	Wolhuter G. M.	
106	228	I	29	B	—	28/5	Storekeeper	—	1, Market Street	
107	232	W	25	B	r	8/6	Dealer	R	Stand 90, Becker St.	
108	234	Wf	12	B	r	15/6	Schoolgirl	R	Stand 450, Anderson Street	
109	235	W	35	B	r	16/6	Domestic Servant	R	Stand 450, Anderson Street	
110	236	N	30	P	—	16/6	Wash Boy	—	Langlaagte Washing Site	
111	237	N	25	B	r	16/6	Labourer	R	488, Burghersdorp	Weevil Bros., Market Street
112	239	N	25	B	R	28/6	House Boy	R	Stand 42, Noord St.	
113	240	Wf	2	B	—	3/7	Child	—	Stand 175, Marshall [Street	

NOTE.—The C in Column 6 includes all the cases which are included in Chart , no differentiation has been made in this Column between those cases which were infected directly from previous cases, or merely from the infected residence. If this column be taken in conjunction with Column 9 this Chart will be found to agree with Chart .

Column 7 indicates the probable onset of the disease. It will be noticed that the 20th March is placed opposite all the cases from 1 to 33. The reason for this is that it is, except in one or two cases, impossible to state exactly when these persons contracted the disease or even died. This particular date, therefore, means only that the disease was contracted not later than the 20th March. The remaining dates are very approximately correct.

The ten cases which occurred outside Johannesburg have not been included because very little was found out about them, and there is good reason for believing that they were infected from Johannesburg.

EXPLANATION OF THE TABLE.

In Column 3, five letters are used :—

W.—White.
I.—Indian.
C.—Coloured.
N.—Native.
f.—Female.

In Column 5, four letters are used :—

P.—Pneumonic.
B.—Bubonic.
M.—Mixed Pneumonic and Bubonic.
S.—Septicaemic.

In Column 6, the letters bear the following significations :—

C.—Contact either of place or person.
R.—Plague Rats found on the premises.
r.—Dead rats. ,, ,,
P.C.—Probable Contact.
Po.C.—Possible Contact.

Column 8 gives the occupations, so far as it has been able to ascertain them.

Column 9 indicates the probable source of the infection.

R.—From a residence infected by a previous case.
P.—From a previous case by direct contact.
W.—From the place of work and not of residence.

Column 10 indicates the residence. In some of the cases this has been a temporary residence. Cases 12, 25, 38, and 39, for instance, had two distinct residences, the one at their place of work, namely, the Village Deep Mine, and the other an occasional one in the Coolie Location.

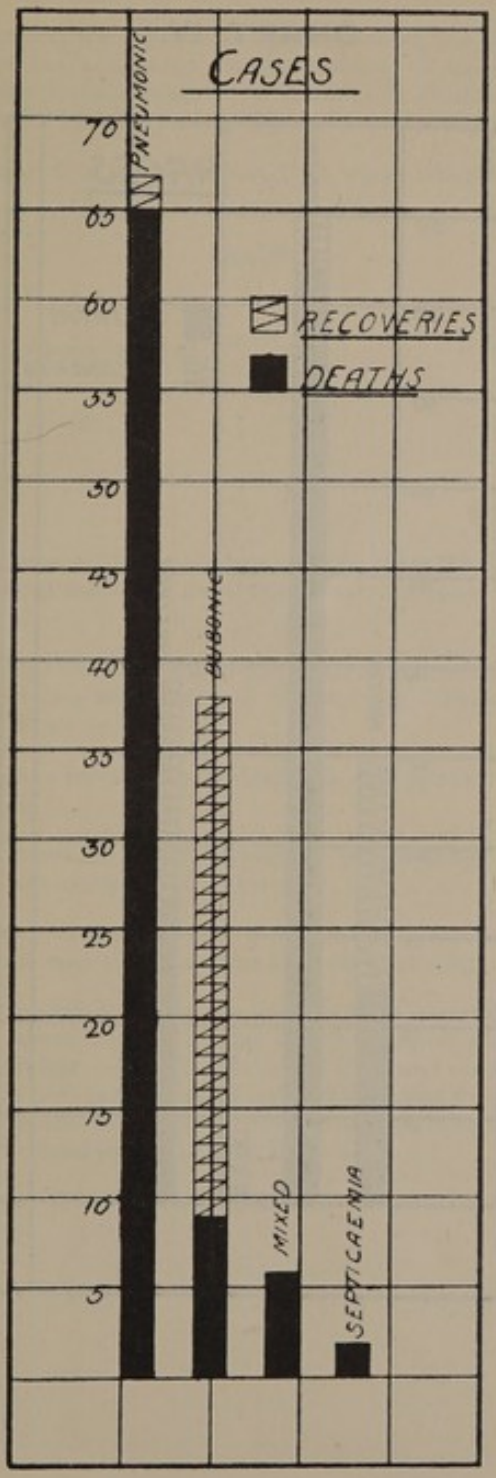
Column 11 gives the place of work, if that is different from the place of residence. In the case of hawkers, newsboys, and trolley drivers, their work taking them as it did all over the town, no place of work could be specified.

The following chart gives the general analysis of the outbreak, as far as Johannesburg is concerned :—

TABLE II.

Type of Disease.		White. M.	White. F.	Indians. M.	Indians. F.	Coloured. M.	Coloured. F.	Native. M.	Native. F.	TOTALS.
PNEUMONIC	Cases	3	4	48	—	—	—	11	1	67
	Deaths ..	3	4	47	—	—	—	10	1	65
BUBONIC	Cases	9	7	5	—	2	1	14	—	38
	Deaths	1	2	3	—	—	—	3	—	9
MIXED	Cases ..	—	—	2	—	1	—	3	—	6
	Deaths ..	—	—	2	—	1	—	3	—	6
SEPTICÆMIA	Cases	2	—	—	—	—	—	—	—	2
	Deaths ..	2	—	—	—	—	—	—	—	2
TOTALS	Cases	14	11	55	—	3	1	28	1	113
	Deaths ..	6	6	52	—	1	—	16	1	82

CHART III.


CASES
70
65
60
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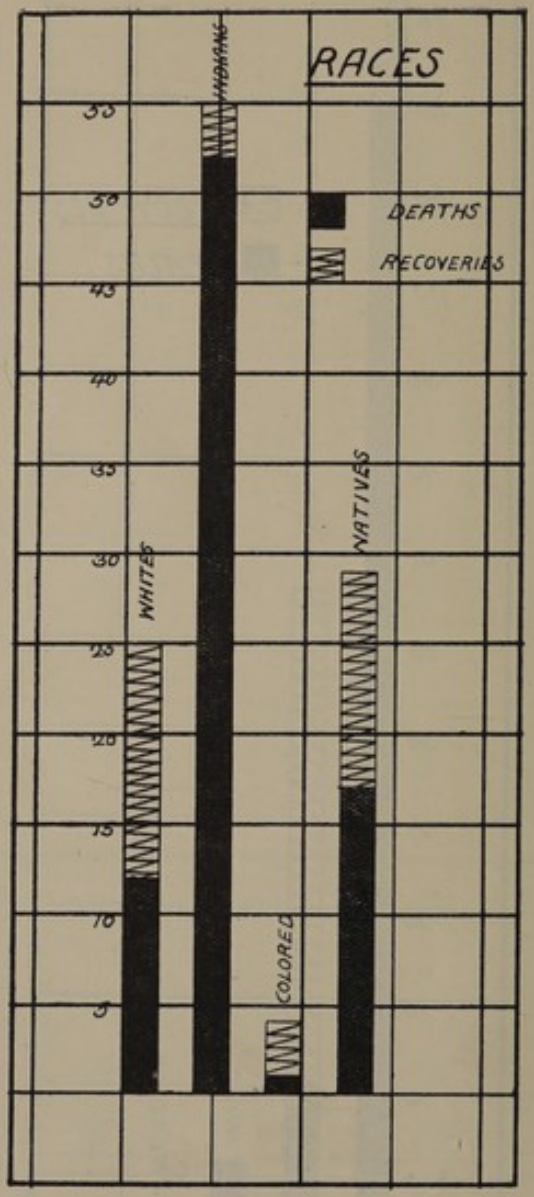
15
10
5
PNEUMONIC
BUBONIC
MIXED
SEPTICAEMIA
RECOVERIES
DEATHS

CHART IV.


RACES
INDIANS
DEATHS
RECOVERIES
NATIVES
WHITES
COLORED
35
30
25
20
15
10
5

INCIDENCE.

The white population of Johannesburg at the time of the Census on April 18th was 83,902. 25 white cases occurred, showing an incidence of 0.29 per thousand.

The total coloured population was 74,678, and the total coloured cases was 88, shewing an incidence of 1.17 per thousand.

At the time of writing the report the figures shewing the number of Indians, coloured people, and natives were not available. By the courtesy of the Secretary of Asiatic Affairs it has been found that the probable number of Asiatics in Johannesburg on the 18th March was 5,500. As there were 55 cases among the Indians, the incidence was 10.0 per thousand.

If the total population is taken, that is, both white and coloured, the incidence is 0.77 per thousand.

RACE.

Of the total cases there were :—

25	Whites, a percentage of	22.1
55	Indians, ,, ,, ,, ...	48.6
4	,, people, ,, ...	3.5
29	Natives, , , ,, ,, ...	25.6
113		99.8

There were 113 cases in Johannesburg, and of these 82 died, shewing a mortality of 72.5 per cent. (Throughout the whole Rand there were 123 cases, with 85 deaths—a mortality of 69.1 per cent.)

There were 25 white cases, 14 males and 11 females ; of these 12 died, 6 males and 6 females. The white mortality was, therefore, 48 per cent. The male mortality was 42.8 per cent., and the female 5.45 per cent.

There were 55 Indian cases, with 52 deaths, a case mortality of 94.5 per cent. All the people affected were males.

There were four cases occuring in coloured people other than Indians and Natives, with only one death, a case mortality of 25 per cent.

There were 29 cases among natives—28 males and 1 female—with 17 deaths—16 male and 1 female. The native case mortality was thus 58.6 per cent.

The cause of the outbreak among the various races is certainly peculiar. On the week ending the 19th March, there were 25 Indian and 2 Coloured cases. During the next week there were 25 Indian, 7 White, and 5 Native, and 1 Coloured cases. During the week ending April 2nd there were only two Indian cases, and 4 Whites and 6 Natives attacked. From this date to the termination of the outbreak not more than one Indian was attacked in any week, the cases being chiefly confined to Whites and Natives.

The following chart gives the cases from the commencement to the finish, distributed in the above manner : —

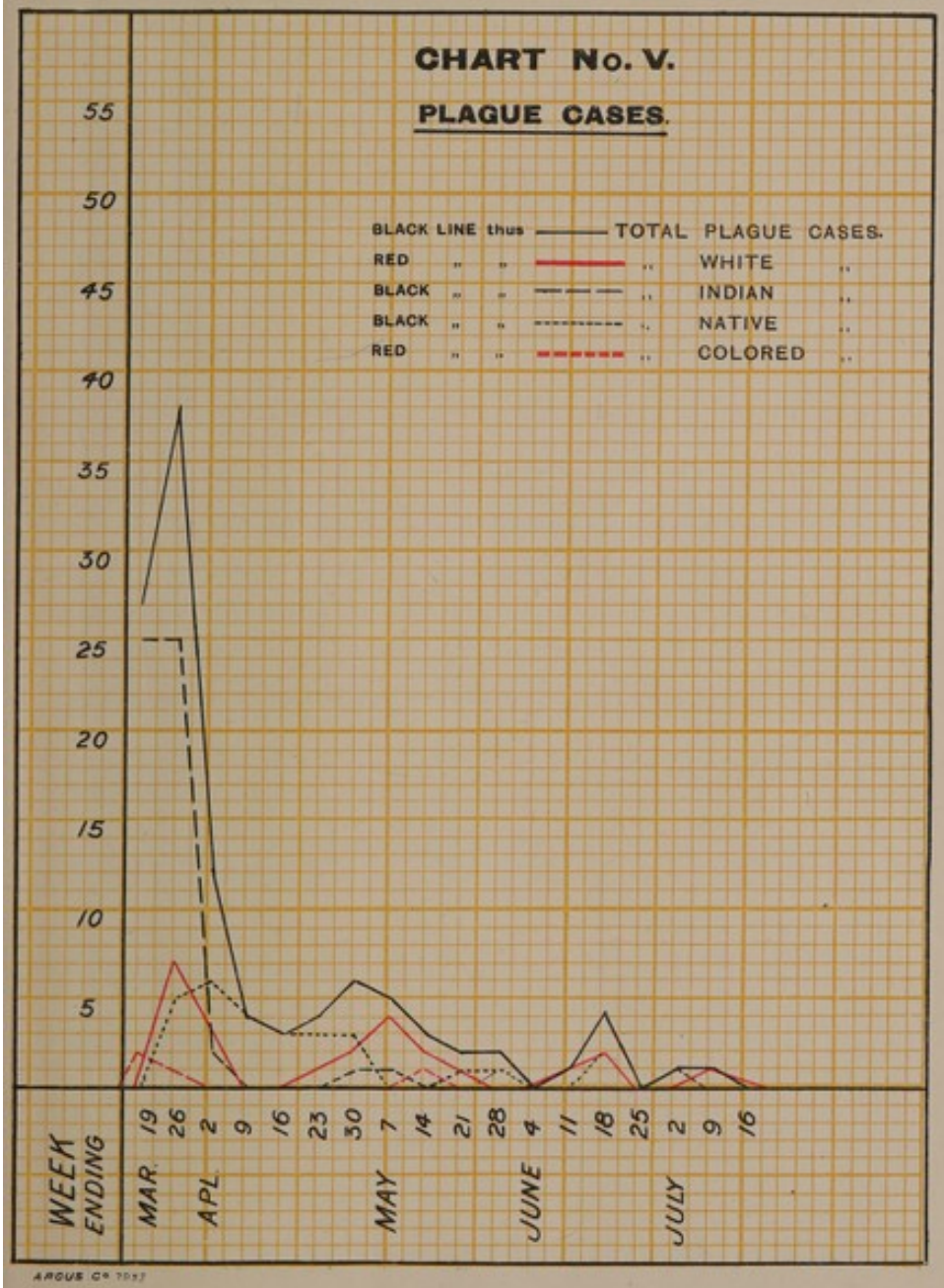
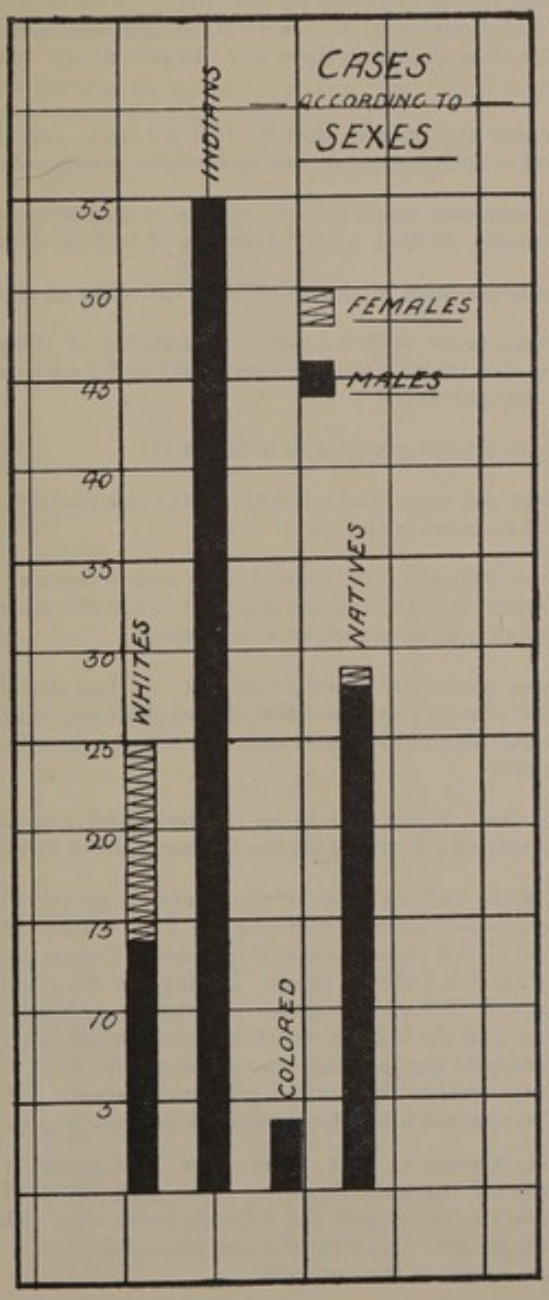


CHART No. V.
PLAGUE CASES.
BLACK LINE thus ——— TOTAL PLAGUE CASES.
RED " " ——— " WHITE "
BLACK " " - - - - " INDIAN "
BLACK " " ---------- " NATIVE "
RED " " - - - - - " COLORED "
55
50
45
40
35
30
25
20
15
10
5
WEEK ENDING
MAR. 19 26
APL 2 9 16 23 30
MAY 7 14 21 28
JUNE 4 11 18 25
JULY 2 9 16
ARGUS Co

SEX.—The small number of females attacked is at first sight very surprising. There were only 13 altogether, of whom 11 were Whites, 1 Coloured, and 1 Native. The fact is, however, not so surprising when it is remembered that there were comparatively few female Indians in the location. The vast majority of the Indians in Johannesburg are young male adults. The same applies to the natives. There is a large male population, but the number of females is very small. On the mines which were infected, and in fact on all the mines the natives live in compounds, and females are not allowed to reside in the compounds. Even in the Locations, the number of women was comparatively small.

CHART VI.



AGE.—The small number of cases and the comparatively large proportion of contacts make any deduction regarding age incidence of little value. Among the Indians the great majority of those affected were young adults, but, on the other hand, a similar majority of young adults is found among the Indian inhabitants of Johannesburg. Of the 25 White cases, 8 were infected by direct contact ; of the remainder the youngest was a child of two months, the oldest a man of 47.

TYPE.—The distribution of the cases from the point of view of the type is interesting. In determining the type the whole history of the case has been taken into account after the event; that is to say, if the case died, the post-mortem appearances and bacteriological examination have been taken together. The pure pneumonic cases were those in which no buboes could be found, but in which there was definite broncho-pneumonia. The mixed cases were those in which there was definite broncho-pneumonia, as well as buboes, and the B. Pestis was recovered both from the foci in the lungs and from the bubo. The septicaemic cases were those without either signs of pneumonia or buboes.

It will be seen that out of 113 cases no less than 67 were of the pneumonic type, that is 59.2 per cent. In the Natal outbreak there were 33 pneumonic cases out of 221 cases, that is, 14.9 per cent., and in the Cape epidemic there were 46 pneumonic cases out of 599 cases, that is, 7.6 per cent.

Only 44 of the cases had buboes, that is, 38.9 per cent., and this includes 6 cases who had the mixed type, that is both buboes as well as broncho-pneumonia.

There were 67 pneumonic cases with 65 deaths, a mortality of 97.0 per cent. Of the 46 cases in the Cape epidemic, 30 died, a case mortality of 65.2 per cent.

There were 38 bubonic cases, with 9 deaths—a mortality of 23.6 per cent.

There were 6 mixed cases, with 6 deaths—a mortality of 100 per cent. (of the 16 Cape cases, 13 died, shewing a case mortality of 81.2 per cent.) and 2 septicaemic cases with 2 deaths, shewing a mortality of 100 per cent.

The above facts are set out graphically in Chart III.

The bubonic cases are very similar, both in the distribution of the buboes and the mortality to those found in other outbreaks.

There were, as has been seen, 38 bubonic cases with 9 deaths. Of the 38 cases, 22 had buboes in the inguinal region, 9 in the axillary region, 1 in the cervical region. Two had buboes in two regions, and one had general glandular enlargement.

The inguinal cases were distributed as follows :—1 had double inguinal buboes, 4 had inguinal buboes, but the side was not specified, 9 had right inguinal and 8 left inguinal. Of these, two cases with right inguinal and one with left inguinal glands died, that is, 3 out of 22, a mortality of 13.6 per cent.

Out of 9 axillary cases, 6 had buboes on the right and 3 on the left side. Of these 1 right and 2 left axillary cases died, giving for the axillary cases a mortality of 33.3 per cent.

The occurrence of the various types of the disease is set out in the following chart. It will be seen that of the 27 cases occurring during the week ending 19th March, 26 were of the pneumonic type, and one mixed pneumonic and bubonic. During the second week there were 31 pneumonic, 2 mixed, and 5 bubonic cases. During the week ending the 2nd April there were only 6 pneumonic and 6 bubonic cases. During no succeeding week was there more than one pneumonic case and there were only four more pneumonic cases during the whole of the outbreak, and this despite the fact that every succeeding week was one week further into the winter, and, therefore, within the normal pneumonic season, The pneumonic form had, therefore, practically disappeared after the third week and was replaced by the bubonic form.

It may be said, therefore, that there were two parts to the outbreak, first the pneumonic part, and second the bubonic part. The majority of the pneumonic cases were probably infected by direct contact, and the bubonic cases were either cases of place infection by rats or contact, in the majority of cases place infection. This will be referred to later when discussing the origin of the outbreak.

THE RELATION OF RACE TO TYPE appears to be quite different to what has been found in other outbreaks.

Out of 25 White cases, 7 were pneumonic in type, 16 bubonic, and 2 septicaemic.

Out of 55 Indians attacked 48 suffered from the pneumonic form, 2 from the mixed, and only 5 had the bubonic form.

Of the Coloured cases, 4 in number, 3 were bubonic and 1 mixed.

Of the 29 Native cases, 12 had the pneumonic form, 14 the bubonic and 3 the mixed form.

Of 67 pneumonic cases, 7 were White, 48 Indian, and 12 Native.

Of 38 bubonic cases, 16 were White, 5 Indian, and 3 Coloured, and 14 Native.

Of 6 mixed cases, 2 were Indian, 1 Coloured, and 3 Native.

Both septicaemic cases were white.

OCCUPATION. — The various occupations of the cases have been set out in Table I. Collected together they are given in the following table :—

TABLE III.

OCCUPATIONS.

Hawkers	11
Labourers	25
Newsboys	8
Storeboys	6
Match-makers	6
Storekeepers	4
Shoemaker	1
Housewives	2
Clerks	2
School children	6
Hospital attendants	2
Medical men	1
Trolley drivers	1
Children	2
Washing people	4
Nurse	1
Carpenters	2
Cigar maker	1
Waiters	2
Kitchen boys	5
House boys	5
Engine Stoker	1
Photographer	1
Vagrant	1
Tailoress	1
Scene Shifter	1
Sanitary Boy	1
Not known	10
	113

In order to arrive at an idea of the effect of the occupation in the incidence of the disease it is obvious that all those cases infected by contact should be excluded. In one of the following tables, Table IV., the occupation of the non-contacts are given :—

TABLE IV.

OCCUPATION OF THE NON-CONTACTS.

	Whites.	Indians.	Coloured.	Natives.	TOTAL.
Carpenters	2	—	—	—	2
Waiters	2	—	—	—	2
Laundry Workers ..	1	1	—	2	4
Photographer	1	—	—	—	1
Housewife..	1	—	—	—	1
Vagrant	1	—	—	—	1
Clerk	1	—	—	—	1
Tailoress	1	—	—	—	1
Scene Shifter	1	—	—	—	1
Storekeeper	1	1	—	—	2
School Children	1	—	—	—	1
Domestic	1	—	1	9	11
Children	1	1	—	—	2
Labourers	—	1	1	10	12
Cigar-maker . ..	—	1	—	—	1
Hawker	—	1	—	—	1
Store Boys	—	—	—	3	3
Sanitary Boy	—	—	—	1	1
Engine Stoker	—	—	—	1	1
Unknown	2	2	—	—	4
	17	8	2	26	53

TABLE V.

OCCUPATIONS OF THE CONTACTS, *I.E.*, THOSE ON THE CONTACT CHART, TOGETHER WITH THE FEW POSSIBLE AND PROBABLE CONTACTS.

	Whites.	Indians.	Coloured.	Natives.	TOTAL.
Housewife	1	—	—	—	1
Clerk	1	—	—	—	1
School Children	3	—	2	—	5
Hospital Attendant	1	—	—	1	2
Medical Man	1	—	—	—	1
Nurse	1	—	—	—	1
Hawkers	—	9	—	—	9
Labourers	—	11	—	2	13
Newsboys	—	8	—	—	8
Store Boys	—	3	—	—	3
Matchmakers	—	6	—	—	6
Storekeeper	—	2	—	—	2
Shoemaker	—	1	—	—	1
Trolley Driver	—	1	—	—	1
Not known	—	6	—	—	6
	8	47	2	3	60

EXPLANATION OF TABLE.

Of the two carpenters, one was infected at his place of residence—of the other no information is forthcoming.

Of the two waiters, one was living on the premises where she was working and was probably infected from the room in which she lived, the other was infected at the place he worked.

Of the 4 cases who were either laundry people or wash-boys or girls, there is no evidence as to the source of infection, each was a single case unconnected with other cases either preceding or succeeding. The only suggestion, therefore, is that they were infected from the clothes. It is certainly significant that of the four cases both Natives and the Indian had the pneumonic form, the White being the only bubonic case.

The photographer contracted the disease in his residence, living, as he was, with his brother the carpenter in a room in the Market Buildings.

The housewife contracted the disease at her residence.

The vagrant happened to be both sleeping and working where plague rats were found.

The clerk possibly picked up the infection at his residence, but there is no evidence. whilst much the same applies to the tailoress.

The scene-shifter lived in a place where dead rats were found and worked in a place where plague rats were found.

Of the two store-keepers, one lived at a place where no plague rats or dead rats were found, the other, a dealer, lived in the next room to a case which had occurred over two months before.

The schoolgirl contracted the disease at her residence.

Of the domestics, 5 were kitchen boys in restaurants—four of them living on the premises ; four were house-boys, all living on the premises ; and two were domestic servants, also living on the premises. On three of the premises plague rats were found, on five dead rats, and on two of the premises no rats were found.

Of the two children, one lived at the Coolie Location, and one lived where no plague or dead rats were found.

Of the 12 labourers, two resided in the Coolie Location, and were, therefore, probably in contact with the patients or infected houses, 3 were seeking work and spent a considerable part of their day in or near the Native Pass Office where plague infected rats were found, one resided at a place where dead rats were found ; of 6 no information can be obtained.

Of the cigar-maker, nothing is known as to the source of the infection and the same applies to the hawker. Of the three store boys, two lived or were working where plague rats were found, and one lived where dead rats were found.

The sanitary boy probably contracted the disease in the course of his work, although dead rats were found in the compound in which he was living.

The Engine Stoker lived where plague rats were discovered.

Thus of the 49 cases of which something is known, there are 30 connected with plague or dead rats, 19 either unconnected or about which the method of infection is unknown. Of the 30 cases, 25 are connected with rats at their residences and only 5 at the place of work.

The shortened summary of these facts is as follows .—

Contacts	55	
Probable Contacts	5	= 60
Possible Contacts		4
Connected with Plague Rats,	15	
Connected with Dead Rats	15	= 30
Untraceable		19
		113

MODES OF DISSEMINATION.

In considering the modes of dissemination of the disease, the two distinct portions of the outbreak which were quite different in respect of this point must be considered. A glance at Chart I., on page 3, shews that during the first fortnight 57 cases out of 65 cases were pneumonic and 3 pneumonic with buboes ; in other words that 60 out of 65 may be classed as of the pneumonic type.

Reference to Chart V., on page 17, shews that, during the same two weeks, 50 of the 65 cases were Indians, and the Chart contains no less than 52 of the 65 cases. These facts taken together shew that, during the first fortnight at least, rats could have had little to do with the spread.

The first 65 cases occurred in 33 places. Of these, 27 cases occurred in 12 places of the Coolie Location, and 6 cases occurring in 6 places were probably infected from the Coolie Location. 9 of the 33 places were responsible for 41 cases. In 6 of the 65 cases there is no evidence of the method of infection. In one there is evidence of rat infection. If, therefore, it is allowed that 7 are probably rat infection, there are no less than 58 where there is strong evidence that rats did not take a part in the dissemination of the disease. It must be further remembered that although these 65 cases are shewn as occurring during a period of two weeks, the whole of the number occurred between 18th and 26th March, *i.e.*, 8 days only.

During the 15 succeeding weeks there were 48 cases occurring in 39 places. There were 6 places giving rise to 15 cases and 33 places in which only single cases occurred.

Two of the cases—Nos. 110 and 111—occurring in one place were contacts, and are on the Chart at the end.

Three cases—Nos. 113, 124, and 143—came from the Native Pass Office and occurred on 29/3, 31/3, and 5/4 respectively. As the neighbourhood of the Pass Office was rat infected and as these boys were all out of employment, it is probable that they were not infected one from the other, but from the place.

Two cases—Nos. 146 and 147—came from Stand 442, Marshall Street, and as they failed with only one day's interval it is possible that they were both infected through the medium of rats. On the other hand both boys were sleeping in the same room, and the first to be taken ill suffered from the pneumonic form and the second from the bubonic form. This may, therefore, despite the short incubation period, be a case of true secondary infection.

Four cases—Nos. 174, 188, 192, and 193—came from the Market Buildings; two White cases slept in the same room where plague rats were found and failed on the same day ; the other two cases came from different parts of the Market Buildings and were, so far as is known, unconnected, indeed one lived in the bulidings and one only worked there. These must be considered as primary cases connected with rats.

Two cases—Nos. 234 and 235—came from Stand 450, Anderson Street. One a school-girl, who failed on the 15/6, and the other a domestic servant in the same house, who failed on 16/6. Dead rats were found on the premises; both suffered from the bubonic form and, therefore, these must both have been primary cases.

Two cases—Nos. 67 and 232—came from 90, Becker Street, the first occurring on 28/3, and the second on 8/6. The second slept in the adjoining room to the one which had been occupied by the first case. As over two months interval elapsed between the two cases, it is possible that both cases were primary ones ; but, although the house was thoroughly disinfected after the first case had been removed, it had not been rendered rat-proof and, therefore, it is probable that the rats remained and kept up the infection. Indeed rats were found upon removing the floor after the occurrence of the second case.

Put in tabular form these figures may be thus represented :—

TABLE VI.

	Cases.	Places.	Proportion.
1st Portion ..	65	33	1·93 : 1
	41	9	4·55 : 1
	24	24	1 : 1
2nd Portion ..	48	39	1·25 : 1
	15	6	2·5 : 1
	33	33	1 : 1

Adding these together, we get during the whole of the outbreak :—

TABLE VII.

Cases.	Places.	Proportion.
113	72	1·56 : 1
56	15	3·71 : 1
57	57	1 : 1

THE CLINICAL ASPECTS OF THE DISEASE.

There is little to be said concerning the clinical aspects of the disease as it occurred in Johannesburg. In the first place the number of cases was comparatively small as compared with the Cape Colony or even Natal. In the next place it was impossible under the circumstances, to arrange for one Medical man to be in charge of the Plague Camp during the whole of the period. Further, very few of the pneumonic cases ever reached the Plague Hospital, and of those who arrived there, several died almost immediately after admission.

The bubonic cases were in no way uncommon. The mortality very nearly approximated the mortality of other outbreaks, the distribution of the buboes, the onset, the history of the bubo and so on, differed in no material points from the already published descriptions of these several features.

As regards the pneumonic cases, except in a few instances, no histories of the onset could be obtained because the patients were moribund by the time they were first medically treated. Of the few who were seen before the disease really developed, the average clinical history is as follows :—

The patient began to feel chilly and complained of pains in the back and headache. The temperature was not then much raised, and the pulse and respiration were practically normal. On the following day, definite symptoms pointing to a pneumonic condition had set in, with raised temperature, pulse and respirations, and generally some scanty but blood-stained expectoration. The pulse, although quickened, was full. Moist râles could be heard perhaps in one or two places. The prominent features, however, were that the condition of the patient as seen in the faeces, was, out of all proportion, grave in comparison with the physical signs and symptoms, and that the patient complained of a pain in and a sense of constriction round the chest. Some 36 hours after the onset, the pulse began to " run " and the breathing became laboured. From this time onward, it was obvious that the patient was in a very precarious condition. The heart did not respond to stimulation, and the patient began to get delirious. Despite all treatment the patient's condition became worse and worse, until he died, generally within 72 hours after the onset. The fatal termination in the cases of some of the Asiatics appeared to have taken place within 48 hours after their complaining of feeling ill.

There were two recoveries only of patients who suffered from pneumonic plague. In both cases the patients were desperately ill for many days, and gradually recovered, the temperature falling by lysis, and the improvement being so slow as to be practically imperceptible.

Whether the pneumonic cases in the Johannesburg outbreak were of a more fatal type than in the Cape Colony or Natal, or whether the sufferers were more susceptible is impossible to determine, but the case mortality was certainly much higher than in either of the other colonies. In another portion of the report (p. 96) the question of diagnosis is discussed. It is admitted that in Natal certain phenomena were observed similar to those observed in the Transvaal. In this report the cases which were at first returned as positive, but which were subsequently found to have been negative, have been deducted. Whether this has been done in other Colonies is not stated. With the evidence of Natal and the Transvaal, however, it seems by no means impossible that cases may have been diagnosed as pneumonic plague from the microscopic examination of the sputa which were not cases of plague at all. The fact, also, of so many previous cases of probable plague which occurred in Johannesburg before the disease was diagnosed, points to the enormous difficulty of diagnosing pneumonic plague when the presence of plague is not suspected, and the converse may hold. Cases of fulminating pneumonia during an outbreak may be diagnosed clinically, and even microscopically as plague, when they are not plague at all. How the fact is to be explained is not evident, but the Case Mortality of the Johannesburg Pneumonic Plague cases is very much higher than it was either in Natal or the Cape, and those who attended the Johannesburg cases certainly looked upon Pneumonic Plague as one of the most fatal diseases occuring in man.

PATHOLOGICAL ANATOMY.

The experience gained in the Rand Outbreak has confirmed the general descriptions of the post-mortem appearances of patients dying of the bubonic and septicæmic forms of plague. These appearances need not be recapitulated since they very closely resemble those detailed in connection with animal experiments, v.p. 92

In the pneumonic cases with which the outbreak commenced, however, the post-mortem appearances did not tally with the usual description. Captain Gordon Tucker, I.M.S., thus describes the post-mortem appearances seen after death from pneumonic plague :—

" At the autopsy acute congestion is found in all the internal organs, and the big veins of the thorax and at the root of the neck are distended with blood. The lungs are large and very heavy when they are removed and show all over the surface extensive ecchymotic patches beneath the visceral pleura. On cutting across the lung it is found filled with large masses of consolidation which are scattered irregularly throughout the organ, and which are surrounded with intensely congested and soft areas. The bronchi are filled with much frothy blood-stained fluid. The spleen is large and very soft and full of blood. The liver is in a similar condition, and all mucous surfaces are injected."

In the great majority of cases no such appearances were found. There was no obvious engorgement of the big veins of the thorax and at the root of the neck ; the lungs were neither abnormally large nor heavy ; there were no ecchymotic patches beneath the visceral pleura ;

the masses of consolidation rarely exceeded the size of a hazel nut ; the areas surrounding the patches of consolidation were not surrounded by intensely congested and soft areas. The spleen was neither enlarged nor soft ; the liver was normal and no signs of injection of the mucous membranes could be made out.

The post-mortem appearances were those of a broncho-pneumonia, signs of pleurisy were common and there was an extensive fibrinous exudation ; occasionally there was fluid in the pleura of a peculiar greenish hue. The absence of any enlargement of the spleen was very noticeable ; when it was examined bacteriologically it was found that the B. Pestis was very difficult to find, whereas in the lung the organism was very abundantly present. The heart-blood of the earlier cases was examined and although the B. Pestis was present, it was present in very small numbers. These facts probably explain the atypical appearances. An examination of the lungs does not reveal sufficient pneumonic lung to account for death ; it seems obvious therefore that in some of the pneumonic cases death is due to toxæmia and not to septicæmia. This being the case, the absence af septicæmic symptoms or appearances would necessarily follow.

The presence of the B. Pestis in the lungs and even in the sputum of purely bubonic cases during the latter stages is difficult to explain, but in one case the B. Pestis was present in the sputum some 24 hours before death from the bubonic form and absolutely no lung lesion to be seen at the autopsy.

PREVIOUS CASES OF PNEUMONIA.

In order to endeavour to trace the origin of the outbreak, a considerable amount of investigation had to be undertaken concerning all the previous deaths occurring in the location and elsewhere. As no real solution of the problem has been arrived at, it will not be out of place to put upon record every fact which has been discovered : this for two reasons, first, in order that, should no further facts come to light, the conclusions of the writer may be accepted or rejected upon the consideration of the facts upon which the conclusions are based, and second, that should any facts subsequently come to light, these may be added to those now published.

A very careful search through the death returns for several months before the 18th March, 1904, fails to reveal any probable case of bubonic plague (as distinguished from pneumonic plague) with the exception of Cases VII. and XIV. recorded below. In order to arrive at the first probable case of plague, therefore, it was necessary to rely upon the previous pneumonia cases.

The deaths from pneumonia among the coloured population were, therefore, taken from the returns and as the plague outbreak began in March it was considered that the most useful period would be October to April.

As a comparison the figures for the corresponding period, 1902–1903, were compiled.

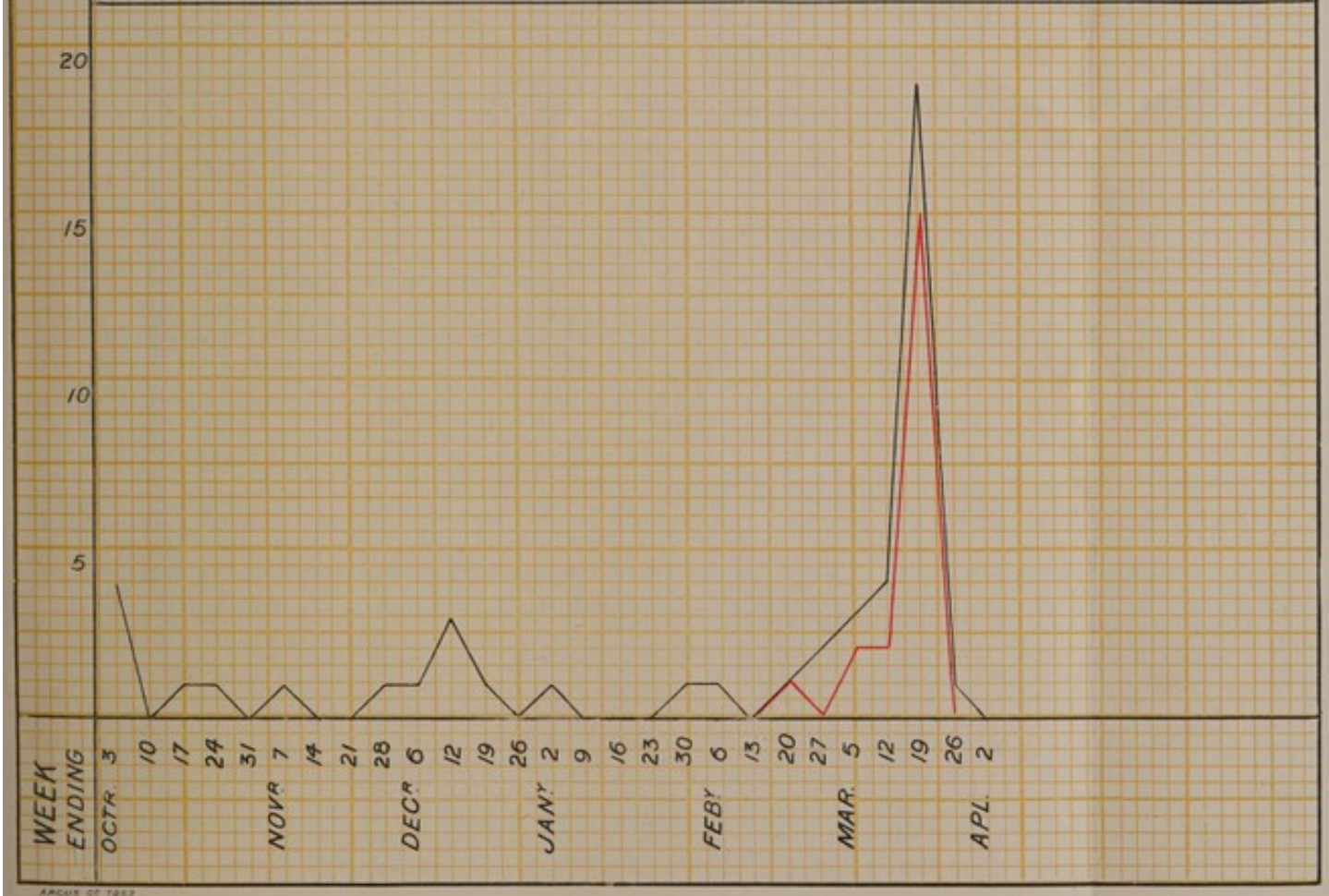
Pneumonia is a disease on the Witwatersrand, which, among the natives, accounts for almost as many deaths as all other diseases. When in March, 1904, therefore, there appeared a slightly increased death-rate from pneumonia, it apparently aroused the suspicions of no one. There had been the greatest number of cases of pneumonia during the week ending 19th March. The death returns for this week were not received until the early days of the week ending 26th March. There was practically nothing, therefore, which could lead the Health Authorities to suppose that the town was on the verge of an epidemic even of pneumonia.

CHART No. VII.

CHART OF DEATHS FROM PNEUMONIA AMONG INDIANS FROM OCTOBER, 1903, TO APRIL, 1904.

RED LINE INDICATES PROBABLE PLAGUE CASES.

NOTE.—THE CASES BEFORE THE 20TH FEBRUARY ARE TAKEN FROM THE REGISTRAR OF DEATHS RETURNS, AND THOSE SUBSEQUENT ARE THE ACTUAL DEATHS.



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The Registrar's returns being made up from the deaths recorded during the preceding week, do not necessarily contain all the deaths occurring in that week. Chart VII. shews the deaths from pneumonia among the Indians. The numbers before the 20th February are taken from the Registrar's returns, but after that date the figures are compiled from the actual dates of death. This shews the true curve, and the sharp ascent from the 12th March to the 19th March, would undoubtedly have been observed by the Health Authorities when the returns had been received even if no outbreak of Plague had been diagnosed. The red line indicating the probable plague cases shews what is in all probability the actual beginning of the epidemic among the Indians ; (this red line was obtained as a result of what follows).

As there was very little information to be obtained from these curves, nothing remained but to obtain as full histories as possible of all the deaths from pneumonia occurring among the Indians.

The following account, as well as a great deal of the information concerning the subsequent early plague cases, is taken in the main from the notes of Messrs. Pinching and Firth, who, throughout the investigation, shewed an amount of intelligence and zeal which cannot be too highly praised.

Although the account which follows appears almost in chronological order from the earliest to the latest cases, the actual investigation had to be conducted in the reverse order. The difficulties encountered can be imagined when it is remembered that—

1.—There was a comparatively large number of almost unknown Indians suddenly dying.

2.—Many relatives and friends died almost synchronously, leaving very few people who knew anything of their history.

3.—Immediately it was known that plague had broken out, every house from which a case had come was immediately disinfected, evacuated, and closed, and, in consequence, the inhabitants were scattered throughout the location.

4.—By April 1st the whole of the inhabitants had been transferred to Klipspruit, where they were still further scattered.

5.—When they returned to Johannesburg it was often extremely difficult to find anyone who could give any information concerning some of the cases.

Had there not been all these difficulties, it is probable that a much more perfect chain could have been presented.

There is no evidence of any plague cases before the outbreak of plague except among the Indians, with the exception of one case in the Location. Further, except at two or three spots outside the Coolie Location, all these cases appear to have occurred among the inhabitants of the Coolie Location.

As far as can be ascertained, the first possible cases occurred early in January, 1904.

Case I.—Govinda Amma, a girl of 8, residing with her father, Marrimatin, at 71, Brickfields, was taken ill on January 3rd. On January 5th she died and was certified as having died of pneumonia and heart failure.

On January 12th, the father, Marrimatin, became ill and died on January 16th, also of pneumonia.

No further case occurred at this address, nor can any connection be traced between these cases and any subsequent cases of pneumonia.

Case II.—Chinnamah, a girl of 7, living at Stand 65, Coolie Location, died on January 5th. She was known to have coughed a great deal and to have spat up blood.

On 27th January her father, Moonasammy, also died, apparently of pneumonia.

Nothing further can be traced from these cases.

Case III.—Sumnariah, a child of 6, died at Stand 17, Coolie Location, on 19th January. Her father, Seeballuck, died on the same Stand on 21st January. There appeared to be no extension from these cases, the wife and three other children all being alive on June 17th, 1904.

Case IV.—Korry Pathia, a confectioner living at Stand 32, Indian Location, was taken ill on January 21st and died on January 24th, being certified as having died of broncho-pneumonia.

Case V.—Navarajee, an Indian store-keeper, living on Stand 45, Coolie Location, died on the 26th January. A friend of Navarajee's, who knew him very well remembers his illness, and, although he did not know what was the matter with him, remembers that he used to cough considerably, and to spit up blood. The doctor who attended him once, has kindly given me the following information :—

He remembers that one day towards the end of January, an Indian whom he had known for some years, asked him to go to the Location to see another sick Indian. He went soon after 4 o'clock in the afternoon and found the patient in an almost pulseless condition, and informed the Indian in attendance that he did not think the patient would live through the night. When the doctor visited him next day he found the patient dead and certified the cause of death as pneumonia.

Case VI.—Behari Singh, a municipal labourer, living on Stand 69, Coolie Location, was ill for only a few days and died of pneumonia on 26th January.

Case VII.—Doman Talu, living at Stand 2, Coolie Location, a rent collector for the Municipality, was taken very suddenly ill, at the end of January and died on February 3rd, 1904. The doctor in attendance has kindly given me the following account :—

" On the 1st February I found Talu suffering from fever, with (if I remember rightly) some pain in the abdomen. On the 2nd I found the temperature less, but there *was*, I am sure, pain in the right iliac region and a swollen inguinal gland on the right side about the size of a pigeon's egg. At 3 a.m., on February 3rd, I was sent for, found the man dead, the gland slightly increased in size and a distinct swelling in the pelvis on the right side about, apparently, the size of my fist. I may mention that on the 2nd February I searched for any wound or abrasion, but could find none."

Doman Talu's brother-in-law points out that he collected the rents throughout the Coolie Location and from among many other, the houses in the Brickfields, where cases of illness were occurring, and that, therefore, it was very probable that he came in contact with some of the sick people. If this was a case of Plague it was of the bubonic type. This and Case XIV. are the only possible cases of bubonic plague that can be found in the death register before the 18th March. No further cases appeared to have arisen from it.

(The case was reported to the Medical Officer of Health, Johannesburg, on February 4th, 1904, and was visited by the Infectious Disease Inspector. It was found that in the meantime the body had been removed to Natal for burial, and no further information could be obtained. The premises, bedding and clothing were thoroughly disinfected and the place kept under observation for 8 days. No further illness, however, occurred.)

Case VIII.—Suchia Maharaj, living on Stand 69, Coolie Location, died on 3rd February, after an illness of four days. This man lived on the same Stand as Case VI., who died on 26th January, and it is known that Suchia attended Case IV., who died on 24th January, during his illness, and that he was actually present when he died. There appears, however, to have been no further case of illness on this Stand.

Case IX.—Tom Nesabi, a Basuto, was in the employ of a store-keeper at Stand 12, Coolie Location. Tom, according to his mother's statement, was quite well, until the evening of February 12th, when he complained of being giddy and of having pains in his head and chest, and on the following morning he began to cough a great deal and to spit blood. His mother gave him some medicine, which appeared to ease his cough, but he got worse and died on the 15th February, the cause of his death having been certified as pneumonia.

Tom did all the rough work in the store, carrying sacks of rice, cleaning up the shop and so on. His employer states that there were no rats in the store, but his mother states that Tom had a dog which used to kill the rats and that the dog died shortly before Tom.

The Native is exceptionally susceptible to pneumonia on the Rand, and there would be nothing astonishing in a Native dying of pneumonia even in February. The coincidence of his being a store boy, of the death of his dog and his own demise, certainly point to the possibility of his having died of plague, and this possibility is increased by the further coincidence of the next case.

Case X.—Miss Cama, a girl of 11 years, lived in Stand 16, Coolie Location, immediately adjoining Stand 12. It is known that prior to the illness of either of them the two were frequently together. About the middle of January the child was suffering from tonsilitis, and the medical man in attendance states that she had a mild pneumonic attack following the tonsilitis, and that she died suddenly of heart failure after practically recovering from the pneumonia. The child's father says, however, that she was allowed up, caught a fresh cold and died on 19th February, *i.e.*, 4 days after the death of Case IX. The position of the room of Case IX. in the Stand would have allowed her easy access to it, and it is not at all unlikely that the child, knowing the boy well, would have visited him when she knew he was sick.

Case XI.—Hoosan Csanda, died on 18th February, 1904, at No. 10, Dam Street. Nothing but the bare fact can be discovered concerning this Indian.

Case XII.—Naran Bhula, a hawker, living on Stand 32, Coolie Location, became ill on February 26th, and died on February 27th, the cause of his death being certified as pneumonia. On the same Stand, Korry Pathia (Case IV.) died on 21st January.

Case XIII.—Pema Valla, a hawker, living on Stand 83, Coolie Location, died on February 27th, after a very brief illness, of pneumonia. He was very friendly with, and constantly in the company of Case XII., and, therefore, most probably came into contact with Case IV.

Case XIV.—Pargee, a labourer in the Johannesburg Cemetery, and living at Stand 54, Coolie Location, died on March 3rd, and the cause of his death was certified as abscess in left groin. He began to feel unwell on 29th February, and complained of a pain in the throat. On March 1st he went to bed. On the 2nd March a doctor was called in and opened a lump which had appeared on his left groin. The deceased told his friend that the lump in the groin was not as painful as the one on the neck. On 3rd March Pargee died. Pargee's friend and fellow-worker says that at that time there were numerous rats in the cemetery. No known connection took place between Pargee and any of the previous cases.

Case XV.—Rogi Purboo, was an underground mine labourer employed at the Ferreira Gold Mining Company, and from time to time visited and lived at Stand 47, Coolie Location. He failed on the 2nd or 3rd of March, died on 4th March, and was certified as having died of pneumonia. Rogi Purboo was very friendly with cases XII. and XIII. and nursed or helped to nurse them both during their illnesses. Indeed Rogi Purboo actually prepared Naran Bhula for burial.

Case XVI.—Govan Mitha, a labourer at the Johannesburg Brick and Pottery Works, resided at Stand 93, Coolie Location. He was taken ill on 5th March and died on the 8th, the cause of his death being returned as pneumonia. The inhabitants of Stand 93, Coolie Location, and No. 10, Dam Street, were very friendly and constantly in communication with one another.

Case XVII.—Kara Bika, a hawker living at No. 10, Dam Street, died on 9th March after 3 days' illness and was certified as having died of pneumonia. He lived at the same address as Case XI. He used to hawk fruit in and about the Simmer and Jack Mine at Germiston, and apparently used to stay on or in the immediate vicinity of the property when he did not return to Johannesburg. He returned from Germiston on the 5th March, took to his bed on 6th March, and died on the 9th.

Case XVIII.—Parboo Tikum, a hawker and shoemaker, living at Stand 520, Malay Location, died on 9th of March of pneumonia. He was in the habit of hawking fruit and vegetables in and around the Simmer and Jack Mine at Germiston. There is little doubt that Parboo Tikum and Case XVII., hawking fruit as they did at the same place, were constantly in one another's company, and it is, therefore, not unreasonable to suppose that they visited one another's residences. As they both died on the same day, the indications would seem to shew that Parboo Tikum contracted the disease at 10, Dam Street.

Case XIX.—Jaga Uka, a hawker living on Stand 89, Coolie Location, died on 10th March, after three days' illness. As no medical man had attended him, a post-mortem examination was made and the cause of death was certified as pneumonia. Dr. Mackenzie, who made the post-mortem, remembers the case and says that the appearances were quite similar to those of the cases post-mortemed on the 19th and 20th March, after the outbreak.

Jaga Uka hawked fruit on the Langlaagte Deep Gold Mining property in company with a great friend of his, Lala Kala (Case XXIV). Lala Kala lived an Stand 83, Coolie Location, *i.e.*, the same stand on which Case XIII. lived. It is highly probable that Jaga Uka visited Pema Valla during his illness.

Case XX.—Bika Veeraji, living at No. 10, Dam Street, died on 13th March after two days' illness. He was living at the same address as Case XVII., and not only looked after him during his illness, but actually slept in the same room with him and prepared him for burial.

Case XXI.—Govinda, an ironer living at Stand 22, Coolie Location, died on 13th March after two or three days' illness, the cause of his death was certified as heart disease, but it is believed that the medical attendant only saw him *in extremis*. This case cannot be connected with any of the preceding ones.

Case XXII.—Meetha Ramjee, a hawker, living on Stand 41, Coolie Location, died on 13th March of pneumonia. It is known that Meetha Ramjee was friendly with Case XVI., who died on 8th March and that he attended the funeral.

Case XXIII.—Uka Valla, a hawker, lived on Stand 83, Coolie Location, the same Stand as Case XIII., and died on 13th March, the cause of death being certified as pneumonia.

He traded on and around the Simmer and Jack Mine, and, therefore, probably knew Cases XVI. and XVII.

Case XXIV.—Lala Kala, a hawker, living on Stand 83, Coolie Location, died on 14th March. He hawked fruit on the Langlaagte Deep Mine property and knew Case XIX. He lived on the same Stand as cases XIII. and XXIII. and attended the funeral of XIX., in company with Vallabh Oonka, (Case XXXIV.)

Case XXV.—Prag Bawa, died on 14th March. He lived on Stand 93, and shared a small cook-house with Cases XVI., XXXI. (Chineah Mitha) and Plague Case J. 12. He assisted in preparing Case XVI.'s body for burial. He was very friendly with the residents of Stand 435, Burgersdorp, and, therefore, with the residents of 10, Dam Street, *i.e.*, Cases XI. and XVII.

Case XXVI.—Jeevana Makan, a hawker, lived at Stand 93, Coolie Location. He died on 14th March, and the cause of death was certified as pneumonia. He hawked fruit in the district of the Langlaagte mines. It is not known whether he helped to nurse Case XVI., but living on the same Stand it is probable that he came in contact with this case.

Case XXVII.—Ganesh Ramjee was a surface labourer at the Ferreira Deep Mine, and lived at Stand 47, Coolie Location. He died on 14th March and was certified as having died of pneumonia. This man lived on the same Stand as Case XV. who died on the 4th March.

Case XXVIII.—Makan Goguoo, lived at Stand 481, New Malay Camp, and died on 15th March. He was a tailor by trade. He had been working at Germiston from 1st March to 9th March, and returned on 10th to his Johannesburg residence. On the 12th he failed and died on 15th, the cause of his death being certified as pneumonia. No connection can be traced between this case and any of the others.

Case XXIX.—Moosa Mahomed, a hawker, lived at No. 10, Dam Street, and died on 15th March, the cause of his death being certified as pneumonia. He used to hawk fruit in the neighbourhood of the Simmer and Jack Mine, and, therefore, possibly knew Case XVIII. He lived on the same Stand as Cases XI., XVII., and XX.

Case XXX.—Mukan Geevan, a hawker, living at Stand 41, Coolie Location, died on 15th March. He lived on the same stand as Case XXII. and was in constant contact with the inhabitants of Stand 93 and, therefore, certainly knew one or more of Cases XVI., XXV., and XXVI.

Case XXXI.—Chineah Mitha, lived at Stand 93, Coolie Location, and died on 15th March, the cause of his death being certified as pneumonia. He lived in a small room and shared a cook-house with Cases XVI. and XXV., and helped to prepare the body of Case XVI. for burial.

Case XXXII.—Goosam Ramjee, a surface labourer at the Ferreira Deep Mine, lived at Stand 47, Coolie Location, and died on 15th March, the cause of his death being certified as pneumonia. He lived with Cases XV., XXVII., and XXXIII. (Mung Aanjee).

Case XXXIII.—Mung Aanjee, a surface labourer at the Ferreira Deep Mine, lived at Stand 47, Coolie Location, and died on 16th March, the cause of his death being certified as pneumonia. He lived with Cases XV., XXVII., and XXXII.

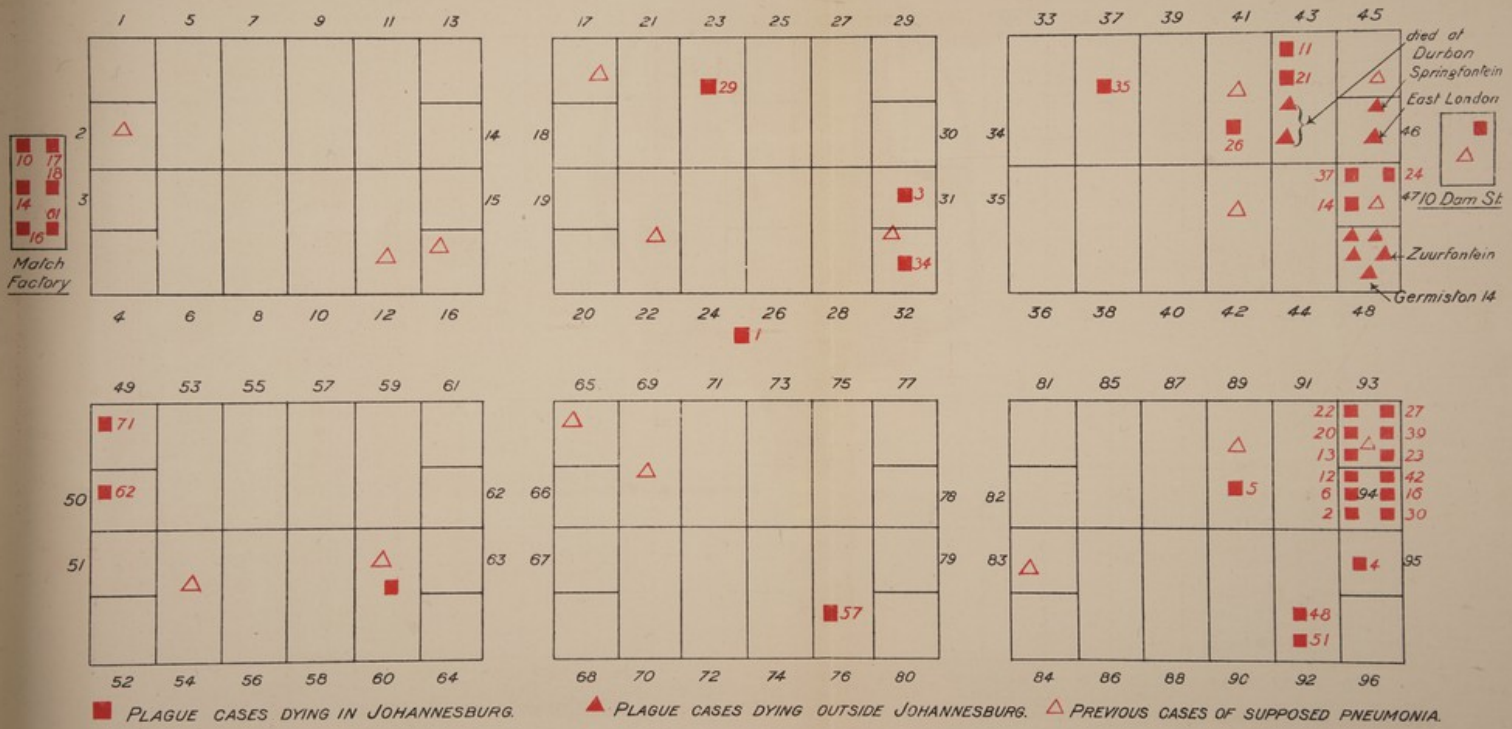
Case XXXIV.—Vallabh Oonka, a hawker, lived on Stand 89, Coolie Location, and died on 16th March, the cause of his death being certified as pneumonia. He hawked fruit in the Langlaagte district and knew Case XXIV. He was the brother of Case XIX., and lived on the same Stand. He and Case XXIV. attended the funeral of Case XIX, together.

Case XXXV.—Lana Zeena, a hawker, lived at Stand 41, Coolie Location. He died on the 17th March, the cause of his death being certified as heart disease and heart failure. He lived on Stand 41 until the 15th March, when, on account of the number of deaths occurring on that Stand he removed to Stand 22, Coolie Location. He was taken ill on the 16th March and died on the 17th.

These facts are shewn graphically in the diagram which follows:—

DIAGRAM OF COOLIE LOCATION

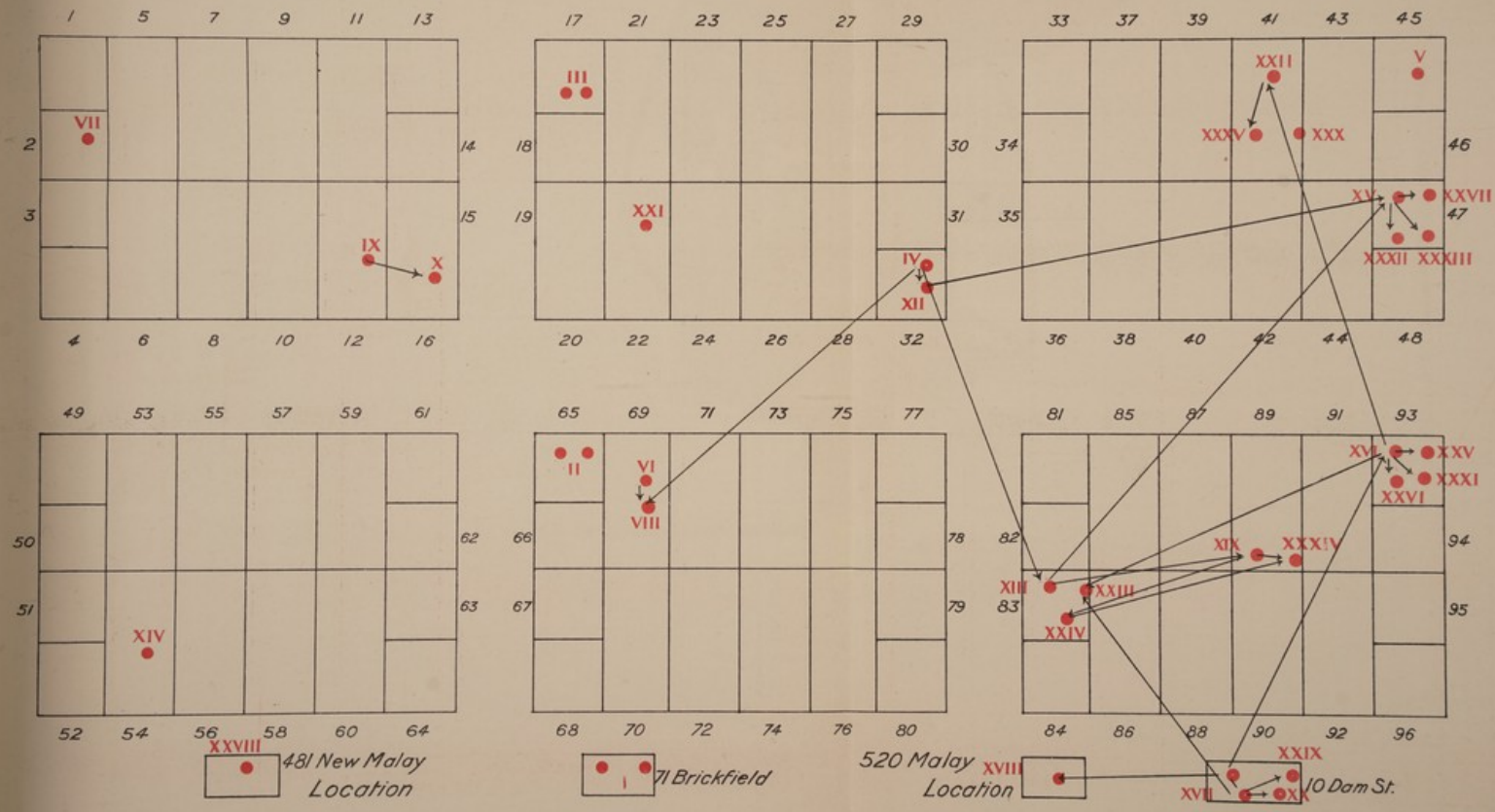
Shewing Distribution of PLAGUE CASES and of previous supposed PNEUMONIC CASES.



■ PLAGUE CASES DYING IN JOHANNESBURG. ▲ PLAGUE CASES DYING OUTSIDE JOHANNESBURG. △ PREVIOUS CASES OF SUPPOSED PNEUMONIA.

DIAGRAM OF COOLIE LOCATION

Shewing Connections between cases Dying of Supposed PNEUMONIA previous to the 19th March, 1904.



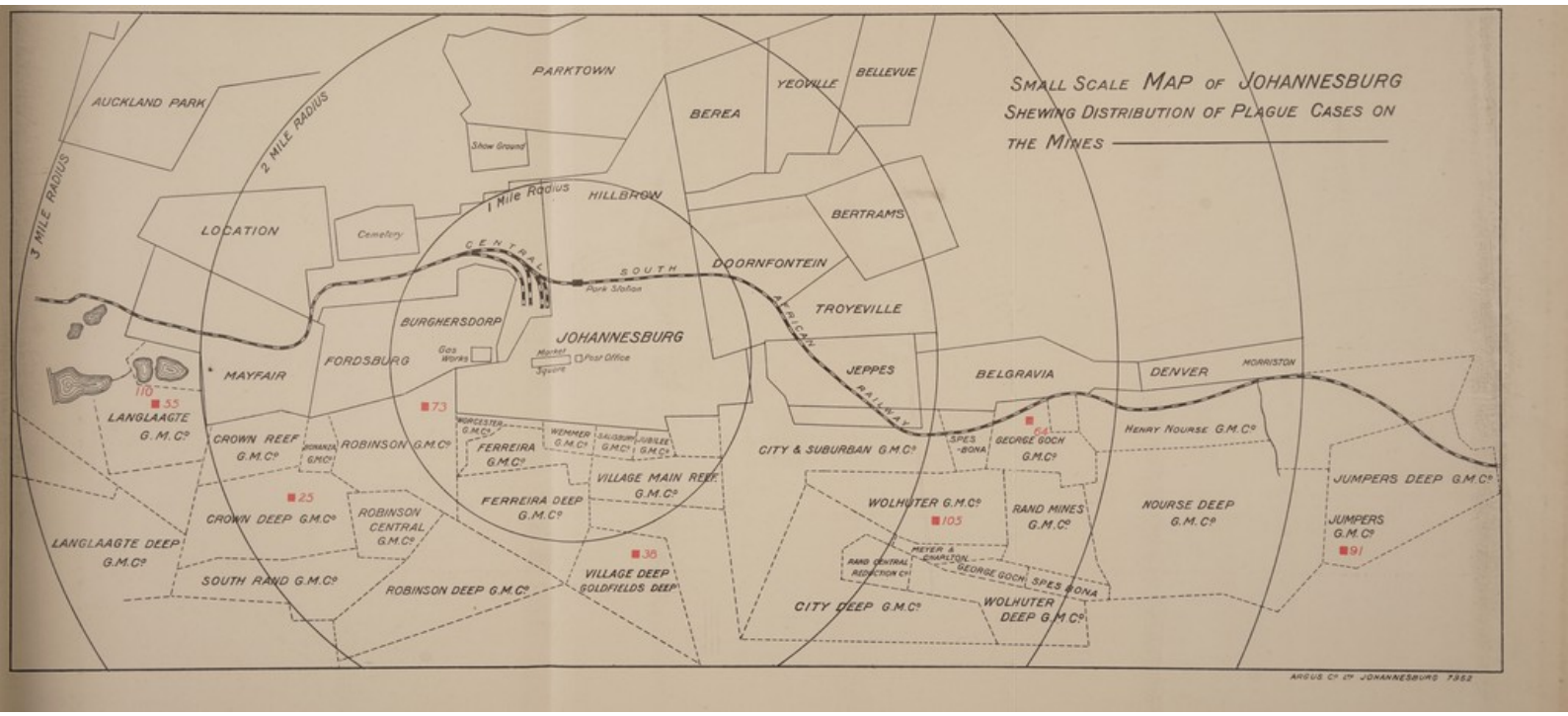

SMALL SCALE MAP OF JOHANNESBURG
SHEWING DISTRIBUTION OF PLAGUE CASES ON
THE MINES
3 MILE RADIUS
2 MILE RADIUS
1 Mile Radius
AUCKLAND PARK
PARKTOWN
BEREA
YEOVILLE
BELLEVUE
Show Ground
LOCATION
Cemetery
HILLBROW
BERTRAMS
CENTRAL SOUTH AFRICAN RAILWAY
Park Station
DOORNFONTEIN
TROYEVILLE
BURGHERSDORP
JOHANNESBURG
Gas Works
Market Square
Post Office
FORDSBURG
MAYFAIR
JEPPES
BELGRAVIA
DENVER
MORRISTON
110
55
LANGLAAGTE G.M.Co
CROWN REEF G.M.Co
ROBINSON G.M.Co
73
WORCESTER G.M.Co
FERREIRA G.M.Co
WEMMER G.M.Co
SALISBURY G.M.Co
JUBILEE G.M.Co
CITY & SUBURBAN G.M.Co
SPES BONA
64
GEORGE GOCH G.M.Co
HENRY NOURSE G.M.Co
JUMPERS DEEP G.M.Co
VILLAGE MAIN REEF G.M.Co
FERREIRA DEEP G.M.Co
WOLHUTER G.M.Co
103
RAND MINES G.M.Co
NOURSE DEEP G.M.Co
JUMPERS G.M.Co
91
25
CROWN DEEP G.M.Co
ROBINSON CENTRAL G.M.Co
LANGLAAGTE DEEP G.M.Co
SOUTH RAND G.M.Co
ROBINSON DEEP G.M.Co
36
VILLAGE DEEP GOLDFIELDS DEEP
RAND CENTRAL REDUCTION Co
MEYER & CHARLTON
GEORGE GOCH
SPES BONA
CITY DEEP G.M.Co
WOLHUTER DEEP G.M.Co
ARGUS Co LTD JOHANNESBURG 7952

Diagram II. shews the distribution of most of the early plague cases which occurred in the Coolie Location, together with the stands upon which previous cases of supposed pneumonia had occurred, and may be studied together with the Chart at the end. It is also supplementary to the two spot maps of Johannesburg.

The first Chart of the Coolie Location opposite shews the distribution of the Cases according to place. (The four places, 520, Malay Location, 481, New Malay Location, 10, Dam Street, and 71, Brickfields, although shewn on the plan, are not in their relative. positions Each of them being some distance from the Coolie Location).

It will be seen there was a great amount of intercourse between the inhabitants of certain of the Stands, particularly between Stands 32, 47, and 83, between 10, Dam Street, Stands 83 and 93, and between Stand 93, 83, and 41.

The residents of Stands 93 and 10, Dam Street, were constantly in one another's company. Some of the residents of Stand 93 were very familiar with the residents of Stand 41, and some with the residents of Stand 83. It may be presumed, therefore, that the residents of Stands 41, 83, and 93 were nearly all known to one another.

In the same manner, the residents on Stand 32 were familiar with some of the residents on Stands 47, 69, and 83, and, therefore, probably also with the residents on Stand 93, and at 10, Dam Street.

If it can be assumed that Case XI. was derived from Case IV., Case IV. was the probable start of the epidemic pneumonia, which being probably pneumonic plague, started the epidemic of plague. The infection from place to place then would be as follows :—

From Stand 32 the infection was carried to Stands 69, 83, and 10, Dam Street. From 10, Dam Street, the infection was carried to Stand 93, and for a second time on to Stand 83. From Stand 93, Stand 41 was infected, from Stand 83, Stand 89 was infected.

As regards the time, there is very little difficulty in accepting the chain of evidence from Case XII., who died on 26th February. Before that time, however, the intervals exceed the usually accepted incubation period of Plague. For instance, starting with Case IV. He, as has been seen, was directly connected with Cases VIII. and XII. Case VIII. died on 3rd February, the interval between the death of Case IV. and Case VIII. being thus 8 days : the interval between the deaths of Cases IV. and XII. being a month.

There is a possible explanation : Many of the Indians in Johannesburg have few, if any, relatives, and they often leave their clothes at their decease to their friends. Under the conditions of the Coolie Location, infected clothing would probably have remained infectious for considerable periods, and it may be, therefore, that Case VIII. handled Case IV.'s clothing a few days after the death of this case. Case XII. lived on the same stand as Case IV., there are, therefore, two possibilities : that Case XII. was infected from Case IV.'s clothing, or that the case was an example of place infection.

The sequence of events in each of the stands on which more than one death took place is as follows :—

STANDS 12 & 16.

Case IX. died on the 15th February, 1904.
Case X. died on the 19th February, 1904.

STAND 17.

Case III., Sumnariah, died on the 19th January, and her father, Seeballuck, died on 21st January.

STAND 32.

Case IV. died on the 24th January.
Case XII. died on the 26th February.

STAND 41.

Case XXII. died on the 13th March.
Case XXX. died on the 15th March.
Case XXXV. died on the 17th March.

STAND 47.

Case XV. died on the 18th February.
Case XXVII. died on the 14th March.
Case XXXII. died on the 15th March.
Case XXXIII. died on the 16th March.

STAND 65.

Case II., Chinnamah, died on the 8th January, and her father died on 27th January

STAND 69.

Case VI. died on the 26th January.
Case VIII. died on the 3rd February.

STAND 83.

Case XIII. died on the 27th February.
Case XXIII. died on the 13th March.
Case XXIV. died on the 14th March.

STAND 89.

Case XIX. died on the 10th March.
Case XXXIV. died on the 16th March.

STAND 93.

Case XVI. died on the 8th March.
Case XXV. died on the 14th March.
Case XXVI. died on the 14th March.
Case XXXI. died on the 15th March.

10, DAM STREET.

Case XI. died on the 18th February.
Case XVII. died on the 9th March.
Case XX. died on the 13th March.
Case XXIX. died on the 15th March.

The Chart at the end of the Report, shews some of the connections just described as well as others about to be described. (The black unbroken lines shew the place infections and the broken lines the contacts. The names over which there is a red square containing a number are the names of Cases, and the number is that on the Plague Register, *i.e.*, the number in Column 2 on pp. 7—10).

THE HISTORY OF THE PLAGUE CASES ARE AS FOLLOWS :—

The first is the group hanging from Haanji Haari. Haanji Haari, Jogi Nayaran, Makan Gopi, and Bahala, all lived on Stand 48, Coolie Location, that is next door to the house where Cases XXVI., XXXII., and XXXIII. had died of pneumonia on the 14th, 15th, and 16th of March, respectively. (It may be here stated that although the Coolie Location is theoretically laid out in stands, the tin shanties were put in all sorts of positions on the stands, and the place was far more like a rabbit warren than a residential place ; in consequence the whole of Stands 43 and 48 must be considered as one mass of little huts, with common latrines, etc., where the inhabitants, although presumably sleeping in separate rooms, were in very constant and close contact with the rest of their neighbours).

On 19th March these five Indians left Stand 47, and three of them went to a farm near Zuurfontein Station, the owners of which they or some of them had known prior to the War. They asked whether they could stay in one of the native houses on the farm as they had become afraid on account of the sickness in Johannesburg, and dared not go back. On the following day two more of them turned up. After an interval of two days one of them died and was buried on the farm. A day or two after two more of the Indians were taken ill, and the District Surgeon of Pretoria was communicated with, and went to see them. He sent sputum to the Government Laboratories, where a positive diagnoses was arrived at. On the 26th, three of the remaining four had died, and the fifth ran away to Germiston, where he informed a friend of his that he and four other Indians had left Johannesburg and been living on the Farm at Zuurfontein, and that they had all died within a few days, and he was frightened. He was taken ill on the following day and died on the 29th March. There was some difficulty in tracing this man, because his friends hid him, and nothing could be discovered about him until he was dead. A post-mortem was made and the case was proved bacteriologically to have been plague. Thus out of the five cases, two were undoubtedly plague, and there is no doubt, therefore, that the other three were cases of plague.

The group of four, Mitha Dulabh, Uka Jeewan, Chuba Heera, and Ravajee Veera, all lived together on Stand 43, Coolie Location. Mitha Dulabh had been working at the Village Deep Mine, but had left that mine, and for some months before his death had been hawking vegetables and fruit. So far as can be ascertained, all four became ill within about 24 hours of each other. On the 17th Chuba Heera and Ravagee Veera left the Location for Durban, and at that time Mitha Dulabh was ill and wanted to go to Durban with the others but had not sufficient money. Uka Jeewan, a newsboy, shared a sleeping room with Mitha Dulabh, and was taken ill about the same time. Mitha Dulabh died on the 19th. Uka Jeewan was removed to the Temporary Hospital and subsequently to Rietfontein, where he recovered.

Chuba Heera and Ravajee Veera were both ill on the 17th March when they left for Durban ; indeed, Chuba Heera was so ill that he had to be helped to the station and seen into the train by a friend. When he arrived at Durban he was worse, and his brother-in-law had to help him out of the train and to the house in Durban, where he died the following day, certified as having died of pneumonia. Ravajee Veera died apparently on the 20th.

Govan Meetha and Ravajee Rama lived together on Stand 46, Coolie Location, and left Johannesburg on the 19th March for East London. Govan Meetha was ill at the time that he left and was taken out of the train dead at Springfontein on the 20th. Ravajee Rama proceeded to East London where he died on the 22nd, certified as having died from pneumonia.

Manga Jogi and Dheda Zeena both lived on Stand 47, Coolie Location, and died on the 21st and 28th March, respectively,

Manga Keeka was a hawker who used to hawk fruit in the neighbourhood of Mr. Nelson's nursery. He lived on Stand 32, Coolie Location, and was known to have been feeling unwell on the 15th March. He was removed to the Government Entrepot and died there on the evening of the 19th or the early morning of the 20th. It will be remembered that on the same stand Naran Bhula had died of pneumonia on the 28th February, 1904. There are, therefore, two possibilities as to the manner of his infection. It might have been derived from the Stand : an interval of three weeks is by no means a long one between two plague deaths in the same house. On the other hand he was a hawker of fruit and was probably friendly with some of the other hawkers who died immediately prior to the date of his attack.

The group of three under Vallabh Oonka, namely, Chuka, Pancha and Seeba Fakir, appears to shew that the infection was obtained in two of the cases by contact. On the 10th and 13th March, Jaga Uka (XIX) and Vallabh Oonka (XXXIV.) had died of pneumonia. Seeba Fakir was the son of Vallabh Oonka, and the nephew of Jaga Uka, and lived in the same house. There is no doubt that he and Vallabh Oonka attended Jaga Uka when he was ill. Further, Chuka and Pancha helped Seeba Fakir to nurse Vallabh Oonka and to prepare the body for burial. Pancha lived at Stand 31, Coolie Location, next door to where Cases IV. and XII. had died of pneumonia on the 21st January and the 27th February. It has been impossible to discover the residence of Chuka. With the evidence at hand, however, there seems to be little reason for not accepting the contact theory in the cases of Pancha and Chuka, whatever may be said about Seeba Fakir.

There are two links between the two trees, namely, Lala Zeena and Heera Meetha.

Lala Zeena was a surface labourer at the Village Deep Mine, and frequently visited the Coolie Location and slept there. He had at one time lived on Stand 93, Coolie Location, with an Indian, Shahoodeen, but had left that Stand and gone to live with Uka Valla and Lala Kala on Stand 83. He had helped to attend them during their illness (Uka Valla died on the 13th March, and Lala Kala on the 14th) and was taken ill on the 17th March. He had, however, continued to work with Shahoodeen, and, therefore, probably kept up his acquaintance with Stand 93.

Heera Meetha was employed at the Match Factory in Auckland Park, and used to sleep from time to time at Stand 47, Coolie Location. As will be seen later, most of the Match Factory boys stayed at Stand 435, Burgersdorp, and it is known that he also frequented this Stand although he did not sleep there. He had helped to nurse his brother Jewana Makan, and most probably had been with other of his friends to see and help Bika Veeraji and Moosa Mahomad, since there was a very close connection between Stand 93, Coolie Location, 10, Dam Street, and Stand 435, Burgersdorp.

The right hand tree, beginning with Hoosan Csanda, is built up in a similar fashion.

Ramjee Fakir died of plague on the 22nd March. He lived on Stand 41, where three Indians had died of what was certified as pneumonia. Moreover, he was the brother of Meetha Ramjee, and slept in the same room in which his brother had been ill and died. He does not appear to have taken ill until five days after his brother died, but he failed three days after the death of Nana Zeena on the same stand.

The group beginning with Moosa Mahomed is unfortunately not clearly made out. Dahya Laloo, Manga Fakeer, Keeka Desai, Chania Nathoo, and Manches Kara, all lived on the same Stand, No. 588, Burgersdorp. Dahya Laloo was a shoemaker and arrived in Johannesburg on March 14th from Durban. He went to see Moosa Mahomed on the same day and again on the following day. Moosa Mahomed was at that time suffering from what appeared to be pneumonia, and he died on the 15th. Dahya Laloo died on the 28th. No case of pneumonia had been reported from this stand—there was, therefore, no evidence of previous infection. There is the fact as above stated, Dahya Laloo came from Durban, stayed at this stand, and immediately went to see Moosa Mahomed. It is reasonable to suppose that, as a stranger to Johannesburg he was taken to see Moosa, and the fact of his visiting him upon the day of his arrival would point to some connection between the other inhabitants of this stand and Moosa ; otherwise, how would Dahya Lalo have known of Moosa's illness ? The suggestion is that the inhabitants of Stand 588 were friends of both Moosa Mahomed and of Dahya Laloo, and immediately upon the arrival of the latter, the former took him to see their mutual friend.

The group on the extreme right of the tree, connected both with Jeevana Makan and Moosa Mahomed, is somewhat complicated. The facts are as follows :—

A portion of it includes a group of Indians who were working together at the Match Factory at Newlands, as well as the three cases which actually occurred in the Johannesburg Hospital.

The Match Factory boys—*i.e.*, those who died of plague, who worked there, were five in number, namely, Heera Meetha, Lala Rogi, Jeevan Makan, Lala Makan, and Choma. Jeevana Makan, who died of pneumonia on the 14th March, Lala Rogi and Heera Meetha, were brothers. Jeevana Makan and Lala Makan were also brothers. When Jeevana Makan fell ill, Heera Meetha and Lala Rogi actually left the Match Factory in order to nurse him. He died on the 14th, and on the 16th Heera Meetha and Lala Rogi both began to feel ill. Heera Meetha appears to have managed somehow or other to get into town, but Lala Rogi was taken to the Johannesburg Hospital on the evening of the 18th March. It was from the sputum of this patient that the first guinea-pig died. There is evidence to shew that others of the Match Factory boys also left the Factory and stayed in town during the early part of the week ending March 19th. The fact that both Jeevana Makan and Choma failed about the same time and died on or about the 15th, would be explained if this were so, it could hardly be explained on the supposition that they acquired the disease from Heera Meetha or Lala Rogi, and there is no evidence that Stand 435, Burgersdorp, was infected prior to this period.

Lala Makan nursed his brother, and died two days after him, and Manches Kara, who had been in the employ of the Match Factory until shortly before the outbreak, died on the 26th March. He had come into town and taken up his residence at Stand 505, Burgersdorp, at a place which was not known to be infected. Although it cannot actually be ascertained whether Manches Kara did visit or nurse any of these Indians, the fact that he had been working with them at the Match Factory until just before Jeevana Makan was taken ill is strong presumptive evidence that he did so visit them.

Ravajee Bhana lived at Stand 435, Burgersdorp, and died on the 20th or 21st. Nothing but the fact has been discovered. As he died so soon after Jeevana Makan it seems impossible for him to have got the infection from the place, and it is not unreasonable to suppose that he, living in the same house, would help Lala Makan to nurse Jeevana Makan.

Lala Rachod died on the 25th ; there would, therefore, be plenty of opportunity for him to have got infected from any of the previous cases. In connection with both of these cases there is a possibility of their having been infected from No. 10, Dam Street, because of the known intercourse between these stands.

There is some doubt as to Kayor Kheeda. It appears that he lived either at Stand 22, or Stand 93, Coolie Location, or at Stand 435, Burgersdorp. He certainly was known well at all these places. He helped to look after Govan Mitha, who died of pneumonia on the 8th March, and was a cousin of Prag Bawa, who died of pneumonia on March 14th, There are,

therefore, at least three reasonable possibilities of direct contact infection, one from Prag Bawa and one from the inhabitants of Stand 93, Coolie Location, and one from the inhabitants of Stand 435, Burgersdorp.

There remain the Hospital cases, two White and one Native. On the evening of the 18th March, Lala Rogi was brought up to the Hospital ; during the 19th three other Indians were left at the Hospital by their friends. They were placed in a separate tent almost as soon as they arrived. During the nights of the 18th and 19th March the night-watchman, F. C. K. and a native boy Jagga, attended to them. Lala Rogi died on the 19th and the other three on the 20th, so that both the night-watchman and the native looked after them for two nights. The watchman was taken ill on the 20th March and the native on the 21st, both were removed to Rietfontein and both died there of pneumonic plague.

The other patient, Dr. Grant, attended the Indians and also made certainly one of the post-mortems, and whilst doing so pricked his finger. He failed with a right axillary bubo, which was very mild, and he recovered.

There can be no doubt that Stand 93, Coolie Location, was infected. Govan Mitha had died there on the 8th March, and Jeevana Makan, Prag Bawa, and Chineah Meetha had died on the 14th. It is true also that the Stand was terribly overcrowded. Whether, therefore, we consider that the subsequent cases were cases of place infection or of contact, does not much matter, it does not seem to affect the problem, because the various inhabitants were undoubtedly sleeping together in the various rooms and in an already infected house. No comment need be made, therefore, concerning the cases at the bottom of the tree, who resided at Stand No. 93.

Three groups, however, call for comment. The first is the group of Alagamuthoo, Shahoodeen, and Suka Cheeba.

Alagamuthoo lived on Stand 93, Coolie Location. He, Shahooden, and Suka Cheeba were great friends, and constantly in one another's company. On March 16th there were several Indians living on Stand 93, who were ill, and two of them were actually lying in the room in which he used to sleep. He, therefore, went to Stand 95 and slept that night with Suka Cheeba. On the 17th he went across to the Village Deep Mine to see Shahooden and to try to look for work. Whilst there he became ill and stayed in the room with Shahooden. He remained in Shahoodeen's room until he died on the 20th March. Shahoodeen became ill on the 19th, and died also on the Village Deep Mine on the 21st. Suka Cheeba became ill on the 21st or 22nd and died on the 23rd. It is difficult to say how or when Suka Cheeba contracted the disease, because, when Alagamuthoo slept with him, as he did on the 16th March, he was apparently well, and, therefore, non-infectious. There is no evidence that he actually visited either Alagamuthoo or Shahoodeen, but, being so very friendly with them there is a strong presumption that he did visit them, as he would probably know that they were ill. There is this to be said that no other case occurred on Stand 95, Coolie Location, so that the direct contact theory would most easily explain the fact unless it is assumed that he contracted it from Stand 93, which he probably visited with Alagamuthoo.

The next group which requires comment is the group consisting of Bhana Nana, Nana Morar, Valla Mavajee, and Nema Dulabh, who failed with plague at Stand 618, Burgersdorp. In the first place these four were all relatives. Vala Mavajee was the uncle of the other three, who were all brothers. Bhana Nana was not employed at Stand 618, but had come up from Durban on March 5th, and was staying with his relatives until he could find work. The other three, as well as a fourth Indian, had been in the employ of the proprietor of the S.A. Fruit Co. for 8 or 9 months, both in Bloemfontein and in Johannesburg. Large quantities of fruit had been imported from Spain, Italy, the Scilly Isles, San Francisco, Melbourne, and Java, but no dead rats had ever been seen, or live ones caught before the appearance of sickness among the Indians. The first to fail was Bhana Nana, who was ill for a day or two before the other three fell ill. The origin of the outbreak here is largely surmise, but there are certain facts which warrant the conclusion which will be given. At the time the S.A. Fruit Co. had a very large stock of fruit, particularly of bananas, and as a matter of fact they were able to undersell the market. Among the inhabitants of Stands 47 and 93 were many fruit hawkers, and some of these were not only of the same caste, but actually came from the same village in India as the Indians employed at the S.A. Fruit Store. There is little doubt, therefore, that they met one another at Stand 93. Moreover, as Bhana Nana was not in employment it is not unnatural

to suppose that he was longer in the company of the inhabitants of Stand 93 than were the others, hence his being the first to be attacked. He certainly was the first of the four to die. Vala Mavajee died on the same day, but it appears that he was not ill for so long a period as was Bhana Nana. It may, therefore, fairly be claimed that the group of four forms a contact group.

The last group is the history of the most tragic incident of the whole outbreak. Dr. Marais had a very considerable practice among the Indians in the Coolie Location, and he had attended a considerable number of the Indians who had been ill and died during the early part of the month. On Tuesday, 15th, he was taken ill and died on the 17th, with all the symptoms of pneumonia.

On the 19th Mrs. Marais was taken ill, and on the 20th and 21st three of the children. Mrs. Marais died on the 21st, and the three children on the 22nd, 24th, and 25th, respectively, leaving out of a family of five one sole survivor, the youngest child, who never had any symptoms. This, however, was not all : A young man who was very friendly with the family made himself useful during the sickness and helped to nurse some of the children. He contracted the disease, and died on the 22nd. The three children were removed to Rietfontein, and one of the nurses who had charge of them also took the disease and died on the 27th March. The nurse in question had been nursing plague both in Capetown and in Port Elizabeth, and it appears that she had acquired the contempt for the disease, which the familiarity breeds, and had treated the pneumonic cases as bubonic cases. Certainly she kissed the children. The above remarks are made as mere statements of fact, in order to shew the direct connection between the various cases and to shew how infectious as well as how deadly the pneumonic form of the disease is. Dr. Marais, like others of the medical profession, during this outbreak, just as during other outbreaks, failed to recognise a disease which simulated pneumonia almost absolutely and he paid the penalty of his mistake with his life. Others have been left who have not had to pay the penalty. In the same way with the nurse ; she was one of the first volunteers, and an excellent nurse, and in view of her previous experience and the usually accepted idea that plague is not a highly infectious disease, it is impossible for any one to hold any feeling but one of deep regret.

In addition to the above there are several cases where the presumptive evidence of contact is so great as to almost amount to certainty.

Case 15, Sairovdeen, who was living at 418, 14th Street, Malay Location, was known to have visited some of the sick in the Coolie Location, but it was impossible to find out the person or persons whom he visited.

Case 25, Rava Bhanga, was a surface labourer at the Crown Reef Mine. It is not known where he lived or who his friends were, but it is significant that Case 82, Dhubol Dayal, was also working on the Crown Deep property, as Case 12, who is connected with Stand 93, Coolie Location. As these two are the only cases from the Crown Deep, and as one has been connected with a definite centre of infection it seems unlikely that the other became infected from the Crown Deep.

Case 29 lived at Stand 23, Coolie Location. This was the only case on the Stand and no previous cases of pneumonia had been reported from here. He, however, came from the same village in India, as Cases 3, 28, and 31, and it is by no means unlikely, therefore, that he had friends in common with them, and was connected by contact with either Stand 89 or 93.

Of Case 42 nothing can be traced.

Case 56 was a Native. No evidence is forthcoming as to how he possibly contracted the disease.

Case 60 was found in an unconscious condition, practically on the veldt, between the Sanitary Compound in Vrededorp and Auckland Park, and no information concerning him could be obtained.

Case 71, Mangaliso, a Yambaan, was taken ill on the 21st March and died on the 22nd. He was lying in one of the rooms on the Langlaagte Mine with 27 other natives, none of whom contracted the disease. It is known that Cases XXIV., XXVI., and XXXIV., all hawkers, used to visit the Langlaagte Mine to hawk fruit ; it is, therefore, probable that this boy contracted the disease by eating fruit which was infected, or by contact with one or other of the hawkers.

Case 74, a Native, lived or was staying at 76, Coolie Location. There is no evidence as to how he contracted the disease. It may be surmised that he was one of the servants which some of the Indians employed, and may have come into contact with some of the Indian cases.

Case 87 was an Indian child of 2 months old living on Stand 50, Coolie Location. No evidence of contact could be found.

Case 92 was a Coloured boy found wandering in Melle Street, Braamfontein, and was taken by the police as a sick boy wandering. He was very ill at the time, and no information as to his residence could be elicited.

Case 96 was a native female at the New Goch Location. The location in question was in a terribly insanitary condition, but this was the only case occurring in it. The Indian hawkers who used to trade between Johannesburg and Germiston used to call at the location and trade there. The origin of this case may, therefore, be similar to that of Case 71.

Of Cases 99 and 106 nothing can be traced. Case 99 was a Native who had been working at the Consolidated Gold Mining Co. at Germiston, and Case 106 was a White case, a Russian Jew, living at 90, Becker Street. No plague or even dead rats were ever found at either place, and no evidence of contact with other cases can be traced

Case 112, an Indian laundry-man was taken ill on March 28th, and died on March 29th of pneumonic plague. No connection can be traced with other cases. Case 87 died next door on the 25th March and since the Indians in the location lived very much together, there is undoubtedly a possibility of contact with Case 87. Another possibility is that he acquired the disease through handling infected washing.

Of case 113 there is no evidence as to how he contracted the disease. The case was that of a Native living in one of several tents on the Robinson Mynpacht near Fordsburg Spruit. This was the only case coming from those tents. He had been employed, until the night he was taken ill, at Rosherville, and he only went into the tents on that night. There is no evidence as to how he contracted the disease at Rosherville, since he was the only case among the Natives there. The possible solution is again, the consumption of infected fruit.

Case 115 was the only case which occurred at Klipspruit after the transfer of the inhabitants from the Coolie Location thither. It was impossible after his death to trace his residence in the location, but the chance of contact was by no means small whilst in the location.

Case 120 was an Indian, a cigar-maker, living at Stand 1011, Burgersdorp. Nothing can be traced as to how he acquired the disease.

Case 175, a white laundry-maid, living at 102, Central Road, and working at the Nelson Laundry, Auckland Park. There is no evidence as to the method of infection. No rats were found at her residence, and no other case came either therefrom, or from the Laundry. The possibility of handling infected clothes seems hardly likely, since she was infected with femoral buboes. She had no pneumonia, nor could the B. Pestis be found in the lung, although it was found in considerable numbers in the buboes.

Case 177 was that of a Native who had been employed by the Salvation Army at 24, Main Street, Ferreira Town, and it has been impossible to trace a possible source of infection.

Case 185, an Indian Hawker of soft goods, was living at 25, Fox Street, and no source of infection can be traced.

Case 187, a Native employed since 18th April by a carpenter near the Jumpers Mine, died on 28th April. It is said that he had been ailing for several days, but no one knew quite where he lived after he was employed by this carpenter. Up to 18th April he had been employed as trolley driver and stable boy at 184, Commissioner Street. No other case of plague or even sickness occurred among either of the batches of boys employed by either of these employers, nor were plague or dead rats ever found at either place.

Case 199, an Indian hawker, living at 576, Station Road, Burgersdorp, became ill on 2nd May. There is no trace of evidence as to how he contracted the disease. He bought his fruit and vegetables from the market every morning.

Case 204 was that of a white book-keeper employed at Chicken's News Agency in President Street, and living at 21, Clare Road, Fordsburg. There were traces of rats found at 21, Clare Road, but no dead ones could be found. There were a few traces of rats at Chicken's News Agency, but no dead ones could be found. There is, therefore, no evidence as to how he acquired the disease.

Case 217, a Coloured servant girl, living at Lindley Street, Fordsburg, was taken ill on May 11th No traces of rats dead or alive could be found in the house in Lindley Street, and no evidence of contact could be found.

Case 227, a Native employed in the Cyanide Works at the Wolhuter Mine died on May 27th. No evidence can be obtained to shew the origin of the disease.

Case 228, an Indian Merchant, came to Johannesburg 12 days before he died, from Vereeniging. In the four days previous to his failing, he had been staying at No. 1, Main Street. No rats were found there. He had been buying stores from a variety of places in Johannesburg. There is, therefore, no evidence as to how he acquired the disease except the possibility that he handled infected stores.

Case 236 was a Native wash-boy, working at the Langlaagte washing site. No evidence can be traced as to the source of the infection.

Case 240 was a White child, 2½ years old, living with her parents at 24, Marshall Street. No trace of evidence as to the source of infection can be found. There were no rats in the house, or signs of dead rats in the immediate neighbourhood.

CASES CONNECTED WITH RATS.

As has been seen previously, plague infected rats were found in certain spots in Johannesburg during the course of the year 1903. It is not impossible, therefore, that there may have been plague infected rats in the Coolie Location, even though the rat-catcher was unable to find any. Upon being questioned upon the subject, the inhabitants of the Coolie Location stated most emphatically that there had been no rats in the location for some considerable time before the outbreak, and the comparative absence of the rats was abundantly proved immediately after the outbreak by the rat-catchers. A well-organised search was made, and, as the result, not a dozen rats in all were found or caught. On 2nd April one rat, and on the 6th two rats were found, all three of them having died of plague. In 1903 it will be seen that plague infected rats were found in the Government Entrepôt, which is situated within the Insanitary Area, but some considerable distance from the actual location.

Excluding what may be termed the contact cases, *i.e.*, the cases coming from the Coolie Location and the other places whence previous pneumonia cases had been derived, the first case possibly connected with plague rats was Case 77, a Native who was working in a store at 47, Market Street. He was employed as a driver. In June, *i.e.*, three months later, a plague rat was found in buildings in the same square of stands as 47, Market Street, viz., at 38, President Street. Whether the store at 47, Market Street, was infected with plague rats as early as 24th March, it is impossible now to say, but the fact remains that on the 24th March this boy failed with plague, and that in June a plague rat was discovered. On the other hand, it is known that he visited the Coolie Location just before it was cordoned.

Case 113, a Native, failed on 26th March, and was admitted to the Native Pass Office Hospital in Market Street. He had been released from Boksburg Gaol a few days before he became ill, and having a brother at the Native Pass Office, he went to see him there. On the 26th he applied for a pass at the Office and not being well, he was admitted to the Hospital. He died on the 29th, and the post-mortem examination shewed that he had died of plague. Plague rats were found on several subsequent occasions all through the block of buildings in which the Native Pass Office is situated.

Case 124, a Native, came from Boksburg, a day or two before March 31st, when he was found to be suffering from plague by the Plague Medical Officer. This case, like case 113, probably spent considerable periods of the days in the neighbourhood of the Pass Office, especially as he was out of work and was waiting for employment.

Case 143, a Native, had been working at and living in the Compound of the Langlaagte Deep Mine until April 3rd. After that date he had slept with a Native Affairs Native Constable and had been about the Pass Office Compound. He was examined on April 5th, and was detained. On the following day it was found that he was suffering from plague.

Case 158, a Native, had been employed as a domestic servant at 38, Marshall Street until 7th April. On that date he was discharged. On 9th April he was detained at the Pass Office and found to be suffering from plague. Plague infected rats were found in the same block.

Case 174, a Native kitchen boy, employed at the Market Coffee Palace in the Market Buildings, where he slept. He was taken ill on the 18th April and found upon examination to be suffering from a right axillary bubo. The first occasion upon which a plague infected rat was found in the Market Buildings was on April 15th ; a plague rat was found actually in the Market Coffee Palace.

Case 183, a Native engine-stoker, employed by the Public Works Department at the General Post Office, where he slept with 15 other boys in the basement. The sleeping accommodation was nearly as bad as that found in the Coolie Location, and plague rats were found in the Post Office.

Case 188, a Native, was employed at the Kalk Bay Fishery Store in the Market Buildings, and became ill on the 22nd April. By this time there was reason to suspect the presence of plague rats in the Market Buildings.

Case 192 and 193 were two brothers, Australians, one a carpenter and the other a photographer ; the latter had two rooms in the Market Buildings, one a dark room and the other a living room, which was shared by his brother. One brother became ill on April 25th, and the other on April 26th. After they had vacated the room several dead rats were found under the floor.

Case 202, was a young Dutch boy, who had run away from home and spent his time chiefly in the Market Buildings doing odd jobs and sleeping at night either in the yard of the " Rand Daily Mail " Offices, or in the passage to the Standard Theatre in the same block of buildings. Although plague rats were found in the same block of buildings where he slept, the most probable source of infection was undoubtedly the Market Buildings.

Case 203, a Colonial woman, living in a room with her husband in a house at the back of the Uppington Hotel, Main Street, at which hotel she was employed as a waitress. She became ill on the 4th May. Many rats had been seen both by herself and her husband before she became ill, and they had noticed a very nasty smell about a week before she failed. The house was very dilapidated, and contained 7 rooms ; the room opening into that she occupied was used for storing vegetables. In the same yard was another building, part of which was used as a store-room and part as a sleeping place for natives. After evacuating the place 2 dead rats were found under the floor of the room she occupied, and 12 under the floors of the other rooms. One of these, which was not so putrid as the remainder, was proved to have died of plague. Her husband never contracted the disease.

Case 225, a Native, was employed as kitchen boy at the Standard restaurant, and fell ill on the 20th May and died on the 21st. A plague infected rat was found in the restaurant on the same day.

Case 239, a Native, was employed as house boy at 38, Noord Street. On 26th June he fell ill, and on the 29th a plague rat was found by the rat-catcher in the house.

Case 109 was that of a Polish Jew who had only been in Johannesburg for 3 or 4 days, and had been staying somewhere at Langlaagte. He had no permit to enter the Transvaal, and could or would give no account of himself.

Case 135, an Italian waiter at the Frascati Restaurant, was taken ill on April 1st, and was found on the following day to be suffering from a femoral bubo. Upon examining the house, dead rats were found, but no plague infected rats could be found.

Cases 146 and 147 were two Natives employed as kitchen boys at the Engineers' Hotel, Marshall Street. They were sleeping in a cellar which was without light or ventilation. The kitchen and food store room was found in a shocking condition of filth and signs of rats were found. Under the conditions existing at the hotel it is possible that the place was infected with rats or that they were infected with food brought from the Market Buildings. Case 146 was taken ill on the 6th April, and died of pneumonic plague on the 7th. Case 147 failed on the 7th of bubonic plague and recovered.

Case 155, a Native, employed as kitchen boy at the Belvedere Hotel in Fox Street, Ferreira, fell ill on 8th April. No plague infected or dead rats were actually found in the hotel, about this time, but dead rats were found on the same block of buildings. It was at the Belvedere Hotel that plague rats were found on May 12th, 1903, *i.e.*, eleven months previously.

Case 164 was a Native employed by the Municipality as a sanitary boy. He became ill on the 10th April. He was one of a very large number of boys who slept at the Bertrams Compound. Dead rats were found in the Compound but there was no other case from this Compound.

Case 171 was a Native employed as house boy at Stand 55, Anderson Street. He had been apparently ailing for a day or two before his employer had him removed to the Hospital, where he died on the 16th April. Dead rats were found in the house.

Case 186, a Native, was employed at No. 56, Fox Street, as storeboy, and had a room in which he lived at Stand 94, Anderson Street. He fell ill on the 25th April. No rats were found at 56, Fox Street. The only suspicion of possibility of infection from the place where he worked is that the proprietor had recently received consignments of tobacco from Durban, and forage from the Cape Colony. Dead rats were found in the same block of buildings as 94, Anderson Street, and a human case had occurred at, and dead rats found in, the house immediately opposite to that in which he resided.

Case 200, a Russian woman, residing at Stand 56, Anderson Street, was taken ill on Tuesday, 3rd May, and found to be suffering from bubonic plague. She was prematurely confined. Dead rats were found in the house. Case 171 occurred on the 14th April in the next house, and Case 186 on 25th April occurred in the house just opposite.

Case 215, an Italian baker out of employment, living at Stand 62, Main Street, was taken ill on the 9th of May and died on the 10th. Dead rats were found in the house, as well as in the same block of buildings just across the street.

Case 221, a Dutch female tailoress, living in 10th Street, Vrededorp, and working in Rissik Street, failed on the 9th May and died on the 14th. No dead rats were found in the house, but dead rats had been discovered in the neighbourhood of her residence. There is nothing to connect her place of work with the infection.

Case 223 was a white scene-shifter at the Standard Theatre, who lived on Stand 1,440, Kerk Street. He fell ill on the 17th May, and died on the 20th. Plague infected rats had been found in the block in which the Standard Theatre is, and he informed his medical attendant that he had been handling dead rats in and about the building. In addition to this, dead rats had been found in the same block of buildings as his residence, which was next door to a forage store.

Case 232, a Russian Jew, who carried on the trade of egg and potato dealer in the Market Square, and lived at Stand 90, Becker Street, fell ill on the 14th June. No dead rats were found in or near the house. Case 106 was removed on the 26th March from the room adjoining that in which the present case slept. Whether or no rats were the cause of the extension from Case 106 to case 232 cannot be proved. The infection was possibly a place infection.

Case 234, a white girl of 12 years of age, fell ill on the 12th June, and died on the 15th. She was living on Stand 450, Anderson Street. Cases 146 and 147 occurred on April 8th in the same block of buildings and dead rats were also found in the same block.

Case 235, a white woman employed as domestic servant by the mother of the last case. fell ill on 13th June, *i.e.*, the day after Case 234.

Case 237, a Native employed as blacksmith's boy, and living at Stand 488, Burgersdorp, fell ill on the 13th or 14th June. There were no rats found in the building, but on the opposite stands they had been found.

HISTORY OF THE RATS BEFORE THE 18TH MARCH, 1904.

In view of the fact that plague existed at the Cape Ports, a Municipal ratcatcher was appointed for Johannesburg on August 5th, 1903.

From the time of his appointment to the 17th March, he succeeded in catching and finding 8,972 rats. These were caught and found as follows :—

Week ending.	Rats caught and found dead.
1903. August 15th	92
,, 22nd	205
September 5th	302
,, 12th	380
,, 19th	374
,, 26th	507
October 3rd	333
,, 10th	509
,, 17th	480
,, 24th	463
,, 31st	451
November 7th	402
,, 14th	376
,, 21st	460
,, 28th	345
December 5th	392
,, 12th	332
,, 19th	272
,, 26th	230
1904. January 2nd	258
,, 9th	253
,, 16th	189
,, 23rd	201
,, 30th	212
February 6th	159
,, 13th	143
,, 20th	127
,, 27th	188
March 5th	119
,, 12th	129
,, 19th	89
	8,972

The first occasion upon which rats were sent to the Government Laboratories was upon the 27th December, 1902. Two rats were sent on this date from the Market Buildings, where it was stated that rats were found to be dying in considerable numbers. Both rats were negative. It has since been ascertained that some of the shop-keepers in the Market Buildings put down a considerable amount of poison about this time.

On April 4th, 1903, a rat was found dead in some forage from Graff Reinet, the examination failed to reveal the presence of the plague bacillus.

On April 23rd, 1903, three rats were found dead at 57 President Street. One of these was sent for examination, but the plague bacillus was neither seen nor recovered.

On April 23rd, 1903, a consignment of 38 rats was received from the M.O.H. Johannesburg, who forwarded them for examination. They had been found by the Secretary of the Market Buildings on taking up the skirting boards of two sleeping rooms in the building, on account of complaints of very bad smells during the preceding four days. They were, however, in a state of so advanced putrefaction that an examination would have been certainly unsuccessful, and they were not examined.

On May 12th, 1903, 7 rats were found dead in the yard of the Belvedere Hotel, Johannesburg. Each rat was examined, and an organism morphologically identical with the plague bacillus was found in the heart blood and tissues of each rat. Cultures were obtained from 6 of the 7 and inoculaton experiments made with two of the cultures. The inoculated animals died and had the typical post-mortem appearances of death from septicæmia and the plague bacillus was recovered from their cadavers. This was the first occasion therefore, on which a plague-infected rat had been found in Johannesburg, and indeed, so far as the Government Laboratories are concerned, in the Transvaal.

On June 19th, 1903, a medical man in Johannesburg sent a kitten, which was one of a litter which had all died. The owner of the cat had seen her kill and consume a rat which was walking as if it were ill. The kitten was examined and the plague bacillus was isolated therefrom. Laboratory animals inoculated with these cultures succumbed, and the plague bacillus was again recovered in culture.

On July 7th, 12 rats were examined, they were derived as follows :—5 from the Kaffir Location ; 2 from house 4, 1st Street, Vrededorp ; 3 from house 6, 10th Street, Vrededorp ; and 2 from the extreme end of the Kaffir Location, opposite the slaughter poles. No plague bacillus was recovered from any of these rats.

On July 9th, 5 rats were found in a bin in 12th Street, Vrededorp, but no plague bacillus could be found in any of them.

On July 16th, 3 rats were found ; one as Stand 149, 6th Street, Vrededorp ; one at Stand 98, 4th Street Vrededorp ; and one at a house in Mayfair. These rats were free from plague.

On July 18th, 8 rats were found on Stand 97, 4th Street, Vrededorp, and 5 in a bin in 12th Street, Vrededorp, These rats were free from plague.

On July 20th, 4 rats were found in some waste ground close to the King's Warehouse ; one was too decomposed to allow of an examination but the B. Pestis was recovered from the other three.

On July 22nd, 7 rats were examined, they were found in various parts of Vrededorp. No plague bacilli were found.

On July 25th, 12 rats were found in Vrededorp and the Kaffir Location, but in none of them could the B. Pestis be discovered.

On July 25th 12 rats were found in Vrededorp and the Kaffir Location, but were free from plague.

On July 28th, 3 rats were found at the King's Warehouse, but the B. Pestis could not be found.

On August 11th, one rat was found but was apparently unaffected with plague.

On August 18th, one rat was found in the King's Warehouse, and one in No. 4 Goods Warehouse. The B. Pestis could not be found in the first, and the second was too decomposed for examination.

On August 19th, a rat was found in the King's Warehouse, but was too decomposed for examination.

On August 24th, a rat was found in the King's Warehouse, but no plague bacilli could be found.

On August 27th, one rat was found at the King's Warehouse, and one at the Goods Station, but no B, Pestis could be found in either rat.

On September 9th, a rat was found in the Goods Yard, but no plague bacilli could be found.

On September 11th, a rat was found in Fordsburg, but no plague bacilli could be found.

On September 14th a rat was found at the Fordsburg Hotel, but was too decomposed for examination.

On September 23rd, a rat was discovered at Rosenberg & Fraenkel's, at the corner of Kruis Street, but the B. Pestis was not discovered.

On September 29th, a rat was discovered in Central Road, Fordsburg, but no B. Pesti could be found.

On September 30th, a rat was found on Stand 587, Burgersdorp, but no B. Pestis could be isolated.

On October 9th, a rat was discovered in Alexander Street, Fordsburg, but it was too decomposed for examination,

On October 13th, a rat was found in O'Grady's Store, in Commissioner Street, in the centre of the town. This rat was plague infected, the B. Pestis being recovered in culture.

On October 20th, a rat was found at the Forfarshise Hotel in Ferreira's Township, but the B. Pestis could not be seen or recovered.

On Octobe 23rd, 14 rats were caught at O'Grady's Store, but the B. Pestis could not be seen in, or recovered from a single rat.

On November 11th, a rat was found on a Stand in Mint Road, Fordsburg, but was apparently uninfected with plague.

On November 13th, a rat was found dead at the Tramway Stables in Doornfontein, but the B. Pestis could be neither seen nor recovered.

On December 1st, a rat was found at the Forfarshire Hotel, but was apparently uninfected.

On December 8th, a rat was found dead in Hunt's Stables, Ferreirastown, but was apparently uninfected.

On December 14th, a rat was found dead at the Turffontein Hotel, but no plague bacilli could be seen.

On December 30th, a rat was sent from Clare Road, Fordsburg, but was too decomposed for examination.

On 12th January, 1904, a rat from Doyle's Stables, Avenue Road, Fordsburg, was proved to be negative.

On 19th January, two rats found in Ransome Road, Ophirton, were too decomposed to allow of an examination.

On 24th January, a rat from the Coronation Café, was found not to have died of plague.

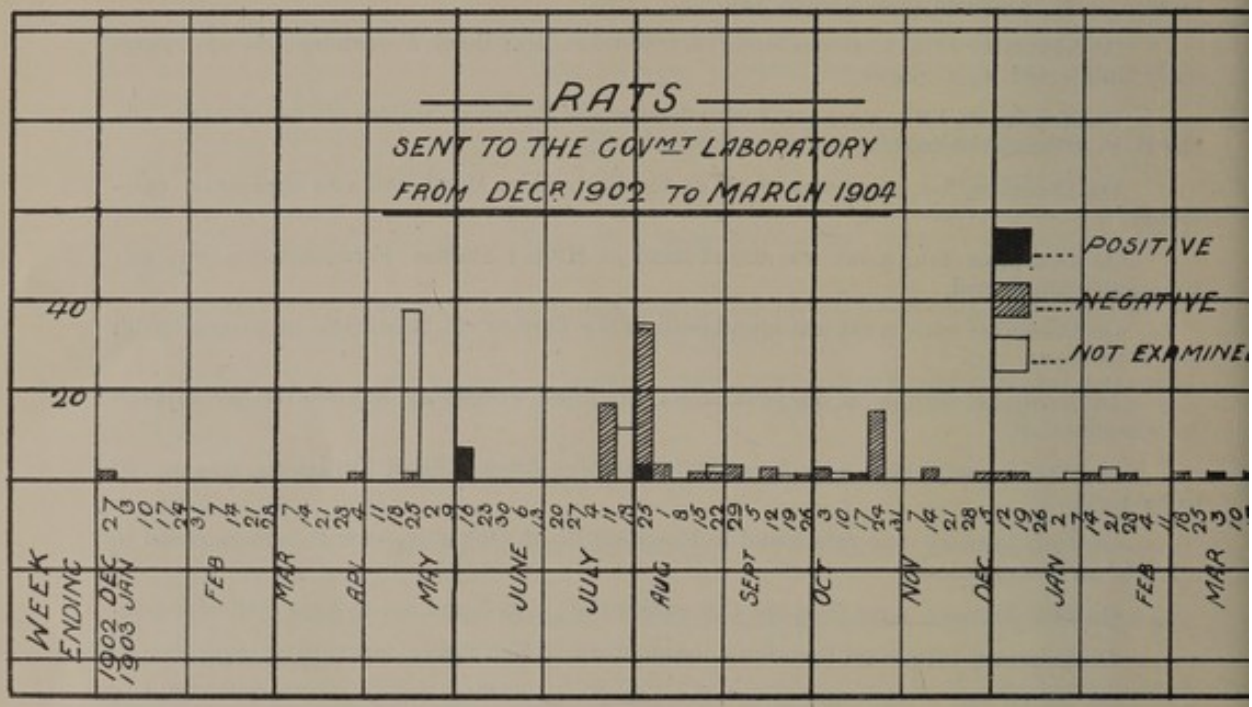
On February 14th, a rat found in a forage store, in End Street, was proved negative.

On March 1st, a rat found in the Ferreira Hotel Stables, was proved to have died of plague.

On March 17th, a rat from the forage store in End Street, was again shewn to be negative.

The following Table and Chart express the above account graphically :—

CHART VIII.

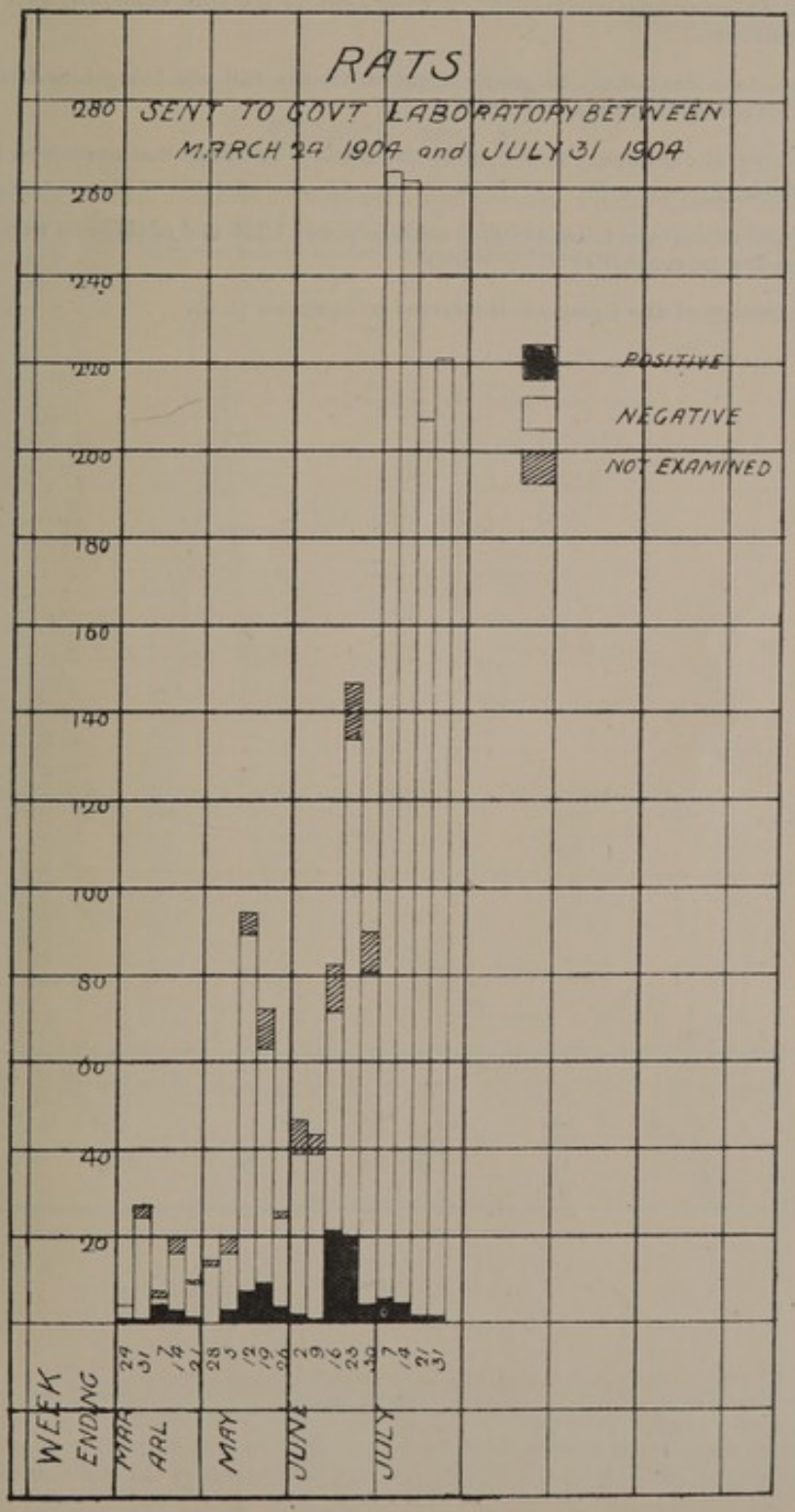


There were 160 rats and 1 cat sent to the Laboratories during the period 27th December, 1902, to March 18th, 1904. Of these 47 were either too decomposed for examination, or were mummified ; 114 were examined bacteriologically ; 13 were found to be positive and 101 negative. All these rats were found dead, so that there was presumptive evidence that they all might have died of plague.

HISTORY OF THE RATS BETWEEN 18TH MARCH AND 31ST JULY, 1904.

The accompanying chart explains the history of the rats examined during the period above mentioned.

CHART IX.



1,657 rats were sent for examination, of these 1,583 were actually examined, the other 74 being either mummified or too decomposed to allow of the examination. 95 rats were found to have died of plague and 1,488 gave negative results. 5.73 per cent. of the total rats sent for examination were thus found to be plague infected and 6.38 per cent. of those actually examined.

129 mice were sent for examination, 3 were not examined, 3 were found to be plague-infected, and 123 gave negative results. 2.5 per cent. of the mice examined were thus found to be plague infected.

13 cats were examined, 12 giving negative results and one being found to be plague-infected. This cat is referred to on p. 91.

A number of canaries removed from the Market Buildings was examined but all gave negative results.

The total of the rats, mice, and cats examined was 1,722 and of these 99 were found to be plague-infected, a percentage of 5.7 per cent.

The question of the Epizootic is referred to again on p. 65.

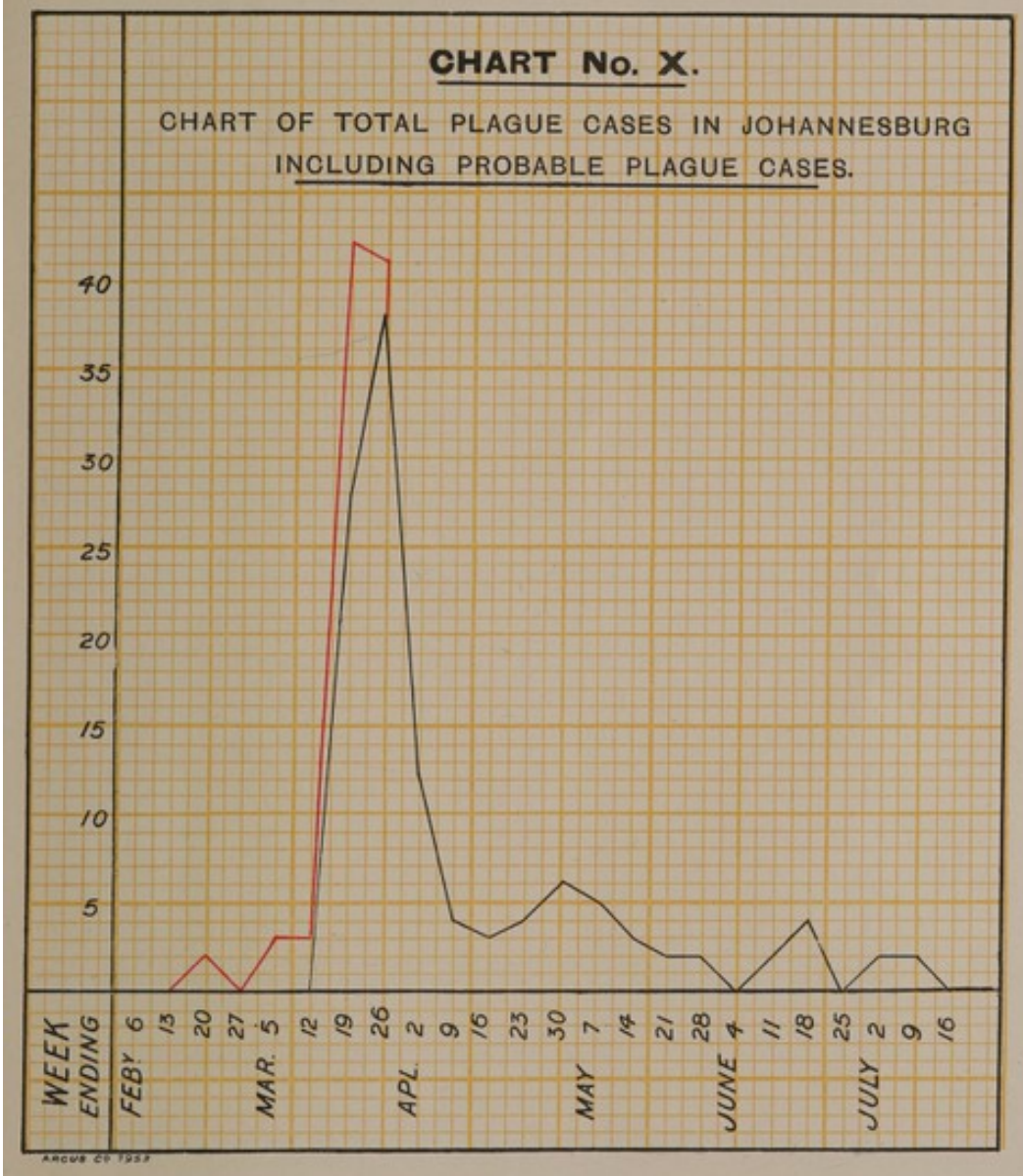
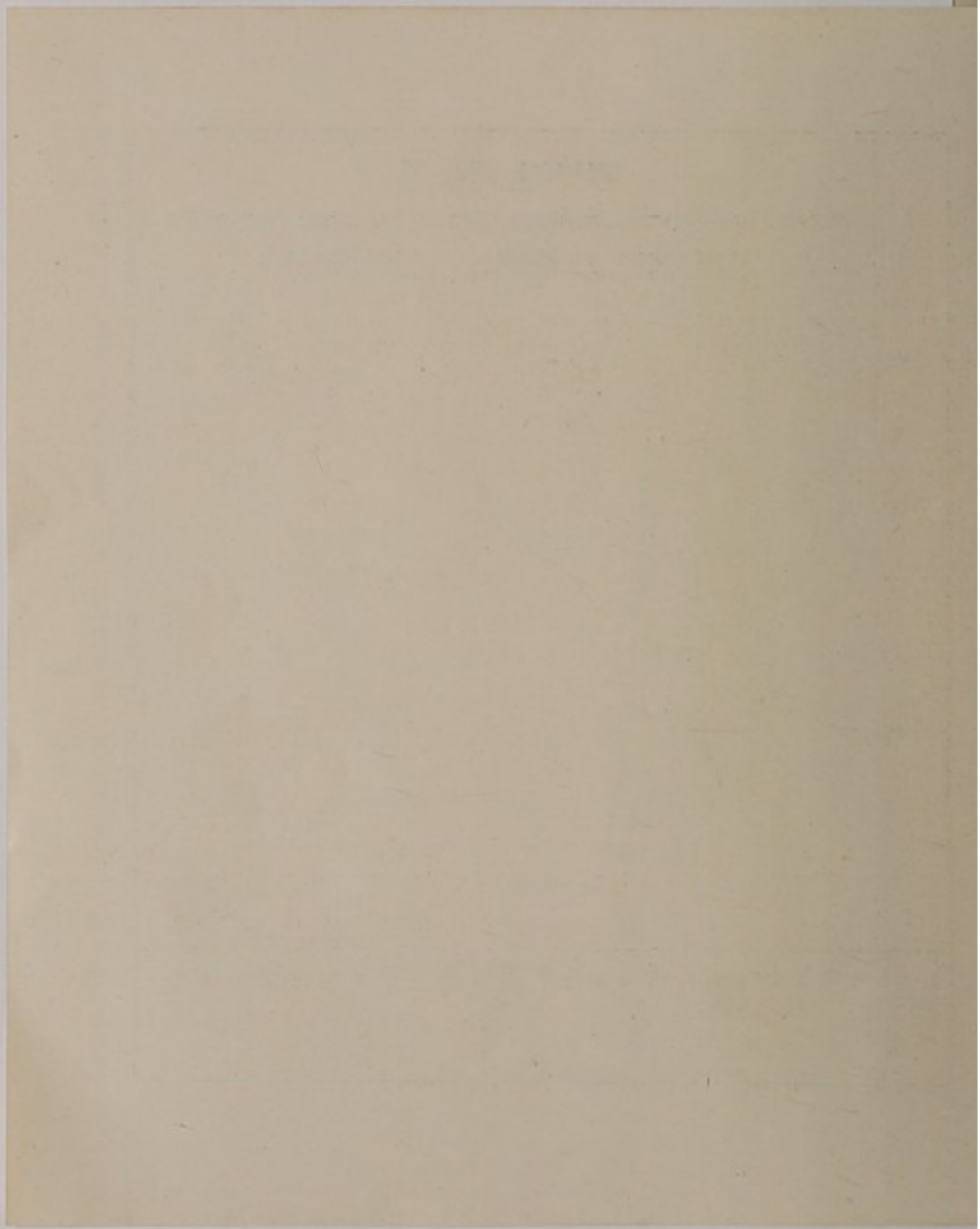


CHART No. X.
CHART OF TOTAL PLAGUE CASES IN JOHANNESBURG
INCLUDING PROBABLE PLAGUE CASES.
40
35
30
25
20
15
10
5
WEEK ENDING
FEBY 6 13 20 27
MAR. 5 12 19 26
APL. 2 9 16 23 30
MAY 7 14 21 28
JUNE 4 11 18 25
JULY 2 9 16
ARGUS CO 1913



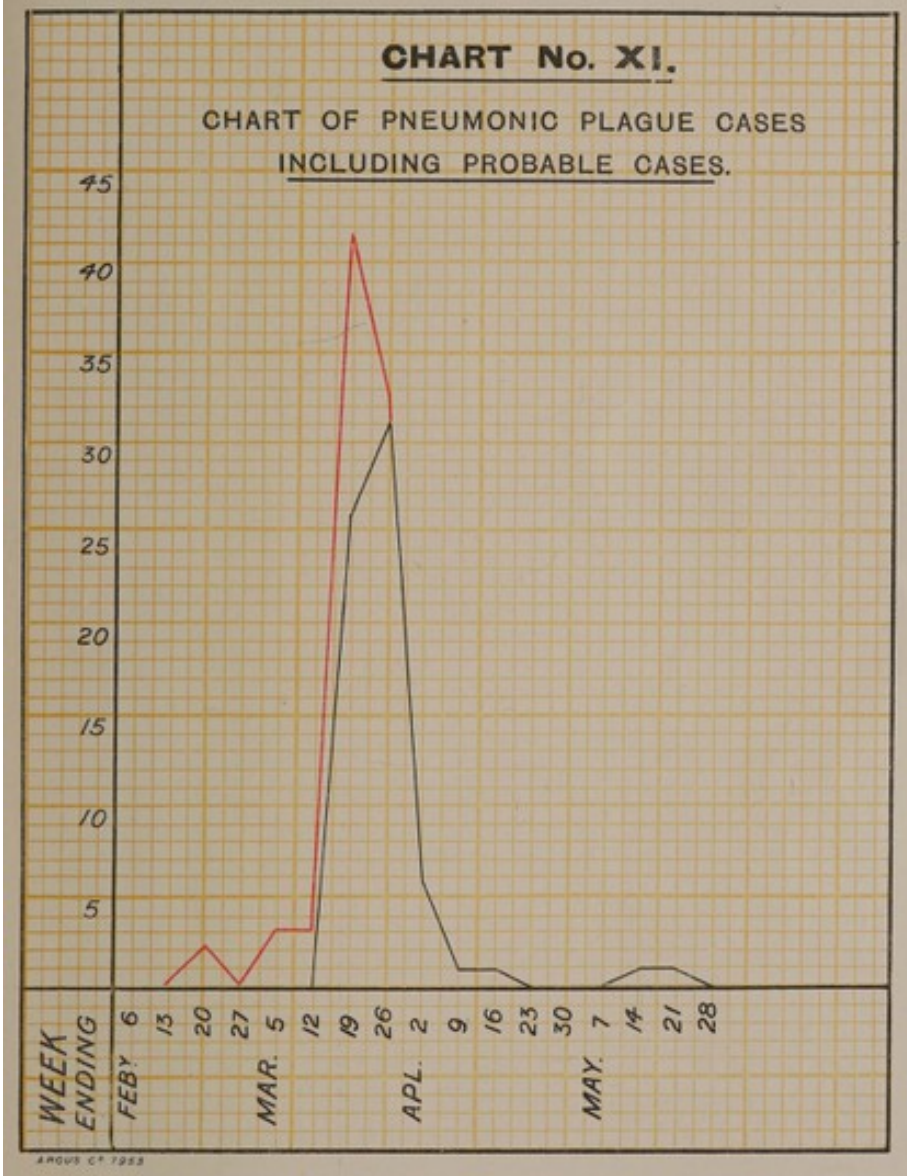


CHART No. XI.
CHART OF PNEUMONIC PLAGUE CASES
INCLUDING PROBABLE CASES.
45
40
35
30
25
20
15
10
5
WEEK ENDING
FEBY 6 13 20 27
MAR. 5 12 19 26
APL. 2 9 16 23 30
MAY. 7 14 21 28
ARGUS Co 1903

THE ORIGIN OF THE OUTBREAK.

The two Charts, X. and XI., shew what is probably the true curve of the plague outbreak, Chart X. shewing the total curve, and Chart XI. the curve of pneumonic plague.

In order to endeavour to arrive at the probable origin of the outbreak, it is first necessary to briefly recapitulate the facts which have been previously stated.

In the first place practically all the early cases occurred among the Indians. This fact might have arisen because the Indians are more susceptible to the disease than either whites or natives, but the history of the outbreak after the 25th March does not bear this out. The estimated Indian population of Johannesburg on March 18th was about 5,500. The White population on the same date was about 84,000, and exclusive of those employed or living on the mines there were some 10,000 natives living within the Johannesburg area. 1,600 Asiatics and 1,358 Natives were removed to the Klipspruit Camp. There were therefore 3,400 Asiatics and 8,700 Natives in Johannesburg after the removal of this number to Klipspruit. The 5 Asiatic cases give an incidence for the Asiatics of 1.47 per mille and 24 native cases giving an incidence of 2.75 per mille among the natives.

Of the first 65 cases 50 were Indians, and of these it may be said that all were directly connected with if not actually living in the Coolie Location; four native cases at most, of these 65 cases, were connected with the Coolie Location. The Indian population in the location was 1,600. There was an incidence therefore of 31.25 per mille.

The Natives removed to Klipspruit, 1,358 in number, was larger than the usual Native population, because a considerable number had gone into the location only for the Saturday night. If 500 are deducted as casual visitors, there were four cases among 850 Natives, an incidence of 4.7 per mille. It is obvious, therefore, that the high incidence on the Indian population during the beginning of the outbreak was not due to their greater susceptibility.

In the second place all the first 65 cases occurred among those living in or very directly connected with the Coolie Location. Thus the commencement of the outbreak was confined to the Coolie Location. It is true as has been pointed out on p. iv. that the Coolie Location was an extremely insanitary area and therefore one of the most likely places in which to find plague spreading. On the other hand Ferreira Town was equally insanitary. Although the Indians gave such a large proportion of the cases in comparsion with the Natives, there is no evidence that the Indians were living in a more insanitary condition than the Natives, indeed the Natives were frequently tenants or sub-tenants of the Indians.

Thirdly, the great majority of the early cases were of the pneumonic type.

There are therefore three main facts; the great majority of the early cases were of the pneumonic type occuring in Indians living in the Coolie Location.

Fourthly, the second portion of the outbreak, that occurring after the 25th March was not confined to any race, but was largely confined to a district.

Fifthly, the type of the second portion of the outbreak was essentially bubonic, the number of pneumonic cases being very small.

How can these facts be explained?

In the first place it may be supposed that it was the result of an Epizootic in 1903. This hardly seems feasible, because the evidence of any such Epizootic is very small indeed. The plague rats found were found in erratic positions totally unconnected with each other, and it is most reasonable to suppose that they were imported from the Coast.

Had there been an Epizootic in 1904 the result of the plague rats found in 1903, there seems no reason why only places in the Coolie Location inhabited by Indians should have been affected by the rats, nor why, as the rats of 1903 were found in Ferreira Town, there should not have been some early cases from the margin of this district; nor does it seem reasonable to suppose that the early cases were derived from a rat infection, because they were nearly all of the pneumonic type and experience in India has shewn that there is no such preponderance of this type in Indians when the epidemic has been derived from a previous rat Epizootic.

Further, the latter cases which were undoubtedly infected from rats were of the bubonic type, and it is certainly difficult to conceive any reason why, if the method of infection was the same in both parts of the outbreak, the two types should have been so distinct in respect of time—8 days, with a preponderance of the pneumonic type in the first part, and 15 weeks with a preponderance of the bubonic type in the second part.

It may be said with certainty, therefore, that the first part of the epidemic was not the result of infection by rats, although the second part undoubtedly was. On the other hand it may be contended that although the occupants of the Coolie Location were cordoned and finally removed to Klipspruit, the outbreak was continuous, thus pointing to a persistence in the cause. The theory which is now propounded, in the opinion of the writer, explains these facts in a better manner than the hypothesis that the epidemic was subsequent to and consequent upon an Epizootic.

In the second place it is a strange coincidence, if it is a mere coincidence, that the first names on the genealogical chart, Korry Pathia and Hoosan Csanda were those of storekeepers, and that it has been impossible to trace any connection between the plague cases and possible plague cases beyond these two.

Thirdly, the Indian Storekeepers were importing rice from Bombay in December, 1903, and January, 1904, and they state very definitely that this rice contained rat-droppings. Plague was at this time in Bombay, and no special precautions are taken at Bombay to prevent the export of probably and possibly infected rice.

From all these facts the hypothesis suggested is as follows :—

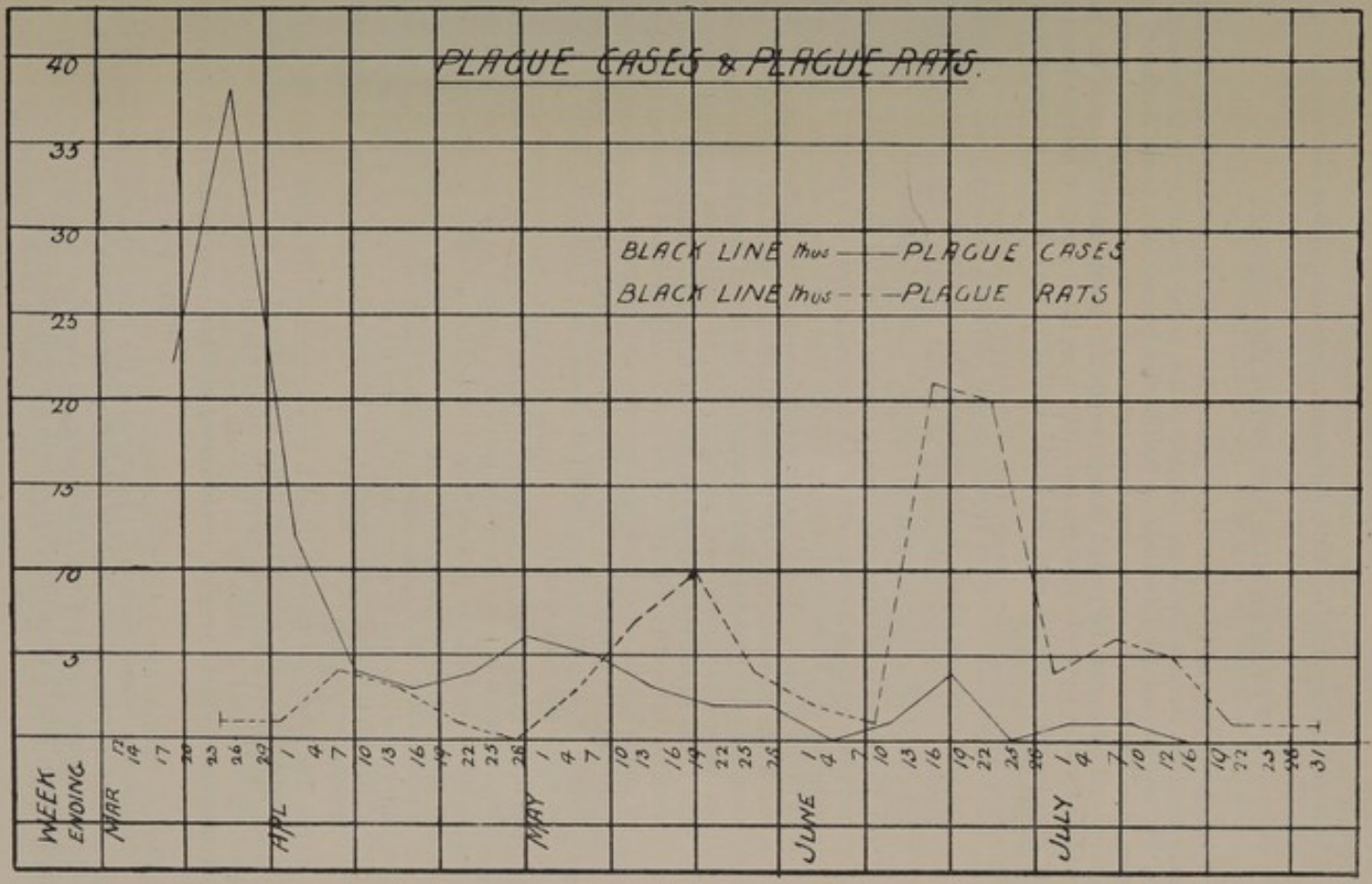
Plague infected rice was imported from Bombay during December, 1903, and January, 1904. From this rice a few Indians were infected with the pnuemonic form of plague. From these few, others of their fellow-countrymen became infected and the disease gradually spread in the Coolie Location, where so many Indians of the same caste were living together.

The rats were infected from the rice, or from the sputum of the human patients or from both, and they began to die. They, as is not unusual with rats, finding that their brethren were dying, fled the location and went to the next suitable haunt, namely Ferreira Town, about the end of the first week of February. The inhabitants of the location are practically unanimous in stating that the rats did leave the location about this date.

The first portion of the outbreak was due directly to the spread of the disease from person to person, the origin of the first cases being the plague-infected rice imported from Bombay. The second portion of the outbreak was due to a rat infection which had been set up in the Coolie Location by the plague patients in January and the early part of February. The first plague patient died in January, the rats left the location in February and plague cases occurred in Ferreira Town in March, just over a month after the rats went there ; this supposition will explain both why the outbreak was apparently continuous, and why the two portions of the outbreak differed so essentially in type.

This hypothesis is borne out by the curves of the epidemic and epimuic which have been placed on the same chart. This chart shews very distinctly that the crest of the epidemic curve occurred a considerable time before that of the epimuic. In the Johannesburg outbreak therefore, the epimuic was subsequent to and consequent upon the first portion of the epidemic, and was responsible for the second portion of the outbreak.

CHART XII.


PLAGUE CASES & PLAGUE RATS.
BLACK LINE thus ——PLAGUE CASES
BLACK LINE thus - - -PLAGUE RATS
40
35
30
25
20
15
10
5
WEEK ENDING
MAR
APL
MAY
JUNE
JULY

POWERS UNDER WHICH THE PREVENTIVE MEASURES WERE TAKEN.

Section VII., Chapter III., of the Johannesburg Municipal Bye-laws reads as follows :—

PREVENTION OF EPIDEMIC DISEASE.

"Whenever it appears to the Local Authority on the certificate of the Medical Officer of Health that the District under the control of the Local Autherity is threatened with, or affected by, any formidable infections or pestilential disease, the Local Authority may, by resolution, direct that the following Bye-laws for the prevention of Epidemic Disease shall be of full force and effect for the period in such resolution mentioned, and upon the passing of such resolutions such Bye-laws shall immediately come into operation and continue in operation for such period, provided that the Local Authority may by any subsequent resolution abridge or extend such period.

"'(A) The Medical Officer of Health or any Sanitary Inspector may forthwith enter on any premises which, in his opinion, require cleansing, whitewashing, or disinfecting, and may by such persons as he may appoint, cleanse, whitewash, and disinfect the same and any articles therein, to his satisfaction.

"'(B) The Local Authority may make a special order for the immediate closing of any premises, and for the removal of the inmates thereof to a place of shelter to be provided by the Local Authority, provided that such special order shall not be made as to any premises except upon the certificates of the Medical Officer of Health and the Town Engineer that the occupation of such premises constitutes a great and imminent danger to the public health by reason of their liability in consequence of defective construction and arrangements, to retain and engender infection ; and the Local Authority may, if the Medical Officer of Health and the Town Engineer shall further certify that the demolition of such premises is desirable in the interests of public health, enter upon and demolish any premises as to which any such special order has been made, and the compensation payable by the Local Authority in respect of any premises so demolished shall not exceed the value of the materials of which the same consist.

"'(C) If any person, not being himself sick, has been exposed, or is suspected of having been exposed to the infection of small-pox, plague, or cholera, and is so lodged that in the opinion of the Medical Officer of Health, he either is not effectively isolated or cannot conveniently be kept under observation, the Local Authority may, on a certificate to such effect signed by the Medical Officer of Health, by special order direct the removal of such person to, and his detention in, a proper place of observation for a period not exceeding the known maximum period of incubation of the disease in question.

"'(D) The Medical Officer of Health may order the immediate removal and burial of any corpse, and, where such order is not complied with, the Local Authority may cause any such corpse to be removed and buried forthwith.'"

Acting under these Bye-laws, the following certificate was issued to the Town Clerk :—

"21st March, 1904.

"In accordance with Section 7, Chapter 3, of the Public Health Bye-laws, I hereby give my certificate that it was ascertained on Saturday last, the 19th inst., that plague had broken out in Johannesburg, and that the Municipality is therefore infected by a formidable infectious disease within the meaning of the Section above referred to.

"WALTER C. C. PAKES.

"Acting M. O. H."

"The Town Clerk.

"Johannesburg."

Owing to the fact that the Witwatersrand is practically a single mining centre, it was deemed advisable to extend the area of operation of the Plague Regulations, and the following Regulations were promulgated in accordance with Section 58 of Ordinance 58 of 1903, which reads as follows :—

" In cases of urgent necessity arising from the existence or threatened outbreak in any Municipality of small-pox, cholera, diphtheria, typhus, yellow fever, bubonic plague or any contagious or infectious disease within the meaning of this section, it shall be lawful for the Colonial Secretary to make and proclaim such regulations to be in force within such Municipality as may be required to prevent the outbreak or check the progress of or eradicate such disease : any regulations so made and proclaimed under the provisions of this section for any such Municipality shall have the force of law therein, until repealed or amended by the Lieutenant-Governor."

GOVERNMENT NOTICE NO. 420 OF 1904.

Whereas the disease known as Bubonic Plague has broken out in the Municipality of Johannesburg and it has became of urgent necessity to make regulations to prevent an outbreak of the said disease in other parts of the Transvaal.

NOW therefore under and by virtue of the powers conferred on me by Section 58 of Ordinance No. 58 of 1903, I do hereby proclaim, declare, and make known the following regulations to be in force in all Municipalities and in all areas under the jurisdiction of Urban District Boards.

P. DUNCAN,
Colonial Secretary.

REGULATIONS.

Framed under Section 58 of the Municipal Corporation Ordinance, No. 58 of 1903.

NOTIFICATION OF SUSPICIOUS ILLNESS.

1.—It shall be the duty of any person suffering from any of the following symptoms, namely:—fever, delirium, inflammation of the lungs, acute glandular swelling or abscess or any illness suspected of being Bubonic or Oriental Plague, to give or cause to be given, if he is able to do so, immediate notice to the Local Authority.

2.—It shall be the duty of any medical practitioner in attendance upon, or any person in charge of any person suffering from any symptoms, as in the last preceding regulation mentioned, or of any householder, hotel-keeper, boarding-house keeper, lodging-house keeper, or school-keeper, on whose premises there is any person so suffering, on becoming aware of such illness, to give immediate notice thereof to the Local Authority.

Any medical practitioner as aforesaid giving such information as aforesaid shall be entitled to charge and recover from the Local Authority in respect of each such notification, a reasonable sum, not exceeding two shillings and sixpence, for the same.

3.—On the receipt of any such notification, the Local Authority receiving the same shall forthwith cause the nature of the illness to be enquired into and shall without delay report the notification and the results of any such enquiry to the Medical Officer of Health for the Colony.

THE ISOLATION OF INFECTED PERSONS AND DISINFECTING AND CLEANSING OF DWELLINGS, PUBLIC BUILDINGS AND OTHER PLACES :—

4.—It shall be lawful for the Medical Officer of Health for the Colony or any person duly appointed by the Colonial Secretary or any Local Authority, to do or cause to be done any of the following things, namely :—

(A) Remove to any place appointed for the purpose and isolate for such period and under such restrictions as may be deemed necessary at such place or at the person's own dwelling, any person suffering from Bubonic or Oriental Plague, or any illness suspected of being such disease or any person who may be likely to be infected with or to spread Bubonic or Oriental Plague.

(B) Do all things necessary for disinfecting or cleansing any dwelling, public building, or other place or part of a dwelling, public building or other place likely to be or become infected with or spread the infection of Bubonic or Oriental Plague, and may prohibit the habitation or use of any such dwelling, public building, or other place or any part thereof until such time as such Medical Officer of Health, person, or Local Authority aforementioned shall deem such dwelling, public building, or other place or part thereof, as the case may be, to be free from the infection of or likelihood of spreading such disease.

(C) May cause any clothing, furniture, or any other article likely to be infected with the said disease to be disinfected to the satisfaction of the Medical Officer of Health, and, in case disinfection shall be impossible for any reason, cause the same to be destroyed.

(D) May prohibit the sale of second-hand clothing and other articles likely to carry infection unless and until the same shall have been disinfected.

OVERCROWDING.

5.—Whenever the Medical Officer of Health for the Colony or any person duly authorised by the Colonial Secretary or any Local Authority shall find any dwelling or part of a dwelling to be overcrowded, such Medical Officer, person, or Local Authority may order the removal to a location or other place of accommodation of all or any persons who, by their presence in such dwelling or part of a dwelling, cause such overcrowding, and who are unable to furnish to the satisfaction of such Medical Officer of Health, person, or Local Authority, proof that he has or they have, some suitable habitation elsewhere.

For the purpose of this regulation a dwelling or part of a dwelling shall be deemed to be overcrowded which shall not be properly and sufficiently ventilated and provide for each inmate over the age of ten years 300 cubic feet of air space, and 30 square feet of floor space and for each inmate below the age of ten years half of these amounts.

RIGHT OF ENTRY.

6.—For the purposes of these regulations the Medical Officer of Health for the Colony, any person duly authorised by the Colonial Secretary, police constable, Justice of the Peace, or Health Officer, or other Officer duly appointed by a Local Authority, may enter at all times during the day or night on any premises to ascertain whether there is anything occurring thereon in contravention of any of the aforesaid regulations.

PENALTY CLAUSES.

7.—Any person failing to perform or carry out any duty required by these regulations or obstructing any officer or person in carrying out any lawful duty under these regulations, or causing by his presence or allowing any person to cause the overcrowding of any dwelling, public building, or other place, or refusing to give any information he may be lawfully required to give, or refusing to be removed, or obstructing the removal of any person to any hospital or place of isolation or observation, or escaping or attempting to escape from any such place, or occupying or allowing any person to occupy any dwelling, public building, or place or part of a dwelling, public building, or place legally closed against occupation or use, or in any way contravening any of the provisions of these regulations shall be liable to a penalty not exceeding fifteen pounds, or in default of payment, to imprisonment for a period not exceeding three months for a first offence and on conviction for any second or subsequent offence to a fine not exceeding fifty pounds, or to imprisonment with hard labour for a period not exceeding six months.

Any police constable or other person duly authorised by the Colonial Secretary, any Resident Magistrate or Justice of the Peace, is hereby empowered to use any force necessary to prevent any contravention of these regulations.

8.—In the interpretation of these regulations, "Local Authority" shall mean the Council of any Municipality or Urban District Board as the case may be.

9.—A Committee, to be styled the Rand Plague Committee shall be and is hereby constituted, consisting of the following persons :—

W. St. John Carr (Chairman),
Sir George Farrar, D.S.O.,
George Goch,
John Roy,
Julius Jeppe,
William Kidger Tucker,
Harold Strange,
J. W. S. Langermann,
Samuel Evans,

And also of the Mayors of the Municipalities of Boksburg, Germiston and Krugersdorp, and the Chairmen of the Urban District Boards of Roodepoort-Maraisburg and Springs.

The said Committee shall have full powers to act under any regulations made by the Colonial Secretary throughout the Witwatersrand District, and any reference in the said regulations to any Local Authority shall, within the said District, be deemed and taken to apply to the said Committee as if the said Committee had been mentioned therein instead of the Local Authority.

GOVERNMENT NOTICE NO. 421—1904.

Under and By Virtue of the powers conferred upon me by Section 58 of Ordinance 58 of 1903, I hereby declare, proclaim, and make known, the following regulations additional to those published in Government Notice No. 420 of 1904.

(Sgd) P. DUNCAN,
Colonial Secretary.

Colonial Secretary's Office,
Pretoria, 23rd March, 1904.

10.—It shall be lawful for the Committee constituted under Regulation No. 9 published in Government Notice No. 420 of 1904, to prohibit, by notice in some newspaper circulating in the Witwatersrand District any Asiatic proceeding beyond the limits of any Municipality or Urban District Board within such District, except on a permit to be issued by some person or persons duly authorised by it. Such permit shall contain a description of the person in whose favour it is issued, together with his place of destination.

Any Asiatic proceeding beyond the limits of any locality to which such prohibition has been applied by notice as aforesaid without a permit shall be liable to a fine not exceeding ten pounds, and in default of payment to imprisonment not exceeding three months with or withour hard labour.

11.—Regulation No. 9, published in Government Notice No. 420 of 1904, is hereby amended by the addition of the Commissioner of Railways as a member of the Rand Plague Committee.

GOVERNMENT NOTICE NO. 465 OF 1904.

Under and by virtue of the powers conferred on me by Section 58 of Ordinance 58 of 1903, I hereby declare, proclaim, and make known the following regulation additional to those published in Government Notices Nos. 420 and 421 of 1904.

(Sgd) P. DUNCAN,
Colonial Secretary.

Colonial Secretary's Office,
Pretoria, 24th March, 1904.

12.—Regulation No. 9 published in Government Notice No. 420 is hereby amended by the addition of R. G. Fricker, Esquire, as a member of the Plague Rand Committee.

PROCLAMATION.

By His Excellency the Lieutenant-Governor of the Transvaal.

WHEREAS it has been made to appear to me that the disease known as Bubonic Plague being an epidemic disease has developed in the Municipality of Johannesburg so as to be specially dangerous to the whole of the Witwatersrand District :

And whereas in certain portions of the Witwatersrand District by reason of such portions not being within the limits of a Municipality or within the jurisdiction of an Urban District Board the regulations published under Government Notices Nos. 420 and 421 are not in force :

Now therefore under and by virtue of the powers in me vested by Articles two seventeen and twenty-seven of Law No. 12 of 1895 by Section seventeen of Proclamation Transvaal No. 15 of 1902 and by Ordinance No. 24 of 1902 I do hereby declare proclaim and make known that the regulations published under Government Notices Nos. 420 and 421 of 1904 shall be the regulations made under the said Articles and shall therefore be in force and be deemed to be law in every portion of the Witwatersrand District until withdrawn by me by Proclamation under the said powers.

And I do hereby under the said powers, further declare, proclaim, and make known that the Committee styled the " Rand Plague Committee," mentioned in such regulations and constituted for the purpose of carrying out the same shall have full power to carry out each and all such regulations or any regulation which may hereafter be made in every portion of the said Witwatersrand District.

GOD SAVE THE KING.

Given under my Hand and Seal, at Pretoria, the 30th day of March, 1904.

(Sgd) ARTHUR LAWLEY,
Lieutenant-Governor.

By command of His Excellency the Lieutenant-Governor,

(Sgd.) P. DUNCAN,
Colonial Secretary.

31st March, 1904.

GOVERNMENT NOTICE NO. 507 OF 1904.

Under and by virtue of the powers conferred upon me by Section 58 of Ordinance 58 of 1903, I hereby declare, proclaim, and make known, the following regulation, additional to those published in Government Notices Nos. 420, 421, and 465 of 1904.

P. DUNCAN,
Colonial Secretary.

Colonial Secretary's Office,
Pretoria, 6th April, 1904.

13.—The following regulations shall apply to any Isolation Camp appointed under Clause 4 (a) of these Regulations by the Rand Plague Committee (herein referred to as the Committee) :—

(A) The Committee shall appoint an Officer to supervise every Isolation Camp established or controlled by the Committee : the term " Superintendent," as used in these regulations, shall mean any such officer or his authorised assistant, and the term " Camp " shall mean any such isolation camp.

(B) The Superintendent shall be responsible for maintaining discipline in any camp under his supervision, and for seeing that such camp is kept in a sanitary condition. All persons residing in such camp shall be subject to the orders of the Superintendent, and any person failing or refusing to obey any order of the Superintendent,

which is reasonably given for the purpose of maintaining discipline in such camp, or keeping such camp in a sanitary condition, shall be deemed to be guilty of a breach of these regulations.

(C) No person other than Officials of the Committee may enter or leave any camp unless in possession of a pass signed by some authorised Official of the Committee entitling him to enter or leave such camp.

(D) On the expiration of the period during which it may be deemed necessary to detain any person in any camp a pass shall be issued to such person entitling him to leave such camp, and such pass shall be signed by the Medical Officer of Health of the Committee.

(E) The Superintendent may issue to any person detained in any camp a pass entitling such person to leave such camp for a time specified on such pass, and no person to whom such pass is issued shall remain outside such camp beyond the time specified in such pass, and shall, immediately on his return, deliver up such pass to the Superintendent.

(F) Any person found within any camp who is not detained therein by order of she Committee may be ordered by the Superintendent to leave such camp immediately and any person failing to leave such camp immediately upon being so ordered shall be guilty of a breach of these regulations.

(G) Every person occupying a tent or hut in any camp shall keep such tent or hut clean and in good order to the satisfaction of the Superintendent. The Superintendent and any police constable shall at all times have access to all tents, huts, and buildings within any camp for the purpose of inspection.

(H) The Superintendent shall appoint from time to time in each camp places for the deposit of rubbish and also for the deposit of liquid refuse, and no person shall deposit any rubbish or any liquid refuse in any camp except in place so appointed.

(I) No person shall perform the requirements of nature in any camp except in the latrines provided in such camp.

(J) No person shall wilfully or negligently damage or destroy any tent, building, or erection, nor any refuse recepticle or other appliance in any camp which is the property of the Committee.

14.—Any person failing to perform or carry out any duty required by these regulations, or obstructing any officer or person in carrying out any lawful duty under these regulations, or causing by his presence, or allowing any person to cause, the overcrowding of any dwelling or other place, or refusing to give any information he may be lawfully required to give, or refusing to be removed, or obstructing the removal of any person to any hospital or place of isolation or observation, or escaping or attempting to escape, or assisting any person to escape or attempting to escape from any such place, or occupying, or allowing any person to occupy any dwelling, public building or place, or part of a dweling, public building or place legally closed against occupation or use, or in any way contravening any of the provisions of these regulations, shall be liable, on conviction, to a penalty not exceeding fifteen pounds, or, in default of payment, to imprisonment for a period not exceeding three months for a first offence and on conviction for any second or subsequent offence, to a fine not exceeding fifty pounds, or to imprisonment with hard labour for a period not exceeding six months.

And any police constable or other person duly authorised by the Colonial Secretary, any Resident Magistrate, or Justice of the Peace, is hereby empowered to use any force necessary to prevent any contravention of these regulations.

GOVERNMENT NOTICE NO. 534 OF 1904.

Under and by virtue of the powers conferred upon me by Section 58 of Ordinance No. 58 of 1903, I do hereby declare, proclaim, and make known the following Regulation additional to those published in Government Notices Nos. 420, 421, 465, and 507 of 1904.

(Sgd) P. DUNCAN,
Colonial Secretary.

Colonial Secretary's Office,
Pretoria, 11th April, 1904.

15.—Any employers, in the event of any native or coloured person employed by him suffering from any of the symptoms mentioned in Section 1 of the Regulations published in Government Notice No. 420 of 1904 shall immediately, at his own expense, cause such native or coloured person to be examined by a duly qualified medical practitioner. Any employer who shall commit a breach of this Regulation shall be liable to the penalties provided in Section 7 of the aforesaid Regulations, provided that no employer shall be liable to be convicted of a breach of this Regulation if he shall prove in respect of any native or coloured person in his employ both (1) that the time during which such native or coloured person had been suffering from such symptoms without being examined as aforesaid did *not* exceed twelve hours, and (2) that he was not aware, and that he could not, by taking any reasonable precaution, have ascertained that such native or coloured person was suffering from such symptoms.

PROCLAMATION

By His Excellency the Lieutenant-Governor of the Transvaal.

Under and by virtue of the powers in me vested by Articles two, seventeen and twenty-seven of Law No. 12 of 1895 by Section seventeen of Proclamation Transvaal No. 15 of 1902, and by Ordinance No. 24 of 1902, I do hereby declare, proclaim, and make known that the Regulation published under Government Notice No. 672 of 1904 shall be additional to the Regulations made under the said Articles of Proclamation Administration No. 21 of 1904, and to that contained in Government Notice No. 534 of 1904, and shall be in force and be deemed to be law in every portion of the Witwatersrand District, until withdrawn by me by Proclamation under the said powers.

GOD SAVE THE KING.

Given under my hand and seal at Pretoria, this tenth day of May, One thousand Nine hundred and Four.

(Sgd) ARTHUR LAWLEY
Lieutenant-Governor.

By command of His Excellency the
Lieutenant-Governor.

(Sgd) P. DUNCAN
Colonial Secretary.

GOVERNMENT NOTICE NO. 672 OF 1904.

Under and by virtue of the powers conferred upon me by Section 58 of Ordinance 58 of 1903, I hereby declare, proclaim, and make known the following Regulation, additional to those published in Government Notices Nos. 420, 421, 465, 507, and 534 of 1904.

16.—The regulations for isolation camps contained in Government Notice 507 of 1904, shall apply to any location or other place of accommodation to which any person may be or may have been removed by order of the Medical Officer of Health for the Colony or any person duly authorised by the Colonial Secretary or any Local Authority under Clause 5 of these regulations, and the terms "Isolation Camp" and "Camp" as used in the said regulations shall include any such location or place of accommodation.

The camp established by the Rand Plague Committee on a portion of the Farm Klipspruit No. 58, is hereby declared to be a place of accommodation within the meaning of this regulation.

(Sgd) P. DUNCAN,
Colonial Secretary.

Colonial Secretary's Office,
Pretoria, 9th May, 1904.

No. 28 of 1904 Assented to 28th July, 1904.

ORDINANCE.

To validate the acts of Local Authorities and of other persons committed in excess of their legal powers.

WHEREAS certain local authorities in the belief that certain bye-laws made by them severally under the provisions of the Municipal Corporations Ordinance 1903 had been duly published in accordance with the requirements of the said Ordinance have done certain acts under such bye-laws and have instituted prosecutions and recovered penalties from divers persons for contraventions of such bye-laws ;

And whereas by virtue of a decision of the Supreme Court of this Colony it has been made to appear that the said bye-laws were not duly published in accordance with the requirements of the said Ordinance ;

And whereas it is desirable to validate the acts done by such local authorities and by other persons under the said bye-laws ;

And whereas a body of persons known in this Ordinance described as the " Rand Plague Committee " was constituted and empowered under various Government Notices to carry out in the Witwatersrand District of the Colony certain Regulations made by the Colonial Secretary under section *fifty-eight* of the said Ordinance for the purpose of checking the progress of the disease known as Bubonic plague ;

And whereas doubts have arisen as to the legality of the acts done or authorised to be done under the said Regulations by the Rand Plague Committee and other persons by its authority and direction and it is desirable to validate such acts and further to make provision for the payment of the expenditure incurred by the said Committee in carrying out the said Regulations :

Be it enacted by the Lieutenant-Governor of the Transvaal with the advice and consent of the Legislative Council thereof as follows :—

PART I.

1. The Publication in the Gazette of the Government Notices mentioned in the first column of the First Schedule hereto shall be deemed to have been due publication in accordance with the requirements of section *forty-five* of the Municipal Corporations Ordinance 1903 of the bye-laws mentioned in the second column of the said Schedule for each of the districts of local authorities set forth in the third column of the said Schedule and to the extent to which they purported to have been published respectively for such districts and from and after the date of such purported publication.

2. No Action shall lie against any such local authority aforesaid or any other person for any damages alleged to have been caused by the exercise of any such local authority or by such other person of the powers and duties conferred and imposed by the said bye-laws or for the recovery of any moneys paid into the revenue of any such local authority under the said bye-laws or for the recovery of any moneys paid as and for a penalty for contravening any such bye-law and all sentences of fine or imprisonment imposed by any Court for a contravention of any such bye-law shall be deemed to have been validly imposed.

PART II.

3. All acts done by the Rand Plague Committee constituted by and in the Regulations published under Government Notice No. 420 of 1904 or any addition to or amendment of Regulations and all acts done in good faith by any persons under the authority of such Committee in the exercise of the powers which any such Regulation purports to have conferred upon it or them shall be deemed to have been lawfully done ; and no action shall lie against any member of such Committee or officer thereof or any person acting under the authority or direction of such Committee or of a member or officer of such Committee by reason of the *bona fide* exercise of the powers conferred by the said Regulations and all sentences whether of fine or imprisonment imposed by any Court for contravention of the said Regulations shall be deemed to have been validly imposed. Such Regulations as are referred to in this section were published under the Second Schedule hereto and every such Regulation shall be deemed to have the force of law throughout every part of the Witwatersrand District as and from the date on which it was published in the Gazette.

4. The expenditure incurred by the Rand Plague Committee and any officer thereof in the exercise of the powers conferred by the said Regulations shall be paid in the following manner, that is to say : one-half such expenditure shall be borne out of the public revenue of the Colony and one-half such expenditure shall be borne by the local authorities mentioned in the Third Schedule hereto in certain proportions to be determined as hereinafter provided.

5.—(1) The proportions in which the half share of expenditure which under the last preceding section is to be borne by the said local authorities shall be determined by a qualified Accountant after an examination of the accounts of the Rand Plague Committee.

(2) The appointment of such qualified accountant aforesaid shall be made by all the local authorities mentioned in the Third Schedule hereto ; provided that if each and every such local authority shall not agree upon the appointment of such qualified Accountant within three months from the date of any notice or proclamation declaring the Rand Plague Committee to be abolished notice shall be given by the Secretary of the Rand Plague Committee to the Colonial Secretary who thereupon shall appoint a qualified Accountant for the purposes of sub-section (1) of this section.

(3) The qualified Accountant appointed as aforesaid shall as soon as may be after the date of his appointment prepare and submit to each of the said local authorities a statement showing the amounts which from the said examination of accounts appear to be due from each such local authority and showing also the basis of calculation of such amounts and if within one month of the submission of the said statement to any such local authority such local authority shall give notice to the said qualified Accountant that it objects to the terms of the said statement the said qualified Accountant shall on a day to be appointed by him hear any such objection and may after such hearing either amend the said statement or confirm the same and the statement as amended or as confirmed, shall be final and conclusive as between the said local authorities as determining the amounts respectively payable by them. For the purposes of the hearing of objections to the said statement the provisions of the Commissions Powers Ordinance 1902 shall *mutatis mutandis* apply as if the said qualified Accountant were a Commission to which such Ordinance had been applied.

(4). Such qualified Accountant is hereby authorised (if necessary) to recover from any such local authority in any competent Court the amount determined to be payable as aforesaid by it.

(5) The amounts so determined to be respectively payable by such local authorities shall be paid out of the several revenues of such local authorities.

(6) The remuneration of the qualified Accountant appointed under this section shall be deemed to be expenditure incurred by the Rand Plague Committee.

6. This Ordinance may be cited as the Local Authorities and Plague Committee Validation Ordinance 1904.

SECOND SCHEDULE.

Government Notices publishing Plague Regulations and constituting the Rand Plague Committee :—

No. 420 of 1904.
No. 421 of 1904.
No. 465 of 1904.
No. 507 of 1904.
No. 534 of 1904.
No. 578 of 1904.
No. 672 of 1904.

THIRD SCHEDULE.

Names of local authorities contributories to expenses of the Rand Plague Committee :—

Johannesburg Municipality.
Boksburg Municipality.
Springs Urban District Board.
Roodepoort-Maraisburg Urban District Board.
Krugersdorp Municipality.
Germiston Municipality.

PREVENTIVE MEASURES.

The measures adopted for the suppression of the outbreak fall into two parts, and may be conveniently described separately. First were the immediate measures taken in connection with the Coolie Location and its inhabitants, and second, those taken in Johannesburg and throughout the area of the Rand.

COOLIE LOCATION.

First the Coolie Location.

On Saturday morning, the 19th March, the patients had been moved from their houses to a vacant stand, No. 36, and temporary arrangements had been made by the Indians themselves for nursing and feeding the sufferers, chiefly through the agency of Mr. M. K. Gandhi and his friends.

It was obvious, however, that the accommodation on Stand 36 was both unsuitable and inadequate ; steps were, therefore, at once taken to open the Government Entrepôt as a temporary hospital. This was situated close to the Lighting Works, and, although outside the Coolie Location was within the Insanitary Area. The Government Entrepôt had been the Customs Warehouse, but had been purchased by the Municipality under the Expropriation Scheme. At the time of the outbreak it was fortunately empty and was at once hurriedly fitted up ; beds, bedding etc., obtained, a nurse and orderlies engaged, and by 4.0 p.m. all the patients then alive were removed to the temporary hospital. The house on Stand 36 was thoroughly disinfected and an Inspector and Orderly were left in charge in order to take care of any other patients found sick in the location previous to their removal to the temporary hospital.

During the course of the day it was found that the patients had been living in some dozen different houses in the location.

Upon the publication of the fact that the disease was plague, therefore, it was clear that there was an unknown number of possible or probable foci. In order to prevent the disease spreading into the town, it was at once decided to cordon the location. Accordingly, the Commissioner of Police (Mr. Showers) placed a cordon of police round the location at 4.0 a.m. on Sunday the 20th March. The cordon was too late to prevent some of those who were incubating from getting away. In another part of the report mention is made of some Indians dying of plague in Zuurfontein, Springfontein, East London, and Durban. These had, however, all left the location on Friday the 18th, or on Saturday the 19th March. No cases were traced to the people who had left the location after the cordon was drawn, although it is said that a few of the inhabitants escaped.

On Saturday afternoon several of the Municipal Inspectors were detailed to the Chief Disinfector and every house from which it was known that a patient had been taken was evacuated, disinfected and closed.

On Sunday morning a staff of Inspectors was detailed to Dr. Godfrey in order to make a house to house inspection of the location and see and treat any sick found there.

The Municipal rat-catchers were instructed to proceed to the location and catch all the rats which could be found. It may be here stated that the Indians themselves asserted that there were no rats ; that they had all disappeared a short time before. This fact was found to be nearly the case. Not more than a dozen rats in all were found—of these three were found to be plague-infected.

It had been well-known for some time past that the whole location was in a most insanitary condition. On Monday morning, therefore, a special staff of scavengers was sent down, and every particle of rubbish that could be collected was so collected and burnt. All the houses were made as clean as possible, and extra precautions were taken with regard to the E.C.'s, rubbish-bins, etc.

Since at the outset the only cases came from the location, the house on Stand 36 was turned into a receiving hospital. It was soon found, however, that there were a few cases coming from outside the area. It was, therefore, deemed advisable to remove the receiving hospital to a spot outside the cordon, and on the 22nd March a vacant house in Station Road, which is within the Insanitary Area was fitted up and the one on Stand 36 was closed.

Almost immediately upon the outbreak of plague it was determined by the Health Committee of the Town Council to evacuate the location ; a Sub-Committee was, therefore appointed to search for and recommend a site whither the inhabitants of the location might be transferred. The principal reasons for this step were first, that it was impossible to make the location fit for habitation short of reconstructing it, and, secondly, in view of the possibly wide-spread affection, it was deemed wiser to treat all the inhabitants, for the time at least, as suspects and not as mere contacts ; it would have been impossible to have inspected them daily had the cordon been broken and the inhabitants allowed to go where they pleased. It was eventually decided to remove the inhabitants to the farm Klipspruit, which is situated about 12 miles from Johannesburg. The various requirements of a camp were, therefore, purchased, officers and police sent out, and on March 23rd, 100 natives, having been medically examined, were despatched for the purpose of erecting tents, digging latrines, etc. On March 24th, 360 Indians were despatched and Dr. McMunn was placed in Medical charge. By March 30th all the inhabitants had been removed. These numbered 3,100, and consisted of—

1,600 Asiatics.

142 Coloured.

1,358 Natives.

From the moment the cordon was drawn round the location to the time that the camp was opened at Klipspruit the inhabitants were fed entirely at the expense of the Rand Plague Committee. There were large stores of food in some of the shops in the location, and, until the evacuation, the Rand Plague Committee purchased the food from the store-keepers and so provided the inhabitants. When the location was evacuated all the foodstuffs which were not in tins were left *in situ*, and burnt with the location itself. The tinned stuff was removed from the location, the tins were dipped in disinfectant, and those tins which were in a sound condition were taken to the accommodation camp at Klipspruit and distributed to the inhabitants.

The personal belongings of the inhabitants were inventoried, removed to the Government Entrepôt—which was closed as a hospital when the Plague Camp at Rietfontein was opened—disinfected, and subsequently handed back to the owners upon their return to town.

The number of fleas transferred with the personal belongings to the Entrepôt was enormous, the place literally swarmed with them. They were, however, entirely destroyed by fumigation with sulphur dioxide, spraying with formalin and sprinkling with pyrethrum powder.

Directly it was decided to burn the location, a corrugated iron fence was built right round it, sunk eighteen inches in the ground. Organised hunts were undertaken to destroy all dogs, cats, rats, fowls, etc., many of the former being shot with shot guns.

All the belongings of the Indians which were worth moving having been moved to the Entrepôt, the location was handed over to the Chief of the Fire Brigade for destruction. Various houses, which were almost without exception built of corrugated iron and wood, having been saturated with kerosene, at 6 a.m. on the 8th April the place was fired. A number of firemen were on duty with all the necessaries to prevent any damage being done to surrounding houses, but the burning was so skillfully managed, that, with the exception of one or two very minor accidents to the firemen, the whole place was burnt to the ground without mishap.

Although the fence had been built round the location for the purpose of preventing the egress of rats, they were conspicuous by their absence. The place was fired on the outside and burnt towards the centre, but, as the streets divided the various blocks, it is quite certain that had rats been present they would have left the burning houses and tried to escape towards the fence. It is certain, therefore, that on April 8th there were no rats in the location.

GENERAL MEASURES.

For the first three or four days the whole of the energies of the Rand Plague Committee were directed towards the Coolie Location and the prevention of the spread therefrom to other parts of the town or Colony. It was soon evident, however, that other parts of Johannesburg were already affected (it might here be said that all these early cases were in all probability directly infected from the inhabitants of the location), and steps were immediately taken to cope with an outbreak however large.

Ambulance Service and Receiving Hospital.

The Plague Camp at Rietfontein, being 7½ miles from Johannesburg, it was necessary to have a receiving hospital. A house in Station Road, within the Insanitary Area, was, therefore, obtained and fitted up. It was divided first into two portions for the reception of suspects on the one side and for plague patients on the other. So far as possible Asiatics and natives were still further separated. Although this was only a receiving hospital it was fitted up practically as a Cottage Hospital for medical cases, and staffed on similar lines, the difference being that the attendants were men and not women.

The Ambulance Staff as well as the number of ambulances was very considerably increased. Each ambulance was accompanied by a white driver as well as by a native attendant. Separate ambulances were kept for white patients.

It was found convenient to have two methods of procedure in respect of white and coloured patients respectively. Any white patients, whether suspects or plague patients, were removed direct to Rietfontein from their places of residence and did not go to the receiving hospital. All coloured patients were removed to the receiving hospital, and remained there until the ambulance left for Rietfontein. When there were patients to transfer, the ambulance left daily at 10 a.m. and 2 p.m.

As there was only one Plague Camp for the whole of the Witwatersrand area, a railway ambulance was necessary. A box-truck was, therefore, placed at the disposal of the Plague Committee and fitted up with the stretcher beds. When a coloured patient was transferred from an outside district to Rietfontein, after leaving the railway ambulance he was taken to the receiving hospital and from there he was taken to his final destination.

These arrangements enabled the Plague Officers to remove patients from their residences, or from the places where they were found, without more delay than was entailed in sending for the ambulance. This is a very important thing since it enables the patient to come under observation and treatment early, and secondly, it allows the premises to be evacuated and disinfected at the earliest possible moment.

The Plague Camp.

In view of the possibility of the outbreak of plague in the Witwatersrand, the Town Council of Johannesburg, in conjunction with the Government, had in December, 1902, selected a site measuring 200 yards by 300 yards on the farm Rietfontein, which was the property of the Government, and on a part of which the Lazaretto and Incurable Home were situated, for a Plague Camp. The Town Council had fenced this site round, had made concrete floors for Marquee tents and had erected a kitchen, three stores, four bathrooms and baths, and latrines, and provided a water supply, and equipment for the immediate reception of twenty patients, at a total cost of £2,655. These preliminary preparations were as complete as could reasonably be expected, but it was found necessary to make some important additions and alterations.

Plans were immediately passed by the Rand Plague Committee for the further equipment of the camp. These plans were drawn out by the Town Engineer after consultation with Drs. Mackenzie, Montgomery, and the Medical Officer of Health to the Rand Plague Committee. Although the want of the additions and alterations subsequently made in the camp did not affect the mortality of the cases or the comfort of the patients, there was not sufficient accommodation for the Staff, and during the early period the nurses had to perform their duties under extremely uncomfortable circumstances. The tents which were obtained from the army were not sound, and this report cannot be written without containing an appreciation of the abnegation of the nursing staff who volunteered to go to Rietfontein and nurse the patients at a time when they literally had not a rain proof roof over their heads.

The camp, as constructed by the Rand Plague Committee, was divided into two parts, separated by a corrugated iron fence. The part on the left of the main entrance being for plague patients, and that on the right for suspects. Each camp was further sub-divided into three divisions, for whites, Asiatics and natives, by barbed wire.

A receiving block was built at the junction of the two camps for the admission and discharge of the patients: a division being made in this in order to provide bathrooms for white and coloured cases separately.

Arrangements were made whereby the Administrative Camp, the Suspect Camp, and the Plague Camp were each separate entities, each having kitchens, bath-rooms, etc. The camp was opened and occupied on Tuesday 22nd March (the temporary hospital in the Government Entrepôt having been closed and thoroughly disinfected) and closed down on 1st August. During this time 206 patients were admitted and treated. The majority of these cases were, as would be expected, in the Suspect Camp.

Dr. Mehliss was at first the Superintendent, and was assisted by Drs. Archer Brown and Schmauser. Subsequently it was found more convenient to dissociate the camp from the Lazaretto, and Dr. Allen was appointed Senior Medical Officer, and later, when the camp ceased to increase, Dr. Allen was brought into town, and Dr. Sheridan took over the duties of Senior Medical Officer.

The difficulties attendant upon the equipment of an infectious hospital in the Transvaal are as great, if not greater, than are found elsewhere. Provision had to be made for the whites, Asiatics and natives of each sex, so that there were six different camps separated either by barbed wire or corrugated iron. This fact made every detail of management more difficult and, *inter alia*, more expensive.

Post Mortem Examinations.—Plague Mortuary.

Owing to the peculiar character of the first cases it was considered necessary to hold post-mortem examinations of every case of death occurring within any possibly infected area which could not be absolutely assigned to causes remote from plague. To this end, the Government Mortuary was used exclusively for these doubtful cases, and, by the courtesy of the Superintendent, which was subsequently confirmed by the Board of the Johannesburg Hospital, the Hospital Mortuary was placed at the disposal of the Government for the purpose of holding post-mortem examinations on the bodies of those who had died by accident, or from causes which were not suspected to be plague. Later on, the Rand Plague Committee built a mortuary in Johannesburg for this purpose, in order to allow the Hospital to retain their mortuary for their own purposes.

Dr. A. D. M. Grant was appointed as Pathologist to the Rand Plague Committee, whilst Dr. Alexander, the Acting District Surgeon, continued to make ordinary post-mortem examinations as heretofore.

The Plague Mortuary was supplied with all the necessary bottles for the collection of specimens, and, with the exception of two cases occurring within the first 48 hours, every body post-mortemed in the plague mortuary was also submitted to bacteriological examination.

The result of this arrangement was that many post-mortem examinations which were held in the Plague Mortuary were found to have died of other diseases, but the satisfactory part was that no case examined in the Hospital Mortuary after the division of the mortuaries was proved to have died of plague.

In the districts outside Johannesburg the District Surgeon was requested to make all post-mortem examinations, and mortuaries were built at Germiston and Krugersdorp, and tents set aside at smaller places where there was a chance of plague appearing.

The arrangements were so complete that it may be said that, throughout the area of the Rand, every case of death which was in the least suspicious of plague was submitted to post-mortem examination/

Burial of the Dead.

In this Colony it is customary to bury the dead as soon after death as is possible.

As every dead body was removed for burial either from the Plague Hospital at Rietfontein or from the Government Mortuary, the only precaution found necessary was to thoroughly wash the cadever in strong antiseptic.

The exceptions were in the case of some Hindoos and the Mohammedans. The former were allowed to burn their dead: the latter, who have certain religious functions to perform, were given a room in the mortuary in which to perform the rite. They were warned of the dangers of handling the cadavers, and it was suggested to them that the washing should be performed with a solution of corrosive sublimate.

The usual suggestions were made concerning the danger of burying plague cadavers in the cemeteries, but no reason was seen why this should not be done. A certain amount of adverse criticism was offered because a grave containing a plague cadaver was opened to receive another. How the critics thought infection took place it was difficult to conceive. No untoward accident happened.

Intelligence Department.

One of the first steps taken on the outbreak of plague was the establishment of an Intelligence Department. This consisted of a number of special inspectors whose duty it was first to visit all contacts daily; second, to find out any coloured people, Indians or natives, who were sick, and any white people who, being sick, were not attended by a medical man. Each Inspector had a special district in order that, by concentrating his attention upon a comparatively small area, he could become more familiar with that area and be the more likely to hear and find out any sick. The result of this step was that the Plague Office knew of practically every case of illness almost as soon as it occurred, and during the whole period of the outbreak, these officers did their work so effectively that the number of cases not detected by them was negligible. We look upon this measure as one of the most important for the suppression of plague. The moment the people found that contacts would not be segregated, not only was there no concealment, but, on the contrary, they were anxious to report all suspicious cases with a view to their removal.

The few cases that were not found were due to the habit which both Asiatics and natives practise of concealing their sick, and the casual manner in which many employers of native labour treat the natives, and allow them to be sick without even ascertaining what the matter is with them.

The utility of this department cannot be over-estimated. Being as it were the eyes and ears of the Plague Department, the officers were kept acquainted with almost everything which was happening throughout the whole of Johannesburg. It is a matter of fact that more than one case of plague was brought to the notice of the officers 24, or probably 48, hours before they would have heard had the Intelligence Staff not been established, and as the success of the Administration in a plague outbreak depends largely upon early information, there can be no doubt that the success of the Rand operations is, in considerable measure, due to this Staff.

Notification of Sick Natives.

Efficient as the Intelligence Staff was there was always a fear that a case of plague might occur without notification to the Plague Office, especially in view of the laxity on the part of employers of coloured labour. Accordingly, the duty of notifying the sickness of any coloured employé was imposed upon the employer (v. p. 72) under a penalty.

Regulations Concerning Travelling.

In order to be able to surround the probable outbreak, it was at once determined to prevent as much as possible the ingress to and egress from Johannesburg for a brief period. There was little difficulty in preventing the ingress, because the moment plague was declared there appeared not only to be a hesitancy in coming near the place in those who lived outside, but a distinct wish on the part of many living in Johannesburg to get away.

All facilities were at once withdrawn by which Asiatics or natives could travel by train. The mines kept all their coloured employés within the compounds, and, as far as could be arranged, all but the white people were kept where they were. Whether this measure was or was not necessary in the light of after events, and of the recommendations of the Durban Conference is, perhaps, a matter for doubt. But the problem before the Rand Plague Committee had at the time not been defined. How many centres of infection there were it was impossible to say ; how many of the coloured population of Johannesburg were already incubating, no one could know ; how many persons already in the stage of incubation for plague intended to leave Johannesburg it was impossible to conceive. In order, therefore, to gain time, and by this means to find the exact dimensions of the threatened attack, this step was decided upon. The result of the step was, that after the 23rd March the restrictions were relaxed and coloured people were allowed to travel.

There can be no doubt that the cases dying in Springfontein, East London, and Durban, were cases of Pneumonic Plague, and there was a certain amount of fear in the neighbouring Colonies that they would be re-infected from the Witwatersrand, and arrangements were made by them for quarantining all passengers from the infected area. These cases had left the Coolie Location not only before it was cordoned but before it was known that there was plague in the location. When once the Authorities were made aware of the fact that plague existed in the area of the Rand, and the travelling restrictions had been imposed, no single case, either in Natal, the Cape, or the Portuguese Territory was shewn to be connected with the Transvaal outbreak.

As regards Natal, the clean bills of health given by the Rand Plague Committee were not accepted, but the holders were quarantined at the border. It seems strange that this procedure should have been adopted since "no special measures were.....taken in regard to travellers by rail or road" in Natal. That is, restrictions were placed upon travellers from the Witwatersrand into Natal, but none from an infected place in Natal to a clean place in Natal, nor were any steps taken to prevent the Transvaal from being infected from Natal.

It is also to be noted that, although both Natal and the Cape objected to receive coloured inhabitants from the Rand into their territories, plague was still existent in Durban and Port Elizabeth, and the Transvaal placed no restrictions upon the coloured inhabitants of these places entering the Transvaal. Speaking, as it is possible to speak, on behalf of the Medical Staff employed by the Rand Plague Committee, there are far more important things to be done in the suppression of plague than trying to exclude it at the border. To use a military analogy : If the whole of the defending army is at the border it may succeed in keeping the enemy out of the defending territory, but if perchance the enemy does gain entrance the army must be withdrawn from the frontier to combat the invaders.

It was impossible to stop the passage of the Asiatics and natives from Johannesburg by road, but the S.A.C. were instructed to examine the passes of all coloured people whom they met travelling in the neighbourhood of Johannesburg, and latterly anywhere about the area of the Rand. There is a possibility—even a probability—that one or two of the cases in the Rand which occurred outside Johannesburg were attributable to this passage by road, but it was felt that the machinery which would have to be set in motion to prevent this would have been so extremely costly that it would not have warranted the cost, however efficient the machinery might have been. It was felt also that an equally satisfactory result could be, and indeed was, obtained by the formation of a much less expensive intelligence department.

These restrictions were relaxed on the 24th March. After this date the procedure was as follows :—All Asiatics, Cape Coloured people and native Mohammedans wishing to leave any infected area were required to present to the booking clerk at the station whence he wished to proceed, a certificate of good health signed by the Examining Medical Officer and stamped by the Asiatic Department ; in the absence of this certificate he was unable to obtain a ticket, and he was not allowed to travel without a ticket. In the case of natives, they were not allowed to travel without a travelling pass ; this pass they could only obtain from the Native Pass Office, and it was only issued upon the certificate of the Medical Examining Officer.

Medical Inspectors.

A staff of Medical Inspectors was appointed, whose duties were to examine all suspicious cases and take the necessary steps to isolate them, if they considered it necessary. The medical men took every advantage of these Inspectors, and frequently asked them to consult in cases where the case was even of a doubtful character and hardly suspicious. In addition to this they were responsible for the examination of natives and Asiatics in Johannesburg, and reported upon the Native Compounds.

Inspection of Natives.

Throughout the area of the Witwatersrand, and indeed throughout the Transvaal, every native has to be in possession of a native pass, which gives the name of his employer, residence, and date of service. In addition to this he must be possessed of a monthly pass. If he is not in employment, but is a " togt " boy, he has a different pass, and if he is in search of employment, he is given a travelling or special pass. The effect of this is that every native not in a compound must come to one of the Native Pass Offices once a month.

During the period of the outbreak 48,596 natives were medically examined throughout the area of the Rand in the various Native Pass Offices. Of these, 91 were found to be sick, and of these, three were found to be suffering from plague.

Observation hospitals consisting of tents, were erected in the Pass Office Compounds. All natives who were found to be sick and who were not obviously suffering from a disease other than plague were at once isolated and kept under observation until the nature of their illness revealed itself.

In the case of natives working on the mines, the medical observation was as perfect as it could be. The natives, living as they do in compounds, are easily kept under observation. Every day a hut to hut search was made by the Compound Manager and every native who had not gone to work was considered as sick and was seen and examined by the Medical Officer to the mine. Throughout the entire period of the outbreak a careful daily medical inspection was made. Any suspicious case was isolated in the compound hospital, and frequently the Plague Medical Officers were informed and consulted. Not infrequently, when the compound hospital accommodation was inadequate, the suspects were transferred to the Plague Suspect Camp.

These very elaborate arrangements were made because it was felt that no chance of even a small outbreak on any mine could be allowed, on account of the fear of the natives becoming panic stricken and going at once to their kraals.

Notification of Pneumonia.

Since all the first cases of plague had been of the pneumonic type, pneumonia was made a notifiable disease. At the same time all the medical men on the Witwatersrand were requested to obtain sputum and send it to the Government Laboratories for examination. In case the medical men did not do so, an inspector was detailed to endeavour to obtain some and send it to the Government Laboratories. The result of this was that with very few exceptions, the sputum of every case of pneumonia occurring during the period was examined bacteriologicalley. Btween the 18th March and 30th July, 2,345 specimens of sputum were examined, as follows :—

March	201.
April	1,193.
May	394.
June	310.
July	247.
	2,345

Precautions at the Johannesburg Hospital.

Since four of the earliest cases of plague were taken to the hospital in accordance with the usual custom of sending up thither any such native or Asiatic, the Hospital Board appointed Miss Arnott, L.R.C.P., L.R.C.S., who had had considerable plague experience in India, as special Plague Officer to the Hospital. Every suspicious case was seen and examined by her previous to admission. Any suspects were retained until they had been seen by the Plague Medical Inspector and generally removed—if they were coloured patients—to the receiving hospital until a diagnosis could be made. This precaution proved of considerable value, and most probably prevented the infection of the native wards of the hospital.

Contacts.

Subsequently to the drawing of the cordon round the Coolie Location, contacts were not interfered with at all, provided they continued in good health. White contacts were visited by inspectors daily for ten days after the date of contact. Native contacts in the compounds were seen by the Medical Officer of the compound, and Asiatics were seen either by an Inspector or a Medical man. If Asiatics or natives who were contacts could not be kept under observation, or if there was any danger of them trying to evade it, they were treated as suspects for 10 days.

The moment that a contact fell sick during the ten days after contact, he was treated as a suspect by the Plague Medical Officers either in the receiving hospital or at Rietfontein.

The experience of Johannesburg shews that it is impossible to lay down a hard and fast rule as to contacts. It is absurd to go to the expense of segregating the contacts of bubonic cases merely because they are contacts. On the other hand, being contacts they may have been under the influence of the same infection which has given rise to the case, and, therefore, they should not be allowed to escape observation. This fact is borne out by Cases 79 and 80, 84 and 86, 92 and 93, and 108 and 109. In each case the latter number was a contact of the former number, but the evidence shews that the second case was infected from the same source as the first case and not from the first case. The contacts should, therefore, be removed from the place where the case has occurred pending the disinfection of the house, and, if necessary, should be kept by the Plague Officials if this is the only manner in which they can be kept under observation.

Very much greater care must be taken with the contacts of pneumonic cases. It is not necessary to segregate them if they can be kept under observation, but, if there is any danger of their escaping this observation, they should certainly be treated as suspects. The amount of infectious matter spread by a pneumonic case, and the probably greater virulence of the organism, make it absolutely necessary to keep all contacts under most strict observation. The chart at the end shews this very clearly in those secondary cases in which the place infection is eliminated.

The evidence of the infection being a place infection is very great, but many of the Johannesburg pneumonic cases were undoubtedly purely contact infection. What the percentage infection of contacts actually was it is impossible to say, but it must have been very considerable.

On this point, the two distinct periods of the outbreak, the first period almost confined to the pneumonic type and the second period to the bubonic type, are very instructive. The considerable number of contacts infected during the first period, and the practical absence of contacts infected during the second period are certainly most striking.

The moral of the experience really is that every single contact has to be considered separately and the circumstances of each case summed up :—

1. The type of the disease with which he has been brought into contact.

2. The possibility of his removal whilst the premises are disinfected, if he is living on the same premises as the patient.

3. The certainty of being able to keep him under observation.

Prophylactic Inoculation.

As the disease after the lapse of the first three days never assumed alarming proportions, preventive inoculation was not resorted to. This for more than one reason. In the first place the native is a particularly nervous person when he is subjected to unknown forms of treatment, and it was very advisable to avoid any form of scare : secondly, it was felt that inoculation should be reserved in case of serious spread (having once inoculated the community it would be, or might have been, difficult to perform the inoculation again, say at the end of six months) thirdly, the untoward accident in India was known in this country.

It was determined, therefore, to offer inoculation to whomsoever desired it, and stations and times were arranged and a special medical man appointed to perform the inoculations. The net result was the inoculation of 6 Europeans and 14 natives.

Several of those who came into immediate contact with the plague cases were inoculated with Yersin's Serum. This serum was also used at the Plague Camp, but the number of cases is so small that no deductions whatever can be made from the results obtained.

Several thousand doses of both the prophylactic (Haffkine's) and the Curative Serum (Yersin's) were on hand for use if necessary.

Scavenging.

Special instructions were issued by the Rand Plague Committee to all Municipalities and Urban District Boards to pay special attention to the scavenging of the towns and villages under their control, and to actually burn all rubbish, and to endeavour to rid the place of rats. This resulted in a general "clean-up," and probably—especially in the overcrowded areas of Burgersdorp and Vrededorp—prevented the further spread of the outbreak. As scavenging is a purely municipal affair, no part of the cost of this was borne by the Rand Plague Committee.

Disinfection.

Every house from which even a suspect had been removed was thoroughly disinfected with chemical disinfectants. All bedding, clothing, and the like, were disinfected in an Equifex disinfector. In addition to this, during the early days of the outbreak, the public was supplied with disinfectants free of cost. Later on the free distribution was stopped, and disinfectants were supplied at cost price. The cost price was very low because a large stock had been purchased by a Johannesburg firm from the Army, and the firm was, therefore, able to supply the disinfectants at a small cost.

When the house itself had been disinfected, the plague rat-catchers followed and removed sufficient of the flooring to trace any rats. The surface of the ground was removed, deeper layers dug up, and then disinfected with Corrosive Sublimate, and the floors replaced.

Rat Extermination.—Rat Proofing.

Upon the outbreak of plague, one of the first things done was to enlarge the rat-catching staff, by giving the Municipal rat-catcher an increase of assistants. It has been intimated in another part of the report that the rats had practically left the Coolie Location. This fact is recorded as the result of the attempt of the staff to find rats or traces of rats within that area. The staff was given instructions to visit all likely places. The public was informed of the danger of rats, and was invited to communicate with the authorities with a view to getting their rats exterminated. This invitation was accepted by a large number of people and a very considerable number of rats was accounted for. A fair number of the public caught rats of their own accord, and, in order to facilitate the disposal thereof, a rat cart paraded the streets and the public had their dead or caught rats removed free of all charge.

Later it was found advisable to have two different staffs of rat-catchers, the one under Municipal control for the general work of extermination, the other under the control of the Officers of the Rand Plague Committee; the duty of the latter was to go through every block of buildings from which a case of plague had been reported, whether in the human subject or in the rats, and take all the necessary steps to remove all trace of rats from the premises. The steps included taking up all the floors and saturating the floor with a solution of Corrosive Sublimate. The success of this arrangement was undoubted.

Not only were the rats removed, but after the removal, the houses were required to be made rat-proof before the inhabitants were allowed to return.

The Method of Rat-Proofing.

In the first place, the discovery of a rat in any house was followed by the search for rats throughout the whole block, and the whole block was disinfected.

1. Some boards were taken up in all the rooms on the ground floor, and search was made for evidences of the presence of rats or runs. When such were found the majority of the floor-boards were removed.

2. The top layer of soil, debris, &c., was removed and taken at first to the destructor: it was subsequently found that the destructor was damaged by the material and it was subsequently removed and spread out in a thin layer on the ground and exposed to the sun, whereby it was thoroughly dessicated and so sterilised.

3. The surface of the soil left in the house was then soaked with a 1 in 500 solution of corrosive sublimate.

4. The foundation walls were cemented inside the building. Outside, a trench was dug three feet wide at the top and three feet deep. The ground was excavated vertically on the side of the trench furthest from the house, and at an angle of 45° on the side near the house. Corrugated iron was placed on the slope and cemented in the angle.

Note.—The above method of rat-proofing was slightly modified at a subsequent period, but the whole idea originated at first with Dr. Allen, and to him is due the credit, even though subsequent perfection has been reached.

Every rat which was found dead, and a certain proportion of the rats which were caught in traps, were sent up for bacteriological diagnosis. If any rat, whether caught in a trap or found dead, was seen to have a prickly skin, it was invariably sent for bacteriological examination. This remark applies equally to the plague rat-catchers and to the Municipal rat-catchers. The result of this procedure was that between the 18th of March and the 31st July, 1786, rats and mice were examined in the Government Laboratories. Between the 31st July and 16th December 4,207 rats and mice have been examined.

A detail of the administration which was found to be useful was as follows :—If the Municipal rat-catchers found rats which were plague infected, the block in which they were found was at once handed over to the plague rat-catchers and the Municipal rat-catchers visited that block no more.

Every manner of catching rats was employed : trapping with various baits, poisoning, and killing with terriers. When the question of the destruction of rats was first considered, the question of the use of Danysz bacillus was contemplated and rejected. When Dr. Porter was appointed Medical Officer of Health to the Rand Plague Committee he summarised and presented to the Committee the report of the Odessa experiments and urged that this method should be employed if it were found practicable. Experiments were, therefore, tried on as extensive a scale as could be done in a laboratory before attempting the experiment on a large scale. The details of these experiments are given on pp.99 to 103 and at the time of writing the report no further attempt has been made.

Before, during and since the human outbreak, rats and mice have been affected and two cats have been proved to have died of plague. There is no evidence forthcoming that there have been any other animals such as the dog, fowl, etc., affected except in the two cases recorded in another part of the report (p.91).

Despite the findings of Professor Simpson, the experience of South Africa, as hitherto recorded, shew that the great danger is from rats and mice ; the other animals being, except under exceptional circumstances, as in the case of cats in the Cape, practically negligible.

The combined experience of Natal and the Transvaal points conclusively to the necessity of freeing not only the actual house but the whole block of rats, when once a plague-infected rat is found in a single house of a block. It may press hardly upon the inhabitants of houses not infected, but the Natal outbreak shews the danger of leaving any portion of a block untreated.

In the Johannesburg outbreak, plague-infected rats were found where no plague cases occurred ; plague cases occurred where neither plague-infected nor dead rats were found, but a glance at the map will shew that in the latter case either dead or plague-infected rats were found just across the street or in the somewhat immediate vicinity. Further, the habit that rats have of quitting a place may easily account for the presumption that a place may be infected by rats and yet they have all gone before any died of plague.

One fact that has been observed on the Rand which has been previously noted is that rats dying of plague do not often die in their holes, but come out into the open to die. More than one plague-infected rat has been seen staggering about in the open, and has been killed by the observers.

Another point of interest which has been noticed on the Rand, is that it is very often possible to say that a certain rat has probably died of the plague from the prickly skin even after death, and the peculiar hunched position of the cadaver when it is found.

Prevention of Overcrowding, Proper Accommodation for Natives.

The natives live in one of three places: (1) Locations, (2) Compounds, (3) Private premises.

LOCATIONS.

These may be under Municipal or private control. The Native Location in Johannesburg is under Municipal control, and was found to be comparatively satisfactory both as to cleanliness and overcrowding. It contrasted very favourably indeed with the Coolie Location in both respects. The private locations are constituted somewhat as follows: A mine has a certain amount of unoccupied ground, and for certain fees allows natives to build huts, or erect tents and live therein with their wives and families. A manager or overseer is generally appointed to supervise the location. The inspection of these private locations brought a really shocking state of affairs to light. Frequently the latrine accommodation was deficient or absent; the huts were too small, had no windows, no floors, and were used by too many occupiers; the refuse was not adequately removed and the water supply was not infrequently unwholesome. If the incidence of plague varies directly as the filth and overcrowding, it is terrible to contemplate what might have happened had plague broken out in some of these locations.

When a condition similar to the above was discovered the inhabitants of every unsuitable or overcrowded house were moved forthwith to the accommodation camp at Klipspruit, and were not allowed to return to the house until it was altered and complied with the Municipal Building Bye-laws, or to the location until it had been cleaned up and proper latrine accommodation provided.

COMPOUNDS.

All the Mines, Municipalities, and sometimes large employers of labour, provide compounds for the housing of the natives. These compounds are usually built so as to enclose a large quadrangle, the doors of the rooms opening into the quadrangle, the entrance to the compound being through a large gate. Many of these compounds are old, and were built at a time when the natives' well-being was much less considered than it is now. A considerable difficulty arose in connection with a few compounds, the mines to which they belong have only a short life, a few only a life reckoned in months. It was obviously quite impossible to suggest any structural alterations in order to render them habitable.

Every compound within the infected areas of the Witwatersrand was inspected by the Medical Inspectors, and various suggestions made to the Companies. The chief defects were the absence or insufficiency of light, pervious and uneven floors, absence of bunks and ventilation.

In almost every case where suggestions were sent to the Companies, they were accepted and acted upon. It must not be supposed that the Mine Compounds were the only bad ones. The worst were Mine Compounds—the old ones alluded to—but certain Government and Municipal Compounds were very bad.

All the compounds were thoroughly cleaned and whitewashed, and all the rubbish collected and burnt.

PRIVATE PREMISES.

With the exception of one or two of the private locations, the worst conditions met with during the tour of inspection were those found in connection with private premises. The conditions found on a few occasions were almost incredible. One boy was found sleeping in an old hen house, another in a hut made of two packing cases. Two boys were found sleeping in a cellar without either window or ventilation. Not infrequently the boys slept in the kitchen, and this in hotels and restaurants. Whenever proper accommodation for the native servants was not found, the employer was given 24 hours in order to provide it, failing the provision, the native was forthwith removed to Klipspruit. Although the procedure adopted was necessarily inconvenient to the employers, very little friction was produced.

The result of this was that practically all private premises were inspected; 627 notices were served, and 1,295 Indians and natives of both sexes, including children, were removed to Klipspruit.

Klipspruit Camp.

To this camp the whole of the inhabitants, either permanent or casual, of the Coolie Location were transferred. In the location itself, the various castes of Asiatics, Natives, and Coloured people were living apparently mixed up anyhow. The Indians had native sub-tenants. The moment they were to be transferred to Klipspruit, many of the Asiatics found that it would be impossible for them to live close to members of other religion or castes. In order to meet them, therefore, the camps had to be divided : there were two distinct camps, the one for Asiatics and the other for natives. The Asiatics' camp was further sub-divided into smaller camps, each small camp only containing people of the same religion or caste. This made the administration of the camp more difficult, but it effectually put a stop to the cry there would have been that the religious tenets were not being respected.

At first the camp was essentially a contact camp. None of the inhabitants were allowed to go outside under any pretext. After all the inhabitants were removed to the camp, one case of plague occurred in a native. The camp was therefore closed until 12 days after the death of this native. Thereafter the camp became an accommodation camp, and the inhabitants were allowed to come and go under certain restrictions.

As the inhabitants of the location had to take with them clothes which were possibly plague infected they were compelled to allow them to lie in the sun for several hours every day, and it was the duty of the Superintendent of the camp to see that this was done.

There was no possibility of the re-habitation of the Coolie Location since it had been burnt to the ground. As the town was in certain parts, especially in the parts whither it was expected the Asiatics would return, distinctly overcrowded, it was obvious that it would be unsafe to allow them to return how and when they pleased. The Asiatics were, therefore, given daily passes into Johannesburg in order to enable them to find accommodation. Before they were allowed to return to town permanently they were required to state where they proposed to live. The premises were inspected and if found satisfactory, the Asiatic was given a permit to reside at the particular address. If the premises were not satisfactory, permission was refused until they were made satisfactory or until the proposed occupier had submitted premises which were satisfactory.

It was impossible to ensure that there would be no overcrowding even with such precautions, but the amount of overcrowding was very small.

In the case of the natives, all those in domestic employ were allowed to return to their employers if they had satisfactory accommodation. Of the rest the Native Affairs Officials passed them through their hands and found them employment. Some were taken by the Central South African Railways and some by the Witwatersrand Native Labour Association.

Speaking generally, no one who had once been taken to Klipspruit was allowed to leave the camp permanently until he had shewn that he was returning to a proper residence.

The cost of this camp was very great, and helped to swell the plague account very considerably. The reason of the cost was that the inhabitants had to be fed by the Rand Plague Committee from the time they entered the camp until they were allowed to leave it either permanently or daily. Considering it as a contact camp, it did not justify its existence, because out of a population of 3,100 only one native acquired the disease. It was not instituted really as a contact camp, but from the first its object was that of an accommodation camp. The Coolie Location had to be evacuated ; the inhabitants, before they could be allowed into the town had to undergo a certain amount of detention, on account of the large number of infected centres known to have existed in the location, and the only feasible way was to evacuate the location as quickly as possible and at the same time ensure that no fresh centres should be started in the town.

Subsequently the Indians and natives were sent there solely to abate the overcrowding which was found.

Food Supplies.

Very special attention was paid to the food supplies and to the places where food was stored and supplied. Every hotel, restaurant, café, boarding-house, butchery, bakery, and store was inspected and made to conform with the bye-laws in every particular. The grain stores were watched by the rat-catchers, and every precaution taken when plague-infected rats were found. In several cases fairly large quantities of grain and forage were actually destroyed by fire.

The Market Buildings.

These are situated in the centre of the Market Square, which is the practical centre of the town. The owners of these buildings, the Johannesburg Market Concession and Buildings Company, Limited, have a concession and under the terms of this concession have the management of the Market which is at present the only public market in the town, and receive a commission on the goods sold. The buildings themselves were so constructed that rats could infest them without the possibility of being caught. With all the food at their disposal, it is not to be wondered at that they did not walk into the traps set for them, and the stall-holders informed the Plague Officers that there were no rats about.

On April 29th, however, two white cases occurred in the Market Buildings, and inquiry led to the opinion that the disease must have been contracted in the buildings.

On May 2nd a rat was found which was proved on May 4th to have been plague-infected. It was, therefore, decided to close the Market Buildings, clear them of rats and disinfect them. At 1 p.m., on May 4th, the Buildings were closed, the food in the Buildings was confiscated and destroyed. Formal notices prohibiting the use and habitation of the buildings under the Plague Regulations were handed to the representatives of the Market Company and their tenants.

Upon pulling down the inside wooden lining, a terrible condition was found. Rat runs were seen throughout the Buildings and a large number of dead and mummified rats was found, indicating the danger to which the town had been exposed. Having seen the conditions, the wonder is not that some four or five people contracted plague in the Buildings, but that the disease did not spread by means of the food to the inhabitants of the town.

The whole of the wooden lining was stripped from the building by workmen acting under the direction of the Company's Architect, in accordance with instructions given by the Rand Plague Committee ; this material was burnt on the Market Square and the walls were thoroughly disinfected. The Company were informed that the Committee could not accept responsibility for reconstruction of the buildings, and that the prohibition of the use of the buildings could not be withdrawn until the buildings had been rendered ratproof.

Prevention of the Spread Outside The Infected Areas.

The chief preventive measure was the regulation of travel. The measures which have been detailed on p. 79 safeguarded equally the clean areas in the Witwatersrand area, the Transvaal generally, and the neighbouring Colonies. It is impossible to determine the number of natives who travelled, doubtless a considerable number ; 2,320 Asiatics were provided with travelling passes, enabling them to leave infected areas

Since Johannesburg, and the Witwatersrand generally, is an importing centre and not an exporting one, it was not deemed necessary to interfere with the goods traffic. The only extra measure which was taken was the result of the action of the neighbouring colonies. A large amount of fruit is imported by Johannesburg, and the exporting colonies declined to receive the empty fruit baskets back unless they were disinfected. Arrangements were, therefore, made to have each basket immersed in a 2 per cent. solution of formalin before it was returned. Nearly 30,000 such baskets were disinfected.

It will be interesting to see whether any port which may become re-infected will sterilise all the fruit and forage sent thence to Johannesburg.

All letters coming from the Coolie Location and from Klipspruit, until that camp was opened, were disinfected by means of a formalin vapouriser. A special inspector was detailed as plague postman and acted as the carrier between the infected area and the Post Office.

Medical Assistance.

The success of operations for the suppression of any infectious disease will and must depend upon a number of factors. Not the least important is the aid given to the authorities by the Medical Profession. During the outbreak in Johannesburg, the aid given by the medical men was very great. In the first place a large number expressed their willingness to help in any way they could during the first rush, and advantage was taken of their offers before the whole of the Plague Medical Staff was appointed. Throughout the outbreak the profession gave every assistance in informing the Plague Office of every suspicious case, in asking for consultations with the Plague Officers, and in readily falling in with the suggestions emanating from these Officers.

Lay Assistance.

Another important factor, making for success, is the aid given by the people. From first to last the amount of friction was infinitesimal. Undoubted hardships did fall upon many people, and whilst they could hardly be expected to take the situation cheerfully or without a certain amount of grumbling, in only rare instances was it necessary to use the threat of the powers at command. The only instances were in the cases of owners of slum property whose premises had been closed. They objected to the loss of money entailed, but it is hard to see that they were to be more pitied than the usual owner of slum property. The condition of their property clearly shewed that so long as they got their rents they were not troubled about the sanitary condition of the property.

Vigilance Committees were formed, and from these Committees, as well as from individual members of the public, much information was obtained as to particular overcrowded or insanitary places.

The only criticism which it is possible to make about the actions of the public is that after the first few days there was a kind of apathy, and it was sometimes difficult to convince them that there was danger at all.

The Press.

The power of the press whether for good or ill, is always an important factor in all attempts to stay an epidemic. Alarmist reports, the publication of rumours and the criticism of those who are responsible for the Administration, influence the public mind to a very large extent. To say that the Johannesburg press did not in any way hinder the Authorities is less than half the truth. So helpful were they that on more than one occasion they were attacked by members of the public for the alleged suppression of facts at the instigation of the Plague Administration. The relations between the Administration and the press were always most cordial; at any time the mere request to publish a warning or a suggestion was immediately followed by its publication, and it is a matter of fact that the absence of alarm during the first two or three days of the outbreak was due in great measure to the careful manner in which the facts concerning the outbreak was conveyed to the public through the press.

THE GOVERNMENT LABORATORIES.

In another portion of this report (p. vi.) a summary of preparations made by the Government and Municipality of Johannesburg in view of a prospective outbreak of plague is given. Plague-infected rats in small numbers had been found in Johannesburg, and it was evident that provision would have to be made for coping with a possible increase in the bacteriological work, if only in connection with an epimuic; the staff of the Government Laboratories was, therefore, enlarged with that end in view.

The Government Laboratories were situated in Pretoria until August 8th, 1903, when they were transferred to Johannesburg: and from the moment of the transfer preparations were made, as complete as the sums of money at the disposal of the Laboratories would allow, in view of an increase of work in connection with an epimuic, an epidemic, or both, of plague. Among other things, a specially designed rat-proof infected animal-house was built. It was subsequently found that the stocks of bottles, etc., for the collection of specimens, in hand were not nearly sufficient, and had to be considerably increased during the continuance of the outbreak, but this was largely on account of the fact that all the earlier cases were of the pneumonic type, and it had not been anticipated that such an enormous number of sputa would need to be examined. When plague broke out, therefore, everything was in readiness for diagnosing

the disease bacteriologically. Those who were, as it subsequently happened, responsible for the diagnosis, had made themselves familiar with the organism : indeed cultures were obtained from plague-infected rats found in Johannesburg, and from the laboratories in the Cape Colony and in Natal : and these were made the subject of a very careful comparative study, as it appeared to be practically certain that plague would be introduced into the Transvaal from one of these Colonies, since both of them either were or had been plague-infected.

Immediately upon the outbreak of plague, Mr. W. H. Jollyman, F.I.C., was appointed Acting Analyst and Bacteriologist ; Mr. F. H. Joseph took charge of the Bacteriological Laboratory, and was assisted by Miss Winifred Muirhead, L.R.C.P., L.R.C.S.E., Mr. E. H U. Draper, and a staff of laboratory assistants. These without exception, and indeed the whole of the staff of the Government Laboratories worked with absolutely untiring zeal. Had it not been so, it would have been impossible to submit to bacteriological examination more than a fraction of the specimens which were submitted. It would be well-nigh impossible to over-estimate the value of their services.

The Plague Bacillus.

Although the Plague Bacillus has been described by many observers, it might be well to describe the B. Pestis, as it was recognsied in the Laboratories. This for two reasons ; first, because in carefully considering the whole circumstances, it seems certain that errors in diagnosis were made, and that despite inoculation ; and secondly, to shew that, although mistakes were also probably made when the morphology alone was relied upon, this was not from want of knowledge of the morphology. In connection with the latter reason it has not infrequently been stated that a diagnosis may be arrived at by the examination of smear specimens alone. In view of the Johannesburg experience, this statement cannot be allowed to pass unchallenged.

The Plague Bacillus.—The following description is the summary of the reactions obtained from six strains of the B. Pestis. Of these three were from human subjects, two from rats, and one from a kitten. Of these six, four were isolated in the Government Laboratories, one culture was obtained from the Cape and the other from the Natal Laboratories. The observations are, in the main, those of Mr. F. H. Joseph, the Assistant Government Bacteriologist, some being those of Miss Muirhead.

Morphology, etc.—(1) As seen in preparations made from the blood and organs, either of man or experimental animals, the organism is a short ovoid, sometimes almost circular, bacillus. Bipolar staining is usually well marked.

(2) When the organism is obtained from a 24 hour old agar culture, incubated at 37° C, it is seen to be a short bacillus occurring either singly or in pairs. The bipolar staining is usually not so well marked as in the case of organisms obtained from the blood or tissues, and is not infrequently absent.

(3) From a 24 hours old broth culture, grown at 37° C., the individual bacilli are usually smaller than those obtained from an agar culture. They are arranged in long convoluted chains, and at first sight appear not unlike a Streptococcus. The bipolar staining is usually more marked than in the bacilli obtained from an agar culture.

(4) As obtained from a 24 hour old potato culture incubated at 37° C., the organism is seen to be arranged singly or in pairs, many of the individuals presenting a swollen appearance, and staining very indifferently.

(5) When cultivated in milk for 24 hours at 37°C. the bacilli occur in pairs or short chains. When the films are fixed in alcohol, cleared with ether, and stained with Carbol-methylene blue, the bacilli frequently exhibit deeply stained granules at one or both poles, the bacillus remaining only faintly stained. This appearance is not the same as that of the bipolar staining seen in the bacillus obtained from the tissues.

(6) Taken from a glycerin-broth culture, incubated for 24 hours at 37° C., the chain formation is seen, and individual bacilli in a chain may be distinctly swollen.

(7) When grown in dextrose, saccharose, or lactose broth, appearances similar to those seen in ordinary broth are observed.

(8) When taken from a 24 hour old culture upon salt agar there is seen a large variety of forms : coccal, yeast-like, oidia-like, dumbbell, clove-like, pear-shaped, and so on. Several observers consider the marked pleomorhpism upon salt agar is almost diagnostic of the

B. Pestis. Experiments were tried with the bacillus of rabbit septicaemia, Danysz Bacillus, and with the bacillus isolated in the course of plague examinations (v. p. 97). All these bacilli shew very marked involution. If they are actually compared with the B. Pestis they can all with a certain amount of confidence be differentiated but it is by no means the case that, in the absence of the B. Pestis, they could be certainly differentiated.

Motility.—Motility has never been observed in any of the cultures examined, from which ever of the ordinary laboratory media they have been taken.

Staining Reaction.—The bipolar staining which is so frequently seen in the tissues appears to be almost independent of the particular stain used. Whether the bipolar appearance is seen or no the bacillus, when taken from a young and vigorous culture, stains well with Methylene blue or Fuchsin, but is decolourised by Gram's method. The organism stains extremely well, and the bipolar staining is very well marked when stained with "Fugent."

This stain was introduced into bacteriological practice by Mr. Joseph. It consists of a mixture of saturated alcoholic solution of (a) Methylene blue, 4 parts; (b) basic Fuchsin, 3 parts: and, (c) Gentian Violet, 5 parts. (The stains are Grubler's.) When mixed it is allowed to stand for four weeks in order to mature, but can then be kept indefinitely in a well-stoppered bottle, as it does not in this strength appear to deteriorate on keeping.

When used for staining, the above mixture is diluted with two parts of distilled water. The diluted stain should not be used after about three weeks. The bipolarity of the B. Pestis when stained by this means is very marked, the end of the bacilli being of a violet or blue colour whilst the remainder of the bacillus is red. The best results appear to be obtained if the film is slightly over-fixed.

Pleomorphism.—The organism is distinctly pleomorphic. Even on an agar culture 24 hours old, and grown at 37° C, some bacilli may be found five or six times as long as others, whilst many of the long forms are also swollen.

On potato incubated at 37° C, even for 24 hours the pleomorphism is very well marked. Many of the bacilli can be seen to be rounded and swollen or spindle shaped, and these forms are often many times the size of other bacilli seen in the same field of the microscope. Frequently the bacilli grown on potato shew a lightly stained area at or near one end.

Cultural Reactions.

Broth at 37°—24 Hours.—There is a good growth, which may be either of a light floccular character, similar to the growth of streptococcus, or it may appear as a very finely divided, granular, suspended growth. In both cases, the growth sinks to the bottom of the tube when disturbed, leaving the supernatent liquid *quite* clear. The stalactytic appearance has rarely been observed in the test tube. Traces of indol are sometimes present on the fifth or sixth day.

Formate Broth—37°—24 Hours.—The growth very poor and frequently absent.

Dextrose Broth—37°—24 Hours.—There is a fair amount of acid produced, but no gas evolved. On 2nd and 4th days, the acidity increases, but no gas is evolved.

Lactose Broth—37°—24 Hours.—There is a fair growth, but no gas is produced. The reaction of the medium remains neutral.

Saccharose Broth—37°—24 Hours.—The appearances are similar to those produced in Dextrose.

Glycerine Broth—37°—24 Hours.—There is a slight acidity produced. In from 2 to 4 days there is a fair acidity but no gas is evolved.

Nitrate Broth—37°—24 Hours.—There is a fair growth with general turbidity. At the end of 48 hours there is a fair reduction of Nitrate to Nitrite.

Nitrite Broth—37°—24 Hours.—There is sometimes a slight turbidity, and but very little increase in 4 or 5 days. Some strains do not grow in this medium at all and others only feebly.

Lead Broth—37°—There is frequently no growth; sometimes there is a slight turbidity, but without the production of H_2S, even after several days incubation.

Gelatin Stab—20°—24 Hours.—There is a faint growth along the needle track. After two days a thin semi-transparent growth, confined to the needle track, is seen. After three days the growth in the depth shews a slight increase; on the surface the growth is scanty, thin, and non-spreading; in from 8 to 11 days there is very little change, the surface growth is somewhat heaped up. No liquefaction of the gelatin occurs, nor is gas produced.

Gelatin Streak.—Sometimes there is a fairly considerable growth at the end of 24 hours, but usually there is very little until the second day. After 2 days there is a fair growth, which is moist, slightly raised, semi-transparent, whitish, and slightly spreading. In from 4 to 5 days it becomes more opaque and raised; sometimes the margin of the growth is more elevated than the centre. No liquefaction occurs up to 11 days.

Agar Streak—37°—24 Hours.—There is a good growth of small, semi-transparent, discrete, greyish white, slightly raised colonies, somewhat resembling the streptococcus. Several observers have made the definite statement that the B. Pestis grows slowly, so slowly that on agar a lens may be required to perceive the colonies at the end of 24 hours. The experience in these laboratories does not confirm this. Colonies sometimes become visible through a lens at the end of from 6 to 8 hours. At the end of 24 hours the growth is generally more abundant than that of the streptococcus. The growth is confluent towards the lower end of the streak, and the margin is slightly wavy. On the second or third day the growth becomes thicker and confluent, with a peculiar creamy appearance, and very viscid.

Salt Agar.—The growth upon agar containing 2, 3, or 4 per cent. of common salt is similar to that upon agar and glycerine agar except that it is much less vigorous.

Glycerine Agar Streak—37°—24 Hours.—The growth is similar to that on agar, but is not so vigorous.

Serum—37°—24 Hours.—A thin, moist, colourless, non-spreading growth results, but no liquefaction of the serum takes place.

Litmus Milk—37°—24 Hours.—The milk remains neutral or becomes slightly acid. After 48 hours the milk becomes slightly acid. Very little change takes place in 11 days. No clotting is produced.

Potato—37°—24 Hours.—There is no easily visible growth. After 2 or 3 days, a slight, thin, watery streak along the needle track appears, which increases only little in 8 days.

Anaerobiosis.—In broth after 24 or 48 hours, there is a fair growth, similar to that seen in aerobic culture, and in glucose broth there is also a slight growth. (The anaerobic conditions being those of Buchner's Tube.)

Litmus Urine (neutral or slightly alkaline)—37°—24 Hours.—There is a fair growth. The urine becomes slightly acid; there is no increase in the acidity in 6–7 days.

Wort-Gelatin Streak—20° C.—A poor growth only takes place, similar to that on ordinary gelatin.

PATHOGENICITY.

The organism as studied in the Laboratories has been found to be pathogenic for rabbits, guinea-pigs, white rats, wild rats, and wild mice, when either intra-peritoneal or subcutaneous injection was employed. Fowls and pigeons were refractory; a many times lethal dose for rabbit had no apparent effect upon either. It is pathogenic for the cat. Two interesting facts came to light in the laboratories. The one was that a dead kitten was sent for examination and one of the strains employed for the purpose of the above description was obtained from this kitten. The history of the kitten is as follows:—

A cat whilst still suckling her litter, was seen to kill and consume a rat which was noticed to be ill. All the kittens died, and the only one examined was found to have died of plague. The mother, however, survived. The second fact is that cats may become infected from human beings. At the house in which the Marais family lived was a cat which was a great favourite with the children. No rats, or signs of rats were found in the house, but no less than five of the family of six died of plague, and after their removal from the house the cat, which did not appear to be well, was killed and sent for examination. From its tissues the P. Pestis was isolated.

The accompanying table shews the average pathogenicity to the several susceptible laboratory animals :—

Animal.	Inoculation.	Interval between Inoculation and Death.
Rabbit	Intraperitoneal	18 to 24 hours.
,, ...	Subcutaneous	3 to 4 days.
Guinea-pig	Intraperitoneal	2 to 3 days.
,, ...	Subcutaneous	2 to 6 days.
Rat	Subcutaneous	2 to 3 days.

From this it will be seen that the results obtained in these Laboratories are not in accord with the statement so frequently made that the rabbit is less susceptible than is the guinea-pig. If it is so, it can be so only to a very slight degree ; our observation led us to the conclusion that the rabbit is slightly more susceptible than the guinea-pig. When a dose is given, per kilogram weight of animal, it seemed that the rabbit succumbed rather earlier than the guinea-pig.

The Post-Mortem Appearances of animals inoculated with and dying of plague are characteristic, but are not pathognomic. If subcutaneous injection is employed the animal may die comparatively slowly or quickly.

If the animal has died quickly there is an extensive sanguineous gelatinous oedema starting from the seat of inoculation and extending over the abdomen and thorax and subcutaneous petechial haemorrhages are frequently observed. The glands in the region of the seat of inoculation are enlarged and red, and occasionally even those of the opposite groin and axillae ; the internal organs are somewhat engorged with blood, but not necessarily enlarged : the spleen, although not frequently enlarged, has the usual septicaemic characters, being very soft and friable.

If the animal has died slowly, that is, after from 3 to 8 days, there is an oedema round the seat of inoculation, or spreading over the abdomen, but rarely extending to the thorax. The peritoneal fluid is generally increased, but there is no evident peritonitis. The subcutaneous glands are sometimes easily palpable, and may attain to the size of a pea. The glands, especially in the neighbourhood of the seat of inoculation, often contain necrotic tissue, but do not suppurate. In the subcutaneous tissue, around the seat of inoculation, caseous-looking material may be found which contains the B. Pestis. The glands throughout the whole body are generally enlarged and congested. The spleen is nearly always enlarged and studded with whitish tubercles. These tubercles are seen, upon microscopic examination, to consist of necrotic tissue intermingled with an enormous number of plague bacilli. The liver may be enlarged and engorged, and tubercles similar to those seen in the spleen are occasionally observed.

Even when intraperitoneal injection is employed, the animal may die quickly or slowly. If the animal has died quickly, the subcutaneous tissue round the seat of inoculation usually shews induration, haemorrhagic oedema and occasional pus formation ; the oedema may have spread all over the surface of the body, and may be accompanied by petechial ecchymoses and dilatation of the subcutaneous veins. The glands in the groin on the same side as the seat of inoculation may be enlarged. Purulent peritonitis is generally more or less marked, and petechial haemorrhages are not infrequent on the intestinal coats, mesentery and peritoneum. When peritonitis is present the mesenteric glands will be found to be enlarged. The spleen is enlarged and congested, as is usually the liver. Petechial haemorrhages are frequent in the lungs and pleural cavity.

If the animal dies slowly there is more marked subcutaneous induration and sometimes thick caseating material around the seat of inoculation, with enlargement of the glands in the groins and axillae. The spleen is much enlarged and shews discrete mottling or tubercles, varying in size from a pin-point to a pin head : these tubercles may coalesce and reach the size

of a pea, are of a yellowish appearance and contain necrotic tissue with enormous numbers of plague bacilli. The liver often shews mottling, starting round the edges and spreading in patches over the lobes, or the tubercles resembling those seen in the spleen. Pneumonic patches may be present, and rarely pleuritis. Pericarditis is scarcely ever seen. The meninges are not obviously congested.

Rats are usually susceptible to the B. Pestis through ingestion, and both guinea-pigs and rabbits may die. The post-mortem appearances are not quite identical with those found when the animals die after intraperitoneal or subcutaneous injection. The liver is more affected and the Peyer's patches are very obvious, inflamed and even haemorrhagic. The mesenteric glands are nearly always enlarged, but not the subcutaneous glands.

Rabbits and guinea-pigs do not, however, invariably die when fed upon plague-infected food. Out of several of these animals so fed one guinea-pig and one rabbit lived for three weeks, during which time they had had some ten meals with plague-infected material. At the end of this time they appeared to be quite healthy and were accordingly killed. The post-mortem appearances were practically nil. There was no mottling of the spleen or liver, and only very slight, if any, enlargement of the spleen or liver. Cultivations made from the organs failed to shew the presence of the B. Pestis therein.

A second guinea-pig was fed at intervals during a month. It was seedy for about 48 hours before it died. The post-mortem appearances were quite atypical of death from plague, and it was impossible to isolate the B. Pestis from the organs.

The strain of the B. Pestis used for these experiments was pathogenic for the rabbit, guineapig and rat, since all these species had died from inoculation and some from ingestion. It seems possible, therefore, that animals may acquire an immunity against plague from ingestion. There has been neither time nor opportunity to repeat these experiments on a larger scale in order to determine whether a real immunity is produced.

A jackal which was sent by the Director of the Government Zoological Gardens was given the corpses of several guinea-pigs which had been killed by inoculation with the B. Pestis, and readily consumed them. After four weeks, during which the animal appeared to be in normal health, it was killed, and a post-mortem examination held. No trace of the B. Pestis could be found or isolated from any of the organs, nor did they appear to be in any way abnormal.

Distribution of the B. Pestis in the Body.

Death being in most cases due to a septicaemic condition, the bacillus can be, upon occasion, isolated not only from the organs, but from the gall bladder and excreta. The bacillus was isolated from both the urine and the faeces of rats killed by the B. Pestis. The organism goes through the placenta into the foetus. Two female guinea-pigs were inoculated with the B. Pestis : one had one young one just before she died ; on the following morning both mother and young were found dead and the B. Pestis was isolated from the heart blood of both. The other guinea-pig died with a foetus *in situ* and the B. Pestis was isolated from the foetus as well as from the mother.

Vitality.—Several authors state that the B. Pestis dies comparatively quickly when kept on ordinary laboratory media. That it can exist for considerable periods under certain circumstances is evident from the following experiment. A culture which was sealed with paraffin wax, was left in the cold incubator among the stock cultures. After the lapse of a year an emulsion was made of the growth, and this was inoculated into a guinea-pig. The guinea-pig died, and the B. Pestis was recovered from its tissues, and found to be still very pathogenic. A second instance : a culture from the lung of a patient dead of plague was left in the cold incubator for two months, only protected by a fairly tight plug of cotton wool. After this time it was planted on agar and a sub-culture was made on agar ; an abundant growth was obtained. Inoculations made from the second sub-culture shewed that it had not decreased perceptibly in virulence.

Repeated sub-culture in artificial media is stated to reduce the virulence of the organism. Whether this is so or no, no experiments have been undertaken to prove. Three series of experiments undertaken with another object may be quoted. One experiment in which a series of six sub-cultures was made, shewed that six passages had not perceptibly decreased the initial virulence.

A second experiment consisted of passing the B. Pestis through a series of tubes of acid broth. The strain used was known in the Laboratories as B.P.4. For the purpose of the

experiment a vigorous growth was obtained upon +20 broth ten plantings were made on+ 25 broth, at intervals of 48 hours, with the exception of the 6th, and 8th plantings which were made from the 5th and 7th respectively, after 72 hours. Five subsequent plantings were made on +30 broth, the 12th planting was made from the 11th after 72 hours, the remainder after 48 hours.

Guinea-pigs were inoculated from the 1st, 4th, 6th, 11th, and 15th plantings, and no appreciable difference could be observed, the guinea-pigs dying on the 4th, 3rd, 3rd, 5th, and 5th days after inoculation, respectively.

Still another series of plantings on +30 and +25 broth, numbering 10, was made. Inoculation of guinea-pigs from the 4th and 10th plantings resulted in the death of both guinea-pigs, on the 3rd and 7th days, respectively.

Ectozoa as Factors in the Spread of the Disease.

Among the various methods suggested by which plague is spread from man to man, animals to man, man to animals, and animals to animals, is that by means of ectozoa. The number of these upon the various animals used during the course of the epizootic, was by no means small, and the number of animals used was very considerable. In the infected animal house there were from time to time some 30 or 40 animals, some infected with plague, some not. Not a single one of these animals which was not inoculated with the idea that the material contained plague, died. Four experiments were made by placing healthy guinea-pigs or rabbits in a cage with a guinea-pig or rabbit which had been infected. The dead animal was allowed to remain in the cage until it was quite cold, and then removed : each infected animal was found to have died of plague, and the healthy one was allowed to remain in the same cage and kept under daily observation. After the lapse of 12 days one guinea-pig died, and the post-mortem examination shewed that death was due to intestinal obstruction. No signs indicative of plague were seen, nor could the B. Pestis be recovered from the blood or organs. A second guinea-pig lived for two months and no B. Pestis could be recovered from the cadaver. A third guinea-pig was equally unaffected.

If the plague is commonly transferred from animal to animal it would be expected that other diseases to which the animals are equally susceptible could and would be transferred in the same way. For instance, the rabbit is extremely susceptible to the pneumococcus.

Experiments performed by Mr. F. H. Joseph shew how easily the rabbit is infected. At a time when flies were very numerous, some were caught and allowed to walk over a Petri dish which contained some pneumonic sputum. A rabbit was shaved, not very carefully, so that the skin was not intact and the fly allowed to walk over the skin. In 48 hours the rabbit was dead of pneumococcic septicaemia. That this was not accidental was proved by repeating the experiment with similar results.

During the course of the last year many scores of rabbits have been inoculated with the pneumococcus, and, although the infected animal house has contained large numbers of animals not so inoculated, it has never been found that these latter animals have died from the pneumococcus. One experiment was tried with the pneumococcus, a healthy rabbit was placed in the same cage as another which had been inoculated with the pneumococcus and which died in 24 hours. After 14 days the healthy rabbit died, but no trace of the pneumococcus could be found in or isolated from the cadaver.

Methods of Diagnosis Employed.

In the diagnosis of a disease, such as plague, it is necessary to take the greatest care not to fall between Scylla and Charybdis. On the one hand it is desirable to arrive at a definite conclusion as early as possible, on the other there are organisms which sufficiently resemble the B. Pestis as to be mistaken for it when too few observations are made.

During the present outbreak mistakes were made as will be seen later, and these very mistakes may have some bearing upon previous descriptions of the disease.

As has been seen, the first portion of the outbreak was of the pneumonic type, buboes being practically always absent. The diagnosis had, therefore, to be made, either from the sputum during life, or from the lung, spleen, liver, or other organ, after death.

There is little doubt that a mere microscopic examination of a smear made directly from a bubo, may be sufficient to enable the observer to arrive at a positive diagnosis. In the organs after death, however, this is by no means so. From the commencement of the outbreak, therefore, the attempt was made to prove each individual case, both by culture and inoculation. In the first few cases this was done, not only was the B. Pestis actually recovered, but was obtained in pure culture and identified by its cultural reactions.

The large number of cases which occurred within the first 8 days, however, made it quite impossible to continue to do this, and, after the first few cases, the diagnosis was arrived at from the microscopic appearance together with *either* culture *or* inoculation. At first the culture or inoculation was made in each case, later on, however, the microscopic appearances of the specimens stained by Fugent (v. p. 90) determined whether inoculation or culture should be performed. If there were no organisms suspicious of the B. Pestis, nothing more was done, but the case was returned as negative. If any organisms resembling the B. Pestis were found, and the case had not been previously examined, inoculations were made, and the diagnosis withheld until the result of the inoculation was known. Meanwhile, the case itself was treated as a suspect. If the animal died, and organisms resembling the B. Pestis were found in the organs, the case was returned as one of plague. If the animal did not die, then the case was returned as negative.

The value of a negative diagnosis is, however, so small, that arrangements were made to have the sputum of all suspects examined on six occasions. The sputum was obtained, whenever possible, night and morning. Whenever, during the examination, bacilli resembling the B. Pestis were found, inoculations were made, and it was not until six negative results were obtained that the case was finally returned as negative. In some cases, where suspicious organisms had been seen on one occasion, even nine or ten examinations were made before a final result was returned.

In the case of fluid aspirated from buboes, reliance had not infrequently to be placed on the microscopic appearance alone, because of the difficulty so often encountered of obtaining enough of the juice either for inoculation or culture. When a sufficiency was obtained for either then it was done to finally clinch the diagnosis.

The Difficulties.

From the outset there were distinct difficulties. The earlier pneumonic cases suffered as will be seen in the account of the post-mortem appearances, from a definite broncho pneumonia, and pneumococci were associated with the plague bacilli. Rats were unavailable, and the supply of guinea-pigs at one time almost failed. On more than one occasion when both a rabbit and a guinea-pig were inoculated it was found that one animal died of plague and the other of pneumonic septicaemia. The susceptibility of the rabbit to the pneumococcus is generally very great, and it is very possible, therefore, that if rabbits are used for the diagnosis of plague, the association of pneumococci with the B. Pestis might result in the death of the rabbit from the former organism, and the B. Pestis would neither be seen in the microscopic specimens obtained from the organs, nor recoverable therefrom by culture.

Even the guinea-pig is susceptible to the pneumococcus, and some of the guinea-pigs succumbed to the pneumococcus although it was certain that the B. Pestis was present in the material inoculated. On occasion the guinea-pig may die of the double infection, in which case a positive diagnosis could be arrived at, but the possibility of the B. Pestis disappearing is by no means negligible.

This difficulty was to a large extent overcome by the method suggested by Mr. Joseph. He found out, as the result of careful investigation, that the B. Pestis will grow in broth of much greater acidity than will the pneumococcus, and that if such an acid broth be inseminated with both organisms the pneumococcus disappears. When, therefore, a portion of lung, or even sputum was found to contain organisms resembling the B. Pestis, as well as the pneumococcus, cultures in broth of reactions of +25 and +30, respectively, were made and incubated and the animals were inoculated with this broth. The result was that, whether the animals died of plague or no, they did not die of pneumococcal septicaemia.

He also found that the broth prevented the growth of some of the post-mortem bacteria, so that if pneumococci were not present, there was less likelihood of the animal dying of some other disease than plague, if the material were cultivated before inoculation.

Another difficulty which was found was in connection with post-mortem specimens generally, which were undergoing or beginning decomposition. Although the weather was not, at the time of the outbreak, hot, the necessary delays which occurred between the holding of some of the post-mortems and the delivery of the specimens to the laboratories, allowed decomposition to proceed, and not infrequently the specimens contained large numbers of post-mortem organisms. On some occasions there were seen bacteria which had the characteristic staining reaction, and appeared to be the size of the B. Pestis, which were certainly not this organism.

One example to illustrate this difficulty is as follows :—

A rat had been found dead and was sent up for examination, and its spleen was found to contain bacilli which were indistinguishable from the B. Pestis. A guinea-pig was, therefore, inoculated, and the heart blood shewed bacilli similar to those found in the spleen of the rat. Cultivations made from the heart blood gave a pure culture of an organism, which grew and produced gas under anaerobic conditions ; upon inoculating a guinea-pig with this culture, the same appearances were seen in the spleen, shewing that the organism seen in the spleen of the rat was not the B. Pestis.

A second example of the similarity of some post-mortem bacilli occurred, and shews how possible mistakes are when absolute reliance is placed upon the mere morphology of the bacillus. A case in the suspect camp had died of pneumonia, and a portion of the spleen was sent to the laboratories. The result of the examination was negative. The medical men who made the post-mortem kept another portion of the spleen for several days, made a smear from it, and sent the smear to the laboratories as a smear from a bubo. Bacilli were present which certainly in some measure resembled the B. Pestis, but did not appear to be as characteristic as the bacilli usually are in bubonic fluid. The report was therefore sent that suspicious bacilli were present, and a request that, if possible, enough fluid for culture should be obtained, in order that the nature of the bacillus could be accurately determined. It was not until after the report had been sent that the laboratories were informed that the specimen was not from a gland, but was from a decomposing spleen, which, when fresh, had been found free of the B. Pestis.

Still another difficulty arises in connection with post-mortem specimens. Even if it is certain that the B. Pestis is present when decomposition has set in, the bacillus does not stain as characteristically as in quite fresh specimens, and appears to vary considerably in shape.

The Mistakes.

It is impossible to say whether mistakes have been made in the bacteriological diagnosis of plague, during the course of other outbreaks. It is certain that there were one or two mistakes made during the course of the Johannesburg outbreak.

During the outbreak every case of pneumonia was treated in the first instance as a suspect plague patient, and the sputum was submitted to bacteriological examination. Those patients who were admitted to the Suspect Camp, as has been previously stated, had their sputum examined on several occasions. The consequence of these facts was that an enormous number of sputa were examined. The microscopist did not know when he was examining the sputa whether it had ever been examined before, so that to him each case was a new case. It was impossible, however, to cultivate or inoculate every suspicious sputum, and if the case was found to be already a suspect, the microscopic examination was relied upon.

In going through the returns after they were completed the absolute certainty of the mistakes in diagnosis is palpable. A few only need be quoted.

No. of Case.	No. of Examination.					
	1.	2.	3.	4.	5.	6.
57	0	0	+	0	0	–
75	0	+	0	0	0	0
85	0	0	0	+	0	0
158	0	0	+	0	0	?

The last of these cases was a case of bubonic plague without any lung symptoms, which recovered. The three remaining cases had no clinical symptoms of plague at all, and were merely suspects. It is possible to find the B. Pestis in the sputum in bubonic cases just before death, but it seems extremely unlikely to find them in the sputum during the stage of convalescence. This, not because of the impossibility of finding any pathogenic bacteria in the mouth of a person not suffering from the disease produced by that bacterium, but on account of the apparently high virulence of the B. Pestis when inhaled.

Fortunately the mistakes have, to a large extent, been explained. It is well-known that, under certain conditions, bacteria such as the Bacillus of rabbit septicaemia may very closely resemble the B. Pestis, and an organism was actually isolated in the laboratories which bears a very close morphological resemblance to the B. Pestis.

A specimen of sputum was found to contain bacilli which were distinctly suspicious. A guinea-pig was inoculated and died. Upon making smear preparations from the spleen it seemed that there was no doubt but that the suspicious bacilli were in reality plague bacilli. Upon cultivating, however, it was soon found that the bacillus was certainly not the B. Pestis. The organism designated "4277," was, therefore, carefully worked out, and the following is the description.

DESCRIPTION OF "4277."

It is a bacillus rather smaller than the B. Coli Communis, with rounded ends. It occurs singly or in pairs except in liquid media, when there is a tendency to form short chains. It is distinctly motile. It stains with the ordinary analine dyes, but is decolourised by Gram's method. It exhibits 6 or more flagella, but spore formation could not be seen. Occasionally it exhibits distinct bipolar staining even from cultures. It is fairly pleomorphic in culture and in post-mortem specimens varies in size more than does the B. Pestis.

Broth—in 24 Hours at 37° C—There is a general turbidity with a flocculent deposit, and a thin white pellicle : in from 6 to 8 days indol is generally produced.

Peptone Water.—There is a smaller growth, but indol is produced earlier than in broth.

Formate Broth at 37° C—Gas is produced in six hours, at the end of 24 hours the medium is slightly acid, but becomes alkaline at the end of three or four days.

Dextrose Broth, Maltose Broth, Lactose Broth, Glycerin Broth at 37° C—Gas is produced in 6 hours : at the end of 24 hours the medium is acid and remains so.

Saccharose Broth at 37° C—Gas is produced in 6 hours and slight acid within 24 hours. At the end of 4 or 5 days the medium becomes alkaline.

Nitrate Broth at 37° C—24 Hours.—There is a good growth, with the formation of nitrites.

Nitrite Broth at 37° C—24 Hours.—There is a good growth.

Lead Broth at 37° C—24 Hours.—There is a good growth. H_2S is produced after one or two days.

Gelatin Shake at 20° C—48 Hours—Gas is produced, but no liquefaction of the gelatin takes place.

Gelatin Stab.—There is no liquefaction.

Gelatin Plates.—The colonies are thin semi-translucent, small and round : they do not spread nor are the margins crenated.

Litmus Milk—37° C—24 Hours.—Acid is produced, but the milk is not clotted in 8 days.

Litmus Urine—37° C—There is a fair growth and the urine becomes alkaline in 3 days.

Glucose Formate Broth—37° C—The organism grows well anaerobically, and produces gas within 8 hours.

It grows well on acid media, and grows in broth to which from 2.5 per cent. to 4 per cent. of NaCl has been added.

It is very pathogenic to rabbits and guinea-pigs, but less so to white rats. It is also pathogenic by ingestion to the grey wild rat.

The *post-mortem* appearances of an animal dead after inoculation with the organism are not very characteristic. There is usually marked congestion round the seat of inoculation and the neighbouring glands are frequently enlarged. Subcutaneous injection results in enlargement of the subcutaneous glands, and intraperitoneal injection in the enlargement of the mesenteric glands. The spleen is always enlarged and congested, and the liver generally.

Non-characteristic as the post-mortem appearances are, it is obvious from the above description that only a skilled observer could tell the difference between death from the bacillus in question and any chance death from plague.

Upon making smear preparations from an animal dead of this bacillus, organisms are nearly always found shewing marked bipolar staining, and of practically the same size as the B. Pestis. On making a careful comparison between the smear preparations of the B. Pestis and this bacillus obtained from the spleen, a difference in distribution becomes evident. In the case of plague the organisms are numerous and appear to be distributed throughout the spleen practically independent of the cells. In the case of this bacillus, however, there is a great tendency to find the bacilli in the cells or grouped in large numbers round the cells. This difference is, however, merely a comparative difference, and when both smears are crowded with bacteria, as is not infrequently the case, even this difference is difficult to determine. Even when one is on the *qui vive* it is by no means always possible to be certain with which of the two organisms the spleen is infected.

From the above description, it will be seen that the organism "4277" somewhat resembles the bacillus of Danysz, but it produces acid in milk whereas Danysz' bacillus produces alkali.

In 1902 Klein (*) described an organism which he had isolated from the tissues of a rat and which in morphology and staining very closely resembled the B. Pestis. The above described organism is not the same as Klein's since the latter is non-motile and clots milk.

In 1904 Watkins Pitchford (†) described a bacillus, which also closely resembled the B. Pestis. His bacillus is neither Klein's nor the one just described, since it is motile and clots milk.

Klein has stated that Danysz' Bacillus is identical with the B. enteritidis of Gärtner. The bacillus just described certainly nearly resembles them, but there is no alkaline production in milk.

The above organism as has been previously stated, was isolated from sputum. As there was a possibility that it might have been a chance contamination, four other specimens from different patients, and some considerable time after the isolation of the first, which shewed the presence of suspicious bacilli, were inoculated, and cultivated, and the result was that, from each, an organism was isolated which was to all intents and purposes identical with the one described.

During the time that a number of rats were dying in and around Ferreiratown, the post-mortem examinations of some of the rats revealed the presence in the tissues of a bacillus not unlike the B. Pestis. One of these was isolated and worked out and was found to belong to the same group as Danysz' Bacillus and the B. Enteritidis of Gärtner.

It is a short, motile, non-Gram-staining, gas producing bacillus which turns litmus milk alkaline. It differs from Danysz' Bacillus in producing acid in Saccharose and Lactose broth and in producing gas in a gelatin shake at 20° C. It is pathogenic to rats and guinea-pigs. It is obviously not the "4277" previously described.

After the diagnosis of the earlier cases, and before this organism had been isolated and studied, a positive diagnosis was on a few occasions arrived at by microscopic examinations, together with inoculation. Three such cases which were diagnosed in the laboratories as plague had no symptom whatever of that disease. This, of course, raises a very important question in the description of the disease which is discussed in another part of the report.

From the bacteriological point of view the morale of these mistakes is obvious. An organism was found in the sputum on more than one occasion which morphologically and in pathogenicity almost absolutely resembled the B. Pestis, but which when cultivated was found to be a totally different organism.

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* Path Trans. † Plague in Natal.

Whether other experiences have been like the present one, there seems to be no evidence. Watkins Pitchford has described an organism which he at first mistook for the B. Pestis, but even he does not say whether in the light of his subsequent knowledge, mistakes were probably made during the earlier days of the outbreak in Natal.

From the experience of the Transvaal and Natal, there is only one obvious conclusion to be drawn and that is that in the bacteriological diagnosis of pneumonic plague, reliance must not be placed upon the presence of bacilli morphologically identical with the B. Pestis in smear preparations, nor even upon the presence of similar bacilli in the spleens of rats, guinea-pigs or rabbits, inoculated with and dead after injections of emulsions of sputum or lung substance supposed to contain the B. Pestis, but that in addition sufficient cultural reactions must be obtained to identify the B. Pestis before a positive diagnosis can be given. It is certainly most important to do this before declaring an otherwise clean area infected. When the mistake is made in an already infected area the annoyance is not so great because there is extremely little danger in a well-conducted hospital of contaminating a suspect from a plague patient, and from the public health point of view it is better to run that small risk than to miss a single case and possibly start a fresh centre of infection.

This procedure will necessarily entail a larger bacteriological staff than would be necessary if microscopic examination with or without inoculation were relied upon, but from the scientific point of view, it seems essential.

EXPERIMENTS WITH DANYSZ' BACILLUS.

Through the kindness of the Director of the Pasteur Institute in Paris a culture of Danysz' bacillus was obtained with a view to a possible attempt being made to exterminate rats by that means. The organism from the Institute has the following characteristics.

Description.

The bacillus is rather smaller than the B. coli communis. It has rounded ends and is sometimes seen so short as to have a distinctly coccal appearance. It occurs singly or in pairs and in liquid media has a tendency to form short chains of four to five units. In comparison with the B. Pestis it shews greater range of size in the organs and tissues of animals.

Motility.—The organism is about as motile as an average B. coli.

Spores.—No spores are formed.

Pleormorphism.—The organism is fairly pleomorphic, the greatest tendency being to the coccal form although long and swollen forms are met with.

Staining.—The bacillus does not stain by Gram's method. There is a tendency to bipolar staining especially in the tissues of animals.

Pathogenicity.—It is very pathogenic to rabbits and guinea-pigs by inoculation and less so to white rats. It is pathogenic to the wild rat.

Cultural Reactions.

Broth—37°—24 Hours—There is a good growth shewing general turbidity with a flocculent deposit Indol is produced after seven or eight days.

Peptone Water.—The growth is less abundant than in broth but has the same characters. Indol is produced on the sixth or seventh days.

Formate Broth—37°—6 Hours—Both acid and gas are produced, after two or three days the medium becomes alkaline.

Dextrose Broth—37°—6 Hours.—Both acid and gas are produced, the medium remains acid.

Lactose Broth—37°—6 Hours.—Both acid and gas are produced, after four or five days the medium becomes *alkaline*.

Maltose Broth—37°—6 Hours.—Both acid and gas are produced, the medium remaining acid.

Saccharose Broth—37°—6 Hours.—Both acid and gas are produced and the medium becomes *alkaline* after three or four days.

Glycerin Broth—37°—6 Hours.—Both acid and gas are produced, the medium remaining acid in reaction.

Nitrate Broth.—37°—24 Hours.—A good growth takes place and the nitrate is reduced to nitrite.

Nitrite Broth—37°—24 Hours.—A fair growth takes place.

Lead Broth—37°—24 Hours.—A good growth is seen with a fairly abundant production of H_2S.

Gelatin Plates.—The colonies are thin, round, semitranslucent and have slightly crenated edges, but do not spread.

Gelatin Streak.—The appearance is similar to that on the plates. The growth is confluent, thin and semitranslucent.

Gelatin Stab.—Growth takes place on the surface and in the depth but gas is not produced, and the gelatin is not liquefied.

Gelatin Shake.—A growth takes place but no gas is produced and no liquefaction takes place.

Glucose Gelatin Shake.—A growth takes place but no gas is produced.

Litmus Milk—37°—24 Hours.—A good growth takes place and the milk is rendered acid. After two or three days the milk becomes alkaline.

Litmus Urine—27°—3 Days.—A fair growth takes place and the urine becomes alkaline.

Anaerobiosis.—The organism is a facultative anaerobe.

Gas Production.—The above observations shew that the organism will produce gas at 37°C but not at 20°C.

Acid Media.—There is good growth in acid media up to +30 and +35.

Salt Media (containing 2 per cent., 2.5 per cent. and 4 per cent. of NaCl).—There is a good growth and under the microscope a great variety of forms are seen, but in comparison with the B. Pestis on this medium, there is not the same variety as is shewn by the last named bacillus.

1. The Rat House.

Owing to the well known fact that rats kept for experimental purposes in small cages, often die spontaneously and apparently as the result of their mere imprisonment, it was necessary to build a structure which would allow rats to be kept in a state of semi-captivity in order to try the effect of Danysz' Virus on a large laboratory scale. The house was constructed as follows :—The earth was excavated to a depth of 18″ below the ground level. Corrugated iron was then laid on the floor, and the structure built from the level of the floor lining. It was built simply of corrugated iron with a pitched roof, and a window. The angles between the floor and the walls were filled in with cement, mixed with broken glass bottles, in order to prevent the exit of the rats and earth filled in to the ground level. The spaces between the

walls and the eaves were covered with ½" wire netting, and all the holes from which it was expected rats might escape, were treated in a similar manner. In order to allow ingress to, and egress from, the house, without the chance of the rats escaping, a double door was built, the wall of the vestibule between the doors being constructed of a ½" galvanized iron wire netting on strong wooden posts.

Box lids, bags, etc., were placed on the floor in order to allow the rats to burrow, nest, etc., as in their wild state.

The supply of rats was obtained from the Municipal rat catchers, so far as possible from areas not suspected of infection by plague, as a matter of fact no rats sent to the laboratories for the purpose of these experiments were ever found infected with plague.

2. The Virus Used.

Two definite samples of virus were used for the purpose of these experiments. First, some virus actually prepared in Danysz' Laboratory, and kindly sent to me by him for this purpose. Second, virus prepared in the Government Laboratories from cultures of Danysz' Bacillus obtained from the Pasteur Institute in Paris. Danysz' Virus being already prepared, it was not thought necessary to test the virulence before proceeding with the experiments, but the virulence of the bacillus from the Pasteur Institute was first tested and found to be pathogenic for rabbits, guinea-pigs, white rats and grey wild rats.

3. Ingestion Experiments.

A. With Danysz' Virus.—At the beginning of the experiments there were 35 rats in the rat house, and the number of these was increased from time to time by the addition of freshly caught ones. The first experiment consisted in removing all traces of food from the animal house on the day preceding the commencement of the experiment, Then, the rats, being hungry, were given about half a loaf of bread over which had been poured half a pint of the virus. The result of this experiment was as follows :—

On the 3rd day 1 rat had died of the D. Bacillus.
On the 5th day 1 rat had died of the D. Bacillus.
On the 7th day 1 rat had died of the D. Bacillus.
On the 11th day 1 skin was discovered.
On the 19th day 1 rat had died of the D. Bacillus.
On the 20th day 1 rat had died of the D. Bacillus.
On the 21st day 3 rats had died of the D. Bacillus and one skin was found.

Immediately a rat was found dead a post-mortem examination was made and from every rat which is stated to have died of D.B. this organism was recovered in culture.

At the end of three weeks, therefore, out of 35 rats at the beginning of the experiments, eight rats were found to have died of D.B. and two skins were found of rats which had probably or possibly died from the same cause. During the course of the experiments, some 20 or 30 rats were added, and although these could not have ingested the infected material, they, together with those of the 35 who had not died of the ingestion, had the opportunity of consuming the cadavers of their fellows. Assuming that only 35 rats came within the scope of the experiment, less than one-third of these were found to have died, leaving two-thirds unaffected, or, as will subsequently be seen, with some degree of immunity.

B. Second Experiment.—The second experiment was conducted with virus prepared in the Government Laboratories from Danysz' Bacillus, as it was received from the Pasteur Institute. Broth was made, inoculated and grown in the usual method; half a loaf of brown bread was infected by having half a pint of the virus poured on to it, and this was given to the rats, after having taken all other food away from the house. There were, at the commencement of this experiment, between 60 and 70 rats in the rat house, some of which had been the subjects of the first experiment, and some might have eaten the cadavers of their fellows dying of this disease.

On the 3rd day 2 rats died of the D. Bacillus.
On the 5th day 1 rat died of the D. Bacillus.
On the 6th day 2 skins were found.
On the 7th day 2 rats died of the D. Bacillus.
On the 8th day 1 rat died of the D. Bacillus.
On the 10th day 1 rat died, not of D.B., or at any rate no D.B. could be isolated from the cadaver.
On the 11th day 1 rat died of D. Bacillus.
On the 12th day 1 rat died, but not of D. Bacillus.
On the 14th day 1 rat died of D. Bacillus.
On the 15th day 1 rat died of D. Bacillus.
On the 18th day 1 rat died of D. Bacillus.
On the 19th day 1 rat died of D. Bacillus.
On the 21st day 1 rat died, but not of D. Bacillus.

Out of some 60 rats, therefore, only a quarter died during the period of three weeks and rather less than quarter died of the disease.

C. Third Experiment.—This experiment consisted of feeding the remainder of the rats with nothing but virus-infected bread for the period of six days. Only three rats were found to have died of the D. B. and one rat died with no D.B.

4. Loss of Virulence of the Virus.

It has been pointed out by previous observers, that the virus appears to undergo spontaneous loss of virulence in culture, and this was found to be the case with the culture with which we were experimenting. The culture which was at first pathogenic as we have seen to rabbits, guinea-pigs, white and grey rats, on being kept for two or three months, was found suddenly to have ceased to be virulent, or to become very much less virulent than when first the experiment was tried.

The organism has been also found by other observers to lose its virulence by constant passage from animal to animal, and from experiments which we have made, there seems to be no doubt that its virulence decreases when an animal is infected by the ingestion of the cadaver of another animal. It was found that the organism which was recovered from the spleen of an animal inoculated with the bacillus, had a certain degree of virulence. If, however, a healthy rat was fed on the cadaver of the animal from which a culture had been obtained, even though the second animal had died, the organism recovered from this spleen was less virulent than the one recovered from the spleen of the first animal.

This therefore is the obvious reason why previous observers have found that the organism quickly loses virulence when the rats are fed once with virus-infected food, and the attempt is made to produce an epizootic.

Previous observers have noticed that, although it is possible to enhance the virulence of the organism to a certain animal by rapid passages through animals of that species, not only is there a limit to the degree of virulence capable of being obtained, but that after a certain number of passages, usually from 8 to 10, the virulence of the organism then decreases rapidly from animal to animal.

5. Immunity Acquired.

Certain of these observers, have noticed that the rat, on being affected with the virus, may become ill but survive the experiment, and that having gone through a mild form of the disease, the rat acquires a certain degree of immunity therefrom. Our experiments bear out these observations. After the completion of the third experiment two rats were taken and inoculated with a certainly lethal dose of the organism. One died within 24 hours, but the other was absolutely unaffected, shewing that one rat had acquired a considerable degree of immunity.

6. Conclusions.

The conclusions to be drawn from these experiments are :—

1st. That it is useless to depend upon the cannabilistic habits of the rat in order to produce an epizootic by means of Danysz' Virus.

2nd. That any attempt to kill the rats must be by direct feeding with the *materies morbi*.

3rd. That feeding with the virus or virus-infected food only insures the destruction of a comparatively small proportion of the rats, even when all other sources of food are removed.

4th. In a place like Johannesburg, where, owing to the construction of the majority of the houses, grain stores, etc., it would be impossible to insure that the rats had not a sufficiency of ordinary food, only a very small proportion of the rats in Johannesburg could be expected even to consume the infected material and therefore to die in consequence of the ingestion of the virus.

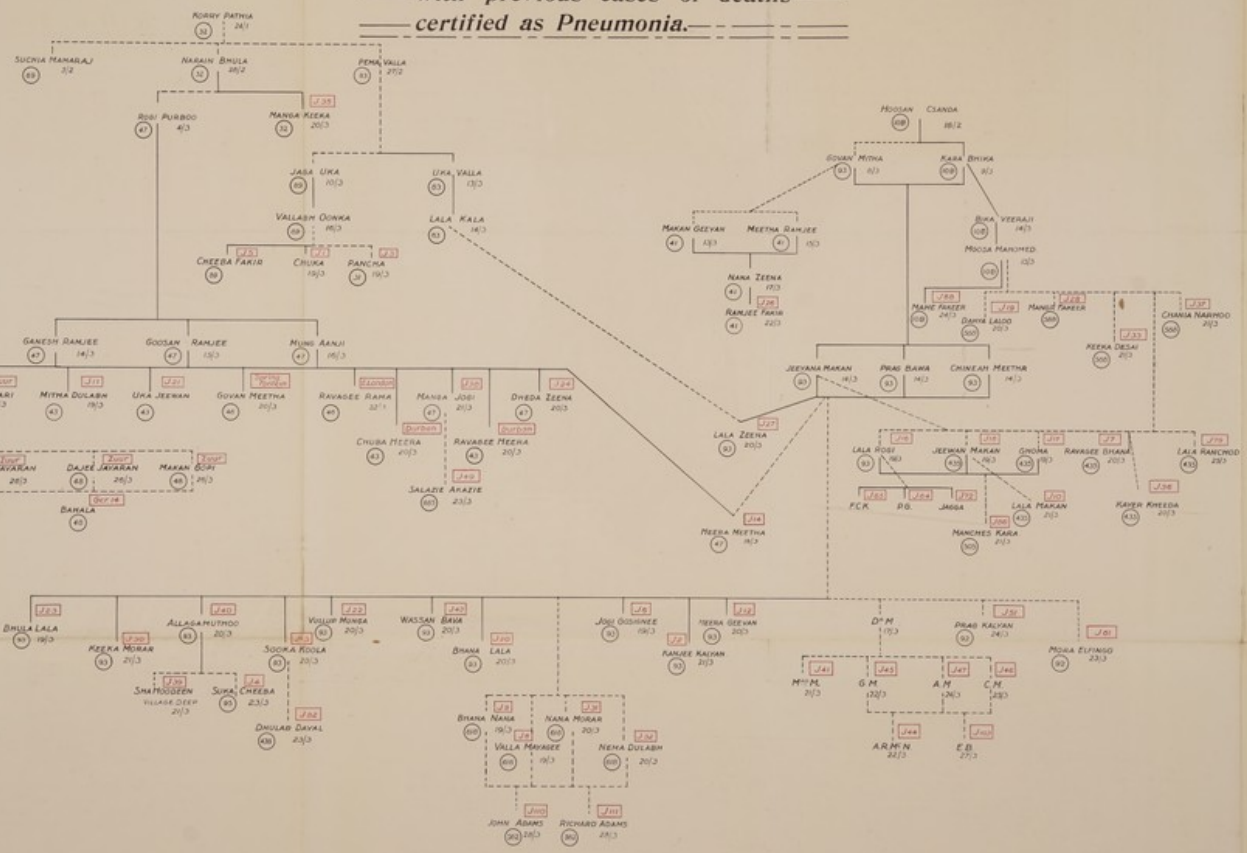
Allowing that these experiments shewed a somewhat low percentage of deaths, and that 33 per cent. of the rats when under some possibly more favourable conditions would die, allowing further that 25 per cent, of the rats in Johannesburg would consume the infected material, it would be possible to suppose that from 8 to 10 per cent. of the rats could be killed by means of the virus.

5th. Considering the expense of preparing the virus, and spreading it broadcast throughout Johannesburg on a large scale, and thereby killing from 8 to 10 per cent. of the rats in question, it seems that the advantage to be gained would be totally incommensurate with the cost of the attempt.

In the Cape a serious attempt was made to deal with the rats by means of Danysz' Virus, but those who had charge of the experiments were so disappointed with the results that the method was abandoned.

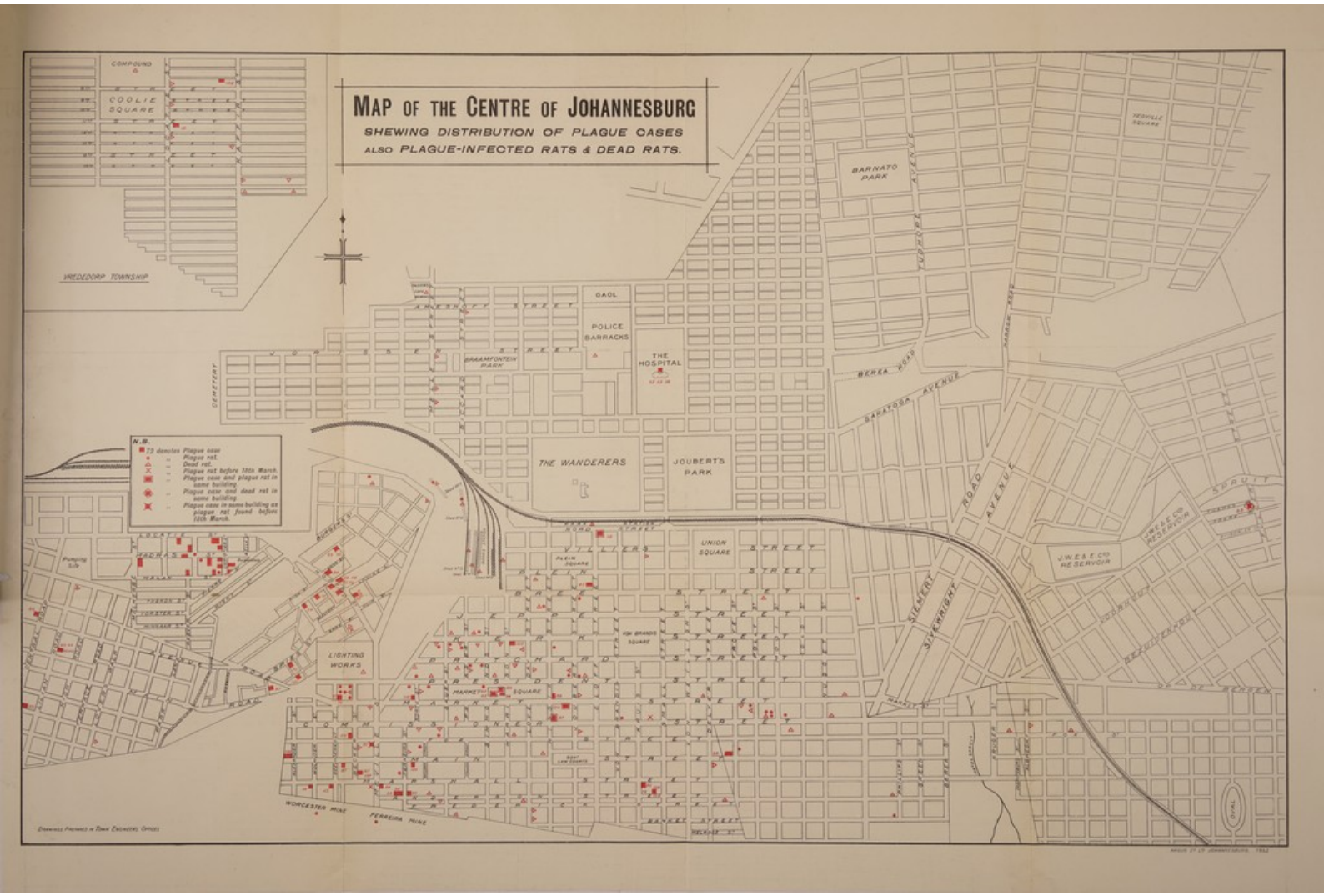
Laboratory experiments were also tried in Natal, but were so unsatisfactory that no attempt was made to exterminate the rats by means of the virus.

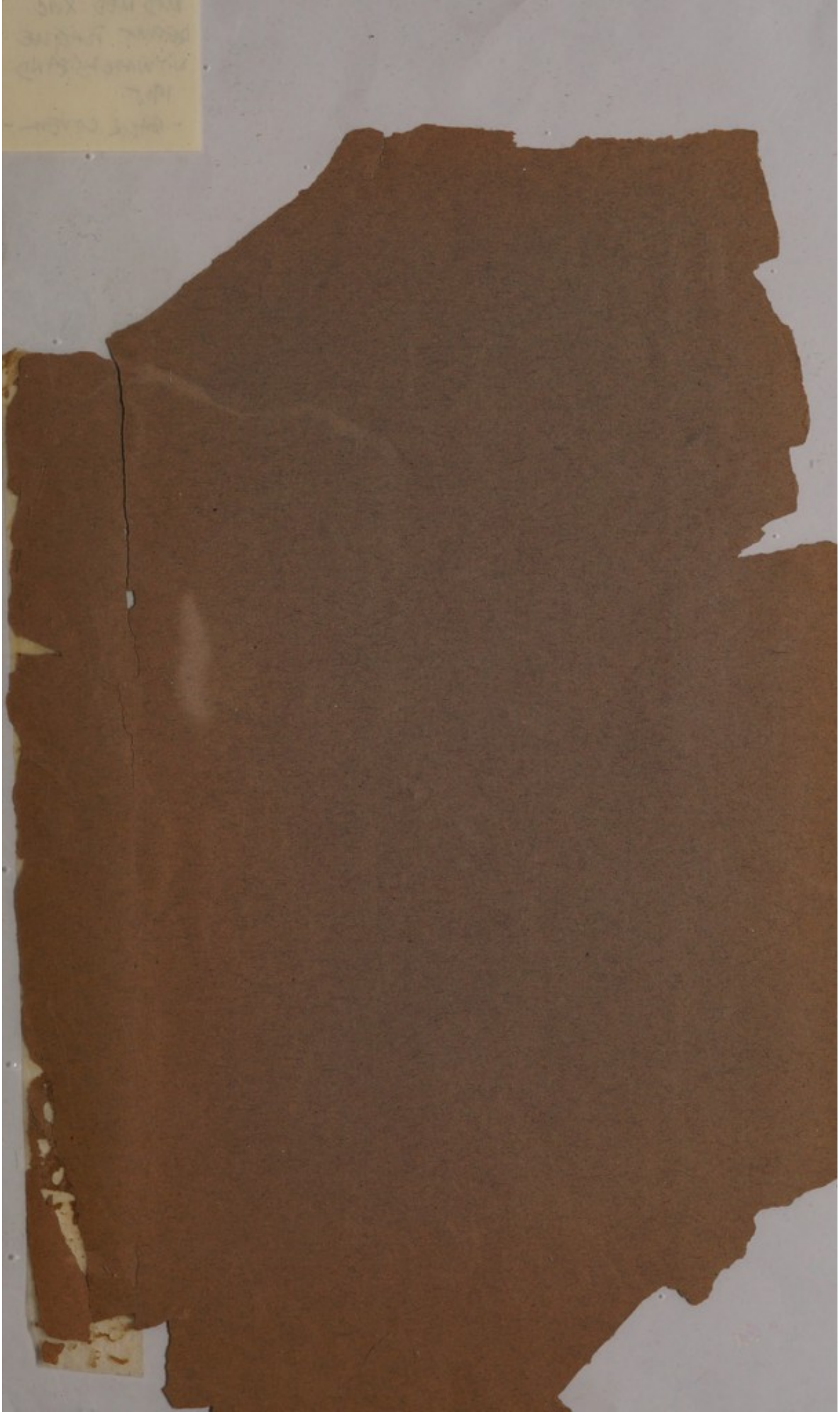
Chart of some of the Plague Cases —— shewing their connection both —— with other Plague Cases and —— with previous cases of deaths —— certified as Pneumonia.

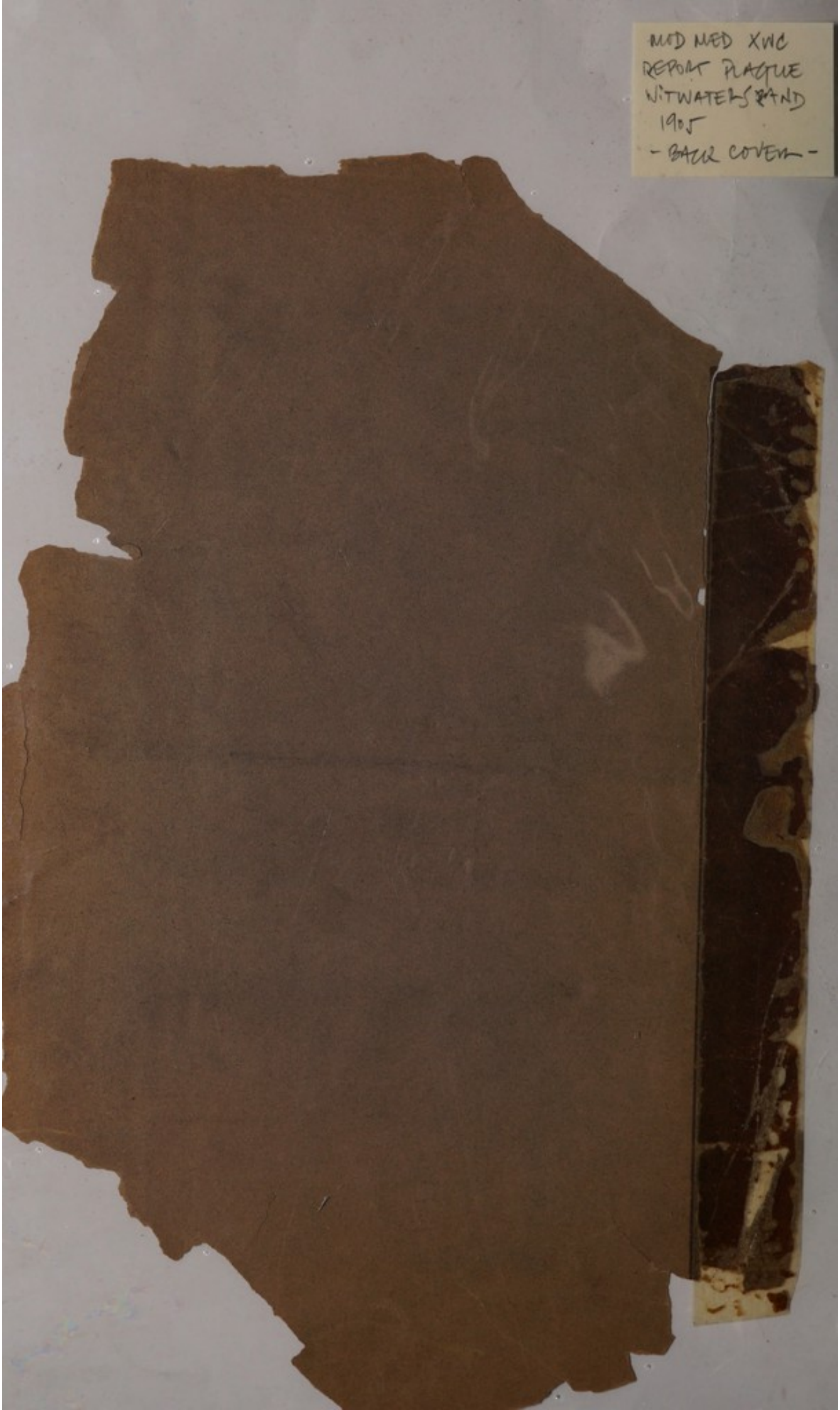


REFERENCE :

- ◯ Indicates residence.
- 21/3 ,, date of death.
- J 23 ,, the number of the Case of Plague on the Register.
- —— ,, probable place infection.
- ------ ,, direct contact.


MAP OF THE CENTRE OF JOHANNESBURG
SHEWING DISTRIBUTION OF PLAGUE CASES
ALSO PLAGUE-INFECTED RATS & DEAD RATS.
COMPOUND
COOLIE SQUARE
VREDEDORP TOWNSHIP
GAOL
POLICE BARRACKS
THE HOSPITAL
BRAMFONTEIN PARK
CEMETERY
THE WANDERERS
JOUBERT'S PARK
BARNATO PARK
BEREA ROAD
SARATOGA AVENUE
UNION SQUARE
PLEIN SQUARE
MARKET SQUARE
LIGHTING WORKS
J.W.E.& E.Co RESERVOIR
SILVERTON
OVAL
WORCESTER MINE
FERREIRA MINE
N.B.
Plague case
Plague rat.
Dead rat.
Plague rat before 10th March.
Plague case and plague rat in same building.
Plague case and dead rat in same building.
Plague case in same building as plague rat found before 10th March.




MOD MED XWC
REPORT PLAGUE
WITWATERSRAND
1905
- BACK COVER -