Report on the outbreak of the plague at Sydney, 1900 / by the Chief Medical Officer of the Government and President of the Board of Health.

Contributors

Thompson, J. Ashburton 1848-1915.
New South Wales. Department of Public Health.
Guy's Hospital. Medical School
King's College London

Publication/Creation

Sydney : W.A. Gullick, government printer, 1900.

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DEPARTMENT OF PUBLIC HEALTH,

NEW SOUTH WALES.

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LEGISLATIVE ASSEMBLY.

NEW SOUTH WALES.

OUTBREAK OF PLAGUE AT SYDNEY, 1900.

(REPORT OF THE CHIEF MEDICAL OFFICER ON.)

Ordered by the Legislative Assembly to be printed, 4 December, 1900.

The Chief Medical Officer of the Government and President of the Board of Health to the Hon. The Premier and Colonial Treasurer.

Department of Public Health,

Sir, 13 November, 1900.

The recent epidemic consisted in the attack with plague of 303 persons between January 19th and August 9th, of whom 103 died; in addition to the suffering and the indirect losses which these figures denote, it necessitated a very considerable immediate expenditure and caused much damage to the commerce of this port. The object of the following account is to inquire into its origin and mode of spread, with a view to deducing the measures which are likely to be effectual in preventing a recurrence.

It will be seen at last that steady attention to the more commonplace details of municipal sanitation during absence of the disease alone affords a reasonable prospect of future safety. Simple as this conclusion appears it has the certainty which is attainable only through close consideration of the facts which, however, cannot be successfully observed save in the light of precedent investigations made in many branches of science. Thus it is unlikely that it will be easily accepted; yet not merely because the weight of the reasoning which leads up to it is hard to appreciate, but also because men still despise the humble stream, and vainly imagine the rivers of Damascus. There is no royal road to the prevention of plague.

It is hardly necessary to point out that the data described below were not accumulated without forethought and industry; this opportunity is therefore taken of commending to your favourable notice the zealous services rendered by the permanent and temporary members of the Staff, whose special duties are mentioned with their names. The Principal Assistant Medical Officer of the Government (Dr. Frank Tidswell, M.B., Syd., D.P.H., Camb.) remained in charge of the laboratories; his account of the observations and researches made by him will be found in Appendix A. The Medical Officer of Health for the Metropolitan Combined Districts (Dr. W. G. Armstrong, M.B., Syd., D.P.H., Camb.) took charge of the Visiting Medical Staff, which consisted of Dr. Theodore Barker, M.B., Ch.M., Edin., and Dr. Arthur Grieves, M.R.C.S., L.R.C.P., and of the Disinfecting and Ambulance Corps. The Maritime Quarantine Hospital was placed in charge of Dr. W. F. M. Shells, M.R.C.S., L.R.C.P., from February 24th to March 17th, and from the latter date to the end in that of Dr. A. E. Salter, M.B., Ch.M., Melb. Dr. Salter's analysis of the clinical records constitutes Appendix B. Mr. C. P. B. Clubbe, M.R.C.S., acted as Consulting Medical Officer, and visited the Hospital on alternate days; Dr. Gordon Macleod, M.B., Ch.M., Edin., Ophthalmic Surgeon (see Appendix C), was

 consulted

consulted on occasion. The ground external to the hospital enclosure was, on April 13th, placed in charge of Dr. Henry Harvey. The general management of the Quarantine Station was, as usual, in charge of the Superintendent of Quarantine (Mr. James Vincent), assisted by the permanent Quarantine Staff and a considerable temporary staff. The Nursing Staff was supplied from the Coast Hospital and from private sources, the whole being under superintendence of Head-nurse Ford, of the Coast Hospital; the Ambulance Staff was also detached from the same Institution. The Inoculation Branch was controlled at first by the Headquarters Staff, but subsequently by Dr. W. F. M. Shells; from time to time many other medical men shared in this work, in which they were assisted by medical students at the University, and occasionally by the laboratory assistants under Mr. Robert Grant. The *post mortem* examinations were made by the Government Pathologist (Dr. George Henry Taylor, L.R.C.P. & S., Edin.), and by the Pathologist to Sydney Hospital (Dr. Sydney Jamieson, M.B., Ch.M., Edin.), whose notes will be found in Appendix D. Sanitary inspections of municipalities and of buildings on infected areas were carried out by a temporarily engaged staff of instructed inspectors under direction of the Board's Sanitary Inspector (Mr. P. E. Getting). About March 25th this staff was increased to 28 and, under the same officer, was turned over to the Department of Public Works to share in the general scavenging operations about that time commenced. The rat-killing staff afloat was managed by the Collector of Customs (Mr. N. Lockyer), and was under supervision of a Superintendent of Fumigation (Captain G. Tait). Others also ultimately bore their share in the multifarious branches of work entailed by the epidemic, but the present object is to draw special attention to those who were immediately connected with the Department; this statement may, therefore, be concluded by mentioning the name of the Secretary (Mr. C. A. Simms), on whom devolved, among many other things, the arduous and responsible task of keeping up communications and daily records, and of attending to visitors, more especially during the hours from 4·30 p.m. to midnight for many weeks together. All of the officers mentioned worked with an intelligence, discretion, and disregard for their own convenience, which are deserving of high commendation and special acknowledgment. For my own part, I beg leave to express here my sense of the obligation under which their generous coöperation and invariable loyalty, in circumstances which were always trying and sometimes difficult, have laid me.

To the Consul-General for France (M. Georges Biard-d'Aunet) and to the Director of the Pasteur Institute at Sydney (Dr. Emile Rougier) warm thanks are owing for the friendly efforts made by these gentlemen to facilitate despatch from the Pasteur Institute of supplies of the anti-plague serum of MM. Yersin and Roux; as well as to the Consul for France (M. L. Vossion), who at a later date presented the Department with a further and welcome quantity brought from Noumea. Unfortunately, neither arrived until the epidemic had begun to show the signs which betoken the period of decline; nevertheless, the public were reassured at hearing that a specific method of treating the disease had become available.

It will be noticed, doubtless, that the advice given by the Department before the plague came (December 26th), while the epidemic was but threatening (January 24th), and at its commencement (February 24th, see Appendix H), practically coincides with the conclusions drawn from the facts of our recent experience. Had it been generally accepted, it would have been well; but it was then impossible to mention reasons fully, nor could many things for which the public themselves clamoured at much later dates have been done at that time. Now, however, reasons can be deduced from facts within our own knowledge. An effort has been made below to express them in the simplest terms (Sections V, VI, and VII), and so that they may be understood by educated readers with little trouble; but if in spite of this attempt they still wear a technical aspect, it must be remembered that after all Preventive Medicine is a branch of science.

I. The Nature of the Disease.

The number of cases which occurred between January 19th and August 9th was 303. The number available for the following clinical description, however, was 262; for in 39 cases death occurred either before notification, or else so soon afterwards that no clinical observation of importance could be made, while two others lay ill at a distance from Sydney and have been omitted from mention.

In very few cases the occurrence of declared symptoms was preceded by feelings of malaise and weariness, which lasted one or two days. This ill-marked and uncommon prodromal stage need not be further referred to, and the observed course of illness may be generally described under the following five heads:—

Onset.—This was a period of from one to about twelve hours, during which the patient passed, very often with alarming suddenness, from a state of apparent health to one of severe illness. It was usually ushered in by a rigor which varied in degree from a feeling of chilliness to a severe shivering fit, and which occasionally lasted for several hours. Acute headache accompanied, or immediately followed, the rigor; it was almost invariably referred to the frontal region, was sometimes felt at the vertex, and was never occipital; it was sometimes accompanied with vertigo. Pain in the back and lower abdomen was common. Vomiting almost constantly occurred; like the headache, it sometimes accompanied the rigor, sometimes followed it after an interval of a few hours, occasionally it was represented by a mere feeling of nausea, sometimes it was severe and long-continued; the contents of the stomach were first rejected, afterwards a greenish or bluish bile was thrown up. The face was usually flushed, and the eyes suffused; the pulse moderately quickened, of good volume, and of apparently increased tension. In all cases which fell under observation during this period there was fever, the temperature ranging between 100° and 102° F. The bowels were constipated, most commonly; diarrhœa occasionally occurred, and even at this early stage warranted a bad prognosis; it was generally accompanied with tympanites. Occasionally at this time, also, superficial lymphatic glands in one or other region—the femoral, inguinal, axillary, subpectoral, cervical, etc.—became spontaneously painful; the pain was described as aching or pricking, and was accompanied with slight swelling and a little tenderness. In five cases out of the whole number, unaccountable swelling and pain in a lymphatic gland were the first signs of illness.

Ingravesence.—This period included a part of the first and the whole of the second day of illness: speaking generally, the symptoms to be shown in individual cases became manifest, and gradually increased in intensity. Often, but by no means always, the patient was now unable to rise from bed. The face was most commonly flushed; the eyes, suffused and congested, were either closed or half-open; not very infrequently the complexion was pallid or livid, and the expression pinched; in a few severe cases it was sallow or yellowish, and a peculiar smell exhaled from the patient. The tongue, very frequently, carried a white coating; this was confined to the dorsum, the tip and edges being either bright red or clean, and it continued moist or, in the severer cases, began to dry. The skin was hot and dry; but when the circulation was extremely feeble, as it was in severe cases almost from the onset, it was bathed in a cold perspiration. The temperature ranged at this time from 101° to 105° F., and occasionally the highest temperature reached during the illness was attained about the end of the second day. The pulse was now much quickened; it continued full, but began to loose tension; in a few cases it had already become weak, very easily compressible, and even dicrotic. Except in very slight cases, appetite was entirely wanting; thirst continued. The bowels remained constipated as a rule. The patient's general expression could rarely be described as anxious, and most often was dazed: sometimes there was mental restlessness, however, and he would exercise his ingenuity to furnish commonplace explanations of his illness, or of the glandular swelling. At this stage affections of speech, and (when the patient was out of bed) of gait, were observed. That of speech varied between slight blurring and almost complete loss of power to pronounce words, while that of gait was manifested merely by staggering; both were clearly due to muscular incoördination, and consequently a stage of alcoholic intoxication was often simulated. Hebetude describes the mental state of the milder cases at this date; but

but in many of the severer kind this had passed into stupor, or even coma, before conclusion of the period. In others, and more commonly, delirium commenced: it was characterised by excitement which not infrequently was furious; the patient constantly struggled to leave his bed, and had to be restrained; he suffered from delusions. In all cases sleeplessness was a marked symptom. The superficial lymphatic gland which had first become painful rather rapidly increased in size, on the average equalling a hazelnut: it was distinct, elastic, and very tender.

State.—The illness having attained the degree of severity above indicated during the first forty-eight hours, became established. The period of maximum intensity was reached; it lasted over the third, fourth, and fifth days, and was sometimes prolonged into the sixth. The temperature now fell, usually ranging between 99° and 102°. The more moderate attacks being excepted, the patient exhibited a state of complete and intense prostration: decubitus was dorsal, the body slipped down in the bed; all excitement abated, and muttering delirium took its place; stupor and coma were likely to supervene. Sometimes diarrhœa set in, and if at all severe was a fatal sign; or external hæmorrhages of grave significance—hæmatemesis, melæna, hæmaturia, or purpura, occurred. The pulse became smaller, weaker, and more rapid, dicrotous, irregular, or running. The tongue continued coated as at first, but now became dry and brown. Albumen was often present in the urine, but always transiently and in small quantity. The bubo increased rapidly in size; the gland often equalled a walnut, while periadenitic effusion increased the swelling to large proportions, and spread over the adjacent glands which were usually very slightly enlarged; although the spontaneous pain which had at first been present in it was almost absent, it continued extremely sensitive; the patient, if not insensible, disposed his limbs so as to avoid pressure upon it, and often its situation could be inferred from the attitude in which he lay. The skin over it also became much reddened. More than half the total deaths occurred on the third, fourth, fifth, or sixth days; they were often due to failure of the heart.

Table, I.—Showing the day of illness on which death occurred in 103 fatal cases.

On Day of Illness.	No. of Deaths.	On Day of Illness.	No. of Deaths.	On Day of Illness.	No. of Deaths.
1st	4	8th	6	31st	1
2nd	5	9th	9	38th	1
3rd	12	11th	1	58th	1
4th	20	12th	2	98th	1
5th	11	13th	2	Unknown ...	1
6th	12	17th	2		
7th	11	30th	1		103

During this stage, cough, due to slight bronchitis, and attended by frothy expectoration, was liable to set in. In a moderate proportion of cases scattered patches of pneumonia were observed; the sputa became less aërated, and contained a little blood, which often stained them uniformly and rather brightly; this expectoration did not at all resemble that of ordinary pneumonia.

Decline.—During the sixth, seventh, or eighth days the disease began to decline in the majority of those cases which terminated favourably. The temperature fell as a rule suddenly, and to about normal; but sometimes it was gradually reduced. All the other symptoms showed a rapid amelioration, and immediately on the fall of temperature sleep returned. The face lost its congested appearance, the tongue began to clean, delirium became mild, intermittent, or was present only for a time after awaking. The bubo continued, and during this stage generally began to soften, if it were going to suppurate; but in a good many cases buboes remained stationary for from six to eight weeks, and yet suppurated at last. The pulse continued small, feeble, and easily compressible, and feelings of great weakness began to be experienced.

Convalescence.—About the ninth or tenth day the stage of convalescence was entered upon in the majority of cases. Almost all the symptoms hitherto mentioned entirely disappeared; only great cardiac weakness and the bubo remained. The temperature

temperature often became subnormal, usually about the ninth day; it sometimes fell below 97° F., and continued subnormal for from one to three days. Suppuration now proceeded rapidly in the bubo, and was usually accompanied by some slight rise of the evening temperature; the abscess was most commonly opened on the thirteenth day. In a less, but considerable proportion of favourable cases, the inflamed gland began to diminish in size, and gradually disappeared by resorption, but this process occupied several, or even many, weeks. The length of the period of convalescence was very irregular; usually it was established thoroughly by the third week, when debility and some discharge from the bubo alone remained. The wound, however, was rarely severe enough to prevent the patient from taking as much exercise as in other respects he was fit for, though occasionally extensive undermining of the skin long delayed his discharge.

If from the foregoing description of the average course of illness in uncomplicated cases, which terminated either in recovery or death, we turn to consideration of individual cases, it appears that the disease exhibited itself in every degree of severity—that is to say, from a slight attack of fever which necessitated confinement to bed for two or three days at most, accompanied by such swelling of a single gland as was a cause rather of discomfort than of pain, to an ill-defined attack of malaise on which death supervened after a few hours—or more often to an apparently moderate illness, which ended with unexpected death in about forty-eight hours from attack. Of the first degree, Case 1 (Appendix L, p. 77) was a good example, while the following are among those which represent the second and third. Case 240, m., *æt.* 45.—It was noticed that the patient's appetite fell off a day or two before attack, but this was not unusual with him, and he made no complaint; he attended to his clerical duties as usual during the morning of May 19th, but at midday was obliged to leave by a fit of colic; he died at 10 p.m. Case 255, m., *æt.* 55.—The patient rose at 6 a.m. and performed his duties as ostler in the usual way, and without having been heard to complain, until 8 a.m.; made a good breakfast, washed and dressed, and sat by the kitchen fire; at 9·30 a.m. he was found dead. Both of these men were intemperate; but this was not so with Case 242, m., *æt.* 17.—The patient rose at 8 o'clock, and complained of slight headache and nausea; he went out, and at 10 a.m. was spoken with by a policeman who afterwards reported that he made no complaint, and did not appear to be ill; at 2·45 p.m. his breathing became laboured, and at 9·45 p.m. he died. The two following patients died unexpectedly, though not so abruptly. Case 142, m., *æt.* 5.—During April 22nd became feverish and vomited several times; during the next thirty-six hours continued feverish, was sleepy or dull, and a tender swelling appeared in the right groin. He died quietly, but suddenly, at about the fifty-first hour of illness, without manifesting any other symptom. Case 84, m., *æt.* 3.—Woke at 3 a.m. on April 5th, feverish, thirsty, and with some slight muscular twitching. Vomiting set in, and continued till midday of April 6th. During the afternoon seemed much better, and played almost as usual. At 6 a.m. on April 7th muscular twitching again appeared; he was sleepy or indifferent, and feverish, and he died suddenly about the fifty-first hour of illness.

Post-mortem Appearances.—These were observed in twenty-four cases (Appendix D, p. 64), among which the five last referred to above were included. From this set of notes it appears that petechiæ of the skin were noted in ten cases; petechiæ of serous membranes, visceral and parietal, or of the mucous coat of the stomach and intestines, in nineteen. They were usually of the size of a pin's head or a little larger, but sometimes as large as a threepenny-piece; and hæmorrhages, or hæmoglobin staining, in the areolar tissue around internal organs were sometimes noticed, apart from enlarged lymphatic ganglions. The spleen was usually enlarged, rounded, softened, and dark in colour on section; it was noticed that the trabeculæ were obscured in six cases; and in only two was this organ reported to be firm and in other respects of normal appearance. Inflamed, swollen, and sometimes necrotic lymphatic glands were noted in twenty-one cases, while in three none were found. They were surrounded with extravasated blood in fourteen cases, and in a less number of the latter there was also œdema of the surrounding areolar tissues. Buboes (sixteen) were—femoral, eight; inguinal, four; axillary, one; and cervical, three. The heart, which often contained soft, pale-yellow gelatinous clots, showed paleness and softening of the myocardium in four cases. The liver was enlarged in fourteen cases, and was

fatty

fatty as well in thirteen; this appeared to be a recent change. In two, minute whitish points distributed throughout its substance betokened necrosis; in three cases it was cirrhosed from old standing disease. The cortex of the kidneys was swollen and pale in twelve cases, and occasionally was speckled with pin-point hæmorrhages. In Case 84 the former condition was ascertained to be due to catarrhal nephritis at an early stage. The lungs were the seat of old-standing disease in three instances, in five others they were congested, in three others engorged with blood, and in eight others there was a moderate œdema; in one case lobular pneumonia was noted.

Bacteriological Evidence.—Once the presence of plague in epidemic form has been recognised, a large majority of cases can be quite certainly diagnosed by clinical methods alone; and this is fortunate, because rigid bacteriological proof of the nature of this disease can seldom be had before the fifth day from beginning to seek it. Nevertheless, not merely at the beginning, but during the course of every epidemic, bacteriological proof is occasionally demanded. At the beginning it is essential, in view of the consequences which at present follow on the announcement that an indigenous case of plague has arisen among the inhabitants of a large city or an important seaport. So momentous an opinion should not be given but on absolute proof that the disease is plague, and the proof remains incomplete until it has been supported by a bacteriological demonstration. In the course of an epidemic it is also occasionally required in cases of doubt; for accuracy of diagnosis is a first condition of successful management. But in this case the same rigid proof is not necessary as in the former, and a microscopical examination of the juice of an enlarged gland, or (in few and fatal cases) of the blood, will furnish all the corroboration needed to establish a diagnosis already highly probable on clinical grounds.

Bacteriological demonstration of the nature of the disease already described, consisted briefly in detection in the juice of buboes, and in some other tissues, secretions, or excretions of the diseased body, of a micro-organism which had the following morphological, cultural, and pathological characteristics, and a definite reaction to certain stains. The organism was usually present in enormous numbers in smears made from enlarged glands, or from viscera. The individual elements were segregated, though not infrequently two were seen end to end, as though they had been produced by recent fission: they stained with aqueous solutions of fuchsin, methyl blue, and gentian violet, and did not retain the stain when treated by Gram's method. In stained preparations it presented a matured form, which was either that of a typical bacillus, or else it was whetstone or boat shaped; interspersed among these were rounded, oval, or dumb-bell shapes resembling micrococci or diplococci. The greatest mixture of forms was observed in smears from tissues, but there was always a preponderance of the "mature" forms. The bacillary form had an average measurement of 1·8μ, and a breadth of ·8μ; the latter showed little variation, the extreme measurements of length were 1·6μ and 2·4μ. The rounded forms had a diameter between ·5μ and 1·0μ. The poles of the bacillary form were often more deeply stained than the centre; in some preparations, practically every bacillus showed more or less deeply stained ends, and a central portion which remained clear and unstained, and which varied in width between a small space and the greater part of the body of the bacillus between the ends. In other preparations only a few elements showed this bi-polar staining, and occasionally it was not at all evident. Cultivation on dry or salted agar produced crops of "involution forms"; some elements became greatly enlarged, so as to measure 5 μ. or 6 μ. in length by 1 μ. in breadth, without losing the shape or staining properties just described; others became otherwise altered, and formed sausage, pear, spindle, circular, or oval shaped bodies, having no resemblance to the bacilli from which they were derived. On nutrient agar, inoculated from buboes or viscera and incubated at 37° C., the first noticeable growth appeared in the form of minute bright specks in from thirty-six to forty-eight hours. In a day or two these colonies become colourless hemispheres from ·5 to 1·0 mm. in diameter; some of them then enlarged slowly to a diameter of 2 to 3 mm., became flattened, and cloudy towards the centre. The maximum development was reached in two weeks. Individual colonies were hard to pick up, slipping about under the needle; fused colonies were often tenacious, and could be pulled out in strings. In sub-culture the growth appeared earlier than in the original, and developed as a confluent streak, raised and cloudy along the middle,

but

but with thin, colourless, iridescent borders, which were often corrugated. At room temperature on this medium the growth was seldom distinct in less than five or six days, and only reached its maximum development in about three weeks. In beef-broth the growth was usually visible on the second day of incubation, in the form of crumblike spicules attached to the sides, with more or less deposit at the bottom of the tube, the broth itself remaining clear and transparent; but in other cases a moderate uniform turbidity was produced. Growth in broth-flasks containing oil resulted in production of a film, scanty crops of stalactites, and a copious deposit. The stalactites present at any one time never exceeded six or eight, and became detached, and sank to the bottom on the least jar; that more were not found at one time was probably due to unsteadiness of the laboratory shelves. The growth in milk was less abundant than in broth, and the milk remained unchanged. Inoculation of guinea-pigs was usually followed by death in four or five days; the extremes were two to ten days, but six were rarely exceeded. The inoculations were made into the inner side of the knee. *Post-mortem* there was sometimes hæmorrhagic swelling at the site of inoculation, and this extended up the thigh; there was always swelling, and usually periadenitic effusion and hæmorrhage of the corresponding femoral glands, while sometimes the related inguinal, and less often the lumbar, glands showed similar changes. There were petechial hæmorrhages under the skin, the serous membranes, and in the viscera. The lungs were almost always more or less inflamed, the liver enlarged (sometimes to twice its normal size), and the latter usually exhibited a fine mottling caused by appearance of white points or by small hæmorrhages. The spleen was enlarged to two or three times the normal, marked with white spots on its surface, was dark in colour, and had thick or rounded edges. The kidneys were enlarged, pale, and, as a rule, full of small hæmorrhages; the suprarenals were usually congested, and of a deep red colour. Occasionally plague bacilli were limited to the seat of inoculation and the bubo; but usually they were present in all parts of the body, though they were not always recoverable from heart's blood. They were twice recovered from the urine, and were never found in the bile. A bacillus having precisely the same characteristics and the same pathogenicity was recovered from the organs by culture. For a full account of the bacteriological observations made during this epidemic, Appendix A, p. 50, from which the foregoing abstract has been made, should be consulted.

From the foregoing account of the usual course of illness, which has been compiled exclusively from the symptoms recorded of each of the 262 cases which could be clinically observed, from the brief abstract of the *post-mortem* appearances noted in the twenty-four cases which alone were examined in that way, and from the abstract account of the bacteriology of the disease given above, it will be seen clearly that the epidemic illness now under consideration was plague. On comparing it with the published accounts of plague as it appeared in other parts of the world, it will be seen that it might have been compiled from records made in China, in Portugal, in India, in Mongolia, in Mauritius, or, in short, from the records of plague outbreaks in any part of the world from which such records are forthcoming. Nevertheless, certain minor differences between the disease as seen here and as it has been seen in India and China, for instance, are distinguishable. But they are non-essential; they are differences in degree of severity or of fatality, and are doubtless due to the indirect influence of local conditions of life—of feeding, housing, cleanliness, and also of race. And of the three recognised forms under which plague exhibits itself—that is to say, the bubonic, the septicæmic, and the pneumonic, the bubonic form was almost exclusively encountered. The septicæmic form was observed only in 17 cases, of which 15 were fatal; primary plague pneumonia probably not once, although a single case was met with (in a Chinese) which possibly may have been an instance of it, the circumstances having prevented the fact from being ascertained. Bronchitis and secondary pneumonia were not uncommon, carbuncles were seen in two instances, and inflammatory and suppurative affections of the eye six times (Appendix C), but for an analysis of the whole series of cases reference must be made to Appendix B, p. 58.

II.—Progress of the Epidemic.

Sydney alone was infected, although several persons first fell ill after leaving for distant places—a matter which will be further mentioned (see p. 32). The total population of the metropolitan area, as defined for registration purposes, was estimated at 438,300 on December 31st, 1899; that of the metropolitan districts as combined for purposes of sanitary administration, was about 456,000. Cases were removed from all parts of the latter area. This population included the small sprinkling of coloured persons usually found at seaports, and a colony of Chinese which numbered less than 4,000 altogether; the latter, for the most part, lived in three separate neighbourhoods. Among the Chinese 10 cases occurred, and 293 among the whites; 226 of the whole number were notified by 87 legally qualified medical practitioners, the remainder (77) having in almost every case been first visited by a Staff Medical Officer.

Table II.—Showing the number of attacks and deaths recorded during each week.

Week Ending.	Cases.	Deaths.
20 January	1	0
27 January	0	0
3 February	0	0
10 February	0	0
17 February	0	0
1st.—24 February	2	1
2nd.— 3 March	2	1
3rd.—10 March	5	3
4th.—17 March	12	3
5th.—24 March	10	3
6th.—31 March	23	6
7th.— 7 April...	29	9
8th.—14 April...	29	12
9th.—21 April ..	16	8
10th.—28 April...	26	7
11th.— 5 May ...	38	10
12th.—12 May ...	23	10
13th.—19 May ...	24	10
14th.—26 May ...	7	6
15th.— 2 June ...	17	3
16th.— 9 June ...	4	3
17th.—16 June ...	10	3
18th.—23 June ...	6	0
19th.—30 June ...	12	3
20th.— 7 July ...	1	0
21st.—14 July ...	3	0
22nd.—21 July ...	2	0
23rd.—28 July ...	0	1
24th.— 4 August	0	0
25th.—11 August	1	0
26th.—18 August	0	1

The weekly notifications showed stages of increase, state, and decline in the epidemic. During the first three weeks only 9 cases occurred, and they were pretty evenly spaced out. During the fourth and fifth weeks, 22 were notified. In the sixth the epidemic became established, and so continued for seven weeks more; two-thirds (208) of the total cases happened during these eight weeks. The period of decline set in with the fourteenth and continued through the nineteenth week; it was marked by great irregularity in the number of cases notified, the series having been 7, 17, 4, 10, 6, and 12. The epidemic then ceased. The twentieth, twenty-first, and twenty-second weeks yielded but 1, 3, and 2 cases, while the last case of all was noted in the course of the twenty-fifth week.

Variation of Virulence.—It is important to remark that the infection had its full virulence from the beginning. The mortality was heavy from February 23rd, when Case 2 died; yet among those which immediately followed it were some which did not exceed Case 1 in severity. The only change observed in it was enfeeblement. This began about May 1st; it was recognised on comparing the state of patients

patients on admission to hospital after May 1st with the state on admission of those received at corresponding dates of illness before May 1st. Nevertheless, among the majority of cases which, as a whole, testified to this, some which appeared to betoken unimpaired virulence were met with to the very end (see Appendix E, Cases 289, 295, and 303). Another point requires notice in this connection. It is that whereas it had taken seven weeks to furnish the first 100 cases, and four weeks to furnish the second, thirteen weeks elapsed before the 303rd case had been recorded.

TABLE III.—Showing the number of attacks and deaths under Sexes and Age Groups.

Age Group.	—5		—10		—15		—20		—25		—35		—45		—55		—65		—75		Total.	
Sex.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Attacks	8	7	11	6	20	11	49	6	35	7	45	10	46	6	16	4	5	5	4	2	239	64
Deaths...	4	1	1	3	2	3	18	2	15	1	15	1	14	1	10	1	4	4	2	1	85	18

Sex Incidence.—The disease attacked nearly four times as many males (239) as females (64). The slight information available on this head does not indicate any special liability of males to attack in other countries, and probably this special incidence may be accounted for by the stress of the disease having fallen on business portions of the city, and on that part of the population which daily leaves home for some place of employment. This conjecture is supported by consideration of the incidence on the sexes in two infected areas which were distinct from that just referred to, and in which it was nearly equal: on one area, out of fifteen "indigenous" cases (that is to say, cases in which the infection was in all probability received on the spot where the patients lived), only 7 occurred in males, but 8 in females (Paddington); and in another group of nineteen, 10 males were attacked to 9 females (Redfern). Slighter testimony to the same effect may perhaps be drawn from Table III, which shows that the incidence on males and females below 10 and above 55 was much more nearly equal than at the intervening ages.

Age Incidence.—The observed incidence was on ages from 2 years to 74; but more than half the cases occurred in persons at ages between 15 and 35, while more than two-thirds occurred at ages between 15 and 45.

General Fatality.—The total number of cases having been 303, the deaths were 103; the gross fatality was thus just below 34 per cent. But 10 of the patients were Chinese, a race amongst whom the fatality of plague is usually from 80 per cent. upwards; and, in fact, 8 of the 10 died. If these be deducted, the fatality of the disease amongst the remainder, who were all whites, was 32·4 per cent.

Fatality at Age-groups under Sexes.—Table IV shows the percentage fatality of the disease at four age-groups in the two sexes; the smallness of the figures relating to females (see Table III) should be borne in mind.

TABLE IV.—Comparative statement of the fatality among Males and Females at four Age-groups.

Age-groups.	—15	—35	—55	—75
M.	18 per cent.	37 per cent.	39 per cent.	67 per cent.
F.	29 „	17 „	20 „	71 „

Fatality,

Fatality, at successive periods.—The fatality of the disease was not uniform throughout the whole series of cases. It was absolutely as shown in the following Table, to form which the 303 cases have been divided into three nearly equal parts:—

TABLE V.—Comparing the fatality of the disease among three arbitrary divisions of the whole series.

100 cases (20 January to 12 April)*	Fatality, 38 per cent.
100 cases (12 April to 8 May)*	Fatality, 35 per cent.
103 cases (8 May to 9 August)	Fatality, 30 per cent.

* The cases which occurred on these days have been divided.

But in this Table the Chinese are included who, for reasons already given are a disturbing element in the calculation, and should be separately dealt with. When they have been excepted, the statement concerning the remaining 293 cases among whites only, assumes the following form:—

TABLE VI.—Comparing the fatality of the disease among three arbitrary divisions of the cases which occurred among whites, the ten Chinese having been deducted as shown below.

	Less Chinese.	
	Cases.	Deaths.
100 cases (20 January to 12 April)*—Fatality, 37 per cent. ...	1	1
100 cases (12 April to 9 May)*—Fatality, 37 per cent. ...	5	4
93 cases (9 May to 9 August)—Fatality, 23 per cent. ...	4	3

* See note to Table V.

A few days after commencement of the term during which the latter 87 cases occurred, Yersin-Roux serum become available, and was thenceforward steadily employed; but it must be added that, in opinion of the clinical Staff, the virulence of the disease had already begun to abate about the beginning of May. The evidence which can be adduced in support of this judgment is given in Appendices B and E.

Meteorology.—Appendix M consists of a chart on which are described curves constructed from the daily notifications, the rainfall, the daily mean temperature, and the daily mean tension of atmospheric vapour. The data were furnished by the Government Astronomer (Mr. H. C. Russell, C.M.G., F.R.S.)

Suspected Cases.—From January 25th, when the nature of the first case was made known, down to a date long after that last mentioned in Table II, a total of 221 cases of suspected plague were reported to the Department for diagnosis; 115 of them were referred by 69 medical men, 106 (of which 32 were presented by the patients themselves) through other channels. Many of the latter offered no resemblance to plague in any form, of course; and many of the former were referred from motives of prudence rather than because doubt as to their nature was really felt. But among these were several cases of glandular swelling, with or without other symptoms of illness. In nearly all of these cases the glandular swelling, could be referred to one or other of the usual causes without difficulty; but in two or three of them no such cause could be assigned. However, very careful consideration of the recent occupation, place of residence, and habits of these patients, of the history of the illness and of the swelling, and of the results of a minute and prolonged bacteriological investigation, quite failed to furnish support to the notion which had made an accurate diagnosis necessary.

Ambulant Cases.—The suspected cases came to notice in greater number during earlier weeks, and thereafter with gradually diminishing frequency. The probability that the first case recorded was the first case in fact is supported on grounds which are given in detail in Section VI; and nothing has come to knowledge which would render it probable that either ambulant or pneumonic cases occurred before

before or during the earlier two-thirds of the time covered by the outbreak. But late in the latter third of that time a few ambulant cases were met with: Case 273, came to notice from the patient himself reporting the serious illness of his daughter, and then mentioning that he had had a somewhat similar attack shortly before; and Cases 299 and 300 (unconnected with each other) were detected after their admission to the Coast Hospital for treatment of the results of an illness (suppuration of inguinal glands) from which they had suffered three and six weeks earlier. So that while the question whether the first recorded case were really the first case which occurred can be answered in the affirmative with great confidence, the further question whether the total recorded cases include all which happened cannot be affirmed without reserve. The accidental discovery of the three just mentioned renders it likely that other such cases occurred in which medical advice never became necessary, or else was sought at a date when the true cause of illness was no longer distinguishable. All that can be said with regard to ambulant cases is that in the general opinion they occurred only at the end of the epidemic, and then were few in number.

Removal to Isolation.—It is convenient to mention here the time which elapsed between notification of cases and their removal to isolation at the Maritime Quarantine Station. The account stands as follows:—

TABLE VII.—Showing the time which elapsed between notification of 303 cases of plague and their removal to isolation.

Removed on the day of notification	154
Removed on the day after notification, to avoid transfer at night ...	99
Removed on the second day after notification, the patients having been too ill on discovery to bear the journey	3
Removed on the fourth day after notification (being the first case, detained at home for investigation)	1
Isolated at country places and not removed to Quarantine	2
First fell ill at Quarantine	7
Died before notification, or immediately after	37
Total	303

253 cases required removal and could be dealt with in the regular way. 154 of them were removed on the day on which they were discovered, while 99 were not removed until the next morning, merely because they had been notified so late in the day that otherwise their transfer must have been effected in darkness.

III.—PROTECTIVE INOCULATION.

Haffkine's prophylactic was alone used. As mentioned below, a small stock had been procured during the latter half of 1899; it was used for protection of those immediately associated with the earlier cases, including the members of the staff. No public inoculation was attempted until a further and large supply came to hand on March 12th. Two considerations governed the manner in which this consignment was expended: First of all persons who lived on, or necessarily frequented areas of known infectivity, had the best right to protection, and the most rational use of the supply was, clearly, inoculation of such persons; secondly, it was impossible (and quite unnecessary) to protect the whole population. But this intention was to a large extent frustrated. Between March 12th and April 2nd, when this supply became exhausted, about 8,000 inoculations were performed, including the small number done before March 12th, which was short of 300. There was then an interval, after which a fresh supply was received, and between May 11th and June 16th, about 2,700 more were done. On this occasion the arrangements made ensured inoculation of a larger proportion of persons considered to be in special danger of infection (see Appendix F., p. 71). Throughout the epidemic inoculation was offered to contacts, either on first being visited, or on arrival at the Maritime Quarantine Station, and the total number segregated having been 1,832, the number then inoculated was 180.

The total number known to have been thus protected was 10,700, all members of the various staffs included; no illness occurred among the latter, except Case 262 (see p. 37), a scavenger at the Quarantine Station who had escaped inoculation,

inoculation, but who was not the only one who was overlooked among the temporary hands employed from time to time. Among the inoculated public, 13 were attacked; particulars are given in the table below. All these patients not merely recovered, but had conspicuously light attacks. The cases occurred almost entirely among the earlier 200, while the virulence of the infection was at its highest, but also among the latter 93 (Chinese being excepted), when it had become feebler.

TABLE VIII.—Showing the dates on which thirteen persons were inoculated, and the dates on which they were subsequently attacked with plague.

No. of Case.	Date Inoculated.	Interval.	Date attacked by Plague.	No. of Case.	Date Inoculated.	Interval.	Date attacked by Plague.
	1900.		1900.		1900.		1900.
36	20 March.	4 days.	24 March.	57	23 March.	3 days.	26 March.
37	21 „	4 „	25 „	66	23 „	6 „	29 „
41	23 „	2 „	25 „	103	26 „	15 „	10 April.
42	23 „	1 „	24 „	115	13 „	1 „	14 March.
44	23 „	4 „	27 „	214	11 May.	0 „	11 May.
47	19 „	5 „	24 „	285	21 March.	93 „	22 June.
51	23 „	7 „	30 „				

There was one other and fatal case (164), which occurred in a boy who was attacked April 29th, and whose relatives insisted that he had been inoculated; they fixed the time, however, at about two months before attack, when none but those who had been in immediate contact with patients were being done. He was certainly not inoculated at that date, nor before commencement of public inoculation, on March 12th. His name could not be found in the register, which was carefully kept, of the names and ages of all persons inoculated by the staff, and inquiry among his fellow-clerks elicited only a vague statement from one of them, that he had been afraid of the plague, and had said something about a sore arm; this permitted the inference that he had been inoculated, but he had not made any direct statement on the subject. On the whole, the question remained undecided, although the statement made by his relatives is entitled to credence.

The immediate effects of inoculation were, in every case, it is believed, such as are commonly described. A few hours afterwards slight malaise and fever began, with swelling about the seat of the puncture; the feverishness increased, and the night was often restless; there was some slight headache and thirst; the temperature rose in observed cases (the night being excluded) from 2 to 3 degrees. The arm became painful, and after 24 hours there was usually a hard lump around the puncture (which was always made at the back of the upper arm), and rather extensive diffuse swelling below it, with much heat and redness. At the same time there was as much general malaise as might cause an unoccupied person to lie up, but not enough to interfere with important engagements. On or before the third day the malaise disappeared; the redness and diffuse swelling continued somewhat longer, and were attended with stiffness and slight tenderness; the hard central lump gradually diminished and could usually be still detected after from two to three weeks, though free from tenderness during the latter part of the term. The inoculations were always performed by medical men under antiseptic precautions; they were assisted by medical students and laboratory assistants. Not more than three or four cases of suppuration came to knowledge.

The inoculations done were hardly numerous enough to interfere with the natural course of the epidemic; but, in point of fact, no interference could be traced. Whole infected households had never been inoculated. If the person attacked had been inoculated it usually turned out that he alone had been done, often having submitted at instance of his employers; and in households where the patient had not been inoculated it was uncommon to find that even one other person among them had been done.

In accordance with the definition of the word "contacts," which will be found at beginning of Section VII, protective inoculation as a preventive measure to be used among a very large city population consisting of white people alone, and during an epidemic of plague which is under management of an efficient sanitary organisation acting under suitable laws, would appear to be practically restricted

to

to persons who cannot be removed from premises which are known to be infective; to those who, having evacuated the premises during cleansing, are returned to them while the area on which they stand is still infective; and to those who are obliged to frequent infective neighbourhoods, if they will receive it. It will be noticed that attacks which occurred at, or before the lapse of about ten days from, inoculation were not aggravated by it.

IV.—Serum-treatment.

Yersin-Roux serum became available on May 13th (Case 217). It was administered only by the Visiting Staff to cases diagnosed by them, and at the Maritime Quarantine Hospital. Its employment did not interfere with the natural course of the epidemic.

Although it was intended to give the serum regularly to all admitted to hospital without exception, so as to avoid selection of cases, it was found that this rule could not be adhered to without introducing an equally objectionable influence. The enfeeblement of the infection, which had begun to be observable by about May 1st, led many patients to defer seeking medical advice, and, consequently, to escape notification until comparatively late dates of illness, when they presented very slight symptoms of constitutional disturbance. Thus a dilemma was caused, out of which no way could be found: if the cases were not selected a false impression of the effects of serum-treatment would certainly be given; on the other hand, if they were selected on principles which necessarily could not be strictly defined, the value of the experience would remain doubtful to all but the observer himself.

Fortunately, averages and percentages are statements quite out of place in such connections as this. As a matter of fact, 22 of the 87 admitted after May 12th were not treated for one reason or other—in 9 cases, because the patients either died before discovery, or were then moribund. On the other hand, to the remaining 65 must be added 6 admitted before May 13th, and on that date lying in a nearly desperate state, of whom 4 afterwards died. Among the 71 were many very slight cases; but some account of all of them will be found in Appendix E, p. 70.

The opinion provisionally formed, and expressed subject to consideration of the day of illness on which the treatment began, the mode of administration, and the general features of each case, is that the serum has antitoxic powers which are manifested in useful recovery of the circulation from the depression which is a constant feature of the natural disease; but that in its present state it can hardly be relied upon as a very active curative agent. Probably the dosage requires revision.

V.—Administrative Measures.

Before the plague came the Board and its permanent staff had been watchful and active.

Appearance of the disease at Hongkong was the beginning of general interest in plague as a modern danger, and the beginning of the special interest of the Department in it as one thenceforward threatening Australia. On four occasions during 1894, and twice in 1895 (when it was thought the disease was dying out at Hongkong and the risk nearly past), as well as in 1896, when plague first appeared in India, this danger was discussed, and was made the subject of resolutions and of special directions by the Board. The steadily progressive spread of the disease in epidemic form to other parts of the world was seen soon afterwards to necessitate further precautionary measures, and additional preparations against it.

Possession and first-hand knowledge of the bacillus was clearly a primary condition of success in attempting to guard against the introduction of cases of plague, or to control spread of the disease after it had gained entrance. Accordingly, cultures of it were procured towards the end of 1897, and during the following twelve months its morphological and cultural characteristics were studied in the laboratories. In October, 1898, the Vienna incident became known; the popular impression it caused was obliquely communicated to the Department through official channels, and it was considered expedient to destroy the enfeebled and harmless specimens which then alone remained in the laboratories. At the same

same time, however, the Board caused a communication to be addressed to the Premier, in which it was pointed out that possession of cultures of the microbe was indispensable to due performance of its appointed functions. During the ensuing year, repeated representations to similar effect were made. But it was not until March 12th, 1900 (Case 14), that formal permission to keep, cultivate, and inoculate this microbe into animals was granted to the Board's micro-biologist by the Department of Lands, which administers the Animals' Infectious Diseases Act, 1888. In the meantime, however, verbal permission to keep, cultivate, and inoculate animals with the microbe of plague had been given by the Premier (March, 1899), and was again given by the Premier (December, 1899) to the President; for it was easy to show that if a suspected case of plague were imported, or occurred on shore, the Department would be in a dilemma in which it must either break the law by making cultures and inoculations, or fail in performance of its duty for want of power to use those means of investigation—means which were open to the rest of the world. It was considered that these permissions, although invalid in law, would suffice to protect the Department in a case where an absolute necessity could be shown. They were relied upon when in October, 1899, it became necessary to examine certain cases which had arrived at Newcastle by the British-India Company's S.S. "Ujina," from Calcutta, *viâ* Port Louis, Mauritius (which turned out not to be cases of plague), and again, in January, 1900, when the first case of plague occurred at Sydney. From this latter, indeed, the cultures in use at the laboratories during the epidemic were in part raised.

During the same term now referred to, namely, from September, 1896, plague had been frequently discussed by the Board in relation to maritime traffic, and had also been a subject of communication between the Board and central health authorities in other parts of Australasia. These communications commenced in January, 1897, and were thenceforward continued. At the end of that year the International Convention which had resulted from the Venice Plague Conference was referred to the Board by the Government; after prolonged consideration it felt obliged to advise that the Government should not adhere to it, the law containing no provision under which the plan of medical inspection permitted by the Convention could be carried out (see Section VII, p. 49). In March, 1898, Madagascar, Mauritius, Réunion, and the Seychelles were proclaimed to be places infected with plague, pre-existing proclamations having covered all other places with which New South Wales has communication, and which had so far been attacked. The gradual infection of a greater and greater number of widely-scattered ports and places was carefully noted, and its bearing on the interests of this port considered; and in October, 1899, the Government was advised to intimate its willingness to adhere to those parts of the Convention which provide for international notification of plague.

Even earlier than the last-mentioned date it had become apparent that, in all probability, Sydney would be attacked; and accordingly in January, 1899, the Board suggested that a member of the staff might be sent to Bombay to study the disease.

The danger which threatened was the importation of plague by sea, and no other. The treatment accorded from the beginning to vessels arriving clean from ports infected with plague (that is, from May, 1894, when plague became epidemic at Hongkong) down to December, 1899, was that accorded to such vessels by an earlier International Convention to clean vessels arriving from cholera-infected ports; a treatment which was also accorded by the Venice Convention to vessels arriving under the conditions now contemplated, that is, from plague-infected ports. But when it was announced that plague was epidemic at Noumea, a town which lies but from three and a-half to six days' steam from Sydney according to the class of vessel making the voyage, it became necessary to alter that method; and, while the regulations laid down in the International Convention were adhered to as far as possible, such vessels were compelled to lie at quarantine after arrival (whatever the state of health of those on board might appear to be) until expiration of the twelfth day from the day of sailing. This term was two days in excess of that prescribed by the International Convention, and was adopted merely because the French Colonial Office had issued instructions to Governors of French Colonies to impose it on vessels arriving at their Governments from plague-infected ports. But, in addition, attempts were made to kill any rats which might still remain on these vessels notwithstanding the efforts to the

the same end which had usually been made at the port of departure; and sometimes these measures yielded a considerable number of dead rats—in one case, as many as 283. Here it is well to note that the Venice Convention contains no reference whatever to rats, and the share they take in disseminating plague.

Lastly, as regards the measures of precaution and of preparation taken by the Board before the plague actually arrived, a supply of prophylactic was sent for about the middle of 1899; and when the infection of Noumea was announced, it turned out that prophylactic was available in this quarter of the world only at Sydney.

The presence of plague at Noumea in epidemic form was admitted towards the end of December, and the information became known in Sydney by cable on the 24th. On December 28th, 1899, the Board resolved that plague should be added to the list of diseases notifiable under the Public Heath Act, Part III., and it was proclaimed on February 6th. On February 1st, New Caledonia was declared infected with plague; and the Loyalty Islands, and the New Hebrides were declared likely to become so infected, by proclamation. The treatment already described was applied to vessels arriving from the latter groups. A cable message asking for a further supply of prophylactic was transmitted to Bombay.

It became known on December 30th that plague was epidemic at Honolulu, and it was announced that the same treatment would be accorded to vessels arriving thence as to those which came from New Caledonia, if they had communicated with the shore. It was also made publicly known by the Department that imported cases of plague would certainly be stopped at Quarantine, and that they were little dangerous; and it was pointed out that the first defence against the disease, under the circumstances then obtaining, consisted in killing all rats, the second in general scavenging of urban areas.

On January 15th, it was said that there were cases of plague at Adelaide, South Australia.

On January 25th, occurrence of the first case of plague at Sydney was made known. The Registrar-General was at once requested to refer to the Department every information received since beginning of the year, in which the cause of death was ascribed to blood-poisoning, septicæmia, acute abscess, septic intoxication, &c., &c., in order that further inquiry into such cases might be made if occasion appeared; and, since the notification of infectious diseases is by law required only as soon as the medical practitioner in attendance becomes aware that the patient is suffering from one of them, a circular letter was addressed to the medical profession on February 8th, in which a hope was expressed that the strict letter of the law would be exceeded, and that not merely cases of plague, but also cases reasonably suspected to be plague, would be reported by them to the Department (see Appendix N, p. 80); it was also desired that they might be reported direct—not, as the regulations made under the Act require, to local authorities in the first place. Circumstances attending the occurrence of this first case caused the Board to insert advertisements requesting information from owners and occupiers of wharves, stores and warehouses, masters of vessels, scavengers, and the public in general, as to unusual mortality or unusual movement among the rats at places under their control, and attempts were made in other ways to obtain such information. This case having occurred in the city, the President placed himself in communication with the Local Authority, and advised the Town Clerk on January 26th; it was then mentioned that some special scavenging and house-to-house visitation was already in progress. At the same time it was made known by the Department, through the public press, that there was little risk attending the care of plague-patients by the healthy, and the need to kill all rats was again insisted upon, as being the essential preventive measure then practicable. The patient was removed, together with his household and several contacts, to the Maritime Quarantine Station (see Diagram A); and in the report upon it, dated February 7th, it was pointed out, that if cases began to be met with in series, it would be necessary to evacuate the Coast Hospital. All members of the staff, and all who had been brought into contact with this case were inoculated with the prophylactic. The house was disinfected and painted; the contacts were released on the tenth day, the patient on the twenty-fourth day.

When the second case was discovered (February 24th), it was perceived that the fears which the circumstances alluded to above had caused the Department to express a month earlier were about to be realised. The same course was taken in isolating

isolating the family as before, but the Board now directed establishment of an ambulance service and of a disinfecting staff at the Quarantine Depôt, Woolloomooloo Bay (see Diagrams); and that temporary equipment of the Quarantine Hospital should be commenced, with a view to transmitting all patients and contacts thither until it should be possible to judge of probabilities in the near future. For it was evident to the Board that if a large number of cases should occur, not merely would the task of fully equipping this hospital for a purpose for which it was never intended, enormously increase the labours of the executive staff, but that it might easily happen that there would not be room enough in the enclosure for all the patients who must accumulate there, and for the nursing and serving staffs as well; while the need to transport all patients to it by sea from a point at the margin of the inhabited area would not merely entail very long journeys on many of them, but would also require organisation of land and water ambulance-services of considerable magnitude.

The infection of Sydney with plague was now officially announced. Once more the Department publicly stated that epidemics of plague were not kept going by communication of the disease from person to person, and again urged a crusade against rats; and it now suggested that a capitation fee should be paid for every dead rat delivered by all except the members of a special rat-catching staff, which should be at once appointed and paid regular wages.

On March 1st, a poster containing advice and instructions to householders was prepared, and subsequently exhibited very freely in conspicuous places all over the metropolitan area; and, notwithstanding the smallness of the Chinese colony, the apparent susceptibility of this race to the disease made it prudent to issue an edition printed in the Chinese language. At a later date (March 29th, case 48) this notice was reprinted in pamphlet form and posted to every householder in the metropolitan area (Appendix H, p. 75).

On March 2nd, the Department announced that for the future it would remove to isolation only actual sufferers from plague, and would quarantine houses and contacts only when the former were overcrowded and filthy, and presumably a source of infection. The plan was disapproved by the Government, which directed strict isolation of all people who had been in contact with plague-patients, and closure of the houses from which they had been removed. This decision subsequently appeared to be in accordance with popular feeling.

In the meantime, local authorities, both in Sydney and elsewhere, had begun to bestir themselves. As regards the City, it was mentioned that special inspection and scavenging had been begun as soon as the rumoured presence of plague at Adelaide became known, and that £2,000 had been thus spent down to February 26th. A house-to-house inspection of the city of Newcastle was carried out at the instance of the Medical Officer of Health for the Hunter River combined Sanitary Districts (Dr. Robert Dick); it had been begun about January 9th, and was reported complete about January 30th. Many metropolitan municipalities also announced the steps they were taking to put their districts in order. The Board gathered together a staff of instructed sanitary inspectors and caused them to visit all municipalities in the metropolitan district, and report (*a*) on the special measures alleged to have been taken or which were being taken; and then (*b*) on the effect produced, as judged after a perambulation of each district, and general inspection of dwellings. About March 2nd, it was stated that the local authority for the City had undertaken the systematic destruction of rats; and on the 9th, it was said, at a meeting of this authority, that 9,000 had already been destroyed. Doubtless, also, there was some private activity in this direction, the Sydney Meat Preserving Company having offered a reward to its workmen for every rat caught on their very extensive premises, as early as February 27th.

Fumigation of coastal vessels, with a view to destruction of rats, had been begun by the several companies at an early date; but a staff to carry out this work on all vessels loading at Sydney, trading between Sydney and other ports and places in New South Wales, or leaving Sydney for other parts of Australia or of the world, was organised and set to work by March 16th. It was placed under a temporary Superintendent of Fumigation, had its headquarters at the Custom House, and was generally supervised by the Collector of Customs (Mr. N. Lockyer). As regards vessels trading within New South Wales, it was ordered that, after leaving Sydney, they must not be allowed to communicate with the shore until they produced a certificate

certificate issued to them by the Department stating that the prescribed fumigation had been done while the holds were empty. These regulations worked without causing any serious interruption to traffic (see Appendix I, p. 76).

On March 22nd, regulations prescribing the mooring of vessels at wharves so as to impede the entry of rats to, and the landing of rats from them, were drawn up and recommended to the Attorney-General for gazettal (Appendix K, p. 77); this was done, but it was found that such regulations could be made only under the Wharfage and Tonnage Rates Act, 1880, so that they could be enforced only in the case of vessels mooring at public wharves.

On March 21st (Case 28), the President suggested to the Government that steps should be taken to call a Special Plague Committee into existence. Popular excitement had gradually increased until it had reached a pitch which threatened further serious interference with the Department's practical management of the epidemic. It was thought that such a Committee, if it included the leading members of the community, might steady the popular mind and afford the Department the kind of support in execution of its difficult and anxious duties which seemed about to become indispensable. Nothing resulted from the proposal at that time. But citizens presently began to move in the direction indicated; and on March 28th, the first meeting of a local Sanitary Committee was held in the municipality of Woollahra at instance, and at the house, of the Hon. Edward Pulsford, M.L.C., Mr. John Garland, M.L.A., in the chair. This example soon bore fruit, a similar Committee being called together at the Glebe, by Mr. J. A. Hogue, M.L.A., and a third at Paddington, on April 2nd. On April 11th, the Attorney-General (the Hon. B. R. Wise, Q.C., M.L.A.), attended a public meeting summoned by the Woollahra Committee, and, after explaining the Public Health Act and other sanitary enactments, took occasion to deliver some timely remarks on the indifference theretofore shown by the people in general to their civic duties, and on the tendency, which was universally evident, to rely on the Government not merely for administrative, but for executive, help in every kind of municipal work and responsibility.

The potential usefulness of such Committees was immediately perceived; and on April 11th, a general Committee, to be called the Citizens' Vigilance Committee, was instituted, which was to have a central office and sub-committees in every municipality. Alderman James Graham, M.D., M.L.A., became Chairman, and Messrs. John Garland, M.L.A., and J. J. Cohen, M.L.A., Hon. Secretaries. This Committee which, under its able managers, flourished greatly, and which still continues at work, did an incalculable amount of good in two main directions. In the first place, it laboured for and secured that coöperation of individual householders in the rat-killing business, without which it was plain the best efforts of the Government, and even of municipal councils, could yield but inadequate results; and, secondly, it set about systematically carrying out in every district the recommendation made by the Department on March 1st, in the poster and pamphlet then issued—namely, that every ratepayer should make it a rule to report to the local authority of his district every matter, or premises, which appeared to him to constitute a nuisance and a danger to health. Neglect to faithfully execute the sanitary powers entrusted to them had been a too common rule with many besides the City Council, though within the City its effects were exemplified on the greatest scale; and in the course of a few weeks the result of this scheme began to be evident, not merely in an improved public opinion, but in the changed attitude of all but one of the local authorities referred to. It seems likely that these results, which have flowed almost entirely from the public-spirited and wise exertions of the members and executive of the Citizens' Vigilance Committee, will in important measure prove to be permanent.

From the beginning, it had been gradually becoming clearer and clearer that the origin of the epidemic, as a local event, lay with certain wharves on Darling Harbour. (See Diagrams A, B, and C.) On February 15th (Case 1) and following days these places had been visited in detail by the Medical Officer of Health for the Metropolitan combined Sanitary Districts (Dr. W. G. Armstrong), and owners had been desired by him to take steps to cleanse them, and to destroy the rats about them. On March 11th, the President inspected them in company with the Collector of Customs (Mr. N. Lockyer), and ascertained that very little had been done in the desired direction; he thereupon communicated with occupiers, and threatened that

that unless large gangs of men were at once put on, and certain specified things done, he would quarantine these wharves. Already it had been perceived that if possible this portion of the city should be evacuated—the first object to be sought under such circumstances being removal of the inhabitants and daily visitors from the apparent focus of infection. But it was the headquarters of a very important branch of trade, and it was thought that this step could not be effectively taken without inflicting a blow on the prosperity of the country (for the welfare of every town would have been affected) which it was little likely to suffer from the epidemic—alarming as the situation was beginning to appear to the public who misconceived of plague as a highly infectious disease, liable at any moment to begin to spread like wildfire. And now two conditions became known, which made some further step than had hitherto been taken imperative. In the first place, while on the one hand it was soon ascertained that wharf-owners in general were not taking the measures which have just been referred to with anything like the requisite energy, it appeared on the other hand that their best efforts could hardly produce the desired results unless business were first stopped, because of the serious structural faults these old wharves exhibited. And then, secondly, the house-to-house inspection of this infected quarter, which was being carried out by the Board's staff of temporary sanitary inspectors, showed that it had fallen into a deplorable state from long-continued omission of the local authority to execute the ample powers to preserve the public health within its district which it enjoyed under its own Act of Incorporation, 1879, and under the Public Health Act, 1896. The result of this maladministration—now for the first time revealed to the general public, though well enough known in several quarters—was precisely that which sanitarians are aware must supervene in every large city, where, though there are good laws, there is an executive authority over a part of it which is at once uninstructed, indifferent, unguided by the routine of an efficient organisation, and ungoverned by strict principles of action.

As soon as these facts were apprehended the Government, after consideration, decided on March 23rd that the parts of the city and the line of wharves referred to, should be mapped out in convenient sub-divisions which should be consecutively closed, and given over to gangs of workmen under its own control. These gangs were to cleanse and disinfect streets, lanes, yards, and the houses inside and out; and, as regards the latter, note was to be made of all which had fallen into disrepair, or were so constructed that they should have been dealt with by the local authority under Part V. of the Public Health Act,with a view to making application for closing orders. The Board, therefore, increased its staff of temporary sanitary inspectors to twenty-eight, placed it under its sanitary inspector (Mr. P. E. Getting), and after furnishing it with a scheme of house-to-house inspection to be filled in and recorded, turned the whole over to the Department of Public Works. Successive portions of the city, which are indicated by dark shading on the three diagrams attached hereto, were closed to traffic and cleansed between March 23rd and July 17th.

Down to about March 23rd (Case 31), the Department had not succeeded—notwithstanding the increasing public alarm—in causing it to be perceived that it was beyond the bounds of possibility that it should not only advise and plan, but also actually supervise unaided all the varied proceedings which on such occasions become necessary. So far it had, by incessant and extraordinary exertions on the part of every member of its permanent and temporary staffs, not only succeeded in the tasks properly arising out of its acknowledged functions, but also in others which did not so arise and which had been silently imposed upon it. But when at this date it appeared to be tacitly assumed that it should supervise the collection, organisation, employment, direction and feeding of a scavenging staff which at the beginning was designed to consist of 1,000 men, and which soon came to number 3,000 men at work at one time, it became necessary to point out not only that this work ought to be intrusted to persons competent in it, but that other subdivisions must be shared out among other public departments which, down to this date (with exception of the Customs, and, as regards the quarantining of individual houses, the Police) had shown little comprehension of the mere physical necessities of the case. From that time forth each took its part. The various branches of the increasing business continued to be smoothly and efficiently worked. The Department was able to turn more attention to its proper occupations, which

from

from the beginning had been sufficient to engross the best energies of every member of the professional staff, weighted as they were with the thousand-and-one interruptions due to popular excitement.

The original supply of prophylactic had been reserved for use in the cases of those persons who had been closely exposed to infection, from their having occupied or frequented the same premises from which cases of plague had been removed; no general public inoculation had, so far, been possible. But on March 12th a fresh supply arrived. Systematic inoculation was begun in the building occupied by the Department. In the morning, ladies and a few other people who came in small numbers, were dealt with upstairs; that part of the general public which lived on, or was employed throughout the day in, the then infected area, was inoculated during the afternoon in the basement. On March 21st, however, the public, without any warning, suddenly arrived in very great numbers, and practically took possession of the building; they invaded the upper part of it, packing the staircases almost beyond possibility of movement, and at imminent risk of a disastrous accident. The building itself was, moreover, unapproachable through the large crowd outside it, which desperately resisted displacement from positions of advantage they had gained near the entrances. The next day, use of the Exhibition Building was granted by the City Council for inoculation purposes. Strenuous efforts were made to restrict public inoculation to those persons who either inhabited the infected area or were obliged to pass the day in it. The medical profession naturally desired that supplies of prophylactic should be placed at its disposal, but, of course, acquiesced in the necessity for restricting its application in the way just mentioned, as soon as it was pointed out; but a portion of the general public were determined to be inoculated at all hazards, though they stood in no known danger of contracting the disease, and very much of this first consignment consequently was wasted. When, at a later date still, a further supply had arrived and the method of inoculation had been organised (Appendix F, p. 71)—being done on this occasion in the basement of the city Town Hall—so entirely had all panic, or even lively interest, in the continued prevalence of the disease died out of the public mind, that between May 11th (Case 215) and June 16th (Case 278) only 2,700 persons presented themselves at the inoculation station, which, consequently, was then closed.

About March 28th it was suggested by the Government that if a new plague hospital were really necessary it should be put up somewhere between the Coast Hospital and Botany North Head, the minimum distance from Sydney thus indicated being 10 miles by road. On March 31st the Board reduced the term of detention of contacts from ten days, at which it had so far stood, to five days; and this was done because it was generally perceived that the former term was unnecessarily long. It was done at this time, however, in order to afford the Quarantine Ground a relief which the accumulation of contacts had made necessary. At the same date the Board once more recommended evacuation of the Coast Hospital; but after deliberation the Government decided that it would be dangerous to remove the patients then in occupation, and, besides, feared it might be necessary to destroy it afterwards if it were used to house plague cases. Not only was the contact camp at Quarantine overcrowded at this date, but the hospital itself was nearly full, being in considerable measure occupied by convalescents. On April 3rd, therefore, a part of the contact-ground and some buildings were transformed as well as possible into a convalescent hospital. This arrangement in turn trenched on the accommodation required for contacts, even after their numbers had been reduced by lessening the term of detention, to an extent which necessitated erection of some fresh buildings; and consequently the Board recommended on April 5th that such new buildings should be at once commenced. This was done. By this time the labour of equipping the hospital, which turned out to be greater even than had been foreseen, had been nearly completed, and as well as circumstances allowed; but only by the hearty and, indeed, self-sacrificing efforts of every member of the staff—medical, nursing, and lay. Quarantine hospitals afford little more than shelter; the buildings in this case happened to be more than usually extensive, but it is not expected—and practically it rarely happens—that more than half-a-dozen persons landed from an infected ship have to be provided for. Its equipment, consequently, and the staff quarters attached to it, little more than suffice to deal with some such small number of persons. There is a vast difference between such an establishment and a hospital which receives a constant stream of patients suffering from an acute fever, and liable

to

to all kinds of serious complications; and which, as a matter of fact, came to house for a long term more than 100 persons at a time. Accommodation for the nursing and serving staffs had to be improvised; they were moreover for months strictly confined to an enclosed area of, perhaps, a couple of acres to a large extent covered with buildings. The only relief which could be afforded the nursing staff was on their journeys to Sydney to attend to the removal of fresh cases, and a rare excursion on the water in one of the launches. It is due entirely to the energy and loyalty not merely of the staffs just mentioned, but of the Superintendent of Quarantine (Mr. James Vincent), and the permanent and temporary staffs under him, that the very great difficulties just adverted to were overcome; and the best evidence of their willing aid is the statement, which can be made without reserve, that whoever else may have suffered, at all events every patient was as comfortably lodged and as carefully tended as could have been the case in the best appointed permanent hospital. The conditions just indicated had been foreseen, and evacuation of the Coast Hospital was recommended in view of them; for by that plan an establishment completely equipped, in going order, and possessing its own ambulance service, would have been rendered available. As it was, the staff of the Coast Hospital had to be very freely drawn upon, in addition to private sources; 18 nurses under Head-nurse Ford were transferred from it to plague duty, whose places had to be hurriedly filled as they best might. Thus the Matron of that Hospital (Miss MacMaster) bore her share in the labours arising out of the epidemic, and succeeded in carrying on the institution very much as usual in spite of the loss of many of the leading members of the staff under her.

On April 17th arrangements were made by which the free distribution of disinfectants to local authorities, which had been going on since March 12th, was supplemented by the free distribution of rat-poison; the Premier also directed that every metropolitan local authority should be empowered to hire at least one man whose duty would be to distribute the poison, to instruct and stimulate householders in its use, to extricate poisoned rats from under floors and other situations in which they had died and become a nuisance, and to destroy the bodies of rats which he himself caught or received. Additionally, a deputation of Members of Parliament urged the Government, on April 11th, to offer a reward for the body of every dead rat delivered to appointed persons; and subsequently a capitation sum of 2d. was so paid. On April 27th, the capitation payment was increased to 6d., and with very satisfactory results as regards the number of rats brought in.

In addition to the measures already described several others were taken, to which but brief reference is necessary. Thus, the powers and duties of local authorities under the Public Health Act, 1896, were explained by the Honourable the Attorney-General, and on March 27th, a circular letter was issued from his Department to all those bodies; and when the deplorable state of some dwelling-houses, and the filthy state of parts of some neighbourhoods, became known in connection with inefficient administration of health laws by some local authorities, he directed that reports upon them should be referred directly to his officers, with a view to taking criminal proceedings against the responsible parties—owners or occupiers as the case might be—in a Court of Quarter Sessions. No such proceedings ever became necessary, but a great amount of cleansing and repairing was speedily effected as soon as they were threatened. So, also, a permanent hospital was erected at Newcastle, on the Stockton Quarantine Reserve, with the probable infection of that port (which is next in importance to Sydney itself) in view.

Local authorities in country districts were requested to secure refusal of a suitable cottage which might be got ready for use in case any person suffering from plague should be imported.

Attempts were made to impart to the public information concerning plague. Dr. Frank Tidswell, M.B. (Syd.), D.P.H. (Camb.), found time to prepare a paper describing the principal epidemiological, clinical, and pathological facts concerning the disease, which was read to a large meeting of the profession at the Royal Society's House on April 27th, and which was reprinted by the Government and suitably distributed. Professor T. P. Anderson Stuart, M.D., LL.D. (Edin.), delivered a popular lecture on plague on April 28th and on May 5th, which was subsequently printed by the Government, and widely distributed; and Dr. Camac Wilkinson, M.D., M.R.C.P. (Lond.), discoursed to the Ladies' Sanitary Association on the same subject on June 5th.

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The policy of indiscriminate removal of both patients and contacts was adhered to till the end of the epidemic; patients were strictly isolated from contacts; contacts after bathing and changing to clean clothes were housed in common—that is, without reference to dates of exposure; inoculation was offered to them on arrival at quarantine, but was rarely accepted, and the term of their detention was five days, except quite at the beginning, when it was ten. Convalescents were discharged as soon as (*a*) they had had a normal temperature for ten days, (*b*) provided they had no unhealed sore, and (*c*) were in general respects fit for discharge. The three clergymen who resided at Quarantine and acted as chaplains (Rev. Father le Mesurier from March 22nd; the Rev. J. F. Moran from April 7th; the Rev. Alan McDougal from April 3rd), the medical staff, the consulting medical officer (Mr. C. P. B. Clubbe), and medical men who desired to study the disease, were allowed to enter and leave the hospital enclosure, the former to return to their quarters on the contact ground, the latter to the city, on condition that they had been inoculated, wore a special suit of clothes during the visit, and bathed before resuming their own clothes. The bodies of persons who had died of plague before removal were coffined by a specially engaged undertaker; the joints of the coffin were rendered watertight; the bodies were wrapped in a sheet wet with sublimate solution 1–1,000, the lid was screwed down, the coffin was then enveloped in a coarse cloth wet with sublimate solution, and delivered at the Quarantine Depôt. It was thence transferred to the Maritime Quarantine Station, and there buried without further precaution in sandy soil, on a steep slope falling to cliffs above the Pacific, and at a part of the grounds far removed from that in common use.

VI.—Origin and Mode of Spread.

All those conditions by which the natural course of the epidemic might have been interfered with or modified having now been mentioned, the epidemiology of the outbreak can be studied.

Five or six localities in different parts of the world are known to be endemic seats of plague; the disease has reappeared in them at short intervals during a long series of years, but it has remained confined to them. From one of these endemic seats, situated in the southern province of China called Yun Nan, plague was carried during 1893 along a caravan route to the town of Liao Tchou in the adjoining province of Kwang Si. From Liao Tchou it was transported by two routes. By one, which followed the Canton River, it reached the city of Canton, and became epidemic there in February, 1894; by the other it was carried to the seaport of Pakhoi, on the gulf of Tonquin. Either from Canton or from Pakhoi it reached Hongkong, where it was officially declared to be epidemic in May, 1894. It has been present at Hongkong ever since; in 1895 only forty-five cases were notified, but in 1896 it again became prevalent. During the latter year it reached India, and was officially declared to be epidemic at Bombay in September; subsequently it spread very widely thence, but Calcutta escaped until the Spring of 1898, or, probably, somewhat earlier. The best opinion is that the disease was carried from Hongkong to Bombay by sea.

Trade between Sydney and the ports of Hongkong and Calcutta has been great for many years past. As regards Hongkong two lines of steam vessels both make monthly voyages thither all the year round; the cargo steamers of some other lines sail between the two ports more or less regularly and frequently according to season; while there are in addition many irregular or casual vessels which arrive from China after touching at many places, including Hongkong. So that Sydney has been in danger of importing plague at all events ever since May, 1894; and the invasion of Calcutta, with which communication is frequent, greatly added to that risk. In Mauritius plague was first officially reported on February 27th, 1899, but cases had been observed as early as the previous December which subsequently came to be looked upon as plague; and this island has a steady though small trade with Sydney, which is carried on both by steam and sailing vessels. Kobe, Japan, became infected some time in December, 1899; Honolulu, H.I., on December 12th; and Noumea, the capital of New Caledonia, was officially declared to be infected on December 24th, 1899, when the news reached Sydney by cable. These are the infected places with

which

which Sydney has the most frequent and regular communication, and from which it was consequently most seriously threatened. Lastly it was announced on January 15th, 1900, that certain cases had occurred at Adelaide, South Australia, which were considered to be plague. The detailed accounts, when they came to hand, hardly pourtrayed plague under its clinical or its epidemiological aspects; they lacked adequate bacteriological data, and they contained statements which were unexpected and strange in connection with plague. The rumour, which from the first had been regarded with doubt, was ultimately discredited; and the matter is mentioned here only in order to direct attention to the effect it had in stimulating that professional alertness and public alarm which had already been aroused by news of the infection of Noumea.

Beyond pointing out the several ports from which plague might have been introduced into Sydney, and the great number of vessels which arrive from those ports during each year, nothing can be said as to the way in which the disease actually was introduced. Since 1894 no vessel has arrived which carried, or (as far as very careful examination and questioning on arrival revealed) which had carried, a case of plague in man. Theoretically the infection might be introduced in goods from infected ports; but the lengthy immunity from attack enjoyed by many cities into which goods drawn from infected centres have been daily poured during several years shows that in practice it is at worst very little likely to happen. All that can be said on this point, consequently, is that the first patient was a carman, who was regularly employed by the Central Wharf Co., who was chiefly occupied in carrying exports from city warehouses to Central Wharf [See Diagrams A, B, and C], and who occasionally visited other wharves to fetch packages in course of transhipment. It was ascertained from his employers' books that during 25 days before his attack (January 19th) he had had business at only one other wharf 10 days before attack, that of the Australasian United S. N. Co., Darling Harbour; but between October 21st, 1899, and January 20th, 1900, four vessels which had touched at Hongkong lay at Central Wharf—one of them from January 9th to January 20th. (For a full account of this case, see Appendix L, p. 77.)

TABLE IX.—Showing the Wharves on Darling Harbour only at which Steamships and Sailing Vessels, which arrived from Plague-infected Ports, lay between October 21st, 1899, and January 20th, 1900. (*See Diagrams.*)

Vessel.	From.	Lying at.....Wharf.	From.	To.
			1899.	1899.
"Prometheus" s.s.	Hongkong	Central Wharf ...	21 October ...	29 October.
"Rockton," s.s. ...	Noumea	Lime-street	28 „ ...	3 November.
"Ching Wo," s.s..	Hongkong	Central Wharf ...	31 „ ...	7 „
"St. Louis," s.s....	Noumea	Smith's	7 November...	11 „
"Kaisow," s.s. ...	Hongkong	Central Wharf ...	18 „ ...	23 „
"Rockton," s.s. ...	Noumea	Lime-street	24 „ ...	29 „
"Moana," s.s. ...	San Francisco and Honolulu	Union Company's, Margaret-street.	25 „ ...	20 December.
"Peru," barque ...	Mauritius	Grafton Wharf ...	27 „ ...	22 „
"St. Antoine," s.s.	Noumea	Smith's and Federal ...	5 December...	23 „
"Umballa," s.s. ...	Calcutta	Lime-street	15 „ ...	21 „
"Rockton," s.s. ...	Noumea	„	21 „ ...	29 „
			1900.	1900.
"Ione," barque ...	Mauritius	Grafton Wharf ...	6 January ...	17 January.
"Kintuck," s.s. ...	Hongkong	Central Wharf ...	9 „ ...	20 „

The case presented a feature, however, which was taken to show that in all probability the infection had been received neither from an earlier case of plague in man, nor from any infected article. The patient suffered from the disease in the bubonic

bubonic form, and the bubo appeared in the lowest gland of the vertical chain in the left thigh. In the external retromalleolar hollow of the same extremity was a circular spot, about 3 mm. in diameter; the cutis was purplish red; the cuticle which had been raised was then adherent to it, and at one point only of its circumference it was ragged. This observation (which I made on the third day of illness) suggested that the infection had been communicated by puncture at this spot, and that the inoculation was most likely to have been effected there—at a part of the foot which was well covered by the boot the patient wore—by an insect, namely, by a flea. The inference drawn was that rats were already dead or dying of plague in Sydney, and this formed the motive of the advertisement requesting information regarding disease among, or emigration of, rats which the Board caused to be inserted in the daily papers as soon as the nature of this case had been established, as well as of the prediction then uttered by the Department—namely, that although no cases would arise by communication from Case 1, yet other cases would probably be met with.

The full justification which this view subsequently received, supports an opinion that the disease was not introduced either by some unobserved imported case in man, or by importation of infected articles, but by infected rats; from which it spread to the local rats which, in turn, communicated it first to Case 1, and, as will subsequently appear, to other persons afterwards. But by what vessel, or from which infected port, such rats were landed at Sydney, there is no evidence. It may be pointed out, however, that communication with the remoter infected places had been extensive, and steadily maintained for long previously without introduction of the infection; and that the latter gained a footing only after the disease had appeared at Noumea, a port which lay close at hand. No official account of the epidemic in New Caledonia has yet been published; the following remarks must therefore be regarded as conjectural to some extent. The first case in man must have happened in New Caledonia some time before the presence of plague was acknowledged on December 24th; and it may have happened considerably before that date. But appearance of the disease among rats, not among the inhabitants, has most interest in relation to risk of importing the infection. Now, it was reported that the rats at Noumea suffered heavily during the epidemic; but the important question whether the epizoötic preceded the epidemic, cannot at present be positively answered, no authoritative information on this point having become available. A frequent experience, however, is that the rats suffer first, and usually several weeks before appearance of the first case in man. If this happened at Noumea there was nothing to prevent importation thence at any time prior to December 24th, for no special precautions were or could be taken at Sydney until after that date, when the disease was first officially admitted to be present there in man.

No information concerning mortality among rats was furnished in response to the advertisement mentioned above nor to other inquiries until February 14th, when an officer in the Customs Department drew attention through the Collector to unusually frequent deaths among them at Huddart, Parker, & Co.'s Wharf, on the eastern side of Darling Harbour (see Diagrams). The wharf being within the city, the President caused the local authority to be informed and advised, and in the course of the afternoon four live rats and three carcases were brought to the laboratories by the Chief Inspector of Nuisances for the city, who said it had taken him two hours to find them. At a later date an inspector of fruit in the Department of Mines and Agriculture reported that he had noticed an unusual mortality among the rats at Huddart, Parker, & Co.'s Wharf about the first week in January. Nothing further on this head has been discovered; and it is important to note that no suggestion that rats were suffering from an epizoötic at any other part of Sydney about or before the dates referred to has ever been made. The beginning of an epizoötic among rats occurred at wharves on the eastern side of Darling Harbour, and it first became manifest at Huddart, Parker, & Co.'s Wharf.

The seven rats above mentioned were at once utilised for the usual bacteriological and inoculation tests, and were shown conclusively to have been suffering from plague. At the same time, glands which had been removed from the body of a man who had died the previous day were brought to the laboratories, and on examination showed with sufficient certainty under the known circumstances that the cause of death had been plague. The beginnings of an epidemic are so important

that

that an account of Case 2, as well as of a few others of the earlier cases, is necessary. The patient had been attacked about February 17th. In the course of his brief illness he had been attended by three medical men, of whom two were called in consultation, not because of the apparent gravity of his case, but for reasons which can be inferred from what follows. A clear history of injury to the lower abdomen received three or four days before attack, and caused by a fall against a plank, was given. The disease was recognised as having the form of septic fever; but no peritonitis or other occasional consequence of such an injury could be made out and, in fact, there was none. The illness was well marked, though as it seemed, not immediately dangerous to life. Death occurred unexpectedly. It was then that plague was judiciously suspected, and that inguinal glands which had become enlarged and painful in the neighbourhood of the seat of injury were removed, and brought to the laboratories for examination at about 3·30 p.m. This patient, who died at his house in a suburb, was a sailmaker. His business is said to have been exclusively among locally-owned craft, and all connection with vessels coming foreign was denied for him by his survivors. He occupied a sail-loft on the water side of Sussex-street, not above 200 yards south of Huddart, Parker, & Co.'s Wharf, where he employed about forty workpeople, men and women. He had also a large household, part of which, at all events, had for some time lived at the workshop with him. As soon as the examination of the glands had been carried sufficiently far, the workshop was placed in quarantine at about 4·45 in the afternoon and, of course, without warning. On being questioned at that time as to the presence of rats there, the inmates said that deceased had removed five dead rats from a water-closet on the same floor two or three days before his attack. This closet was connected in a primitive fashion with a short pipe-drain which discharged under a wharf at the back of the house. No illness occurred either among the members of the family who had been as much associated with these premises as the deceased, nor among the many workpeople who were regularly employed there. No illness occurred, either, among the frequenters of the three premises above which the sail-loft ran, two of which were occupied by a produce salesman, and the other as a merchant's office; however, they were entirely cut off from the sail-loft, which had a separate entrance from the street.

Case 3 was notified by the medical man in attendance the next day (February 24th.) The patient lived on the western side of Darling Harbour, at Pyrmont, but he was a wharf labourer employed at Huddart, Parker, & Co.'s wharf. There was no history of dead rats at his dwelling, nor anywhere in the neighbourhood of it. This patient had a household of six persons, among whom no illness occurred.

Case 4 was notified on February 28th. The patient was a labourer in employment of a produce dealer who lived at the Glebe. He had not been anywhere near Darling Harbour for at least a fortnight before attack; but the supplies for the shop at which he worked all day were in large measure drawn either from Huddart, Parker, & Co.'s wharf, or from another close to it, at the back of the house occupied by Case 2, where the bales of hay, sacks of potatoes, &c., &c., often lay for several days before being delivered. In this case the disease could not be attributed to rats seen; and it may be suggested that the infection was conveyed adherent to some of the articles mentioned. The patient himself was too ill when first visited to speak as to presence or absence of rats, dead or alive, from the bales and sacks which he unpacked. No illness occurred either among his employer's family, or at the house (in a street a mile away) where he lived, and whence ten persons were transferred to observation.

Case 5, notified on March 2nd, occurred in a publican whose house was immediately opposite Huddart, Parker, & Co.'s wharf, and was overrun with rats. No case occurred among the other sixteen members of the household, who were removed to observation.

Case 6 occurred in a boy aged 8, who lived with his uncle and aunt and two other children in a house in Kippax-street, Belmore Park, and was notified on March 7th. No other case occurred in this street until eight weeks later (Case 180); it then seemed probable that the neighbourhood had become infected by extension from the focus to be mentioned in connection with the next case, though at the time of notification Case 6 could not be in any way connected with a probable source of infection. The house was not used for any business. The patient's uncle

(who

(who was not attacked) was employed by a butcher whose shop lay not very far away, but in a neighbourhood which yielded no indigenous cases until long afterwards. It seemed that the child himself did not go far from home except to school. There had been rats on the premises, but they had been killed off about four months before by dogs obtained for the purpose, and there was no history of dead rats having been seen.

Case 7, which is the last which need be here mentioned in detail, occurred on March 8th, in a boy about 2 years old. His parents lived in a cottage which is indicated on the three diagrams by a cluster of five dots which represent the five cases which occurred in this family. The cottage stood in the neighbourhood of the City Corporation tip at Moore Park, a place where all the garbage and street-sweepings of the city are still dumped. To this spot refuse from the neighbourhood of the infected as well as other wharves was carried for some time after the fact of infection became known. There is no difficulty in showing clearly enough that the part of Sydney in this neighbourhood became subsequently a focus of infection which yielded many indigenous cases, of which the present was the first. The circumstances attending this case were the following:—The family consisted of the parents and six children. The cottage had had a good many rats about it; and in an outhouse in which the younger children used to play, one or two dead rats were discovered when, after attack of Case 7, it was cleaned out by the father. On these premises, also, the disinfecting staff found quite an extraordinary number of fleas; the bodies of the younger children were almost literally covered with their punctures. The only persons attacked were four young children who habitually played in the outhouse, and the father who cleaned it; they had none of them visited the garbage tip. All but the youngest child recovered.

The progress of the epidemic in point of time has already been described in Section II; its progress in place may be gathered from the diagrams lettered A, B, and C, which are appended. These diagrams have been constructed as follows:—In all three each case noted is represented by a dot; the dots are printed in four colours, each of which is appropriated to a period of time; thus black indicates the cases which occurred between January 20th and March 24th (Case 32); green, those which occurred between March 25th and April 21st (Case 129); red, those which occurred between April 22nd and May 19th (Case 239); and blue, those which occurred between May 20th and August 9th (Case 303), the end of the epidemic. On Diagram A the spots are so placed as to indicate the houses from which patients *were removed*, or, if they were actually removed from a general hospital, those they had occupied before admission to such hospital. On Diagram B they indicate the places at which the patients *were employed* during the time which covered the date of their infection; a working limit to latency—probably correct also—of five days being assumed, although of course the duration of employment at the place before attack had usually been lengthy. On Diagram C they indicate the probable *place of infection*, which was sometimes the residence, and sometimes the place of employment. The manner in which this place was fixed upon requires describing.

If Diagram A be examined, and if for the sake of clearness attention be confined to the black dots on it, which represent the places from which those cases which occurred between January 20th and March 24th were removed, it will be seen at once that the components of the series were not related by neighbourhood; for although one household afforded five cases, and although at another point six separate households appear close together, speaking generally the black spots are distant, and in several instances very distant, from each other. Secondly, it was ascertained that the members of these infected households were in all cases unacquainted with each other. Thirdly, the patients themselves were unacquainted with each other, except in certain instances in which they were associated at their place of employment or at home (Case 7). Hence it appeared that neither locality of habitation, nor personal communication, was the essential factor in infection. But the observed association of certain cases at their place of employment made it necessary to rearrange the diagram so as to show place of employment instead of the place of residence (see Diagram B); and this having been done, it appeared at once that the black spots were drawn much closer together, and were largely concentrated about Huddart, Parker & Co.'s wharf, and the eastern shore of Darling Harbour, although several of them still remained outlying.

It must be remembered that the time represented by the colour black was considerable (thirty days exclusive of Case 1) and that elucidation of the place of infection lay in reality with the circumstances surrounding the earlier cases of this period; and then, secondly, that the nature of our possible source of local infection had been established at an early date. It did not consist in an infection of the soil; no other reason in support of that supposition could be given than an assumed automatic commencement of specific infectivity of it, which, of course, is absurd. On the other hand it was already known to be present in the rats of the locality. Now rats are not confined in place, but can wander, and in accordance with their known habits were sure to occupy a wider area, or to migrate to different areas as time went on; and hence the black spots on Diagram B are concentrated about the original focus of infection only as regards the earlier numbers of the series, and even then with exception of Cases 4, 6, and 7. In fact, towards the end of the series indigenous cases began to appear at points rather far removed from the original focus (Case 20 at Rowe-street, City, 22 at Windmill-street, City, 23 at Walker-street, on the Redfern focus); and then, as time went on, cases began to be met with in which, although in some instances the patient was employed in or close to the original focus of infection, his case could not reasonably be referred to his place of employment on account of cessation of the neighbourhood it indicated to furnish a succession of fresh cases—because, in short, that focus had ceased to be dangerous. Also, other cases in persons who never had been near the original focus, and who had not been away from their place of residence, began to be met with in appreciable proportion (women and children especially), and with the neighbourhoods in which these occurred some of the cases just before referred to were associated. It became apparent, after careful study of all the circumstances, that fresh foci of infection had become established, and that it was no longer possible (as at first it had been) to assert *a priori* that wherever a patient might be found it would probably be ascertained on inquiry that he was in some way associated with the eastern side of Darling Harbour. The dissociation of these later cases both in place of residence and in personal communication continued to be as conspicuous as at first; if they lived in the same neighbourhood still their houses were more or less distant from each other, and although they might all possibly have encountered each other in the streets, by far the most often they were unacquainted. Consequently these neighbourhoods gradually became distinguishable, and entitled to be designated fresh foci; and as soon as this conclusion presented itself the same relation between them and the presence of diseased rats in them was observed, as had been first observed at the original focus. In many cases the evidence consisted merely in the reported observation of an unusual number of rats, and of dead rats, or of the death of rats in unusual places—under floors, in cupboards, or outhouses, &c.; but in some cases, elsewhere mentioned more particularly, it consisted in actual detection of plague in sick or dead rats, or (in one case) in a cat. Thus Diagram C, which represents the probable place of infection, was constructed from the whole of the facts concerning each case, after they had been weighed. It is in reality, therefore, an expression of opinion—very carefully formed, it is true, but not to be taken in all respects as a representation of ascertained fact; and that is the reason why Diagrams A and B (which state ascertained facts only) are presented along with Diagram C.

On Diagram C the black dots are shown almost entirely gathered together on the eastern side of Darling Harbour, and at the northern end of that shore. Cases 4 and 7 still occupy the positions originally assigned them—in other words have still to be regarded as indigenous to those places, or, at least, as having no personal connection with the original focus; and now Case 23 appears at Walker-street, Redfern, due west of the five dots indicating Case 7. It is the first in immediate relation to Case 7, and the garbage tip at Moore Park, and is seen to have belonged to a considerable collection of cases which occurred thereabouts at later dates. And thus, perhaps, a hint of a possible source of the infection received by Case 6 (Diagram A) is indicated; far as he lived from any area known at the date of his attack to be infected, he attended Bullanaming-street School, and to reach it crossed the area on which Case 23 occurred. To later extension from that area are also ascribed the cases to the north which are marked about the words "Surry Hills," east from Redfern terminus. These patients had no concern with Darling Harbour, nor even with any neighbouring part of the City.

To

To further illustrate the course taken by the infection in spreading to various neighbourhoods, it can be pointed out in relation to the black spot which indicates Case 4 that a green and two blue spots appear near it on Diagram C; not in very close contiguity to it, considering that the locality is closely covered with streets and houses, but still near it. These two colours respectively indicate the period which followed on that indicated by black, and the last period of all. A similar sequence of events might be described in relation to two or three other congeries of spots of different colours which appear on Diagram C. It might be suggested, therefore, that wherever one case of plague occurs there, or thereabouts, other cases may be expected. But the black spot attached to Case 4 indicates the place where the patient was employed; he did not lie ill there, and being attacked suddenly at midnight at his own house a mile away, which he did not leave thereafter except for isolation, he was not even on the premises while suffering, and therefore he could not have been the source of infection for the cases indicated by the green and blue spots, however indirectly. And, in fact, those cases belong to an extension of the infected area at the head of Darling Harbour.

From the head of Darling Harbour the infection spread to the neighbourhood of Redfern terminus, and thence in a south-westerly direction; a rat brought from the house indicated by a green dot towards the western end of Cleveland street and just above the words "Vine-street," as early as March 26th (Case 35) was ascertained to have died of plague. It did not cross the terminus, nor the railway lines to the south, nor the open spaces to the north of it. It proceeded from the terminus along George-street West, to be revealed in part by the cases referred to above as standing near the place at which Case 4 was employed; but it is possible, although, considering the lie of the country not so likely, that it reached this latter neighbourhood on a south-westerly course from the head of Darling Harbour; whence also at a much later date the indigenous cases shown on the promontory marked Pyrmont in all probability derived their infection. The green spots show that the above extensions occurred at all events before April 21st (Case 129).

Reverting now to the original focus, no less than 115 cases, or 38 per cent. of the total number are ascribed on diagram C to the area enclosed by Liverpool-street (running east from near the head of Darling Harbour), Elizabeth-street which intersects it, and a line drawn at right angles to a line produced from the northern end of that street in a northerly direction, so as to run westerly through the words "Bridge-street" and "Charlotte Place" to Darling Harbour again. Black spots (first period) are there seen only near the water; green spots (second period) are in a majority, and are present at the water's edge, but they also appear to the east of the black spot area; there are only two red spots (third period) close to the water, and to the east they far outnumber the green spots; there are but few blue spots (fourth and concluding period), and they chiefly appear at points far removed from any part of this area. As these four colours represent four divisions of the time over which the whole outbreak lasted, they indicate the direction in which the infection extended on this the most heavily stricken area of all, and indicate it very accurately. It appeared at the water's edge; it travelled easterly thence up the ridge which runs north and south parallel with Darling Harbour, and which culminates on the line of York-street; down the other side of this ridge to George-street; and up the ridge on the eastern side of George-street, as far as Elizabeth-street. There it was abruptly stayed; on the easterly side of Elizabeth-street, beginning at the intersection of Liverpool-street, are the uninhabited spaces marked on the diagrams. They are parks, or spaces on the margin of the parks occupied only with public buildings, and they stretch quite to the water at Bennelong Point, the northerly point of their westerly boundary being indicated by the line of Macquarie-street.

At a later date the infection did travel east of Elizabeth-street; perhaps closely round the southern end of the continuous open spaces just mentioned, but more probably from about Campbell and Hay streets (north of Redfern terminus). There was a distinct sub-centre of infection at that neighbourhood, to the south of Oxford-street, through which "Napier-street" runs; the building at the corner of Oxford and Dowling streets, marked by a red dot, being a brewery.

A quite separate focus which requires description became established at Manly. This place is a village situated on a neck of land at the northern end of the harbour, so that it has frontages both to the harbour and to the Pacific (see diagram A);

A); it contains about 3,000 inhabitants, many of whom travel daily to Sydney, and it is a favourite holiday resort which is visited by several thousand persons from Sydney every Saturday afternoon and Sunday. It can be reached by crossing from Circular Quay to Milson's Point, and following a road for thirteen miles, in the course of which the water must be crossed once more. This route is little used as a means of reaching Manly, although—a point of some importance—it is taken occasionally by waggons carrying heavy goods such, for instance, as furniture. The usual route is by ferry from Circular Quay; the distance being then seven miles, and the time occupied about half-an-hour. These ferry-boats convey considerable quantities of stores, including butcher's meat, every day. They lie at the wharves at either end between journeys and at night. From a misunderstanding, it happened that fumigation of these vessels to destroy rats on them, was not begun at the same time as on the ferries which plied from wharves on Darling Harbour.

The ferry runs to a single pier at Manly, on which are the usual shelter-sheds, and at the end nearest the shore a refreshment-room. The lessee had been allowed to convert a part of the structure into a dwelling, for which it was quite unsuited.

On May 1st, the case (163) of a man who kept a tobacconist's shop about 150 yards from the pier was notified. He had visited two warehouses in the immediate neighbourhood of the original focus five days before attack. This shop was subsequently demolished, and then many dead rats were found under the floor. On May 2nd the case (175) of a rouseabout at a public-house about six doors from the foregoing shop was notified. He slept in a shed at the rear of the hotel, getting his meals in return for his casual services, and hung about the pier when he was not wanted at the hotel. This person had not been away from Manly for many days before. On April 28th he removed several dead rats from the cellar of the hotel, on which premises no poison had been laid. On May 11th the case (213) of a vanman who lived in a street within a short distance of the pier, and who plied almost entirely at it, was notified; and the next day that of a girl (217) who was employed at the refreshment-room on the pier. This place was lined with matched-boarding and had a false floor; from this cover about thirty dead rats were removed during disinfection. On the 20th a boy who was practically unemployed, and who was always to be found at the pier if he were wanted to carry a message, was attacked with and died of plague (242). On May 29th the first of two cases in children (253), which occurred at livery stables just across the road from the pier, was notified; the house was emptied and disinfected May 30th, the family returned June 5th, and on June 25th the second case (288) occurred, the first being still in hospital; and between these two, on June 5th, the case of an ostler at another public-house opposite the pier was reported (257). The infected area was closed for general cleansing; and on July 12th, while this was still in progress, the case (298) of a man employed on the scavenging staff was notified. His place of residence was at Manly, but a mile and a quarter away from the neighbourhood of the pier.

Association of most of these cases with the pier is evident; but the first patient (163) had no other communication with it than consisted in frequently walking across it to the ferry-boat; while 175, 253 and 288, and 257 did not frequent it, although in the case of the two children it is likely they were often there. But 298 certainly had no particular communication with it, and, in fact, was infected only long after all the others (seventeen days), and only in the course of scavenging the area on which other cases had resided and (possibly, though not probably, with exception of 163) had been infected. Apparently, then, the infection, although communicated to persons who either frequented the pier or visited it casually more or less often, was not confined to it. On the other hand, it extended only to a short distance from it, and was markedly associated with presence of dead rats. Some of them, however, may have died of poison.

As soon as the first case was notified rats were sought at the pier and in its neighbourhood; nineteen were delivered at the laboratories, and all of them showed signs of disease. In eighteen of them, however, this could not be identified with plague (the bodies were very often more or less putrid), the signs consisting mainly in enlargement of the liver and spleen, and it seemed possible that these changes might have been the effect of poison (phosphorus for the most part), which had several weeks before been supplied to the local authority. Nevertheless, experience having

having already shown that where plague occurred in man there plague in rats existed and could usually be discovered, the tedious bacteriological search was continued until in the nineteenth rat (and in two others afterwards) plague was demonstrated.

This localised outbreak has many attractive features. Although in constant and unusually free communication with Sydney, the place escaped infection until the eleventh week of the epidemic. The occurrence of cases, and therefore the distribution of the infection, was limited to a very small area; an extremely small proportion of the persons living on and passing through that area was attacked, so that it seems that in addition to presence of infection some accidental, and not commonly existing condition was necessary to enable its communication to man. The pier seemed to be the gate by which the infection entered the place, and the special connection of several of the patients with it indicated that it was perhaps the centre of infection, or the most dangerous point of the small area. Lastly, so long as seventeen days after the last case occurred, and the area had therefore begun to be regarded as clean, it was discovered on sufficient search, namely in the course of scavenging operations, that infection still lurked in it. The discovery of plague-rats, and of a large number of dead rats at the pier refreshment-room and elsewhere, showed that plague infection was present on the area in rats, if nowhere else; and consideration of the points summarised above, together with the evidence which is later given that the disease was not communicated directly or (with a single exception) mediately from man, shows that a hypothesis on which the infection is assumed to have been introduced, and to have been spread, by rats comports so well with them that no other source of infection for man need be conjectured.

North Sydney is considered never to have become infected, although six households, shown only on Diagram A yielded cases. These, from which there was no extension of the disease were ascribed, with one exception, to infection received on the chief area in Sydney, where the patients were employed. The exception was the case of a baker's man, whose movements outside North Sydney could not be ascertained, and the source of whose infection was left undetermined.

The apparent spread of infection in Sydney itself need hardly be further traced. It will be seen from Diagram C that indigenous cases are set down far along the course of Oxford-street, the important thoroughfare which runs easterly from the city; along Parramatta-road, the main thoroughfare which runs westerly from the city; and along Botany-road, the main, but much less frequented, thoroughfare which runs southerly from the city. At some of these more distant places plague rats were identified or, as in one case, a plague-stricken cat (see diagram B); while at others there was often a history of dead rats, verified in 70 cases by the disinfecting staff. But it must be noted here that a spot map does not show details; and some of these distant cases are set down as indigenous with hesitation, in as far as the epithet implies—as, in its present use, it is intended to imply—local presence of the infection in rats, and therefore in an automatically transportable form. In a few of them it was clearly possible, as far as ordinary surrounding circumstances went, that the infection might have been introduced together with goods derived from the central infected area; but whether such goods carried deposited infection, or whether they merely harboured infected rats, dead or alive, is a question for the present reserved.

The general outcome of the foregoing examination of the manner in which the 303 cases of plague were situated and successively occurred on the whole area, is to suggest that the infection was in some way or other connected with place. Frequent references have been made to the ascertained presence of dead and of plague rats in this or that neighbourhood; but this has been almost unavoidable, and has not been intended to prejudice the case for other modes of infection, which are known to have operated elsewhere, and one of which, at all events, was seen in operation (in a single instance, Case 262, p. 37) at the Maritime Quarantine Station. And therefore the mode in which the disease actually did spread will now be examined from other points of view.

If the three diagrams be examined in general, it will be apparent on a little reflection that the conditions represented could be produced only by three causes, apart from infection of locality: These are infected water, infected food, and infected persons.

The

The two former can be certainly excluded without difficulty. The bacillus of plague can survive in water for short terms, which vary with the kind of water used (sterilised, distilled, main, or sea water); this knowledge, however, has been gained experimentally (except one observation on sea water), and it has not yet been noted whether plague can be communicated to animals from water carrying plague-bacilli. What is more to the purpose is that while the epidemic spread of plague by town water supplies has never been suggested, the accounts returned from several different parts of the world do not furnish the least ground for suspecting that it may have happened. As regards Sydney, it is enough to point out (*a*) that a very much larger area than that included in Diagram A is supplied from one primary source; (*b*) that while the water from this single source is pumped to, and distributed from, subsidiary reservoirs, more than one such reservoir must have been contaminated to account for the observed distribution of cases; and (*c*) that Manly has its own source of supply, entirely distinct from the former. Secondly, as regards distribution of the infection by food in any form, it is now generally admitted that the disease is rarely communicated to man by feeding; there is no reason for suspecting that this mode can have been a factor in any epidemic prevalence of the disease hitherto observed.

Remains, then, only habitual communication from person to person as a possible cause of the Sydney epidemic. This might be brought about directly or by mediate channels: the infection might pass directly from the sick to the well; or it might be communicated from the sick person to some place or object, whence the second patient could receive the disease without having seen, or even become aware of the existence of, the primary case. These are ways in which epidemics are known to be sometimes caused (of small-pox or scarlet fever, for instance). Whether they had any important share in contributing to cause the Sydney outbreak of plague is the question now to be examined. But, first, the difference there is between the possible communication of disease by one or other means realised only from time to time and rarely, and such a usual communication of it as alone can cause epidemic prevalences, must be referred to. All preventible disease should be prevented; and, therefore, if special dangers exist they should be guarded against by precautions specially taken against them. The first object, however, is to prevent epidemic prevalences; afterwards, the occasional causes of exceptional occurrences of the disease can be considered and steps taken to prevent even them.

In the first place, it may be inquired whether the facts furnish any reason for suspecting that infection mediately communicated from man was the cause, or an important contributory cause, of the epidemic.

How could such mediate infection operate effectively? Only by habitual diffusion of household goods. Only in this way could articles which had been in contact with, and which had received the infection from, the sick, be brought sufficiently often into contact with healthy persons; and such contact to have been a factor in the epidemic must have taken effect on persons outside the house occupied by the primary patient. Firstly, then, the infected households were much the most often those of respectable working-people who carried on no business at home, but who left home every day for some place of employment. These are not the people whose household belongings are commonly liable to wide diffusion; but if they were, the suddenness with which this disease usually attacks must be remembered, and that it would be singular if the first few days of an illness which was almost always alarming from the first, were chosen for such diffusion. Secondly, although in order to cause an epidemic spread of disease such communication must be between the primary household and others, yet, if it could take effect on the latter, much more should it take effect within the primary household itself; but it will be seen directly that only 10 altogether out of 276 households yielded secondary cases, and those occurred under circumstances so different that they cannot be classed together. If, then, mediate infection played so small a part (if any) within households, it could not have played a larger part outside them. One other possibility remains open, namely, unconscious diffusion of the infection by means of articles of commerce handled by the sick. Here, again, the suddenness of attack must be referred to. Persons did not, and, for the most part, could not, remain at work a moment after onset of the disease, and until then they were

were incapable of communicating the infection. However, in the following table the occupations of the 303 patients are classified and presented :—

TABLE X.—Occupations of persons attacked.

Occupation.	Male.	Female.	Total.	
Food Trades :—				
Hotels and Public Houses	7	6	13	
Butchers	3	1	4	
Fishmongers	2	...	2	
Fruiterers	4	...	4	
Restaurants, Cooks, Waiters, &c.	6	3	9	
Bakers	2	...	2	
Provision Stores	14	...	14	
Produce Stores	14	2	16	
				64
Other Trades :—				
Carters and Horse Tenders	12	...	12	
Bootmakers	3	...	3	
Carpenters	6	...	6	
Ironworkers	5	...	5	
Painters and Plumbers	6	...	6	
Printers and Bookbinders	19	...	19	
Tailors, Drapers, and Shop Assistants ..	6	3	9	
Warehouses	16	...	16	
				76
Labouring Work :—				
Timber Yards	6	...	6	
Labourers (Miscellaneous)	19	...	19	
Wharf Labourers	11	...	11	
				36
House Work :—				
Domestic Duties (including servants and children at home)	26	45	71	
				71
Miscellaneous Occupations	32	2	34	
No Occupation	10	2	12	
Chinese	10	...	10	
				56
Total	.....	.....		303

Mediate infection as a cause of the epidemic may be excluded then, and without hesitation; the question of possible spread from man to man by intermediate animate objects being for the present reserved. The possibility that direct communication of the infection from the sick to the healthy was the cause of the epidemic spread of the disease now alone remains; it must be examined with care.

Two sets of facts furnish the requisite evidence. In the first place, those which concern the total cases will show whether the persons who did contract the disease got it from preceding cases; and secondly, the fate of those who were in contact (usually household contact) with the sick will show in what degree (if any) it was communicated to them.

The first statement is as follows:—There were 303 cases altogether; but thirteen were secondary cases which occurred in ten households; so 290 households yielded 303 cases. Four of the 303, however, occurred in members of scavenging gangs while

while they were at work on the area to be scavenged; these, though actually in contact with large numbers of people, cannot be reckoned as belonging to households. Four cases and four households must be deducted, therefore; and the statement then is, that 286 households yielded 299 cases (it is true, also, that several of the 299 had no fixed place of abode – but they had usually been in known contact subsequent to attack with more or fewer persons among whom no illness occurred, so that it is not worth while to complicate this statement by excepting them). But a further deduction must be made of ten Chinese who occupied ten different dwellings, because too little (and that untrustworthy) could be learned concerning them. So the nett statement, which applies to whites only, is that it took 276 households to furnish 289 cases. This by itself is sufficient to show that direct communication of the infection from the sick to the well could have occurred but rarely, and even exceptionally.

Among the cases just mentioned were some persons who, after receiving the infection at Sydney, travelled to more or less remote towns and there fell ill, from none of whom was there any extension of the disease. Particulars of these cases are given in the table below :—

TABLE XI.—Showing the number of persons who left Sydney and were attacked at distant places within five days thereafter.

No. of Case.	Residence in Sydney.	Left Sydney.	Arrived at.	On.	Distance from Sydney.	Was attacked.	No. of Contacts.
115	Balmain	April 13	Goulburn ...	April 13	134 m.	April 14	9
127	Balmain	„ 18	Menangle ...	„ 19	41 „	„ 20	1
154	Paddington	„ 23	Glenfield ...	„ 23	26 „	„ 25	5
166	Surry Hills	„ 28	Ballina	„ 30	331 „	„ 27	56
264	Pitt-street, City	May 30	Mittagong ...	May 30	77 „	May 26	4
...	Fireman, s.s. "South Australian"...	April 3	Melbourne*	April 7	576 „	April 5	...
...	Fireman, s.s. "Gera"	May 5	Adelaide* ...	May 10	1,074 „	May 10	...

* Reported from these ports, where the vessels were held in Quarantine.

But it will already have been perceived that several other cases, which are precisely similar to those in Table XI, except in the comparative shortness of the distance to which they travelled from the centre, occurred within the metropolitan district (see Diagram A).

These particulars, which have been cited as evidence that the disease never within our experience was set going by the arrival at uninfected places of persons who fell ill shortly after, introduce the second set of witnesses which consists of those who lived for a time in contact with others who had the disease. Attention is here drawn to the statement already made that although inoculation was offered to contacts it was seldom accepted by them; to which it may now be added, that the total persons among the contacts (total 1,832) who were inoculated, either before being sent to isolation or on arrival there, was so small (180) that they may be left out of account in this connection. Further, it has already appeared from Table VII, that isolation followed very speedily on notification, and it may now be asked whether the contacts had remained in communication with the primary patient sufficiently long to contract the disease from him, if so it might be contracted. But the duration of exposure to the infection was the interval which elapsed not between notification

notification and removal, but between attack and notification; and what this was is shown for each of the 289 cases in the following table:—

TABLE XII.—Showing the day of illness on which 289 patients and households were removed to isolation. Also the number of secondary cases which occurred after isolation in four households.

Day of Illness.	No. of Cases.	No. of Contacts.	No. of Cases among Contacts attacked in Isolation.
1st day	10	156	.....
2nd „	35	170	.....
3rd „	77	458	1
4th „	53	320	5
5th „	31	240	.....
6th „	27	142	.....
7th „	14	66	.....
8th „	13	91	.....
9th „	7	40	1
10th „	5	24	.....
11th „	2	13	.....
12th „	1	2	.....
13th „	1	1	.....
14th „	1	5	.....
17th „	1	2	.....
20th „	1	1	.....
22nd „	1	.....	.....
46th „	1	.....	.....
Uncertain date	1	21	.....
	282	1,752	7

This table may be read in the following way:—458 persons were exposed to risk of infection from 77 cases during the first two to three days of illness, and one was attacked after separation from them and from the houses at which they lay ill; or, 240 persons were exposed to 31 patients during the first five to six days of illness, and none of them fell ill, &c., &c.

Plague as seen at Sydney during the outbreak under notice was not "catching."

Under certain circumstances, however, plague can be communicated from the sick to the healthy; and although Table XII shows only 7 secondary cases (because seven only occurred after separation from the primary patient and from the infected premises), the fact is that 10 households altogether yielded 13 secondary cases. The circumstances under which plague is known to be communicable from the sick consist either in the form assumed by the disease, or in inoculation of diseased products of the sick body. Thus, primary plague pneumonia is very easily communicated to others (but compare the statement contained in Dr. Lorans' report on the epidemic in Mauritius, p. 17), while several of the secretions, excretions, and tissues of the diseased body carry the bacillus which is the cause of the disease. Inoculation of these products can be effected in two ways: a wound may have been made first, and the diseased matter may have been subsequently brought into contact with it; or the wound may have been made with an instrument already carrying infectious matter. This latter mode is scarcely likely to be witnessed except in the case of post-mortem examinations of the bodies of persons who have died of plague; but probably it does happen, and much more frequently than is generally supposed, when a suctorial insect first punctures the skin of a person suffering from plague, and soon afterwards punctures the skin of a healthy person. But this way can be effectual only when the blood of the plague-patient carries bacilli into the circulatory vessels of the skin; and this it does only when the patient has either suffered from the septicæmic (or blood-poisoning) form of the disease from the beginning, or else is about to die and is within 24 hours of death. The septicæmic form is seen in a minority of cases in man (in 17 out of 303 at Sydney); on the other hand, it is the commonest form of the disease in rats. It is therefore necessary to ascertain if possible, exactly how the secondary cases in the 10 households acquired their disease, before concluding that they did not get it from the primary patient.

Nine of these households yielded two cases each, one of them yielded five cases. But the secondary cases occurred under very different circumstances, according to which the 10 households will be divided into three classes: (*a*) four in which the secondary cases occurred after separation from the primary patient and the house in which he had lain ill; (*b*) three in which the secondary cases occurred before removal to isolation; and (*c*) three in which the secondary cases occurred after return of the family to the house after the latter had been cleansed and disinfected, and before release of the primary patient in two of them. The following are the requisite and available details concerning the first group:—

Case 7, m. *æt.* 2; attacked March 8th; transferred to Sydney Hospital the same day; died early on the 10th. The family of two adults and five children was removed to isolation on the 10th. On March 11th, f., *æt.* 9, and m., *æt.* 5, were attacked; on the 13th, m., *æt.* 7, and during the night of the 13th to 14th, m., *æt.* 45; form, bubonic in all. All were indigenous.

Case 15, m., *æt.* 20; attacked March 11th; notified and removed to isolation, together with 18 on the 13th. Case 18, m., *æt.* 18, was attacked March 14th. These patients were brothers who lived together; they also worked at the same warehouse; form, bubonic in both.

Case 159, f., *æt.* 24; attacked April 23rd; died May 1st before removal. Case 177, f., *æt.* 4; attacked April 29th; form, bubonic in both. The house stood on the area indicated by a cluster of dots west of the five dots representing Case 7, and the cases were indigenous to it.

Case 161, m., *æt.* 15, was attacked April 28th; removed to isolation, together with 170, May 1st. Case 170, f., *æt.* 11, was attacked May 2nd; form, both bubonic. These two patients were brother and sister; they lived on the area last-mentioned above, and the cases were indigenous to it.

Case 7 could not have infected the other four, because the patient was taken to a public hospital as soon as he was attacked and left there; and notwithstanding the plague of fleas in the cottage (see p. 25), the latter could not have derived from him any infection they may have carried, because his case was bubonic, and because he was not near death at the time he was removed from their reach. Case 15 had all those opportunities of infecting 18, which their relationship and occupation of the same dwelling imply, and the interval between the attacks was just sufficiently long for communication to have taken place, but 15 was a bubonic case, and he recovered; on the other hand, both of these patients had been occupied immediately before and down to the attack of 15 in collecting dead rats, and in destroying live ones at the warehouse at which both were employed, and which had suddenly become overrun. 177 having been closely exposed to 159 during six days of the latter's illness, and having been attacked only a little more than 24 hours before 159's death, it is possible, and even likely, that the infection was communicated from 159 to 177. 161 had opportunity of infecting 170, and in this instance no source of infection was actually discovered; but the house they occupied stood on the Redfern secondary focus, and in accordance with the views already expressed hardly requires special explanation. While the details, then, do not positively exclude communication of the infection from the primary to the secondary cases, they do not conclusively point to it either; the first two instances, indeed, strongly indicate that the infection was received from a source common to primary and secondary cases alike.

If this interpretation be correct, then among so large a total number of households it is probable that there would be some in which the primary and secondary cases were either simultaneously attacked, or were attacked successively, but at a very short interval. There were three such occurrences, of which the requisite particulars are given below.

Case 84, m., *æt.* 3; attacked April 5th; died before removal April 7th. Case 85, f., *æt.* 30; attacked April 5th; form, bubonic in both. Mother and child; lived on the original focus.

Case 101, f., *æt.* 42; attacked April 8th; removed April 12th. Case 102, f., *æt.* 32; attacked April 7th; removed April 12th; form, bubonic in both.

Case 272, f., *æt.* 13; attacked June 8th. Case 273, m., *æt.* 41; attacked June 6th; form, bubonic in both. Father and daughter; both were removed June 13th. The house is represented by two contiguous blue spots on the Botany-road.

The first pair were simultaneously attacked, the second within twenty-four hours of each other; in neither could the infection have been communicated. There must have been a common source from which both took it. In fact, 84 and 85 lived at a public-house on the infected area, close to the waters of Darling Harbour; while 101 and 102 were fellow-servants at an hotel overrun with rats, of which many had died shortly before the dates mentioned. In the third pair communication was hardly possible; it cannot have been effected by inoculation (see p. 33) from 273, whose case was bubonic and ambulant; and if not so (but still communicated in some other way), attack of 272 could scarcely have followed within,

or

or just beyond, forty-eight hours of the attack of 273. And on the other hand, 273 was a cow-keeper, who had a large stock of fodder, in which a great number of dead rats was found by the disinfecting corps when they turned it over.

A still further test can be applied to the correctness of the interpretation put upon the facts recorded above. If, in those instances, primary and secondary cases alike owed their illness to a common source of infection, which consisted neither in infected human beings nor in infected goods, it must have inhered in some way in the premises; and, consequently, there should be instances in which the disease occurred among men who frequented premises on which no plague patient had ever lain ill, nor even had ever been while suffering. In the following Table several such instances are mentioned; the premises are places of business which were not places of residence, and which were frequented by the patients during the daytime only:—

TABLE XIII.—Showing places of business at which more than one case occurred among the workmen, and distinguishing those workmen who lived on uninfected areas.

Place of Business.	Position of Place of Business.	No. of each Case among the Workmen.	Area on which Patient lived—Infected or not.
1... ...	Kent-street	14	
,,... ...	,, ...	19	Not.
,,... ...	,, ...	21	
2... ...	,, ...	30	Not.
,,... ...	,, ...	31	
,,... ...	,, ...	41	Not.
3... ...	Pitt-street	87	
,,... ...	,, ...	168	Not.
4... ...	O'Connell-street...	199	Not.
,,... ...	,, ...	207	
,,... ...	,, ...	214	
5... ...	Haymarket	99	
,,... ...	,, ...	225	Not.
6... ...	George and Clarence Streets	106	
,,... ...	,, ,, ...	149	
,,... ...	,, ,, ...	171	Not.
,,... ...	,, ,, ...	178	Not.
7... ...	George-street	33	Not.
,,... ...	,, ...	60	Not.
,,... ...	,, ...	69	Not.
8... ...	Clarence-street	36	Not.
,, ...	,, ...	40	
,,... ...	,, ...	44	Not.
,,... ...	,, ...	51	
9... ...	Castlereagh-street	91	Not.
,,... ...	,, ...	92	
,,... ...	,, ...	96	Not.
10... ...	Pitt-street	164	
,, ...	,, ...	189	
11... ...	George-street	131	
,, ...	,, ...	137	
12... ...	,, ...	246	
,, ...	,, ...	247	Not.
13... ...	Castlereagh-street, Redfern	150	
,, ...	,, ,, ...	193	
14... ...	Park-street	227	Not.
,, ...	,, ...	236	Not.
15... ...	Pitt-street	243	
,, ...	,, ...	264	
16... ...	King-street	67	
,, ...	,, ...	83	Not.
17... ...	Pyrmont...	126	
,, ...	,, ...	302	

Only 17 such places yielded multiple cases, but to a total number of 43. 10 yielded 2, 5 yielded 3, and 2 yielded 4 cases each. As will be seen from the last column of the Table, the workmen who were attacked sometimes had their homes on areas regarded as infected in accordance with the method of judgment already described; they must be excepted, therefore, as owning (in the present relation) a doubtful place of infection. But at 12 of these premises, 3 patients in a total of 3, 2 in 3,

2 in 3; 2 in 4, and 2 in 4; 2 in 2, 1 in 2, 1 in 2, 1 in 2, and 1 in 2; 1 in 3, and 1 in 3, lived on areas to which no suspicion of infectivity ever attached. It seems by far the most probable that these cases were infected on the premises at which they worked during the day; and that being so, it is on the whole likely that the remainder were infected there also, though on this it is not necessary to lay stress. The only objection which can be raised to these examples when they are relied upon to show that infection was present on premises quite apart from man is this—they all stood on the area of severe infection defined above (see par. 3, p. 27); so that these workmen ran some daily risk in crossing it, and perhaps some more definite and greater risk during the dinner hour. But, as to the former, the whole outbreak negatives liability to contract the infection by merely passing along the streets, &c.; while as to the second, it is evident that if the infection had not habitually spread on erratic courses (as judged by occurrence of cases on individual premises) an infinitely larger number of such premises should have yielded cases than actually did so, for the 17 stood precisely on that part of the city which is given up to such establishments. Yet this argument must not be incautiously pressed; for these very cases show clearly that mere presence of the infection is not enough to ensure attack. Something further, and something not commonly existent, seems necessary to enable communication of the infection from the source to man; for when buildings, which daily receive from one hundred to several hundred workpeople are judged (on the evidence just mentioned) to be seats of infection, only an exceedingly small proportion of the latter are likely to contract the disease. This has already been pointed out in another connection (see p. 26); but, indeed, the experience of ordinary houses supports the same view, since the occurrence of single cases in them was the common rule.

Even yet the evidence which points to the conclusion that the infection was erratically diffused, and which can be drawn from this epidemic, is not quite complete. Usually disinfection of premises appeared to be thoroughly effective; as a rule no cases occurred on premises which had once been evacuated, disinfected, and cleansed and which were re-occupied after five days. But in the very small minority of 3 households out of 276 further cases did occur; and this is exactly what might be expected to happen if the infection did not (as it has hitherto been expressed) inhere in the house itself, but was present in a form which allowed of its withdrawal and return.

Case 50, f., *æt.* 13; attacked March 27th, removed March 30th, together with 186. The house and contents were disinfected, and the family resumed occupation April 6th. Case 50 was released April 24th, and returned home. Case 186, m., *æt.* 5, attacked May 3rd, removed May 5th. Form, bubonic in both. The house stood on the Redfern secondary focus, not far from case 7; 186 had not been away from the house and the street in which it stood since April 6th. There was no history of rats about the house.

Case 253, m., *æt.* 6; attacked May 23rd, removed May 30th, with 288; was released June 28th; the family returned June 5th. Case 288, f., *æt.* 5, attacked June 26th; form, bubonic in both; brother and sister; lived on the Manly focus.

Case 270, m., *æt.* 5, attacked June 4th, removed June 11th, released August 24th; the family returned June 16th. Case 296, f., *æt.* 12, attacked June 26th; form, bubonic in both; brother and sister; the house stood at Surry Hills, a neighbourhood infected by extension from the Redfern focus; the cases were indigenous to it. Case 270 had found a dead rat in the kitchen two or three days before attack, and the disinfecting corps discovered several others after raising the kitchen floor.

These three instances are not cited to show that the several houses did become reinfected from the outside after they had been cleansed and disinfected; for it is quite possible that the secondary cases acquired their infection at some neighbour's house to which they may have gone. They are mentioned merely as being consistent with the supposition that the source of infection was automatically transportable, and had reintroduced itself. It can be objected that if this were the true explanation such cases should have occurred much more frequently, whereas the fact is that the disease recurred on premises after they had been cleansed only 3 times in 276; but this is conjectural, and may be met by the reply that even when the infection certainly was present it by no means followed that it would be communicated to the inhabitants.

It appears then, from the foregoing considerations, that the infection attached to neighbourhoods; that it was encountered on premises, and usually in houses; that, as judged by the occurrence of cases in man, it fell erratically on the houses in any infected district; and that even when it was known to be present on premises

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its communication to man was also erratic—or, at least, was effected much less commonly than might be expected in the case of this disease against which none of the population was protected. It is true that between March 12th (Case 14) and April 2nd (Case 67) 7,700 persons, and between May 11th (Case 215) and June 15th (Case 278) 2,700 more were inoculated, and that great efforts were made to restrict inoculation to those who lived on infected areas; but while this latter attempt largely failed, the total number of inoculations done in proportion to the number of persons living on or frequenting infected neighbourhoods, was far too small to account for the erratic incidence of the infection on the inhabitants or frequenters of infected premises; and, as a matter of fact, it was ascertained either not to have been received by any of the persons now referred to, or else to have been received by one here and there only. The observed behaviour of the infection, then, seems to require scrutiny with two points specially in view: the mode of its distribution in place, and the mode of its communication to man.

As to the mode of its distribution in place, it has already been remarked more than once that the only situation in which it was found (out of connection with the bodies of the sick) was in the bodies of sick and of dead rats. But that is hardly a fair statement which leaves the supposition open that it may have been present in a dozen other situations as well, but was merely not detected in them. The fact has been shown more or less fully (as regards man) that it did not exist effectively in soil, water, food, or fomites. Hence the known presence of the infection in rats points to these animals as the source from which man derived the disease. How the rats became infected is, doubtless, a question in relation to which possible infectivity of soil is of importance. But if it should be contended that the local rats received their infection thence, it must be shown first how into this virgin soil the infection came to be implanted; secondly, that having been implanted it could rest and even grow there. Now, if no case of plague in man preceded our Case 1, and if the soil became infected (if it were at all infected) otherwise than through ingress of sick rats, apparently this must have happened from communication of infection deposited on merchandise and thence transferred to the soil. Yet, while it has never been suggested that an intermediate stage of growth in soil is necessary, and while all pathological experience shows that it certainly is unnecessary (whether or not it be possible), it has been pointed out above that introduction of merchandise from infected into clean countries has never satisfactorily been shown to have communicated the infection to man, who is as susceptible to it as are rats. So it must be supposed that the infection in merchandise which did not communicate itself to rats on board ship, nor to man after it was landed, did communicate itself to rats on shore after an unnecessary, and in all probability hindering residence in soil. The merely practical consideration how the infection could probably be transferred from merchandise to soil under the usual conditions of packing, handling, and warehousing, need only be mentioned. It is manifestly most likely that the infection, if communicated to the soil at all, was so communicated by sick rats landed from a ship; but then, why should the soil-stage be imagined? Plague spreads from rat to rat in part, at all events, and with certainty, by the healthy feeding on the bodies of the dead. This is the way in which Loeffler's mouse-typhoid, and the disease of rats caused by Danysz' organism are spread, and in those cases is, perhaps, the only way—both being diseases caused by organisms which belong to the same group as *B. Pestis*. In short, the introduction of sick rats would seem to be an adequate and highly probable cause of the direct infection of local rats, while suggestion of the soil as a link seems unnecessary, and besides almost entirely lacks the requisite basis in observed facts.

The question whether Case 1 were the first case which occurred has little importance in relation to the epidemic (because this was not due either to direct or mediate infection from the sick), but may have some in relation to the epizoötic. Exceptionally in our experience, though certainly if suitable measures are employed, the infection is communicable from man to man by mediate means, and therefore may be communicated from man to rat: the following is the only instance which we met with, and it concerns man alone.

Case 262, m., *æt.* 22, engaged March 8th as scavenger at the Maritime Quarantine Station.

May 30th, at 6·30 p.m., went to lie down as usual before beginning his night duty, and afterwards had shivering, nausea, and headache; slept.

May 31st.—Awoke feeling well, but had slight diarrhœa; continued well all day; in the evening headache came on again; it lasted an hour only. Did his work during the night.

June 1st.—Was thirsty all day; went to his work at night.

June 2nd.—Was obliged to give up work at 4·30 a.m. Reported himself sick at 11·30 a.m.; was admitted to hospital at 2 p.m. On examination, temperature 98°·8, face flushed, eyes suffused, but not markedly; pulse slightly quickened, and of normal tension. A swollen gland the size of a large almond, and very tender, in right axilla; less enlargement of three or four cervical glands behind the sterno-cleido-mastoid muscle, which were not tender. 40/c/c. Yersin-Roux serum subcutaneously.

June 28.—Returned to duty.

The progress of the case calls for no special remark. The patient began to recover soon after admission. Liquid was withdrawn from the axillary gland (probably on June 5th) and microscopically examined on June 7th, with a negative result as regards *B. Pestis*, but streptococci were present. None of the enlarged glands suppurated. In the opinion of three experienced medical men who examined the case on or shortly after admission, there was no doubt the illness was plague.

On May 22nd the patient had received at the gate of the hospital enclosure the coffined bodies of two plague patients. These bodies had, as usual, been wrapped in a sheet wet with sublimate solution, and placed in a coffin having water-tight joints, by wardsmen; the coffins were then screwed down, wrapped in a cloth wet with sublimate solution, and handed to the patient, who helped the sexton to wheel them to the burying-ground. His other duties consisted in scavenging refuse and night-soil from all parts of the Station, except the hospital enclosure, but including the convalescent quarters; this he did during the night, and he never came into personal contact with the convalescent patients. He had on his right hand six grazes which were scabbed over, and which seemed not to have healed as quickly as such slight injuries should; he had also several horizontal cracks in the skin of the right fore-finger.

On the whole, the above account cannot be accepted as proof of mediate infection (inoculation of infectious material, perhaps from dressings discarded by convalescents); but the case was diagnosed as plague by gentlemen who at that date had had very considerable experience, and apparently inoculation could have come about only in some such way.

At this date, then—namely, more than nine months after the recognition of Case 1—it is still the general opinion that no other case in man preceded it. A comparison of the rates of death under causes in corresponding months of previous years disclosed rather smaller rates than usual. A stronger argument (because there is no reason whatever for suspecting that unobserved plague caused such fatality as would impress the returns with unusual features) can be deduced from the general proficiency and public spirit of the medical profession of Sydney; from the population being either of immediate European descent, or at the older ages actually of European birth in considerable proportion, and almost entirely British; from the ease with which medical advice can be obtained, and the universal habit of seeking it on occasion; from the number of friendly or provident societies; from the number, size, and accessibility of the public hospitals, as well as of other institutions where gratuitous medical advice is either available or whence applicants are directed to other places where it is furnished. Under these circumstances the presence of plague in New Caledonia became known, and placed the medical profession on its guard a month before Case 1 occurred (and effectually, as the instant report of Case 1 itself shows); while after the published identification of that case a whole month elapsed before the occurrence of Case 2, though in the interval suspected cases were referred for diagnosis. It is, nevertheless, possible, of course, that one or more unrecognised cases did occur; but to assume this seems as unnecessary as does the assumption that the epizoötic sprang, not directly from infected rats, but in a roundabout way from some unidentified source through the soil. At the same time, the possibility that the epizoötic arose from communication of the infection to rats (perhaps in sewers) through the infected excreta of an unknown case in man cannot be excluded, for no demonstration is or can be possible. It is perfectly clear, however, that Case 1 followed, and did not precede, the epizoötic; while reason has been shown for asserting that Case 1 actually did receive his infection from a rat. That reason will appear the stronger to those who are well acquainted with the investigations of Dr. P. L. G. Simond, *Médicin Principal des Colonies Françaises*, and who have observed that they explain and bring into accord many apparently dissociated or even opposed facts recorded of plague.

Admitting, then, that the source of infection for the local rats cannot be demonstrated to have been infected foreign rats, but asserting on ætiological and general grounds that this origin is almost infinitely probable, it must be enquired whether the observed distribution of plague rats in Sydney was sufficiently wide to account for the epidemic. It has been subsumed throughout the foregoing pages that man was usually infected by rats; whether it actually were so or not, was it possible?

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On diagram B certain dates are inserted in red ink, some of which are underlined. They indicate some of the neighbourhoods in which diseased or dead rats were discovered. The under-score means that plague was demonstrated in the rats indicated by microscopical, cultural, and inoculation tests conducted in the laboratories. Where there is no under-score the note means that dead rats in numbers had been seen by some member of the staff, under circumstances which denoted death by disease, not by poison; very often (in 70 infected houses) the report was received from the disinfecting corps by which the bodies had been (and often had first been) discovered. It was rather commonly the case that the members of infected households had nothing to report concerning presence of rats alive or dead on the premises where these animals and their bodies were found on proper search. In one case (Queen-street, Woollahra) the infected animal was a cat; it was forwarded by Dr. W. H. Quaife, and was the only one of 5 received at the laboratory which had plague. No case of illness occurred in the house whence it came, which stood, however, on an infected area. Of 6 house-mice received, 2 had plague. The total number of rats examined at the laboratories was 167, of which 50 were alive; 10 of these were sick, and 4 of the sick rats had plague; of the 117 dead rats, many of which were putrid, 19 were shown to have had plague (see Appendix A, p. 53). The infected animals came from widely-separated localities within the city of Sydney where 41·5 per cent. of the total cases occurred; and two of them from the distant suburbs, Manly and Woollahra. These 23 are all the instances in which plague was rigidly demonstrated in animals; but very many rats were examined which there was no reason to doubt had also died of plague.

The above is the recorded evidence that rats over a considerable area of Sydney, which was the area on which cases of plague in man occurred, suffered from an epizoötic; and that this epizoötic (which began before plague in man occurred, and ceased, as far as can be learnt, about the same time as the epidemic ceased) was plague. In practice, however, many reports of dead rats, and of the sudden invasion of premises by rats where none had been before, which were commonly made during continuance of the epidemic were taken as supplementing the evidence already given; and it would be erroneous to suppose that the recorded and rigidly proved instances were the only ones which were credible. This was far from being the case; and if it be desirable that many more well-established observations should have been recorded—as, undoubtedly, it is—it is also the case that our resources were not adequate to furnish a separate staff to watch over the epidemiological features of this outbreak. What was possible was done

In short, that the infection was disseminated by rats appears tolerably certain, and it may not be too much to surmise that plague is primarily a disease of the rat which is communicable to some other animals, among which man happens to be included. The real difficulty is encountered when an explanation of the way in which it was communicated from rats to man is sought. It must be remembered that the prevalent opinion now is that, generally speaking, man contracts plague by inoculation. A rat might well disseminate the infection on the air by sneezing, since it is found on the nasal mucous membrane of rats; but this, perhaps, would produce the primary pneumonic form in man—not a common form in any epidemic, and, with a single doubtful exception, not seen during the Sydney epidemic. A rat might also disseminate it with its excreta; but, if this should suffice to bring it within striking distance of man sufficiently often to cause epidemic prevalence of a practically non-infectious disease (in the common bubonic and the less common septicæmic forms), it must operate usually by contamination of food or of articles other than food. As to food man rarely (if ever), as a matter of fact, gets the disease by ingestion. Many an article might be soiled with the infection without causing inoculation or, rather, few articles so soiled are capable of inflicting a wound, and still less often are likely to enter into the circumstances which would afford the necessary opportunity; but there is certainly one exception. If hay became the medium for deposited infection any person handling it would be very likely to receive the slight wound which alone is necessary to inoculation; but hay is just as likely to carry the rats themselves, dead or alive. After all, however, this accident could not occur often enough to be of importance in causation of an epidemic, and the opportunity is taken to mention it merely because it affords a possible explanation of Cases 4 and 272-3 as well, perhaps, as of some others of those which are classed in Table X as employed at produce stores. But case 273, p. 35, hints another and simpler interpretation.

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The means of inoculation must be one commonly in operation in order to be an efficient cause of epidemics. Hence the observed preponderance of bubonic enlargement of the glands of the groin, which indicates entry of the infection at some part of the lower extremity, and which has been observed in the barefooted populations of the East, is often ascribed to the wounds which unprotected feet receive. It may even be surmised that the notion of spread of the infection mediately through the soil has received some unacknowledged support from this theory. But the facts do not at all warrant it. The preponderance of groin buboes at Sydney was as striking as in any other part of the world. Among the total 303 cases there were 17 which had no bubo; in the remaining 286 cases the bubo occupied the right inguino-femoral region in 99, the left in 101, and it was bilateral in 9; making altogether 209 in which the bubo occurred in the inguino-femoral region and no where else, or 73 per cent. of all those which showed buboes at all. Yet the inhabitants of Sydney, and those among them who were attacked, no more go barefoot than do the inhabitants of London. They live in a sub-tropical climate, but their habits in all matters of dress are still entirely those of the people of northern Europe.

Needless, however, to beat about the bush. Granting that plague in man is usually the result of inoculation, the manner in which this can be brought about on a sufficient scale to account for an epidemic would remain hidden but for the observations of Dr. P. L. G. Simond, already referred to. A sufficient account of the leading points in his teaching appears in Appendix A, p. 56, and need not be repeated here; but to appreciate the weight of his observations his original paper must of course be studied. He considers that plague is most often communicated to man by fleas which, after feeding on plague rats, become transferred to man whom they inoculate. Thus also, he thinks, is the disease sometimes conveyed from rat to rat and to other susceptible animals. The minute puncture usually leaves no mark, but in a small proportion of cases it produces a phlyctenule or a bleb. Such a lesion was observed in seven of our cases; excepting Case 1 it appeared as a small papule, surmounted with a minute vesicle; from two of these in two different cases smears were made; in one of the smears bacilli morphologically resembling *B. Pestis* were demonstrated. It is not to be supposed that all our cases were searched with this object in view; many were, and the six formed but a small proportion of the total examined, but a quite systematic and quite thorough search could not be carried out in all cases. Several fleas taken from infected rats were examined; in one a bacillus resembling *B. Pestis* was demonstrated, and it was identified by the result of inoculation into a guinea-pig.

Nine fleas taken from rats received at the laboratories were referred to the Government Entomologist (Mr. Walter. W. Froggatt) for classification. Mr. Froggatt reported upon them as follows:—

Slide No. 2 Dog-flea (*Pulex Serraticeps, Gerv.*). This is our common cat and dog flea, and has been described under the name *P. Canis* and *P. Felis*. These specimens do not exactly agree with my typical form (which was caught in the office), as the teeth-like spines on the lower edge of the head are absent, but this may be a variation in the sexes. The dog flea is the common house-flea in the United States, *P. Irritans* being a rare species with them, and seldom found. "Examination of many specimens of fleas sent to the Department in recent years shows that the species which commonly overruns houses during damp summers in our eastern cities at least, is not, as many have supposed, the human flea, but the common cosmopolitan flea of the dog and cat." (L. O. Howard, in Bulletin No. 4, division of Entomology, U.S. Department of Agriculture, 1896, p. 24).

Slide No. 3. This slide contains 3 specimens; one, the largest, is another specimen of *P. Serraticeps;* the 2 small ones are rat-fleas (*P. Fasciatus, Bosc.*)

Slide No. 4. Rat-flea (*P. Fasciatus, Bosc.*) Slide No. 5. Three specimens of the same.

P. Fasciatus was of the most usual brown colour. *P. Serraticeps* is said by Neumann not to bite man; but this is not in accord with general experience, and would seem from the reference furnished by Mr. Froggatt not to be the case in the United States. Whether *P. Fasciatus* will bite man is not known here; no experiments to test this point were tried during the epidemic. As Dr. Frank Tidswell has suggested, it is likely enough that varieties which will not, or do not, commonly infest houses and man, may yet bite once when they find themselves on the human body. *P. Serraticeps*, however, which certainly does bite man, was found on two of the small number of rats thus examined.

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The teaching of the foregoing study of plague as it appeared at Sydney, seems to be as follows :—

1. The disease was not directly communicated from the sick to the well—in other words was not "catching."

2. It was not communicated in any important degree, at all events, from the sick to the well by mediate channels (clothes, household goods, merchandise, excreta).

3. The infection attached to localities, and spread to others adjoining and continuous with that in which it was first manifested.

4. It also spread in a fashion which betokens the possibility of its being transported mechanically from an existent focus to a considerable distance (Moore Park garbage-tip and Manly), and there initiating an independent focus.

5. In the buildings on any infected locality cases occurred irregularly, and showed no special proneness to occur in adjoining houses.

6. When the occurrence of one case among the inhabitants of a building showed that the infection was present in it, secondary cases rarely followed. Irregularity of incidence on houses was accompanied with irregularity of incidence on the inmates.

7. An epizoötic disease among rats preceded the first case which occurred in man.

8. This epizoötic disease was plague.

9. The area over which the epizoötic extended was practically co-extensive with that on which cases of plague in man were observed.

10. The epizoötic died out as far as can be learned at the same time as the epidemic ceased.

11. The epidemic was caused by communication of the infection from rats to man.

VII.—Prevention.

It will appear ultimately that the best protection against epidemic plague lies in sufficient sanitary laws, persistently and faithfully executed by Local Authorities during absence of the disease, and that no other general scheme of defence is practicable.

Successful prevention of epidemic diseases depends entirely on knowledge of their nature, of their causes, and of the means by which the latter are diffused. On these points our experience has shed useful light, though many details remain to be worked out—some in the laboratory, some in the field ; while others still require, and now urgently demand, assistance from those who profess correlated branches of science. In such circumstances practical management of a present epidemic cannot proceed unless certain assumptions are made; and it is worth while to point out here that rational assumptions which coördinate and explain accurately observed facts have nothing in common with guesses. Accordingly, the following remarks are made in view of the facts and inferences recorded above, and with reference to epidemic plague in the bubonic form.

The prevention of epidemic plague might be discussed under the three heads importation, local diffusion, and exportation. Under importation fall international notification, arrest of infected persons and things, and destruction of rats afloat. Under local diffusion fall care of the sick, care of contacts, protective inoculation, exclusion of rats from dwellings and the immediate neighbourhood of man, destruction of rats, destruction of human parasites, cleansing and disinfection. Under exportation fall the steps which can practically be taken with hope of preventing diffusion of the disease from infected spots (*a*) to clean places within the same country, and (*b*) to clean places beyond its borders. It will not be convenient to take these subjects exactly in the above order. It will be best to inquire first who may properly be designated "contacts," and how these persons should be treated.

The term is much in use; it has a certain convenience, but unfortunately no defined meaning. Probably it was devised to indicate those who had recently been in close association with the sick; and were it so employed in connection with smallpox, for instance (which is maintained and diffused exclusively by communication of the infection from the sick to the healthy), it would be not merely useful, but sufficiently exact. But in the present connection it is inaccurate. As we have now learned, bubonic plague and smallpox do not become epidemic by the same means; our epidemic was not caused or maintained by communication of the infection from the sick to healthy human beings, either mediately or directly. As long, then, as the word "contact" is used with reference to preventive measures, of which one is obviously indicated by it, it does not necessarily apply to those who have been recently associated with persons who are actually suffering from plague. On the other hand, our experience has shown that infectiveness attaches to localities; so that "contact" might properly be used to designate a person who had lived on, or who had been exposed to the influence of, an infective locality; and he would deserve this distinctive epithet for five days after he had been completely separated from that place, because the infection (if it has been taken) reveals itself within that period in occurrence of the disease. But our experience has further taught that local infectivity is not due to any inherent peculiarity (attaching, for example, to the soil), but merely to the casual presence of plague-rats. So a "contact" is one who has been more or less closely associated with plague-rats.

The other persons living in any house which contains a plague-stricken human being, then, may or may not be "contacts." The presence of the patient is evidence merely that he has at some time been a "contact" himself within the meaning of the definition, but it predicates nothing of the rest of the household. Effective exposure to the infection (inoculation) must necessarily be little more than momentary; so that no person who moved about up to the time of his attack can be assumed to have received the infection either at that place where he lives and is found or at those other places which he frequented. In point of fact it has been shown that the place of infection was sometimes not the dwelling, but the workshop; and, on the other hand, that it was sometimes not the workshop, but precisely the place of residence. In short, the first hint that infection is somewhere to be encountered usually consists in occurrence of the disease; and this only furnishes occasion for inquiring where it was encountered. The search will naturally begin with the patient's immediate surroundings, but often these furnish no clue; it must be continued to distant places frequented by him, and there the source may be found.

It is plain, therefore, that no general rule according to which all those who are found in contact with a plague patient shall be dealt with can be laid down, and that the attempt to enforce such a rule will not only lead to injustice in a majority of the cases submitted to it, but must unnecessarily embarrass the central health authority; more than that, it would be found practically impossible to adhere to it in the case of many business establishments, such as banks, public Departments, and the like. Each case must be treated according to the known facts of the place or places concerned, and the general features of the epidemic. What these are is always much better known to the central health authority than to any other party, for it has (and, if it be properly organised, it alone can have) possession of the information on which a prudent judgment can be based; it is, additionally, the most competent interpreter of the facts within its knowledge. The central health authority will be most wisely left absolutely free to take such measures to control the epidemic as to it seem best; much more, therefore, should it be left absolutely free to deal as it thinks most prudent with individual premises and the persons associated with the patient. It is also obviously necessary that its decisions be accepted as final and unquestionable. Every other course must result in increase of public agitation, in unnecessary expenditure, and in great risk of prolonging the visitation.

Secondly, it is convenient to inquire how the sick themselves should be dealt with. It has now been said many times that the epidemic was not maintained either by direct or mediate communication of the infection from man, and it has doubtless seemed—and very naturally seemed—that no better reason for leaving the sick where they are found could be given. But true though the statement be, this inference would be false. Plague is a disease common to man and to rats; whether it be primarily a disease of rats or not is of little immediate importance.

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It can be communicated from rats to men, and from men to rats by suitable means—the word "suitable" in this connection meaning "by inoculation," though as regards rats only it includes also feeding on plague-rats. Those are the facts of such communication experimentally ascertained; it is probable also, but not ascertained, that the disease can be communicated from man to rat in other ways—namely, through the infective matters cast off from the diseased human body. Indian records are not devoid of instances which suggest that this may occasionally have been the true sequence of events in a few localities; and therefore, although they scarcely amount to proof, and although (it is believed) communication of the disease to rats by such means has not been demonstrated to be an experimental possibility, yet there is ample reason for collecting everything which proceeds from the infected human body and for destroying it, or at least for rendering it non-infectious by one or other of those means which are known to be efficacious. Now, a central health authority, charged with the heavy responsibilities which attach to management of an epidemic of plague, would be imprudent which left the precautions just mentioned to be taken by the members of individual households, whatever their resources might be. All of the sick should be removed at the earliest possible moment to an isolation hospital strictly managed under immediate direction of the central health authority; but cases occur in which no isolation hospital exists within reach, and some others in which ample means and the isolated situation of the houses in which they occur render it not absolutely necessary to remove the patient. In all such cases the central health authority may leave him at home, but only on condition that he is nursed by nurses in its employment and under direction (in all matters relating to prevention of spread of the infection) of a member of its own medical staff. On the whole, though extreme care is in every case necessary, greater care, if possible, would appear to be requisite with houses connected to a sewerage system than with others.

Thus, for the present at all events, every actual case of plague must be regarded as a danger to the whole community; and therefore, in connection with the question whether the sick must be isolated, attention should be drawn to the fact that plague is communicable from man to man both by direct and mediate channels, although our epidemic was not maintained by such communication. Primary plague pneumonia is directly communicable to man; and further, whatever the form of plague may be in which a case of the disease begins, secondary plague pneumonia is liable to supervene. The patient's expectorations then carry the bacillus, and therefore are probably dangerous. Additionally, the excreta, both solid and liquid, sometimes (with unascertained frequency) also carry the bacillus; this happens at all events when the minute hæmorrhages into the submucous coats escape into hollow organs, and possibly under other circumstances; while the discharge from bubonic abscesses always carries the bacillus in profusion at first, and on very good authority is said to continue to carry it in viable (though not necessarily in virulent) form for many days. Lastly, in almost all septicæmic cases, and in many others of whatever form when death impends, bacilli are easily found in profusion in the general blood-stream, even in the capillary vessels of the skin, and from the latter the infection can be abstracted by suctorial insects (fleas and bugs), and may be inoculated by them into the healthy, or into rats. So that for the sake of preventing as much as possible occasional communication of the disease from the sick to others associated with them, and largely for the sake of diminishing the risk of infection of rats from cases in human beings, and of rendering control of those risks more easy and certain, all plague-cases in man must be isolated under immediate direction of the central health authority; and in the vast majority of cases it will be not only expedient, but necessary, to effect this by transfer to hospital. In view of the rare exceptions which will be met with, the central health authority must be left absolutely free to decide what shall be done in each case on its merits, and, again, its decisions must be accepted as final, and must be unquestionable. The fears and fancies which preoccupy the mind of the general public on such occasions, and the dicta of those among them who rely for guidance on common sense, cause confusion, sap confidence, favour panic, and pave the way for disaster.

International notification of plague has its uses, although the information thus communicated comes too late to set in motion those preventive measures which would prevent importation—if they ever could be thoroughly effectual. It is not customary to notify the presence of plague unless there is good reason to consider it

epidemic

epidemic. But, which is of more importance, the notification regards exclusively manifestation of the disease in man. This, we have learned, is a matter of secondary importance. It has been preceded by the epizoötic; and the real danger to the importing country lies with plague-rats, not with plague-stricken men. Evidently notification, as at present understood and practised, cannot much help in preventing importation of plague.

It is hardly possible to conceive how a measure taken to prevent the risk of importing plague-rats could be made dependent on notification of disease among rats at the port of departure; besides which the defences of that country which relies on other countries for aid in raising them are likely to be inefficient. Were the fullest information always available in time, which it never could be, the object would be to kill all the rats—not a majority, but all of them must be destroyed—on every incoming vessel; and this could be done in practice only by landing cargo on a small island, overhauling it, treating the hull, and reloading the vessel before allowing it to approach the quays. But there can be little doubt that this is impracticable. It is possible to kill many rats on laden vessels; though at the best it must always remain doubtful whether all have been killed, and a difficulty arises in connection with damage to cargo. Experience has led us to rely on sulphur fumes.

Rats will not venture where there is the least smell of sulphur dioxide, and they are easily killed by respiring air which contains a moderate proportion of it. The practical use which has been made of these facts, is the following:—Small quantities of sulphur are burned on upper decks, &c., being only enough to taint the air rather strongly; this not merely causes rats to retire to the lower parts, but seems sufficient to prevent them from returning even when the next stage of the process is in full swing. This consists in closing holds, bunkers, &c., &c., by the usual means, and in then burning sulphur in the estimated proportion of about 2 lb. to every 1,000 cubic feet of unoccupied space. The exposure should last not less than six hours. This plan is effectual, though there is reason to think it is not always completely so. It is easily managed, and the only objection to it is damage to some kinds of cargo by taint of sulphurous acid. It has already been mentioned that as many as 287 dead rats were gathered from a small steamer after fumigating it in the above-mentioned manner; and at Newcastle where vessels generally arrive in ballast to load coal, or else carrying a moderate load (say up to 1,000 tons) of general cargo for the most part cased, the number thus destroyed has varied from a few to a "tubful". As a matter of fact, no serious complaint of damage to cargo has been made; but vessels from New Caledonia ceased to bring coffee during continuance of these precautions which, it was thought, would be unmerchantable after fumigation with sulphur. The alternatives to sulphur appear to be formaldehyde and carbon dioxide, both of which were suggested at an early date. As to the former, its practical use requires more careful management than available fumigators can be relied upon for; errors and omissions can seldom be made good by a second operation, for although shipowners submit willingly enough to a detention of known duration, they expect the time to be utilised in a businesslike way. Formaldehyde is, moreover, expensive. Carbon dioxide appears a more promising agent, but it has serious drawbacks. In the first place it does not favour collection of living rats in holds and bilges where alone this gas would in all probability collect in sufficient proportions to kill, and if perceived by the rats it would be easily evaded by them. As to disengaging it in the required quantity and with the requisite promptitude, this could only be effected with cylinders of the compressed gas; but those who have used them are aware of the practical difficulties which are encountered. The gas might be disengaged from chalk and muriatic acid; but it happens that the Department has had some practical experience of this method in connection with the killing of stray dogs by the police, and the result of the experiments conducted by the Government Analyst (Mr. W. M. Hamlet, F.I.C., F.C.S.) precluded all thought of attempting to employ this plan on shipboard. On the whole, our experience has shown us that sulphur dioxide is the only agent practically useful for the present purpose, notwithstanding some drawbacks.

But we have learned more than this, which leaves the cargo difficulty (in practice not important with us) untouched. It would be much better not to have rats on board ship, than to attempt to kill them off on laden vessels; and there is not much difficulty in keeping them away. The method is to fumigate the vessels with sulphur while empty, or nearly empty, at the beginning and end of voyages. According to the reports furnished by the Superintendent of Fumigation (Captain G. Tait) it appears that if vessels which engage in coasting voyages lasting about three weeks, or from that to a month, are fumigated at the port of departure before loading, and at the ultimate port touched on the voyage (when they usually have some cargo on board), few and often no rats are discovered after the next fumigation done on return to the port of departure before commencing a fresh voyage. This statement applies to steam-vessels of various tonnages up to about 4,000. The method has been practically carried out under intercolonial agreement, which requires that such vessels shall produce a certificate of fumigation while empty at the port of departure, and at the ultimate port of the voyage, without which they are not allowed to communicate with the shore except after a prohibitory detention at quarantine.

In conjunction with this precaution, which might well be adopted under an international agreement, others, designed to prevent intercommunication between shore and ship rats while lying at quays, should be adopted. These consist essentially in

in the use of shields on springs and hawsers, in fending off vessels from quays, or in hauling off at nightfall, in closing openings in the sides, and in hauling up gangways at night unless in actual use, in illuminating the quay and the ship's side, and in providing watchmen.

Lastly, quays must be properly constructed—that is to say, they must terminate in a solid sea-wall of masonry or concrete at a point below low-water mark, so that wharves built out always have water beneath them. The wharves at Darling Harbour, which were the starting-point of the epidemic, are very old, and everything which wharves should not be. They consist of staging carried out over the foreshores, the quay wall being sometimes barely within reach of high water, and constructed either of seriously defective rubblework, or else of sheet-piling in bad order and filled in behind with large stones. Both afford ample harbour for rats, which were found to exist there in great numbers, while the mudbanks which are exposed at low tide and the piles which support the wharf-deckings collected and retained the dead animals and heaps of organic wastes, which insufficient scavenging and defective supervision caused to be thrown into the water. These faults will now be remedied in course of time under the Darling Harbour Resumption Act, and the Harbour Trust established by it, and this part of Darling Harbour will be reconstructed to resemble other parts which are already built in the manner recommended above.

While very much can be done to impede entry of plague-rats by the means described, which, therefore, should be adopted and steadily used, it is evidently unlikely that they can prevent such entry, or, in other words, be at all times completely effectual. Failure in connection with a single vessel, even though partial only, the entry of a single plague-rat to the rat community ashore is all that is necessary to originate an epizoötic of plague: and this is likely to occur, first, because all the described precautions can hardly be continuously taken; secondly, because information of the occasion for taking them is usually received after the risk has been run; and, thirdly, because of the unavoidable uncertainty of their effect when they have been taken. We pass on, then, to consider what should be done to control a present epidemic, and what should be done ashore to render recurrence of it as difficult as possible.

During an epidemic the only proceeding of much value is destruction of rats and of their nests, burrows, and habitual haunts, and those others which are calculated to prevent access of surviving rats to proximity with human beings—in other words, to expel them from occupied premises, and to keep them outside. This measure was given a first place in the precautions recommended to householders in the pamphlet issued from the Department on March 1st (Appendix H, p. 75), and, on the whole, subsequent experience may be said to have established its usefulness. It is true, no doubt, that several people were infected at wharves, and four others in the course of scavenging infected areas (though whether within or outside dwellings does not appear) but the great majority were infected on premises. On premises where indigenous cases had occurred, moreover, the presence of freshly-deceased rats was discovered quite often enough to support the general proposition that the danger of contracting plague stood in relation to the presence of rats in dwellings or enclosed premises. A general slaughter of rats would answer the purpose, if it could be carried out quickly, and with tolerable completeness; but that is practically impossible.

Slaughter of rats was attempted by us, and doubtless should always be attempted. The following steps were taken:—The City Council, within whose district the epidemic commenced and fell most heavily, early instituted a special rat-catching staff, and ultimately reported that it had destroyed 38,600; the business was then taken over by the Government. A considerable staff of rat-catchers was employed, who worked according to indications furnished by the Department, or else from observation; a capitation fee of 2d., subsequently raised as already described to 6d., was paid for the body of every rat brought in by the public; depôts at which rats were received, paid for and burned, were established at various points in the suburbs; municipal councils were gratuitously supplied with rat-poison for distribution among their ratepayers, and with a man to distribute it, and to exhort the people to lay it; the Board of Water Supply and Sewerage, fumigated the sewers with sulphur in a systematic way; officers in charge of public buildings were instructed to take similar measures; and many private firms, including owners of wharves and steamships, as well as private householders, dealt with their own property. There was delay in commencing the destruction of rats on a scale likely to be at all useful. It was only seriously attempted after the public attention had been aroused by a last appeal made by the Department on April 9th, when the 96th case had already occurred. It is difficult to estimate the effect on the rat population which was produced. The total recorded number of rats killed by the Government staff between April 18th and October

October 31st was, in the city, 56,136; in the suburbs, 13,572; total, 69,708. To this must be added the number claimed to have been killed by the local authority for the city, namely, 38,600, making a recorded grand total of 108,308. Private persons probably killed a considerable additional number; and many were killed by the scavenging staff in the course of its operations.

On April 3rd the Water and Sewerage Board commenced fumigating the sewers. Within the city of Sydney, though many intercepting sewers have been constructed by the Board which are in all respects in good order, the greater part of the district is still served by very old and ill-constructed sewers; and the house-connections are, in the case of about 20–21,000 houses out of 22,000, improper, imperfect, and dangerous. Outside the city all sewers have been constructed by the Board; these in themselves and in their connections are what they should be. In the first place, then, the general statement may be made that probably very few rats existed in the new sewers, but great numbers in the old ones. While the new sewers afford them no lodgement, the outfalls discharge either into deep water or on well-tended filtration areas or sewage farms; while the old city sewers are too often accessible from harbour foreshores. The method adopted was either to blow the fumes of sulphur into them, or to burn sulphur in trays suspended beneath manholes; afterwards they were flushed with water to wash down the dead rats. The result, gathered from the reports regularly issued by the Board, cannot be expressed in numbers. From the new sewers very few carcases were got; from the old sewers large numbers were washed down (at all events at commencement of these operations), and it is believed that many must have been killed which never were seen. As a matter of fact only between 300 and 400 were actually gathered by the workmen employed, but, as just mentioned, this does not bear any definite relation to the numbers actually killed and seen, though not collected. In the city an incidental and useful effect of the fumigation was to fix the position of many faults in the old system, through which the fumes escaped so as to be strongly perceived within houses, and even in the open.

Employment of the organism used by Professor Loeffler to destroy mice had at an early date been recommended in letters to the daily papers for the destruction of rats. The Department, however, had investigated this matter at great length two years earlier in relation to its proposed use for destroying flying-foxes (see Annual Report of the Board of Health for the year 1898), and had subsequently extended the inquiry to ascertain its powers and usefulness for the destruction of rats both in the laboratory and in the field. The results showed that while the scattering of bait impregnated with broth cultures of Loeffler's *B. Typhi Murium* often resulted in disappearance of rats from their old haunts, very few sick rats were ever seen and no dead bodies were ever found; while in one locality unmistakable evidence was got that the infection of a few animals was immediately followed by retirement of the whole horde to some neighbouring spot not far distant, where it lived in good health.

Cultures of Danysz' organism, recommended by the discoverer for destruction of both rats and mice, had been cabled for at beginning of the year, in consequence of an account of its apparent effects which had been communicated to the President by a *confrére* in New Caledonia. As soon as they arrived (May 3rd) this organism also was examined in the laboratory and tested in the field, without any useful result being attained. At a later date Danysz' own account of the organism was published, from which it appeared that the disease caused by it spread only to rats which fed on the bodies of rats killed by eating the original bait, and that it was not alleged to cause a disease freely communicable in other ways, such as seems to be requisite to its effectiveness in the desired direction.

Nevertheless, it is likely enough that an impression was produced on rats in certain districts, and in as far as such districts were infected that impression was useful. It can have been useful, however, only to the inhabitants; for rats flee as soon as they are persistently disturbed, and partly (only) for this reason the infected rats spread beyond that area on which the epizoötic first appeared. This danger was recognised by the public, which desired that before attempts at destroying rats in an infected district were made the locality should be surrounded by a fence to prevent their dispersion. This, as well as many another suggestion of a different kind, was made at a comparatively late stage of the epidemic—at a time, at all events, when alarm had rendered it possible to secure public approval for almost any proceeding, however inconvenient, expensive, or oppressive it might be; and it is necessary to point this out because, even at the date when it might have been tried, it would no longer have been useful. Without discussing the question whether any fence which could be erected in a large city would have the desired effect, the fact was that before they were disturbed by efforts made to destroy them, infected rats had spread far beyond any such restricted area as could be fenced. This had happened in accordance with the instinct which causes rats to desert places where disease attacks them, or where poison is effectually laid for them. Case 7 (March 8th), it has been shown above, was infected where the patient was found, at a distance of about 2 miles from Darling Harbour; while the occurence of Case 15 showed that plague-rats had already invaded premises as far away from the shore line as York-street by March 13th. Other instances could be mentioned; but, in short, while it was sufficiently difficult to watch the progress of the epidemic in man, it was quite impossible to observe extension of the disease among rats. The conclusion as to rat-fencing is that it is one of those measures which would be useful if only they were practicable, while the conclusion as to rat-killing is that it may be useful and should be persevered with, but that it can never be more than an assistant means, and never can be a preventive. A better defence must be looked for in other directions.

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What this is has already been mentioned. Importation of plague-rats may be impeded if good fortune accompany care, but in the long run it cannot be prevented. Rats ashore may be killed in large numbers, but it is hardly possible to suppose that they might be exterminated; besides, the epizoötic will usually have made considerable headway before the disease has been communicated to man, and, therefore, before it has been noticed. In the meantime, the rats will have scattered widely, not in consequence of attempts to destroy them, but of their own motion, and in accordance with those habits which are commonly known to cause them to leave any place where they find their companions dying. Under these apparently hopeless circumstances, examination of the facts of the late epidemic show that the infection was practically always taken on premises. This was only learned from careful observation, record, and consideration of all the facts of the outbreak; but, having been pointed out, the deduction from it is obvious. It is that the important practical protection against epidemic plague consists in removal of all those conditions which favour the harbourage, feeding, and breeding of rats in the immediate neighbourhood of occupied premises, and in excluding rats from dwellings.

This mode of defence is no sooner mentioned than it is seen to be practicable; and not merely so, but to be attainable by the steady and faithful execution of the elementary details of municipal sanitation. The places in which rats live and breed are the dark and intricate recesses which exist about ill-constructed or decaying structures; heaps of household refuse, which afford warmth, and in which they burrow; ill-made basements, cellars, and store-rooms, where defective flooring is supported above the natural soil; stables and dungheaps. The conditions which attract and retain them are the presence or near neighbourhood of food; if (as is usually the case) they are to be met with in hardware and soft goods stores which have been ill-constructed or which have fallen into disrepair, they are more constantly found in butchers' shops, produce stores, grocers' shops, public houses, hotels, and kitchens; and are always to be seen at night in lanes and rights-of-way, however well paved these may be, hunting for food in garbage boxes or dustholes. Access to buildings and to dwellings from the outside is furnished to them sometimes by defects of structure which may even be such as in every other relation are unimportant; at others through doors left open at night; but largely through the more serious gaps which occur in the course of decay of dwellings in which, also, there are sure to be many nooks in which they can permanently establish themselves. And, again, they are attracted to the neighbourhood of such dwellings especially by the lumber and organic refuse which too often are allowed by local authorities to accumulate in back yards and on waste land, and which furnish food and cover for them. The conditions adverted to are often accompanied by permanent infestation of premises with parasitical insects, among which fleas and bugs are of most importance in the present connection; for dirt, decay, darkness, and filth favour them at least as much as they favour the presence of rats. Lastly, as with other matters which fall under the general heading of care of the public health—and which comprise, it should be remembered, all matters relating to communal health or disease, from the most abstruse down to the simplest item of municipal scavenging—the dangers just indicated as conducive to epidemic plague carry others with them which are of even greater importance. Darkness, dampness, filth, and bad construction of dwellings are causes of the prevalence of consumption (for example) which annually kills more people than, it may be safely said, plague ever will destroy here during the epidemics which may occur at intervals of years. And these dangers of fostering plague, and plague especially and singularly, are by no means confined to the houses on which they actually exist. Rat-infested premises threaten the inhabitants of every dwelling in average good order which stands within a few hundred yards of them. Numbers of cases of plague occurred, no doubt, on premises which conspicuously presented some or all of the faults just mentioned; but a larger proportion occurred in the dwellings of artisans which were sometimes in good order, at others in an ordinary and fair state, and which laboured under the disadvantage of entirely insanitary methods of connection with sewers, or of the neighbourhood of ancient and dangerous sewers or drains, only within the city of Sydney.

Thus the best, and the only attainable, defence against epidemic plague lies in removal of dangerous conditions which for the most part could not occur under good municipal management, even of the elementary processes of inspection, record, and scavenging.

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The epidemic, and the efforts to abate it by cleansing a part of the infected area, revealed to the general public the inefficiency of the work to that time done by some local authorities which, consequently, were loudly accused of neglect. Neglect there had been, no doubt; but, except in the city of Sydney, where large revenues and powers under special Acts of Parliament render excuse difficult, it has been largely unavoidable. There seems to be little ground for hope of important improvement in municipal sanitary administration until local authorities are granted power to strike a sanitary rate, from which the expenses of business-like supervision and improvement of their districts may be defrayed by them.

But funds are not all that is requisite. Knowledge and guidance are also necessary. The Public Health Act provides for appointment of Medical Officers of Health to districts, and to groups of districts. The Board carried out this instruction of the Legislature by combining the populous municipalities in the Metropolitan and Hunter River Districts, and by appointing to each combined district a Medical Officer of Health whose whole time should be devoted to his duties, the opinion having been formed by it that such officers can act efficiently only when they have no other interests. Thus the local authorities administering districts which carry rather more than a third of the total population, were furnished with competent advisers on all matters relating to the public health; for the officers referred to are officers of the combined local authorities, and are not (as they are often taken to be) officers of the central authority. But in the metropolitan district, the local authority for the city of Sydney has power, under its Act of Incorporation (1879), to appoint its own Health Officer. Without reflection on the manner in which the present and past holders of this post have done their duty, it may be pointed out that every incumbent has laboured under those very disadvantages which the Board has striven to remove in the cases just mentioned, namely, of being embarrassed by the cares of private practice, and of being entirely under direction of the Council. It is necessary that the sections of the Act of Incorporation which granted this power should be repealed, and that the city, like other metropolitan municipalities, should be transferred to the care of a medical officer the terms of whose appointment not merely ensure that he shall be skilled in the work which he undertakes, but shall also save him from all those influences which, if they came into play, would seriously impede him in doing it.

The Board, by its use of the opportunity afforded by the Public Health Act, took an important step towards establishment of a public health service on the only basis which renders sound progress possible. It is to be feared that its bearing has, so far, hardly been generally appreciated. And perhaps one reason is that, while providing for the appointment of specially-educated directorial officers, the Act stopped there, and made no provision either for giving sanitary inspectors a similar security of tenure, nor for making sure that they have had reasonable instruction in their special business before they are allowed to undertake it; nor did it co-ordinate them with the Medical Officer of Health, whose assistants and executants, under the local authority, they are. This omission should now be rectified; probably no better plan can be mentioned than that of paying half the salaries of sanitary inspectors in populous districts on condition that they are neither appointed nor discharged except with approval of the Board, which latter would have power gradually to require that every such inspector should produce some certificate or voucher for his having been through a course of instruction in the subjects of which his occupation requires knowledge. There is no doubt that local authorities would gladly accept such an arrangement, which would, besides, relieve them of some local difficulties in executing the law which they now occasionally meet with.

As soon as they are mentioned it will be perceived, doubtless, that these proposals, which were submitted on July 3rd in the form of amendments to the Public Health Act, are of a fundamental character. No efficient execution of health laws need be expected until they have been adopted; and especially no such improvement in scavenging and in buildings as can be a useful defence against incursions of rats is at all likely to be effected until, by means of the organisation sketched above, there is at least a possibility of steadily carrying out the regular inspections, keeping the registers, and causing the improvements which are required.

In special connection with the present subject certain detail amendments of the Public Health Act must be mentioned. The spread of disease by rats is a fact new to practical hygiene; but, for the future, cognisance must be taken

of

of it, and special powers must be given to meet the newly recognised danger. In the first place, premises which on inspection by the proper authority furnish evidence of infestation with rats should be declared to be a nuisance liable to be dealt with summarily by addition of a definition to that effect to those which stand at commencement of the Public Health Act, Part VI. This would give magistrates power to require the owner or occupier to remove wooden floors (if any) in basements and to substitute concrete, to repair walls and effectually stop holes, to guard entrances with wire-netting, to cause doors to close thoroughly, to shield the lower parts of doors with iron plates, to remove accumulations of useless lumber from yards, and to do all other things which might seem necessary in order to prevent a recurrence of the nuisance. Secondly, power should be given to the Board to order vessels lying at wharves and quays to moor with such precautions as are best calculated to prevent free interchange between ship and shore rats, the law at present only permitting such regulations to be made under an Act which applies to public wharves alone. Thirdly, a general building Act not being in force, something of the kind should be substituted without any delay; and in the proposed amendments, already referred to, a way has been suggested by which this might probably be effected without serious difficulty. Fourthly, the law relating to management of epidemics of dangerous diseases should be so altered as to permit medical inspection or surveillance of suspected persons to be used as an alternative to detention at quarantine—namely, so as to make it possible to order persons to live at any address chosen by them, and to present themselves for examination either there or at prescribed times and places. Fifthly, local authorities should be supreme in all health matters not directly undertaken by the central health authority under the Government; their ratepayers should not be subject to the annoyance and confusion caused by liability to receive notices touching the same subject from different authorities as at present they are; but all such notices, from whomsoever emanating, should be given and enforced by the local authority alone. All of these points were also included in the amendments proposed on July 3rd, and, together with those mentioned before, have been approved by you.

It is clear that the beneficial effect of the foregoing provisions, if they were already law, could not be speedily realised. But notwithstanding the singular way in which plague is diffused, it much resembles all other epidemical diseases in this: That there is no royal road to prevention, and that safety can be attained only by steady and long-continued effort. On the other hand, the result of such efforts would tell largely towards prevention of many other diseases which afflict the dwellers in cities. The best internal defence against plague consists in good construction of dwellings and in household and municipal cleanliness, together with the slighter special precautions mentioned above. The origin of this defence lies solely in knowledge of the disease and the mode of diffusion peculiar to it; the possibility of raising it lies with the Legislature; the execution of it lies with local authorities under the Public Health Act, and can lie with no others.

I have the honor to be,
Sir,
Your obedient Servant,
J. ASHBURTON THOMPSON.

APPENDIX A.

Bacteriological Report.

By Frank Tidswell, M.B., Ch.M. (Syd.), D.P.H. (Camb.), Principal Assistant Medical Officer of the Government, Microbiologist to the Board of Health.

SYNOPSIS.

1. Initiation of Observations.

The bacteriological observations were initiated with sanious lymph obtained from the femoral gland of the first case of the series (A.P.), on January 20th, 1900, the third day of illness. The immediate microscopical examination gave every support to the suspicion of plague roused by the clinical aspects of the case, but in view of the importance of the question at issue, a final pronouncement was deferred pending the completion of the cultural and inoculation tests. The positive results obtained in both of these directions permitted the report of a definite diagnosis of plague on January 23rd, 1900, and the decision thus given received ample confirmation by subsequent observations.

The next point of evidence was secured on February 14th, when, in response to an appeal by the Department, evidence was obtained of excessive mortality amongst rats at one of the wharves in an important business section of the city. On the date mentioned seven rats, three dead and four living, were forwarded for examination, and the microscopical, cultural, and inoculation tests clearly and decisively demonstrated the existence of plague amongst the rats.

On February 24th, femoral and inguinal buboes obtained after the death of the second case in a human being (Case 2) were forwarded, and the series of tests again yielded positive results in all particulars.

From this date onwards throughout the epidemic, a period of four and a half months, practically all the time of the laboratory staff, other than that occupied in the ordinary routine of the laboratory, was taken up by plague work. The demands in this respect comprised examination of specimens from cases in human beings in which the clinical evidence admitted of doubt, or the *post-mortem* appearances were indecisive, or from hospital patients either for information with regard to some particular lesion or symptom, or as to their freedom from infection and safe discharge; examination of rats and other animals taken dead or alive at various parts of the city and suburbs; and observations on the morphology, biology, and pathogenicity of the bacilli isolated from these various sources. The data obtained in these different ways, collected and classified, form the basis of the following descriptions of the more important aspects of the bacteriology of plague.

2. Bacillus Pestis Bubonicæ.—(Figures 1–10.)

(*a*) *Morphological Characters.*

In smear preparations of material from buboes or viscera the micro-organisms were usually present in enormous numbers (v. Figs. 1, 8, 9, 10). As a general rule, the first glance revealed a field teeming with bacilli, and it was very seldom that any lengthy search was required for their detection. The individual elements were isolated, save that here and there two short bacilli were commonly seen end to end in such a position as to suggest recently-accomplished fission, whilst in preparations made from broth-cultures there were sometimes short chains of four to ten bacilli (Fig. 4). In certain specimens, especially those obtained from cases in which the severity of the illness was mild, or in which the acute stage had passed, the bacilli appeared to be enclosed within leucocytes.

Hanging-drop preparations usually showed Brownian motion. Here and there an individual element was seen to be vigorously wriggling, but no movement of translation was ever observed. No essential differences in this respect were noted between specimens taken direct from infected tissues, from young or old cultures, from liquid or solid media, or whether examined at the room temperature, or at 37 degrees C. in the Nuttall incubator. It may here be mentioned that staining methods failed to reveal the spiral flagellum described by Gordon, but it is possible that the few wriggling bacilli which may have possessed one might escape detection.

The application of Widal's method was unsuccessful with specimens taken during the early stages of illness, and blood from convalescents, whilst producing imperfect agglutination in one or two instances, was neither constant nor complete in its effect.

The bacilli stained readily with ordinary aqueous solutions of fuchsine, gentian violet, or methylene blue. They did not retain the colour when treated by Gram's method.

In stained preparations the micro-organisms usually had the appearance of a short straight bacillus, but, as a rule, there was considerable variation in the forms presented by the different elements in the same preparation (Figs. 1, 8, 9). In what may be regarded as the mature form, the outline was either that of a typical bacillus, the sides being parallel for the greater part of their length (Fig. 1), or it was whetstone

or

or boat-shaped, the sides being convex outwards (Figs. 6, 10). Interspersed amongst these were rounded, oval, or dumb-bell shaped elements resembling micrococci or diplococci (Figs. 1, 6, 9). The greatest mixture of forms was observed in smear preparations from infected tissues, but there was always a predominance of those above referred to as mature. In young cultures (24–48 hours) the elements were sometimes very minute, and rounded or oval in outline (Fig. 2); but the later growth was usually made up entirely of bacillary forms. As a general rule, the ends were smoothly rounded-off, but in certain preparations were more abrupt, and even irregular.

An occasional element was surrounded by a halo, which could not be demonstrated as a capsule by staining. This appearance was noted only in specimens taken directly from infected tissues. The "stickiness" of many agar-cultures was suggestive of some glutinous envelope or matrix, but nothing of the kind was to be seen in preparations from cultures, even when mounted without previous suspension of water. Spores were not detected.

The average of a number of measurements gave the bacillary forms a length of 1·8 μ, with a variation between 1·6 μ and 2·4 μ. Rarely longer forms were seen. The breadth averaged ·8 μ, and showed little variation, this feature being much more constant than the length.

In young cultures (24–36 hours) the rapidly-multiplying bacilli were sometimes smaller, but after the second or third day they attained the dimensions given above. The rounded forms had a diameter varying between ·5 and 1·0 μ.

The appearance of the unstained specimen indicated aggregation of the protoplasm at the ends of the rods. The deeper colouration of the poles after staining would thus appear to be accounted for by the structure of living bacilli, and not to result from any plasmolytic effect of the processes of drying and staining. But whilst it may be said that the majority of the specimens contained bacilli showing bipolar staining, this feature was far from being a constant character of individual elements. In some specimens it was exhibited by practically every bacillus (Figs. 6, 8, 10); in others a few elements showing it were only found after some search; in others, again, it was no more than suggested, whilst occasionally it was not at all evident. In general, bipolar staining was much more distinct in bacilli obtained directly from infected tissues than in those from cultures. The degree of colouration varied. There was rarely only a comparatively thin band at the poles with the rest of the bacillus clear; more frequently only a small clear space in the middle of the rod, which was otherwise deeply tinted throughout; but most usually the bacilli presented some intermediate condition.

As mentioned below, cultivation upon dry or salted agar readily produced crops of "involution forms" (Fig. 3). In undergoing this process some elements became greatly enlarged, reaching a length of 5 μ or 6 μ and a breadth of 1 μ, but without loss of the shape and staining properties of the original bacillus. They thus represented, so to speak, giant plague bacilli. But other elements became laterally distended as well as enlarged, forming large sausage-shaped, pear-shaped, spindle-shaped, oval, biscuit-like, circular or irregular bodies, staining with a pale uniform colour, and having no resemblance to the bacilli from which they were derived. Many of these metamorphosed bacilli contained clear round spaces (vacuoles), and if these happened to be at the edge the appearance produced was as if a bite had been taken out of them. The more characteristic involution forms have not been met with in the tissues, but the smaller circular bodies, sometimes found in considerable numbers, may, perhaps, represent them. The production of one or other of the forms above mentioned did not appear to depend upon any particular rule. The bizarre shapes were only found in young cultures; as the growth became older, the elements assumed rounded outlines, but sometimes only the latter were present from the first. The ultimate change appeared to be disintegration.

(b) Cultural Characters.

The initial cultures with material from infected tissues were usually obtained by inoculation of nutrient agar, coagulated serum, or beef bouillon. Subcultures were grown on other ordinary media (gelatine, milk, potato, &c.)

On agar tubes, inoculated with material from buboes or viscera, and incubated at 37° C., the first noticeable growth usually appeared in 36 to 48 hours, in the form of minute bright specks, very slightly raised above the surface of the medium. In the course of a day or two, the colonies became small colourless hemispheres, ranging from ·5 to 1 millimetre in diameter, then having the appearance of tiny drops of dew. Many colonies never developed beyond this stage; others extended to more or less circular patches having a diameter of 2 or 3 millimetres. When so extending, the slightly raised patch became flat on the surface, and acquired a cloudy opacity, the edges remaining thin and colourless. The cloudiness was also developed when a number of colonies became confluent. Rarely it was present from the first appearance of the colonies. A degree of opacity beyond cloudiness was not seen in growths upon agar. The maximum amount of development appeared to be reached during two weeks incubation; after that time no obvious extension of the growths was observed. When the medium was moist the colonies were apt to fuse into an expansion of irregular contour. Individual colonies were sometimes difficult to pick up, slipping about over the surface of the medium when touched by the needle. The confluent growths were often tenacious and sticky, pulling out into strings. In many instances smaller colourless and large cloudy colonies grew up side by side. The bacilli appeared to be morphologically the same in both, and although no observations were made as to their relative pathogenicity, they probably correspond to the two varieties mentioned by Yersin. In subculture the growth appeared earlier than in the original (24–48 hours), and developed as a confluent streak, raised and cloudy along the middle, but with thin, colourless, iridescent borders often having a fine corrugated appearance. The extreme border was wavy. Sometimes a row of isolated colonies formed along both sides of the streak. The breadth of the streak rarely exceeded 2 or 3 millimetres, except at the lower end, where there was often an expansion 6 or 8 millimetres wide. By rubbing or spreading out a streak, a thin, slightly-cloudy growth was obtained, which gave a ground-glass appearance when looked looked at through the thickness of the agar. With age the growth became more transparent, and often developed a mother-of-pearl iridescence.

Anaërobic cultures gave scanty growths. On agar at the room temperature, the growth was much slower, being seldom distinct in less than five or six days from the time of incubation, and reaching its maximum development in about three weeks. The appearances were very much the same, but the ultimate amount of growth less, than in cultures developing in the incubator. On perfectly dry or salted agar the growth

growth developed in very much the same way as on ordinary agar, resulting in a few days in the production of the involution forms already described. The addition of glycerine or glucose was not found to have any advantage over the simple medium. No redness was produced on slightly alkaline litmus agar, whilst the culture itself often acquired a pale-blue colour from the litmus.

On nutrient (17 per cent.) gelatine, at the room temperature the growth appeared in 3–4 days, and reached its maximum development in the course of the succeeding fortnight. In gelatine tubes, kept in the warmer atmosphere of the incubating room (16–20° C.), the colonies sometimes appeared in 24–36 hours. The general appearance of the surface culture was similar to that upon agar, but often had a white colour. In stab-cultures the growth appeared first in the form of a row of closely-placed, fine granules, which later became more or less confluent, and appeared as a well-marked whitish streak. There was a slowly-growing white expansion on the surface. No liquefaction of the gelatine occurred.

On ordinary serum tubes, inoculated with material from buboes or viscera, and incubated at 37° C., growth usually appeared in 36 to 48 hours after inoculation in the form of small, rounded, cloudy colonies. In their development the colonies reached a diameter of 2 or 3 millimetres, and acquired a creamy colour. In general, the growth was more opaque and more abundant on serum than on agar. Occasionally the serum appeared to be depressed in the neighbourhood of the growth, but there was never any observable liquefaction. In subculture the growth on serum was often visible in 24 hours.

In ordinary beef-bouillon tubes, incubated at 37° C., the growth was usually visible on the second day after incubation. As a general rule, it appeared in the form of fine crumb-like spicules attached to the sides, with more or less deposit at the bottom of the tube, the broth remaining clear and transparent. In other cases a moderate uniform turbidity was produced. No change of colour was observed in neutral litmus agar. No reaction for nitrites nor for indol was obtained, except in a few instances of growths several weeks old, in which, however, the culture appeared to be pure bacilli pestis. Growth in bouillon flasks containing oil resulted in the production of a film, scanty crops of stalactites, and a copious deposit. The number of stalactites present at any one time never exceeded six or eight; they were very fragile, and were noticed to become detached from the film and sink to the bottom of the flask with a worm-like motion. The paucity of growth of stalactites is probably attributable to the fact that the laboratory is subject to a considerable amount of vibration, sometimes marked enough to be distinctly felt, and always such as to prevent micro-photographic work in the daytime. The use of the pepto-gelatine medium of Yersin did not give results obviously better than those obtained with ordinary bouillon.

In milk the growth was much less abundant than in bouillon, and development was effected without change in the appearance of the medium.

On ordinary potato, and also on alkalinised potato, a scanty creamy growth, limited to the lower end of the line of inoculation, developed on only a few of the many tubes inoculated.

(c) *Pathogenic Characters.*

The reports of numerous investigators indicate that plague not only affects man, but is liable to attack several different species of lower animals. Rats, mice, pigs, monkeys, cats, marmots, bandicoots, and pigeons are mentioned as having acquired the disease in a natural way, whilst guinea-pigs and rabbits are the most important items of a long list of animals susceptible of infection by artificial means. In Sydney plague has been found in specimens from human beings, rats, mice, and cats forwarded for examination, and in the laboratory experimental observations have been made upon rats, mice, cats, and guinea-pigs.

The specimens from human subjects of plague comprised materials from buboes, carbuncles, blood, sputum, urine, faeces, and from the viscera in *post-mortem* cases.

The material was obtained sometimes at the initial examination by means of a sterilised syringe; and sometimes from patients in the hospital by the same procedure, or after incision when the gland had suppurated. In a few instances sloughs from buboes were examined. The results of the examinations as regards the detection of plague bacilli are shown by the following statement:—

Material taken.	Number examined.	Result positive.	Result negative.
On 2nd day of illness	1	1	...
„ 3rd „ „	5	5	...
„ 4th „ „	1	1	...
„ 6th „ „	3	3	...
„ 7th „ „	4	4	...
„ 8th „ „	4	3	1
„ 9th „ „	4	4	...
„ 10th „ „	3	1	2
„ 13th „ „	1	...	1
„ 14th „ „	3	...	3
„ 15th „ „	1	1	...
„ 16th „ „	1	1	...
„ 18th „ „	1	...	1
„ 19th „ „	1	...	1
„ 20th „ „	2	...	2
„ 21st „ „	1	1	...
„ 23rd „ „	1	...	1
„ 24th „ „	1	...	1
„ 25th „ „	2	1	1
„ 26th „ „	3	1	2
„ 32nd „ „	2	2	...
Between 38th and 94th day of illness	13	...	13
Total	58	29	29

It will be seen that plague bacilli were forthcoming in 50 per cent. of the specimens; that material taken during the first week yielded uniformly positive results, that bacilli were discoverable up to the thirty-second

thirty-second day of illness; but that at later stages, up to the ninety-fourth day, the results were uniformly negative. It may be added that pus from suppurating buboes nearly always gave negative results as regards plague bacilli; it was generally sterile, but sometimes contained micrococci.

Material from carbuncles was examined in three cases, and all gave positive results.

Material from phlyctenules was examined on two occasions, with a positive result in one case.

Blood was taken during life from thirty-two patients either from the finger or from the lobe of the ear. The results were positive in four cases, all of which ended fatally within twenty-four hours after the examination. The negative results were obtained with specimens taken at periods ranging from the second to the seventeenth day of illness.

The sputum was examined in five cases having clinical indications of pneumonia, perhaps primary in one, and secondary in four cases. Plague bacilli were detected in sputum from the possibly primary case, in which they were extremely numerous and practically pure, and in two of the secondary cases in which they were mixed with various other micro-organism.

The urine from twenty-nine patients was received into sterilised bottles, conveyed to the laboratory, centrifugalised, and the sediment examined. Micro-organisms morphologically resembling bacilli pestis were observed in ten of the twenty-nine specimens, but in no instance were they obtained by cultivation or the inoculation of guinea-pigs. In this connection it may be mentioned that no growth was observed in tubes of human urine inoculated from cultures, although other media (agar, serum, &c.) inoculated with the same material, at the same time, showed abundant development. The results were equally negative whether the urine used was sterilised by heat or by passage through the Pasteur-Chamberland filter; and whether left acid or neutralised. As well as the visible evidence, the results were tested by sub-cultivations from the urine tubes on agar or serum, which always remained sterile. But on two occasions growths were obtained from the (alkaline) urine of guinea-pigs dead after inoculation with plague bacilli.

The fæces were examined in twenty cases, microscopically and by plate cultivation, but plague bacilli were neither isolated nor seen.

Plague bacilli have been detected in specimens from various lymphatic glands, spleen, liver, lungs, and blood taken at *post-mortem* examinations on fatal cases. These specimens were submitted for examination as a matter of diagnosis, so that the results are not representative of the intra-corporeal distribution of the bacilli.

The rats forwarded for examination from various parts of the city and suburbs numbered 167. The general results are stated in the following table:—

Condition.	No.	Sick.	Putrid.	Injured.	Result positive.	Result negative.
Living	50	10	.....	3	4	46
Dead.....	117	.....	30	22	19	46
Totals	167	10	30	25	23	92

It will be seen that of the 167 rats, plague bacilli were detected in twenty-three, equal to about 12 per cent. In fifty instances the rats were alive, and 117 were dead. Of the fifty live rats, ten were sick and three injured. They were all killed and examined, with the result that plague bacilli were detected in four, all of which were sick on receipt. Of the 117 dead rats, thirty were too putrid for reliable examination, and twenty-two had injuries of such severity and character as to account for their deaths. Plague bacilli were detected in nineteen of the remaining sixty-five rats.

The pathological appearance presented by the tissues of naturally infected rats (Fig. 15 and 16) was briefly as follows:—There was usually general congestion, œdema, occasional excess of fluid in the serous cavities, and minute hæmorrhages under the skin and into various viscera. Enlargement of the lymphatic glands was a common, but not a constant feature, and when present was usually exhibited in several different situations—femoral, inguinal, brachial, lumbar. On two occasions cervical glands and on one occasion a mesenteric gland were found swollen to the size of a pea, but in all three there was great enlargement of glands elsewhere. The swollen glands were not generally discoloured, and though there were sometimes small hæmorrhages under the capsule, the periadenitic swelling and hæmorrhage characteristic of a bubo were never observed. Generally, but not always, the lungs showed patchy pneumonia, and occasionally a few hæmorrhages. The liver was usually enlarged, sometimes to as much as two or three times its normal bulk (Fig. 15), was of a lighter colour than normal, and on a few occasions was mottled with small white points. The spleen was usually swollen (Fig. 15 and 16), in some specimens it was 2 inches long and correspondingly thickened, but occasionally it was not in excess of the normal limits. The suprarenal bodies were frequently of a dark colour, and in a few instances there were small hæmorrhages under the capsule of the kidney. No definite lesions of the gastro-intestinal tract were noted. With the exception of petechial hæmorrhages under the parietal pleura and peritoneum, the remaining parts of the body presented no pathological appearances meriting special mention.

Preparations, cultures, and inoculations with material from the different viscera indicated that the plague bacilli were generally distributed throughout the bodies of the rats, but they were not always detected in the blood, nor in the lungs.

Experimental inoculation of rats was invariably successful; the animals dying after three to four days. The resulting lesions resembled those after natural infection, except that a bubo was produced in the glands corresponding to the site of inoculation.

The mice taken in different parts of the city and suburbs and forwarded for examination numbered six, and plague bacilli were detected in two of them. The pathological lesions were similar to those observed in the rat, but the small size of the organs prevented accurate observations of the finer changes. Experimental inoculation was performed on eight mice. It proved fatal in five, the deaths occurring in two and a half, two and a half, two and a half, three, four and a half days respectively. A bubo was formed

formed in all cases. The mice surviving after inoculation were observed to be very quiet, and ate sparingly between the third and sixth days after injection, but after that rapidly recovered, and became quite lively in the course of the second week. In all three instances the material used, culture or infected organs, killed guinea-pigs inoculated at the same time. In a series of three mice, the first inoculated with material from a bubo in a human patient, and the others with material from the spleen of the preceding mouse of the series, the animals died in two and a half, three, and four and a half days respectively.

Five cats were forwarded, all living, but two were sick. They were killed with chloroform. In the three apparently healthy cats no abnormalities were found on *post-mortem* examination. One of the sick cats had an angry-looking, discharging ulcer at the right angle of mouth, with inflammation of the adjacent mucous membrane extending back as far as the pillars of the fauces. The autopsy revealed general congestion of the tissues, but no œdema, nor hæmorrhages. The lymphatic glands were not enlarged. Pneumonic consolidation of lower part of right lung; other thoracic viscera normal. Spleen slightly swollen and showing numerous grey nodules; liver enlarged and mottled, section had a vague nutmeg appearance, small intestine congested, stomach and large intestine unaffected. Other viscera presented no departure from normal, except as regards congestion. Smear preparations from the ulcer showed a variety of micro-organisms, but none resembling bacilli pestis; those from the spleen contained a minute bacillus, whilst blood, lung, liver, and mesenteric gland were negative. The culture tubes remained sterile, except those inoculated from the ulcer, which gave mixed growths. A guinea-pig inoculated with a portion of the spleen remained unaffected. There was thus no evidence that this animal suffered from plague. The second sick cat was practically moribund on receipt. There was a subpectoral swelling on the left side, near the axilla, about 2 inches in diameter. This was found to have a nucleus of thin pus, surrounded by œdema, but no hæmorrhage, and involved all structures down to the ribs. In the internal organs there was general congestion, slight œdema, but no general hæmorrhages. The pleura adjacent to the pectoral abscess was intensely inflamed. Both lungs showed numerous broncho-pneumonic areas generally about the size of peas, with hæmorrhagic exudation, and sometimes necrotic central points. The bronchial glands were not visibly abnormal. The spleen was very dark in colour, but not obviously altered in other respects. No special lesions were detected in other parts of the body. Smear preparations from the subpectoral pus and œdema contained innumerable plague bacilli (Fig. 9); and preparations from the pneumonic areas were also positive; but liver, spleen, and blood were examined with negative results. Cultures from the subpectoral œdema gave abundant growths, which at subsequent dates produced fatal plague on inoculation into six guinea-pigs and two rats. No differences were observed as regards morphological, cultural, and pathogenic characters between the bacilli obtained from the cat and those derived from man or other animals.

A healthy cat was experimentally inoculated in the thigh with an emulsion of serum-culture in distilled water. Local swelling appeared in two days, with some apparent malaise. The animal was definitely ill on the fifth day, grew steadily worse during the sixth day, was comatose on the evening of the seventh day, and was found dead on the morning of the eighth day after inoculation. *Post-mortem* examination revealed hæmorrhagic exudation at the site of inoculation extending upwards to the femoral region, where a bubo existed. The corresponding inguinal and, to a less extent, the lumbar glands were congested and enlarged. There were no enlarged glands elsewhere. Beyond congestion and slight enlargement of the liver and spleen the organs showed no obvious departure from the normal. Smear preparations from the local exudation, femoral, inguinal, and lumbar glands showed innumerable plague bacilli, and though less numerous, bacilli were also plentiful in the spleen and liver. The lungs and blood gave negative results. Cultures gave vigorous growths.

Guinea-pigs inoculated in the laboratory usually died within four to five days. The exact times ranged from two to ten days, but was rarely longer than six days. No definite differences were obtained in this respect as regards the effect of material from different sources. The inoculations were generally made into the inner side of the knee. The *post-mortem* examinations (Figs. 11, 12, and 13) sometimes revealed hæmorrhagic swelling at the site of inoculation, extending up the leg, but generally there was no such local reaction. In every case there was swelling of the corresponding femoral glands, and usually also periadenitic exudation and hæmorrhage. The related inguinal were frequently, and the lumber glands sometimes, swollen, and occasionally showed periadenitic hæmorrhage (Fig. 13). In some instances other glands were were involved, *e.g.*, the deep abdominal, brachial, and cervical groups, and might even show petechial hæmorrhage, but never the appearances observed at the primary bubo. The mesenteric glands were always free from visible alteration. The tissues were generally congested, dusky, œdematous, and very commonly there were petechial hæmorrhages under the skin, serous membranes, as well as in the viscera. The lungs were rarely normal; usually they showed degrees of alteration varying from limited areas of congestion to inflammation of the greater part on both sides (Fig. 11), and petechial hæmorrhages were commonly observed in them. In some cases they were studded with miliary points (Fig. 12). The pericardium and heart rarely showed any changes beyond congestion, and sometimes hæmorrhages. The liver was usually enlarged, sometimes to twice its normal size (Fig. 11). The surface often showed discoloured areas, fine mottling of white points or numerous small hæmorrhages. The spleen was almost invariably enlarged to two or three times its normal size (Figs. 11 and 12), occasionally it was much larger. The surface was usually marked by a variable number of white spots (Figs. 11 and 12), irregularly distributed, and sometimes very numerous. The general colour was much darker than normal, either uniformly or in patches. The edges were thick and rounded. The kidneys were sometimes larger than normal, as a rule pale and marked by hæmorrhages (Fig. 13). The suprarenal bodies were generally swollen and congested, and sometimes of a deep red colour (Fig, 13). The stomach and intestines were usually unaltered in appearance, but occasionally the small intestine was congested. No definite changes were observed in the urinary organs.

The bacteriological examinations showed that occasionally the plague bacilli were practically limited to the site of inoculation and bubo, but that usually they were present in all parts of the body. They were often very abundant in the bubo, in other lymphatic glands, in the spleen, and in the liver. They were not always discoverable in the blood of the heart, even when numerous in the viscera. On two occasions they they were recovered from the urine, but were not found in the bile. Micro organisms, morphologically resembling plague bacilli, were detected in the nasal mucus on three occasions, in all of which there was marked pneumonia.

3. Experimental Observations on the Mode of Infection in Plague.

As opportunity offered, experimental observations were made with the object of instituting comparisons with the reports of other investigators on certain epidemiological aspects of the bacteriology of plague. The work in this respect had to do with various assertions as to the manner in which plague is acquired, and more especially with regard to inoculation, ingestion, and inhalation. The results here reported represent the first fruits of a plan of investigation not yet completed in detail.

(*a*) *Inoculation.*

The experiments described in the foregoing section afford abundant testimony of the susceptibility of various animals to plague bacilli inoculated under the skin, and are in accord with the reports of authorities. It is generally believed that inoculation at some point on the external surface of the body is also the principal mode of infection in man. The significance attached to the occurrence of a bubo is that the inoculation took place through the skin of the region from which lymph is collected to pass through the affected gland. The validity of this inference is vouched for by both clinical and experimental evidence. It has occasionally happened that medical men engaged in investigations on plague have become accidentally inoculated in some particular place, and the resulting bubo has always developed in the glands associated with the part known to be the site of inoculation. Thus Dr. Sticker, a member of the German Commission sent to India to study the plague, received a scratch on the hand whilst performing an autopsy on a plague subject. This small wound was followed by enlargement and tenderness of the glands in the corresponding axilla. A similar sequence of events occurred in the cases of Drs. Aoyama and Ishigami, of the Japanese Commission, who were infected in the same way during their work at Hong Kong. Experimental inoculation of animals always results in a bubo affecting the nearest-related group of lymphatic glands. In the observations made in this laboratory, inoculation in the thigh was followed by a femoral bubo, and inoculation in the fore-leg by an axillary bubo. Hence when a bubo is present the entry of infection occurred in the corresponding part of the body, and observers have very generally endeavoured to find indications of it in the patients coming under their notice. As a matter of fact, any such evidence of the exact site of infection is rarely forthcoming. In the great majority of cases searches for such prove futile; no lesions are to be discovered. They had either disappeared by the time the examination was made, or had never existed. This has also been our experience in human beings; and in most of the inoculations on lower animals performed in the laboratory there was no local reaction at the actual point at which the bacilli were injected, all traces of the tiny wounds made being obliterated in the course of a day or two. But in many instances scratches, abrasions, or wounds of the skin have been credited with affording the means of ingress; whilst Simond and some other observers have described the occasional presence of a special local lesion, a phlyctenule, as indicative of the point of entry. Observations on both have been made in this laboratory.

(i) The Significance of Wounds of the Skin.

In a few of our cases in human beings scratches or abrasions were found which might have sufficed to admit the infection, but in all cases, when discharges or scrapings from them were examined, no plague bacilli were detected. The contamination of such wounds with plague microbes involves contact with a plague subject or with some infected inanimate material. The acquisition of plague by direct contagion has been asserted in a few instances, but the conditions under which it is said to have occurred have never been such as to place the matter beyond question. On the other hand, there is abundant evidence that even close association with the plague-stricken, as in hospitals and in most households, does not involve infection. Experimental verification of this fact has also been obtained by many investigators, and was the outcome of the following observations made upon the point in this laboratory:—

1. A healthy mouse was placed in the same jar with another mouse inoculated with material from a bubo. They remained in association during two and a half days, when the inoculated mouse died, and on *post-mortem* examination was found to be generally infected with plague. The other mouse remained perfectly healthy for a period of three weeks, and on being then killed was found to be free from disease.
2. A healthy rat was placed in the same cage with a rat inoculated from a culture. They remained in association during three days, when the inoculated rat died, and was found to be generally infected with plague. The other rat remained perfectly healthy for a fortnight, when it was inoculated from a culture of plague bacilli. It died of plague in three days.

It will be seen that in both instances animals intimately associated with others fatally sick with plague escaped infection, although in one case at least there was no insusceptibility to the disease.

In connection with this aspect of the question some experiments may be mentioned, which were designed to investigate the liability of infection being derived from the surroundings of the sick. On one occasion a mouse, on another a guinea-pig, and on six occasions rats were placed in the uncleaned jars in which animals had died of plague. In no instance did the animal so exposed become infected, although the conditions may be regarded as eminently favourable for mediate contagion. The failure to acquire the disease was not due to insusceptibility, for most of the animals subsequently succumbed to inoculation with plague-cultures or infected organs.

These experiments upon the acquisition of plague from inanimate objects raises the question of the extra-corporeal existence of bacillus pestis. The many experiments which have been performed to ascertain the behaviour of the bacilli under conditions as nearly as possible similar to those in Nature are in general accord in the conclusion that bacillus pestis is not capable of prolonged saprophytic life. As the possibility of the contamination of wounds is most likely to occur from clothing, or from dirt, some experiments on the viability of plague bacilli in such materials were made in this laboratory. The series of experiments is not yet complete, the articles hitherto used comprising only (a) silk and (b) garden soil.

(a.) Small pieces of old soft silk, 1 centimetre square, were placed in a glass double dish, sterilised, allowed to cool, and then soaked in a bouillon-culture. In the first series the excess was removed and the squares placed in the incubator at 37° for about twenty-four hours. They were then removed and kept at the room temperature; pieces being taken at intervals of a few days, and inoculated into bouillon tubes. Growths were obtained up to, but not after, the fourteenth day from the date of infection. In a second series the

sojourn

sojourn in the incubator was omitted, but otherwise the observations were made exactly as before. Again, no growth was obtained in bouillon receiving the squares of silk after the lapse of more than fourteen days from the date of infection. Thus the bacilli on the silk retained their vitality for about a fortnight only.

(b.) In the other experiments baccilli were inoculated from an agar-culture into sterilised garden mould. In some cases the dry culture was mixed with the dry mould, in others the culture was made into an emulsion with sterilised distilled water, and this added in a quantity such as to render the soil merely moist. Samples removed from the dry tubes after six and thirteen days gave no growths in bouillon. Samples removed from the moist tubes continued to give growths up to the twenty-first day. After this the soil had become drier and the subcultures showed no growths.

The two kinds of observations just described are not in themselves adequate proof of brief survival of plague bacilli in natural materials. But taken in conjunction with the results of other investigators, they suggest that the assumption of the derivation of infection from inanimate objects through wounds and abrasions can only be regarded as valid when the contact has clearly been with quite recently-infected articles.

(ii) The Significance of Phlyctenules.

The second kind of local lesion, the phlyctenule, found in plague patients, is ascribed by Simond to inoculation of plague bacilli by fleas—a conclusion at which he arrived as the result of a series of interesting observations which may here be briefly summarised. As the outcome of close inquiry into the circumstances attendant upon the well-known liability to plague infection as a consequence of handling rats dead of the disease, Simond states that a plague rat is dangerous or not, in accordance with the time that has elapsed since it died. If handled soon after death, plague may follow ; but if not touched for some hours, it may then be handled without risk. It was, says Simond, just as if the infection completely evaporated within a few hours after death. He also states that perfectly healthy rats harbour very few fleas, and are very expert in removing them ; but as they become sick they neglect their toilet, and fleas become more and more abundant upon them, so that they sometimes swarm upon moribund rats. After death, on cessation of the circulation, and as the body becomes cold, the fleas leave it and seek another host.

By associating the "evaporation" of the infection with the departure of the fleas, Simond inferred that these parasites were implicated in the transport of the infection. This inference was further supported by clinical observations of two kinds, viz., the site of the bubo, and the existence of a phlyctenule. Simond noticed that persons becoming plague-stricken after handling a dead rat did not necessarily develop their bubo in the axilla. As often as not in such cases the bubo was femoral. Hence the infection was not due to direct contact with the rat, but to some associated circumstance, such as invasion by fleas from the rat. It is obvious that such fleas might inflict a bite and inoculate the bacilli not on the hand or the arm, but on the leg or trunk, and thus produce a bubo elsewhere than in the axilla. He also observed that occasionally a small papule or vesicle—phlyctenule—was present on the area corresponding to the bubo ; and more especially on a part where the skin was thin, *e.g.*, the dorsum of the foot. The occurrence of such a phlyctenule is vouched for by several other investigators, though not all concur in Simond's interpretation of it. This local lesion is not always apparent, and, in fact, in the majority of cases it is not to be found ; but this frequent absence, Simonds contends, is due to the fact that it would only be produced when the inoculated bacilli were of comparatively mild virulence or in small quantity. Under such conditions there would ensue positive chemiotaxis, local leucocytosis and reaction ; whereas, if the bacilli were very virulent, the chemiotaxis would be negative, and no such local reaction occur. Following up these observations, Simond succeeded in detecting plague bacilli in some of the phlyctenules and in fleas from plague rats, and with the latter he produced plague by inoculation of animals. He therefore concluded that if the fleas from the dead plague rat reach another rat or a human being, they may inoculate the bacilli they acquired by ingesting the blood of their former host, and so produce plague ; the site of inoculation being occasionally indicated by a phlyctenule. By way of complete demonstration of his hypothesis, he showed that plague could be conveyed in the way suggested. He placed in a large glass jar a sick rat, and also a healthy animal (rat or mouse), the latter being enclosed in a small cage so as to prevent contact with the sick rat. If he left or placed fleas upon the sick rat, and allowed its body to remain lying in the jar for some hours after death, the healthy animal sometimes developed plague and died ; but if he previously removed all the fleas from the rat and repeated the experiment otherwise precisely as before, the healthy animal did not die, but remained perfectly well.

Simond's observations and experiments were repeated in this laboratory as opportunity offered. As already mentioned, phlyctenules were found in six patients, and smear preparations were obtained from two of them. The examination of the preparations from one proved negative, but those from the other showed a small number of micro-organisms having the morphological characters of plague bacilli. As no further tests were possible, the exact nature of the bacilli remained unascertained. It may here be mentioned that a lesion resembling a phlyctenule was artificially produced in one of the experimental animals. A guinea-pig was inoculated in a small, shaved, sterilised area on the fore-leg, by being pricked with a needle previously sterilised, cooled, and then dipped in a plague-culture. On the following day a small inflamed papule had developed at the site of inoculation, and on the third day, when the animal died, this papule showed a whitish spot at its apex as though about to undergo vesiculation. *Post-mortem* examination revealed the general appearances of plague, including an axillary bubo, and plague bacilli were found in the papule, bubo, liver, and spleen. The production of the phlyctenule in this case corresponds with Simond's hypothesis, inasmuch as the number of bacilli inserted by the process adopted was very much less than in inoculation performed in the usual way, which is not followed by any such lesion.

Examinations were made of fleas from healthy human beings, from a plague patient, from mice, from rats, and from cats. The microscopical examinations all prove negative except in the case of fleas obtained from a rat actually sick with plague. This rat was taken in a house from which a case of plague had been removed five days previously, and in the vicinity of which many persons were attacked. The animal was killed with chloroform, and about a dozen apparently stupefied fleas were obtained from its body. The fleas were crushed up in a few drops of sterilised distilled water, and as preparations from the emulsion so obtained showed micro-organisms resembling plague bacilli (Fig. 5), the remainder of it was inoculated into a guinea-pig. The animal became sick, and died on the seventh day. The *post-mortem* appearances were those of plague, and micro-organisms resembling bacilli pestis were found in the bubo, in the blood of the heart, in the spleen, and in the liver.

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In the experiments performed with living fleas, the conditions described by Simond were slightly modified. A rat, selected because of its having many fleas upon it, was inoculated with plague bacilli from a culture and placed in a small wire cage. A second healthy rat was placed in a similar wire cage. The two cages containing the rats were both placed in the same (sheet iron) larger cage, the interval between them being about 2 inches. The inoculated rat died in three days, and its dead body was allowed to remain in the cage for twenty-four hours. It was then removed, and on examination was found to be generally infected with plague. The other rat remained perfectly well for a period of four weeks. The experiment was repeated under exactly the same conditions, except that numerous fleas, obtained by the chance discovery of a mouse's nest, were thrown into the cage, and upon the inoculated rat. This animal also died in three days, its body left twenty-four hours in the cage, and when examined found to be generally infected with plague. A third rat was placed in the uncleaned cage. Neither the first nor the third rat became infected.

It will be seen that the observations we had the opportunity of making in this laboratory gave support to Simond's assertions, as regards the presence of plague bacilli in phlyctenules and in fleas from plague rats, and, whilst the results in the experiments with living fleas were negative, it has to be noted that such tests are obviously liable to miscarry owing to the several uncontrollable factors involved in their performance.

(*b*) *Ingestion.*

Authorities are not agreed upon the question of the acquisition of plague by ingestion of infected diet. In the epidemic at Hong Kong in 1894, plague was said to sometimes take a special form indicating that the infection had entered through the stomach or intestines. This form is said not to have been observed in India, and *post-mortem* examinations have generally failed to reveal evidence of gastro-intestinal infection. No sign of intestinal plague was observed in our own cases. Experimentalists are also at variance—some having succeeded, others having failed, to infect animals by feeding. In this laboratory ingestion experiments were performed by feeding animals with bread, or biscuit, sopped in a bouillon-culture, or in an emulsion of agar-culture; and by the contamination of carrots or bread with, or, in the case of rats, actual feeding upon infected organs. The result of the eleven experiments of this series are shown in the following tabular statement:—

No.	Animal.	Experiment.	Result.
1	Guinea-pig	Fed with bread; infected from agar-culture	Unaffected.
2	"	" bouillon-culture	"
3	"	" infected liver	Died in 5½ days.
4	"	"	Unaffected.
5	Mouse	" biscuit, sopped in bouillon-culture	"
6	Rat	" bread infected from agar-culture	"
7	"	" biscuit infected from bouillon-culture	"
8	"	" liver and sternum of infected rat	Died in 6½ days.
9	"	" " " "	" 10½ "
10	"	" spleen "	" 4½ "
11	"	" " "	" 4½ "

The various animals received the infected food on one occasion only, and in all cases a control animal, inoculated with the same material, died in the usual time. It will be seen that whilst feeding with cultures was always unsuccessful, a diet of infected organs proved fatal in one of two guinea-pigs, and in all from rats fed upon it. In the fatal cases there were no signs of external injury such as might result from scratching with infected claws, and no bubo indicating that inoculation had occurred in any such way. Further, in most instances the animals were kept in cages by themselves, so as to prevent fighting, &c., by which inoculation might also be effected. The fact of plague infection was verified by *post-mortem* and bacteriological examinations. The guinea-pig and two of the rats which died showed no gastro-intestinal lesion beyond congestion of the iliac portion of the small intestine, and even this was absent in a third rat. The mesenteric glands were not enlarged in these cases. But in the fourth rat there were well-marked indications of the passage of the infection through the walls of the digestive tract. The stomach and intestines showed fine hæmorrhages, and the ilium and first part of the large intestine were intensely inflamed. Connected with the stomach there was a large deeply-congested lymphatic gland. The blood-vessels in the mesentery were engorged with blood, and the mesenteric lymphatic glands were swollen and fused into a sausage-shaped mass. The cæcal end of the large intestine was involved in hæmorrhagic fibrinous exudation, causing adhesions, and extending into the swollen mesenteric glands. These various changes are shown in Figure 14.

From the results of these experiments, the provisional conclusion is drawn that animals may become infected by ingestion of infected materials. The susceptibility would appear to vary in different animals, rats being more liable to acquire infection in this way than the other species tested. It would seem also that something depends on the exact condition (virulence?) of the plague bacilli with which the food is contaminated.

(*c*) *Inhalation.*

Infection by inhalation is stated to be responsible for plague pneumonia, a fatal form of the disease of which we have fortunately had practically no experience. As in the case of ingestion, so with inhalation experiments, observers have sometimes succeeded, sometimes failed, to infect animals. In this laboratory the only experiments made in connection with this aspect of plague-infection were repetitions of those of Batzaroff, who produced pest-pneumonia by deposition of culture material on the uninjured nasal mucous membrane of rabbits and guinea-pigs, and by smearing the nostrils of rats and mice. The material used by us included culture material, and fresh plague-infected organs, but in five experiments performed the results were always negative.

APPENDIX B.

The Clinical Aspects of Bubonic Plague, as observed in the outbreak of the disease in Sydney during the period commencing 20th January and ending 9th August.

By A. E. Salter, M.B., Ch.M., Melb., in charge of the Isolation Hospital.

During that time, as the subject matter of the report which precedes this has shown, there were 303 cases of this disease reported at the office of the Department of Public Health for New South Wales.

Of these 303 cases, 10 were among persons of the Chinese race, and the remaining 293 among persons of European descent; of the 293 Europeans, 13 had become affected with the disease at some time subsequent to their inoculation with Haffkine's serum.

In order that a comparison may be instituted between persons of the same race only, these 10 Chinese have been kept in a separate group by themselves.

The 293 Europeans have been divided into four groups—the first three according to centuries—the first of these contains the first 100 Europeans reported suffering from Bubonic Plague, the second group contains the second 100 reported, the third contains the 93 remaining after the first 200 have been dealt with, the fourth being made from Haffkine's inoculated cases, which have been picked out from the different groups in which they are scattered and placed in Table 2, in order that the prodromal symptoms with which they were attacked may be compared with the prodromal symptoms of the complete group. Thus we have a total of five groups, which for convenience of reference have been called by the letters A for the first 100 European cases, B for the second 100, C for the remaining 93 Europeans, D for the inoculated persons, and E for the 10 Chinese.

Comparing the first three Groups A, B, C, of the series, to learn when they came under the notice of this Department, it is found that Group A was reported between the 20th January and the 12th April, in fact that these 100 cases developed in a period of 82 days. Group B came to light in 28 days, so that the second 100 cases were produced in slightly more than one-third the time that it took to produce the first 100. The cases of Group C were discovered between 9th May and 9th August, that is in 93 days, or in a period more than three times as long as it took to produce the cases comprising Group B.

As there is this difference between the periods of time taken to produce these three groups, it might be inferred that the virulence of the infection accrued during the first period, reached its zenith in the second, and declined during the third. Yet the death rate among the cases in Group A was 37 per cent., while it was 37 per cent. among the cases in Group B, and 22·6 per cent. among the cases in Group C, which seem to point, if not to a greater virulence in the first portion, to at least an equal virulence, and a study of the incidence of nervous symptoms tends to strengthen the latter inference. Taking a mean of all the temperatures recorded, when the case has been seen for the first time, the mean for Group A is 103·2, the mean for Group B is 102·8, and for Group C it is 102·1, showing that there was a gradual ebb in the temperature wave. Whatever be its cause, the first 100 cases of Bubonic Plague occurred at the rate of 1·2 per day, the second 100 at the rate of 3·5, and the third at the rate of 1 per day. The premonitory symptoms most frequently complained of in each group have been taken out and put into Table 1, and the number of deaths in each set of symptoms has been put down with the object of showing what mode of attack may be regarded most gravely, and therefrom to form a basis for prognosis in the earlier stages from the initial symptoms.

Group A.

From Table 1 it appears that pains in the body, back, and chest were complained of as initial symptons in 23 cases; of these 23 eleven died giving a mortality of 47·8 per cent. Vomiting, not the commonest premonitory symptom, had the second greatest percentage of deaths among those who suffered from it. It was a premonitory symptom in 55 cases, and of the 37 persons who made up the total number of deaths in Group A 26 suffered from this initial symptom so that 47·3 per cent. of the persons affected with vomiting died. Headache was complained of in 72 cases, of them 26 died, giving a percentage of 36, while symptoms referable to the lymphatic glandular system were complained of at the very onset of the attack in 29 cases with 11 deaths. The percentage of deaths among cases presenting this symptom was 37·9.

For purposes of prognosis in Group A pains in the body, back, and chest were most important, vomiting being almost equal. The mean average of all the first recorded temperatures was 103·2.

Buboes.—The lymphatic glandular system was affected in the cases of this group 97 times, while in the remaining 3 no abnormalities were discovered nor referred to by the patient.

From Table 4 it appears that the most frequently affected glands were the right femorals, the next in order being the left femorals, while those next in order were the inguinals, but far behind the two first. The femoro-inguinal regions were responsible for a total of 83 cases, leaving 14 to be divided among all the others when the mortality among these cases is considered it is found that in the 3 cases with no glands there were 3 deaths, and among the 30 cases of right femoral, that there were 10 deaths, among the 25 cases of left femoral that there were 7 deaths. The femoro-inguinal regions with 83 cases were responsible for 25 deaths, while among the remaining glandular regions there were 9 deaths; so that the 14 cases of Bubonic Plague in which the sub-pectoral, axillary, or cervical glands were affected were responsible for 9 deaths showing a percentage of 64·2. The preponderance of mortality was much greater in cases with glandular troubles of the cervico-axillary regions. In 46 cases the buboes were incised. Of these 46 there were 3 operated upon which died subsequently, therefore, 43 of the incised cases recovered and 34 of the deaths took place prior to the suppurative stage being reached, leaving 20 cases in which recovery took place and the buboes resolved, so that of the 63 persons altogether who survived, 68 per cent. suffered from suppuration of their enlarged glands and 30 per cent. recovered with resolution of their glandular affections. Pain or tenderness of the glands at some period of the illness, not necessarily at first—was complained of 57 times altogether.

Secondary Buboes.—These occurred 7 times, but by the expression secondary buboes is meant those buboes occurring after a well-defined term had elapsed between the appearance of the first bubo or chain of buboes, because it was not always easy to determine the order of precedence where several buboes arose in the illness.

Nervous Symptoms (*see* Table 3.)—Symptoms referable to derangement of the nervous system, such as trismus, delirium, coma, semi-coma, staggering gait, thickness of speech, convulsions, screaming, occurred either singly or in combination with each other in 72 cases. Of these 72, there died 28, or a

percentage

percentage of 38·9 Taking these symptoms separately, coma was seen 4 times, semi-coma 25 times, delirium (ordinary) 33 times, delirium (furious) 17 times, getting out of bed 9 times, hebetude 12 times, speech was affected 23 times, staggering gait is recorded as occurring twice, screaming of a wild and furious nature twice, convulsions 6 times, trismus twice, insomnia 7 times. Spitting: This curious habit occurred in 5 cases; it consisted of a desire to expectorate, though there was no mucous which could be regarded as obnoxious, as far as its appearance afforded opportunity for judgment. The cases which exhibited this symptom would sometimes expectorate right across a ward. If addressed upon the subject they continued their habit, taking no notice of remonstrances, and not trying to avoid any object which might be in the line of fire. Among these 5 there were 3 deaths. It was always regarded as a grave symptom, and in the 2 cases in this group which exhibited it, yet recovered, the train of the symptoms was as follows:—In the first, temperature 104·6, with furious delirium, clammy perspiration, pains in the muscles, irregular pulse, respirations with a frequency of 30 and in the second temperature 103·8, ordinary delirium, pulse very soft 124, respirations 38 and insomnia.

Organs of Vision.—The conjunctivæ were deeply injected in 7 cases; the ultimate result of this injection was as follows:—In two cases considerable mischief to the eyeball took place, the sight of the right eye being quite lost in the one, and considerable corneal impairment supervening in the other. In 3 cases it gradually dispersed, no lesion of the eye taking place; in the other two, though iritis and ulceration of the cornea took place, both recovered and left the Quarantine hospital without any apparent mischief being left behind.

Eruptions of the Skin.—Ecchymotic patches were seen in 6 cases, Erythematous eruptions 3 times, Petechial eruptions twice, Miliary eruptions 3 times, Scarlatiniform once, Eczematous once.

Tongue.—This organ presented the character of being covered with a creamy white fur on the dorsum, and having the tip and edges bright pink and clean in 43 cases.

Septicæmic Cases.—Those 3 cases, with no glandular lesions discoverable during life, died and were not admitted to hospital. The course of their illness in two cases was 30 hours; the third had been ill several days at notification. These may be regarded as Septicæmic cases.

GROUP B.

The premonitory symptoms of this group are found by reference to table 1 to have been, as in the former group, headache, vomiting, rigours, symptoms referable to the lymphatic glandular system, pain in the back, body, and chest, in the order named as far as frequency is concerned. When the mortality in each set of symptoms is considered, the cases of vomiting are accredited with 40·4 per cent. of deaths, the cases of pains in the body, back, &c., with 36·6 per cent., headache with 31·2 per cent., rigors with 34 per cent., and symptoms referable to the glandular system with 25·6 per cent. For purposes of prognosis in these cases, the vomiting stands the highest in the rate of mortality, pains in the back or body coming next. The mean average of all the temperatures first recorded is 102·8.

Buboes.—The lymphatic glands in this group were affected in 93 cases, and in 7 cases no glandular troubles could be discovered. The left femoral glands were affected alone 21 times, the right femoral alone 16 times. The right inguinal were affected 10 times, and the left inguinal 5 times. Taking inguinal and femoral for both sides together, we find the right groin affected 32 times, and the left groin affected 31 times. To get the femoro-inguinal chain complete there should be added the 4 cases in which both groins were affected in the one individual, and the one case in which the right femoral and left popliteal were affected. The total in this chain for Group B is, therefore, 68. It appears from these observations, and from the observations in Group A, that the femoro-inguinal chains on both sides had about equal chances of infection, and were very much more often affected than the other regions. It must be remembered that the glands of the groin were also frequently affected at the same time as were those of the region next to be considered.

The Axillary Region.—The axillary glands were affected unilaterally once for each side—the cervical glands of the right side once, and of the left side 3 times, in each case unilaterally; but axillary and cervical glands (not considering those just mentioned) were, in combination with some other of the lymphatics, affected 17 times. There were also 1 right and 1 left subpectoral, which are included in the axillary chain. On adding all these together, it appears that the cervico-axillary chain was affected 25 times. The mortality in these two divisions was 19 for the femoro-inguinal chain and 12 for the cervico-axillary chain, being a percentage of 26·4 in the first case and 48 in the second. The most fatal kind were the cervical, as in the 4 cases where the cervical alone were affected 3 died, or 75 per cent. Incision was necessary in the glands of this group in 41 cases. Of the 41 buboes incised there were 2 among them in which death supervened, leaving 39 cases operated upon with recovery, and 34 cases of death without the stage for operation being reached, and 25 in which there was recovery without incision. Taking the cases, therefore, of recovery, viz., 63 in all, it appears that the percentage of them which needed operation was 62, or somewhat less than the percentage needing operation in Group A, while the percentage of cases recovering in which the glandular structures did not break down at all was 39.

Secondary buboes occurred in 17 cases.

Nervous symptoms (*see* Table 3). Symptoms indicating derangement of the nervous system occurred either singly or in combination with each other in 62 cases; of these 25 died, giving a percentage of 42 deaths. Separately they occurred as follows:—Coma, 9 times; semi-coma (not counting it when it went on to coma), 8 times; delirium of an ordinary kind (not counting it when it became furious), 33 times; furious delirium, 15 times; getting out of bed, 18 times; mental hebetude, 6 times; wild delirious screaming, once; convulsions, twice; affection of the speech was noted in 15 cases; insomnia was complained of 5 times; and staggering gait noticed 5 times; spitting occurred in 4 cases, with 3 deaths.

The Organs of Vision.—In this group 4 persons suffered from a deep injection of the conjunctivæ, with the final result that in the case of 1 bilateral iritis, hypopyon and panophthalmitis supervened, with complete blindness. One case cleared up when in hospital, but on returning to work the left eye was found to be weak, and to have a tendency to a recurrence of the injection. The third cleared up completely, and the eyes were strong and well when last heard of. The last of these 4 died before the eyeball became affected.

Eruptions of the Skin.—Erythema occurred 4 times, ecchymoses 4 times, and petechiæ 4 times. In 1 case the body became purple all over sometime before death; in another varicella was just disappearing as bubonic plague came on. Epistaxis occurred in 1 case in this group important enough to require special notice (Case 183).

Septicæmic Cases.—There were 7 cases without glandular symptoms. Of these, 2 were admitted to hospital, the other 5 died too soon in their progress of their illness to admit of removal; of those 2 who were admitted, 1 recovered; the other, after lingering some days, finally succumbed. GROUP C.

GROUP C.

As in the previous groups, the same premonitory symptoms were recorded. Forty-nine cases complained of vomiting, and 14 died; 49 also complained of headache, of them 10 died. Pains in the back, etc., were complained of only 13 times, with 3 deaths; rigors occurred in 62 cases, with 14 deaths. Symptoms referable to the glandular system are noted in 34 cases, with 5 deaths. Even when allowance is made for the fact that in this group only 93 cases are under consideration as against 100 in the two previous groups, it would appear that the number of persons complaining of pains in the back and bones had very markedly decreased. The mean average of the first noted temperatures was found to be 102·1.

Buboes.—The inguino-femoral chain in this group produced 58 of the total of 89 cases in which buboes were found, the remaining 31 being divided thus: Axillary and subpectoral regions furnished 16, cervical 4, and the cervico-axillary region combined with some other region, or with each other, furnished 11. There were 4 cases without any buboes, which brings the total up to 93. The mortality as shown in Table 4 points to the same preponderance in the same regions as was noticed in the other groups, the axillary and subpectoral chain being most fatal, with 50 per cent.; the cervical being the next in order, with 25 per cent., until the inguino-femoral chain is reached with 12 per cent. Thirty buboes were incised. Of these 30 incised cases 1 died, and 43 recovered without incision, the buboes resolving. Thus 40 per cent. of the cases recovering needed operation. There were 20 deaths in which no incision was justified. The percentage of cases recovering with resolution was 59·7.

Nervous Symptoms.—Symptoms referable to derangements of the nervous system: Coma occurred in 3 cases, with 3 deaths; semi-coma (not going into coma) in 3 cases, with 2 deaths; delirium (ordinary) in 18 cases, with 7 deaths; delirium (furious) in 6 cases, with 3 deaths; getting out of bed in 7 cases, with 2 deaths; hebetude is noted once, with no deaths; affection of speech in 12 cases, with 2 deaths; insomnia in 3 cases, with 2 deaths; loud screaming in 3 cases, with 1 death; convulsions in 1 case, with 1 death; staggering gait in 2 cases, with 2 deaths. One or more of the foregoing occurred either singly or in combination with each other in 39 cases, or in 42 per cent. of the total admissions. Of these 39 there died 16, being 41 per cent. of deaths. Spitting was observed in 1 case, which was fatal.

Organs of Vision.—The conjunctivæ were deeply injected in 5 cases with following result:—That in 1 case there was some iritis going on to hypopyon, which cleared up the eye, recovering finally, though very weak. Of the other 4 cases, 1 died too early in his illness to show what the future held in store for his eyes, while the remaining 3 never became more than merely conjunctiva injection; finally they cleared up altogether. Eruptions of the skin in this group were: Eczema, once; urticaria, several times; erythema, once; petechia, once; large ecchymosed patches came out in 1 case a short time before death.

Septicæmic Cases.—There were 4 cases in which no glandular symptoms were distinguishable during life. Of these, 2 were admitted to hospital, and 2 were overcome before it was possible to remove them. Of the 2 who were removed to hospital, 1 recovered; the other, after an illness of 9 days, died.

GROUP D.

This group comprises the cases inoculated with Haffkine's prophylactic. They are placed in Table 2 to show how their premonitory symptoms compare with those of the cases in Table 1, where the whole list of cases in each group is dealt with. It is worthy of note that on comparing these two tables it appears that the inoculated cases had milder prodromal symptoms. These persons suffered from vomiting as an initial symptom only 4 times out of the 13, and from pains in the back and body only once. Their glandular regions were affected as follows:—

Swelling of the right femoral occurred 4 times, of them 1 was incised; left femoral 4 times, of them 3 were incised; right inguinal once it was incised; left inguinal twice, 1 was incised; right inguinal and femoral once it was incised; right and left femoral once, and was not incised; right cervical once, and was not incised. Thus of these 14 buboes, 7 were incised, the remainder resolved. As strengthening this comparison, it is to be borne in mind that Table 1 has the advantage of having the inoculated cases included in it, so that it gets the benefit of their less-marked symptoms.

GROUP E.

Chinese.—There is not much to be said of this group, because of the 10 persons who were attacked 7 were discovered in extremis. Those whose faculties were not completely clouded by the intoxication of their disease were unable to speak English well, and could not give much information. Two out of 10 recovered, and of them 1 suffered the loss of an eye as a result of the injection of the conjunctivæ followed by iritis and panophthalmitis. Both eyes were affected with iritis, but in the 1 case it cleared away, and good vision has remained in this eye, while total loss of vision resulted in the other. The buboes recorded were 1 right inguinal, 1 right inguinal and femoral, 1 right and left inguinal, 1 left axillary, 1 left cervical, 1 right and left cervical, 1 right femoral. Three had no buboes, as far as can be ascertained. That case with the right inguinal and femoral gland affected, and that case with the right femoral affected, are the 2 which recovered. In both cases the buboes were incised. In 1 of the Chinese a carbuncle formed on the right hip. He recovered. Of the 10 who were attacked, 5 were admitted to hospital, the other 5 died before they could be removed. Of the 5 admitted to hospital, 2 recovered, the remainder died.

Taking all the cases together, reference must be made to a symptom exhibited by a few cases, and not referred to in the detailed account, viz., swelling of the legs, especially of the thigh. The swelling was not œdematous. No glands were perceptible to the touch, and there was no tenderness in any of the glandular regions.

This occurred only occasionally during the acute febrile stage of the disease, and in some cases death supervened, in others recovery.

That swollen condition frequently seen during and after convalescence is not the swelling now referred to. This last was fairly frequent, and was doubtless caused by the impediment to the return circulation resulting from a healing bubo.

The first took place when there had been no apparent bubo.

Hæmorrhages.—Those hæmorrhagic effusions occurring under the skin in cases of bubonic plague have been dealt with in the various groups under the heading of eruptions of the skin.

Under the present heading the symptom referred to is an unnatural discharge of blood, sufficient in quantity either to threaten the life of the patient, or being poured into some important organ to cause the destruction of that organ. Although

Although hæmorrhage from the lungs, in the form of hæmoptysis, occurred in about half of the cases in which the secondary cause of death is set down as apnœa, that form of hæmorrhage is not meant here. It never occurred in sufficient quantity to endanger life.

Epistaxis.—This was not at all frequent, even in a mild form, although it was seen occasionally. I had no bearing on the cases, and did not happen in the earlier course of the fever, excepting in one case. This was one of those cases in which the hæmorrhage was excessive enough to be a source of danger to the patient. It was stopped only with difficulty, and later on death supervened, and appeared to have been accelerated by the loss of blood. Hæmorrhage from the stomach occurred twice in such large volume that it caused the collapse of the patient. It came on suddenly, and lasted for but a few minutes, very large quantities of dark red blood being ejected.

The patients admitted to Quarantine hospital were suffering from an acute febrile disease, having prevailing characteristics distinguishing them from the ordinary run of febrile diseases met with in general practise.

Those characteristics were most commonly some affection of the lymphatic glands, such as swelling, pain, or tenderness referable to one or more of the glandular regions. Considerable mental disturbance usually appearing in the form of drowsiness and a general appearance of being very ill without any cause being found. These indications were accompanied by marked disturbance in the circulation, concerning which nothing has been said in the detailed report of the symptoms. The pulse, in all cases where it was evident from other indications that the person under consideration was very ill, had characters which were in sympathy with the general condition; it was usually accelerated and compressible; sometimes dicrotic, sometimes intermittent; and was always watched with the greatest care.

In cases where the illness was prolonged past the stage of acute plague, the pulse would often be found accelerated, and as many as 120 or 130 beats to the minute without any marked rise in temperature. This acceleration was not reduced by the exhibition of such drugs as digitalis and strophanthus, although given in large continuous doses. It seemed that where the disease left the pulse with those characteristics it gradually returned to its natural condition of its own accord. The respirations were accelerated not, however, on account of any mischief being present in the structure of the lung itself, but irrespective of lung complications, and in cases that were about to end fatally that increase would gradually continue until as many as fifty per minute would be recorded. During the month of May and thereafter the character of the symptoms, as shown by the cases on their admission to the Quarantine hospital, changed. It was conjectured from the alteration in the type of the cases received that the outbreak was coming to a conclusion. Cases were admitted but seldom in which unconsciousness was present. Usually the cases showed very little indications of being very ill. Either some fever or glandular trouble was present, generally there were both, but other constitutional symptoms were less frequent. Not only was the mean average temperature lower, but there was a diminution in frequency in the derangement of the nervous system. This is evidenced by the fact that the records of the cases show that the frequency of certain nervous symptoms, either alone or combined, was in Group A, 72 per cent.; in Group B, 62 per cent.; but was in the cases of the last ninety-three only 42 per cent. (*see* Table 3). This marked alteration was not due to any particular method of treatment adopted; it was due to the difference in the type of the cases. The 72 or 62 or 42 per cent. of the persons who suffered from the nervous symptoms detailed did so from the time of their admission to Quarantine; patients were, in the early part of the outbreak, for the most part in a drowsy or semi-conscious state when admitted. In the latter part of the outbreak these symptoms were conspicuously absent in the patients when admitted. Indeed, no such thing as a case entering Quarantine with mild symptoms, and getting worse or dying, ever happened. The first 200 cases were, with some exceptions, either delirious or drowsy or in a comatose state when they were received, but more than half the latter cases were quite conscious, mentally clear, and not inclined to believe that they were seriously ill, nor did they turn out to be so. Probably the source whence the infection was being received was no longer producing such virulent material, but whatever be the reason it is certain that the type of the disease was becoming modified.

Cause of Death.—In considering the secondary cause of death, only those cases which were admitted to Quarantine and died there are referred to.

The number of these is 64, leaving 39 who died elsewhere, the end having come either too quickly to permit of their removal, or else, as no doubt happened in the case of some of the Chinese, the fact of the individual's illness did not become known until he was in a moribund condition, or perhaps actually dead.

The secondary cause of death is as follows:—

Cardiac failure.—Failure of the central organ of circulation was the secondary cause of death in 26 cases—that is to say, the heart gradually grew weaker and weaker until death supervened.

Apnœa.—In 24 cases the patients were really asphyxiated. There was a collection of thin mucous in the trachea and bronchi; sometimes there was hæmoptysis. Abnormal chest sounds were not always discernible.

The condition seemed to be as if the mucous membrane of the bronchi was affected similarly to the mucous membrane of the eye, and by the same irritant. (The same irritant no doubt was at work on the mucous membrane of the fauces in the cases where spitting was a prominent symptom.)

Exhaustion.—In 5 cases the patients, having got through the acute stage of plague, seemed unable to recover their vitality. The digestive organs did not act, or there was continuous vomiting, or the rate of the pulse, as has already been stated, became very high, and did not respond to the drugs which were exhibited. The nervous system seemed to have received permanent injury, and they died ultimately of exhaustion, after an illness of from thirteen to ninety-eight days.

Convulsions.—These were the secondary cause of death in 6 cases, and of them there was a previous history of convulsions in one case only; but, probably, if the facts could have been traced, it would have been found that a family history of convulsions existed in the majority.

Hæmorrhage.—Hæmorrhage from the stomach (already mentioned among the hæmorrhages) was so profuse as to terminate life suddenly in 2 cases.

Coma.—In 1 case the patient was in a profound coma, and continued so until death, being in that condition a little over two days.

TABLE 1 showing the number of times the symptoms mentioned occurred as the earliest observed symptoms of illness in 293 whites, divided into three arbitrary groups containing—in Group A, 100 cases, 20th January to 12th April; in Group B, 100 cases, 12th April to 9th May; and in Group C, 93 cases, 9th May to 9th August;—together with the number of Deaths which occurred among patients having the symptoms as specified.

Symptoms occuring at the onset of illness.	Group A.			Group B.			Group C.			Totals.		
	No. of Cases in which the Symptoms mentioned occurred at onset.	No. of Deaths among Cases in preceding column.	Per-centage of Deaths.	No. of Cases in which the Symptoms mentioned occurred at onset.	No. of Deaths among Cases in preceding column.	Per-centage of Deaths	No. of Cases in which the symptoms mentioned occurred at onset.	No. of Deaths among Cases in preceding column.	Per-centage of Deaths.	No. of Cases in which the symptoms mentioned occurred at onset.	No. of Deaths among Cases in preceding column.	Per-centa of Death
Vomiting	55	26	47·3	57	23	40·4	49	14	28·5	161	63	39·1
Pains in the back, body and chest bones,	23	11	47·8	30	11	36·6	13	3	23·	66	25	37·1
Headache	72	26	36·	64	20	31·2	49	10	20·4	185	56	30·3
Rigors	32	10	31·2	50	17	34·	62	14	22·5	144	41	28·7
Symptoms referable to the Lymphatic Glandular System, as pain or swelling.	29	11	37·9	43	11	25·6	34	5	14·7	106	27	25·7

TABLE 2 showing the number of times the symptoms mentioned occurred as the earliest observed symptoms of illness in thirteen patients who had been inoculated with Haffkine's prophylactic, at dates before attack, which varied between one day and thirteen weeks, for comparison with Table 1, in which they are also included.

Consecutive No. of Case	36	37	41	42	44	47	51	57	66	103	115	214	285	Total
Vomiting	...	...	...	•	...	...	...	...	...	•	•	•	...	4
Pains in Back, Body, &c.	...	...	...	...	...	...	...	...	...	•	...	...	...	1
Headache	•	•	•	•	•	•	•	•	...	...	•	•	•	11
Rigors	...	...	...	...	...	...	...	...	...	•	...	•	•	3
Symptoms referable to the Lympathic Glandular System, as pain or swelling.	•	...	...	•	•	•	•	•	•	...	•	•	•	10

All the patients referred to in Table 2 recovered.

TABLE 3 showing the number of times that one or more of the following symptoms, indicating derangement of the Nervous System, were observed in the patients constituting each of the three Groups at admission to hospital and the percentage of the total number in each Group who were affected thereby.

Symptom.	Group A (First 100 Whites).				Group B (Second 100 Whites).				Group C (Remaining 93 Whites).				Totals.				
	No. of times observed.	No. of Deaths among Patients in whom the respective symptoms were observed.	Total number of cases in this group in which one or more of the foregoing symptoms were observed = 72 (or 72 per cent.)	Percentage of deaths among the above = 33·9 per cent.	No. of times observed.	No. of Deaths among Patients in whom the respective symptoms were observed.	Total number of cases in this group in which one or more of the foregoing symptoms were observed = 62 (or 62 per cent.)	Percentage of deaths among the above = 42 per cent.	No. of times observed.	No. of Deaths among Patients in whom the respective symptoms were observed.	Total number of cases in this group in which one or more of the foregoing symptoms were observed = 39 (or 42 per cent.)	Percentage of deaths among the above = 41 per cent.	No. of times observed.	No. of Deaths among Patients in whom the respective symptoms were observed.	Percentage of Deaths.	Total number of cases in which one or more of the foregoing symptoms were observed = 173 (or 59 per cent. of total number of patients).	Percentage of deaths among the above = 40·5 per cent.
Coma	4	3			9	3			3	3			16	9	56·2		
Semi-coma (not ending in Coma)	25	17			8	2			3	2			36	21	58·3		
Delirium (ordinary)	33	12			33	10			18	7			84	29	34·5		
,, (furious)	17	8			15	10			6	3			38	21	55·3		
Getting out of bed	9	6			18	13			7	2			34	21	61·8		
Hebetude	12	6			6	...			1	.....			19	6	31·6		
Affections of speech	23	11			15	8			12	2			50	21	42·0		
,, gait	2	1			5	2			2	2			9	5	55·5		
Trismus	2	1			...	.....			...	.....			2	1	50·0		
Furious screaming	2	.....			1	1			3	1			6	2	33·3		
Convulsions	6	4			2	2			1	1			9	7	77·7		
Insomnia	7	.....			5	3			3	2			15	5	33·3		

Regional Buboes.	(First 100 Whites.) No. of Cases in which Symptoms mentioned occurred.	(First 100 Whites.) No. of Deaths among foregoing.	(Second 100 Whites.) No. of Cases in which Symptoms mentioned occurred.	(Second 100 Whites.) No. of Deaths among foregoing.	(Remaining 93 Whites.) No. of Cases in which Symptoms mentioned occurred.	(Remaining 93 Whites.) No. of Deaths among foregoing.	Group D.	(10 Chinese.) No. of Cases in which Symptoms mentioned occurred.	(10 Chinese.) No. of Deaths among foregoing.	No. of Cases.	Deaths	Per-centage of Deaths.
Femoro-Inguinal Chain only.												
Right. Femoral	30		16		12			1				
Right. Inguinal	5		10		10			1				
Right. Femoral and Inguinal	3		5		4			1				
Right. Femoral or Inguinal	1		...		...			...				
Right. Femoral, Inguinal, and Iliac	1		1		...			...				
Right. Groin	1		...		...			...				
	41	10	32	8	26	3		3	1	102	26	25·5
		D. 34·1 % 14		*D. 25 %*		*D. 11·5 %*			*D. 33·3 %*			
Left. Femoral	23	7	21	7	16	3		...	...			
Left. Inguinal	8	2	5	2	5	...		...	...			
Left. Femoral and Inguinal	7	1	5	1	7	...		...	...			
Left. Femoral, Inguinal, and Iliac	1	1	...	...	...	...		...	...			
Left. Groin	1	...	...	...	...	...		...	...			
	42	11	31	10	28	3		...	...	101	24	23·7
		D. 26·2 %		*D. 32·2 %*		*D. 10·7 %*						
Bilateral. Right and Left Femoral	...	...	3	...	...	...		...	...			
Bilateral. Right Femoral and Left Popliteal	...	...	1	...	...	...		...	...			
Bilateral. Right and Left Femoral and Left Inguinal	...	...	1	1	...	...		...	...			
Bilateral. Right and Left Inguinal	...	...	...	...	3	...		1	1			
Bilateral. Right Femoral and Left Inguinal	...	...	...	...	1	1		...	...			
	...	...	5	1	4	1		1	1	10	3	30·
				D. 20 %		*D. 25 %*			*D. 100 %*			
	83	*D. 30 %* 25	68	*D. 28 %* 19	58	*D. 12 %* 7		4	*D. 50 %* 2	213	53	25·
Axillary Chain. Right Axillary	1	1	1	...	7	5		...	...			
Left Axillary	4	2	1	...	2	...		1	1			
Right and Left Axillary	1	1	3	1	3	1		...	...			
Right Subpectoral	2	2	1	...	3	1		...	...			
Left Subpectoral	...	...	1	1	1	1		...	...			
Right Subpectoral and Right Axillary	...	...	1	...	..	..		...	...			
	8	6	8	2	16	8		1	1	33	17	51·5
		D. 75 %		*D. 25 %*		*D. 50 %*			*D. 100 %*			
Cervical Chain. Right Cervical	2	...	1	1	3	...		...	...			
Left Cervical	2	2	3	2	...	...		1	1			
Parotid	1	...	...	...	...	...		...	...			
Right and Left Cervical	...	...	...	...	1	1		1	1			
	5	2	4	3	4	1		2	2	15		53·3
		D. 40 %		*D. 75 %*		*D. 25 %*			*D. 100 %*			
Axillary, Cervical, and Others Combined. Right Axillary, Cervical, and Femoral	1	1	...	...	...	...		...	...			
Right Femoral, Right and Left Axillary, Left Cervical	...	...	1	1	...	...		...	...			
Left Cervical and Left Axillary	...	...	1	...	1	1		...	...			
Right Femoral, Left Axillary, Right and Left Cervical	...	...	1	...	...	...		...	...			
Right Femoral and Left Axillary	...	...	1	1	1	1		...	...			
Right and Left Cervical	...	...	1	1	...	...		...	...			
Right and Left Femoral and Cervical, and Right Axillary	...	...	1	1	...	...		...	...			
Right Axillary, Right and Left Femoral	...	...	1	...	...	...		...	...			
Right Cervical and Left Axillary	...	...	1	...	1	...		...	...			
Right and Left Cervical, and Left Femoral	...	...	1	1	...	...		...	...			
Right and Left Axillary, Right Supratrochlear	...	...	1	1	...	...		...	...			
Right Femoral and Axillary	...	...	1	1	1	...		...	...			
Right Femoral, Left Cervical, and Iliac	...	...	1	...	...	...		...	...			
Supratrochlear and both Cervical	...	...	1	...	...	...		...	...			
Sublingual and Left Cervical	...	...	...	...	1	...		...	...			
Right Inguinal and Axillary	..	...	...	...	1	...		...	...			
Right Inguinal, Femoral, and Cervical	...	...	...	...	1	...		...	...			
Right Axillary and Cervical	...	...	...	...	1	...		...	...			
Right Brachial and Axillary	...	...	...	...	1	...		...	...			
Right Femoral, Inguinal, Right and Left Cervical	...	...	...	...	1	...		...	...			
Right Cervical, Left Subpectoral	...	...	...	...	1	...		...	...			
	1	1	13	7	11	2		...	...	25	10	40·
		D. 100 %		*D. 53·9 %*		*D. 18·2 %*						
Totals	97	*D. 35 %* 34	93	*D. 33·3 %* 31	89	*D. 20·2 %* 18		7	*D. 71·4 %* 5	286	88	30·8
Cases in which no Buboes occurred (Septicæmic)	3	*D. 100 %* 3	7	*D. 86 %* 6	4	*D. 75 %* 3		3	*D. 100 %* 3	17	15	88·2
	100	37	100	37	93	*D. 22·6 %* 21		10	*D. 80 %* 8	303	103	34·

The cases in Group D are those of inoculated persons, and have been reckoned in the previous columns of this Table.

A. E. SALTER, M.B.

APPENDIX C.

Notes on some Lesions of the Eye; by C. Gordon McLeod, M.B., Ch.M.

On April 14th I visited the Quarantine Hospital at North Head, and examined four patients suffering from eye trouble. They were as follows:—

Case 10.—Right eye; large superficial corneal ulcer of dendritic type; little photophobia; moderate ciliary congestion; no hypopyon.
Case 17.—Right eye; extensive exudation of pure lymph in anterior chamber; subsiding iritis, with closed pupil. No keratitis.
Case 86.—Both eyes; slight attack of simple iritis.
Case 40.—Left eye; small central cornial ulcer, with considerable iritis.

In case 17, the eye lesion appears to be specific to the general disease from which the patient is suffering. The entire absence of outside causes points to a septic embolus setting up a disastrous intra-ocular suppuration.

As to the other cases, there is nothing in the appearances to distinguish them from similar trouble occurring under many other circumstances; but as keratitis and iritis have been frequently noted in the course of plague, their presence here is probably more incidental than accidental.

APPENDIX D.

Post-mortem notes made on twenty-four cases of plague by the Government Pathologist (Dr. G. H. Taylor), by the Pathologist to Sydney Hospital (Dr. Sydney Jamieson), and by Dr. F. P. Sandes, Resident Medical Officer, Prince Alfred Hospital.

Case 22. *March* 17. *F., æt.* 14. *Duration of illness,* 30 *hours.*

Body well nourished. Skin pale. No enlarged glands. Hæmorrhage around the femoral glands, but no œdema. Arachnoid and pia mater much congested. Small hæmorrhages scattered over pulmonary pleura, upper surface of diaphragm, costal pleura, surface of heart, interior of heart and pericardium, the capsule of kidneys, and surface of intestines. Several of these hæmorrhages appeared to have a slightly necrotic centre. Hæmorrhage into the mucous coat of stomach. The hæmorrhages varied in size from a pin's head to a three-penny piece. The lungs were congested and œdematous. The liver slightly fatty. The spleen normal in size and firm. Colour of splenic pulp a dark red. Dr. Armstrong removed a piece of the spleen. G.H.T.

Case 58. *April* 1. *M., æt.* 43. *Duration of illness,* 7 *days.*

External appearances.—Fairly well nourished. Body pale. Rigor mortis universally present. *Post-mortem* lividity very marked over dependent parts of body. A few small livid petechiæ, about size of pin-heads, were found in the anterior aspects of both legs.

Lymphatic Glands.—The axillary, brachial, and inguino-femoral glands were dissected out. In the case of the latter groups some of the glands were slightly enlarged, and on section were softened and somewhat mottled, but no hæmorrhagic extravasation was found around them.

Thorax.—Cavities: Contained no subserous hæmorrhages and no excess of fluid.

Lungs.—Both were somewhat congested and slightly œdematous, but were otherwise normal. The glands at the roots of the lungs were normal in appearance. No petechial hæmorrhages were found in the pleuræ.

Heart (weight 10¾ oz.).—Both ventricles were filled by pale yellow gelatinous clot, which was tightly adherent to the meshes of the columnæ carneæ. Otherwise the organ was healthy looking.

Abdomen.—Peritoneum healthy. No petechial hæmorrhages.

Liver.—Enlarged (weight, 5 lb. 8¾ oz.). It was of a uniform yellow colour, and of soft consistence. This was found microscopically to be due to an extensive fatty degeneration of the liver.

The gall-bladder and its contents appeared normal.

Stomach and Intestines.—In the stomach were numerous submucous extravasations of blood, especially towards its cardiac end. The mucous membrane was corrugated and covered by a thick, glairy, tenacious mucus.

The mucous membrane of the intestines was slightly congested, but otherwise normal.

Genito-urinary System.—Right kidney (6¾ oz.): Organ swollen, and of soft consistence. Its cortex was pale and swollen. On section the kidney substance overlapped the divided capsule. The capsule was thin, translucent, and non-coherent.

Left Kidney (7¼ oz.).—Similar to its fellow.

Microscopically the kidneys showed proliferation and desquamation, with cloudy swelling of the tubular epithelium, and also of the epithelial lining of the Bowman's capsules.

The bladder and ureters showed nothing abnormal.

Hæmopoietic System.—The spleen was enlarged; somewhat softer than normal. On section the pulp had a brownish-red colour, and the trabeculæ were obscured by the swelling of the pulp.

The

The mediastinal and mesenteric glands were unaffected, but chains of vessels running along both iliac vessels were somewhat enlarged and redder than normal.

Nervous System.—The brain showed nothing abnormal save some slight excess of fluid beneath the lepto-meninges.

Films from the spleen pulp and the blood of the right median basilic vein were made and stained by dilute aqueous solution of fuchsin, and showed numerous short oval-shaped bacilli, many of which showed characteristic bipolar staining.

Films were also stained by Gram's method, and showed the bacilli to be decolourised. S.J.

Case 78. *April* 6. *M., æt.* 18. *Duration of illness, 72 hours.*

Body pale, but cyanosed. Numerous small excoriations in both forearms, the result of scratching—resulting from the irritation of mosquito bites. Some abrasions on lower parts of both legs. No petechiæ. The inguino-femoral glands and the glands above Pouparts' ligament on the right side were enlarged.

Thorax.—Cavities: Nil.

Lungs.—Nothing abnormal, except a few small petechial hæmorrhages. Heart.—Muscle apparently healthy. All its cavities were completely filled by pale yellow gelatinous clot, firmly adherent to columnæ carneæ. Valves and aorta healthy.

Abdomen.—Liver: Enlarged and mottled. Gall, bladder, and bile apparently normal. Stomach and intestines.—Mucosa of stomach swollen and mamillated, and covered with ropy mucus. Numerous petechiæ in the submucous coat. In some parts of the large intestine there were many submucous hæmorrhages, some as large as a three-penny piece.

The mesenteric glands were enlarged, but not hæmorrhagic.

Genito-urinary System.—Kidneys enlarged, and softer than normal. Cortex swollen and pale. No hæmorrhages in substance or capsule. Capsule stripped readily.

Bladder and Ureters.—Healthy.

Hæmopoietic System.—Spleen: Slightly enlarged, and somewhat soft. On section of a dark reddish-brown colour.

Nervous System.—Brain healthy. The iliac and inguino-femoral glands on the right side were enlarged and softened. On section they were dark and mottled, and there was a considerable amount of peri-capsular hæmorrhage. There was also marked œdema (inflammatory) of the retro-peritoneal tissue in both iliac regions.

The blood, spleen, and enlarged glands all showed numerous plague bacilli. S.J.

Case 79. *April* 6. *F., æt.* 61. *Duration of illness, 7 days.*

Heart and lungs not examinad. Axillary glands enlarged. Femoral glands not increased in size. Liver normal in appearance. No superficial hæmorrhage. Spleen enlarged somewhat, soft, darker colour than normal; no superficial hæmorrhages. Intestines normal. Mesenteric glands firm and rather prominent. Kidneys healthy. F.P.S.

Case 84. *April 7th. M., æt.* 3. *Duration of illness, 51 hours.*

External appearances.—Rigor mortis universally present. *Post-mortem* lividity well marked. Numerous petechiæ on chest, abdomen, and legs. No definite bubo to be made out.

Thorax.—Cavities: Empty. No petechial hæmorrhages.

Lungs.—Somewhat congested. There were a few petechial sub-pleural hæmorrhages, otherwise nothing abnormal found.

Heart.—Showed nothing abnormal except some pallor of its muscular walls.

Abdomen.—Peritoneum: No petechiæ; no abnormality observed.

Liver.—Somewhat enlarged and softened. It was very much mottled in appearance, and was found to be the seat of an extensive fatty degeneration.

The gall bladder and its contents showed nothing unusual.

Stomach and Intestines.—The stomach showed a few submucous hæmorrhages. The small intestine showed some swelling and infiltration of the solitary glands and Peyer's patches. Throughout the whole length of the intestines were found numerous small submucous hæmorrhages.

The pancreas was the seat of a somewhat extensive hæmorrhagic extravasation, both into its substance and beneath its serous coat.

Genito-urinary System.—Right kidney was enlarged and softer than normal. The capsule was tightly stretched over the organ. It stripped readily. No hæmorrhagic extravasations were found either in the substance of the organ or beneath its capsule.

The cortex was pale and swollen, and found to be the seat of an early catarrhal nephritis (microscopically).

Left kidney similar to its fellow.

Bladder and ureters.—Healthy.

Hæmopoietic System.—The spleen was enlarged and of subnormal consistence. Its pulp was of a light brownish-red colour, and its trabeculæ were obscured.

The lymphatic glands along the course of the iliac and femoral vessels were slightly enlarged and of a dark-red colour. On section they were found to be of soft consistence and to be markedly mottled. Around these enlarged glands was an area of subserous hæmorrhages.

The brain showed no abnormality.

Microscopic examination of the spleen pulp and blood was made, and enormous numbers of typical plague bacilli were found.

The blood, in addition, was found to show a very extensive leucocytosis and there were present also numerous myelocytes and nucleated red corpuscles. S.J.

Case 93. *April* 9. *M., æt.* 22. *Duration of illness,* 36 *hours.*

Died 8th April. Body, face, and neck cyanosed. No petechiæ. Femoral, inguinal, and iliac glands, red in colour and mottled in section, not enlarged: surrounded by hæmorrhage. Lungs œdematous and congested with numerous small sub-pleural hæmorrhages. Hæmorrhage in pericardium and surface of heart. Heart contained dark clots. Liver mottled with patches of fatty degeneration. Spleen slightly enlarged and softer than normal. A few hæmorrhages on surface of intestines. A few submucous hæmorrhages in stomach. Large sub-capsular hæmorrhages in kidney.

Death reported to coroner as due to plague. Spleen and blood afterwards examined by Dr. Bowker, who confirmed the opinion, which was quite clear from the *post-mortem.* G.H.T.

Case 111. *April* 13. *M., æt.* 36. *Duration of illness,* 36 *hours.*

The body was that of a well-nourished and fairly muscular man; skin pale, and face placid. Hæmorrhage around the inguinal bubo, and œdema; hæmorrhage around the femoral, iliac up to the lumbar glands. A few petechiæ in the pulmonary pleura. Lungs œdematous. Dark soft clots on both sides of heart, with soft pale clot in right ventricle. Muscle and valves normal. Scattered hæmorrhage in posterior mediastinium. Hæmorrhage around round ligament of liver. Scattered petechiæ on surface of liver. Subserous and submucous hæmorrhages in gall-bladder. Hæmorrhages into pancreas and into retro-peritoneum and surface of kidneys. Spleen normal in size and consistence, dark red in colour. Many small areas of congestion in arachnoid, which, from simple inspection, resembled hæmorrhages (small).

G.H.T.

Case 114. *April* 15. *M., æt.* 62. *Duration of illness,* 48 *hours.*

Body fairly nourished. Numerous petechiæ all over the body. No wounds or abrasions of any sort. Double inguinal hernia. Decomposition signs showing in legs and lower abdomen.

Thorax.—Lungs: Both were markedly congested. A few small sub-pleural hæmorrhages.

Heart.—A few sub-epicardial hæmorrhages. Marked *post-mortem* staining of the endo-cardium. Heart muscle soft and flabby. Badly formed pale clots on both sides.

Abdomen.—Liver: A few small sub-capsular hæmorrhages. Organ slightly pale, but no marked fatty change. Consistence soft.

Stomach.—Showed some small hæmorrhages near the pyloric end.

Kidneys.—Very soft, and somewhat swollen. Cortex swollen, especially the inter-pyramidal portion.

Bladder and Ureters.—Showed some sub-peritoneal hæmorrhages over the fundus of the bladder.

Spleen.—Much enlarged and very soft in consistence.

Brain.—Nothing abnormal.

Lymphatic Glands.—The left inguinal and iliac glands were slightly enlarged and discrete. There were some hæmorrhages around the iliac glands.

Films from the blood and spleen pulp showed a few plague bacilli and numerous streptococci. Films from the enlarged gland showed numerous plague bacilli.

S.J.

Case 129. *April* 21. *F., æt.* 68. *Duration of illness,* 24 *hours.*

All the organs were very much congested and in a decomposing state; they were also, especially the liver, full of air cavities. Heart showed old mitral disease. Liver not enlarged. Spleen not enlarged. Numerous hæmorrhages in the capsule. Hæmorrhage along the line of iliac vessels. Brain, like other organs, soft and congested. Smear preparations from blood in iliac vein, and also from spleen, showed numbers of bacilli corresponding to those of pestis bubonica with bi-polar staining, also proteus vulgaris.

S.J.

Case 132. *April* 22*nd. F., æt.* 17. *Duration of illness,* 96 *hours.*

Body well nourished. A few petechiæ about the legs. Large swellings on both sides behind and below the angles of the lower jaw.

Thorax.—Cavities: No gland or adhesions.

Lungs.—Over both pleural surfaces were a few subserous hæmorrhages. Both were slightly congested, but otherwise healthy.

Heart.—Muscle firm and pale. The right ventricle was filled by mixed clot. Valves and endo-cardium healthy.

Abdomen.—Peritoneum: Several small hæmorrhages seen beneath the peritoneum covering the lumbar portion of spine.

Liver.—Numerous small hæmorrhages on anterior surface of liver and over the fundus of the gall-bladder. Scattered through the substance of the liver were numerous small pin-point white masses closely resembling miliary tubercles. Some of these were surrounded by hæmorrhage.

Stomach and Intestines.—A few submucous hæmorrhages in the stomach.

Genito-urinary System.—Both kidneys were slightly enlarged and showed a few sub-capsular hæmorrhages. Cortex swollen and pale in both. Bladder and Ureters: Nil.

Uterus: Small. Tubes and ovaries congested, but no hæmorrhages around them.

Hæmopoietic System.—Spleen: Enlarged and softer than normal. On section of a dark reddish-brown colour.

Tonsils.—On the surfaces of both were sloughy patches, and on squeezing them a puriform fluid exuded from the crypts.

The lymphatic glands at the root of the mesentery below the pancreas were enlarged and softened and had hæmorrhage around them.

The glands on either side of the neck near the angle of the jaw were somewhat enlarged, softened, and mottled in appearance. They were absolutely embedded in a tissue composed of extravasated blood and inflamed cellular tissue. This appearance was visible along the entire course of both sterno-mastoid muscles.

Brain.

Brain.—Somewhat hyperæmic, but otherwise normal.

Microscopic examination of the blood, spleen pulp, and the juice of the enlarged cervical glands showed numerous plague bacilli.

The puriform fluid from the faucial tonsils was inoculated upon some sloped serum (solidified). In eighteen hours a copious growth took place, which was found to consist of rod-shaped organisms closely resembling the Bacillus Coli Communis. No Klebs Loeffler bacilli were found.

S.J.

Case 140. *April* 24. *M., æt.* 59. *Duration of illness, 5 days.*

Body rather obese. Small bruise over left eye. Numerous petechiæ on trunk and limbs. Rigor mortis and lividity well marked.

Thorax.—Lungs: Showed nothing unusual.

Heart.—Apparently healthy; full of pale yellow gelatinous clot on both sides.

Abdomen.—Peritoneum: Showed no petechiæ.

Liver.—Enlarged. Very fatty, and in an advanced stage of cirrhosis.

There were numerous hæmorrhagic points in the mucous coat of the gall-bladder.

Spleen.—Very large (about twice its normal size). On section it was found to be very soft and of a dark reddish-brown colour. Its trabeculæ were obscured.

Kidneys.—Both were enlarged; softer than normal. Numerous small sub-capsular hæmorrhages. Capsule was thin and non-adherent. The cortex was pale, swollen, and slightly mottled.

Lymphatic System.—No enlargement or sign of disease was found in any of the lymphatic glands.

A microscopic examination of the spleen pulp showed numerous typical plague bacilli present.

S.J.

Case 142. *April* 25. *M., æt.* 5. *Duration of illness, 51 hours.*

Body well nourished; skin pale, excepting slight *post-mortem* lividity on back. No enlarged glands. Hæmorrhage around the femoral, inguinal, and iliac glands on left side. Glands slightly inflamed. Lungs slightly œdematous, with a few petechiæ in pulmonary pleura. Liver slightly enlarged. Hæmorrhage into pancreas. Spleen normal in size and firmness. Splenic pulp dark red in colour. Heart contained dark and pale clots.

Piece of the spleen afterwards handed to Dr. Tidswell. G.H.T.

Case 143. *April* 25. *M., æt* 49. *Died in a Public-house bar. No information.*

A few petechiæ were present on the arms and legs. *Post-mortem* lividity and rigidity were both well marked.

Thorax.—The lungs showed nothing abnormal.

The heart showed nothing abnormal, except a few petechiæ on the visceral pericardium. It contained dark fluid blood.

Abdomen.—Peritoneum: There were numerous petechiæ upon the serous coats of the intestines.

Liver.—Somewhat enlarged and fatty.

Spleen.—Slightly enlarged; of firm consistence. On section of a dark reddish-brown colour.

The kidneys were swollen and pale. The cortices were somewhat swollen.

There was no evidence of enlargement of the lymphatic glands in any part of the body.

Microscopic films of the splenic pulp showed enormous numbers of plague bacilli.

S.J.

Case 173. *May* 3. *F., æt.* 56. *Duration of illness, 9 days.*

Body very obese. Face and neck much swollen, livid, and congested. *P.M.* lividity very marked.

Thorax.—Cavities: No hæmorrhages or fluid. Lungs: Engorged, but otherwise normal. Heart (13¾ oz.): Muscle pale; both ventricles and auricles contained a small amount of mixed clot.

Abdomen.—Peritoneum: Nil.

Liver.—Slightly enlarged, of soft consistence. Had a mottled appearance. No sub-capsular hæmorrhage. Liver evidently fatty.

Stomach and Intestines.—A few small submucous petechiæ in the stomach. Intestines were in places somewhat congested looking.

Genito-urinary System.—Both were enlarged and of rather soft consistence. On section they were dark and cyanotic. Cortex swollen. Capsule healthy.

Hæmopoietic System.—Spleen: Slightly enlarged; darker than normal; on section it was of about normal consistence and of a mahogany colour. Brain: Nil. Lymphatic Glands: In the right femoral region was an enlarged gland, about the size of a small hen's egg. The inguinal glands were also enlarged. The glands along the iliac vessels were also enlarged. All these glands were softened and somewhat mottled, and were surrounded by areas of extravasated blood.

Microscopic examination of the blood, spleen pulp, and the juice of the enlarged glands showed numerous plague bacilli.

S.J.

Case 184. *May* 2. *M., æt.* 59. *Duration of illness, 75 hours.*

Body well nourished. Rigor mortis universally present. *Post-mortem* lividity well marked. A few small petechiæ on legs and flanks. An enlarged gland could be felt in the left groin.

Thorax.—Lungs: Somewhat congested, but otherwise normal. Heart: Showed nothing abnormal. No ecchymoses in pleural or pericardial serous sacs.

Abdomen.—Liver: Slightly enlarged and mottled. A few petechial hæmorrhages found beneath the capsule of Glisson.

Spleen.—Enlarged; somewhat subnormal in consistence. On section the pulp was found to be softened and of a dark reddish-brown colour.

Kidneys.—Enlarged; capsule stripped readily; cortex pale and swollen.

Bladder

Bladder and Ureter.—Healthy.

Stomach and Intestines.—Showed nothing abnormal, except that there were a few petechiæ in the mucous membrane of the stomach near its cardiac end.

Pancreas.—Nil.

The femoral group of glands in the left groin were enlarged, softened, and surrounded by hæmorrhage. On section they were mottled.

Microscopic films from the spleen and enlarged glands showed numerous plague bacilli.

S.J.

Case 197. *May* 6. *F., æt.* 5. *Duration of illness,* 48 *hours.*

Body was well nourished. A few petechiæ about the neck. On left side of neck, a little below the ear, I found a bubo about the size of a pigeon's egg. On cutting into this I found the gland surrounded by hæmorrhage, with œdema of the adjoining tissues. Slight œdema of the lungs, with numerous petechiæ in pulmonary pleura. Heart contained dark and soft pale clots. Liver soft and fatty. Hæmorrhage into pancreas. Small hæmorrhages on surface of liver, intestines, and kidneys. Spleen normal in size, not softened. Splenic pulp red in colour.

Death due to plague. This was afterwards confirmed by an examination of the spleen made by Dr. Tidswell.

G.H.T.

Case 198. *May* 7. *F., æt.* 65. *Duration of illness,* 6 *days.*

The body was that of a stout, well-nourished woman; skin was pale, excepting slight *post-mortem* lividity over the back; the face was placid. No enlarged glands. Lungs œdematous. Heart soft and fatty; dark and soft pale clots on both sides. Liver enlarged and fatty. Spleen much enlarged and soft. Splenic pulp very dark in colour. Kidneys cirrhotic. The femoral glands on right side were deeply congested, but not enlarged, and the tissues around them appeared to be normal. I dissected out the inguinal, axillary, and cervical glands, and found nothing abnormal. No trace of hæmorrhage, excepting a small patch, close to right ovary, which was bound down by old adhesions to the peritoneum; the hæmorrhage was beneath the peritoneum, and very dark in colour.

G.H.T.

Case 226. *May* 15. *M., æt.* 28. *Duration of illness,* 24 *hours.*

Well-nourished, muscular Chinaman. Body and face livid; hands clenched. Numerous petechiæ in neck and chest. Bubo about size of a hen's egg, a little behind and below the left ear. On cutting into this I found hæmorrhage surrounding the gland with œdema of the adjoining tissues. Lungs congested, and slightly œdematous. Small scattered hæmorrhages in pulmonary pleura, and pericardium; also on surface of heart. In the centre of several of these hæmorrhages there appeared to be a necrotic spot. The heart contained a quantity of imperfectly clotted dark blood. Numerous hæmorrhages on surface of liver and kidneys. Liver enlarged and fatty. Spleen slightly enlarged and soft, of a dark red colour.

G.H.T.

Case 234. *May* 18. *M., æt.* 20. *Duration of illness,* 7 *days.*

Body spare. Rigor mortis present, but not yet complete. Body still warm. Lividity marked. No petechiæ. Enlarged gland felt in left groin.

Thorax.—Lungs: Deeply engorged, but otherwise normal. Heart: Somewhat flabby, but otherwise not abnormal. Both sides filled with whitish-yellow gelatinous clot.

Abdomen.—Liver: Not enlarged. Numerous subcapsular hæmorrhages. Organ very soft and extensively fatty.

Spleen.—Very large (about twice normal size), of subnormal consistence. On section of a dark red colour. Pulp very soft. Trabeculæ obscured.

Kidneys.—Softer than normal. Cortex swollen and pale and speckled with numerous pin-point hæmorrhages. Capsule thin and non-adherent.

Lymphatic Glands.—One of the femoral glands on the left side was enlarged slightly and surrounded by sub-capsular hæmorrhage. On section it had a mottled appearance.

Films were made both of the spleen pulp and of the juice of the enlarged gland. In the former no plague bacilli were found, whereas the latter contained typical plague bacilli in great abundance.

S.J.

Case 238. *May* 19. *M., æt.* 70. *Duration of illness,* 48 *hours.*

Body well nourished. Rigor mortis and lividity both present, the latter excessive. A few small petechiæ about the size of pin-heads were scattered over the trunk and limbs.

Thorax.—Both lungs were the seat of a chronic interstitial pneumonia, the result of irritation from inhaled coal pigment. There were no petechiæ on the pleura. The bronchial mucous membrane was swollen and reddened, and the tubes contained a quantity of frothy muco-purulent matter.

The heart showed nothing abnormal, except that its right side was distended by pale yellowish gelatinous firmly adherent clot.

Abdomen.—Peritoneum healthy. Liver enlarged and mottled in patches. There were numerous hæmorrhages of small size into its capsule. Spleen enlarged, somewhat softer than usual. Its pulp was of a dark reddish-brown colour. The trabeculæ were obscured owing to the swelling of the pulp.

The kidneys were swollen and of soft consistence. These capsules stripped readily. Cortices were pale, somewhat mottled and swollen. On division of the capsule the kidney substance "lipped" over the divided capsule. The other organs in the abdomen showed nothing abnormal.

Lymphatic Glands.—One of the glands in the left femoral region was swollen, enlarged, and surrounded by a zone of hæmorrhage. On section it was soft and had a mottled appearance. The other glands showed nothing abnormal.

Microscopic examination was made of films from the spleen and enlarged gland, and large numbers of plague bacilli were found.

S.J.

Case 240.

Case 240. *May* 20. *M., æt* 45. *Duration of illness,* 12 *hours.*

Body very obese. A few petechiæ were found on the trunk and limbs.

Thorax.—Lungs somewhat engorged. Heart.—The walls of the heart, especially the left ventricle, were of soft consistence, and mottled from early fatty degeneration. The cavities of the organ contained a small quantity of dark fluid blood. Valves were healthy.

Abdomen.—Liver markedly enlarged, and the seat of extensive fatty degeneration. Spleen enlarged, of normal consistence. On section of a dark red colour. Trabeculæ obscured.

Kidneys somewhat enlarged and of soft consistence. On section the capsule stripped readily. The cortex was paler than usual and mottled throughout with numerous pin-point hæmorrhages. Stomach showed evidence of chronic gastric catarrh, and also numerous recent submucous hæmorrhages.

Lymphatic Glands.—In the right femoral region one of the glands was found to be swollen slightly, and to be surrounded by a small hæmorrhagic zone. On section it had a mottled appearance.

Microscopic examination of the spleen and lymphatic gland pulps showed numerous plague bacilli.

S.J.

Case 242. *May* 21. *M., æt* 17. *Duration of illness,* 12 *hours.*

External appearances.—A few petechiæ on sides of chest and on back. Rigor mortis present. Lividity marked. The glands in both inguino-femoral regions were felt to be enlarged and "shotty."

Thorax.—Lungs somewhat engorged. No sub-pleural hæmorrhages. Heart apparently healthy. A parti-coloured clot filled the right auricle and ventricle.

Abdomen.—Liver enlarged and slightly mottled. A few petechial hæmorrhages beneath the capsule of Glisson. In one small area in the substance of and on the surface of the organ was a group of small pin-point yellowish-white bodies closely resembling miliary tubercles. Spleen enlarged and almost semi-diffluent. On section it was of a dark reddish-brown colour.

Kidneys beyond being somewhat congested showed no abnormality.

Stomach.—The mucous membrane was swollen, red, mammillated, and at the cardiac end were numerous small submucous hæmorrhages.

Lymphatic Glands.—The glands in both inguino-femoral regions were found to be somewhat enlarged. In consistence they were harder than normal (resembling the condition seen in syphilitics). One of the femoral glands on the right side was somewhat redder than the rest, and on section were somewhat mottled.

Microscopic Examination.—Films were made, both of the spleen pulp and of the pulp of the gland described above. No organisms resembling the plague bacillus were found in the spleen, but the film taken from the gland contained innumerable plague bacilli. S.J.

Case 255. *May* 31. *M., æt* 55. *Duration of illness,* 15 *hours.*

The body was that of a muscular and well-nourished man; the face and neck deeply cyanosed; the mouth contained some semi-digested food. No enlarged glands. Old pleuritic adhesions in both sides of chest, the large bronchi inflamed, and the lungs somewhat congested. Heart large. Left ventricle hypertrophied; heart much diseased. Coronary vessels slightly atheromatous. Dark clots in both sides. Liver in an advanced stage of cirrhosis. Kidneys granular. Stomach contained a quantity of food; its mucous coat in a condition of chronic inflammation. Spleen enlarged; softer than normal. This appeared to be a recent change, and was a little suggestive of plague.

In the brain the arachnoid was thickened and opaque, with some atrophy of the convolutions.

A piece of the spleen was removed and handed to Dr. Tidswell, and, after examination, the case was reported as one of plague. G.H.T.

Case 295. *June* 29. *M., æt.* 55. *Duration of illness,* 70 *hours.*

Body very emaciated. A swelling about the size of a hen's egg in the right groin. Numerous petechiæ on the trunk and limbs. On the right leg were two small vesicular papulæ, which looked as though they had had their heads scratched off.

Thorax.—Both pleural sacs were entirely obliterated by old, tough, fibrous adhesions, the result of previous repeated attacks of pleurisy.

Lungs.—At the apices of both lungs were old deposits of chronic fibroid tubercle, and in the upper lobe of the right lung was a somewhat more recent spread of miliary tubercle. The bronchi showed signs of chronic catarrhal inflammation.

Heart.—There was considerable hypertrophy of the right ventricle. Both ventricles were distended by blood clot; that on the right side was for the most part of a yellowish-white colour, and slightly adherent to the columnæ carneæ. On the left side the clot was dark-coloured and very "crumbly." At the root of the aorta was some evidence of advanced atheroma; otherwise the heart showed no abnormality.

Abdomen.—There were no ecchymoses on the peritoneal covering of the intestines.

Liver.—Very soft and flabby, and of a pale yellow colour. On its surface were numerous small hæmorrhages beneath the capsule.

Spleen.—Enlarged; fairly firm in consistence, and of a dark reddish-brown colour.

Kidneys.—Both were enlarged and obviously congested. The cortex was swollen, and paler than normal.

Brain.—Nothing abnormal found.

The femoral and inguinal glands on the right side were enlarged and somewhat softened. They were surrounded by a small amount of hæmorrhagic extravasation. On section they were mottled in appearance. The glands along the line of the external and common iliac arteries on both sides were somewhat enlarged, and of a dark red colour.

Films of the blood, spleen, and enlarged lymphatic glands contained enormous numbers of plague bacilli. S.J.

APPENDIX E.

APPENDIX E.

Cases treated with Yersin-Roux Serum.

TABLE showing particulars of all cases admitted on and after May 13th (Case 217), when Serum first became available, and distinguishing those (22) which did not receive it. The first 6 were admitted before May 13th, and were treated merely because their cases were almost desperate. From Dr. Salter's clinical notes.

Consec. No.	Sex.	Age.	Day of illness on which admitted.	(1) Days of illness on which Serum was injected. (2) Quantity in Cub. Cents. (3) Place of injection (S. = Subcutaneously; V. = Intravenously).	Day after attack on which Patient—		Remarks.
					Was discharged.	Died.	
201	F	10	3rd	5/20 V	...	6th	Left cervical bubo; slight enlargement and tenderness of glands in both axillæ, and femoral gland on one side.
202	M	30	7th	9/20 V, 11/40 S, 12/20 S, 13/40 S, 15/20 V.	...	16th	Chinese; right inguinal bubo; steadily declined from attack.
204	M	19	4th	7/40 S, 8/20 V, 9/20 V ...	...	11th	Septicæmic form; on 7th day right cervical gland became slightly enlarged, and others at later dates.
205	M	28	3rd	7/40 S	...	8th	No buboes; right femoral gland and right axillary became slightly enlarged on 3rd day.
208	F	16	3rd	8/20 V	42nd	...	Bubo, subpectoral on right side, and left cervical; afterwards right femoral also.
216	F	29	3rd	3/20 S	97th	...	Bubo, left femoral; extreme lethargy on admission.
217	F	14	3rd	.....	32nd	...	*No serum;* left femoral bubo; had a vesicular eruption considered to be chickenpox (which others in the family had lately had); hæmorrhage occurred into each vesicle.
218	M	15	2nd	2/40 S, 3/20 V, 7/20 S, 8/20 V.	75th	...	Left femoral bubo; no other enlargement.
219	M	45	4th	.....	56th	...	*No serum;* right femoral bubo; did not appear very ill on admission; T. 101, P. 92; T. fell to normal next day and never rose again.
220	F	23	4th	5/40 S	76th	...	Admitted 4th day; moderate attack.
221	F	15	5th	4/30 S	76th	...	Left femoral bubo only.
222	M	38	5th	5/40 S	76th	...	Some tenderness and indistinct swelling in both axillæ; T. 100, P. 80, on admission.
223	M	15	5th	.....	41st	...	*No serum;* admitted 5th day; left inguinal bubo; T. 98·4, P. 68, on admission; was never worse.
224	F	14	6th	6/40 S	53rd	...	Left femoral bubo; T. 99, P. 92, on admission; was never worse.
225	M	16	2nd	2/40 S, 3/20 V, 4/20 S, 5/20 S.	42nd	...	On first day (evening) T. 103; P. dicrotic and very rapid; lethargic; face pallid. On admission 2nd day, almost comatose; T. 99·2.
226	M	28	.....	.....	...	...	*Died before reception;* Chinese.
227	M	26	2nd	1/40 S, 2/40 S, 6/20 V, 7/30 S.	...	7th	Right axillary bubo; other glands slightly enlarged; delirium and stupor at end of 1st day of illness; serum temporarily exhausted.
228	M	11	7th	7/20 S	35th	...	Notified 7th day; small right femoral bubo; a slight case.
229	M	43	1st	1/40 S	29th	...	Left femoral; did not appear to be very ill on admission.
230	M	20	.....	3/40 S	...	3rd	Right inguinal; on discovery patient too ill to remove; died same day.
231	F	40	4th	3/30 S	80th	...	Left femoral only; a moderately severe case.
232	M	38	.....	.....	...	...	*Died before reception.*
233	F	35	5th	5/40 S	31st	...	Left femoral; a mild case.
234	M	20	.....	.....	...	...	*Died before reception.*
235	M	46	6th	6/40 S	100th	...	A diabetic.
236	M	24	5th	.....	52nd	...	*No serum;* supply threatened to run short temporarily; patient hardly exhibited any constitutional symptoms on admission.
237	F	44	9th	.....	34th	...	*No serum;* admitted 9th day, and showed no constitutional symptoms.
238	M	70	.....	.....	...	...	*Died before reception.*
239	M	41	2nd	.....	33rd	...	*No serum;* although the bubo was axillary, and patient admitted on 2nd day of illness, he offered very slight symptoms of constitutional illness; he was said to have been very delirious during the night which followed attack.
240	M	45	.....	.....	...	...	*Died before reception.*
241	M	4	.....	.....	...	...	*Died before reception.*
242	M	17	.....	.....	...	...	*Died before reception.*
243	M	28	8th	8/40 S, 9/20 V, 11/40 S ...	98th	...	Left cervical bubo; left sublingual gland enlarged and tender.
244	M	26	5th	5/40 S	...	6th	23 hours in hospital; hopeless at admission. Chinese.
245	M	18	7th	.....	42nd	...	*No serum;* right femoral; slight case; did well from admission.
246	M	46	7th	7/40 S	...	8th	Right cervical; cough, and bright red sputum at first examination, 6th day of illness; bubo not observed till 6th day; declined steadily from admission.
247	M	28	6th	.....	32nd	...	*No serum;* right inguinal.
248	M	17	4th	4/40 S, 6/40 S, 7/40 S, 8/120 S.	...	10th	Septicæmic case.
249	M	38	3rd	.....	42nd	...	*No serum;* supply short; showed no constitutional symptoms except slight feverishness; other severe cases under treatment.
250	F	13	3rd	3/75 S, 4/40 S	68th	...	A severe case.
251	M	23	4th	4/40 S, 5/30 S	...	5th	Right axillary, left axillary slightly enlarged and tender; patient moribund; veins could not be entered.
252	M	74	12th	.....	45th	...	*No serum;* left femoral; practically convalescent on reception.
253	M	6	6th	.....	36th	...	*No serum;* right inguinal; P. 112 the only sign of illness on reception, when appetite very good.
254	F	26	2nd	2/30 S, 3/20 S, 5/20 S	30th	...	Left femoral; a mild case.
255	M	55	.....	.....	...	...	*Died before reception.*
256	M	44	15th	1/40 S	89th	...	Semi-conscious on reception; left femoral, inguinal; left axillary; right and left cervical also enlarged; Chinese.

Consec. No.	Sex.	Age.	Day of illness on which admitted.	(1) Days of illness on which Serum was injected. (2) Quantity in Cub. Cents. (3) Place of injection (S. = Subcutaneously; V. = Intravenously).	Day after attack on which Patient—		Remarks.
					Was discharged.	Died.	
257	M	33	3rd	3/40 S, and 20 V, 8/40 S	84th	...	Left inguinal; a small carbuncle, abdomen, left side.
258	M	29	3rd	3/40 S, 4/20 V	30th	...	Large right cervical bubo.
259	M	9	2nd	1/17 S, 4/40 S	36th	...	Right inguinal; right sterno-mastoid glands also tender.
260	M	7	2nd	2/50 S, 3/20 S	...	3rd	Right axillary, size of small orange; 19 hours in hospital.
261	M	17	3rd	2/40 S, 3/20 V, 4/40 S	...	4th	No bubo; carbuncle on back of neck; 21 hours in hospital.
262	M	22	2nd	2/40 S	28th	...	Right axillary and right cervical.
263	M	68	6th	6/40 S	58th	...	Supra-trochlear, right; also right axillary; a slight case.
264	M	27	9th	7/40 S, 9/80 S, 20/40 S	60th	...	Right femoral and inguinal.
265	M	25	2nd	2/40 S, and 20 V	39th	...	Left inguinal.
266	F	6	2nd	2/55 S, 3/40 S, 4/20 S, 5/60 S, 6/40 S.	...	6th	Right subpectoral.
267	F	44	3rd	3/40 S, and 20 V	118th	...	Right femoral.
268	M	10	2nd		36th	...	*No serum*; left femoral.
269	M	21	3rd	3/40 S	28th	...	Right inguinal; a slight case.
270	M	5	5th	5/20 S	78th	...	Left cervical.
271	M	15	2nd	2/40 S and 40 V	34th	...	Left subpectoral.
272	F	13	6th	6/40 S	40th	...	Left inguinal; very slight case.
273	M	41	8th	8/20 S	22nd	...	Right femoral; ambulant case; hardly ill on reception.
274	M	22	10th	10/40 S	36th	...	Right axillary; a mild case.
275	M	50	.....	4/40 S	...	4th	No bubo; moribund on discovery.
276	M	20	19th	19/40 S	44th	...	Right femoral; convalescent on reception.
277	M	32	5th	5/80 S	30th	...	Left axillary; subsequently gland in right axilla became tender.
278	M	30	8th		33rd	...	*No serum*; left inguinal; very slightly ill on reception.
279	M	13	9th	9/40 S	49th	...	Left femoral; convalescing on reception.
280	M	17	3rd	3/40 S and 20 V, 4/40 S, and 20 V, 6/40 S, 8/40 S, 16/40 S.	46th	...	No enlarged glands; a severe case.
281	M	36	4th	4/40 S, and 40 V	43rd	...	An ambulant case; right femoral bubo.
282	M	19	6th	6/40 S	105th	...	Right femoral; an ambulant case; had not lain up before reception.
283	M	19	5th	5/40 S, and 20 V	45th	...	Right femoral.
284	F	65	5th	5/80 S, 6/40 S	...	6th	Left subpectoral.
285	M	33	2nd	2/40 S	26th	...	Right femoral; very slightly ill; had not lain up before reception.
286	M	20	2nd	2/40 S, and 40 V	31st	...	Left femoral.
287	M	17	1st	1/40 S, and 40 V, 2/40 S, 10/40 S, 12/40 S.	44th	...	Right inguinal.
288	F	5	2nd	1/35 S	31st	...	Left axillary.
289	M	29	2nd	2/20 S	...	4th	Right femoral; in hospital 11 hours; hopeless when notified.
290	M	18	2nd	2/40 S	38th	...	Left femoral.
291	M	7	8th	8/37 S	38th	...	On reception, both inguinals.
292	M	38	5th	5/40 S, 7/40 S	46th	...	Left femoral; at time of reception stock of serum had become temporarily exhausted.
293	F	38	5th	5/80 S	45th	...	Right femoral.
294	F	2	2nd	1/30 S, 4/20 S	34th	...	Left axillary.
295	M	55	.....	.....	...	...	*Died before reception.*
296	F	12	4th	4/20 S, 6/40 S	36th	...	Right cervical.
297	M	42	2nd	2/40 S, 3/40 S	40th	...	Right femoral.
298	M	22	6th	6/40 S and 40 V	33rd	...	Right axillary.
299	M	41	45th	45/60 S	78th	...	Right inguinal; convalescent on reception.
300	M	45	21st	21/60 S, 27/40 S	60th	...	" "
301	M	2	6th	6/20 S	36th	..	Right subpectoral.
302	M	56	5th	5/40 S	...	37th	Right axillary.
303	M	36	7th	7/40 S	58th	...	Left femoral; this case was quite well marked, and approached the severe.

APPENDIX F.

Form 258.

Inoculation against Plague.—Second Series.

Department of Public Health, New South Wales, Sydney, 10 May, 1900.

In view of the expected arrival of a further consignment of plague prophylactic, the Honorable the Premier and Colonial Treasurer has been pleased to approve of the following regulations for its distribution.

J. ASHBURTON THOMPSON,
President of the Board of Health.

Regulations.

1. Preference will be given to persons resident or employed within the infected area.

2. Application must be made by persons desiring to be inoculated at the Town Hall (Druitt-street entrance), between 9 a.m. and midday, on and after a day which will be announced.

3. Applicants will be furnished with a dated ticket entitling them to be inoculated on the date specified thereon.

4. Inoculations will be performed at the Town Hall (Druitt-street entrance) every day except Sunday from 1·30 p.m., until the supply of prophylactic has been exhausted. Two afternoons a week will be reserved for inoculation of women and children.

5. No person unprovided with a ticket will be inoculated. No person provided with a ticket will be inoculated on any but the date specified thereon. Should any holder of a dated ticket allow the appointed day to pass without appearing, a new ticket must be procured before inoculation will be done.

6. Managers of business establishments may furnish lists of their employees by letter, addressed to the Secretary, Department of Public Health, and endorsed "Inoculation." Dated tickets will then be posted to them in return. Employees may be divided by managers into batches, and request made that the different batches may be inoculated on different days.

7. Inoculation is gratuitous and voluntary.

Circular Letter to the Public.

Form No. 256.

Sir, Department of Public Health, N.S.W., Sydney, 1 May, 1900.

A further consignment of plague prophylactic being expected to arrive shortly, I have the honor to inform you that the following arrangement has been made for convenience of those managers of business establishments who may desire inoculation for themselves and their staffs.

2. On receipt of this letter a list of the persons employed at your establishment may be made out by you, and may be forwarded by post to me at the above address. As soon as the prophylactic has arrived you will then receive by post a ticket for each person named in your list, entitling him to inoculation on a date stamped thereon. You may find it convenient to divide your list, so as to avoid absence of your whole staff on one day, and if you do so it will be understood that you desire a different date to be appointed for inoculation of each division.

3. No inoculations will be done at this Department, and the place chosen will be duly announced in the newspapers.

I have, &c.,
C. A. SIMMS,
Secretary.

Letter to Heads of Departments of the Public Service.

Form No. 257.

Sir, Department of Public Health, N.S.W., Sydney, 1 May, 1900.

A fresh consignment of plague prophylactic being expected to arrive shortly, I have the honor, by direction of the President of the Board of Health, to inform you of the arrangements which have been made for inoculation of Civil Servants employed in Sydney.

2. Three methods will be available, and in accordance with regulations which the Premier and Colonial Treasurer has been pleased to make, the number inoculated on any one day will be strictly limited.

(*a*) If you have the goodness to furnish me with a list of the names of officers in your Department who desire to be inoculated, a portion of prophylactic will be forwarded to you sufficient for the number. You may then provide a medical man to make the inoculations, a room in which he can operate, and a clerk to record the names of those operated on, together with the date of operation. This list to be forwarded to me for record with reference to possible occurrence of cases of plague among the persons inoculated at some future date—a matter of great practical importance at this time.

(*b*) You may send a list of the names of members of your staff who desire inoculation to me, when you will receive tickets entitling the holder to be inoculated on a day specified thereon. The names may be divided into batches to be inoculated on different days (so as not to interfere with business unduly). The holders will then present themselves at the place of public inoculation on the appointed day, and will take their turn with the general public.

(*c*) Individuals may make personal application at the place which will be appointed for the issue of tickets, when they will receive dated tickets as last mentioned.

3. Should you decide to adopt either of the methods (*a*) or (*b*), I am to ask you to be good enough to communicate with me at the earliest possible date. It is particularly requested that the names of gentlemen who are habitually employed in Sydney may alone be mentioned, others being in no known danger, and the supply of prophylactic being limited. The place at which tickets will be issued, and the place of public inoculation, will be announced in due course in the newspapers.

I have, &c.,
C. A. SIMMS,
Secretary.

Form No. 268.

Department of Public Health, N.S.W.

Sir, Sydney,

In answer to your recent request, I have the honor, by direction of the Chief Medical Officer of the Government, to forward you herewith doses of Haffkine's plague prophylactic, and to call your attention to the instructions and conditions mentioned hereunder.

As a matter of convenience the form referred to, which will be found overleaf, is perforated, so that it may, when filled up with the particulars, be torn off and returned to me.

I have, &c.,
C. A. SIMMS,
Secretary.

To Dr. ———

Haffkine's

Haffkine's Prophylactic.

The prophylactic is issued to medical practitioners on condition that they forward to the Secretary of this Department, as soon as possible, particulars concerning ages, addresses, and doses administered, &c., by them, in accordance with subjoined form :—

Dosage.

For a male aged 25 years or over ... ... 5cc.
" " " 20 " " ... ... 4cc.
" " " 15 " " ... ... 3cc.
" " " 10 " " ... ... 2cc.
" " " 5 " " ... ... 1cc.

Intermediate ages, intermediate doses. Females to receive one-fifth less than males of same age.

NOTE.—It is not safe to use the prophylactic save within an hour or two after the bottle has been opened. Arrangements should be made for the attendance at the same time of a sufficient number of people to use up the whole bottle.

Schedule.

PARTICULARS of Persons inoculated with Haffkine's Prophylactic.

Date of Inoculation.	Name.	Age.	Address.	Dose.

(Signed)

(Address)

The Secretary, Department of Public Health, Sydney.

APPENDIX G.

Cleansed Areas.

TABLE showing the dates on which Cases were infected within the several Areas which were specially cleansed, before, during, and after completion of cleansing : together with the dates on which each area was closed for cleansing. The dates of release are often merely formal ; areas seldom remained closed more than seven or eight days, and often less. (*See* Diagrams A, B, and C.)

	Case No.	Date.		Case No.	Date.
		1900.			1900.
Area 1.—Subdivision 1	5	March 1	Area 2.—Subdivisions 1 and 2	56	March 30
	11	" 5		70	April 1
	14	" 10		Closed ...	" 2
	19	" 13		Released	" 6
	21	" 14	Subdivision 3	9	March 7
	24	" 18		67	" 31
	25	" 18		Closed ...	April 2
	26	" 15		83	" 5
	32	" 20		84	" 5
	Closed ...	" 23		85	" 5
	37	" 25		Released	" 10
	Released	" 31	Subdivisions 4 and 5	Closed ...	" 2
	104	April 4	Subdivision 4	Released	" 12
	165	" 30	Subdivision 5	"	May 22
Subdivision 2	2	Feb. 18	Subdivision 6	49	March 26
	Closed ...	March 23		55	" 28
	39	" 25		58	" 26
	Released	April 3		64	" 29
				65	" 29
Subdivision 3	Closed ...	March 23		66	" 29
	Released	May 22		Closed ...	April 2
				Released	June 4
Subdivision 4	10	March 7	Area 3.—Subdivision 1	29	March 20
	Closed ...	" 23		Closed ...	April 9
	97	April 6		Released	" 12
	103	" 10	Subdivision 2	27	March 17
	Released	May 22		Closed ...	April 9
Subdivisions 5 and 6	Closed ...	March 23		Released	May 22
Subdivision 5	Released	May 22	Subdivision 3	Closed ...	April 9
Subdivision 6	"	" 22		Released	June 27

	Case No.	Date.
		1900.
Area 4	Closed ...	April 9
	Released	,, 20
Area 5.—Subdivision 1	53	March 29
	100	April 6
	Closed ...	,, 12
	140	,, 19
	Released	,, 20
Subdivision 2	52	March 25
	75	April 2
	86	,, 5
	107	,, 12
	Closed ...	,, 12
	Released	,, 24
	189	May 3
	223	,, 10
	255	,, 31
	285	June 22
Area 6	Closed ...	April 20
	Released	,, 24
Area 7	8	March 6
	110	April 10
	Closed ...	,, 20
	173	,, 25
	Released	May 1
Area 8	61	March 29
	62	,, 31
	Closed ...	April 24
	Released	May 25
Area 9	34	March 21
	183	April 25
	Closed ...	,, 27
	Released	May 1
Area 10	89	April 7
	Closed ..	,, 30
	Released	May 15
	290	June 24
Areas 11 and 12	Closed ...	May 1
	Released	,, 15
Area 13	57	March 26
	Closed ...	May 2
	Released	,, 15
Area 14 (Redfern)	23	March 17
	59	,, 30
	77	April 5
	80	,, 3
	134	,, 21
	159	,, 23
	177	,, 29
	Closed ...	May 3
	Released	,, 15
Areas 15 and 16	Closed ...	May 5
	Released	,, 15
Area 17	Closed ...	,, 7
	224	,, 9
	Released	,, 22
Area 18	129	April 20
	Closed ...	May 15
	245	,, 17
	Released	June 1
	297	,, 29
Area 19	72	March 31
	Closed ...	May 15
	Released	June 1
Areas 20 and 21	Closed ...	May 15
	Released	June 1
Area 22	4	Feb. 26
	Closed ...	May 15
	Released	June 1
	303	August 2
Area 23	Closed ...	May 15
	Released	June 1

	Case No.	Date.
		1900.
Area 24	234	May 11
	Closed ...	June 1
	Released	July 3
Area 25	230	May 14
	258	,, 29
	Closed ...	June 1
	Released	,, 15
Area 26	Nil.	Nil.
Area 27 (Paddington)	76	April 4
	121	,, 16
	151	,, 21
	154	,, 25
	167	,, 23
	208	May 8
	Closed ...	June 7
	Released	July 3
Area 28 (Paddington)	Closed ...	June 7
	283	,, 17
	284	,, 18
	Released	July 3
Area 29	233	May 13
	Closed ...	June 15
	295	,, 26
	Released	July 10
Area 30	127	April 20
	231	May 13
	Closed ...	June 15
	Released	July 10
Area 31	212	May 11
	Closed ...	June 15
	Released	July 10
Area 32	94	April 6
	123	,, 18
	176	,, 26
	Closed ...	June 15
	Released	July 10
Area 33	116	April 11
	136	,, 22
	172	,, 30
	Closed ...	June 15
	Released	July 10
Area 34 (Waterloo)	161	April 28
	162	,, 28
	170	May 2
	237	,, 10
	Closed ...	June 15
	Released	July 10
Area 35	190	May 1
	266	June 3
	Closed ...	,, 15
	Released	July 10
Area 36	35	March 25
	111	April 11
	160	,, 26
	235	May 13
	254	,, 29
	263	,, 28
	Closed ...	July 17
	Released	August 5
Area 1 (Manly)	175	May 2
	213	,, 11
	217	,, 13
	242	,, 21
	253	,, 29
	257	June 1
	Closed ...	,, 4
	288	,, 25
	Released	July 3
Areas 2 and 3 (Manly)	Closed ...	June 26
	298	July 12
	Released	,, 13
Areas 5 and 6 (Manly)	Closed ...	,, 10
	Released	,, 13

APPENDIX H.

Text of the Poster and Pamphlet issued on March 1st, 1900.

Department of Public Health, New South Wales.

Prevention of Plague.

PLAGUE is present in Sydney. It has been introduced by diseased rats, and there is great danger of its spreading still further.

Great efforts must therefore be at once made by Municipal Councils and by individual householders to kill all rats. This war must be persistently and steadily carried on. It must extend to every neighbourhood, as well as to those where the rats are known to be infected, for the following reason :—As soon as rats find they are dying in numbers, or are being trapped and killed, in any place they inhabit, they leave that place and go to some other. If there are already rats at the latter place, these become infected by the immigrants, and then disperse in their turn, thus carrying the disease still further. All rats, therefore, must be exterminated as far possible, and the attack upon them should be simultaneous in the healthy and infected neighbourhoods.

The following hints should be carefully read :—

1. It is most necessary that rats should be kept out of dwellings. Take care that doors are not broken near the ground, and close them at night ; see that all gullies are effectually trapped ; see that every house connected with the sewers is so connected according to the Regulations of the Board of Water Supply and Sewerage, and that the traps are in good order, so that rats cannot get past them.

2. Gather up with scrupulous care all fragments of food, bones, vegetables, potato-peelings, corn, &c., &c., and either burn them at once behind the kitchen fire, or place them in a securely covered dirtbox ; as far as possible also leave no water about where rats can get at it. Rats are always looking for food, and will not stay where none is to be found.

3. Lastly, take measures to kill any rats which happen to reach the premises. Poison is the best means, and nothing is better than arsenic, which is sold as "Rough on Rats," and under other names. It should never be spread on bread and butter, which might attract children, nor on any similar food. It should be mixed with a little meal and water. Oil of aniseed and an oil called oil of rhodium are said to be specially attractive to rats, and a little may be mixed with the meal, or smeared on traps. Set traps also. Use dogs too ; dogs very rarely indeed have suffered from plague, and, at all events, it is not only diseased rats which are to be destroyed, but also healthy ones.

Dead rats found about premises should not be touched until they have first been scalded with boiling-water where they lie ; they should then not be taken up in the hands but with tongs ; they should be burnt.

Extermination of rats is the most important thing to be attempted at this time. Very good reason has been shown for thinking that the plague spread in Indian cities not so much in proportion to overcrowding nor to filth as in proportion to the facilities which houses afforded by their construction for entrance of rats to dwelling-rooms.

Still, it must be remembered that, although rats may begin an epidemic of plague in man, they are by no means the only carriers of the contagion. Plague is a fever ; like other fevers, it is aided in its attacks by filthy surroundings, and probably its infection is fostered by filthy heaps of neglected and putrefying material, and by filthy earth.

Very great and special pains must therefore be taken by householders to thoroughly cleanse their houses internally, their yards, their gutters, and their drains. Municipal authorities should increase their staff of scavengers, and take care that all the minor nuisances (which at present are subject of daily complaint to this Department) are abated forthwith, and prevented from recurring ; they should also regularly collect and destroy filth, sweep and flush road and other gutters under their control, and take care that sewers within their jurisdiction are often flushed. Municipal authorities are seldom provided with large staffs, and nuisances sometimes exist for long before they are detected and dealt with. Every ratepayer should make a point, therefore, of reporting every nuisance which he observes in his district to the Council Clerk, who represents the Council, which latter is the Local Authority under the Public Health Act for the district it serves. It has full legal power to deal with and prevent all nuisances, either by its own action or through the Police Courts. Such complaints should not be addressed to this Department, which cannot execute detail work over the whole Colony. Detail work is the duty of Local Authorities within their several districts or municipalities.

Directions for Special Cleansing and Disinfecting.

Limewash all ceilings and whitened walls afresh ; limewash all cellar, basement, and outhouse walls.

Swab all woodwork thoroughly with carbolic water—include sash frames, window cases, &c.

Remove all floor coverings ; have carpets beaten ; oilcloth, &c., to be washed with carbolic water on both sides. Scrub the floors if of boards, and swab with carbolic water. Water stone, brick, and earth floorings with carbolic water three times a week.

All lumber and the like not in actual use must be removed from the premises and not returned to them. All wastes, garbage, ashes, dung, stable bedding, &c., &c., must be removed, and stable bedding renewed with clean stuff.

Stable floors, if of wood, or likely to be foul beneath, must be torn up, the surface below thoroughly cleansed as described, and replaced with good floors properly close-jointed and caulked, well-bedded on a sound bottom, and graded to a gutter. The gutter must be placed in communication with a gulley leading to the sewer.

All drains, gullies, sinks, water-closets must first be flushed with hot water. They must then be flushed with carbolic water, and afterwards be kept dressed with chloride of lime.

Furniture must be moved so as to give access to walls for cleansing, &c., and to the floor on which it has been standing.

All makeshift buildings and and sheds in bad repair must be pulled down and removed before the premises can be considered clean.

Solid disinfectant—Chloride of lime.
Liquid disinfectants—Carbolic water—Miscible carbolic, ¾ pint; water, 1 gallon.
Carbolic limewhite—Miscible carbolic, ½ pint to the gallon.

For household use, chloride of lime, mixed with water in the proportion of half a pound to the gallon, may be used for all purposes within and outside; or carbolic acid and the well-known tarry disinfectants, suitably diluted according to instructions with which they are sold. The poorer inhabitants should be supplied by the Local Authority for the district (the Municipal Council) free of cost, and Sanitary Inspectors should see that the disinfectant is properly applied.

The fullest information as to disinfection and disinfectants has been printed in a pamphlet, containing Suggestions for the prevention of the Infectious Diseases proclaimed under the Public Health Act, of which large numbers of copies have been sent to each Local Authority over the whole country. This was done more than a year ago. Any ratepayer can get one by application at the Council Chambers in his district.

By order,
C. A. SIMMS,
Secretary.

Sydney, 1st March, 1900.

*** Local Authorities will be supplied gratis with the disinfectants called miscible carbolic acid, cresylene, and chloride of lime, on application to the Chief Inspector of Stores, Young-street, Sydney; but of the two first named one only will be furnished.

APPENDIX I.

Form No. 251.

Department of Public Health, New South Wales.

Prevention of Plague.

Notice to Shipmasters, Agents, and Owners touching fumigation and destruction of rats.

All vessels trading between Sydney and every other port or place in New South Wales having to be fumigated under the Proclamation No. 286 of Friday, 30th March, 1900, in accordance with the requirements of the Board of Health, and having to produce a certificate that such fumigation has been so done to the Customs Officer at the ports or places at which they touch before communication with the shore will be permitted them, the following suggestions are published with a view to prevent loss of time in performing fumigation:—

1. Masters are expected to assist the officers of the Board in every way.
2. Preparation for fumigation should be made by the Masters as follows:—Compartments to be carefully examined and all openings closed, except one for access, as well as all cracks and crevices. A bucket of paste and a bundle of old newspapers are all that is required besides the usual closings, hatches, &c., &c.
3. As soon as these preparations are complete or well under way, notice must be given to Captain Tait, Superintendent of Fumigation, at the Customs House, Circular Quay, stating where the vessel is lying, and when she will be ready for fumigation to begin. The Superintendent will supply forms on application.
4. The actual fumigation must be done by or under immediate superintendence of the appointed officers of the Board.
5. After completion of fumigation to the satisfaction of the Superintendent, a certificate will be given in the appointed form, stating that fumigation has been done, and that the certificate is good until the date mentioned therein, when it will expire, and when fumigation must be repeated.

By Order,
C. A. SIMMS,
Secretary.

Sydney, 30 March, 1900.

Form 243.

Certificate of Fumigation delivered to Master by Superintendent.

Department of Public Health, New South Wales.

This is to certify that the vessel Master, tons register, was fumigated at this port for the purpose of destroying rats on board, under supervision of an officer of this Department, on this day of 1900.

C. A. SIMMS,
Secretary.

Signed, Superintendent.

1900.

Note.—This certificate is incomplete and of no avail unless countersigned by the Superintending Officer

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APPENDIX K.

APPENDIX K.

Governor's Regulations under the "Wharfage and Tonnage Rates Act of 1880."

1. Every vessel lying at a public wharf at any port or place in New South Wales must be maintained by fenders at a distance of not less than 4 feet from the wharf.

2. The fenders used, as required by the last preceding Regulation, together with any ropes attached to them must be freshly tarred each time before use, and daily if continuously used for more than twenty-four hours.

3. To each hawser and rope by which the vessel is made fast for 6 feet of length from the shore end, and for 6 feet in length from the ship end, and to fore and aft springs throughout their whole length, tar must be applied so that the said parts and springs are thoroughly covered, freshly before each time of use and daily if continuously used for more than twenty-four hours. The tar may be applied by means of bagging securely fastened around the hawser, rope, or spring.

4. All gangways must be drawn up, except when in actual use, for reception of cargo, except a single passenger gangway, and the said passenger gangway while in use must be constantly maintained freshly tarred on its upper surface for a distance of 3 feet at least from its shore end, and for a distance of 3 feet at least from its ship end.

5. Between sunset and sunrise, lamps of the best available sort must be suspended over the side sufficient to keep the wharf fore and aft brightly lighted.

6. All port and other holes in the ship's side next the wharf must be kept closed, unless in actual use for reception of cargo, when they must be brightly lighted as long as the vessel lies at the wharf.

7. No net must be used between the ship and the wharf.

8. No lighter must be allowed alongside except by special written permission of the Manager of Public Wharves.

9. Every master of a vessel who contravenes any of these Regulations shall be liable to a penalty not exceeding £20, and not less than £5, which may be recovered in a summary way before a Police or Stipendiary Magistrate, or any two Justices of the Peace, in accordance with the Acts relating to proceedings before Justices of the Peace, adopted by the Act 14 Vic. No. 43, and any Acts amending the same.

APPENDIX L.

Report of the Board of Health upon the Case of A.P.

The Chief Medical Officer of the Government and President of the Board of Health to The Honorable the Premier and Colonial Treasurer.

February 7, 1900.

* * * * * * * * * * *

I.—Clinical Account.

A.P., aged 33, married, a rather slight but muscular man, fair, and of nervous temperament; had had no illness for several years past. On *January 19th* he was driving a lorry through the city about 12 o'clock, on a very hot day, when he was suddenly seized with giddiness, headache at the vertex, and pain in the region of the stomach; he was obliged to lie down for a time when he reached the warehouse to which he was then going, but afterwards finished his day's work, though still suffering. About four hours after attack he began to feel pain in the left thigh near the groin, and discovered a small lump which had not been there before. He left work at 6 o'clock and went to bed; he took some castor oil, and had free action of the bowels; he also vomited, the vomit being of natural appearance. He was very ill all night with headache, thirst, fever, and continued pain in the gastric region; the lump in the thigh ached continuously. *January 20th*, at 2·15 p.m., he was found dozing, but was easily roused to attention; his face was flushed, and a little puffy or heavy-looking; his eyes were slightly suffused; the skin felt burning hot, the axillary temperature was 104·9° F., and the pulse was rapid and bounding. Examination of the lungs discovered no sign of disease; he was able to move about the bed freely, and to show various parts of his body readily; he answered questions promptly and clearly; there was no delirium, nor anxiety, nor interference with speech; the spleen could not be felt. The left lower extremity showed the lowest gland of the femoral chain enlarged; it was just visible, was about the size of an unshelled almond, indurated, and but slightly tender on pressure; the swelling was well defined, and limited to the gland itself, there being no infiltration of the surrounding tissues; two other glands, which seemed not to be enlarged, could be distinguished just above it. There was no inguinal enlargement, and careful examination of the rest of the body failed to discover any other swollen ganglion, except one in the right submaxillary region; this was hard, was not tender, and, though the patient was unaware of it, was probably old. The genital organs were perfectly free from lesions of any kind, and there were no signs of venereal disease present or past. The leg was examined for injuries which might have given rise to swelling of the gland, but none were found. A further examination, made two days later, disclosed the following:—Behind the left external malleolus, and just anterior to the edge of the achilles tendon, was a circular spot, about 3 mm. in diameter; the cutis was purplish red; the cuticle which had been detached was then adherent to the skin; at one point of the circumference it was slightly ragged. It seemed probable that this had been a bleb; its circular form and protected position suggested that it had not been produced by abrasion; and, while the feet showed no evidence of chafing at any other point, the patient said he had been wearing the same boots for three or four months past, and that they had never hurt him. Three days afterwards the cutis had lost its reddish-purple colour, and new cuticle had been formed. Earlier observers felt unable to say that this lesion had not been present at the first examination.

On *January 21st* his temperature had fallen to 102·2° F.; the pulse was no longer bounding, and was occasionally intermittent (imperfect systole); he still had some headache at the vertex, but he had slept tolerably well, and was better. The gland formed a visible lump of the size of a walnut; the skin

over

over it was slightly red, but it had been continuously fomented with hot boracic lotion; there was commencing peri-adenitic effusion, but no matting with the smaller glands immediately above could be made out. On *January 22nd* his temperature about midday had fallen to 99·2° F.; he was cheerful and alert, but pale and rather tremulous; the headache was less; he felt weak, but not exhausted; the gland had markedly increased in superficies, but was not much thickened, and though still quite tender was not at all acutely sensitive. He had slept well. On *January 23rd* the patient was in a similar state, but decidedly thinner and paler than at first; his temperature had risen again to 102·4° F.; the pulse was weak and easily compressed, but not intermittent. The femoral swelling had increased, and was nearly circular, about 2 inches in diameter. On *January 24th* his temperature was still 102·4° F., and his general state about the same; the femoral gland was of the size of a mandarin orange; it was still hard, surrounded with effusion, only moderately tender, and free from fluctuation.

2.—Bacteriological Investigation.

The bacteriology of this case was described by Dr. Frank Tidswell in the following report:—

On January 21st a puncture of the gland was made with instruments just previously sterilised by exposure to steam for half an hour in the Koch steriliser. The cotton-wool wrappings were retained till the time of operation, and the instruments were still warm when used. The part had been continuously treated with boracic acid fomentations for the previous twenty-four hours. Just prior to the operation the skin was shaved, well washed with 5 per cent. carbolic lotion, then with recently boiled and still warm distilled water, and finally dried with sterilised cotton wool. Through the single opening in the skin by partial withdrawal the syringe needle was passed in six different directions through the gland. The piston was raised on each occasion, but no fluid entered the barrel of the syringe. On its final removal the channel of the needle was found to contain a minute quantity of blood. This was ejected over the surface of a serum culture tube brought for the purpose, and a second serum culture tube was inoculated from the first in the ordinary way by means of the platinum needle. Both of these tubes incubated at 37° C. remained sterile for a period of ten days, when their further observation was abandoned.

On January 22nd, whilst palpating the gland, a drop of pus-like fluid was expressed through the puncture hole of the previous day. On the 23rd and 24th also similar fluid was obtained in the same way. On each occasion the single drop issuing was used to make smear preparations, and cultivations on serum and agar; and that obtained on the 22nd was also used to inoculate a mouse. As the microscopical and cultural characters of the three samples of fluid were identical, one description will serve for all.

The fluid expressed was of a dark greyish colour, showing a little red (blood), but no yellow. A small portion set aside was found to have clotted firmly when examined half an hour afterwards. The amount of blood present was far too small to account for this clotting, and, moreover, the clot was pale in colour. It is evident, therefore, that the fluid contained a large admixture of lymph. Under the microscope the fluid was seen to contain numerous lymph cells. A few were normal in character, but most of them showed fragmented nuclei, and more or less granular cytoplasm, *i.e.*, resembled "pus cells." Lying in groups and singly amongst the cells were numerous bacilli, varying, but commonly ovoid or cylindrical in form, ranging between 1μ and 3μ in length and about ·5μ broad; ends tapering and finally rounded off; staining well with gentian violet, fuchsine, or methylene blue, and more densely at the poles than in the middle of the rods. The majority did not retain the stain when treated by Gram's method, although here and there an individual bacillus remained coloured. No spores were seen. Rounded bacterial elements were not uncommon, and the results of cultivation subsequently showed them to be micrococci, and not merely cocco bacilli.

The cultivations were upon ordinary serum and upon nutrient agar, the inoculations being made at the bedside with the platinum needle sterilised in the flame of a spirit-lamp. The tubes, inoculated about noon, showed definite growth on the second morning afterwards, *i.e.*, in about forty-five hours, having been incubated at 37° C. in the interval. The growths were of two kinds, one composed of micrococci, the other of bacilli.

The micrococcal growth upon serum developed in the form of rounded colonies, attaining a diameter of ·5 mm. in forty-eight hours, and extending to 2 or 3 mm. in three or four days. Thick, opaque, flat, slightly irregular margins, smooth surface, creamy white in colour. In subculture the growth was more rapid at first, a 1 mm. wide creamy streak developing in twenty-four hours. After this the growth extended slowly, reaching a width of about 3 mm. after five days at 37° C. No alteration in colour was observed. There was a thick deposit and turbidity in the condensation water. Upon nutrient agar the growth was similar to that on serum, but whiter. On glucose agar the growth was more abundant than on nutrient agar, and was well up in twenty-four hours. In bouillon there was uniform turbidity already apparent in twenty-four hours.

The cocci stained readily with gentian violet, fuchsine or methylene blue, and retained the colour when treated by Gram's method. Under the microscope they were seen to be regular in outline, and to lie singly or in groups (staphylo cocci). There were no chains. Individual cocci measured ·5 to ·8 μ. in diameter. The transverse line commonly seen in the pyogenic cocci was not detected in any of the specimens examined.

The bacilliary growth upon serum at 37° C. was scanty. It appeared in forty-eight hours in the form of small, round, slightly raised translucent colonies, of a little less than ·5 mm. in diameter. The growth had not extended much by the third day, after which, in the original tubes, it became overgrown by more rapidly developing micrococci. In subculture upon serum the growth was visible as a thin colourless streak, in forty-eight hours it increased to a band about a millimetre wide. After five days it formed a thin translucent streak still limited to the neighbourhood of the inoculation line, slightly thicker at the margins with outlying colonies, and showing granular raised specks at irregular intervals. Upon nutrient agar and glucose the growth was very similar, and when looked at from the back had a ground-glass appearance. In broth it formed abundant spicular or crumb-like particles attached to the side of the tube, with an obvious deposit of same character as that in Haffkine's prophylactic, the broth itself remaining perfectly clear and transparent. A filmy appearance on the surface disappeared on shaking, and was not reformed after four days at 37° C. In flasks with oil a film and a few pendent growths 2 to 6 mm. long were formed, as well as a copious deposit.

The bacillus stained readily with violet, fuchsine, or methylene blue. Is decolourised by Gram's method, although here and there individual bacilli or small groups of them retain the colour. Non-mobile, at least as regards obvious movements of translation. The bacillus shows very distinct bipolar staining, more marked in some specimens than in others, but clearly recognisable in all. This characteristic may amount to the colouration of only a polar granule, or to colouration of most of the bacillus, leaving only the middle of the rod unstained. Intermediate gradations are common. The bacillus varies very much in form, regularly cylindrical, boat-shaped, club-shaped, dumb-bell, and oval elements are the commonest forms. The length varies between 1 μ and 3 μ, and the breadth is usually about ·5 μ. The ends are rounded off. No spores were observed.

Some of the material obtained from the femoral swelling on 22nd January was inoculated at 4·30 p.m. into a mouse—into the back at the root of the tail. The animal was lively during all the next day. There was no visible swelling at the site of inoculation; but the mouse was not handled. Next day it was much less lively in the morning, and got very sick during the afternoon. At 6 p.m. it was huddled up, coat rough, respiration hurried, refusing food, but started up when the glass of its jar was flicked. It was found dead and stiff next morning at 9 a.m., having thus become definitely sick within forty-eight hours, and died within sixty-four hours after inoculation.

The principal *post-mortem* features were as follows: Hæmorrhagic œdema at site of inoculation; enlargement of the ingüino-femoral glands on the right side; no enlargement of glands detected elsewhere; pericardium dusky, but no hæmorrhages seen; both ventricles of the heart distended with feebly clotted blood; lungs bright red in colour, patchy pneumonia (?); liver definitely but not very much swollen, mottled white and pink on surface; deep red on section; gall bladder empty, or nearly so; spleen not much, if at all, longer than normal, but thicker, swollen in such a way as to lose its normal sharp edges and assume a sausage-shaped form, section deep red, trabeculæ could not be seen with a hand lens; stomach normal, small intestine congested, large intestines not obviously affected, but contain fluid fæces; kidneys mottled, ection pale, internal structure obscure; bladder distended with urine of normal colour. Smear preparations and cultures made from various organs gave the bacilli showing bipolar staining.

A second mouse, inoculated with a small piece of the spleen of mouse 1 on 25th January, at 10·30 p.m., was lively on the following day (26th). On the 27th it became sick, exhibiting the same symptoms as the first mouse. On the 28th, at 9 a.m., it was lying partly upon its left side—the hind quarters being in a normal position; but the forelegs were tucked away, the left shoulder touching the wire-gauge floor of the cage, and the head stretched out. It remained quiescent in this position till it died at 11 o'clock. The second mouse thus became sick in about forty-eight hours, and died in seventy-two and a half hours after inoculation.

The principal *post-mortem* features were as follows, the animal being examined ten minutes after death: Hæmorrhagic œdema at the site of inoculation; enlargement of hæmorrhagic infiltration round the right inguino-femoral glands; enlargement of the left inguino-femoral, and right and left axillary glands, but no hæmorrhage. Pericardium dusky, but no hæmorrhages; right ventricle of heart contains fluid blood, left ventricle contracted and empty; lungs redder than normal, but not so much affected as in first mouse; liver slightly swollen, mottled pink and white on surface, section deep red; gall bladder distended with clear yellow bile; spleen not visibly altered internally, but section a little thicker than normal, and of a deep red colour; trebeculæ faintly discernible with lens; stomach normal, small intestines markedly congested, large intestine contains fluid fæces; kidneys normal on surface; section pale; structure obscure; bladder empty. Smear preparations and cultures were made from various organs gave bacilli as in first mouse.

A third mouse, inoculated on 28th instant with a small piece of the spleen of mouse No. 2, became sick on the 30th instant. During 31st January and 2nd February it had a series of seizures, characterised by very hurried and laboured breathing and prostration, and on each occasion appeared about to die. In the intervals it sat quietly huddled up, rarely moving, and taking very little food. It was found dead at 9 a.m. on the morning of 2nd February, having thus become sick on the second day, and died in about four and a half days. The *post-mortem* appearances were very similar to those shown by the other mice; in particular, the left inguino-femoral glands were swollen and surrounded by hæmorrhagic œdema, and the spleen enlarged to twice its normal size.

A guinea-pig, inoculated in left thigh on 25th January with a small piece of the spleen of mouse 1, showed no sign of illness till the 27th, but upon that day became quiet and drowsy, and took food sparingly. On the 28th it became very obviously sick, sitting huddled up with the back arched, eyes partly closed, and rarely moving. On the 29th and 30th it remained in very much the same condition, and was found dead at 9 a.m. on the 31st instant. The principal *post-mortem* features were as follow:—Hæmorrhagic infiltration at site of inoculation and in left inguino-femoral region; right groin normal; enlargement of and hæmorrhage round left axillary glands; right axillary glands enlarged; heart shows subpericardial hæmorrhages along auriculo-ventricular and interventricular grooves, and also along the edge of the right ventricle; lungs dark in colour, especially upper and middle right lobes, in which there is broncho-pneumonic consolidation; subpleural hæmorrhages in various places in all lobes; liver enlarged to about twice normal size, mottled red and white on surface, numerous small subcapsular hæmorrhages; spleen about three times larger than normal, deep violet in colour, showing very numerous white areas on both sides resembling miliary tubercle in appearance, edges rounded, no hæmorrhages; kidneys not enlarged, dusky in colour, hæmorrhages under capsule; suprarenals, especially left, enlarged and hæmorrhagic; bladder distended with clear urine giving albumin ring with nitric acid. No definitely abnormal appearances were detected in stomach or intestines. The blood-vessels found on reflecting the skin were markedly injected, and the blood fluid. The viscera were not sliced as it was desired to preserve the specimen with the organs *in situ*, for microscopical and cultivation purposes small pieces were obtained through areas on the under parts of the organs, previously seared in the usual way with a hot knife-blade. The smear preparations and cultures showed the bacilli already described.

A second guinea-pig, inoculated on 30th January with a small piece of the spleen of guinea-pig No. 1, became sick on 29th January, was very sick during 31st January and 2nd February, and died at 1·30 p.m. on 2nd February, having thus become sick in two days, and died in about four days. The *post-mortem* appearances were similar to those of guinea-pig No. 1, except that the spleen, though twice the normal size, did not show the miliary-tubercle-like appearance.

From the foregoing description of the bacteriological examination of material obtained from the enlarged femoral gland of A.P., it will be seen that two microbes were isolated—(*a*) a micrococcus still undetermined, but most likely one of the varieties of staphylococcus pyogenes albus; and (*b*) a bacillus answering positively to all the immediately applicable tests for *Bacillus Pestis Bubonicæ*.

FRANK TIDSWELL.

3.—Epidemiological Relations.

A.P. was a lorry-driver, employed by the Central Wharf Company. His chief occupation was carting exports from city warehouses to the wharf, and delivering them either at his employer's warehouse or at the ship's side. For several months past he had been thus engaged in carting wool almost exclusively. Occasionally he used a truck to run goods from the warehouse across the wharf. He had not handled goods discharged from any ship since the previous August. He had no business on board ships, though he may occasionally have carried a message to the mates; and he had not been below on any ship for three months past at all events. Since Christmas he had only visited one other wharf, that of the A.U.S.N. Co., on January 9th, when he removed green hides imported from Queensland to a city warehouse. Both steam and sailing vessels from plague-infected ports must by this time (namely, near the end of the sixth year from the date of declaration of the epidemic at Hongkong) have discharged or loaded at every suitable wharf in the harbour; and, as regards Central Wharf alone, between November 1st and January 20th four steamships, which all carried Chinese crews, and which had all touched at Hongkong, had lain there—one of them from January 9th to 20th.

4.—Local Conditions.

A.P. had lived in the house where he was found for eight years (see illustration). It was built of brick, on a sandstone ridge, which sloped rather steeply to a branch of the harbour, within the city limits, and in a neighbourhood containing many large warehouses. It had two stories, four rooms, a small attic, and an unused basement, of which the natural rock formed the floor. It was in average general repair, but the sewerage was seriously defective.* There were no inside fittings, but there was a yard gulley halfway down the small walled yard, and a water-closet at the end of it. These were drained by 6-inch glazed E.W.P., which ran forward under the house in a chase cut in the rock floor of the basement. The drain was in aërial connection with the sewer, and the last length of piping against the front wall of the house had had a considerable hole knocked in it; the interior of the dwelling was thus brought into direct connection with the interior of the sewer. On the other hand, however, the basement had a large opening at pavement level in its front wall, and a door at the back, both of which were said to be kept constantly open. The drain junctioned with a very old oviform rubble sewer, which discharged on the foreshore at Dalton's Wharf, about 50 feet below the house and about 150 yards away, next to the Central, and which was unprovided with any tide-flap. Very few houses were connected with it, and its chief use seemed to be discharge of storm-waters. In every domestic respect the house was tidy, clean, and well-kept.

J. ASHBURTON THOMPSON.

* This is too generally the case within the city of Sydney, which in this respect is very sharply distinguished from the rest of the Metropolitan area. In the latter sewerage is under exclusive control of the Metropolitan Board of Water Supply and Sewerage; and the 38,000 houses, containing 182,000 persons, to which the Board's service had been extended down to December 31st, 1899, are in every case connected on the most approved principles.

APPENDIX N.

Circular. Form No. 236.

Department of Public Health, New South Wales, Sydney, 8 February, 1900.

Bubonic Plague.

Sir,

I do myself the honor to draw your attention to the enclosed copy of *Supplementary Government Gazette* of the 6th instant, No. 108, in which Plague is proclaimed to be a notifiable disease under the Public Health Act, Part III, in accordance with Section 20 thereof.

2. In connection with this proclamation, I would point out that, whereas notification of the commoner infectious diseases is properly not required until the diagnosis has become clear [see Public Health Act, Section 21 (b)], it is desirable in the general public interest that a somewhat different course should be taken with Plague. Success in the prevention of this disease depends so largely on early knowledge of all cases which occur that, although it is not the law, I venture to urge upon you the desirability of notifying not only declared cases, but also those in which the clinical symptoms, the patient's occupations, his recent movements, &c., &c., furnish ground for reasonable suspicion of plague.

I have, &c.,
J. ASHBURTON THOMPSON,
Chief Medical Officer of the Government.

APPENDIX O.

Department of Public Health, N.S.W. Form 247.

Directions for Special Cleansing and Disinfecting, issued to the Staff of Sanitary Inspectors, Scavengers, &c.

LIMEWASH ceilings whenever dirty, and in all small property; spare good ceilings in good condition or decorated, &c., &c.

Limewash all whitened walls afresh; limewash all cellar, basement, and outhouse walls.

Swab all woodwork thoroughly with carbolic water—include sash frames, window cases, &c.

Remove all floor coverings; have carpets beaten; oilcloth, &c., to be washed with carbolic water on both sides. Scrub the floors if of boards, and swab with carbolic water. Thoroughly saturate inside stone and brick floorings with carbolic water.

Saturate all outside pavements and soil with sulphuric acid water.

All lumber and the like not in actual use must be removed from the premises and not returned to them. All wastes, garbage, ashes, dung, stable bedding, &c., &c., must be removed, and stable bedding renewed with clean stuff.

Stable floors, if of wood, or likely to be foul beneath, must be torn up, the surface below thoroughly cleansed as described, and replaced with good floors properly close-jointed and caulked, well-bedded on a sound bottom, and graded to a gutter. The gutter must be placed in communication with a gulley leading to the sewer.

All drains, gullies, sinks, water-closets must be first flushed with hot water. They must then be flushed with carbolic water, and afterwards be kept dressed with chloride of lime.

In warehouses, &c., merchandise (except heavy machinery) must be moved so as to give access to walls for cleansing, &c., and to the floor on which it has been standing.

All makeshift buildings and sheds in bad repair will be condemned, and must be pulled down and removed before the premises can be passed as clean.

Occupants of premises which have been passed as clean will be furnished with a small placard, which they may affix in a conspicuous position, stating that the premises have been cleansed in accordance with the requirements of the Board.

Solid Disinfectant.—Chloride of lime.

Liquid Disinfectants.—Carbolic water—Miscible carbolic, ¾ pint. Water, 1 gallon.

Sulphuric acid water.—Sulphuric acid, ½ pint. Water, 1 gallon.

Carbolic limewhite.—Miscible carbolic, ½ pint to the gallon.

By Order,
C. A. SIMMS,
Secretary.

Department of Public Health, New South Wales. Form No. 246.

THESE premises have been cleansed and disinfected, in accordance with the requirements of the Board.

C. A. SIMMS,
Secretary.

Address of premises, Date,

Signed, Sanitary Inspector in Charge.

No

No. . Department of Public Health. Form 250.

Notice to Cleanse and Disinfect, under the Public Health Act.

To occupier of situated at No. street.

The Board of Health, being of opinion that it is necessary that the premises occupied by you should be cleansed and disinfected, and that the drains of the said premises should also be cleansed and disinfected, and that certain articles should be destroyed, notice is hereby given that unless within twenty-four hours from the receipt of this notice you inform the Board of Health, in writing, that within a further period of hours you will carry out the cleansing and disinfecting operations, and the destruction of certain articles hereinafter mentioned, the Board of Health will enter on the said premises and carry out the said cleansing and disinfecting operations and the destruction of the said articles at your expense, in pursuance of the powers vested in them by the provisions of the Public Health Act.

Particulars of cleansing and disinfecting operations required

List of articles to be destroyed

Note.—All such cleansing and disinfecting operations, and the destruction of such articles, must be done to the satisfaction of a legally-qualified medical practitioner.

Date of Service

Hour of Service

Inspector.

Under this notice you may elect to take any of the following courses:—

"A" To cleanse and disinfect the premises yourself within the period mentioned in the notice.

"B" To request the Board of Health to undertake the cleansing and disinfecting of the premises.

Penalties for Non-compliance.

If, having elected to carry out the required operations, you fail to do so within the time mentioned, a breach of the Act will have been committed.

Note.—In addition to the penalties incurred under the Public Health Act, you will be liable to have your premises placed in quarantine and isolated.

C. A. SIMMS,
Secretary.

No. Form No. 265.

Department of Public Health, N.S.W.

Notice under the Public Health Act.

To occupier of situated at No. street.

You are hereby notified that the undermentioned works must be executed before your premises can be certified as sanitary,

To avoid institution of proceedings against you under the provisions of the Public Health Act, the improvements must be taken in hand at once, and most be completed within from date of service of this notice.

Date of Service Inspector.

Hour of Service

[Five Plates, One Diagram, Four Plans.]

Sydney: William Applegate Gullick, Government Printer.—1901.

[7s. 6d.]

PLATE 1.

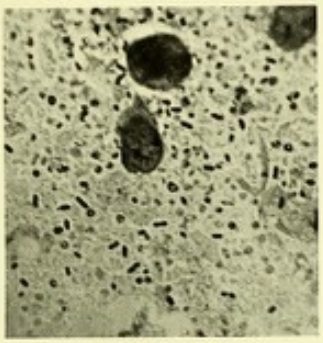


FIGURE 1.
FROM A BUBO. × 1000.

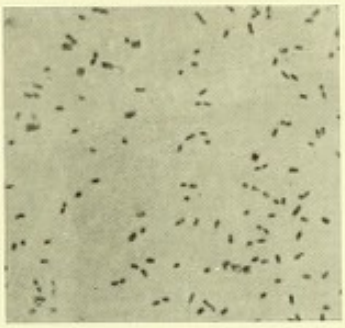


FIGURE 2.
FROM AN AGAR CULTURE. × 1000.

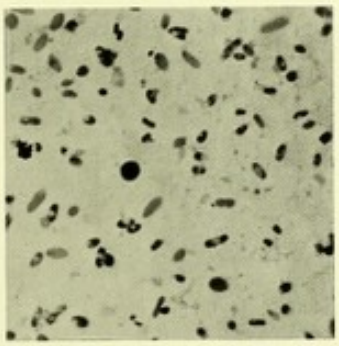


FIGURE 3.
FROM A DRY AGAR CULTURE. INVOLUTION FORMS.
× 1000.

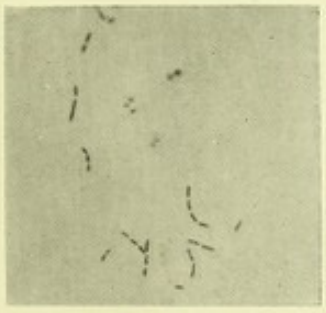


FIGURE 4.
FROM A BOUILLON CULTURE. × 1000.

FIGURE 5.
SMEAR PREPARATION FROM A FLEA. × 1000.

Frank Tidswell.

BACILLUS FESTIS BUBONICÆ.

PLATE 2.

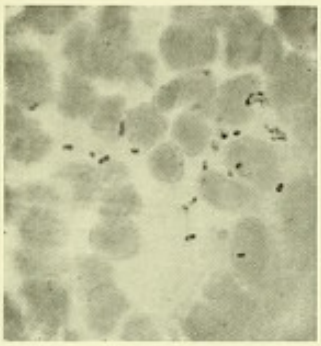


FIGURE 6.
FROM A CARBUNCLE. CASE OF J.D. $\frac{1}{12}$ 1000.

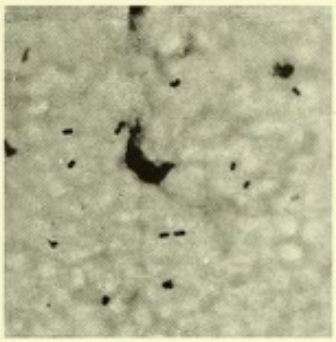


FIGURE 7.
FROM BLOOD OF HEART. INOCULATED GUINEA-PIG.
$\frac{1}{12}$ 1000.

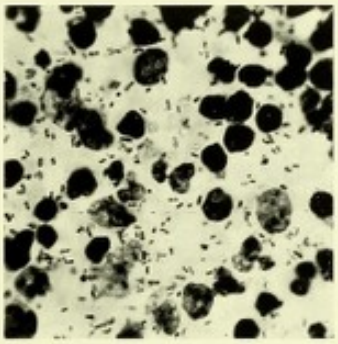


FIGURE 8.
FROM THE SPLEEN. CASE OF E. MIC. $\frac{1}{12}$ 1000.

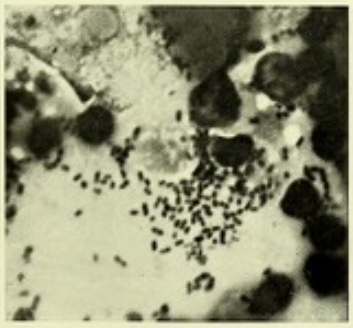


FIGURE 9.
FROM A BUBO. NATURALLY INFECTED CAT. X 1000.

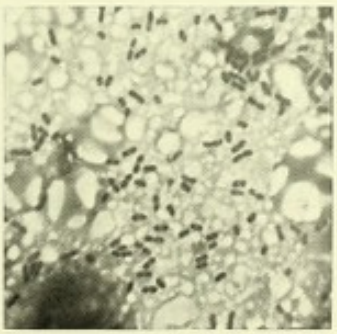


FIGURE 10.
FROM THE LIVER. NATURALLY INFECTED RAT. X 1000

Frank Tidswell.

BACILLUS PESTIS BUBONICÆ.

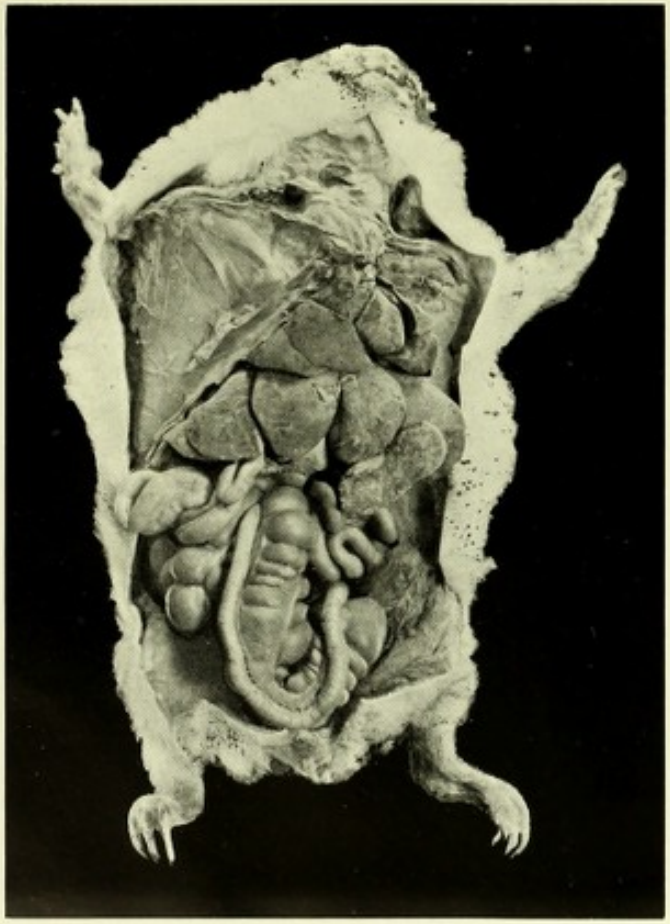


FIGURE 11.

PATHOLOGICAL APPEARANCES IN A GUINEA-PIG. PNEUMONIA, ENLARGEMENT OF THE LIVER, ENLARGEMENT AND MILIARY MOTTLING OF THE SPLEEN, BUBO IN THE LEFT GROIN.

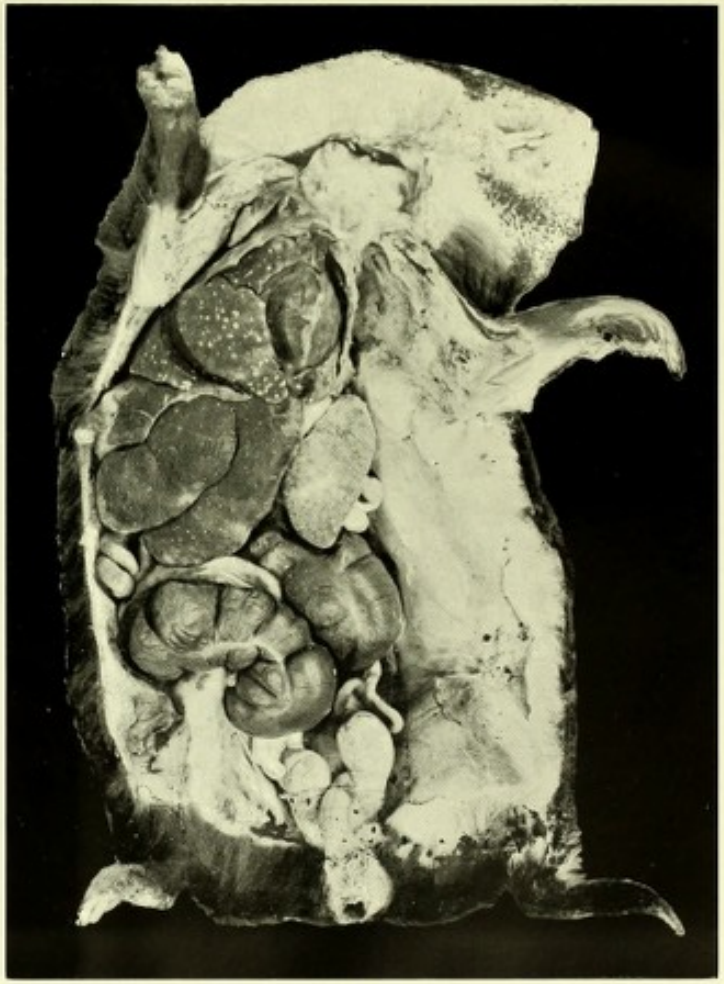


FIGURE 12.

PATHOLOGICAL APPEARANCES IN A GUINEA-PIG. PNEUMONIA WITH NECROTIC POINTS IN THE LUNGS, ENLARGEMENT OF THE LIVER, ENLARGEMENT AND MILIARY MOTTLING OF THE SPLEEN, BUBO IN THE RIGHT GROIN.

Frank Tidswell.

PATHOLOGICAL APPEARANCES IN INOCULATED GUINEA-PIGS.

FIGURE 13.

DISSECTION OF AN INOCULATED GUINEA-PIG, SHOWING HÆMORRHAGES IN THE KIDNEYS, ENLARGEMENT AND CONGESTION OF THE SUPRARENAL BODIES, BUBO IN THE RIGHT GROIN, WITH HÆMORRHAGIC EXUDATION EXTENDING INTO THE PELVIS.

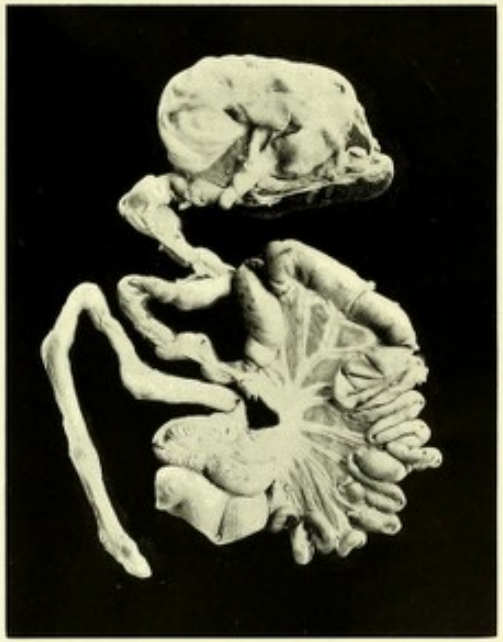


FIGURE 14.

DISSECTION OF THE GASTRO-INTESTINAL TRACT OF A RAT DEAD AFTER BEING FED UPON INFECTED VISCERA, SHOWING ENLARGED AND CONGESTED LYMPHATIC GLAND CONNECTED WITH THE STOMACH, CONGESTION OF THE MESENTERIC BLOOD-VESSELS, HÆMORRHAGIC EXUDATION AT FIRST PART OF LARGE INTESTINE, AND A MASS OF SWOLLEN MESENTERIC LYMPH GLANDS.

Frank Tidswell.

DISSECTIONS OF GUINEA-PIG AND RAT.

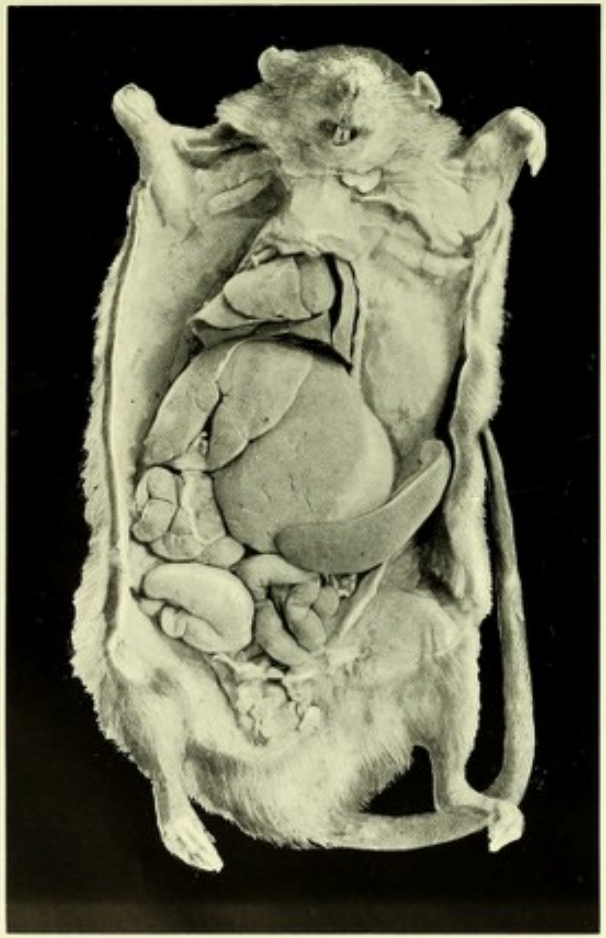


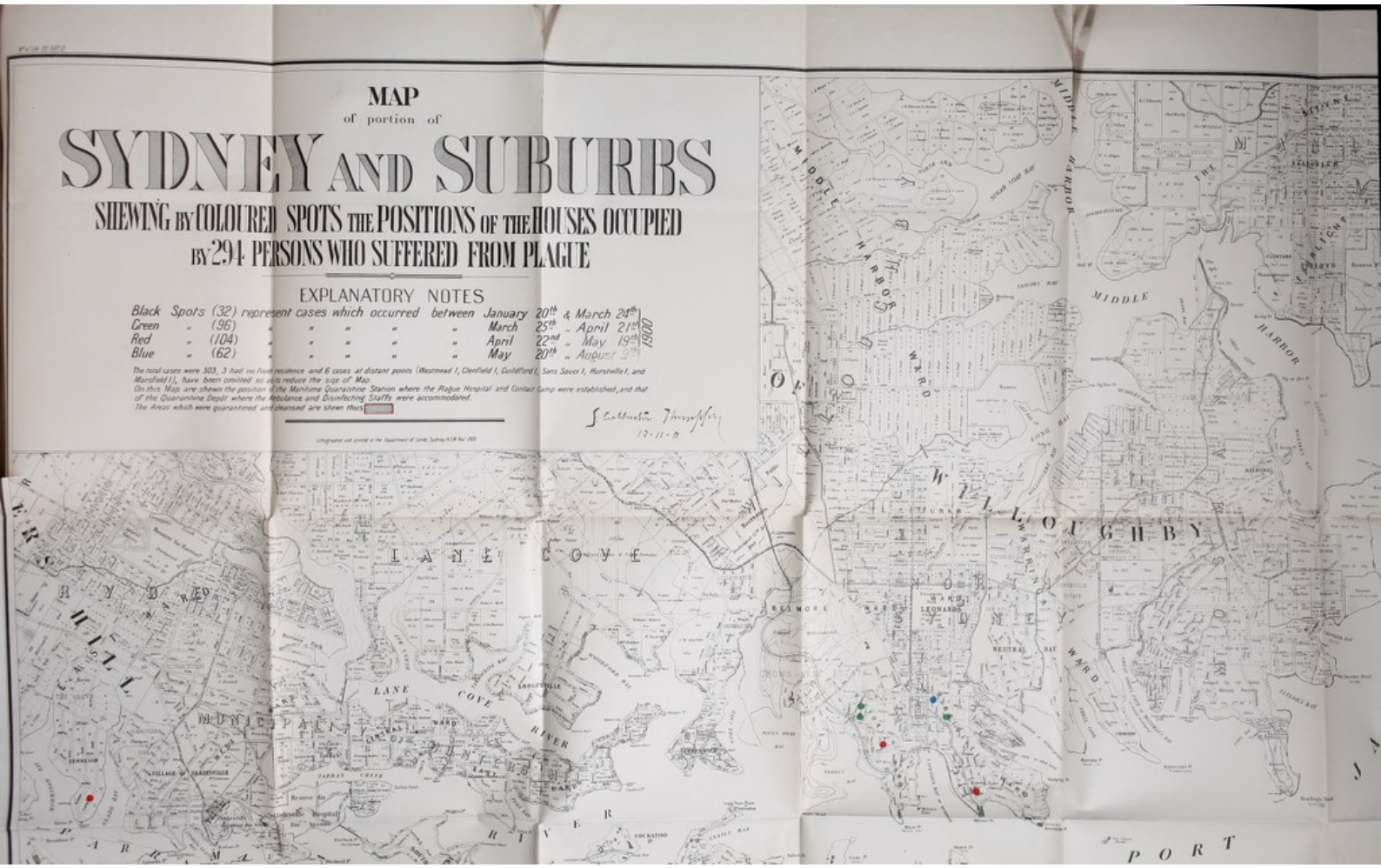
FIGURE 15.
PATHOLOGICAL APPEARANCES IN A NATURALLY INFECTED RAT. PNEUMONIA, ENLARGEMENT OF LIVER, SPLEEN AND AXILLARY GLANDS.

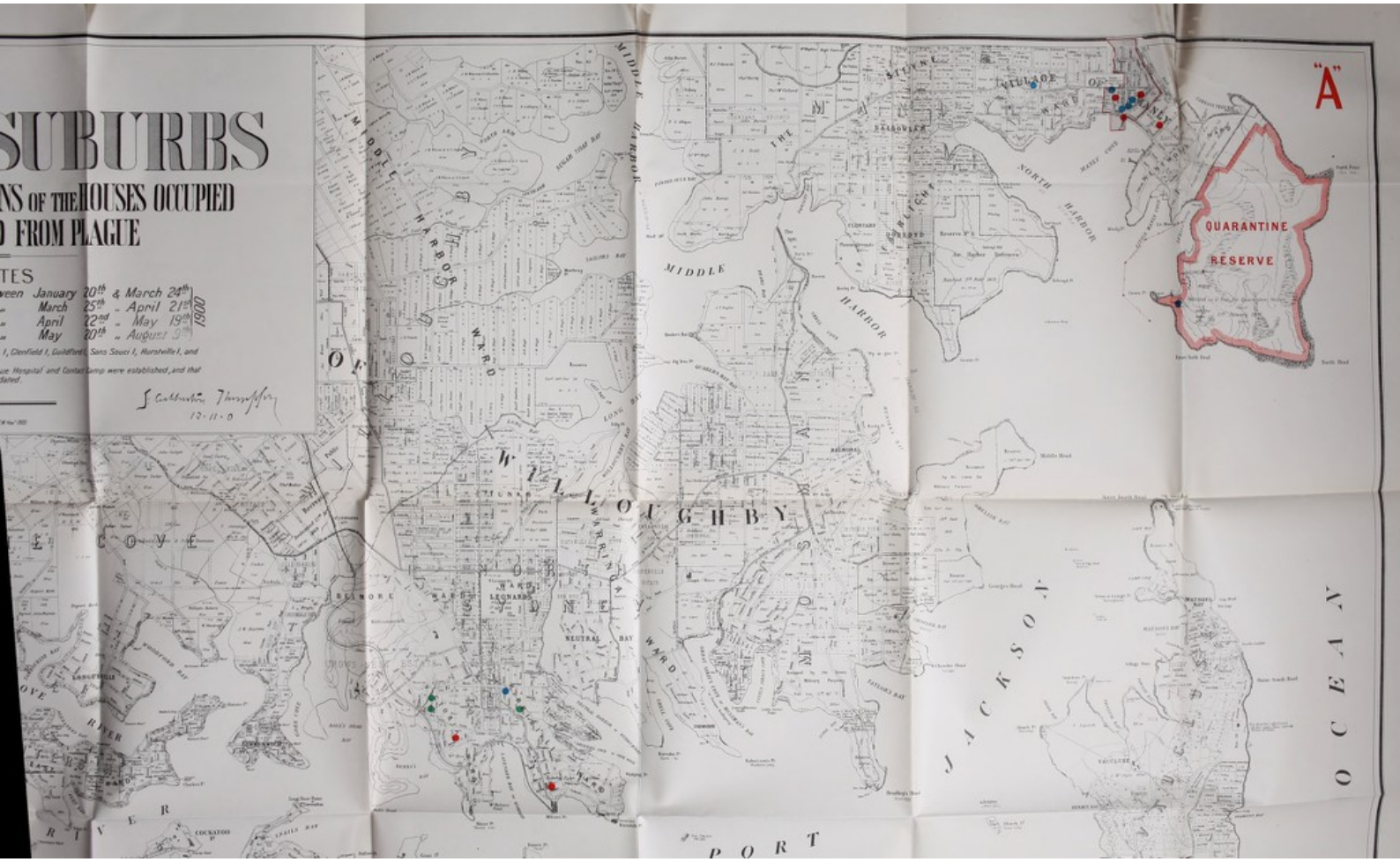
FIGURE 16.
PATHOLOGICAL APPEARANCES IN A NATURALLY INFECTED RAT. ENLARGEMENT OF LIVER AND SPLEEN.

Frank Tidswell.

PATHOLOGICAL APPEARANCES IN NATURALLY INFECTED RATS.


Daily Totals of Cases ___ 23rd Feb. to 30th June, 1900.
Mean Elastic Force of Vapour (3 observations daily)
Mean Temperature.
Rainfall.
Mean Temperature
Elastic Force
Daily Totals
Inches
Feb.
March
April
May
June
1900

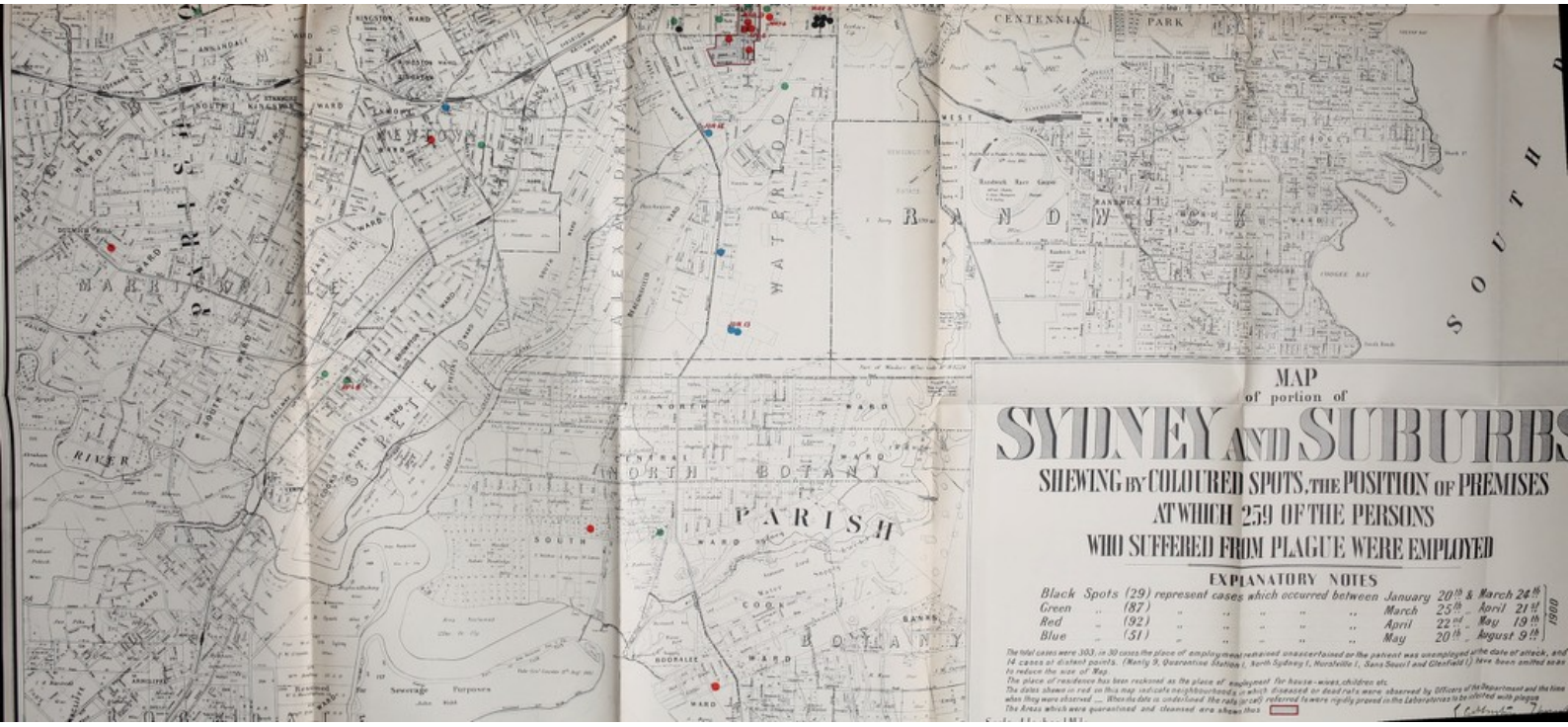

MAP
of portion of
SYDNEY AND SUBURBS
SHEWING BY COLOURED SPOTS THE POSITIONS OF THE HOUSES OCCUPIED
BY 294 PERSONS WHO SUFFERED FROM PLAGUE
EXPLANATORY NOTES
Black Spots (32) represent cases which occurred between January 20th & March 24th
Green " (96) " " " " " March 25th - April 21st
Red " (104) " " " " " April 22nd " May 19th
Blue " (62) " " " " " May 20th " August 3rd
1900
The total cases were 303, 3 had no fixed residence and 6 cases at distant points (Westmead I, Clenfield I, Guildford I, Sans Souci I, Horstville I, and Marsfield I.), have been omitted so as to reduce the size of Map.
On this Map are shewn the position of the Maritime Quarantine Station where the Plague Hospital and Contact Camp were established, and that of the Quarantine Depôt where the Ambulance and Disinfecting Staffs were accommodated.
The Areas which were quarantined and cleansed are shewn thus
J. Cullen Thompson
12-11-0
LANE COVE
WILLOUGHBY
MUNICIPALITY
NORTH SYDNEY
MIDDLE HARBOR
PORT


SUBURBS
NS OF THE HOUSES OCCUPIED
D FROM PLAGUE
TES
ween January 20th & March 24th
" March 25th " April 21st 1900
" April 22nd " May 19th
" May 20th " August 9th
I, Clenfield I, Guildford I, Sans Souci I, Morsrelle I, and
se Hospital and Contact Camp were established, and that
dated.
12-11-0
"A"
QUARANTINE
RESERVE
MIDDLE HARBOR
NORTH HARBOR
WILLOUGHBY
SYDNEY
NEUTRAL BAY
JACKSON
OCEAN
RIVER
PORT


CONCORD
BURWOOD
ENFIELD
CANTERBURY
PETERSHAM
MARRICKVILLE
COOKS
RIVER
CANADA BAY
NEWTOWN
PARISH OF ALEXANDRIA
WATERLOO
CENTENNIAL PARK
NORTH BOTANY
PARISH
BOTANY
BROADWAY


PARISH OF ALEXANDRIA
CENTENNIAL PARK
SYDNEY COMMON
PACIFIC
SOUTH
PARISH OF BOTANY
NORTH BOTANY
CENTRAL
SOUTH
WATERLOO
ALEXANDRIA
CAMPERDOWN
NEWTOWN
GLEBE
ANNANDALE
LEICHHARDT
PETERSHAM
STANMORE
ENMORE
MARRICKVILLE
DULWICH HILL
ASHFIELD
PADDINGTON
WOOLLAHRA
BONDI
RANDWICK
COOGEE
WAVERLEY
BOTANY
BANKS
CHURCH LAND
SCHOOL ESTATE
BOORALEE
Randwick Race Course
Sewerage Purposes


"B"
PORT JACKSON
SOUTH PACIFIC OCEAN
PARISH OF ALEXANDRIA
CENTENNIAL PARK
WATERLOO
MAP
of portion of
SYDNEY AND SUBURBS


CENTENNIAL PARK
WATERLOO
ALEXANDRIA
NORTH BOTANY
PARISH
BOTANY
SOUTH
RIVER
MAP
of portion of
SYDNEY AND SUBURBS
SHEWING BY COLOURED SPOTS, THE POSITION OF PREMISES
AT WHICH 259 OF THE PERSONS
WHO SUFFERED FROM PLAGUE WERE EMPLOYED
EXPLANATORY NOTES
Black Spots (29) represent cases which occurred between January 20th & March 24th
Green .. (87) .. .. March 25th _ April 21st
Red .. (92) .. .. April 22nd _ May 19th
Blue .. (51) .. .. May 20th _ August 9th
1900
The total cases were 303, in 30 cases the place of employment remained unascertained or the patient was unemployed at the date of attack, and 14 cases at distant points. (Manly 9, Quarantine Station 1, North Sydney 1, Hurstville 1, Sans Souci 1 and Glenfield 1) have been omitted so as to reduce the size of Map.
The place of residence has been reckoned as the place of employment for house-maids, children etc.
The dates shown in red on this map indicate neighbourhoods in which diseased or dead rats were observed by Officers of the Department and the time when they were observed ... When the date is underlined the rat(s) so referred to were rightly proved in the Laboratories to be infected with plague
The Areas which were quarantined and cleansed are shown thus


PORT JACKSON
SOUTH PACIFIC OCEAN
"B
PARISH OF ALEXANDRIA
CENTENNIAL PARK
PARISH
MAP
of portion of
SYDNEY AND SUBURBS
SHEWING BY COLOURED SPOTS, THE POSITION OF PREMISES
AT WHICH 259 OF THE PERSONS
WHO SUFFERED FROM PLAGUE WERE EMPLOYED


CENTENNIAL PARK
SOUTH PA
RANDWICK
WATERLOO
NORTH BOTANY
PARISH
BOTANY
MARRICKVILLE
ROBERTSON
RIVER
COOKS
BOORALEE
WARD
MAP
of portion of
SYDNEY AND SUBURBS
SHEWING BY COLOURED SPOTS, THE POSITION OF PREMISES
AT WHICH 259 OF THE PERSONS
WHO SUFFERED FROM PLAGUE WERE EMPLOYED
EXPLANATORY NOTES
Black Spots (29) represent cases which occurred between January 20th & March 24th
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1900
The total cases were 303, in 30 cases the place of employment remained unascertained or the patient was unemployed at the date of attack, and 14 cases at distant points. (Manly 9, Quarantine Station 1, North Sydney 1, Hurstville 1, Sans Souci 1 and Glenfield 1) have been omitted so as to reduce the size of Map.
The place of residence has been reckoned as the place of employment for house-wives, children etc.
The dates shown in red on this map indicate neighbourhoods in which diseased or dead rats were observed by Officers of the Department and the time when they were observed. ... Where the date is underlined the rats (or all) referred to were rigidly proved in the Laboratories to be infected with plague.
The Areas which were quarantined and cleansed are shown thus
Scale 4 Inches 1 Mile
12-11-01