

COMMONWEALTH OF AUSTRALIA  
Department of Health

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SERVICE PUBLICATION No. 32.

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**THE HISTORY OF  
PLAGUE  
IN AUSTRALIA  
1900—1925**

*By*

**J. H. L. CUMPSTON, M.D., D.P.H.,**  
*Director-General of Health and Director of Quarantine,*

AND

**F McCALLUM, M.B., B.S., D.P.H., D.T.M. & H.**  
*Quarantine Officer,*  
*Commonwealth Department of Health.*

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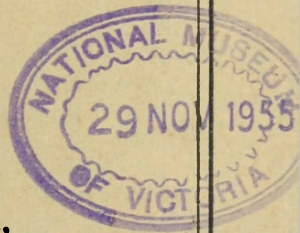
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**1926**

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H. J. GREEN, GOVERNMENT PRINTER, MELBOURNE.



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## PREFACE.

The records of plague incidence and of activities directed against plague are scattered through a large number of official records and current journals. Some of the facts have never hitherto been published. It has seemed desirable to collect all the available information and compile it as a consecutive statement for the benefit of future students of the subject, and also for the preservation of some material which otherwise would be permanently lost. Some features, easily perceptible, are not without importance in relation to the administrative control of plague in Australia. Acknowledgement of the source of information has not invariably been made throughout this work, but, by the compilation of a comprehensive bibliography, an endeavour has been made to rectify any such omission.

J. H. L. CUMPSTON, M.D., D.P.H.

*Director-General of Health.*



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## INTRODUCTORY.

As of importance in regard to the introduction of plague into Australia and as indicating the development of knowledge concerning the ætiology and epidemiology of plague, some of the more important dates in connexion with the present pandemic are set out in the following chronological table:—

- 1894.—Infection of Hong Kong probably through Canton from an endemic focus in the Chinese province of Yunnan. *Bacillus pestis* discovered independently by Kitasato and Yersin in Hong Kong. Association of epidemic and epizootic observed by Yersin and Lawson in Hong Kong (previously noted by Planck in India (1876) and other observers) and possibly referred to in the Bible (First Samuel, Chapters IV., V., and VI.).
- 1896.—Infection of Bombay, Osaka, and Formosa. Haffkine (Bombay) developed anti-plague serum.
- 1897.—International Conference on Plague at Venice. Ogata (Japan) suggested suctorial insects as vectors from rat to man. Association of epidemic and epizootic observed by Snow, Weir, Hankin, and Simond in India.
- 1898.—Infection of Madagascar and Jeddah. First Plague Commission of India appointed. Simond (France) reported observations on the rôle of fleas as vectors from rat to man.
- 1899.—Infection spread to Malay States, Philippine Islands, Japan, New Caledonia, the Sandwich Islands, San Francisco, Asuncion, Rosario, Buenos Ayres, Rio de Janeiro, Oporto, Lisbon, Alexandria, further Red Sea ports, French Ivory Coast, Persian Gulf, and Mauritius. German Plague Commission appointed.
- 1900.—Infection spread to Australia, Cape Town, and Glasgow. Plague present in every quarter of the Globe—Europe, Asia, Africa, North and South America, and Australasia.
- 1903.—Infection of Peru. International Sanitary Conference of Paris.
- 1904.—Infection of Johannesburg, South Africa. Appointment of an Advisory Committee of the India Office, Royal Society, and Lister Institute to investigate plague.
- 1905.—Infection of Persia and Russia.
- 1906.—Infection of Leith (Scotland) and Guayaquil (Ecuador).
- 1908.—Infection of Shanghai.



- 1907.—Infection of Accra (Gold Coast). Appointment of second Plague Commission of India.
- 1910.—Infection of Soerabaya (East Java). Pneumonic plague epidemic in Manchuria.
- 1911.—Spread of infection inland in East Java.
- 1914.—Infection of Colombo (Ceylon).
- 1916.—Infection of Semarang (Mid-Java).
- 1917.—Extension of infection in Mid-Java.
- 1920-21.—Pneumonic plague epidemic in Manchuria.

### Plague in Australia.

Any discussion of the history of plague in Australia falls naturally into consideration of five periods:—

- (1) Prior to the introduction of plague;
- (2) The outbreaks of 1900-1909;
- (3) The plague-free years of 1910-1920;
- (4) The outbreaks of 1921-1922;
- (5) The years 1923-1925.

With regard to the period prior to the discovery of plague in Sydney in 1900, during the pandemic extension of that time, there is nothing to indicate that infection had ever appeared in Australia. It is interesting to note, however, that in a "Table of Deaths for Hobart Town for the Years 1842, 1843, 1852, 1853," appended to a paper on "The Epidemics of 1852-3" (Proceedings of Royal Society of Van Diemen's Land, Vol. II., Part III., January, 1854), Dr. E. S. P. Bedford records a death from plague in November, 1843. It is now obviously impossible to interpret this entry, in view of the loose use of the term "plague", even at the present time.

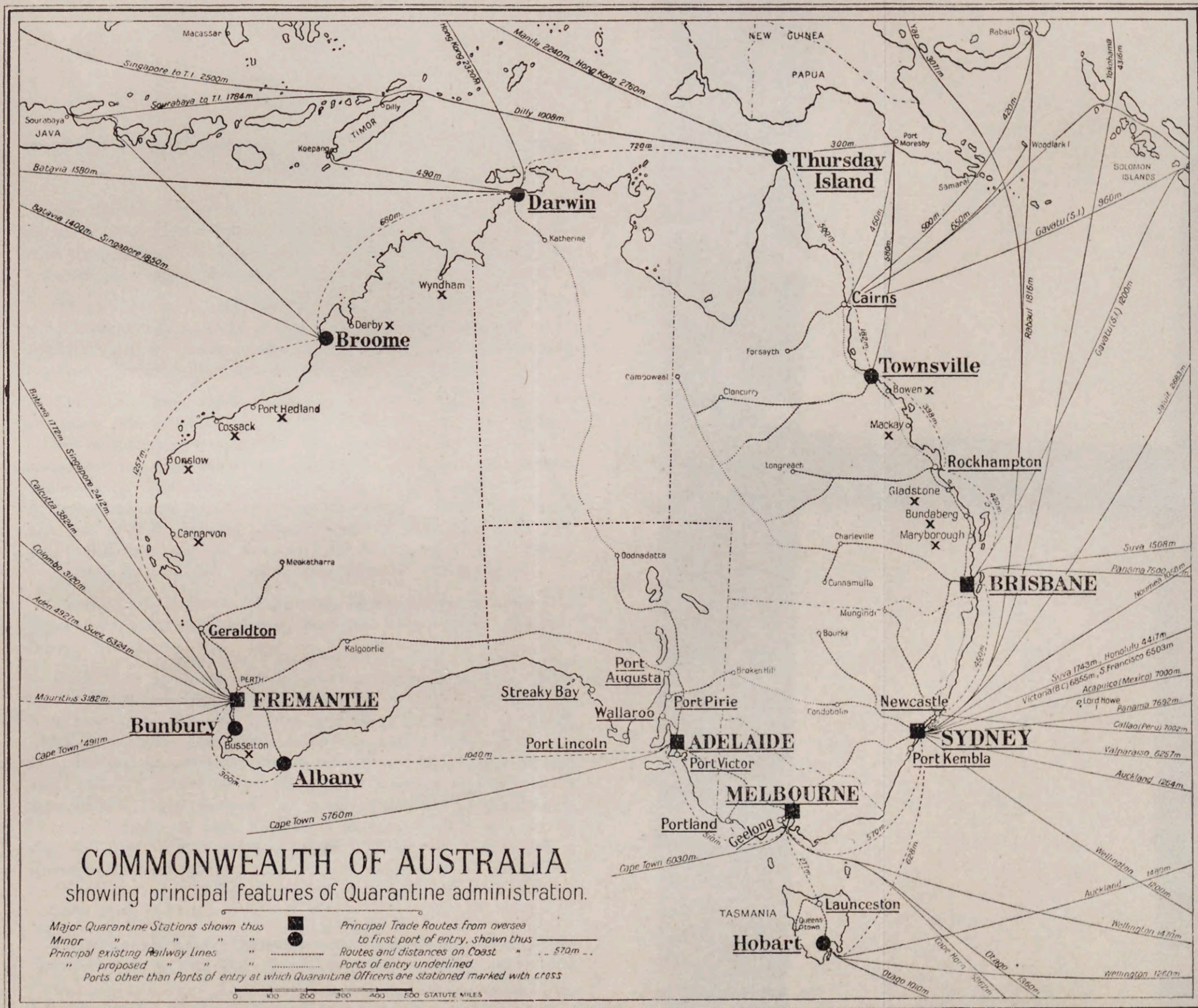
In giving evidence before the Select Committee that inquired into the quarantine laws at Sydney in 1853, Dr. H. G. Alleyne, the Port Health Officer, stated: "We are not at present threatened with the importation of yellow fever, plague, or cholera, against which quarantine is established in other countries."—(N.S.W. *Votes and Proceedings*, 1853, Vol. II.)

At the time of the origin of the pandemic wave that spread over the world following the year 1896, it may be noted that the leading health authorities in Australia were fully conversant with the world movements of the pandemic, with the resolutions of the Venice Plague Conference of 1897, on which the control measures then in force were based, and with the significance of the association of epidemic with epizootic which was then being recognized by sanitary officers in the Far East and India.

In Victoria in 1898 a proposal was mooted to send a medical man to study bubonic plague in India at first hand, but, failing Government support, the project fell through.

The declaration of Noumea as plague-infected in December, 1899, resulted in the adoption of intensive rat-destruction measures on vessels arriving in Sydney from that port (see page 15). The role of the flea in the transmission of plague had been indicated by the work of Ogata (1897), of Japan, and Simond (1898), of France, and the observations of the latter were noted by Ashburton Thompson in his 1900 Plague Report as having furnished a guide for epidemiological and laboratory investigation on the first appearance of plague in Australia. This early recognition by the authorities of the factors concerned in the transmission of plague, and the enthusiasm of sanitary officers throughout Australia, led to a gradual confirmation and extension of knowledge throughout the 1900-1909 series of outbreaks. The detailed records of Ashburton Thompson and Tidswell at Sydney, and of Burnett Ham at Brisbane, now rank amongst the classical literature of the world on the epidemiology of plague.











## PART I.

### CHAPTER I.—THE FIRST INTRODUCTION OF PLAGUE INTO AUSTRALIA.

The definite history of plague in Australia commenced on 19th January, 1900, when a carman, regularly employed in carrying goods from city warehouses in Sydney to Central Wharf, Sydney, fell ill with a disease, subsequently diagnosed to be the bubonic form of plague.

On 15th January, 1900, certain cases had occurred at Adelaide which were considered to be plague. These are discussed later (*vide* page 31); but, as Thompson says, "the rumour, which from the first has been regarded with doubt, was ultimately discredited."

The source from which the disease entered Australia was never accurately determined. As shown in the introduction, the overseas centres of infection were, at this date, very numerous, and included many countries with which Australia was in constant maritime communication. The danger of importation of plague by sea into Australia had never been absent from May, 1894, at which time plague had been officially declared to be epidemic at Hong Kong, and this danger had increased *pari passu* with the establishment of the disease in epidemic form at other ports in communication with Australia.

During 1899, Mauritius (February), Japan (December), Honolulu (December), and New Caledonia (December) had all become definitely infected with plague.

Thompson's conclusion as to introduction is contained in the following:—"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."—(1900 P.R., p. 22)\*. As to the precise mode of introduction, Thompson is more definite. He expresses "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 . . . ; but by what vessel, or from which infected port, such rats were landed at Sydney, there is no evidence."—(1900 P.R., p. 23.)

Notwithstanding this expressed uncertainty as to the overseas source of infection, it appears likely from Thompson's remarks that he held

\* Wherever the letters "P.R." are used they refer to the Plague Reports issued in series by the New South Wales Board of Health.

strongly the suspicion or conviction that the disease had been introduced from New Caledonia:—

“The first case in man must have happened in New Caledonia some time before the presence of plague was acknowledged on 24th December (1899); 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 the 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 epizootic preceded the epidemic cannot at present be positively answered, no authoritative information on this point having become available. A frequent experience, however, is that 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 24th December, 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.”—(1900 P.R., p. 23.)

At the International Medical Congress of Berlin, in 1907, Thompson stated:—“Australia escaped invasion by plague until after the disease had appeared at the capital of New Caledonia, an island which lies 1,000 miles from Sydney, in the fourth quarter of 1899. The infection entered by way of Sydney, where attack in the first case occurred on 19th January, 1900.”—(*Cong. Trans.*, Vol. VII., p. 672.)

Tidswell states:—“We did not succeed in discovering how the rats first became affected. The Port of Sydney is in frequent communication with infected places in China and India, and also with the Sandwich Island and Noumea, where plague was prevalent at the time of our outbreak. But there was no evidence that any contaminated article or plague rats reached our shores from any of these places. The only fact bearing upon the point is that, amongst the rats forwarded to the laboratory for examination there was a large rough black-coated rat, different from the local rats, and said to be an Indian species. This particular specimen was perfectly healthy. . . . We did not succeed in gleaning even a suspicion that any person sick with plague had come to the Colony from abroad.”—(*Journal of the Royal Sanitary Institute*, Vol. XXI., Part IV., pp. 563, 569.)

The French authorities have adopted an unequivocal attitude:—

“La peste fut importée d’Australia en 1899. Elle persista en 1900 au chef-lieu et réapparut en 1901. En 1902-1903, divers points de la brousse furent envahis. En 1899-1900, 124 cas furent constatés à Nouméa et dans la brousse, dont 45 Européens, avec 59 décès sur les 79 cas indigènes et 21 décès chez les Européens.—(*Chantemesse et Mosny Traité d’Hygiène*, Vol. XI., *Hygiène Coloniale*, p. 504.)



In connexion with this controversy, some interest attaches to the fact that the first patient was a carter, whose daily work took him continuously to the Central Wharf during 25 days before his attack, and between 21st October, 1899, and 20th January, 1900, four vessels which had touched at Hong Kong lay at Central Wharf—one of them from 9th January to 20th January.—(P.R., 1900, p. 22.)

After the declaration of Noumea as plague infected, attempts were made to kill any rat which might still remain on these vessels, notwithstanding the efforts to 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. It does not, however, appear that similar measures were taken before the declaration of Noumea.—(P.R., 1900, p. 14.)

The first mortality among rats had occurred at wharfs adjacent to the Central Wharf above-mentioned, and during the first week in January. After the first human case, the next four cases all were undoubtedly infected within a small area round these particular wharfs.

The circumstances associated with the beginning of plague in Australia direct attention to—

- (1) the long latent period, 1894-1899, during which plague was spreading only slowly in the Far East; this period being followed by
- (2) the appearance of plague in Australia concurrently with a rapid world-wide spread of the disease—new appearances being recorded from widely-separated countries within a few months;
- (3) the uncertainty as to the overseas source of infection;
- (4) the absence of any indication of danger which might have been afforded by the presence on arriving vessels of human cases of the disease;
- (5) the international transfer of infection by means of rats;
- (6) the absence of any measures to prevent importation of infection by rats from overseas.

## CHAPTER II.—PLAGUE IN NEW SOUTH WALES.

### The First New South Wales Epidemic.

The first case recorded in New South Wales was that of the carter mentioned in the previous chapter, whose illness first declared itself on 19th January, 1900.

Thereafter the course of the epidemic may be followed in the table hereunder:—

TABLE 1.  
NUMBERS OF ATTACKS AND DEATHS RECORDED DURING EACH WEEK.  
1900.

| Week Ending.  | Cases. | Deaths. |
|---------------|--------|---------|
| Jan. 20 .. .. | 1      | 0       |
| 27 .. ..      | 0      | 0       |
| Feb. 3 .. ..  | 0      | 0       |
| 10 .. ..      | 0      | 0       |
| 17 .. ..      | 0      | 0       |
| 24 .. ..      | 2      | 1       |
| March 3 .. .. | 2      | 1       |
| 10 .. ..      | 5      | 3       |
| 17 .. ..      | 12     | 3       |
| 24 .. ..      | 10     | 3       |
| 31 .. ..      | 23     | 6       |
| April 7 .. .. | 29     | 9       |
| 14 .. ..      | 29     | 12      |
| 21 .. ..      | 16     | 8       |
| 28 .. ..      | 26     | 7       |
| May 5 .. ..   | 38     | 10      |
| 12 .. ..      | 23     | 10      |
| 19 .. ..      | 24     | 10      |
| 26 .. ..      | 7      | 6       |
| June 2 .. ..  | 17     | 3       |
| 9 .. ..       | 4      | 3       |
| 16 .. ..      | 10     | 3       |
| 23 .. ..      | 6      | 0       |
| 30 .. ..      | 12     | 3       |
| July 7 .. ..  | 1      | 0       |
| 14 .. ..      | 3      | 0       |
| 21 .. ..      | 2      | 0       |
| 28 .. ..      | 0      | 1       |
| Aug. 4 .. ..  | 0      | 0       |
| 11 .. ..      | 1      | 0       |
| 18 .. ..      | 0      | 1       |
| Totals .. ..  | 303    | 103     |

### The Second New South Wales Epidemic.

The last case of the epidemic of 1900 was notified on 9th August of that year. "An interval of rather more than fifteen months ensued, during which careful watch was kept for the commencement of the recurrence which was feared; but among the many cases which were reported for diagnosis during its continuance, there were but two which afforded good ground for prima facie suspicion, and after investigation it was shown that both were due to streptococcic infection. The rats which infested the areas on which cases had arisen were also watched until it appeared probable that the epizootic of plague which had prevailed among them had died out." The long interval was ended by the



attack of a man on 4th November, 1901; his case was notified on 12th November. A free term of 34 days ensued, and then, on 8th December, a second man was attacked. After a further free term of about 35 days, a woman fell ill on 10th or 11th January, 1902. During these two intermissions several cases of illness were reported for diagnosis, but no case of plague, nor any in which there was real ground for doubt, was among them. The epidemic declared itself with the third case, and, as the last patient was attacked on 8th June, it may be referred to conveniently as the epidemic of 1902. It consisted of 139 cases, of which 39 ended fatally. The sequence of the cases is shown in the table hereunder:—

TABLE 2.  
NUMBERS OF ATTACKS AND DEATHS RECORDED DURING EACH WEEK,  
1901-1902.

|          |    |    | Attacks. | Deaths. |
|----------|----|----|----------|---------|
| 1901.    |    |    |          |         |
| November | 9  | .. | 1        | 0       |
|          | 16 | .. | 0        | 0       |
|          | 23 | .. | 0        | 0       |
|          | 30 | .. | 0        | 0       |
| December | 7  | .. | 0        | 0       |
|          | 14 | .. | 1        | 1       |
|          | 21 | .. | 0        | 0       |
|          | 28 | .. | 0        | 0       |
| 1902.    |    |    |          |         |
| January  | 4  | .. | 0        | 0       |
|          | 11 | .. | 1        | 0       |
|          | 18 | .. | 2        | 0       |
|          | 25 | .. | 3        | 1       |
| February | 1  | .. | 0        | 0       |
|          | 8  | .. | 5        | 2       |
|          | 15 | .. | 9        | 4       |
|          | 22 | .. | 12       | 5       |
| March    | 1  | .. | 14       | 4       |
|          | 8  | .. | 5        | 0       |
|          | 15 | .. | 12       | 5       |
|          | 22 | .. | 18       | 3       |
| April    | 29 | .. | 8        | 1       |
|          | 5  | .. | 5        | 0       |
|          | 12 | .. | 1        | 0       |
|          | 19 | .. | 6        | 1       |
| May      | 26 | .. | 8        | 2       |
|          | 3  | .. | 5        | 3       |
|          | 10 | .. | 6        | 1       |
|          | 17 | .. | 7        | 3       |
| June     | 24 | .. | 2        | 1       |
|          | 31 | .. | 2        | 0       |
|          | 7  | .. | 5        | 2       |
|          | 14 | .. | 1        | 0       |
|          |    |    | 139      | 39      |

*The Newcastle Case.*—On 6th August, however, one further case occurred at Newcastle. It was “indigenous” to that city, and was not followed by other cases. (P.R. 1902 p. 3.)

### The Third New South Wales Epidemic.

The date of attack in the last case of the 1901-1902 outbreak was 8th June, 1902; the last plague rat was taken on 14th July, 1902. The 1903 outbreak began in an epizootic of plague of which the first evidence was got on 12th May, 1903, and the last on 15th August, 1903. It consisted, on the human side, of two cases of plague in man; in one of which the date of attack was 17th June, and in the other of which the date of attack was 2nd July; both of these persons recovered. It will be necessary at a later stage to consider the course of this epizootic, but for present purposes the human cases are recorded in the following—

TABLE 3.  
NUMBERS OF ATTACKS AND DEATHS IN THE THIRD EPIDEMIC, 1903.

|               | Attacks. | Deaths. |
|---------------|----------|---------|
| June 17 .. .. | 1        | 0       |
| July 27 .. .. | 1        | 0       |
| Totals .. ..  | 2        | 0       |

### The Fourth New South Wales Epidemic.

The last evidence of presence of plague in Sydney connected with the preceding outbreak was got on 15th August, 1903, when the infection was identified in the carcase of a rat. The outbreak of 1904 consisted in an epizootic of plague of which the first direct evidence was got on 1st March, 1904, the last on 3rd December; thus it continued during nine months. Its course was marked by the occurrence of plague in twelve persons who inhabited eleven dwellings, of whom six died; the first case was notified 9th March, the last on 10th September, 1904, and these dates defined a period of a little over six months, which fell within the time limits of the epizootic. The following table shows the dates on which the twelve cases occurred:—

TABLE 4.  
NUMBERS OF ATTACKS AND DEATHS IN THE FOURTH EPIDEMIC, 1904.

|                | Attacks. | Deaths. |
|----------------|----------|---------|
| March 9 .. ..  | 1        | 0       |
| April 10 .. .. | 1        | 0       |
| 20 .. ..       | 1        | 0       |
| 22 .. ..       | 1        | 0       |
| 25 .. ..       | 1        | 1       |
| May 8 .. ..    | 1        | 0       |
| 25 .. ..       | 1        | 0       |
| 31 .. ..       | 1        | 1       |
| June 19 .. ..  | 1        | 1       |
| July 31 .. ..  | 1        | 1       |
| Sept. 7 .. ..  | 1        | 1       |
| 10 .. ..       | 1        | 1       |
| Totals .. ..   | 12       | 6       |



### The Fifth New South Wales Epidemic.

*Epidemic in Sydney.*—Although the sequence of cases in Sydney in 1905 is called by Thompson the “fifth outbreak of plague in Sydney,” it cannot be considered otherwise than as continuous with the outbreak of 1904. The last case in 1904 had occurred on 10th September, and the last plague rat had been identified on 3rd December. The continuous examination of rats, which began with the outbreak of 1901-2, having been maintained steadily since then, the first plague rat in 1905 was identified on 18th January. The date of attack in the first case of 1905 was 11th March, and in the last case of that year it was 12th July. The last plague rat was identified on 5th December. The number of cases was eighteen, of which five were fatal. The following table shows the sequence of cases in Sydney during the year 1905:—

TABLE 5.  
NUMBERS OF ATTACKS AND DEATHS IN THE “FIFTH OUTBREAK.”

|              |          | Attacks. | Deaths. |
|--------------|----------|----------|---------|
| March        | 11 .. .. | 1        | 0       |
|              | 24 .. .. | 1        | 1       |
| April        | 2 .. ..  | 1        | 0       |
|              | 3 .. ..  | 1        | 0       |
|              | 6 .. ..  | 1        | 0       |
|              | 10 .. .. | 1        | 1       |
|              | 13 .. .. | 1        | 0       |
|              | 15 .. .. | 1        | 0       |
|              | 20 .. .. | 1        | 0       |
|              | 23 .. .. | 1        | 0       |
|              | 24 .. .. | 1        | 0       |
|              | 26 .. .. | 1        | 0       |
| May          | 5 .. ..  | 1        | 0       |
|              | 13 .. .. | 1        | 0       |
|              | 15 .. .. | 1        | 0       |
|              | 23 .. .. | 1        | 1       |
| June         | 27 .. .. | 1        | 1       |
| July         | 14 .. .. | 1        | 1       |
| Totals .. .. |          | 18       | 5       |

*Extra-Metropolitan Epidemic in New South Wales.*—The year 1905 is notable for the fact that, although plague had been present in Sydney since the beginning of 1900, there had been no record of plague in either epizootic or epidemic form outside of the metropolis until that year. To this statement an exception must be made of the single case which occurred at Newcastle in 1902. As this was an isolated case, it does not affect the general statement here made. The outbreaks in that year in New South Wales outside of the metropolitan area were as follow:—

1. An epidemic at Ulmarra, on the Clarence River.
2. An epizootic at Woolgoolga.
3. An epidemic at Ballina, on the Richmond River.
4. An epizootic at South Woodburn, on the Richmond River.
5. An epidemic at Lismore, on the Richmond River.
6. An epidemic at Newcastle.

*The Epidemic at Ulmarra.*—This epidemic extended over the period 14th December, 1904, to 6th May, 1905, the attack dates of the thirteen cases being as follows:—

| —         |          | Cases. | Deaths. |
|-----------|----------|--------|---------|
| 1904.     |          |        |         |
| Dec.      | 14 .. .. | 1      | 1       |
|           | 29 .. .. | 2      | 1       |
|           | 30 .. .. | 2      | 1       |
| 1905.     |          |        |         |
| Jan.      | 1 .. ..  | 1      | 1       |
|           | 21 .. .. | 1      | 0       |
|           | 22 .. .. | 1      | 0       |
|           | 23 .. .. | 1      | 1       |
|           | 26 .. .. | 2      | 1       |
|           | 27 .. .. | 1      | 1       |
| May       | 6 .. ..  | 1      | 1       |
| Totals .. |          | 13     | 8       |

*The Epidemic at Ballina.*—This epidemic comprised four cases in all, the attack dates being as follows:—

| —         |          | Cases. | Deaths. |
|-----------|----------|--------|---------|
| 1905.     |          |        |         |
| Feb.      | 3 .. ..  | 1      | 1       |
| April     | 22 .. .. | 1      | 1       |
| May       | 2 .. ..  | 1      | 1       |
|           | 28 .. .. | 1      | 0       |
| Totals .. |          | 4      | 3       |

*The Epidemic at Lismore.*—Millard, in describing this outbreak, indicates the possibility of certain unrecorded cases of plague preceding the officially controlled epidemic—

“The first recognized case of plague at Lismore was attacked on 1st May, 1905. It is not, however, certain that this was the first case that occurred. Three deaths, one in March, and two in April, had been certified as due to dengue fever. This disease is seldom fatal, and, in discussing these cases with their medical attendants, I learned that their symptoms were not typical of dengue, and that, in the light of subsequent occurrences, plague could not be absolutely excluded. At the same time, however, there was widespread epidemic of dengue in Brisbane, and several other cases are said to have occurred in Lismore.” (P.R., 1905, p. 35.)



The recorded epidemic included eight cases which occurred as follows:—

| —         |    |       | Attacks. | Deaths. |
|-----------|----|-------|----------|---------|
| 1905.     |    |       |          |         |
| May       | 1  | .. .. | 2        | 1       |
|           | 3  | .. .. | 1        | 0       |
|           | 7  | .. .. | 2        | 2       |
|           | 9  | .. .. | 1        | 0       |
|           | 11 | .. .. | 1        | 0       |
|           | 30 | .. .. | 1        | 0       |
| Totals .. |    |       | 8        | 3       |

*Epidemic in the City of Newcastle.*—Subsequent to the notification of the single case on 6th August, 1902, no further case of plague was reported at Newcastle until 25th March, 1905. Following on this case was a series of fourteen cases, which comprised the Newcastle epidemic of 1905. These cases occurred as follow:—

| —         |    |       | Attacks. | Deaths. |
|-----------|----|-------|----------|---------|
| 1905.     |    |       |          |         |
| March     | 22 | .. .. | 1        | 0       |
|           | 25 | .. .. | 1        | 1       |
|           | 28 | .. .. | 1        | 0       |
|           | 31 | .. .. | 1        | 0       |
| April     | 22 | .. .. | 1        | 1       |
|           | 27 | .. .. | 1        | 0       |
| May       | 3  | .. .. | 1        | 1       |
|           | 5  | .. .. | 1        | 0       |
|           | 11 | .. .. | 1        | 0       |
|           | 19 | .. .. | 1        | 0       |
|           | 26 | .. .. | 1        | 0       |
|           | 29 | .. .. | 1        | 0       |
|           | 30 | .. .. | 1        | 0       |
| July      | 2  | .. .. | 1        | 0       |
| Totals .. |    |       | 14       | 3       |

### The Sixth New South Wales Epidemic.

The sixth epidemic of plague in New South Wales was limited to the metropolitan area of Sydney.

“Attack occurred on 12th July in the last case of plague in 1905, and the last plague rat in 1905 was identified on 5th December. In 1906 the first plague rat was identified on 23rd January. Attack occurred in the first case in man on 12th March, 1906, in the last on 22nd December, 1906; and the last plague rat was identified on 29th December, 1906. The total number of cases was 20, of which eight were fatal.” (P.R., 1906, p. 1.)

The sequence of cases in this outbreak is shown in the following table:—

TABLE 6.  
NUMBER OF ATTACKS AND DEATHS IN THE "SIXTH OUTBREAK."

| —     |           | Attacks. | Deaths.                                  |
|-------|-----------|----------|--|
| 1906. |           |          |  |
| March | 9 .. ..   | 2        | 0  |
|       | 10 .. ..  | 2        | 0  |
|       | 12 .. ..  | 2        | 0  |
|       | 16 .. ..  | 1        | 0  |
| May   | 11 .. ..  | 1        | 1  |
| June  | 5 .. ..   | 1        | 1  |
|       | 17 .. ..  | 1        | 1  |
|       | 20 .. ..  | 1        | 1  |
|       | 23 .. ..  | 2        | 0  |
|       | 26 .. ..  | 1        | 1  |
|       | 28 .. ..  | 1        | 1  |
|       |           |          | } Pneumonic cases<br>(P.R., 1906, p. 7)* |
| July  | 3 .. ..   | 1        | 0  |
|       | 10 .. ..  | 1        | 1  |
|       | 14 .. ..  | 1        | 0  |
| Oct.  | 1 .. ..   | 1        | 1  |
| Dec.  | 22 .. ..  | 1        | 0  |
|       | Totals .. | 20       | 8  |

\* This was the only occurrence of pneumonic plague recorded in New South Wales.

### The Seventh New South Wales Epidemic.

The seventh epidemic of plague in New South Wales affected two distinct localities—the metropolitan district of Sydney, and the northern country centre of Kempsey, on the Macleay River.

*The Epidemic in Sydney.*—In 1906 attack occurred in the last case on 22nd December, and the last plague-rat was taken on 29th December. In the year under review, attack occurred in the first case on 7th January, 1907; the first rat in which plague was identified was taken on 10th January, the last on 21st September. Attack in the last case occurred on 29th December, 1907; but plague-rats in number were discovered in connexion with it, and with another which preceded it (attacked 27th December) as soon as search had proceeded sufficiently, namely, on 2nd January, 1908 [P.R. 1907, p. 1]. Forty-seven cases occurred during 1907, of which 16 ended fatally.



The sequence of cases during this outbreak was as follows:—

TABLE 7.  
ATTACKS AND DEATHS RECORDED DURING 1907.

|        |      |    | Attacks. | Deaths. |
|--------|------|----|----------|---------|
| 1907.  |      |    |          |         |
| Jan.   | 7..  | .. | 1        | ..      |
|        | 9..  | .. | 1        | 1       |
|        | 15.. | .. | 1        | 1       |
|        | 17.. | .. | 1        | ..      |
|        | 18.. | .. | 1        | ..      |
|        | 21.. | .. | 1        | 1       |
|        | 22.. | .. | 1        | ..      |
|        | 23.. | .. | 1        | ..      |
|        | 24.. | .. | 1        | 1       |
|        | 25.. | .. | 2        | ..      |
|        | 26.. | .. | 3        | 1       |
| Feb.   | 5..  | .. | 1        | ..      |
|        | 6..  | .. | 2        | 1       |
|        | 9..  | .. | 2        | ..      |
|        | 10.. | .. | 1        | ..      |
|        | 12.. | .. | 1        | 1       |
|        | 13.. | .. | 1        | ..      |
|        | 14.. | .. | 1        | ..      |
|        | 15.. | .. | 1        | 1       |
|        | 16.. | .. | 2        | 1       |
|        | 20.. | .. | 1        | ..      |
|        | 21.. | .. | 1        | ..      |
| March  | 1..  | .. | 1        | ..      |
|        | 3..  | .. | 1        | ..      |
|        | 4..  | .. | 1        | 1       |
|        | 7..  | .. | 1        | ..      |
|        | 9..  | .. | 1        | ..      |
|        | 15.. | .. | 1        | ..      |
|        | 16.. | .. | 1        | ..      |
|        | 18.. | .. | 1        | 1       |
|        | 21.. | .. | 1        | 1       |
|        | 22.. | .. | 1        | 1       |
| April  | 7..  | .. | 1        | ..      |
|        | 8..  | .. | 1        | 1       |
|        | 9..  | .. | 1        | ..      |
|        | 13.. | .. | 1        | 1       |
|        | 14.. | .. | 1        | ..      |
| May    | 5..  | .. | 1        | 1       |
|        | 19.. | .. | 1        | ..      |
| Dec.   | 28.. | .. | 1        | ..      |
|        | 29.. | .. | 1        | ..      |
| Totals |      |    | 47       | 16      |

*The Epidemic at Kempsey.*—At this country town the outbreak was limited to four human cases which occurred in the following sequence:—

|        |      |    | Attacks. | Deaths. |
|--------|------|----|----------|---------|
| 1907.  |      |    |          |         |
| Jan.   | 23.. | .. | 1        | 1       |
|        | 29.. | .. | 1        | 1       |
| Feb.   | 1..  | .. | 1        | 1       |
|        | 6..  | .. | 1        | 1       |
| Totals |      |    | 4        | 4       |

1908.

During 1908 there were six cases, all in the metropolitan area. Details of these cases are as follow:—

|       |    |    |    | Attacks. | Deaths. |
|-------|----|----|----|----------|---------|
| 1908. |    |    |    |          |         |
| Jan.  | 8  | .. | .. | 1        | ..      |
| Feb.  | 24 | .. | .. | 1        | ..      |
| March | 29 | .. | .. | 1        | 1       |
| May   | 4  | .. | .. | 1        | 1       |
|       | 9  | .. | .. | 1        | 1       |
| June  | 24 | .. | .. | 1        | ..      |

1909.

During 1909, 23 cases occurred—twenty of which were in the metropolitan area; two were members of the crew of the steamer *St. Louis*; and one case occurred at Newcastle; this latter case (a rat-catcher) was infected at Sydney, and developed the disease at Newcastle. It is therefore proper to include this case amongst the metropolitan cases, making a total of 21.

The following table shows the sequence of cases in Sydney during 1909, the dates given being the date of onset of the disease:—

TABLE 8.  
NUMBER OF ATTACKS AND DEATHS, SYDNEY, 1909.

|        |    |    |    | Attacks. | Deaths. |
|--------|----|----|----|----------|---------|
| 1909.  |    |    |    |          |         |
| March  | 6  | .. | .. | 2        | 1       |
|        | 12 | .. | .. | 1        | 1       |
|        | 13 | .. | .. | 1        | 1       |
|        | 15 | .. | .. | 1        | ..      |
|        | 20 | .. | .. | 1        | ..      |
|        | 22 | .. | .. | 2        | ..      |
| April  | 3  | .. | .. | 1        | 1       |
|        | 5  | .. | .. | 3        | ..      |
|        | 7  | .. | .. | 3        | ..      |
|        | 10 | .. | .. | 1        | ..      |
|        | 19 | .. | .. | 1        | ..      |
| May    | 7  | .. | .. | 1        | ..      |
|        | 8  | .. | .. | 1        | 1       |
|        | 7* | .. | .. | 1        | 1       |
|        | 13 | .. | .. | 1        | ..      |
| Totals |    | .. | .. | 21       | 6       |

\* Date of notification, 28.5.09.

The case on 13th May, 1909, was the last case which occurred in New South Wales. Human plague disappeared totally until 1921.



## CHAPTER III.—PLAGUE IN QUEENSLAND.

### Origin of the Epidemic.

The origin of the outbreak in Queensland is ascribed by Ham to the importation of infection, conveyed through the agency of rats, from vessels arriving at Queensland ports from Sydney at a time when plague was known to exist at the latter place. On 19th January, 1900, plague was reported to have broken out at Sydney, and it was subsequently ascertained that rats had been dying upon one of the wharves at that town about the first week in January, 1900. On 14th February, seven plague-infected rats were obtained from one Sydney wharf. In view of the close and constant commercial communication between Sydney and Brisbane, the health authorities at Brisbane were on the alert and inaugurated a crusade of rat destruction combined with bacteriological examination of all rats found sick or dead. On 5th March, 1900, a black rat (*Mus rattus*) found dead in a shop in Brisbane, close to a wharf at which vessels from Sydney had recently arrived, was found to be infected with plague. It was not, however, till the 27th April, 1900, that a plague case occurred among human beings in Brisbane. This case was not the first case of plague in man in Queensland. On 17th April, 1900, the head stoward on board the s.s. *Burwah*, a coastal vessel, carrying passengers and cargo between Sydney and Rockhampton, and calling *en route* at Brisbane, was reported by the health officer at Rockhampton to be suffering from plague. As this patient was taken ill a day prior to the arrival of the vessel at Rockhampton, it is fair to assume that he contracted the disease either at Brisbane—where rats had been found dead of plague on the wharves since 5th March, but where no case had as yet occurred in human beings—or at Sydney, where an epizootic and an epidemic were both present at the time the vessel left on the 10th April, 1900. On removal of the lining of the cabin occupied by the patient on the s.s. *Burwah*, several dead rats were found. In a report dated 8th May, Dr. Turner, the special plague medical officer at Rockhampton, stated that about a fortnight previously the head wharfinger at Rockhampton had noticed four or five dead rats lying about the wharves every morning for three consecutive days; after this he found two rats daily, the last being found five days prior to 8th May. During the same period three or four dead rats had been observed every morning in a store opposite the wharves. On 15th April, a resident of Rockhampton was attacked, and, thereafter, until 15th June, 1900, twenty-five cases occurred in that town. Ham [*Plague in Queensland*, p. 3], after reviewing the evidence, concludes:—“The above facts support the opinion that the disease was introduced by plague-infected rats from Sydney, and that the infection spread to the local rats, which in turn communicated it to man.”

### Course of the Epidemic.

The course of the epidemic in Queensland is concisely outlined hereunder.

1900.

The first plague-infected rat was found at a Brisbane wharf on 5th March, 1900. The first human case of plague was reported on 15th April, 1900, at Rockhampton. The first case in man in Brisbane occurred on 27th April, followed by a rapid succession of cases comprising the epidemic. The last case of plague in man was reported at Brisbane on the 13th December, 1900, the last infected rat at Brisbane on 24th October, 1900.

The following statement shows the progress of the epidemic in Queensland during the year 1900:—

TABLE 9.

| Place.                     | Population. | Duration of Epidemic.     | Cases. | Deaths. | Probable Source of Infection.   |
|----------------------------|-------------|---------------------------|--------|---------|---------------------------------|
| Brisbane—Metropolitan Area | 125,500     | 27th April—13th December  | 56     | 25      | Sydney                          |
| Ipswich ..                 | 15,246      | 21st May .. ..            | 1      | 0       | Brisbane                        |
| Rockhampton ..             | 19,691      | 15th April—17th August    | 36     | 21      | Sydney                          |
| Townsville ..              | 15,506      | 28th April—16th September | 37     | 9       | Sydney or Rockhampton           |
| Charters Towers            | 20,976      | 30th September ..         | 1      | 0       | Townsville                      |
| Cairns .. ..               | 3,467       | 10th May—26th July        | 5      | 2       | Sydney, Brisbane, or Townsville |

The following table shows the monthly distribution of the human cases and of infected rats identified:—

TABLE 10.

|                 | Metropolitan Area. |                |
|-----------------|--------------------|----------------|
|                 | Human cases.       | Infected Rats. |
| January .. ..   | 0                  | 0              |
| February .. ..  | 0                  | 0              |
| March .. ..     | 0                  | 5              |
| April .. ..     | 3                  | 3              |
| May .. ..       | 11                 | 0              |
| June .. ..      | 8                  | 15             |
| July .. ..      | 15                 | 21             |
| August .. ..    | 4                  | 24             |
| September .. .. | 5                  | 15             |
| October .. ..   | 4                  | 7              |
| November .. ..  | 4                  | 0              |
| December .. ..  | 2                  | 0              |

1901.

After an interval of seventy-five days, plague again made its appearance in Brisbane, the first case in 1901 being reported on 28th February, 1901. The first infected rat in this year was found on 4th April, 1901. The last infected rat was found on 22nd November, 1901, and the date of the last human case was 9th December, 1901.



During this year no case of human plague was officially reported outside of the Brisbane area. During the year a total of 36 cases, twelve of which were fatal, was recorded. The highest number of cases reported in any one week was four, for the week ending 14th May, 1901.

1902.

During the year 1902, the epidemic in Brisbane ran a rapid and somewhat severe course, reaching its maximum in the month of April. By the end of May, 81 cases had been recorded, with 26 deaths. One sporadic case occurred in August after a quiescent period of over two months. Cases occurred also in Townsville, Bundaberg, and Gladstone.

The following statement shows the incidence of plague in Queensland for the year 1902:—

TABLE 11.

| Place.           | Date.                           | Cases. | Deaths. |
|------------------|---------------------------------|--------|---------|
| Brisbane .. ..   | 27th January to 4th August ..   | 82     | 26      |
| Townsville .. .. | 20th August to 26th November .. | 7      | 5       |
| Bundaberg .. ..  | 13th October .. ..              | 1      | 1       |
| Gladstone .. ..  | 25th August .. ..               | 1      | 1       |

1903.

This outbreak, the fourth in Queensland, consisted of 29 cases with seventeen deaths, distributed as follows:—

TABLE 12.

| Place.           | Date.                          | Cases. | Deaths. |
|------------------|--------------------------------|--------|---------|
| Brisbane .. ..   | 8th February to 11th September | 21     | 11      |
| Bundaberg .. ..  | † .. ..                        | 2      | 1       |
| Rockhampton ..   | 11th February to 21st February | 2      | 2       |
| Townsville .. .. | † .. ..                        | 3      | 2       |
| Cairns .. ..     | † .. ..                        | 1      | 1       |

† The dates of these cases are not now available.

1904.

The last human case of plague in Brisbane during 1903 occurred on 11th September; thereafter there was an interval until February, 1904, when plague was again reported in Brisbane. It continued to occur until 14th September, after which no further cases were reported for the year. During the year 35 cases, with twelve deaths, occurred in Queensland, the distribution being as follows:—

TABLE 13.

| Place.         | Date.                          | Cases. | Deaths. |
|----------------|--------------------------------|--------|---------|
| Brisbane .. .. | 9th February to 14th September | 30     | 8       |
| Ipswich .. ..  | 10th July .. ..                | 1      | 1       |
| Maryborough .. | 3rd June to 13th June .. ..    | 2      | 1       |
| Cairns .. ..   | 16th February to 22nd March .. | 2      | 2       |

1905.

The first case in Queensland in 1905 was reported in Brisbane on 1st January.

The distribution throughout the State for the year was as follows:—

TABLE 14.

| Place.            | Date.                            | Cases. | Deaths. |
|-------------------|----------------------------------|--------|---------|
| Brisbane .. ..    | 1st January to 14th June .. ..   | 28     | 15      |
| Bundaberg .. ..   | 3rd February .. ..               | 1      | 1       |
| Ipswich .. ..     | 5th May to 4th July .. ..        | 8      | 2       |
| Childers .. ..    | 16th May .. ..                   | 1      | 1       |
| Maryborough .. .. | 19th May to 10th June .. ..      | 10     | 8       |
| Cairns .. ..      | 24th June .. ..                  | 2      | 0       |
| Townsville .. ..  | 4th August to 19th October .. .. | 6      | 6       |

Ham (Ann. Rep., 1905, p 2), states that two of the Cairns cases were men employed in rat-catching.

The Maryborough outbreak was the only instance of pneumonic plague in Queensland throughout the whole period.

1906.

The distribution of plague cases in Queensland in 1906 was as follows:—

TABLE 15.

| Place.            | Date.                           | Cases. | Deaths. |
|-------------------|---------------------------------|--------|---------|
| Brisbane .. ..    | 6th March to June .. ..         | 8 } 11 | 4 } 7   |
|                   | November to 18th December .. .. | 3 }    | 3 }     |
| Rockhampton .. .. | 3rd April to May .. ..          | 11     | 4       |
| Cairns .. ..      | July, September, October .. ..  | 10     | 1       |

1907.

The first human case of plague in Queensland in 1907 occurred in Brisbane on 3rd January. The first plague-infected rat had been found in the city the day before—the 2nd January, 1907.

The distribution of the plague cases in Queensland in 1907 was as follows:—

TABLE 16.

| Place.             | Date.                          | Cases. | Deaths. |
|--------------------|--------------------------------|--------|---------|
| Brisbane .. ..     | 3rd January to September .. .. | 40     | 20      |
| Ipswich .. ..      | 12th February .. ..            | 1      | 1       |
|                    | 23rd May .. ..                 | 1      | 1       |
| Port Douglas .. .. | January to May .. ..           | 10     | 2       |
| Townsville .. ..   | 17th March .. ..               | 1      | 1       |



1908.

The distribution of plague cases in Queensland in 1908 was as follows:—

TABLE 17.

| Place.         | Date.                         | Cases. | Deaths. |
|----------------|-------------------------------|--------|---------|
| Brisbane .. .. | January to 5th November .. .. | 14     | 8       |
| Cairns .. ..   | January to June .. ..         | 14     | 7       |
| Mackay .. ..   | 29th April .. ..              | 1      | 1       |

1909.

This was the last year in which human cases of plague were recorded in Queensland, two cases being recorded at Mackay, one in January and one in June, both of which were fatal. The only plague-infected rats identified in this year were five, which were found at Mackay during July, August, and September, 1909. No plague-infected rats were found during this year in the metropolitan area.

TABLE 18.

## PLAGUE IN QUEENSLAND, 1900-1909.

| Locality.                     | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. | 1906. | 1907. | 1908. | 1909. | Total Cases. | Total Deaths. |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|---------------|
| Brisbane (Metropolitan Area)— |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 56    | 36    | 82    | 21    | 30    | 28    | 11    | 40    | 14    | ..    | 318          | ..            |
| Deaths .. ..                  | 25    | 12    | 26    | 11    | 8     | 15    | 7     | 20    | 8     | ..    | ..           | 132           |
| Ipswich—                      |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 1     | ..    | ..    | ..    | 1     | 8     | ..    | 2     | ..    | ..    | 12           | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | 1     | 2     | ..    | 2     | ..    | ..    | ..           | 5             |
| Maryborough—                  |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | ..    | ..    | 2     | 10    | ..    | ..    | ..    | ..    | 12           | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | 1     | 8     | ..    | ..    | ..    | ..    | ..           | 9             |
| Childers—                     |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | ..    | ..    | ..    | 1     | ..    | ..    | ..    | ..    | 1            | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | ..    | 1     | ..    | ..    | ..    | ..    | ..           | 1             |
| Bundaberg—                    |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | 1     | 2     | ..    | 1     | ..    | ..    | ..    | ..    | 4            | ..            |
| Deaths .. ..                  | ..    | ..    | 1     | 1     | ..    | 1     | ..    | ..    | ..    | ..    | ..           | 3             |
| Gladstone—                    |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1            | ..            |
| Deaths .. ..                  | ..    | ..    | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..           | 1             |
| Rockhampton—                  |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 36    | ..    | ..    | 2     | ..    | ..    | 11    | ..    | ..    | ..    | 49           | ..            |
| Deaths .. ..                  | 21    | ..    | ..    | 2     | ..    | ..    | 4     | ..    | ..    | ..    | ..           | 27            |
| Townsville—                   |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 37    | ..    | 7     | 3     | ..    | 6     | ..    | 1     | ..    | ..    | 54           | ..            |
| Deaths .. ..                  | 9     | ..    | 5     | 2     | ..    | 6     | ..    | 1     | ..    | ..    | ..           | 23            |
| Cairns—                       |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 5     | ..    | ..    | 1     | 2     | 2     | 10    | ..    | 14    | ..    | 34           | ..            |
| Deaths .. ..                  | 2     | ..    | ..    | 1     | 2     | ..    | 1     | ..    | 7     | ..    | ..           | 13            |
| Port Douglas—                 |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 10    | ..    | ..    | 10           | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 2     | ..    | ..    | ..           | 2             |
| Charters Towers—              |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1            | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..           | ..            |
| Mackay—                       |       |       |       |       |       |       |       |       |       |       |              |               |
| Attacks .. ..                 | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1     | 2     | 3            | ..            |
| Deaths .. ..                  | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1     | 2     | ..           | 3             |
| Total Cases ..                | 136   | 36    | 91    | 29    | 35    | 56    | 32    | 53    | 29    | 2     | 499          | 219           |
| „ Deaths ..                   | 57    | 12    | 33    | 17    | 12    | 33    | 12    | 25    | 16    | 2     | 219          | ..            |

TABLE 19.

## MONTHLY DISTRIBUTION OF HUMAN PLAGUE IN BRISBANE, 1900-1908.

| —                       | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. | 1906. | 1907. | 1908. | Total Cases. |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|
| January ..              | ..    | ..    | 1     | ..    | ..    | 4     | ..    | 21    | 4     | 30           |
| February ..             | ..    | 1     | 13    | 5     | 5     | 16    | ..    | 3     | 2     | 45           |
| March ..                | ..    | 7     | 21    | 4     | ..    | 2     | 2     | 3     | 3     | 42           |
| April ..                | 3     | 7     | 28    | 6     | 7     | 1     | 2     | 4     | 1     | 59           |
| May ..                  | 11    | 12    | 18    | 4     | 11    | 4     | 2     | 4     | ..    | 66           |
| June ..                 | 8     | 3     | ..    | ..    | 1     | 1     | 2     | 1     | 2     | 18           |
| July ..                 | 15    | 3     | ..    | ..    | ..    | ..    | ..    | 3     | ..    | 21           |
| August ..               | 4     | 1     | 1     | ..    | 5     | ..    | ..    | ..    | 1     | 12           |
| September ..            | 5     | ..    | ..    | 2     | 1     | ..    | ..    | 1     | ..    | 9            |
| October ..              | 4     | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 5            |
| November..              | 4     | ..    | ..    | ..    | ..    | ..    | 2     | ..    | 1     | 7            |
| December                | 2     | 1     | ..    | ..    | ..    | ..    | 1     | ..    | ..    | 4            |
| Total cases<br>for year | 56    | 36    | 82    | 21    | 30    | 28    | 11    | 40    | 14    | 318          |



## CHAPTER IV.—PLAGUE IN SOUTH AUSTRALIA.

1900.

The commencement of the epidemic as officially declared in South Australia was marked by a controversy between different sections of the medical profession. Three cases were reported during January, 1900, and officially recognized by the Central Board of Health. The facts are best presented by quoting from the report by the Chairman of the Board of Health, Dr. W. Ramsay Smith [Report on Bubonic Plague at the Adelaide Hospital, 1900, p. 20] :—

“It will be well at this stage to give a historical résumé of the appearances in connexion with this outbreak of plague, so far as they are known at the present time—

1st January, 1900.—Eppstein admitted to Adelaide Hospital from Gawler; died 12th January.

5th January.—McCann admitted to Adelaide Hospital from Gawler.

10th January.—Nurse V. developed glandular swellings.

18th January.—Boy Neale, from Knox-street, city, examined by Dr. Morris at Destitute Asylum; found to be suffering from plague for some time previously.

18th January.—Nurse D. developed glandular swellings.

18th January.—Dead rat found at Hospital near place where Eppstein had been.

21st January.—Two more rats, one mouse, and one bird found dead at the same place.

21st January.—Boy Neale removed to Adelaide Hospital.

29th January.—Rat found dead in King William-street, examined, and found to have been suffering from plague.

It will be seen that Eppstein and McCann were admitted from the country to the Adelaide Hospital with plague on the 1st and 5th of January, respectively. On the 18th the boy Neale, in Knox-street, was found to have been suffering from a disease for some weeks, which was proved on investigation to be plague. I am not in a position to lay before you evidence regarding other cases of illness that have presented suspicious symptoms, but which were not sufficiently investigated during life to settle the diagnosis.

The conclusion to be drawn from these reports is that plague has existed—

- (1) In Eppstein and McCann, when admitted from Gawler.
- (2) In Neale, in Knox-street, city.
- (3) Among rats, both at the Adelaide Hospital and in the city.”

The detailed evidence regarding these three, and other reported cases, is set out in a comprehensive manner by Dr. Ramsay Smith in the report above quoted.

Dr. Borthwick, Medical Officer of Health for the City of Adelaide, has recorded his doubts (*Aust. Med. Gaz.*, 20th Oct., 1900, p. 433) whether any of the cases officially accepted as plague in South Australia in 1900, were in fact true plague. To this general position he makes an exception of the case which occurred in the *Gera*, a vessel which came from Sydney. With reference to these cases the divergence of opinion was not limited to South Australia. Apparently the Victorian Health Department did not entirely accept the cases as plague. The report of the Board of Public Health for the years 1898 to 1904 inclusive, contains (p. 13) the following statement—"Plague made its appearance in Australia in March, 1900. On 7th March, 1900, plague appeared at Sydney." This may be taken as equivalent to a declaration that the Victorian authorities did not recognize the Adelaide cases (which occurred in January) as true plague—although the statement that plague appeared in March is difficult to understand, as the first case in Sydney occurred in January, 1900.

Ashburton Thompson [Plague at Sydney, 1900, p. 22], says of these cases:—"It was announced on 15th January, 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 portrayed plague under its clinical or its epidemiological aspects. The rumour, which from the first had been regarded with doubt, was ultimately discredited."

Whatever views may be held as to the merits of either side in this controversy, it is impossible, in an historical account of the present kind, to do more or less than accept the cases officially accepted and recorded as plague by the Department of Health of South Australia. These cases are indicated above as accurately as information now available will permit.

The epidemiology of these cases is obscure. The first case, Eppstein, was a seaman, who had arrived in the State of South Australia on a sailing ship, *Formosa*, direct from New York. He had been six weeks in South Australia when he took ill. The other two cases were residents of South Australia, and the records do not contain any reference to epizootic plague antecedent to these cases.

#### 1909.

On 6th April, 1909, two cases of plague (G.F.C. and A.C.) were notified to the Local Board of Health at Port Adelaide. In each of these cases the diagnosis was confirmed by laboratory tests.

Subsequently, three other cases occurred, the last being on 5th June.



All the patients were men who worked in connexion with shipping, either on ships or on the wharfs.

Prior to the occurrence of the first case, there had been no dead rats found with any suspicion of plague, and it was assumed that the infection in these cases was obtained from shipping, but, at a later stage, the occurrence of rat plague on the wharfs at Port Adelaide was established, and it is probable that all the cases had been locally infected at Port Adelaide.

The last infected rat was found on 19th June, 1909.

On 12th July, 1909, the Central Board of Health took over the sanitary administration of Port Adelaide, and after that date there was no further case.

The following is a statement of the actual cases:—

|                | Date of Notification. | Date of Death. | Recovered and Discharged. |
|----------------|-----------------------|----------------|---------------------------|
| G.F.C. .. .. . | 6.4.09                | 6.4.09         |                           |
| A.C. .. .. .   | 6.4.09                | ..             | 14.5.09                   |
| G.S. .. .. .   | 23.4.09               | 23.4.09        |                           |
| W. T. .. .. .  | After death           | 19.5.09        |                           |
| C.G. .. .. .   | „ „                   | 5.6.09         |                           |

## CHAPTER V.—PLAGUE IN VICTORIA.

The following details regarding plague in Victoria are taken from the "General Report for the Years 1898 to 1904 by the Board of Public Health, Victoria"—

1900.—"On 7th March, 1900, plague appeared at Sydney, and on 27th March, plague-infected rats were discovered in Melbourne. At the end of April a case of plague, discovered by the Port Health Officer on the s.s. *South Australian* on her arrival at Melbourne from Sydney, was isolated at the Nepean Quarantine Station. The first Victorian case of plague occurred on the 8th May, and between that date and the 13th June, nine additional cases (five being in one family) were discovered, two of which proved fatal. Of the above cases one was discovered at Geelong and one on H.M.S. *Cerberus*, in Hobson's Bay; the remainder occurred in various parts of the metropolis, viz., Collingwood, Port Melbourne, Camberwell (each one case), and Kensington (five cases).

No case of plague occurred in Victoria during the year 1901, though the disease reappeared in other Australian States.

1902.—In March, 1902, a case was discovered in Fitzroy, Melbourne. This is, so far (30th March, 1906), the last case that has occurred in this State.

The total number of cases that have occurred in Victoria since the appearance of the disease in Australia is eleven, with two deaths, ten of these cases having taken place in 1900, and one in 1902."

1907.

On the 17th May, 1907, a case of plague was reported by the Medical Superintendent of the Melbourne Hospital. On inquiry it was ascertained that the patient was a steward from the s.s. *Arawatta*, which had arrived on the previous day. The patient was isolated, and died on 21st May. No other case was reported."

[Report of the Board of Public Health for the years 1905-6-7, p. 9.]

There is no record of any further case of plague in Victoria.

The following is a tabulated list of the cases:—

TABLE 20.

| Case. | Date of Report. | Residence.              | Remarks.   |
|-------|-----------------|-------------------------|--|
| 1     | 8th May, 1900   | Collingwood ..          | Frequented wharfs  |
| 2     | 10th May, 1900  | Port Melbourne          | Frequented wharfs  |
| 3     | 11th May, 1900  | H.M.S. <i>Cerberus</i>  | Probably acquired ashore   |
| 4     | 14th May, 1900  | Geelong ..              | In Geelong four days only; came from South Melbourne                 |
| 5-9   | 21st May, 1900  | Kensington ..           | All in one family  |
| 10    | 5th June, 1900  | Camberwell ..           | Market gardener; dead rats on premises; carted manure from Melbourne |
| 11    | 4th March, 1902 | Fitzroy ..              | Lumper on wharf; "apparently infected on s.s. <i>Coolgardie</i> "    |
| 12    | 17th May, 1907  | s.s. <i>Arawatta</i> .. | Steward  |



## CHAPTER VI.—PLAGUE IN WESTERN AUSTRALIA.

### Introduction of the Disease.

The first indication of the presence of the disease in Western Australia was the death of a patient in the Fremantle Hospital on 8th April, 1900. The first case was not suspected to be one of plague until the time of his death, when the nature of his illness being a little obscure it was thought well to make a post mortem examination. The result of this was to establish with definiteness the presence of plague in this case. It is not likely that there had been other cases before this one, for the number of medical men in Fremantle is small, and all reconsidered their recent cases in the light of this death without being able to recall any other in the least suspicious.

This first case was a man, aged 19, who was by occupation a shunter in the railway yards attached to the wharf. It is stated in the official records that "he had recently been engaged in handling cargo from Sydney." Apparently the deduction intended by this is that he was infected by this cargo. The real truth as to the actual origin must remain always undetermined. From a detailed consideration of the location of the cases in the first epidemic it was seen that the man lived as near to the wharfs as it was possible for him to do, so that the possibility of infection direct from a ship or as the outcome of a rat epizootic ashore or both exists.

### Association with other Epidemic Centres of Plague.

Vessels called at Fremantle regularly from other Australian ports, including Brisbane, Sydney and Adelaide, between which ports and Fremantle there was a regular weekly service. Vessels also arrived regularly from Singapore, Colombo, Calcutta, Bombay and South Africa. It becomes, then, necessary to examine the possibility of spread of infection from these ports to Fremantle with the consequent establishment of a rat epizootic in the latter port.

*Sydney.*—The following facts are taken from the report of the first outbreak of plague in Sydney by Ashburton Thompson:—

"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 was actually introduced." On 14th February, 1900, the existence of an extensive epizootic of plague amongst the rats was definitely determined. "No information concerning mortality among rats was furnished in response to . . . inquiries until 14th February." "At a later date it transpired that an unusual mortality among rats had been noticed as far back as the first week in January." The first human case of the disease occurred on 20th January, 1900.

Although, as Dr. Thompson states, precautions were taken with outgoing shipping after the existence of the epizootic was known, yet there must have been a longer or shorter interval before these precautions were instituted during which infected rats may have made their way on board vessels bound for Western Australia. This possibility

is rendered greater by the fact that the epizootic in Sydney was found to have existed earliest at those wharfs at which Western Australian vessels were loaded.

That the measures taken by the Sydney authorities after the existence of the epizootic became known to them were in certain respects efficacious is evidenced by the fact that a report by the Chief Inspector of the Western Australian Central Board of Health, dated 20th May, 1900, refers to the strong sulphurous odour pervading all the cargo of a certain vessel and the discovery of rats killed by the sulphur.

In the absence, then, of any more definite evidence, all that can be said of Sydney as a possible source of infection is that at the time of the occurrence of the first case in Fremantle (8th April) the epidemic was well established in Sydney, that the epizootic was also well established, but that measures were being taken on all outgoing vessels for some time before the appearance of plague in Fremantle. (The proclamation dealing with the fumigation of vessels was issued on 30th March, 1900). If, therefore, Sydney was the source from which Fremantle was infected, there was probably a transmission of infection from Sydney to Fremantle some appreciable time before the first human case at Fremantle (8th April).

*Adelaide.*—A case of plague was reported from Adelaide on 15th January, 1900. About this case, however, there was considerable controversy, and Dr. Ashburton Thompson, in his report above quoted (p. 32) throws doubt upon the diagnosis of plague in this case. There has not been any evidence that the port of Adelaide was at this period the scene of any epizootic amongst rats and it is probable that the infection at Fremantle was not brought from Adelaide.

*Brisbane.*—On 5th March, 1900, a rat was found on one of the Brisbane wharfs dead, and the cause of death was established as plague. Subsequently a human case occurred on 27th April—this was the first case amongst the residents of Brisbane. Other cases had, however, occurred. On the 17th April, at Rockhampton, a steward on the s.s. *Burwah* fell ill with plague. (See pages 25 and 71.)

These and other facts are considered by Dr. Ham (from whose reports all the facts are taken) to justify his conclusion that the disease was introduced into Brisbane and Rockhampton by plague infected rats from Sydney.

Speaking of Brisbane, he says that “an unusual fatality amongst rats had taken place prior to the occurrence of the first case in man on 27th April.”

In Brisbane, therefore, as in Sydney, there was an unrecognized epizootic for some longer or shorter time before measures were taken against outward going vessels. As, however, the first case occurred in Fremantle 22 days before the case in Brisbane—and the length of time during which rats were infected in Brisbane before the fact of their



infection was determined is not known—it may reasonably be said that the probability of the Fremantle infection coming from Sydney is greater than the probability of its coming from Brisbane.

*Melbourne.*—A few cases of plague occurred in Melbourne, but the first case there was on 8th May, while the first case in Fremantle was attacked on 5th April, 1900.

### Course of the Epidemic.

The following is a tabulated statement of the cases which occurred during 1900, and during the subsequent outbreaks:—

TABLE 21.  
1900.

| No. | Place.       | Initials. | Age. | Attack.      | Result.          |
|-----|--------------|-----------|------|--------------|------------------|
| 1   | Fremantle .. | W.C.      | 19   | 5th April .. | Died, 8th April  |
| 2   | „ ..         | S.W.      | 24   | 8th April .. | Died, 12th April |
| 3   | „ ..         | A.M.      | 43   | 13th May ..  | Died, 15th May   |
| 4   | „ ..         | J.F.      | 40   | 6th June ..  | Recovered        |
| 5   | „ ..         | K.M.      | 23   | 12th June .. | Recovered        |
| 6   | „ ..         | H.S.      | 14   | 17th June .. | Recovered        |

### 1901.

| No. | Place.        | Initials. | Age. | Attack.       | Result.          |
|-----|---------------|-----------|------|---------------|------------------|
| 1   | Perth ..      | J.K.      | ..   | 1st March ..  | Died, 4th March  |
| 2   | „ ..          | A.F.      | 40   | 28th February | Died, 8th March  |
| 3   | „ ..          | H.G.      | 30   | 28th February | Recovered        |
| 4   | „ ..          | J.C.      | ..   | 12th March .. | Recovered        |
| 5   | „ ..          | C.F.      | 19   | 11th March .. | Recovered        |
| 6   | „ ..          | C.L.      | 42   | 13th March .. | Recovered        |
| 7   | „ ..          | D.W.      | 19   | 15th March .. | Recovered        |
| 8   | „ ..          | F.S.      | 19   | 16th March .. | Recovered        |
| 9   | „ ..          | W.D.      | 5    | 17th March .. | Recovered        |
| 10  | „ ..          | E.B.      | 33   | 18th March .. | Recovered        |
| 11  | „ ..          | F.S.      | 36   | 17th March .. | Recovered        |
| 12  | „ ..          | E.B.      | 23   | 19th March .. | Died, 1st April  |
| 13  | Fremantle ..  | S.J.      | ..   | 22nd March .. | Recovered        |
| 14  | Perth ..      | P.S.      | ..   | 24th March .. | Recovered        |
| 15  | „ ..          | D.S.      | 19   | 14th April .. | Recovered        |
| 16  | Kalgoorlie .. | J.T.      | 50   | 26th March .. | Recovered        |
| 17  | Perth ..      | G.L.      | 4    | 16th April .. | Recovered        |
| 18  | „ ..          | H.C.      | 48   | 17th April .. | Recovered        |
| 19  | „ ..          | H.B.      | 23   | 19th April .. | Recovered        |
| 20  | „ ..          | A.K.      | 40   | 14th April .. | Died, 27th April |
| 21  | Fremantle ..  | A.C.      | 21   | 28th April .. | Recovered        |
| 22  | Perth ..      | G.M.      | ..   | 28th April .. | Died, 1st May    |
| 23  | „ ..          | W.F.      | 32   | 11th May ..   | Recovered        |

It is officially recorded that the Kalgoorlie case was infected in Perth.

### 1902.

| No. | Place.       | Initials. | Age. | Attack.     | Result.        |
|-----|--------------|-----------|------|-------------|----------------|
| 1   | Fremantle .. | E.P.      | 24   | 19th May .. | Died, 25th May |
| 2   | „ ..         | J.M.      | 17   | 15th May .. | Died, 22nd May |
| 3   | „ ..         | C.L.      | 32   | 4th July .. | Died, 8th July |

1903.

| No. | Place.         | Initials. | Age. | Attack.        | Result.             |
|-----|----------------|-----------|------|----------------|---------------------|
| 1   | Fremantle ..   | H.M.      | 19   | 24th January.. | Recovered           |
| 2   | " ..           | N.B.      | 20   | 27th January.. | Died, 29th January  |
| 3   | " ..           | L.B.      | 23   | 27th January.. | Recovered           |
| 4   | " ..           | R.S.      | 15   | 10th February  | Recovered           |
| 5   | " ..           | P.C.      | 27   | 15th February  | Died, 18th February |
| 6   | " ..           | N.R.      | 15   | 17th February  | Died, 24th February |
| 7   | " ..           | J.G.      | 52   | 19th February  | Recovered           |
| 8   | " ..           | V.H.      | 26   | 24th February  | Died, 28th February |
| 9   | " ..           | E.C.      | 52   | 22nd May ..    | Recovered           |
| 10  | South Perth .. | A.D.      | 32   | 26th September | Died                |
| 11  | " ..           | A.T.      | ..   | 26th September | Died                |
| 12  | " ..           | A.S.      | 32   | 26th September | Died                |
| 13  | Bellevue ..    | J.G.      | ..   | 6th November   | Died                |

1904.

| No. | Place.       | Initials. | Age. | Attack.        | Result.        |
|-----|--------------|-----------|------|----------------|----------------|
| 1   | Perth ..     | J.L.      | 43   | 21st June ..   | Recovered      |
| 2   | " ..         | P.D.      | 14   | 29th June ..   | Died, 4th July |
| 3   | Fremantle .. | J.M.      | 54   | 28th July ..   | Recovered      |
| 4   | " ..         | W.P.      | 27   | 19th August .. | Recovered      |

1905.

Nil.

1906.

| No. | Place.       | Initials. | Age. | Attack.         | Result.             |
|-----|--------------|-----------|------|-----------------|---------------------|
| 1   | Perth ..     | N.P.      | ..   | 9th January ..  | Recovered           |
| 2   | " ..         | G.L.      | 14   | 28th January..  | Recovered           |
| 3   | " ..         | W.D.      | 16   | 7th February..  | Recovered           |
| 4   | Fremantle .. | G.F.      | 44   | 10th February   | Died                |
| 5   | " ..         | A.F.      | 33   | 10th February   | Recovered           |
| 6   | " ..         | F.F.      | 6    | 11th February   | Recovered           |
| 7   | " ..         | D.G.      | 3    | 13th February   | Died                |
| 8   | " ..         | P.J.      | 40   | 19th February   | Recovered           |
| 9   | Geraldton .. | M.K.      | ..   | 19th February   | Died, 22nd February |
| 10  | " ..         | L.G.      | ..   | 19th February   | Died, 24th February |
| 11  | " ..         | C.G.      | ..   | 19th February   | Died, 22nd February |
| 12  | " ..         | W.A.      | ..   | 21st February   | Died, 24th February |
| 13  | " ..         | J.B.      | ..   | 21st January .. | Died, 24th January  |
| 14  | Fremantle .. | E.B.      | 22   | 17th February   | Recovered           |
| 15  | Geraldton .. | W.B.      | ..   | 23rd February   | Died, 5th March     |
| 16  | " ..         | H. D.     | ..   | 18th February   | Died, 27th February |
| 17  | Perth ..     | J.R.      | ..   | 24th February   | Recovered           |
| 18  | " ..         | H.H.      | ..   | 28th February   | Recovered           |
| 19  | Geraldton .. | E.C.      | ..   | 2nd March ..    | Recovered           |
| 20  | " ..         | H.M.      | ..   | 8th March ..    | Recovered           |
| 21  | Fremantle .. | P.R.      | 26   | 19th March ..   | Died, 21st March    |
| 22  | " ..         | C.K.      | ..   | 21st March ..   | Died, 27th March    |
| 23  | " ..         | C.D.      | 15   | 21st March ..   | Recovered           |
| 24  | " ..         | M.W.      | 57   | 20th March ..   | Recovered           |
| 25  | " ..         | M.L.      | 26   | 24th March ..   | Recovered           |
| 26  | " ..         | P.B.      | 23   | 25th March ..   | Recovered           |
| 27  | Geraldton .. | E.C.      | ..   | 15th February   | Died, 18th February |
| 28  | Fremantle .. | E.F.      | 26   | 28th March ..   | Recovered           |
| 29  | Perth ..     | A.T.      | 24   | 10th May ..     | Died, 15th May      |
| 30  | Fremantle .. | R.B.      | 39   | 29th May ..     | Died, 2nd June      |
| 31  | " ..         | H.F.      | 20   | 23rd May ..     | Recovered           |



TABLE 22.

## MONTHLY DISTRIBUTION OF HUMAN PLAGUE IN WESTERN AUSTRALIA.

| Month.          | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. | 1906. | Total. |
|-----------------|-------|-------|-------|-------|-------|-------|-------|--------|
| January .. ..   | ..    | ..    | ..    | 3     | ..    | ..    | 3     | 6      |
| February .. ..  | ..    | 2     | ..    | 5     | ..    | ..    | 16    | 23     |
| March .. ..     | ..    | 13    | ..    | ..    | ..    | ..    | 9     | 22     |
| April .. ..     | 2     | 7     | ..    | ..    | ..    | ..    | ..    | 9      |
| May .. ..       | 1     | 1     | 2     | 1     | ..    | ..    | 3     | 8      |
| June .. ..      | 3     | ..    | ..    | ..    | 2     | ..    | ..    | 5      |
| July .. ..      | ..    | ..    | 1     | ..    | 1     | ..    | ..    | 2      |
| August .. ..    | ..    | ..    | ..    | ..    | 1     | ..    | ..    | 1      |
| September .. .. | ..    | ..    | ..    | ..    | ..    | ..    | ..    | nil    |
| October .. ..   | ..    | ..    | ..    | 3     | ..    | ..    | ..    | 3      |
| November .. ..  | ..    | ..    | ..    | 1     | ..    | ..    | ..    | 1      |
| December .. ..  | ..    | ..    | ..    | ..    | ..    | ..    | ..    | nil    |
| Total .. ..     | 6     | 23    | 3     | 13    | 4     | nil   | 31    | 80     |

**Reported Plague at Geraldton (W.A.), 1909.**

One case of plague was reported in 1909 at Geraldton, and after the death of the patient, the medical attendant certified that the death was due to plague. The patient came from far inland, and bacteriological examination with careful inquiries established that the case could hardly be legitimately regarded as one of plague.

The official report to the Health Department by the medical man who certified to plague as the cause of death contained the statement that the immediate cause of death was abscess of the liver.

**CHAPTER VII.—IMMUNITY OF TASMANIA.**

The State of Tasmania was not invaded by plague at any time during the course of the epidemics on the mainland.



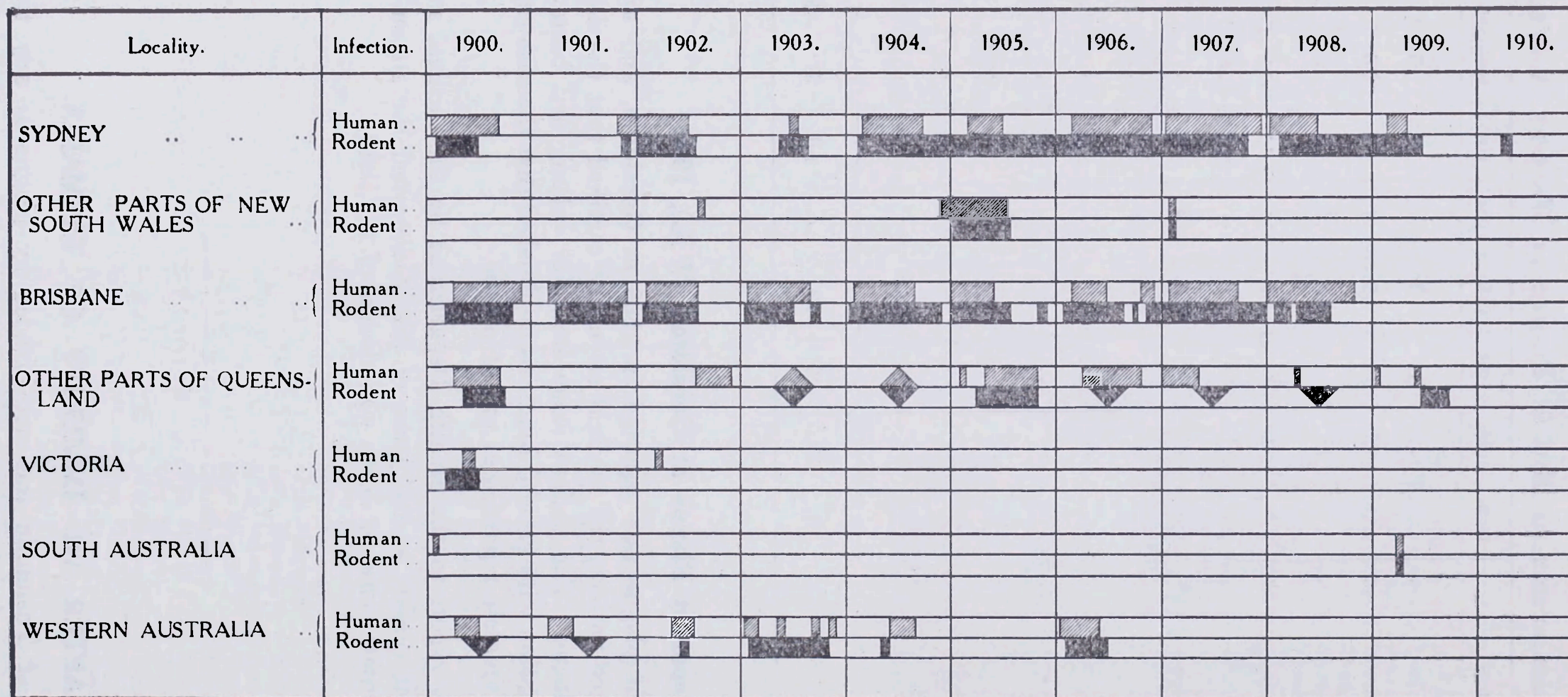


FIG. 2. DIAGRAM ILLUSTRATING THE REPORTED COURSE OF INFECTION IN DIFFERENT LOCALITIES IN AUSTRALIA, 1900-1910. (Hatched areas represent human infection; blocked areas represent rodent infection; triangular areas indicate that scattered infection only occurred during the year.)



## CHAPTER VIII.—THE COURSE OF PLAGUE IN AUSTRALIA, 1900-1909.

The course of plague in its epidemic, as contrasted with its epizootic, manifestations, throughout Australia, may now be reviewed. The disease, appearing first in 1900, continued until 1909—a period of ten years. The following table shows the numbers of cases in each of the States for each of the years concerned:—

TABLE 23.

|                      | 1900. | 1901. | 1902. | 1903. | 1904 | 1905. | 1906. | 1907. | 1908. | 1909. | Total. |
|----------------------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|--------|
| New South Wales ..   | 303   | 2     | 138   | 2     | 12   | 57    | 20    | 51    | 6     | 23    | 614    |
| Victoria ..          | 10    | ..    | 1     | ..    | ..   | ..    | ..    | 1     | ..    | ..    | 12     |
| Queensland ..        | 136   | 36    | 91    | 29    | 35   | 56    | 32    | 53    | 29    | 2     | 499    |
| South Australia ..   | 3     | ..    | ..    | ..    | ..   | ..    | ..    | ..    | ..    | 4     | 7      |
| Western Australia .. | 6     | 23    | 3     | 13    | 4    | ..    | 31    | ..    | ..    | ..    | 80     |
| Tasmania ..          | nil   | nil   | nil   | nil   | nil  | nil   | nil   | nil   | nil   | nil   | ..     |
| Total ..             | 458   | 61    | 233   | 44    | 51   | 113   | 83    | 105   | 35    | 29    | 1,212  |

The total number of cases, therefore, in Australia for the whole period of ten years was 1,212. In order that these may be summarized according to locality distribution, the following table is compiled:—

TABLE 24.

| Locality.          | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. | 1906. | 1907. | 1908. | 1909. | Total. |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| NEW SOUTH WALES.   |       |       |       |       |       |       |       |       |       |       |        |
| Metropolitan ..    | 303   | 2     | 137   | 2     | 12    | 18    | 20    | 47    | 6     | 23    | 570    |
| Newcastle ..       | ..    | ..    | 1     | ..    | ..    | 14    | ..    | ..    | ..    | ..    | 15     |
| Ulmarra ..         | ..    | ..    | ..    | ..    | ..    | 13    | ..    | ..    | ..    | ..    | 13     |
| Ballina ..         | ..    | ..    | ..    | ..    | ..    | 4     | ..    | ..    | ..    | ..    | 4      |
| Lismore ..         | ..    | ..    | ..    | ..    | ..    | 8     | ..    | ..    | ..    | ..    | 8      |
| Kempsey ..         | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 4     | ..    | ..    | 4      |
| VICTORIA.          |       |       |       |       |       |       |       |       |       |       |        |
| Metropolitan ..    | 10    | ..    | 1     | ..    | ..    | ..    | ..    | 1     | ..    | ..    | 12     |
| QUEENSLAND.        |       |       |       |       |       |       |       |       |       |       |        |
| Metropolitan ..    | 56    | 36    | 82    | 21    | 30    | 28    | 11    | 40    | 14    | ..    | 318    |
| Ipswich ..         | 1     | ..    | ..    | ..    | 1     | 8     | ..    | 2     | ..    | ..    | 12     |
| Rockhampton ..     | 36    | ..    | ..    | 2     | ..    | 11    | ..    | ..    | ..    | ..    | 49     |
| Townsville ..      | 37    | ..    | 7     | 3     | ..    | 6     | ..    | 1     | ..    | ..    | 54     |
| Charters Towers .. | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1      |
| Cairns ..          | 5     | ..    | ..    | 1     | 2     | 2     | 10    | ..    | 14    | ..    | 34     |
| Bundaberg ..       | ..    | ..    | 1     | 2     | ..    | 1     | ..    | ..    | ..    | ..    | 4      |
| Gladstone ..       | ..    | ..    | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1      |
| Maryborough ..     | ..    | ..    | ..    | ..    | 2     | 10    | ..    | ..    | ..    | ..    | 12     |
| Childers ..        | ..    | ..    | ..    | ..    | ..    | 1     | ..    | ..    | ..    | ..    | 1      |
| Port Douglas ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 10    | ..    | ..    | 10     |
| Mackay ..          | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1     | 2     | 3      |
| SOUTH AUSTRALIA.   |       |       |       |       |       |       |       |       |       |       |        |
| Metropolitan ..    | 3     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 4     | 7      |
| WESTERN AUSTRALIA. |       |       |       |       |       |       |       |       |       |       |        |
| Perth ..           | ..    | 20    | ..    | 4     | 2     | ..    | 6     | ..    | ..    | ..    | 32     |
| Fremantle ..       | 6     | 2     | 3     | 9     | 2     | ..    | 15    | ..    | ..    | ..    | 37     |
| Geraldton ..       | ..    | ..    | ..    | ..    | ..    | ..    | 10    | ..    | ..    | ..    | 10     |
| Kalgoorlie ..      | ..    | 1     | ..    | ..    | ..    | ..    | ..    | ..    | ..    | ..    | 1      |
| Annual Totals ..   | 458   | 61    | 233   | 44    | 51    | 113   | 83    | 105   | 35    | 29    | 1,212  |

From considerations of plague epidemiology, the course of plague in Australia is of very great interest. There are some prominent features which at once arrest attention. These features are readily appreciated by a reference to the accompanying maps of the Commonwealth, on which are indicated the places at which plague occurred. The first point which attracts attention is that Tasmania entirely escaped infection, while Victoria and South Australia were only very lightly invaded. The case shown in Victoria as having occurred in 1907 was not actually a Victorian case, as it occurred on a vessel on its way to Victoria from Queensland ports, so that a total of eleven cases only occurred in a metropolitan population of 500,000. In South Australia, also, in a metropolitan population of 200,000, only seven cases are recorded.

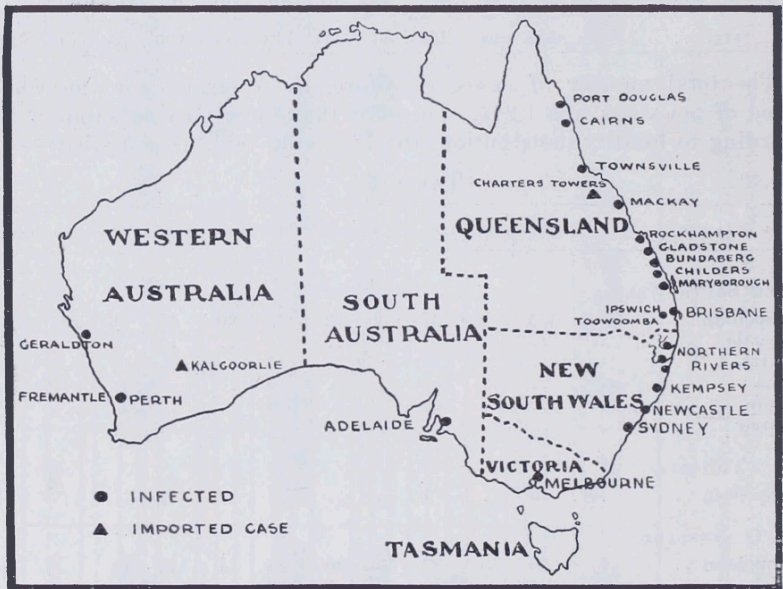


Fig. 3. Map of Australia, showing localities where Plague occurred, 1900-1909.

In Western Australia, Perth and Fremantle may be considered as one district. Fremantle is the seaport of Perth, the capital city, being distant only 13 miles, and there is constant water-carriage by lighters between the two cities of merchandise brought overseas or from the other States. The case at Kalgoorlie will be considered in detail at a later stage; but, for present purposes, it may be ignored as having no general epidemiological significance. The only other centre attacked was Geraldton, a seaport town, some 215 miles north of Perth.

In New South Wales, the epidemic commenced vigorously, subsided during 1903 and 1904, becoming again slightly active in 1905, 1906, and 1907; subsiding again to vanishing point during 1908 and 1909. Even in the years 1905-1907, the disease did not manifest any degree



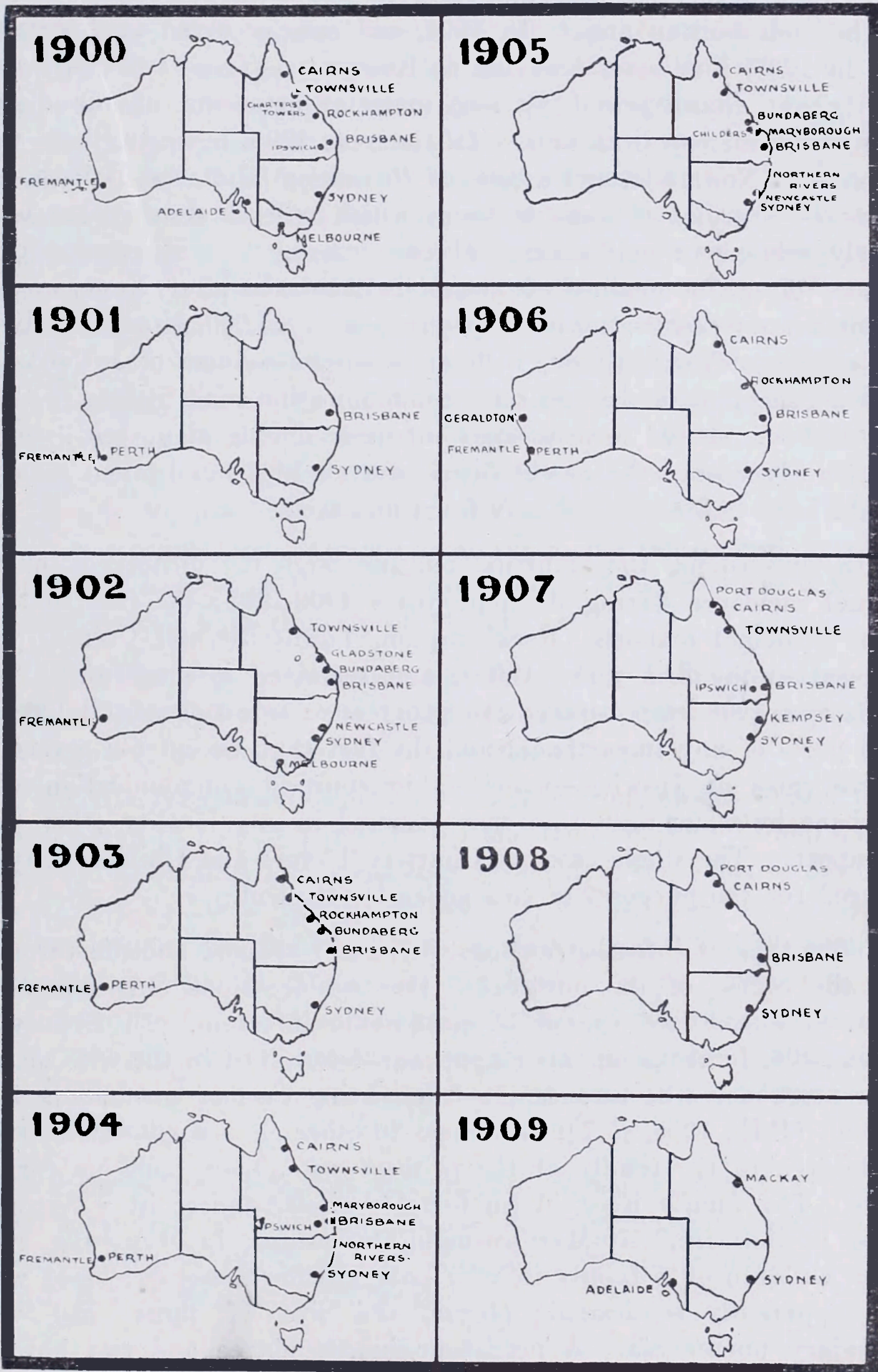


Fig. 4. Localities in which Plague occurred in each year, 1900-1909.



of activity comparable with that of the years 1900-1902. During the whole ten years during which epidemic plague persisted in Sydney, there were only three separate years in which cases occurred outside of the metropolitan area. In 1901, one case occurred at Newcastle, and in 1907, four cases occurred at Kempsey. These two years were clearly not characterized by any material extension of the disease outside the metropolitan area. In the year 1905, however, there were 14 cases at Newcastle, and a total of 25 cases at Ulmarra, Ballina, and Lismore—a group of country towns which will be shown later to be closely related in epidemiological association. It is an important feature of the occurrence of plague in Australia that Newcastle, an important city seaport, with a population of 45,000, situated only 70 miles by sea from Sydney, with an immense volume of inward and outward shipping, and in constant communication with Sydney, both by rail and sea, should have escaped infection during eight years out of the ten—excepting the one isolated case of 1902—and when infected should have had a total of only fourteen cases.

In Queensland, the principal features were the uniformity of the annual incidence during the nine years 1900-1908; the fact that the three principal seaports (Rockhampton, Townsville, and Cairns), were infected in the first year (1900), and remained infected until 1906, 1907, and 1908 respectively; the progressive infection of all Queensland ports of any importance; and the fact that, except for a total of twelve cases at Ipswich—which is in constant communication with Brisbane by water-route—no case occurred in any locality other than a seaport. The single cases at Charters Towers and Childers may be ignored for the purposes of this general statement.

The type of infection amongst humans remained bubonic throughout the course of the outbreaks. On two occasions only was there reported a localized spread of pneumonic infection. In Sydney in June, 1906, fatal pneumonic plague was determined in the wife of, and in a neighbour who attended, a fulminating case of pneumonia in a seaman (P.R., 1906, p. 7). Amongst 29 other close contacts, including 9 children in the family of the primary case, there were no further cases. The family lived in comfortable circumstances in a 7-roomed house in Balmain. At Maryborough, Queensland, in May-June, 1905, seven children of a family in very poor circumstances developed what was apparently septicaemic plague, and five of them died with secondary pneumonia. A neighbour in attendance and two hospital nurses contracted pneumonic plague and died. (Ham, Special Report, 1903.)



## CHAPTER IX.—EPIZOOTIC PLAGUE IN AUSTRALIA.

At the time when plague first made its appearance in Australia, the importance of the part played by rats in the epidemiology of the disease was not officially, or even generally, recognized. For this reason, the information concerning plague in rats is not complete for the earlier years of the epidemic, although, thanks to the intelligent recognition by such distinguished hygienists as Gresswell and Thompson, the importance of measures directed against rats was recognized from the outset. There is clear evidence of this, not only in the contemporary reports, but in the provisions of the Australian Plague Convention of 1900 (see Appendix A). This latter Convention, to which subscribed five of the six Australian States—New South Wales not participating in the Conference—was adopted at a Conference which sat on 11th, 12th, and 13th April, 1900. The Convention was based on the Venice Convention of 1897; but, although this latter Convention contained no reference whatever to the rôle played by rats in plague, the Australian Plague Convention of 1900 contained definite provisions dealing with this aspect, as follows:—

“All vessels to be disinfected at once after discharge of cargo to the satisfaction of the health authority, and all practicable measures to be taken for the destruction of rats.

When a reasonable suspicion of danger from plague arises, the destruction of rats by poison at sea and land frontiers to be immediately undertaken and vigorously prosecuted, the expense of this procedure, as far as regards shores, river banks, piers, and wharfs, to be borne in the first instance by the Government; and the several Departments of the State, and the local sanitary authorities, to immediately undertake and be responsible for the extermination of rats on their several properties, or within their several districts; and the bodies of all rats taken alive or dead to be destroyed in every case by fire.”

The records of the progress of epizootic plague, incomplete at first, become more detailed and exact as the experience gained with each successive outbreak indicated the nature of the information to be obtained, and of the records to be kept.

## APTER X.—THE EPIZOOTIC IN NEW SOUTH WALES.

### Epizootic Plague at Sydney.

1900.—From May, 1894, to December, 1899, the treatment accorded to vessels arriving from ports infected with plague was that prescribed by the Venice Convention of 1897. But when it was announced that plague was epidemic at Noumea, attempts were made to kill any rats which might still remain on vessels from plague-infected ports, notwithstanding the efforts to the same end which had usually been made at the port of departure.

On 25th January, 1900, the first case of human plague at Sydney was made known. The circumstances attending the occurrence of this first case caused the Board of Health to insert advertisements requesting information from owners or occupiers of wharfs, 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. No information concerning mortality among rats was furnished in response to these advertisements, nor to other inquiries, until 14th February, when an officer in the Customs Department drew attention to unusually frequent deaths amongst rats at Huddart, Parker and Company's wharf. During that day, four live rats and three carcasses were brought to the Board of Health laboratories. These seven rats were proved to be infected with plague. At a later date, an official reported that he had noticed an unusual mortality among the rats at Huddart, Parker and Company's wharf about the first week in January; but no confirmation of this was ever forthcoming. The disease was not introduced into New South Wales 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 afterwards to other persons. But by what vessel, or from which infected port, such rats were landed at Sydney, there is no evidence. During the course of the epidemic of 1900, 167 rats were examined, and plague bacilli were detected in 23 of these. Actually, however, many reports of dead rats were received, and it would be erroneous to suppose that the 23 proven infections were the only occasions of the presence of rodent plague rats over a considerable area of Sydney, which was the area on which cases of plague in man occurred, suffered from epizootic plague. This epizootic began before plague in man occurred, and ceased, as far as can be learnt, about the same time as the epidemic ceased.

Thompson, from whose "Report of the Outbreak of Plague at Sydney, 1900," the above remarks are quoted practically verbatim, summarizes as follows:—

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



This epizootic disease was plague.

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

The epizootic died out, as far as can be learned, at the same time as the epidemic ceased.

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

The last infected rat was located on 12th July, 1900.—(Map B, Plague Reports, 1900.)

1901 and 1902.—The monthly distribution of epidemic and epizootic plague during the years 1900, 1901, 1902, is shown in the following table:—

TABLE 25.

| Year.   | Month.       | Number of Persons Infected. | Number of Plague-rats Identified. |
|---------|--------------|-----------------------------|-----------------------------------|
| 1900 .. | January ..   | 1                           | ..                                |
|         | February ..  | 3                           | 9                                 |
|         | March ..     | 51                          | 2                                 |
|         | April ..     | 107                         | 6                                 |
|         | May ..       | 93                          | 5                                 |
|         | June ..      | 41                          | 1*                                |
|         | July ..      | 6                           | ..                                |
|         | August ..    | 1                           | ..                                |
|         | September .. | ..                          | ..                                |
|         | October ..   | ..                          | ..                                |
|         | November ..  | ..                          | ..                                |
|         | December ..  | ..                          | ..                                |
| 1901 .. | January ..   | ..                          | ..                                |
|         | February ..  | ..                          | ..                                |
|         | March ..     | ..                          | ..                                |
|         | April ..     | ..                          | ..                                |
|         | May ..       | ..                          | ..                                |
|         | June ..      | ..                          | ..                                |
|         | July ..      | ..                          | ..                                |
|         | August ..    | ..                          | ..                                |
|         | September .. | ..                          | ..                                |
|         | October ..   | ..                          | ..                                |
|         | November ..  | 1                           | 4                                 |
|         | December ..  | 1                           | ..                                |
| 1902 .. | January ..   | 6                           | 5                                 |
|         | February ..  | 26                          | 25                                |
|         | March ..     | 57                          | 6                                 |
|         | April ..     | 20                          | 37                                |
|         | May ..       | 22                          | 23                                |
|         | June ..      | 6                           | 4                                 |
|         | July ..      | ..                          | 1                                 |
|         | August ..    | ..                          | ..                                |
|         | September .. | ..                          | ..                                |
|         | October ..   | ..                          | ..                                |
|         | November ..  | ..                          | ..                                |
|         | December ..  | ..                          | ..                                |

\* The fact that the last plague-infected rat is here recorded as having been identified in June instead of July, as above recorded, is as recorded in the original reports (see Plague Reports 1902, p. 60.)

As to the origin of this second epizootic and epidemic, Thompson remarks as follows:—

“The only hypotheses worth serious examination, in our opinion, are the two following: Either the epidemic depended on a recrudescence of the epizootic of 1900, or upon a second epizootic set going by newly imported plague rats. As to the former, we had reason to believe that the epizootic of 1900 died out in the course of that year; but the evidence gathered was insufficient to establish the fact; still, the recurrence was apparently too long delayed to have been a recrudescence, the interval of fifteen months which elapsed before the disease again occurred having extended far beyond the time at which generations of new and susceptible rats had come into existence. Further, it will presently be shown that the state of rats as to disease was very carefully, and it is thought completely, ascertained over the whole of the threatened area from conclusion of the epidemic in June, 1902, to 31st December; while from the latter date the wharfs were watched in the same thorough way until far into 1903. Now, the last plague rat was discovered on 13th July, 1902; consequently, there is good ground for asserting that the second epizootic, at all events, died completely out; and, therefore, as regards commencement of the second epizootic, the balance of evidence at Sydney appears to tell in favour of reimportation.”—(P.R., 1902, p. 11.)

1903.—Attack occurred in the last human case of the preceding outbreak on 12th June, 1902; the last plague-rat was taken on 14th July, 1902.\* The 1903 outbreak began in an epizootic of plague, of which the first evidence was got on 12th May, 1902, and the last on 15th August, 1903.

Thompson in his reports deals, for the sake of convenience, with three periods—(a) from 15th July, 1902, to 30th April, 1903, being the preliminary plague-free period; (b) from 1st May, 1903, to 15th August, 1903, being the epizootic period; and (c) from 16th August to 31st December, 1903, comprising a large part of the ensuing plague-free period. During the first of these periods, the rat-catching staffs continued at work, and during the whole of the first of the three periods, 31,075 rodents were taken, of which 17,160 were examined in the laboratory; and these rodents had been taken in neighbourhoods selected in accordance with the experience which had taught that recurrent plague would probably first betray itself in them. None of the 17,160 were infected with plague. Thompson claims that Sydney had actually been rat-free during the period in question. He says:—“On the whole, it appeared, on 30th April, 1903, to be probable that Sydney had for eight months and a half been really free from plague in its rats, as it certainly had been free from plague in man.—(P.R., 1903, p. 2.)

\* See Report for 1902, p. 11, which gives this date as 13th July, 1902.



On 8th May, 1903, plague-infected rats were found in a produce store. From that date until 15th August, 8,695 rats and 5,976 mice were examined at the laboratory. Of these, 111 rats and 50 mice were found to be plague-infected. From 15th August until 31st December, 1903, a total of 13,389 rodents was examined without the discovery of one plague-infected individual. Thompson claims that, "at the end of 1903, it once more appeared that Sydney had been free from epizootic plague for four months and a half."

1904.—The first direct evidence of epizootic plague in this year was got on 1st March, 1904, the last on 3rd December. Following his previous practice, Thompson establishes three periods:—the precedent plague-free period from 16th August, 1903, to 29th February, 1904; the epizootic period, from 1st March to 3rd December; and the ensuing plague-free period from 4th to 31st December, 1904.

The number of rodents destroyed during the precedent plague-free period was 78,161, of which 18,456 were examined—all being free from plague. During the epizootic period, the total number of rodents destroyed was 108,936, of which 43,822 were examined. Among them, 181 rats and 62 mice were found to be infected with plague.

From 4th December to 31st December, 8,231 rodents were destroyed, of which 3,145 were examined without the discovery of any plague infection.

Thompson, at this stage in the evolution of plague in Sydney, was able to say, with regard to the 1904 cases, "Close association with plague-rats was shown to have existed in every one of the series of cases which constituted the outbreak under review." And he was able to state that his deductions in 1900 (see p. 47) remained substantially unaltered. These deductions included, *inter alia*, that important conclusion that "the area over which the epizootic extended was practically co-extensive with that on which cases of plague in man were observed.

1905. It was remarked previously that the importance of accurate and detailed records of rats in relation to plague was not generally recognized in 1900. By 1904, the relation had become very generally accepted, but difficulties were experienced in the making of detailed observations. Thompson's report for 1905 states the position:—

"During the outbreak of 1904, a special effort was made to ascertain whether close connexion between cases and plague-rats could not be established in every instance, provided sufficient time were devoted to the search; and it was made with reference to two points. One was the difficulty, thought to be merely incidental, which had so often prevented demonstration of the presence of plague-rats on premises which had proved themselves to be infective, and the consequent incompleteness of the evidence, which in

general supported the view that rat-plague is a condition precedent of plague in man. The other was the desirability of examining more exactly into cases where it was thought, after due search, that neither rats nor signs of infestation by rats were present, which had appeared to have been the case in a very few instances; in which, nevertheless, presence of plague-rats in the immediate neighbourhood had been ascertained. However, while only twelve cases occurred in connexion with nine places of infection, the presence of plague-rats at each place was established; so that no opportunity of further examining the second point then offered.

As far as it went, that evidence was against the soundness of the observation which had been made, namely, that very rarely a house might prove to be a place of infection in absence of signs of infestation by rats; still, the point has been noted for further inquiry. But, although in the year referred to the number of cases and of places was extremely small, it had been found that the labour involved in the constant watchfulness of all concerned, which turned out to be necessary to success, and of long quasi-detective inquiries, were too great to be continued by a staff whose daily avocations were multifarious and exacting. During the year now reported upon, therefore, no special attempt was made to run the plague-rat down in connexion with every case, although the more salient points were as carefully recorded as usual."—P.R., 1905, p. 1.)

The three periods to be considered in this year were:—(a) the precedent plague-free term from 4th December, 1904, to 17th January, 1905; (b) the epizootic period, from 18th January to 5th December; and (c) the subsequent plague-free period, from 6th December to the end of the year. This latter period, it may be noted here, lasted only 49 days, the first plague-rat of 1906 having been taken at the Baltic Wharf, Darling Harbour, on 23rd January, 1906.

During the precedent plague-free period, 4th December to 17th January, 5,086 rodents were examined and found to be plague-free. During the epizootic period, 18th January to 5th December, 28,446 rodents were examined, among which plague was identified in 123 rats and 18 mice, a total of 141 rodents.

From 6th December to the end of the year, 956 rodents were examined and found to be plague-free.

With regard to the commencement of this 1905 epizootic, Thompson finds the explanation as follows:—"Recommencement of the epizootic at Sydney—19th January, 1905, at the North Coast Steamship Company's Wharf—was thought to have resulted from re-introduction of



the infection from a district on the northern coast-line of the State, which itself was probably infected by sea from another source than Sydney.”—(P.R., 1904, p. 2.)

1906.—The last plague-rat in 1905 was identified on 5th December. In 1906, the first plague-rat was identified on 23rd January, and the last plague-rat was identified on 29th December, 1906. During the precedent plague-free period, 6th December, 1905, to 22nd January, 1906, 3,225 rodents were examined without the discovery of any evidence of plague. During the epizootic period, 23rd January to 29th December, 27,731 rodents were examined, and plague was identified in 135 rats and 39 mice—total, 174.

1907.—In 1906, the last plague-rat was taken on 29th December. In 1907, the first rat in which plague was identified was taken on 10th January, the last on 21st September. Attack in the last human case occurred on 29th December, 1907; but plague-rats in number were discovered in connexion with it; and with another which preceded it (attacked 27th December) as soon as search had proceeded sufficiently, namely, on 2nd January, 1908. During the whole year, 31,621 rodents were examined, of which 219 were plague-infected.

1908-1920.—For the years subsequent to 1907, the following table may be given:—

TABLE 26.

| Year.      | Total Rodents Examined. | Total Infected. |
|------------|-------------------------|-----------------|
| 1908 .. .. | 26,849                  | 175             |
| 1909 .. .. | 26,737                  | 178             |
| 1910 .. .. | 22,821                  | 5               |
| 1911 .. .. | 22,774                  | ..              |
| 1912 .. .. | 17,154                  | ..              |
| 1913 .. .. | 10,615                  | ..              |
| 1914 .. .. | 9,439                   | ..              |
| 1915 .. .. | 9,673                   | ..              |
| 1916 .. .. | 7,943                   | ..              |
| 1917 .. .. | 8,231                   | ..              |
| 1918 .. .. | 7,779                   | ..              |
| 1919 .. .. | 3,165                   | ..              |
| 1920 .. .. | 6,667                   | ..              |

TABLE 27.

## MONTHLY DISTRIBUTION (1900-1912) OF PLAGUE RATS IDENTIFIED IN SYDNEY.

|         | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Totals. |
|---------|----------|-----------|--------|--------|------|-------|-------|---------|------------|----------|-----------|-----------|---------|
| 1900 .. | ..       | 9         | 2      | 6      | 5    | 1     | ..    | ..      | ..         | ..       | ..        | ..        | 23      |
| 1901 .. | ..       | ..        | ..     | ..     | ..   | ..    | ..    | ..      | ..         | ..       | 4         | ..        | 4       |
| 1902 .. | 5        | 25        | 6      | 37     | 23   | 4     | 1     | ..      | ..         | ..       | ..        | ..        | 101     |
| 1903 .. | ..       | ..        | ..     | ..     | 27   | 96    | 24    | 14      | ..         | ..       | ..        | ..        | 161     |
| 1904 .. | ..       | ..        | 4      | 32     | 30   | 50    | 94    | 6       | 15         | 10       | 1         | 1         | 243     |
| 1905 .. | 7        | 10        | 32     | 65     | 3    | 1     | 7     | 4       | 2          | ..       | 9         | 1         | 141     |
| 1906 .. | 1        | 15        | 29     | 21     | 2    | 12    | 24    | 23      | 40         | 3        | 1         | 3         | 174     |
| 1907 .. | 11       | 54        | 25     | 29     | 17   | 33    | 13    | 16      | 19         | 2        | ..        | ..        | 219     |
| 1908 .. | ..       | ..        | ..     | ..     | Not  | avail | able. | ..      | ..         | ..       | ..        | ..        | 175     |
| 1909 .. | 3        | 10        | 78     | 63     | 20   | 4     | ..    | ..      | ..         | ..       | ..        | ..        | 178     |
| 1910 .. | ..       | ..        | ..     | 5      | ..   | ..    | ..    | ..      | ..         | ..       | ..        | ..        | 5       |
| 1911 .. | ..       | ..        | ..     | ..     | ..   | ..    | ..    | ..      | ..         | ..       | ..        | ..        | nil     |
| 1912 .. | ..       | ..        | ..     | ..     | ..   | ..    | ..    | ..      | ..         | ..       | ..        | ..        | nil     |

The examination of rodents was continued systematically after this period, but no infected rodent was discovered in New South Wales until 1921.

### Epizootic Plague in Extra-Metropolitan Districts, New South Wales.

1902. *Newcastle*.—In connexion with the single indigenous case of human plague, which occurred at Newcastle in 1902, there was some evidence of antecedent rodent plague. The patient became suddenly ill on 3rd August, and was reported to the Medical Officer of Health on 6th August. After the preliminary inspection of the premises on 6th August, the Medical Officer of Health had reported the finding of a dead rat, too decomposed for laboratory examination, and that the licensee had stated that shortly before the patient's illness he had found other dead rats. On complete inspection of the premises, abundant evidences of rat-infestation were found, and it was recorded that the patient had removed eight dead rats from the cellar shortly before he became ill. During cleansing, four other carcasses, but no live rats, were found. The basement of this building communicated directly, by means of an unused drain, with a wharf. At this wharf, very large quantities of fodder had been landed during several previous months, either from ships or from the adjacent railway. This fodder was almost or entirely the produce of New South Wales, and had, no doubt, been exposed to incursions of rats during its collection at Sydney.

The rat-destruction operations, which, begun in 1900, had been discontinued in 1901, were recommenced on 6th March, 1902. Special measures were applied after the discovery of the human case; and



between 8th August and 11th September, rats were collected from 125 different premises. A total number of 1,598 were collected, in none of which was the presence of plague established.

Thompson comments as follows:—"It must therefore be recorded that no plague-rats were found at Newcastle. Nevertheless, for reasons which have already been given above, it cannot be affirmed that there were no plague-rats there; and it is a significant fact that no rumour of unusual mortality among the rats of any part of Newcastle was heard during the investigation, except at the Criterion Hotel" (the premises where the human case occurred).

From Thompson's account of this outbreak, it is clear that he draws the inference that some infected rats were conveyed from Sydney to the immediate neighbourhood of the Criterion Hotel, at Newcastle; that there was created a local focus at that hotel which did not spread.

1905. *Ulmarra*.—This outbreak furnishes evidence of primary importance and interest, because being in a limited community it offered exceptional facilities for inquiry, and because Millard, who was alert to take advantage of those facilities, has placed on record an account of exceptional completeness. The first human case occurred on 14th December, 1904. The last human case occurred on 6th May, 1905. The first rat in which plague was identified was examined on 8th January. The last infected rat was found on 8th March. During that period infected rats and mice were found as follows:—

|                         | Examined. | Infected |
|-------------------------|-----------|----------|
| Ulmarra .. .. .         | 1684 ..   | .. 103   |
| Woodford Island .. .. . | 308 ..    | .. 6     |
| Southgate .. .. .       | 68 ..     | .. nil   |
| Grafton .. .. .         | 319 ..    | .. nil   |
| South Grafton .. .. .   | 244 ..    | .. nil   |

"Of the conditions prevailing among the rats of the Ulmarra district prior to 8th January, nothing can with certainty be said, but from the information locally available, it appeared that rats had been unusually numerous some four to six weeks previously, i.e., about the beginning of December, and that later on dead and sick rats had been seen at several places in the township and along the river bank. The mortality had been commented on, and had been loosely explained by the suggestion that the rats had been poisoned." On inquiry, however, "there appeared little reason to suppose that poison had been used at all generally."

"The report of previous rat mortality was supported by the finding, on 9th and 10th January, of 50 rats and 65 mice mummified, in a barn at the residence of case D, and of three rats and one mouse in a similar condition at the residence of cases B, E, and F. Under the existing climatic conditions this mummification would probably be produced in a week or ten days."

The rumour of rat mortality was not confined to the Ulmarra or right bank of the river. Similar statements were made with respect to the village of Southgate, on the left bank, opposite Ulmarra. No human cases occurred at, or were connected with, Southgate. The epizootic appeared to gradually die down, the last infected rat was obtained on 8th March, and no further rat mortality was reported from any part of the district. When, some two months later, search for rats was reinstated in connexion with another case of plague (6th May), it was found that rats were still exceedingly scarce."

In all of the human cases except the last (6th May) the association between epizootic and epidemic plague was shown to be intimate.

Whence the epizootic infection was introduced, and at what point in the district it first manifested itself can only be conjectured. Ulmarra had commercial relations with both Sydney and Brisbane—with the former by a regular semi-weekly service of steamers, in addition to occasional extra cargo boats, and with the latter by one weekly steamer. There was at that time no overland trade. At Sydney plague-infected rodents had been obtained on 10th October, 1904, at Sussex-street; on 11th October, at Dalgety's wharf; on 4th November and 3rd December, at the A.U.S.N. Company's wharf. After this last date, though the systematic rat examination was maintained, no more infected rats were brought in until 18th January, 1905, when one was obtained at the Sydney wharf of the North Coast Steam Navigation Company—the wharf at which the steamers from both the Clarence and the Richmond rivers lie while discharging and loading cargo in Sydney. This was the first of seven infected rats obtained from the same wharf on 18th, 19th, 23rd, 24th and 25th January.

At Brisbane the official returns report finding of an infected rat on 8th October, 1904; but after this no more until 21st January, 1905, an interval of 105 days, during which, as far as is officially known, the town and port were free from plague in rats.

From this evidence as to known rat infection at the two places respectively—which, probably, however, cannot be accepted as fully and completely stating the actual conditions prevailing—and from the facts as to relative amounts of trade with Sydney and Brisbane, it would appear that the importation of infection from Sydney was more probable than from Brisbane.

The actual point or points at which the infection was introduced cannot be stated. The most probable theory as to the sequence of events appears to be that the infection was introduced at two points—Ulmarra and Bushgrove; that the epizootic spread was first along the river bank, possibly because the rat population was more continuously distributed there than elsewhere; that it subsequently at Ulmarra spread through the township, and then from farm to farm in the immediate neighbourhood. The actual vehicle of the infection or infected rats could not



be determined. Among the merchandise imported from Sydney were several kinds which might have served as a means for transporting rats, such as bales of empty bags and empty cases (egg and butter boxes). The imports from Brisbane were, generally speaking, of a less likely character.

1905.—*Ballina*.—The first positive proof of epizootic plague in Ballina was furnished on 14th February, 1905, when six dead rats were found at Webster's stables, of which four were demonstrably plague-

infected, and the other two were putrid. The first human case occurred on 3rd February, 1905. Information had been obtained that on the premises occupied by this first human case, dead rats had been noticed about the middle of January. Further examination of Webster's stables resulted in the discovery of fifteen other dead rats, of which eight were demonstrably infected. Between 11th and 24th February, 403 rats and mice were examined, of which sixteen rats were identified as plague-infected, the last in this series occurring on 17th February. After 17th February there ensued an interval of six weeks until the finding of the next plague-infected rat on 31st March. The plague rats identified occurred as follows:—31st March, 5th and 27th April, 1st, 17th and 19th May—

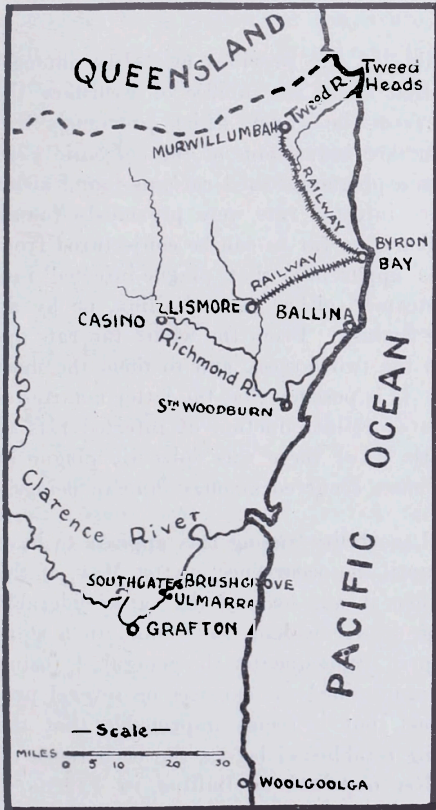


Figure 5. Sketch Map of the Northern Rivers District, New South Wales.

three premises being infected. The epizootic manifestations extended over the period 14th February to 19th May, 1905, during which 28 infected rats and mice were identified. After this period no more plague-infected rats were discovered in Ballina.

Whence the plague rats were introduced to Ballina can only be conjectured, but it is at least very suggestive that the first case occurred on premises closely related to the wharf used by the Brisbane trader,

the s.s. *Pyrmont* and that Webster's stables, which appeared to be the important focus of the epizootic, were connected by an untrapped sewer with the foreshore near the same wharf.

1905.—*South Woodburn*—On 18th March a dead and a sick rat from Murray's Hotel, South Woodburn, and on 20th March a third rat from the same hotel, were found to be plague-infected. Between 18th March and 16th April, 249 rats and 80 mice from this village were caught and examined, and one further rat was found to be infected. In addition twelve dead rats were found, but these were too decomposed for examination.

No information was obtainable of any previous mortality amongst rats, but it was stated locally that about the middle of February the rats had suddenly disappeared from the wharf, which previously had been infested with them. No further indications of the epizootic were manifested until 29th May, when a plague-infected rat was found about half-a-mile from the place where infected rats were previously found. The sequence of events at Woodburn, as far as can be conjectured from the meagre data available, was apparently that plague-infected rats were landed at the wharf by steamer, either from Ballina, or by an ocean steamer from Brisbane or Sydney. From the wharf the rats appear to have made their way to the two largest, and to them the most attractive, premises—the hotels. It is possible that the latter manifestation (28th May) was the result of re-introduction of infected rats to Woodburn, as at that date (28th May) there was epizootic plague at both Ballina and Lismore. No cases occurred amongst human beings.

1905.—*Lismore*—No unusual mortality among rats appears to have attracted attention at Lismore, until the occurrence, on 1st May, of the first human case of plague. Then it was learned that a considerable number—nineteen or twenty—of dead rats had been found in a store in the town on 22nd and 25th April. Subsequently the general cleansing operations discovered putrid or mummified rat carcasses on several premises in the same neighbourhood, but it seems improbable that the epizootic had been severe or long established before the occurrence of human cases. When plague first occurred at Ballina in February, Lismore rats to the number of 52 were examined for plague with negative results. On 5th May, a mouse, found dead at some auction rooms, harboured bacilli morphologically resembling *B. pestis*.

On the first day of systematic examination, namely 12th May, two rats and one mouse were found to be plague-infected. The last plague-infected rats or mice were examined on 13th June. Examination of all rats and mice was kept up for three weeks longer—till 7th July—but with negative results. In all, a total of 377 rats and 176 mice were examined, eleven rats and eight mice having been identified as being plague-infected.



With the exception of one case, of whose movements no one could give certain information, and who may have been infected at his place of residence, all of the cases notified were connected either with the store above mentioned or with the lane or premises at the rear. It is worthy of note that none of the eleven premises above mentioned as furnishing plague-infected rats furnished patients also, and this although three were hotels and the other premises of such a character as to be much frequented.

Whence the plague-infected rats were introduced into Lismore must necessarily be a matter for conjecture, but the most reasonable supposition is that they were brought up the river. At Ballina plague rats were found in February, April, and May, and at Woodburn in March, April, and May. The frequent communication by steamer between these places and Lismore obviously offered abundant facilities for such transport of rats, despite all precautions, such as rat-guards, tarred mooring-lines, &c.

The information relating to epizootic plague at Ulmarra, Ballina, South Woodburn and Lismore, has been taken, almost verbatim, from the excellent reports by Millard. [Plague Reports, New South Wales Board of Health, 1905.]

1905.—*Newcastle*—The first case of human plague in Newcastle in 1905 was notified on 25th March, 1905, and the first plague-infected rat was found on 29th March. On the discovery of this first case of plague in man, steps were taken to provide for the destruction of rats in the city and district. Between 28th March and 14th August, 1905, 13,901 rodents were destroyed. Of these, 6,653 were examined for plague, and 206 were definitely proved to be infected with the disease. It should be stated that a large number of the rodents brought for examination were too far advanced in decomposition to enable a definite decision to be formed as to the cause of their death, though it was in all probability due to plague, for it not infrequently happened that one or more of a batch found on the same premises were plague-infected, whilst the remainder were too decomposed to allow of a prompt and definite decision being arrived at, though the indications pointed to plague having been the cause of their death. Leaving this out of account, however, it is still found that 3 per cent. (206 out of 6,653) of the rodents examined were plague-infected. This was a considerably higher proportion than had previously been found in New South Wales. The last case of plague in the epidemic was attacked on 2nd July; the last plague-infected rat was taken on 6th July; From 6th July to 14th August, 594 rats from different parts of the city were examined, but all were healthy.

The weekly occurrence of epizootic and epidemic plague in Newcastle is shown hereunder:—

TABLE 28.

| Week Ending.   | Rodents Examined. | Number Infected. | Human Cases Notified. |
|----------------|-------------------|------------------|-----------------------|
| April 1 .. ..  | 300               | 10               | 3                     |
| 8 .. ..        | 310               | 14               | 1                     |
| 15 .. ..       | 275               | 4                | ..                    |
| 22 .. ..       | 314               | 17               | ..                    |
| 29 .. ..       | 279               | 9                | 1                     |
| May 6 .. ..    | 646               | 23               | 3                     |
| 13 .. ..       | 664               | 20               | 1                     |
| 20 .. ..       | 616               | 42               | ..                    |
| 27 .. ..       | 729               | 33               | 3                     |
| June 3 .. ..   | 518               | 22               | ..                    |
| 10 .. ..       | 393               | 2                | 1                     |
| 17 .. ..       | 454               | 7                | ..                    |
| 24 .. ..       | 209               | ..               | ..                    |
| July 1 .. ..   | 163               | 1                | ..                    |
| 8 .. ..        | 245               | 2                | 1                     |
| 15 .. ..       | 143               | ..               | ..                    |
| 22 .. ..       | 78                | ..               | ..                    |
| 29 .. ..       | 118               | ..               | ..                    |
| August 5 .. .. | 122               | ..               | ..                    |
| 12 .. ..       | 44                | ..               | ..                    |
| 19 .. ..       | 33                | ..               | ..                    |

Though more than 2,500 rats caught in the suburbs of Newcastle were examined, only five were found to be infected with plague. Four of these were taken from a garbage tip, at which two cartloads of refuse from an extensively infected building were surreptitiously deposited. This happened on 6th May, 1905; four plague-infected rats were discovered at this tip between 12th June and 15th June, 1905. The other infected rat was caught on 31st May at a stable where a large consignment of chaff had been delivered from a badly infected premises in Newcastle. At this stable six other putrid carcasses were discovered.

Dick, in his account of this Newcastle epidemic, comments upon the relation between epizootic and epidemic plague as follows:—

“Consideration of the subject of plague in rats, and its relation to plague in man, shows on the one hand that at 41 different premises in the city (excluding the wharfs) which yielded plague rats, no cases of plague occurred amongst the occupants or employees of any of these premises. A premises may apparently be grossly infested by plague rats, and yet no case occur amongst the inmates of those premises. On the other hand, in the thirteen cases of plague (one case being excluded), infected rats were discovered at the residence or place of employment of eleven out of the thirteen cases.” In the other two cases there was good reason to believe in the probability of incidental exposure within the limits of an infected area.



*Origin of the Epizootic Infection in Newcastle.*

"Little consideration need be given to the question whether the disease was introduced into Newcastle by means of ships from plague-infected places in other parts of the world. Never at any time has there been a history of plague infection in man or rats on board any ship reaching Newcastle from any foreign port. Newcastle is in daily communication with Sydney by rail and sea, the trade between the two cities being very considerable by both routes. Frequent communication is maintained by sea between Newcastle and the northern ports in this State, as well as with Brisbane and other ports in Queensland.

"Epidemics of plague were experienced in Sydney during 1900 and 1902, and occasional cases occurred in 1901, 1903, and 1904, whilst plague-infected rats were found there, especially about the harbour frontages, during each succeeding year since 1900.

"In Brisbane plague has not been absent since 1901.

"There has been no positive evidence that plague in rats or man reached Newcastle by means of vessels trading with any of the above-mentioned places.

"All that can be definitely stated in reference to the source of infection of the Newcastle outbreak is this: At several State and inter-State ports with which Newcastle was in direct and frequent communication by sea, as well as by land, cases of plague in rats and man existed for several months prior to the occurrence of the first case of plague in Newcastle; that produce and other goods were shipped direct from these ports to produce stores in Newcastle; that, after the notification of the first case of plague, on 25th March, search of the produce store at which the patient worked resulted in the finding of a number of plague-infected rats, and the carcasses of a large number of dead and putrid rats which had apparently succumbed some weeks previously. That similar conditions, as regards rats, were met with on other premises in the city. That, as soon as search was made, plague-infected rats were found about the wharfs, where vessels from the places referred to above lay, and infected rats continued to be taken about these wharfs down to 6th July, 1905.

"The inference drawn from these circumstances is, that the infection was transported to Newcastle, either by produce infected by means of plague rats, and conveyed from it to the local rats, or what is much more probable, that rats were transported, and landed at Newcastle, and, in turn, communicated the disease to the local rodents, and, from them, to human beings."

Inasmuch as Dick lays so much emphasis on produce in connexion with the origin of this outbreak, and as the commencement of the outbreak is so definitely associated with a known focus in a produce store, it is unfortunate that no record seems to have been kept of the places from which that store had received consignments of produce within the period preceding the assumed date of the onset of the epizootic outbreak in the produce store. This information, if adequately analyzed, and followed up, might have produced evidence of great value in connexion with the epidemiology of plague in Australia.

1907. *Kempsey*.—The first human case of plague at Kempsey occurred on 23rd January, 1907. This patient had been employed in a produce store, where, on 16th and 17th January, he had assisted at the removal and destruction of 31 dead rats which were found beneath one of the floors. Many vague statements were rife as to rats having been unusually numerous in Kempsey in the latter part of December, 1906, and the beginning of January, 1907, but no rat mortality appears to have been observed until the finding of the 31 dead rats at the produce store. As soon as the diagnosis of the first case had directed attention to the matter, definite evidence was obtained of epizootic plague in the Kempsey rats. On 29th January was found a dead rat which was probably plague-infected. The last infected rat was found on 18th February, and, altogether, seven premises were found to be harbouring infected rats, infection being positively demonstrated in twelve rats from these places, and on some other premises evidence was obtained of previous rat mortality. A total of 514 rodents was examined.

As to the source whence the infection was carried to Kempsey, there can be little doubt that it was carried from Sydney in produce or other merchandise. The owner of the produce store received frequent consignments of horse-feed from Sydney. His books showed that in the month of December, 1906, he had received 393 bags of chaff from produce merchants in Sussex-street, Sydney. Infected rats were taken at the Federal wharf, which is in the vicinity of the premises whence the chaff was supplied, on 19th November, 11th December, and 12th December. The finding of infected rats at the North Coast Steam Navigation Company's Kempsey wharf on 17th and 18th February may probably be accepted as a further indication of the path by which the infection was conveyed to the produce store. [Millard: *Plague at Kempsey*, p. 30.]



## CHAPTER XI.—EPIZOOTIC PLAGUE IN QUEENSLAND.

### Epizootic Plague in Brisbane.

The first record of plague in rats in Brisbane was on 5th March, 1900, when one rat was found dead in a shop close to a wharf at which vessels from Sydney had recently arrived. On examination this rat was found to be infected with plague. The first plague case in man occurred on 27th April. It is assumed by Ham (page 3) that the infected rat found on 5th March marked the commencement of the epizootic in Brisbane. Inquiry of wharfingers and officials whose business took them to the wharves elicited the information that an unusual fatality among rats had taken place prior to the occurrence of the first case in man on 27th April. After reviewing the evidence Ham concludes that "the above facts support the opinion that the disease was introduced by plague-infected rats from Sydney, and that the infection spread to the local rats, which in turn communicated it to man. The last case of plague in man in Brisbane during 1900 was reported on the 13th December, 1900; the last infected rat on 24th October, 1900. The total number of rats examined in this year was 735, the number identified as infected, 90.

1901.—In this year no infected rats were found in January, February or March, the first being found infected on 4th April. The last infected rat was found on 22nd November, 1901. During the year, 1,851 rats were examined, of which 101 were found to be infected.

1902.—The first infected rat was found in the third week in January, the last during the second week in August. The total examined was 3,851, of which 106 were found to be infected.

1903.—The first infected rat was found in the second week in January, the last on 28th September. A total of 14,361 rodents was examined, of which 88 were found to be infected.

1904.—The first infected rat was found on 8th January, and the last on 15th December. A total of 25,653 rats and mice was examined, of which 404 were found to be infected.

1905.—The first infected rat in this year was found on 4th January. The last infected rat was found on 29th November. With the exception of one infected rat on the 4th July, and one on the 29th November, there was no plague in man or rats from July to December. A total of 16,780 rodents was examined, 129 being found to be infected.

1906.—The first plague-infected rat was found on 12th January, and the last infected rat on 28th December. A total of 12,195 rodents was examined, of which 48 were infected.

1907.—The first infected rat was found on 2nd January, and the last on 20th December. A total of 19,610 rodents was examined, of which 45 were infected.

1908. The first infected rat was found on 22nd January, and the last on 15th September. The total rodents examined was 20,426, of which 71 were infected.

1909.—During this year a total of 27,828 rodents was examined, none being found infected within the metropolitan area.

This was the last year in which epizootic plague is known to have occurred in Queensland.

The monthly statement of infected rats identified in the metropolitan area of Brisbane is as shown in the following table:—

TABLE 29.

| Year.    | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Total. |     |
|----------|----------|-----------|--------|--------|------|-------|-------|---------|------------|----------|-----------|-----------|--------|-----|
| 1900     | ..       | ..        | 5      | 3      | ..   | 15    | 21    | 24      | 15         | 7        | ..        | ..        | 90     |     |
| 1901     | ..       | ..        | ..     | 16     | 23   | 32    | 20    | 8       | 1          | ..       | 1         | ..        | 101    |     |
| 1902     | ..       | 3         | 6      | 7      | 53   | 16    | 12    | 8       | 1          | ..       | ..        | ..        | 106    |     |
| 1903     | ..       | 1         | 8      | 30     | 20   | 15    | 6     | ..      | ..         | 4        | ..        | ..        | 84     |     |
| 1904     | ..       | 21        | 3      | 25     | 25   | 89    | 150   | 38      | 17         | 4        | ..        | 6         | 2      | 380 |
| 1905     | ..       | 5         | 59     | 48     | 3    | 7     | 5     | 1       | ..         | ..       | ..        | 1         | ..     | 129 |
| 1906     | ..       | 1         | 6      | 6      | 3    | 5     | 6     | 2       | 8          | ..       | 1         | ..        | 10     | 48  |
| 1907     | ..       | 4         | 6      | 1      | 5    | 3     | 3     | 4       | 6          | 5        | 2         | 5         | 1      | 45  |
| 1908     | ..       | ..        | 21     | 1      | ..   | 17    | 11    | 14      | 2          | 5        | ..        | ..        | ..     | 71  |
| 1909     | ..       | ..        | ..     | ..     | ..   | ..    | ..    | ..      | ..         | ..       | ..        | ..        | ..     | ..  |
| Total .. | 35       | 109       | 123    | 128    | 175  | 240   | 108   | 66      | 34         | 10       | 13        | 13        | 1,054  |     |

### Extra-Metropolitan Epizootic Plague in Queensland.

*Rockhampton, 1900-1906.*—Human cases occurred at Rockhampton, in the separate years 1900, 1903, and 1906. The sequence of events associated with the presumed introduction of infection into Rockhampton is as follows:—On 16th April, 1900, s.s. *Burwah* had arrived from Sydney via Brisbane, carrying passengers and cargo. On 17th April, the head steward was reported as suffering from plague, having fallen ill on 15th April. The ship was moved from the wharf to the quarantine anchorage on discovery of the condition of the steward. On the removal of the lining of the cabin occupied by the steward, several dead rats were found. On 20th April, a waiter at the Criterion Hotel, Rockhampton, who, in the course of his hotel duties, boarded all passenger steamers arriving at Rockhampton, was first attacked with plague. In a report dated 8th May, Dr. Turner reported that “the head wharfinger informs me that rats have not been numerous about the wharfs. Notwithstanding this, about a fortnight ago, he observed (what he had never observed before) four or five dead rats lying about the wharfs every morning for three consecutive days. After this he found two rats daily, the last being found five days ago.” Up to 15th June, 1900, 25 cases had occurred at Rockhampton, and it had then been well established that an epizootic existed among the rats of the city.



A study of the above sequence of events makes clear that the s.s. *Burwah* was infected prior to arrival at Rockhampton, probably at Sydney, and contained on arrival at Rockhampton a fully-developed epizootic of rat plague, transmitting infection to one human resident, and to the local rats of Rockhampton.

Ham records that in 1903 "infected rats were found at Rockhampton." "After an absence of six years, plague in epidemic form reappeared at Rockhampton on 3rd April, 1906. There is good reason to believe that infection was imported by rats from vessels arriving at the town wharfs." This statement by Ham (page 16) appears to ignore the two human cases which occurred in 1903, and no evidence is given for discarding any hypothesis that epizootic plague had persisted in Rockhampton through the six years, or in support of the statement that plague had been re-introduced. It is stated that eight of the eleven cases were directly connected with one warehouse, and all eight cases were reported within a period of eight days. It was ascertained that dead and diseased rats had been found in the warehouse premises just prior to the outbreak. Dead rats had also been found in a store adjacent to the warehouse.

During 1907, 6,982 rodents from Rockhampton, and, during 1908, 1909, and 1910, a total of 7,210 were examined, without any infected rat being identified.

*Townsville, 1900-1907.*—Human cases of plague occurred at Townsville in the separate years 1900, 1902, 1903, 1905, 1907.

On 27th April, 1900, a steward on board s.s. *Cintra* was reported as suffering from plague. The patient had been taken ill on 20th April, the day on which the vessel had left Sydney, and had been ill on the vessel while the latter was at Brisbane on 22nd and 23rd April.

No further information is available concerning subsequent events at Townsville.

Ham states (page 9) that "infected rats were found at Townsville during 1903. During the twelve months ending 30th June, 1904, 28 rodents were found to be infected. In 1905, 63 plague-infected rats were discovered at the jetty wharf. Of 489 rats examined at Townsville during October, five were found plague-infected. The last infected rat in 1905 was found there on 6th October.

During the year 1907, 3,007 rodents were examined, none of which was found to be infected.

During 1908, 724, and, during 1909, 5,353, none being identified as plague-infected. In 1907, a fatal case occurred at Townsville on 17th March. This patient was also employed in a produce store where dead rats were subsequently obtained.

*Cairns.*—Human cases of plague occurred at Cairns in the separate years 1900, 1903, 1904, 1905, 1906, 1908. There is no record concerning rodent plague at Cairns until 1903, when it is stated that “infected rats were found at Cairns.” In 1905, a man employed as a rat-catcher contracted plague at Cairns during the month of June. Early in the same month two dead rats had been found at Cairns with naked-eye evidence of plague. During the year 1906, ten cases of human plague occurred at Cairns, and, consequently, the town of Cairns was thoroughly cleansed, and a vigorous crusade carried on against rats. Although active search for rats was continued during and after the outbreak, comparatively few rats were found in the town. One rat, dead of plague, was found on the premises where one human case had occurred ten days previous to the onset of illness. The number of rodents examined at Cairns during 1907 was 246, of which 60 were found to be infected. In 1908, 126 were examined, of which 34 were infected. In 1909, 278 were examined, none being infected.

*Bundaberg.*—Human cases occurred in the years 1902, 1903, 1905, but the total cases for the three years was only 4. In 1903, infected rats were found. In 1907, 590 rodents; in 1908, 243; and in 1909, 1,180 rodents were examined, none being infected.

*Childers.*—In this small town, approximately equidistant between Bundaberg and Maryborough, one human case occurred on 16th May, 1905. Large numbers of rats were found dead in the town, the epizootic being severe. Circumstances seemed to indicate that infection was conveyed by fodder from Bundaberg. After vigorous sanitary measures no further human or rodent plague was identified.

*Maryborough.*—Human cases of plague occurred in this town in 1904, 1905. The first human case in 1905 fell ill on 19th May, the patient being a boy employed in a fruiterer’s shop, beneath and alongside of which ran an open sewer which afforded an excellent harborage for rats. A careful search for rats at the time in the vicinity of this sewer elicited no evidence of plague infection among the rodents, which, however, were found in large numbers. During the cleaning of the town, 266 rodents were examined, only two being found to be infected. There is a discrepancy in Ham’s report with regard to rodent plague. On page 59, it is stated as above that two rats were found to be infected, while on page 49 it is stated that “a subsequent search for rats in the vicinity of the infected house, and about the town in general, revealed no evidence of plague infection among the rats.”

*Ipswich.*—Human cases of plague occurred at Ipswich in the years 1900, 1904, 1905, 1907. In 1900 and 1904, there occurred only one case each year. In 1904, infected rats were found at Ipswich. In 1905, on 4th May, one human case of plague was discovered. Within a week six other cases occurred. All of these cases were traced directly to a produce store, a dilapidated shed in which rats had been reported to be dying in large numbers a week before the outbreak.



No further information with regard to Ipswich is available.

*Port Douglas.*—In connexion with the epidemic of plague at this place in 1907, no information is available as to the occurrence of rat plague.

*Mackay.*—Following the occurrence of two human cases, one in January and one in June, 1909, intensive inspection and rodent destruction measures resulted in the discovery of five positive smears amongst 1,358 smears of spleen blood examined from rats obtained at Mackay during the months of July, August, and September, 1909.

## CHAPTER XII.—EPIZOOTIC PLAGUE IN VICTORIA.

Although there occurred eleven local human cases of plague in Victoria—ten in 1900, and one in 1902—there is no reference in the published official reports to plague amongst rats in Victoria. By the courtesy of Dr. Robertson, Chairman of the Health Commission of Victoria, I am enabled to publish the following brief records of epizootic plague:—

- 5th March, 1900.—Reported to the Board that “many plague rats had recently been found about the wharfs.”
- 7th March, 1900.—Plague rats found in a store in South Melbourne.
- 11th March, 1900.—Plague rats found in a bag store in Flinders-street.
- 30th May to 22nd June, 1900.—Plague rats found on wharfs.
- 29th August, 1903.—Plague rats on s.s. *Syrian* from Queensland. Of 158 dead rats found after disinfection one was shown to be infected.
- 30th September, 1903.—Plague rats on *Margaretha*, from Buenos Ayres. With reference, however, to this entry it is elsewhere stated that a number of dead rats were found after disinfection of the vessel. The presence of rat plague was not proven.



### CHAPTER XIII.—EPIZOOTIC PLAGUE IN SOUTH AUSTRALIA.

1900.—Human cases of plague occurred during January, 1900. In that month plague was identified in rats during the same month, three infected rats having been found at the Adelaide Hospital, and one in one of the main streets of the city of Adelaide.

In connexion with the 1909 cases of plague at Port Adelaide, plague-infected rats were found in the locality involved. The exact number is not known, but the last infected rat was found on 19th June, 1909.

## CHAPTER XIV.—EPIZOOTIC PLAGUE IN WESTERN AUSTRALIA.

1900.—In the first year of epidemic plague there is no mention of rat-plague. In one of the infected premises (case 5) "there was ample evidence of the ravages of rats or mice."

1901.—In this year it is recorded that one of the cases from Fremantle (case 13) "visited Perth with goods, and went to various shops in the rat-infected area there." From the available records which are incomplete, it appears that infected rats were found in several parts of Perth, but the actual number is unknown.

1902.—Three human cases, which occurred at Fremantle, had an interesting relationship to previous cases of plague. The official report says—"Two years ago cases of plague occurred in the restaurant situated next door to the present cases' residence; another case occurred in a man working at a warehouse situated 70 yards away, whilst in another house, 80 yards away, a case occurred two years and three months ago, this being the first case in Fremantle (1900). On 3rd June two plague-rats were discovered at the flour mill where case 1 worked."

1903.—During the outbreak in this year (January and February) the first infected rat this year was found on 2nd February—nine days after the first case had occurred, and after 30 rats had been examined. During the outbreak 471 rats were examined, and 99 of them found infected. The worst rat infection appears to have been during the week ending 15th March, 1903, when, of 65 rats examined, 29 were infected. Infected rats "were still being found on 24th March, 1903." (Official Report on Plague.) Between that date and 4th April, 65 rats were examined, two being infected. During October, 1903, plague-rats were discovered in Perth.

The official records are not complete, but it is evident that, in addition to the rats recorded above, which came from Fremantle, a total of at least 1,786 rats from Perth were examined, of which 297 were infected.

1904.—The first human case of plague occurred in Perth on 20th June, 1904. Blackburne, in his official report, states: "I have found no infected rats since about 20th March last." That statement refers to Perth. With regard to Fremantle, the first human case occurred on 28th July, the last infected rat having been found there on 21st March. Infected rats were found at Perth on 17th May, and at Fremantle on 16th May. No further reliable information is available for this year.

1906.—Human cases occurred this year between January and May. The epizootic evidently accompanied the epidemic, although detailed information is not available. It is clear that rat-plague continued after



human plague, as plague-rats were found during June. The following is a tabulation (incomplete) of the results of rat examination from February to June, 1906:—

TABLE 30.

| Week Ending.  | Perth.    |           | Fremantle. |           |
|---------------|-----------|-----------|------------|-----------|
|               | Examined. | Infected. | Examined.  | Infected. |
| Feb. 17 .. .. | ?         | Nil       | ?          | Nil       |
| 24 .. ..      | ?         | ?         | ?          | ?         |
| March 3 .. .. | 71        | 4         | 120        | 5         |
| 10 .. ..      | 165       | 41        | 93         | ..        |
| 17 .. ..      | 113       | 5         | 133        | ..        |
| 24 .. ..      | 63        | 1         | 123        | 7         |
| 31 .. ..      | 53        | ..        | 72         | ..        |
| April 7 .. .. | 49        | ..        | 71         | ..        |
| 14 .. ..      | 35        | ..        | 84         | 3         |
| 21 .. ..      | 20        | 1         | 49         | ..        |
| 28 .. ..      | 30        | ..        | 52         | ..        |
| May 5 .. ..   | 23        | ..        | 49         | ..        |
| 12 .. ..      | 30        | ..        | 72         | ..        |
| 19 .. ..      | 20        | ..        | 32         | ..        |
| 26 .. ..      | 43        | ..        | 60         | ..        |
| June 2 .. ..  | }         | 23        | 21         | 2         |
| 9 .. ..       |           | 22        | 29         | 2         |
| 16 .. ..      |           | }         | ..         | ..        |
| 23 .. ..      | 11        |           | 47         | ..        |
| 30 .. ..      |           |           |            |           |

## CHAPTER XV.—EPIZOOTIC PLAGUE IN TASMANIA.

Epizootic plague has never been recorded in Tasmania. On the outbreak of plague in Australia in 1900, a joint committee to supervise all measures for the destruction of rats was formed. Between May, 1900, and 31st October, 1900, a total of 13,993 rats destroyed was confirmed, and it is estimated by the Board that 20,000 represented more accurately the number killed. Work was recommenced on 25th March, 1901, and suspended on 28th September, 1901. Within that period, 15,878 rats had been destroyed and accounted for.

As far as can be ascertained, no measures were taken to ascertain whether any of these rats was plague-infected. The numbers destroyed in the years 1902 and 1903 are not recorded. In 1904, some 15,500 are known to have been destroyed. During the official year 1905-6, organized rat destruction operations were discontinued. In the official year 1906-7 Elkington reports: "A number of rat carcasses have been examined in the laboratory for traces of plague, but without result." This is the first reference to any laboratory examination of rats.



## CHAPTER XVI.—PLAGUE ON SHIPBOARD, 1900-1909.

1900.

*Burwah*.—This vessel, carrying passengers and cargo, left Sydney on 10th April, 1900, and called at Brisbane, which port was left on 13th April. On 16th April the vessel arrived at Rockhampton. On 17th April the head steward was found to be suffering from plague, having been taken suddenly ill on the evening of 15th April. On removal of the lining of the cabin occupied by the patient, several dead rats were found. It is presumed in the official reports that an hotel runner, who developed plague on 20th April, was also infected from this vessel. No further details are available with regard to this vessel.

*Cintra*.—This vessel left Sydney for Queensland ports on 20th April, 1900, called at Brisbane and remained there on 22nd and 23rd April, and arrived at Townsville about 27th April. On this date a steward on the vessel was found to be suffering from plague. The patient first became ill on 20th April, the date on which the vessel left Sydney. No further information is available.

*South Australian*.—At the end of April, 1900, a case of plague was discovered on the s.s. *South Australian* on her arrival at Melbourne from Sydney. The patient was a fireman, whose infection was traceable to Sydney. (N.S.W. P.R., 1900, p. 32.) No other details are available.

*Nera*.—The s.s. *Nera*, from Colombo, was quarantined at Fremantle on 22nd May, 1900, on account of plague. No details are available. The agents of the vessel contested payment of expenses, maintaining that the case was not plague.

*Cerberus*.—One case of plague was discovered on H.M.S. *Cerberus* at Melbourne, but, as this vessel was a store-ship at permanent moorings, it is probable that this case should properly be regarded as a shore case.

1901.

*Antillian*.—This vessel was a chartered troopship, which left Cape Town on 1st February, 1901, in ballast, and carrying no cargo. The vessel had a crew of 65, and no passengers. The vessel arrived at Albany on 20th February, anchored in stream, and took coal from a lighter, leaving Albany on 22nd February. On arrival at Sydney on 2nd March, 1901, an able seaman was reported as being ill, and his illness was determined to be plague. This patient had become ill on 27th February. On 11th March another member of the crew, a storekeeper, became ill with plague.

On 2nd March the putrid carcase of a rat was found on the vessel; on 4th March the bodies of two other rats were found, both of which were identified as being plague-infected. The master of the vessel stated that there had not been many rats on board the vessel; but that, on the

day of departure from Albany (22nd February), some unusual, though not great, mortality had been discovered, about fifteen carcasses having been found and thrown overboard.

In view of the fact that plague had occurred in South Africa, the *Antillian* had been placed under fumigation with sulphur almost immediately on arrival at Sydney. After the diagnosis of the first case had been established, the vessel was submitted to a second fumigation, which began on 3rd March, and continued till the morning of 4th March. Neither of these fumigations can have much affected the storerooms, since they were separately built up within the forward compartment. On 5th March the storerooms were inspected preliminary to directing special disinfection, and the carcasses of one putrid and one desiccated rat were then found. The rooms and their contents were thoroughly sprayed with sublimate solution, 1-500, by the quarantine staff, and afterwards were fumigated with burning sulphur. On 9th March the stores were transferred to a lighter under the direction of the storeman (who was the second case), so that the rooms might be more thoroughly cleansed. During this removal ten more carcasses were found. After the cleaning the stores were replaced on 11th March—again under the supervision of the storeman. The latter, who had not been on board except on the dates mentioned, fell ill during the night of 11th-12th March. It is, therefore, most probable that he was infected on 8th March, during removal of the stores. Several other persons were engaged in this work, none of whom fell ill. The rats taken from this vessel were all *Mus decumanus*.

There is an important statement by Thompson in his account of the outbreak on this vessel. Writing under date 31st July, 1903, Thompson says: "The *Antillian* is the only vessel entering the port of Sydney on which either plague-rats or cases of plague in man have been discovered."

1902.

*Eulomene*.—The four-masted barque *Eulomene* left Liverpool on 12th October, 1901, carrying a crew of 34, and a general cargo. She arrived at Sydney 15th January, 1902, without evidence of plague during the voyage. She lay in the stream until 21st January, when she went alongside Federal Wharf and discharged cargo. On 26th February she left Federal Wharf and lay in the stream till 6th March. On 6th March the vessel was fumigated, after which process the holds were searched for dead rats, many fresh carcasses being found, altogether about 40 being found and thrown overboard, none being examined. On arrival at Newcastle on 7th March, the *Eulomene* went alongside, discharging cargo and taking in coal. On 20th March the vessel moved to permanent dolphin moorings. On 17th March the ship's steward was taken ill with plague. On confirmation of this case, a further fumigation was carried out, and a very thorough search for rats was made. About 20 desiccated carcasses were found, but only two recently-dead rats and one mouse; the latter, on examination, showed no evidence of plague.



The patient, who, as ship's steward, was responsible for obtaining the ship's stores, stated that he had obtained, while the ship lay at Sydney, fresh meat and vegetables from the ship's butcher ashore. A bag or two of potatoes were supplied at a time, and were left on board in his store; on several occasions, on putting his hand into the bags, he encountered rats which were stupid and sluggish, and were easily destroyed. He said that he had thus found six rats at least, on different occasions, and for the last time some few days before leaving Sydney.

Thompson, in discussing the circumstances of this case, canvasses the alternatives in detail—

“It is quite possible that at some time or other before 5th March, during the *Eulomene's* stay there, the Federal wharf may have harboured plague rats, of which specimens were secured from other wharfs at no great distance. The ship's rats may also have become infected during her long stay at a wharf in an infected neighbourhood in other ways, as exemplified by the steward's account, which latter seemed trustworthy as regarded the important points. Secondly, after the first fumigation at Newcastle, 20 desiccated carcasses of rats were found. The one person infected in this instance was the steward, and, according to his account, he had been specially exposed. Was he infected directly from the sick rats he took out of the potato bags? This cannot have been the case, because he was not attacked until ten days after he had left Sydney, and the last occasion on which he had caught a rat was several days, as he said, before leaving. For similar reasons he cannot have been otherwise infected at Sydney, for he had not been ashore there for nine days before he arrived at Newcastle, or nineteen days before his attack; and he was not infected on shore during his stay at Newcastle, because there had never been plague there, and the only case which occurred at Newcastle (see p. 17) was not attacked until 7th August, or five months afterwards.”

It seems clear that there had been an epizootic of plague on the vessel, the infection of the ship's rats being traceable to Sydney, and that the steward was infected from these rats.

*Paroo*.—The shipping inspector at Fremantle reported on 5th June, 1902, as follows:—“Soon after the arrival of the *Paroo* (an overseas vessel trading from Singapore) on her last trip here, I heard that rats were dying all over the ship, and after some trouble was enabled to get possession of six or seven of them, which I delivered to the plague medical officer at once.” No further information is available concerning this incident.

1903.

*Alsterschwan*.—The barque *Alsterschwan* left Tacoma, Washington, on 18th September, 1902. From Tacoma the vessel went to Callao (14th December), Buenos Ayres (4th March), Rosario (17th April), Buenos Ayres (1st June), whence she sailed on 1st June for Sydney, arriving

at that port on 29th July with a crew of 26, no passengers, and a full cargo of maize in bags. No sickness was reported on board. From 29th July until 3rd August the vessel lay at anchor in Sydney Harbour, going alongside a wharf at Darling Island on the latter date. On 3rd August one of the crew offered 112 rats at the public depot. This fact was at once reported, and investigations made. It was learned that these rats had been found dead near the ventilators in the holds as soon as the hatches were removed. The Health Department staff commenced operations on the ship, and on 4th, 5th, 6th and 7th August delivered 1, 9, 25, and 16 rats, all of which were examined in the laboratory. Two of the sixteen were found to be plague-infected. Nine other infected rats were found subsequently. During the emptying of the ship 117 carcasses were discovered in various parts of the vessel, but no live rats were seen. No further incident occurred in connexion with this vessel.

The *Alsterschwan* was the second vessel on which plague-rats had been detected in Sydney. All of the rats found on this vessel were *Rattus alexandrinus*.

*Innamincka*.—The *Innamincka*, a coasting steamer of 2,500 tons, was trading between Melbourne and Northern Queensland ports. This vessel had arrived at Sydney from Melbourne on 27th August, 1903, and had left Sydney on 29th August. The vessel arrived at Brisbane on 31st August, leaving again on 1st September. On 3rd September an able seaman fell ill, and on arrival of the vessel at Townsville, Queensland, on 4th September, the illness was diagnosed as plague, and the patient was removed to hospital, where he died on 6th September. No other case occurred, and there was not at any time evidence of rodent plague on the vessel.

Thompson (P.R., 1903, p. 9), in discussing this case, says: "Three sources of infection lay open to the patient, therefore; these were Sydney wharfs, the vessel itself, and Brisbane. Melbourne wharfs were under no sort of suspicion then or later, and may be safely excluded. Nothing at any time appeared pointing to infectiveness of the vessel, so that choice lay between Sydney and Brisbane." Thompson, after discussing the incubation periods in the alternative possibilities of infection at Sydney (156-108 hours) and at Brisbane (59-35 hours), concludes: "A decision as to the place at which the patient was infected is, of course, not possible; but, in my opinion, the balance of reasonable probability inclines to Brisbane."

*Sultan*.—One case of plague was landed from this vessel at Fremantle on its arrival from Singapore. No further details are available.

*Lingard*.—Two cases of plague were landed from this vessel at Fremantle on its arrival at Bunbury from Africa. No further details are available.



*Pilbarra*.—A steward from this vessel was removed to hospital for observation at Fremantle on 3rd June, 1903, but was discharged three days later. An examination of ten rats found dead on this vessel on 29th May, 1903, showed five to be plague-infected "very severely." The *Pilbarra* had been in Sydney on 17th April, from whence she had travelled to Fremantle, thence to Melbourne, and returned to Fremantle, when the infected rats were discovered. The New South Wales authorities, in correspondence with the Western Australian department, suggested the probability of infection of the vessel having occurred during the stay of the vessel at Fremantle on 30th April.

Amongst the cases of plague occurring at Fremantle in 1903, one patient (No. 7, *vide* p. 103) was by occupation, a "ship's steward." He was a resident of Fremantle, and there is no evidence available as to the source of his infection.

*Syrian*.—For details of this vessel, see page 66.

#### 1904.

*Meenderry*.—On the arrival of this vessel, a coastal steamer, at Geraldton (Western Australia) on 28th July, 1904, one of the crew was found to be suffering from plague. This patient had been living at Fremantle and working on the wharf there until 26th July, and the conclusion officially accepted was that the patient had been infected in Fremantle before joining the vessel.

*Illawarra*.—On 10th May (?), 1904, plague-infected rats were found on this vessel, a coastal steamer, at Sydney. The information in respect of this vessel is incomplete.

*Hobart*.—On the arrival of this vessel, a coastal steamer, at Fremantle, on 22nd March, 1904, from Sydney, a plague-infected rat was reported as having been discovered on board, but it appeared later that the rat was discovered in the shed on the wharf at which the *Hobart* had been berthed. The rat was discovered after cargo had left the ship, and it was only presumed, but not established, that it came from the vessel. At this date plague-infected rats were being found in Fremantle.

#### 1905.

*Ville de la Ciotat*.—The French mail steamer *Ville de la Ciotat*, from Noumea, was quarantined at Fremantle on 15th November, 1905. This vessel had left Noumea on 17th October for Europe, via eastern ports of Australia and Fremantle. Between 17th October and 1st November about eleven dead rats were discovered on board, but no particular attention was paid to this, although unusual on this vessel. Four cases of plague developed on board, one fireman (H.N.) on 12th November and a fireman (G.) and sailor (Mi.) on 13th November. One other case (Mw.) developed, concerning which no records are available. The vessel was handled in quarantine at Fremantle, passengers and the four cases being landed into quarantine, mails and cargo lightered

and fumigated at a buoy, and coaling carried out by the ship's crew from hulks alongside. Of the four cases landed, Mw. died of pneumonia on 21st November, and Mi. of pneumonia shortly afterwards. The other two cases recovered.

1906.

*Aramac*.—On 9th and 10th February, 1906, five plague-infected rats were found on board the coastal steamer *Aramac* on her arrival at Brisbane from Sydney, and before berthing at the Brisbane wharf. There is no evidence to show how these rats came to be sought for or discovered.

*Bega*.—On 15th June, 1906, a donkeyman fell ill on this coastal steamer whilst at sea. Less than a week previously he had handled two dead rats on board. He landed at Sydney on 19th June and died suddenly from a fulminating pneumonia on 23rd June. His wife and an attendant neighbour subsequently died from pneumonic plague. Investigation showed no signs of infected rats on the vessel. (P.R., 1906, p. 7.)

1907.

*Arawatta*.—On 17th May, 1907, a case of plague was reported from the Melbourne Hospital. The patient was a steward from the s.s. *Arawatta* which had arrived in Melbourne the previous day. The crew were at once placed under close surveillance, and arrangements were made for the disinfection and sulphur fumigation of the vessel. The rats killed by the fumigation process were examined, and found to be free from plague. No further case occurred. The vessel was trading between Melbourne and Queensland ports.

*Mareeba*.—On 16th September, the *Mareeba* arrived at Brisbane, and a steward, aged 47, was found to be ill with plague. The vessel was a cargo vessel trading between Sydney and Rockhampton via Newcastle and Brisbane. The patient was first taken ill on the 12th, when the vessel was at Newcastle, bound for Sydney. He was seen in Sydney by a medical man, but was not considered to be suffering from plague. After fumigation of the vessel, a thorough search for rats was made, all the linings and ceilings were pulled down, and a number of rats in various stages of decomposition were found, several dead rats being found amongst the provisions in the food lockers. "During this work, 68 rats and 10 mice were found; 42 of the rats (probably plague-infected) were too decomposed for examination, and of the remaining 26 rats and 10 mice none was found infected. All the rats on the vessel were *Mus alexandrinus rufus*. All circumstances point to the ship as the source of infection." (*Aus. Med. Gaz.*, 1907, p. 539.)

1909.

"Two cases of plague were imported into the Port of Bunbury by a vessel seventeen days out from Bombay and Madras. The patients recovered, and fumigation of the vessel resulted in 40 rats being found, of which seven were infected with plague." (*Ann. Rep. Health Dept.*, 1909, p. 17.)



TABLE 31.

SUMMARY OF VESSELS ON WHICH PLAGUE OR SUSPECTED PLAGUE OCCURRED, 1900-1909.

| Vessel.                         | Year. | Source of Infection. | Human Infection, Number of Cases. | Rodent Infection. | Class or Rating of Patient.    |
|---------------------------------|-------|----------------------|-----------------------------------|-------------------|--------------------------------|
| <i>Burwah</i> ..                | 1900  | Sydney ..            | 2                                 | Positive          | Head Steward, Hotel Runner     |
| <i>Cintra</i> ..                | 1900  | Sydney ..            | 1                                 | Unknown           | Steward                        |
| <i>South Australian Nera</i> .. | 1900  | Unknown              | ?                                 | Unknown           | Fireman                        |
| <i>Antillian</i> ..             | 1901  | Africa ..            | 2                                 | Positive          | Able Seaman, Store-keeper      |
| <i>Paroo</i> ..                 | 1902  | Unknown              | Nil                               | Probable          | —                              |
| <i>Eulomene</i> ..              | 1902  | Sydney ..            | 1                                 | Positive          | Steward                        |
| <i>Sultan</i> ..                | 1903  | Singapore?           | 1                                 | Unknown           | Unknown                        |
| <i>Lingard</i> ..               | 1903  | Africa ..            | 2                                 | Unknown           | Unknown                        |
| <i>Pilbarra</i> ..              | 1903  | Unknown              | Nil                               | Positive          | —                              |
| <i>Alsterschwan</i> ..          | 1903  | South America        | Nil                               | Positive          | —                              |
| <i>Innamincka</i> ..            | 1903  | Sydney or Brisbane   | 1                                 | Negative          | Able Seaman                    |
| <i>Syriani</i> ..               | 1903  | Sydney or Brisbane   | Nil                               | Positive          | —                              |
| <i>Meeinderry</i> ..            | 1904  | Fremantle            | 1                                 | Unknown           | Unknown                        |
| <i>Illawarra</i> ..             | 1904  | Unknown              | Nil                               | Positive          | —                              |
| <i>Hobart</i> ..                | 1904  | Unknown              | Nil                               | Doubtful          | —                              |
| <i>Ville de la Ciotat</i>       | 1905  | Unknown              | 4                                 | Probable          | 2 Fireman, 1 Sailor, 1 Unknown |
| <i>Bega</i> ..                  | 1906  | Sydney ..            | 1                                 | Doubtful          | Donkeyman                      |
| <i>Aramac</i> ..                | 1906  | Unknown              | Nil                               | Positive          | —                              |
| <i>Arawatta</i> ..              | 1907  | Unknown              | 1                                 | Negative          | Steward                        |
| <i>Mareeba</i> ..               | 1907  | Unknown              | 1                                 | Positive          | Steward                        |
| <i>Redbridge</i> ..             | 1909  | India ..             | 2                                 | Positive          | Unknown                        |
| <i>St Louis</i> ..              | 1909  | .. ..                | 2                                 | .. ..             | Fireman, Boatswain,            |

The most striking fact which appears from a compilation of the records relating to plague on shipboard in Australia is the extreme paucity of the information which has been preserved. Even on official files material information of the first order of epidemiological importance has not been recorded. Alone amongst those concerned with plague at the time, Ashburton Thompson had realized that the conditions existing on board various types of mercantile vessels offer most favorable opportunities for obtaining most valuable evidence in respect of some phases of the behaviour of a disease like plague; and Thompson has left on record the most complete and detailed account of the circumstances in the case of each vessel on which plague occurred within his jurisdiction.

The number of cases which occurred on any vessel is small; with the exception of the French mail steamer *Ville de la Ciotat*, on which there were on arrival at Fremantle four cases, there were not more than two cases on any vessel.

A total of 21 vessels were dealt with during the ten years of epidemic or epizootic plague in Australia. Of these six (*Antillian*, *Paroo*, *Sultan*, *Lingard*, *Alsterschwan*, and *Redbridge*) were certainly, or most probably, instances of direct importation from overseas. Of the *Ville de la*

*Ciotat* nothing more can be said than that the vessel came from Noumea, via Sydney, and that plague existed at both places. The precautions which were then being taken at Sydney might be taken into consideration in arriving at a judgment, but the information is altogether too scanty to warrant any definite statement.

Five of the vessels (*Nera, Illawarra, Hobart, Bega, Aramac*) must be dismissed from further consideration as the information available is too incomplete for discussion. Concerning the *Cintra* and the *South Australian*, all that is known is that one human case occurred on each vessel, and, that, according to Thompson, the infection in the case on the *South Australian* was traceable to Sydney.

Three vessels (*Innamincka, Meeinderry, Arawatta*), and probably also the *South Australian*, were instances of vessels acting as carriers of human cases infected at some point external to the ship. In each case there was no evidence of the rats on the ship being infected, or of the ship being in any way a focus of infection.

The *Pilbarra* was an example of a vessel on which rodent plague was demonstrated, without the occurrence of a definite human case of plague. The *Alsterschwan* was another striking instance of a ship epizootic without a ship epidemic.

The *Burwah, Mareeba, and Eulomene* were cases in which epizootic and epidemic plague were co-existent. Of the human cases concerning which anything is known, and excluding the hotel-runner from the shore, allegedly infected on the *Burwah*, six were stewards or storekeeper, two were able seamen, and one was a fireman. One of these seamen and the fireman were infected ashore. This exceptional incidence upon one section of the crew is merely an expression of the greater personal risk involved in handling of ship's stores and food materials, these materials attracting rats to those portions of the ship where the stewards and storekeepers work.

This group of ships on which plague was identified offer interesting examples of the three types of vessels which are liable to require treatment during an epidemic or epizootic of plague.

- (a) The vessel on which there has occurred a human case of plague, the human case having been infected before joining the ship, or whilst ashore at some port of call.
- (b) The ship on which there occurs an established outbreak of plague amongst rats, without the infection of humans on board. The barque *Alsterschwan* was a most striking instance of this kind, an extensive and apparently severe epizootic being unaccompanied by any human case.
- (c) The ship on which plague has occurred amongst rats, and on which human cases have also been identified. It is of some importance to note that in the case of every vessel in the present series, which fell within this group, the first intimation of plague either in man or rats was given



by the detection of the human case. This is necessarily so in the case of the detection of a human case on the arrival of a vessel from oversea; but, with full realization of the relationship between epidemic and epizootic plague, and with the application of proper measures, it would be expected that the number of vessels in which epizootic plague had been permitted to progress to a stage at which human infection became probable would be small, and would be, in any event, considerably less than the number in which epizootic plague without epidemic plague had been detected.

It would appear, from the evidence available in this series, that human cases do not occur until rodent plague has become well established, and, it may even be said, has become extensive in distribution, which presupposes a considerable rat population.

Administratively, the significance of this fact is obvious. If vessels are kept free from rats they will not carry plague. If rat destruction is persistent and systematic, and is combined with routine examination of rats killed on shipboard, the earliest occurrence of rodent plague will be noted, and in this way the occurrence of human cases on shipboard will, except in respect of infection ashore, be anticipated and largely prevented.

From the point of view of the spread of plague within the Commonwealth, it is important that during the ten years in which plague was present in Australia, only fourteen vessels were recorded on which plague either definitely or possibly of Australian origin occurred.

Three of these are epidemiologically of little importance, the presence aboard of shore-infected persons being, as it were, incidental, and of no significance in relation to the distribution of infection.

So far as is now known, then, eleven vessels were infected with plague in Australia, and became potential distributors of infection during a period of eleven years, during ten of which plague was present in two States, and during seven of which plague was present in three States.

In the earliest days of 1900, when plague first appeared in Australia, it is obvious from the records that the demands upon the various State Departments of Health\* were so great, and the realization of the part played by rats in the spread of plague as yet so incomplete, that it is probable there were some, if not many, instances of infected vessels which not only escaped detection by reason of the non-occurrence of human cases, but which actually carried the infection and were responsible for the occurrence of new foci of epizootic and epidemic plague. Of such there is, however, no record.

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\* The Commonwealth Quarantine Act did not operate until 1909.









The information available is complete and reliable only for the two States—Queensland and New South Wales.

*New South Wales.*—Thompson, in his Plague Report for 1900, states:—"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 epizootic; and that this epizootic (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." Again in 1906 (Address on Epidemiology of Plague, Congress American Medical Association) he said:—"The result of continuous examination of our rats has been to show us that rat plague always coincides in place with plague in man, and in time always precedes it; but the presence of plague rats was not always attended by plague in man. Out of many things which have been asserted of plague as the result of incomplete observation, occurrence of an interval between attack of the rat and attack of man stands out as a reality. We have seen it constantly; but we have also seen that it need not be long, as is generally asserted, but may be quite short. The occurrence of a definite interval is well exemplified by the following observations. We have good reason for believing that our rats were dying of plague on the first occasion during the first week of January, 1900, and that they had probably become infected some time before; but the first case was not attacked till 19th January, the second not until 17th February; and the disease did not become widespread till two or three weeks later still. In the second outbreak, immediately after the first case had been notified, we ascertained that the infection was already present at three or four separate points; namely at the produce store at which the patient had been employed, at a wharf where produce was habitually handled, and soon afterwards at another produce store, and at a stable a few hundred yards from it, all the latter having stood a little way inland of the wharf, and all having probably been infected *per saltum* from it. Yet there was an interval of 34 days between that first case and the second, and of 35 days between the second and the third. In 1903 the epizootic was recognized on 12th May; but the first of the only two cases which followed was not attacked till 17th June. On the fourth occasion the epizootic began 29th February at a certain produce store; the first person was attacked 9th March at that store, whence he had removed dead rats as late as 3rd March, and where others were afterwards found and plague in them identified; but the second case did not follow until 32 days later. An interval was observed on every occasion, both in districts and in houses.

Of this interval many mysterious things have been alleged; but I believe it is now hardly necessary to point out that the first step towards explanation of it lies in recognition of the simple requirement that time must elapse before the rats, which are usually first infected at such uninhabited places as wharfs, &c., can sufficiently penetrate to the dwellings of man. But another condition contributes to lengthen it, which cannot be so easily explained. An interval is always observed even between the invasion of individual



houses and the occurrence of cases in them. Now, the difficulty of *identifying* plague in rats has already been mentioned. It has arisen in this, that however soon after attack cases have been notified dead rats have been found, and usually they have been found in an advanced stage of putridity. This is the common rule. Occasionally prompt notification has led to the discovery of fresh carcasses; but always some of the rats found have died already. Plague cases do not occur till rats have died of plague in the house, or in its immediate neighbourhood; then, and not till then, may man be attacked.

With assistance of the first four outbreaks the seasonal incidence of plague can be fixed. The first or crude statement is the following:—The first epizootic began with January, and the last plague-rat was identified in August; the second began in November, and the last plague-rat was identified in July; the third began in May, and ended in August; the fourth began in March and ended at the beginning of December. But it requires some adjustment as to the beginning of the second and the end of the fourth outbreak. Although infection of the rats began in November, and evidence of it was found on four separate premises during the latter half of that month, no further evidence of it was got, notwithstanding continuous search, until the middle of January; in other words, nothing that could be called an epizootic then existed. The period of widespread plague in the rats did not set in until about the beginning of February. And as to the end of the fourth, although it actually fell in December, still the end of that which could be called an epizootic prevalence clearly fell in September; the plague-rats identified during the three latter months of that year numbered only five, two, and one respectively. So that the epizootic period may be fixed as falling between February and August, there or thereabouts. And the height of the epidemic period coincided nearly with the height of the epizootic; March, April, and May were the months in which the disease was most active in both forms—that is to say, in as far as we could estimate the smaller fluctuations of the latter.”

The conclusions arrived at by Ham from his experience in Queensland are similar, although more concisely expressed.

“That the epizootic (Rat Plague) and the epidemic (Human Plague) are commonly successive is a fact in harmony with the observation that when any animal succumbs or, indeed, is even moribund, from one cause or another the fleas that have been subsisting on it leave it and attach themselves to another animal host, should there be one that can afford them sustenance, and we may thus on occasion observe the co-existence of rats dead of plague, fleas, and human plague.

Rat mortality was invariably discovered in every indigenous centre of plague throughout the State, the rise in rat infection always preceding the manifestation of the cases in man. Epizootics occurred at periods when epidemics were prevalent, and both took place at certain seasons of the year which extended observation led us to anticipate. The association was observed year after year.

Sporadic cases in man during periods of quiescence were also attended by the presence of plague of sporadic occurrence in rats. The assumption that the epidemic was a consequence of the epizootic is further based on the fact that the dissemination of travelling plague cultures in the living bodies of rats was over areas which coincided with areas over which the epidemic was observed to extend. A reference to Table 34, and a survey of the graphs appended hereto, will show the weekly course of the epidemics and epizootics for the years 1900-1907 within the metropolitan area of Brisbane. The epidemic is marked by broken lines, the epizootic by continuous lines. The graphs correspond with Tables 34 and 35.

In connexion with the epizootic curves it may be explained that they only indicate approximately the proportional severity of the disease amongst rats, since the number actually found infected in the daily collection made for bacteriological examination must fall far short of the number naturally infected in the open, but, for obvious reasons, not obtainable. The rat curves, therefore, indicate the extent and result of the search, but cannot be considered as complete. It will be noticed for the years 1900, 1902, 1903, 1904, and 1906 that infected rats were discovered previous to the cases in human beings.

In 1901, 1905, and 1907, human cases apparently occurred early in these years, either before, or concurrently with, the mortality of rats; but on reference to the charts it will be seen that infected rats were found in the latter end of the year—November and December immediately preceding those under discussion.

The conclusions deduced from a study of the charts are the following:—

1. That a close association exists between plague in rats and plague in man.
2. That the epizootic invariably precedes the epidemic.
3. That the epizootic runs concurrently with and outlasts the epidemic.
4. That an interval usually short elapses between the death of rats and the attacks of human beings.
5. That the curves of the epizootics bear a general resemblance to the curves of the epidemics, the rise and fall in the former being followed by a rise and fall in the latter.
6. That both the epidemic and the epizootic exhibit a period of incidence, stasis, and decline.
7. That the incidence on both rats and man is heaviest in the months of April, May, and June.
8. That from the middle of the year—end of June—to the end of the year, there is a marked period of quiescence.
9. That in a few years this period of freedom is broken by sporadic cases both in man and rats.
10. That both the epidemics and the epizootics have been of comparatively modest dimensions. [Plague in Queensland, pp. 126-7.]



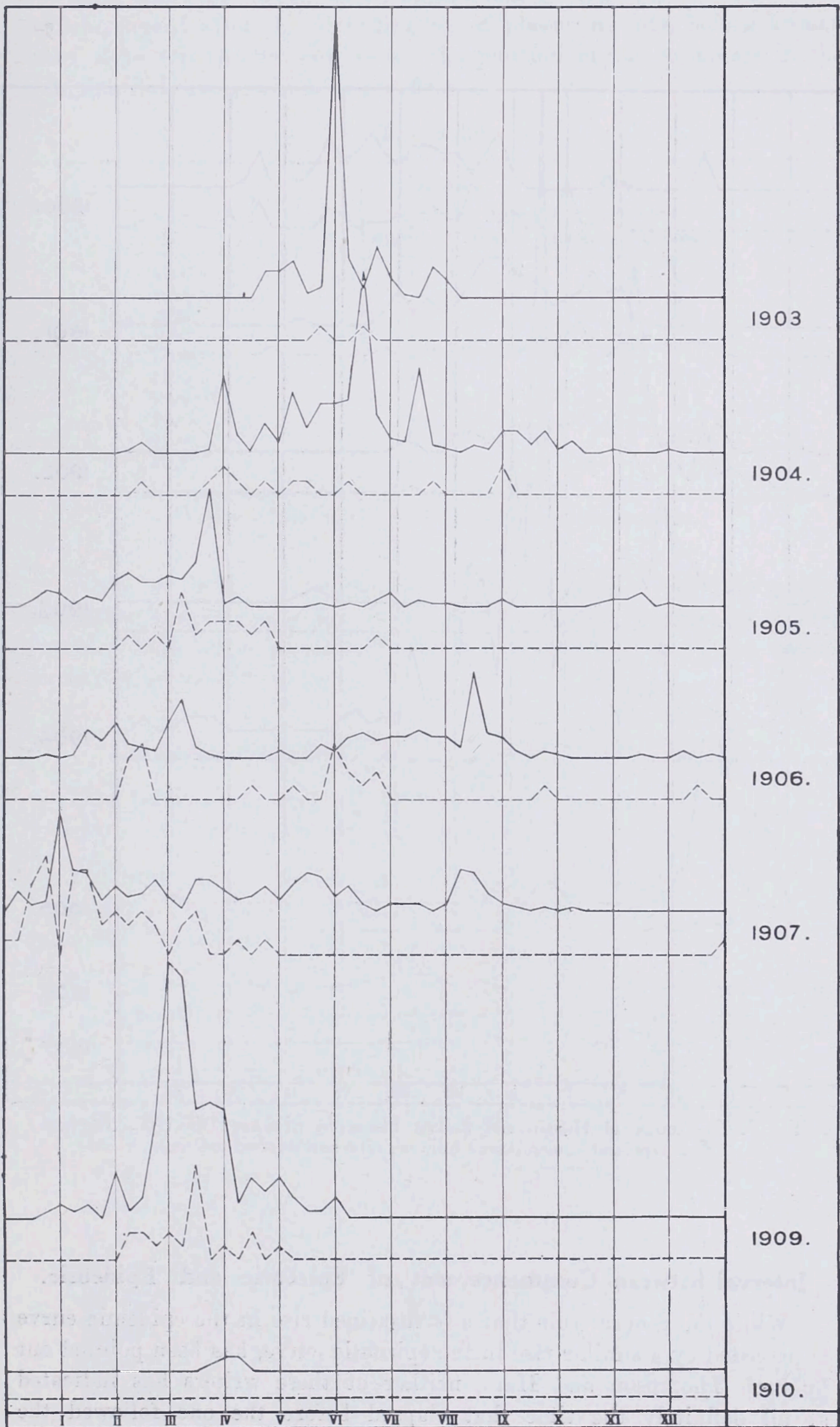


Fig. 6. The Course of Human and Rodent Plague in Sydney, 1903-1910. (Broken lines represent human cases ; full lines represent infected rodents).

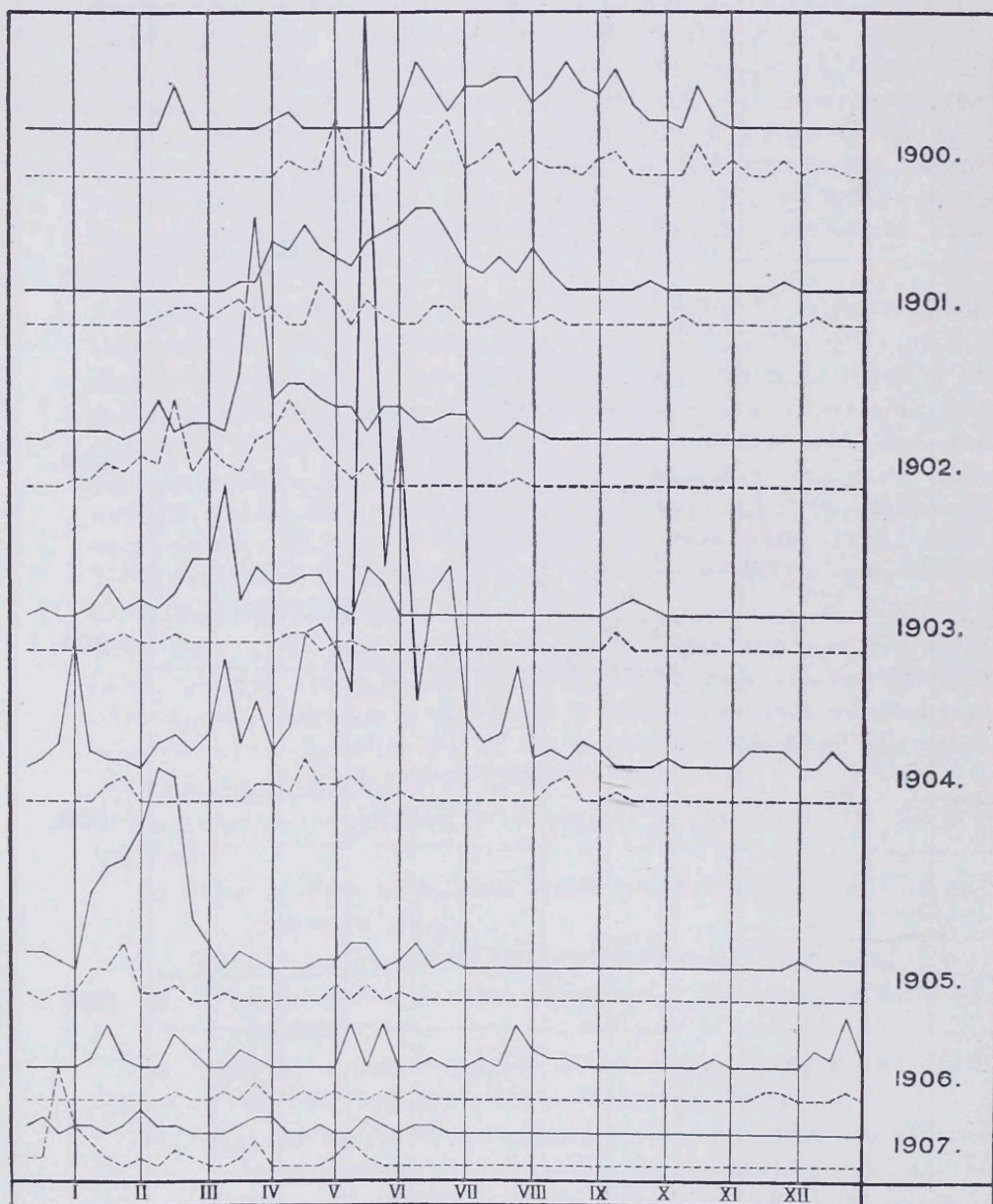


Fig. 7. The course of Human and Rodent Plague in Brisbane 1900-1907. (Broken lines represent human cases ; full lines represent infected rodents).

#### **Interval between Commencement of Epizootic and Epidemic.**

While the general rule that any sustained rise in the epidemic curve is preceded by a similar rise in the epizootic curve, has been pointed out by both Thompson and Ham, neither of these writers has indicated at all definitely the time that elapsed before the one followed the other.



The following table shows approximately the periods in weeks which elapsed after the identification of plague in rats, before human cases were reported or vice versa, the position of the numerals in the columns indicating which began first.

TABLE 36.

|            | Brisbane. |        | Sydney.  |        |
|------------|-----------|--------|----------|--------|
|            | Rodents.  | Human. | Rodents. | Human. |
| 1900 .. .. | 1         | ..     | †        | ..     |
| 1901 .. .. | ..        | 5      | †        | ..     |
| 1902 .. .. | 1         | ..     | †        | ..     |
| 1903 .. .. | 1         | ..     | 4        | ..     |
| 1904 .. .. | 3         | ..     | 1        | ..     |
| 1905 .. .. | *         | ..     | 6        | ..     |
| 1906 .. .. | 5         | ..     | 3        | ..     |
| 1907 .. .. | *         | ..     | *        | ..     |
| 1908 .. .. | †         | ..     | ..       | ..     |
| 1909 .. .. | †         | ..     | 6        | ..     |

\* Continued from previous year. † Information not available.

While no definite rule can be stated, it appears that the period is between one and six weeks, with a slight tendency towards the shorter period. This must be always subject to the efficiency of the search during interepidemic periods.

### Epizootic Periodicity Amongst Different Rat Species.

This information is available for Sydney only, no published data in relation to other places in the Commonwealth being available.

The behaviour of the two species of rats in their relation to plague is shown in the following table and graph. In this connexion, Asburton Thompson states that:—

“Past records, and that for the present year, do not afford evidence that either species usually begins to suffer before the other. In 1903 infected specimens of *M. decumanus* were taken five weeks, and in 1905, eight weeks before any infected *M. rattus* was found; in 1904 and 1906, infected *M. rattus* was found five weeks and six weeks before infected *M. decumanus*; while in 1907 the first infected rats brought in were of both species. On six of the eleven premises on which both species were found in 1907, infected *M. decumanus* was first found, and the intervals after which infected *M. rattus* was first found were 5, 7, 9, 19, 27, 49, and 53 days. In the five houses where the contrary was the case, the intervals were 1, 21, 22, 184 and 187 days. So that it does not appear from the records that there is here any other than a casual connexion between plague in the one and in the other species.” (N.S.W., P.R., 1907, page 3.)







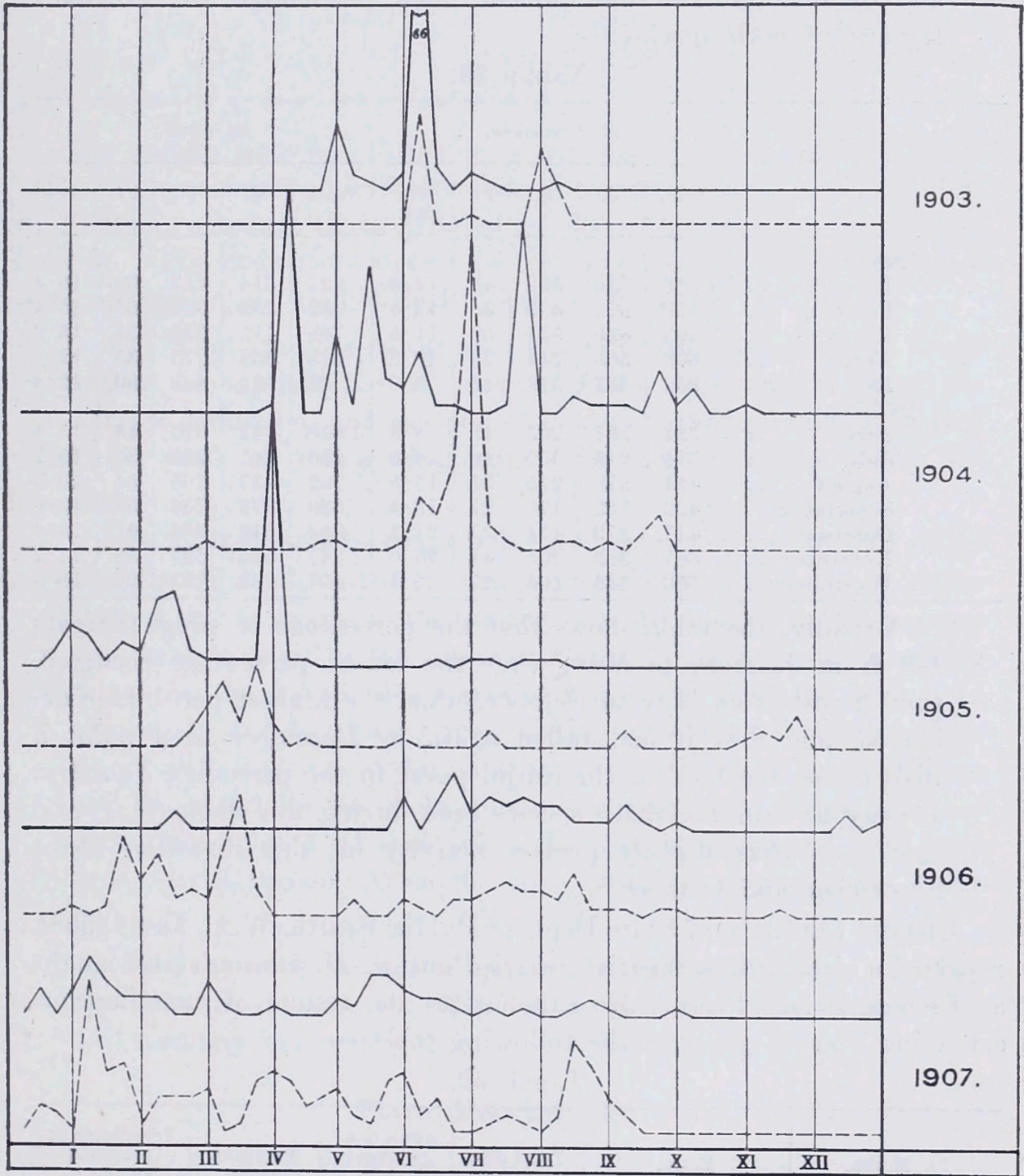


Fig. 8. The Course of Rodent Plague in Sydney, 1903-1907. (Full lines represent infected *Mus decumanus*; broken lines represent infected *Mus rattus*).

### Effect of Period of Pregnancy on Numbers of Rodent Population.

Thompson [P.R., 1907, p. 3] discusses this interesting question as follows:—

In the following table there is shown the number of rats collected in twelve consecutive calendar months, the number of males and of females, and the number and percentage of pregnant females of each species:—

TABLE 38.

|              | <i>M. decumanus.</i> |     |     |     |           | <i>M. rattus.</i> |     |     |     |           |
|--------------|----------------------|-----|-----|-----|-----------|-------------------|-----|-----|-----|-----------|
|              | Total.               | M.  | F.  | Pr. | Per cent. | Total.            | M.  | F.  | Pr. | Per cent. |
| 1908—        |                      |     |     |     |           |                   |     |     |     |           |
| January ..   | 1,058                | 726 | 332 | 48  | 14·4      | 927               | 514 | 413 | 68  | 16·4      |
| February ..  | 1,369                | 961 | 408 | 55  | 13·4      | 952               | 582 | 370 | 65  | 16·4      |
| March ..     | 763                  | 426 | 337 | 39  | 11·5      | 748               | 413 | 335 | 51  | 15·2      |
| April ..     | 609                  | 365 | 244 | 25  | 10·2      | 613               | 338 | 275 | 35  | 12·7      |
| May ..       | 852                  | 533 | 319 | 16  | 5·3       | 1,161             | 693 | 468 | 60  | 12·8      |
| 1907—        |                      |     |     |     |           |                   |     |     |     |           |
| June ..      | 584                  | 381 | 203 | 18  | 8·8       | 1,053             | 743 | 310 | 48  | 15·4      |
| July ..      | 374                  | 215 | 159 | 16  | 10·0      | 490               | 265 | 225 | 34  | 15·1      |
| August ..    | 494                  | 279 | 215 | 34  | 15·8      | 702               | 437 | 265 | 54  | 20·3      |
| September .. | 422                  | 252 | 170 | 27  | 15·8      | 639               | 373 | 266 | 53  | 19·9      |
| October ..   | 447                  | 273 | 174 | 37  | 21·2      | 984               | 612 | 372 | 91  | 24·4      |
| November ..  | 587                  | 382 | 205 | 41  | 20·0      | 741               | 504 | 237 | 35  | 14·7      |
| December ..  | 550                  | 345 | 205 | 27  | 13·1      | 477               | 282 | 195 | 26  | 13·3      |

“Broadly, the table shows that the percentage of pregnant rats fell from January to May, when the lowest percentage occurred, that it rose from May to October, when the highest percentage occurred, and that it had fallen again by December to a point a little below the level of the initial point in the preceding January. It may be said that both species bred during the whole year, and that there was slightly greater activity in this direction about September and October.”

Cleland (Bulletin of State Dept. of Public Health, W.A., Dec., 1908) reported a similar investigation, carried out on *M. alexandrinus* caught at Fremantle and Perth. He summarizes the results of examinations extending over  $2\frac{3}{4}$  years in the following table:—

TABLE 39.

| Month.       | Years.           | Total rats examined. | Adult non-pregnant females. | Pregnant females. | Percentage of pregnant females to total females. |
|--------------|------------------|----------------------|-----------------------------|-------------------|--|
| April ..     | 1906, 1907, 1908 | 552                  | 247                         | 28                | 10·1   |
| May ..       | ..               | 442                  | 180                         | 20                | 10·0   |
| June ..      | ..               | 377                  | 149                         | 15                | 9·0  |
| July ..      | ..               | 265                  | 80                          | 15                | 15·7   |
| August ..    | ..               | 489                  | 149                         | 38                | 20·3   |
| September .. | ..               | 312                  | 101                         | 16                | 13·6   |
| October ..   | ..               | 295                  | 86                          | 29                | 25·1   |
| November..   | ..               | 684                  | 214                         | 59                | 21·2   |
| December ..  | ..               | 321                  | 88                          | 42                | 32·3   |
| January ..   | 1906, 1907       | 382                  | 110                         | 40                | 26·6   |
| February ..  | ..               | 346                  | 84                          | 46                | 35·3   |
| March ..     | ..               | 452                  | 161                         | 28                | 14·7   |



“The above figures are, of course, rather small to generalise upon. The five months, October to February inclusive, however, seem to possess a distinctly higher percentage of pregnant rats than the other seven, and the young rats from these litters would reach maturity a little while before plague is usually epidemic in man in the State.”

According to Ham (Qld., P.R., 1900-1907, p. 129):—“At Brisbane it has been ascertained that rats breed all the year round with but little variation in any particular month.”

The results may be conveniently recorded here of an interesting series of experiments in hybridization of rat species carried out in 1913 by Foreman-assistant G. C. Hughes, of the Commonwealth Quarantine Service. The deductions drawn by Mr. Hughes from his experiments were included in an unpublished report as follows:—

(1) That the *Mus rattus* and *Mus alexandrinus* will breed freely either in captivity or at large. These experiments prove the former deduction, and the fact that the quarantine staff have captured nests of young containing both these varieties proves the latter.

(2) That *Mus decumanus* will breed with neither the *Mus rattus* nor the *Mus alexandrinus*, and seemingly it is the doe of either species that is averse to the mating. In the case of the *decumanus* doe, as soon as either the *rattus* or *alexandrinus* buck starts making advances, the doe at once starts to worry and fight the buck. In the case of the *decumanus* buck making advances to either a *rattus* or *alexandrinus* doe, either of these does will repel his attentions, and the buck kills the doe in spite as a consequence. This deduction seemingly holds good even when the rats experimented with have been reared together from the time of being two or three weeks only.

(3) That until the age of puberty is reached the sexes of either the *Mus decumanus*, the *Mus rattus*, and the *Mus alexandrinus* will nest together comfortably.

### Place Relationship.

There is no more important phase of the epidemiology of plague than the place-relation between epizootic and epidemic plague. Upon an accurate knowledge of the various aspects of this relationship alone is it possible to base accurately conceived administrative measures of plague control. It is probably correct to say that in all the literature of plague there is no record of a study of this epidemiological problem so detailed and so complete as that recorded by Ashburton Thompson in his seven reports upon plague, and in his communications to the American Medical Association Congress, the International Congress of Hygiene, and to the *Journal of Hygiene*.

The close analytical study of the behaviour of rat plague and of human plague in Thompson's report on a Second Outbreak of Plague at Sydney, 1902, should be carefully and deliberately dissected by every student of the epidemiology of plague, as, even when so much is known of plague, there is much of primary importance on the practical side of the control of plague that is not mentioned in any complete way by other writers.

It is impossible in a brief review such as the present volume to do more than indicate the conclusions and principal considerations.

Thompson commences his discussion of this subject thus:—"If man commonly received the infection from the rats—if epizootic plague were indeed the cause of epidemic plague at Sydney then coincidence between plague-rats and plague in man on the same premises should be demonstrable. But in the course of the review of the epidemic outbreak of 1900, we found that we had not demonstrated it. Dr. Tidswell had, indeed, been enabled to identify but 23 plague-rats throughout the epidemic, and none of them were obtained from premises which had yielded cases of plague in man. Or, if findings of putrid carcasses in which the nature of the disease, which, evidently, had been the cause of death, could not be rightly identified, be accepted as evidence of epizootic plague (as under all the circumstances it reasonably may), then dead rats in number were only observed on about 70 premises, although 221 premises were the adjudged places of infection for 255 cases. But there is no evidence that this discrepancy was a matter of fact; clearly it may have been apparent only, and may have resulted from the method of observation, which was certainly imperfect."

During the outbreak of 1902, improved methods of observation were adopted, with the result that "whereas 113 cases have been adjudged to have been infected on 86 separate premises, and although plague rats were identified on 40 inhabited premises (be they dwellings or places of employment), plague rats and cases coincided but four times. Or, should that way of judging the facts be thought too rigid (as I have no doubt it is), then it can be stated that cases and the removal by the disinfecting staff of dead rats from the premises which were the adjudged places of their infection coincided only 47 times.

During 1903 only two cases of human plague occurred, in one "direct connexion with rats affected by disease was clear"; in the other "no direct connexion with plague rats was established."

During 1904 only twelve human plague cases occurred, and "close association with plague rats was shown to have existed in every one of this series of cases." (1904, p. 25.)

After 1904 the position is described by Thompson--

"During the outbreak of 1904 a special effort was made to ascertain whether close connexion between cases and plague rats could not be established in every instance, provided sufficient time



were devoted to the search. While only twelve cases occurred in connexion with nine places of infection, the presence of plague rats at each place was established. But although in the year referred to the number of cases and of places was extremely small, it had been found that the labour involved in the constant watchfulness of all concerned, which turned out to be necessary to success, and of long quasi-detective inquiries, were too great to be continued by a staff whose daily avocations were multifarious and exacting. During 1905, therefore, no special attempt was made to run the plague rat down in connexion with every case, although the more salient points were as carefully recorded as usual." (P.R., 1905, p. 1.)

It may be assumed, therefore, that complete information was not collected in this particular point in 1905 and succeeding years. If Thompson's conclusions may be assumed from the general bearing of his discussion of the subject, the deduction would be drawn that the direct connexion between human plague and rodent plague could be established in all cases if the conditions were such as to permit of complete "inquiries into the circumstances of the patients at home, at work, and at leisure, into those of the businesses with which they were connected, into the state of the rats on premises occupied or frequented by them, into the state of neighbourhood of the premises as to rat infection and as to freedom from it, and the establishment of dates by documentary evidence whenever possible."

Apart from the limitations of administrative practicability which prevent the intensive inquiries here postulated, there are other practical difficulties in connexion with rodent plague presented by natural conditions which are important enough to be indicated. Before dealing with these, however, it would be well to outline certain recorded facts, which, while not modifying the general thesis of invariability of association between rodent and human plague, should be considered in association with it.

The limitation of association between rodent and human plague to individual premises is a very rigid procedure, and although it may be necessary to accuracy, in order to avoid the introduction of the hypothetical or the probable into the discussion, yet it does not exclude the consideration of other topographical distribution. For example, it was found, when a retrospective survey was made in 1904, that the relationship between rodent and human plague became more defined if larger areas were considered. A table showing the divisions of the City of Sydney, and the metropolitan municipalities, reveals "that the feature which distinguished areas on which cases occurred from others which yielded none was the presence upon them of plague rats." It is to be noted that the evidence for 1900 is defective, the necessary measures of rat search not having been carried out. As the conditions in this respect became improved, "it appeared that plague rats

could be found always on areas which yielded indigenous cases." On such areas plague rats were found in some occupied buildings which, nevertheless, yielded no case in man; sometimes, also, a whole area which at some parts carried plague rats, furnished no case in man. On the other hand, large and thickly-populated areas were seen in which the infection was closely limited. Thus in 1902, although Alexandria and Waterloo have a combined area of 1,830 acres, which carries 3,947 houses, the findings of plague rats were confined exactly to those neighbourhoods in which the cases of plague were found, or although Paddington has an area of 403 acres, which carries 4,386 houses, plague rats were found only on that very small part (of about 16 acres, carrying 163 houses) which has been named the Paddington area, where the cases which constituted that sub-epidemic were found. Again, Camperdown covers 435 acres, and carries 1,503 houses, but plague rats were identified only at premises in that street where the two indigenous cases of plague were met with. So also at Newtown, where the municipality covers 442 acres, and contains 4,521 houses, the only case of plague which happened there was found within half a dozen doors of the butcher's where a local manifestation of the epizootic occurred, and at the same date.

There is good evidence then of close association in place between plague cases and plague rats.

In 1904 three cases occurred in metropolitan municipalities in remote and isolated areas; and "if it be asked what was the special circumstance which led to occurrence of the disease in these remote and isolated areas, it can be replied at once that it was the presence upon them of plague rats, since this alone distinguished them from very extensive tracts of town land which entirely surrounded them. The reason why these two distant places carried plague rats can also be assigned, for it is known that goods of particularly dangerous kinds were transported from infected premises to each of them. When the form in which the infection reached these distant localities is sought, doubt begins. Plague rats have not been detected in goods carried, or in course of being carried, to a distance by land, although, of course, rats have been commonly seen to be so carried. Actual transport of plague rats appear to me to be the best supposition." (P.R., 1904, 23.)



## CHAPTER XVIII.—SOME DIFFICULTIES OF PLAGUE INVESTIGATION.

The difficulties encountered during an investigation to define the limits of association between rodent and human plague, are met in connexion with both human and rodent infections.

### Difficulties in Tracing Sources of Human Infection.

The experience of 1902-3 illustrates these difficulties very clearly. During that outbreak, there occurred 139 cases:—

“From the total 139 cases, one, attacked on board the ship *Eulomene*, may be excepted (*vide* p. 72). Of the remaining 138, the place of infection was determined in 113; and that number of cases were adjudged to have received the infection on 86 different premises. Remain, therefore, 25 cases in which the available information did not suffice to indicate any particular place as probably having been that at which the infection was taken. Two of the 25 were Chinese; 4 of them were idlers or prostitutes; 3 were labourers out of work, who were taken ill while searching for employment; 3 others were boys under fifteen; and 3 were either rat-catchers or scavengers in employment of the local authority for the City of Sydney, whose occupation led them into special danger at many different places. There remain ten cases, therefore, in which it might be reasonably expected that the place of their infection would be discoverable. The history of each of them prior to attack was very carefully inquired into, and although nothing of apparent importance was elicited, the following data concerning some of them are worth mention. One was a druggist; one was a groom, who slept over a stable, and in the same building with his horses' feed; another was a clergyman, actively occupied in district visiting; another habitually gathered mill-wastes for poultry feed at places on the Darling Harbour area; another was an unemployed man, apparently not an idler, but whose movements were obscure. Other three were housewives, one was a waitress at a restaurant, and one a barmaid. Evidently many of these persons ran, or were likely to run, into danger in the course of their occupation or idle wanderings, at a time when plague was epizootic and epidemic.”—(P.R., 1902, p. 10.)

### Difficulties in Establishing the Presence of Rodent Plague.

The City of Sydney provided conditions especially favorable for the epidemiological study of a disease like plague. "The population numbered about 500,000. This population was not merely wholly white, of English extraction and speech, and fully civilized, but intelligent, instructed, and orderly, accustomed to direction, and amenable to it." In view of these conditions, it might have been thought likely that vigorous and well-designed measures would have succeeded in detecting the presence of, and in eradicating all foci of, rodent plague wherever it existed. It has been sufficiently shown that, while the appearance of human plague was very frequently a sign-post pointing to the locality of a related epizootic focus, yet there existed a large number of epizootic loci, in which the infection was not communicated to any human. While, for administrative control of the epidemic, the declared presence of human plague indicated directions for active measures against infected premises, yet it was the repeated experience that human plague was not known in a freshly-invaded locality until epizootic plague had been existent for a considerable period of time.

Measures designed to secure immediate information of the presence of plague in epizootic form in any part of the metropolitan area were an essential feature of the plague campaign. For this purpose, a *rat intelligence service* was organized, and kept constantly active, during periods when neither human nor rat plague was being observed, as well as during periods of activity in either of these phases.

The first obvious difficulty is that, in a city of the size of Sydney, it is impossible in practice, whatever it may be in theory, to have a sufficient staff to continue anti-rodent operations over the whole area simultaneously throughout the year. A selection of areas was necessary, on the basis of either experience directing attention to them as specially liable to repeated rodent-plague manifestations, or the nature of the ground or the premises as being specially favorable for rat harbourage.

For the portion of the area not at any time being visited by this trained staff, the only measure found practical was the payment of a bounty for the carcase of each rat presented at a collecting station. The conditions under which these rats were ordinarily received were such that no reliable information could be obtained as to the place from which they had been taken. Consequently, it was decided at an early stage that laboratory examination of carcasses received in this way was not justified.



The number of rats received, examined, and identified as plague-infected, is shown hereunder:—

TABLE 40.  
NEW SOUTH WALES.—RODENTS COLLECTED AND EXAMINED.

| —                      | Collected. | Examined. | Infected. | Percentage Infected. |
|------------------------|------------|-----------|-----------|----------------------|
| 1900 .. ..             | 108,308    | 187       | 23        | 12·30                |
| 1901 (to 31.3.1902) .. | 47,522     | 1,967     | 40        | 2·03                 |
| 1902 (from 1.4.1902)   | 54,282     | 40,669    | 65        | 0·16                 |
| 1903 .. ..             | 88,829     | 33,169    | 161       | 0·48                 |
| 1904 .. ..             | .. ..      | 52,014    | 243       | 0·47                 |
| 1905 .. ..             | 91,119     | 31,895    | 141       | 0·44                 |
| 1906 .. ..             | 54,151     | 29,447    | 174       | 0·59                 |
| 1907 .. ..             | 90,375     | 31,621    | 219       | 0·69                 |
| 1908 .. ..             | .. ..      | 26,849    | 175       | 0·65                 |
| 1909 .. ..             | .. ..      | 26,744    | 178       | 0·61                 |
| 1910 .. ..             | .. ..      | 22,821    | 5         | 0·02                 |

TABLE 41.  
BRISBANE.—RODENTS COLLECTED AND EXAMINED.

| —          | Collected. | Examined. | Infected. | Percentage Infected. |
|------------|------------|-----------|-----------|----------------------|
| 1900 .. .. | .. ..      | 735       | 90        | 12·24                |
| 1901 .. .. | .. ..      | 1,851     | 101       | 5·46                 |
| 1902 .. .. | 4,671      | 3,851     | 106       | 2·75                 |
| 1903 .. .. | 24,050     | 14,153    | 84        | 0·59                 |
| 1904 .. .. | 52,566     | 24,642    | 380       | 1·54                 |
| 1905 .. .. | 31,375     | 16,780    | 129       | 0·77                 |
| 1906 .. .. | 17,647     | 12,295    | 48        | 0·39                 |
| 1907 .. .. | 14,808     | 10,379    | 22        | 0·21                 |
| 1908 .. .. | .. ..      | 20,690    | 73        | 0·35                 |

These figures represent a very extensive system of rat destruction and rat examination. The low percentage of infected rats identified as plague-infected is a striking feature of these tables.

This low percentage is explained by Thompson, as follows:—

“But there are several considerations which show that such comparisons (i.e. between percentages), if they are made with a view to gauging the severity of an epizootic, are illusory. The most important of them is that the only methods practically available to rat-catchers tend to ensure capture of healthy rats for the most part. Those alone are taken in traps, as a rule, which are in good health, and which enter them in course of their active search for food; or, if infected, have not reached a stage of illness at which pathological signs have appeared. Hence, the percentage of identified plague-rats thus calculated must always be extremely small. An additional reason can be assigned for the low percentage which our accounts show; this attaches to the manner in which I

think it best to state the facts. A considerable number of carcasses have been delivered at the laboratory in a state too putrid for useful bacteriological examination, but in which there was every reason to think plague has been the cause of death; and were these counted as plague-rats, the percentage would be increased. But I do not think the term "plague-rat" should be applied to any carcass in which the disease has not been identified; and I do not think that the term "identified" should be employed unless the presence of *B. pestis* has been bacteriologically demonstrated.—(New South Wales P.R., 1903, p. 13.)

In any endeavour to estimate the intensity of the epizootic on any premises, other difficulties are met:—

"In the first place, the number of the horde which infested the building never could be ascertained; in the second, certainty that the plague-rats identified comprised all which had died of plague never could be reached. For, while in some instances very considerable numbers of carcasses have been found, the rule has been to find but few, even on premises where it seemed certain the disease had had every opportunity of spreading."—(New South Wales P.R., 1903, p. 15.)

The practical conclusion is that intelligence staffs can do no more than indicate the area over which an epizootic has extended. Even within this limitation, it is not possible to ensure with certainty that all plague-rats within this area are discovered.

"Plague is commonly represented as spreading among the rats of a district with extreme rapidity, and as exterminating them almost. Contrary to reported experiences in many other countries, sick rats have not often been seen in the open at Sydney; the carcasses picked up in streets and lanes were almost always putrid, and beyond reasonable doubt had been thrown out from premises on which they had died. The finding of plague-rats by the rat-catchers—particular premises being excepted, and reference made merely to buildings and their curtilages, which were examined in the ordinary course of the night's work on infected areas—was not common. Then, again, we have no evidence of rapid spread over neighbourhoods."—(New South Wales P.R., 1902, p. 246.)

"As a rule, plague among rats in any district is so far from possessing a devastating character that its progress is slow, long drawn-out, and even insidious. The disease picks out individual rats, affects a minority of the horde at any one time, and exhibits its activity only in comparatively small, circumscribed areas which are successively attacked. On individual premises, I have occasionally found almost the whole colony dead; but this has been exceptional, and even there the rule has been that few plague-rats,



any many more healthy rats, have been collected during many consecutive weeks.”—(Thompson, International Congress Hygiene, see New South Wales P.R., 1907, p. 63.)

“Our general experience, as far as it has gone, shows that only a moderate, or even a small, proportion of adjacent premises may be infested with rats—apart from the question of plague—although from their structural state and use, nearly all of them appear equally likely to be so. Further, it appears that often the epizootic is largely confined to the rats inhabiting particular premises, and at any one time probably affects but a small proportion of the total rats in the district. Secondly, we have evidence of establishment of centres of infection by a mode of transportation from the local *fons et origo* which does not cause infection of the traversed interval, and of slow and irregular spread of the epizootic from them; while many adjacent buildings might at the same time harbour a plague-stricken horde. On the whole, this appears to be seldom the case.”—(New South Wales P.R., 1902, p. 79.)

Quite apart from the difficulties in the way of detection of rodent plague, there are practical difficulties in the actual catching of rats on a large scale:—

“During a term of eight months, the intelligence staff paid 17,656 visits to foreshores, wharfs, and stores; only 4,095 of these visits resulted in captures, and the number of rodents taken was only 10,579. The premises were entirely open to the men; but had the area examined been residential, it is clear the result would have been still less satisfactory, since admission at night would often have been refused to them. All buildings which seem to be likely to harbour rats are not infested with them. House-to-house examination of a group of blocks of squalid, but solidly constructed, buildings, which contained 387 houses, resulted in finding 57 infested with rats, or about 15 per cent. only; although all of them, from dilapidation, and a majority from the uses to which they were put, appeared equally exposed to infestation. These blocks, then, furnished an explanation of the erratic incidence of plague on houses—not in that these 57 were infected, but in that they alone were infested.”—(Thompson, Congress American Medical Association, see New South Wales P.R., 1905, p. 72.)

### **Where Plague-rats are Most Constantly Found.**

“Analysis shows that plague-rats have been found most persistently at wharfs; then in warehouses and shops; then in stables; and then in more or less dilapidated cottages. One circumstance is common to all these kinds of places; either they are easily accessible to rats, or they are used in ways likely to attract rats. Such uses are the storage and distribution of food-stuffs. But there is

one use which is pre-eminently favorable to rat-infestation, this is the produce trade in hay, straw, chaff in bags, maize, and potatoes.”—(Thompson, Congress American Medical Association, see New South Wales P.R., 1905, p. 74.)

This coincides with the experience in Queensland:—

“The incidence of plague, both in man and rats, was heaviest on particular localities where produce and grain were stored.”—(Plague, Queensland, p. 10.)

### **The Interval between Epizootics and the “Bridge” which Connects them.**

Thompson, in discussing this, states that, while he does not deny the existence of plague in the rat in a chronic form, which causes but few deaths until something occurs to revive its virulence, he had yet failed to find any evidence pointing to it. (1906.) Yet, shortly afterwards, in his address to the International Congress on Hygiene, at Berlin (1907), he makes this statement:—

“This evidence shows, I think, that epizootic plague may pursue a chronic course, and that its long continuance may not be attended at any stage by such a mortality as could not be easily overlooked.”

From this, it is probably permissible to deduce that Thompson's later opinion was that the “bridge” was undetected rodent plague, except where the fresh appearance of the disease could with certainty be ascribed to a re-importation from some distant locality.

In connexion with this possibility of re-importation, Thompson, after discussing certain evidence, states that: “It is reasonable to infer that coastal steamers have probably been an important means of maintaining plague in the Commonwealth from year to year, and special treatment of them is needed.”—(New South Wales P.R., 1907, p. 25.)



## CHAPTER XIX.—RAT DESTRUCTION.

“Rat destruction is a subject on which a great deal might be said. Extermination of the rat is impossible with any means thus far made available. Perhaps larger numbers have been destroyed during several years at Tokio than anywhere else, and yet it was hardly possible to recognize any impression made in the rat tribe as a whole. My own experience has been similar: but from time to time diminution in the numbers present in circumscribed districts has been produced by energetic poisoning and trapping. This has importance in relation to the limited areas over which the epizootic extends at any one time. But although occasions will arise from time to time on which effort may be directed to destruction of rats known to be present, as a rule infected neighbourhoods must be dealt with in a more general way, by scavenging and destruction of accumulations or places in which rats have been found, or probably may find harbourage, and especially by storing food and food-wastes so that rats cannot reach them. These operations should be guided, not by rats seen, or even traced, but by the conviction, otherwise acquired, that rats must be present, seen or not seen, wherever man has been infected, and can be driven out. Unless rat-staffs are firmly impressed with that belief, such operations will seldom be thoroughly successful.

“Lastly, the difficulty in arresting rat-plague is in direct ratio to the bad construction of wharfs, quays, and the buildings upon or near them. The danger to man from plague is everywhere directly proportionate to the accessibility of the interior of buildings to rats, although it is quite absent outside them. When the difficulty of staying the infection by action directed to the rat is considered, and, above all, the impossibility of staying it within so short a period of time as shall effectually avoid the danger to man, I think it will be perceived that the rational method of defence lies in so improving the construction of buildings as greatly to impede the entrance of rats to them, and in so taking care of food that it shall not attract them.

“In a broad view, then, all other measures must be considered as subsidiary to reconstruction of ill-built wharfs, stores, and warehouses, and to such repair and special fitting of inhabited houses as will keep rats outside them.”—(Thompson, International Congress on Hygiene, see New South Wales P.R., 1907, p. 67.)

## CHAPTER XX.—SPECIES OF RATS WHICH ARE NATURALLY FOUND PLAGUE-INFECTED.

The following is Thompson's recorded experience during the first six years of plague in Sydney:—

“A note on the species of *Mus* met with at Sydney, on their susceptibility to plague under natural conditions, and on the observed association of the different species with plague in man. The species are *M. decumanus*, *M. rattus*, together with its Alexandrine variety which it is unnecessary further to mention separately, and *M. musculus*. These comprise all which have become domesticated. Plague has been identified in all of them, and in such numbers as show, I think, that the proportions of each species enumerated in any year depended rather on local distribution than on any difference in susceptibility. In the first year to which I now refer, plague was identified in 86 D., 26 R., and 49 M.; in the second, 106 D., 73 R., and 62 M.; in the third in 78 D., 45 R., and 18 M.; in the fourth in 46 D., 89 R., and 39 M. I have found each of the two species of rats infected and associated with plague in man by itself, as well as the two together, on the same premises. Infected mice have never been found alone in that association, so that I have nothing which points to the mouse as an efficient cause of plague in man; on the other hand, I have not observations sufficiently extensive to show that it does not so act. In a short series of nine houses, infected *M. musculus* was once actually found alone in association with one case of plague, but rats had at the same time died in number on the premises, although none were secured in a state which admitted of identification of the infection; *M. decumanus* was associated alone in a second, *M. musculus* and *M. decumanus* together in a third, all three species together in a fourth and fifth, and *M. musculus* with *rattus* in the remaining four. All the rats on the troopship *Antillian* (*vide* p. 71), on which was one case of plague on arrival, while another occurred in connexion with cleansing of the store-room, were *decumanus*. All those found on the other vessel, the *Alsterschwann*, were *rattus* in its Alexandrine variety; in that instance no one was infected, either among the crew or among the many persons engaged in unloading and in disinfecting her. In a rural district, 300 miles from Sydney, where twelve



cases occurred in ten houses, all the rats (1,128) taken, whether in the houses or in farm buildings or on river banks, were *decumanus* with three exceptions; all the infected rats (101) were of that species, and there were two infected mice. At an important seaport 70 miles to the north of Sydney, where an outbreak consisting of fourteen cases occurred, plague was identified in 296 rodents out of 6,653 examined; 171 were *decumanus*, 13 were *rattus*, and there were 22 mice. The association of the infected species with plague in man at this place in the eleven cases which could be so examined was *decumanus* alone eight times, *decumanus* and *musculus* together twice, and *decumanus*, *rattus*, and *musculus* together once. The species found in connexion with two large warehouses at Sydney where eight cases occurred was *rattus*; all the patients recovered. That connected with six cases which occurred at a small hotel was also *rattus*, and two of these patients died. After having mentioned the caution that the following opinion does not result from complete knowledge, but only from what happened to be discovered, I may point out that the experience appears to indicate *M. decumanus* as rather the more susceptible, and practically rather the more dangerous. At all events, the suggestion recently made that in this relation *M. rattus* is the species to be feared, and that *M. decumanus* is, or, perhaps, may be, harmless, would fatally influence preventive operations at Sydney if it were adopted, and if it were possible to so conduct the destruction of rats as to spare the *decumanus* species on the ground that it would eventually destroy *rattus*. Doubtless there are variations in the susceptibility of the two species, and of each species in different countries, or even in different parts of the same country; but I incline to think that the proportions observed to be infected depend primarily on local distribution."—(International Congress on Hygiene, Berlin, 1907, see New South Wales P.R., 1907, p. 64.)

Some other animals were proven to have received a natural infection of plague during the course of the outbreak. In New South Wales, four cats were infected, two at Sydney and one each at Woodford Island and Ballina. In 1902 an outbreak occurred at the Sydney Zoological Gardens in which the following animals died from an infection with *b. pestis*:—Four wallabies, one wallaroo, one pademelon, one tree kangaroo, one Indian antelope, three guinea-pigs.

The following table shows the number of rodents examined and found infected at Sydney from 1903-1920. The table—data from 1903-1920—is taken from the Eleventh Report of the Microbiological



TABLE 42.  
SHOWING THE NUMBER OF RATS ANNUALLY EXAMINED FROM THE FIRST APPEARANCE OF PLAGUE AT SYDNEY IN 1900  
TO 31ST DECEMBER, 1920.

| Year.     | Period of Rat Examination. | Rats Examined.   |           |                |           | Mice Examined.     |           | Total.<br>Rodents. | Infected.           |           |                |           |                    |           | Percentage of infected to total examined. |       |      |      |
|-----------|----------------------------|--|-----------|----------------|-----------|--------------------|-----------|--------------------|---------------------|-----------|----------------|-----------|--------------------|-----------|---|-------|------|------|
|           |                            | <i>Decu- manus.</i>  | Per cent. | <i>Rattus.</i> | Per cent. | <i>Mus- culus.</i> | Per cent. |                    | <i>Decu- manus.</i> | Per cent. | <i>Rattus.</i> | Per cent. | <i>Mus- culus.</i> | Per cent. | Total.                                    | D.    | R.   | M.   |
|           |                            | † 1900—First plague outbreak, 19th January to 9th August.<br>† 1901-2—Second plague outbreak, 12th November 1901, to 8th June, 1902. |           |                |           |                    |           |                    |                     |           |                |           |                    |           |   |       |      |      |
| 1903      | 1st May to 15th Aug.       | 8,695  | ..        | ..             | ..        | 5,976              | ..        | 14,671             | { Rats<br>111       | ..        | ..             | ..        | { Mice<br>50       | ..        | 161                                       | ..    | ..   | ..   |
| 1094      | 1st Mar. to 3rd Dec.       | 12,169   | 27·76     | 8,225          | 18·76     | 23,428             | 53·48     | 43,822             | 108                 | 44·26     | 73             | 29·92     | 62                 | 25·41     | 243                                       | ·76   | 1·16 | 0·26 |
| 1905      | Year.                      | 11,383   | 53·72     | 5,681          | 17·81     | 14,831             | 46·47     | 31,895             | 78                  | 55·32     | 45             | 31·91     | 18                 | 12·77     | 141                                       | ·79   | ·88  | ·13  |
| 1906      | „                          | 9,275  | 31·49     | 8,694          | 29·52     | 11,478             | 38·97     | 29,447             | 46                  | 26·44     | 89             | 51·15     | 39                 | 22·41     | 174                                       | ·49   | 1·02 | ·34  |
| 1907      | „                          | 8,628  | 27·2      | 10,479         | 33·9      | 12,244             | 38·7      | 31,621             | 57                  | 26·03     | 143            | 65·29     | 19                 | 8·68      | 219                                       | ·66   | 1·3  | ·15  |
| 1908      | „                          | 7,622  | 28·39     | 9,207          | 34·29     | 10,020             | 37·32     | 26,849             | 82                  | 46·36     | 78             | 44·57     | 15                 | 8·57      | 175                                       | 1·075 | ·84  | ·14  |
| 1909      | „                          | 6,752  | 25·26     | 11,259         | 42·08     | 8,726              | 32·66     | 26,737             | 22                  | 12·36     | 138            | 77·53     | 18                 | 10·11     | 178                                       | ·32   | 1·22 | 2·06 |
| 1910      | „                          | 5,708  | 24·98     | 10,076         | 44·15     | 7,044              | 30·87     | 22,821             | 4                   | 80·0      | 1              | 20·0      | ..                 | 5         | ·07                                       | ·009  | ..   |      |
| 1911      | „                          | 6,025  | 26·45     | 10,830         | 47·55     | 5,919              | 26·0      | 22,774             | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1912      | „                          | 6,510  | 37·82     | 7,922          | 46·18     | 2,722              | 16·0      | 17,154             | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1913*     | „                          | 5,020  | 47·29     | 5,477          | 51·59     | 118                | 1·1       | 10,615             | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1914      | „                          | 3,732  | 39·53     | 5,487          | 58·14     | 220                | 2·33      | 9,439              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1915      | „                          | 3,592  | 37·13     | 5,946          | 61·48     | 135                | 1·39      | 9,673              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1916      | „                          | 2,807  | 35·33     | 4,967          | 62·53     | 167                | 2·1       | 7,943              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1917      | „                          | 3,026  | 36·76     | 5,110          | 62·08     | 95                 | 1·15      | 8,231              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1918      | „                          | 2,601  | 33·43     | 5,109          | 65·67     | 69                 | ·88       | 7,779              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1919      | „                          | 849  | 26·82     | 2,303          | 72·76     | 13                 | ·41       | 3,165              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| 1920      | „                          | 2,707  | 40·6      | 3,960          | 59·4      | ..                 | ..        | 6,667              | ..                  | ..        | ..             | ..        | ..                 | ..        | ..  | ..    | ..   | ..   |
| Total †.. |                            | 98,399   | 31·08     | 121,002        | 38·21     | 97,229             | 30·71     | 316,632            | 397                 | 34·98     | 567            | 49·96     | 171                | 15·06     | 1,135                                     | ·64   | 0·88 | ·19  |

\* Examination of rodents was suspended during the months of August, September, and October, owing to an outbreak of small-pox.

† No record was kept during this period of the actual number of rats examined, but they all belonged to one of two species—*Mus decumanus* and *Mus rattus*. The infected specimens were all *Mus decumanus*. † Inaccuracies in this Table are as in the original; the percentages have been corrected.



The following table gives the figures for Brisbane, so far as they are available (*Plague in Queensland*, p. 131) The table has little value, as the total number of *decumanus* and of *rattus* examined is not known:—

TABLE 43.

|                            | 1904.          |                |              | 1905.          |                |              | 1906.          |                |              | To 30th June, 1907. |                |              |
|----------------------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|--------------|---------------------|----------------|--------------|
|                            | Ex-<br>amined. | In-<br>fected. | Per<br>cent. | Ex-<br>amined. | In-<br>fected. | Per<br>cent. | Ex-<br>amined. | In-<br>fected. | Per<br>cent. | Ex-<br>amined.      | In-<br>fected. | Per<br>cent. |
| <i>Mus decu-<br/>manus</i> | 19,689         | 309            | 1.55         | 13,283         | 87             | 0.65         | 10,847         | 16             | 0.14         | 9,254               | 13             | 0.14         |
| <i>Mus rat-<br/>tus</i>    |                | 63             | 0.32         |                | 41             | 0.24         |                | 32             | 0.29         |                     | 9              | 0.09         |
| <i>Mus mus-<br/>culus</i>  | 4,963          | 3              | 0.06         | 3,497          | 1              | 0.03         | 1,348          | ..             | ..           | 1,125               | ..             | ..           |



## CHAPTER XXI.—SPECIES OF FLEAS CONCERNED IN PLAGUE TRANSMISSION.

In Thompson's series of reports, this question is not very fully discussed, although early in the outbreak he accepted, on epidemiological grounds, the rôle of the flea in transmission, and his comments in this connexion show that he closely followed the confirmatory work of investigators in other countries. In the reports for 1900 (page 57) and for 1902 (page 71), Tidswell reports the results of flea investigations, and in a report on "The Ectoparasites of the Rat" in this latter report (1902) he gives the following table of species of fleas identified from various localities:—

TABLE 44.  
NUMBERS AND SPECIES OF FLEAS OBTAINED FROM DIFFERENT PARTS OF  
AUSTRALIA.\*

| Locality.         | No. of Specimens. | <i>Typhlopsylla musculi</i> . | <i>Pulex fasciatus</i> . | <i>Pulex serraticeps</i> . | <i>Pulex pallidus</i> . |
|-------------------|-------------------|-------------------------------|--------------------------|----------------------------|-------------------------|
| Brisbane .. ..    | 103               | 18                            | ..                       | 6                          | 79                      |
| Perth .. ..       | 6                 | 5                             | ..                       | ..                         | ..                      |
| Newcastle .. ..   | 34                | 24                            | 3                        | ..                         | 7                       |
| Sydney .. ..      | 100               | 8                             | 10                       | 1                          | 81                      |
| New Zealand .. .. | 56                | 3                             | 53                       | ..                         | ..                      |

The reports of the New South Wales Bureau of Microbiology give complete records of flea censuses by months from 1909 onwards. These are shown on page 109 *seqq.*)

Ham collected in 1907 (*Plague in Queensland*, p. 147) some information as to species of fleas in Australia.

"The species of fleas that have been met with on rats and mice associated with man in Australia: *Pulex irritans*, *Pulex cheopis*, *Ctenocephalus canis*, *Ceratophyllus fasciatus*, *Ctenopsylla musculi*. Their relative frequency of occurrence, in connexion with the rodents named, in the principal cities in the different States is shown in the following table:—

TABLE 45.  
DISTRIBUTION OF RAT-FLEA SPECIES IN AUSTRALIA.

| ---   | Total Number of Fleas Examined. | <i>Irritans</i> .  | <i>Cheopis</i> . | <i>Canis</i> . | <i>Fasciatus</i> . | <i>Musculi</i> . |
|---|---------------------------------|--|------------------|----------------|--------------------|------------------|
| Queensland .. ..                                  | 1,609                           | %  | %                | %              | %                  | %                |
| Rockhampton .. ..                                 | 40                              | 0·18   | 90·8             | 1·8            | 0·37               | 2·8              |
| Townsville .. ..                                  | 10                              | ..   | 100              | ..             | ..                 | ..               |
| New South Wales (1902) ..                         | 100                             | ..   | 81               | 1              | 10                 | 8                |
| Sydney (1904) .. ..                               | 134                             | ..   | 69               | ..             | 9                  | 23               |
| Newcastle .. ..                                   | 34                              | ..   | 20·5             | ..             | 3                  | 70               |
| Western Australia (Perth) ..                      | 66                              | ..   | 50               | ..             | 1·5                | 48·5             |
| Western Australia (during epidemic period) .. ..  | 36                              | ..   | 78               | ..             | ..                 | 22               |
| Western Australia (during non-epidemic period) .. | 23                              | ..   | 17               | ..             | ..                 | 82·6             |
| Victoria .. ..                                    | 80 or 90                        | Only one was <i>P. cheopis</i> —all others were <i>C. musculi</i> or <i>C. canis</i> |                  |                |                    |                  |
| Tasmania .. ..                                    | 290                             | 0·3  | 1·4              | ..             | ..                 | Common rat flea  |

\* The synonymic names of fleas used in this table are:—*T. musculi* (*Ctenopsylla musculi*); *P. fasciatus* (*Ceratophyllus fasciatus*); *P. serraticeps* (*Ctenocephalus canis*); *P. pallidus* (*Xenopsylla cheopis*).



It is important that Ham's original report should be consulted in connexion with this table, both for the sources of his information and for his annotations. Ham commented as follows (p. 148):—

“From the foregoing tables it may be concluded that—

- (1) In Queensland, in New South Wales, and Western Australia the rat-flea that preponderates is *Pulex cheopis*.
- (2) On the other hand, in Victoria and Tasmania it is least prevalent.

“This varying numerical representation bears no relation to the kind of rat most prevalent, for in Tasmania and Western Australia—where, in both alike, the commoner rodent is *Mus rattus*—we have the rat-fleas that preponderate different ones.

“It is unnecessary to point out that the distribution of *Pulex cheopis*, both in time and place, has its strange counterpart in that of epidemic and, perhaps, also epizootic plague.”

In 1908-9 Dr. T. Borthwick carried out a limited investigation into the flea parasites of rats in Adelaide, and his findings were reported in a note in the *Australasian Medical Gazette* for 20th May, 1910. A total of 80 rats were examined from Adelaide, Port Adelaide, and Port Victor, mostly in the latter half of 1908. The rats were—70 *M. decumanus*, 6 *M. rattus*, and 4 *H. chryogaster*. Of the 418 fleas obtained, the species were identified as follows:—

- C. fasciatus*, 137 on 27 hosts;
- C. musculi*, 203 on 23 hosts;
- L. cheopis*, 67 on 20 hosts;
- C. londiniensis*, 7 on 4 hosts;
- E. myrmecobii*, 4 on 2 hosts.

## CHAPTER XXII.—INFLUENCE OF SEASON ON THE OCCURRENCE OF PLAGUE.

Ham deals, in definite terms, with this aspect as follows (*Plague in Queensland*, p. 43):—

“The most striking factor in the history of plague in Brisbane is the cyclical character of its annual increase and decrease. The development and decline of the eight epidemics of plague in Brisbane during the successive years 1900-1907 are shown in the chart attached.

“A consideration of the chart as a continuous record will show the epidemic curve to be in fairly close agreement with that of the epizootic curve. Both reach their maxima in the autumn months of April or May, are lowest in the winter months of June or July, and are normal, or absent altogether, during the spring and early summer months of the latter half of the year.

“The cases in human beings are observed to begin during the hot and moist or “muggy” season of the year—the end of January and the month of February—reach their limit about May, and notably decline at the beginning of June, when the colder weather with dry westerly winds sets in.

“It has been suggested by some observers that the seasonal variation of plague may be due to seasonal increase of plague amongst rats. A more feasible explanation of this variation may, perhaps, be found in the prevalence and activity of insect life, notably fleas, and the development of the egg, larva, and pupa of fleas under certain environmental conditions. It was noticed that during an epidemic of plague little difficulty was experienced in collecting the fleas from off the rats, but towards the end of the epizootic the number of fleas on rats was small.”

Thompson dealt briefly, but concisely, with the conditions so far as Sydney was concerned—

“The greatest prevalence of epidemic plague has occurred with us during March, April, and May. That is the season when most people suffer, and when rats most suffer. It is also the season of fleas.”—(Congress of American Medical Association, 1906.)

Appended is a series of tables showing the seasonal prevalence of fleas in Sydney according to species. Interruptions in the records of examinations in 1913 and 1919 were the direct result of pressure of work in connexion with the outbreaks of small-pox and of influenza during these years.

These tables are taken from the Annual Reports of the Bureau of Microbiology.

In Western Australia, as will be seen by reference to the previous chapters, the months of greatest plague incidence were February and March.



TABLE 46.

HUMAN AND RODENT PLAGUE AND PREVALENCE OF FLEA SPECIES,  
BY MONTHS, SYDNEY, 1909-1920.

(From Annual Reports of Bureau of Microbiology, New South Wales.)

| Year.        | Human Cases. | Rodents Examined. | Number Plague-Infected. | <i>(Laemopsylla Xenopsylla cheopis.</i> |                 | <i>Ctenopsylla musculi.</i> |                 | <i>Ceratophyllus fasciatus.</i> |                 |
|--------------|--------------|-------------------|-------------------------|---|-----------------|-----------------------------|-----------------|---------------------------------|-----------------|
|              |              |                   |                         | Gross.                                  | Per 1,000 Rats. | Gross.                      | Per 1,000 Rats. | Gross.                          | Per 1,000 Rats. |
| 1909—        |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..   | ..           | 1,865             | 3                       | 108                                     | 57              | 81                          | 43              | 52                              | 26              |
| February ..  | ..           | 2,355             | 10                      | 120                                     | 50              | 60                          | 34              | 11                              | 4               |
| March ..     | 11           | 2,930             | 78                      | 331                                     | 112             | 77                          | 26              | 35                              | 11              |
| April ..     | 9            | 3,225             | 63                      | 314                                     | 97              | 42                          | 13              | 8                               | 2               |
| May ..       | 4            | 3,428             | 20                      | 108                                     | 31              | 38                          | 11              | 5                               | 1               |
| June ..      | ..           | 1,918             | 4                       | 55                                      | 28              | 25                          | 13              | 4                               | 2               |
| July ..      | ..           | 1,915             | ..                      | 42                                      | 21              | 20                          | 10              | 10                              | 5               |
| August ..    | ..           | 1,522             | ..                      | 9                                       | 5               | 16                          | 10              | 1                               | 63              |
| September .. | ..           | 1,518             | ..                      | 76                                      | 50              | 62                          | 40              | 5                               | 3               |
| October ..   | ..           | 1,835             | ..                      | 16                                      | 8               | 50                          | 27              | 47                              | 20              |
| November ..  | ..           | 1,713             | ..                      | 3                                       | 2               | 15                          | 8               | 6                               | 3               |
| December ..  | ..           | 2,400             | ..                      | 9                                       | 3               | 28                          | 11              | 26                              | 10              |
| 1910—        |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..   | ..           | 1,825             | ..                      | 14                                      | 8               | 41                          | 22              | 36                              | 20              |
| February ..  | ..           | 1,798             | ..                      | 88                                      | 49              | 34                          | 19              | 19                              | 11              |
| March ..     | ..           | 1,717             | ..                      | 80                                      | 47              | 33                          | 19              | 23                              | 13              |
| April ..     | ..           | 2,130             | 5                       | 139                                     | 65              | 48                          | 23              | 11                              | 5               |
| May ..       | ..           | 2,118             | ..                      | 43                                      | 20              | 37                          | 17              | 5                               | 2               |
| June ..      | ..           | 1,750             | ..                      | 54                                      | 31              | 56                          | 32              | 13                              | 8               |
| July ..      | ..           | 1,923             | ..                      | 44                                      | 23              | 57                          | 30              | 24                              | 12              |
| August ..    | ..           | 2,043             | ..                      | 67                                      | 33              | 46                          | 23              | 28                              | 14              |
| September .. | ..           | 1,949             | ..                      | 121                                     | 68              | 88                          | 45              | 48                              | 25              |
| October ..   | ..           | 1,849             | ..                      | 20                                      | 11              | 87                          | 47              | 33                              | 18              |
| November ..  | ..           | 2,179             | ..                      | 11                                      | 5               | 6                           | 3               | 9                               | 4               |
| December ..  | ..           | 1,540             | ..                      | 20                                      | 13              | 8                           | 5               | 17                              | 11              |
| 1911—        |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..   | ..           | 1,711             | ..                      | 97                                      | 57              | 46                          | 27              | 53                              | 31              |
| February ..  | ..           | 1,745             | ..                      | 316                                     | 181             | 106                         | 61              | 20                              | 11              |
| March ..     | ..           | 1,726             | ..                      | 191                                     | 111             | 59                          | 34              | 12                              | 7               |
| April ..     | ..           | 2,522             | ..                      | 103                                     | 41              | 37                          | 15              | 13                              | 5               |
| May ..       | ..           | 1,941             | ..                      | 47                                      | 24              | 57                          | 29              | 11                              | 6               |
| June ..      | ..           | 1,612             | ..                      | 17                                      | 10              | 28                          | 17              | 3                               | 2               |
| July ..      | ..           | 2,235             | ..                      | 122                                     | 54              | 121                         | 54              | 16                              | 7               |
| August ..    | ..           | 1,789             | ..                      | 55                                      | 31              | 124                         | 69              | 38                              | 21              |
| September .. | ..           | 2,291             | ..                      | 27                                      | 12              | 205                         | 89              | 66                              | 29              |
| October ..   | ..           | 1,561             | ..                      | 26                                      | 17              | 97                          | 62              | 54                              | 34              |
| November ..  | ..           | 1,804             | ..                      | 43                                      | 24              | 106                         | 59              | 38                              | 21              |
| December ..  | ..           | 1,837             | ..                      | 61                                      | 33              | 79                          | 43              | 51                              | 28              |
| 1912—        |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..   | ..           | 1,606             | ..                      | 44                                      | 27              | 23                          | 14              | 24                              | 14              |
| February ..  | ..           | 1,404             | ..                      | 129                                     | 91              | 14                          | 9               | 7                               | 4               |
| March ..     | ..           | 1,701             | ..                      | 128                                     | 75              | 25                          | 14              | 18                              | 10              |
| April ..     | ..           | 1,264             | ..                      | 66                                      | 52              | 45                          | 35              | 9                               | 7               |
| May ..       | ..           | 1,602             | ..                      | 59                                      | 36              | 12                          | 7               | 2                               | 1               |
| June ..      | ..           | 1,603             | ..                      | 62                                      | 38              | 32                          | 19              | 11                              | 6               |
| July ..      | ..           | 1,213             | ..                      | 42                                      | 34              | 15                          | 12              | 17                              | 14              |
| August ..    | ..           | 1,434             | ..                      | 30                                      | 20              | 67                          | 46              | 14                              | 9               |
| September .. | ..           | 1,045             | ..                      | 14                                      | 13              | 40                          | 38              | 9                               | 8               |
| October ..   | ..           | 1,326             | ..                      | 17                                      | 12              | 75                          | 56              | 31                              | 23              |
| November ..  | ..           | 1,781             | ..                      | 11                                      | 6               | 34                          | 19              | 29                              | 16              |
| December ..  | ..           | 1,175             | ..                      | 39                                      | 33              | 60                          | 52              | 48                              | 40              |

TABLE 46—continued.

## HUMAN AND RODENT PLAGUE, ETC.—continued.

| Year  | Human Cases. | Rodents Examined. | Number Plague-Infected. | <i>(Laemopsis)</i><br><i>Xenopsylla</i><br><i>cheopis.</i> |                 | <i>Ctenopsylla</i><br><i>musculi.</i> |                 | <i>Ceratophyllus</i><br><i>fasciatus.</i> |                 |
|---|--------------|-------------------|-------------------------|--|-----------------|---------------------------------------|-----------------|---|-----------------|
|   |              |                   |                         | Gross.   | Per 1,000 Rats. | Gross.                                | Per 1,000 Rats. | Gross.                                    | Per 1,000 Rats. |
| 1913—   |              |                   |                         |  |                 |                                       |                 |   |                 |
| January ..  | ..           | 1,436             | ..                      | 30   | 21              | 7                                     | 5               | 11  | 8               |
| February ..   | ..           | 1,781             | ..                      | 77   | 43              | 24                                    | 13              | 5   | 3               |
| March ..  | ..           | 933               | ..                      | 29   | 31              | 3                                     | 3               | ..  | ..              |
| April ..  | ..           | 1,469             | ..                      | 11   | 7               | 4                                     | 3               | ..  | ..              |
| May ..  | ..           | 1,846             | ..                      | 28   | 15              | 17                                    | 9               | 2   | 3               |
| June ..   | ..           | 1,171             | ..                      | 62   | 53              | 27                                    | 24              | 4   | 1               |
| July ..   | ..           |                   |                         |  |                 |                                       |                 |   |                 |
| August ..   | ..           |                   |                         |  |                 |                                       |                 |   |                 |
| September ..  | ..           |                   |                         |  |                 |                                       |                 |   |                 |
| October ..  | ..           |                   |                         |  |                 |                                       |                 |   |                 |
| November ..   | ..           | 929               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| December ..   | ..           | 776               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| } Examination interrupted by small-pox outbreak. No complete returns available from end of June |              |                   |                         |  |                 |                                       |                 |   |                 |
| 1914—   |              |                   |                         |  |                 |                                       |                 |   |                 |
| January ..  | ..           | 824               | ..                      | 25   | 30              | 5                                     | 6               | 2   | 2               |
| February ..   | ..           | 836               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| March ..  | ..           | 661               | ..                      | 29   | 43              | 2                                     | 3               | ..  | ..              |
| April ..  | ..           | 726               | ..                      | 33   | 45              | 3                                     | 4               | ..  | ..              |
| May ..  | ..           | 726               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| June ..   | ..           | 708               | ..                      | ..   | ..              | 2                                     | 2               | ..  | ..              |
| July ..   | ..           | 753               | ..                      | 12   | 15              | 2                                     | 2               | 1   | 1               |
| August ..   | ..           | 885               | ..                      | 21   | 23              | 44                                    | 49              | 6   | 6               |
| September ..  | ..           | 953               | ..                      | 14   | 14              | 48                                    | 50              | 27  | 28              |
| October ..  | ..           | 923               | ..                      | 55   | 59              | 234                                   | 253             | 37  | 40              |
| November ..   | ..           | 728               | ..                      | 8  | 10              | 24                                    | 32              | 14  | 19              |
| December ..   | ..           | 716               | ..                      | 36   | 50              | 7                                     | 97              | 7   | 97              |
| 1915—   |              |                   |                         |  |                 |                                       |                 |   |                 |
| January ..  | ..           | 907               | ..                      | 88   | 97              | 4                                     | 4               | 7   | 7               |
| February ..   | ..           | 898               | ..                      | 8  | 8               | 1                                     | 1               | 1   | 1               |
| March ..  | ..           | 949               | ..                      | 77   | 81              | 7                                     | 7               | 5   | 5               |
| April ..  | ..           | 729               | ..                      | 14   | 19              | 26                                    | 35              | 2   | 2               |
| May ..  | ..           | 917               | ..                      | 1  | 1               | 6                                     | 6               | ..  | ..              |
| June ..   | ..           | 649               | ..                      | 18   | 27              | 8                                     | 12              | ..  | ..              |
| July ..   | ..           | 744               | ..                      | 13   | 17              | 33                                    | 44              | 3   | 4               |
| August ..   | ..           | 768               | ..                      | 15   | 19              | 27                                    | 35              | 3   | 3               |
| September ..  | ..           | 661               | ..                      | 5  | 7               | 27                                    | 40              | 12  | 18              |
| October ..  | ..           | 907               | ..                      | 5  | 5               | 6                                     | 6               | 23  | 25              |
| November ..   | ..           | 835               | ..                      | 5  | 5               | ..                                    | ..              | 6   | 7               |
| December ..   | ..           | 709               | ..                      | 3  | 4               | 11                                    | 15              | 10  | 14              |
| 1916—   |              |                   |                         |  |                 |                                       |                 |   |                 |
| January ..  | ..           | 720               | ..                      | 73   | 101             | 11                                    | 15              | 4   | 5               |
| February ..   | ..           | 856               | ..                      | 120  | 140             | 12                                    | 14              | 30  | 35              |
| March ..  | ..           | 712               | ..                      | 43   | 60              | 17                                    | 23              | 13  | 18              |
| April ..  | ..           | 600               | ..                      | 9  | 15              | 10                                    | 16              | 9   | 15              |
| May ..  | ..           | 835               | ..                      | 16   | 19              | 13                                    | 15              | ..  | ..              |
| June ..   | ..           | 625               | ..                      | 3  | 4               | ..                                    | ..              | ..  | ..              |
| July ..   | ..           | 744               | ..                      | 26   | 34              | 10                                    | 13              | 8   | 10              |
| August ..   | ..           | 748               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| September ..  | ..           | 593               | ..                      | 7  | 11              | 11                                    | 18              | 6   | 10              |
| October ..  | ..           | 515               | ..                      | ..   | ..              | ..                                    | ..              | ..  | ..              |
| November ..   | ..           | 498               | ..                      | 3  | 6               | 19                                    | 38              | 6   | 16              |
| December ..   | ..           | 497               | ..                      | ..   | ..              | 5                                     | 10              | ..  | ..              |



TABLE 46—continued.  
HUMAN AND RODENT PLAGUE, ETC.—continued.

| Year.  | Human Cases. | Rodents Examined. | Number Plague-Infected. | <i>(Laemopsylla Xenopsylla cheopis.</i> |                 | <i>Ctenopsylla musculi.</i> |                 | <i>Ceratophyllus asiaticus.</i> |                 |
|--|--------------|-------------------|-------------------------|---|-----------------|-----------------------------|-----------------|---------------------------------|-----------------|
|  |              |                   |                         | Gross.                                  | Per 1,000 Rats. | Gross.                      | Per 1,000 Rats. | Gross.                          | Per 1,000 Rats. |
| 1917—  |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..                                       | ..           | 508               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| February ..                                      | ..           | 552               | ..                      | 104                                     | 188             | 13                          | 23              | ..                              | ..              |
| March ..   | ..           | 671               | ..                      | 38                                      | 56              | 3                           | 4               | 5                               | 7               |
| April ..   | ..           | 699               | ..                      | 2                                       | 2               | 4                           | 5               | ..                              | ..              |
| May ..   | ..           | 879               | ..                      | 5                                       | 5               | 4                           | 4               | 5                               | 5               |
| June ..  | ..           | 675               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| July ..  | ..           | 721               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| August ..  | ..           | 837               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| September ..                                     | ..           | 645               | ..                      | 22                                      | 34              | 10                          | 15              | 1                               | 1               |
| October ..                                       | ..           | 788               | ..                      | 21                                      | 26              | 3                           | 3               | 16                              | 21              |
| November ..                                      | ..           | 720               | ..                      | 4                                       | 5               | 23                          | 31              | 10                              | 13              |
| December ..                                      | ..           | 536               | ..                      | 1                                       | 1               | ..                          | ..              | ..                              | ..              |
| 1918—  |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..                                       | ..           | 582               | ..                      | 12                                      | 20              | 5                           | 8               | 14                              | 24              |
| February ..                                      | ..           | 721               | ..                      | 7                                       | 9               | 6                           | 8               | 1                               | 1               |
| March ..   | ..           | 726               | ..                      | 5                                       | 6               | 1                           | 1               | 3                               | 4               |
| April ..   | ..           | 760               | ..                      | 20                                      | 26              | 6                           | 7               | 2                               | 2               |
| May ..   | ..           | 706               | ..                      | 1                                       | 1               | 3                           | 4               | ..                              | ..              |
| June ..  | ..           | 546               | ..                      | 2                                       | 3               | 5                           | 9               | ..                              | ..              |
| July ..  | ..           | 698               | ..                      | 2                                       | 2               | 1                           | 1               | 10                              | 14              |
| August ..  | ..           | 710               | ..                      | 8                                       | 11              | 18                          | 25              | 3                               | 4               |
| September ..                                     | ..           | 699               | ..                      | 4                                       | 5               | 12                          | 17              | 2                               | 2               |
| October ..                                       | ..           | 586               | ..                      | 6                                       | 10              | 2                           | 3               | 6                               | 10              |
| November ..                                      | ..           | 444               | ..                      | ..                                      | ..              | 4                           | 9               | 6                               | 13              |
| December ..                                      | ..           | 601               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| 1919—  |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..                                       | ..           | 500               | ..                      | 10                                      | ..              | ..                          | ..              | ..                              | ..              |
| February ..                                      | ..           | 165               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| March ..   | ..           | 172               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| April ..   | ..           | 28                | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| May ..   | ..           | 323               | ..                      | 32                                      | ..              | 4                           | ..              | 14                              | ..              |
| June ..  | ..           | 284               | ..                      | 22                                      | ..              | 3                           | ..              | 16                              | ..              |
| July ..  | ..           | 288               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| August ..  | ..           | 340               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| September ..                                     | ..           | 316               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| October ..                                       | ..           | 223               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| November ..                                      | ..           | 208               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| December ..                                      | ..           | 318               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| } Examination interrupted by influenza epidemic. |              |                   |                         |   |                 |                             |                 |                                 |                 |
| 1920—  |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..                                       | ..           | 480               | ..                      | ..                                      | ..              | ..                          | ..              | ..                              | ..              |
| February ..                                      | ..           | 614               | ..                      | 89                                      | 144             | 14                          | 22              | 12                              | 19              |
| March ..   | ..           | 650               | ..                      | 34                                      | 52              | 19                          | 29              | 12                              | 18              |
| April ..   | ..           | 495               | ..                      | 32                                      | 64              | 18                          | 36              | 4                               | 8               |
| May ..   | ..           | 550               | ..                      | 37                                      | 67              | 22                          | 40              | 13                              | 22              |
| June ..  | ..           | 498               | ..                      | 33                                      | 66              | 15                          | 30              | 5                               | 10              |
| July ..  | ..           | 574               | ..                      | 7                                       | 12              | 6                           | 10              | 5                               | 8               |
| August ..  | ..           | 541               | ..                      | 9                                       | 16              | 8                           | 14              | 8                               | 14              |
| September ..                                     | ..           | 492               | ..                      | 5                                       | 10              | 26                          | 52              | 21                              | 42              |
| October ..                                       | ..           | 608               | ..                      | 6                                       | 9               | 16                          | 26              | 39                              | 64              |
| November ..                                      | ..           | 597               | ..                      | 6                                       | 10              | 23                          | 38              | 23                              | 38              |
| December ..                                      | ..           | 568               | ..                      | 44                                      | 79              | 35                          | 61              | 27                              | 47              |

TABLE 46—continued.

## HUMAN AND RODENT PLAGUE, ETC.—continued.

| Year.       | Human Cases. | Rodents Examined. | Number Plague-Infected. | <i>(Laemopsylla)</i><br><i>Xenopsylla cheopis.</i>        |                 | <i>Ctenopsylla musculi.</i> |                 | <i>Ceratophyllus asiaticus.</i> |                 |
|-------------|--------------|-------------------|-------------------------|---|-----------------|-----------------------------|-----------------|---------------------------------|-----------------|
|             |              |                   |                         | Gross.  | Per 1,000 Rats. | Gross.                      | Per 1,000 Rats. | Gross.                          | Per 1,000 Rats. |
| 1921—       |              |                   |                         |   |                 |                             |                 |                                 |                 |
| January ..  | ..           | 433               | ..                      | 27  | 62              | 52                          | 120             | 23                              | 53              |
| February .. | ..           | 477               | ..                      | 40  | 84              | 15                          | 31              | 29                              | 61              |
| March ..    | ..           | 443               | ..                      | 17  | 38              | 3                           | 7               | ..                              | ..              |
| April ..    | ..           | 593               | ..                      | 40  | 67              | 41                          | 69              | 15                              | 22              |
| May ..      | ..           | 773               | ..                      | 52  | 67              | 85                          | 110             | 1                               | 1               |
| June ..     | ..           | 500               | ..                      | 34  | 68              | 51                          | 102             | 19                              | 38              |
| July ..     | ..           | 464               | ..                      | 49  | 106             | 83                          | 179             | 17                              | 37              |
| August ..   | ..           | 519               | ..                      | 26  | 50              | 12                          | 23              | 19                              | 37              |
| September   |              |                   |                         | Plague outbreak. See page 196 for continuation of record. |                 |                             |                 |                                 |                 |



## PART II.—THE INTER-EPIDEMIC PERIOD, 1910-1920

### CHAPTER XXIII.—MEASURES ADOPTED AGAINST THE INTRODUCTION OF PLAGUE, 1910-1920.

The first epidemic of plague in Australia covers a period of nearly ten years, commencing with the discovery of infection in Sydney in January, 1900, and terminating with the two cases reported in Mackay, Queensland, in June, 1909. In 1909, there were cases also in Sydney, Brisbane, and Adelaide.

No case of plague in man appeared again in Australia until 23rd August, 1921.

#### **Development of the Federal Quarantine System.**

The intervening years saw in Australia the abolition of the State systems of quarantine, the Commonwealth undertaking quarantine as a matter for which, by the Constitution, it was authorized to legislate. This was the consummation of the recommendations of the Australian Sanitary Conferences of Sydney, 1884 and 1896, convened when small-pox had become a question of quarantine importance to the Colonies, and also of the Intercolonial Plague Conference of 1900, which had taken the Vienna Convention of 1897 as a basis of discussion, but had recognized the importance of the rat as a factor in relation to plague more clearly than had the International Convention of 1897 (see Appendix A). The resolutions of these Australian Conferences had guided the quarantine legislation in the several States along more or less uniform lines of general policy, but in practice considerable overlapping and confusion had occurred prior to the advent of a federal form of control. The draft legislation for a Federal Quarantine Act was discussed in conference by the principal Health officers of the various States in 1904, and again in 1909, when various details of practical administration were laid down, the principles adopted not being divergent from the aims and objects of the International Sanitary Convention of Paris, to which the Commonwealth became a signatory in 1909. A quarantine service, a branch of the Department of Trade and Customs, but under the immediate control of a medical Director of Quarantine, was created to administer the provisions of the Quarantine Act, which came into force on 1st July, 1909. Quarantine regulations were proclaimed, prescribing the requirements and measures provided for in the Act.

In 1912, Dr. W. Perrin Norris, the first Director of Quarantine, made an official tour of inspection abroad, during which he visited and inquired into the quarantine organizations in the United States of

America, Canada, England, Germany, France, Egypt, Aden, Colombo, Singapore, Japan, Honolulu, and Manila. His report, "Quarantine in other countries and the quarantine requirements of Australia," appropriately formed the first service publication issued by the Federal Quarantine Service. In later years, other publications were compiled for the information of quarantine officers, dealing with various phases of quarantine administration and practical procedure. In connexion with plague, there were issued a descriptive pamphlet of the species of rodents found in Australia, and a review of recent literature on the epidemiology of plague, with original observations of practical points on rodent control on vessels and on shore, with especial reference to Australian conditions. From 1916 onwards, a fortnightly bulletin was circulated, summarizing for quarantine officers the latest reports concerning quarantinable diseases in overseas countries, with especial reference to plague and small-pox.

The Quarantine Act was amended in various particulars in 1912, 1915, and 1920, and the regulations corrected in accordance with recent developments in the practice and principles of disease control. Thus definite quarantine measures were provided against the introduction of plague, and were enforced at all ports by quarantine medical officers and a trained staff under the administrative control of a chief quarantine officer in each capital city, directly responsible to the Director of Quarantine. On 7th March, 1921, a Commonwealth Department of Health came into being, the quarantine service being incorporated as a division of marine hygiene, and carrying out, under the control of the Director-General of Health, the provisions of the Quarantine Act.

The operations of the quarantine service ensured a full medical inspection of all persons on every ship from oversea, whilst inquiries were initiated into the sanitary history of the voyage before pratique was granted. Included in the primary health report submitted by the master at the port of entry in Australia were the following questions:—

- (a) Is there now, or has there been during the voyage, any unusual number of rats or mice on board?
- (b) Have any dead or apparently sick rats or mice been found on board during the voyage?

A question was also asked as to whether during the voyage any person had been affected with any illness attended with glandular swelling. In regard to vessels from plague-infected ports, quarantine officers were instructed to obtain specific information as to the measures taken to prevent infection during the vessel's stay at those ports. Inquiry was made as to whether the vessel was berthed alongside a wharf or lay out in the stream; if the former, what steps were taken



to prevent the migration of rats to and from the vessel; if the latter, to and from the lighters; the nature of the cargo; whether the vessel was fumigated, and, if so, before or after the loading; whether any passengers were taken on board at the port; if so, whether inspected before embarkation; whether any passengers left the ship during its stay and visited the port; whether the passengers' effects and cargo were disinfected before being placed on board. Instructions were given to the masters of vessels as to the requirements of the berthing regulations in Australian ports, and an inspection instituted for evidences of rodent infestation, both in cargo likely to show such infestation, or in those special places in a vessel where these are likely to be found. As a routine, all second-hand clothing and all baggage of deck or steerage passengers from a proclaimed place was subjected to fumigation. The regulations in force very definitely provided for the measures which were to be adopted against the ingress to or egress from a vessel of rodents, and for the destruction of rodents which might exist on a vessel. These special measures were contained in Part IV. (Special Measures against Plague and Cholera) of the Quarantine Regulations 61 to 66A:—

61. (1) The master or owner of any vessel in any port in Australia shall—

- (a) effectively obstruct by means of stout netting or other means all openings or holes in the side of the vessel next to any wharf or lighter or other vessel, and shall keep them so obstructed while the vessel is alongside such wharf or lighter or other vessel;
- (b) affix and keep affixed an effective rat guard, disc, or screen not less than 1 foot or more than 3 feet from the side of the vessel to every rope or hawser connecting the vessel with any wharf or lighter or other vessel;
- (c) when so ordered by a quarantine officer, thoroughly illuminate, from sunset to sunrise, with electric or other brilliant lights, the whole of the side of the vessel next to the wharf or to any vessel or lighter lying alongside;
- (d) remove at sunset, and keep removed until sunrise, the landing stages and all nets and gangways between the vessel and any wharf, except during such time as those landing stages, nets, or gangways are required for the discharge or loading of cargo, or for access of persons to and from the vessel, and are actually being used for such discharge, loading, or access; and
- (e) take any other necessary and practicable measures to prevent the migration of rats to and from the vessel.

(2) No rat guard, disc, or screen shall be regarded as effective for the purpose of these Regulations unless it complies in all respects with the following requirements:—

- (a) it shall be circular in outline, formed in the shape of a cone, and shall measure not less than 6 inches from base to apex, and not less than 24 inches directly across any diameter of its base rim to rim;
- (b) it shall be made of sheet metal of at least 26 gauge, without any opening or perforator, except as hereafter specified;
- (c) it shall be so constructed that when fitted the apex of the cone shall point away from the vessel and the rope or hawser shall pass through the apex of the cone and the centre of the base, and all openings in the disc, screen, or guards shall be effectively closed.

62. The master or owner of any vessel in any port in Australia shall—

- (a) thoroughly empty, or flush out and empty, the bilges prior to berthing the vessel;
- (b) keep all foodstuffs and food refuse in rat-proof and mouse-proof receptacles, rooms, or compartments;
- (c) prevent the discharge of any organic refuse, galley scraps, and waste from the vessel on to the wharfs or into the waters of the port;
- (d) maintain on board and use effective means for the destruction of rats and mice; and
- (e) when so ordered by a quarantine officer, lay on the vessel poison baits effective for rats and mice.

63. The master or owner of any vessel in any port in Australia shall, if so ordered by a quarantine officer—

- (a) submit any part or the whole of the vessel to sulphur fumigation as prescribed, or to some other approved method of fumigation, or to such trapping or poisoning operations for the destruction of rodents as are specified in the order. If so directed by the quarantine officer, the fumigation or trapping or poisoning operations for the destruction of rodents shall be carried out while the vessel is alongside a wharf or while the vessel is in stream, and either before or after the cargo has been discharged;
- (b) wash or spray thoroughly with the prescribed insecticidal solution all portions of the vessel likely to harbor or to afford a shelter for fleas, lice, bugs, and other vermin;



- (c) empty and flush or disinfect and clean all lavatories, water tanks, or any closed space on board the vessel:

Provided that in any case where there is reasonable cause to apprehend that the vessel may be endangered by the removal of water ballast, the quarantine officer may cause any tank or other receptacle to be sealed; and thenceforward, so long as the vessel remains within the port, the master shall prevent the breaking or removal of the seal or the discharge or removal from the tank or receptacle of any part of the water ballast except with the written permission of the quarantine officer;

- (d) cause to be disinfected or fumigated any articles specified by the quarantine officer;
- (e) remove and re-stow or re-arrange, in such a manner as to prevent access or harbourage of rats or mice, any dunnage, rubbish, or deck cargo;
- (f) remove, open up, or otherwise render thoroughly accessible to fumigation any linings, casings, partitions, lockers, and similar enclosed spaces above or below deck;
- (g) protect effectively against the passage of rats or mice all openings, other than doors or hatches, which are liable to afford communication for rats from any hold or cargo space to any other part of the vessel; and
- (h) protect effectively against the passage and harbourage of rats or mice any specified opening or place, whether below or above deck.

63A. The master or owner of any vessel in any port in Australia shall, when the vessel is about to undergo overhaul or to be docked for repairs, or for any other purpose, give notice to that effect to the quarantine officer at least twenty-four hours before the beginning of any such overhaul or before the vessel is taken to the dock.

64. The master or owner of any vessel on arrival at any port in Australia from a place proclaimed infected with plague, or as a place from or through which plague may be carried, shall—

- (a) submit the vessel to fumigation and other treatment as prescribed for the destruction of rats, mice, and other vermin:

Provided that the vessel may be exempted from fumigation if the master produce—

- (i) a certificate showing that at the port of departure the vessel, while empty or after loading for the current voyage, was fumigated as prescribed; and

- (ii) a certificate or certificates showing that at the port of departure (if a proclaimed place), and at every proclaimed place subsequently called at, effective measures were taken to prevent the migration of rats to the vessel. The measures adopted shall be specified in the certificate.

The certificate or certificates in each case shall be signed by the Port Health Officer or local quarantine officer if the proclaimed place is within the British Dominions, or be endorsed by the British Consul if the proclaimed place is a foreign port or country:

Provided further that in the absence of such certificates the vessel may, if no plague-infected rats or mice have been found on board, be exempted from fumigation at any port of call in Australia excepting the terminal port;

- (b) if so ordered by a quarantine officer, discharge the cargo into lighters in stream.

65. The following processes are prescribed:—

- (a) For the destruction of rats and mice in closed spaces in vessels—thorough sulphur fumigation for at least eight hours with a gaseous mixture containing not less than three parts per centum of sulphur oxides. The fumigation shall, wherever practicable, be effected by passing sulphur fumes under pressure into the closed space, the contained air being at the same time partially exhausted;
- (b) for the destruction of insects and other vermin in vessels—sulphur fumigation as prescribed, or thorough application of an aqueous solution or emulsion of soft soap, cyllin, and kerosene, containing of each one part per centum. The application must be made by means of a mop or scrubbing brush or similar appliance, or by forcibly spraying the mixture into all places infested with or suspected of being infested with fleas, lice, bugs, or similar insects or vermin.

66. For the purpose of these Regulations, “wharf” includes any pier, stage, landing place, jetty or similar structure, foreshore, or place at which a vessel may lie.

### **Control of Rodents on Vessels.**

For practical routine purposes, quarantine regulation 64 in regard to the fumigation of vessels from infected oversea ports, was interpreted to ensure that every vessel from oversea was fumigated when empty at the terminal port called at in Australia. Sulphur-dioxide was used as a routine, a barge installed with a Clayton machine being available at Fremantle, and barges with the Ritchie modification of the Clayton



machine at Sydney and Brisbane. Otherwise, the tub method was adopted, and with intelligent supervision gave satisfactory results. Hydrocyanic gas and the Harker carbon-monoxide method were tried in an experimental way, and were used on occasion under special circumstances.

On coastwise vessels trading either between inter- or intra-state ports, fumigation was effected at least once every three months. During the stress of the war-time period it was found necessary to extend this period to six months, which is in accordance with the period specified in article 26 of the Paris Sanitary Convention.

Systematic trapping and poisoning were, in addition, carried out on both oversea and coastwise vessels, either at regular intervals or as occasion demanded.

The following table summarizes the fumigations of vessels carried out by the quarantine service in the more important ports of the Commonwealth from 1916 onwards:—

TABLE 47.  
RETURN OF VESSELS FUMIGATED.

| State.               | Port.            | 1916. | 1917. | 1918. | 1919. | 1920. | To 30th<br>September<br>1921. |
|----------------------|------------------|-------|-------|-------|-------|-------|-------------------------------|
| Victoria .. ..       | Melbourne ..     | 346   | 248   | 310   | 283   | 268   | 215                           |
|                      | Geelong .. ..    | ..    | ..    | ..    | 29    | 6     | 19                            |
| New South Wales ..   | Sydney .. ..     | 714   | 628   | 712   | 710   | 743   | 669                           |
|                      | Newcastle ..     | 137   | 151   | 67    | 68    | 273   | 186                           |
| Queensland .. ..     | Brisbane .. ..   | 102   | 80    | 99    | 67    | 120   | 102                           |
|                      | Townsville ..    | 35    | 49    | 35    | *     | *     | 35                            |
|                      | Cairns .. ..     | 22    | 12    | 10    | *     | *     | 4                             |
|                      | Darwin .. ..     | ..    | 13    | 7     | *     | *     | 2                             |
|                      | Thursday Island  | 8     | 85    | 87    | *     | *     | 60                            |
|                      | Rockhampton ..   | 11    | 3     | *     | *     | *     | 2                             |
|                      | Mackay .. ..     | 1     | *     | *     | *     | *     | *                             |
| South Australia ..   | Adelaide .. ..   | 15    | 39    | 57    | 127   | 78    | 87                            |
|                      | Port Pirie .. .. | 27    | 24    | 17    | 43    | 26    | 17                            |
|                      | Wallaroo .. ..   | 1     | 12    | 9     | 27    | 10    | 12                            |
|                      | Port Lincoln ..  | ..    | 4     | 1     | 2     | 4     | 8                             |
|                      | Port Victoria .. | ..    | 6     | ..    | ..    | 3     | 2                             |
| Western Australia .. | Port Augusta ..  | 1     | 2     | ..    | ..    | ..    | ..                            |
|                      | Fremantle .. ..  | 39    | 95    | 78    | 78    | 97    | 45 and<br>all<br>barges       |
|                      | Bunbury .. ..    | 13    | 7     | 5     | 31    | 47    | 43                            |
|                      | Busselton .. ..  | 1     | ..    | ..    | ..    | ..    | 5                             |
|                      | Albany .. ..     | 1     | 2     | 2     | 1     | 4     | 1                             |
|                      | Geraldton .. ..  | 2     | ..    | ..    | ..    | 1     | ..                            |
| Tasmania .. ..       | Broome .. ..     | ..    | 12    | 3     | ..    | ..    | ..                            |
|                      | Hobart .. ..     | 4     | 36    | 49    | 33    | 19    | 25                            |
| Grand Total .. ..    |                  | 1,480 | 1,508 | 1,548 | 1,499 | 1,699 | 1,539                         |

\* Complete figures for outports in Queensland are not available for the years 1919, 1920, and 1921.

Examination of rats trapped or killed by fumigation during the period under review failed to find any evidence of plague infection.

### Control of Rodents on Shore.

The rat-proofing of premises and rodent destruction and examination on shore (which included wharfs and water frontages) remained a province of the State Health Departments, and was either carried out by the Departments concerned, or delegated to the local authorities under the several State Health Acts. In Sydney, both State and municipal rat-staffs operated and submitted rodents for examination to the State microbiological laboratory. In Queensland, rodent destruction and rat-proofing of premises passed from the State Health Department to the local authorities under the *Rat and Mosquito Prevention and Destruction Regulations* 1916. A rat gang continued, however, to be employed by the State Health Department to deal with Government property, shipping companies' wharfs, and meat works in Brisbane.

The records of rat destruction and examination for the several States are not complete, excepting those for Sydney, which have already been shown on page 104. The following tables give the number of rodents examined in Queensland during the period under review, and the available records of species of rodents examined, from Brisbane, 1909-12, and from Townsville, 1912-15, at which latter date the northern office of the State Health Department was abolished.

Routine weekly statements of the results of rat examination were made by the Health Departments of the several States to the Commonwealth Quarantine Service. During this period no infected rodent was reported in Australia. A mention should be made of the fact that on 7th April, 1914, the Health Department of Queensland reported that two smears of rat-spleens from Townsville showed bacilli "suspicious of plague." Inquiry showed no evidence of rat-plague epizootic in Townsville. Ultimately the Director of the Laboratory of Microbiology decided the microscopic appearance of the bacilli did not justify a diagnosis of plague.



TABLE 48.

## EXAMINATION OF RODENTS† FOR PLAGUE.—QUEENSLAND.

(From Annual Reports of Commissioner of Public Health.)

| Fiscal Year.<br>1st July to<br>30th June. | Brisbane.   |       |        |                | Townsville.  |       |        |                | Cairns. |       |        |                | Maryborough. |       |        |                | Bundaberg. |       |        |                |
|---|---|-------|--------|----------------|--|-------|--------|----------------|---------|-------|--------|----------------|--------------|-------|--------|----------------|------------|-------|--------|----------------|
|   | Rats.   | Mice. | Total. | In-<br>fected. | Rats.  | Mice. | Total. | In-<br>fected. | Rats.   | Mice. | Total. | In-<br>fected. | Rats.        | Mice. | Total. | In-<br>fected. | Rats.      | Mice. | Total. | In-<br>fected. |
| 1909-1910                                 | 21,489  | 3,284 | 24,773 | ..             | 2,580  | 156   | 2,736  | ..             | 271     | 7     | 278    | ..             | 2,392        | 615   | 3,007  | ..             | 1,132      | 48    | 1,180  | ..             |
| 1910-1911                                 | 28,066  | 2,479 | 30,545 | ..             | 2,936  | 220   | 3,156  | ..             | 406     | 3     | 409    | ..             | 4,369        | 756   | 5,125  | ..             | 1,093      | 32    | 1,125  | ..             |
| 1911-1912                                 | 24,703  | 1,919 | 26,622 | ..             | 2,741  | 198   | 2,939  | ..             | ..      | ..    | ..     | ..             | 4,930        | 827   | 5,757  | ..             | 832        | 27    | 859    | ..             |
| 1912-1913                                 | 8,420   | 755   | 9,175  | ..             | 4,038  | 38    | 4,076  | ..             | ..      | ..    | ..     | ..             | 4,034        | 771   | 4,805  | ..             | 703        | 93    | 796    | ..             |
| 1913-1914                                 | 9,165   | 653   | 9,818  | ..             | ..   | ..    | 2,913* | ..             | ..      | ..    | ..     | ..             | 4,420        | 715   | 5,135  | ..             | 840        | 36    | 876    | ..             |
| 1914-1915                                 | 6,060   | 866   | 6,926  | ..             | ..   | ..    | 2,223* | ..             | ..      | ..    | 928*   | ..             | ..           | ..    | ..     | ..             | ..         | ..    | 2,050* | ..             |
| 1915-1916                                 | 9,084   | 677   | 9,761  | ..             | ..   | ..    | 1,701* | ..             | ..      | ..    | 754*   | ..             | ..           | *     | 544*   | ..             | ..         | ..    | 1,278* | ..             |
| 1916-1917                                 | 1,823   | 259   | 2,082  | ..             | ..   | ..    | 563*   | ..             | ..      | ..    | 545*   | ..             | ..           | *     | 658*   | ..             | ..         | ..    | 1,035* | ..             |
| 1917-1918                                 | ..  | ..    | ..     | ..             | Not available.   |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |
| 1918-1919                                 | 1,143   | 45    | 1,198  | ..             | Total smears from extra-metropolitan ports, 2,750. Nil positive for <i>B. pestis</i> . |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |
| 1919-1920                                 | 1,365   | 56    | 1,421  | ..             | ..   | ..    | 810*   | ..             | ..      | ..    | 262*   | ..             | ..           | ..    | 326*   | ..             | ..         | ..    | 836*   | ..             |
| 1920-1921                                 | Total examinations of plague specimens from Brisbane and Northern Seaport towns: 3,826, all negative. |       |        |                |  |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |
| Fiscal Year.<br>1st July to<br>30th June. | Gladstone.  |       |        |                | Rockhampton.   |       |        |                | Mackay. |       |        |                | Bowen.       |       |        |                | Ipswich.   |       |        |                |
|   | Rats.   | Mice. | Total. | In-<br>fected. | Rats.  | Mice. | Total. | In-<br>fected. | Rats.   | Mice. | Total. | In-<br>fected. | Rats.        | Mice. | Total. | In-<br>fected. | Rats.      | Mice. | Total. | In-<br>fected. |
| 1909-1910                                 | 14  | 2     | 16     | ..             | 3,149  | 458   | 3,607  | ..             | ..      | ..    | 1,358* | 5              | ..           | ..    | ..     | ..             | 333        | ..    | 333    | ..             |
| 1910-1911                                 | ..  | ..    | ..     | ..             | 4,635  | 704   | 5,339  | ..             | ..      | ..    | 1,510  | ..             | 728          | ..    | 728    | ..             | ..         | ..    | ..     | ..             |
| 1911-1912                                 | ..  | ..    | ..     | ..             | 5,158  | 556   | 5,714  | ..             | ..      | ..    | ..     | ..             | ..           | ..    | ..     | ..             | ..         | ..    | ..     | ..             |
| 1912-1913                                 | ..  | ..    | ..     | ..             | 4,073  | 189   | 4,262  | ..             | ..      | ..    | 1,144* | ..             | ..           | ..    | ..     | ..             | ..         | ..    | ..     | ..             |
| 1913-1914                                 | ..  | ..    | 81*    | ..             | 3,945  | 104   | 4,049  | ..             | ..      | ..    | 826*   | ..             | ..           | ..    | 96*    | ..             | ..         | ..    | ..     | ..             |
| 1914-1915                                 | ..  | ..    | ..     | ..             | ..   | ..    | 298*   | ..             | ..      | ..    | 566*   | ..             | ..           | ..    | ..     | ..             | ..         | ..    | ..     | ..             |
| 1915-1916                                 | ..  | ..    | ..     | ..             | ..   | ..    | 1,276* | ..             | ..      | ..    | 515*   | ..             | ..           | ..    | 97*    | ..             | ..         | ..    | ..     | ..             |
| 1916-1917                                 | ..  | ..    | ..     | ..             | ..   | ..    | 389*   | ..             | ..      | ..    | 556*   | ..             | ..           | ..    | ..     | ..             | ..         | ..    | ..     | ..             |
| 1917-1918                                 | ..  | ..    | ..     | ..             | Not available.   |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |
| 1918-1919                                 | ..  | ..    | ..     | ..             | Total smears from extra-metropolitan ports, 2,750. Nil positive for <i>B. pestis</i> . |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |
| 1919-1920                                 | ..  | ..    | ..     | ..             | ..   | ..    | 182*   | ..             | ..      | ..    | 104*   | ..             | ..           | ..    | ..     | ..             | ..         | ..    | ..     | ..             |
| 1920-1921                                 | See above   |       |        |                |  |       |        |                |         |       |        |                |              |       |        |                |            |       |        |                |

\* Smears examined at Laboratory of Microbiology, Brisbane.

† Species of rodents not available.



TABLE 49.

SPECIES OF RODENTS RECORDED AT BRISBANE, 1909-1912, AND AT TOWNSVILLE, 1912-1915.

| Fiscal Year. |    |    |    | <i>M.<br/>decumanus.</i> | <i>M.<br/>rattus.</i> | <i>M.<br/>alexandrinus.</i> | Total. |
|--------------|----|----|----|--------------------------|-----------------------|-----------------------------|--------|
| Brisbane—    |    |    |    |                          |                       |                             |        |
| 1909-1910    | .. | .. | .. | 13,075                   | 3,037                 | 5,367                       | 21,479 |
| 1910-1911    | .. | .. | .. | 20,121                   | 2,971                 | 4,247                       | 27,339 |
| 1911-1912    | .. | .. | .. | 9,540                    | 1,497                 | 1,364                       | 12,401 |
| Townsville—  |    |    |    |                          |                       |                             |        |
| 1912-1913    | .. | .. | .. | 1,115                    | 259                   | 73                          | 1,447  |
| 1913-1914    | .. | .. | .. | 2,509                    | 117                   | 273                         | 2,899  |
| 1914-1915    | .. | .. | .. | 2,005                    | 140                   | 145                         | 2,290  |

### Notification of Cases of Plague on Shore.

Section 87 (e) of the Commonwealth *Quarantine Act* 1909 provides for "notification to a quarantine officer of each case of a quarantinable disease which arises in Australia, or within any specified part of Australia, or within any quarantine area."

Regulation 58 (a) prescribes that "every medical practitioner in Australia, on becoming aware of or suspecting the existence of quarantinable disease affecting any of his patients in any part of Australia shall immediately report the case by telegram or by the speediest means available to the Chief Quarantine Officer in the State in which the case occurs."

"Quarantinable diseases" are defined as meaning plague, cholera, yellow fever, typhus fever, or leprosy, or any disease declared by proclamation.

In addition, under the several State Health Acts, plague is a notifiable disease.

During the period 1910-1920, no confirmed case of plague occurred. Two suspected cases, negative on bacteriological examination, were reported in Queensland in the fiscal year 1910-11, and in the reports of the Laboratory of Microbiology, which are contained in the Annual Reports of the Commissioner of Health for Queensland, the following examinations of specimens for human plague were reported:—

TABLE 50.

| Report for year ended. | Specimen.                 | Number. | Result of Examination. |
|------------------------|---------------------------|---------|------------------------|
| 30th June, 1910        | Lymph .. .. .             | ..      | ..                     |
|                        | Sputum .. .. .            | 8       | All negative           |
|                        | Viscera .. .. .           | ..      | ..                     |
| " 1911                 | From two suspected cases  | ..      | Negative               |
|                        | Agar culture .. .. .      | 1       | "                      |
| " 1913                 | Blood and lymph .. .. .   | 1       | "                      |
|                        | Blood and culture .. .. . | 1       | "                      |
| " 1916                 | Human* (no other record)  | 2       | "                      |
| " 1919                 | Sputum .. .. .            | 1       | "                      |

\* Presumably refers to suspected case from s.s. *Empire* (see page 127).



## CHAPTER XXIV.

## Plague on Vessels in Australia, 1910-1920.

The adoption of uniform quarantine practice in all ports of Australia under the control of Commonwealth Quarantine Service resulted in the compilation of uniform records, and, therefore, the histories of vessels quarantined for plague during this period are for the most part complete. Quarantine of vessels for plague was reported on six occasions, one vessel having cases of plague on board on three different voyages, while three vessels were handled in quarantine as under suspicion for plague. The histories of these quarantines are set out hereunder:—

1912. *Taiyuan* (steamship of 1,439 tons. Crew—13 European, 61 Chinese. Passengers—3 second cabin, 10 steerage. Total souls on board, 87).—This vessel left Hong Kong on 15th May, 1912, calling at Manila (18th May) and Zamboanga (20th May), and arrived at Darwin on 26th May. On inward medical inspection by the quarantine officer at Darwin, the surgeon of the vessel reported two cases of illness, one of mumps in a Chinese child, *ætatis* 2, and a case of cellulitis of the supraclavicular region in a Chinese fireman, *ætatis* 39, who had joined the vessel at Hong Kong on 14th May. This latter case had a temperature of 103 degrees, and had been sick since 23rd May, but his general condition was reported on by the quarantine officer as "quite well." He was landed for surgical treatment, together with the case of mumps, into isolation at the Darwin Hospital.

After the departure of the vessel for Thursday Island, the question of the case of cellulitis being one of plague was raised, and on examining a smear from the abscess, bacilli resembling *B. pestis* were seen, and confirmed on cultural examination. The case was quarantined in an isolated hut at the hospital. He developed pneumonic symptoms on 28th May, and died on 29th May. Post-mortem examination showed a double pneumonia, smears from the cut lung showing *B. pestis* in abundance. The spleen was enlarged. The body was cremated, and action taken to prevent any spread of infection at the hospital. The case of mumps from the vessel proved definitely to be one of a double parotitis, and there was no question of plague.

The vessel arrived at Thursday Island on 29th May, where the quarantine officer, having been advised by telegram of the circumstances at Darwin, ordered the vessel into quarantine. Full medical inspection showed no further illness on board. The crew's quarters were fumigated with sulphur and washed down with a carbolic solution. Cargo was lightered, and local passengers landed to the quarantine station for disinfection and detention for the prescribed period of seven days. Careful inquiry did not reveal any evidence of infected rodents on board.

The vessel called at Cairns (31st May), and at Townsville (1st June), medical inspection at the ports showing no further case of illness. At Townsville, cargo, mails, and baggage were lightered and fumigated, and two local passengers released under surveillance after personal disinfection. The vessel left in quarantine on the following day for Sydney direct. On passing Cape Moreton on 4th June, the master reported by signal "all well."

On arrival at Sydney on 5th June, the vessel was kept in the stream. Medical inspection showed no further illness, and passengers were released under surveillance. A thorough search for rats was instituted. Sulphur fumigation was carried out in the holds for seventeen hours, and in the forepeak, seamen's and firemen's quarters, and second and third-class accommodation for eight hours. Saloon and first-class cabin accommodation and officers' quarters were fumigated with formaldehyde gas for six hours. No dead rats were found after fumigation. One rat caught on trapping was examined, and found not infected. A bag of peanuts in No. 1 hold only showed signs of rat infestation and was burnt. Cargo was then discharged into lighters, and the vessel, after taking in coal, left for Melbourne.

The vessel arrived at Melbourne on 10th June. Medical inspection showed no sickness on board. The discharge of cargo was closely supervised, and rats watched for without result.

The bills of health for this voyage showed that for the week ended 13th May Hong Kong reported 149 cases and 132 deaths from plague.

1913. *Taiyuan*. (Crew—12 European, 62 Asiatic. Passengers—13 saloon, 19 second, 19 third cabin, 20 deck. Total souls on board, 145).—The history of this voyage showed that the vessel arrived from Australian ports at Hong Kong on 24th April, 1913, and discharged cargo into lighters in the stream. On 26th April, the vessel proceeded to Taikoo Dock, and remained in dock until 7th May. The vessel then proceeded to an anchorage in the stream, and was fumigated with sulphur for twelve hours when empty (holds and crew's quarters) on 8th May. Cargo was taken on from lighters, and the vessel left Hong Kong on 10th May, called at Manila on 14th May, and Zamboanga (15th-16th May), and arrived at Darwin on 21st May. On 18th May, a Chinese fireman had complained of headache and constipation, temperature 104 degrees, and there was enlargement of the femoral and inguinal glands on both sides. He gave a history of syphilis ten years previously. He was isolated on board. On arrival at Darwin (21st May), his temperature was 103 degrees, and a smear taken from the glands was negative for pestis. Pratique was limited, and cargo and mails were landed and disinfected without direct communication between ship and shore. One local passenger was landed under surveillance. The vessel left Darwin on 22nd May, and arrived at Thursday Island on 25th May.



The patient had a normal temperature and pulse, and showed no prostration, but the glands in both femoral and inguinal regions were enlarged, without tenderness, redness, or œdema. A smear from a puncture was negative. Another member of the crew, a Chinese storekeeper *ætatis* 33, had had a temperature of 102 degrees, sick since 20th May, but without other suspicious symptoms. He was isolated on board. He had occupied the same quarters as the original case in the firemen's quarters amidships with 16 other men. His bunk was near the entrance, that of the original case in the middle, against a bulk-head. The ship sailed the same day without touching at the port, mails being disinfected and landed by launch, and ten local passengers landed under surveillance.

On 26th May, a Japanese passenger who had landed at Thursday Island from the vessel, developed a temperature of 104 degrees with enlarged femoral glands. He was isolated, and the other passengers detained at the quarantine station. On 27th May, three more of the contacts developed temperatures over 100 degrees, common ailments being excluded and glands shown enlarged in all. On bacteriological examination, bipolar staining organisms could not be demonstrated, but the quarantine officer made a provisional diagnosis of "pestis minor."

The Chinese storekeeper on the vessel developed enlarged femoral and inguinal glands, but on arrival at Townsville, on 28th May, these two cases on board showed normal temperatures and nothing except some slight indication of the femoral glands. These two cases, together with fourteen local and over-carried Cairns passengers, were landed at the quarantine station. Third-class accommodation and crews' quarters were fumigated, and cargo and mails lightered for fumigation. The vessel sailed in quarantine direct for Sydney on the night of 28th May. Smears from gland puncture in the two cases landed were negative for pestis.

The vessel arrived at Sydney late on the evening of 2nd June, and proceeded to the quarantine anchorage on the morning of 3rd June. Full medical inspection was carried out with a glandular examination of all Chinese crew and passengers. No cases of illness were shown on board. European passengers were bathed and disinfected with their effects and were released under surveillance. The Chinese passengers were landed into detention at the quarantine station. The holds of the vessel were fumigated and the cargo lightered. A careful search discovered only one rat, which was negative for plague infection on examination. The vessel left for Melbourne on 8th June without any subsequent development. The original cases, which had been landed at Townsville, convalesced without complications.

The sickness which had developed amongst passengers landed at Thursday Island did not extend to other contacts. The original case

amongst these passengers developed hæmorrhages from the mucous membranes of the mouth, conjunctiva and sclera of eyes, with a subcutaneous hyperæmia, dusky in appearance, obliterated by pressure, over both extremities. By 30th June, however, his condition had improved, the glands resolved, and he quickly recovered. In the other three cases the temperature remained up for a few days, but fell as the glands resolved. Leucocytes only were demonstrated in further smears from gland puncture.

The passengers held in quarantine detention were released at each port on expiration of the quarantine period of seven days.

There was a marked decrease in plague registered in Hong Kong during 1913—408 cases occurring, compared with 1,847 in 1912, and 249 rodents found infected, compared with 390 in 1912.

1914. *Taiyuan* (Crew—11 European, 63 Asiatic. Passengers—2 saloon, 7 second cabin, 39 steerage. Total souls on board, 122).—On this voyage this vessel was fumigated with sulphur for twelve hours at Hong Kong on 7th July, 1914, and sailed from Hong Kong on 11th July, calling at Manila on 14th July, and at Zamboanga on 16th July. On the morning of 14th July, a Chinese fireman reported sick with a temperature of 105.8 degrees. On 15th July, his temperature was 104 degrees, pulse good, and he was diagnosed as a case of typhoid fever. On 16th July, at Zamboanga, his condition was unchanged, and he was landed to hospital, where, on the following day, a diagnosis was made of septicæmic plague. The case proved fatal. The vessel left Zamboanga on 18th July without disinfection, excepting fumigation of the crew's quarters by the ship's officers on 17th July. The vessel arrived at Thursday Island on 25th July. No sickness was found on board; but, in view of the history of the voyage, the vessel was quarantined and cargo lightered for fumigation, and passengers and their effects released under surveillance after disinfection. The vessel left Thursday Island on 26th July, and arrived at Townsville on 29th July, where no further sickness was found. Five local passengers were landed under surveillance, and baggage and mails disinfected. The vessel left the same day for Sydney, after taking in water. On arrival at Sydney, on 3rd August, full medical inspection and glandular examination of all Asiatics showed no further sickness on board. Cargo was lightered under close supervision, and the vessel was fumigated throughout when empty. No rats were found, nor traces of rat infestation in the closely supervised cargo. Melbourne cargo was reshipped, and the vessel sailed for Melbourne without later developments. The bills of health carried on this voyage showed that Hong Kong, for the week ended 8th July, had 21 cases and 17 deaths from plague, and Zamboanga was clean. During this year, Manila reported only scattered cases of plague, 26 in all for the whole year, with 29 infected rodents among 118,282 examined.



### Suspected Plague on Vessels.

1915. *Empire* (Steamship, 4,496 tons).—This vessel had left Melbourne, Sydney, and Newcastle on an outward voyage, and on arrival at Brisbane, on 2nd September, 1915, signalled for the quarantine officer in the bay. A Chinese, number one boy on the steward's staff, had eleven days previously developed illness with headache, pain in lower abdomen, with enlarged gland in left inguinal region. On examination, on 2nd September, temperature was normal, a superficial inguinal gland on the left side was enlarged to the size of a small hen-egg, tender, skin reddened, no fluctuation. Several glands in the femoral chain were palpable. There was no obvious lesion present in the area of drainage of these glands. The case was landed to the quarantine station pending the result of a laboratory examination of a gland puncture. European passengers and crew were released under surveillance. An inspection for signs of rats was made, and only a very few and slight traces of infestation were found in the quarters. The vessel was allowed alongside to work cargo, and on the receipt of a negative report from the laboratory in regard to the case, all quarantine restrictions were raised and the case returned on board.

*Mataram* (Steamship, 3,278 tons).—This vessel, from Singapore, via Soerabaya and Darwin, arrived at Thursday Island on 12th November, 1915. One Malay member of the crew was reported to be suffering from strangulated hernia. He was first seen by the surgeon on 11th November, when he had a temperature of 102.5 degrees, pulse 103, with spasmodic pain about the umbilicus and over the swelling. On examination by the quarantine officer, on 12th November, his temperature was 99.9 degrees, pulse 95, and there was a hard round swelling the size of a goose-egg in the right inguinal region, firmly fixed to structures behind, and not palpable through the inguinal canal. There were hard discrete glands in the left groin. There was no local lesion to account for a glandular swelling. His general condition was excellent. As *pestis ambulans* could not be definitely excluded, pratique was limited, and no communication was allowed between the vessel and shore. Cargo was lightered and fumigated, and one passenger landed for release under surveillance. The case was landed to the isolation ward at the hospital. An incision was made in the swelling, and revealed a homogeneous bound-down mass of glands with small collections of pus. There was no hæmorrhage into the glands or surrounding tissues. A smear from the glands was negative for pestis. From 16th November, the temperature declined, and the glands drained and subsequently healed, the patient only complaining of continued weakness. A diagnosis of acute lymphadenitis from a pyogenic organism was made. The vessel arrived at Cairns on 14th November, and at Townsville on 16th November. At this latter port, the crew's quarters and third-class accommodation were fumigated, and cargo lightered. At

Brisbane, on 20th November, there was no further illness on board, and no traces of rat infestation found, either in holds or cargo, on careful search and supervision of discharged cargo. No further developments occurred on the vessel.

*Eastern* (Steamship, 3,586 tons).—This vessel left Kobe on 22nd October, 1915, after fumigation, and called at Moji (28th October), Hong Kong (1st-4th November), and Dilly, Timor (12th November). The vessel was cleared at Darwin on 14th November, and extended pratique up to Brisbane granted at Thursday Island on 17th November. The vessel, therefore, arrived at Cairns on 20th November without inward medical inspection. After arrival, Mrs. G. B., a second-class female passenger, reported to the surgeon with pain in the groin. She had previously reported, on 17th November with pain in the pelvis and scalding on micturition, relieved on treatment. She had come from Shanghai, and boarded the vessel at Hong Kong on 3rd November. The case was reported to the quarantine officer at Cairns, who found the woman suffering from an inflamed and tender gland in the left inguinal region, temperature 98.8 degrees. He ordered the vessel into quarantine to proceed to Townsville, where on arrival, on 21st November, the bacteriological examination of a smear from a gland puncture was negative. Pratique was granted for that port, and the vessel left for Brisbane on 22nd November.

On 22nd November, the quarantine officer, Cairns, reported that a Russian female, Mrs. E., a third-class passenger, who had landed from the vessel, was reported ill at a local boarding-house, with a temperature of 99 degrees, pulse 100, and a large inflamed tender gland in the groin, without any obvious lesion to account for it. The case was removed to the isolation hospital, and the boarding-house quarantined. Cargo from the vessel was traced and fumigated, and a vigorous rat campaign initiated. Contacts were disinfected and released under surveillance. A smear from gland puncture of the case proved negative, and this was verified on subsequent examination at the Australian Institute of Tropical Medicine, Townsville.

The vessel arrived at Brisbane on 24th November, and was again ordered into quarantine. Mrs. G. B. was landed to the quarantine station, and local passengers released under surveillance after disinfection. The second, third, and deck passengers' accommodation and the crew's quarters were fumigated. Cargo was lightered under supervision, and, excepting packages likely to be damaged, was fumigated. Meanwhile all cargo landed at Queensland ports (Townsville and Cairns) was traced and fumigated, and contacts released under surveillance after disinfection. The vessel left Brisbane for Sydney on 25th November.

On arrival at Sydney, 27th November, a medical inspection and glandular examination of all Asiatics showed no further sickness on



board. Cargo was discharged under supervision, no rats or traces of rat infestation being discovered, nor were any rats obtained on trapping. The routine fumigation of the baggage of steerage passengers was carried out.

Further examination of Mrs. G. B. at the Brisbane Quarantine Station showed a negative result on examination of a gland puncture. A diagnosis was made of suppurative salpingitis characterized by an intense pelvic inflammation with a vaginal discharge, with secondary enlargement of the inguinal glands. The case was therefore removed to the Brisbane General Hospital.

Vessels were detained in 1911, 1913, 1914, 1915, 1916 on account of members of the crew who, on examination, were discovered to have enlarged glands. Further investigation excluded a diagnosis of plague, and search of the vessels revealed no evidence of rat-plague. In this connexion, it may be noted that considerable diagnostic difficulties often confront the quarantine officers in giving a definite decision in connexion with cases of climatic bubo occurring in members of the crews of vessels from Asiatic ports.

In March, 1918, the s.s. *Montoro* arrived at Thursday Island from Singapore via Java ports, Koepang, and Darwin. After leaving Darwin six cases of pneumonia, with four deaths, occurred amongst Javanese coolie deck passengers. Special consideration was given with a view to determining the possible risk of plague having been a factor in the pneumonia. Careful investigation at Thursday Island, Townsville, and Brisbane, and the clinical history of the two survivors, appeared to exclude plague with reasonable certainty.

The histories of these vessels show in a clear manner the administrative difficulties which may arise in the control of plague reported on ship-board. Of those three types of vessels which are liable to require treatment for an epidemic or epizootic of plague, under which categories vessels quarantined during the 1900-1909 epidemic were discussed (page 78), the *Taiyuan*, in 1912 and 1914, came within the first category, the cases having possibly been infected on shore. It is worthy of notice, however, that in the 1912 quarantine the illness is reported to have developed eight days after the vessel left Hong Kong, and nine days after the man had joined the vessel. This 1912 quarantine is the only instance in which *bacilli pestis* were demonstrated in Australia, either in man or rodents, during this period. No vessel during this period comes within the second category, vessels on which epizootic occurred without cases in man. Of the third category, over this period of eleven years there is no clear-cut history of a concurrent epidemic and epizootic on board vessels, such as occurred on the *Burwah* and *Eulomene* in Australia in 1900 and 1902, or such as has been reported on several occasions on vessels making the longer

voyage from the Orient to Europe. In the 1913 quarantine of the *Taiyuan*, if the cases be accepted as cases of plague, evidence would point to a focus of infection on board, but the occurrence of an epizootic on board, or the presence of infected fleas, cannot be determined. It is significant that on each of these three occasions the vessel left Hong Kong during the months of May or June.

Of those cases of suspected plague on the three vessels concerned, plague can be ruled out on reviewing the histories of these quarantines, although the administrative measures adopted at the time can be endorsed as necessary.

In 1919 the port health officer at Bombay reported that the s.s. *Malta* arrived at that port on 26th March, 1919, with one of the crew suffering from plague of 48 hours' duration, and with rats dying in large numbers in No. 1 hold. The rat mortality was proved bacteriologically as due to plague. The vessel had come from Wellington, New Zealand, via Sydney (26th February), Newcastle (28th February), Fremantle (9th March), and Colombo (29th March). At Sydney the vessel had loaded 200 tons of wheat from lighters in the stream, and coaled from lighters at Colombo. The recent epizootic on arrival would indicate that infection in this instance had come on board the vessel at Colombo.

It is shown on page 119 that no evidence of an epizootic was determined on any vessels calling at Australian ports during this period. Either, then, no such rodent infection was present, or the measures adopted were insufficient to detect the presence of such infection on board. This point will be discussed at a later stage, when the origin and course of the 1921-1922 outbreak can be reviewed.



## CHAPTER XXV.—PLAGUE IN OVERSEA COUNTRIES.

This period under discussion saw a marked strengthening in the quarantine liaison which had developed between the health services of different countries. The Office International d'Hygiene Publique, which had been instituted in 1907 under the terms of the International Sanitary Convention of Paris, served as a central clearing house for quarantine intelligence. The British Local Government Board (which became the Ministry of Health in 1919) and the United States Public Health Service were enabled by reports from their consular services to compile valuable publications, which disseminated information as to the progress and diffusion of the quarantinable diseases throughout the world. The reviews by Dr. R. Bruce Low, of the British Local Government Board, were of especial value from the epidemiological view-point, although their late compilation limited their value from the quarantine aspect. In Australia, information received from these sources or extracted from bills of health brought by vessels from oversea countries was, from 1916 onwards, forwarded to quarantine officers as a fortnightly bulletin.

It has been shown on page 13 that the introduction of plague into Australia in 1900 coincided with a world-wide quickening up of the pandemic spread, which had commenced in 1896. For the years which preceded the 1921 outbreak it is not possible to show such a dramatic extension of plague, but nevertheless there was an antecedent lighting up of plague infection, particularly in the Far East. Most striking, although of doubtful significance from the epidemiological view-point in this connexion, was the epidemic of pneumonic plague which swept through Manchuria in 1920-21, and spread, in 1921, to Vladivostock. In this latter port, in 1921, two cases of bubonic plague and five infected rodents were also discovered, possibly introduced, however, from oversea. In Turkestan, there was, in 1921, a notable incidence. In British India, following the severe epidemic years of 1917-18, plague had appeared to wane, and although the 1921 "plague year" was one of the mildest on record, the decline was most marked in those districts which in previous years had suffered most severely. In those districts where plague had been mildly epidemic only, the decline was less appreciable. In French Indo-China, although not assuming large proportions, definite outbreaks occurred early in 1921, involving the ports of Haiphong and Saigon. In Europe there was little change, but in Russia there was some evidence of development and extension of infection, which later culminated in definite outbreaks. In the endemic centres in America and Africa, plague persisted with little change or extension. In Mauritius, plague made a reappearance in May, 1921, and developed into a sharp epidemic. In Ceylon, first infected in 1914, plague had declined

markedly, and possibly died out in 1919 (87 cases over seven months). In 1920, however, 235 cases occurred, and although the number of reported cases is small, infection has since persisted. In Java, despite strenuous and well-applied measures of eradication, plague, which had declined since 1914, in 1918 caused 733 deaths; in 1919, 2,954 deaths; in 1920, 8,918 deaths; and in 1921, 9,727 deaths; the most severe infection occurring in districts in mid-Java. In Hong Kong and the China ports, plague persisted in endemic form, with occasional outbreaks in the latter ports, the usual maximum incidence being in the months of June and July. It is significant that this period of maximum plague incidence in the Far East precedes the season of maximum risk in Australia, as evidenced by the experience of the previous outbreaks and the history of vessels quarantined for plague in Australian ports.

SUMMARY OF HUMAN AND RODENT PLAGUE INFECTIONS 1921-1922  
EPIDEMIC.

|                        | Human Plague.    |         |                           |                          | Rodent Plague.              |                                     |                               |
|------------------------|------------------|---------|---------------------------|--------------------------|-----------------------------|-------------------------------------|-------------------------------|
|                        | Number of cases. | Deaths. | Date of first human case. | Date of last human case. | Number of infected rodents. | Date of first infected rodent.      | Date of last infected rodent. |
| Queensland ..          | 116              | 63      | 21.8.21                   | 13.3.22                  | 306                         | 31.8.21                             | 31.10.22                      |
| Brisbane ..            | 58               | 27      | 21.8.21                   | 8.3.22                   | 190                         | 6.9.21                              | 31.10.22                      |
| Townsville ..          | 33               | 21      | 20.9.21                   | 11.1.22                  | 64                          | 19.9.21                             | 16.11.21                      |
| Cairns ..              | 18               | 11      | 4.10.21                   | 5.12.21                  | 18                          | 31.8.21                             | 18.2.22                       |
| Port Douglas ..        | 2                | 1       | 15.10.21                  | 13.11.21                 | 1                           | 23.11.21                            | 23.11.21                      |
| Innisfail ..           | 1                | Nil     | 1.11.21                   | 1.11.21                  | 4                           | 17.11.21                            | 17.11.21                      |
| Ipswich ..             | 1                | 1       | 12.12.21                  | 12.12.21                 | 2                           | 4.10.21                             | 7.10.21                       |
| Bundaberg ..           | 1                | 1       | 25.2.22                   | 25.2.22                  | Nil                         | ..                                  | ..                            |
| Aramac ..              | 1                | 1       | 13.3.22                   | 13.3.22                  | Nil                         | ..                                  | ..                            |
| Toowoomba ..           | 1                | Nil     | 18.10.21                  | 18.10.21                 | Nil                         | ..                                  | ..                            |
| Maryborough ..         | Nil              | Nil     | ..                        | ..                       | 2                           | 13.10.21                            | 23.10.21                      |
| Rockhampton ..         | Nil              | Nil     | ..                        | ..                       | 5                           | 26.9.21                             | 18.2.22                       |
| Ingham and District .. | Nil              | Nil     | ..                        | ..                       | 20                          | 12.10.21                            | 12.1.22                       |
| New South Wales        |                  |         |                           |                          |                             |                                     |                               |
| Sydney ..              | 35               | 10      | 29.11.21                  | 9.6.22                   | 151                         | 19.9.21                             | 13.7.22                       |
|                        |                  |         |                           |                          |                             | ( <i>ex ss.</i><br><i>Wyreema</i> ) |                               |
| Total for Australia .. | 151              | 73      | 21.8.21<br>(Brisbane)     | 9.6.22<br>(Sydney)       | 457                         | 31.8.21<br>(Cairns)                 | 31.10.22<br>(Brisbane)        |



## PART III.—PLAGUE IN AUSTRALIA, 1921-1922.

## CHAPTER XXVI.—COMMENCEMENT OF THE EPIDEMIC.

On 13th September, 1921, the Commissioner of the State Public Health Department, Queensland, notified the Director-General of Health, Commonwealth Health Department, of a death from plague which had occurred in Brisbane on 23rd August, 1921, the diagnosis having been bacteriologically confirmed. A rodent crusade has been initiated by the State authorities, and up to 13th September spleen smears in five rats from two produce stores in Brisbane showed plague bacilli. The produce stores were some distance apart, one in South Brisbane, one in North Brisbane. On 16th September an infected rat was found at stables in North Brisbane, more than a mile from the nearer of the two produce stores. On 16th and 17th September one infected rat was found each day at the produce store in North Brisbane.

On 18th September seven infected rats were found at widely-separated points.

The first case of plague was a workman employed at a produce store which was found to be free from rats, but which was adjacent to the North Brisbane produce store at which plague rats were found on 13th, 16th, and 17th September.

The varieties\* of rats found infected up to this stage comprised—

|                             |    |    |    |
|-----------------------------|----|----|----|
| <i>Rattus rattus rattus</i> | .. | .. | 10 |
| <i>Rattus norvegicus</i>    | .. | .. | 6  |
| Unclassified                | .. | .. | 1  |

The first stage of the outbreak then may be summarized as follows:—

On the 23rd August, 1921, a man fell ill with plague, and no further case occurred until 21st September. In the meantime rodent plague attacking both *rattus* and *decumanus* was discovered in several premises which, as will be seen from the map facing page 204, were separated from each other by considerable distances.

*Sydney*.—On 19th September, 1921, s.s. *Wyreema* from North Queensland ports via Brisbane, arrived at Sydney, having sailed from Brisbane on 17th September. The cargo was discharged under supervision, and, during unloading, six dead rats were found in No. 4 hold.

\* The rodent classification adopted in this outbreak was:—

*Rattus norvegicus* (R.N.) = *Mus* (*Epimys*) *decumanus*.  
*Rattus rattus rattus* (R.R.R.) = *Mus* (*Epimys*) *rattus*.  
*Rattus rattus alexandrinus* (R.R.A.) = *Mus alexandrinus*.  
*Mus musculus* (M.M.) = The Common Mouse.

The specific distinction of *Rattus rattus alexandrinus* was not adopted by the health authorities of New South Wales.

Of these one was found to be plague-infected (bacteriologically confirmed) the remainder being too putrescent for examination. The vessel was further fumigated before any more cargo was removed, and after fumigation twenty dead rats were found, of which eleven were infected. At the conclusion of unloading the *Wyreema*, and after terminal fumigation, 70 dead rats were found, making a total of 142 found in the vessel.

*Townsville.*—On 19th September the quarantine officer, Townsville, reported the presence of a number of dead rats on s.s. *Kuranda* at Townsville. The health inspector at Townsville also reported dead rats in a local store, which on examination proved to be infected. The rats from the *Kuranda* had been thrown overboard, and were not available for examination. On 24th September, however, two rats found on this vessel proved to be infected. The vessel had not been in Brisbane since April, 1921.

*Brisbane.*—On 19th September two, and on 20th September one, infected rats were found, the last-mentioned in a dwelling house 2 miles from any previously known infected premises. On 21st September a further infected rat was found in a suburban dwelling house. On 21st September also, the second human case of plague occurred, a female cleaner in a city office.

S.s. *Levuka* reported from Mackay that two dead rats had been noticed on the vessel at Brisbane on 9th September, and subsequently, while discharging cargo at Mackay, Bowen, Townsville, and Cairns, dead rats were seen in the holds. The vessel was ordered to Brisbane, the cargo lightered under supervision, and the vessel fumigated. No infected rat was found, but eight dried carcasses were found in the fruit holds. The conditions on 23rd September suggested that there had been on the vessel an epizootic of rat plague for about three weeks, and that this had come to an end.

*Brisbane.*—Infected rats, all *rattus norvegicus*, were found in Brisbane as follows:—

|                      |    |    |     |
|----------------------|----|----|-----|
| 21st September, 1921 | .. | .. | 1   |
| 22nd September, 1921 | .. | .. | 5   |
| 23rd September, 1921 | .. | .. | Nil |
| 24th September, 1921 | .. | .. | 1   |

*Townsville.*—On 22nd September, 1921, a case of human plague (a girl) was reported from Townsville.

*Cairns.*—On 23rd September, 1921, the Commissioner of Public Health, Queensland, reported that a rat-spleen smear from a rat caught near the wharf on 31st August showed plague bacilli. Another rat caught on 12th September on the Esplanade was infected.





- 26th September—1 (R.N.), Edward-street.  
                                   1 (R.N.), North Quay.  
 27th September—1 (M.M.), Roma-street.  
                                   4 (R.R.R.), Enoggera.  
                                   1 (R.R.R.), Edward-street.  
                                   1 (R.N.), Queen-street.  
                                   1 (R.N.), South Brisbane.  
 28th September—Nil.  
 29th September—1 (R.R.A.), Roma-street.  
 30th September—Nil.

*Townsville.*—On 25th September, 1921, it was reported that 53 rats taken in Townsville had been examined. Of these fourteen were infected and two doubtful. The infected rats were obtained at premises situated within one block in the town. On 27th four, and on 28th three further infected rats were found out of a total examined on the two days of 23. Up to 30th September, 28 infected rats were found out of a total of 182 examined.

*Sydney.*—On 24th September one infected rat was caught at premises opposite the Lime-street wharf. On 26th September a second infected rat was caught at these premises. On 27th two infected rats were caught at the Lime-street wharf, making a total of six infected rats found at this wharf since 20th September in a total of 31 examined.

On 28th three further infected rats were found at this wharf and two at the premises opposite.

No infected rats were discovered in any other part of Sydney; the infected area being very circumscribed in the immediate neighbourhood of Lime-street wharf.

*Brisbane.*—On 30th September the third human case of plague occurred in Brisbane. The patient was a boy, five years old, living at Spring Hill.

*Rockhampton.*—Three rats (R.N.) found on 26th and 27th September were infected.

*Townsville.*—One infected rat found on 30th September.

There are several features of great epidemiological importance in connexion with this invasion period. The account given above has been set out in chronological order with the object of emphasizing the rapid sequence of events at this time.

The first reported case died on 23rd August, 1921. A careful search of death certificates for the previous weeks disclosed no evidence to suggest that other cases had been missed. The onset of the illness in this first case was probably on 21st August. Allowing for incubation period it is probably reasonably accurate to assume that this patient was actually infected from a week to ten days before 23rd August. It is evident then that rodent plague must have existed in Brisbane at the middle of August.



There had been nothing prior to this which had attracted notice to the possibility of rodent plague.

By 13th September it had been demonstrated that rodent plague existed in two produce stores situated about 1 mile apart, and on 18th September the more extensive search instituted revealed, as is seen from the map facing page 204 that rodent plague was widely distributed in the city.

It is a general rule, well enough established by experience, that epizootic plague precedes epidemic plague, and it is also a common experience that the first human case does not usually occur until the rat epizootic has become well established. In the present instance the cessation or partial suspension of routine rat-suppression measures in Brisbane removed all possibility of evidence as to the condition of the rat population during July and August, or even earlier. The experience in Brisbane during the invasion stage (1900) of the last plague epidemic in Brisbane was (Plague in Queensland—Ham) that "the incidence of rat plague in Brisbane rose steadily during June and July, reaching its maximum in August." It is, however, improbable that the same course was followed on this occasion. All that can be said is that rat plague existed in Brisbane for a shorter or longer, but uncertain, period prior to the middle of August.

A plague-infected rat was caught at Cairns on 31st August, and there was evidence that a plague epizootic had commenced on s.s. *Levuka* in the first week in September. It is clear, therefore, that by the end of August rat plague in Brisbane had become active enough to infect the coastal shipping, which, it may be presumed (although no direct evidence has ever become available) in turn infected the northern port of Cairns.

This activity became more pronounced during September. A definite plague epizootic was established on s.s. *Kuranda* by 19th September, on s.s. *Wyreema* by 19th September, and on s.s. *Bombala* by 23rd September. There is considerable significance attachable to the outbreak on s.s. *Kuranda*, as this vessel had not been in Brisbane since April, 1921, but was trading between Townsville and Cairns. Plague was definitely established in epizootic form in Cairns by 31st August, in Townsville by 19th September, in Rockhampton by 26th and 27th September, and in Sydney by 21st September.

The only other localities infected throughout the whole period were Maryborough and Ingham, in neither of which was there any human case; Ipswich and Innisfail (with one human case each); and Port Douglas (two human cases). The dates of the discovery of the first infected rat and the total numbers of infected rats are as follows:—

|                                      |                  |
|--------------------------------------|------------------|
| 4th October, 1921, Ipswich .. .. .   | 2 infected rats. |
| 12th October, 1921, Ingham .. .. .   | 20 " "           |
| 31st October, 1921, Maryborough .. . | 2 " "            |
| 17th November, 1921, Innisfail .. .  | 4 " "            |
| 23rd November, 1921, Port Douglas .. | 1 " "            |

Taking the middle of August as a known starting point, rat plague had become established in Cairns within three weeks, and within six weeks had taken firm hold of all the principal ports along nearly 2,000 miles of coast line. Assuming, as is legitimate, that some days after the introduction of infection must elapse before dead rats are observed in local stores, the infection must have been introduced into Cairns and Townsville within the days preceding 31st August and 19th September respectively. The case of human plague in Brisbane was known on 23rd August, but was not declared officially until 13th September. This was the period during which infection possibly, or even probably, left Brisbane for Cairns and Townsville. This rapidity of spread of plague infection over long distances in a short time, emphasizes the necessity for immediate action upon verification, and even upon suspicion, of plague in man or in rodents.

### The Origin of the Infection.

There are two alternative hypotheses as to the source of the infection—either it was introduced into Australia from abroad, or it had remained present since the last recorded rat plague in 1910, in a condition of low infectivity and mild virulence, until under the influence of some factor it had become more active in respect of both infectivity and virulence.

In Chapter XXV. it was shown that—

- (a) Plague had between 1918 and 1921 become somewhat more active throughout the world, a condition similar to that in 1899-1900 when the previous epidemic began;
- (b) Regular and extensive rat destruction with post-mortem examination had been continued in Sydney since 1910 without any revelation of the existence of plague infection;
- (c) Similar rat-control measures had been sustained in Brisbane for the earlier part of the same period, but had in the years just preceding the outbreak been barely maintained. Nevertheless, there was no sign of rat plague in Brisbane.
- (d) There had been maintained systematic and regular rat-control measures on all ships from overseas;
- (e) There had been only two ships with human plague on board arriving in Australia, and in no ship was there discovered any sign of rat plague.

All that can be said is that the infection may have persisted from the previous epidemic, or it may have been introduced from overseas; and that the argument against either alternative is precisely the same in each case—that, in spite of rigorous and systematic search patiently maintained over the long series of years no plague-infected rat was identified either on shore or on incoming vessels.



## CHAPTER XXVII.—THE SPREAD WITHIN THE CITY OF BRISBANE.

A comparison of the two maps shown facing page 204 will illustrate the extent of rodent plague in Brisbane by 24th September, 1921, eleven days after the existence of rat-plague had become known. It is very improbable that the spread took place within that period—it is, on the contrary, most probable that rodent plague had become widely distributed throughout the metropolitan area some considerable time before it was recognized, and that the extent of its spread was revealed as the search proceeded.

This provides a convincing demonstration of the necessity for unceasing vigilance and activity in conformity with those standards of rat control and rat proofing now universally accepted; or, at the least, for an intelligence service sufficiently efficient to be depended upon to detect, at a very early stage, the presence of rodent plague.

The subsequent course of the epidemic and of the epizootic in the metropolitan area of Brisbane is shown by the tables hereunder, in which are set out:—

- (a) The details of each verified human case.
- (b) The details of rodents destroyed, examined, and infected.
- (c) The parallel course of the epidemic and epizootic in weeks.



TABLE 51.—METROPOLITAN AREA OF BRISBANE.  
*Human Cases of Plague.*

| No. | Date reported. | Name.     | Age. | Sex. | Occupation.   | Address.                             | By whom reported. | Date of Onset.    | Date Isolated. | Susp. or Pos. | Discharged cured. | Date of Death. | Remarks.   |
|-----|----------------|-----------|------|------|---|--------------------------------------|-------------------|-------------------|----------------|---------------|-------------------|----------------|--|
| 1   | 23.8.21        | W.H.L.    | ..   | M    | Employee, Denham Bros.' Produce Store, Roma-st.     | Roma-street ..                       | C.P.H.            | 21.8.21           | ..             | P             | ..                | 23.8.21        | First seen by doctor at P.M. Employed at Denham Bros.' Produce Store, Roma-st. Infected rodents found 8.9.21 and 15.9.21, at Addis Bros.' Produce Store, next door to his place of employment. A number of infected rodents were afterwards found in this block, in which there are numerous produce stores.           |
| 2   | 21.9.21        | L.G.F. .. | 32   | F    | Office cleaner ..                                   | Mary-street, Long Hill, Kelvin Grove | C.P.H.            | 20.9.21           | 21.9.21        | P             | ..                | 21.9.21        | Employed at <i>Courier</i> Office, Queen-street, and Desmond Chrs., Adelaide-street. No infected rodents found in area where employed prior to infection. No infected rodents found in area where residing prior to or after infection.  |
| 3   | 30.9.21        | P.S. ..   | 5    | M    | Home .. ..  | 44 Birley-street, Spring Hill        | C.P.H.            | 29.9.21           | 30.9.21        | P             | 5.11.21           | ..             | First isolated at Lytton Quarantine Station. Removed to Wattlebrae Isol. Hosp., 14.10.21. Four human cases subsequently occurred within area of $\frac{1}{2}$ mile of residence in Spring Hill. See note under Case No. 32.  |
| 4   | 6.10.21        | R.A.R. .. | 32   | M    | Carter .. ..  | Ipswich-road, Rocklea                | C.P.H.            | 4.10.21           | 6.10.21        | P             | ..                | 8.10.21        | Smear positive. Employed carting flour from Flour Mill, South Brisbane where infected rodents were found on 24.9.21, 4.10.21 (2), 6.10.21 (2), 22.10.21 (1). No infected rodents were found within 2 miles of residence.   |
| 5   | 14.10.21       | B.J.M. .. | 59   | M    | Engine-driver, Laidlaw's Produce Store, Grey-street | Merivale-street, South Brisbane      | C.P.H.            | Ill since 7.10.21 | 14.10.21       | P             | 8.12.21           | ..             | Infected rats found at Laidlaw's Produce Store, September, 1921. Infected rodents were also found at a residence in Russell-street about 250 yards away from his residence on 22.9.21 and at Flour Mills, Stanley and Tribune-streets, about 200 yards away from residence on 24.9.21, 4.10.21, 6.10.21, and 22.10.21. |



TABLE 51—METROPOLITAN AREA OF BRISBANE—continued.

## Human Cases of Plague—continued.

| No. | Date reported. | Name.      | Age. | Sex. | Occupation.  | Address.                                    | By whom reported. | Date of Onset.          | Date Isolated.        | Susp. or Pos. | Discharged cured. | Date of Death. | Remarks.  |
|-----|----------------|------------|------|------|--|---|-------------------|-------------------------|-----------------------|---------------|-------------------|----------------|---|
| 6   | 16.10.21       | J.D. ..    | 27   | M    | Packer and storeman  | Thorrold - street, Wooloowin                | C.Q.O. & C.P.H.   | 14.10.21                | 16.10.21              | P             | ..                | 19.10.21       | B. pestis found in smear. Employed Barry and Roberts, Queen-street, Brisbane. No infected rodents found near residence. Infected rodent was found in block opposite Barry and Roberts on 21.9.21, i.e., Burnett-lane; one found in <i>adjoining</i> block near Elizabeth-street and Edward-street on 27.9.21. Rodent infected found Harringtons in same block, Queen-street, on 4.10.21. One infected rat found at Barry and Roberts' stables, Stanley-street, South Brisbane, on 12.11.21. |
| 7   | 17.10.21       | G.R. ..    | 41   | M    | Packer and grocer's assistant                                  | Tingal-road, Wynnum South                   | C.P.H.            | 15.10.21                | 18.10.21              | P             | ..                | 22.10.21       | B. pestis found in smear. Same remarks as No. 6. No infected rats found in vicinity of residence.   |
| 8   | 22.10.21       | L.A.B. ... | 42   | F    | Home duties ..   | Racecourse - road, Ascot                    | C.P.H.            | 18.10.21                | 22.10.21              | P             | 28.11.21          | ..             | Bubo developed 20.10.21. Forty rats found on these premises by rat gang. Nil infected.  |
| 9   | 23.10.21       | W.M.F.     | 61   | M    | Chinese cabinet maker  | C/o Mee Lee Bros., Wickham - street, Valley | C.P.H.            | Not seen during illness | during by medical man | P             | ..                | 23.10.21       | Smear positive. Confirmed P.M. Date of onset was probably very shortly after 14.10.21. Infected rat found on these premises, 14.10.21, and an infected cat was found at the residence at the rear of these premises, 25.10.21.  |
| 10  | 24.10.21       | L.H. ..    | 32   | M    | Employed at his father's grocery store, Musgrave-road, Redhill | Boardinghouse, Musgrave - road, Redhill     | C.P.H.            | 22.10.21                | 24.10.21              | P             | 10.12.21          | ..             | Right femoral bubo. Smear positive. Two infected rodents found in this street on 22.9.21. An infected rat was found on the grocery store premises, 28.10.21.  |
| 11  | 25.10.21       | J.R.H. ... | 35   | M    | Butcher ..   | Douglas-street, Milton                      | C.P.H.            | 24.10.21                | 24.10.21              | P             | ..                | 25.10.21       | Smear positive. One infected rat found Douglas-street premises, 21.10.21. One infected rat found butcher's premises at Irving - street; Auchinflower, 26.10.21  |
| 12  | 28.10.21       | H.D. ..    | 49   | M    | Employed at H. A. Petersens Ltd., Seedsmen, George-street      | Wilson-street, Kangaroo Point               | C.P.H.            | 22.10.21                | 28.10.21              | P             | 8.12.21           | ..             | Smear positive. An infected mouse from Petersen's premises was found on 28.10.21. Same block as human case No. 1 (W.H.L.).  |



TABLE 51—METROPOLITAN AREA OF BRISBANE—*continued.*  
*Human Cases of Plague—continued.*

| No. | Date reported. | Name.      | Age. | Sex. | Occupation.                   | Address.  | By whom reported. | Date of Onset. | Date Isolated. | Susp. or Pos. | Discharged cured. | Date of Death. | Remarks.  |
|-----|----------------|------------|------|------|-------------------------------|---|-------------------|----------------|----------------|---------------|-------------------|----------------|---|
| 13  | 31.10.21       | J.C.M.S.   | 45   | M    | Ratman, Brisbane City Council | Cr.bb-street, Milton                              | C.P.H.            | 30.10.21       | 31.10.21       | P             | 24.12.21          | ..             | Smear positive. Occupation, ratman. This would take him into infected areas.  |
| 14  | 1.11.21        | E.J.C.C.   | 42   | F    | Boardinghouse proprietress    | Morven Boarding-house, Sandgate                   | C.P.H.            | 20.10.21       | 30.10.21       | P             | ..                | 31.10.21       | Smear positive. Source of infection not traced. No infected rodents found in locality.  |
| 15  | 2.11.21        | R.H. ..    | 55   | M    | Overseer, Bryce's stables     | Musgrave - street, West End                       | C.P.H.            | 28.10.21       | 1.11.21        | P             | 13.12.21          | ..             | Smear positive. A second human case occurred in this same block (Case No. 28) on 20.11.21. No infected rodents in street.   |
| 16  | 2.11.21        | J.R.A.H.   | 12   | M    | Schoolboy ..                  | Douglas-street, Milton                            | C.P.H.            | 29.10.21       | 1.11.21        | P             | 13.12.21          | ..             | Smear positive. Son of Case No. 11.   |
| 17  | 2.11.21        | S. ..      | 25   | F    | .. ..                         | Cambridge - street, West End                      | Dr. Meek          | 17.10.21       | ..             | S             | ..                | ..             | Not verified.   |
| 18  | 3.11.21        | C.S.N. ..  | 71   | M    | Printer ..                    | Main-street, Eagle Junction                       | C.P.H.            | 1.11.21        | 2.11.21        | P             | ..                | 3.11.21        | Reported by C.P.H. as pneumonic plague. Confirmed post-mortem. No injected rodents in vicinity residence. It appears probable that this man worked as printer in George-street (Nichols, Larwill, and Butler, Printers). Infected rodent found next door at Petersen's, Seed Merchants, 28.10.21. |
| 19  | 7.11.21        | Allen C... | 42   | M    | Storeman ..                   | Gordon-street, Paddington                         | C.P.H.            | 5.11.21        | 6.11.21        | P             | 13.12.21          | ..             | Smear positive. Employed W. Siemon and Sons, Produce Merchant, Roma-street, where infected mice were found on 9.11.21 (1), 10.11.21 (1), and 19.11.21 (2).  |
| 20  | 12.11.21       | I.D. ..    | 31   | F    | Cook .. ..                    | York Hotel, Queen-street                          | C.P.H.            | 10.11.21       | 10.11.21       | P             | 28.1.22           | ..             | Smear positive. Infected rodent at Harrington's, two doors away, on 4.10.21.  |
| 21  | 12.11.21       | J.K. ..    | 52   | M    | .. ..                         | Williams' Coffee Palace, George-street            | C.P.H.            | 7.11.21        | 10.11.21       | P             | ..                | 17.11.21       | Smear positive. Premises adjoining cases Nos. 40 and 42, a badly infected locality. Infected rodents were found at Petersen's, five doors away, 28.10.21, and other places in this locality.  |
| 22  | 14.11.21       | V.G.T. ..  | 6    | F    | .. ..                         | C/o Mrs. Roach, 138 Melbourne-street, S. Brisbane | C.P.H.            | 10.11.21       | 12.11.21       | P             | ..                | 15.11.21       | Smear positive. 20.10.21, infected rodent from Holzberger's Bulk Stores, Melbourne-street, four blocks away.  |



TABLE 51—METROPOLITAN AREA OF BRISBANE—continued.

## Human Cases of Plague—continued.

| No. | Date reported. | Name.      | Age. | Sex. | Occupation.                   | Address.   | By whom reported. | Date of Onset. | Date Isolated. | Susp. or Pos. | Discharged cured. | Date of Death. | Remarks.  |
|-----|----------------|------------|------|------|-------------------------------|--|-------------------|----------------|----------------|---------------|-------------------|----------------|---|
| 23  | 14.11.21       | J.L.A. ..  | 11   | M    | Schoolboy ..                  | C/o Mrs. McClure,<br>Kelvin Grove-road,<br>Normanby Hill | C.P.H.            | 10.11.21       | 13.11.21       | P             | 31.12.21          | ..             | Smear positive.   |
| 24  | 14.11.21       | W.F. ..    | 12   | M    | Schoolboy ..                  | Hayward - street,<br>Paddington                          | C.P.H.            | 10.11.21       | 13.11.21       | P             | ..                | 15.11.21       | Smear positive.   |
| 25  | 14.11.21       | W.E.S. ..  | 44   | M    | Cellarman ..                  | 103 Roger-street, off<br>Gregory-terrace                 | C.P.H.            | 10.11.21       | 13.11.21       | P             | ..                | 17.11.21       | Smear positive. Employed by Brabant and Co., Charlotte-treet, an infected rodent locality.  |
| 26  | 18.11.21       | W.H.C.     | 15   | M    | Factory hand ..               | Merivale - street,<br>South Brisbane                     | C.P.H.            | 17.11.21       | 18.11.21       | P             | ..                | 20.11.21       | Employed Dixon's Tannery, off Montague road, West End.  |
| 27  | 19.11.21       | W.J.Y. ..  | 24   | M    | Chinese ..                    | Roma-street ..   | C.P.H.            | 19.11.21       | 19.11.21       | P             | ..                | 21.11.21       | Infected rat found at adjoining premises, Baltic Separator Co., 11.11.21.   |
| 28  | 21.11.21       | Carl B. .. | 19   | M    | Labourer ..                   | C/o Anthony and<br>Buchanan - street,<br>West End        | C.P.H.            | 20.11.21       | 21.11.21       | P             | ..                | 24.11.21       | Employed at Old. Preserves l.d., Vulture-street. Infected rat found at Harper's Pickle Factory nearby on 15.11.21.  |
| 29  | 23.11.21       | H.J.Y. ..  | 4/12 | M    | Infant ..                     | Roma-street ..   | C.P.H.            | 21.11.21       | 23.11.21       | P             | ..                | 23.11.21       | Son of case No. 27. See above.  |
| 30  | 24.11.21       | T.J.B. ..  | 40   | M    | Yardman ..                    | Union Hotel, Wick-<br>ham-street                         | C.P.H.            | 22.11.21       | 24.11.21       | P             | ..                | 26.11.21       | Infected rats were obtained from the adjoining premises, Parisian Medical Agency, on 1.11.21 and 19.11.21.  |
| 31  | 26.11.21       | M.H. ..    | ..   | F    | Barmaid ..                    | Union Hotel, Wick-<br>ham-street                         | C.P.H.            | 21.11.21       | 25.11.21       | ..            | 4.1.22            | ..             | Mild plague. Case No. 30 occurred a same premises, 22.11.21. Infected rats on adjoining premises, Parisian Medical Agency, on 1.11.21 and 19.11.21.   |
| 32  | 28.11.21       | E.G. ..    | 65   | F    | Washerwoman ..                | 75 Bradley-street,<br>Spring Hill                        | C.P.H.            | 20.11.21       | 26.11.21       | P             | ..                | 28.11.21       | Three other human cases occurred in this neighbourhood. Case No. 3, 29.9.21. Case No. 38, 8.12.21. Case No. 104, 25.12.21.  |
| 33  | 29.11.21       | M.T. ..    | 44   | F    | Boardinghouse<br>proprietress | C/o Ernest and Meri-<br>vale-street, South<br>Brisbane   | C.P.H.            | 22.11.21       | 28.11.21       | P             | ..                | 28.11.21       | Pneumonic plague. An infected rodent from these premises, 16.11.21.   |
| 34  | 29.11.21       | Eric G. .. | 13   | M    | Schoolboy ..                  | 23 Belgrave-street,<br>Red Hill                          | C.P.H.            | 24.11.21       | 28.11.21       | P             | ..                | 5.12.21        | Employed on Saturdays at Head's Grocery Store (see Case 10), at which an infected rat was found on 28.10.21. Two sisters of this patient were employed at Bickford and Sons, Little Roma-street, where infected rodents were found on 24th, 26th, and 28th October, 1921. |



TABLE 51—METROPOLITAN AREA OF BRISBANE—*continued.*

*Human Cases of Plague—continued.*

| No. | Date reported. | Name.     | Age. | Sex. | Occupation.        | Address.                            | By whom reported. | Date of Onset. | Date Isolated.      | Susp. or Pos. | Discharged cured.   | Date of Death. | Remarks.  |
|-----|----------------|-----------|------|------|--------------------|-------------------------------------|-------------------|----------------|---------------------|---------------|---------------------|----------------|---|
| 35  | 2.12.21        | C.F. ..   | 70   | F    | .. ..              | 28 John - street, Valley            | C.P.H.            | 30.11.21       | 1.12.21             | P             | ..                  | 3.12.21        | Infected rodent at premises at rear, in Windmell-street, on 12.11.21.   |
| 36  | 5.12.21        | W.M. ..   | 32   | M    | .. ..              | Gloucester - street, South Brisbane | C.P.H.            | 4.12.21        | 5.12.21 and 19.1.22 | P             | 12.1.22 and 23.1.22 | ..             | Employed by J. Campbell and Sons (Timber Merchants), Creek-street, Brisbane, which was in an infected rodent locality.  |
| 37  | 6.12.21        | M.E.S. .. | 20   | F    | .. ..              | "Norbury," Race-course-road, Ascot  | C.P.H.            | 5.12.21        | 6.12.21             | P             | 17.1.22             | ..             | This case is from the same road as case No. 8.  |
| 38  | 12.12.21       | W.McD.    | 12   | M    | Schoolboy          | 579 Boundary-street, Spring Hill    | C.P.H.            | 8.12.21        | 11.12.21            | P             | ..                  | 13.12.21       | Attended Christian Bros. School, Spring Hill. See note under case No. 32.   |
| 39  | 12.12.21       | K.C. ..   | 32   | F    | Laundress          | Bond-street, West End               | C.P.H.            | 9.12.21        | 12.12.21            | ..            | 14.1.22             | ..             | Clinically plague. Animal inoculation negative. Infected rodents in this small street, 31.12.21, 21.12.21, and from actual house on 5.12.21.  |
| 40  | 12.12.21       | G.H.L. .. | 32   | M    | Storeman           | Terrace-street, Paddington          | C.P.H.            | 8.12.21        | 11.12.21            | ..            | 9.1.22              | ..             | Clinically plague. Animal inoculation, negative. Employed at Park and Co., Produce Merchants, George-street. Infected rodents found at Petersen's, Seed Merchants, 28.10.21, five doors away in same street. Other infected rodents have been obtained in this locality. A badly infected locality. See cases Nos. 21 and 42. |
| 41  | 13.12.21       | W.S. ..   | 25   | M    | Railway fireman    | Green - terrace, Windsor            | C.P.H.            | 12.12.21       | 12.12.21            | P             | 9.1.22              | ..             |   |
| 42  | 19.12.21       | R.C. ..   | 18   | M    | Store hand         | McDougall - street, Milton          | C.P.H.            | 15.12.21       | 17.12.21            | P             | ..                  | 22.12.21       | Animal inoculation negative. Employed at The Merchants Ltd., Roma-street, in close proximity to cases Nos. 21 and 40. A badly infected locality.  |
| 43  | 23.12.21       | C.C. ..   | 28   | F    | .. ..              | Lutwych - street, Petrie-terrace    | C.P.H.            | 21.12.21       | Not isolated        | P             | ..                  | 22.12.21       | Confirmed post - mortem. Lived near case No. 34. No infected rodents found in this locality.  |
| 44  | 25.12.21       | K.E.C. .. | 3    | F    | Infant             | Russel-street, South Brisbane       | C.P.H.            | 24.12.21       | 25.12.21            | P             | ..                  | 25.12.21       | An infected rodent area.  |
| 45  | 28.12.21       | H.M.P. .. | 14   | F    | Barber's assistant | Westbury - street, Ithaca           | C.P.H.            | 25.12.21       | 27.12.21            | P             | ..                  | 28.12.21       | Employed at barber's shop kept by her father, Queen-street. Cousin of case No. 34.  |
| 46  | 24.12.21       | A.C. ..   | 42   | F    | Domestic duties..  | 37 Warry - street, Valley           | C.P.H.            | 22.12.21       | 24.12.21            | ..            | 5.2.22              | ..             | Animal inoculation negative.  |



TABLE 51—METROPOLITAN AREA OF BRISBANE—*continued.**Human Cases of Plague—continued.*

| No. | Date reported. | Name.     | Age. | Sex. | Occupation.          | Address.  | By whom reported. | Date of Onset. | Date Isolated. | Susp. or Pos. | Discharged cured. | Date of Death. | Remarks.   |
|-----|----------------|-----------|------|------|----------------------|---|-------------------|----------------|----------------|---------------|-------------------|----------------|--|
| 47  | 23.12.21       | M.C. ..   | 23   | F    | Typiste ..           | C/o McDownie, London-road, Clayfield                        | C.P.H.            | 21.12.21       | 22.12.21       | ..            | 17.1.22           | ..             | Animal inoculation negative. Employed Lands Department, Brisbane.  |
| 48  | 29.12.21       | G.H.B. .. | 11   | M    | Schoolboy ..         | Earl-street, Thompson Estate                                | C.P.H.            | 26.12.21       | 26.12.21       | ..            | 29.12.21          | ..             | Clinically plague.   |
| 49  | 31.12.21       | E.C. ..   | 11   | F    | Schoolgirl ..        | C/o Mrs. McCrae, Boardinghouse, Vulture and Stanley streets | C.P.H.            | 27.12.21       | 30.12.21       | P             | 20.2.22           | ..             | A badly infected area. Eight infected rodents found in vicinity between 25.11.21 and 16.12.21, but none on actual premises.                                      |
| 50  | 3.1.22         | J.D.E. .. | 59   | M    | Plumber ..           | 19 Arthur street, Spring Hill                               | C.P.H.            | 25.12.21       | 3.1.22         | ..            | 26.2.22           | ..             | Employed by Water and Sewerage Board. See note under case No. 32.  |
| 51  | 3.1.22         | J.W.T. .. | 18   | M    | Garbage contractor   | Judge-street, Petrierterrace                                | C.P.H.            | 1.1.22         | 3.1.22         | P             | 3.1.22            | ..             | Employed by Henry Carr and Co. His occupation would take him into infected areas.  |
| 52  | 6.1.22         | W.B. ..   | 12   | M    | Schoolboy ..         | Folkestone - street, Mayne Junction                         | C.P.H.            | 4.1.22         | 5.1.22         | ..            | 23.1.22           | ..             | Attended Valley State School.  |
| 53  | 7.1.22         | H.B. ..   | 65   | M    | Driver ..            | Raymond - street, Sandgate                                  | ..                | 3.1.22         | 6.1.22         | ..            | 26.2.22           | ..             | Delivers bread for Webster's, Queen-street.  |
| 54  | 19.1.22        | C.B. ..   | 38   | M    | Barman ..            | Allen-street, Hamilton                                      | ..                | 14.1.22        | 19.1.22        | ..            | 1.2.22            | ..             | Employed Hamilton Hotel, Hamilton. Rats numerous at this hotel, but nil found to be infected.  |
| 55  | 18.1.22        | W.C. ..   | 34   | M    | Dispatch clerk order | Gertrude - street, Highgate Hill                            | ..                | 16.1.22        | 17.1.22        | ..            | 1.2.22            | ..             | Infected rats found on premises where employed, Shaw & Sons, Queen-street, 19.11.21 (4), 25.11.21 (1), and 30.11.21 (1). No rats or mice were found at his home. |
| 56  | 21.1.22        | T.T. ..   | 61   | M.   | Shearer ..           | No settled address  | ..                | 15.1.22        | 20.1.22        | ..            | 4.2.22            | ..             | Constantly moving. Last address, 199 Wharf-street.   |
| 57  | 3.2.22         | M.S. ..   | 39   | F    | Home duties ..       | Brook-street, South Brisbane                                | ..                | 31.1.22        | 2.2.22         | ..            | 18.2.22           | ..             | Infected rats in neighbourhood.  |
| 58  | 14.3.22        | C.H. ..   | 12   | M    | Schoolboy ..         | Yundah - street, Sandgate                                   | ..                | 3.3.22         | 13.3.22        | P             | 6.4.22            | ..             | Admitted General Hospital, 8.3.22.   |



TABLE 52.  
METROPOLITAN AREA OF BRISBANE.  
*Rodent Plague.*

| Week Ended.                 | Number Destroyed. | Number Examined. | Number Infected. | R.N.              | R.R.B.  | R.R.A.  | M.M. |
|-----------------------------|-------------------|------------------|------------------|-------------------|---------|---------|------|
| 1921—                       |                   |                  |                  |                   |         |         |      |
| Period, September 3 to 24 } | 4,935             | 4,269            | 28               | 6†<br>7*          | 10<br>3 | ..<br>1 | ..   |
|                             |                   |                  |                  | One unclassified. |         |         |      |
| October 1 ..                | 1,592             | 1,592            | 15               | 8                 | 5       | 1       | 1    |
| 8 ..                        | 1,882             | 1,882            | 17               | 14                | 1       | 2       | ..   |
| 15 ..                       | 2,078             | 2,078            | 12               | 7                 | 5       | ..      | ..   |
| 22 ..                       | 1,872             | 1,872            | 15               | 10                | 2       | 2       | 1    |
| 29 ..                       | 1,954             | 1,954            | 21               | 12                | 5       | 2       | 2    |
| November 5 ..               | 1,560             | 1,560            | 8                | 5                 | ..      | 2       | 1    |
| 12 ..                       | 1,593             | 1,593            | 11               | 8                 | ..      | 1       | 2    |
| 19 ..                       | 1,703             | 1,703            | 10               | 8                 | ..      | ..      | 2    |
| 26 ..                       | 1,347             | 1,347            | 5                | 2                 | 2       | 1       | ..   |
| December 3 ..               | 1,342             | 1,342            | 2                | 2                 | ..      | ..      | ..   |
| 10 ..                       | 1,312             | 1,212            | 9                | 9                 | ..      | ..      | ..   |
| 17 ..                       | 1,580             | 1,580            | 4                | 4                 | ..      | ..      | ..   |
| 24 ..                       | 2,167             | 2,167            | 4                | 2                 | 2       | ..      | ..   |
| 31 ..                       | 997               | 997              | 1                | 1                 | ..      | ..      | ..   |
| 1922—                       |                   |                  |                  |                   |         |         |      |
| January 7 ..                | 2,663             | 2,592            | 5                | 4                 | 1       | ..      | ..   |
| 14 ..                       | 2,149             | 2,149            | 1                | 1                 | ..      | ..      | ..   |
| 21 ..                       | 2,215             | 2,090            | 3                | 2                 | ..      | 1       | ..   |
| 28 ..                       | 1,722             | 1,689            | nil              | ..                | ..      | ..      | ..   |
| February 4 ..               | 1,722             | 1,655            | 1                | 1                 | ..      | ..      | ..   |
| 11 ..                       | 2,193             | 2,109            | nil              | ..                | ..      | ..      | ..   |
| 18 ..                       | 1,978             | 1,684            | 3                | 2                 | ..      | 1       | ..   |
| 25 ..                       | 2,017             | 1,536            | 1                | ..                | ..      | 1       | ..   |
| March 4 ..                  | 2,106             | 1,643            | 2                | 2                 | ..      | ..      | ..   |
| 11 ..                       | 2,089             | 1,836            | nil              | ..                | ..      | ..      | ..   |
| 18 ..                       | 1,939             | 1,811            | ..               | ..                | ..      | ..      | ..   |
| 25 ..                       | 2,446             | 2,116            | ..               | ..                | ..      | ..      | ..   |
| April 1 ..                  | 2,893             | 2,445            | 1                | 1                 | ..      | ..      | ..   |
| 8 ..                        | 3,084             | 2,645            | 6                | 5                 | ..      | ..      | 1    |
| 15 ..                       | 2,337             | 1,983            | nil              | ..                | ..      | ..      | ..   |
| 22 ..                       | 3,299             | 2,938            | ..               | ..                | ..      | ..      | ..   |
| 29 ..                       | 4,183             | 3,716            | 1                | ..                | ..      | ..      | 1    |
| May 6 ..                    | 4,696             | 4,096            | nil              | ..                | ..      | ..      | ..   |
| 13 ..                       | 8,485             | 7,932            | ..               | ..                | ..      | ..      | ..   |
| 20 ..                       | 11,154            | 10,481           | ..               | ..                | ..      | ..      | ..   |
| 27 ..                       | 10,687            | 10,378           | ..               | ..                | ..      | ..      | ..   |
| June 3 ..                   | 4,133             | 4,093            | ..               | ..                | ..      | ..      | ..   |
| 10 ..                       | 2,437             | 2,346            | ..               | ..                | ..      | ..      | ..   |
| 17 ..                       | 2,474             | 2,473            | ..               | ..                | ..      | ..      | ..   |
| 24 ..                       | 1,964             | 1,964            | ..               | ..                | ..      | ..      | ..   |
| July 1 ..                   | 1,457             | 1,457            | ..               | ..                | ..      | ..      | ..   |
| 8 ..                        | 1,546             | 1,546            | ..               | ..                | ..      | ..      | ..   |
| 15 ..                       | 1,498             | 1,498            | ..               | ..                | ..      | ..      | ..   |
| 22 ..                       | 1,492             | 1,492            | ..               | ..                | ..      | ..      | ..   |
| 29 ..                       | 1,172             | 1,172            | 1                | 1                 | ..      | ..      | ..   |
| August 5 ..                 | 1,359             | 1,359            | nil              | ..                | ..      | ..      | ..   |
| 12 ..                       | 971               | 971              | ..               | ..                | ..      | ..      | ..   |
| 19 ..                       | 1,168             | 1,168            | ..               | ..                | ..      | ..      | ..   |
| 26 ..                       | 1,329             | 1,329            | ..               | ..                | ..      | ..      | ..   |
| September 2 ..              | 1,581             | 1,581            | ..               | ..                | ..      | ..      | ..   |
| 9 ..                        | 1,209             | 1,209            | ..               | ..                | ..      | ..      | ..   |
| 16 ..                       | 1,502             | 1,502            | ..               | ..                | ..      | ..      | ..   |
| 23 ..                       | 1,715             | 1,175            | ..               | ..                | ..      | ..      | ..   |
| 30 ..                       | 1,642             | 1,642            | ..               | ..                | ..      | ..      | ..   |
|                             | 134,620           | 127,289          | 187              | 124               | 36      | 15      | 11   |

† Week ended 24th September.

\* Period, 3rd to 15th September, 1921.



Table 52—*continued.*

| Week Ended. |    |    | Number<br>Destroyed. | Number<br>Examined. | Number<br>Infected. | R.N. | R.R.R. | R.R.A. | M.M. |
|-------------|----|----|----------------------|---------------------|---------------------|------|--------|--------|------|
| October     | 7  | .. | 1,451                | 1,451               | nil                 | ..   | ..     | ..     | ..   |
|             | 14 | .. | 1,296                | 1,296               | "                   | ..   | ..     | ..     | ..   |
|             | 21 | .. | 1,626                | 1,626               | "                   | ..   | ..     | ..     | ..   |
|             | 28 | .. | 1,083                | 1,083               | " 1                 | 1    | ..     | ..     | ..   |
| November    | 4  | .. | 1,135                | 1,135               | 2                   | 2    | ..     | ..     | ..   |
|             | 11 | .. | 1,167                | 1,167               | nil                 | ..   | ..     | ..     | ..   |
|             | 18 | .. | 1,200                | 1,200               | "                   | ..   | ..     | ..     | ..   |
|             | 25 | .. | 1,440                | 1,440               | "                   | ..   | ..     | ..     | ..   |
| December    | 2  | .. | 934                  | 934                 | "                   | ..   | ..     | ..     | ..   |
|             | 9  | .. | 976                  | 976                 | "                   | ..   | ..     | ..     | ..   |
|             | 16 | .. | 953                  | 953                 | "                   | ..   | ..     | ..     | ..   |
|             | 23 | .. | 1,135                | 1,135               | "                   | ..   | ..     | ..     | ..   |
|             | 30 | .. |                      |                     | "                   | ..   | ..     | ..     | ..   |
| 1923—       |    |    |                      |                     |                     |      |        |        |      |
| January     | 6  | .. | 524                  | 524                 | "                   | ..   | ..     | ..     | ..   |
|             | 13 | .. | 958                  | 958                 | "                   | ..   | ..     | ..     | ..   |
|             | 20 | .. | 1,091                | 1,091               | "                   | ..   | ..     | ..     | ..   |
|             | 27 | .. | 997                  | 997                 | "                   | ..   | ..     | ..     | ..   |
| February    | 3  | .. | 752                  | 752                 | "                   | ..   | ..     | ..     | ..   |
|             | 10 | .. | 935                  | 935                 | "                   | ..   | ..     | ..     | ..   |
|             | 17 | .. | 1,061                | 1,061               | "                   | ..   | ..     | ..     | ..   |
| March       | 24 | .. | 1,068                | 1,068               | "                   | ..   | ..     | ..     | ..   |
|             | 3  | .. | 738                  | 738                 | "                   | ..   | ..     | ..     | ..   |
|             | 10 | .. | 868                  | 868                 | "                   | ..   | ..     | ..     | ..   |
|             | 17 | .. | 920                  | 920                 | "                   | ..   | ..     | ..     | ..   |
|             | 24 | .. | 1,565                | 1,565               | "                   | ..   | ..     | ..     | ..   |
| 31          | .. | "  |                      |                     | ..                  | ..   | ..     | ..     |      |
|             |    |    | 160,493              | 153,162             | 190                 | 127  | 36     | 15     | 11   |

TABLE 53.  
METROPOLITAN AREA OF BRISBANE.  
*Human and Rodent Plague.*

| Period.                       | Human Cases. | Infected Rodents. |
|-------------------------------|--------------|-------------------|
| 1921—                         |              |                   |
| Prior to 3rd September ..     | 1            | ..                |
| Period, 3rd-15th September .. | ..           | 16                |
| „ 15th-24th September ..      | 1            | 12                |
| Week ended—                   |              |                   |
| October 1 .. ..               | 1            | 15                |
| 8 .. ..                       | 1            | 17                |
| 15 .. ..                      | 1            | 12                |
| 22 .. ..                      | 3            | 15                |
| 29 .. ..                      | 4            | 21                |
| November 5 .. ..              | 6            | 8                 |
| 12 .. ..                      | 4            | 11                |
| 19 .. ..                      | 5            | 10                |
| 26 .. ..                      | 5            | 5                 |
| December 3 .. ..              | 3            | 2                 |
| 10 .. ..                      | 2            | 9                 |
| 17 .. ..                      | 5            | 4                 |
| 24 .. ..                      | 3            | 4                 |
| 31 .. ..                      | 4            | 1                 |
| January 7 .. ..               | 4            | 5                 |
| 14 .. ..                      | ..           | 1                 |
| 21 .. ..                      | 3            | 3                 |
| 28 .. ..                      | ..           | ..                |
| February 4 .. ..              | 1            | 1                 |
| 11 .. ..                      | ..           | ..                |
| 18 .. ..                      | ..           | 3                 |
| 25 .. ..                      | ..           | 1                 |
| March 4 .. ..                 | ..           | 2                 |
| 11 .. ..                      | ..           | ..                |
| 18 .. ..                      | 1            | ..                |
| 25 .. ..                      | ..           | ..                |
| April 1 .. ..                 | ..           | 1                 |
| 8 .. ..                       | ..           | 6                 |
| 15 .. ..                      | ..           | ..                |
| 22 .. ..                      | ..           | ..                |
| 29 .. ..                      | ..           | 1                 |
| May 6 .. ..                   | ..           | ..                |
| 13 .. ..                      | ..           | ..                |
| 20 .. ..                      | ..           | ..                |
| 27 .. ..                      | ..           | ..                |
| June 3 .. ..                  | ..           | ..                |
| 10 .. ..                      | ..           | ..                |
| 17 .. ..                      | ..           | ..                |
| 24 .. ..                      | ..           | ..                |
| July 1 .. ..                  | ..           | ..                |
| 8 .. ..                       | ..           | ..                |
| 15 .. ..                      | ..           | ..                |
| 22 .. ..                      | ..           | ..                |
| 29 .. ..                      | ..           | 1                 |
| August 5 .. ..                | ..           | ..                |
| 12 .. ..                      | ..           | ..                |
| 19 .. ..                      | ..           | ..                |
| 26 .. ..                      | ..           | ..                |
| September 2 .. ..             | ..           | ..                |
| 9 .. ..                       | ..           | ..                |
| 16 .. ..                      | ..           | ..                |
| 23 .. ..                      | ..           | ..                |
| 30 .. ..                      | ..           | ..                |
| October 7 .. ..               | ..           | ..                |
| 14 .. ..                      | ..           | ..                |
| 21 .. ..                      | ..           | ..                |
| 28 .. ..                      | ..           | 1                 |
| November 4 .. ..              | ..           | 2                 |
| 11 .. ..                      | ..           | ..                |
| 18 .. ..                      | ..           | ..                |
| 25 .. ..                      | ..           | ..                |
| Total .. ..                   | 58           | 190               |



## CHAPTER XXVIII.—PLAGUE AT TOWNSVILLE.

On 21st September, 1921, two of several rats found dead at a local store in Flinders-street, and at a hotel in the same street, were plague-infected. On 25th September, 1921, of 53 rats from various sources, 14 were, on examination, found to be plague-infected. The premises from which these 14 rats were taken, were situated in five different streets. On 27th September, 4 out of 8 were examined, and on the 28th 3 out of 15 examined were found to be infected.

It was evident that by 21st September, 1921, plague was well established in epizootic form in Townsville. By 1st October, out of a total of 182 rats examined, 28 were infected. The second human case was from the hotel above mentioned, from which seven infected rats had been taken. The third and fourth cases also were infected at this hotel. Amongst seventeen separate premises known to be harbouring infected rodents prior to 5th October, three were responsible for human cases up to 13th October. Sufficient information is not now available for a full description of the epidemic and epizootic in Townsville. Hereunder is given in tabular form the sequence of human plague cases in Townsville from the beginning to the end of the epidemic.



TABLE 54.—HUMAN PLAGUE AT TOWNSVILLE.

| No. | Date reported. | Name.                | Age. | Sex. | Occupation.                                | Address.                          | By whom reported.     | Date of Onset. | Date Isolated. | Susp. or Pos. | Discharged cured. | Date of Death.   | Remarks.  |
|-----|----------------|----------------------|------|------|--|-----------------------------------|-----------------------|----------------|----------------|---------------|-------------------|------------------|---|
| 1   | 22.9.21        | G.D.                 | ..   | F    | Domestic                                   | Boardinghouse, Walker-street      | Q.O., Townsville      | ..             | 21.9.21        | P             | ..                | 21.9.21          | Private address, Bell-street, South Townsville  |
| 2   | 3.10.21        | E.D.                 | 21   | F    | Barmaid, Queensland Hotel, Flinders-street | Queensland Hotel, Flinders-street | C.P.H.                | 29.9.21        | 29.9.21        | P             | ..                | 3.10.21          | Seven infected rats had been found at this hotel  |
| 3   | 3.10.21        | M.T.<br>(coloured)   | ..   | M    | ..   | Boarding house, Sturt-street      | C.P.H.                | 3.10.21        | 3.10.21        | P             | ..                | 5.10.21          | This man spent considerable time at Queensland Hotel. Smear positive                              |
| 4   | 6.10.21        | T.C.                 | 64   | M    | Yardman at Queensland Hotel                | Townsville                        | C.P.H.                | ..             | 6.10.21        | P             | 10.11.21          | ..               | Smear positive  |
| 5   | 7.10.21        | J.A.<br>(aboriginal) | 7    | F    | ..   | Great Northern Hotel              | Q.O., Townsville      | ..             | 5.10.21        | P             | 16.11.21          | ..               | Smear positive  |
| 6   | 10.10.21       | I.H.                 | ..   | F    | Charwoman, Queensland National Bank        | Sturt-street, West End            | C.P.H.                | ..             | 8.10.21        | P             | ..                | 10.10.21         | Worked close to Queensland Hotel. Confirmed P.M.  |
| 7   | 10.10.21       | R.A.                 | ..   | M    | ..   | ..                                | C.P.H.                | ..             | 10.10.21       | P             | ..                | ..               | Smear positive  |
| 8   | 14.10.21       | J.M.                 | 64   | M    | Storeman, Cummins and Campbell             | Hodel-street, West End            | C.Q.O., C.P.H.        | 7.10.21        | 11.10.21       | P             | ..                | 14.10.21         | Employed Cummins and Campbell, Flinders-street, where plague rats found                           |
| 9   | 14.10.21       | E.R.                 | 22   | M    | Storeman                                   | West End                          | C.Q.O.                | 10.10.21       | 13.10.21       | P             | ..                | 17.10.21         | Employed by Thos. Brown & Son as storeman   |
| 10  | 13.10.21       | B.N.                 | 37   | M    | ..   | Flinders-street                   | C.Q.O.                | 13.10.21       | 13.10.21       | P             | ..                | 17.10.21         | ..  |
| 11  | 17.10.21       | —H.                  | ..   | M    | Employed at Howard Smith's Wharf           | Morehead-street, South Townsville | C.P.H.                | 17.10.21       | 17.10.21       | P             | 1.12.21           | ..               | Smear positive.   |
| 12  | 17.10.21       | G.R.                 | 37   | M    | Storeman                                   | Sturt-street, South Townsville    | C.P.H.                | 13.10.21       | 14.10.21       | P             | ..                | 17.10.21         | Notified after death. Employed O.K. Stores, Flinders-street, Townsville                           |
| 13  | 24.10.21       | S.C.                 | 65   | M    | Carpenter, Howard Smith's Wharf            | Wills-street, Townsville          | Q.O.                  | 21.10.21       | 22.10.21       | P             | ..                | 22.10.21         | ..  |
| 14  | 24.10.21       | G.H.                 | 1.8  | F    | Infant                                     | Blackwood-street                  | C.P.H.                | 18.10.21       | 18.10.21       | P             | 7.11.21           | ..               | Clinically plague. Smear positive. 24.10.21   |
| 15  | 24.10.21       | M.E.E.               | 9    | F    | ..   | Flinders-street                   | C.P.H.                | ..             | 23.10.21       | P             | 17.11.21          | ..               | ..  |
| 16  | 24.10.21       | M.V.                 | 8    | F    | ..   | Flinders-lane                     | C.P.H.                | 19.10.21       | 23.10.21       | P             | ..                | 23.10.21         | ..  |
| 17  | 25.10.21       | M.E.                 | ..   | M    | ..   | Flinders-street                   | C.P.H.                | ..             | 25.10.21       | P             | ..                | ..               | Same family as case No. 15. Smear positive.   |
| 18  | 26.10.21       | S.G.                 | 43   | M    | Boatswain, Kuranda                         | Stanton Hill                      | Dr. Elliott, Cooktown | 26.10.21       | 26.10.21       | P             | 7.12.21           | ..               | Pestis minor. Removed from s.s. Kuranda at Cooktown. Infection probably contracted at Townsville. |
| 19  | 26.10.21       | M.R.                 | ..   | M    | ..   | ..                                | C.P.H.                | 22.10.21       | ..             | P             | ..                | Suicide 26.10.21 | Confirmed as P.M.   |
| 20  | 27.10.21       | W.W.                 | ..   | M    | Hotelkeeper                                | Grand Hotel                       | C.P.H.                | 21.10.21       | ..             | P             | ..                | ..               | ..  |
| 21  | 29.10.21       | K.F.                 | ..   | M    | Chinese                                    | ..                                | C.P.H.                | ..             | ..             | P             | ..                | 28.10.21         | Confirmed P.M. Smear pos  |



TABLE 54—HUMAN PLAGUE AT TOWNSVILLE—*continued.*

| No. | Date reported. | Name.     | Age. | Sex. | Occupation.            | Address.                         | By whom reported. | Date of Onset. | Date Isolated.         | Sups. or Pos. | Discharged cured. | Date of Death. | Remarks.   |
|-----|----------------|-----------|------|------|------------------------|----------------------------------|-------------------|----------------|------------------------|---------------|-------------------|----------------|--|
| 22  | 29.10.21       | J.O. ..   | ..   | M    | (Chinese) Store-keeper | Flinders-street ..               | C.P.H.            | ..             | Found dead<br>29.10.21 | P             | ..                | 29.10.21       | Confirmed P.M.   |
| 23  | 1.11.21        | G.Q. ..   | 50   | M    | Cook, Palace Hotel     | Flinders-street ..               | C.P.H.            | ..             | 26.10.21               | P             | ..                | 31.10.21       |  |
| 24  | 3.11.21        | S.R. ..   | 14   | F    | Schoolgirl ..          | Flinders-street ..               | C.P.H.            | ..             | 2.11.21                | P             | ..                | 7.11.21        | Smear positive.  |
| 25  | 7.11.21        | T.A.G. .. | 59   | M    | .. ..                  | Flinders-street ..               | C.P.H.            | 6.11.21        | 6.11.21                | P             | ..                | ..             | Smear positive.  |
| 26  | 18.11.21       | C.B. ..   | 21   | M    | Packer.. ..            | South Townsville ..              | C.P.H.            | 12.11.21       | 16.11.21               | P             | ..                | 18.11.21       | Employed at Allen's Store. Confirmed P.M.                                    |
| 27  | 22.11.21       | G.R. ..   | 64   | M    | Wharf labourer ..      | Hubert-street, South Townsville  | ..                | 17.11.21       | 21.11.21               | P             | ..                | 21.11.21       | Smear positive.  |
| 28  | 2.12.21        | A.L. ..   | ..   | M    | Chinese ..             | Flinders-lane ..                 | ..                | ..             | ..                     | P             | 2.12.21           | ..             | Found dead. Plague confirmed P.M.  |
| 29  | 5.12.21        | W.G. ..   | 16   | M    | Grocer's assistant     | Jones-street ..                  | ..                | 29.11.21       | Treated at home        | P             | ..                | ..             | Employed Rees & Thomas, Flinders-street. Infected rats found these premises. |
| 30  | 5.12.21        | W.H. ..   | 18   | M    | Joiner .. ..           | Macrossan-lane ..                | ..                | 5.12.21        | Treated at home        | P             | ..                | ..             | Employed by Geo. Lear, Flinders-street                                       |
| 31  | 6.12.21        | J.C. ..   | 50   | M    | Warder .. ..           | Reception House and Sturt-street | ..                | ..             | ..                     | P             | 6.12.21           | ..             | Confirmed P.M. Septicaemic plague  |
| 32  | 3.1.22         | F.D. ..   | 50   | M    | Chinese gardener       | Rollingstone ..                  | ..                | ..             | ..                     | P             | 2.1.22            | ..             | Had been nine days in Townsville (Palmer-street). Plague confirmed P.M.      |
| 33  | 2.1.22         | M.H. ..   | ..   | M    | Chinese .. ..          | Morey-street, South Townsville   | ..                | ..             | ..                     | ..            | 11.1.22           | ..             | Found dead. Plague confirmed P.M.  |



**Rodent Plague at Townsville.**

The first infected rats were found at Townsville on 21st September, 1921, dead rats having been found at a local store.

Thereafter the distribution of the dead rats discovered was as follows:—

TABLE 55.

| Week Ending.       | Total. | R.N.         | R.R.R. |
|--------------------|--------|--------------|--------|
| 1921—              |        |              |        |
| September 24 .. .. | 11     | } 24         | 9      |
| October 1 .. ..    | 14     |              |        |
| 8 .. ..            | 8      |              |        |
| 15 .. ..           | 7      | 1            | 6      |
| 29 .. ..           | 8      | 2            | 6      |
| November 5 .. ..   | 5      | 3            | 2      |
| 19 .. ..           | 6      | Not recorded |        |
| Total .. ..        | 59     | 30           | 23     |

The last infected rodent was reported as having been identified on 16th November, 1921. As the last human case in Townsville did not occur until 11th January, 1922, there was the very unusual experience of human plague occurring two months after the last discovery of rat-plague. The conditions obtaining at the time were such that it may be regarded as doubtful whether the infected rat recorded on the 16th November represented the last rat host in the plague epizootic. The Commissioner of Public Health, Queensland, in his Annual Report, 1922, gives a total of 26 infected rodents in Townsville for the whole outbreak. This figure cannot be accepted as correct, and, although owing to various alterations from time to time in the method of examination, there is some confusion as to the exact number, it is beyond question that the number given above is the lowest figure that can be considered. Up to the 5th October only, 230 rats had been examined, and 37 had been found infected. The Commissioner has probably omitted from his table the positive results obtained in September and early October at the Institute of Tropical Medicine, at Townsville.



## CHAPTER XXIX.—PLAGUE AT CAIRNS.

The information relative to plague at Cairns is not very complete. Hereunder is given in tabulated form the cases which occurred from first to last through the epidemic.

TABLE 56.—HUMAN PLAGUE IN CAIRNS.

| No. | Date reported. | Name.         | Age. | Sex. | Occupation.                              | Address.                                     | By whom reported.     | Date of Onset. | Date Isolated.      | Susp. or Pos. | Discharged or cured. | Date of Death. | Remarks.  |
|-----|----------------|---------------|------|------|--|--|-----------------------|----------------|---------------------|---------------|----------------------|----------------|---|
| 1   | 7.10.21        | S.S.          | 25   | F    | Waitress at Lake's Restaurant            | Laxe-street, Cairns                          | Q.O., Cairns          | 4.10.21        | 4.10.21             | P             | ..                   | ..             | Employed by case No. 13 as waitress at this restaurant in Laxe street |
| 2   | 7.10.21        | P.B.          | 16   | M    | Printer's assistant (Chinese)            | Sachs-street, Chinatown, Cairns              | C.P.H.                | 1.10.21        | 7.10.21             | P             | ..                   | ..             | ..  |
| 3   | 10.10.21       | M.K.          | 29   | M    | Labourer                                 | Court House Hotel, Abbott-street, Cairns     | C.P.H.                | ..             | 10.10.21            | P             | ..                   | 16.10.21       | Smear positive.   |
| 4   | 10.10.21       | A.L.          | 84   | M    | Restaurant proprietor                    | Sachs-street, Cairns                         | C.P.H.                | ..             | 10.10.21            | P             | ..                   | 15.10.21       | Case No. 1 was employed by this man.                                  |
| 5   | 11.10.21       | I. (Japanese) | 39   | M    | Laundryman                               | Sence-street, Cairns                         | C.P.H. & Q.O., Cairns | 8.10.21        | 10.10.21            | P             | ..                   | 13.10.21       | ..  |
| 6   | 12.10.21       | J.W.          | ..   | M    | Draper's assistant, Burns & Philip Store | McLeod-street ..                             | C.P.H.                | ..             | 11.10.21            | P             | ..                   | 13.10.21       | ..  |
| 7   | 14.10.21       | D.C.          | 55   | M    | ..                                       | Sachs-street, Chinatown                      | Q.O. & C.P.H.         | ..             | Found dead 13.10.21 | P             | ..                   | 14.10.21       | Found dead in premises opposite those occupied by case No. 2.         |
| 8   | 14.10.21       | A.G.          | 13   | F    | Schoolgirl, State School                 | McLeod-street ..                             | C.P.H.                | ..             | 13.10.21            | P             | ..                   | ..             | ..  |
| 9   | 14.10.21       | V.M.          | 19   | F    | Birmaid, Federal Hotel                   | Federal Hotel, Sachs-street and Sence-street | C.P.H.                | ..             | 13.10.21            | P             | ..                   | ..             | ..  |
| 10  | 14.10.21       | Q.M.          | 28   | M    | Storeman, also worked on wharfs          | Draper-street ..                             | C.P.H.                | ..             | 13.10.21            | P             | ..                   | 16.10.21       | Employed by Burns, Philip Co. See case No. 6                          |
| 11  | 14.10.21       | S.C.          | 38   | M    | Manager, Beales' Pianos                  | Sheridan-street ..                           | C.P.H.                | 3.10.21        | 3.10.21             | P             | ..                   | ..             | ..  |
| 12  | 4.11.21        | I.M.          | 63   | M    | Shop assistant                           | Abbott-street ..                             | C.P.H.                | ..             | 4.11.21             | P             | ..                   | 6.11.21        | Smear positive.   |
| 13  | 14.11.21       | C.K.          | 12   | M    | Schoolboy                                | McLeod-street ..                             | C.P.H.                | 8.11.21        | 12.11.21            | P             | ..                   | 17.11.21       | Smear positive.   |
| 14  | 15.11.21       | H.J.          | 14   | M    | Schoolboy                                | Laxe-street ..                               | C.P.H.                | 14.11.21       | 15.11.21            | P             | ..                   | ..             | Smear positive.   |
| 15  | 21.11.21       | G.S.          | 25   | M    | Labourer                                 | Tent near Railway (Goods) Shed, Sence-street | ..                    | 14.11.21       | 18.11.21            | P             | 23.11.21             | ..             | Employed at molasses tank near wharf.                                 |
| 16  | 1.12.21        | V.D.          | 14   | F    | Waitress                                 | Sachs-street, Cairns                         | ..                    | 28.11.21       | ..                  | P             | 24.12.21             | ..             | Employed railway boardinghouse, Sheridan-street                       |
| 17  | 7.12.21        | F.W.          | 32   | M    | Labourer                                 | Railway boarding-house, Sheridan-street      | ..                    | 3.12.21        | 7.12.21             | P             | ..                   | 7.12.21        | Case No. 16 was employed at this boardinghouse.                       |
| 18  | 9.12.21        | H.D.          | 54   | M    | Architect and cane farmer                | Abbott-street ..                             | ..                    | 5.12.21        | 8.12.21             | P             | 8.12.21              | ..             | ..  |



### Rodent Plague at Cairns.

The first infected rat at Cairns was caught on 31st August. The subsequent findings of infected rats are as follow:—

TABLE 57.

| Week Ending. |    |    |    | Total Infected. | R.N. | R.R.R. |
|--------------|----|----|----|-----------------|------|--------|
| 1921—        |    |    |    |                 |      |        |
| August       | 31 | .. | .. | 1               | ..   | ..     |
| September    | 12 | .. | .. | 1               | ..   | ..     |
| October      | 15 | .. | .. | 1               | ..   | ..     |
|              | 22 | .. | .. | 3               | 3    | ..     |
|              | 29 | .. | .. | 2               | 1    | ..     |
| November     | 5  | .. | .. | 3               | 3    | ..     |
|              | 12 | .. | .. | 1               | 1    | ..     |
|              | 26 | .. | .. | 2               | 2    | ..     |
| December     | 17 | .. | .. | 1               | 1    | ..     |
|              | 26 | .. | .. | 2               | 1    | 1      |
| 1922—        |    |    |    |                 |      |        |
| February     | 11 | .. | .. | 1               | 1    | ..     |
|              | 18 | .. | .. | 1               | ..   | 1      |
| Total .. ..  |    |    |    | 19              | 13   | 2      |

The last human case of plague in Cairns occurred on 5th December, 1921.

The course of the epidemic is given in parallel column with that of the epizootic.

TABLE 58.

| Week Ending. |    |    |    | Human Cases. | Infected Rodents. |
|--------------|----|----|----|--------------|-------------------|
| 1921—        |    |    |    |              |                   |
| August       | 31 | .. | .. | ..           | 1                 |
| September    | 5  | .. | .. | ..           | ..                |
|              | 12 | .. | .. | ..           | 1                 |
| October      | 8  | .. | .. | 2            | ..                |
|              | 15 | .. | .. | 9            | 1                 |
|              | 22 | .. | .. | ..           | 3                 |
|              | 29 | .. | .. | ..           | 2                 |
| November     | 5  | .. | .. | 1            | 3                 |
|              | 12 | .. | .. | ..           | 1                 |
|              | 19 | .. | .. | 2            | ..                |
|              | 26 | .. | .. | 1            | 2                 |
| December     | 3  | .. | .. | 1            | ..                |
|              | 10 | .. | .. | 2            | ..                |
|              | 17 | .. | .. | ..           | 1                 |
|              | 26 | .. | .. | ..           | 2                 |
| February     | 11 | .. | .. | ..           | 1                 |
|              | 18 | .. | .. | ..           | 1                 |
| Total .. ..  |    |    |    | 18           | 19                |



## CHAPTER XXX.—PLAGUE IN OTHER PLACES IN QUEENSLAND.

*Port Douglas.*—On 10th October, 1921, dead rats were found at Port Douglas. On 19th October, 1921, a human case was reported, the onset of illness being 15th October. The patient, a male aged 60 years, was isolated, and the disease bacteriologically confirmed.

On 15th November another case was reported. This was a female, aged 50, whose illness occurred on 13th November. This case proved fatal, having been bacteriologically confirmed as plague.

On 23rd November one *Rattus Norvegicus* from Port Douglas was found to be infected.

Thereafter no further information is available.

*Ipswich.*—Between 14th October and 3rd December, 1921, 240 rats were examined, none being found infected.

On 12th December there occurred a case of human plague in Brisbane-street.

The case—N.M.S., a school-boy, aged 14—was reported on 13th December; he died on 14th December, the diagnosis having been bacteriologically confirmed. His parents kept a fruit shop in Brisbane-street.

Two infected rats were found at Ipswich—one on 4th October, and one on 7th October.

*Rockhampton.*—No human case was reported here throughout the outbreak. Plague rats were identified as follow:—

26th September, 1921.—3—Newmarket Hotel, East-street (R.N.); White, Denison-street (R.N.); Scott, Cambridge-street (R.N.).

11th November, 1921.—1—Brown, Bolsover-street (R.N.).

11th February, 1922.—1—Denham, East-street (R.N.).

18th February, 1922.—1—Broome, East-street (R.N.).

The case at Aramac (*vide infra*) was regarded as having been infected in Rockhampton.

*Mackay.*—On 17th November, J.P., *aet* 24, male, steward on s.s. *Levuka*, was landed at Mackay. (See s.s. *Levuka*, p. 186.) No plague rats were found at Mackay.

*Bundaberg.*—On 1st March, 1922, a suspicious case of plague was reported. This patient (P.W., female, *aet.* 52) left Brisbane on 23rd February, became ill at Bundaberg on 25th February, and died on 7th March. This case was infected in Brisbane, and should properly be regarded as a Brisbane case. No human or rat plague of indigenous origin was reported at Bundaberg throughout the whole period.

*Aramac.*—On 15th March, 1922, a case of suspected plague was reported. The patient was an aboriginal woman, aged 30 years. She left Rockhampton on 5th March, became ill on 11th March, and died on 18th March. There was never any report of plague rats in Aramac, but plague rats were found in Rockhampton up to 18th February.

*Maryborough.*—Infected rats were found on two occasions:—

13th October, 1921, at corner of Vulcan and Ann streets.

4th November, 1921, at corner of Lennox and Albert streets.

No human case was reported at Maryborough.

*Toowoomba.*—On 20th October, 1921, a boy aged 9 was reported to be suffering from plague. This boy arrived from Brisbane on 14th October, and fell ill on 18th October. It is considered that he was infected in Brisbane. Plague rats were never found in Toowoomba.

*Innisfail.*—It was reported on 21st October that rats were dying in large numbers at Innisfail and on plantations on the Babinda line. On 1st November, a male, *aet.* 46, became ill with plague. This patient was living in Rankin-street. One infected rat was at the same time stated to have been obtained at adjacent premises in the same street. On 16th November four infected rats were obtained from Howard Smith's Wharf, railway station, Crown Hotel, residence of Mr. G. Bass. No further evidence of human or rat plague was obtained.

*Ingham.*—A smart epizootic amongst rats occurred at the McNade Sugar Mill, near Ingham. Infected rats were obtained as follow:—

|                                   |    |
|-----------------------------------|----|
| Week ending 29th October .. .. .  | 2  |
| Week ending 4th November .. .. .  | 2  |
| Week ending 11th November .. .. . | 9  |
| Week ending 18th November .. .. . | 2  |
| Week ending 25th November .. .. . | 2  |
| Week ending 3rd December .. .. .  | 1  |
| Week ending 10th December .. .. . | 1  |
| Week ending 17th December .. .. . | 1  |
| Week ending 24th December .. .. . | —  |
| Week ending 31st December .. .. . | 1  |
|                                   | —  |
| Total .. .. .                     | 21 |

No human case of plague occurred.



## CHAPTER XXXI.—PLAGUE IN SYDNEY.

The plague epidemic in Sydney is exhaustively described by Dr. W. G. Armstrong in his Annual Report for 1922 as Director-General of Public Health for New South Wales.

The following description is taken, *verbatim*, from that report\* :—

The invasion of New South Wales by plague in 1921-22 exhibited some features of peculiar interest. Within a small compass it presented a very perfect picture, both epidemiologically and epizootologically, of a typical plague outbreak and, largely owing to its limited extent, its observation was able to be very thorough. The links in the chain of evidence illustrating the progress of the rat epizootic were fairly complete, and the connexion between each human patient and the infected rat was, with few exceptions, established. Additionally—and this is an unusual feature of plague outbreaks—the very earliest beginnings of the epizootic were observed and traced with considerable certainty to the actual ship which was responsible for the introduction of the infection to Sydney from overseas. On the therapeutical side, the outbreak witnessed the introduction and use of what appears to have proved an effective curative serum.

The outbreak in New South Wales lasted from 19th September, 1921, until 13th July, 1922, a period of nearly nine months. Sydney was the only locality affected. During the period in question 35 human beings were attacked, of whom 10, or 28.6 per cent., died. The number of plague-infected rats found was 151. The first plague rat was got on 19th September, 1921, and the last on 13th July, 1922. The first human case occurred on 29th November, 1921, and the last on 9th June, 1922. An isolated case occurred in 1923 (vide p. 209).

The 1921-22 outbreak consisted of a primary focus of infection and nine off-shoot groups, most of them situated at considerable distances from the primary focus. The primary focus was situated in the business portion of the city, near the wharfs of Darling Harbour, and it became infected by means of plague rats which reached it oversea from Queensland. In five of the secondary outbreaks the infection was definitely grouped round a produce store or a stable which had been supplied with fodder, &c., from the Darling Harbour wharfs. The inference was that plague rats carried in the produce had infected each of these localities, and with one exception plague rats were found in every distinct area infected.

On 21st September, 1921, two black rats were found dead on the A.U.S.N. Wharf, near where the *Wyreema* had been tied up. On examination they were found to be plague infected.

\* This quotation continues to the foot of page 165.

On 22nd September, 1921, a grey rat (*Rattus norvegicus*), caught on the same wharf, proved on examination to be plague infected, and between that date and 6th October twelve more infected rats were found, either upon the same wharf or in an engineering workshop situated at the base of the wharf, during operations of cleansing and disinfecting which were carried out at the wharf throughout the period in question.

The sequence of events in the North Central Area ("A") was as follows:—Plague rats continued to be taken upon the A.U.S.N. wharf, and one wharf adjoining it (Howard Smith's No. 1 wharf), until 6th October. After that date, though intensive rat catching operations upon those wharfs and the surrounding neighbourhood were continued without intermission, no more plague rats could be got until 5th December. On 3rd December, a case of human plague (case No. 2) occurred on business premises at 102 Sussex-street, situated about 100 yards from the A.U.S.N. wharf, and on 5th December, a rat from the same building was ascertained to be plague infected. Between that date and 20th January, 1922, 20 additional plague rats were found on seven business places—mainly produce stores—in Sussex, Day, and Kent streets, all within 150 yards of the centre of the group. Again there was a lull, until 13th April, when five infected rats were obtained at 197A Sussex-street, a little distance south of the A.U.S.N. wharf, and from then until 13th July, an occasional infected rat was brought in by the rat-catchers. The total number of infected rats found in this area was 56. Only one human infection occurred in the area.

The South Central infected area ("B") is over a quarter of a mile distant in a southerly direction from the north-central area, and, although the district between the two areas was assiduously searched and trapped from the first beginnings of the outbreak, no plague rats were taken there. In contrast to the compactness of the northern area, the infected premises in this group are strung out in a straggling line, stretching east and west from Sussex-street to Bourke-street. This area yielded 23 plague rats from four premises—besides a considerable number of carcasses presumably dead of plague, but too putrid for examination—together with seven infections (cases Nos. 1, 3, 4, 6, 19, 22, and 23) in human beings. The evidence as regards the location of the infection of one case, however, is presumptive rather than absolute (case No. 4).

Plague rats were first found in this area in a large produce store at 361 Sussex-street, on 1st November, by the City Council rat staff. Fifteen plague rats were obtained on these premises, but no human infection occurred. The next-door premises, however, yielded the first human patient of the outbreak—on 26th November, 1921 (case No. 1). Though no proved plague rats were discovered here, two or



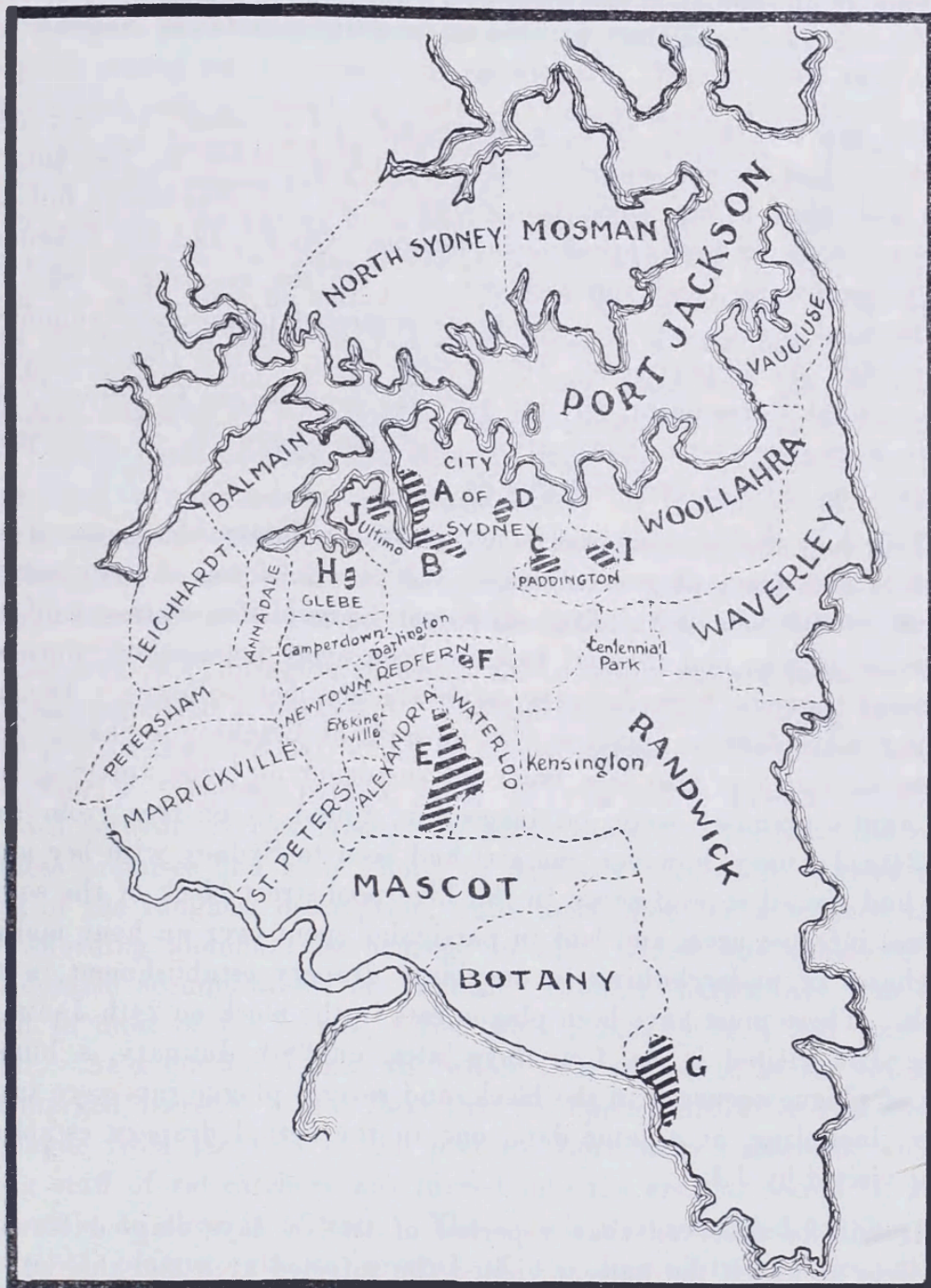


Figure 9. Map of portion of Sydney and Suburbs, showing areas affected during the 1921-1922 Plague Outbreak. References:—A. North Central; B. South Central; C. Paddington No. 1; D. Woolloomooloo; E. Alexandria; F. Redfern; G. Bunnerong; H. Glebe; I. Paddington, No. 2; J. Pyrmont.

(After W. G. Armstrong, Report of the Tenth Outbreak of Plague at Sydney; Report of the Director-General of Public Health, New South Wales, 1922.)

three carcasses of rats, which were suspected of having died of plague, but were too putrid for examination, were found on the premises. They had been no doubt infected from next door.

One of the human cases connected with this area was surrounded by circumstances of sufficient interest to warrant a detailed statement of facts here.

On 9th February, 1922, a school-girl (J.L., case No. 4), aged thirteen, died rather suddenly at a boarding school in Parramatta. She had been ailing since the afternoon of 5th February, but her illness did not at first appear to be serious. On 7th and 8th February, she became worse, and vomiting set in. On the morning of the 9th, the medical practitioner in attendance suspected plague, and communicated with the Department. Dr. Robert Dick, of the Health Department, visited Parramatta, but the girl was dead before he arrived. He made a post-mortem examination, and the diagnosis of septicæmic plague was verified bacteriologically.

How had she been infected? As far as was known, Parramatta was entirely free from plague infection, and remained so. A very careful search of the school buildings disclosed no evidence whatever of the presence of rats, and the girl had not been away from school since she returned there on 29th January, after the summer holidays. She had spent the holidays in question with an aunt at Brighton-le-Sands. This latter district was also free from all suspicion of being infected, and the aunt's premises were, on inspection, found to be free from rats. On 24th January, however, the girl had been to Sydney with her aunt, and had visited several shops in the Liverpool-street block of the south-central infected area, and had in particular spent over an hour making purchases of underclothing in one large drapery establishment in the block. There must have been plague rats in the block on 24th January, when J.L. visited it, as, four days later, on 28th January, a human case of plague occurred in the block, and several plague rats were taken there, including, at a later date, one in the actual drapery establishment visited by J.L.

It will be observed that a period of twelve days elapsed between the time at which the patient visited the infected area and the date of her attack. This is a long incubation period for plague, which does not as a rule exceed five days. The Indian Plague Commission, however, ascertained experimentally that a plague flea might remain infective for fifteen days after it had left its rat host. The possibility, therefore, cannot be overlooked of J.L. having picked up a rat flea in the course of her visits to shops in the infected area and having been bitten by it at a later date. Such an occurrence, though an evident possibility, is unusual, and the source of infection in this case must still be regarded as obscure. After careful investigation, however, it is the only likely hypothesis which can be advanced.



The Paddington No. 1 Area ("C").—On 18th February, 1922, the Medical Superintendent of the Royal Prince Alfred Hospital reported the case of J.A.R. (case No. 5), a man aged seventeen, residing in Comber-street, Paddington, and employed in a produce store situated at 76 Oxford-street, a few yards from his residence, as one of plague. The patient was immediately removed by ambulance to the Coast Hospital, where the diagnosis was confirmed. The produce store was quarantined, and searched for rats. Two carcasses were found, but both were too decomposed for bacteriological examination. There was, however, good reasons for believing that they had died of plague. A history of sick rats having been seen about the store was also obtained. When admitted to the Coast Hospital, J.A.R. was very ill and delirious, but a few days later he stated that he had seen dead rats in the basement of the store where he had been working a few days before his illness. Examination of the store disclosed numerous rat holes and abundant traces of rat infestation. On investigation, it was ascertained that several loads of chaff and other produce had been brought to this store from a plague-infected establishment in Sussex-street (north-central area) between three weeks and a month before J.A.R. was attacked, and it seemed clear that plague rats or fleas must have been concealed in the produce and infected the rats in the Oxford-street store.

The area of Paddington in which this produce store is situated, was in a bad condition structurally. The buildings upon it facing Oxford-street are for the most part small combined shops and dwellings, and at their rear is a closely packed mass of old, small terrace dwellings crowded between narrow lanes. In many cases, the yards at the rear of these premises had been wholly or partially covered by stables and sheds of the roughest description, quite unsuitable for a modern city, and affording abundant harbourage to rats, which was enhanced by considerable accumulations of rubbish. Similar harbourage was disclosed in most of the houses, which were generally in a bad state of repair. As a matter of fact, the whole area proved to be rat infested to a marked degree. It was clear that the opportunities for the spread of plague from the rats at the produce store were numerous, and a strong staff of rat-catchers was turned into the area to search it, and, if possible, to clear it of rats. The search was rewarded by the discovery of plague rats on several of the immediately surrounding premises, including Nos. 72A, 80, 84, and 88 Oxford-street, and No. 5 West-street; while several carcasses of rats, which were ascertained to have died of plague, were picked up in the streets and lanes of the area.

Two other human cases of plague occurred in this area (cases Nos. 7 and 8). Both the patients acquired infection at No. 84 Oxford-street, while the premises were in quarantine on account of a plague-infected cat and a plague rat having been found there. One was the wife of the occupier, and the other a young tradesman engaged in carrying out

repairs to the premises enforced upon the owner by the Department. This young man's case is specially interesting from the fact that the incubation period of his attack could be very accurately fixed. He began work on these premises on the morning of 7th March, and continued there during that day. On the eighth, he was not at the premises at all, being engaged at work in another district which was never attacked by plague. On the ninth he again returned to 84 Oxford-street, and worked there till 4.30 p.m., when he returned to his home at Mosman, and was taken ill with a headache and rigor at 9 p.m. He must have been infected on the seventh, between 10 a.m. and 5 p.m. The incubation period in his case was therefore more than 52 hours and less than 59 hours.

The Woolloomooloo Area ("D").—The Woolloomooloo group of cases or sub-epidemic presents many interesting features. It centred round a livery stable, with dwelling attached, situated at 119 Dowling-street, in a residential district. On 22nd March, 1922, a motor-car driver (J.C., case No. 9), a single man, residing in lodgings in Darlinghurst, and employed in a motor garage in Castlereagh-street, died suddenly of plague in the Sydney Hospital before he could be removed to the Coast Hospital. Careful investigation led to the conclusion that he had not contracted infection either at his lodgings or the place of his employment, and for a few days the Department was at a loss. At length, a minute inquiry into his movements during the week before his illness disclosed that on at least two occasions during that time he had spent the evening at 119 Dowling-street, Woolloomooloo, and that a young woman residing on the same premises had recently had an illness described as "slight," from which she was convalescent. She was visited by a medical officer of the Department, and the opinion formed that she had undergone a mild attack of plague, from which she had scarcely recovered, as there was still an indurated and slightly enlarged glandular mass in the right groin. The diagnosis was subsequently confirmed serologically (E.S., case No. 14). Inquiry elicited from the convalescent herself, and from other inmates of the premises, that rats had been dying in the livery stables for two or three weeks before E.S. became ill. The facts of the visits of the motor-driver J.C. to the premises in the three or four days immediately preceding his illness was also established, and it became clear that he had contracted infection there.

On 28th March, a little girl (M.W., case No. 10) was found to be ill with plague at No. 115 Dowling-street, and it was ascertained that she had been a frequent visitor at No. 119 (two doors from her own residence), and had waited on Miss E.S. during the latter's illness. M.W. had a very severe attack of plague. The next day a stableman (R.R.) employed in the livery stable attached to No. 119 Dowling-street presented himself with an "abscess" in the groin, which he had had



for some days, and which had followed an illness accompanied by headache, shivering, and vomiting. The illness, he said, had only lasted for one day. He was sent to the Coast Hospital as a plague suspect, and later the diagnosis of plague was confirmed bacteriologically and serologically (case No. 13). This case, and that of E.S., are interesting as being the first "mild" cases of the outbreak. It will have been gathered that four cases of plague were traced to No. 119 Dowling-street, three of which occurred before any suspicions were directed to the premises. As soon as the premises became suspect, they were quarantined, searched for rats, and disinfected. A number of rat carcasses, all of them two or three weeks old, and too far advanced in putrefaction for bacteriological examination, were found in the basement of the dwelling and the attached stables. They had evidently died of plague. The fodder used in the stables had been obtained from several firms in the infected area in Sussex-street, and had no doubt been the vehicle of infection to the premises. More definite information on this point was lacking. During the process of cleaning up and disinfecting the block of buildings in which No. 119 was situated, a mother and her little daughter, residing in Judge-street, in the same block as 119 Dowling-street, and at the rear of the latter, were both attacked by plague, and both were very seriously ill (cases Nos. 12 and 15). Altogether, six persons were attacked by plague in this area. Only one rat was obtained from the area which could be rigidly proved to have died of plague, but many rat carcasses brought in were too old for useful bacteriological examination. There was ample proof forthcoming of an extensive and fatal epizootic among the rats of the area, which, under the circumstances, was in itself sufficient evidence of plague among them.

The Redfern ("F") and Bunnerong ("G") Areas.—These are grouped together, because the epidemiological circumstances in the two areas resembled one another rather closely. In each locality a strictly limited outbreak of plague occurred in the immediate neighbourhood of a building—a produce store in the Redfern area and a stable in the Bunnerong area—which was used for the storage of fodder. In both cases the fodder had been obtained from business places in the infected area (north-central) on the shores of Darling Harbour. Subsequently to the occurrence of cases of human plague in each area, it was ascertained that heavy mortality had occurred among rats in the produce store and the stable in question, and in both cases, although the rat mortality had been observed by persons employed in or about the buildings, it had been attributed to the effects of poison, and had not been reported to the Department. Both establishments yielded rat carcasses, which, on examination, were proved bacteriologically to have died of plague. In each case, this took place after the occurrence of the first human case of plague. Three cases of human plague (Nos. 24, 31, and 35, including a father and son from one house) occurred in the Redfern area, and five cases (Nos. 25, 26, 28, 29, and 30), of which a mother

and two children came from one house, in the Bunnerong area. Bunnerong is a locality situated on the northern shore of Botany Bay in the southern portion of the municipality of Randwick. The area attacked consisted of a small isolated group of four dwellings surrounding a wool-washing establishment with a stable attached. The immediate neighbourhood consists of open country covered with a low scrubby growth. The Redfern area, on the contrary, is in a very thickly built-on neighbourhood in one of the most populous suburbs of Sydney.

The Alexandria Area ("E") presents a different picture. Here the outbreak was more diffuse, and though the area yielded but six cases of human plague and four proved plague rats, infection must have been rather widespread, as dead rats, partly dried up, or too advanced in decay for bacteriological diagnosis, were found on many premises in the area. The sanitary circumstances of the area are not good. Much of it is low-lying and swampy, and vegetable gardens owned and worked by Chinese, cover a considerable proportion of the surface. The dwellings occupied by many of these people, as well as those of not a few Europeans, were found to be unfit for human habitation, and of a nature calculated to give abundant harbourage to rats. A number of them were condemned and demolished by the action of this Department. Their continued existence was a disgrace to the local authority. Many noxious trade establishments are situated on the area, and stables often of a makeshift and dilapidated structure are fairly numerous. There were, in short, great facilities for rat infestation, which, as a matter of fact, was found to be considerable.

The first human case from this area was that of a young man (No. 11) of no very definite occupation, who resided in a ruinous hut in a Chinese garden in Godfrey-street. He lived alone, and information as to his illness was difficult to obtain, but he was said to have been first attacked on 27th March, 1922. On the 30th of the same month, he was found lying delirious and moribund in his hut. He was taken to the Coast Hospital, and died of plague about two hours later. After his removal, a survey of the hut disclosed a number of decomposing rat carcasses, some of them under his bed. All were too putrid for bacteriological examination, but the circumstances indicated that they had died of plague. Of the five other cases from this area, three (Nos. 16, 17, and 20) occurred in one house, distant about 10 chains from the dwelling of the first patient. The other two cases (Nos. 18 and 21) were furnished by more remote places in the area. Dead rats were found by the cleansing staff on or near each of the premises on which cases of human plague occurred.

The Glebe Area ("H").—Two persons residing in Darghan-street, Glebe, within ten doors of one another, were attacked by plague at about the same date (1st and 2nd May), under circumstances which are worthy of description (cases 27 and 32). The persons attacked were both



young men employed in different business places in George-street, City, in an area which was never proved to be plague infected. No plague rats were found in the neighbourhood of Darghan-street, or, indeed, in any part of the municipality of the Glebe, and although a very extensive search of the premises surrounding the homes of both patients in Darghan-street was made, no rat carcasses were found by the departmental staffs. There were, however, a few small stables in the vicinity, and a certain degree of local rat infestation was established. A very interesting circumstance came to light at the dwelling occupied by one of the patients (case No. 27). One of two pet guinea pigs kept on the premises became sick on the same day as the patient, and on its death two days later, it was brought to the bacteriological laboratory of this Department, where it was ascertained to have died of plague. A history was also elicited from the inmates of the house that a recently dead rat had been found in a shed on the premises about a fortnight before the patient was attacked, although no poison had ever been laid. On review of all the circumstances, it was judged probable that the infection in cases 27 and 32 was acquired at their dwellings, and the area was proclaimed as infected.

Paddington No. 2 Area. ("I").—This area, which is nearly three-quarters of a mile distant from the Paddington No. 1 Area, was invaded nearly two months later than the latter, and was considered to have been separately infected. It yielded two human cases (33 and 34) and five proved plague rats. The district is a residential one at the north-eastern end of the municipality of Paddington, near a park (Hampton Park), a portion of which had for some years been used as a municipal refuse tip. The area is closely covered with small houses, and rats were found to be rather numerous, probably owing to the vicinity of the tip. A few small stables existed in the neighbourhood, which, as a rule, drew their fodder supplies from the Darling Harbour produce stores. It was surmised that infection reached the area through one of the stables in question, though it could not be ascertained which one was at fault.

The Pyrmont Area ("J").—No human cases occurred in relation to this area, but nine plague mice and one plague rat were obtained therefrom. The area is situated on the western shore of Darling Harbour, immediately opposite the North Central Plague Area, but separated from the latter by the waters of an arm of Port Jackson. The plague-infected rodents were found on the wharfs of this neighbourhood or in the buildings at the base of the wharfs. Large quantities of wheat are stored upon the wharfs at the time, and the whole locality was over-run with mice. It is judged that the rodents in this area must have become infected by direct extension from the south-central area, as a railway goods line extends round the head and along the whole western foreshore of Darling Harbour, and this would have afforded a free runway to rats and mice.



TABLE 59—SHOWING LOCATION OF PLAGUE-INFECTED AREAS AT SYDNEY, NEW SOUTH WALES, 1921-22, AND NUMBER OF HUMAN PLAGUE CASES AND INFECTED ANIMALS ASSOCIATED WITH EACH AREA.

| Infected Areas.   | Dates.   | Associated Human Cases.     | Serial Number and Species of Infected Rats.                 |                 |                      |                    | Other Infected Animals. |                      |
|---|--|-----------------------------|---|-----------------|----------------------|--------------------|-------------------------|----------------------|
|   |  |                             | Serial No.  | Total Infected. | Species.             |                    |                         |                      |
|   |  |                             |   |                 | <i>R. norvegicus</i> | <i>R. rattus</i> . |                         | <i>M. musculus</i> . |
| A. North Central, Period 1  | 19.9.21—6.10.21 ..                             | Case 2 .. ..                | 1—29 .. ..  | 29              | 14                   | 15                 | ..                      | ..                   |
| „ 2   | 5.12.21—20.1.22 ..                             | .....                       | 45, 46, 48—52, 54—67 ..                                     | 21              | 15                   | 6                  | ..                      | ..                   |
| „ 3   | 13.4.22—13.7.22 ..                             | .....                       | 96—100, 102, 105, 106, 111, 114, 116, 121, 143—145, 147—151 | 20              | ..                   | 17                 | 3                       | ..                   |
| B. South Central ..   | 1.11.21—3.5.22 ..                              | Cases 1, 3, 4, 6 ..         | 30—44, 47, 68—74, 101, 113, 119                             | 26              | 4                    | 21                 | 1                       | ..                   |
| C. Paddington, No. 1 ..   | 22.2.22—21.3.22 ..                             | Cases, 5, 7, 8 ..           | 75—79, 93, 94, 82—84, 86—89<br>85 (cat)<br>92 (kitten)      | 14              | 13                   | ..                 | 1                       | 2 cats               |
| D. Woolloomooloo ..   | 28.3.22 .. ..                                  | Cases 9, 10, 12, 13, 14, 15 | 95, 146 .. ..   | 2               | 2                    | ..                 | ..                      | ..                   |
| E. Alexandria .. ..   | 26.4.22—3.5.22 ..                              | 11, 16, 17, 18, 20, 21      | 103, 104, 112, 115 ..                                       | 4               | 4                    | ..                 | ..                      | ..                   |
| F. Redfern .. ..  | 5.5.22—22.5.22 ..                              | 24, 31, 35 ..               | 117, 127, 131, 132 ..                                       | 4               | 4                    | ..                 | ..                      | ..                   |
| G. Bunnerong .. ..  | 3.5.22—12.5.22 ..                              | 25, 26, 28 ..               | 108, 109, 122 .. ..   | 3               | 1                    | 2                  | ..                      | ..                   |
| H. Glebe .. ..  | 2.5.22—3.5.22 ..                               | 27, 32 .. ..                | 107 (guinea pig) ..   | ..              | ..                   | ..                 | ..                      | 1 guinea pig (pet)   |
| I. Paddington, No. 2 ..   | 29.5.22—15.6.22 ..                             | 33, 34 .. ..                | 133—140, 142 .. ..  | 9               | 9                    | ..                 | ..                      | ..                   |
| J. Pyrmont .. ..  | 3.5.22—8.6.22 ..                               | .....                       | 110, 120, 123—126, 128—130, 141                             | 10              | ..                   | 1                  | 9                       | ..                   |
| Miscellaneous—six plague rats obtained from isolated localities outside above areas | 20.12.21 ; 24.2.22 ; 3.3.22 ; 15.4.22 ; 8.5.22 | .....                       | 53, 80—81, 90—91, 118 ..                                    | 6               | 2                    | 4                  | ..                      | ..                   |



TABLE 60.—CASES OF HUMAN PLAGUE, SYDNEY.

| Case No. | Date reported. | Infected Locality.            | Name.  | Age. | Sex. | Occupation.                          | Address.                                      | Date of Onset. | Date Isolated. | Date Discharged. | Date of Death. | Remarks.   |
|----------|----------------|-------------------------------|--------|------|------|--------------------------------------|---|----------------|----------------|------------------|----------------|--|
| 1        | 29.11.21       | Sussex-street, City of Sydney | P.M.   | 45   | M    | Storeman ..                          | 19 Queen-street, Glebe                        | 23.11.21       | 28.11.21       | ..               | 2.12.21        | Left inguinal bubo. Smear positive. Employed at Foley Bros.' Produce Store, 353 Sussex-street, Sydney.   |
| 2        | 5.12.21        | Sussex-street, City of Sydney | F.S.G. | 50   | M    | Mechanic ..                          | 142 Brook-street, Coogee                      | 1.12.21        | 3.12.21        | 23.1.22          | ..             | Left inguinal bubo. Smear positive. Employed at a rabbit fumigating appliances store, 102 Sussex-street, Sydney. An infected rat was found on these premises on 5.12.21.   |
| 3        | 30.1.22        | Liverpool-street, Sydney      | V.G... | 19   | F    | Housemaid, Lynch's Court House Hotel | C/o Kingston, 205 Rocky Point-road, Arncliffe | 25.1.22        | 28.1.22        | 14.2.22          | ..             | Right axillary bubo. Smear positive. Employed at Lynch's Court House Hotel, corner of Liverpool and George-street, Sydney. From 18th to 23rd January three infected rats were found at 263 and 266 Kent-street. From 6th to 8th February, 1922, six infected rats were obtained from a china shop at 97A Liverpool-street, three doors from Court House Hotel. |
| 4        | 10.2.22        | Probably Liverpool-street     | J.L.   | 14   | F    | Schoolgirl ..                        | Resident pupil, Convent School, Paramatta     | 9.2.22         | Died at home   | ..               | 10.2.22        | Septicaemic plague. Confirmed post mortem. This girl had been shopping in Liverpool-street, Sydney, in the infected neighbourhood  |
| 5        | 19.2.22        | Oxford-street, Paddington     | J.R.   | 18   | M    | Storeman ..                          | 39 Comber-street, Paddington                  | 15.2.22        | 18.2.22        | 24.4.22          | ..             | Left femoral bubo. Smear positive. Employed at Maloney's Produce Store, 76 Oxford-street, Paddington. Infected rats found at several places in immediate vicinity, viz.—At 98 Oxford-street, 72A Oxford-street, 80 Oxford-street, and 84 Oxford-street, from 22.2.22 to 1.3.22.  |
| 6        | 19.2.22        | Liverpool-street, Sydney      | P.G.A. | 32   | M    | Window dresser                       | Berith-road, Wentworthville                   | 17.2.22        | 18.2.22        | 29.3.22          | ..             | Right femoral bubo. Smear positive. Employed at Ainsworths, Drapers, 133 Liverpool-street, Sydney. Infected rats in this neighbourhood (see details under case No. 8).   |
| 7        | 11.3.22        | Oxford-street, Paddington     | J.L.   | 17   | M    | Carpenter ..                         | 9 Rosebury-street, Mosman                     | 9.3.22         | 11.3.22        | 10.4.22          | ..             | Right inguinal bubo. Smear positive. Infected at 84 Oxford-street, Paddington, where he was temporarily employed. (See case No. 8.)  |
| 8        | 11.3.22        | Oxford-street, Paddington     | E.F.   | 27   | F    | Domestic duties..                    | 84 Oxford-street, Paddington (Chemist's shop) | 10.3.22        | 11.3.22        | 2.4.22           | ..             | Left inguinal bubo. Smear positive. One infected rat and one infected cat found on these premises on 28.2.22, and one infected kitten on 6.3.22. Further infected rats in other premises in the vicinity. (See notes under case No. 5.)  |



TABLE 60—CASES OF HUMAN PLAGUE, SYDNEY—*continued.*

| Case No. | Date reported. | Infected Locality.            | Name.    | Age. | Sex. | Occupation.                                   | Address.                           | Date of Onset. | Date Isolated.            | Date Discharged. | Date of Death. | Remarks.   |
|----------|----------------|-------------------------------|----------|------|------|---|------------------------------------|----------------|---------------------------|------------------|----------------|--|
| 9        | 23.3.22        | Livery Stables, Woolloomooloo | J.C. . . | 30   | M    | Motor mechanic . .                            | 12 Rosebank - street, Darlinghurst | ..             | 20.3.22 (Sydney Hospital) | ..               | 22.3.22        | Septicæmic plague (confirmed post mortem). Employed at 181 Castle-reagh-street, Sydney. No infected rodents found in this locality. Source of infection traced to livery stables, 119A Dowling-street, Woolloomooloo |
| 10       | 28.3.22        | Livery Stables, Woolloomooloo | M.W.     | 9    | F    | Schoolgirl ..                                 | 115 Dowling-street, Woolloomooloo  | 26.3.22        | 27.3.22                   | 13.5.22          | ..             | Left inguinal bubo. Source of infection same as case No. 9.  |
| 11       | 31.3.22        | .. ..                         | J.C. . . | 22   | M    | Employed Collins-street, Alexandria           | Collins-street, Alexandria         | 28.3.22        | 30.3.22                   | ..               | 30.3.22        | Left inguinal bubo. Died within 2½ hours of admission to hospital.   |
| 12       | 31.3.22        | Woolloomooloo ..              | S.B. . . | 4    | F    | Infant ..                                     | 2 Judge-street, Woolloomooloo      | 29.3.22        | 30.3.22                   | 23.4.22          | ..             | Left inguinal bubo. Source of infection probably at her home which is in the same block of buildings as case No. 10. 115 Dowling-street.   |
| 13       | 31.3.22        | Woolloomooloo ..              | R.R.     | 50   | M    | Employed 119 Dowling-street                   | 42 Brougham-street, Woolloomooloo  | 21.3.22        | 29.3.22                   | 12.5.22          | ..             | Right inguinal bubo. Ambulant case. Date of onset not known. Source of infection probably 119 Dowling-street   |
| 14       | 31.3.22        | Woolloomooloo ..              | E.S.     | 43   | F    | Home duties ..                                | 119 Dowling-street, Woolloomooloo  | ..             | Not isolated              | ..               | ..             | Ambulant case. Date of onset considerably in advance of the date notified. Source of infection her own home.   |
| 15       | 1.4.22         | Woolloomooloo ..              | J.B.     | 27   | F    | Home duties ..                                | 2 Judge-street, Woolloomooloo      | 31.3.22        | 1.4.22                    | 23.4.22          | ..             | Right inguinal bubo. Mother of case No. 12. Source of infection the same.  |
| 16       | 4.4.22         | Alexandria ..                 | E.F.     | 7    | F    | Child ..                                      | 3 William-street, Alexandria       | 2.4.22         | 3.4.22                    | 28.4.22          | ..             | Right inguinal bubo. Source of infection her own home which is close to residence of the fatal case No. 11.  |
| 17       | 10.4.22        | Alexandria ..                 | A.D.     | 24   | M    | Carter ..                                     | 6 Botany-road- Alexandria          | 6.4.22         | 8.4.22                    | 4.5.22           | ..             | Right femoral bubo. Source of infection, relative's house at 3 William-street, residence of case No. 16.   |
| 18       | 12.4.22        | Alexandria ..                 | R.P. . . | 15   | M    | Employed Eterno Cement Factory, McEvoy-street | 51 Fanning-street, Tempe           | 8.4.22         | 11.4.22                   | 12.5.22          | ..             | Right femoral bubo. Source of infection probably at place of employment, Eterno Cement Factory, McEvoy-street, Alexandria.   |
| 19       | 12.4.22        | .. ..                         | H.J.L    | 15   | M    | Messenger ..                                  | Crondale-street, Oatley            | ..             | ..                        | ..               | 12.4.22        | Died suddenly at his home. Was employed at Wragge & May's Hat Factory, 50 Wentworth-avenue, Sydney.  |
| 20       | 18.4.22        | Alexandria ..                 | M.F.     | 50   | F    | Home duties ..                                | 3 William-street, Alexandria       | 6.4.22         | 8.4.22                    | 9.5.22           | ..             | Septicæmic case. Infected at her own home. See case No. 16.  |
| 21       | 18.4.22        | Waterloo ..                   | A.E. . . | 43   | M    | .. ..   | 60 Paul's road, Waterloo           | 16.4.22        | 17.4.22                   | ..               | 20.4.22        | Right femoral bubo.  |
| 22       | 22.4.22        | Surry Hills ..                | G.B. . . | 73   | M    | Wharf labourer, Huddart Parker's              | 2 Ryder-street, Surry Hills        | 19.4.22        | 21.4.22                   | ..               | 24.4.22        | Right axillary bubo.   |



TABLE 60—CASES OF HUMAN PLAGUE, SYDNEY—*continued.*

| Case No. | Date reported. | Infected Locality. | Name.  | Age. | Sex. | Occupation.                        | Address.                                  | Date of Onset. | Date Isolated. | Date Discharged. | Date of Death. | Remarks.  |
|----------|----------------|--------------------|--------|------|------|------------------------------------|---|----------------|----------------|------------------|----------------|---|
| 23       | 27.4.22        | Sydney .. ..       | E.O'D. | 21   | F    | Waitress ..                        | Cr. Acacia and Waratah-streets, Oatley    | 24.4.22        | 27.4.22        | 28.5.22          | ..             | Left inguinal bubo. Was employed as waitress at Criterion Cafe, 305 Pitt-street, Sydney, Infected rodent found at Civic Club, Pitt-street, on 8.5.22.   |
| 24       | 2.5.22         | Redfern .. ..      | D.A.   | 8    | M    | Schoolboy ..                       | 101 Elizabeth-street, Redfern             | 27.4.22        | 29.4.22        | 2.6.22           | ..             | Right axillary bubo. Probably infected at place of residence. Infected rodents found Spierman's stables, Elizabeth-street, Redfern, on 8.5.22 and at a produce store in same street on 17.5.22 and 22.5.22. |
| 25       | 2.5.22         | Randwick .. ..     | E.M.   | 17   | F    | Home duties ..                     | McWilliam's Wool Scouring Works, Randwick | 28.4.22        | 1.5.22         | 31.5.22          | ..             | Right inguinal and right cervical bubo. Infected rodents found dead at McWilliam's Wool Scouring Works on 3.5.22 and 12.5.22.   |
| 26       | 2.5.22         | Randwick .. ..     | T.M.   | 2½   | F    | Infant ..                          | McWilliam's Wool Scouring Works, Randwick | 30.4.22        | 2.5.22         | 31.5.22          | ..             | Left axillary bubo. Daughter of case No. 25.  |
| 27       | 3.5.22         | Glebe .. ..        | A.N.   | 16   | M    | Employed Harrington, Photographers | 58 Darghan-street, Glebe                  | 2.5.22         | 2.5.22         | 10.6.22          | ..             | Right femoral bubo. Dead guinea pig found on premises, 58 Darghan-street, Glebe. Plague infected 3.5.22.  |
| 28       | 5.5.22         | Randwick .. ..     | E.E.M. | 1    | F    | Infant ..                          | McWilliams' Scouring Works, Randwick      | 30.4.22        | 4.5.22         | 31.5.22          | ..             | Left cervical bubo. Daughter of case No. 25.  |
| 29       | 5.5.22         | Randwick .. ..     | L.P.   | 33   | F    | Home duties ..                     | Bunnerong Estate, Randwick                | 25.4.22        | 30.4.22        | ..               | 12.5.22        | Septicæmic plague. Premises next to Murray family. See cases No. 25, 26 and 28.   |
| 30       | 8.5.22         | Randwick .. ..     | W.P.   | 11   | M    | Schoolboy ..                       | Bunnerong Estate, Randwick                | 3.5.22         | 5.5.22         | 18.5.22          | ..             | Right inguinal bubo. Son of case No. 29.  |
| 31       | 9.5.22         | Redfern .. ..      | T.A.   | 35   | M    | .. ..                              | 101 Elizabeth-street, Redfern             | 1.5.22         | 5.5.22         | 4.7.22           | ..             | Septicæmic. Father of case No. 24. Probably infected at own home.   |
| 32       | 16.5.22        | Glebe .. ..        | R.S.   | 27   | M    | Painter ..                         | 78 Darghan-street, Glebe                  | 3.5.22         | 4.5.22         | 20.5.22          | ..             | Right axillary bubo. Probably infected at place of residence. See case No. 27. Infected guinea pig at 58 Darghan-street, Glebe.   |
| 33       | 19.5.22        | Paddington .. ..   | J.W.   | 61   | F    | .. ..                              | 61 Harris-street, Paddington              | 12.5.22        | 17.5.22        | 6.6.22           | ..             | Left inguinal bubo. Plague infected rodents found in several localities in Paddington, which is an infected area.   |
| 34       | 7.6.22         | Paddington .. ..   | M.Q.   | 70   | F    | .. ..                              | 155 Sutherland-st., Paddington            | 31.5.22        | 4.6.22         | ..               | 6.6.22         | Right femoral bubo. See remarks case No. 23. Infected rodents found in near vicinity of Sutherland-street, from 29.5.22 to 15.6.22  |
| 35       | 12.6.22        | Redfern .. ..      | M.D.   | 60   | F    | .. ..                              | 57 Elizabeth-street, Redfern              | 6.6.22         | 9.6.22         | ..               | 10.6.22        | Left inguinal bubo. For source of infection, see remarks under case No. 24.   |



The sequence of events in this epidemic is so unusually demonstrative of the close relationship between epidemic and epizootic plague, that it is worth while setting out in full detail the daily occurrences.

This is done in the tables hereunder.

TABLE 61.

## HUMAN AND RODENT PLAGUE IN SYDNEY.

1921—

|           |                           |  |
|-----------|---------------------------|--|
| September | 21—2 at Lime-street Wharf | } During this period between 150 and 200 rats were examined in this circumscribed area |
|           | 22—1 „ „ „                |  |
|           | 23—1 „ „ „                |  |
|           | 24—1 premises opposite    |  |
|           | 26—1 „ „                  |  |
|           | 27—2 at Lime-street Wharf |  |
|           | 28—3 „ „ „                |  |
|           | 2 premises opposite       |  |

|          | Total examined.  | No. infected.                                      |
|----------|------------------|--|
|          | 29—160 ..        | nil  |
|          | 30—210 ..        | „  |
| October  | 1—116 ..         | „  |
|          | 2--not stated .. | 1 Adjoining Lime-street Wharf—Howard Smith's Wharf |
|          | 3—136 ..         | 1  |
|          | 5—180 ..         | ..   |
|          | 6—119 ..         | ..   |
|          | 7—145 ..         | ..   |
|          | 8—109 ..         | 1 Adjoining Lime-street Wharf—Howard Smith's Wharf |
|          | 9— 92 ..         | ..   |
|          | 10—239 ..        | ..   |
|          | 11—130 ..        | ..   |
|          | 13—187 ..        | ..   |
|          | 15—126 ..        | ..   |
|          | 16— 17 ..        | ..   |
|          | 17—125 ..        | ..   |
|          | 18—132 ..        | ..   |
|          | 19—131 ..        | ..   |
|          | 20—121 ..        | ..   |
|          | 21—133 ..        | ..   |
|          | 22— 78 ..        | ..   |
|          | 24—134 ..        | ..   |
|          | 25—142 ..        | ..   |
|          | 26—137 ..        | ..   |
|          | 27—115 ..        | ..   |
|          | —                | —  |
| Total .. | 3,214            | ..   |
|          | —                | —  |



TABLE 62.

| Week Ending. | Rodent Plague. |        |        |      |           |  | Human Cases. |          |  |
|--------------|----------------|--------|--------|------|-----------|--|--------------|----------|--|
|              | R.N.           | R.R.R. | R.R.A. | M.M. | Infected. | Locus of Infected Rodents—Remarks.     | Date.        | Case No. | Source of Infection.                                       |
| 1921—        |                |        |        |      |           |  |              |          |  |
| Oct. 28      | 50             | 42     | ..     | 2    |           |  |              |          |  |
| 29           | 68             | 49     | ..     | 16   |           |  |              |          |  |
| 31           | 53             | 56     | ..     | 3    |           |  |              |          |  |
| Nov. 1       | 77             | 139    | ..     | 9    | 2         | At Produce Store, 361<br>Sussex-street |              |          |  |
| 2            | 47             | 93     | ..     | 9    | 4         | 2 from Sussex-street                   |              |          |  |
| 4            | 49             | 72     | ..     | 18   | 2         | " " "                                  |              |          |  |
| 5            | 51             | 74     | ..     | 2    | 1         | " " "                                  |              |          |  |
| 7            | 39             | 101    | ..     | 6    | 3         | " " "                                  |              |          |  |
| 8            | 22             | 69     | ..     | 5    | 3         | " " "                                  |              |          |  |
| 9            | 38             | 69     | ..     | 11   |           |  |              |          |  |
| 10           | 42             | 73     | ..     | 16   |           |  |              |          |  |
| 11           | 21             | 40     | ..     | 10   |           |  |              |          |  |
| 12           | 34             | 44     | ..     | 7    |           |  |              |          |  |
| 14           | 46             | 83     | ..     | 2    |           |  |              |          |  |
| 15           | 14             | 112    | ..     | 9    |           |  |              |          |  |
| 16           | 47             | 75     | ..     | 9    |           |  |              |          |  |
| 17           | 52             | 104    | ..     | 8    |           |  |              |          |  |
| 18           | 44             | 84     | ..     | 5    |           |  |              |          |  |
| 19           | 24             | 55     | ..     | 10   |           |  |              |          |  |
| 20           | 46             | 57     | ..     | 3    |           |  |              |          |  |
| 22           | 40             | 197    | ..     | 10   |           |  |              |          |  |
| 23           | 28             | 77     | ..     | 5    |           |  |              |          |  |
| 24           | 24             | 52     | ..     | 31   |           |  |              |          |  |
| 25           | 55             | 62     | ..     | 10   |           |  |              |          |  |
| 26           | 130            | 45     | ..     | 8    |           |  |              |          |  |
| 28           | 43             | 62     | ..     | 9    |           |  |              |          |  |
| 29           | 122            | 56     | ..     | 13   | ..        | .. ..                                  | Nov. 29      | 1        | Employed at Produce Store next to Denham Bros. (see above) |
| 30           | 40             | 81     | ..     | ..   |           |  |              |          |  |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |        |        |      |           |  | Human Cases. |          |                               |
|--------------|----------------|--------|--------|------|-----------|--|--------------|----------|-------------------------------|
|              | R.N.           | R.R.R. | R.R.A. | M.M. | Infected. | Locus of Infected Rodents—Remarks.                                     | Date.        | Case No. | Source of Infection.          |
| 1921—        |                |        |        |      |           |  |              |          |                               |
| Dec. 1       | 24             | 75     | ..     | 26   |           |  |              |          |                               |
| 2            | 19             | 63     | ..     | 17   |           |  |              |          |                               |
| 3            | 16             | 50     | ..     | 8    | ..        | .. ..  | Dec. 4       | 2        | Employed at 102 Sussex-street |
| 5            | 33             | 71     | ..     | 6    | 1         | R.N. trapped at 102 Sussex-street where second human case was employed |              |          |                               |
| 6            | 51             | 60     | ..     | 10   |           |  |              |          |                               |
| 7            | 37             | 103    | ..     | 16   | 2         | 1 rat—99 Sussex-street<br>1 mouse—Whiteheads', Factory-street          |              |          |                               |
| 8            | 28             | 128    | ..     | 11   |           |  |              |          |                               |
| 9            | 44             | 144    | ..     | 9    |           |  |              |          |                               |
| 10           | 30             | 62     | ..     | 11   |           |  |              |          |                               |
| 12           | 31             | 105    | ..     | 15   |           |  |              |          |                               |
| 13           | 26             | 119    | ..     | 23   | 1         | R.R.R.—99 Sussex-street  |              |          |                               |
| 15           | 24             | 202    | ..     | 7    |           |  |              |          |                               |
| 16           | 18             | 81     | ..     | 10   | 1         | R.R.R.—52 Day-street, between Lime and Sussex streets                  |              |          |                               |
| 17           | 19             | 69     | ..     | 13   | 2         | R.R.R.—52 Day-street   |              |          |                               |
| 20           | 44             | 94     | ..     | 16   |           |  |              |          |                               |
| 21           | 26             | 92     | ..     | 15   | 2         | R.R.R.—52 Day-street   |              |          |                               |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |        |        |      |           |  | Human Cases. |          |                      |
|--------------|----------------|--------|--------|------|-----------|--|--------------|----------|----------------------|
|              | R.N.           | R.R.R. | R.R.A. | M.M. | Infected. | Locus of Infected Rodents—Remarks.             | Date.        | Case No. | Source of Infection. |
| 1921—        |                |        |        |      |           |  |              |          |                      |
| Dec. 22      | 40             | 114    | ..     | 5    | 2         | Species not specified, both from 52 Day-street |              |          |                      |
| 23           | 46             | 80     | ..     | 8    | 2         | " " "  |              |          |                      |
| 24           | 18             | 30     | ..     | 3    | 1         | " " "  |              |          |                      |
| 28           | 10             | 69     | ..     | 1    | 2         | R.R.R.—52 Day-street                           |              |          |                      |
| 29           | 33             | 71     | ..     | 9    |           |  |              |          |                      |
| 30           | 33             | 79     | ..     | 9    |           |  |              |          |                      |
| 31           | 8              | 54     | ..     | 4    |           |  |              |          |                      |
| 1922—        |                |        |        |      |           |  |              |          |                      |
| Jan. 3       | 14             | 108    | ..     | 7    | 1         | From 52 Day-street                             |              |          |                      |
| 4            | 35             | 82     | ..     | 3    |           |  |              |          |                      |
| 5            | 18             | 77     | ..     | 9    |           |  |              |          |                      |
| 6            | 29             | 76     | ..     | 7    |           |  |              |          |                      |
| 7            | 18             | 33     | ..     | 5    |           |  |              |          |                      |
| 9            | 26             | 78     | ..     | 11   |           |  |              |          |                      |
| 10           | 21             | 63     | ..     | 7    |           |  |              |          |                      |
| 11           | 29             | 63     | ..     | 13   |           |  |              |          |                      |
| 12           | 39             | 71     | ..     | 13   |           |  |              |          |                      |
| 13           | 31             | 82     | ..     | 9    |           |  |              |          |                      |
| 14           | 13             | 36     | ..     | 17   |           |  |              |          |                      |
| 15           | 28             | 83     | ..     | 3    |           |  |              |          |                      |
| 16           | 62             | 101    | ..     | 9    |           |  |              |          |                      |
| 17           | 42             | 84     | ..     | 7    | 1         | R.N.—118 Sussex-street                         |              |          |                      |
| 18           | 28             | 52     | ..     | 8    | 1         | R.N.—263 Kent-street                           |              |          |                      |
| 19           | 39             | 106    | ..     | 4    | 1         | " " "  |              |          |                      |
| 20           | 18             | 41     | ..     | 5    |           |  |              |          |                      |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |        |        |      |           |   | Human Cases. |          |  |
|--------------|----------------|--------|--------|------|-----------|---|--------------|----------|--|
|              | R.N.           | R.R.R. | R.R.A. | M.M. | Infected. | Locus of Infected Rodents—Remarks.  | Date.        | Case No. | Source of Infection.                                       |
| 1922—        |                |        |        |      |           |   |              |          |  |
| Jan. 23      | 38             | 98     | ..     | 6    | 1         | R.N.—266 Kent-street  |              |          |  |
| 24           | 19             | 76     | ..     | 6    |           |   |              |          |  |
| 25           | 46             | 50     | ..     | 9    |           |   |              |          |  |
| 27           | 42             | 77     | ..     | 4    |           |   |              |          |  |
| 28           | 11             | 70     | ..     | 7    |           |   |              |          |  |
| 30           | 15             | 46     | ..     | 4    | ..        | .. .. .   | Jan. 30      | 3        | Employed at a hotel, three doors from 97A Liverpool-street |
| 31           | 16             | 34     | ..     | 12   |           |   |              |          |  |
| Feb. 1       | 28             | 36     | ..     | 7    |           |   |              |          |  |
| 2            | 27             | 70     | ..     | 11   |           |   |              |          |  |
| 3            | 32             | 51     | ..     | 17   |           |   |              |          |  |
| 4            | 28             | 34     | ..     | 10   |           |   |              |          |  |
| 6            | 35             | 92     | ..     | 13   | 3         | From 97A Liverpool-street, three doors from the premises at which the human case of January 30 was employed |              |          |  |
| 7            | 39             | 56     | ..     | 8    | 2         | R.R.R.—97A Liverpool-street   |              |          |  |
| 8            | 55             | 62     | ..     | 14   | 1         | .. .. .   | Feb. 10      | 4        | Infection possibly traceable to Liverpool-street           |
| 11           | 17             | 44     | ..     | 7    |           |   |              |          |  |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |                |                |                |                |                |                |                | Human Cases.  |         |          |   |
|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---|---------|----------|---|
|              | R.N.           |                | R.R.R.         |                | R.R.A.         |                | M.M.           |                | Locus of Infected Rodents—Remarks.  | Date.   | Case No. | Source of Infection.  |
|              | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. |   |         |          |   |
| Feb. 11      | 184            | 1              | 336            | 5              | ..             | ..             | 62             | ..             | All from 97A Liver-<br>pool-street  | Feb. 20 | 5 & 6    | One employed at<br>Liverpool - street,<br>and one at 76<br>Oxford-street, Pad-<br>dington |
| 18           | 164            | ..             | 458            | ..             | ..             | ..             | 62             | ..             | .. .. ..  |         |          |   |
| 25           | 317            | 7              | 273            | ..             | ..             | ..             | 71             | 1              | 1—350 Pitt-street<br>4—88 Oxford-street,<br>Paddington<br>1—72A Oxford-street,<br>Paddington<br><br>1—5 West-street, Pad-<br>dington  |         |          |   |
| March 4      | 270            | 5              | 275            | 2              | ..             | ..             | 78             | 1              | 2—84 Oxford-street,<br>Paddington<br><br>1—88 Oxford-street,<br>Paddington<br><br>1—128 Oxford-street,<br>Paddington<br><br>1—Green's-road, Pad-<br>dington<br><br>1—Victoria Barracks,<br>Paddington<br><br>2—Under Pymont<br>Bridge |         |          |   |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |                |                |                |                |                |                |                | Human Cases.   |         |          |  |
|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|---------|----------|--|
|              | R.N.           |                | R.R.R.         |                | R.R.A.         |                | M.M.           |                | Focus of Infected Rodents—Remarks.                             | Date.   | Case No. | Source of Infection.   |
|              | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. |  |         |          |  |
| March 11     | 255            | ..             | 257            | ..             | ..             | ..             | 66             | ..             | 1 infected kitten, 84 Oxford-street                            | Mch. 11 | 7 & 8    | Both infected at 84 Oxford-street, Paddington                            |
| 18           | 302            | 1              | 313            | ..             | ..             | ..             | 88             | ..             | 1—88 Oxford-street, Paddington                                 |         |          |  |
| 25           | 266            | ..             | 338            | ..             | ..             | ..             | 100            | ..             | .. .. ..   | 23      | 9        | 119A Dowling-street, Woolloomooloo                                       |
|              |                |                |                |                |                |                |                |                |  | 28      | 10       | " " " "  |
|              |                |                |                |                |                |                |                |                |  | 31      | 11       | Godfrey-street, Alexandria   |
|              |                |                |                |                |                |                |                |                |  |         | 12       | } 119A Dowling-street  |
|              |                |                |                |                |                |                |                |                |  |         | 13       |  |
|              |                |                |                |                |                |                |                |                |  |         | 14       |  |
| April 1      | 327            | 1              | 328            | ..             | ..             | ..             | 134            | ..             | Shadforth-street, Paddington                                   | April 1 | 15       | " " "  |
| 8            | 350            | 1              | 349            | ..             | ..             | ..             | 188            | ..             | Stephen-street, Woolloomooloo                                  | 4       | 16       | Same as Case 11  |
|              |                |                |                |                |                |                |                |                |  | 10      | 17       | " " "  |
|              |                |                |                |                |                |                |                |                |  | 12      | 18       | McEvoy-street, Alexandria  |
|              |                |                |                |                |                |                |                |                |  |         | 19       | Source of infection doubtful   |
| 15           | 317            | ..             | 230            | 1              | ..             | ..             | 199            | ..             | 187A Sussex-street ..  | 18      | 20       | Same as Case 16  |
| 22           | 257            | ..             | 310            | 5              | ..             | ..             | 134            | ..             | 4—187A Sussex-street<br>1—554 George-street<br>1—69 Day-street | 22      | 21       | Unknown  |
|              |                |                |                |                |                |                |                |                |  | ..      | 22       | "  |
|              |                |                |                |                |                |                |                |                |  | 27      | 23       | Employed Pitt-street near Civic Club, where infected rodent found 8.5.22 |
| 29           | 257            | 1              | 261            | ..             | ..             | ..             | 146            | ..             | O'Riordan-street, Alexandria.                                  |         |          |  |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |                |                |                |                |                |                |                | Human Cases.  |                                   |                                  |   |
|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---|-----------------------------------|----------------------------------|---|
|              | R.N.           |                | R.R.R.         |                | R.R.A.         |                | M.M.           |                | Locus of Infected Rodents—Remarks.  | Date.                             | Case No.                         | Source of Infection.  |
|              | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. |   |                                   |                                  |   |
| May 6        | 377            | 4              | 435            | 6              | ..             | ..             | 282            | 2              | 1—147 Sussex-street<br>1—194 Sussex-street<br>2—Stables, Randwick<br>1—Union-street, Pyrmont<br>1—139 Sussex-street<br>1—Queen-street Tip, Alexandria<br>1—Quay-street, Sydney<br>1—Municipal Shop, Day-street, Sydney<br>O'Riordan - street, Alexandria<br>1—123 Sussex-street<br>1—Elizabeth-street, Redfern<br>1—Civic Club, Pitt-street<br>1—Railway, Darling Harbour<br>1—Wheat Shed, Darling Harbour<br>1—Day-street, Sydney<br>1—Stables (Wool-scouring) Randwick<br><br>1—Shed (Wharf No. 10) Pyrmont | May 2<br>..<br>..<br>3<br>5<br>.. | 24<br>25<br>26<br>27<br>28<br>29 | Elizabeth-street, Redfern<br>Stables, Randwick<br>58 Darghan-street, Glebe<br>Same as Case 26<br>Same as Cases 25, 26, 28                                 |
| May 13       | 293            | 3              | 401            | 1              | ..             | ..             | 465            | 3              | 1—Elizabeth-street, Redfern<br>1—Civic Club, Pitt-street<br>1—Railway, Darling Harbour<br>1—Wheat Shed, Darling Harbour<br>1—Day-street, Sydney<br>1—Stables (Wool-scouring) Randwick<br><br>1—Shed (Wharf No. 10) Pyrmont  | May 8<br>9<br>16<br>19            | 30<br>31<br>32<br>33             | Son of Case 29—same infection<br>Elizabeth-street, Redfern<br>Darghan-street, Glebe<br>Resident in Paddington, but particular source of infection unknown |



TABLE 62—continued.

| Week Ending. | Rodent Plague. |                |                |                |                |                |                |                |  | Human Cases. |          |                           |
|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|--------------|----------|---------------------------|
|              | R.N.           |                | R.R.R.         |                | R.R.A.         |                | M.M.           |                | Locus of Infected Rodents—Remarks.   | Date.        | Case No. | Source of Infection.      |
|              | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. |  |              |          |                           |
| May 20       | 388            | 1              | 334            | 1              | ..             | ..             | 501            | 5              | 3—No. 10 Wharf, Pyrmont<br>3—Wheat Sheds, Darling Island<br>1—73 Elizabeth-street, Redfern |              |          |                           |
| 27           | 222            | 2              | 216            | ..             | ..             | ..             | 610            | ..             | 73 Elizabeth-street, Redfern (2)   |              |          |                           |
| June 3       | 198            | 5              | 272            | ..             | ..             | ..             | 1,059          | ..             | 2—Soudan-lane, Paddington<br>1—Cecil-street, Paddington                                    | June 7       | 34       | See remarks Case 33       |
| 10           | 135            | 3              | 170            | ..             | ..             | ..             | 268            | ..             | 3—Cecil-street, Paddington   |              |          |                           |
| 17           | 189            | 1              | 254            | ..             | ..             | ..             | 316            | ..             | 1—No. 12 Wheat Shed Pyrmont<br>1 Soudan-street, Paddington                                 | 12           | 35       | Elizabeth-street, Redfern |
| July 24      | 152            | ..             | 219            | 2              | ..             | ..             | 376            | ..             | 2—239 Sussex-street  |              |          |                           |
| 1            | 111            | ..             | 181            | 1              | ..             | ..             | 247            | ..             | 1—239 Sussex-street  |              |          |                           |
| 8            | 98             | 1              | 267            | 1              | ..             | ..             | 295            | 1              | 1—Robinson-lane, W.<br>1—255 Sussex-street<br>1—Stables, Sussex-street                     |              |          |                           |
| 15           | 112            | ..             | 240            | 3              | ..             | ..             | 197            | ..             | 3—255 Sussex-street  |              |          |                           |
| 22           | 107            | ..             | 179            | ..             | ..             | ..             | 216            | ..             |  |              |          |                           |
| 29           | 97             | ..             | 193            | ..             | ..             | ..             | 126            | ..             |  |              |          |                           |
| Aug. 5       | 170            | ..             | 313            | ..             | ..             | ..             | 107            | ..             |  |              |          |                           |
| 12           | 129            | ..             | 194            | ..             | ..             | ..             | 99             | ..             |  |              |          |                           |
| 19           | 70             | ..             | 172            | ..             | ..             | ..             | 113            | ..             |  |              |          |                           |
| 26           | 72             | ..             | 151            | ..             | ..             | ..             | 106            | ..             |  |              |          |                           |

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TABLE 62—continued.

| Week Ending. | Rodent Plague. |                |                |                |                |                |                |                | Human Cases.                       |       |          |                      |
|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------------------------|-------|----------|----------------------|
|              | R.N.           |                | R.R.R.         |                | R.R.A.         |                | M.M.           |                | Locus of Infected Rodents—Remarks. | Date. | Case No. | Source of Infection. |
|              | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. | Ex-<br>amined. | In-<br>fected. |                                    |       |          |                      |
| Sept. 2      | 80             | ..             | 160            | ..             | ..             | ..             | 126            |                |                                    |       |          |                      |
| 9            | 75             | ..             | 148            | ..             | ..             | ..             | 304            |                |                                    |       |          |                      |
| 16           | 88             | ..             | 162            | ..             | ..             | ..             | 106            |                |                                    |       |          |                      |
| 23           | 80             | ..             | 175            | ..             | ..             | ..             | 99             |                |                                    |       |          |                      |
| 30           | 65             | ..             | 174            | ..             | ..             | ..             | 94             |                |                                    |       |          |                      |
| Oct. 7       | 73             | ..             | 187            | ..             | ..             | ..             | 66             |                |                                    |       |          |                      |
| 14           | 57             | ..             | 131            | ..             | ..             | ..             | 90             |                |                                    |       |          |                      |
| 21           | 97             | ..             | 142            | ..             | ..             | ..             | 127            |                |                                    |       |          |                      |
| 28           | 82             | ..             | 148            | ..             | ..             | ..             | 86             |                |                                    |       |          |                      |
| Nov. 4       | 110            | ..             | 185            | ..             | ..             | ..             | 143            |                |                                    |       |          |                      |
| 11           | 77             | ..             | 164            | ..             | ..             | ..             | 141            |                |                                    |       |          |                      |
| 18           | 83             | ..             | 202            | ..             | ..             | ..             | 98             |                |                                    |       |          |                      |
| 25           | 77             | ..             | 142            | ..             | ..             | ..             | 82             |                |                                    |       |          |                      |
| Dec. 2       | 100            | ..             | 176            | ..             | ..             | ..             | 96             |                |                                    |       |          |                      |
| 9            | 117            | ..             | 189            | ..             | ..             | ..             | 79             |                |                                    |       |          |                      |
| 16           | 77             | ..             | 231            | ..             | ..             | ..             | 49             |                |                                    |       |          |                      |
| 23           | 64             | ..             | 222            | ..             | ..             | ..             | 34             |                |                                    |       |          |                      |
| 30           | 48             | ..             | 106            | ..             | ..             | ..             | 21             |                |                                    |       |          |                      |
| Jan. 6       | 73             | ..             | 124            | ..             | ..             | ..             | 43             |                |                                    |       |          |                      |
| 13           | 130            | ..             | 165            | ..             | ..             | ..             | 71             |                |                                    |       |          |                      |
| 20           | 188            | ..             | 186            | ..             | ..             | ..             | 81             |                |                                    |       |          |                      |
| 27           | 166            | ..             | 214            | ..             | ..             | ..             | 123            |                |                                    |       |          |                      |
| Feb. 3       | 142            | ..             | 198            | ..             | ..             | ..             | 134            |                |                                    |       |          |                      |
| 10           | 129            | ..             | 244            | ..             | ..             | ..             | 105            |                |                                    |       |          |                      |
| 17           | 52             | ..             | 267            | ..             | ..             | ..             | 79             |                |                                    |       |          |                      |
| 24           | 93             | ..             | 255            | ..             | ..             | ..             | 133            |                |                                    |       |          |                      |
| March 3      | 134            | ..             | 172            | ..             | ..             | ..             | 101            |                |                                    |       |          |                      |
| 10           | 97             | ..             | 247            | ..             | ..             | ..             | 92             |                |                                    |       |          |                      |
| 17           | 64             | ..             | 171            | ..             | ..             | ..             | 72             |                |                                    |       |          |                      |



**Summary.**

| Rodents<br>Examined— | R.N.     |           | R.R.R.    |           | M.M.      |           | Unclassified. |           |
|----------------------|----------|-----------|-----------|-----------|-----------|-----------|---------------|-----------|
|                      | Examined | Infected. | Examined. | Infected. | Examined. | Infected. | Examined.     | Infected. |
| Totals ..            | 11,846   | 43        | 19,476    | 39        | 10,356    | 14        | 3,214         | 42        |

NOTE.—Total figures given in Annual Report for 1922 of Director-General of Public Health for New South Wales (including infected rodents from s.s. *Wyreema*) were :—

R.N., 67 ; R.R.R., 67 ; M.M., 14 ; total infected, 148. (See page 192.)



## CHAPTER XXXII.—THE INTRODUCTION OF PLAGUE INTO SYDNEY.

The first intimation of the existence of plague within the State of New South Wales was the discovery, on 19th September, 1921, on board the A.U.S.N. Company's steamer *Wyreema*, of one infected rodent during the unloading of the vessel. The history of this vessel was important, in view of the suggestion that infection was introduced by her into Sydney. The vessel, a coastal steamer, left bound for Queensland ports on 30th August, 1921. Thereafter her movements were as follow:—

|                  |       | Date of Arrival. |       | Date of Departure. |
|------------------|-------|------------------|-------|--------------------|
| Sydney .. ..     | .. .. | 29.8.21          | .. .. | 30.8.21            |
| Brisbane .. ..   | .. .. | 1.9.21           | .. .. | 3.9.21             |
| Rockhampton ..   | .. .. | 4.9.21           | .. .. | 4.9.21             |
| Mackay .. ..     | .. .. | 5.9.21           | .. .. | 5.9.21             |
| Bowen .. ..      | .. .. | 6.9.21           | .. .. | 6.9.21             |
| Townsville .. .. | .. .. | 7.9.21           | .. .. | 7.9.21             |
| Cairns .. ..     | .. .. | 8.9.21           | .. .. | 10.9.21            |
| Townsville .. .. | .. .. | 11.9.21          | .. .. | 12.9.21            |
| Bowen .. ..      | .. .. | 12.9.21          | .. .. | 13.9.21            |
| Mackay .. ..     | .. .. | 14.9.21          | .. .. | 14.9.21            |
| Rockhampton ..   | .. .. | 15.9.21          | .. .. | 15.9.21            |
| Brisbane .. ..   | .. .. | 16.9.21          | .. .. | 17.9.21            |
| Sydney .. ..     | .. .. | 19.9.21          | .. .. | —                  |

The vessel berthed at a shore wharf or jetty at every port except Mackay.

The *Wyreema* berthed at the A.U.S.N. (Lime-street) Wharf at 8.40 a.m. on 19th September, 1921, there being no sickness on board. A commencement was made with unloading the cargo, this process being carried out under the close and continuous supervision of officers of the Quarantine Service. At 3 p.m., five dead rats were seen in No. 4 hold. The discharge of cargo was stopped while these rats were examined. Four of them were too decomposed for examination. The fifth was plague-infected. At about 4 p.m., a further putrid rat was found after searching. The vessel was fumigated with the cargo in position, all cargo being lightered under close scrutiny, and after minute inspection of the vessel when empty, more infected rats were found. The total number of rats recovered from the ship was 142, of which 12 were found to be infected.

The last occasion on which this vessel had been fumigated was 18th June, 1921, when she had been fumigated at Cairns.

At the time of her visit on that trip to Queensland ports, rodent plague existed at Brisbane and Cairns. The stage of decomposition of the rats on 19th September was inconsistent with infection of the

vessel on the 16th or 17th. The activity of the epizootic was not inconsistent with infection at Brisbane on 1st to 3rd September, or with infection at Cairns on 8th to 10th September.

If this vessel could become infected on 1st to 3rd September in Brisbane on the northward journey, other coastal vessels could become infected on the southward journey and have transmitted the infection to Sydney by live rats. As the waterfront of Sydney Harbour was, throughout the whole epidemic, entirely uninvaded, except for the A.U.S.N. Wharf, it follows as a probability that infection was brought from Queensland by some previous vessel berthing at that wharf, if the *Wyreema* was not responsible.

Regular visits had been paid by the rat-catchers to this wharf throughout the year, the following numbers having been caught to the end of August—none of these having been infected:—

|          |    |    |    |        |    |    |    |
|----------|----|----|----|--------|----|----|----|
| January  | .. | .. | 17 | May    | .. | .. | 29 |
| February | .. | .. | 20 | June   | .. | .. | 30 |
| March    | .. | .. | 18 | July   | .. | .. | 15 |
| April    | .. | .. | 18 | August | .. | .. | 15 |

During September, the daily catches were as follow:—

|           |    |    | Numbers Caught. |    | Numbers Infected. |
|-----------|----|----|-----------------|----|-------------------|
| September | 1  | .. | —               | .. | —                 |
| "         | 2  | .. | —               | .. | —                 |
| "         | 3  | .. | 1               | .. | —                 |
| "         | 4  | .. | —               | .. | —                 |
| "         | 5  | .. | 1               | .. | —                 |
| "         | 6  | .. | —               | .. | —                 |
| "         | 7  | .. | —               | .. | —                 |
| "         | 8  | .. | —               | .. | —                 |
| "         | 9  | .. | 1               | .. | —                 |
| "         | 10 | .. | —               | .. | —                 |
| "         | 11 | .. | —               | .. | —                 |
| "         | 12 | .. | —               | .. | —                 |
| "         | 13 | .. | 3               | .. | —                 |
| "         | 14 | .. | —               | .. | —                 |
| "         | 15 | .. | —               | .. | —                 |
| "         | 16 | .. | —               | .. | —                 |
| "         | 17 | .. | 1               | .. | —                 |
| "         | 18 | .. | —               | .. | —                 |
| "         | 19 | .. | 1               | .. | —                 |
| "         | 20 | .. | 8               | .. | —                 |
| "         | 21 | .. | 4               | .. | 2                 |
| "         | 22 | .. | 10              | .. | 1                 |
| "         | 23 | .. | 12              | .. | 1                 |
| "         | 24 | .. | 3               | .. | 1                 |
| "         | 25 | .. | 3               | .. | —                 |
| "         | 26 | .. | 6               | .. | 1                 |
| "         | 27 | .. | 2               | .. | 2                 |
| "         | 28 | .. | (unknown)       | .. | 5                 |



The degree of activity in respect of trapping at this wharf—which produced a catch of seven rats in eighteen days, while nine rats were caught on the same wharf during the next two days—does not represent an examination of the wharf sufficiently exhaustive to exclude the possible presence of plague. Moreover, the succession of infected rodents on 21st, 22nd, and 23rd, is less suggestive of the first introduction of plague infection on 19th, than it is of the second stage of an epizootic from an infection previously introduced. It cannot be contended that the five infected rodents on 21st, 22nd, and 23rd all come from s.s. *Wyreema*, nor can it be contended that an infected rat, accidentally brought ashore on 19th, could, taking the incubation period into consideration, have resulted in the development of the disease to a detectable stage in shore rats by the 21st, or even the 22nd.

On the other hand, s.s. *Levuka*, which belongs to the same company, and berths at the same wharf, had on board an epizootic, which, by 23rd September, had already lasted for about three weeks.

While it may reasonably be assumed that the A.U.S.N. wharf, at Sydney, was infected from Brisbane, yet, notwithstanding Dr. Armstrong's opinion that "plague had invaded the wharf contemporaneously, or nearly so, with the first discovery of plague rats" (*Medical Journal of Australia*, 20th May, 1922, p. 547), from the above evidence, it would not appear to be reasonable to reject the possibility of an earlier invasion by a previous boat visiting Sydney prior to official notification of plague in Brisbane, and, therefore, uncontrolled and unsupervised whilst in Sydney.

### CHAPTER XXXIII.—IMMUNITY OF OTHER PARTS OF AUSTRALIA.

Excepting those places recorded in Queensland and Sydney, there was no spread of infection to other parts of Australia, either on the coast or inland.

Following intensive rat destruction, numerous examinations of rats were made at other ports, such as Thursday Island, Bowen, Newcastle, Melbourne, Port Pirie, Fremantle, Broome, Launceston, and Hobart, without any suspicion of infection.



## CHAPTER XXXIV.—PLAGUE ON SHIPBOARD 1921-1922.

### Vessels Infected with Plague.

*s.s. Wyreema.*—On the 19th September, 1921, the *Wyreema*, from North Queensland ports, via Brisbane, arrived at Sydney, having sailed from Brisbane on the 17th September. The cargo was discharged under supervision, and, during unloading, six dead rats were found in No. 4 hold. Subsequently other rats were found, and, at the conclusion of unloading and of terminal fumigation, a total of 142 rats had been found in the vessel, of which 12 were infected. No human plague occurred on this vessel. It is probable that the infection had been present on the ship prior to the last call at Brisbane on the 17th September (for discussion see Chap. XXXII.).

*s.s. Kuranda.*—On the 19th September, a number of dead rats were found on the *Kuranda*, at Townsville. The vessel had not been in Brisbane since April, 1921. On 24th September, another rat found on this vessel was proved to be infected, and, subsequently, another two infected were found.

*s.s. Levuka.*—On the 20th September, it was reported by *s.s. Levuka* that two dead rats had been noticed on board at Brisbane on the 9th September—subsequently dead rats were found in the holds while discharging cargo at Mackay, Bowen, Townsville, and Cairns. On arrival at Brisbane, cargo was lightered under quarantine conditions, several dried carcasses being found. The conditions suggested that there had been a rat-epizootic on the vessel for about three weeks, and that this had come to an end.

*s.s. Bombala.*—On the 23rd September, 1921, one plague-infected rat was found dead in No. 2 hold of the *Bombala*, at Townsville. The cargo of the vessel was discharged into lighters under quarantine conditions, and the vessel fumigated. Of 60 rats found, three were infected. There was no human case of plague on the vessel. Before unloading was completed, this vessel was laid up at Brisbane on account of a strike. When unloading was resumed, one infected rat was found on board on the 11th October. Another was found on the 13th October.

*s.s. Kuranda.*—On 26th October, 1921, S. G., boatswain on *s.s. Kuranda*, was reported as suffering from plague while the vessel was at Cooktown. The patient resided at Townsville where he was probably infected. There was no evidence that the vessel itself was a source of infection. The vessel was then fumigated throughout, but no rats were found. One live, healthy rat was caught in one of the ship's boats. The vessel was not infected.

*s.s. Levuka.*—On the 16th November, 1921, a steward on the *Levuka* developed plague. The vessel left Sydney on 12th November,

arrived at Brisbane on the 14th, leaving again for northern ports on the 15th. The patient was ashore in Brisbane on the evening of the 14th. The vessel was carefully fumigated after unloading under supervision, but no dead rat was found. The vessel was not a source of infection, the patient clearly having been infected ashore, probably at Sydney.

*s.s. Tango Maru.*—On arrival of the *s.s. Tango Maru* at Thursday Island on 31st December, 1921, a third-class passenger was found to be suffering from an illness associated with inguinal bubo.

There was at this time no evidence of any local infection or of venereal disease to account for the bubo.

The history pointed to fever in the earlier stages of the illness, and extreme tenderness and pain in the inguinal glands, which were incised on the ship on 27th December, 1921. Bacilli were found in smears from the bubo, but it could not be definitely stated that these were *B. pestis*.

The patient, Sukesaburo Yamashita, aet 32 years, boarded the vessel at Hongkong, on 20th December, 1921, for Thursday Island. On 22nd December, 1921 (two days' after leaving Hongkong), he reported sick to the ship's surgeon with glandular swelling in the inguinal region. The swelling was thought to be due to chancroid, and was opened on the 27th December, 1921. This man occupied quarters in the steerage with 25 other passengers. His illness was probably contracted at Hongkong. On arrival at Thursday Island (31st December, 1921), the patient's temperature was 99.2, and on the following days 99.6 and 99.8. The case was considered by the quarantine officer, Thursday Island, as one of ambulatory plague. The patient had not been isolated on board the vessel.

The vessel left Kobe on the 13th December, 1921, with crew 132 and passengers 60. She called at Nagasaki and Hongkong, Manila, and Zamboanga. At Hongkong sixteen passengers were disembarked and forty taken on including the patient subsequently landed at Thursday Island as suspected plague.

At Thursday Island, owing to the presence on board of a case of suspected plague, the vessel was handled in strict quarantine. The patient and 24 Thursday Island passengers were landed at the quarantine station, the patient being isolated, and the passengers released under surveillance on 3rd January, 1922, after disinfection of themselves and their effects. No cargo was landed or taken aboard at Thursday Island. The ship was fully examined, but no signs of rats were discovered. The master gave no history of rats since leaving Kobe, but stated that on arrival at Nagasaki, on the previous voyage, two dead rats found on the vessel had been handed to the health authorities, who reported that one was definitely plague infected. The vessel was then quarantined and fumigated throughout at Nagasaki, and again when empty at Kobe before loading for the present voyage.



The vessel left Thursday Island for Townsville at noon on the 31st December, 1921. On arrival at Townsville (3rd January, 1922), the vessel was ordered into quarantine. The passengers were all removed to the quarantine station during sulphur fumigation of quarters, passengers' accommodation, and saloons. Townsville passengers (four) were released under surveillance after disinfection of themselves and their effects. Cargo for Townsville was loaded into lighters. No rats were found on searching after the completion of fumigation of quarters and passengers' accommodation, and no evidence of the presence of rats on the vessel was noticed.

The vessel left Townsville for Brisbane in quarantine on the 3rd January, 1922. On arrival at Brisbane (6th January, 1922), cargo was lightered under supervision in the bay, and one passenger was landed at the quarantine station for disinfection, and subsequently released under surveillance. Quarters and pantries on the vessel were trapped, and poison baits were laid. One rat (R.R.R.) was trapped in the second-class quarters, and on examination was found to be healthy.

Close examination of the vessel and of cargo unloaded showed no evidence of rat infestation.

The *Tango Maru* left Brisbane for Sydney in quarantine at 7 a.m. on the 7th January, 1922, and arrived at Sydney at 1.30 a.m. on 9th January, 1922. All on board were healthy with the exception of one fireman suffering from appendicitis, and subsequently one case of a coal passer with chancre and enlarged inguinal gland, and a slightly raised temperature 99.2. Sydney passengers were landed at the quarantine station, and, after disinfection of themselves, and their belongings, were released. The steerage quarters and crew's quarters were placed under sulphur fumigation, and the crew landed and bathed, and their effects disinfected. The vessel then proceeded to Athol Bay, where her Sydney cargo was discharged into lighters.

No evidence of rat infestation was observed on the vessel. The vessel left Sydney for Melbourne at 12.30 p.m., on 11th January, in quarantine, and arrived at Melbourne on 13th January, 1922.

As the patient was removed from the vessel at Thursday Island on the 31st December, 1921, and as no evidence of infection existed on the vessel, the date for release of passengers under surveillance at the various ports where they had been landed was fixed at the 7th January, 1922 (seven days after removal of the patient from the vessel).

On 9th January, 1922, the quarantine officer, Thursday Island, reported the patient removed from the *Tango Maru* to be progressing favorably, the temperature having been normal for two days, and the incision in the bubo healing, though some discharge still persisted.

The vessel, when empty at Melbourne on the 13th January, 1922, was fumigated throughout including holds, quarters, engine-room, and all the superstructure. Four mice only were found after fumigation.

*s.s. Southgate.*—The *s.s. Southgate*, which left Calcutta on 2nd May, 1922, and Rangoon on 9th May, arrived at Thursday Island on 30th May, and on inspection a case of human plague (a fireman) was found on board. The disease had not been diagnosed on the vessel, and the case had not been isolated. The vessel was badly rat infected. The patient was landed into quarantine at Thursday Island, and the quarters and store rooms fumigated. The vessel then proceeded in quarantine direct to Sydney. Subsequent bacteriological examination revealed the presence of *B. pestis* in fluid from the patient's bubo. Twenty rats from the *s.s. Southgate* were examined at Thursday Island, but were negative for *pestis*.

On arrival at Sydney, the *Southgate*, which had no cargo to discharge at that port, was not permitted alongside, but was allowed to load bunker coal from lighters under close supervision, the ship being kept under strict supervision during her stay in port.

Holds, quarters, &c., were fumigated, with the exception of those holds which contained produce which would have been destroyed by fumigation. These latter holds were battened down while in port. After taking on bunker coal, the vessel proceeded direct overseas.

#### Suspected Plague on Vessels.

*s.s. Dimboola.*—11th May, 1922.—On arrival at Fremantle, on 11th May, 1922, from Sydney, a dead rat was found on *s.s. Dimboola*. As the cause of death was not evident, the vessel was ordered into quarantine pending bacteriological examination of the rat. This examination showed no positive evidence of plague, and the vessel was released from quarantine on 12th May. Cargo was unloaded under the strictest precautions, and no further dead rats were found. The vessel was then fumigated. Three further rats were picked up after fumigation, and were examined and found to be healthy.

*s.s. Taiyuan.*—14th June, 1922.—On the arrival of the *s.s. Taiyuan* at Townsville from Hongkong, via Sandakan, on the 11th June, 1922, a saloon passenger was found to have glandular swellings in both axillae, showing marked tenderness on palpation. A diagnosis of plague could not be immediately excluded, and the vessel was ordered into quarantine. The patient and the passengers for Townsville were landed in quarantine, and the vessel fumigated. The vessel then proceeded in quarantine to Sydney. Further investigation showed the disease not to be plague, and the vessel was released from quarantine on arrival Sydney.

*s.s. John Williams.*—29th June.—The *s.s. John Williams*, crew 3 (8 Europeans, 25 natives), returned to Sydney on 29th June from



voyage to the Pacific Islands. During the voyage 26 dead rats had been found in the forehold and foredeck of the vessel, and as plague was suspected the forehold was closed down and sealed up, and the vessel returned to Sydney. No case of human plague or other illness occurred on the voyage.

A medical glandular inspection of all on board was held on arrival at Sydney, but no evidence of human plague was discovered. The vessel was ordered into quarantine, and was at once placed under fumigation.

On opening up this vessel on 1st July, after fumigation, 8 dead rats were found in No. 1 'tween decks, and a further 28 on removing the small amount of cargo (about 2 tons) in the forehold. All of these rats were too decomposed for bacteriological examination. The sum total of dead rats found on the vessel including those found prior to fumigation) was 64.

Trapping was continued on board, but no rats were trapped, and no live rats seen on the vessel.

On the 4th July, the empty vessel was again fumigated, and a thorough search on the 6th July revealed no carcass.

The vessel was released from quarantine on the 7th July.

*s.s. Enoggera.*—The *s.s. Enoggera* arrived at Adelaide on 3rd July, fourteen days from Java, via Fremantle. On the 4th July, a fireman reported with inguinal bubo, but with no constitutional symptoms. The patient was removed to hospital ashore, and the vessel was ordered into quarantine, and proceeded in quarantine to Melbourne. No traces of rats were found on the vessel. Subsequent clinical observation of the patient and bacteriological examination of fluid from the bubo negated any suspicion of plague. On arrival at Melbourne, medical inspection revealed no sickness on the vessel, which was at once released from quarantine.

*s.s. Cooma.*—On arrival of the *s.s. Cooma* at Melbourne, from Brisbane, on 26th September, 1921, during the unloading of cargo four (4) dead rats were found. Poison baits had been laid freely on this vessel at Brisbane and Sydney, and the external post-mortem appearance of the carcasses suggested death by poisoning. The carcasses were considerably decomposed, and were sent to the laboratory for examination.

The fact of the presence of dead carcasses on the vessel was sufficient to cause the vessel to be treated thereafter throughout as if she were plague infected, and complete fumigation with the cargo *in situ* was made immediately, followed by completion of unloading, and a second complete fumigation after unloading. At the same time immediate measures were taken on the neighbouring wharfs for the destruction of rats, although these wharfs had been thoroughly gone over with the same object within the previous few days.

On examination at the laboratories, a few organisms suggesting *Bacillus pestis* were found on first examination, but the subsequent investigation led to a definite report that the organisms could not be regarded as *Bacillus pestis*. The examination was continued, however, and after numerous attempts at isolation and identification directly from the organs of the original rats, none gave the cultural reactions of *Bacillus pestis*.

The main difficulty in isolation came from a rapidly growing organism, probably *Bacillus proteus*.

A pure culture was eventually obtained, and on careful subsequent examination it was found to be a non-motile, gram negative bacillus bipolar staining and morphologically resembling *B. pestis*. It also resembled *B. pestis* in its growth on agar and in broth.

The sugar reactions were acid, but no gas in dextrose, laevulose, galactose, mannite; nil in lactose and dulcitol. Litmus milk not changed in 24 hours. Malachite green not decolorized. These reactions are those given by *Bacillus pestis*.

The strain isolated proved to be pathogenic to white rats in three days with lesions consistent with plague, and two guinea-pigs, one inoculated sub-cutaneously, and the other on the shaven skin, both died on the fifth day.

The result of the examination, therefore, is that from one rat out of four found dead, an organism apparently identical with *Bacillus pestis* was eventually isolated. From the other rats such organisms could not be isolated.

On subsequent fumigation of this vessel, and very careful examination, eight dead rats were found.

Apart from the s.s. *Southgate* and the s.s. *Tango Maru*, which must be considered as a doubtful instance of plague on shipboard, the only cases of ship-plague were s.s. *Wyreema*, s.s. *Kuranda*, s.s. *Levuka*, s.s. *Bombala*, and the unsatisfactory example of s.s. *Cooma*. These were all coastal vessels in regular trade between Queensland ports and the rest of Australia.

The most striking fact about these vessels is that they were all grouped between 19th and 26th September. After 26th September, no coastal vessel was infected. The reason for this is seen by the tables on page 207, which show clearly that frequent fumigation and close supervision of loading and unloading had established a condition throughout the coastal shipping of practically absolute freedom from rats.



## CHAPTER XXXV.—SOME EPIDEMIOLOGICAL FEATURES OF THE 1921-1922 OUTBREAK.

The time and place relationships of epidemic and epizootic in this outbreak have already been discussed in regard to each infected locality. There are, however, several features of the outbreak which may be reviewed as of importance in establishing the epidemiology of plague in Australia and in assessing the value of certain control measures which were adopted.

### **Infection and Prevalence of Rat Species in Australian Ports.**

The nature of the onset of the epizootic in each place where rodent plague existed was such that, by reason either of abruptness, as in Sydney, or obscurity, as in Queensland ports, no comparison can be made between the curves of incidence and progress of infection among the various rodent species.

The following tables show for each infected port such particulars as are available in regard to the infection and prevalence of rodent species. The records of the prevalence of rodent species in Queensland are incomplete for the earlier phases of the epizootic, but Table 65 shows the available records from the inception of classified returns. Table 66 shows similar data for those Australian ports not infected during this outbreak. These data are extracted from returns published in the series of plague bulletins issued by the Commonwealth Department of Health, and are quoted as an indication of the percentage prevalence of rodent species in each port, and *not* as a record of rodents destroyed and examined.



TABLE 63.

SHOWING THE NUMBER AND SPECIES OF RATS EXAMINED AND THE NUMBER AND PERCENTAGE OF EACH SPECIES FOUND INFECTED IN SYDNEY, DURING THE PLAGUE PERIOD, SEPTEMBER, 1921-JULY, 1922.

(From Report of the Director-General of Public Health, New South Wales, for 1922.)

| Month.       | No. and Species of Rats examined, showing per cent. of each Species. |           |                       |           |                     |           |        | No. and Species of infected Rats, showing per cent. of each Species infected. |           |                       |           |                     |           |        |
|--------------|--|-----------|-----------------------|-----------|---------------------|-----------|--------|---|-----------|-----------------------|-----------|---------------------|-----------|--------|
|              | <i>R. rattus.</i>  |           | <i>R. norvegicus.</i> |           | <i>M. musculus.</i> |           | Total. | <i>R. rattus.</i>   |           | <i>R. norvegicus.</i> |           | <i>M. musculus.</i> |           | Total. |
|              | Gross.   | Per cent. | Gross.                | Per cent. | Gross.              | Per cent. |        | Gross.  | Per cent. | Gross.                | Per cent. | Gross.              | Per cent. |        |
| 1921.        |  |           |                       |           |                     |           |        |   |           |                       |           |                     |           |        |
| September .. | 455  | 35·46     | 810                   | 63·13     | 18                  | 1·40      | 1,283  | 2   | 11·76     | 15                    | 88·24     | ..                  | ..        | 17     |
| October ..   | 1,437  | 33·32     | 2,634                 | 61·08     | 241                 | 5·59      | 4,312  | 11  | 91·67     | 1                     | 8·33      | ..                  | ..        | 12     |
| November ..  | 1,063  | 33·25     | 1,889                 | 59·09     | 245                 | 7·66      | 3,197  | ..  | ..        | 15                    | 100       | ..                  | ..        | 15     |
| December ..  | 1,000  | 27·48     | 2,368                 | 65·07     | 271                 | 7·45      | 3,639  | 11  | 61·11     | 6                     | 33·33     | 1                   | 5·56      | 18     |
| 1922.        |  |           |                       |           |                     |           |        |   |           |                       |           |                     |           |        |
| January ..   | 649  | 26·97     | 1,588                 | 66·00     | 169                 | 7·02      | 2,406  | 4   | 80        | 1                     | 20        | ..                  | ..        | 5      |
| February ..  | 811  | 33·69     | 1,338                 | 55·59     | 258                 | 10·72     | 2,407  | 9   | 56·25     | 6                     | 37·5      | 1                   | 6·25      | 16     |
| March ..     | 1,093  | 41·91     | 1,183                 | 45·36     | 332                 | 12·73     | 2,608  | 6   | 75        | 2                     | 25        | ..                  | ..        | 8      |
| April ..     | 1,508  | 39·82     | 1,478                 | 39·03     | 801                 | 21·15     | 3,787  | 4   | 40        | 6                     | 60        | ..                  | ..        | 10     |
| May ..       | 1,280  | 28·29     | 1,386                 | 30·64     | 1,858               | 41·07     | 4,524  | 10  | 35·71     | 8                     | 28·57     | 10                  | 35·71     | 28     |
| June ..      | 674  | 18·68     | 915                   | 25·36     | 2,019               | 55·96     | 3,608  | 9   | 75        | 2                     | 16·67     | 1                   | 8·33      | 12     |
| July ..      | 525  | 19·69     | 1,060                 | 39·76     | 1,081               | 40·55     | 2,666  | 1   | 14·28     | 5                     | 71·43     | 1                   | 14·28     | 7      |
| Total ..     | 10,495   | 30·48     | 16,649                | 48·34     | 7,293               | 21·18     | 34,437 | 67  | 45·27     | 67                    | 45·27     | 14                  | 9·46      | 148    |



TABLE 64.

SHOWING THE NUMBER AND PERCENTAGE OF EACH SPECIES OF RATS  
FOUND INFECTED IN QUEENSLAND PORTS.

| Place.       | <i>R. norvegicus.</i> |              | <i>R. R. rattus.</i> |              | <i>R. R. alex-<br/>andrinus.</i> |              | <i>M. musculus.</i> |              | Unclassified. |              | Total. |
|--------------|-----------------------|--------------|----------------------|--------------|----------------------------------|--------------|---------------------|--------------|---------------|--------------|--------|
|              | Num-<br>ber.          | Per<br>cent. | Num-<br>ber.         | Per<br>Cent. | Num-<br>ber.                     | Per<br>Cent. | Num-<br>ber.        | Per<br>Cent. | Num-<br>ber.  | Per<br>Cent. |        |
| Brisbane ..  | 127                   | 66·84        | 36                   | 18·95        | 15                               | 7·89         | 11                  | 5·79         | 1             | ·53          | 190    |
| Townsville   | 30                    | 50·85        | 23                   | 38·98        | ..                               | ..           | ..                  | ..           | 6             | 10·17        | 59     |
| Cairns ..    | 13                    | 68·42        | 2                    | 10·53        | ..                               | ..           | ..                  | ..           | 4             | 21·05        | 19     |
| Ingham ..    | ..                    | ..           | ..                   | ..           | ..                               | ..           | ..                  | ..           | 21            | 100·00       | 21     |
| Innisfail .. | ..                    | ..           | ..                   | ..           | ..                               | ..           | ..                  | ..           | 4             | 100·00       | 4      |
| Rockhampton  | 6                     | 100·00       | ..                   | ..           | ..                               | ..           | ..                  | ..           | ..            | ..           | 6      |
| Maryborough  | ..                    | ..           | ..                   | ..           | ..                               | ..           | ..                  | ..           | 2             | 100·00       | 2      |
| Ipswich ..   | ..                    | ..           | ..                   | ..           | ..                               | ..           | ..                  | ..           | 2             | 100·00       | 2      |
| Port Douglas | 1                     | 100·00       | ..                   | ..           | ..                               | ..           | ..                  | ..           | ..            | ..           | 1      |
| Total ..     | 177                   | 58·22        | 61                   | 20·07        | 15                               | 4·93         | 11                  | 3·62         | 40            | 13·16        | 304    |

TABLE 65.

SHOWING PREVALENCE OF RAT SPECIES IN QUEENSLAND PORTS  
(1921-1922).

| Place.          | <i>R. norvegicus.</i> |           | <i>R. R. rattus.</i> |           | <i>R.R. alexandrinus.</i> |           | Total. |
|-----------------|-----------------------|-----------|----------------------|-----------|---------------------------|-----------|--------|
|                 | Number.               | Per cent. | Number.              | Per cent. | Number.                   | Per cent. |        |
| Brisbane ..     | 8,508                 | 51·32     | 3,578                | 21·59     | 4,491                     | 27·09     | 16,577 |
| Townsville ..   | 109                   | 40·08     | 130                  | 47·79     | 33                        | 12·13     | 272    |
| Cairns ..       | 70                    | 23·18     | 128                  | 42·38     | 104                       | 34·44     | 302    |
| Ingham ..       | 17                    | 6·97      | 148                  | 60·65     | 79                        | 32·38     | 244    |
| Mackay ..       | 70                    | 11·59     | 167                  | 27·65     | 367                       | 60·76     | 604    |
| Rockhampton ..  | 2,087                 | 87·43     | 96                   | 4·02      | 204                       | 8·55      | 2,387  |
| Maryborough ..  | 269                   | 19·45     | 713                  | 51·55     | 401                       | 29·00     | 1,383  |
| Ipswich ..      | 23                    | 2·46      | 863                  | 92·20     | 50                        | 5·34      | 936    |
| Port Douglas .. | 26                    | 45·61     | 29                   | 50·88     | 2                         | 3·51      | 57     |

NOTE.—Records of the prevalence of *Mus musculus* are incomplete and are not included in this Table. The data here shown relate to prevalence of rodent species only, and are not complete records of rodents destroyed or examined.

TABLE 66.

SHOWING PREVALENCE OF RAT SPECIES IN PORTS OF AUSTRALIA NOT INFECTED BY PLAGUE (1921-1922).

| Place.                    | <i>R. norvegicus.</i> |           | <i>R. R. rattus.</i> |           | <i>R. R. alex.</i> |           | Total. |
|---------------------------|-----------------------|-----------|----------------------|-----------|--------------------|-----------|--------|
|                           | Number.               | Per cent. | Number.              | Per cent. | Number.            | Per cent. |        |
| <i>Victoria.</i>          |                       |           |                      |           |                    |           |        |
| Port of Melbourne—        |                       |           |                      |           |                    |           |        |
| Wharfs .. ..              | 498                   | 31·72     | 1,046                | 66·62     | 26                 | 1·66      | 1,570  |
| Vessels .. ..             | 58                    | 1·38      | 3,449                | 81·88     | 705                | 16·74     | 4,212  |
| City of Melbourne ..      | 2,800                 | 46·18     | 1,010                | 16·66     | 2,253              | 37·16     | 6,063  |
| <i>South Australia.</i>   |                       |           |                      |           |                    |           |        |
| Adelaide—                 |                       |           |                      |           |                    |           |        |
| City (Incomplete) ..      | 186                   | 55·69     | 29                   | 8·68      | 119                | 35·63     | 334    |
| Wharfs and Vessels ..     | 171                   | 6·35      | 1,136                | 42·22     | 1,384              | 51·43     | 2,691  |
| <i>Western Australia.</i> |                       |           |                      |           |                    |           |        |
| Perth .. .. .             | 1,095                 | 12·71     | 4,357                | 50·60     | 3,158              | 36·68     | 8,610  |
| <i>Tasmania.</i>          |                       |           |                      |           |                    |           |        |
| Hobart—                   |                       |           |                      |           |                    |           |        |
| Wharfs .. ..              | 3,454                 | 90·58     | 359                  | 9·42      | ..                 | ..        | 3,813  |
| City .. .. .              | 22,520                | 92·58     | 1,806                | 7·42      | ..                 | ..        | 24,326 |
| Launceston—               |                       |           |                      |           |                    |           |        |
| Wharfs .. ..              | 564                   | 92·76     | 44                   | 7·24      | ..                 | ..        | 608    |
| City .. .. .              | 4,801                 | 90·93     | 479                  | 9·07      | ..                 | ..        | 5,280  |

NOTE.—Records of the prevalence of *Mus musculus* are incomplete, and are not included in this Table.

### Distribution of Flea Species.

The Conference of 14th November, 1921 (*vide* Appendix B, page 217), carried a resolution as follows:—

“ That the examination of fleas from rodents be carried out, as a routine measure, in both infected and apparently uninfected districts and States, the specific purposes of such examination being the determination of species with reference to the distribution and relative numbers of *Xenopsylla cheopis* and the presence or otherwise of infected fleas and their species.”

In accordance with this resolution some fleas were collected and examined. The number is given in the subjoined table. The number is not great enough to justify any deductions—all that can be said is that *Xenopsylla cheopis* is generally predominant throughout the table. *Xenopsylla astia* has not been determined in Australia.



TABLE 67.

| Place.                           | From Local Sources.        |                                 |                        |                             |                             | From Shipping.             |                                 |                        |                             |                             |
|----------------------------------|----------------------------|---------------------------------|------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------------|------------------------|-----------------------------|-----------------------------|
|                                  | <i>Xenopsylla cheopis.</i> | <i>Ceratophyllus fasciatus.</i> | <i>Pulex irritans.</i> | <i>Ctenocephalus felis.</i> | <i>Ctenopsylla musculi.</i> | <i>Xenopsylla cheopis.</i> | <i>Ceratophyllus fasciatus.</i> | <i>Pulex irritans.</i> | <i>Ctenocephalus felis.</i> | <i>Ctenopsylla musculi.</i> |
| Adelaide .. ..                   | 49                         | 11                              | ..                     | 3                           | 11                          | 180                        | 16                              | ..                     | ..                          | 1                           |
| Melbourne .. ..                  | ..                         | ..                              | ..                     | ..                          | ..                          | 167                        | 24                              | ..                     | ..                          | ..                          |
| Brisbane .. ..                   | 132                        | 1                               | 3                      | 12                          | 3                           | 12                         | ..                              | ..                     | ..                          | ..                          |
| Cairns .. ..                     | 223                        | ..                              | 1                      | 43                          | 1                           | 1                          | 2                               | ..                     | ..                          | ..                          |
| Fremantle .. ..                  | 39                         | 2                               | ..                     | 1                           | 3                           | ..                         | ..                              | ..                     | ..                          | ..                          |
| Cooktown .. ..                   | 7                          | ..                              | ..                     | 12                          | ..                          | ..                         | ..                              | ..                     | ..                          | ..                          |
| Kangaroo Island .. ..            | ..                         | 6                               | ..                     | ..                          | ..                          | ..                         | ..                              | ..                     | ..                          | ..                          |
| Townsville Local .. ..           | 13                         | ..                              | 8                      | 5                           | ..                          | 3                          | ..                              | ..                     | ..                          | 1                           |
| Townsville Experimental Animals* | 3,496                      | ..                              | ..                     | 81                          | ..                          | ..                         | ..                              | ..                     | ..                          | ..                          |

\* These animals were the experimental animals in captivity (guinea-pigs, rabbits, white rats, &c.) at the Australian Institute of Tropical Medicine.



In Sydney, the State Microbiological Laboratory continued the examination of rodent fleas, the reports of which are available since 1909 (see page 109). For the period of the 1921-1922 outbreak, the following table records the prevalence of species of rodent fleas examined:—

TABLE 68.  
SHOWING IN MONTHS NUMBER AND SPECIES OF FLEAS COLLECTED AND PERCENTAGE OF EACH SPECIES FOUND IN SYDNEY, DURING THE PLAGUE PERIOD, SEPTEMBER, 1921—JULY, 1922.

(From Report of the Director-General of Public Health, New South Wales, for 1922.)

| 1921-1922.<br>Month. | Cases in Human Beings. | Number of Rats Examined. | Number of Rats found Infected. | Number and Species of Fleas collected from Rats examined. |             |                             |             |                                 |             |                                       |             |                         |             |                                 |             | Total Fleas Collected |     |
|----------------------|------------------------|--------------------------|--------------------------------|---|-------------|-----------------------------|-------------|---------------------------------|-------------|---------------------------------------|-------------|-------------------------|-------------|---------------------------------|-------------|-----------------------|-----|
|                      |                        |                          |                                | <i>Xenopsylla cheopis</i> .                               |             | <i>Ctenopsylla muscui</i> . |             | <i>Ceraophyllus fasciatus</i> . |             | <i>Ctenoxiphilus canis or felis</i> . |             | <i>Pulex irritans</i> . |             | <i>Echinophaga myrmecobii</i> . |             |                       |     |
|                      |                        |                          |                                | Gross.  | Per centum. | Gross.                      | Per centum. | Gross.                          | Per centum. | Gross.                                | Per centum. | Gross.                  | Per centum. | Gross.                          | Per centum. |                       |     |
| September ..         | ..                     | 1,265                    | 17                             | 21  | 21.88       | 44                          | 45.83       | 31                              | 32.29       | ..                                    | ..          | ..                      | ..          | ..                              | ..          | ..                    | 96  |
| October ..           | ..                     | 4,071                    | 12                             | 90  | 27.27       | 119                         | 36.06       | 121                             | 36.67       | ..                                    | ..          | ..                      | ..          | ..                              | ..          | ..                    | 330 |
| November ..          | 1                      | 2,952                    | 15                             | 134   | 32.06       | 154                         | 36.84       | 119                             | 28.47       | 11                                    | 2.63        | ..                      | ..          | ..                              | ..          | ..                    | 418 |
| December ..          | 1                      | 3,368                    | 18                             | 82  | 25.71       | 121                         | 37.93       | 109                             | 34.16       | 5                                     | 1.57        | 2                       | 63          | ..                              | ..          | ..                    | 319 |
| January ..           | 1                      | 2,406                    | 5                              | 205   | 69.73       | 58                          | 19.73       | 20                              | 6.80        | 8                                     | 2.72        | 3                       | 1.02        | ..                              | ..          | ..                    | 294 |
| February ..          | 4                      | 2,407                    | 16                             | 166   | 61.25       | 72                          | 26.57       | 30                              | 11.07       | 3                                     | 1.11        | ..                      | ..          | ..                              | ..          | ..                    | 271 |
| March ..             | 5                      | 2,608                    | 8                              | 119   | 63.64       | 43                          | 22.99       | 21                              | 11.23       | 4                                     | 2.14        | ..                      | ..          | ..                              | ..          | ..                    | 187 |
| April ..             | 11                     | 3,787                    | 10                             | 174   | 72.5        | 33                          | 13.75       | 29                              | 12.08       | 3                                     | 1.25        | 1                       | 42          | ..                              | ..          | ..                    | 240 |
| May ..               | 10                     | 4,524                    | 28                             | 162   | 65.59       | 52                          | 21.05       | 33                              | 13.36       | ..                                    | ..          | ..                      | ..          | ..                              | ..          | ..                    | 247 |
| June ..              | 2                      | 3,608                    | 12                             | 98  | 45.16       | 79                          | 36.40       | 39                              | 17.98       | 1                                     | 46          | ..                      | ..          | ..                              | ..          | ..                    | 217 |
| July ..              | ..                     | 2,666                    | 7                              | 75  | 30.61       | 101                         | 41.23       | 64                              | 26.12       | 4                                     | 1.63        | ..                      | ..          | 1                               | 41          | ..                    | 245 |



In Hobart, the Government Microbiologist, in his report for the year 1921-22 (Tasmanian Department of Agriculture and Stock), stated that all local specimens of rodent fleas examined by him during the course of the outbreak on the mainland proved to be *Ceratophyllus fasciatus*. In the examination of a considerable number of rodent fleas at different times, he had not found *Xenopsylla cheopis* on rats taken in Hobart.

### Species of Fleas on Particular Rodent Species.

The data collected during this outbreak from ports in Australia other than Sydney are insufficient on which to base conclusions, but the following table given by Dr. Armstrong in his report for 1922 (page 45) indicates that in Sydney there is no significant preference shown by any one species of flea for a particular species of rat:—

TABLE 69.

| Period.   | Rodent Species. | <i>X. cheopis</i> . | <i>C. musculi</i> . | <i>C. fasciatus</i> . | Total. |
|-----------|-----------------|---------------------|---------------------|-----------------------|--------|
| 1911-1917 | R.R.R.          | 1,530 (47·8%)       | 1,209 (37·8%)       | 457 (14·3%)           | 3,196  |
|           | R.N.            | 1,161 (54·6%)       | 688 (32·4%)         | 274 (12·9%)           | 2,213  |
| 1922 ..   | R.R.R.          | 366 (33·4%)         | 449 (40·5%)         | 292 (26·3%)           | 1,107  |
|           | R.N.            | 246 (31·2%)         | 331 (42·0%)         | 211 (26·4%)           | 788    |

Records in somewhat more detail showing weekly prevalence of flea species on rodent species are given in the report of the Microbiological Laboratory appended to the 1922 report of Dr. Armstrong (page 122). Therein Dr. E. W. Ferguson records data which are summarized in the totals for the year 1922 shown hereunder:—

TABLE 70.

| Rodent Species.         | No. of Rodents Examined. | Species of Fleas found.     |                            |                                  |  |                         |                                  | Total fleas found. |
|-------------------------|--------------------------|-----------------------------|----------------------------|----------------------------------|--|-------------------------|----------------------------------|--------------------|
|                         |                          | <i>Xenopsylla cheopis</i> . | <i>Ctenopsylla musculi</i> | <i>Ceratophyllus fasciatus</i> . | <i>Ctenocephalus felis</i> or <i>canis</i> . | <i>Pulex irritans</i> . | <i>Echidnophaga myrmecobii</i> . |                    |
| <i>R. norvegicus</i> .. | 8,433                    | 701                         | 211                        | 251                              | 7  | 4                       | nil                              | 1,174              |
| <i>R. rattus</i> ..     | 12,822                   | 567                         | 535                        | 290                              | 22   | nil                     | 1                                | 1,415              |
| <i>M. musculus</i> ..   | 8,783                    | nil                         | 11                         | 1                                | nil  | nil                     | nil                              | 12                 |
| Total rodents           | 30,038                   | 1,268                       | 757                        | 542                              | 29   | 4                       | 1                                | 2,601              |

References to the fleas found on *Mus musculus* in Australia are few. In 1918, Cleland stated that "In one sample—they were not looked for in others—the only fleas encountered were the blind flea *Ctenopsylla musculi*, which does not apparently bite man." (*Proc. Roy. Soc., N.S.W.*, Vol. LII, 1918.) Negative findings were reported by Johnstone and Harrison (*Proc. Roy. Soc. Q'land*, Vol. XXIV., 1912, p. 105), Ferguson (*Aust. Zoologist*, Vol. III., Part III., 1923, p. 114), and McCallum (*Health*, Vol. III., No. 6, 1925, p. 175).

### Correlation of Infection Incidence with Meteorological Conditions.

The outbreaks of 1921-22 were not sufficiently extensive to provide data for consideration of the meteorological influence on the course of the epidemic and epizootic, whilst the data in respect of flea and rodent prevalence are, excepting those for Sydney, too incomplete to enable definite deductions to be drawn in regard to the distribution and spread



TABLE 71.  
METEOROLOGICAL DATA FOR SYDNEY, NEW SOUTH WALES.

| Data.                                   |                                      | Period.                   | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |    |
|---|--------------------------------------|---------------------------|------|------|------|------|------|-------|-------|------|-------|------|------|------|---------|----|
| Temperature.                            | Mean ..<br>Maximum (de-<br>grees F.) | Normal for<br>62 years .. | 78.5 | 77.4 | 75.5 | 71.1 | 65.1 | 60.7  | 59.1  | 62.4 | 66.7  | 71.1 | 74.4 | 77.3 | 69.9    |    |
|   |                                      | 1921 ..                   | 77.0 | 78.7 | 77.1 | 73.5 | 68.1 | 66.2  | 65.3  | 64.8 | 71.6  | 70.1 | 76.8 | 75.3 | 72.0    |    |
|   |                                      | 1922 ..                   | 78.7 | 78.4 | 79.1 | 78.1 | 67.1 | 63.8  | 62.0  | 63.9 | 67.2  | 74.3 | 77.7 | 80.6 | 72.6    |    |
|   | Mean ..<br>Minimum (de-<br>grees F.) | Normal for<br>62 years .. | 64.9 | 64.9 | 63.0 | 58.1 | 52.1 | 48.2  | 45.8  | 47.6 | 51.4  | 55.8 | 59.6 | 62.9 | 56.2    |    |
|   |                                      | 1921 ..                   | 64.0 | 65.1 | 62.7 | 58.8 | 55.3 | 49.0  | 49.4  | 45.2 | 52.8  | 53.5 | 61.7 | 63.4 | 56.7    |    |
|   |                                      | 1922 ..                   | 63.3 | 65.6 | 60.6 | 60.2 | 53.2 | 47.9  | 46.5  | 46.8 | 52.1  | 56.5 | 59.5 | 64.6 | 56.4    |    |
| Rainfall.                               | Inches ..                            | Normal for<br>62 years .. | 3.57 | 4.55 | 5.11 | 5.43 | 5.21 | 5.00  | 4.83  | 3.09 | 2.92  | 2.97 | 2.89 | 2.62 | 48.19   |    |
|   |                                      | 1921 ..                   | 3.15 | 0.93 | 3.12 | 5.77 | 7.28 | 0.89  | 7.03  | 0.95 | 2.82  | 3.10 | 3.02 | 5.28 | 43.34   |    |
|   |                                      | 1922 ..                   | 7.01 | 2.55 | 1.66 | 1.30 | 3.69 | 1.26  | 10.82 | 1.81 | 4.22  | 3.21 | 0.35 | 1.47 | 39.35   |    |
|   | Wet Days ..                          | Normal for<br>58 years .. | 14   | 14   | 15   | 13   | 14   | 13    | 12    | 11   | 12    | 13   | 12   | 12   | 155     |    |
|   |                                      | 1921 ..                   | 14   | 9    | 18   | 8    | 20   | 8     | 11    | 5    | 8     | 13   | 12   | 14   | 140     |    |
|   |                                      | 1922 ..                   | 20   | 14   | 6    | 8    | 14   | 12    | 16    | 9    | 15    | 6    | 5    | 11   | 136     |    |
| Relative Humidity.<br>Saturation = 101. | Normal<br>56 years % ..              | Mean, 9 a.m. ..           | 70   | 72   | 75   | 77   | 78   | 78    | 77    | 74   | 69    | 68   | 67   | 67   | 73      |    |
|   |                                      | Mean, 3 p.m. ..           | 68   | 66   | 69   | 78   | 80   | 81    | 81    | 71   | 61    | 62   | 60   | 68   | 70      | 69 |
|   |                                      | Mean, 9 p.m. ..           | 66   | 68   | 70   | 63   | 72   | 79    | 79    | 76   | 64    | 68   | 54   | 52   | 57      | 64 |
|   | 1921 % ..                            | Mean, 9 a.m. ..           | 68   | 66   | 69   | 78   | 80   | 71    | 71    | 61   | 62    | 60   | 68   | 70   | 69      |    |
|   |                                      | Mean, 3 p.m. ..           | 66   | 64   | 60   | 68   | 67   | 60    | 58    | 48   | 53    | 52   | 65   | 66   | 61      |    |
|   |                                      | Mean, 9 p.m. ..           | 80   | 79   | 77   | 83   | 81   | 82    | 76    | 68   | 75    | 70   | 78   | 79   | 77      |    |
|   | 1922 % ..                            | Mean, 9 a.m. ..           | 66   | 68   | 70   | 63   | 72   | 79    | 76    | 64   | 68    | 54   | 52   | 57   | 66      |    |
|   |                                      | Mean, 3 p.m. ..           | 58   | 66   | 51   | 52   | 62   | 57    | 56    | 46   | 57    | 49   | 50   | 54   | 55      |    |
|   |                                      | Mean, 9 p.m. ..           | 75   | 78   | 74   | 66   | 78   | 76    | 79    | 66   | 72    | 65   | 66   | 71   | 72      |    |

of infection in different parts of Australia. It can be stated, however, that the correlation of seasonal flea prevalence with the incidence of infection corresponds with known epidemiological facts. The following tables of meteorological data in respect of Sydney and Brisbane are given for completeness of record:—



TABLE 72.  
METEOROLOGICAL DATA FOR BRISBANE, QUEENSLAND.

| Data.              | Period.  | Temperature.         |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                       | Rainfall.               |      |         | Relative Humidity,<br>Saturation = 100. |                        |      |      |
|--------------------|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|-------------------------|------|---------|---|------------------------|------|------|
|                    |  | Mean<br>Maximum      | Mean<br>Minimum      | Jan.                 | Feb.                 | Mar.                 | Apr.                 | May.                 | June.                | July.                | Aug.                 | Sept.                | Oct.                  | Nov.                    | Dec. | Annual. | Wet days                                | Normal for<br>33 years | 1921 | 1922 |
| Mean<br>Maximum    | Normal for<br>34 years<br>1921<br>1922                   | 85.4<br>82.5<br>87.8 | 84.5<br>84.1<br>81.4 | 82.3<br>79.5<br>83.9 | 79.1<br>78.0<br>82.3 | 73.4<br>75.2<br>75.2 | 69.4<br>71.2<br>69.9 | 68.4<br>70.2<br>66.5 | 71.2<br>67.9<br>70.9 | 75.8<br>74.0<br>73.8 | 79.8<br>77.2<br>80.3 | 83.0<br>83.4<br>83.8 | 85.3<br>83.6<br>86.3  | 78.1<br>77.2<br>78.5    | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| Mean<br>Minimum    | Normal for<br>34 years<br>1921<br>1922                   | 68.8<br>68.1<br>69.7 | 68.2<br>67.6<br>68.9 | 66.3<br>65.8<br>65.4 | 61.6<br>63.2<br>62.7 | 55.3<br>57.2<br>55.9 | 50.8<br>56.6<br>52.6 | 48.3<br>53.9<br>48.2 | 49.8<br>49.2<br>47.9 | 54.8<br>56.9<br>54.8 | 59.9<br>58.0<br>61.6 | 64.1<br>65.9<br>65.7 | 67.5<br>67.5<br>69.2  | 59.6<br>60.8<br>60.2    | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| Inches             | Normal for<br>69 years<br>1921<br>1922                   | 6.50<br>4.04<br>3.62 | 6.41<br>1.08<br>7.55 | 5.86<br>7.87<br>2.02 | 3.58<br>8.06<br>0.27 | 2.93<br>.78<br>2.05  | 2.57<br>7.99<br>1.85 | 2.22<br>6.14<br>4.67 | 2.19<br>.41<br>.17   | 2.08<br>2.02<br>3.38 | 2.64<br>1.36<br>2.11 | 3.67<br>3.24<br>3.53 | 4.87<br>11.32<br>4.60 | 45.52<br>54.31<br>35.82 | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| Wet days           | Normal for<br>33 years<br>1921<br>1922                   | 14<br>21<br>11       | 14<br>10<br>22       | 15<br>19<br>10       | 12<br>20<br>4        | 10<br>14<br>10       | 9<br>17<br>8         | 8<br>12<br>8         | 7<br>7<br>4          | 9<br>15<br>11        | 9<br>9<br>7          | 10<br>9<br>5         | 12<br>14<br>10        | 129<br>167<br>110       | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| Normal<br>37 years | Mean, 9 a.m. ...<br>Mean, 3 p.m. ...<br>Mean, 9 p.m. ... | 67<br>70<br>66       | 70<br>67<br>79       | 73<br>77<br>70       | 74<br>80<br>69       | 74<br>81<br>68       | 74<br>84<br>76       | 75<br>77<br>75       | 69<br>66<br>62       | 65<br>73<br>69       | 61<br>57<br>65       | 60<br>67<br>62       | 63<br>68<br>68        | 69<br>72<br>69          | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| 1921               | Mean, 9 a.m. ...<br>Mean, 3 p.m. ...<br>Mean, 9 p.m. ... | 70<br>62<br>77       | 67<br>58<br>74       | 77<br>70<br>82       | 80<br>70<br>83       | 81<br>63<br>79       | 84<br>68<br>85       | 77<br>60<br>78       | 66<br>52<br>70       | 73<br>61<br>79       | 57<br>52<br>69       | 67<br>64<br>86       | 68<br>62<br>81        | 72<br>62<br>79          | ..   | ..      | ..                                      | ..                     | ..   | ..   |
| 1922               | Mean, 9 a.m. ...<br>Mean, 3 p.m. ...<br>Mean, 9 p.m. ... | 66<br>55<br>75       | 79<br>71<br>82       | 70<br>59<br>77       | 69<br>56<br>78       | 68<br>55<br>74       | 76<br>60<br>81       | 75<br>56<br>76       | 62<br>44<br>66       | 69<br>58<br>79       | 65<br>58<br>83       | 62<br>66<br>85       | 68<br>66<br>84        | 69<br>59<br>78          | ..   | ..      | ..                                      | ..                     | ..   | ..   |



## Persistence of Infection in Premises as Determined by the Use of Sentinel Guinea-pigs.

The use of sentinel guinea-pigs for the detection of lurking and persistent infection on infected premises was extensively practised throughout the epidemic.

The results are tabulated hereunder in respect of the majority of the infected premises, Table 73 showing data for Brisbane and Table 74 those for Sydney.

There were 39 premises concerned. Guinea-pigs became infected on six only of these premises.

In no instance in which there was a human case without infected rats did the sentinels become infected.

Of the six instances in which infection of guinea-pigs resulted—

- (1) Two batches became infected on first exposure on the date of first discovery of infected rats—no further guinea-pigs exposed here within the next ten days became infected.
- (2) In one instance the first guinea-pigs exposed on the date of discovery of infected rats escaped, but others exposed four days later became infected.
- (3) In three instances two successive batches of exposed guinea-pigs became infected, the maximum duration of persistence of infection on the premises being in each case twelve and fourteen days, and in the somewhat unusual instance of the Remount Dépôt at Brisbane, 28 days. (These buildings were too large and open for fumigation.) In one of these cases infected rats were found after the last guinea-pig was infected.

So far as this experience goes, therefore, premises do not generally retain infection, after proper treatment by the authorities, for longer than fourteen days. The experience is, however, too limited for this to be accepted as a rule having general application.

TABLE 73.  
PARTICULARS OF SENTINEL GUINEA-PIGS AT BRISBANE.

| Premises.                            | First Date of Known Infection of Premises. | First Date Exposure of Sentinels.                                    | Second Exposure.   | Third Exposure.                           |
|--------------------------------------|--|--|--|---|
| Remount Depot, Brisbane ..           | Rats, 27.9.21                              | 7th–11th Oct.<br>Two sentinels exposed, both died + <i>b. pestis</i> | 17th to 24th Oct.<br>Two sentinels exposed, both died + <i>b. pestis</i> | Later exposure.<br>No record of infection |
| Laidlaws, Grey-street, Brisbane      | Rats, 1.9.21,<br>7.9.21                    | Three sentinels exposed — ve   |  |   |
| Gee's, Hope-street, Brisbane         | Rat, 17.12.21                              | Exposed, 17–24 Dec. + ve.  | Exposed, 23–31 Dec. + ve   | Exposed, 3–5 Jan. — ve                    |
| Stanley-street, South Brisbane       | Cat, 3.1.22<br>case 44,<br>24.12.21        | 29th Dec. — ve   | 5th Dec. — ve  | 5th Jan. — ve                             |
| Warry-street, Brisbane ..            | Case 46, 22.12.21                          | 23rd Dec. — ve   |  |   |
| London-road, Brisbane ..             | Case 47, 21.12.21                          | 22nd Dec. — ve   |  |   |
| Earl-street, Brisbane ..             | Case 48, 26.12.21                          | 27th Dec. — ve   |  |   |
| Spring Hill, Brisbane ..             | Case 50, 25.12.21                          | 27th Dec. — ve   |  |   |
| Judge-street, Brisbane ..            | Case 51, 1.1.22                            | 3rd Jan. — ve  |  |   |
| Mayne Junction, Brisbane             | Case 52, 4.1.22                            | 5th Jan. — ve  |  |   |
| Sandgate, Brisbane ..                | Case 53, 3.1.22                            | 4th Jan. — ve  |  |   |
| Allan-street, South Brisbane         | Rat, 17.1.22 ..                            | 17th Jan. — ve   | 21st Jan. + ve   | 31st Jan. — ve                            |
| Petrie-terrace, Brisbane ..          | Rat, 17.1.22 ..                            | 17th Jan. — ve   | 24th Jan. — ve   |   |
| Ascot, Brisbane ..                   | Case 54, 14.1.22                           | 19th Jan. — ve   | 25th Jan. — ve   |   |
| Hamilton, Brisbane ..                | Case 54, 14.1.22                           | 19th Jan. — ve   | 25th Jan. — ve   |   |
| Queen-street, Brisbane ..            | Case 55, 16.1.22                           | 19th Jan. — ve   | 25th Jan. — ve   |   |
| Gertrude-street, Brisbane ..         | Case 55, 16.1.22                           | 19th Jan. — ve   | 25th Jan. — ve   |   |
| Stanley-street, Brisbane ..          | Rat, 20.1.22 ..                            | 21st Jan. — ve   | 25th Jan. — ve   |   |
| Graham-street, Brisbane ..           | Rat, 1.2.22 ..                             | 1st Feb. — ve  | 10th Feb. — ve   |   |
| Brook-street, Brisbane ..            | Case 57, 31.1.22                           | 2nd Feb. — ve  | 10th Feb. — ve   |   |
| Petrie's Bight, Brisbane ..          | Rats, 14–<br>18.2.22 ..                    | 14th Feb. + ve   | 18th Feb. — ve   | 23rd Feb. — ve                            |
| Reid-street, Woolloongabba, Brisbane | Rat, 18.2.22 ..                            | 20th Feb. — ve   | 24th Feb. — ve   |   |
| Hawthorne-street, Brisbane           | Rat, 24.2.22 ..                            | 25th Feb. — ve   | 2nd March — ve   |   |
| Brooke-street, Brisbane ..           | Rats, 28.2.22.<br>3.3.22                   | 28th Feb. — ve   | 7th March — ve   |   |
| Sandgate, Brisbane ..                | Case, 14.3.22                              | 15th March — ve  |  |   |



TABLE 74.

## PARTICULARS OF SENTINEL GUINEA PIGS AT SYDNEY.

(From Report of the Director-General of Public Health for New South Wales for 1922, page 49.)

| Location of Infected Premises.    | Associated Human Plague Case or Plague Rat. | Date Human Case Reported or Infected Rats Found. | Number of Guinea-pigs used. | Cages placed on Premises. | Cages removed from Premises. | Number of Days on Premises. | Guinea-pig results.  | Species of Fleas found on Guinea-pigs after Removal. |                            |                                 |                                      |                        | Result of Dissection of Fleas. |                           |
|-----------------------------------|---|--|-----------------------------|---------------------------|------------------------------|-----------------------------|--|--|----------------------------|---------------------------------|--------------------------------------|------------------------|--------------------------------|---------------------------|
|                                   |   |  |                             |                           |                              |                             |  | <i>Xenopsylla cheopis.</i>                           | <i>Ctenopsylla muscuh.</i> | <i>Ceratophyllus fasciatus.</i> | <i>Ctenocephalus canis or felis.</i> | <i>Pulex irritans.</i> |                                | Total.                    |
| 353 Sussex-street ..              | Case 1 ..                                   | 1.12.21  | 4                           | 1-2.12.21                 | 5.12.21                      | 3-4                         | Discharged from observation on 24.12.21  | ..   | ..                         | ..                              | 1                                    | ..                     | 1                              | Neg.                      |
| 102 Sussex-street ..              | Case 2 ..                                   | 3.12.21  | 2                           | 5.12.21                   | 12.12.21                     | 7                           | 1 died on 22.12.21. <i>B. pestis</i> present ..                                    | 2  | 2                          | 2                               | 1                                    | ..                     | 7                              | Neg.                      |
| " ..                              | " ..  | 3.12.21  | 2                           | 28.12.21                  | 30.12.21                     | 2                           | 1 died on 8.1.22. P.M. No evidence of plague                                       | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | " ..  | 3.12.21  | 1                           | 3.1.22                    | 6.1.22                       | 3                           | Discharged, 28.1.22 ..   | 1  | ..                         | ..                              | 2                                    | ..                     | 3                              | Neg.                      |
| 90 Sussex-street ..               | Rats, 46 and 48                             | { 7.12.21 }<br>{ 13.12.21 }                      | 2                           | 13.12.21                  | 19.12.21                     | 6                           | Discharged from observation on 24.12.21  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 52 Day-street ..                  | Rats, 49-52 and 54-63                       | 16.12.21 to 3.1.22                               | 2                           | 19.12.21                  | 23.12.21                     | 4                           | 1 died 24.12.21. P.M. <i>B. pestis</i> present                                     | 2  | ..                         | ..                              | ..                                   | ..                     | 2                              | 1 showed <i>B. pestis</i> |
| " ..                              | " ..  | 16.12.21 to 3.1.22                               | 2                           | 28.12.21                  | 30.12.21                     | 2                           | 1 died 3.1.22. <i>B. pestis</i> present ..   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | " ..  | 16.12.21 to 3.1.22                               | 2                           | 3.1.22                    | 6.1.22                       | 3                           | 1 died 9.1.22. P.M. No evidence of plague  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 263-277 Kent-street ..            | Rats, 65-67 ..                              | 16.12.21 to 3.1.22                               | 2                           | 18.1.22                   | 21.1.22                      | 3                           | Discharged from observation on 11.2.22   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | " ..  | 19-23.1.22                                       | 2                           | 25.1.22                   | 2.2.22                       | 3                           | 1 died 20.2.22; 1 died 21.2.22. No evidence of plague. (Gærtner's bacillus found)  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 118-120 Sussex-street ..          | Rat, 64 ..                                  | 18.1.22  | 2                           | 23.1.22                   | 27.1.22                      | 4                           | Discharged from observation on 11.2.22   | 44   | ..                         | ..                              | ..                                   | 1                      | 45                             | Neg.                      |
| 97A Liverpool-street ..           | Rats, 68-73 ..                              | 6.2.22 to 8.2.22                                 | 1                           | 1.2.22                    | 7.2.22                       | 6                           | Discharged from observation on 4.3.22  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | " ..  | 6.2.22 to 8.2.22                                 | 2                           | 6.2.22                    | 7.2.22                       | 1                           | 1 Discharged from observation on 4.3.22; 1 died on 26.2.22. (Gærtner infection)    | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 76 Oxford street, Paddington      | Case 5 ..                                   | 11.2.22  | 1                           | 22.2.22                   | 28.2.22                      | 6                           | Discharged from observation 22.3.22 ..   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 88 Oxford-street ..               | Rats, 75, 77-79                             | 22-24.2.22                                       | 1                           | 22.2.22                   | 28.2.22                      | 6                           | Discharged from observation on 22.3.22   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | " ..  | 22-24.2.22                                       | 1                           | 14.3.22                   | 15.3.22                      | 1                           | Discharged from observation on 8.4.22  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 84 Oxford-street ..               | Case 7 ..                                   | 11.3.22  | 1                           | 8.3.22                    | 15.3.22                      | 7                           | Discharged from observation on 1.4.22  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| " ..                              | Rats, 92 and 84, cat 85                     | 28.2.22 and 5.3.22                               | 2                           | 13.3.22                   | 17.3.22                      | 4                           | Discharged from observation on 8.4.22  | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 119 Dowling-street, Woolloomooloo | Cases 9, 13, and 14                         | 31.3.22  | 2                           | 28.3.22                   | 4.4.22                       | 7                           | Discharged from observation on 29.4.22   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 115 Dowling-street ..             | Case 10 ..                                  | 27.3.22  | 1                           | 28.3.22                   | 4.4.22                       | 7                           | Discharged from observation on 29.4.22   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| Collins-street, Alexandria        | Case 11 ..                                  | 30.3.22  | 2                           | 1.4.22                    | 4.4.22                       | 3                           | 1 died on 11.4.23. No evidence of plague. 1 discharged from observation on 29.4.22 | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |
| 2 Judge-street, Woolloomooloo     | Cases 12 and 15                             | 30.3.22 and 1.4.22                               | 1                           | 28.3.22                   | 4.4.22                       | 7                           | Discharged from observation on 29.4.22   | ..   | ..                         | ..                              | ..                                   | ..                     | ..                             |                           |



### Persistence of Infection in Localized Areas.

The localization of the areas of infection in Sydney and the duration of infection within these areas have been discussed by Dr. Armstrong (see page 157). In Brisbane, both human and rodent plague persisted in the area about the Roma-street produce stores. The first infected rodents were found in this locality—Addis Bros.' Produce Store—on 8th September, 1921, and infected rodents continued to be found until 19th November, 1921. The first human case occurred in this locality—next to Addis Bros.' Store—on 23rd August, 1921, and human cases continued to occur in this neighbourhood until 19th December, 1921. Another area in which infection persisted was in South Brisbane—Stanley-street and Vulture-street—along the water-front, infected rodents being found as early as 7th September, 1921, and persisting up till 31st October, 1922, when the last infected rodent in Brisbane was found in a vacant store in Stanley-street.

Instances of persistent discovery of infected rodents in premises in infected areas in Brisbane were as follows:—

TABLE 75.

| Premises.   | Dates Found.    | No. of Infected Rodents. |
|---|-----------------|--------------------------|
|   | 1921.           |                          |
| Flour Mill, corner of Stanley and Tribune streets, South Brisbane       | 24th September, | 1                        |
|   | 4th October ..  | 2                        |
|   | 6th October ..  | 2                        |
|   | 22nd October .. | 1                        |
|   | 24th October .. | 1                        |
| Bragg's Bakery, Ann-street, Valley .. .. .                              | 1st October ..  | 1                        |
|   | 5th October ..  | 3                        |
|   | 8th October ..  | 1                        |
| Shaw & Sons, Hardware Merchants, Queen-street, Brisbane                 | 19th November   | 4                        |
|   | 25th November   | 1                        |
|   | 30th November   | 1                        |
| Siemon & Sons, Produce Merchants, Roma-street, Brisbane (infected mice) | 9th November    | 1                        |
|   | 10th November   | 1                        |
|   | 19th November   | 2                        |



## CHAPTER XXXVI.—THE SPREAD OF PLAGUE.

### Plague Spread only by Sea Routes.

During the period in late August and early September, when plague was spreading rapidly without any control, the only places infected were those in communication by sea or water routes with Brisbane. No single instance of an inland town becoming infected was recorded. This is a striking confirmation of the experience during the previous period of plague endemicity in Australia. Throughout the whole 1921-22 outbreak no inland town was infected. For practical purposes, therefore, the risk of the spread of infection along land transport routes can be considered as negligible, the spread of infection being from port to port along sea or water routes.

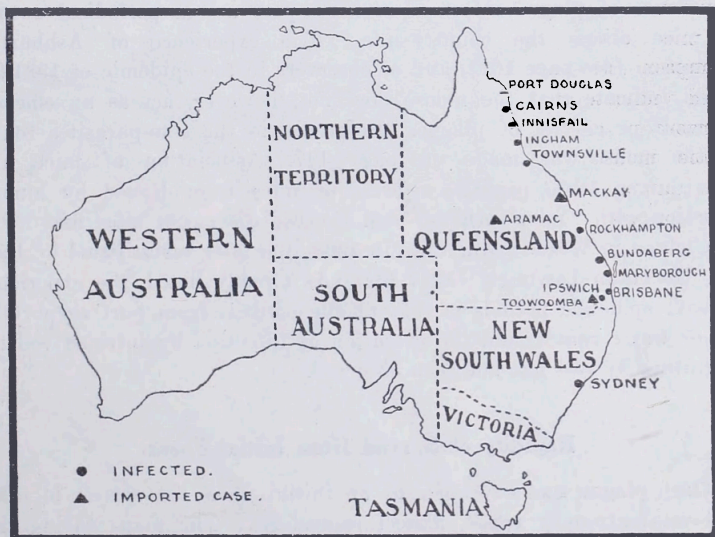


Fig. 10.—Map of Australia, showing localities where Plague occurred, 1921-1922.

### Migration of Rodents by Rail.

Throughout the 1921-22 outbreak, close supervision of goods shipped by rail was instituted at infected ports. In addition, a Commonwealth official supervised all goods transhipped at Wallangarra, the border station between New South Wales and Queensland, where a break of gauge occurs. Fruit (mainly bananas and pineapples) were consigned interstate in considerable quantities without showing evidence that

rodents migrated to any extent in trucks and freight cars. Grain and produce is not consigned through Wallangarra in any large quantities, and what there was showed only occasional traces of rodent infestation. Although mice have been common in grain stored in the proximity of rail yards, they were not noted in any large number during the course of the outbreak. Of 30 rats killed in the yards at Wallangarra, 25 were *Rattus rattus*, 4 were *Rattus alexandrinus*, and 1 *Rattus norvegicus*. Although occasions have been reported in which large numbers of rats have infested grain stored along rail yards, the more outstanding rodent infestation in this connexion has been that of mice; for instance, during the accumulation of grain during the war period of 1917-18, with the resultant dislocation of shipping. Periodically, these swarms of mice spread widely across the countryside.

Attention has recently been called to the possibility of the spread of plague inland in the advent of a coincident occurrence of plague infection at a sea-port and a periodical swarm of mice across the countryside. The experience of Ashburton Thompson (see page 102), and of observers in the epidemic of 1921-22, would indicate that the mouse does not, however, act as an efficient reservoir or carrier of plague. Reference to the ecto-parasites found on the mouse was made on page 197. Association of mice and man during these periodic swarms of mice is evidenced by human infection with "mouse disease"—a fungoid disease of mice first noted by Cleland in Western Australia in 1908, and later investigated by Paul and Hermann Lawrence (1917-18). As already noted, the experience of both epidemic periods is that plague spreads from port to port by sea or water routes, and the extension of infection by infected rodents migrating by rail has not been observed.

### **Rapidity of Spread from Initial Focus.**

Once plague had developed at an initial focus, the spread to other foci was extremely rapid, almost immediate. The maps facing this page, indicating the localities by periods, show this clearly for Brisbane. Figure 11 shows the localities where infected rodents were found in Brisbane up to 18th September, 1921. Figure 12 shows the localities where infected rodents were found between 18th September and 24th September (in red); and includes these found up to 18th September (in green). The rapidity of spread over a wider area for the whole Queensland coast and Sydney has been already indicated in Chapter XXVI. Granting the development of the epizootic prior to the epidemic appearance, it was during this earlier epizootic extension that the spread developed; that, is, prior to the development of human cases calling attention to the existence of the infection.



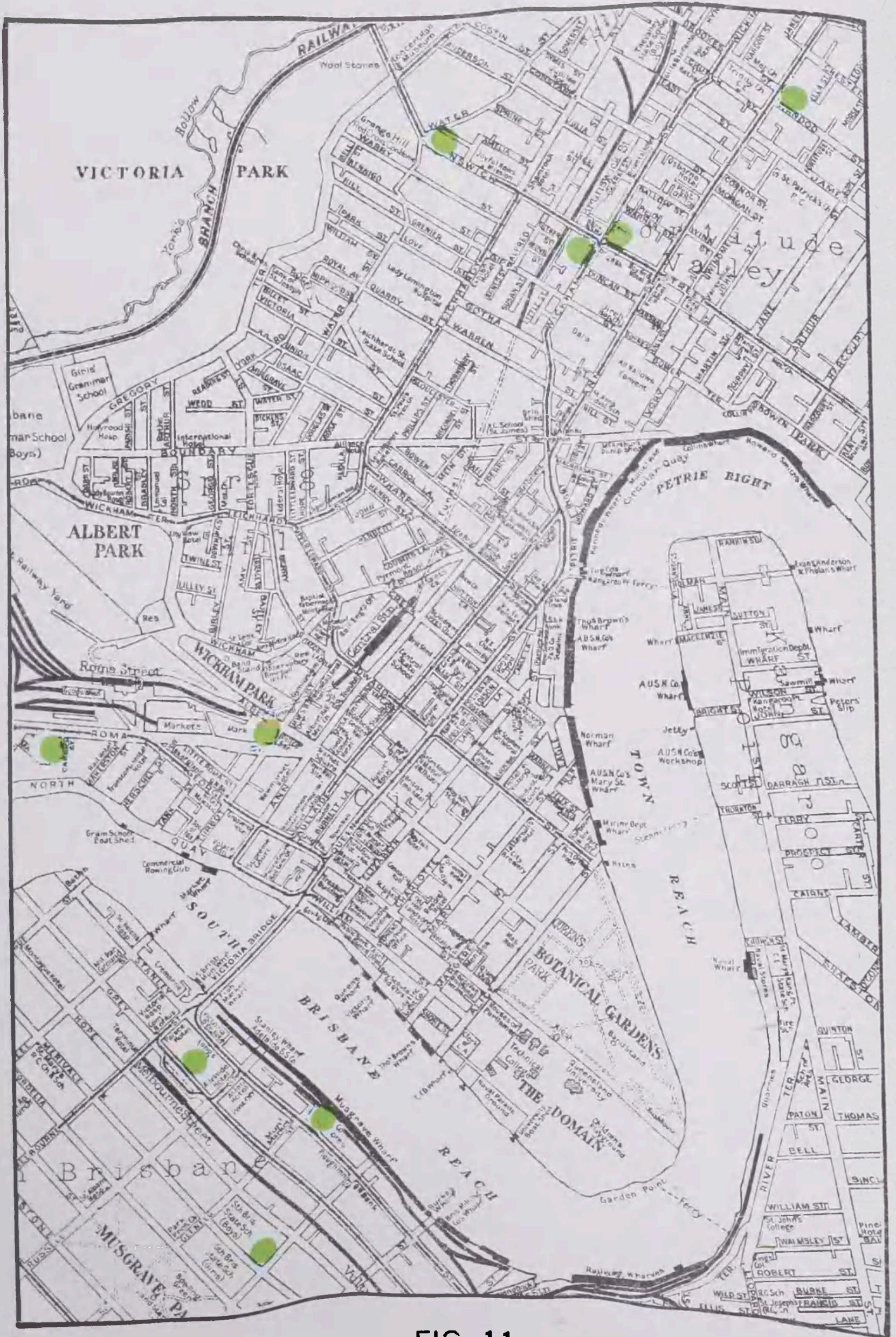


FIG. 11.









FIG. 12.







### **The Individual Infected Rodent not Important on Shipboard.**

The experience of the 1900-1909 and 1921-22 years of plague indicates that in no instance was the presence of a single infected rat, or the transmission of infection by a single infected rat, suspected or proven. In every case, plague on shipboard was in epizootic form, multiple rodents being identified. This would suggest that the single infected rat is not an epidemic factor of material importance, except as an initial focus for a definite ship epizootic. The risk of one infected rat as a passenger on shipboard surviving, passing ashore, and then surviving to spread infection on shore, is remote; whilst this experience indicates, as an important control measure, the frequent deratization of vessels to keep the rodent population below the numerical level of epizootic density.

## CHAPTER XXXVII.—FUMIGATION OF VESSELS.

The fumigation of both coastal and oversea vessels was carried out vigorously throughout the whole period of plague prevalence in Queensland. This fumigation was, from the end of September, 1921 (i.e., from the receipt of the first notification of plague in Brisbane), done after each voyage from Brisbane. This means, in the case of coastal vessels, very frequent fumigations, in some cases vessels were for a time fumigated each week; but, the coastal vessels rapidly becoming rat-free, the intervals between fumigations were gradually lengthened—at first to fumigation on alternate trips, later to monthly, and still later to two-monthly intervals.

Appended are tables showing the results obtained in rats collected after fumigation in the ports of Sydney and Melbourne.

No attempt was made after the first few weeks to secure every dead rat in the ship, and, consequently, the numbers are not exhaustive, although they are indicative.

From these tables it is seen that—

- (a) the dominant ship rat for both Australian and oversea ships was *Rattus rattus rattus*;
- (b) the repeated fumigations, after the first four or five weeks of activity, maintained the coastal shipping in a condition of almost absolute freedom from rats.

That there should be found in one week at the port of Sydney only one rat, or two rats, or occasionally none at all, when scores of vessels were fumigated is sufficient proof of this statement.

The condition of the oversea vessels offered a definite contrast.







TABLE 77.

## RODENTS COLLECTED AFTER FUMIGATION OF VESSELS—MELBOURNE.

| Week Ended.    | Vessels—Oversea and Australian. |        |        |        |
|----------------|---------------------------------|--------|--------|--------|
|                | R.N.                            | R.R.R. | R.R.A. | Total. |
| 1921.          |                                 |        |        |        |
| November—      |                                 |        |        |        |
| 12th .. .. .   | ..                              | 29     | 6      | 35     |
| 19th .. .. .   | ..                              | 72     | 37     | 109    |
| 26th .. .. .   | ..                              | 17     | 16     | 33     |
| December—      |                                 |        |        |        |
| 3rd .. .. .    | ..                              | 28     | 34     | 62     |
| 10th .. .. .   | ..                              | 16     | 18     | 34     |
| 17th .. .. .   | ..                              | 61     | 36     | 97     |
| 24th .. .. .   | ..                              | 19     | 5      | 24     |
| 31st .. .. .   | ..                              | 27     | 6      | 33     |
| 1922.          |                                 |        |        |        |
| January—       |                                 |        |        |        |
| 7th .. .. .    | ..                              | 38     | 16     | 54     |
| 14th .. .. .   | ..                              | 62     | 21     | 83     |
| 21st .. .. .   | 9                               | 16     | 6      | 31     |
| 28th .. .. .   | 5                               | 42     | 27     | 74     |
| February—      |                                 |        |        |        |
| 4th .. .. .    | 8                               | 27     | 20     | 55     |
| 11th .. .. .   | 7                               | 84     | 6      | 97     |
| 18th .. .. .   | 2                               | 90     | 1      | 93     |
| 25th .. .. .   | ..                              | 43     | ..     | 43     |
| March—         |                                 |        |        |        |
| 4th .. .. .    | 2                               | 90     | 1      | 93     |
| 11th .. .. .   | 7                               | 40     | 31     | 78     |
| 18th .. .. .   | ..                              | 46     | 10     | 56     |
| Totals .. .. . | 40                              | 847    | 297    | 1,184  |

| Week Ended.    | Australian Vessels. |        |        |        | Oversea Vessels. |        |        |        |
|----------------|---------------------|--------|--------|--------|------------------|--------|--------|--------|
|                | R.R.                | R.R.R. | R.R.A. | Total. | R.N.             | R.R.R. | R.R.A. | Total. |
| April—         |                     |        |        |        |                  |        |        |        |
| 1st .. .. .    | ..                  | 5      | ..     | 5      | 6                | 119    | 25     | 150    |
| 8th .. .. .    | ..                  | 5      | ..     | 5      | ..               | 72     | 13     | 85     |
| 15th .. .. .   | ..                  | 3      | ..     | 3      | ..               | 143    | 32     | 175    |
| 22nd .. .. .   | ..                  | 3      | ..     | 3      | ..               | 50     | ..     | 50     |
| 29th .. .. .   | 3                   | 6      | ..     | 9      | 2                | 58     | ..     | 60     |
| May—           |                     |        |        |        |                  |        |        |        |
| 6th .. .. .    | ..                  | ..     | ..     | ..     | ..               | 66     | 6      | 72     |
| 13th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 66     | 19     | 85     |
| 20th .. .. .   | ..                  | ..     | ..     | ..     | 1                | 103    | 13     | 117    |
| 27th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 76     | 1      | 77     |
| June—          |                     |        |        |        |                  |        |        |        |
| 3rd .. .. .    | ..                  | 10     | 2      | 12     | ..               | 138    | ..     | 138    |
| 10th .. .. .   | ..                  | 4      | ..     | 4      | ..               | 37     | 2      | 39     |
| 17th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 130    | 33     | 163    |
| 24th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 44     | 20     | 64     |
| July—          |                     |        |        |        |                  |        |        |        |
| 1st .. .. .    | ..                  | 14     | 5      | 19     | 2                | 78     | 21     | 101    |
| 8th .. .. .    | ..                  | ..     | ..     | ..     | ..               | 37     | 3      | 40     |
| 15th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 32     | 19     | 51     |
| 22nd .. .. .   | ..                  | ..     | ..     | ..     | 17               | 24     | ..     | 41     |
| 29th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 12     | 8      | 20     |
| August—        |                     |        |        |        |                  |        |        |        |
| 5th .. .. .    | ..                  | 7      | 14     | 21     | ..               | 14     | ..     | 14     |
| 12th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 59     | 2      | 61     |
| 19th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 46     | 1      | 47     |
| 26th .. .. .   | ..                  | 3      | ..     | 3      | 1                | 61     | ..     | 62     |
| September—     |                     |        |        |        |                  |        |        |        |
| 2nd .. .. .    | ..                  | 3      | ..     | 3      | ..               | 20     | 2      | 22     |
| 9th .. .. .    | ..                  | ..     | ..     | ..     | ..               | 70     | 6      | 76     |
| 16th .. .. .   | ..                  | ..     | ..     | ..     | ..               | 25     | 29     | 54     |
| 23rd .. .. .   | ..                  | ..     | ..     | ..     | 1                | 69     | 9      | 79     |
| 30th .. .. .   | ..                  | ..     | ..     | ..     | 1                | 106    | 5      | 112    |
| Totals .. .. . | 3                   | 63     | 21     | 87     | 31               | 1,755  | 26     | 2,055  |



## PART IV.—THE PERIOD, 1923-1925.

### CHAPTER XXXVIII.—RECORDS OF THE PERIOD, 1923-1925.

The close of the year 1922 saw Australia apparently free from plague. Intensive rat destruction and examination was continued in all ports. The last human case, as already recorded, had appeared at Sydney on 9th June, 1922, and the last infected rodent had been reported from Brisbane on 31st October, 1922. The only evidence of infection within Australia since 1922 was the occurrence of a sporadic case at Sydney, in June, 1923. In 1925 a suspected case was reported at Brisbane, but subsequent investigation appeared to negative plague infection.

#### **Sporadic Case of Plague at Sydney in June, 1923.**

On 5th July, 1923, a sporadic case of plague was reported at Sydney. The patient, W. J. C., male, *aet.* 22 years, who resided in Camperdown and was employed in the city, became ill on 27th June. He was not seen by a medical practitioner until 30th June, when he was in a moribund condition. Post-mortem examination showed death to be due to septicaemia, and the possibility of plague was recognized. The diagnosis was confirmed by subsequent microbiological examination at the State Health Department's Laboratory. The source of infection was not ascertained. No rats were found at the patient's residence, but 40 rats were caught in the neighbourhood, all being free of disease. All rats and mice caught in the place of occupation in the city and in its vicinity were similarly found to be healthy. Sentinel guinea pigs placed in the residence and in the place of occupier gave negative results. Close and continuous search for evidence of rodent plague was sustained without result, and no further case of human plague occurred.

The last previous case of human plague had been reported on 12th June, 1922, more than twelve months before, and the last infected rodent in Sydney had been found on 13th July, 1922.

(See *Health*, I., 8, Sept., 1923, page 246, and Report of the Director-General of Public Health, N.S.W., for the year 1923, page 49.)

#### **Suspected Case of Plague at Brisbane in June, 1925.**

A case of human plague was reported on the 22nd June, 1925, from the metropolitan area of Brisbane, Queensland. On receipt of this notification from the State Health Department of Queensland, the Commonwealth Government proclaimed Queensland infected with plague, notified all nations concerned under the terms of the International Sanitary

Convention, and put into operation certain precautionary measures in relation to shipping in order to prevent spread of infection. These precautions included—

- (1) Examination at Brisbane of classes of cargo liable to harbour rats;
- (2) Strict enforcement of berthing regulations in all Australian ports (Quarantine Regulations 61 and 62);
- (3) Examination of all rats obtained from vessels in all Australian ports. This was in addition to the routine destruction and examination of shore rats at these ports;
- (4) The fumigation of vessels which had called at Brisbane.

Inquiries were also instituted as to whether any goods had been consigned from the infected locality to other States or oversea, but no evidence was obtained that any such shipment of goods had taken place.

Meantime the State Health Department had instituted steps to trace up any association between the human case and possible rodent plague in Brisbane. A gang of nine rat-men were employed by the State Government and 42 rat-men by the Municipal Councils of the metropolitan area, and all rodents obtained were examined at State Health Department Laboratory. No infected rodents were found. Rat destruction measures had been regularly and continuously carried out in Brisbane since the plague epidemic of 1921-22, and rodents destroyed had been regularly examined by the State Health Department Officers. The actual figures of the rats destroyed and examined for the month of May, 1925, are as follows:—

|            |         |    |    |    | Destroyed. | Examined. | Infected. |
|------------|---------|----|----|----|------------|-----------|-----------|
| Week ended | 2nd May | .. | .. | .. | 1,834      | 203       | Nil       |
| ..         | 9th     | .. | .. | .. | 1,408      | 151       | ..        |
| ..         | 16th    | .. | .. | .. | 2,478      | 189       | ..        |
| ..         | 23rd    | .. | .. | .. | 2,216      | 170       | ..        |
| ..         | 30th    | .. | .. | .. | 2,376      | 108       | ..        |

On the 2nd July, 1925, the State Health Department reported a case of suspected plague also from the Brisbane metropolitan area. In this case the bubo occurred in the axillary region and further investigation proved the infection to be streptococcal and the case was definitely diagnosed "not plague." In the meantime the State Health Department of Queensland, as the result of further investigations carried out in connexion with the human case reported as plague on 22nd June, 1925, had come to the conclusion that the early diagnosis of plague was incorrect. Inoculation of guinea pigs with material from the bubo of the patient gave negative results, the guinea pigs being alive and active after ten days.

The position therefore is that the last evidence of infection reported from Brisbane was the infected rodent found on the 31st October, 1922.



### Quarantine of Vessels for Plague.

During the three years, 1923-1925, four vessels were quarantined for plague or suspected plague amongst members of the crews. The records of these vessels are as follows:—

S.S. "HELICION."—The s.s. *Helcion* (British Imperial Oil Company) left Soe Soe on 14th November, 1922, for Brisbane, via ports, with a cargo of case benzine and kerosene. Crew.—Nine Europeans and 31 Chinese. The vessel loaded further benzine at Singapore, arriving on 16th November, 1922, and sailing on 19th November, 1922, direct for Thursday Island, which was reached on 1st December, 1922. On medical inspection at Thursday Island a Chinese fireman was found by the Quarantine Officer to exhibit signs of probable bubonic plague infection.

The vessel was ordered into quarantine, and the suspected case landed at the Quarantine Station.

There was very little evidence of rat infestation on the vessel, which was permitted to proceed in quarantine to Townsville, where she was held in quarantine. Five rats were trapped on the vessel and bacteriologically examined at the Institute of Tropical Medicine, Townsville, and found to be healthy. No further cases of sickness suggestive of plague occurred on the vessel, which was released from quarantine at Townsville on 14th December, 1922, the pratique certificate being endorsed "Subject to the condition that all present cargo must be unloaded at each port under quarantine supervision."

These conditions were strictly observed at the next port of call—Brisbane—where the vessel was emptied of cargo. No further rats were seen or caught.

History of the Case.—The Chinese fireman, Ah Lok, complained of abdominal pain on 23rd November, 1922, four days after the vessel left Singapore. On 1st December, 1922, his temperature was 101.

On examination at the Quarantine Station, Thursday Island, the same day, his temperature was 103.6 degrees, and the symptoms of plague were present. There was a large bubo in the right inguinal region, extremely tender and with marked periglandular involvement. Pus from the bubo contained numerous gram-negative bi-polar organisms. A guinea pig inoculated with pus from the bubo gave the post-mortem appearances of plague infection on the fourth day from inoculation.

The course of the disease in the patient was mild and recovery was uncomplicated.

S.S. "CHINKOA."—The s.s. *Chinkoa* (crew, 93; passengers, 3) left Calcutta on 11th June for Australia, via Rangoon, Penang, and Singapore. On the 18th June a native fireman suffering from plague was landed into shore hospital at Rangoon, and the vessel on arrival at Penang had her holds and crew's quarters fumigated.

On arrival at Fremantle, 8th July, the vessel was medically inspected, and all on board were found to be healthy.

The vessel was ordered into quarantine pending investigations for rat infestation. Rats were found in several parts of the vessel, and these localities were at once fumigated. Cargo was discharged into lighters under strict supervision, and such as would not suffer damage was fumigated in the lighters, the remainder after strict search being released without fumigation. Passengers for Fremantle were released under surveillance. Stevedores working the cargo were also kept under surveillance for seven days. The *Chinkoa* left Fremantle on 17th July, and proceeded in quarantine to Adelaide, and subsequently to Melbourne, at both of which ports the same precautions as at Fremantle were enforced. The vessel left Melbourne, in quarantine, for Sydney on 4th August, and on arrival at Sydney the remainder of the perishable cargo was unloaded into lighters under strict supervision. The holds were then fumigated with the remainder of the cargo *in situ*, this cargo then unloaded, and the empty vessel fumigated throughout. The vessel was then released from quarantine. No infected rodents were obtained from the vessel.

S.S. SCOTTISH STRATH.—*s.s. Scottish Strath* (crew, 37; no passengers) arrived at Thursday Island on 25th December, 1923, from Singapore (9th December, 1923), Samboe (9th December, 1923), and Balik Papan (17th December, 1923). On medical inspection, one fireman, *aet.* 26, was discovered with swollen matted glands in groin, moderately tender, temperature 100 degrees F. (onset 12th December, 1923). He was landed to the Quarantine Station. The vessel was an oil-tanker, and there were no signs of rat infestation. The vessel left on 27th December, in quarantine, for Sydney. On bacteriological examination, a smear from the bubo and guinea pig inoculation both proved negative. On arrival at Sydney, on 2nd January, medical inspection showed no signs of illness on board. The quarters on board were disinfected with cyanide, and the crew landed to the Quarantine Station, North Head, for bathing and disinfection. The vessel was then released from quarantine on 3rd January.

S.S. ARAFURA.—(3,401 tons; crew, 17 European, 97 Asiatic; passengers, 24 saloon, 124 Chinese deck; total souls on board, 262; cargo, general, principally case goods, but including merchandize in bales, crates, and mats.) This vessel arrived at Thursday Island on 15th July, 1924, from Yokohama (18th June), Yokkaichi (19th June), Kobe (20th-24th June), Moji (25th June), Hong Kong (30th June-1st July), Manila (4th-7th July), Sandakan (7th July). On inward inspection at Thursday Island the surgeon reported a case of right inguinal bubo in a Malay quartermaster, *aet.* 37, who had reported sick on 13th July, but the bubo had developed about 5th July. There was no lesion to account for the bubo, some pyrexia, and a diagnosis of plague was made and the



vessel ordered into quarantine. The patient was landed to the quarantine station and local cargo lightered for disinfection. The quarters of the patient and adjacent 'tweendecks were disinfected. The vessel sailed the following day and proceeded, in quarantine, to Townsville (19th July), Brisbane (22nd July), Sydney (24th-30th July), and Melbourne (1st August). At each port the vessel was handled in quarantine. Passengers were landed and released under surveillance after personal and baggage disinfection. Cargo was lightered under supervision and fumigated. At each port a close inspection for rat infestation was carried out, and at Sydney inspection and trapping yielded no rats but several mice, one dead, but all negative on bacteriological examination. After fumigation throughout at Melbourne, the vessel sailed for Hobart without subsequent developments. The passengers were released from surveillance after expiry of the quarantine period of seven days. The patient, after several days of pyrexia, proceeded to convalescence.

## APPENDICES.

### APPENDIX A.

## Australian and Tasmanian Intercolonial Plague Conference of Melbourne, Victoria, 1900.

This Conference, which met at Melbourne in April, 1900, on the invitation of the Honorable Allan McLean, Premier of Victoria, to the Governments of Australia and Tasmania, consisted of delegates from all those Governments except that of New South Wales, the presence of plague in the latter colony requiring the special attention of the officers of the Health Department there.

#### THE RESOLUTIONS.

The Conference recommended that the resolutions of the Venice Plague Convention be adopted by the Governments of Australia and Tasmania, subject to the following alterations and additions:—

1. Each Government to send through its health authority a daily telegraphic report to the health authorities of the said Governments of every fresh case of plague, locality of same, and notable occurrence, and, in addition, to send a weekly general report of cases and deaths, specifying type of case and occupation of patient.

2. Every case of plague and of suspected plague to be made immediately and compulsorily notifiable to the central and local health authorities.

3. If the prevalence of plague be considerable, no ship to leave an infected place for another Colony until inspected by a medical officer appointed or approved by the health authority for the purpose, and until the master or person in charge of such ship has obtained a certificate in the form of the schedule hereto appended from such officer that the master or person in charge, the crew, and passengers have been medically examined by him by day, and after embarkation, and that every such person is free of plague. Provided that, in the event of any communication taking place after such certificate has been given between the ship and the shore, or any other ship (other than orally or by signal), the ship shall not leave without a fresh examination and certificate.

4. "Bones" to be added to the list of "susceptible" articles.

5. If the prevalence of plague be considerable in any Colony, a medical passport system to be introduced on the land frontiers of adjoining Colonies for the purpose of exercising surveillance, notification being made at once to the health authority of the Colony to which any person under surveillance may be about to proceed.

6. Governments not to encourage by means of cheap fares the passage of persons from or to an infected place.

7. The division of ships into four classes—infected, suspected, ordinarily healthy, and healthy—and the definitions of the same given in the Bombay Regulations of the 17th August, 1898, to be adopted, with the insertion of the



words "or that has had a case of plague on board" after the words "that has left an infected port," and with the addition of the words "or has received any cargo from an infected place."

\*8. As regards the recommendation in the Convention for "infected ships" the words "ou a une surveillance" to be struck out.

9. As regards "suspected" and "ordinarily healthy" ships, such of the passengers and crew as in the opinion of the health authority are likely to spread the infection, to be kept under observation for a period not exceeding ten days from such time as the health authority may consider danger of infection to have ceased.

10. Every ship to be disinfected at once after discharge of cargo to the satisfaction of the health authority, all practicable measures being at the same time taken for the destruction of rats, and disinfection being conducted either by means of steam-sulphur fumes passed into the ship under pressure—the sulphur being used in the proportion of 1 lb. to every 1,000 cubic feet, and the fumigation being continued for at least six hours—or by other equally effective means.

11. In all cases of death from plague, cremation or burial at sea to be adopted where practicable, and where neither is practicable then the corpse to be at once surrounded by a sheet soaked in the solution (*specified in the Venice Plague Convention*) of corrosive sublimate or carbolic acid, and placed in a coffin containing freshly burnt and slaked lime, or other equally effective disinfectant, and surrounded therewith; the burial, if possible, being made in a deep dry grave that is not likely to be again used or disturbed, and, if made in a cemetery, the coffin being surrounded by a layer of chlorinated lime at least 6 inches thick.

12. When a reasonable suspicion of danger from plague arises, the destruction of rats by poison at sea and river-frontiers to be immediately undertaken and vigorously prosecuted, and the expense of this procedure, so far as regards shores, river banks, piers, and wharfs, to be borne in the first instance by the Government; the several departments of State also, and the local sanitary authorities to immediately undertake and to be responsible for the extermination of rats on their several properties, or within their several districts; bodies of rats taken dead or alive to be destroyed in every case by fire.

13. Ship-berthing regulations, similar to those in operation in Melbourne and Sydney, to be enforced by each Government.

14. Each Government to undertake the expense involved in the isolation and treatment of persons, not arriving by sea, whom such Government has deemed it necessary to isolate and treat.

15. Each Government to afford facilities for persons being inoculated with Haffkine's prophylactic.

16. No ship from any place, where plague is known or suspected, to be granted pratique, except between sunrise and sunset.

17. Persons on land exposed to infection of plague to be subjected to observation or surveillance at the discretion of the health authority.

18. Each Government to provide special means for the proper bacteriological investigation for determining the presence or absence of plague-infection.

19. Each Government, for the purpose of preventing infection, to regulate the means of transport of articles suspected of being plague-infected, and forward for the purpose of bacteriological examination.

## SCHEDULE.

*Bill of Health.*

This is to certify that the ship \_\_\_\_\_, sailing under the \_\_\_\_\_ flag, and under the command of \_\_\_\_\_ as master, of \_\_\_\_\_ tons, bound for \_\_\_\_\_, with a crew of \_\_\_\_\_ persons† and passengers, and laden with a cargo of \_\_\_\_\_, is, at the time of leaving this port, in a satisfactory sanitary condition, and that no case of bubonic plague exists amongst the officers, passengers, or crew, all of whom have been inspected by me.

It is further certified that the town and port \_\_\_\_\_ are at present *free*‡ from plague.

†Including master, mates, engineers, apprentices, and private servants, when the latter are not mentioned in the ship's articles.

‡Or as the case may be.



## APPENDIX B.

## Commonwealth and States of Australia Conference on Plague, Sydney, 1921.

This Conference met at Sydney in November, 1921, at the invitation of the Prime Minister of the Commonwealth, and following the decision of a Premiers' Conference. The delegates present represented the Commonwealth Department of Health, the Health Department of each State, and the New South Wales and Queensland Branches of the British Medical Association.

The Conference discussed the subject of plague in Australia under the heads of the following agenda:—

### AGENDA.

- A.—Introduction of Disease.
- B.—Commonwealth responsibilities under International Convention.
- C.—Discussion of measures for the control of disease in any infected locality, including procedure on premises where infected rats are found, the control of fleas on such premises, and the principles of an effective campaign immediate and future.
- D.—Discussion of measures for the preventing of spread of disease from infected to uninfected localities, including transport of infected rodents in merchandise.
- E.—Discussion of measures in uninfected localities, including payment for rats destroyed and educational leaflets.
  - Control of persons and goods from infected localities.
  - Survey of rat infestation.
  - Survey to determine rat and flea species.
  - Systematic destruction of rats.
  - Rat-proofing centrifugally from transport centres.
  - Rodent eradication.
- F.—Relative spheres of activity of, and co-operation between State and Commonwealth Governments.
- G.—Discussion of preventive inoculation and policy in regard to its use.
- H.—Discussion on use of plague serum.
- I.—Clinical and bacteriological diagnosis.
- J.—The medical profession—
  - (a) Responsibilities of.
  - (b) Co-operation in campaign.

### SCHEDULE TO AGENDA.

#### INFECTED FOCI.

(a) *Cases*.—Reporting. Diagnosis, clinical and microscopical. Hospitalization, including removal. Location of apparent source of infection. Destruction of rodents and rat fleas and rat-proofing of apparent source of infection.

(b) *Contacts*.—Surveillance and disinfection of effects, dwelling, &c., as required by conditions.

(c) *Determination of Extent of Focus*.—Radial rodent examination. Sentinel guinea-pigs. Flea examination for numbers, species, and infectivity.

(d) *Isolation of Focus*.—As circumstances permit, by netting, walling, &c., to avoid driving infected rodents outwards.

(e) *Intensive Rodent Destruction*.—Removal of food-stuffs. Poisoning. Removal and destruction of harbourage. Trapping. Hunting. Fumigation by SO<sub>2</sub> or HCn. Rodent proofing.

(f) *Flea Destruction*.—Fumigation by SO<sub>2</sub> or HCn. Kerosene emulsion and other pulicides. General cleaning (harbourage and breeding places). Exclusion of domestic animals. Collection by exposed guinea pigs.

#### PROTECTION OF OTHER CENTRES.

##### 1. *Sea or River Communication*.—

(a) Wharfs and vicinity.—Inspection, eradication, rodent proofing.

(b) Foreshores.—Inspection, eradication, rat-proofing, as circumstances permit.

(c) *Shipping*.—Inspection for rodents. Eradication and rat-proofing on board. Enforcement of berthing regulations against ingress and egress of rats. Fumigation when empty. Inspection of cargo during loading. Rejection of rat-infested or rat-broached merchandise and of packages not obviously rat-free. Fumigation of certain classes of outward cargo. Protection against rat-infestation of cargo awaiting shipment. Outward medical inspection of passengers.

##### 2. *Land Communications*.—

(a) Railway inspection. Eradication and rodent-proofing of goods sheds. Inspection and rodent-proofing of goods vans as required. Inspection of outward goods to secure rat freedom. Fumigation of certain classes of outward goods. Protection from rats of goods awaiting despatch.

Surveillance of outward passengers and arrangements for reporting sick from trains.

(b) Road traffic.—Outward inspection of goods, fumigation of certain classes of goods; protection of goods awaiting despatch, and reporting of such travellers may be required under certain conditions.

The object of measures is to preserve rat-free routes with as little interference with trade traffic and commerce as is consistent with safety on the known epidemiological features of plague.

#### GENERAL MEASURES.

##### 1. *Survey*.—

(a) Location of rat-infestation by skilled inspection with systematization of results in maps, tables, returns, &c.

(b) Location of plague-foci by rodent examination. Examination of rodent fleas for species and infectivity. Use of sentinel guinea pigs as tests and collectors. Study of epidemiological history of human cases.

(c) Laboratory indications.—Human plague, rodent plague, flea plague.

##### 2. *Rodent Eradication*.—

(a) Destruction.—Trapping, poisoning, hunting, fumigation, and miscellaneous.

(b) Exclusion.—Elimination of available food, harbourage, and means of access.

(c) Keeping area free.—Inspection. Enforcement of regulations to prevent reinfestation.



3. *General.*—

- (a) Flea census from rats caught for determining local and seasonal prevalence of *Cheopsis*.
- (b) Enlistment of public effort against domestic infestation by rats and fleas, and of public interest in measures taken through press, societies, business firms, &c., and by means of special literature, notices, &c.
- (c) Intensive study of bionomics of local rat species and rat-flea species.

## RESOLUTIONS.

After discussion, the following resolutions were adopted by conference:—

A.—*The Introduction of Disease.*—

That there is not sufficient evidence to justify a conclusion as to the fact or method of introduction of the present outbreak of plague into Australia, but, as no practicable system of coastline sanitary defence can infallibly prevent the importation of infected rodents, the possibility of the re-introduction of plague into Australia has always been recognized.

B.—*Commonwealth Responsibility under the International Convention.*—

The Conference was informed that, so far as was possible, the obligations involved in the articles of the International Sanitary Convention of Paris (1912) had been discharged, although on account of a delay in receipt of notification of the first case from the Queensland authorities the notification to other signatory Governments had not been “immediate” Resolved:—

“That the several State Health Authorities undertake to supply to the Commonwealth Government all information necessary to enable the latter Government to comply fully with the requirements of the International Sanitary Convention.”

## C, D, E.—

The Conference then proceeded to the discussion of items C, D, and E on the agenda sheet, the discussion being directed according to the schedule attached to the agenda.

The Conference, after a comprehensive discussion upon all phases of the epidemiology and control of plague, decided that as so much of these aspects of the question was already scientifically and administratively well established, a complete set of resolutions covering all of the measures for the control of plague was unnecessary. Certain resolutions dealing with aspects which had been proved to have a special importance during the present epidemic were adopted as follows:—

*Infected Foci.*—

- (a) *Cases.*—1. That where in the opinion of a medical practitioner any case is one of plague the State Department of Public Health should provisionally regard such case as one of plague, even in the absence of initial bacteriological confirmation, and should admit such case after consultation to an observation ward for exhaustive examination.
- 2. That the use of animal inoculation should always be resorted to in case of doubt, in the diagnosis of any human case.
- 3. That suspicious as well as declared cases should be reported by practitioners.

4. That the risk of infection from bubonic or septicæmic cases of human plague is negligible, and that such cases may safely be treated in isolation wards of a general or an infectious diseases hospital.

5. That it is not essential for plague cases to be treated in isolation hospitals at a distance from population.

(b) *Contacts*.—1. That contacts of plague cases suffering from bubonic or septicæmic plague should be allowed freedom of movement under surveillance for a period of seven days. Contacts of pneumonic plague cases should be isolated for seven days after last contact with the case.

2. That private houses do not require to be quarantined or isolated where it is reasonable to suppose that the infected person has acquired the infection elsewhere. Isolation would more reasonably be applied to the place where the disease was contracted.

(c) *Determination of Extent of Focus*.—1. That test-trapping for rats along lines approximately radial within an area of 200 yards distance around an infected focus should be resorted to as soon as a focus is known to be infected.

That the area enclosed by a line drawn between the points at which infected rats are so trapped should be at once dealt with by intensive trapping and rodent eradication.

2. That the use of guinea pigs on the "sentinel" system, as indicators of plague-flea infection in any premises is approved as effective.

3. That the examination of fleas from rodents be carried out, as a routine measure, in both infected and apparently uninfected districts and States, the specific purpose of such examination being the determination of species with reference to the distribution and relative numbers of *Xenopsylla cheopis* and the presence or otherwise of infected fleas and their species.

4. That access to the whole or such portion of the premises on which infected rats have been found and which are deemed to be infective be denied to employees and public, except under control of the Health Authorities until the place is proved flea-free.

(d) *Isolation of Focus*.—That, in special circumstances and when the conditions indicate such action, the enclosure of any localized infected area with a rat-proof fencing is to be regarded as a valuable preliminary measure for the purpose of preventing the escape of rats which may be incubating the disease or which may carry infected fleas.

(e) *Intensive Rodent Destruction*.—1. That the following draft regulations are approved by the Conference as representing the minimum standards for regulations relating to the control of plague, which should be adopted and enforced by all States in view of the plague situation as it is to-day in Australia.

The Conference is of opinion that, in any State in which the existing legal powers are inadequate for the enforcement of such regulations, the necessary legal powers should without delay be obtained from Parliament:—

1. No owner or occupier shall place, throw, leave, or suffer to remain on his premises any waste food, refuse, garbage, waste



matter, or thing which would have a tendency to encourage or attract rats to visit or frequent premises or to form or afford harborage or shelter to rats.

2. Whenever upon any premises any litter, hay, straw, packing material, manure, building material, produce, timber, bags, tins, old iron, paper, packing cases, or similar material is kept or stored in such a way as to afford or form shelter or harborage for rats, it shall be removed or so stacked, stored, arranged, or protected as to no longer afford or form shelter or harborage for rats.

3. No waste food, garbage, edible trade waste, horse-feed or cow-feed, food intended for birds or other animals, or similar material, shall be kept or allowed to remain on any premises unless it is contained in rat-proof receptacles or compartments which are kept effectively covered or closed against access by rats.

4. Every opening from or into any covered drain or sewer within the curtilage of any premises, and every opening from or into any pipe, covered conduit, or covered channel (whether or not used for drainage) which affords or is likely to afford, access, shelter, or harborage for rats, shall be so trapped or otherwise protected as to prevent effectively the ingress or egress of rats.

5. Every disused covered drain, disused covered sewer, disused pipe, disused covered conduit, or disused covered channel within the curtilage of any premises which affords or is likely to afford access, harborage, or shelter for rats, shall, upon notice to that effect, being given by the \_\_\_\_\_ to the owner or occupier of the premises, be taken up, repaired, blocked, or otherwise so dealt with in the manner specified in such notice as to effectively prevent the access, harborage, or shelter of rats therein.

6. Whenever in any building the floors, skirtings, wainscots, walls, partitions, ceilings, or like internal fittings, or any of these are so constructed or are in such a condition as to permit the access, shelter, or harbouring of rats in, under, or about such building, the said floors, skirtings, wainscots, walls, partitions, ceilings, or like internal fittings, shall be so removed, refitted, reconstructed, altered, or repaired, as to prevent as far as practicable the access, shelter, or harbouring of rats in, under, or about such buildings.

7. Every retaining wall, embankment, structure, improvement, or work of any kind, or any formation, whether natural or artificial, within the curtilage of any premises, which affords or provides, or is likely to afford or provide, the means of access, harborage, or shelter for rats, shall, in accordance with an inspector's order, be removed or so reconstructed or repaired or altered as to prevent the access, harborage, or shelter of rats.

8. Every hotel, restaurant, butcher's shop, small-goods shop, baker's shop, grocer's shop, fruit shop, fish shop, oyster saloon, produce store, hide store, flour mill, stable, and slaughter-house shall be so protected, altered or refitted in accordance with



inspector's orders, as to effectively prevent rats from gaining access to or harbouring in, under, or about the building or buildings thereof. All holes or openings in the external walls of such buildings which are of such a nature as to permit the entry of rats shall be blocked with cement or protected with stout wire netting or metal, in such a manner as to effectively prevent the entry of rats. All supplies or collections of water to which rats may have access in or on such premises shall be so protected as to effectively prevent such access.

9. For every hotel, restaurant, butcher's shop, small-goods shop, baker's shop, grocer's shop, fruit shop, fish shop, oyster saloon, produce store, hide store, flour mill, stable, and slaughter-house there shall be provided at least two rat traps of a pattern approved by the \_\_\_\_\_, or as many more as may be required from time to time by the \_\_\_\_\_. Every such trap shall be baited with fresh bait at least twice in each week, and shall be kept set. Every such trap shall be inspected daily by the owner or occupier, or his agent or servant, and all rats found therein shall be killed and their carcasses forthwith disposed of so as not to cause a nuisance, and the trap or traps re-set and re-baited by the said owner or occupier or his agent or servant.

10. In addition to the foregoing, every owner and occupier shall use all reasonable means by blocking access ways, destroying harbourage, protecting foodstuffs, poisoning, trapping, the use of rat-killing dogs, cats, or other animals, and otherwise, to keep the premises occupied by him free from rats, and to prevent and discourage the access to or harbouring of rats in, on, or about such premises.

11. All public and private docks and wharfs, including all sheds and other buildings thereon shall be so protected as to prevent rats from gaining entrance to such docks or wharfs, or sheds or buildings, at any state of the tide, from vessels moored or anchored alongside of such docks or wharfs or from other sources, and all goods, products, wares, and merchandise liable to attract or to become infested or infected with rats on any dock or wharf shall be so kept or stored as to prevent rats from gaining access to or coming into contact therewith.

Every dock or wharf shall be provided with not less than \_\_\_\_\_ traps of a pattern approved by an authorized officer, and as many more as may from time to time be required by any authorized officer. Every such trap shall be baited with fresh and suitable bait at least twice a week and shall be kept set. Every such trap shall be inspected at least once daily by the owner or occupier, or his agent or servant, and all rats found therein shall be killed and their carcasses shall be forthwith disposed of in such manner as the \_\_\_\_\_ may from time to time require, and the trap or traps re-set and re-baited by the said owner or occupier, or his agent or servant.

12. The presence of rat holes, rat runs, fresh rat dung, or other evidence of rat infestation upon any premises, dock, wharf, land or place shall be taken as evidence that these regulations have not been complied with, and shall be held to constitute a breach of these regulations.







That medical inspection in uninfected States of passengers on vessels from an infected State is not necessary, and that a declaration covering the name, destination, and addresses of all passengers will be sufficient.

*F.—Preventive Inoculation—*

That, though sufficient evidence is not available to enable the Conference to speak decisively as to the value of prophylactic inoculation with vaccine against plague, the evidence available favours its use as an optional measure in those specially exposed to infection. The essential feature of an anti-plague campaign should be the extermination of rodents and not immunization by means of vaccines.

*G.—Use of Plague Serum—*

The Conference considers that curative serum is of sufficient value to be used in cases of plague, and it is important that it should be administered at an early stage in the disease, and in sufficiently large doses.

The Conference considers that a record of the effect of the use of serum should be kept according to a uniform clinical record scheme, to be drafted by the Commonwealth Department of Health.

*I.—The Medical Profession—*

The co-operation which is very essential between the health authorities and the general practitioner may be specially directed (1) on the part of the profession to ensuring the prompt and willing carrying out of responsibilities laid down by the Health Department, and (2) on the part of the Health Department to ensuring the early diagnosis and treatment of cases of plague, the making of adequate provision for cases, and for dealing with suspects.

*General.*—(1) That the Conference views with apprehension the existing situation in Queensland with respect to human plague and rat plague, and records its opinion that the epidemiological history of plague in Australia points to an extreme likelihood of a serious outbreak amongst human beings in the early months of the ensuing year or years.

This Conference considers that, although it is not too late to introduce measures calculated to reduce the total mortality of such an outbreak, which measures are indicated broadly in the foregoing resolutions, it is essential that these recommendations be adopted with the minimum of delay; and also considers that the beneficial results to be expected are likely to be directly proportioned to the promptness and efficiency with which they are put into effective operation by the health authorities concerned.

(2) That the Conference is of opinion that, with respect to plague administration, the central authority should have sufficient powers of supersession of any local authority when it appears that the latter is, in the opinion of the central authority, failing to do its duty.

(3) That it is essential to have laboratory facilities, mobile or fixed, available for use at points where plague is liable to occur or has occurred.

(4) That the development of an enlightened and active public opinion with reference to the part played by rats and rat fleas in the spread of plague is a factor of outstanding importance to the success of measures for the prevention and eradication of plague. To this end, the Conference urges that deliberate and co-ordinated effort should be made by all sanitary authorities in Australia to enlist public effort and public opinion in support of the measures required.



## Practical Results of the Resolutions of the

The State Government of each State signified its adoption of the report of the Conference in full, and legislation was set in motion covering the model regulations approved by the Conference.

*New South Wales.*—In New South Wales a new *Public Health (Amendment) Act* came into force on the 17th December, 1921, having for its principal object the acquisition of greater powers for dealing with plague. Regulations issued under this Act to cover the recommendations of the Conference came into force on the 8th February, 1922. These Regulations were directed towards the destruction and eradication of rats and mice, and of all insects capable of carrying plague, in all places and premises, public and private, and also towards the rat-proofing of buildings, docks, wharfs, embankments, and other structures. The removal of goods from premises where plague infection has occurred was controlled by regulation.

*Queensland.*—In Queensland the following legislation was passed:—

1. *The Rat, Flea, and Plague Carrying Insects Prevention and Destruction Regulations of 1921* were gazetted on 3rd December, 1921. These regulations dealt with—

- (a) Measures to be taken by owners and occupiers for the prevention of breeding and harbourage of rats, fleas, and plague carrying insects, and of their access to premises.
- (b) Destruction of rats and elimination of rat food and rat harbourage by local authorities.
- (c) General matters such as keeping in repair of drains and sewers. The keeping clean of roads and allotments so as to prevent the deposition of material serving as harbourage for rats or as food for rats.

These regulations were varied on the 19th January, 1922, to embody the model regulations approved by the Plague Conference.

2. *The Epidemic Diseases Regulations 1921* provided for house to house inspection and the powers and duties of health officers or authorized medical practitioners in connexion with cases of dangerous infectious diseases, including plague, and in connexion with suspected cases of disease, contacts, and premises.

3. *The Plague Regulations of 1921* for the control of goods traffic provided for the control of the removal of goods from premises where plague has occurred.

4. *The Queensland Metropolitan Joint Health Board Order of 1921* provided for the formation of a board called the Metropolitan Joint Health Board. Its district embraced the City of Brisbane and its suburbs. The board consisted of nine representatives of the Metropolitan Local Authorities elected by the councils comprised within the district. The Commissioner of Public Health for Queensland was an ex-officio member of the board. This Joint Health Board was charged with the superintendence, execution, and enforcement of the *Rat, Flea, and Plague Carrying Insects Prevention and Destruction Regulations of 1921* within the district of the board.

In areas outside the boundaries of the district of the Metropolitan Joint Health Board the health officers appointed under the Health Acts ensured that all the requirements of the regulations and Health Acts as far as practicable were carried out, and they were assisted in this direction by the Health Inspectors and Local Authorities.

Conference, 1921.

*Victoria.*—The Victorian *Plague Regulations* 1922 were gazetted on 11th January, 1922. These regulations were directed towards the prevention of plague, which disease had not appeared in Victoria, and the mitigation of the disease should it appear in this State. The regulations dealt with the notification and isolation of cases, control of contacts, and disinfection measures. Clinical, chemical, bacteriological, and other examinations were provided for.

*South Australia.*—On 24th October, 1921, the Central Board of Health in Adelaide issued a circular to Local Boards of Health, in which was set forth the powers and responsibilities of Local Boards, the preventive measures to be taken, the procedure to be taken in the detection of cases, the necessity for providing for the isolation of cases, and the measures to be adopted in dealing with rats.

Six Local Boards adopted the model regulations which were approved by the Plague Conference, and took steps to put them in legal form.

The remaining Local Boards did not adopt these regulations, but in some cases took action for the detection of human cases and for destruction of rats. In some cases, also, provision was made for the isolation of any human cases that might occur. A large number of Local Boards reported no rats present in their districts.

*Western Australia.*—The model regulations approved by the Conference were adopted and copies sent to all local authorities for formal adoption by each local authority within the State.

*Tasmania.*—Regulations under *The Public Health Act* 1903 for the extermination of rats were gazetted on the 2nd day of December, 1921. These regulations embodied the model regulations for the control of plague which were approved by the Plague Conference held at Sydney in November, 1921.

The duty of destroying rats was placed on both the occupier and the owner of premises. An inspector under the Health Act was empowered to enter any premises where he suspected rats to be, and to require by notice all rats to be destroyed forthwith. If the order was not complied with the inspector, with any necessary assistants, might enter and remain on the premises in order to destroy all rats, and might take any measures necessary to that end.

*General.*—Arrangements were put into operation for the collection of all data regarding details of the plague situation in the infected States, the measures being taken in all States for the destruction and examination of rats and other animals, and of fleas, including the use of sentinel guinea-pigs for ascertaining the presence of infection on premises. The information obtained in this way was summarized and inserted in the *Bulletin of the Commonwealth Department of Health*, which was issued weekly and a copy regularly sent to all consulates and to countries overseas which are not represented in Australia by a Consul.

The above special legislation in regard to plague control was, of course, additional to the general health legislation embodied in the Health Acts and regulations in force in each State, and which embraces all aspects of sanitation and the control of infectious diseases generally.



## APPENDIX C.

## Epidemiological Records of Plague Outbreaks.

An outstanding feature of the two periods during which plague has been epidemic and epizootic in Australia is generally a paucity of records of epidemiological importance. When records have been kept and made available for reference, a lack of uniformity detracts from their usefulness when a wide epidemiological survey of the whole situation is desired. The history of both the 1900-1909 and 1921-1922 periods of infection in Australia shows the gradual development of systematized compilation of records, but during that period of development much matter of epidemiological importance has either not been recorded or has been lost. The following summary is intended to serve as a guide for tabulation of data in a manner which will ensure completeness and uniformity of record. Hereunder also is shown the data required for notification to oversea Governments in accordance with the terms of the International Sanitary Convention.

## SUMMARY OF RECORD REQUIRED IN PLAGUE OUTBREAKS.

*Human Cases.*—Register of all cases (positive and suspected), with full particulars, including locality, name, age, sex, occupation, full directory addresses of residence and business (number, street, and locality), date of onset, date of reporting, date of isolation, date of death or discharge, by whom reported, result of bacteriological or biological examination.

*Epidemiological Data.*—Connexion with the presence of infected rats on premises at the time or prior to the occurrence of the case, any association with a previous case of plague or with infected premises (rodent or human).

*Clinical Data.*—Date of onset, signs and symptoms, progress report with four-hourly temperature chart, diagnosis (clinical and full bacteriological report), type and severity of infection (pestis minor, pneumonic, septic-æmic, bubonic, intestinal); treatment, general and serological (detail brand and batch number of serum used, date and hour of injections, method of injection, clinical effect (including anaphylactic symptoms, if any); result (death or recovery): autopsy report (if held).

*Rodents.*—A rodent register should be maintained, and should specify daily returns of rodents destroyed (stating species—R.R.N., R.R.R., R.R.A., M.M., total), number of rodents examined (stating species), number of rodents found infected (stating species); locality in which each infected rodent is found, giving full directory address of premises (number, street, and locality), and whether residence or type of business; measures taken at premises concerned, and records of sentinal guinea-pigs used to determine persistence of infection.

*Fleas.*—A dated record should show each species of fleas or other ectoparasites determined for each rodent species examined.

*Meteorological Data.*—Records of temperature, humidity, and rainfall are available from the recording stations of the Commonwealth Bureau of Meteorology.

*Maps.*—Spot-maps showing the location of infection of human cases and rodents should be maintained, the necessary modern maps on a suitable scale to show location of premises being available from the local offices of the Departments of Lands and Survey. Addresses of premises should be checked on a current directory, if available, for the locality.



INFORMATION RELATING TO PLAGUE REQUIRED UNDER THE  
OBLIGATIONS OF THE INTERNATIONAL SANITARY CONVENTION,  
1926. TO BE SUPPLIED TO OTHER GOVERNMENTS BY THE  
GOVERNMENT OF THE COMMONWEALTH OF AUSTRALIA.

| Article<br>in<br>1926<br>Conven-<br>tion. | Information to be Collected and Sent.   | How often.   | By what<br>Means.              |
|---|---|--|--------------------------------|
| 1   | (1) The first recognized case of plague . . . . .<br>(2) The first recognized case of plague, supervening<br>outside the limits of the local areas already<br>affected  | Immediately  | Telegram<br>(Priority)         |
| 2   | (1) Place where disease has appeared . . . . .<br>(2) The date of its appearance, its source, and type<br>(3) The number of recognized cases and deaths<br>(4) The extent of the local area or areas affected<br>(5) In the case of plague the presence of that<br>disease or an unusual mortality among rodents<br>(6) The measures taken  | Promptly<br>following<br>Article 1   | Mail or<br>Telegram            |
| 4   | All subsequent information under Articles 1 and 2<br>above, and any particular precautions taken to<br>prevent the spread of the disease<br>The precise measures carried out on outgoing<br>vessels to prevent the exportation of the disease<br>Measures taken against rodents and insects   | Regularly<br>and as<br>promptly<br>as possible<br>(Weekly as<br>regards the<br>number of<br>cases and<br>deaths) | Mail                           |
| 5   | Replies to any requests for information which the<br>Office International may make in respect of—(1)<br>Epidemic diseases mentioned in the Inter-<br>national Sanitary Convention; (2) Circum-<br>stances likely to affect the transmission of these<br>diseases from one country to another  | As occasion<br>arises  | Mail or<br>Telegram            |
| 6   | Information as to—<br>(1) Methods adopted for keeping in touch with<br>conditions as regards rodent infestation in<br>ports and as regards plague infection in<br>rodents, by frequent and regular periodical<br>examinations<br>(2) Systematic collection and bacteriological<br>examination of rats in plague infected areas<br>(3) Results of these measures<br>(4) The first discovery of the existence of plague<br>in rats on land in a port which has been<br>healthy during the previous six months | At regular<br>intervals<br>Monthly<br>when<br>plague is<br>present<br><br><br><br>(4) By wire                    | Mail                           |
| 9   | Any special arrangements between neighbouring<br>countries for the direct exchange of information   | As occasion<br>arises  | Mail                           |
| 12  | Information as to when the danger of infection<br>from any area has ceased, and when all preventive<br>measures have been taken   | As occasion<br>arises  | Telegram<br>or mail or<br>both |



INFORMATION RELATING TO PLAGUE REQUIRED UNDER INTERNATIONAL SANITARY CONVENTION, 1926—*continued.*

| Article in 1926 Convention. | Information to be Collected and Sent.   | How often.                               | By what Means. |
|-----------------------------|---|--|----------------|
| 14                          | <p>An annual report on the health services in ports . .</p> <p>The state of the sanitary organization of each of the ports as regards organization and equipment capable of securing the application of the preventive measures against diseases dealt with in the Convention, and also arrangements made for application of these measures, for keeping in touch with the conditions of ports as regards rat infestation and plague infection in rats by means of frequent and periodical examinations, for the collection and bacteriological examination of rats, for compulsory notification of diseases, for preventing the embarkation of persons suffering from these diseases and of their contacts</p> <p>In the case of plague for preventing access of rats to vessels</p> <p>Steps taken with regard to the rat proofing of warehouses, docks, &amp;c., in the port should also be included</p> | Annually..                               | By mail        |
| 16                          | <p>Measures adopted with regard to arrivals from an infected country. Withdrawal of these measures or any modification of them</p>  | Immediately                              |                |
| 28                          | <p>A list of ports furnished with necessary equipment and persons to carry out the deratization of vessels</p> <p>An annual statement of the measures taken for deratization of vessels in each of the ports, including the number of ships deratized, the number of ships to which deratization exemption certificates have been given</p>   | <p>As required above</p> <p>Annually</p> | By mail        |
| 50                          | <p>Information as to the ports open to vessels arriving from ports infected with plague ; (b) Ports which are open to infected and suspected vessels</p>  | As occasion arises                       | Mail           |
| 57                          | <p>The text of any special arrangements between Governments with a view to making the application of the sanitary measures more effective and less irksome</p>  | As occasion arises                       | Mail           |
| 58                          | <p>Places to which frontier traffic is limited, and where duly equipped sanitary stations are established</p>   | As occasion arises                       | Mail           |

## APPENDIX D.

## Bibliography of Plague in Australia.

*Note.*—Routine returns and reports of rodent destruction, rat-proofing of premises, and details of administrative action, contained in various departmental reports and Parliamentary Papers of the several States, are not included except where special data of epidemiological importance are given. Likewise, no effort has been made to compile complete references of purely entomological reports of flea distribution and description or zoological descriptions of rodent species. The list has, however, been made as complete as possible in regard to medical and epidemiological records that bear upon the natural history of plague as it has occurred in Australia. In order to follow the sequence of the outbreaks and the development of knowledge concerning the ætiology and epidemiology of plague, this index has been arranged on a chronological basis.

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